ELECTRICITY SECTOR CLIMATE INFORMATION PROJECT

ESCI Climate Risk Assessment Framework

User Guide

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Australian Government
Department of Industry, Science, Energy and Resources
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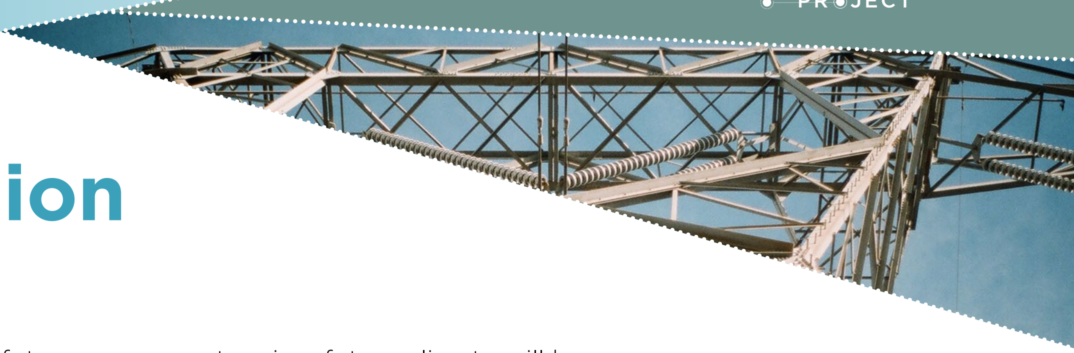
CSIRO

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR



Introduction

Overview

The impacts of weather on a future energy system in a future climate will become increasingly significant. Using a standard framework for a climate risk assessment provides a consistent, structured and pragmatic approach for minimising harm and capturing opportunities.

The ESCI climate risk assessment framework follows the International Standard ISO 31000 for Risk Management, starting with understanding the context, then identifying and analysing the climate risk, prioritising risks, and then determining how to mitigate the key risks. The suite of tools developed by the Electricity Sector Climate Information Project (ESCI) can be used to integrate climate risk consistently into sector planning and risk modelling using a standard process.

Introduction

The guidance is structured around the 5-step ESCI Climate Risk Assessment Framework. The framework has been designed and tested by key electricity sector stakeholders and climate experts in CSIRO and the Bureau of Meteorology, with support from the Department of Industry, Science, Energy and Resources. The guidance includes recommending climate data, case studies showing how the climate risk assessment framework and associated data have been used, and other supporting documentation.

> The Electricity Sector Climate Information (ESCI) project provides guidance for electricity sector stakeholders on using climate information in risk assessments.

While the framework is aimed at the electricity sector, it can be used by other sectors to incorporate climate risk into decision-making.

Why is climate risk assessment needed?

The International Standard ISO 31000 for Risk Management defines risk as the ‘effect of uncertainty on objectives’.[1] For the electricity sector, the National Electricity Objective (AEMC 2019) is:

to promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to:

- price, quality, safety and reliability and security of supply of electricity
- the reliability, safety and security of the national electricity system

1 ISO 31000 (2018) Risk Management https://www.iso.org/iso-31000-risk-management.html

Context for using the climate risk assessment framework

There is clear evidence that the climate has been changing (BoM and CSIRO, 2020). Australia has warmed by 1.4 °C since 1910 (Figure 1), with less rainfall in the south and east and more rainfall in the north. Impacts on the electricity system have been felt through extreme weather events such as heatwaves, floods, wind-storms, droughts and fires.

