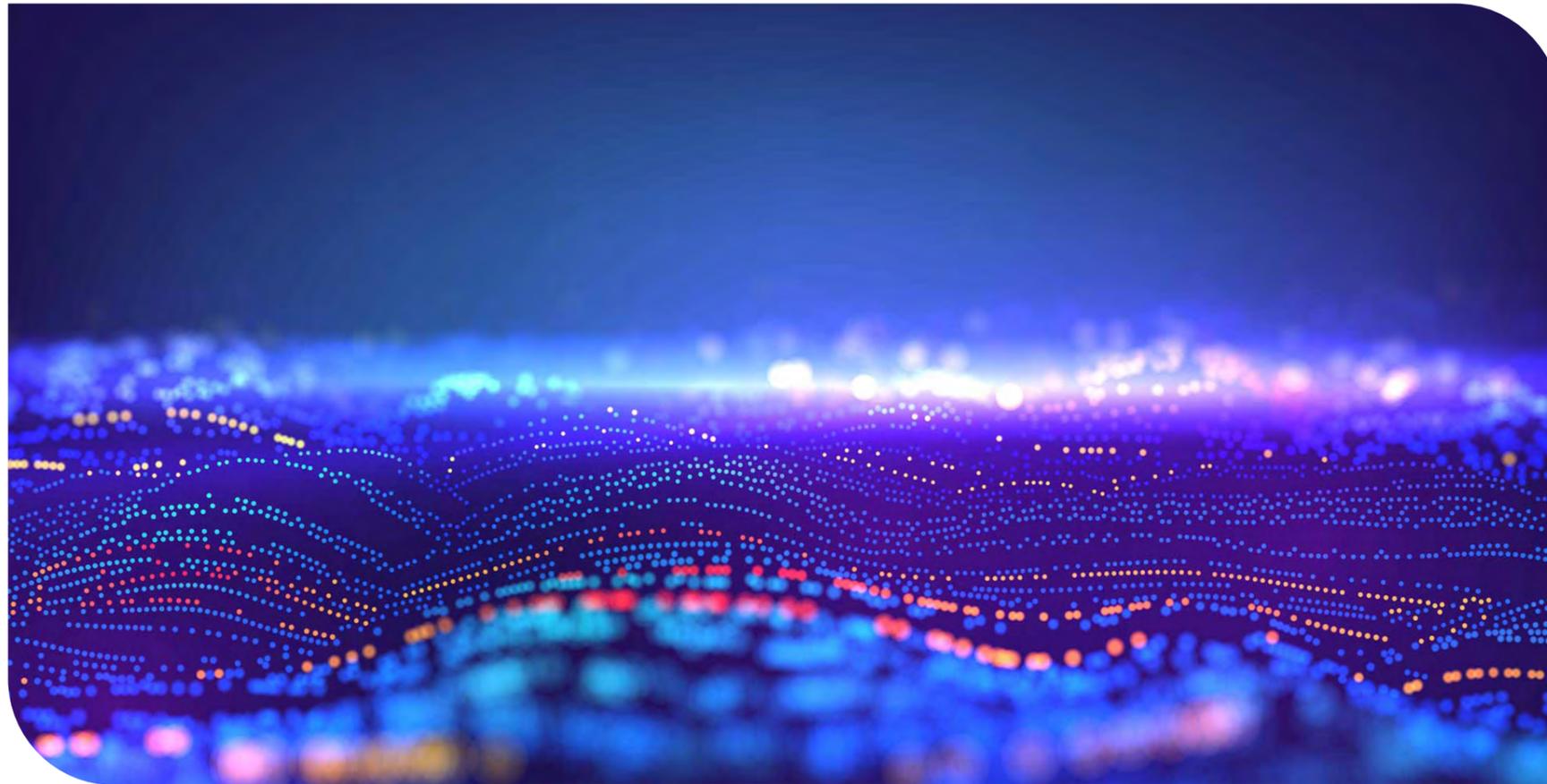


# Vision 2050

Findings from Stage 1

Version 2



# Vision 2050

Findings from Stage 1



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# Executive Summary

Aiming to identify the factors that will impact Ireland's water sector over the next 30 years, as well as shared desired outcomes, we collaborated with key stakeholders to start the development of our Vision for 2050.

Using a structured foresight approach, we worked with stakeholders and identified and explored how underpinning driving forces may plausibly interact to shape alternative future scenarios. Whilst we cannot predict the future, we have described three scenarios that aim to help us consider and manage future uncertainty. Looking ahead to potential futures will enable identification of future opportunities and challenges and ensure our water services are delivered in a safe, resilient, efficient and sustainable manner into the long term.

With insight from stakeholders in the form of literature review, and interviews and workshops, we articulated desired long-term outcomes for the water sector in Ireland in 2050. The desired outcomes are a synthesis of key stakeholder sentiment on what a good outcome might look like for society. They set a common direction of travel and a reference to identify possible future opportunities, challenges and risks.

A systemic in-depth horizon scan was then completed to provide a broad view of trends and developments that will likely impact the 2050 operating environment. Collaboratively in a workshop with Uisce Éireann stakeholders, these trends and drivers were shortlisted and assessed in terms of impact and uncertainty to feed into our scenario development.

Three plausible future scenarios for 2050 were developed collaboratively in a second workshop with stakeholders. In developing these scenarios, we do not attempt to define the future or predict the future, but rather give a number of plausible alternative futures against which we can test assumptions, plans and strategies. There is opportunity for UÉ to influence both the more certain drivers (critical certainties) and less certain certainties (critical uncertainties). Adaptive planning (planning with uncertainty in mind) enables the flexibility and agility to adapt to alternative scenarios that may play out.

The first scenario 'Suaimhneas/ Sunny outlook' describes the most preferable climate pathway playing out, with circular economy principles integrated into industries and a highly digitised and technological developed future. The second scenario 'Rír/ Storms forecast' articulates the most severe climate pathway playing out, with extremely poor economic conditions and limited meaningful action on circular economy. The final scenario 'Gan ord ná eagar/ Cloudy with a chance of rain' describes a future where there is a mismatch between the location of water services supply and demand, limited collaboration across industry stakeholder and a preferred but still challenging climate pathway.

An extensive list of opportunities, challenges and risks associated with achieving the desired outcomes, in each of the three future scenarios, were identified through stakeholder interviews and a stakeholder workshop. These were summarised into key themes, acknowledging that opportunities or challenges may be independent of the scenarios, play out differently in each scenario or depend on the perspective of the reader.

This report summarises the findings of Stage 1 of the project. In Stage 2, we will explore, develop and assess the list of opportunities, challenges and risks in order to identify prioritised strategic actions and inform Uisce Éireann's adaptive planning into the future. We will identify actions we can take now or into the future that will be positive 'no regrets' actions and how these can be exploited individually and collectively to drive desirable outcomes. We will also identify actions where we need to develop our understanding, solutions and direction of future travel first.

**Vision 2050 - Findings from Stage 1**

**Uisce Éireann**  
In collaboration with stakeholders

Vision 2050 aims to identify drivers of change impacting the water sector in Ireland over the next 30 years, and the opportunities and challenges these may create in meeting the desired outcomes. Through collaboration of the water sector with key stakeholders and experts, we use a structured foresight approach to describe a series of plausible scenarios to define the boundaries of our future operating environment. These scenarios will help Uisce Éireann plan adaptively to ensure we meet multiple stakeholders needs and expectations, ensuring water services are delivered in a safe, resilient, efficient, and sustainable manner.

**Desired Outcomes** With insight from stakeholders, we have developed desired outcomes for the water sector in Ireland in 2050.

- All citizens have access to trusted, safe and equitable water and wastewater services
- The water sector is a leader in climate adaptation and mitigation in Ireland
- Stakeholders work in partnership to maximise common benefits for the Ireland
- Water network infrastructure and operations are efficient, secure, resilient, and adaptable
- The water sector enhances the environment and biodiversity
- Society places a high value on water as a resource and service
- Water services enable and support economic prosperity in Ireland

**Scenarios** Working collaboratively with stakeholders and using a structured foresight approach, the following scenarios were developed to describe three plausible futures of the water sector in Ireland in 2050.

- Sunny outlook**  
Climate has been the centre of policy agenda for Ireland and most global nations for decades. Policy makers, governments and businesses have implemented complementary strategies to reverse the historic rise in atmospheric carbon, along with measures to adapt to climate change impacts. The global economy has largely transitioned to net zero, and circular economy principles are integrated across the water sector and associated industries in Ireland.
- Storms forecast**  
A so-called climatic tipping point has been transcended, resulting in irreversible and unpredictable climate-related chain reactions. There are extremely poor economic conditions in Ireland corresponding with a global and European Union wide recession, and aggregate economic losses accelerate with increasing temperatures and extreme weather events.
- Cloudy with a chance of rain**  
Development is haphazard across Ireland, with misalignment between planning, government policy and existing water and wastewater infrastructure. The location of rapid population and industrial growth, for example hydrogen production, is piecemeal and unpredictable. There is a fundamental difference between where water is available and where Ireland's development is centred. At the same time, Ireland is experiencing more extreme weather patterns, following a middle climate pathway.

**Opportunities and Challenges** The opportunities, challenges and risks associated with achieving the desired outcomes in each of the future scenarios were identified in collaboration with stakeholders. To provide the reader with an overview of these, they were clustered into themes which are common across all future scenarios and these are summarised below. A simple example of a suggested opportunity is also illustrated.

