Climate Northern Ireland

INFRASTRUCTURE

Northern Ireland Climate Change Risk Assessment

Risks & Opportunities

www.climatenorthernireland.com

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About Climate NI

Climate NI Programme Vision

> *Climate Northern Ireland is a cross-sectoral partnership devoted to understanding and enabling adaptation and mitigation actions in Northern Ireland that can address the climate emergency.*

Climate NI Programme Aims

- **Support development and implementation of climate policy** by enabling the exchange of expertise and advice between Government Departments, public bodies, and civil society.
- **Engage the research community** to help define and address evidence needs for climate policy and action.
- **Increase co-ordination and awareness on climate change** through partnership and clear communication.
- **Enable delivery of climate action in NI** by addressing barriers and building capacity at local, regional and national levels.

Climate Northern Ireland

Northern Ireland environment link

Funded via the Carrier Bag Levy by:

Department of Agriculture, Environment and Rural Affairs
www.daera-ni.gov.uk

An Roinn Talmhaíochta, Comhshaoil agus Gnóthaí Tuaithe

Depairtment o' Fairmin, Environment an' Kintra Matthers

Climate Northern Ireland is funded by DAERA to raise awareness of and support climate change policy development through stakeholder engagement.

Climate Change & Northern Ireland

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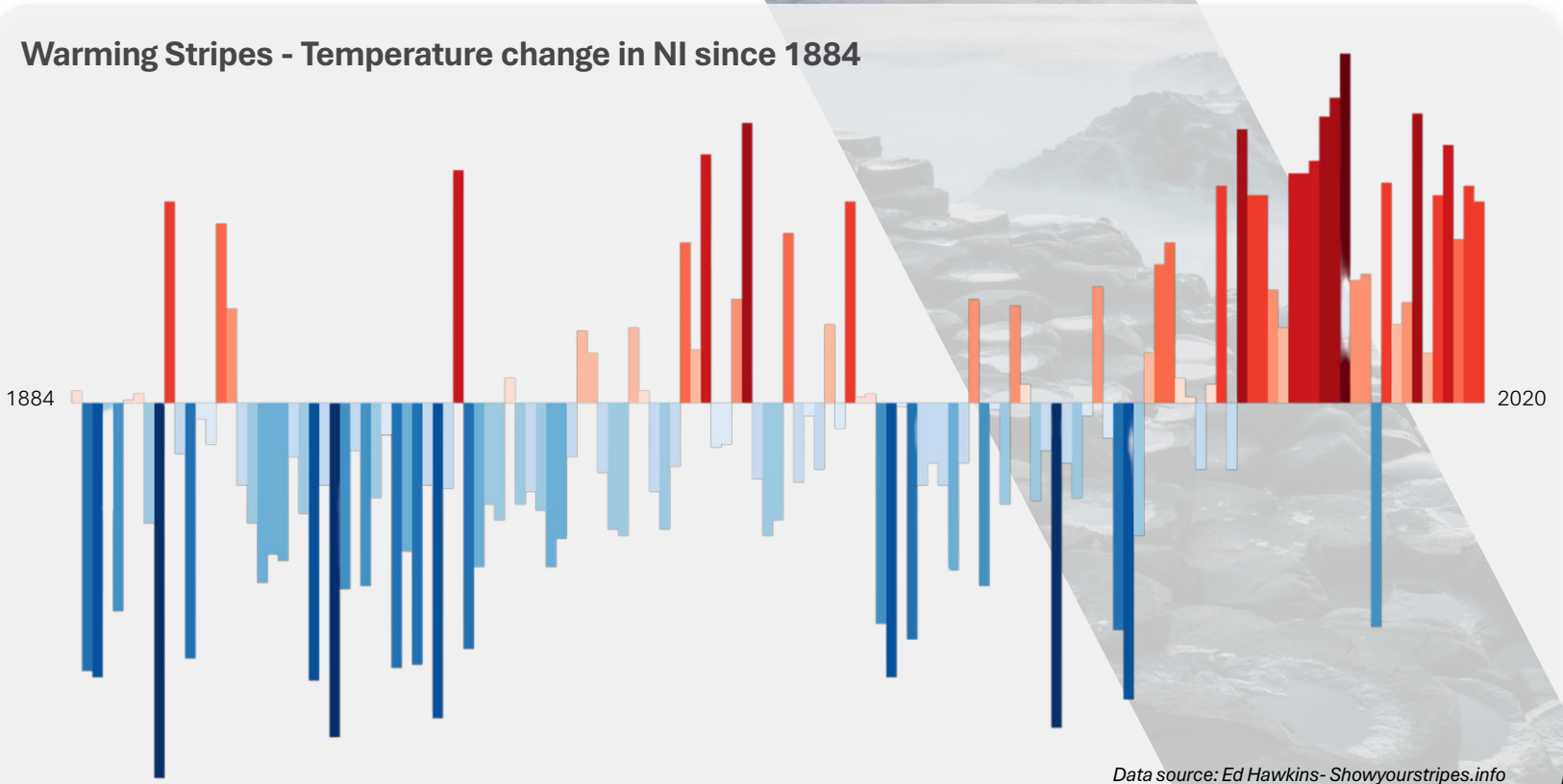
Changes in average temperatures

