CONNECTIONS SUMMIT

EVs, Storage and Microgrids - What's the Current State?

Doug Staker, Vice President of Utility Business Development, Enel X

ELECTRICITIES of NORTH CAROLINA, INC.

Enel X in USA: Flexibility Solutions and Energy Advisory

Focus on grid optimization, using flexible solutions

- Front-of-meter and Behind-the-meter
- Use technology-enabled solutions
  - Goals: (1) increase customer satisfaction
    (2) drive down energy costs

Advise on energy procurement

- Wholesale supply
- Active risk management strategies planning, & strategy implementation

Enel X Services

- Energy Storage
- Solar + Storage
- Demand Response/DM
- Electric Vehicle Charging
- Renewable Energy Advisory
- Wholesale Procurement

Enel: <u>multi-local</u> company

- ~45GW of thermal generation capacity; ~43GW renewables capacity
- Big Data: ~64,000,000 customers in 30+ utilities; ~1.3 million miles of lines
- USA: green Independent Power Producer: 2200+ MW managed installed capacity (wind; solar; hydro); ~100 projects

Source: Bloomberg New Energy Finance
Note: Prices are an average of BEV and PHEV batteries and include both cell and pack costs. Cell costs alone will be lower. Historical prices are nominal, future ones are in real 2016 U.S. dollars.

Perspective: Tremendous change, faster than you think

"The electric industry is in a period of momentous change. The innovative potential of the digital economy has not yet been accommodated within the electric distribution system.

Information technology, electronic controls, distributed generation, and energy storage are advancing faster than the ability of utilities and regulators to adopt them, or to adapt to them.

At the same time, electricity demands of the digital economy are increasingly expressed in terms of reliability, choice, value, and security."

Opening Paragraph:
ORDER ADOPTING REGULATORY POLICY FRAMEWORK AND IMPLEMENTATION PLAN
New York Public Service Commission - February 26, 2015

Trend: Electrification of Transportation is Inevitable

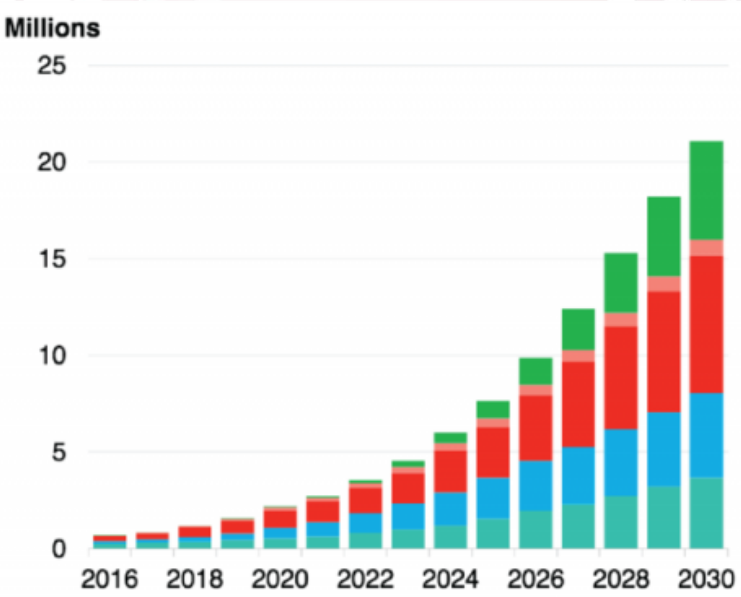
Diesel bans & ZEV mandate

- China
- USA
- Norway
- Sweden
- France
- Denmark
- Spain
- Germany
- Netherlands
- Italy (Rome)
- Canada (British Columbia)

Auto EV Investment $$$

TESLA
BMW
VOLVO
NISSAN
GM General Motors
HONDA
Volkswagen
DAIMLER
KIA

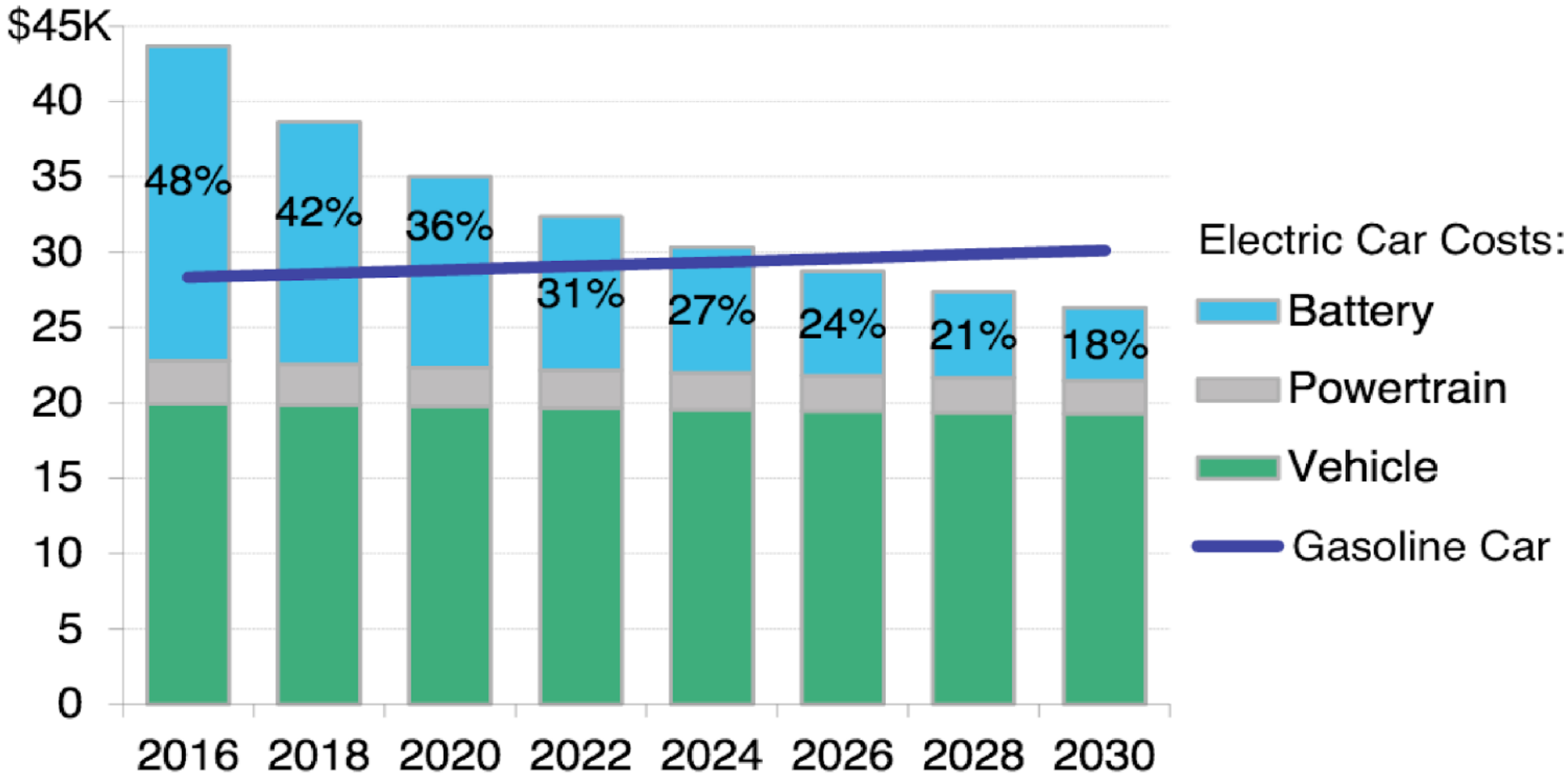
Expected Volume



BNEF forecasts more than 20 million EV sales by 2030.

Trend: Falling Li-ion Prices Drive EV Market Growth

*Falling battery prices are expected to **undercut gasoline cars by mid-2020s***



Source: Bloomberg New Energy Finance

Note: Prices are an average of BEV and PHEV batteries and include both cell and pack costs. Cell costs alone will be lower. Historical prices are nominal. Future ones are in real 2016 U.S. dollars.

Why Does e-Mobility Matters for you?

Potential to drive value across your system!