- Collaboration and Influence
- Resilience
- Net Zero carbon
- Compliance with regulation and fitness for purpose
- Innovation and integrating new technologies
- Data and Digital Technology
- Blue-green infrastructure, nature-based solutions and catchment initiatives
- Demand on Water Resources and Services

**Example Opportunity**  
A number of organisations seek to promote the value of water. A collaborative approach to developing and delivering a co-ordinated national initiative, leveraging resources and capabilities of stakeholders could be highly effective.

**Next Steps**  
In the next stage of this project, we will identify prioritised strategic responses and inform Uisce Éireann's adaptive planning.

# 1. Introduction

Our Vision 2050 aims to gain insights from a sectoral perspective on the factors that will have the greatest impact on our future operating environment, as well as the shared desired outcomes for the wider water sector. The project develops a series of shared sectoral scenarios to define plausible alternative ways in which the future could play out. This supports identification of future opportunities and challenges, and the development of our capacity to plan adaptively, manage future uncertainty and deliver resilient and sustainable outcomes.

There are numerous shared benefits in undertaking this project collaboratively with stakeholders. It will enable a better understanding of each other's perspectives on what is important, and how our activities and desired outcomes are interconnected. It also enables a wider and more comprehensive understanding of the forces that will impact on our shared future operating environments and attaining desired outcomes. Finally, it enables us to identify opportunities where better outcomes might be attained through collaboration.

As an organisation, this process starts to develop a framework and the tools to test the adaptability and resilience of our strategies and plans. It will improve our forecasting capacity through taking cognisance of alternative scenarios. It will bring into focus key issues in the context of knowledge gaps and capabilities that we need to develop to attain desirable outcomes under different scenarios. Furthermore, it will evolve our insight on risk management by challenging assumptions on which identified risks are founded.

A '30 Year Look-back' was prepared to provide a retrospective of the scale and level of change which can occur over a relatively short period of time, in this case 30 years and is included in Appendix A. This sets the context for long-term future thinking by creating a heightened awareness of the level of change that can occur in a 30-year time span.

This report summarises the findings from Stage 1 of the project where key trends and drivers likely to influence our future are considered, possible 2050 scenarios outlined and high-level opportunities, risks and challenges are identified. Stage 2 of the project will further develop an adaptive planning approach to enable our water services to be delivered in a safe, resilient, efficient and sustainable manner.



# 2. Desired Outcomes

When thinking about the future, it is important to consider the desired long-term outcomes or aspirations. This sets a common direction of travel and a reference to identify possible future opportunities, challenges and risks.

With insight from stakeholders in the form of a literature review (see Appendix B) and stakeholder interviews (see Appendix C), we describe below our desired outcomes for the water sector in Ireland in 2050. We have identified seven outcomes in the form of one overarching statement and several supporting sub-outcomes.



**All citizens have access to trusted, safe and equitable water and wastewater services**

- Public health is central to water services delivery
- Water services respond effectively to changes in societal needs and expectations
- Fairness and impartiality underpin water service delivery
- Uisce Éireann is trusted to plan, develop and provide high quality water services



**The water sector is a leader in climate adaptation and mitigation in Ireland**

- The water sector is net-negative carbon
- Carbon impacts and climate targets are primary factors in all of our decision-making
- Water services are resilient and adequately protected from the effects of a changing climate and extreme weather events
- We are capturing and generating energy from low carbon sources, which we use to offset our consumption and carbon impact. We are reusing waste and waste stream by-products, and facilitating others to do so in a wider circular economy



**Stakeholders work in partnership to maximise common benefits for Ireland**

- Effective multi-stakeholder approaches are implemented across the sector, for example in the delivery of infrastructure and catchment management, to leverage synergies and deliver value
- Governance is outcome centric and encourages multi-stakeholder working
- Wider community benefits (social, environmental and economic) are realised through early and wider engagement in decision making processes
- Data, information and knowledge are securely and widely shared between stakeholders to maximise societal, environmental and economic benefits



**Water network infrastructure and operations are efficient, secure, resilient, and adaptable**

- Digital technology and secure data are leveraged to ensure the optimal management of water network infrastructure and operations
- The sector workforce is skilled, diverse and agile
- Infrastructure and operations are resilient and adaptable to changing needs
- Innovative solutions are nurtured and optimally deployed in a timely manner



**The water sector enhances the environment and biodiversity**

- The water sector works collaboratively to place biodiversity and ecosystem health at the centre of water services planning and decision making
- Partnerships work to protect, restore and enhance natural ecosystems and biodiversity
- Promoting and operating an integrated blue/green/grey asset base while optimising the use of nature-based solutions



**Society places a high value on water as a resource and service**

- The water sector is effective at providing trusted services and influencing customer behaviours
- The water sector collaborates with citizens to support water conservation and the efficient operation of the network through behavioural change
- The maximisation of circular economy opportunities is facilitated in how water services are managed



**Water services enable and support economic prosperity in Ireland**

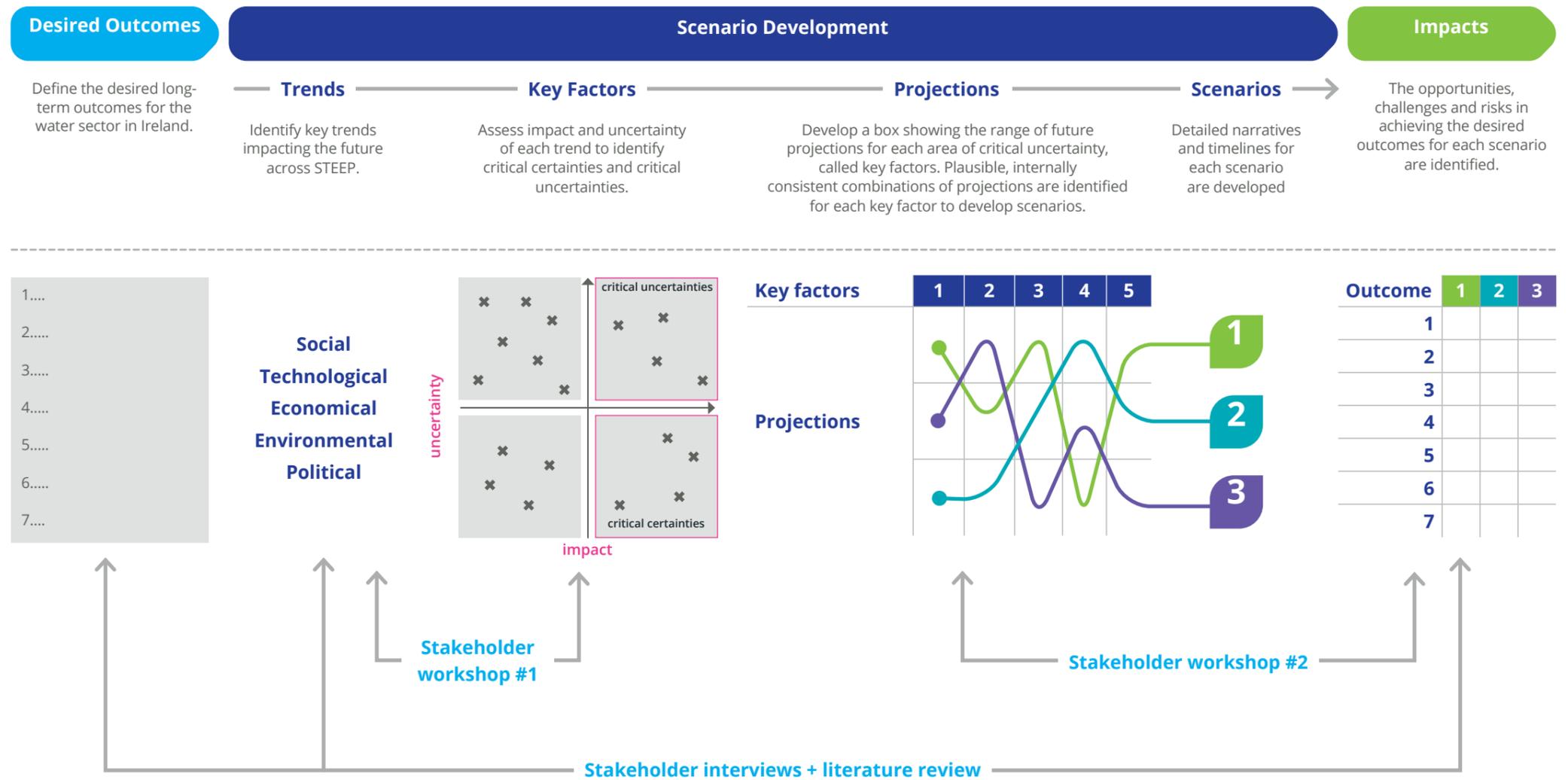
- Water services are planned and delivered to support economic and spatial planning policy
- The provision of water services are economically sustainable
- Investment in assets maximises whole lifecycle value
- Finance and funding is sustainable, accessible and secure to enable exemplar water and customer services

# 3. Scenario development

## Our Approach

Resilience for the long-term is critical across the water sector. We will face numerous pressures in the years ahead, including balancing the need for continued investment in maintaining and renewing a 19th century legacy asset base, against the backdrop of a growing economy, changing customer expectations, regulatory change and population requiring additional capacity. Within this project, a holistic, guided foresight process helps us understand and explore plausible scenarios, to give strategic guidance for proactively shaping the future water sector.