NI's climate is changing in line with the global average temperature.

> *An increased chance of **warmer, wetter winters** and **hotter, drier summers** along with an increase in **frequency and intensity of extremes**.*
>
> Met Office

Northern Ireland is **locked in to at least 11cm of sea-level rise by 2100**, but unless global emissions decline, that number could be as much as 94cm.



Climate Change Risk Assessment

Climate Northern Ireland

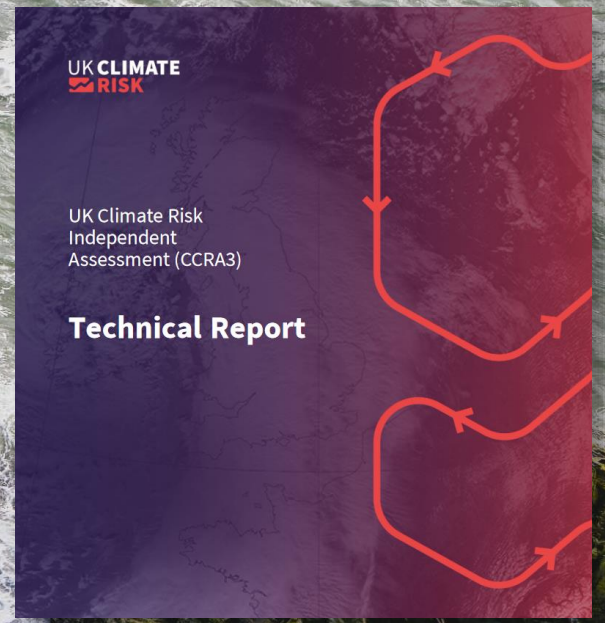
The Third UK Climate Change Risk Assessment (CCRA3)

The evidence for the third UK **Climate Change Risk Assessment** (CCRA3) is compiled by the UK Government's independent advisors, the **Climate Change Committee** (CCC).

61 risks and opportunities were assessed in detail. Alongside technical reports a summary was produced for each region, including Northern Ireland.

Each risk is assessed by answering the following questions:

1. What is the current and future level of risk?
2. To what extent is the risk going to be managed?
3. Are there benefits of further action in the next five years, over and above what is already planned?



For detail on the climate risk for NI and a range of short sector briefing papers, check out:

ukclimaterisk.org

Climate Change Risk Assessment

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Urgency score for Climate Change Risk Assessment

