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# Planning Forecasting Methodology Updates

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# Agenda

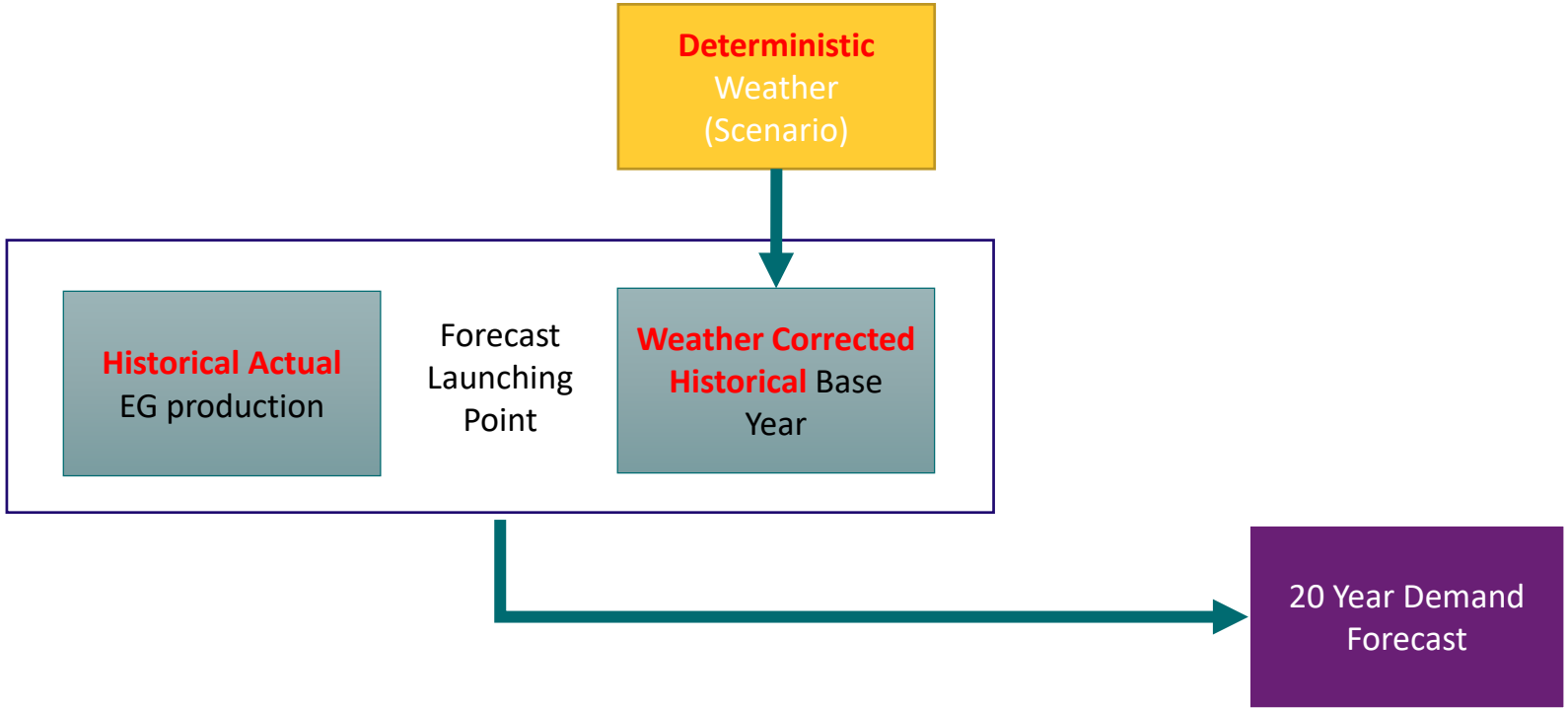
1. Executive Summary
2. Purpose
3. Background
4. Methodology Updates
5. Type of Forecast
6. Weather Methodology
7. Launching Point
8. Future work and Engagements