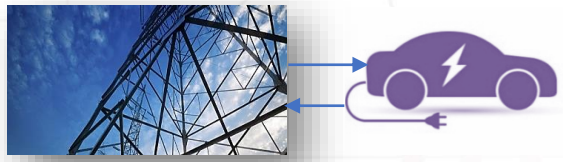
Renewable Energy Systems

RES are **irregular** and **intermittent**

e-Mobility can contribute to **stabilize the system** and **provide flexibility**

Infrastructure & Networks

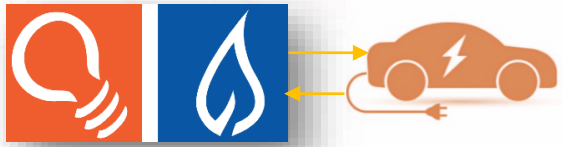
I&N are affected by **power congestion**



e-Mobility can avoid power congestion by **balancing the grid**, **sharing infrastructures** with many users connected to multiple networks and **decentralizing control and management**

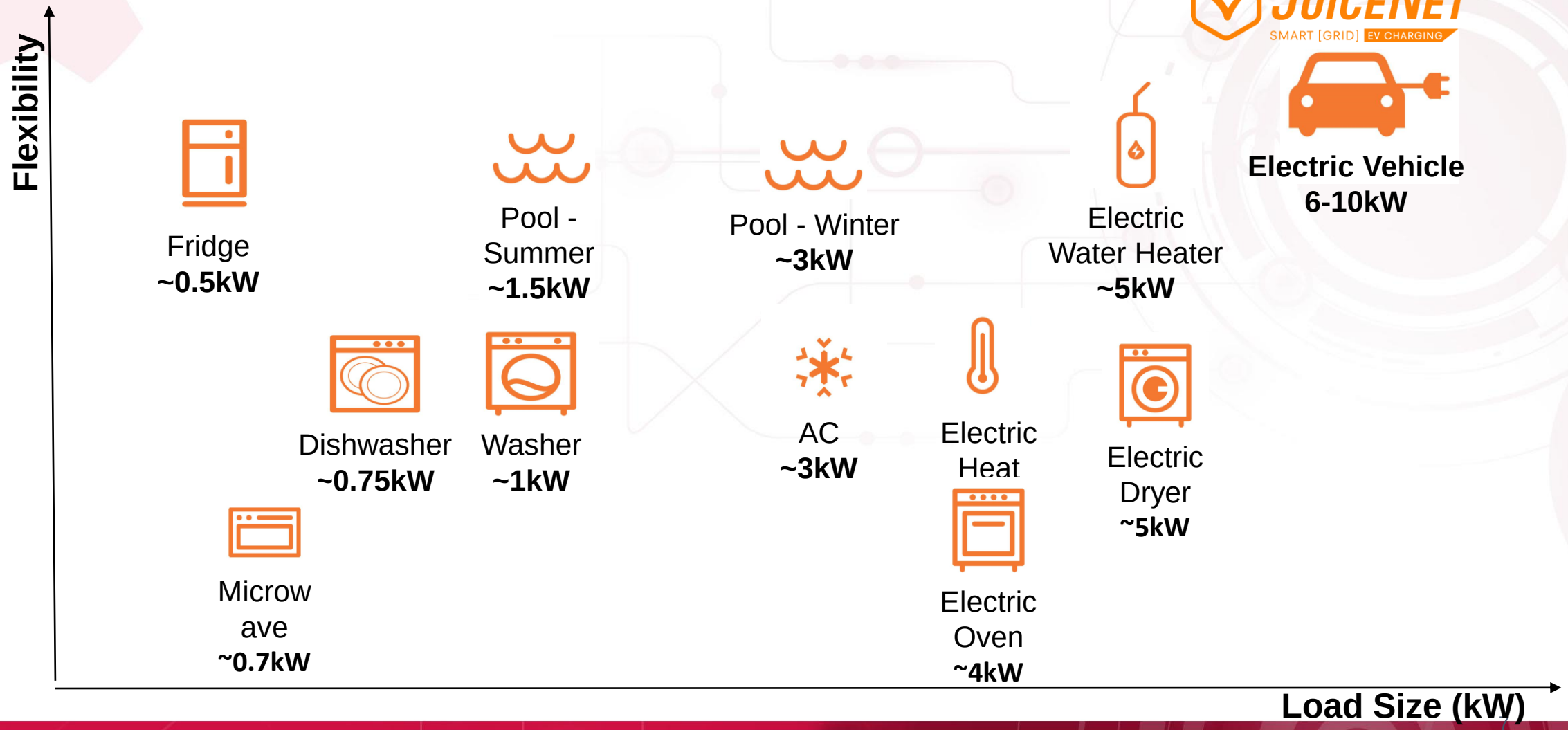
Retail

Customers are getting more power

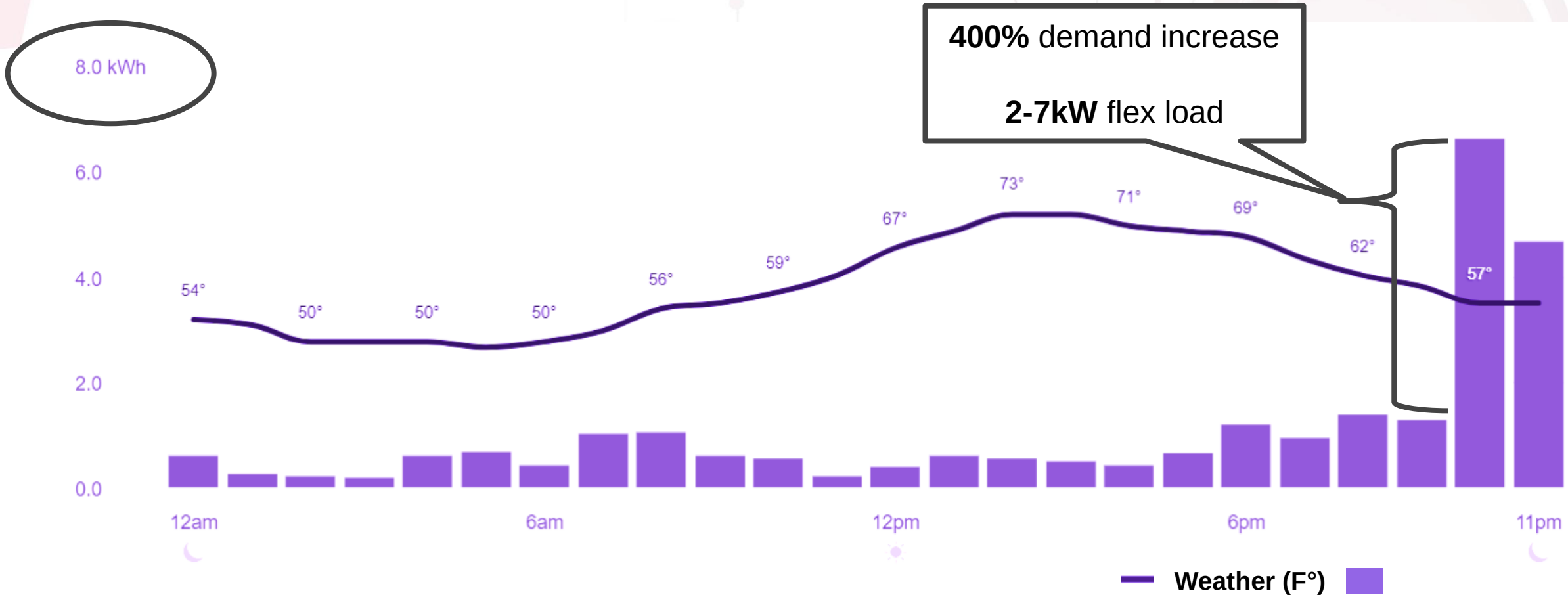


e-Mobility can drive the retail in the energy transition, **enabling the breaking of the boundaries among sectors** thanks to new **ancillary services** to the grid such as supplying energy if needed in change of remuneration.