Category	Description
More action needed	New, stronger or different Government action, whether policies, implementation activities or enabling environment for adaptation – over and above those already planned – are beneficial in the next five years to reduce climate risks or take advantage of opportunities. This will include different responses according to the nature of the risks and the type of adaptation: Addressing current and near-term risks or opportunities with low and no-regret options (implementing activities or building capacity). Integrating climate change in near-term decisions with a long life-time or lock-in. Early adaptation for decisions with long lead-times or where early planning is needed as part of adaptive management.
Further investigation	On the basis of available information, it is not known if more action is needed or not. More evidence is urgently needed to fill significant gaps or reduce the uncertainty in the current level of understanding in order to assess the need for additional action. *Note the category of 'Research Priority' in CCRA2 has been replaced with 'Further investigation' in CCRA3. This is because of some confusion following CCRA2 that 'research priority' only denoted that more research was needed, when in fact the urgency is to establish the extent to which further adaptation is required.*
Sustain current action	Current or planned levels of activity are appropriate, but continued implementation of these policies or plans is needed to ensure that the risk or opportunity continues to be managed in the future.
Watching brief	The evidence in these areas should be kept under review, with continuous monitoring of risk levels and adaptation activity (or the potential for opportunities and adaptation) so that further action can be taken if necessary.

Risk Overview

Risk	Urgency score
I1: Risk of cascading failures to infrastructure networks (water, energy, transport, ICT)	More action needed
I2: Risk of river, surface water and ground water flooding to infrastructure services	More action needed
I3: Risk of coastal flooding and erosion to Infrastructure services	Further investigation
I4: Risk of flooding and erosion to bridges and pipelines	Further investigation
I5: Risk of slope and embankment failure to transport networks	More action needed
I6: Risk of low or high river flows on hydroelectric generation	Watching brief
I7: Risk of subsidence to subterranean and surface infrastructure	Further investigation

Risk	Urgency score
I8: Risk of reduced water availability to public water supplies	Sustain current action
I9: Risk of reduced water availability for energy generation	Watching brief
I10: Risk of high and low temperatures, high winds, lightning to energy	Further investigation
I11: Risk of storms and high waves to offshore infrastructure	Sustain current action
I12: Risk of high and low temperatures, high winds and lightning on transport	More action needed
I13: Risk of high and low temperatures, high winds, lightning to digital	Further investigation
ID7: Risk of climate hazards affecting supply chains	More action needed

Risk in Northern Ireland

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“Rising sea levels 'a risk' to NI rail network” - BBC

28 February 2024

A Translink report focuses on the impact of rising sea levels on the rail network and warns that by 2040 a number of locations are at high risk.

The report found that by 2040, seven locations including on Londonderry and Larne lines are at high risk of rising seas. A further four are also deemed to be at medium risk within the next 16 years.

It further projects the impact of rising sea levels in 2060, 2080 and found that by the year 2100, the number of high-risk locations could rise to 13. The most severely impacted lines are in Derry and Larne, with high-risk locations identified by 2100 including Larne, Derry, Castlerock, the Bann estuary, Glynn and Ballycarry.

Ulster Unionist assembly member John Stewart said the report’s conclusions will be of concern to many, especially in his east Antrim constituency.

He said the loss of any part of the network will impact both the economy and local communities. “It is inevitable that within the next 16 years the impacts of climate change will destroy parts of the Larne and Londonderry line, with no option existing to save these tracks,” he said.

Rail lines in Northern Ireland face climate risks from increased flooding, coastal erosion, and extreme weather events. Sections of track near rivers and coastlines are vulnerable to rising sea levels and storm surges, which can lead to erosion and track instability. Heavy rainfall could overwhelm drainage systems, causing landslides or washouts that disrupt services.

More Action Needed

I1: Risk of cascading failures to infrastructure networks (water, energy, transport, ICT)

- **Vulnerabilities on one network can cause problems on others**, both within and beyond the infrastructure sector. Given the wide-ranging nature of the linkages, a full understanding of the impacts of cascading failures is difficult to ascertain. However, recent international research has indicated that the vulnerability of interconnected systems may be significantly underestimated.
- Across the UK examples of cascading failures in the infrastructure sector include, coastal flooding causing power infrastructure inundation, and power supply interruption leading to impacts on travel and freight operations.
- The **current magnitude of this risk is high with high confidence**, with disruption in urban areas potentially impacting on hundreds of thousands of people. The risk is high magnitude both now and in future.

