Integration of Renewable Resources in California and Beyond

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Changing landscape of distributed energy resources

New Technologies

- Storage
- EVs

New Players

- High Tech
- Innovative
- Sophisticated

Multiple paths for delivery

- Interconnection
  - •Transmission
  - •Distribution
- Behind the Meter (BTM)

Significantly different timelines to bring to market

- Utility rules and processes for connecting to distribution system (lengthy)
- Behind the Meter (short)

Multiple Operational Configurations

- Maximized output (solar/wind)
- Dispatchable/Controllable
  - •DR
  - •Storage
  - •Small generator
- Demand Charge Management

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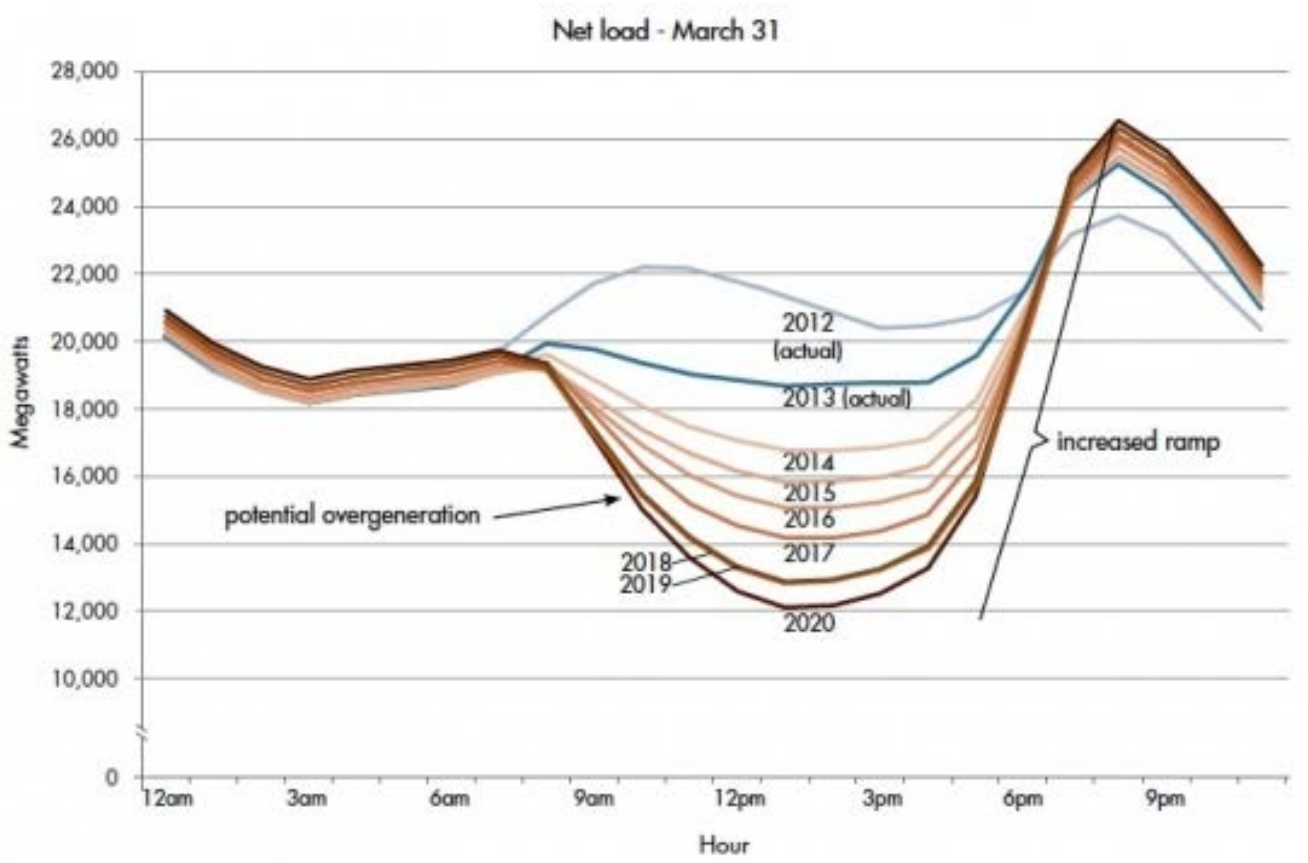
Solar output drops as load rises in the late afternoon