# Executive Summary

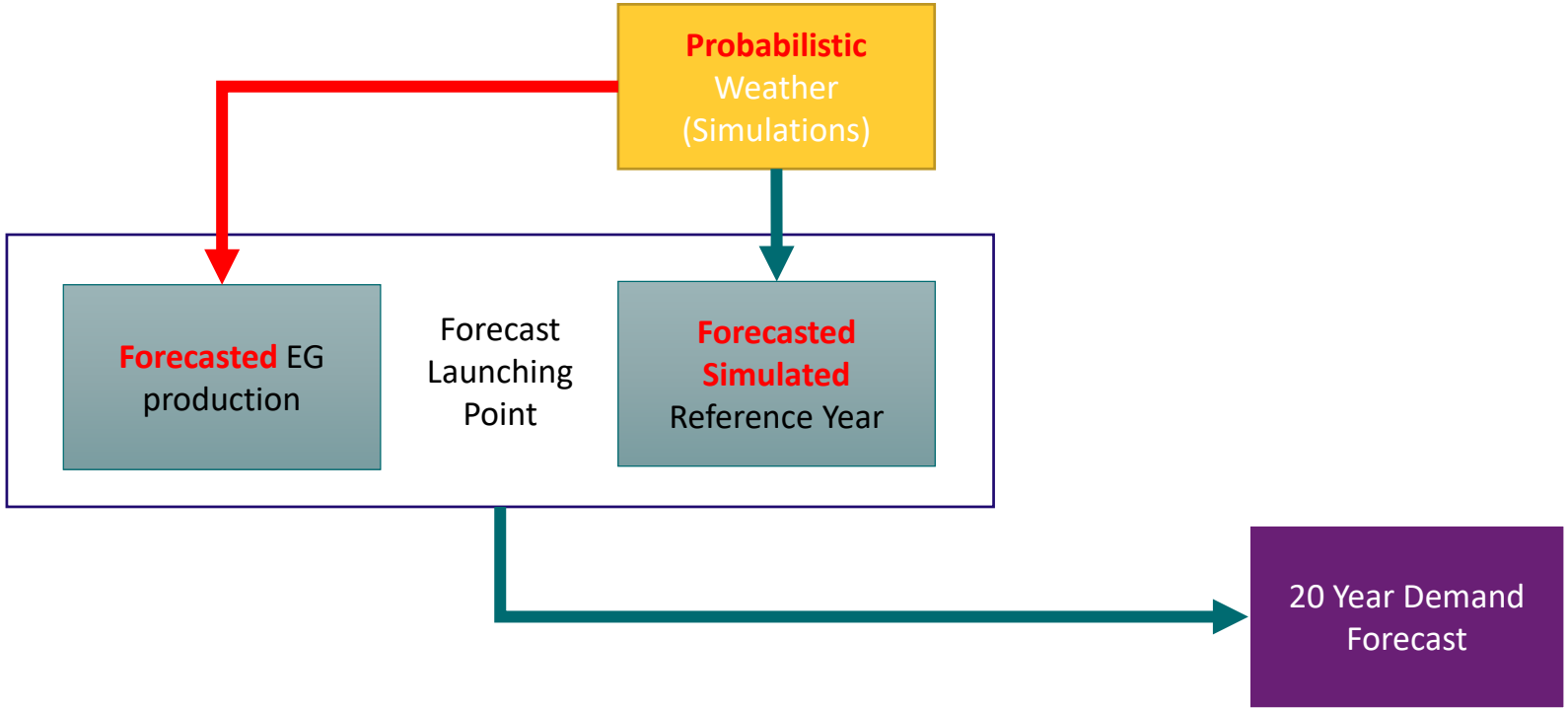
Enabled by technological innovation, new data, and to respond to a changing marketplace and market participant concerns, IESO has updated specific areas within forecasting methodology. Updates include:

- **Forecast type:** creating 20 year grid and net forecasts in IESO long-term forecasts
- **Weather methodology:** using weather simulations to forecast demand, better capturing median weather and the interplay between weather, demand and Embedded Generation (EG)
- **Launching point**: using a simulated forecasted year as the launching point for the forecast, better capturing the totality of history

# Summary Previous Methodology



# Summary New Methodology



# Purpose

- Inform market participants and other stakeholders on changes and updates to planning methodologies
- To respond to feedback on planning forecasting methodology from previous stakeholder engagements

# Background

- During the 2018 Technical Planning Conference, stakeholders had indicated certain areas for the IESO to consider updating with regards to demand forecasting
  - Expressed interest in aligning planning methodologies between planning products
  - Encouraged IESO to move towards probabilistic forecasting
- Additionally, system make-up has significantly evolved over the last decade. This includes the impact that COVID has had on electricity demands, and sectoral electricity usage.

