4 Calculation of Demand Curve Parameters

This section addresses the demand curve for the Alberta capacity market, including the calculations for the components of the demand curve.

4.1 Resource adequacy standard

4.1.1 The Government of Alberta announced it will legislate a minimum resource adequacy standard. This value represents a maximum of 0.0011% unserved energy, described as normalized expected unserved energy. The AESO is currently evaluating whether the demand curve can be developed using this minimum resource adequacy standard or whether it is necessary to also define a target resource adequacy standard value.

4.2 Resource adequacy model & procurement volume determination

4.2.1 The AESO will develop and run a resource adequacy model (RAM), which performs a Monte Carlo simulation to probabilistically model hundreds of inputs to consider supply adequacy factors and understand their impacts on reliability. The simulation tool for performing the RAM is a computer program that uses data inputs, methodologies and assumptions to identify the relationship between expected unserved energy (EUE) and installed capacity (ICAP). The RAM will consider factors that impact the supply and demand balance in Alberta, such as:

(a) Load forecast. The AESO’s forecast of gross load includes multiple annual hourly load profiles based on historical hourly weather patterns of the past 30 years and a set of economic growth scenarios.

(b) Supply availability. Current and anticipated generation and demand response assets with maximum capability of 5 megawatts (MW) or greater is included in the RAM irrespective of technology type or eligibility to participate in the Alberta capacity market.

(c) Characteristics of thermal assets. Thermal asset are modeled using market simulation input assumptions and will be dispatched to load and optimized for both energy and ancillary services. Historical available capability (AC) data informs planned outage periods, forced outage rates and temperature derates:

   i. Forced outages – a distribution of time-to-fail hours (TTF) and time-to-repair (TTR) hours will be calculated for each generating unit to capture historical estimated forced outage rates in the resource adequacy model, which are then used in simulating unit forced outage events.

   ii. Planned outages – hours on planned maintenance will either be calculated as a percentage maintenance rate or manually scheduled based on historical data. This information will then be used to schedule maintenance events in the resource adequacy model.

   iii. Seasonal outage – technology output curves that are calculated using historical AC data and corresponding weather data to capture ambient temperature

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1 At this time, transmission constraints within Alberta will not be considered as a factor that will impact resource availability.
derates. Such curves will be used to model weather related derates for combined cycle and simple cycle units. The RAM references the curve to an hourly temperature value to look up an associated capacity multiplier to determine the output capacity of a unit.

(d) **Load served by onsite generation.** The gross availability of generating assets which serve load onsite (typically large industrial facilities that produce electricity and steam for other processes) in aggregate is correlated to gross load. Using historical hourly data, the daily gross peak load and daily gross peak availability can be calculated in aggregate and grouped into a number of different normalized load levels with a number of distribution points. The RAM will estimate gross availability in the hourly simulation, and draw an output from the daily gross peak availability distribution based on the daily peak load.

(e) **EEA event measurement.** The RAM will define an EEA event as the activation and utilization of contingency reserves and measure the average amount of hours that supplemental reserves and spinning reserves are dispatched over the number of iterations that are run. The RAM will begin measuring simulated firm load shed once contingency reserves are depleted. Regulating reserves will be maintained during load shed events.

(f) **Renewable profiles.** Wind and solar hourly output profiles will be developed to account for geographical diversities and technological advancements:

   i. **Wind** – the RAM maps wind resource profiles to the same weather year used for the load profiles in order to capture the correlation between load and intermittent wind generation. Wind profiles are developed by using metered output from existing wind farms and simulated for weather years for which there is no historical metered output. Correlations between aggregated wind zones are maintained.

   ii. **Solar** – the RAM maps solar resource profiles to the same weather year used for the load profiles in order to capture the correlation between load and intermittent solar generation. Solar profiles are developed by using National Renewable Energy Laboratories data and simulated for weather years for which there is no data.

(g) **Hydroelectric generation.** Hydro is modelled using historical values to develop dispatch schemes for hydro so that simulated dispatch of the hydro fleet closely mimics the actual dispatch of the fleet, taking into account the hydrological nature of a year, month, and system conditions.

(h) **Imports.** Historic available transfer capacity (ATC) data is used to develop a distribution of transmission availability to model the impact of committed and uncommitted import capability from neighboring power grids and capture the effect of transmission constraints and outages.

4.2.2 The AESO will add or subtract volumes of ICAP to identify the relationship between capacity and resource adequacy (EUE). The type and characteristics of the capacity added to the RAM will align with the characteristics of the reference technology. The AESO will identify appropriate ICAP values that meet resource adequacy requirements based on the ICAP-EUE relationship.

