Workshop Report

Climate Resilient Critical Energy Infrastructure Workshop

Held virtually on 17th May 2023

Executive Summary

The workshop examined climate resilience and adaptation of critical energy infrastructure and downstream applications on the Island of Ireland. While the primary focus was on electricity networks, other critical infrastructure stakeholders were invited to contribute to illustrate the links and dependencies between energy critical infrastructure providers and services that depend on resilient energy supplies. An important aim of the workshop was to foster a greater interconnectedness between all key stakeholders.

The workshop focused on the following three main objectives:

1. assessing critical infrastructure resilience to current and projected extreme climate related events and their impacts;

2. identifying information gaps that need to be filled to achieve energy resilience; and

3. governance, coordination, and cross cutting issues - identifying barriers to systemic coordination and ensuring that there is good coherence with other policies.

The workshop included two presentations from guest speakers: Ms. Cara Labuschagne on delivering climate resilient energy infrastructure in the UK; and Prof. Paul Chinowsky on international perspectives on resilient infrastructure planning.

Over fifty participants from government departments, academia, policy-making and the private sector took part in the event. They contributed to three breakout sessions split over five virtual groups addressing aspects of the three key areas of focus identified above. A virtual whiteboard tool (Miro) was used to increase the interactivity of the sessions and help to gather the participants' insights. Detailed notes and virtual post-it notes from the Miro whiteboards were consolidated to capture the findings of the facilitator-led breakout sessions.

Key recommendations were identified based on discussions under the three main objectives. These recommendations are presented under the categories of: governance and regulation; planning and future developments; resources; and information. Agencies considered as being best placed to lead on implementing the proposed recommendations are also identified where possible.

Governance and regulation

- Centralised coordination is needed to strengthen delivery of policy actions to improve resilience in the electricity and gas infrastructure sector – **Department of the Environment, Climate and Communications**.
- The establishment of a coordination platform looking at ensuring the resilience of all critical infrastructure should be considered to address interdependencies and adaptation needs in the area of infrastructure – **Department of the Environment, Climate and Communications (Adaptation) as possible coordinator with participation from Department of the Environment, Climate and Communications (Electricity and Gas), Department of the Environment, Climate and Communications (Communications Networks), Department of Transport (transport infrastructure), Department of Housing, Local Government and Heritage (water infrastructure), National Framework for Climate Services (Met Éireann), Department of Transport (transport infrastructure), Department of Defence**.

Planning and future developments

- Agencies must be sufficiently resourced to process the volume of onshore and offshore planning applications and associated grid infrastructure in line with the statutory timeframes for planning decisions. Planning agencies should build capacity and expertise so that climate impacts on development projects are considered in the planning process – **An Bord Pleanála, Local Authorities, the Maritime Area Regulatory Authority (MARA), the National Parks and Wildlife Service, the Office of the Planning Regulator, Eirgrid, Commission for the Regulation of Utilities and other relevant agencies**.
- Local spatial development plans should facilitate the coordinated delivery of critical infrastructure and climate change considerations should be incorporated into these plans – **Local Authorities, and Climate Action Regional Officers (CAROs)**.

Resources

- The Commission for Regulation of Utilities' price review mechanism should prioritise the financing of projects to make vulnerable critical energy infrastructure more resilient to the impacts of climate change – **Commission for the Regulation of Utilities**.
- There is a need to attract and retain persons with specialist relevant skills in the public service. The areas identified in this workshop included adaptation risk experts, ecologists, geophysicists, and IT and communications professionals. Moreover, human resources should be strengthened in key central government departments to allow for improved coordination and action in making Ireland's critical infrastructure more resilient to climate change. – **Department of Public Expenditure, NDP Delivery and Reform as a possible coordinator with participation from Department of Further and Higher Education, Research, Innovation and Science**.

Information

- A centralised open access all of Island data/observatory platform in the area of resilient critical infrastructures is needed. This should include data that can be used for understanding social vulnerability. – **National Framework for Climate Services (Met Éireann), Department of the Environment, Climate and Communications (Adaptation), and Climate Ireland (EPA)**.
- There is significant potential to deploy effective information sharing methods when dealing with commercially sensitive or otherwise sensitive information. Several countries have developed programs and approaches to build trust-based connections between government and private owners and operators. Examples include Australia's Trusted Information Sharing Network; Canada's Critical Infrastructure Gateway; and the European Union's Critical Infrastructure Warning Information Network (CIWIN). – **Department of Enterprise, Trade and Employment, IDA Ireland, and Enterprise Ireland**.

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1. Background and Opening

The workshop examined climate resilience and adaptation of critical energy infrastructure and downstream applications on the Island of Ireland. While the primary focus was on electricity networks, other critical infrastructure stakeholders were invited to contribute to illustrate the links and dependencies between energy critical infrastructure providers and services that depend on resilient energy supplies. This will become increasingly critical in coming years and decades as the solution in many sectors to mitigation challenges involves electrification and thus resilience of supply will become an ever more critical challenge. An important aim was to foster a greater interconnectedness between all relevant stakeholders. The workshop focused on the following three key areas:

1. assessing critical infrastructure resilience to current and projected extreme climate related events and their impacts;

2. identifying information gaps that need to be filled to achieve energy resilience; and

3. governance, coordination, and cross cutting issues - identifying barriers to systemic coordination and ensuring that there is good coherence with other policies.

1.1 Opening Remarks

Opening remarks at the workshop were provided by Marie Donnelly, Chairperson of the Climate Change Advisory Council and Prof. Peter Thorne, Chairperson of the Adaptation Committee.

Ms. Donnelly welcomed the participants to the workshop and thanked the presenters for sharing their expertise and the international perspective on the subject matter. She provided a brief background to the Climate Change Advisory Council and its Adaptation Committee. She highlighted some of the major changes that are underway in the sector, particularly in terms of demand increases, and the decarbonization and diversification of supply. She stated that it is an opportune time to ensure that the upgrades to existing systems and the design of our new infrastructure and its components are made resilient to the many climate change risks we are facing and will face into the future.

Prof. Thorne referred to the recently published Synthesis Report of the Intergovernmental Panel on Climate Change (IPCC) and the importance of making Ireland's electricity and gas sector more resilient to climate change. He outlined the urgent need to ramp up the actions, solutions and investments needed to make Ireland's increasingly vulnerable infrastructure and systems more resilient. This would require planning and implementation of new infrastructure projects while integrating the principles of the just transition framework as it evolves and becomes more resilient to climate change.

In terms of the outcomes from the workshop, Prof. Thorne stated that a post-workshop report would be produced and that this would help to support adaptation planning including the development of the next iteration of Sectoral Adaptation Plans.

1.2 Overview of the Workshop

Dr. Stephen Flood, Climate Change Advisory Council Secretariat provided an overview of the workshop. This included the workshop objectives, planned outcomes, draft agenda and an explainer of the virtual whiteboard tool Miro that was to be used in the breakout sessions.

1.3 The UK Climate Change Committee's advice on resilient energy infrastructure

Ms. Cara Labuschagne, Lead Analyst – Resilient Infrastructure, UK Climate Change Committee Secretariat provided a presentation focused on delivering climate resilient energy infrastructure in the UK. The presentation outlined climate hazards with potential to impact on the UK energy system including: heatwaves; river, surface and coastal flooding; drought; wind strength and wind regimes, and storminess; and occurrence of storm events.