# Background - 2

- Additional technological advancements enabled IESO to improve our modeling to better reflect the current market trends
  - **Updated data sets:** global horizontal irradiance (GHI) data and local distribution company embedded generation (LDC EG) data provides greater granularity in forecast
  - **Artificial intelligence:** technological advancements allowed for more computation and simulations

# Methodology Updates

Enabled by technological innovation, new data, and to respond to a changing marketplace and market participant concerns, the IESO has updated specific areas within our forecasting methodology

| Updates | Before | After |
|---|---|---|
| **1. Forecast Type** | Long-term forecasts only produced a net forecast | Long-term forecasts will produce net *and* grid forecast |
| **2. Weather** | a) Long-term forecasts used weather scenarios to weather correct history for the launching point<br>b) Long-term forecasts' EG independent of weather | a) Long-term forecasts will use weather simulations to develop launching point<br>b) Long-term forecasts will capture interplay between weather, demand and EG |
| **3. Launching Point** | a) Long-term forecasts launching point was a historical base year<br>b) EG in launching point were historical actuals | a) Long-term forecasts launching point will be a simulated forecasted year<br>b) EG in launching point will be a forecast |

# Impact of Changes

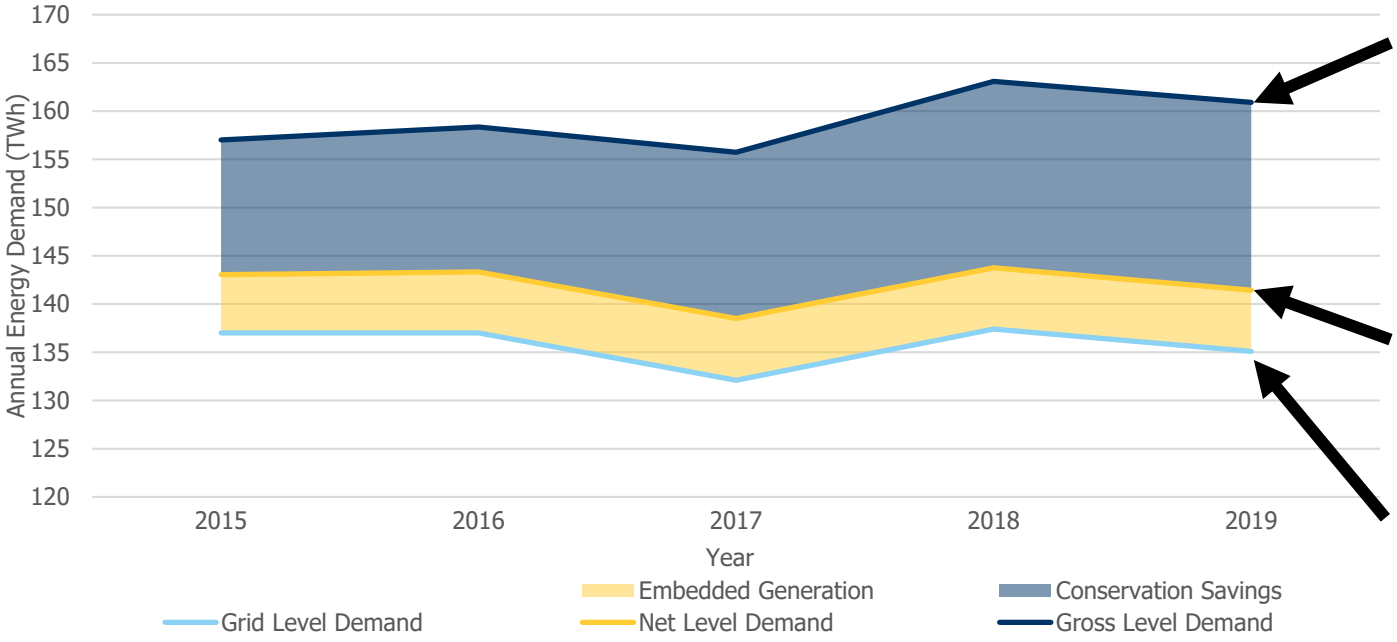
| Change | Before | After | Impact of Change |
|---|---|---|---|
| **1. Type of Forecast** | • Long-term forecast contained a net forecast | • Long-term forecasts will now also contain a grid forecast | • Grid level demand forecasts will be produced across all time horizons, which will lead to more aligned products and more consistent messaging |
| **2. Weather**<br>**a. Simulations**<br>**b. EG profiles** | a) Long-term forecasts used weather scenarios to weather correct history for the launching point<br>b) Long-term demand forecasts forecasted EG independent of weather | a) Moved from deterministic weather corrected history to weather simulations forecast<br>b) Updated embedded wind and solar models to reflect interdependencies on weather, demand, and EG | a) Considers totality of weather history. IESO can also better reflect the changing weather patterns due to climate change concerns |