More Action Needed

UK CLIMATE RISK

Climate Northern Ireland

I2: Risk of river, surface water and ground water flooding to infrastructure services

- In terms of future risk, **railway lines are the only infrastructure type in NI projected to increase in risk from river flooding.** Risk increases by 50% by the 2080s with 4°C global warming at 2100.
- All other **infrastructure types are projected to decrease in risk.**
- Freshwater sites, electricity substations, railway lines and railway stations are projected to see an increase in risk from surface water flooding. By the 2080s in a +4°C at 2100 scenario, this increase in risk ranges from 49% for freshwater sites to 137% for railway lines. The risk to power stations is projected to decrease under all scenarios.

Infrastructure Asset	Exposure to surface water flooding (1:30 or greater)	Exposure to river flooding (1:75 or greater)
Water sites (no.)	382	91
Sewage treatment works (no.)	0	0
Power stations (no.)	3	0
Electricity substations (no.)	6	1
Rail length (km)	183	87
Rail stations (no.)	3	0
Landfill sites (no.)	0	0

Figure 5. Number or length of infrastructure assets currently exposed to 'significant' surface water or river flooding in Northern Ireland. Reproduced from Infrastructure technical chapter.

I3: Risk of coastal flooding and erosion to Infrastructure services

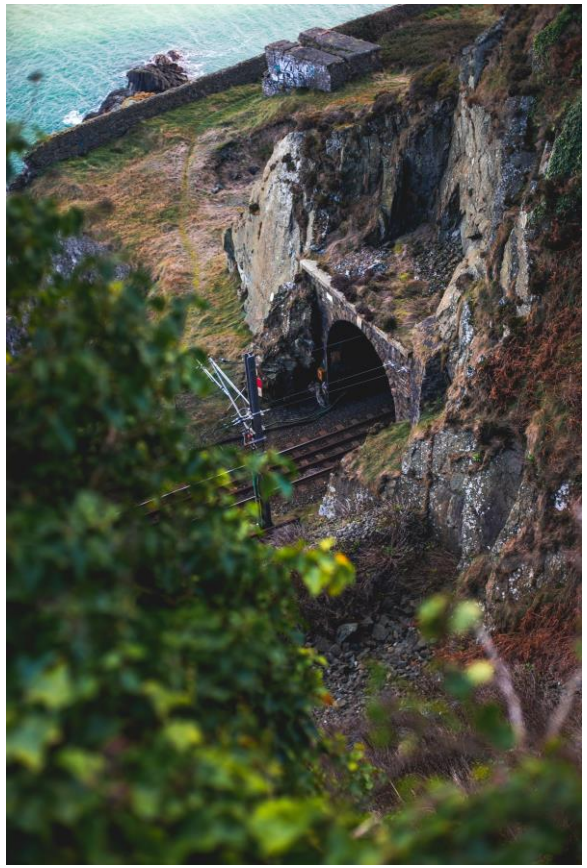


Photo by C. Luddy from Unsplash

- Current projections for sea level rise in Northern Ireland are between 27 and 58cm by 2080, with larger rises considered possible
- Rail networks tend to be exposed to significant coastal flooding, as well as a number of sewage treatment works.
- The assets facing the largest risks from coastal flooding are rail lines and station, and sewage treatment works.
- It has been estimated that **19.5% of the coastline is either eroding or at risk of erosion and that 32% of the coast has some form of manmade protection.**
- It is projected that, in the absence of further adaptation and in a +4°C at 2100 scenario (low population growth), by 2080 the length of railway track exposed to coastal flooding could potentially double in Northern Ireland (100% increase).

I4: Risk of flooding and erosion to bridges and pipelines

- Some modelling has been completed for bridges in the UK as a whole, that states that **increased winter precipitation and river flows will increase scour at bridges**, potentially **increasing the rate of failure** to an average of one bridge per year in the UK. Bridges also have significant potential for lock-in of climate risks due to their long service lives (50 - 100 years), and high cost of retrofitting, making them priority assets for adaptation.