Potential impacts to electricity generation, transmission and distribution associated with the relevant hazards were then presented. For example, an increase in heatwaves could lead to electricity generation supply side impacts including efficiency loss at thermal generation plants, and the risk of maximum operating temperature for generator components being exceeded. On the transmission and distribution side, heatwaves could lead to efficiency loss on transmission lines at high temperatures and restrictions of thermal ratings of assets. Demand side impacts project a 50% increase in electricity demand by 2035 and a doubling in electricity demand by 2050 in the UK.

Cascading impacts across the electricity infrastructure system have also been considered including associated impacts across IT and communications infrastructure, transport infrastructure, emergency response demand, flood water pumping, and water and sewage infrastructure.

It was also noted that the UK Third Climate Change Risk Assessment (CCRA3) identified 'risks to people and the economy from climate-related failure of the power system' as a high priority, high magnitude risk.

In addition, an overview of the current state of play of progress assessment in UK adaptation was provided. The presentation described the monitoring framework's structure. An apex goal provides an overarching vision statement that describes what being well-adapted to climate change looks like. In the case of energy, the goal is 'reliable energy supply in a Net Zero economy'. Underneath this apex goal the monitoring framework identifies required outcomes for achievement of the goal. In the case of electricity supply this includes reduced vulnerability of energy assets to extreme weather, system level security of supply, and the identification and management of interdependencies (such as transport, water and digital systems). Enablers to achieve these outcomes have been identified as governance, data, and funding and investment. Policies and plans were next identified to capture key roles and milestones for public policy and planning to deliver the identified climate resilience outcomes and put the necessary enablers in place. Finally, contextual factors were also identified. These are largely (but often not entirely) independent of Government policy, but important for building climate resilience. These identified contextual factors include climate hazards (for example, higher summer temperatures and extreme heat events), identified exposure (for example, location of power infrastructure), and vulnerability (for example, proportion of power users in remote communities).

The presentation closed by highlighting ten principles for effective adaptation, noted to be still largely missing from UK adaptation policy (Figure 1). These principles provide a useful roadmap of important elements to consider to facilitate effective adaptation.
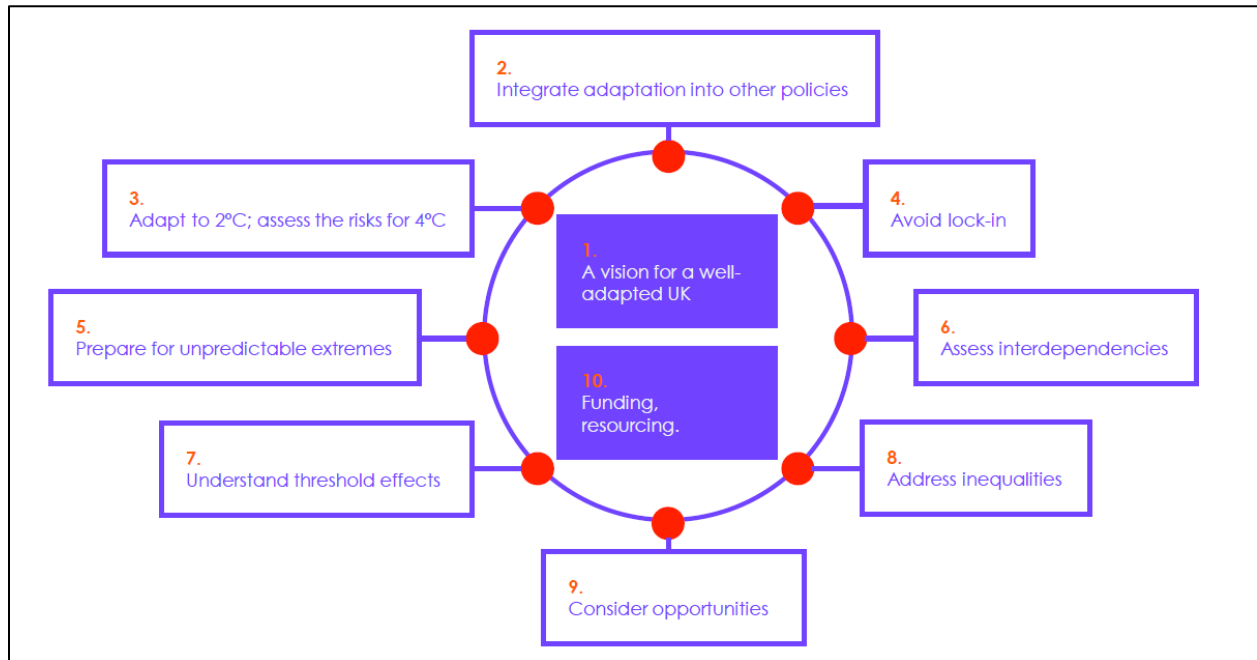

Figure 1. Ten principles for effective adaptation. Source: Labuschagne, 2023.

1.4 International perspectives on resilient infrastructure planning

Prof. Paul Chinowsky, Director, Resilient Analytics, Colorado, United States presented on international perspectives on resilient infrastructure planning. The presentation focused on determining the cost of climate change through climate impact analysis and set out how a climate impact analysis (under four levels) can provide the support for actionable strategic climate plans. This process is outlined in a number of steps that include awareness, vulnerability, operational analysis, and strategic analysis. Awareness (level 1) is understood as an awareness of projected threats to given locations including the identification of specific threats and where they are projected to occur. Vulnerability analysis (level 2) is understood here as the potential exposure of locations to climate change. The focus is to provide an understanding of what specific assets, systems, and populations are vulnerable to projected climate change impacts. Operational analysis (level 3) is concerned with identifying the financial, social, and operational costs of climate change to assets, systems, and populations in geographic areas of concern. Strategic analysis (level 4) is focused on identifying the actions that should be taken in the near- and long-term to mitigate climate change impacts including appropriate prioritization and adaptation actions.

In summary, Prof. Chinowsky identified several key messages. It was suggested that most countries are still in the awareness phase when it comes to climate adaptation, that strategic decision making around climate is being driven by non-profits around topics such as nature-based

solutions, and that a small group of countries are pushing hard on adaptation contingent on political support. Finally, Prof. Chinowsky highlighted the need to focus on climate related impacts as a starting point to avoid the risk of 'getting lost in opinions' on where to focus attention and effort.

2. Break Out Sessions

The workshop participants were split into five working groups to address the three main objectives of the workshop. Each of the main objectives were addressed in 40-minute breakout sessions based on three guiding questions. The discussion of the guiding questions and results of these sessions are summarized in this section.

2.1 Assessing critical infrastructure resilience to climate related events

The three guiding questions under this breakout session were:

a) What are the current and planned key critical energy infrastructure assets and systems on the Island of Ireland?
b) What are the key interdependencies between identified critical energy infrastructure and other key infrastructure?
c) What are the priority climate hazards and associated impacts on these infrastructures and what are the key vulnerabilities?

2.1.1 Current and planned key critical energy infrastructure assets

The following existing critical energy infrastructure was identified:

- Power generation plants, sub-stations and control rooms.
- Transmission and distribution lines, particularly overhead lines and cables.
- Onshore wind farms.
- Gas network and storage infrastructure.
- Solar farms.

