Changes in the WECC from Increased Renewable Generation

ETAC

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Electricity markets have changed significantly in the West due to increased penetration of renewable resources, namely solar and wind.

The Production Tax Credit ("PTC") of approximately $24 per MWh instituted by the U.S. government as well as Renewable Portfolio Standards ("RPS") enacted by states have been driving forces in bringing about this change.
Western electricity markets have traditionally been broken into two distinct periods: on-peak (also referred to as heavy load or 6x16) and off-peak (light load or 6x8,1x24).

On-peak hours are 7:00 am to 10:00 pm (Pacific Time) Monday through Saturday. Off-peak periods are 10:00 pm to 6:00 am Monday through Saturday and all day Sunday.

Historically, large baseload plants fueled by coal and natural gas as well as hydroelectric dams would operate during on-peak hours when loads were high, and a portion of them would go offline when loads were low.

Today, intermittent renewable resources like solar and wind have changed that operating pattern.
Energy and policy initiatives, especially in California, are causing changes in traditional grid operations and markets

California
- RPS currently 25%, 33% by 2020, 50% by 2030
- Goal of greenhouse gas emissions to 1990 levels
- Existing power plants that use coastal waters for cooling must either repower, retrofit, or retire over the next 8 years
- Executive order for 1.5 million zero emission vehicles by 2025

RPS Standards are Increasing
- Oregon 25% by 2025, 50% by 2040
- Washington currently 9%, 15% by 2020
- Nevada 25% by 2025
- Montana currently at 15%

Resources, Needs, and Markets are Evolving
- Traditional on-peak and off-peak markets are breaking down
- The need for flexible resources has increased dramatically
• Traditional summer “super peak” hours are now becoming net “low load” hours due to increased penetration of solar PV

• Short, steep ramps, both increasing and decreasing, are becoming much more pronounced and they require dispatchable resources to move with changes to net load

• Oversupply risk is real. Much of the solar and wind resources (rooftop solar) do not have ramp-down capabilities

• Renewable generation displaces thermal generation which in turn decreases frequency response which in turn reduces grid reliability

• The need for fast-acting, flexible resources is without question
To highlight this new development the California ISO ("CAISO") developed a graphical representation commonly referred to as the "Duck Chart"

The Duck Chart shows, among other things, the potential for “over-generation” occurring at increased penetration of solar photovoltaics (PV)

The “Duck Chart” shows the potential for PV to provide more energy than can be used by the system, especially considering the host of technical and institutional constraints on power system operation

During over-generation conditions, the supply of power could exceed demand, and without intervention, generators and certain motors connected to the grid would increase rotational speed, which can cause damage

The Duck Chart highlights the need for flexible resources that can be dispatched quickly and reliably to support changes to net load
Managing Frequency through Reliability Based Control

Balancing Authority ACE Limit RADAR

Current
Last 5 mins
Last 6-15 mins
Last 16-30 mins

BAAL shall not be exceeded for more than 30 consecutive clock-minutes

ACE
-10.7

BAAL
-128

Distance from Limit
117

Frequency
59.9986

Current Event Duration:
0

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CAISO Net Load January 11
• During a typical day in January the first ramp in an upward direction (duck’s tail or secondary ramp) occurs in the morning starting around 4:00 a.m. as people get up and go about their daily routine.

• The second ramp, in a downward direction, occurs after the sun comes up around 7:00 a.m. when on-line conventional generation (coal and natural gas fired resources) is replaced by supply from solar, producing the belly of the duck.

• As the sun starts setting around 4:00 p.m., and solar generation ends, the CAISO must dispatch resources that can meet the third and most significant daily ramp (the arch of the duck’s neck or primary ramp).

• Finally, as demand decreases into the evening hours, the generation that was brought on-line for the duck’s neck must be reduced or shut down to meet the final downward ramp.
Net load - March 31

- Overgeneration risk
- Ramp need: ~13,000 MW in three hours
CAISO Market Prices Reflect Supply and Demand

Prices increase at dusk due to ramping

Solar reduces peak prices

Hour

$/MWh

2012

2016

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Changes in California are Being Felt in Montana

Below are Powerdex hourly prices for Mid C which closely approximate hourly prices in Montana.
Powerdex Hourly Prices
Options Being Weighed by CAISO

- Increase demand by expanding the ISO control area beyond California to other states so that low cost surplus energy can serve consumers over a large geographical area.

- Increase participation in the western Energy Imbalance Market in which real-time energy is made available in western states.

- Help transition cars and trucks to electricity.

- Offer consumers time-of-use rates that promote using electricity during the day when there is plentiful solar energy and the potential for oversupply is higher.

- Increase energy storage.

- Increase the flexibility of power plants to more quickly follow ISO instructions to change its generation output levels.
CAISO’s Need for Flexible Resource Capabilities

- CAISO states:
  “To reliably operate in these conditions, the ISO requires flexible resources defined by their operating capabilities. These characteristics include the ability to perform the following functions:”

  - sustain upward or downward ramp
  - respond for a defined period of time
  - change ramp directions quickly
  - store energy or modify use
  - react quickly and meet expected operating levels
  - start with short notice from a zero or low operating level
  - start and stop multiple times per day
  - accurately forecast operating capability
CAISO states:

“To reliably manage the green grid, the ISO needs flexible resources with the right operational characteristics in the right location. The ISO is actively engaged in policy efforts to build awareness of the new grid needs. Working with the industry and policymakers, the ISO is collaborating on rules and new market mechanisms that support and encourage the development of flexible resources to ensure a reliable future grid.”
Discussion