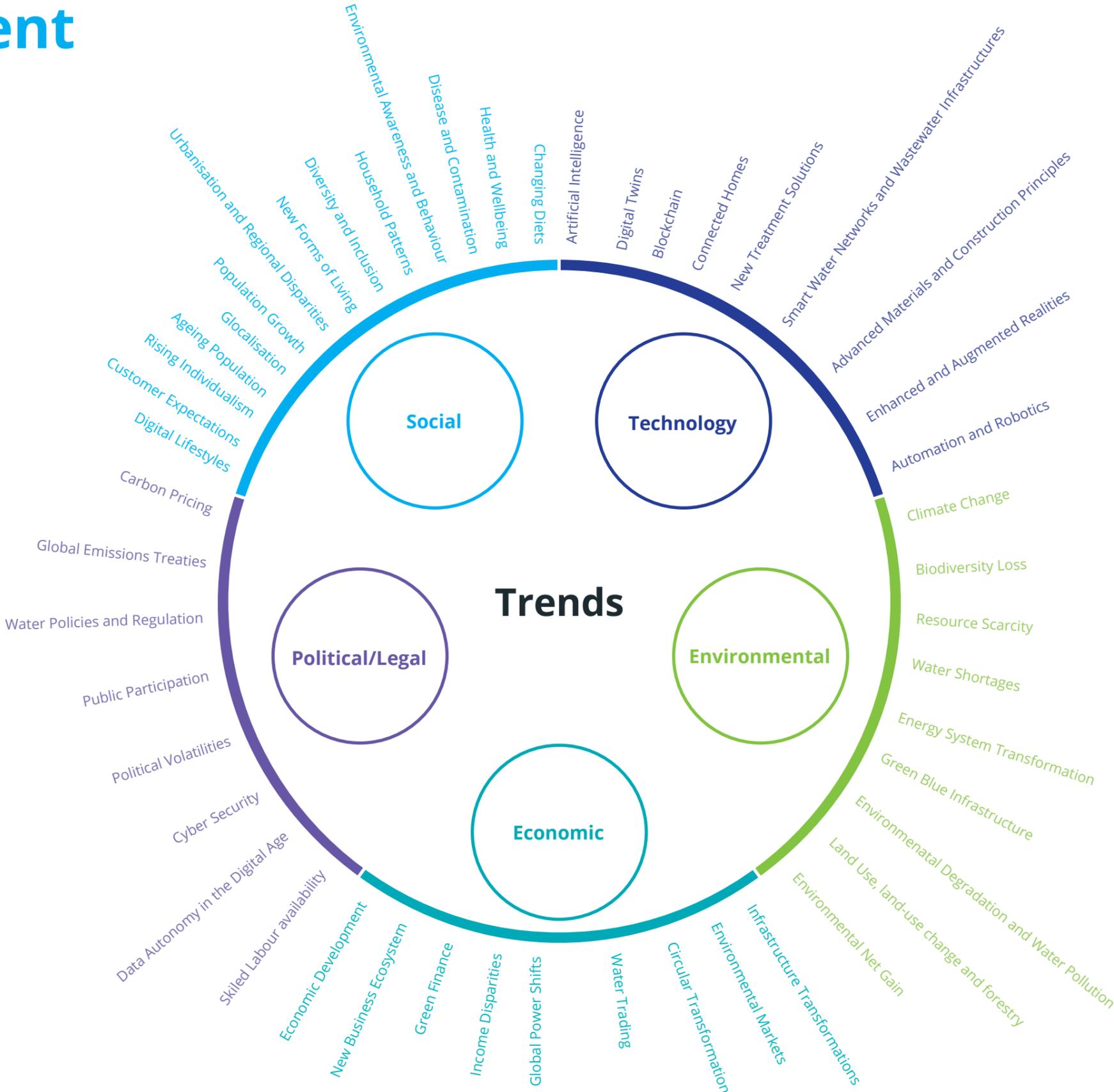
Scenarios are plausible narratives that describe the future of a given focal area or geography, in this case, the water, wastewater and related services in Ireland. Our operating environment is a complex system with many drivers and interactions playing out. The scenario approach used, therefore, explores how multiple drivers of change might evolve and interact over time; to provide a structured framework to help us consider and manage future uncertainty. The foresight process followed is summarised below and how it was applied is presented in more detail in Appendix D.



# 3. Scenario development

## Trends and Drivers

A systematic in-depth horizon scan was completed to provide a broad view of trends and developments that will likely impact the 2050 context and these are presented on the adjacent figure. This long list was synthesised down and a detailed review of these trends is included in Appendix E. Collaboratively with Uisce Éireann stakeholders, these trends and drivers impacting the future of water and wastewater services in Ireland were shortlisted in Workshop 1 (see Appendix F for details).

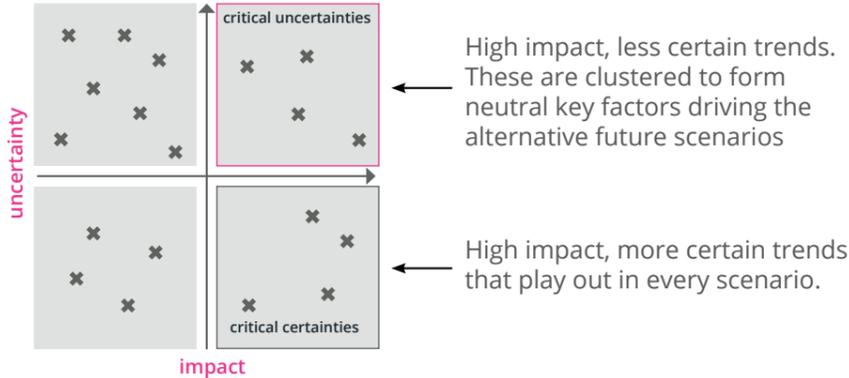


# 3. Scenario development

## Impact and Uncertainty

The trends and drivers were assessed in terms of impact and level of uncertainty. Impact describes the level of impact or change the trend will create or affect. The level of uncertainty describes whether the trend will mature and scale over time and the level of uncertainty of the types of impact or effect the trend will have. For example, whilst it is certain that climate change will mature, there is uncertainty as to the scale of climate change and the types of impact on the water and wastewater services in Ireland. This trend is therefore assessed as highly uncertain.

The assessment of trends and drivers enabled critical certainties and uncertainties to be identified (see Appendix D for further detail).



Graphic to illustrate the relationship between uncertainty and impact when assessing trends.



# 3. Scenario development



## Critical Certainties

More certain, high impact trends that play out in every scenario are known as 'critical certainties'. They are important to consider as they are likely to create significant opportunities and challenges in any future scenario. The shortlist of Critical Certainties is as follows:

**Water Policies and Regulation:** changing policy and regulation

**Energy system transformation:** towards distributed, renewable smart energy systems

**Skilled labour availability:** increasing shortage of skilled labour

**Environmental awareness and behaviour:** rise of sustainable lifestyles

**Household patterns and new forms of living:** increase in smaller household sizes

**Ageing infrastructure:** ageing infrastructure that is struggling to cope with intensifying challenges

**Environmental degradation and water pollution:** increasing negative impact of human activities on the natural environment, including biodiversity loss



## Critical Uncertainties

The critical uncertainties are high impact trends, where we can be less certain of the scale or type of resulting effects. These are clustered to form neutral key factors driving the alternative future scenarios. The shortlist of Critical Uncertainties is as follows:

**Climate change:** rising risks and impacts from global warming

**Funding availability and governance:** the challenge of accessing required funding

**Economic development and income disparities:** steady economic growth and prosperity concentration

**Collaboration and influence:** increasing need to collaborate with and influence stakeholders and customers to overcome complex sectoral and industry challenges

**Population growth:** overall population growth in Ireland

**Infrastructure transformation:** need for infrastructure renewal, expansion and upgrading

**Circular transformation:** increasing shift from conventional, linear to circular economies

**Artificial intelligence:** rise of artificial intelligence (AI), machine-learning and new data analytics

**Automation and robotics:** new technological opportunities in the water sector

**Digital twins:** increasing use of digital twins as digital representation of real-world entities

**Smart water networks and wastewater infrastructures:** increasing use of smart technologies

**Cyber security:** rising intensity and sophistication of cyber attacks

**Resource scarcity:** increased uncertainty around resource availability of energy, ecology, water, food and land

**Urbanisation:** steady rise of urban population

**Industrial technology:** pace, scale and adoption of industrial innovation and new technology

# 3. Scenario development

## Key Factors

The scenarios are underpinned by six key factors, identified collaboratively with stakeholders. Key factors are the variables influencing the scenarios, with each key factor having a range of plausible projections at 2050. They are identified by clustering the critical uncertainties (i.e. the high impact and highly uncertain trends). For example, the trends of robotics and autonomous systems, artificial intelligence, digital twins, cyber security and industrial technology were clustered into one key factor 'digital water and technological development'.

The key factors are listed in order starting with the most exogenous, whereby Uisce Éireann will have the least influence.



**Climate change:** the IPCC Representative Concentration Pathway (RCP) realised and the associated impacts in respect to weather related metrics and associated water stresses in Ireland. It also considers climate change mitigation and adaptation efforts.



**Location of water services supply and demand:** the distribution of population growth and loss, asset location and economic development across Ireland.



**Funding availability and governance:** the economic conditions in Ireland, the level of investment in the water sector and the ease of accessing funding.



**Water sector ecosystem:** the success of the water sector ecosystem in collaborating across local and national stakeholders and customers to overcome complex industry challenges and deliver the best holistic outcomes.



**Circular economy:** the scarcity of resources and the extent to which the water sector and associated sectors in Ireland moves away from a conventional, linear approaches to a circular economy.



**Digital water and technological development:** the pace and extent of successful water industry digitisation and technological development, considering robotics and autonomous systems, artificial intelligence, digital twins, cyber security, new materials and advances in life sciences.

