

# California Takes Charge

## Advanced Energy Storage (AES)

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Center for Sustainable Energy

Accelerating the transition to a sustainable world powered by clean energy



# Center for Sustainable Energy

CSE is an expert implementation partner to energy policy makers, regulators and businesses tasked with achieving ambitious energy goals.



## We accelerate the clean energy future







# **Energy Storage is a Game Changer**



# THE ROLE OF ENERGY STORAGE IN CALIFORNIA

# The Need for Energy Storage Resources

- Aggressive transition from fossil fuels to renewable energy sources, energy efficient homes and businesses, and flexible transmission and distribution infrastructure
- Helps achieve various California policies and mandates already in place, including:



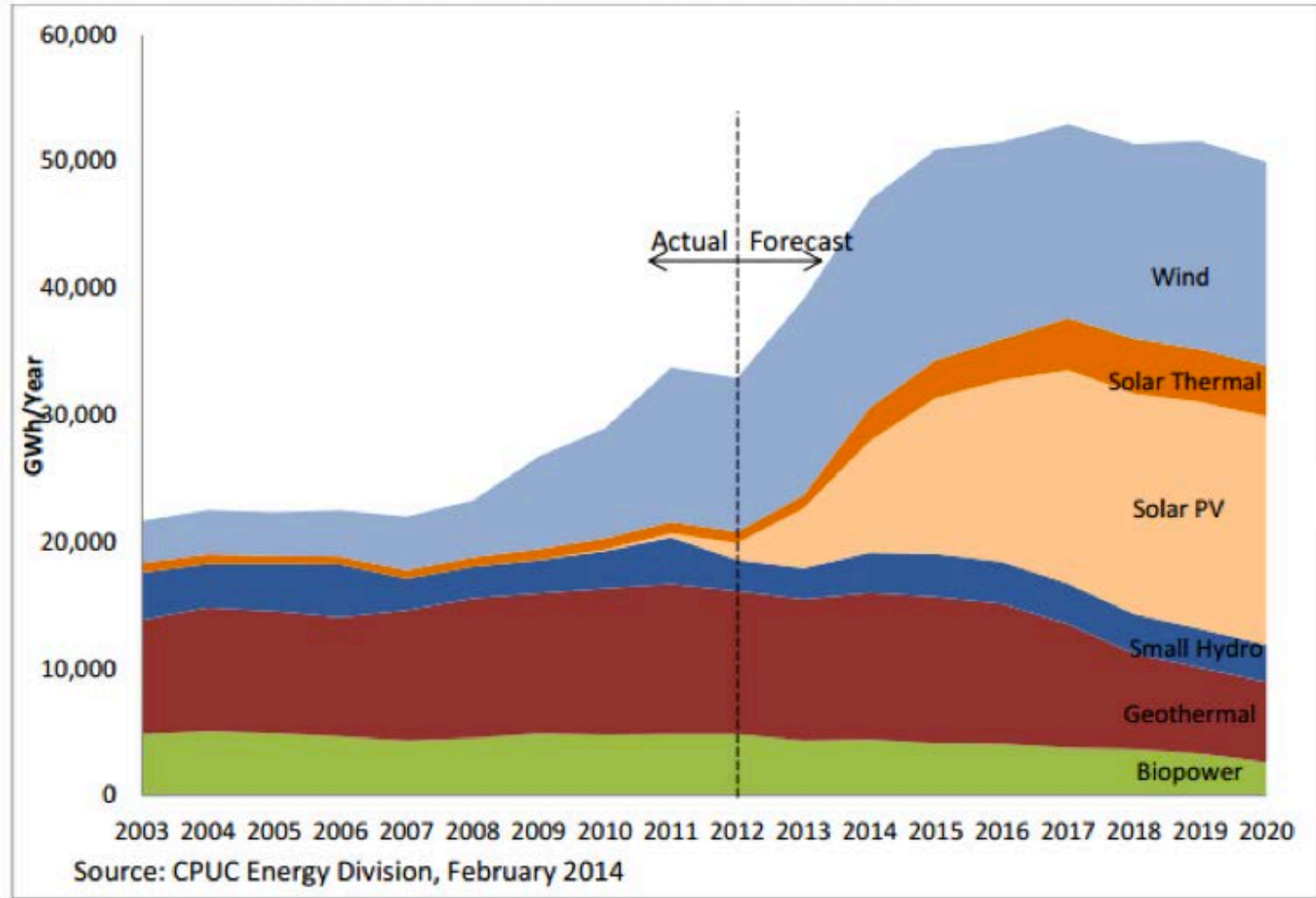
Executive Order for 1.5 million electric vehicles by 2025



