# High Fidelity Simulation of Future Low Emissions Stationary Electricity Generation Scenarios

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## STATEMENT OF ORIGINALITY

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## *Nomenclature*

The following abbreviations are used throughout the document and refer to sites renewable generators can be located.

Sites capable of wind based generation

| | |
|---|---|
| ARDO | Adelaide Regional Office |
| LOFT | Mount Lofty |
| NRLG | Noarlunga |
| OHBP | Outer Harbour Black Pole (at the North West edge of Adelaide City) |
| SELL | Sellicks Hill |
| THEV | Thevenard |
| YCDU | Ceduna |
| YGLS | Giles |
| YMTG | Mount Gambier |
| YPAD | Adelaide Airport |
| YPED | Edinburgh |
| YPWR | Woomera |

Sites capable of solar based generation

| | |
|---|---|
| ADEL | Adelaide |
| MILD | Mildura |
| MTGA | Mount Gambier |
| WAG | Wagga Wagga |

### General Nomenclature

Col - (area of near equal mean sea level pressure resulting in low winds)

Baseload Generator – a generator whose output is planned to be at high output percentages the majority of the time.

Peaking Generator - a generator whose output is planned to be used at high output percentages but infrequently

Intermediate Generator – a generator whose output is planned to be at low output percentages the majority of the time, but whose output is adjusted to higher output before Peaking Generators are started.

Fully-Dispatchable. A generator which is fully able to control its output at any time of the year

Semi-Dispatchable. A generator which can only partially control its output and may not be able to increase output due to local weather conditions.

## List of Abbreviations.

CCGT – Combined Cycle Gas Turbine

EMIX-WIND-S05 and similar – an abbreviation for a scenario name. Refer to Augmentation Naming structure section for more details.

GHG – Greenhouse Gas

kWh – kilo watt hour

MWh – Megawatt hour. Equal to 1000 kWh

MWt – Megawatt Thermal energy.

OCGT – Open Cycle Gas Turbine

# Abstract

This project was concerned with analysing future low emissions scenarios from an Australian perspective through electricity network simulation using software to simulate each generator on the network each second using historical weather and demand data. The main aim of this project was to create a framework where future energy scenarios can be simulated and assessed and improved before billions of dollars is committed to building infrastructure. This project analyses the impacts of adding significant wind, solar thermal and geothermal generation to an existing network in a fictional state of Australia similar to South Australia over a time period of one year.

The baseline generator portfolios consisted of a coal dominated network and a mixed network which includes coal, CCGT, OCGT and Hydro-Electric generation and each scenarios key outputs were total emissions for the year and stability which measured whether the generators were under or over generating based on the systems present demand.

As more wind generation was added to the network, the volatility of the output of the generator in the system increased and an alternate dispatching method was used instead of the Least Cost Dispatching. Enhanced Intermittent Dispatching deliberately dispatched a peaking generator to act as a buffer and dampen the effect of a large change in wind based output.

This study found there were days of high volatility for both solar and wind based energy sources and both sources had days of low contribution which would lead to an inability to retire existing generation.

It is recommended that further work be done in this field and that planning for future low emissions networks involve the exploitation of generator synergies and an approach which includes a whole of network analysis to ensure the lowest risk transition to a low emissions electricity generation network.