# 4. The Scenarios

## Scenario Summaries

The following scenarios describe the future of the water sector in Ireland in 2050.

Each of the scenarios within this document are comprised of several components. The various components together aim to articulate a compelling description of the future and a plausible pathway for how this future could be realised over the next 30 years.

- > A core narrative that describes the future in 2050
- > The most active key factors and their projections
- > A speculative event timeline that supports the narrative

The timeline is illustrative and should not be perceived as a prediction of future events. For more information on how the scenarios were developed, please refer to Appendix D.



## Suaimhneas Sunny outlook

Climate has been at the centre of policy agenda for Ireland and most global nations for many decades. Policy makers, governments and businesses have implemented complementary strategies to reverse the historic rise in atmospheric carbon, along with other measures to adapt to climate change impacts. The global economy has largely transitioned to net zero, and circular economy principles have been integrated across the water sector and associated industries in Ireland. This has been enabled by broad-ranging information sharing, and underpinned by innovative solutions and advanced technologies successfully unlocking actionable insights by analysing vast amounts of data. Water access and quality is an important driver for the sustainable prosperous economic activity and development occurring in Ireland, with the sector working collaboratively towards holistic outcomes. The worst fears of climate extremes have proved unfounded, and the most preferable climate pathway is unfolding.



## Rírú Storms forecast

A so-called climatic tipping point has been transcended, resulting in irreversible and unpredictable climate-related chain reactions. There are extremely poor economic conditions in Ireland, corresponding with a global and European Union wide recession, and aggregate economic losses accelerate with increasing temperatures and extreme weather events. Ireland experiences frequent, localised droughts and increasingly intense rainstorms. Sea levels are rising at an accelerated rate and storm surges regularly cause severe flooding in coastal conurbations. Despite water stresses, the conservation, protection and management of water supplies is not optimised, with meaningful action towards a circular economy limited. Natural habitats and ecosystems are degraded, with tangible negative impacts on Ireland's biodiversity. Adaptation has become normalised as it becomes clear that humanity is heading down the most extreme climate pathway.



## Gan ord ná eagar Cloudy with a chance of rain

Development is haphazard across Ireland, with misalignment between planning, government policy and existing water and wastewater infrastructure. The location of rapid population and industrial growth, for example hydrogen production, is piecemeal and unpredictable. There is a fundamental difference between where water is available and where Ireland's development is centred. This makes it extremely difficult to invest in assets and water services in a way that maximises service benefits and lifecycle value to stakeholders and customers. At the same time, Ireland is experiencing more extreme weather patterns, including increased flood intensity and higher frequency of droughts. The world is experiencing a dangerous climate pathway, with varying degrees of consequences in towns and cities worldwide.

# Suaimhneas/ Sunny outlook

## Key Factor projections

The most active key factors driving the alternative scenarios.



**Climate change:** The most preferable climate pathway RCP 2.6 is playing out. Extreme weather events weather changes in Ireland have been minimised. There is an insignificant shift in river flow quantities. There is significant climate change mitigation action and adaptation to the changing climate. Ireland and Uisce Éireann achieved net zero carbon.



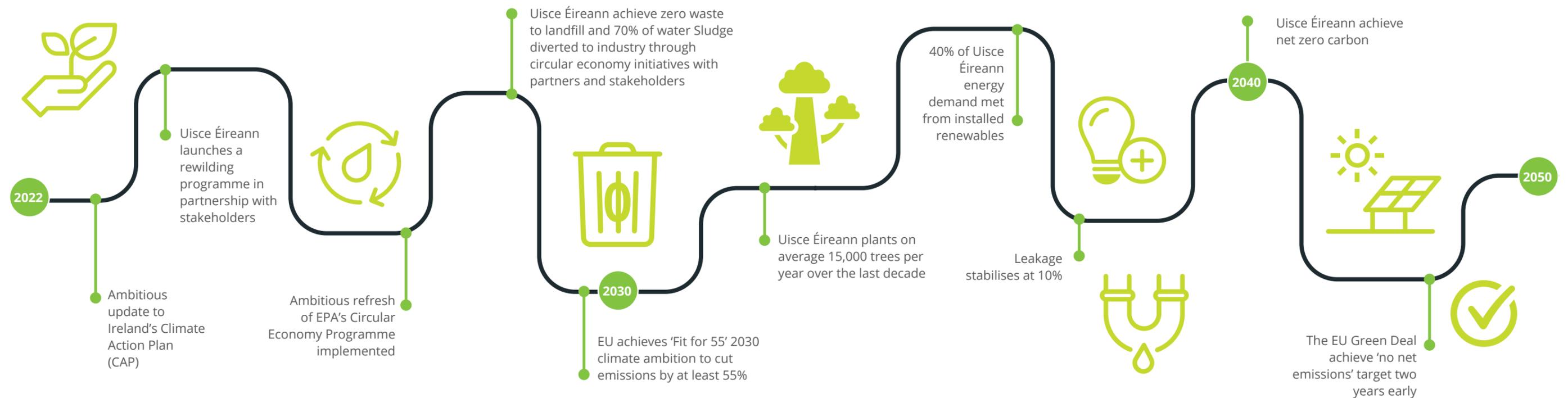
**Digital water and technological development:** Networks, infrastructure and operations are optimally managed by leveraging automation, digital capacity, sensors, machine learning and AI. Innovative technology and industrial solutions are deployed effectively and in a timely manner. Data and communications are secure and cyber security is effectively managed.



**Circular economy:** Circular economy is prioritised in Ireland and principles are successfully integrated across the water industry and associated industries. This enables the conservation, protection and management of water supplies alongside economic benefits. Solutions include water reuse at domestic and commercial level, retrofitting schemes to increase water reuse and new buildings requirements.

## Fictional timeline

The events below are fictional and should not be perceived as predictions of specific future events. The purpose of the timelines is to allow the reader to be immersed in the 2050 scenario and to consider events which may have led to the scenario playing out.



# Suaimhneas/ Sunny outlook

## Scenario description

Climate has been front and centre of the policy agenda for Ireland and most nations around the world for many decades. Policy makers, governments and businesses have implemented complementary strategies to reverse the historic rise in atmospheric carbon, along with other measures to adapt to climate change impacts. The sustainable global economy has largely transitioned to net zero, circular economy principles have been integrated across the water sector and associated industries in Ireland.

This has been enabled by broad-ranging information sharing, and underpinned by innovative solutions and advanced technologies successfully unlocking actionable insights by analysing vast amounts of data. Water access and quality is an important driver for the sustainable economic activity and development occurring in Ireland, with the sector working collaboratively towards holistic outcomes for customers and stakeholders. The worst fears of climate extremes have proved unfounded, and the most preferable climate pathway is unfolding (Representative Concentration Pathway 2.6).

The country was shocked into scaling up climate action due to an increase in extreme weather events, e.g. droughts in large cities, and worrying findings in Ireland's annual Climate Status Report. The Emerald Isle, known for its resplendent greenery, was under threat. With unprecedented mobilisation across every level of Irish society, carbon emissions have peaked and are reducing dramatically year on year. Ireland's natural habitats continue to be restored, and carbon is removed from the atmosphere through multiple nature-based and technological interventions.

Ireland prepared diligently for the changing climate, revising the National Adaptation Framework and increasing capital expenditures to adapt and upgrade critical and ageing infrastructure. Early investments in resiliency paid off as contingency spend, infrastructure damage and supply chain disruptions all steadily declined. Ireland and Uisce Éireann are now net carbon negative and Ireland has a fully decarbonised energy system, comprising onshore and offshore wind, green hydrogen, solar and sustainable bioenergy.

**Fresh water is a valued commodity.** Industries consume, produce and recycle water and wastewater efficiently and Ireland has a conservation-based water management approach. As per Ireland's Circular Economy Programme, circular economy principles are successfully integrated across industries and new and existing housing developments to make best use of water (blue, green and grey). Policy mandates encourage circular approaches, local-catchment management and more collaborative multi-stakeholder and decentralised solutions. Domestic water customers are environmentally aware and are adopting water saving strategies and products, such as recycling rainwater and smart showers.



© Mae Mu / unsplash

# Suaimhneas/ Sunny outlook

**Ireland consistently ranks in the top two places in Europe's Digital Economy and Society Index.** Sensors, big data, AI and machine learning are unlocking valuable water insights from vast amounts of data. This helps to assess the full asset lifecycle, the lifetime cost of water infrastructure investment, manage risk and rehabilitate ageing and neglected water infrastructure. Data covers everything from water safety, the real-time condition of underground pipes, carbon usage and customer sentiment to provide full visibility of all aspects of the network and service delivery. Water information is integrated into a connected, secure national water data framework, helping to fully understand the impacts of network events and asset failures on service. The move to almost fully predictive maintenance meant Uisce Éireann were able to start predicting the next mains burst, raw sewerage discharge or pollution incident.