RPS: 33% renewable procurement by 2020

# California's Renewable Resource Mix

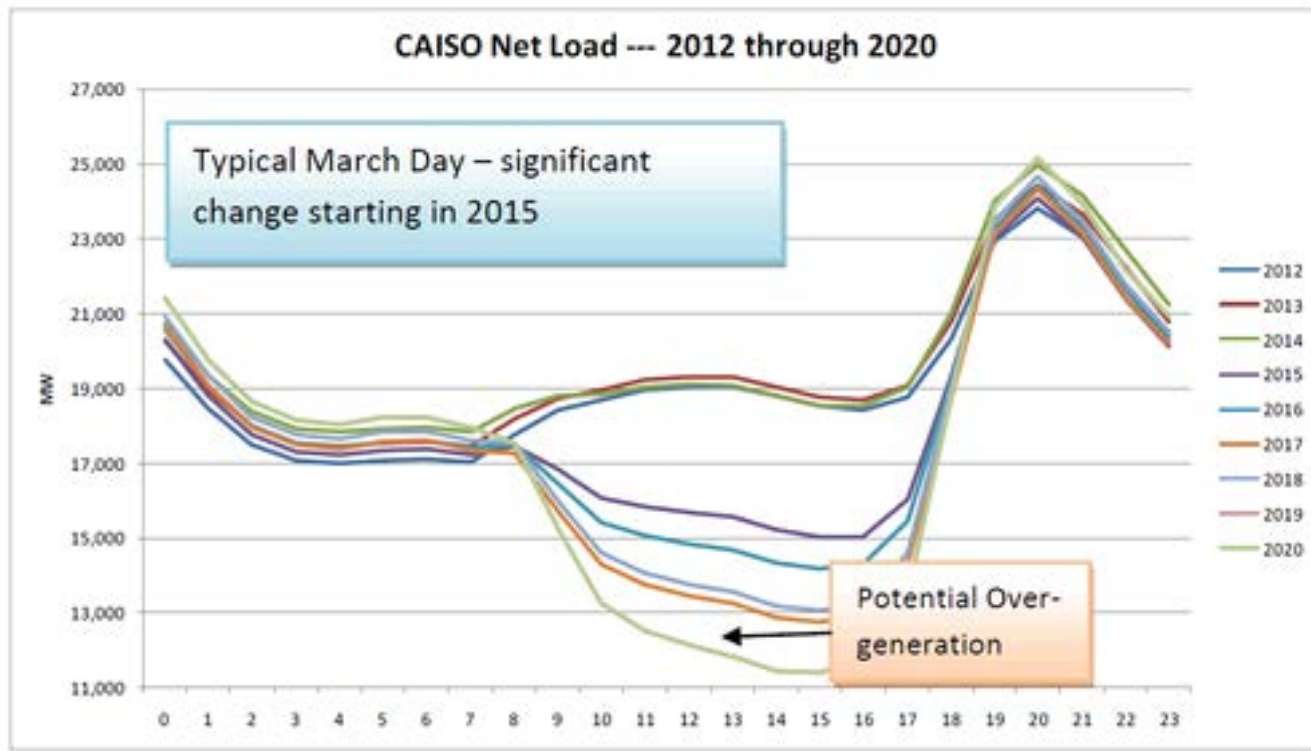
Figure 3: Renewable Resource Mix, Actual and Forecasted by Year<sup>11,12</sup>