The following planned critical energy infrastructure projects were identified:

- Offshore wind farms – the four offshore wind projects recently auctioned are expected to deliver around 3GW of electricity per year once operational by 2030. Three of these projects (Codling, Dublin Array and Oriel) are located along the east coast and one (Sceirde Rocks off Connemara) on the west coast. Ensuring that this infrastructure, including the necessary onshore infrastructure, is resilient was identified as a key requirement.
- Geothermal – research from the Geological Survey Ireland suggests that there is potential for deep geothermal energy in Ireland and a first Geothermal Energy Summit was held in November 2022. The geothermal energy resource beneath Dublin is currently being explored as a joint project between the Geological Survey Ireland and TU Dublin.
- Regional cooperation infrastructure for interconnectors – these interconnectors include the North-South interconnector (linking the island of Ireland), Celtic Interconnector (linking France and Ireland) and the Greenlink Interconnector (linking Ireland and Wales). Overall developments at EU level and the possible need to develop a European super grid were also considered notable.
- Expansion of energy storage plants. Reference was made to plants at Poolbeg and Aghada (Cork) and the need to balance electricity generation and storage systems.
- Phase out of the Moneypoint coal-fired generation plant.

- Hydrogen – scaling up the production of green hydrogen in support of energy decarbonisation and energy security needs as envisioned in the National Hydrogen Strategy.
- District heating schemes such as the operational Tallaght district heating scheme and others planned in the Dublin area.
- Microgeneration of renewable energy including sustainable energy communities and through solar PV on housing and for car ports. Potential of energy storage at household level.
- Shift towards greater electrification of heat and transport and a possible lack of infrastructural capacity to handle increased demand.
- Production of biomethane and biofuels. This will involve private ownership and biomethane and biofuels are likely to be produced in a wide variety of locations.
- Hydro-pumped storage assets such as Turlough hill and Silvermines (in future).
- Potential use of tidal energy.
- Development of carbon capture facilities at existing sites such as the Kinsale Gas Field.
- Smart City commitments from cities such as Cork and Dublin to become net zero by 2030.

2.1.2 Key interdependencies between energy and other infrastructure

It was noted in most groups that energy underpins the economy, and the quality of life of citizens. Moreover, almost all sectors are reliant on electricity and with increasing electrification of transport and heating, the cascading risk to other key infrastructure and systems is significant. The knock-on effects of electricity interruptions caused by extreme events on other sectors was considered a major concern.

The working groups identified the following main interdependencies and vulnerabilities:

Inter-relationship between electricity and water supply – it was noted that water supply and wastewater treatment plants are often affected by extreme weather events, especially flooding. The analysis of water needs for net zero and developing technologies such as hydrogen production and battery storage needs to be further explored. The need for adequate supplies of water for cooling was considered a risk.

Waste to energy – challenges were identified in terms of limitations in supplying the grid from waste sources.

Transportation needs – the move towards greater electrification of modes of transport will make the sector more reliant and prone to any interruptions in power generation and supply. The need to look at the resilience of infrastructure for charging electric vehicles was also mentioned. The onshore or offshore production of green fuels for aviation and broader transport was raised as well as measures to ensure security of supply. Transport facilities for energy generation fuels (imported fuels gas, coal), including the transport of fuels itself on roads, was highlighted.

Inter-relationship between gas and electricity supply – it was noted that the gas network is dependent on the reliability of electricity supply and that the electricity network is largely dependent on gas when supplies from renewables are low. Resilience from the perspective of ensuring power distribution through different sources was considered important.

Internet and communications – it was noted that communications and digital networks are highly vulnerable to loss of services during extreme weather events. The importance of having communications networks in working order during and after extreme weather events was highlighted, particularly to inform the general public about emergency management and response measures. The expansion of IT infrastructure and increased demands on the electricity grid from data centres were acknowledged.

Food safety – potential challenges to refrigeration and storage of perishable goods.

Vulnerable people – the vulnerability of the elderly, people with limited mobility, those under residential care and those reliant on ventilators was emphasized and the need to consider them as part of just transition and resilience.

Development of port infrastructure – it was noted that port infrastructure would need to be expanded to handle the construction and operation of offshore wind farms. Participants acknowledged that Belfast is the only suitably equipped port on the island of Ireland currently. The appropriate location of other onshore infrastructure such as sub stations to handle energy generated offshore was identified as an important consideration, especially avoiding sites vulnerable to sea level rise and coastal erosion.

Capitalizing on innovation – the inter-dependencies between energy and other critical infrastructure was considered a potential area for innovation. The potential to generate electricity from wastewater flows was identified. The use of smart meters to reduce electricity demand was also raised as was the use of digital systems such as SCADA to monitor and control the power generation and transmission processes.

Micro-generation of electricity – participants felt that the evolution and resilience of micro-generation at the household level and by private companies such as data centres has not been adequately developed and exploited to date.

Access routes to energy and other critical infrastructure – it was noted that extreme weather events can impair access via key roads and bridges to electricity assets as well as other critical infrastructure such as hospitals, ports and airports.

Importance of electricity for other critical infrastructure – electricity was acknowledged as the most important enabler for a range of critical infrastructure, including ports, airports, hospitals and health care facilities. The sustainability of back up generation in a changing climate at these critical infrastructure sites was identified as a critical consideration.

Availability and development of skills – the importance of availability of appropriate human resources and skills to manage outages, ensure service deliveries and oversee the necessary technological changes over the coming years was identified.

2.1.3 Climate hazards and associated impacts and vulnerabilities
Each of the working groups highlighted the main climate hazards facing the sector and explored how these hazards impact and will impact electricity generation, transmission and distribution:

Flood events – Eirgrid identified flooding as the main climate change risk to the transmission system and the risks from flooding were mentioned by several participants, in particular from the expected increase in heavy rainfall events as well as storm surges and sea level rise. The loss of

generation capacity at power plants, damage to the transmission and distribution capacity due to flooding, landslides and erosion were identified as the main risks. Damage to transport links including roads, rail and ports required for supply, maintenance and repair of the energy infrastructure is a further key risk. It was noted that gas infrastructure is often buried underground but that this could also be vulnerable to subsidence and disturbances caused by heavy rainfall events. In terms of flooding, assets and zones most at risk to coastal flooding, extreme rainfall events and river floods are mapped through the OPW's www.floodinfo.ie portal.

Sea level rise – it was observed that many power stations and electricity sub-stations are located in coastal areas. Sites in Belfast, Cork, Dublin, Galway and Limerick were considered highly vulnerable to sea level rise. The need to plan for the likelihood of a 2˚C and 4˚C global increase in temperature was identified and to plan for the implications these scenarios would have for sea level rise for coastal locations and building barriers and flood defenses. The impact of sea level rise on interconnectors between Ireland and Britain and Europe also needs consideration.

Coastal erosion – the coastal erosion rate is expected to increase with sea level rise, changes in wave heights and increasing extreme weather events. Low lying areas along the eastern coast are particularly exposed to coastal erosion, and energy infrastructure in these areas could be most vulnerable. Damage from spray and sand to equipment was identified as another challenge linked to coastal erosion.

Windstorms and high winds – the transmission and distribution system is particularly vulnerable to high wind events, which often combine with heavy rainfall events. High wind events may necessitate underground reinforcements in some places as well as the use of underground cabling. The risk of damage to power lines from falling trees was also considered as increasing due to an increased growing season. High waves and stormy seas also have the potential to disrupt infrastructure linked to the interconnectors and offshore wind generation. The need to balance the grid and power supply during intense wind and storm events was identified as a further challenge.

Low wind events / wind droughts – the effect of low wind events and the possibility for increased cases of wind droughts was identified as a challenge for both offshore and onshore wind energy generation capacity. This occurred in December 2022 and had a profound effect on wind energy generation and could become more common with a weakening of the Gulf Stream. Reference was made to Met Éireann data that average windspeeds are decreasing over time and that this could have an effect on onshore capacity in particular. It was also observed that wind droughts are increasing in the north of Ireland.