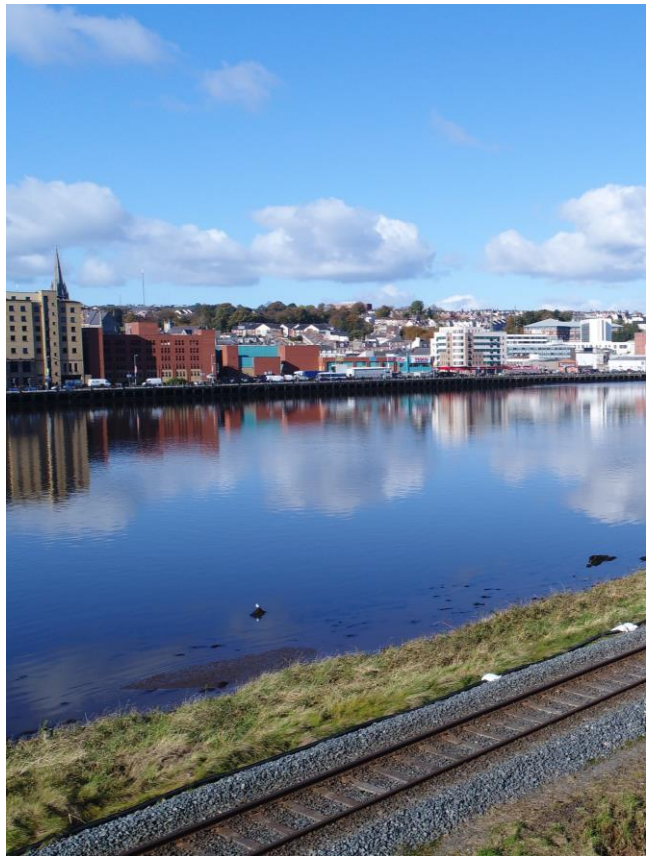
- Currently, no systematic quantitative assessment of climate risks to bridges or pipelines for the UK exists.

- Results are limited to the identification of weather events and environmental hazards which underlie the risk, such as rainfall, temperature and erosion for pipelines, and increased hydrostatic pressure and scour for bridges.

The Peace Bridge in Derry. Photo by K. M. Hodge

More Action Needed

I5: Risk of slope and embankment failure to transport networks



River Foyle. Photo by T. White

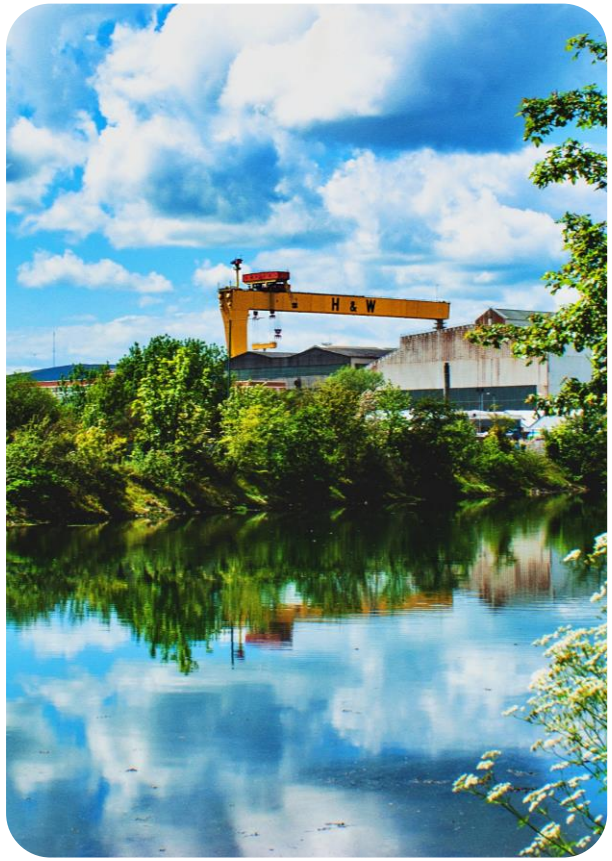
- Increased incidence of high rainfall combined with preceding periods of dry weather and subsequent cracking are expected to lead to an increase in incidents of slope failure within the transport network.
- Rainfall is seen as the main trigger of deterioration and extreme weather is expected to increase the rate of these deterioration processes, albeit with some uncertainty. E.g., in County Down, hydrogeological processes caused unexpected instability and quick conditions during the excavation of a 25m deep cutting through a drumlin.
- Soil moisture fluctuations will lead to increased risk of shrink-swell related failures. This is likely to be the most significant geological hazard to UK infrastructure.
- A LiDAR survey of the Irish Rail network shows that slope vulnerability to shallow planar type failures is expected to increase with predicted changes in climate such as more intense and longer rainfall events with longer dry periods between.