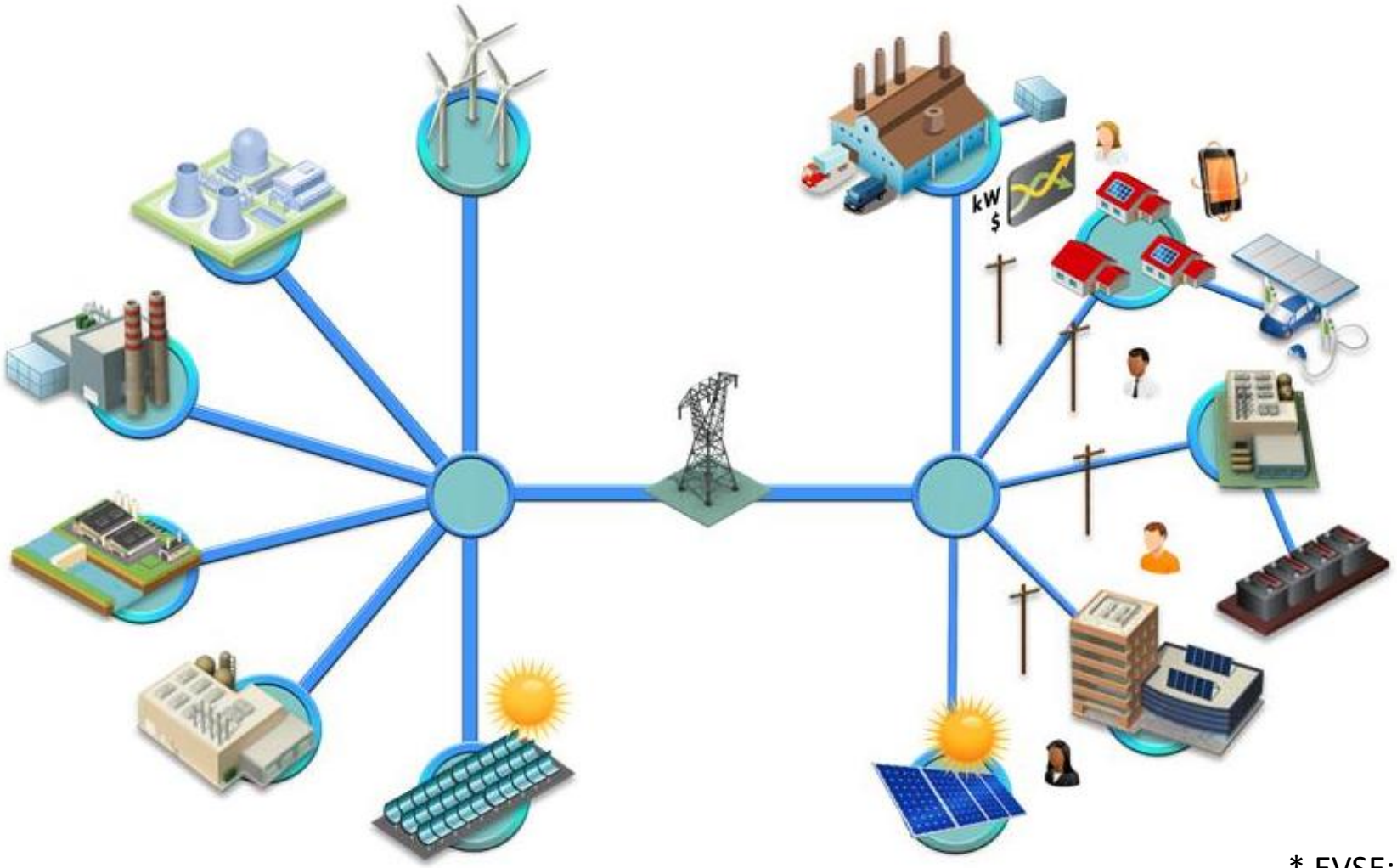
EV Charging: Large(& Growing), Highly Flexible Load



Residential Load Profile **With EV Charging**



Use Case: utility scale renewables balanced w EV platform



WHAT does a good platform do?

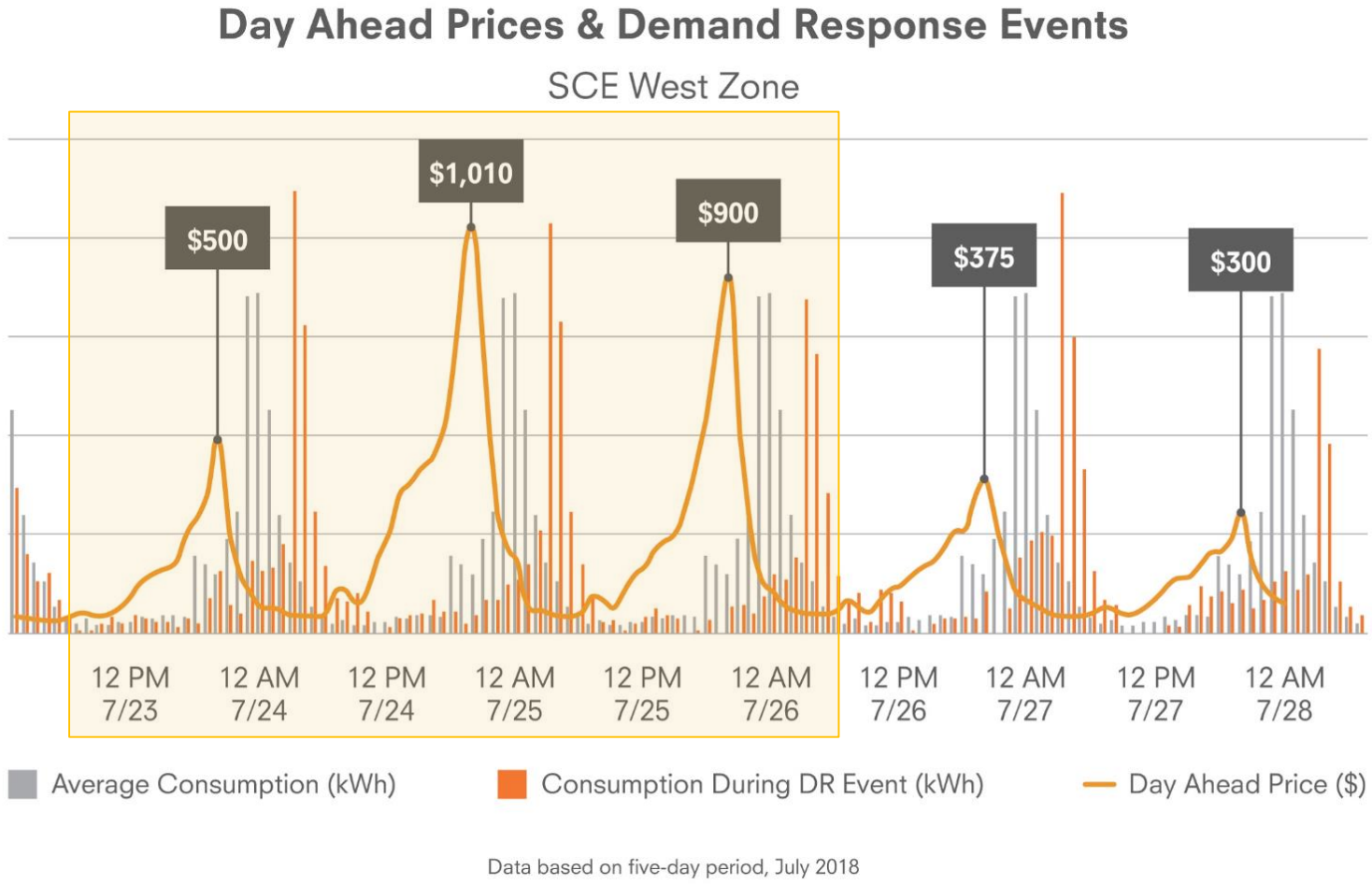
- Coordinate w/ grid to modulate EVSE* rate, optimizing against selected goal(s), like:
  - wholesale/retail costs,
  - T&D balancing
- Balance Intermittency of solar and wind

Outcomes

- Stabilize cost-of-service, by enabling "more" solar & wind capacity
- Improve grid reliability and resilience
- Avoid costs assoc. w/ peak generation

* EVSE: Electric Vehicle Supply Equipment

Real Results: A Virtual Battery In Action



3 CAISO Flex Alert Days

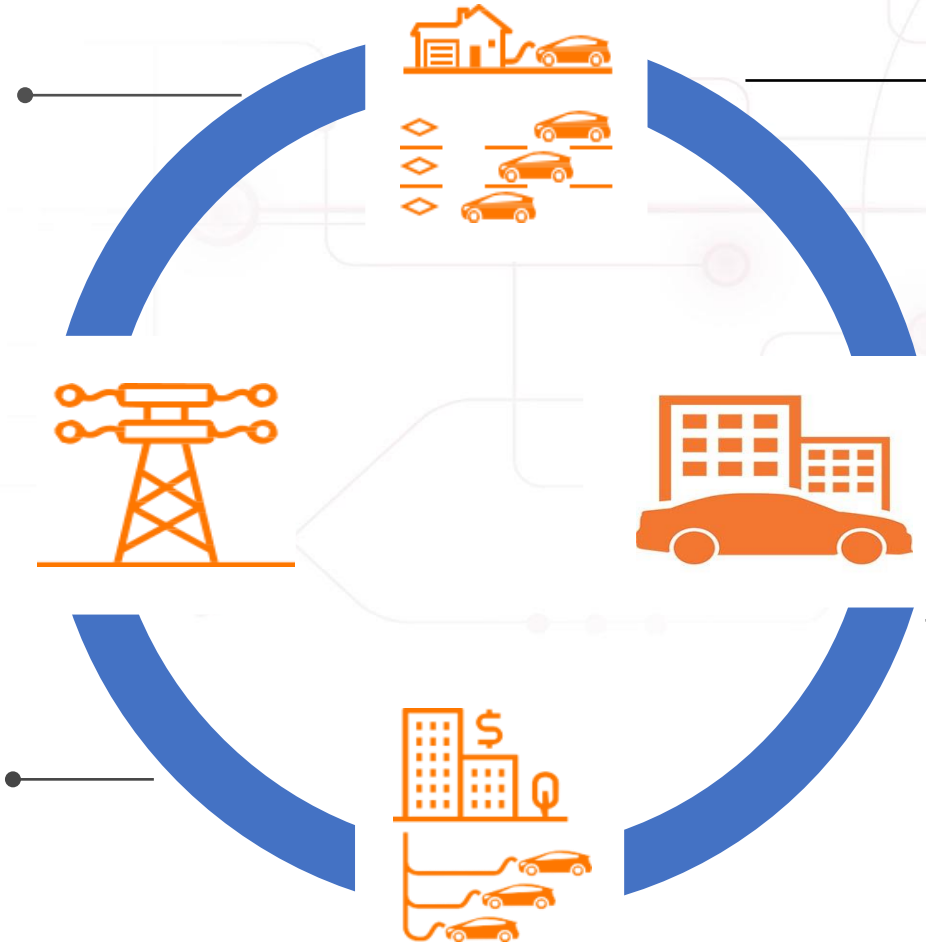
- No Maintenance Days
- Day Ahead $$$ @ Price Cap
- All eMotorWerks' CAISO Resources dispatched for multiple hours
- Dispatched EVSE network to shift demand to lowest cost intervals