# Impact of Changes - 2

| Change | Before | After | Impact of Change |
|---|---|---|---|
| **3. Launching point**<br>**a. Simulated year**<br>**b. EG forecast** | a) Long-term forecasts launching point was a historical base year<br>b) EG in launching point were historical actuals | a) The launching point of the long-term forecasts changed from a historical year to a simulated forecasted year that is calibrated to the Q1 Reliability Outlook<br>b) EG in launching point is consistent with the EG in the rest of the forecast, and also captures interplay between weather, demand, and EG | a) Reference year is more representative of totality of history, and is more aligned with the reliability outlook<br>b) Consistency between what is used in the reference year and what is forecasted for the rest of the outlook. EG is higher in base year than previous, due to shift from actuals to resource potential |

# #1: Forecast Type: Gross, Net, Grid

# #1 Type of Forecast: Gross vs Net vs Grid




**Gross:** Ontario Demand: inclusive of Natural Conservation; excludes impacts from: Load Modifiers, Demand Measures, and Embedded Generation;

**Net:** represents Gross Demand plus the energy and capacity impacts from Load Modifiers;

**Grid:** represents Net Demand plus the energy and capacity impacts from Embedded Generation.

# 20 year Grid Forecast

- **Before:**
  - Reliability Outlook (RO) was 0-18 months, updated quarterly, and at the grid level
  - Long-term forecasts were 0-20 years, updated annually, and at the net level
- **After:**
  - Long-term forecast will now also contain a grid forecast, which will match the socio-economic assumptions of the RO

- **Impact**: Provides a more consistent approach across all time horizons, which will lead to more aligned products and more consistent messaging