I6: Risk of low or high river flows on hydroelectric generation

- Hydroelectric power is vulnerable to low flows and extreme high river flows. Low flows reduce power output, whereas extreme high river flows damage generation equipment and associated infrastructure, including spillways and weirs.

- Damage from extreme high river flows can be exacerbated by debris carried by the river. More modest high flow can, however, improve output.

- The CCRA3 Technical Report identified there are few major hydro power producers in Northern Ireland, hence this risk is scored as watching brief. Risk is low now and in the future, assuming there is not a significant increase in hydro power installations.



Connswater River. Photo by K. M. Hodge

I7: Risk of subsidence to subterranean and surface infrastructure

Photo by H. Rudolph from Unsplash

- Ground subsidence can occur due to shrinking and swelling of clay soils due to changes in soil water content and can also occur due to collapse of pre-existing cavities in the ground such as voids in soluble rocks and mine workings.
- Transport infrastructure and buried infrastructure is vulnerable to damage and disruption due to climate change driven subsidence effects.
- The formation of sinkholes under road and rail infrastructure can be precipitated by prolonged or extreme rainfall. Areas underlain by soluble rocks are most vulnerable though the collapse of poorly capped and filled mineshafts can exhibit the same effects.
- There are over 2,400 known abandoned mine workings in Northern Ireland, containing vertical shafts and horizontal adits extending underground to great distances.
- The current risk is deemed low, rising to medium in future. Confidence in this assessment is low as no further quantitative evidence has been identified since CCRA2 on the potential future risk.

I8: Risk of reduced water availability to public water supplies

- The UK faces an increased demand for water in a changing climate. Research indicates that the UK currently has a supply-demand surplus of 950 Ml per day. However, without adaptation and under a central population scenario, a deficit across the UK of between around 1,220 and 2,900 Ml per day (+2°C and +4°C at 2100 scenario range) is projected by the late century, equating to the daily water usage of around 8.3 to 19.7 million people.

- Northern Ireland has an overall supply-demand surplus by the late century under the central population scenario and for both 2°C and 4°C global warming at 2100. The southern water resource zone in Northern Ireland is projected to have a supply-demand deficit in the late-century, in both +2°C and +4°C at 2100 scenarios under central population projection and assuming no additional adaptation action.