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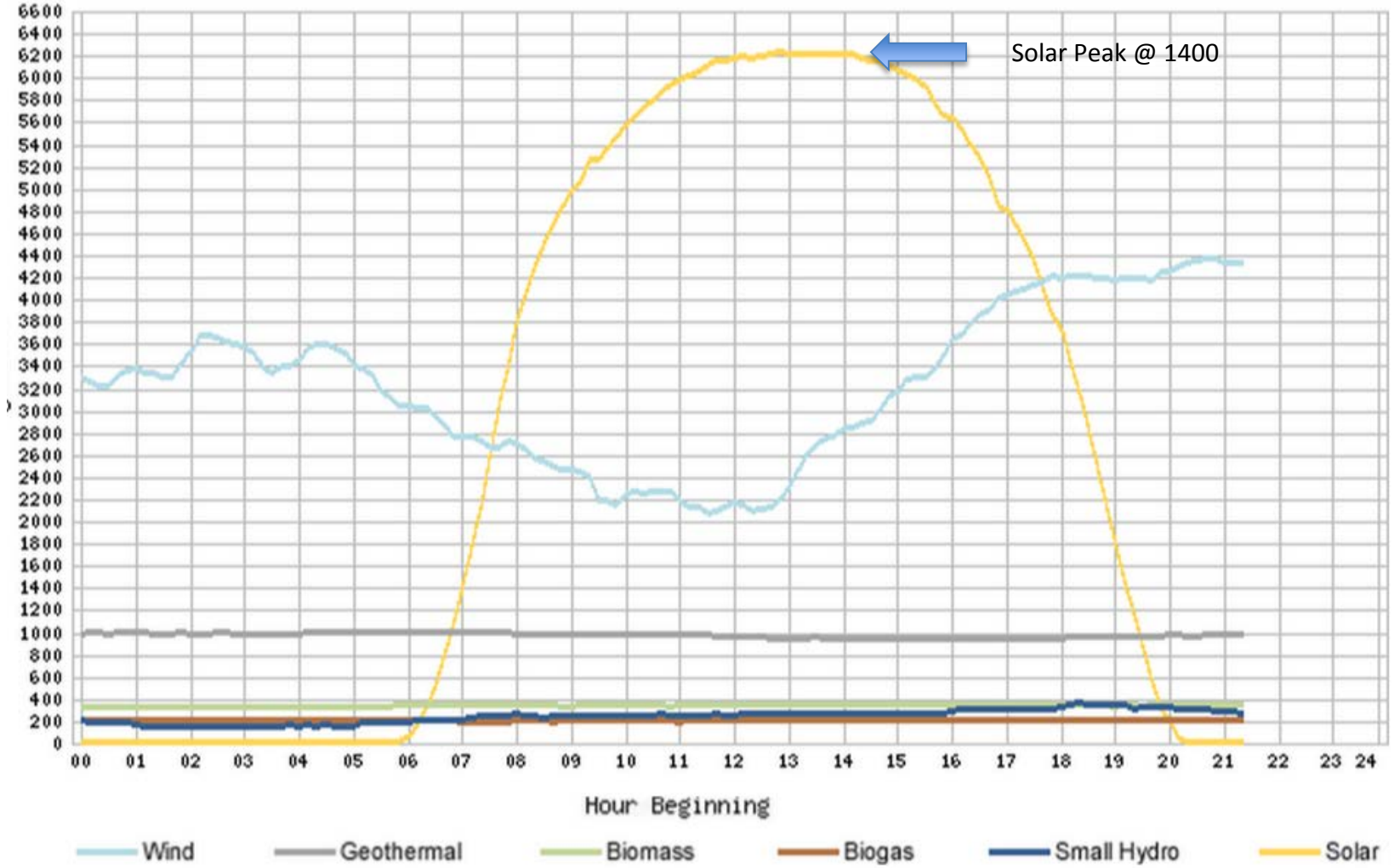
Solar and Wind Variability…