Manage EV load and demand-side flexibility in real time

Grid services
Support grid reliability and decarbonization with demand-side flexibility programs, lower operational cost with market participation

Data storage & security
Collect and store up to 90 days of 15 min interval data on EVSE, leverage EVSE smart metering capabilities, and best-in-class data security

EV-smart facilities
Give employees access to smart EVSEs, manage EV load and reduce operational costs with JuiceNet Enterprise



Residential customers
Support smart EVSE adoption with rebates, increase enrollment and participation in TOU and DR programs with targeted incentives, control and dispatch EV loads in real time

C&I customer
Support smart EVSE adoption with rebates, increase enrollment and participation in TOU and DR programs with targeted incentives, control and dispatch EV loads in real time

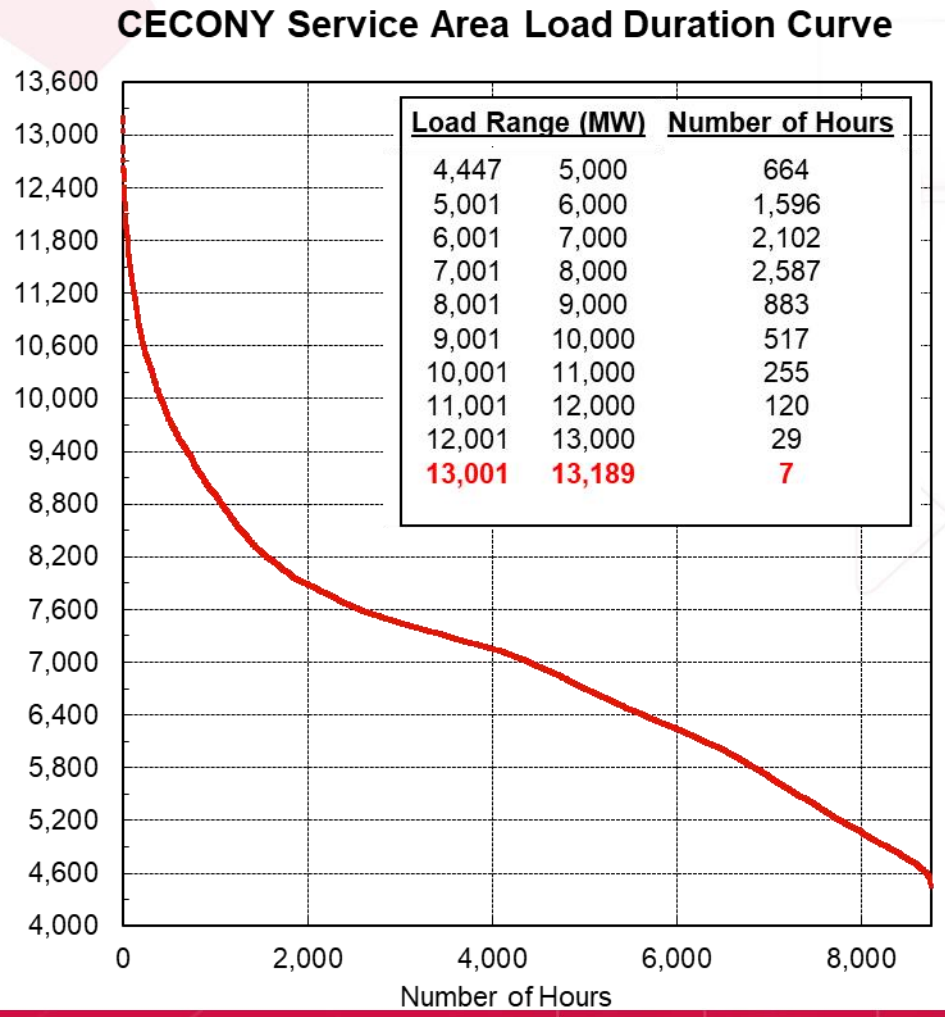
Optimizing the Delivery System

Generation	Transmission	Distribution	EDGE of the Grid
			

Managing load at the edge of the grid helps optimize the entire energy supply chain

Increasing Locational Value

Macro Challenge- Peak Load

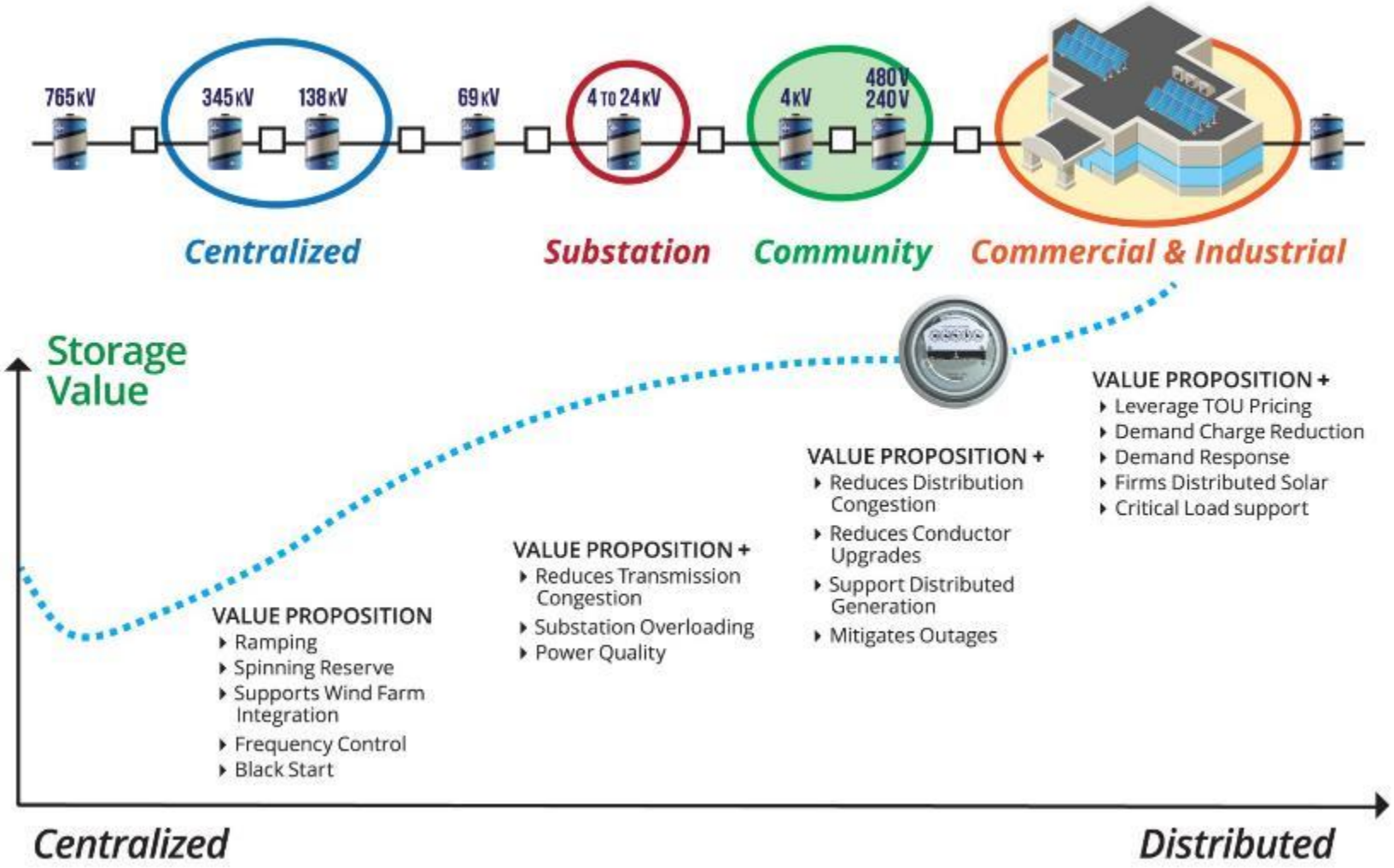


Load Range (MW)		Number of Hours
4,447	5,000	664
5,001	6,000	1,596
6,001	7,000	2,102
7,001	8,000	2,587
8,001	9,000	883
9,001	10,000	517
10,001	11,000	255
11,001	12,000	120
12,001	13,000	29
13,001	**13,189**	**7**