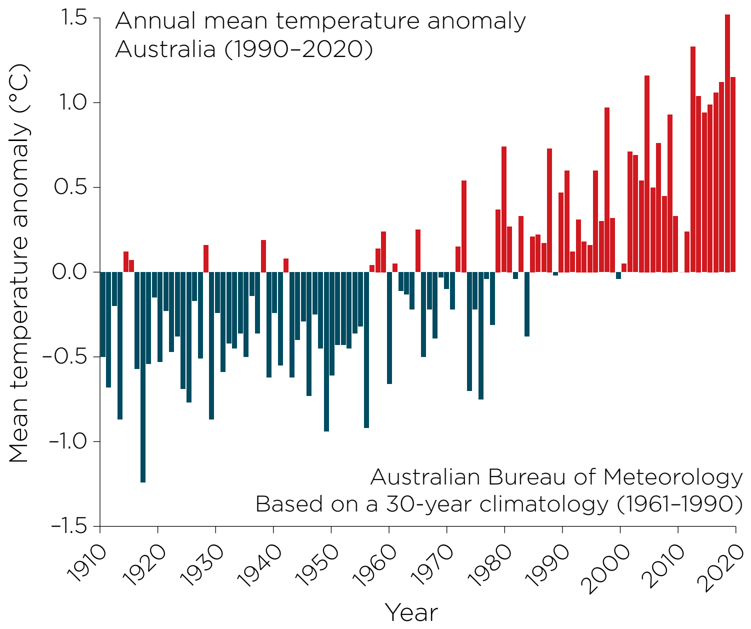


Figure 1: All parts of the electricity sector, from generation to transmission and supply to demand, are sensitive to heat. Increasing average and extreme temperatures due to climate change present an operating environment different from the past. (Source: Bureau of Meteorology Climate change and variability: Tracker: Australian timeseries graphs)

Climate change is creating new risks for businesses (Table 1). For example, high temperatures increase electricity demand and affect all electricity supply infrastructure; as temperatures rise with climate change, the risks to the sector will also rise.

The development of the ESCI climate risk assessment framework

The framework provides detailed and context-specific guidance on conducting a climate risk assessment. The method uses the approach taken for most risk assessments in the sector, so allows climate risk to be seamlessly incorporated into decision-making. It integrates relevant information from:

- International Standard *ISO 31000 Risk Management*, which provides a general framework that is widely used internationally
- International Standard *ISO 14090 Adaptation to Climate Change*, which is consistent with ISO 31000 and well aligned with climate risk assessment for the electricity sector
- the *Australian Climate Compass*, which is also consistent with ISO 31000, with a focus on climate risk assessment for policy and programs
- Australia's *National Disaster Risk Reduction Framework*
- Australian Standard *AS 5334 Climate change adaptation for settlements and infrastructure*
- Climate Risk and Resilience Guidance Manual (Energy Networks Australia 2015), a detailed guide to risk assessment for energy networks that provides advice that can be used by other parts of the sector

Table 1: The risks that climate change poses to the electricity sector

Physical risks		
• Electrical assets are likely to be affected by weather that differs from the historical expectation. • Physical risks include: - changing wind, irradiance, precipitation and temperature, affecting the instantaneous supply and demand balance - increases in extreme weather and compound weather events that affect the operability and failure rates of assets **This category is the focus of the ESCI project**		
Supply-side transition risks	Demand-side transition risks	Institutional risks
As part of global greenhouse gas emission reductions and changing technology prices, electricity generation is transitioning from fossil fuels to renewable sources such as wind and solar. The intermittent nature of these sources affects the operability of systems, as well as transmission needs, reliability, system stability, strength, fault levels and synchronous support.	Climate change and decarbonisation will affect electricity users and their needs. Impacts to residential consumption may include additional rooftop PV and electric vehicles. Impacts to business consumption may include additional desalination, further restructuring of the economy and changing agricultural and industrial needs.	Failure of sector institutions and organisations to consider climate change will produce financial, legal, governance and reputational impacts.

Potential applications of a climate risk assessment include:

- prioritising climate risks that require mitigation
- managing asset safety and reliability risks
- managing the potential for asset or value destruction
- managing the potential for changes in cash flow or profitability
- managing consumer outcomes from the integrated power system
- designing new asset specifications for future operating conditions
- calculating market benefits attributable to regulated investments, considering changes to operating conditions of the integrated power system

Climate change is superimposed on natural weather and climate variability, and while historical records provide a good indication of emerging risks, future risks are likely to be underestimated or may appear in new locations. Climate risks to the electricity sector are likely to be most relevant in strategic or planning time frames (5–50 years). However, some impacts are already evident and are relevant to operational time frames (1–5 years).

What does the framework cover?

The framework covers the analysis of physical climate risks, defined by the Intergovernmental Panel on Climate Change (IPCC) as the combination of hazards, exposure and vulnerability (Cardona 2012). Exposure is the presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected by a hazard. Vulnerability refers to the propensity of assets, systems and consumers to experience adverse effects. This may be the result of design or engineering, or the inability to adapt, such as a community not being able to move out of the way of a hazard such as a fire or flood.

