Project Title - Modernising Electricity Pricing and Dispatch

Host University - University of Auckland

Industrial Partner - Transpower

Academic Supervisor(s)

Prof. Andrew Bryan Philpott
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Engineering Science and Biomedical Engineering
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Industrial Supervisor(s)

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Project Description

The SPD optimisation model used by Transpower for dispatching and pricing energy in the wholesale electricity market has remained essentially unchanged since 1996. The electricity market design that led to this model involves dispatchable plant and reasonably predictable short-term demand. With increasing penetration of renewables (mainly solar and wind generation) the dispatch and pricing model needs to evolve. This project will investigate the benefits and drawbacks of changes to the dispatch and pricing model to see what changes, if any, should be made to SPD. The project will make use of the Electricity Authority vSPD software and modify this with new features that can be tested and compared with the existing system.

The research will:

[Year 1] Investigate dispatch and pricing based on Agent Decision Rules as discussed in the recent EPOC paper “Electricity Dispatch and Pricing using Agent Decision Rules”.
[Year 2] Investigate the value of a day-ahead dispatch using HydrovSPD in conjunction with a real-time dispatch model

[Year 3] Develop a machine-learning model to replace RMT for determining risk levels for reserve scheduling.

This project is grounded in Aotearoa's economic development goals, natural resources, and emissions goals. The country has committed to grow its renewable electricity generation capacity to meet increased demand from the electrification of transport and process heat that will be needed to meet emissions targets. The transition must solve the energy trilemma: being reliable, sustainable and affordable.

Economic impact: Wind and solar energy are intermittent and uncertain. To enable this energy to be used efficiently Transpower's scheduling software must account for this, and must also be robust to sudden changes in supply that might lead to cascading failures. These are more probable with renewables than with conventional plant. The research will explore the modelling improvements needed to enable the growth of intermittent renewables without risking blackouts. Solar energy is now the least expensive source of renewable energy, but it peaks in the middle of the day and is not available in the early morning or evening. Unless solar energy can be shifted to these times, it will not be economic to build enough to contribute to the electrical energy needed for decarbonization. Batteries can shift the energy between times. Scheduling batteries using improved dispatch rules will do this efficiently. This will incentivize more grid-scale solar installations.

Social impact: The transition to renewable electricity must be affordable. It is likely that a day-ahead market will reduce the risk arising from volatile real-time wholesale prices. This risk reduction will translate into lower retail prices for consumers.

Environmental impact: Wind and solar energy are key technologies in the transition to renewable energy supply. Enabling their growth by using better dispatch models will yield environmental benefits from lower carbon emissions not only from thermal electricity generation but also through the electrification of transport and process heat that will reduce emissions from these sources.

Student Time Split

University base for student (university, campus, department):

Department of Engineering Science and Biomedical Engineering 70 Symonds Street, Auckland

Industry base for student (company, site, address):

Waikoukou, 22 Boulcott St, Wellington 6011

Expected Time Split Between University and Industry Partner (in months):

30 months University. 6 months Transpower

Rationale for Time Split:

The university-based phase will focus on building the student's research capability in optimisation and understanding of the mathematical models underlying dispatch and pricing of electricity. We foresee the student spending 12 months at the University, followed by 3 months internship at Transpower, then repeating this after 15 months. The final 6 months would be spent at the University completing the PhD thesis.

The Transpower placement will embed the student within New Zealand's national grid operator, allowing them to test ideas against real operational data and decision-making processes. This placement ensures that the outcomes are relevant, applicable, and aligned with national needs. Ramu Naidoo will be the industry supervisor and has extensive industry experience in the field in addition to Professor Philpott.

The 6-month placement duration provides sufficient time for meaningful engagement with industry teams while recognising operational constraints.

Application

To apply for this project please first read the Application Guidance document, including the note for University of Auckland applicants. Due to differing processes, candidates must apply for admission through the University of Auckland portal before submitting their Applied Doctorates Scheme application.

Once issued with a unique University of Auckland ID number and application number, candidates will be able to go on and complete the application form on the Applied Doctorates Scheme website.