New Projected Peak of 13.7 GW

2 GW Peak/ 3.2 GW Renewable/ 2 GW Indian Point

Locational Value of Storage



Shared Value

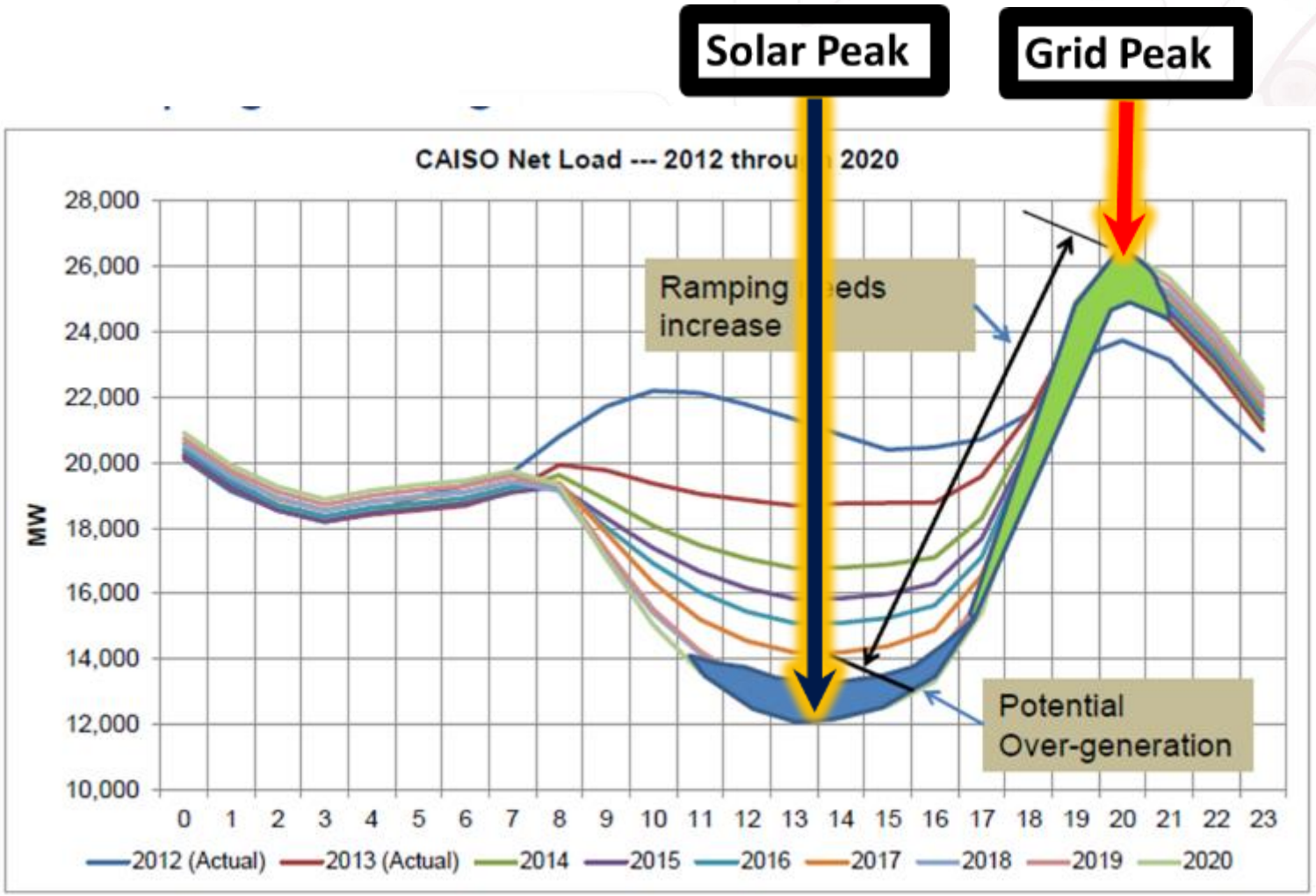
UTILITIES

- Conversion of variable generation to base load generation
- Better utilization of Transmission & Distribution resources
- Integration of Renewable Generation
- Better solution to Demand Response
- System balancing-Load, Frequency-Voltage
- Lessen the impact of EV Charging integration

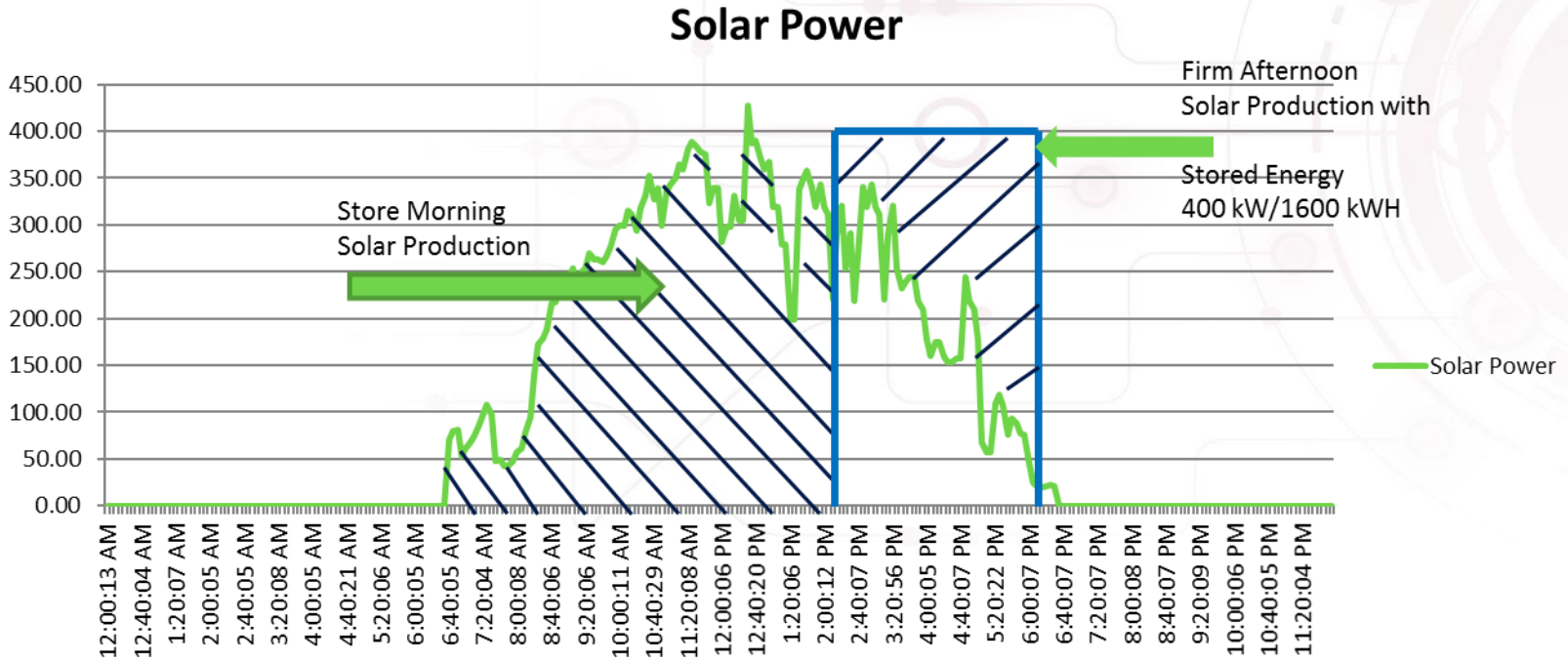
CUSTOMER SIDE

- Take Advantage of Market Price Incentives- TOU & Demand
- Demand Response w/o load reduction
- Overall Load management
- Renewable Integrations- Net Zero
- Disaster Response Services
- Minimize EV Demand Charges