Increasing temperatures and cases of droughts and heatwaves - it was considered that these have had limited impact on electricity infrastructure and equipment to date. Prolonged droughts are expected to impact water availability and temperature for cooling power generating plants. The need for assets and equipment to be able to cope with wide range of temperature changes was identified. Increasing electricity demand to cool buildings is expected.

Ice and snow – these were considered as risks mainly for the transmission and distribution system.

Salt fog - this was considered as a risk mainly for the transmission and distribution system.

Lightning – this was considered as a risk mainly for the transmission and distribution system.

2.2 Identifying information gaps that need to be filled in order to achieve energy resilience

The groups discussed information gaps by way of building energy resilience. The question was broken down into three sub questions.

a) What current actions are being taking to manage for climate impacts/disruptions to critical energy infrastructure and dependent infrastructures?
b) What data are currently used to support climate risk management?
c) Where do you see the urgent current and anticipated future information gaps arising to help manage critical energy infrastructure and dependent infrastructures?

2.2.1 Current actions being taken to manage climate impacts on critical infrastructure

The participants identified various agencies involved in ensuring actions are being taken to build resilience of Irelands national infrastructure through government departments, public bodies and research agencies. These agencies are listed in section 2.3.1.

It was noted that collaboration across sectors is required to build resilience due to the clear interdependencies that exist. A good example of collaboration between agencies provided by a participant was between Dublin City Council and the HSE who are currently developing a toolkit for power outages. Other actions currently being taken to manage disruptions resulting from climate impacts were also discussed.

Policy development was identified as one of the main actions to manage climate impacts on critical infrastructure as well as dependent infrastructure. A wide range of relevant policies are in place, including:

- National Climate Action Plan (2023) and the National Adaptation Framework of 2018 at the national level.
- Sectoral Adaptation Plans to guide adaptation actions at sectoral level. The critical infrastructure theme identified in the National Adaptation Framework requires DECC and the Department of Transport to develop Sectoral Adaptation Plans for electricity and gas networks, communications networks and transport infrastructure. These were developed in 2018. The implementation of the Sectoral Adaptation Plans is monitored through the scorecard process of the Climate Change Advisory Council.
- Local Authority Climate Action Plans – these incorporate adaptation and mitigation actions at each local authority in Ireland and are due to finalised in 2024.
- Specific climate action plans and strategies – a number of public and private agencies have developed their own relevant climate action plans and strategies. Relevant examples include the ESB's Networks for Net Zero and Transport Infrastructure Ireland's Climate Adaptation Strategy.
- Mainstreaming adaptation into Gas and Electricity Network Development Plans and other relevant policies, plans and programmes.

Climate impact screening was identified as one of the fundamental steps to be undertaken by sectors in the formulation of the Sectoral Adaptation Plans. Its main purpose is to develop a broad understanding of the sectoral vulnerability and consequences of ongoing and future climate

impacts and to collect all the relevant preliminary information to allow for the prioritisation of the most urgent climate impacts and vulnerabilities for further and more detailed analysis.

Climate risk assessments have also been undertaken at various levels including by different sectors and local authorities. The National Climate Risk Assessment is under development and the EPA-funded research project INFRALINC (Infrastructure climate risk resilience considering interdependencies and cascading hazards) is assessing the risks posed to critical infrastructure in Ireland due to climate change. The workshop noted that risk assessments are also being carried out by private consultancies whereby data inputs and data may not be transparent.

Ireland has considerable experience in undertaking **flood risk assessments**. Under the EU floods directive, a Preliminary Flood Risk Assessment (PFRA) and National Catchment-based Flood Risk Assessment and Management (CFRAM) Programme were undertaken by the Office of Public Works. This identified and mapped the existing and potential future flood hazards and flood risk in the areas at significant risk (known as Areas for Further Assessment (AFAs)). It also prepared a set of Flood Risk Management Plans for the AFAs, that set out the proposed feasible measures and actions to manage the flood risk in these areas and their river catchments. These plans are available at www.floodinfo.ie. An updated PFRA is under development and is expected to be completed in 2024.

It was highlighted that most of the risk assessments and climate impact screening exercises are based on different climate models and data sources. The idea of a centralised open access observatory/data platform could benefit agencies who are ultimately working towards the same objective of building climate resilience for our critical infrastructures. The launch of the Met Eireann Translate project should begin this process.

The use of **carbon budgets** was raised as an important action to build resilience. Carbon budgets represent the total amount of emissions, measured in tonnes of CO_2 equivalent, that may be emitted during a specific time period. Ireland's carbon budget programme came into effect in 2022 and comprises three 5-year budgets (2021-2025; 2026-2030; and an indicative budget for 2031-2035 which shall be revised in 2025). The sectoral emission ceilings set by government identify the emission reduction targets by 2030 and these affect, amongst others, the electricity, transport and built environment sectors.

The **diversification of energy supply** in Ireland is an important action and the shift towards solar and wind energy was considered critical to ensuring a resilient energy sector. Improving the resilience of infrastructure, including buildings, communication networks, transportation systems and energy grids was also emphasised.

Specific concerns that were mentioned by participants included the uncertainty of climate models and the concern for battery and wind storage. Furthermore, the point that data was out there but not processed or harnessed or linked up was put forward as a concern.

2.2.2 Data being used to support climate risk management

The next breakout session discussed the data that is currently being used to support climate risk management. Participants discussed the various data sources currently employed in the critical infrastructure area. This highlighted the range of agencies involved and further highlighted the importance of collaboration and knowledge sharing between agencies. An example of

collaboration was discussed in the group between Transport Infrastructure Ireland (TII) collaborating with Climate Ireland and EPA in developing a pilot set of adaptation indicators.

Examples of the main data sources and platforms being used included:

- **www.floodinfo.ie** – this platform, operated by the Office of Public Works, serves as a national flood information portal, providing location specific access to flood risk and flood management information. It was noted that this is being used by several sectors and allows for flood risk and impacts to be determined by infrastructure owners and operators and for measures to be taken to reduce risk.
- **National Framework for Climate Services and the Met Éireann Translate dataset -** In June 2022, the Irish Government agreed to establish a National Framework for Climate Services (NFCS): a mechanism to coordinate, facilitate and strengthen the collaboration among climate information providers and users. This enables the co-production, delivery and use of actionable and accessible climate information and tools to support climate resilience planning and decision making. Met Éireann was approved to lead and develop Ireland's National Framework for Climate Services and to continue to work with other government departments and agencies in initiating, coordinating and supporting Ireland's provision of climate services. The Translate dataset provides standardised climate projections for Ireland, which combine both national and international climate projections. It is expected to provide the most comprehensive snapshot of Ireland's future changes in temperature and precipitation across a range of scenarios, including different global warming levels (1.5°C, 2°C, 2.5°C, 3°C, 4°C).
- **Irish Coastal Protection Strategy Study –** this is a national study commissioned in 2003 to provide information to support decision making about how best to manage risks associated with coastal flooding and coastal erosion.
- **Geoportal site of the Environmental Protection Agency (https://gis.epa.ie)** – this site provides spatial information on different environmental aspects in Ireland.
- **www.predictwind.com -** this site is used by the wind energy industry to forecast wind speeds and direction.
- **ESB PowerCheck service** – this is a tool that allows customers to see any ESB faults, the exact location, how many customers have been affected and whether the interruptions were scheduled or unplanned.
- **National Land Cover Map tool** that was developed and launched by Tailte Éireann in 2023. Tailte Éireann also produces other ecological and geophysical surveys.
- **Climate hazard tool** developed by the Environmental Protection Agency and available on the Climate Ireland portal (Climate Ireland). It is intended to provide stakeholders with information on the key climatic hazards of concern for Ireland and to assess current levels of exposure as well as projected future levels of exposure.
- The **Triton and Tidewatch early warning systems** – these systems are based in Dublin Bay and provide continuous information on sea-level changes and sending alarm messages to relevant personnel in the Local Authorities.
- **UK climate projections –** these are a set of tools and data that shows how the climate is likely to change into the future and is used by some Irish practitioners given the geographical proximity of the UK.
- **Sub-surface mapping tools** provided by the Geological Survey of Ireland.