Data from CAISO Website 6/22/2015

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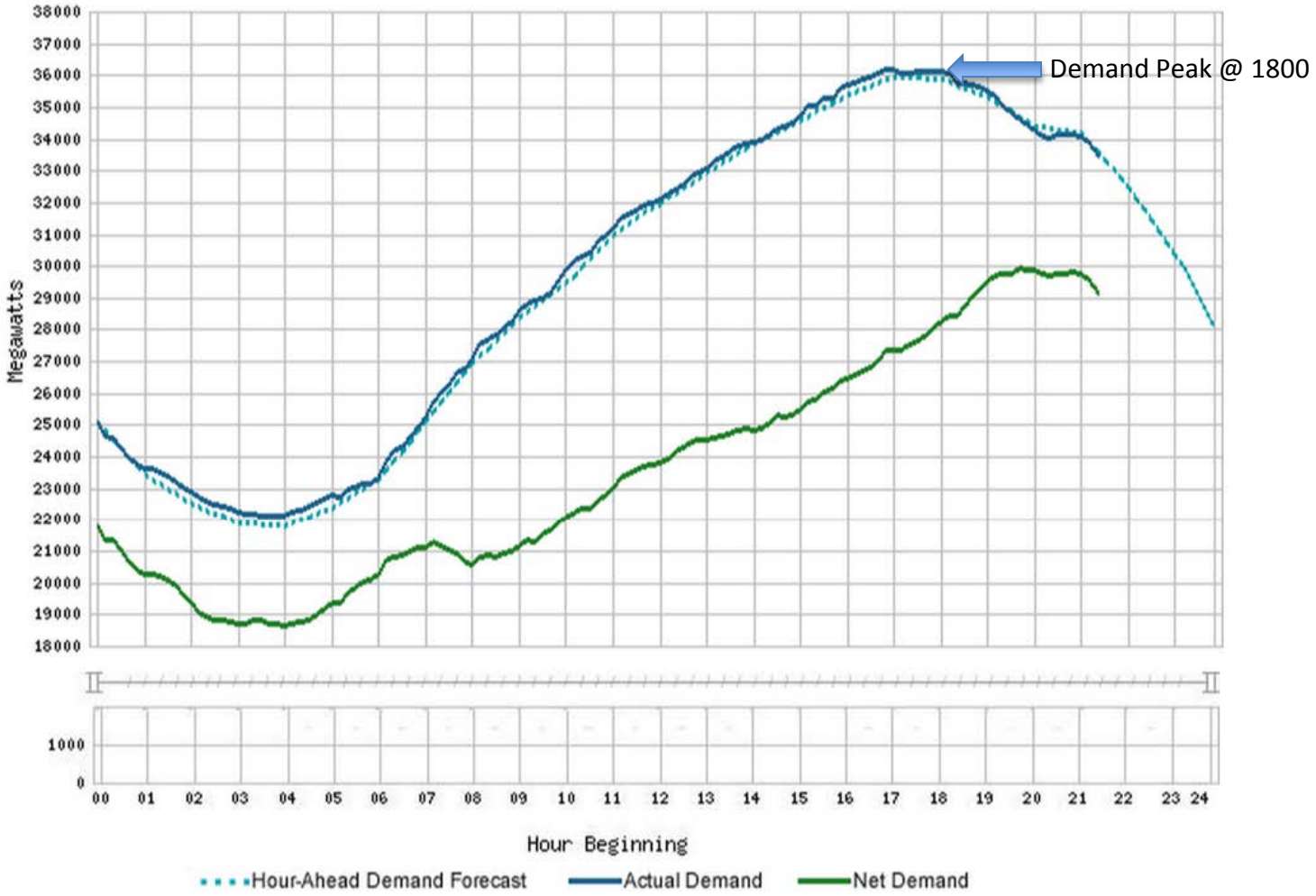
…Impact “Net Demand”