Here Comes the Sun



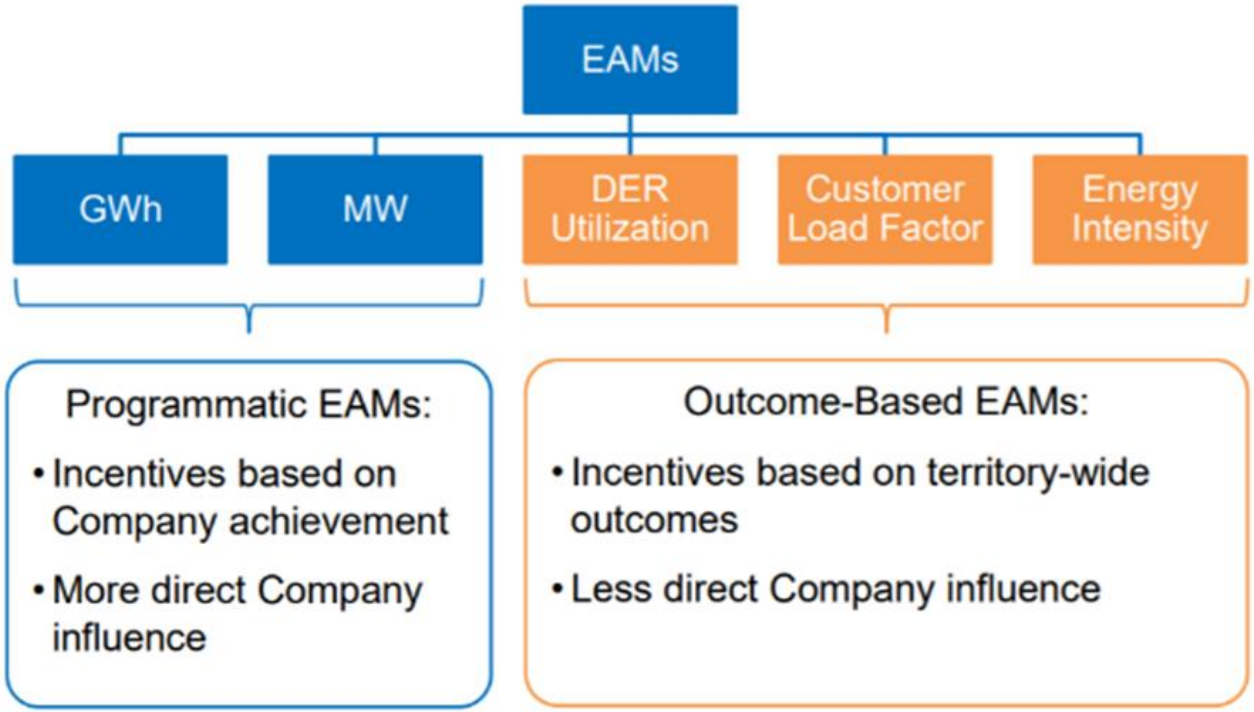
Building Solar Peakers



- Solar Production- Time shifted to period of highest benefit
- All intermittent performance removed
- Increased Value should receive a higher FIT price/kWh

Performance Based Rates

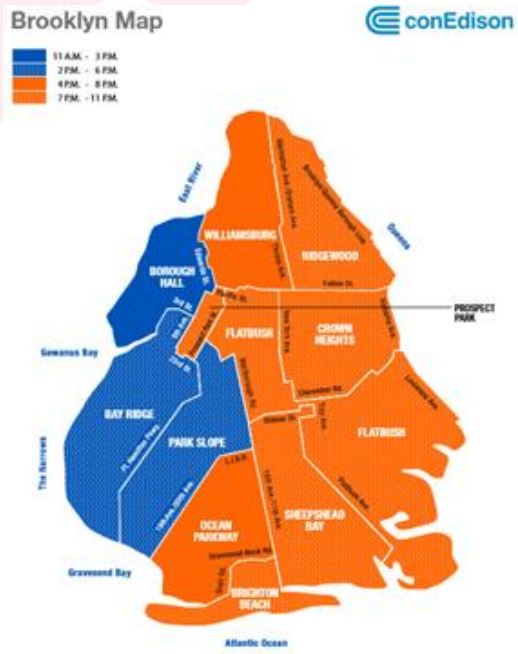
Company Financial Motivations
Earnings Adjustment Mechanisms



Specific Programs

- BQDM-Brooklyn Queens Demand Management
- NWA-Non Wire Alternatives
- DMP II- Demand Management Program.

Rate Evolution



Monthly

Electricity you used during this 29 day billing period
from Apr 03, 2012 to May 02, 2012
Rate: EL9 General Large Meter# 8023664

We measure your electricity by how many kilowatt hours (kWh) you use. One kWh will light a 100 watt bulb for 10 hours. The meter multiplier is the factor by which the meter reading difference is multiplied to determine your usage. Demand or kW is the highest amount of electric usage in any half hour during the billing period.

May 02, 12 actual reading	8227	18.46
Apr 03, 12 actual reading	-7987	-17.97
Reading difference	240	.49
Meter multiplier	X800	X800
Your electricity use	**192,000 kWh**	**392.00 kW**

▸Your supply charges

These charges are for the delivery portion of your electricity bill. You will receive a separate bill for your electricity supply. If you have a question about your supply bill, please call CONEDISON SOLUTIONS at (800) 789-1565.

▸Your delivery charges

Energy delivery 192,000 kWh — $9,080.73
Charge for maintaining the system through which Con Edison delivers electricity to you.

Demand delivery 392.0 kW — $8,882.36
Charge for maintaining the system through which Con Edison delivers electricity to you.

Total delivery charges — $18,817.50

▸▸ Total electricity charges — $18,817.50

Daily

Name: BARCLAY ST DEVELOP MENT LLC — Account Number: 49-4013-8030-0000-5 — Billing period ending: Aug 30, 2013

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As Used Daily Demand

DATE	WD=Weekday or WE=Weekend	PERIOD 1: MON - FRI 8 AM - 6 PM			PERIOD 2: MON - FRI 6 AM - 10 PM		
		DAILY DEMAND kW	STANDBY	MAC	DAILY DEMAND kW	STANDBY	MAC
08/02/2013	WD	365.6	$159.60	$17.73	372.9	$567.79	$46.83
08/03/2013	WE	-	$0.00	$0.00	-	$0.00	$0.00
08/04/2013	WE	-	$0.00	$0.00	-	$0.00	$0.00
08/05/2013	WD	346.5	$150.03	$16.67	353.3	$358.32	$39.78
08/06/2013	WD	348	$150.68	$16.74	355.6	$360.73	$38.04
08/07/2013	WD	372	$161.06	$17.89	391.6	$376.37	$41.79
08/08/2013	WD	391.6	$169.55	$18.84	421.9	$416.12	$46.20
08/09/2013	WD	432	$1				
08/10/2013	WE	-					
08/11/2013	WE	-					
08/12/2013	WD	367.2	$1				
08/13/2013	WD	381.6	$1				
08/14/2013	WD	335.5	$1				
08/15/2013	WD	331.2	$1				
08/16/2013	WD	356.6	$1				
08/17/2013	WE	-					
08/18/2013	WE	-					
08/19/2013	WD	366.7	$1				
08/20/2013	WD	382.5	$1				
08/21/2013	WD	394.5	$1				
08/22/2013	WD	402.2	$1				
08/23/2013	WD	374.4	$1				
08/24/2013	WE	-					
08/25/2013	WE	-					
08/26/2013	WD	374.8	$1				
08/27/2013	WD	409.9	$1				
08/28/2013	WD	408.5	$1				
08/29/2013	WD	404.6	$1				
08/30/2013	WD	410.4	$1				
			$3,4				