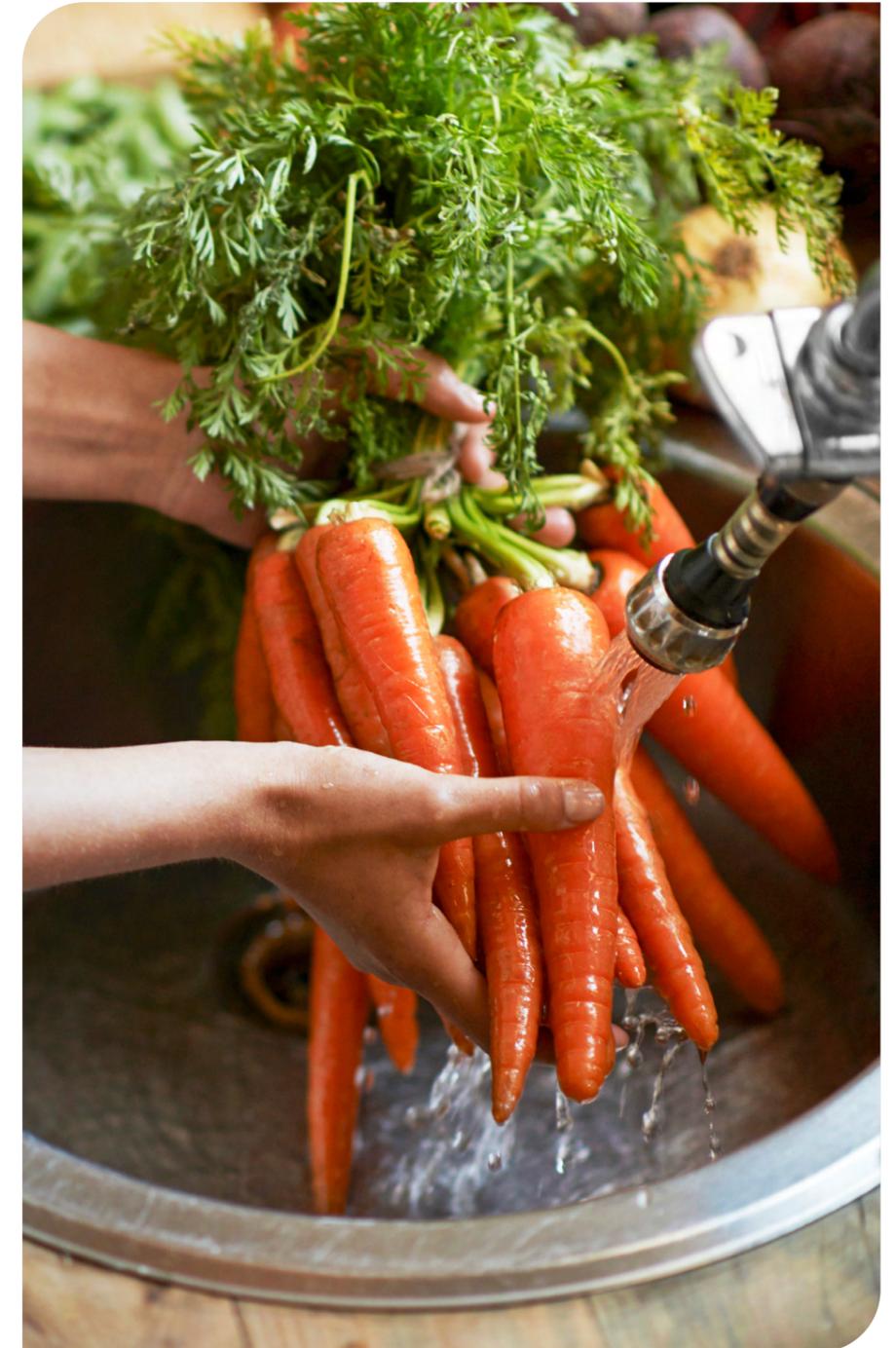
**Open data is providing customers access to data on water services and providing greater understanding of their usage, catering to digital lifestyles.** This is driving a better and more equitable service – for example, customers were shocked at how much water was being lost through leakage, resulting in them demanding change. Utilities are also able to strategically influence and engage customers to reduce water demand.

**The water sector has an early adopter culture, whereby innovative technology and industrial solutions are tested and deployed effectively and in a timely manner.** This is supported by high levels of collaboration within the sector and across related industries. The high cost of water services and strict regulations have provided an environment for high quality low-cost advanced filtration technologies to become popular across industry. Natural treatment solutions are also common to maximise the environmental and societal benefit of wastewater treatment.

**There was a real squeeze on Ireland's public finances in the 2020s.** Difficult policy decisions and trade-offs were made in order to prioritise long-term investment into climate action and innovation. An overhaul of funding governance also meant that programmes aligning with climate and innovation policy in sectors such as the water sector could access funding more easily. Planning and delivery processes were streamlined. Sustainable finance initiatives including Green Bonds and Sustainability Performance Linked Lending were leveraged. Regulatory Control 'RC' periods were extended to help support longer term regulatory funding decisions.

**There is now sustainable economic growth in Ireland with relatively high levels of FDI and tax receipts benefitting public finances.** The heavy focus previously on funding climate action was at the expense of other social and economic priorities, despite efforts for a just and socially fair transition. Ireland is still grappling with issues of skills shortages, however in the water sector, rationalisation of plants, automation and digitisation have provided some relief.

**Water availability and quality is recognised as an important driver in attracting business to Ireland.** There is an integrated national plan for water together with agriculture, energy, industry and housing. However, development over the years has not always been aligned with planning policy and existing water and wastewater infrastructure. This has caused challenges with delivering water services to meet demand, exasperated by smaller household sizes.



# Rír / Storms forecast

## Key factor projections

The most active key factors driving the alternative scenarios.



**Climate change:** The most severe climate pathway RCP 8.5 is playing out. Extreme weather events and significant variation in weather conditions occur in the West and East of Ireland. There are low climate mitigation efforts and it is challenging to keep pace with significant adaptation to the changing climate. Uisce  ireann and Ireland have not achieved net zero carbon.



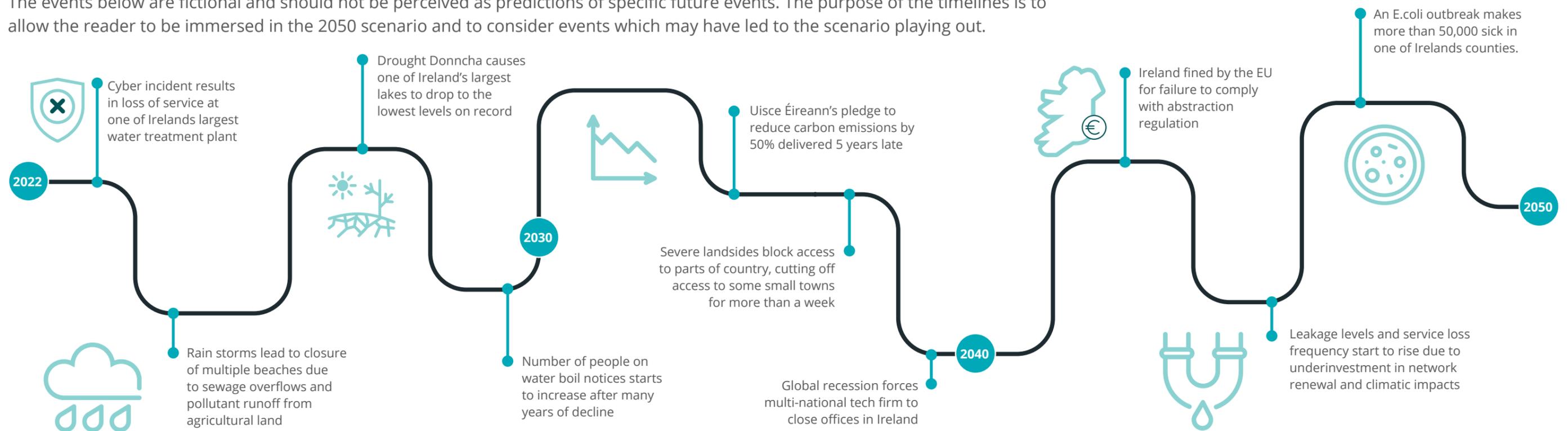
**Funding availability and governance:** There are extremely poor economic conditions in Ireland, corresponding with a global and European Union wide recession. There are significant investment cuts and an inability to fund the operational and maintenance requirements to meet standards. Access to funding is a lengthy and complicated process.



**Circular economy:** Circular economy principles are communicated as a priority in Ireland but meaningful action is limited across all industries, including water. The conservation, protection and management of water supplies have not been optimised.

## Fictional timeline

The events below are fictional and should not be perceived as predictions of specific future events. The purpose of the timelines is to allow the reader to be immersed in the 2050 scenario and to consider events which may have led to the scenario playing out.



# Rír/ Storms forecast

## Scenario description

**A so-called climatic tipping point has been transcended, resulting in irreversible and unpredictable climate-related chain reactions. Ireland experiences frequent, localised droughts (mainly in the East) and increasingly intense rainstorms (West). Sea levels are rising at an accelerated rate and storm surges regularly cause severe flooding in coastal conurbations, including Dublin.**

Some residents have moved to higher ground away from the coast. Increased storm events have overpowered combined sewer systems, causing pollution events on a more regular basis. Treatment facilities have been adversely impacted by reducing raw water quality. Natural habitats and ecosystems are degraded, with tangible negative impacts on Ireland's biodiversity. After many years of life-threatening summer temperatures, seasonal heatwaves are given names in order to help alert the public. Adaptation has become normalised as it becomes clear that humanity is heading down the most extreme climate pathway, Representative Concentration Pathway 8.5.

**Climate mitigation efforts are, and have been, inadequate for decades.** Well-intentioned, net zero carbon plans were not translated into meaningful action. Efforts by the European Union on taxonomy to clearly define 'sustainable' failed to have impact. 'Greenwashing' was commonplace and identified solutions such as afforestation were often poorly managed, so were ineffective. Therefore, today, Uisce Éireann and Ireland suffer the consequences of global failure to adequately tackle climate change, and have still not achieved net zero carbon. As a result, the focus for Ireland has shifted from mitigation to adaptation.