Data from CAISO Website 6/22/2015

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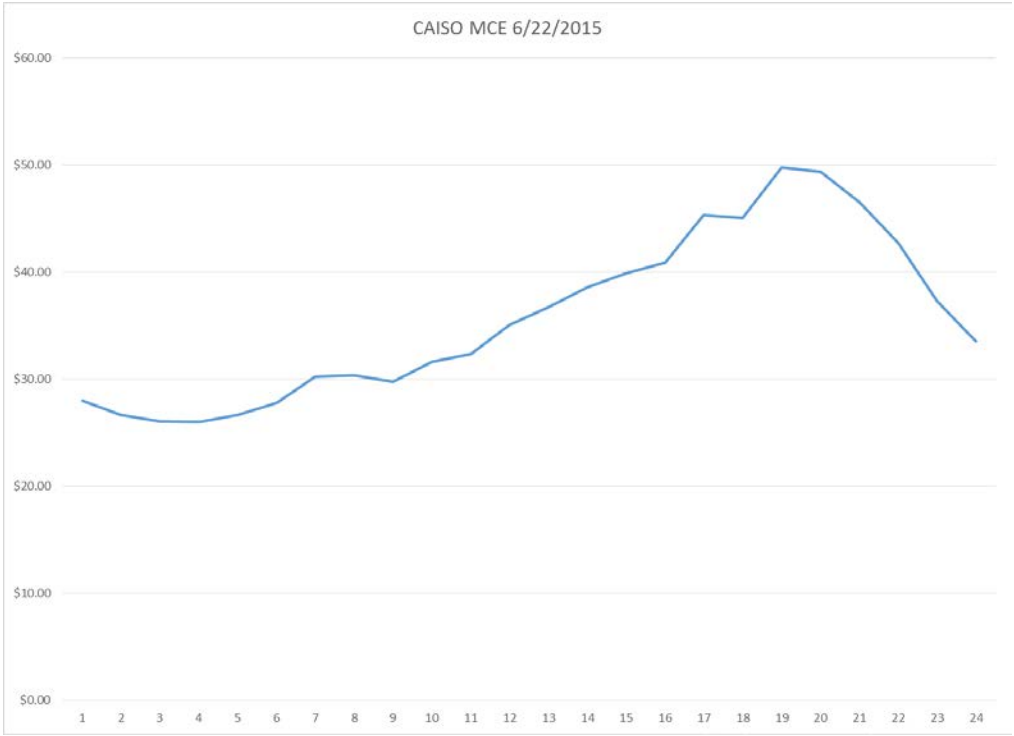
Price Curve Follows Closely