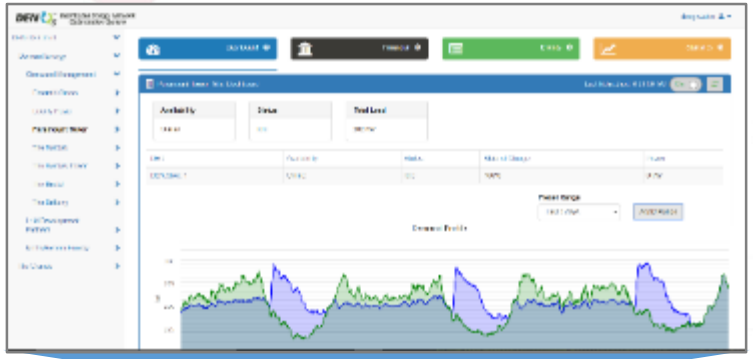
Hourly

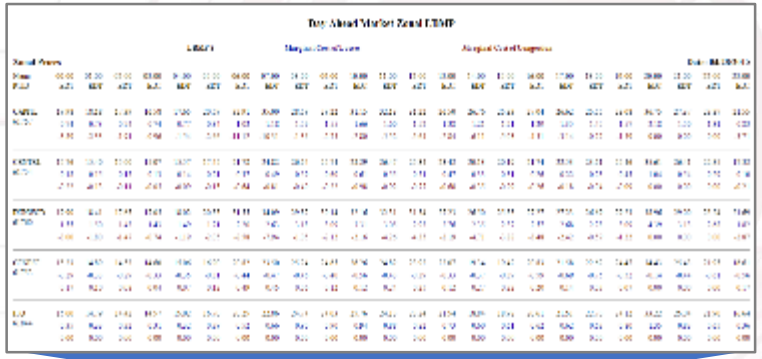
25 MW Rate Pilot- 2018

Zonal Prices — Date: 04/28/2015

Name / PTID	00:00 EDT	01:00 EDT	02:00 EDT	03:00 EDT	04:00 EDT	05:00 EDT	06:00 EDT	07:00 EDT	08:00 EDT	09:00 EDT	10:00 EDT	11:00 EDT	12:00 EDT	13:00 EDT	14:00 EDT	15:00 EDT	16:00 EDT	17:00 EDT	18:00 EDT	19:00 EDT	20:00 EDT	21:00 EDT	22:00 EDT	23:00 EDT
CAPITL 61757	19.98	18.18	17.39	16.58	17.65	20.59	32.91	35.00	28.59	29.22	31.15	32.13	31.22	26.50	26.76	25.83	27.04	26.62	25.55	28.08	36.75	27.37	23.87	21.55
	0.74	0.73	0.74	0.74	0.77	0.84	1.02	1.18	1.59	1.55	1.66	1.60	1.52	1.38	1.21	1.21	1.29	1.35	1.45	1.57	2.18	1.50	1.31	0.83
	-3.89	-2.33	-1.91	-0.96	-1.54	-2.66	-11.12	-10.31	-1.36	-2.75	-2.80	-5.52	-5.64	-2.84	-6.11	-5.03	-4.51	-3.14	-0.77	-1.59	0.00	0.00	0.00	-3.71
CENTRL 61754	15.76	15.40	15.00	15.07	15.57	17.45	21.78	24.82	26.64	25.74	28.29	26.47	25.34	23.42	20.13	20.19	21.74	22.53	23.61	25.46	35.61	26.41	22.85	17.32
	0.18	0.15	0.15	0.13	0.14	0.21	0.37	0.49	0.59	0.60	0.61	0.55	0.51	0.47	0.33	0.31	0.26	0.22	0.23	0.45	1.04	0.54	0.29	0.10
	-0.22	-0.13	-0.11	-0.05	-0.09	-0.15	-0.64	-0.81	-0.40	-0.22	-0.98	-0.92	-0.77	-0.68	-0.35	-0.29	-0.26	-0.18	-0.04	-0.09	0.00	0.00	0.00	-0.21
DUNWOD 61760	19.90	18.41	17.65	17.05	18.02	20.85	31.55	34.09	29.87	30.14	32.16	32.31	31.34	27.23	26.50	25.83	27.27	27.23	26.69	29.23	38.96	29.00	25.24	21.69
	1.55	1.50	1.43	1.43	1.49	1.71	2.20	2.63	3.18	3.09	3.31	3.05	2.93	2.76	2.35	2.37	2.57	2.68	2.78	3.09	4.39	3.13	2.68	1.82
	-3.00	-1.80	-1.47	-0.74	-1.19	-2.05	-8.58	-7.94	-1.05	-2.12	-2.16	-4.26	-4.35	-2.19	-4.71	-3.88	-3.48	-2.42	-0.59	-1.22	0.00	0.00	0.00	-2.87
GENESE 61753	15.23	14.89	14.53	14.60	15.06	16.90	20.82	23.50	25.24	24.65	26.26	24.82	23.92	22.07	19.34	19.42	20.83	21.58	22.62	24.47	34.43	25.43	21.95	16.61
	-0.29	-0.33	-0.29	-0.33	-0.35	-0.31	-0.44	-0.47	-0.46	-0.40	-0.56	-0.43	-0.39	-0.33	-0.37	-0.39	-0.59	-0.69	-0.75	-0.52	-0.14	-0.44	-0.61	-0.56
	-0.17	-0.10	-0.08	-0.04	-0.07	-0.12	-0.49	-0.45	-0.06	-0.12	-0.12	-0.24	-0.25	-0.12	-0.27	-0.22	-0.20	-0.14	-0.03	-0.07	0.00	0.00	0.00	-0.17
HQ 61844	15.00	14.79	14.42	14.57	15.02	16.70	20.25	22.86	24.74	24.03	25.76	24.13	23.24	21.54	18.84	18.98	20.61	21.51	22.70	24.12	33.22	25.04	21.90	16.64
	-0.35	-0.33	-0.32	-0.31	-0.32	-0.39	-0.52	-0.66	-0.90	-0.90	-0.94	-0.88	-0.82	-0.73	-0.60	-0.61	-0.62	-0.62	-0.63	-0.80	-1.35	-0.83	-0.65	-0.36
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Value Stacking Revenue Streams





Demand Charge Management

- Optimized load management from the combined Battery Operations

Utility/ISO Load Relief Compliance

- Called when the day-ahead forecast is projected to be 93% of the summer forecasted peak