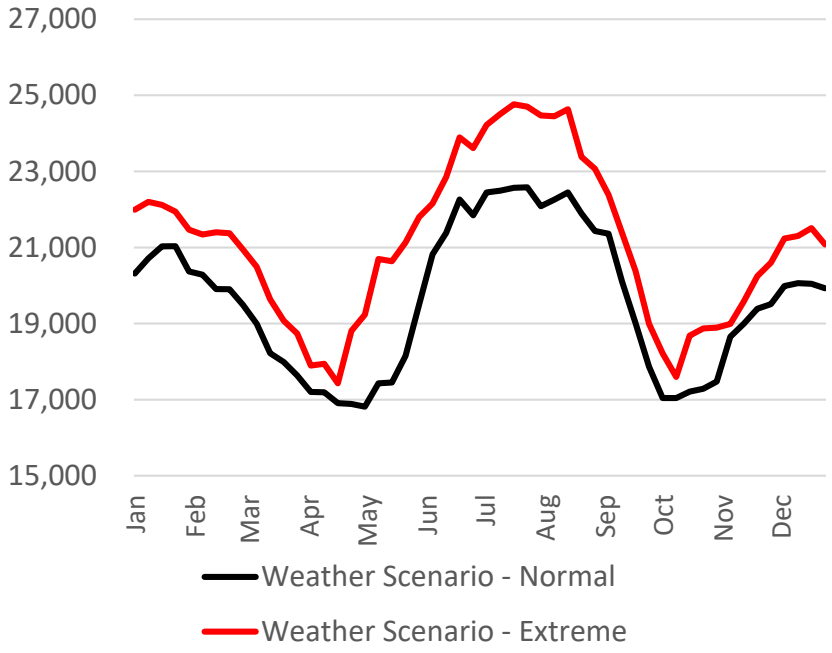
# #2 Weather Methodology

# #2 Weather Methodology: a) Simulations

- **Before:**
  - Reference year was built on a deterministic model, to arrive at weather history corrected weather **normalized demand**
- **Now:**
  - Updated weather methodology is probabilistic, based on weather simulations
  - Updated weather history includes recent years of weather history
- **Impact:**
  - IESO can better reflect the changing weather patterns due to climate change concerns, and account for the impact it has on demand
  - Builds the foundation to allow for scenarios using a probabilistic lens

# Weather Scenarios

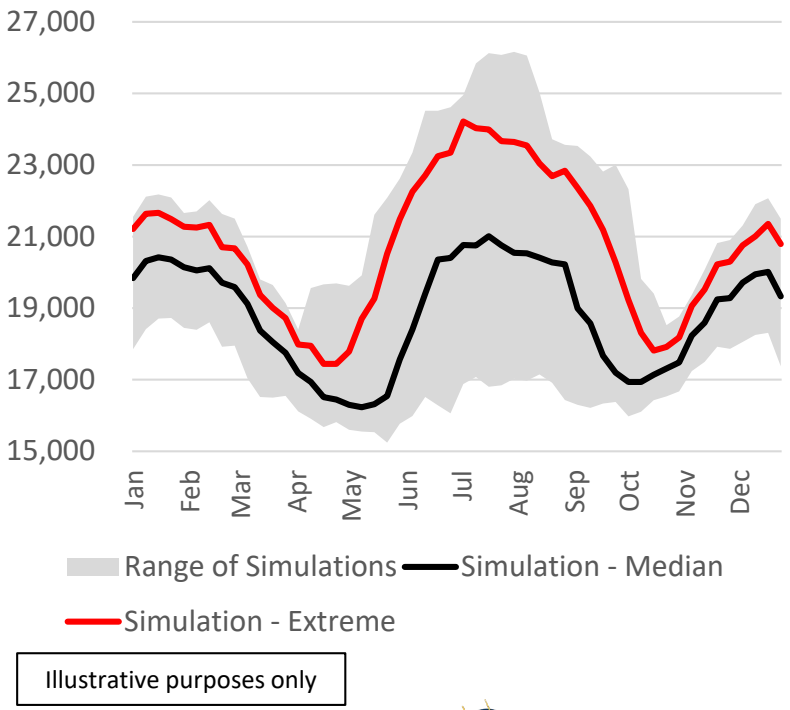
- Deterministic approach to weather
- Normal and Extreme weather determined a priori. Those two weather scenarios are then passed through the demand models
- Weather scenarios determined based on system peak and then mapped to the calendar
  - Did not adequately capture the interplay between weather, demand and embedded generation
  - Not designed for energy modelling, minimum or zonal demands




Illustrative purposes only

# Weather Simulations

- Probabilistic approach to weather
- Historical weather is passed through demand and embedded generation models to produce a range of simulated system, zonal and embedded generation output
  - Normal and Extreme are selected from the resulting output
  - Dataset is applicable for energy modelling, minimums and zonal analysis
  - Flexibility in inputs and outputs




Illustrative purposes only

# #2 Weather Methodology b) Updated EG profiles

- **Before:**
  - Wind and solar were not modeled with same weather as demand
- **After:**
  - Embedded wind and solar reflect interdependencies on weather, demand, and EG
  - Updated profiles to reflect actuals from recent history