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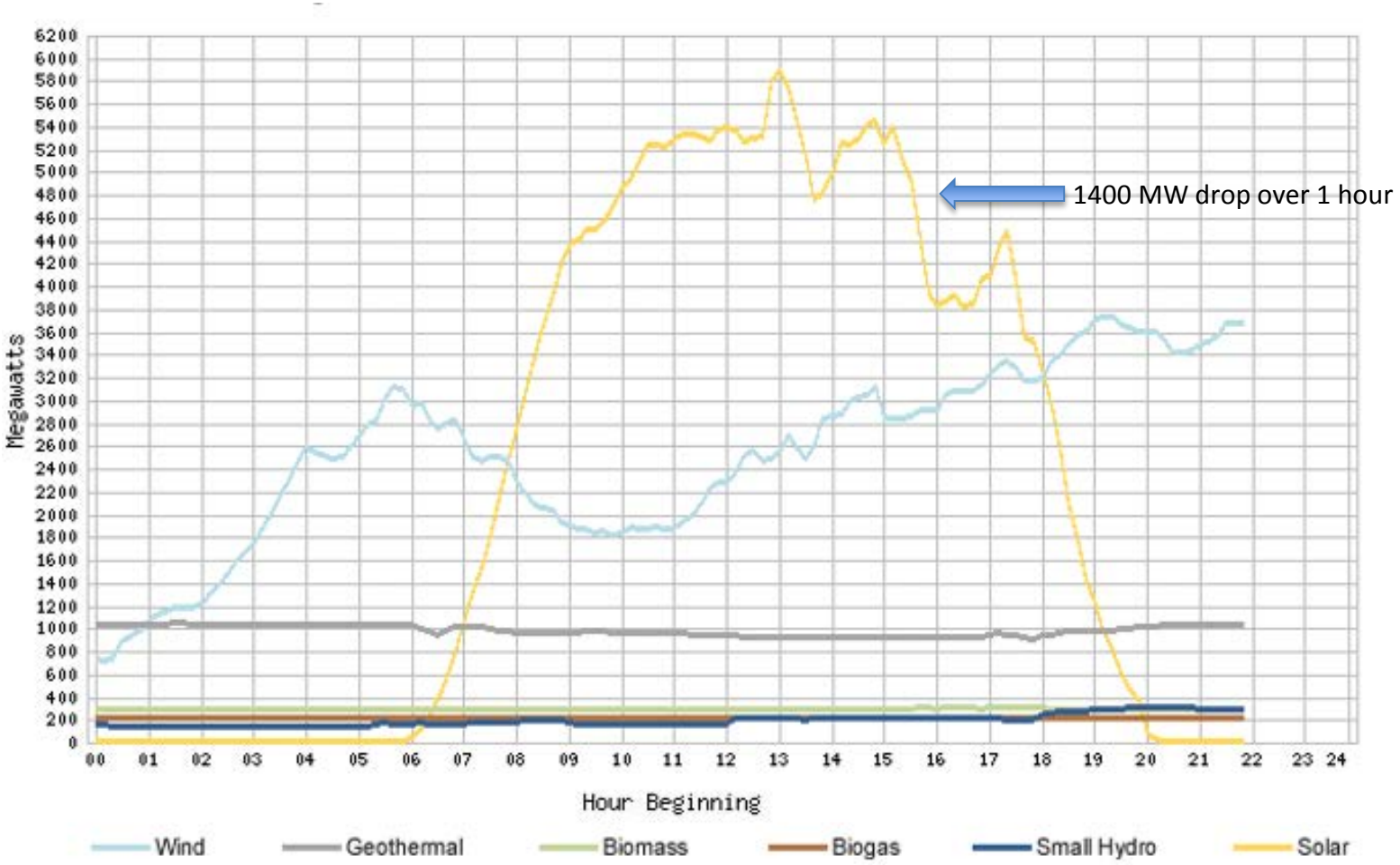
Intermittency Creates a Different Need



Data from CAISO Website 6/16/2015

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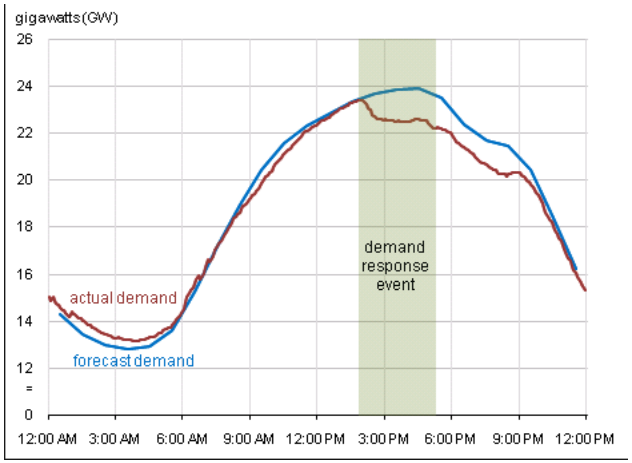
Traditional Demand Response 1.0



Reduce peak load

Alleviate distribution system constraint

Mitigate grid emergencies

Signaled by utility

Payments made based on load reduction

Seen as a replacement for generation

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Demand response 2.0 for integration of renewables

Requires resources that must respond faster and more frequently than usually called for in the context of utility-administered peak load shaving demand response programs.