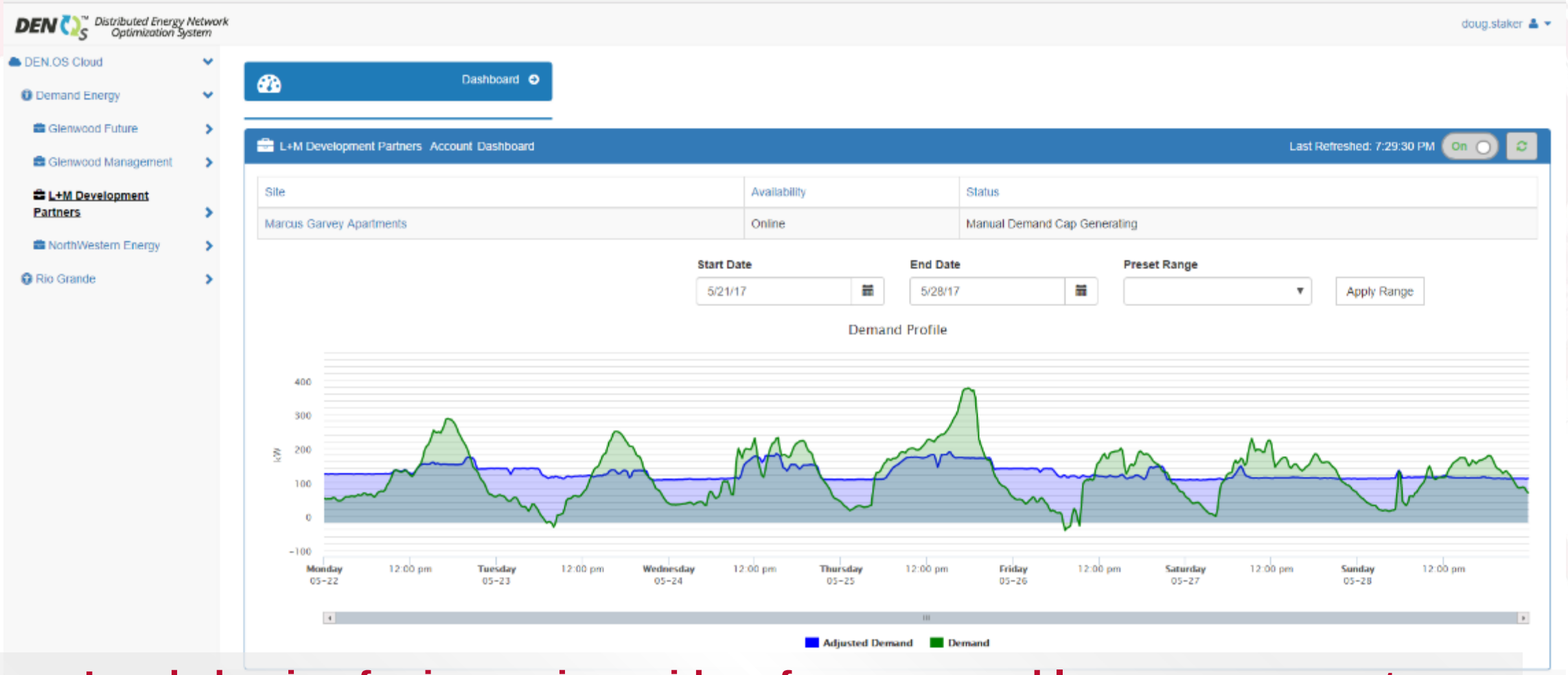
Market Participation

- Day ahead hourly pricing
- ISO winter DR
- Emergency Load Relief Program

PLUS: Emergency Back-Up Power

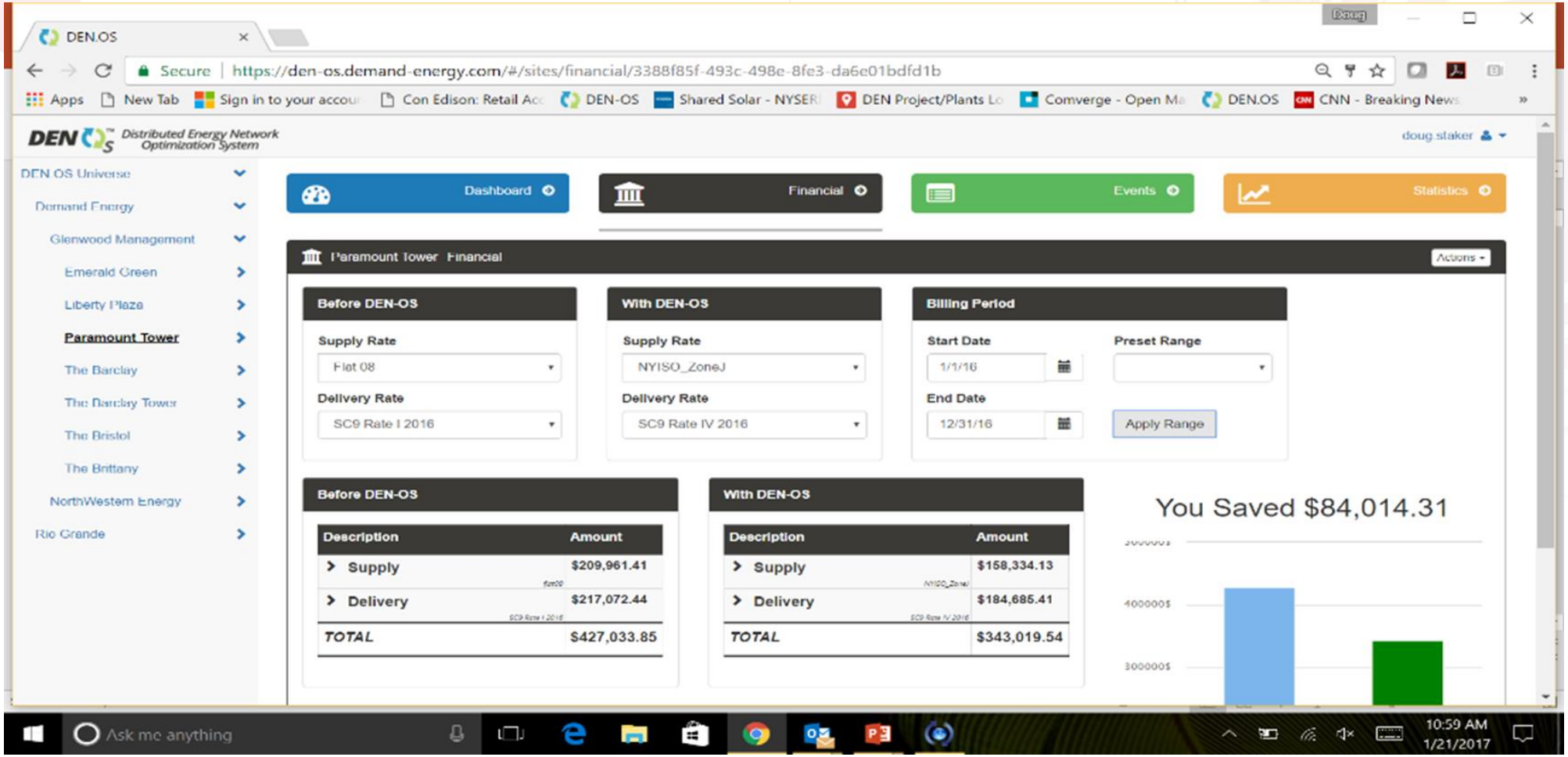
- Critical loads for management and building security
- Community emergency response facility for extended outages

Demand Charge Management

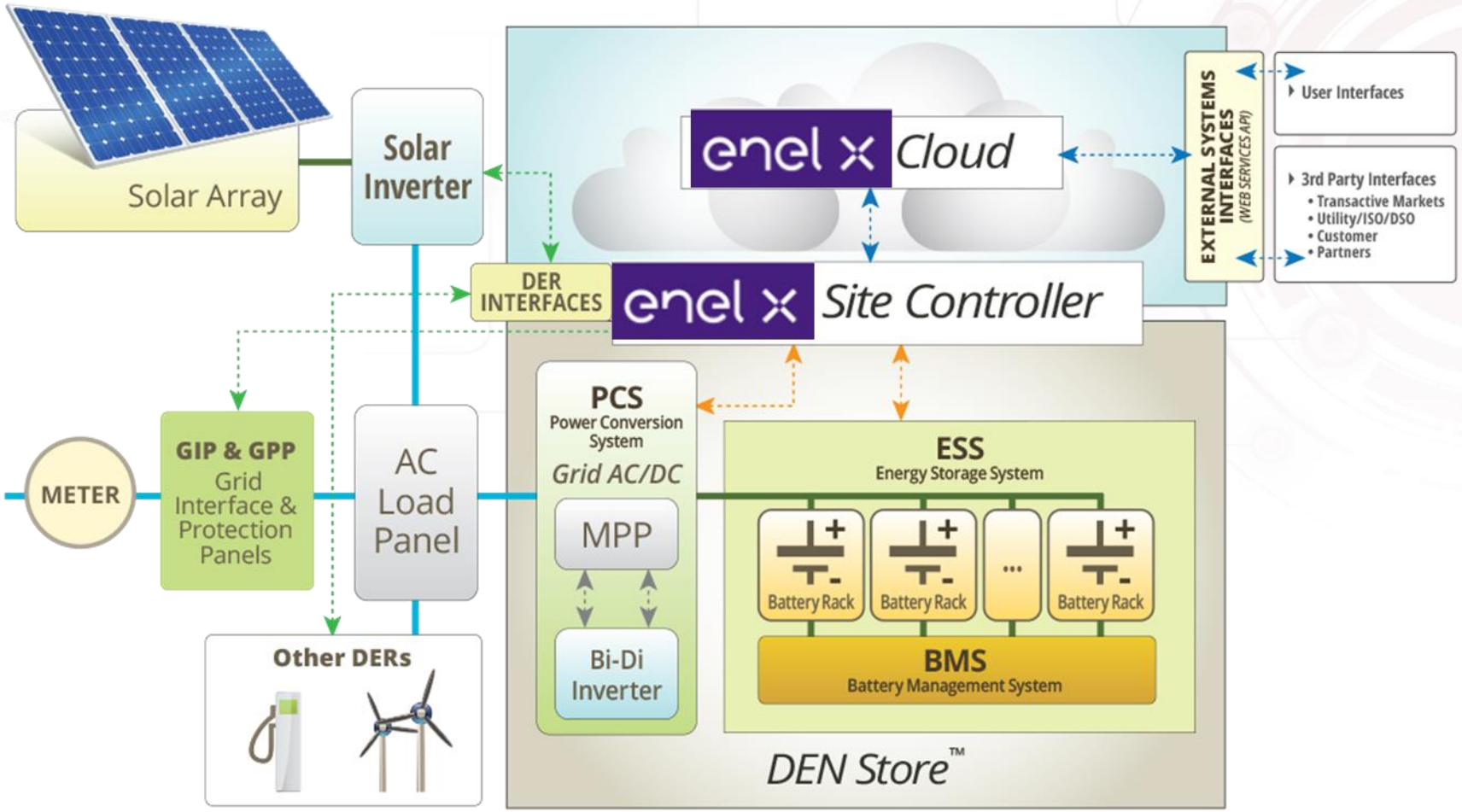


Load shaping for improving grid performance and lower energy costs

Building Savings 2016



System Control



Optimization

Cloud-based platform enables real-time optimization engine to produce predictable financial returns from any combination of DER assets across any market and timeframe

Utility & Market Interfaces

- Utility tariffs
- Electricity prices
- Demand response

Cloud-Based Platform

Network Optimization Engine

- Intelligent aggregation
- Global modeling and analytics

User Interface

- View real-time performance
- View value streams
- View historical information

Site Awareness

- Demand profile
- Weather
- Time of day

DER.OS

Site-Level Controls

- Site Optimization Engine
- Real-time demand management
- Connection to site utility meter

Distributed Energy Resources

- Battery Storage
- Solar PV
- Generator
- Fuel Cell
- E-Vehicle
- Etc.

Questions?

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The Enel Group Worldwide

- A multinational power company and leading integrated player in the world's power and gas markets

Publicly Committed to UN Sustainable Development Goals

$84 B
Annual Revenue

65,000
Employees

31
Countries in 5 continents

42 GW
Renewable Capacity

50+ Yrs
Experience

No. 20
Fortune's Change the World List

Enel X: Flexibility Solutions Business

enel X

We are integrating and aligning….

ENERNOC
An Enel Group Company

DEMAND energy
An Enel Group Company

eMotorWerks®
An Enel Group Company

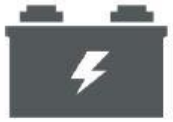
To optimize grid and retail "flexibility services"…

Using all types of distributed energy assets

Real-time Variable Loads

PV & Other Distributed Generation

EV Charging



Energy Storage