COAG Energy Council
Energy Security Board
Via email to: info@esb.org.au

24 September 2019

Dear Sir or Madam,

Re: Post 2025 Market Design Issues Paper

As a global leader in renewable energy engineering, construction, strategy and energy sector analytics, ITP Renewables (ITP) welcomes the opportunity to provide this submission to the Energy Security Board (ESB) in response to the Post 2025 Market Design Issues Paper.

ITP is proud to be part of the ITP Energised Group, one of the world's most experienced and respected specialist engineering consultancies focussed on renewable energy, energy efficiency and energy markets. We offer expertise in energy market modelling and analysis and have undertaken a wide range of projects including strategic and policy advice to Australian and international governments.

The purpose of this submission is to provide feedback on the three issues raised in the Paper. These are:

(i) the possible future scenarios that should be used to test market design,

(ii) how energy market modelling can best be utilised to evaluate market operation, and

(iii) the assessment framework for evaluating future market design.

Future Scenarios

The ESB's Issues Paper notes the most comprehensive future scenarios of the NEM are set out the Australian Energy Market Operator (AEMO) Integrated System Plan (ISP) and that these scenarios 'provide a foundation for defining a range of potential future worlds that could exist'.

While ITP agrees with this assertion as it applies to a 'central NEM' future, we note that the NEM is evolving such that sections of the grid, including in particular fringe of grid areas, will increasingly operate in semi-autonomous micro-grid or off-grid mode. This is a result of customers and networks taking up distributed energy, micro-grid and off-grid power options as the cost and technical capability of these technologies improve.

ITP considers it important that the scenarios tested include the new grid layouts of an evolving NEM. Potentially this could involve modelling scenarios of the NEM with grid sections that can operate self-reliantly for short or long periods, depending on existing resources, loads, customer types and grid availability, especially under extreme weather events. It could also involve modelling scenarios of significant numbers of customers moving to off-grid supply.

Energy Market Modelling

The ESB has indicated that it will undertake modelling where instructed to do so and expects to model an energy-only market. We appreciate the ESB is likely to receive approaches from many modelling providers, however we consider an open-source model offers many advantages in a public review and policy-making process.

About openCEM

The *openCEM* model is an open-source capacity expansion model of the National Electricity Market (NEM) which is available free of charge at: www.openCEM.org.au

Users can run unlimited scenarios to explore the implications of a wide range of input assumptions including policy goals, technology characteristics and costs, and electricity demand profiles, out to 2050. Use of *openCEM* will enable insights into potential pathways for the evolution of the NEM. Amongst other things, users will be able to examine the impact of:

- economic and regulatory factors such as technology costs or changes in fuel prices,
- technological changes, including improvement in the performance of energy generation and storage electricity, transmission, and energy use efficiency,
- different levels and types of targets, such as renewable energy or greenhouse gas reduction targets, and
- specific large energy projects.

The *openCEM* model optimises for a least-cost solution that maintains energy security. It reveals when, where and what kind of energy generation, storage and transmission capacity should be added, and when and where carbon intensive generation should be retired, in order to achieve policy goals.

Similar models are privately held, expensive to commission, and offer the public scant detail on how they actually work. By contrast, *openCEM* is free to use and open to scrutiny and expert review. Users can inspect every line of code and can control every input assumption. The model's open-source and freely available nature will enable the results to be verified, reproduced and extended by interested stakeholders. We expect a community of expert users including policy makers, project developers, investors and the interested public to collaboratively improve *openCEM* over time.

The *openCEM* model has been developed by ITP together with the Centre for Energy and Environmental Markets at University of New South Wales, the Energy Transition Hub at the University of Melbourne, the software development specialists ThoughtWorks and US Strategic Energy Analysis Center (SEAC) of the National Renewable Energy Laboratory.

The development of *openCEM* was supported financially by the Australian Renewable Energy Agency and the Governments of New South Wales, Victoria and South Australia. There were also significant in-kind contributions from the development partners. The development process was also generously assisted by many firms and organisations participating in an Industry Reference Group.

Model Operation

The operation of the *openCEM* model involves two steps. For every simulated year, a capacity expansion model finds the least cost additions to generation, transmission and storage from an existing NEM configuration to satisfy forecast electricity demand, subject to renewable energy resource availability, and economic retirement of existing generation capacity. Step two involves running a chronological dispatch model of the NEM under the capacity conditions obtained in the first stage. This stage verifies how the electricity system operates, on an hourly basis over a given year, ensuring reliability standards are met and that the load is met under all conditions, including peak demand events. The resulting generation, storage and transmission decisions obtained after this process carry forward to the next year and so forth.

Starting assumptions regarding technology and fuel costs and performance characteristics are taken from the Australian Energy Market Operator's (AEMO) Integrated System Plan (ISP). For

example, the 'base case' scenario takes most of its cost, performance and demand data from the ISP Neutral Scenario, and shows results that are qualitatively similar to the ISP modelling. Each time AEMO publishes updated data, or other sources of data become available, it will be possible to update *openCEM's* starting assumptions. Other scenarios to be added will be based on the CSIRO's GenCost data.

The *openCEM* model subdivides the NEM into the same 16 planning zones that AEMO uses for the ISP and their National Transmission Network Development Plan. For each zone the capacity expansion model considers a configurable list of generators, storage devices and hybrids (generator + storage). Intra-regional transmission power flow is modelled in the form of 'zonal interconnectors' between zones and the cost and benefit of building new interconnectors between planning regions at selected locations is evaluated.

Using openCEM

There are two ways to use *openCEM*. The simpler option is to explore a range of pre-run scenarios on the openCEM website. Results such as generation capacity, dispatch and wholesale electricity cost are displayed visually using a range of graphics. At this stage ten scenarios have been selected to demonstrate the capability of the model, but more will be added in response to user feedback and requests.

The more sophisticated option is for users to download and install *openCEM* on their computer. Users can then run their own scenarios, with tailored assumptions about inputs such as technologies, policies and demand profiles. Note that a single run typically takes 2-3 days on a good desktop computer, and setting up the scenario requires some basic understanding of Python. After the simulation is complete, a complete dataset of the simulation is produced that contains all input assumptions (e.g. costs, policies, traces, demand, etc) as well as all dispatch and building decisions.

We suggest a mix of both options could be suitable for the ESB's process, (i.e. with assistance from ITP, the ESB could develop scenarios based on stakeholder feedback and make these available as part of the public consultation).

Assessment Framework

Future market design will need to take into account the significant uptake of distributed energy resources, where individual customers, groups of customers, or potentially whole regions may operate autonomously for hours, days or weeks under conditions when local generation can readily match local load, or during extreme weather events, when grid lines are down or otherwise. Such scenarios will require different market structures:

- different grid configurations than those expected under a 'central NEM',
- different roles for retailers, and
- more customer involvement and interaction in the market.

It will be important to model and test new market structures which better cater for customers in future. ITP would be keen to develop and test such scenarios in *openCEM*.

ITP would be pleased to meet with the officials supporting the Energy Security Board to provide further information or discuss any aspect of this submission.

Yours sincerely,

Simon Franklin
Managing Director, ITP Renewables