**There are signals of positive change with carbon dioxide levels starting to fall.** Technological development, such as direct air capture, has become more common. However, the material impact on extreme weather is not yet being felt. As a last resort, Solar Radiation Management techniques are implemented, reflecting heat from sunlight back into space. It is extremely challenging and expensive to adapt water infrastructure to keep pace with the climate threat. The frequency of emergency measures are resulting in spiralling costs.

**There are extremely poor economic conditions in Ireland, corresponding with a deep and long-term global and European Union wide recession.** Climate change contributes to the economic conditions as economic losses accelerate with increasing temperatures. Multinationals leave, FDI is low and there are key skills shortages. The economic devastation is reminiscent of that following the collapse of the Celtic Tiger in 2008. There are significant investment cuts in water services and an inability to fund the operational and maintenance requirements to meet standards. Planned improvements are put on hold. Access to the funding that is available is a lengthy and complicated process. There is also extreme pressure to deliver water services at the lowest possible cost.



# Rírá/ Storms forecast

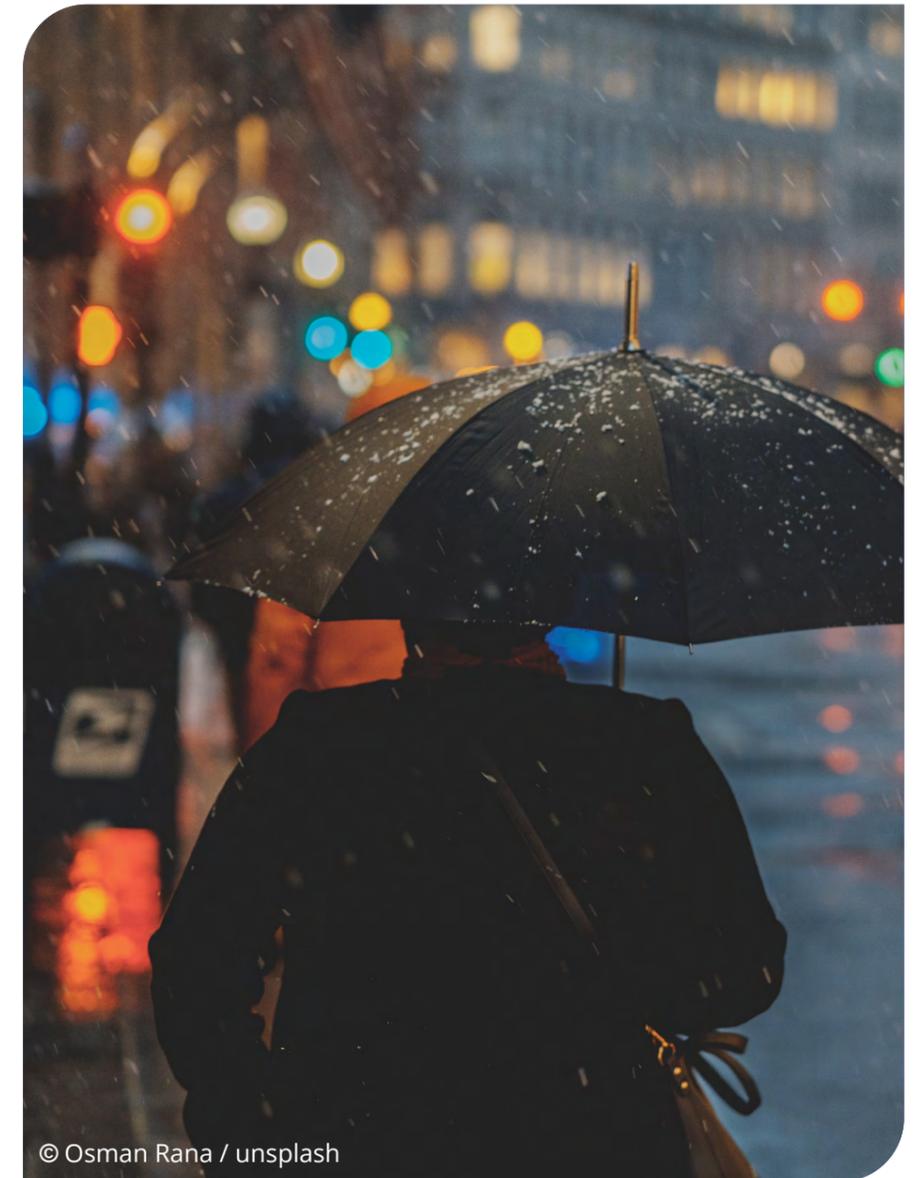
**There are low levels of development in Ireland due to poor economic conditions, and extreme flooding and landslides limiting possible locations for water infrastructure and industrial and residential development.** Ireland's population continues to grow but due to weaknesses in planning and government policy, the location of development that does take place is unpredictable. Along some coastal regions where flood defences are not viable, people are having to move inland. In this challenging context, Ireland fails to reach its ambitions as set out in the National Planning Framework, Project Ireland 2040.

**Changes in agricultural practices and rural depopulation puts further strain on maintaining standards and service under a centralised service network model.**

Existing infrastructure is struggling to support these changes playing out across Ireland, in combination with deteriorating infrastructure and severe weather events. In some areas, water networks fragment and decentralise, with the industrial sector and wealthier consumers often choosing to decouple from the network.

**Networks, infrastructure and operations are leveraging digital capacity, automation sensors and artificial intelligence.** However, due to a lack of available funding, this is predominantly focused around maintaining services and achieving basic compliance in the face of extreme climate conditions and infrastructure decay. The constant 'firefighting' means that wider possibilities and benefits of digitisation are fragmented. Innovative technology and industrial solutions are being deployed but at a slow pace, largely due to a global slowdown in innovation and a lack of available funding to test and scale new solutions in Ireland. New vulnerabilities result in more frequent data and communications breaches.

**Circular economy principles are communicated as a priority in Ireland. Similar to climate action, meaningful action has been limited across all sectors, including water.** The sentiment that there was 'enough' water in Ireland slowed the uptake and implementation of circular use of water. Now, financial constraints are limiting the capacity to invest in circularity. There is also a lack of resources to invest in solutions. Collaboration across industry stakeholders and customers is piecemeal. Some effective multi-stakeholder local catchment management approaches are in place, but efforts are highly regionalised. This means there is still much opportunity to conserve, protect and manage water supplies and improve wastewater treatment.



© Osman Rana / unsplash



# Gan ord ná eagar/ Cloudy with a chance of rain

## Key factor projections

The most active key factors driving the alternative scenarios.



**Location of water services supply and demand:** Weaknesses in the planning system results in industrial and residential development being unpredictable and misaligned with existing water and wastewater infrastructure.



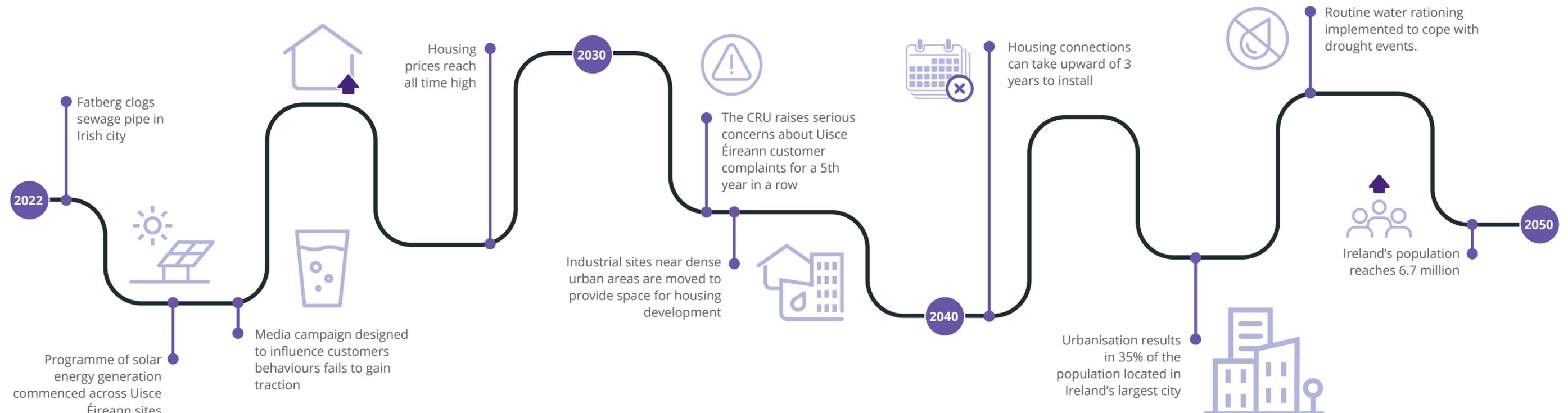
**Water industry ecosystem:** Collaboration across industry stakeholders and customers to deliver the best holistic outcomes is limited. Effective multi-stakeholder local catchment management approaches are limited. Governance and policies are not informed by diverse stakeholders and customers.



**Climate change:** Climate pathway RCP 4.5, which represents a more preferred but still challenging climate is unfolding. There is moderate variation in weather between the West and East of Ireland and moderate shifts in river flow quantities. There is moderate climate change mitigation and adaptation. Uisce Éireann are net zero but Ireland is not yet net zero carbon.

## Fictional timeline

The events below are fictional and should not be perceived as predictions of specific future events. The purpose of the timelines is to allow the reader to be immersed in the 2050 scenario and to consider events which may have led to the scenario playing out.