- **Flood vulnerability** of critical infrastructure study for in Cork City in 2016. This led to a comprehensive set of measures around flood forecasting, practical interventions to strengthen quays and embankments and to protect transformer stations, management of reservoirs and emergency management.
- **Social Vulnerability Index** – it was noted that work is underway to develop an index that will map different aspects of social vulnerability using open-source tools. This is being developed through the University College Cork.
- **Terrain AI Project** – using innovative AI solutions and technologies to advance standards of measurement, monitoring, verification and reporting of carbon stocks and emissions across complex environments. It is also integrated with computational models, to provide more accurate estimates of carbon fluxes across scales, and a deeper understanding of the effects of human activities, to enable decision makers to develop more effective climate mitigation and adaptation strategies.
- Other **remote sensing platforms** such as the National Oceanic and Atmospheric Administration (NOAA) and Sentinel satellite used by the Copernicus Programme.
- **Citizen science crowd sourcing tools** – it was considered that crowd sourcing allows researchers to collect and analyse data on a much larger scale while citizen science can build greater public trust in research. The extent to which these approaches are being driven in Ireland in terms of climate change was not clear.

2.2.3 Current and anticipated future information gaps

During this session participants identified and discussed what information gaps exist now and what information gaps are likely to exist into the future.

Social vulnerability was highlighted as an area that needs to be understood now and into the future in the context of climate change resilience. In this context, participants explained that decisions regarding forward planning of critical infrastructures are often informed by a cost benefit analysis which does not include social vulnerability in the analysis. Social vulnerability is also a key consideration for issues such as energy poverty and exposure to the impacts from a range of climate hazards. Ensuring social vulnerability data is accessible is required to build resilience in the context of critical infrastructure.

It was highlighted that the **costs of adaptation** and non-action should be built into appraisal frameworks which are aligned with Public Spending Code and cost benefit analyses.

It was also highlighted that building the resilience of critical infrastructure is often approached from a business lens that does not incorporate or discounts **health and wellbeing**. For example, assessments should consider the impact of increased number of heat days not only on buildings but for people working outdoors. The impacts of climate change on the health of workers at critical infrastructure facilities was raised as an issue requiring careful consideration during the planning process. It was acknowledged that data also needs to be available to help support this type of assessment and analysis.

Participants discussed the need to consider future impacts of **climate induced migration** on our critical infrastructures. Data is needed to accurately plan for future increased climate induced migration flows. By doing so, policies can be developed to ensure those migrating to Ireland, either forced or voluntary, can have equal opportunities.

Participants discussed various gaps that need to be considered into the future including the need for better **communication pathways** to allow for fast connections and sharing of information between operators of critical infrastructures. This refers to the use of digital systems such as SCADA to monitor and control the power generation and transmission process and to identify and communicate faults across the system in real time.

Participants highlighted that there are **different layers of risks**. For instance, flood risks and locations of communities at risk.

For a holistic approach to building resilience to climate change, **access to current and accurate data** from across agencies was considered necessary. Lack of access to data tools and programmes and lack of specialised skills were identified as major barriers in this context.

Skills shortages were referenced in terms of helping to support a reliable data infrastructure.

Overall, the need for a harmonised **open access data platform** as an architecture for data sharing was identified. It was observed that while there are a multitude of data sources available there is no harmonized system of data provision. The challenges of data sharing in competitive markets were also identified as a barrier. This was identified as a weakness for agencies working to build resilience both within and across critical infrastructures. This topic was a recurrent theme across sessions. It was also highlighted that the data infrastructure system should follow an all of island approach and be cybersecure.

Uncertainties and gaps in information from climate modelling and different parameters were observed as challenges. Projections of changes in wind speed and direction and timings of extreme wind and rainfall events were identified as significant gaps in this respect.

The discussion ended with participants highlighting the **importance of forward planning** beyond 2050 informed by most accurate state-of-the-art data and what critical infrastructures will be required on the Island of Ireland in the future and how can we prepare now to ensure resilience into the future.

2.3 Governance, coordination and cross cutting issues

The three guiding questions under this breakout session were:

1. Identify key stakeholders in the area of critical energy infrastructure and dependent infrastructures?
2. What are the main barriers to effective coordination to increase resilience?
3. How can the identified barriers, including policy coherency issues, be addressed to increase resilience?

2.3.1 Key stakeholders

The key stakeholders identified are listed in the table 1 below.

Table 1: Key stakeholders and their main role in terms of critical energy infrastructure resilience.

Stakeholder	Role
Central and Local Government	

Stakeholder	Role
Department of Agriculture, Forestry and Marine	Lead the sustainable development of the agri-food, forestry and marine sector. DAFM will also have a leading role to play in the development of the biomethane and biofuels industries.
Department of Defence	Responsible for the office of emergency planning and coordinating the national emergency response.
Department of the Environment, Climate and Communications	Delivery of policies and programmes to ensure Irish energy supply is secure, sustainable and competitive and complies with international energy and climate change policies.
Department of Enterprise, Trade and Employment	Leads in advising and implementing the government's policies of stimulating the productive capacity of the economy and creating an environment which enables employment creation and sustainability.
Department of Finance	Lead the achievement of the government's economic, fiscal and financial policy goals, having regard to the goals set out in the Programme for Government – Our Shared Future.
Department of Further and Higher Education, Research, Innovation and Science	Funds and creates policy for the higher and further education and research sectors and makes sure that state agencies and public institutions support and encourage Ireland's social and economic development.
Department of Health	Provision of health care services (this sector was identified as being highly vulnerable to the cascading impacts from extreme events and electricity outages). It was noted that a vulnerability assessment of health infrastructure is also underway.
Department of Housing, Local Government and Heritage	Responsible for the sustainable and efficient delivery of well-planned homes, effective local government and the protection and improvement of water resources.
Department of Public Expenditure, NDP Delivery and Reform	Manage public expenditure at sustainable levels in a planned, balanced and evidence informed manner in order to support Ireland's economic, social and climate goals. It also oversees and monitors progress in implementation of Project Ireland 2040 (National Planning Framework and the National Development Plan) and capital projects.
Department of the Taoiseach	Hosts a Climate Action Unit which supports the work of the Cabinet Committee on the Environment and Climate Change, Climate Action Delivery Board and a number of related senior officials' groups and interdepartmental working groups.
Department of Transport	Ensuring the safe and sustainable development of transport to support economic growth and social progress. This sector is considered highly interdependent with energy infrastructure.
Office of Public Works	Government agency that advises the Minister for Public Expenditure and Reform on flood risk management.
Local Authorities	31 Local Authorities are responsible for delivering a broad range of services in relation to road transportation and safety, housing and building, water services, development management, environmental services, agriculture, education, health and welfare. Planning sections in Local Authorities have an important role in controlling development in areas vulnerable to flooding and sea level rise.
Climate Action Regional Offices	Coordinate and support local government to lead transformative change and measurable climate action across cities and counties.
State Agencies	

