# Value of ensemble models in planning the energy market

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**Abstract**

AEMO is responsible for planning and operating the energy market. To fulfil this role AEMO forecasts demand and supply from 5 minutes ahead, the next season, and out to 20 or 30 years.

Focusing on the 20 to 30-year horizon, climate change is increasing temperatures and the frequency and intensity of extreme events. AEMO needs to plan the energy market for this future to ensure that the grid is sufficiently hardened to cope. The power system needs to operate 24 hours a day all year round. The challenges for the power system are not increasing average temperatures but rather increasing extremes temperatures (one in ten-year events). Extreme temperature events drive extreme electricity load events, stretching the supply fleet and stressing transmission infrastructure.

AEMO’s planning role can be broken down into energy demand, supply, and network infrastructure:

* Supply and network assets de-rate at high temperatures reducing the amount of available generation and energy throughput of the network assets. High temperatures may also permanently damage network infrastructure. Further, sustained heatwaves reduce the ability of Generators to cool generation turbines.
* Demand increases during high temperature events driven by air-conditioner load. Heatwaves further increase energy demand as heat builds up in houses and apartments.

AEMO currently uses ensemble model results to plan the energy system in the presence of climate change over the next 20-30 years. Using the CMIP5 ensemble model results freely available on ClimateChangeInAustralia.gov.au AEMO downscales the projected daily maximum temperature data to half-hourly frequency using a quantile-quantile mapping algorithm. AEMO uses the half-hourly projected temperature data to forecast maximum demand percentiles out 20-30 years. AEMO uses every ensemble member in projecting the distribution of maximum daily temperatures treating each ensemble member as a separate simulation of the future.

For planning network and supply assets AEMO uses the threshold calculator on ClimateChangeInAustralia.gov.au to calculate the average number of days above 35-40 degrees per year. In the 2018 Integrated System Plan (ISP), AEMO assessed whether the operating limits of the network infrastructure today would be adequate for the climate in 30 years’ time.

The global climate models represent spatially averaged temperature data. Due to this, the model data has lower extremes when compared to temperature observations from a single weather station. AEMO needs to understand temperature extremes at spatially discrete locations to understand the resilience of the energy system to cope with these extremes. AEMO is continuing to work with the Bureau of Meteorology to further downscale the ensemble model data so that the model data has extremes of similar magnitude to extremes experienced at a range of weather stations across the National Energy Market.

In addition to considering temperature projections, AEMO considers other weather metrics, although is less advanced in our understanding, including wind, rainfall and bushfire for hardening the energy system for climate change.