Photo by P. Xiapzhen from Unsplash

I9: Risk of reduced water availability for energy generation

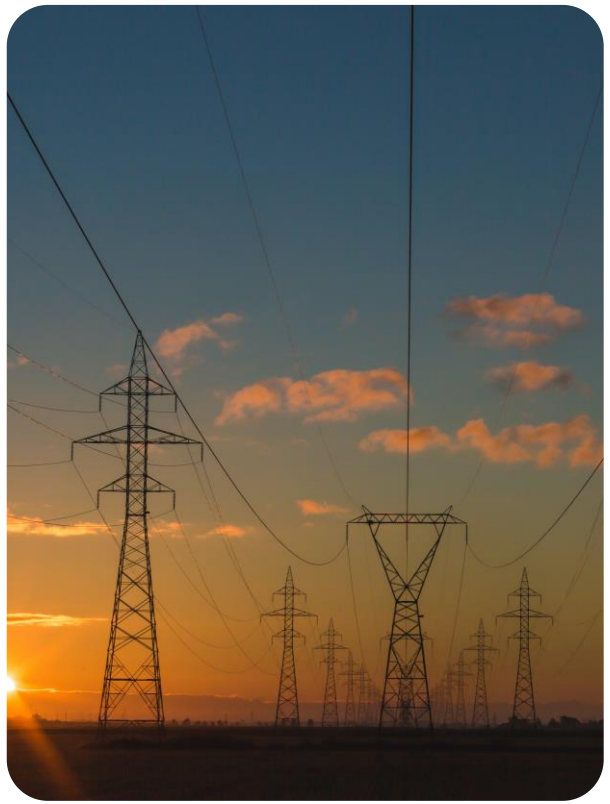


Photo by M. Henry from Unsplash

- Thermal power generators, including energy from waste plants sited inland, are the main type of generation vulnerable to reduced water supply.
- All Northern Ireland's large thermal power generation is coastal. Projections of future catchment water availability suggest there could be reductions in catchment water availability by mid-century in some catchments of Northern Ireland under a pathway to 2°C global warming at 2100. This would have implications for the siting of any future thermal generation plant.
- **Current and future risk for Northern Ireland is low.** Changes to the energy mix introduced by Net Zero policy could potentially increase this risk if the technologies that are favoured have high water demand. Future water availability should be considered in selecting sites for these plants.

I10: Risk of high and low temperatures, high winds, lightning to energy

- There is some evidence of how, currently, energy infrastructure is affected by extremes of weather, such as reducing the amount of energy generated from thermal generators and solar PV cells (caused by hot temperatures), line faults (caused by cold temperatures, snow and ice), damage from debris caused by (wind) and power cuts caused by (lightning).

- **The future changes to the impacts of lightning strikes and wind are uncertain and not discernible by nation.** Therefore, the current and future risk magnitude is high but with significant uncertainty, hence further investigation is required.

Photo by Vivint Solar from Unsplash

I11: Risk of storms and high waves to offshore infrastructure

Photo by J. De Meulenaere from Unsplash

- Offshore infrastructure includes equipment used by the oil and gas industry, wind, tidal and wave energy, and gas pipelines and power cables on or under the seabed. Their vulnerabilities because of storms and high waves include the destabilisation or degradation of mechanical structures, reduced energy output and operating periods, damage to cabling systems during storms and prevention of access for maintenance and inspection activities.

- The current risk to offshore infrastructure is low, based on a good level of evidence within the CCRA3 Technical Report which has not changed much since the previous CCRA2.

- Changes to mean sea level rise, wave height and wind speed could exacerbate the above impacts in the future. There is no documented evidence of any difference in the risk to offshore infrastructure in Northern Irish waters compared to assets off other coasts.

More Action Needed

I12: Risk of high and low temperatures, high winds and lightning on transport

- **Rail:** Heat can cause rails to buckle, overhead cables to sag, signals to fail and maintenance from being performed. Railway assets tend to demonstrate threshold temperatures beyond which failures manifest. Once the track is laid this resilience can reduce as the ballast moves and settles. Wind can disrupt rail operations by blowing branches, trees and debris onto the line. Lightning can cause damage to electronic equipment, line-side trees and buildings as well as cause risk of line-side fires.

- **Road:** High summer temperatures can increase thermal loading on bridges and pavements causing expansion, bleeding and rutting. Wind affects road operations, with high sided vehicles becoming unstable in gusts of wind over 45mph (particularly on exposed bridges). High winds can also damage roadside furniture such as traffic signs, and blow nearby vegetation onto the road. There is a general lack of quantified data on the impact of high and low temperatures, wind and lightning on road infrastructure.