# Gan ord ná eagar/ Cloudy with a chance of rain

## Scenario description

**Development is haphazard across Ireland, with misalignment between planning, government policy and existing water and wastewater infrastructure. The location of rapid population and industrial growth, for example hydrogen production, is piecemeal and unpredictable. There is a fundamental difference between where water is available and where Ireland's development is centred. This makes it extremely difficult to invest in assets and water services in a way that maximises service benefits and life-cycle value to stakeholders and customers.**

**Ireland has seen a long period of economic stability with high levels of FDI and population growth, in part driven by climate migration.** Foreign owned multinationals hold a huge amount of economic and political influence. They now account for 90% of Ireland's total net corporate tax, 55% of employment taxes and 40% of employment. The economic landscape, lack of integrated cross-sectoral and long-term planning, and underestimated growth, has led to high levels of unplanned, uneven development,

**Eighty percent of Ireland's population is now urban.** The housing 'disaster' and the pressure to build new homes is driving sprawling residential developments, some of which are sited in poorly serviced locations. The shift to smaller household sizes, smaller living units and new housing concepts has impacted the number and location of future homes requiring water services, and operational requirements, such as metering for shared living spaces. The combination of these factors is creating huge challenges for water service provision, including the adoption of sustainable sources and affordability.

**For decades, Ireland has ranked lowest in the European Union in terms of expenditure per person on water supply and sanitation services.** The levels of funding available are seldom aligned to changing dynamics within water and wastewater service demand and the impacts of regulatory change. Furthermore, the governance process to access funding for prioritised capital projects is often too slow, meaning there is little agility in response to unpredictable growth. Planning approval is also time consuming and expensive for water infrastructure.



# Gan ord ná eagar/ Cloudy with a chance of rain

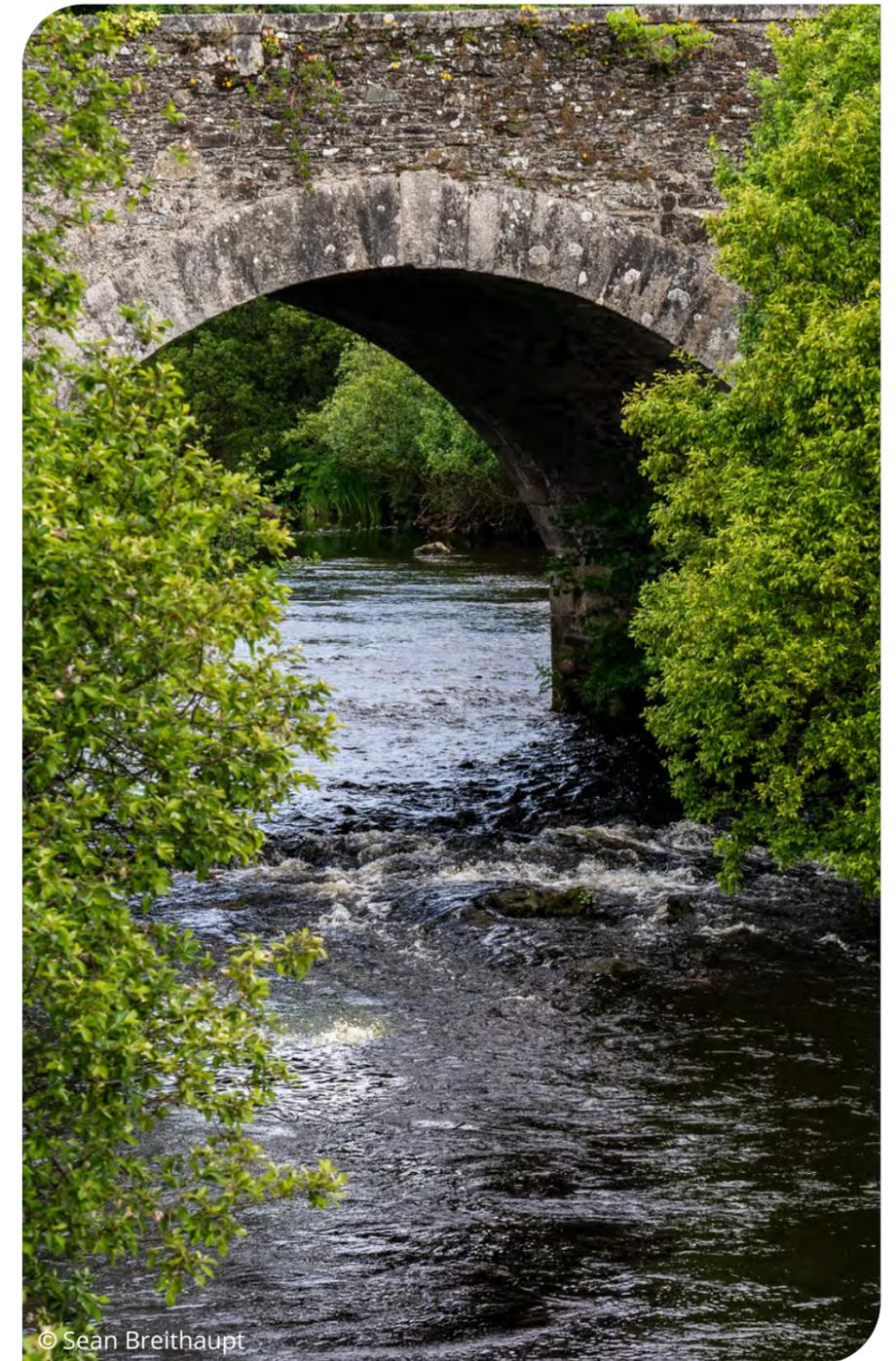
## **Ireland is experiencing extreme weather patterns.**

Increased rainfall intensity, higher frequency of droughts and seasonal weather are all impacting the hydraulic cycle on an annual basis. These impacts are varied across Ireland with river flows decreasing in the south and east, while increasing elsewhere. The world is experiencing a dangerous climate pathway, Representative Concentration Pathway 4.5, however the impacts could be worse. Ireland has prioritised climate mitigation and adaptation of critical infrastructure. Uisce Éireann are net zero carbon and have adopted on-site energy production and sourcing green electricity and heat. However, Ireland itself is lagging behind and is not yet net zero carbon.

**Ireland has been grappling with biodiversity loss for decades, despite a number of European regulatory changes to improve biodiversity.** The latest indicators report by the Environmental Protection Agency states that 75% of rivers in Ireland are of unsatisfactory biological quality. The public want to protect habitats, so conflicts arise where critical infrastructure is needed to support communities and catch up with the pace of development. Great efforts are made to deliver co-benefits, such as restoring habitats of brownfield sites, to create new habitat areas that increase biodiversity and also sequester carbon.

**The water and wastewater sector is a pioneer of the circular economy.** This enables some conservation, protection and integrated management of water and wastewater, as well as economic benefits. However, industries with large water consumption, such as agriculture, tech and manufacturing, are falling behind, despite efforts to collaborate across sectors. Collaboration across industry stakeholders and effective multi-stakeholder local catchment management approaches are limited. The full potential of a circular economy is, therefore, not being unlocked.

**Networks, infrastructure and operations are leveraging digital capacity, sensors and AI as unpredictable demand for water services creates a need to squeeze as much capacity as possible from existing assets.** However, the benefits realised are underwhelming as advancements are often required just to maintain current levels of service in the context of ageing infrastructure and more stringent regulation. Innovative technology and industrial solutions are being deployed particularly in areas that support infrastructure transformation, for example, building materials that store carbon. However, implementation and scaling are at a slow pace and it is extremely difficult to attract and retain individuals with the skills required.



© Sean Breithaupt

# 5. Opportunities and Challenges

## The opportunities, challenges and risks associated with achieving the desired outcomes in each of the future scenarios were identified through in-depth stakeholder interviews and a stakeholder workshop.

In Stage 2 these will be explored, developed and assessed in order to identify prioritised strategic actions and inform Uisce Éireann's adaptive planning into the future.

A full list of opportunities, challenges and risks identified by stakeholders can be found in Appendix G. However, to provide the reader with an overview of these, the opportunities, challenges and risks were clustered into themes which are common across all future scenarios (albeit, with nuances as to how they may play out in each). These are described in the following sections.



### Collaboration and influence

Each of the scenarios drew out a common theme of both an opportunity and a risk around Uisce Éireann's influence and how this influence could be mobilised through collaboration. Stakeholders framed this both around opportunities to better utilise and increase influence, as well as risks around the inability to influence key stakeholders and the public. For example, there is an opportunity to collaborate as a sector to develop and communicate a co-ordinated narrative around the value of water, enabling better appreciation, thus influencing public behaviour. There are also opportunities around influencing regulations, for example, to implement specific policy changes (such as in building regulations and domestic retrofitting schemes). However, a key risk identified was Uisce Éireann having insufficient ability to meaningfully influence behavioural change such as a reduction on public water consumption.



### Net Zero Carbon

There were numerous opportunities and risks identified regarding achieving Net Zero Carbon. For example, there is an opportunity to improve governance around how carbon impacts are factored into Uisce Éireann decision-making and reduce carbon usage through circular economy principles. There is also an opportunity with infrastructure renewal to utilise low carbon or carbon neutral construction materials and methods, and incorporate solutions to sequester carbon. In addition, an opportunity was raised to increase energy efficiency and renewable energy production, with the co-benefit of shielding against energy price volatility and any future changes to charging models. A key risk identified in some of the scenarios was the inability to achieve the target to become Net Zero Carbon by 2040, due to issues of affordability or the influence of ageing infrastructure.