- **Impact:**
  - Consistency between the weather used for demand and the weather underlying the wind and solar profiles
  - Reflect production data which is fleet specific, as opposed to general standards

# #2 Weather Methodology b) Updated EG profiles - 2

| Fuel Type | Old EG profiles | New EG profiles | Impact |
|---|---|---|---|
| **Solar** | Not tied to demand, forecasted based on profiles from consultant | Tied to demand, forecasted based on historical actuals and weather profile that feeds into demand profile | Consistency between the weather used for demand and the weather underlying the wind and solar profiles<br>Reflect production data which is fleet specific, as opposed to general standards |
| **Wind** | Not tied to demand, forecasted based on profiles from consultant | Tied to demand, forecasted based on historical actuals and weather profile that feeds into demand profile | |
| **Hydro** | Forecasted based on available historical production data | Profiles updated to reflect historical actuals, on a zonal, hourly basis | |
| **Bio** | Forecasted with non-embedded Bio plants, with limits on annual energy | Profiles updated to reflect historical actuals, on a zonal, hourly basis | |
| **CHP*** | Forecasted based on hours of operation and dispatch algorithm | Forecasted based on hours of operation and dispatch algorithm | |

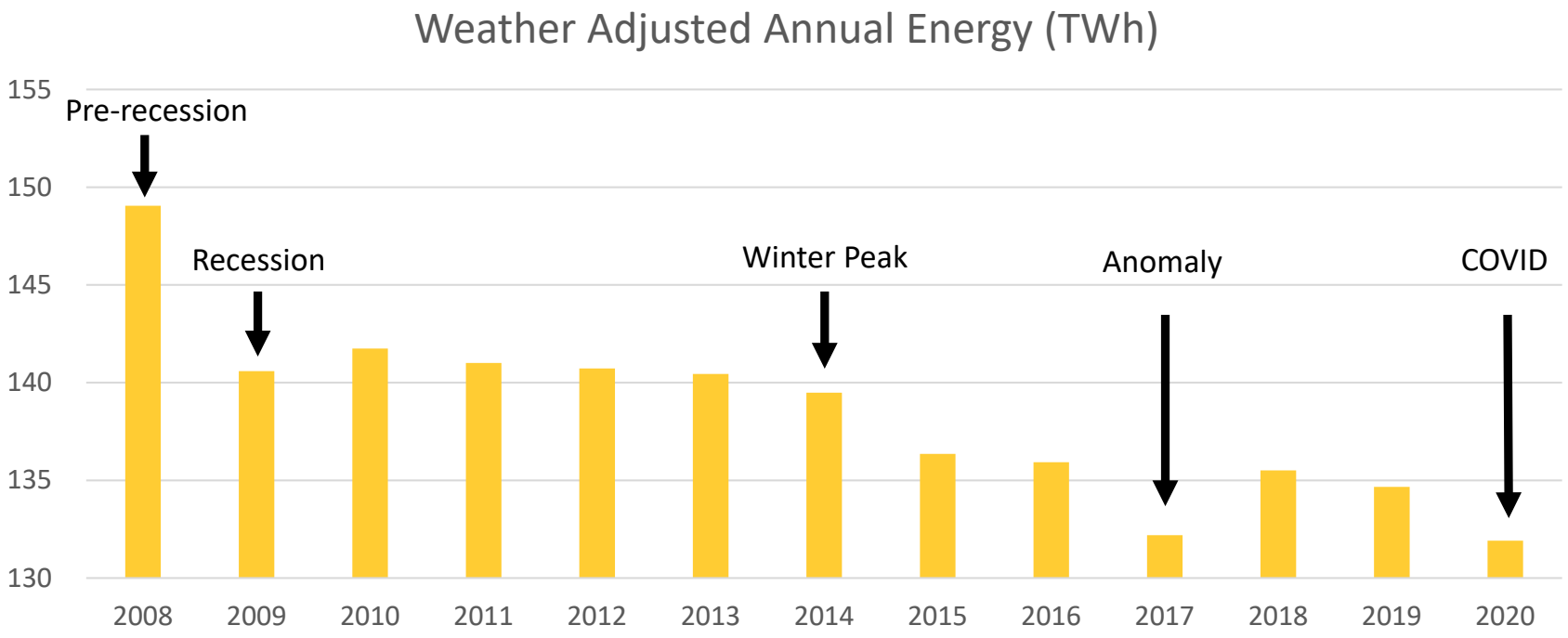
*The methodology for CHP has not changed, thus the output should remain the same. However, output may vary over the timeframe due to dispatch algorithm