The ESCI project provides information on the intensity and frequency of weather and climate hazards.[2] For a complete risk assessment, exposure and vulnerability need to be considered. For example, the National Energy Market (NEM) has long interconnectors between population, industrial and other demand centres. Thus, the NEM is widely exposed to extreme weather events, climate variability and climate change.

The ESCI Climate Risk Assessment Framework has 5 steps (Figure 2).

2 Note, a *hazard* could be a change in a climate *variable*—for example, temperature is a *variable*, but an extreme temperature is a *hazard*.

Figure 2: The ESCI Climate Risk Assessment Framework

The 5 steps for climate risk assessment are:

1

Understand context

This takes a decision-centred approach involving broad stakeholder engagement which focuses on understanding the vulnerabilities of key assets, systems and consumers, and the purpose of the risk assessment. The ESCI project provides guidance on climate information that can be used to scan quickly for exposure and vulnerability to climate hazards.

2

Identify historical climate risk

Risk identification builds upon the initial scan in step 1 by developing a deeper understanding of the historical relationships between weather, climate and electricity system performance. This step produces a statistical model describing the relationship between weather, climate and performance and will define the temporal and spatial scale of interest. Relevant engineering standards and performance standards should be considered and can help identify the metrics for use in the analysis.

3

Analyse climate risk

This step uses the model developed in Step 2 and the purpose of the risk assessment to identify climate scenarios of interest. The most appropriate climate projections can then be used to determine how the asset or system performance is likely to be affected in the future. Because of the complexity of projecting future climate, the ESCI project provides recommendations on suitable climate information and associated confidence and uncertainty.

4

Evaluate all risks

Climate change is only one risk to be considered in electricity sector planning. This step involves comparing all material risks by assessing consequences and likelihoods and producing a risk rating matrix. This helps to rank or prioritise risks that require treatment. Risk evaluation may lead to further risk analysis or a decision not to undertake risk treatment. Organisations should define criteria to evaluate the significance of current and future climate risks, consistent with criteria used for other types of risk.

5

Treat climate risk

Risk treatment involves developing and selecting one or more options for modifying the risk, which may then need an investment case or a change in process. Selecting a risk treatment requires consideration of the costs and benefits of reducing the risks and the tolerance for residual risks. Factors that contribute to the cost-benefit analysis include effectiveness, robustness, practicality, economic efficiency, co-benefits, equity and greenhouse gas emissions. Large-scale investment cases will need to follow regulatory frameworks to be approved by the Australian Energy Regulator.

How should the assessment framework be used?

Risk assessment is an iterative process. Depending on the work your organisation has undertaken on climate risks, the risk management processes involved and the objectives and resources available, the climate risk assessment may range from simple to complex. You should start with a simple, rapid and qualitative assessment to prioritise where detailed effort may be needed in a subsequent assessment, also referred to as a 'scan cycle' (CSIRO 2018). If this has already been completed, you may wish to undertake a more comprehensive assessment. It is unlikely that you will work sequentially through each step in the method. You will probably repeat some steps as you develop your understanding of climate risks and fine-tune your objectives.

The ESCI project user guide includes detailed information on the assessment framework steps and how to integrate historical and projected climate information. ESCI case studies provide worked examples of using the climate risk assessment framework to assess exposure to future risk.

The steps of the ESCI project user guide include detailed information for each of the framework steps.

The ESCI website provides access to high resolution climate projection data: 5–12 km across the NEM, at sub-daily intervals, to 2100. It includes insights which enable users to choose appropriate data and to plan for this future with greater confidence

ESCI case studies show how the tools available on the website have been used in a climate risk assessment—accompanying documents step through the case study process in detail. *Note: every business, location and asset combination is different, so the case studies do not provide a comprehensive overview of electricity system vulnerabilities and should not be used be used to inform operational decision-making*.

Key concepts provide as-needed insights into climatology concepts used in analysing climate risk, as well as information on how the climate data were evaluated and the recommended data sets chosen.

The ESCI Website: www.climatechangeinaustralia.gov.au/esci

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