4.2.3 The AESO will use a formula to translate the ICAP values into fleet-wide unforced capacity values. The formula will align with the UCAP calculation approach defined in subsection 3.1.4 of Section 3, *Calculation of Unforced Capacity (UCAP)* to ensure consistency of the resource adequacy requirements from the RAM and the resource adequacy contribution of the various capacity assets. The AESO reduces the fleet-wide unforced capacity value by the pre-qualified volume of self-supply and ineligible assets, taking into account unqualified import UCAP, to determine the procurement volume for the capacity auction.
4.3 Calculation of gross-CONE & net-CONE

Reference technology

4.3.1 The AESO will select a reference technology for use in the development of the demand curve. For the transitional capacity auctions, the reference technology will be a natural gas-fired technology determined through detailed cost screening. The technologies that will be assessed in greater detail include:

(a) an aeroderivative simple-cycle gas turbine generation facility, comprised of two LM6000 turbines;

(b) a simple-cycle frame gas turbine generation facility, comprised of one F-class turbine;

(c) a combined-cycle frame gas turbine generation facility, comprised of one H-class gas turbine and one steam turbine.

Approach to gross-CONE estimate

4.3.2 The AESO will contract with an independent consultant that has Alberta-specific experience in power plant development, engineering/construction, and finance to develop appropriate cost and financing assumptions for the reference technology.

4.3.3 The independent consultant will provide the AESO with a credible gross-CONE estimate, reflecting the plant development and financing costs for the reference technology in Alberta. Plant development costs will incorporate equipment, construction labour, materials, emissions control, and related owner costs. Financing costs for the reference technology will be measured as an after-tax weighted average cost of capital (ATWACC). ATWACC will be composed of equity and debt rate components that are weighted according to a debt/equity split. The ATWACC will be used to calculate the levelized annual return on, and return of capital associated with the reference technology. The levelized annual return will be added to the annual fixed operating and maintenance costs for the reference facility to arrive at the annual gross-CONE value.

4.3.4 The AESO will update the gross-CONE study at regular intervals (i.e., every 3 to 5 years), and in the interim will follow a defined process to adjust the gross-CONE estimate annually using applicable cost indices and interest rates.

Approach to energy and ancillary services offset

4.3.5 To calculate the energy and ancillary services offset (EAS offset) that will then be used to estimate net-CONE, the AESO will use a revenue certainty methodology that is conducted in accordance with the following assumptions:

(a) the new entrant will be a stand-alone entity not within a portfolio of assets;

(b) the EAS offset will be estimated using an approach as if the new entrant will use forward power and natural gas prices to generate a forward commodity margin in the energy market;\(^2\)

(c) the EAS offset will exclude revenues from ancillary services;

(d) the new entrant will assess different forward products (i.e., baseload versus peak products) to maximize its offsets.

\(^2\) Other components of the commodity margin will include but not be limited to carbon costs, variable operations and maintenance and losses.
**Approach to net-CONE estimate**

4.3.6 The AESO will determine net-CONE by subtracting the energy and ancillary services offset from the gross-CONE:

\[
\text{net CO} = \text{gross CO} - \text{EAS Offset}
\]

4.3.7 The net-CONE will have a minimum of zero and a maximum of gross CONE. The net-CONE estimate will measure the capacity market based revenue required to ensure the reference technology will recover an annualized return on and of capital. The inflection point and the capacity price cap on the demand curve will be set in reference to net-CONE.

**4.4 Shape of the demand curve**

4.4.1 The demand curve for the Alberta capacity market will be a downward-sloping, convex curve consisting of three segments: (i) horizontal section from zero to the minimum quantity; (ii) downward-sloping section from the minimum quantity to inflection point; and (iii) downward-sloping section from inflection point to the foot, at zero price.

(a) With the convexity, the slope on the minimum-to-inflection segment of the curve will be steeper than the slope of the inflection-to-foot segment.

(b) The Y-axis points for the demand curve will be set in reference to price $/kW-year ($/kW-yr).

(c) The foot will be set at a price of zero.

(d) The X-axis points for the demand curve will be set in reference to quantity of megawatts of capacity.

(e) The foot of the demand curve will be set at a level such that the resource adequacy target is expected to be met on average, and price outcomes can be expected to average at a net-CONE level while also balancing capacity price volatility and maintaining the desired convexity of the curve.

4.4.2 The demand curve parameters continue to be evaluated by the AESO considering further information on the resource adequacy standard and outputs from the resource adequacy modelling. The proposed curve from CMD1 continues to be carried forward as the working assumption. The proposed curve is described below and illustrated in Figure 1:

(a) The minimum quantity point will be set at a value of capacity commensurate with 800 MWh (similar to the government set minimum of 0.0011% of EUE) in one year, based on the output of the RAM (peach line in figure below).

(b) The target quantity has been set at the 400 MWh of Expected Unserved Energy (orange line in figure below).

(c) The price cap will be set based on the maximum value of either a 1.75 net-CONE multiple or a 0.5 gross-CONE multiple.

(d) The inflection point is set at 0.875 x net-CONE, at a quantity 4% above the target quantity.

(e) The foot is set at 13% above the target quantity, at a price of zero.
4.5 Demand curve for rebalancing auctions

4.5.1 The rebalancing demand curve will have the same shape as the base auction demand curve and it will be based on the same net-CONE. However, the procurement volume will be updated using an updated resource adequacy assessment completed prior to the commencement of each rebalancing capacity auction.