Stakeholder	Role
Electricity Supply Board	Delivery of a new energy future for Ireland based on reliable, affordable, zero carbon electricity.
Commission for the Regulation of Utilities	Maintain security of supply, ensure efficient network delivery and promote competition and innovation in the generation and supply of electricity and supply of natural gas. It is also the economic regulator for public water and wastewater services.
Northern Ireland Electricity Networks	Owner of the electricity transmission and distribution networks in Northern Ireland, transporting electricity to over 910,000 customers including homes, businesses and farms.
System Operator for Northern Ireland	SONI is the Electricity Transmission System Operator for Northern Ireland.
Uisce Éireann	Responsible for the delivery of secure, safe, and sustainable water services for the people of Ireland.
Gas Networks Ireland	Operation and maintenance of Ireland's national gas network.
EirGrid	Operating and planning the development of the electricity transmission system. The North-South Interconnector is a joint initiative by EirGrid and SONI.
An Bord Pleanála	Determining planning applications for strategic infrastructure and other developments as well as appeals on planning.
Office of the Planning Regulator	Responsible for the evaluation of local authority development plans and local area plans, review of systems and procedures used by local authorities and An Bord Pleanála, and driving national research, education and training on good planning.
Met Éireann	Monitor, analyse and predict Ireland's weather and climate and to provide a range of high quality meteorological and related information to the public and to specific customers.
Environmental Protection Agency	Protection, improvement and restoration of the environment through regulation, scientific knowledge and working with others.
Transport Infrastructure Ireland	Provide an integrated approach to the future development and operation of the national roads network and light rail infrastructure throughout Ireland.
ComReg	Regulation of the electronic communications and postal sectors in Ireland.
Sustainable Energy Authority of Ireland	Working with householders, businesses, communities and government to create a cleaner energy future.
Maritime Area Regulatory Authority	Assessing Maritime Area Consent (MAC) applications required by developers before development permission can be granted, granting marine licensing for specified activities and compliance and enforcement of MACs.
National Standards Authority of Ireland	Setting standards and issuing of certification in the quality and safety of goods and services.
Port authorities of Ireland	Various authorities responsible for operating and developing ports in Ireland (including Dublin Port Company, Belfast Harbour Company, Port of Cork, Port of Galway, Port of Waterford, Shannon Foynes Port Company and Rosslare Europort).
Airport authorities of Ireland	Various authorities responsible for operating and developing airports in Ireland (including Irish Aviation Authority, Dublin Airport Authority (for Dublin and Cork airports), Shannon Airport Authority).

Stakeholder	Role
Health Service Executive	Responsible to run all of the public health services in Ireland. It has a climate action strategy in place for the period 2023-2050.
Tailte Éireann	Responsible to bring together land and property information services in the State, including registration, valuation, and surveying services.
Competition and Consumer Protection Commission	Enforce competition and consumer protection law in Ireland.
Institute of Public Administration	Responsible for the training of public servants and building capacity to meet challenges.
Just Transition Commission	To ensure a fair and equitable transition in the energy sector.
Industrial Development Authority Ireland	Responsible for the attraction and retention of inward foreign direct investment into Ireland.
Enterprise Ireland	Responsible for supporting the development of manufacturing and internationally traded services companies. Also responsible for providing funding supports for companies.
Skillnet Ireland	Business support agency of Government which works with industry to create upskilling programmes which are responsive to business needs and designed to develop future-ready talent.
Private Sector and Associations	
Wind Energy Ireland	Representative body for the Irish wind industry, working to promote wind energy as an essential, economical and environmentally friendly part of the country's low-carbon energy future.
Irish Solar Energy Association	Representative body seeking to advance a policy and regulatory landscape promoting solar as a leading renewable energy technology that will push the energy transition forward and contribute to a successful and strong clean economy.
Renewable Energy Ireland	Partnership of sustainable energy associations working collectively to support the energy transition in Ireland.
Commercial Banks	Provision of loans to investors and private energy operators.
Telecommunications companies	Telephone operators, satellite companies, cable companies and internet service providers. The telecommunications sector is considered highly interdependent with the energy sector.
Energy network operators	Companies that manage and maintain the wires, pipes and other infrastructure which delivers electricity and gas to homes and businesses.
Engineers Ireland	Community of engineers that aim to deliver sustainable solutions for society.
Research Institutions	Undertaking of research and innovation to guide climate resilient infrastructure development and to inform evidence-based policy development.
End users	
Miscellaneous	A variety of end users were identified including large scale users such as data centres, industrial producers and food processors. Communities and vulnerable groups with special needs were also highlighted.

2.3.2. Main barriers to effective coordination to increase resilience

The breakout groups held discussions focused on identifying the barriers, including policy coherency issues, to address increased resilience. The following barriers were identified by compiling the points raised across the breakout groups.

Communication and collaboration

- The lack of clear and consistent communication and guidance from government was cited as a barrier to effective coordination. It was observed that there is no coordination platform in place to oversee the implementation of the Sectoral Adaptation Plan for Electricity and Gas Networks. Communication and guidance were observed to be lacking on the objectives or ultimate aims of energy infrastructure resilience.
- The failure from Government to recognise the importance of co-ordinated strategic communications and assigning responsibilities was raised.
- A lack of awareness and information among all stakeholders relating to infrastructure development projects was highlighted. A more holistic approach to the development of infrastructure was considered necessary to leverage synergies and to future proof different types of infrastructure from climate change.
- Competing priorities and interests were recognised among different agencies and there is limited opportunity for energy providers (wind, solar, gas) to collaborate on policy issues due to competing commercial interests between them.
- It was identified that it is necessary to work towards a common goal in terms of infrastructure resilience across different sectors, including gas, electricity, communication networks and water.
- The need for better coordination between major infrastructural projects across different disciplines was identified.
- Different levels of risk tolerance between providers creates challenges in coordinating resilience efforts.
- Differences in language and terminology was observed to result in challenges in understanding between potential collaborators.
- Knowledge transfer was identified as lacking across sectors, including gas, electricity and communication networks.

Information availability and accessibility

- Participants identified accessibility to climate-related information as a key barrier to coordination. Participants noted that there are many different sources to access information, and this can lead to confusion and a lack of clarity on where to source reputable and trustworthy data and information to support decision making and planning.
- The role of knowledge brokers and translators on providing climate information was discussed. The National Framework for Climate Services (Met Éireann) and Climate Ireland (EPA) were identified as important sources of standardised information on climate impacts and related information.
- Inadequate information on climate impacts and scenarios to inform long-term planning was raised by several participants. The focus on short- and medium-term policies was

raised as a concern and the need to integrate adaptation into longer term planning and development frameworks was raised.

- Commercial sensitivities around sharing information were identified as a challenge in the sector.

Planning and policy

- It was considered that there are regulatory barriers and shortcomings in the area of infrastructure resilience. The appropriate development and use of regulatory instruments such as standards and codes may help to ensure the resilience of infrastructure, equipment, network development plans and the work of system operators.
- Discussants identified that there is no 'clear policy road map' in place to help support the coordination of activities.
- It was highlighted that public consultation processes for energy projects do not always effectively capture broader concerns. Many stakeholders do not have the resources to feed into these consultations and lobby groups tend to crowd out other voices. There was also concern that government often gives greater consideration to the economic impacts of projects rather than their social and / or environmental impacts.
- Several stakeholders expressed concern with the planning process for new developments. The main concerns were the lengthy processes for new developments and the capacity of the systems within Local Authorities and An Bord Pleanála to handle issues such as climate vulnerability and risk.
- The complexity of property rights was also identified as a challenge to renewable energy schemes and often results in delays to environmental assessments.