Projected Demand Response Notification Timescales				
	Day-ahead	**Day-of**	**Auto-DR**	**Direct Load Control**
Time between signal & response	20-26 Hours	3-5 Hours	-15 min.	0-5 min.
Duration	1-4 hours	1-4 hours	20 min – 2 hours	5-60 min
Frequency	Often less than 100 hours / season	Often less than 100 hours / season	Depends on end-use	Often less than 100 hours / season

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Characteristics of Program Classes

Day ahead/Day of Programs

- Geared towards large C&I customers
- Participants are paid capacity and energy payments
- Many programs entail limits on the number of dispatches per season (i.e., 100)
- Advance notification requirements and dispatch limitations relegate applicability of these programs to addressing the duck curve

Auto Demand Response

- Automates response to event signal, decreasing latency + increasing likelihood of response
- Much potential to aid in flexibility on a variety of time scales
- More sophisticated technology may bring higher costs
- Auto-DR is currently providing a variety of grid and ancillary services in PJM, MISO and other ISOs/RTOs around the country
- Auto DR, even though it may not meet all flexibility needs, should be utilized insofar as it is cost-effective compared to other solutions such as batteries

Residential Direct Load Control (DLC)

- DLC programs install simple controls on devices such as air-conditioning units or electric water heaters
- Program or system operators can directly control, and dial down to reduce load
- These programs have much demonstrated potential to aid in renewable integration, although they must be carefully structured to unlock it

Program Examples

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Pacific Gas and Electric Company – IRM2

PG&E pilot directly participating in CASIO wholesale market

Operated by Olivine

- Platform Services
- Demand Response Provider
- Scheduling Coordinator

Capacity and Energy

- Program capacity payment and market revenue from energy
- Must offer obligation
- Floor and ceiling for energy bids

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IRM2 Participants

Large Industrials

Manufacturing plant with stationary battery storage

Gas storage

Hotel chain

3P aggregation

Stationary batteries and HVAC

High Tech Campus

Direct participation

EV charging and HVAC

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IRM2 resource configuration and operations

CAISO Proxy Demand Resource (PDR)

- 100kW Minimum
- Performance measured with 10 in 10 baseline
- Day Ahead and RT Energy
- AS –Requires telemetry and 500kW

Resource Aggregations

- Same Sub-LAP
- Same LSE
- Single event notification

2014 Day Ahead energy only

Multiple days cleared by energy market

- Wholesale price dictated events rather than peak forecast
- Typically single or dual hour

Timely deployment of resources when dispatched

Meter data collected, aggregated and delivered on time for CAISO and program settlement

- Utility provided raw meter data with customer permission (CISR)

New Brunswick Power – PowerShift Atlantic (2010-2014)

- Led by New Brunswick (NB) Power, Spans Canada's three Maritime Provinces
- PowerShift relied upon year-round, bi-directional load response to help integrate massive wind resources
- Virtual Power Plant (VPP) system interacts with aggregators, sending them signals to have their customers reduce or increase load accordingly
- VPP optimizes to overall net load (not wind forecasts) in order to ensure that system needs are met

