MARKETS, POLICY AND REGULATIONS

Chaired by Professor Stefan Trueck
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The roadmap to 100% renewables in WA

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Western Australia's (WA's) largest power system, the South West Interconnected System (SWIS) is transitioning from predominantly coal and gas-powered thermal generation to increasingly higher levels of distributed and renewable energy sources. While this aligns with Australia's announced policies for decarbonisation, it brings many engineering challenges that need to be fully understood and resolved before we are able to operate the power system at higher share of renewables, and at times with 100% renewables.

AEMO has produced a SWIS Renewable Energy Roadmap which provides AEMO's integrated view of the steps towards the engineering and operational readiness needed to prepare the SWIS to manage very high levels of renewables, with periods of 100% renewables. This talk will present the pertinent points of this roadmap and what needs to be in place for that desired future state.

Planning and governance decision-making informed by sequential design of net zero greenfield energy hubs

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Australia's Emissions Reduction Plan targets net zero emissions (NZE) by 2050, emphasising the role of technology in driving sustainability and economic growth. Aligning with this objective, our joint research between the University of Sydney (USYD) and Mitsubishi Heavy Industries (MHI) focuses on the efficient design of power grids through optimising energy systems planning, energy demand modelling, and addressing mineral constraints for new energy technologies.

Designing energy systems involves complex considerations of varying energy demand, evolving techno-economic factors, and carbon accounting. Tools that optimise energy systems planning and operation are crucial, particularly in greenfield energy hubs where infrastructure can be established from the ground up. This allows for local power generation and reduces network expansion costs. However, there is a lack of such tools, especially those that simultaneously address these complexities.

This study addresses this energy systems design tools gap, by presenting a sequential co-optimisation tool (DEEPSyM-Power) for the planning and operation of greenfield energy hubs, in the context of NZE. The tool integrates with other tools developed through collaboration between USYD and MHI, namely 'DEEPSym-Grid' and 'DEEPSyM-Scen' for demand modelling and transition scenario development, respectively. DEEPSyM-Power is a dynamic and adaptable framework that enables the step-by-step development of greenfield energy hubs from scratch. It accounts for the evolution of emissions policies, energy demand fluctuation, technology feasibility, and techno-economic advancements at each design stage. It targets optimal hub design considering generation and consumption impacts. The framework highlights the changing effects of demand flexibility options like vehicle-to-grid, electrolysis, and hydrogen storage, along with co-generation, on hub design.

A sensitivity analysis is conducted to evaluate the impact of environmental factors, evolving energy demand, cost forecasts, and techno-economic advancements on energy hub design. The results indicate that greenfield energy hub design enables the creation of large-scale distributed energy systems that meet local demand and participate in the electricity market. Sequential co-optimisation harmonises economic and environmental needs for electricity, heating, cooling, and hydrogen demands.

Correlated planning and operation modelling of energy hubs identifies economically feasible investments over a long-term horizon for NZE. It also determines the type, capacity, synergy, and operation of greenfield energy hub units, all ultimately informing planning and governance decision making for carbon-neutral developments.

Engaging with communities to plan transmission

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Good community engagement is required to obtain and maintain social licence for the delivery of transmission infrastructure

Social licence is critical to the timely delivery of major transmission infrastructure required to connect cheaper renewable generation to consumers and transition to net zero.

Transmission businesses, local communities and other stakeholders affected by transmission projects are critical partners in their delivery. Enhanced community engagement helps build and maintain trust between these stakeholders and improves the quality of planning which is critical to deliver transmission projects efficiently and on time.

We made a rule to require transmission businesses to engage with local communities earlier and to set a minimum standard for engagement with local communities

The Australian Energy Market Commission (AEMC) made a final determination and final rule to enhance community engagement by clarifying that transmission businesses must engage with communities earlier and more effectively when planning for major transmission projects. The final rule primarily applies to projects in the Australian Energy Market Operator's Integrated System Plan (ISP).

The final rule addresses current uncertainty and inconsistency, in the national electricity rules, over transmission network service providers' obligations and expectations to engage with local communities, early in the planning process. The rule enables local knowledge and expertise to be more effectively considered when choosing routes and infrastructure design to mitigate risks of delays later in the process.

The final rule clarifies who transmission businesses need to engage with and introduces a set of community engagement expectations. Community engagement is enhanced by changes that:

- clarify that transmission businesses are required to engage with stakeholders who are reasonably expected to be affected by the development of an ISP project as part of preparatory activities and when undertaking the regulatory investment test for transmission. Stakeholders include local landowners, local council, local community members, local environmental groups and traditional owners.
- introduce community engagement expectations which TNSPs are required to make reasonable endeavours to satisfy when engaging with these local stakeholders as a minimum standard of practice. These expectations go to the quality and accessibility of the information provided to community members and require the role of communities in the engagement process to be transparent.

The final rule complements broader social licence reform being pursued by the AEMC and other workstreams undertaken by other entities across the National Energy Market to support the timely delivery of major transmission and other renewable energy infrastructure.

Stakeholders were consulted throughout the process with their feedback shaping the final rule

The AEMC engaged with stakeholders through public forums, bilateral discussions, and formal submissions to both the rule change and the preceding Transmission planning and investment review, in developing the policy reflected in the rule. Stakeholders broadly agreed that engagement with communities should be earlier and more effective during the transmission planning process.

Stakeholder feedback helped shape the final rule, including changes to improve accessibility for community stakeholders and clarity around who should be engaged with at a minimum.

Modeling the dynamics of wind generation in the Australian National Electricity Market

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This presentation provides a comprehensive analysis of the dynamics of wind output within the Australian National Electricity Market (NEM) and its implications for system reliability. As Australia accelerates its transition towards renewable energy sources, wind power has emerged as a key component of the energy mix. However, due to the intermittent nature of wind and solar, the rapid deployment of renewable generation also poses significant challenges for maintaining a reliable electricity supply. The study applies advanced econometric techniques to examine the temporal and spatial patterns of wind output across different regions of the NEM. Using historical data, we examine how the increased growth of wind capacity over the past 10 years has changed the statistical profile of cumulative generation output from wind. In particular, we are interested in examining the risk of low generation output from wind as well as whether adding additional wind capacity has helped to stabilize the output from wind generation relative to the installed capacity. To answer these questions, we propose the use of a so-called aggregated capacity factor from wind generation and analyze the dynamics of this factor and related variables. Our analysis addresses the intermittency of wind power, shedding light on the fluctuations in wind output and their impact on the dispatch and operation of the electricity grid. Overall, our study contributes to a deeper understanding of the complexities associated with wind power integration in the NEM, offering valuable insights for policymakers, grid operators, and energy market participants as they work towards a sustainable and reliable energy future in Australia.

Research priorities for the rapid re-engineering of Australia's power systems

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Australia's energy systems are at the forefront of a global transition towards net zero operation. We have a rapidly diminishing window of time to re-engineer our power systems, whose foundations have remained consistent for a hundred years. To meet its emission reduction targets by 2030, Australia will need to navigate an array of questions unanswered anywhere in the world. The only way this can be achieved is through a collaborative effort between industry and academia, leveraging local and international expertise.

The Engineering Roadmap to 100% Renewables (Engineering Roadmap) outlines the pre-conditions that will need to be satisfied for Australia's National Electricity Market to operate with up to 100% instantaneous renewables. It offers a foundation to support collaborative discussions on research priorities out to 2030.

The Australian Energy Market Operator (AEMO) is eager to share its insights on the priority research questions that will help accelerate the transformation of Australia's power systems.