Governance and leadership

- It was observed that agencies, departments and stakeholders are working in silos when it comes the resilience of critical infrastructure. Lack of national coordination and limited remits to work with other organisations was identified as a challenge.
- Lack of ambition and leadership on climate resilience was observed as well as varying levels of commitment at leadership level in different institutions.
- The inter-relationship between sectors and different critical infrastructures makes coordination highly complex.
- Lack of a strategic approach to ensuring the resilience of critical infrastructure and to reduce disaster risk was observed. It was raised that a single oversight body is needed over all infrastructure development projects and to ensure alignment of policies and opportunities under a strategy for infrastructure development.
- Challenges or lack of alignment between actions were identified at the project level.
- Ireland's unique features were discussed, and it was raised that focused collaboration with successful countries with similar circumstances to Ireland (size, economies, networks, topographies, climate etc.) was needed. It was considered that Ireland could be the key to EU's energy in the future but that more ambition, leadership and skills were needed.

Resources

- It was observed that there is limited availability of time and human resources at central government level to coordinate the complex process of ensuring the resilience of energy and related critical infrastructure.
- Lack of climate expertise is evident in different sectors and organisations, and it was felt that there is a lack of adaptation risk management experts in Ireland.
- It was highlighted that there has been a failure to build and retain skills and resources within organisations (including people and digital / communications resources). The loss of skilled workers due to emigration was mentioned and it was raised that there are people with the right skills in the country but that they are often not allocated to the right place in the public service.
- Inadequate understanding of the financing needed to enhance climate resilience was highlighted. It was considered that there are significant unknowns in terms of funding adaptation requirements, both in the public and private sector.
- An assessment of critical and urgent adaptation interventions that are needed was considered important to source investment. It was noted that an EU project called Pathways2Resilience had just commenced and would be focused on building adaptation demonstration projects and better understanding of financing needs.
- Lack of availability of funds at government and household levels was noted as being of concern.

2.3.3 How to address main barriers to increase resilience

The participants lastly deliberated on options to address the main barriers to increasing the resilience of critical infrastructure to climate change. Table 2 presents a summary of the main suggestions that were made by the participants.

Table 2. Suggestions on how to address the main barriers to increasing resilience.

Barrier to building resilience	How to address the barrier
Information availability and accessibility	• The establishment of an open access all of Island National dataset in the area of critical infrastructures. Participants highlighted this will be crucial to building resilience of national critical infrastructures. A transparent system and methodological approaches are called for. • Trust across agencies was identified as being a crucial element in sharing and open access data and information platform. It is suggested that a process be put in place to allow this to develop. It was recognized by some participants that barriers will always remain in terms of the ability of agencies sharing all information.

Communication and collaboration	• Participants suggested the need for improved coordination at two levels (i) coordination platform to oversee the implementation of the Sectoral Adaptation Plan for Electricity and Gas Networks and (ii) a coordination platform looking at ensuring the resilience of all critical infrastructure. It was suggested that a government / department led committee would be useful to bring the different infrastructure sectors together and it was considered that bringing key people from across departments and other stakeholders could break down silos and enable knowledge sharing and better planning. • Regarding the coordination platform for all critical infrastructure, the National Emergency Coordination Group was considered a good model to follow as was the infrastructure operator's adaptation forum and local area forums that are used in the UK. These forums are used to address interdependencies and adaptation needs in the area of infrastructure and explore synergies with other sectors such as the development of co-located infrastructure hubs and long-term planning approach to infrastructure development. • An assessment of interdependencies and prioritisation of interventions was recommended as being key for dealing with significant failures that affect multiple parties. • Participants discussed the need to learn from and collaborate with other countries that demonstrate good practices in ensuring the resilience of critical infrastructure. It was suggested to focus on like-sized countries with similar topographies and circumstances. • A robust definition of resilience was called for by a participant which should be communicated across necessary channels is recommended.
Governance and leadership	• Overall participants agreed that the lack of clear ownership and leadership to ensuring critical resilient infrastructures was a barrier. It was highlighted that having a centralised coordination would result in clear communication and implementation of policy actions across sectors and lead the strengthening of resilience. This is articulated under communication and collaboration above. • It was suggested that an overarching goal in the context of building resilience of critical infrastructures and the identification of clear milestones in reaching the goal were necessary and would take leadership from those in central Government. The importance of adequate monitoring and evaluating progress towards this goal was also highlighted.
Resources	• Participants discussed the lack of specialist skills in the public service. Suggestions to address this barrier included the need for specialists to be recognized when working in the public service, and to retain specialists via promotion opportunities is required. It is suggested there needs to be flexibility in the public sector system for the employee to stay working in a specialization they are interested in as opposed to being decided by the employer. To retain specialist staff, the public appointments system potentially needs to change to be more similar to the private sector. • It was noted that another solution is to give more authority to Local Authorities to create new jobs rather than always needing to seek additional resources from central government.

Planning and policy	• The reform of the planning bill was considered an opportunity to streamline the planning process and to ensure adequate consultation on critical infrastructure projects with all interested and affected parties. • An Bord Pleanála, local authorities, the Maritime Area Regulatory Authority, the National Parks and Wildlife Service and other agencies must be sufficiently resourced to process the volume of onshore and offshore planning applications and associated grid infrastructure in line with the statutory timeframes for planning decisions. The respective planning agencies should build capacity and expertise so that climate impacts on development projects are considered in the planning process. • Forward planning beyond 2050 is needed. This should assess how existing critical infrastructure will be affected by climate change, what critical infrastructures will be required on the island of Ireland in the future and how can we prepare now to ensure resilience of existing and planned critical infrastructure.

3. Summary of Main Recommendations

The main recommendations from across the breakout sessions are grouped and summarised in this section. Agencies that would be best placed to lead on implementing the proposed recommendations are also identified where possible.

Governance and regulation

- Centralised coordination is needed to strengthen delivery of policy actions to improve resilience in the electricity and gas infrastructure sector – **Department of the Environment, Climate and Communications**.
- The establishment of a coordination platform looking at ensuring the resilience of all critical infrastructure should be considered to address interdependencies and adaptation needs in the area of infrastructure – **Department of the Environment, Climate and Communications (Adaptation) as possible coordinator with participation from Department of the Environment, Climate and Communications (Electricity and Gas), Department of the Environment, Climate and Communications (Communications Networks), Department of Transport (transport infrastructure), Department of Housing, Local Government and Heritage (water infrastructure), National Framework for Climate Services (Met Éireann), Department of Transport (transport infrastructure), Department of Defence**.
- Regulatory tools such as standards and codes should be developed so that energy infrastructure and equipment are designed to withstand different climate impacts – **Department of the Environment, Climate and Communications, and National Standards Authority of Ireland**.