### Innovation and integrating new technologies

An area of opportunity referenced frequently was increasing the pace and scale of innovation and the integration of new technologies. This is to achieve sectoral desired outcomes given the context of climate change impacts, net zero ambitions and ageing infrastructure. Opportunities include establishing better processes and a more proactive culture, the use of Building Information Modelling (BIM) to produce a highly coordinated view of the assets, and adopting materials advances, such as nanomaterials. Some of the challenges identified were around ensuring there is a clear business case for new technologies, such as robotics, to ensure the high cost of implementation and maintenance do not outweigh the benefits. There were also challenges identified around the complexity of implementing developments such as Digital Twins and having the required skills and capabilities.



### Blue-green infrastructure, nature-based solutions and catchment initiatives

A common thread across all the scenarios was to incorporate nature-based solutions, blue-green infrastructure and catchment initiatives in suitable locations. For example, to facilitate widespread integration of blue-green infrastructure alongside new residential and industrial development and construct wetlands for wastewater management generally in smaller rural locations. However, challenges were also identified such as the willingness to invest in these solutions as opposed to continuing investment in the rehabilitation of traditional infrastructure. There are also significant complexities around the delivery of solutions due to multiple stakeholder involvement and many different regulatory systems involved. There is also a risk that if biodiversity and habitats are not improved, this could further exasperate climate change impacts such as flooding.

# 5. Opportunities and Challenges



## Resilience

A key theme identified was resilience, in particular the challenge of adapting often ageing infrastructure to climate change impacts but also wider organisational, financial and corporate resilience. For example, the potential limited financial capacity to protect wastewater and water treatment plants from extreme weather events, the statutory approvals system and lack of legislative agility restricting the pace of transformation and adaptation required, and increased storm events increasing pressure on combined systems. Wider resilience challenges include an increased threat level from cyber-attacks, energy price volatility, sustained multi annual funding model and an inability to recruit and retain skilled employees. There were opportunities identified in support of resilience, such as adopting sustainable abstraction sites and leveraging sustainable finance initiatives including Green Bonds and Sustainability Performance Linked Lending.



## Compliance and regulation

A common theme identified was how regulation and planning influences all aspects of the water sector. Streamlining planning system to allow faster infrastructure development and facilitating economic growth through alignment of industrial and infrastructure development were highlighted as both challenges and opportunities. Aligning local, regional and national planning to encourage innovative catchment based approaches were also flagged as a key opportunity. Challenges around governance related to timely access to funding were highlighted. A common theme identified was ensuring regulatory compliance in the context of potentially more stringent environmental parameters, climate change impacts and insufficient funding. There were risks identified due to factors affecting compliance not being under Uisce Éireann's influence, for example, land use impacting on water quality. However, stakeholders did acknowledge the opportunity for innovative approaches to water use and wastewater treatment to ensure compliance with stringent environmental policies and regulations.



## Data and digital technology

There were numerous opportunities, challenges and risks identified in relation to data. Opportunities include establishing the governance and processes to streamline data sharing, hence enabling innovation, research and operational and investment efficiency across Uisce Éireann and stakeholders. In addition, there is an opportunity to use technology and the data captured to identify and significantly reduce leakage and be more resilient to water stresses. There are also opportunities to improve customer insight and engagement through data analytics. However, protecting and managing data from cyber risks, addressing data gaps, strengthening data related skills and the integration of data sets across Uisce Éireann and stakeholders were all identified as challenges.



## Demand on water resources and services

Water service demand and the associated challenges and opportunities were frequently highlighted across all of the scenarios. This theme was also picked up as part of the scenario process with trends such as population growth and household patterns, and the key factor 'location of water services supply and demand'. Specific challenges identified include sectors such as agriculture creating increased competition for water resources, and public resistance and acceptability of inter-catchment transfers to provide sustainable supplies in high demand areas. There are opportunities to develop a national plan for water use, linking the water sector, agriculture and industry, improve demand predictions by monitoring FDI flows and work closely with companies who are investing in large capital intense projects to optimise service use and resource recovery.

## Example opportunities

Local Authorities and UÉ could work together to remove storm water from wastewater networks. Reducing the volume of wastewater would make implementing Integrated Constructed Wetlands cheaper.



Digital Twins could be used to support the implementation of an operational strategy for existing and new assets.



Carbon offsets could be achieved through incorporating nature based solutions into infrastructure development on a catchment scale.



# 5 Opportunities and Challenges

Across the three scenarios there are a variety of opportunities and challenges around meeting each of the desired outcomes. In some cases, the opportunity may also represent a challenge depending on specific nuances or the perspective of the reader.

Outcomes	Suaimhneas Sunny outlook	Rírá Storms forecast	Gan ord ná eagar Cloudy with a chance of rain
All citizens have access to trusted, safe and equitable water and wastewater services			
Society places a high value on water as a resource and service			
Water services enable and support economic prosperity in Ireland			
Stakeholders work in partnership to maximise common benefits for the water sector			
The water sector is a leader in climate adaptation and migration in Ireland			
Water network infrastructure and operations are efficient, secure, resilient and adaptable			
The water sector enhances the environment and biodiversity			

## Legend

Opportunity	Challenge	Theme
		Collaboration and Influence
		Net Zero Carbon
		innovation and integrating new technologies
		Blue-green infrastructure, nature-based solutions and catchment initiatives
		Resilience
		Compliance with regulation and fitness for purpose
		Data and Digital Technology
		Demand on Water Resources and Services

# Next Steps

In the next stage of this project, we will explore, develop and assess the opportunities, challenges and risks in order to identify prioritised strategic actions and inform Uisce Éireann's adaptive planning into the future. An adaptive planning approach monitors change and when key trigger points are met, strategic decisions are adjusted in response. This will help Uisce Éireann to achieve balance between meeting the needs of today while ensuring we meet the longer-term future aspirations of society and our stakeholders.

We will identify actions we can take now or into the future that will be positive 'no regrets' actions and how these can be exploited individually and collectively to drive desirable outcomes. We will also identify actions where we need to develop our understanding, solutions and direction of travel first. As part of this process, we will also assess deliverability and identify our current state of readiness as an organisation, for example, considering capabilities, processes, investment and partners. The outputs of Stage 2 will be presented in the form of roadmaps, providing a framework for a holistic long-term perspective.



Mutton Island , Galway - lighthouse © Keith Arkins

# Acknowledgements

Uisce Éireann would like to thank the wide range of stakeholders who participated in the project to date. Their input provided valuable insight throughout the process, allowing the views of the wider water sector to be considered.



# 6 Glossary and Abbreviations

## Glossary

### Abstraction

The removal of water from a river, lake or groundwater usually with the use of a pump.

### Asset Infrastructure

(e.g. buildings, treatment plants) and equipment (e.g. pumps, screens, treatment units, disinfection systems and control panels) controlled and operated by Uisce Éireann to deliver water and wastewater services. We divide these into Below Ground Assets such as pipework and valves and Above Ground Assets such as treatment plants.

### Biodiversity

The variety of all living things.

### Catchment

The area of land where surface water from rainfall converges to a single point at a lower elevation, usually a point in a river, lake or an estuary. The catchment includes all drainage channels, tributaries (smaller streams) and floodplains.

### Critical certainties

High impact, more certain trends that play out in every scenario.

### Critical uncertainties

High impact, more uncertain trends. These are clustered to form key factors driving alternative future scenarios.

### Discharge

Treated effluent from a wastewater treatment plant which is returned to the water environment. This is usually from a pipe and outflow structure into a river or the sea.

### Key Factors

Neutral topics identified by clustering the critical uncertainties. The variables influencing the scenarios, exploring the range of plausible future extremes using alternative 2050 projections.

### Net-negative carbon

When an organisation removes more carbon than it emits.

### Network

The interconnection of pipes and pumping stations used for the distribution of treated water and the collection of wastewater.

### Raw Water

Water abstracted for drinking water purposes before treatment.

### Resilience

The ability of a system (e.g. water supply zone or wastewater network) to cope with change or stress. In a water services context stress to the system or network could result from increased demand, partial failure of operating plant, climate change or local contamination of water sources.

### Representative Climate Pathway (RCP)

Pathways representing a broad range of climate outcomes based on different emission levels.

### Water Services

All services which provide storage, measurement, treatment or distribution of surface water, ground water or water supplied by Uisce Éireann, or Wastewater collection, storage, measurement, treatment or disposal.

# 6 Glossary and Abbreviations

## Abbreviations

<b>AI</b>	Artificial Intelligence
<b>BIM</b>	Building Information Modelling
<b>CAP</b>	Climate Action Plan
<b>CCMA</b>	Customer Contact Management Association
<b>CRU</b>	Commission for Regulation of Utilities
<b>DAFM</b>	Department of Agriculture, Food and the Marine
<b>DECC</b>	Department of the Environment, Climate and Communications
<b>DHLGH</b>	Department of Housing, Local Government and Heritage
<b>EU</b>	European Union
<b>EPA</b>	Environmental Protection Agency
<b>ESRI</b>	Economic and Social Research Institute
<b>FDI</b>	Foreign Direct Investment
<b>HSE</b>	Health Service Executive
<b>Ibec</b>	Irish Business and Employers Confederation

<b>IDA</b>	Industrial Development Agency
<b>IFA</b>	Irish Farmers' Association
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>UÉ</b>	Uisce Éireann
<b>NUI Galway</b>	National University of Ireland Galway
<b>OPR</b>	Office of the Planning Regulator
<b>RC</b>	Regulatory Control
<b>RCP</b>	Representative Concentration Pathway
<b>STEEP</b>	Social, Technological, Economic, Environmental, and Political
<b>SWAN</b>	Sustainable Water Network
<b>UKWIR</b>	United Kingdom Water Industry Research
<b>e.g.</b>	exempli gratia ("for example")
<b>i.e.</b>	id est ("that is")

# Appendices