Énergie NB Power

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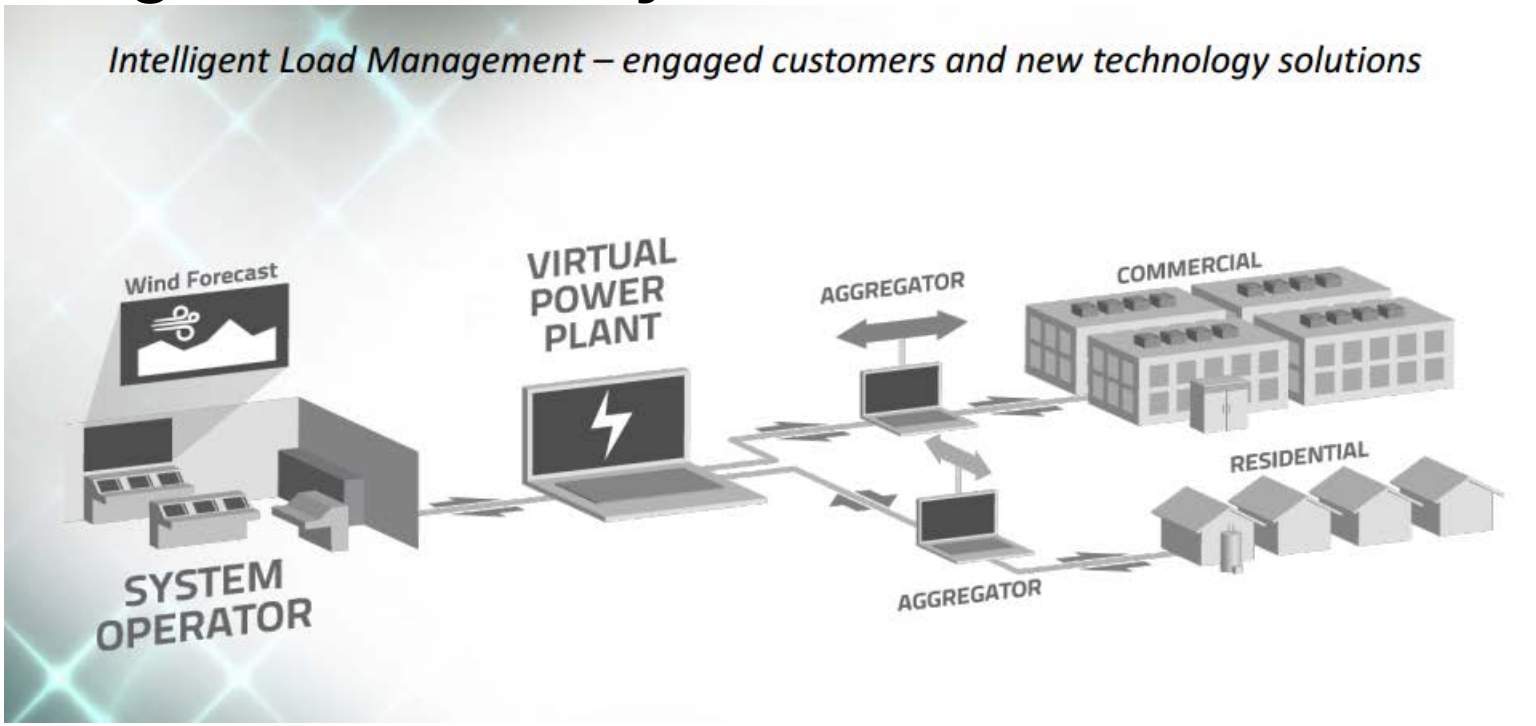
Program Hierarchy



Source: **Engaging Customers in Smart Grid Technology, NB Power** *www.powershiftatlantic.com*

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Steele-Waseca Cooperative Electric (SWCE) – Sunna Project (2015 – until subscribed)

- Based in Owatonna, Minnesota;

  15% of capacity from wind resources

- SWCE has built several community solar

  PV gardens that generate power which is fed into the distribution grid

- Members of the cooperative may subscribe to one 410 watt solar panel

  for one-time fee of $170

- SWCE's 16-Hour Water Heater Program provides willing members with

  a 85 or 105 gallon electric water heater at no additional cost in order to

- SWCE shifts this water heating load from on-peak to off-peak hours to help manage some of the variability from the wind resources

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Integrating DR + Community Solar: Lessons so far

1. Accurate forecasting is critical to DR energy targets if DR is to be effectively employed to help aid in the integration of renewable resources
2. Need for a “fleet” of fast-responding, flexible DR resources to aid in renewable integration.
3. It may be simpler for distribution utilities to create new programs given that modifications to existing programs will likely be necessary to ensure that all the criteria of flexibility are met.
4. The development of DR programs to address renewable intermittency in general need not compete with the traditional demand response programs nor erode their value of addressing seasonal peak load.

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The Presenter and the Project

Beth Reid has over 20 years of experience helping stakeholders navigate the changing landscape of energy markets in California and nationally. She is CEO of Olivine, Inc. a company working to bring distributed energy resources to the grid. Contact her at breid@olivineinc.com

The Community Solar Value Project is focused on improving community-solar program value, through solar + storage + demand-response and other strategies, at electric utilities in Sacramento and beyond. It is led by Extensible Energy, LLC, and draws on expertise from three energy consulting firms. Contact John Powers, john@extensibleenergy.com

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