Planning and future developments

- Involving communities early on in the consultative process for renewable energy projects and conveying the benefits of renewable energy is essential to secure buy-in for new projects – **Energy operators and developers.**
- Agencies must be sufficiently resourced to process the volume of onshore and offshore planning applications and associated grid infrastructure in line with the statutory timeframes for planning decisions. Planning agencies should build capacity and expertise so that climate impacts on development projects are considered in the planning process – **An Bord Pleanála, Local Authorities, the Maritime Area Regulatory Authority (MARA), the National Parks and Wildlife Service, the Office of the Planning Regulator, Eirgrid, Commission for the Regulation of Utilities and other relevant agencies.**
- Local spatial development plans should facilitate the coordinated delivery of critical infrastructure and climate change considerations should be incorporated into these plans – **Local Authorities, and Climate Action Regional Officers (CAROs)**.
- Forward planning beyond 2050 is needed. This should assess how existing critical infrastructure will be affected by climate change, what critical infrastructures will be required on the island of Ireland in the future and how can we prepare now to ensure resilience of existing and planned critical infrastructure – **Department of Public Expenditure, NDP Delivery and Reform, and NewERA, National Treasury Management Agency**.

- A methodological approach that informs future planning of critical infrastructures needs to go beyond a cost benefit analysis and should consider social vulnerability. This will be imperative to ensure a just and fair transition - **An Bord Pleanála, Local Authorities, the Maritime Area Regulatory Authority (MARA), the National Parks and Wildlife Service, the Office of the Planning Regulator**.

Resources

- The Commission for Regulation of Utilities' price review mechanism should prioritise the financing of projects to make vulnerable critical energy infrastructure more resilient to the impacts of climate change – **Commission for the Regulation of Utilities**.
- There is a need to attract and retain persons with specialist relevant skills in the public service. The areas identified in this workshop included adaptation risk experts, ecologists, geophysicists, and IT and communications professionals. Moreover, human resources should be strengthened in key central government departments to allow for improved coordination and action in making Ireland's critical infrastructure more resilient to climate change. – **Department of Public Expenditure, NDP Delivery and Reform as a possible coordinator with participation from Department of Further and Higher Education, Research, Innovation and Science**.
- Significant investment is set to be mobilized as part of the transition towards low carbon energy supply sources. Adequate investment should also be made to enhance the climate resilience of this infrastructure – **Energy operators and developers**.
- Human resources should be strengthened in key central government departments to allow for improved coordination and action in making Ireland's critical infrastructure more resilient to climate change. **Department of Public Expenditure, NDP Delivery and Reform, Department of Further and Higher Education, Research, Innovation and Science, and IPA**.

Information

- A centralised open access all of Island data/observatory platform in the area of resilient critical infrastructures is needed. This should include data that can be used for understanding social vulnerability. – **National Framework for Climate Services (Met Éireann), Department of the Environment, Climate and Communications (Adaptation), and Climate Ireland (EPA)**.
- There is significant potential to deploy effective information sharing methods when dealing with commercially sensitive or otherwise sensitive information. Several countries have developed programs and approaches to build trust-based connections between government and private owners and operators. Examples include Australia's Trusted Information Sharing Network; Canada's Critical Infrastructure Gateway; and the European Union's Critical Infrastructure Warning Information Network (CIWIN). – **Department of Enterprise, Trade and Employment, IDA Ireland, and Enterprise Ireland**.
- An assessment of the interdependencies between critical infrastructures and prioritisation of interventions for climate resilience should be undertaken – **Environmental Protection Agency (under EPA Research Programme)**.

Annex 1: List of Workshop Participants

Name	Organisation
Sabrina Deckker	Dublin City Council (Resilience Officer)
John Stack	Dublin City Council
Paul Blount	Renewable Energy Ireland
Sean O'Leary	Irish Planning Institute
Dervla McAuley	Environmental Protection Agency
Andrea Carroll	Dublin Airport Authority
Kerstie Flanagan	Gas Networks Ireland
Fintan McGrath	Department of Transport
William Mongey	EirGrid
Patrick Winder	EirGrid
Edel Kelly	Dublin City Council
Kevin McCormick	Department of Environment, Climate and Communication
Denise McCullagh	University College Cork MaREI Research Centre
David Stevenson	Department for the Economy Northern Ireland
Stephen Jones	Climate Northern Ireland
Jennifer McKinley	School of Natural and Built Environment, Queens University Belfast
Peter Thorne	Climate Change Advisory Council and Chair of the Climate Change Adaptation Committee
Marie Donnelly	Chair of the Climate Change Advisory Council
Cara Labuschagne	United Kingdom Climate Change Committee
Paul Chinowsky	University of Colorado
John Fitzgerald	Climate Change Advisory Council
Jillian Mahon	Climate Change Advisory Council and member of Climate Change Adaptation Committee
Claire Scannell	Met Eireann
Patricia King	Climate change Advisory Council
Roger Street	Climate Change Adaptation Committee
John Spink	Climate Change Adaptation Committee (Teagasc)
David Joyce	Climate Change Adaptation Committee (Cork City Council, Director of Services)
Adam Fitzpatrick	Commission for Regulation of Utilities
Lucy Cradden	Commission for Regulation of Utilities
Ciaran Horgan	Commission for Communication Regulation
Micheal Gorman	Gas networks
Brid Sheehan	Gas Networks Ireland
Maeve O Reilly	Gas Networks Ireland
Mairini Ní Cheallaigh	Department of Transport
Conor O Raghallaigh	Department of the Taoiseach
Bobby Smith	Energy Storage Ireland
Ian Devine	Dublin Airport Authority
Loretta Joyce	Director of Energy Safety
Gemma O Reilly	National Economic and Social Council
George Hussey	CCAC Secretariat Manager

Stephen Flood	CCAC Secretariat
Gina Kelly	CCAC Secretariat
Philip O' Brien	CCAC Secretariat
Meabh Gallagher	CCAC Secretariat
Syed Faiz-ul Islam	CCAC Secretariat
Kieran Craven	CCAC Secretariat
Jodie Colgan	CCAC Secretariat
Bryn Canniffe	CCAC Secretariat
Eleanor Matthews	CCAC Secretariat
Ciara Hilliard	CCAC Secretariat
Simon Ngorok	CCAC Secretariat
Niamh Mccarthy	CCAC Secretariat

Annex 2: Workshop Agenda

Climate Resilient Critical Energy Infrastructure Workshop

Venue: Virtual meeting

Time and Date: 11:30am-4:10pm, May 17th, 2023

Time	Item	Speaker/s	Time (mins)
11:30am	Welcome & housekeeping – Introduce objectives	Marie Donnelly, Chair Climate Change Advisory Council & Prof. Peter Thorne, Chair of Adaptation Committee, & Director of ICARUS, Maynooth University	15
11:45am	Setting the Scene	Dr Stephen Flood, Resilience Team Lead, Climate Change Advisory Council	15
12:00pm	The UK Climate Change Committee's advice on resilient energy infrastructure	Cara Labuschagne, Lead Analyst – Resilient Infrastructure, UK Climate Change Committee Secretariat	20
12:20pm	Breakout session I – Assessment of Critical Infrastructure	Assessing critical infrastructure resilience to current and projected extreme climate related events and their impacts	40
1pm	Lunch		45
1:45pm	International perspectives on resilient infrastructure planning	Prof. Paul Chinowsky, Director, Resilient Analytics, Colorado, United States	20
2:05pm	Breakout session II – Information Gaps	Identifying information gaps that need to be filled in order to achieve energy resilience	40
2:45pm	Coffee		15
3pm	Breakout session III – Governance, Coordination and Cross Cutting Issues	Identifying barriers to systemic coordination and ensuring that there is good coherency with other policies	40
3:40pm	Overview of breakout discussions	Summary of breakout discussions and overview of key common issues raised	20
4pm	Next steps and close	The secretariat will produce a workshop report to feed into the sectoral adaptation plans and in general adaptation planning	10
4:10pm	Close		-