Climate Change Adaptation Research Grants Program
- Settlements and Infrastructure Projects

Project title:
Analysis of institutional adaptability to redress electricity infrastructure vulnerability due to climate change.

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Objectives:
The main objectives of this project are to examine the adaptive capacity of existing institutional arrangements in the National Electricity Market (NEM) to existing and predicted climate change conditions. Specifically:

1. Identify climate change adaptation issues in the NEM;
2. Analyse climate change impacts on reliability in the NEM under alternative climate change scenarios to 2030, particularly what adaptation strategies will the power generation and supply network infrastructure need; and
3. Assess the robustness of the institutional arrangements that support effective adaptation.

Project design and methods:

Task 1: Literature Review
An extensive literature review will be undertaken in order to identify those areas where key research overlaps. While some studies have been performed to understand the risks associated with climate change, however, the literature relating to Australia's electricity supply interests are significantly under-developed. Specifically, this review will consider:

a) the potential impacts of more variable climate conditions on the electricity industry;
b) the effectiveness of adaptation actions being carried out in the NEM and the potential for maladaptation; and
c) the flow-on effects of climate change impacts and maladaptation actions in other linked infrastructure industries such as water.

It is anticipated that this review will provide focus for the majority of the research outlined below by exposing gaps and informing our methodologies for investigation.

Task 2: Data collation and assessment
During this stage data would be collected from a number of NGF members and AEMO to allow case studies to be undertaken based on their specific data and utilising available climate change data that are currently being developed through the Australian Climate Change Science Program. Initially, models will be developed based on generation data, with the climate change scenarios being added once this detail becomes available. Once all available data has been collected the research team will begin making assessments of possible climate change effects on electricity industry via econometric analysis.

Task 3: Analyse the impacts of climate change on electricity demand
There has been very little work to date examining the effects of climate change within the Australian electricity industry. Although some studies have examined the effects of demand shifts due to higher temperatures, little work has examined the effects on electricity prices due to sustained climate change. The combination of high frequency electricity historical demand and atmospheric data in the form of 5 minute tick data points will be analysed to understand demand changes due to climate change. The effects of atmospheric changes on demand will then be used to forecast demand under a variety of climate changes scenarios to provide insight into future energy demand for the electricity supply industry.

Task 4: Analyse the impacts of climate change on electricity generation capacity and transmission networks

The rated capacity of all combustive electricity generation technology types are affected in a variety of different ways during in summer and winter. The consequences of this lowering of supply could have major implications for spot prices, and the reserve plant margin during extreme weather events. The availability of generator performance data which is to be provided by members of the NGF will provide some insight into supply side effects of climate change. This task will be carried out by examining the output from power stations and high frequency climatic data to produce power curves for all centralised electricity generating units in the eastern states. These power curves will then be used to examine how production will be affected by scenarios developed in the previous task. The main outcome from this task will be the identification of generation technology types which are best suited to operation under uncertain climatic conditions which will provide the electricity supply industry with key criteria for future investment. Extreme weather events have regularly compromised the rated capacity of electricity transmission lines in Australia. This was clearly evident for Victoria in January of 2007, when the availability of imports via the then Snowy region were compromised, resulting in high spikes in spot prices. Understanding the how transmission infrastructure responds to the increased incidence of extreme weather events will provide considerable foresight into the forward deployment of interconnection between the states. Using climate change scenarios developed in Task 3 above, we will examine the likely increase in the unavailability of current transmission capacity and how this affects the future composition of electricity networks. Constraints on capacity of interconnecting transmission lines will be examine by using high frequency climatic data and flow data from. The main outcome of this research will be a better understanding of how our thinly meshed electricity network could be strengthened to cope with transmission constraints during extreme weather events.

Task 5: Analyse the effects of changes in water availability on electricity demand-supply

The outcomes of Tasks 3 and 4 above will be analysed in light of changes in water availability due to climate change using a decision support tool titled the National Electricity Market Model (NEMMOD). A preliminary version of NEMMOD was developed under the aegis of the ANU-UTS Climate Energy Water Links (CEWL) project. This project will further refine the modules and module interface in close consultation with key stakeholder end users. The proposed Climate Module (of NEMMOD) will enable end users to select from climate change scenarios for Australia based on the ACCSP scenarios. The climate scenarios will define future variations in temperature and rainfall, both of which impact on water availability and on electricity demand. The Market Operator module will simulate dynamics in the NEM such as generator scheduling. It will consider inter-regional constraints and changes to the competitive advantage of generation technologies due to the introduction of a carbon price. Other policy-induced investment into low carbon technologies can be incorporated via the proposed Capital Investment module. Through a Graphic User Interface, end users will be able to analyse scenario-specific supply constraints and increases in demand, both of which affect reliability in the NEM. End users will also be able to analyse the scenarios at different spatial scales.

Task 6: Assess the current institutional arrangements for the development of electricity infrastructure, with a view to inform more flexible arrangements for effective adaptation

To meet the third objective, the project will first assess the existing institutional arrangements within the NEM, in relation to its structure, ownership and regulation, against a variety of climate change scenarios. In this phase, the project will draw mainly on the recent work by the Australian Energy Market Commission, which reviewed the existing arrangement of the NEM in light of climate change mitigation policies. With the assistance of key stakeholders, this project will assess the vulnerability of such arrangements against any possible risk of climate change, and will also identify any potential maladaptation that is likely to occur from such arrangements. The project will also identify alternative institutional arrangements, with a view to assess these alternative arrangements against various climate scenarios analysed in the above tasks. Through the identification of the issues (Task 1), analyses of the reliability impacts on infrastructure (Tasks 3- 5), and assessment of the alternative institutional arrangements (Task 6), the project will put forward recommendations that will assist policy makers and key stakeholders to improve their capacity to adapt to climate change.