The Peace Bridge in Londonderry. Photo by K. M. Hodge

More Action Needed

I12: Risk of high and low temperatures, high winds and lightning on transport

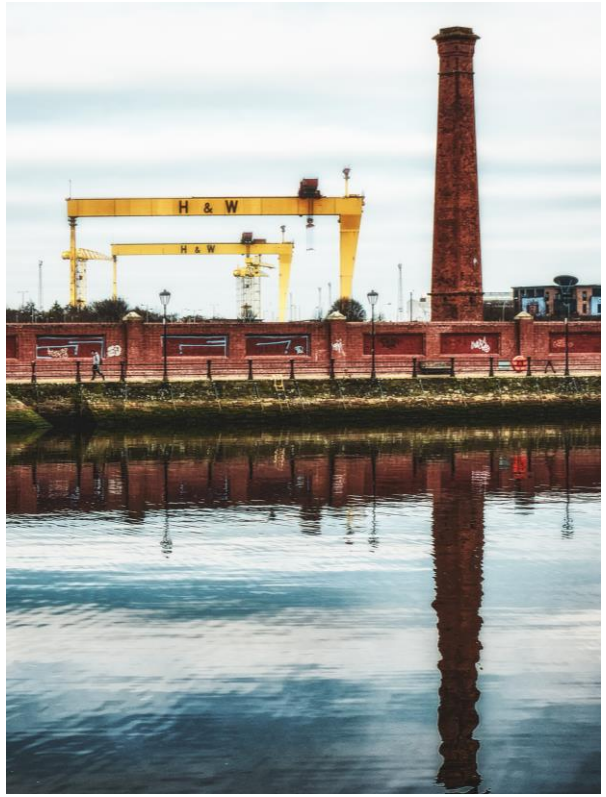


Photo by K. M. Hodge from Unsplash

- **Air Travel:** Higher temperatures can cause problems with runway conditions and the flashpoint of aviation fuel. These factors, combined with changes in air density, would result in greater fuel usage and potentially longer runways for take-off. Overheating of standing aircraft occurs at temperatures above 25 - 30°C and requires the use of aircraft Auxiliary Power Units (APU) or preconditioned air to cool aircraft. Snow and ice can cause severe disruption to operations.

- **Water:** High wind speeds lead to the suspension of port operations including halting crane operations. The understanding of current and future risk from climate impacts is varied across different transport modes and climate hazards.

I13: Risk of high and low temperatures, high winds, lightning to digital

- Risks to digital associated with climate change are considered to currently be of low magnitude, rising to medium under different climate futures.

- Climate-related risks have the potential to disrupt the availability and reliability of digital technology via:
  - Failure of telecommunications leading to reduced capacity in a wide range of other essential services.
  - Mobile base station power failure because of extreme weather.
  - Local outages, given consumer reliability on digital technology today.
  - Ground shrinkage can lead to failure of electricity, gas and water pipes, thereby damaging co-sited ICT infrastructure.
  - High summer temperatures, as well as rapid fluctuations in temperature and humidity, pose challenges to data centres, which must be kept cool to operate.
  - Poorer performance of radio systems due to heavy rainfall.
  - Greater international communication disruption due to increase sea temperature.

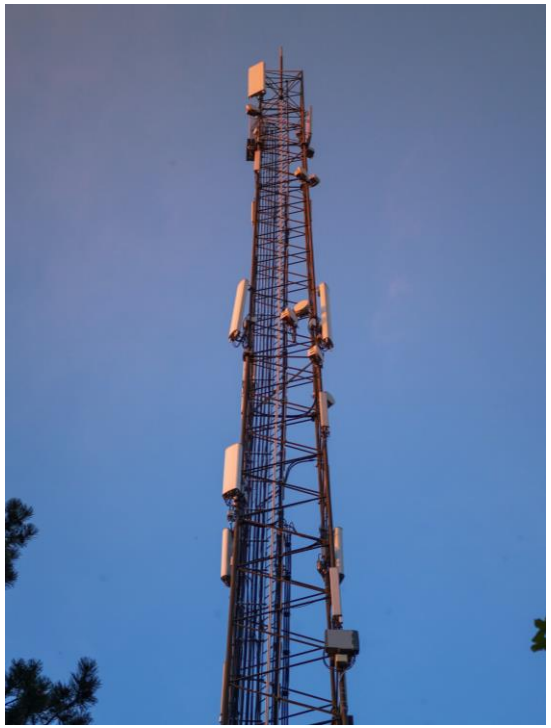


Photo by M. Seegen from Unsplash

More Action Needed

ID7: Risk of climate hazards affecting supply chains

- Climate-related disruption to non-food supply chains may occur in production facilities, for example floods affecting factories or mines, but perhaps is more likely to impact on supply-chain logistics, which can be interrupted in multiple ways.

- With globalised supply chains characterised by ‘just-in-time’ delivery, high efficiency but low redundancy, they can be fragile and lack resilience to disruptions. Given the projected and observed increase in disruptive events, this risk may become more potent in future.

References

1. UK Climate Risk Website

2. UK Climate Risk Independent Assessment (CCRA3) Technical Report

3. Evidence for the third UK Climate Change Risk Assessment (CCRA3) Summary for Northern Ireland

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