# What is the difference?

| Weather Scenarios | Weather Simulations |
|---|---|
| Analyze historical weather data for the past 31 years and select the weather that generates Normal and Extreme system peak demands | Run 31 years of historical data through the demand and embedded generation models |
| Map the normal and extreme weather to a calendar to create the Normal and Extreme Weather Scenarios | Shift the weather data by a day and repeat (do this +/- 7 days). This results in 465 simulated demand forecasts (31 x 15) |
| Generate a demand forecast based on the two Weather Scenarios | From the resulting dataset, select the values that suit the analytical requirements |
| Results in two specific hourly demand scenarios based on the impact on system peak | Results in a rich dataset of hourly system demand, zonal demand and embedded generation output |

# #3 Launching Point

# Historical Base Year



# #3 Launching Point: a) Simulated Year

- **Before:**
  - Launching point of long-term forecast was a weather corrected historical base year
- **After:**
  - Launching point of long-term forecasts is a simulated forecasted reference year
  - Output from RO forecast underpins IESO long-term forecasts reference year
- **Impact:** launching point more representative of totality of history, and is more consistent with the reliability outlook

| Historical Base Year | Forecasted reference Year |
|---|---|
| Weather corrected actual demand | 12 median peak and energy monthly forecasts from the weather simulations "stitched" together |
| Tied to historical demand profile for the base year (e.g. 2020) | Demand profile is representative of totality of history |
| Embedded generation is historical actuals | Embedded generation is a forecast |

# #3 Launching Point: b) EG Methodology

- **Before:**
  - Launching point was a historical base year, and thus used historical EG values
  - Launching point and forecast had different EG values
- **After:**
  - Launching point is a reference year, and uses an EG forecast
  - Reference year and rest of forecast time period use consistent EG values

- **Impact:**
  - Consistency between what is used in the reference year and what is forecasted for the rest of the outlook.
  - EG is higher in launching point than before, due to shift from actuals to resource potential

# #3 Launching Point: b) EG Methodology - 2

| Fuel | Long-term forecast base year | New Long-term forecast reference year | Impact |
|---|---|---|---|
| **Solar** | Historical actuals reported by contract/fuel type | Tied to demand, forecasted based on historical actuals and weather profile that feeds into demand profile | Consistency between what is used in the reference year and the forecast for the rest of the outlook. EG is higher in launching point than before[1], due to shift from actuals to resource potential |
| **Wind** | Historical actuals reported by contract/fuel type | Tied to demand, forecasted based on historical actuals and weather profile that feeds into demand profile | |
| **Hydro** | Historical actuals reported by contract/fuel type | Forecasted profiles updated to reflect historical actuals, on a zonal, hourly basis | |
| **Bio** | Historical actuals reported by contract/fuel type | Forecasted profiles updated to reflect historical actuals, on a zonal, hourly basis | |
| **CHP** | Historical actuals based on settlement data not captured in contracts | Forecasted based on hours of operation and dispatch algorithm | |

[1] Some non-contracted units are not captured in the historical actuals by fuel type, but are captured in the forecast

# Future Work/Flexibility

- This weather simulation, demand and embedded generation methodology update work is setting the foundation to enable IESO to perform additional analysis and modelling in the future:
  - Study impacts of changes in weather patterns and climate on electricity demand
  - Simulate electricity demand based on unprecedented weather events
  - Enhance demand scenario development related to climate change trends

# Upcoming Planning Engagements

- The 2021 Annual Planning Outlook, incorporating the revised forecasting methodology, will be presented at an upcoming IESO stakeholder engagement days
- IESO will seek feedback from stakeholders on the revised forecasting methodology at that time

# Thank You

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