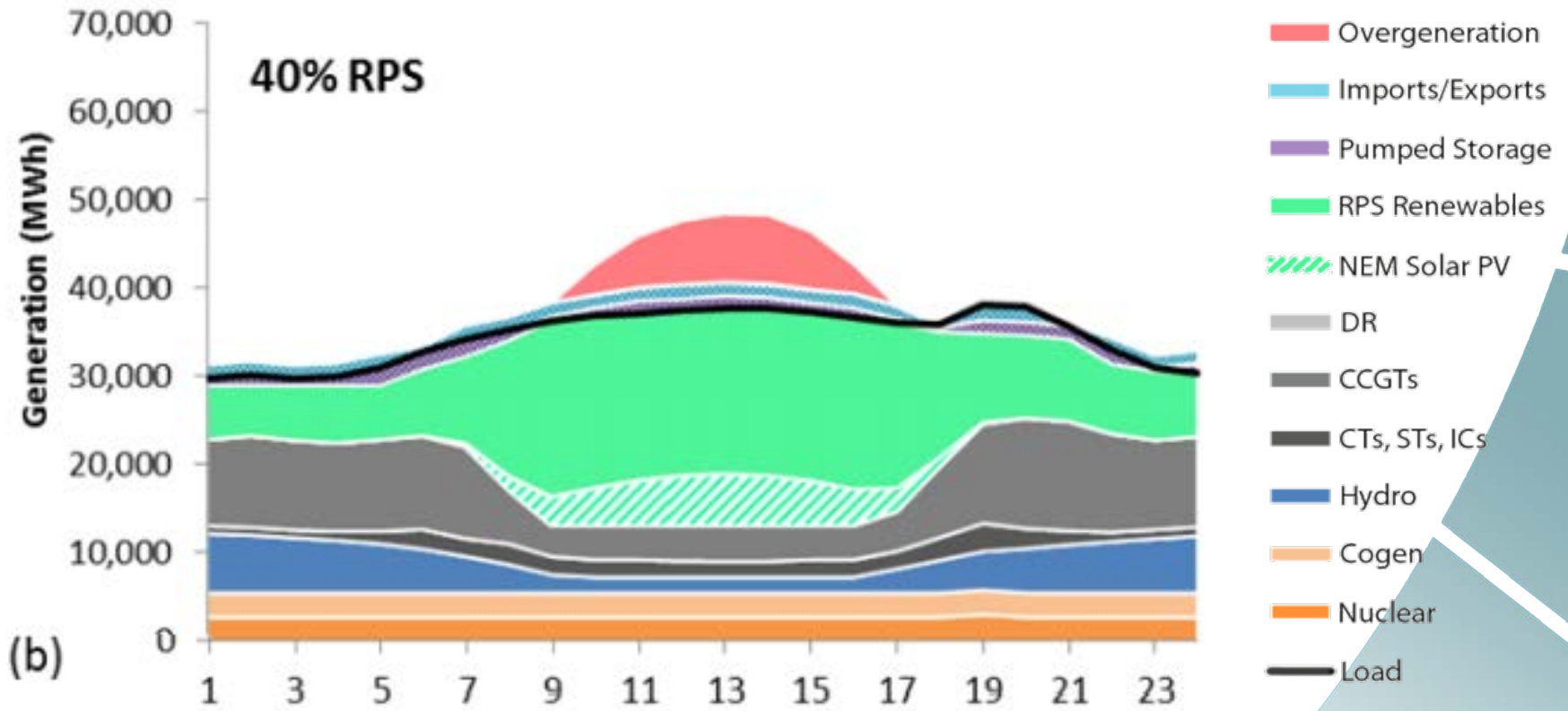
# Duck Curve

*“As more renewable resources come on line, not only will the net load curve look substantially different than it does today but so will the need for load regulation and load following.”*

– CAISO, 2012

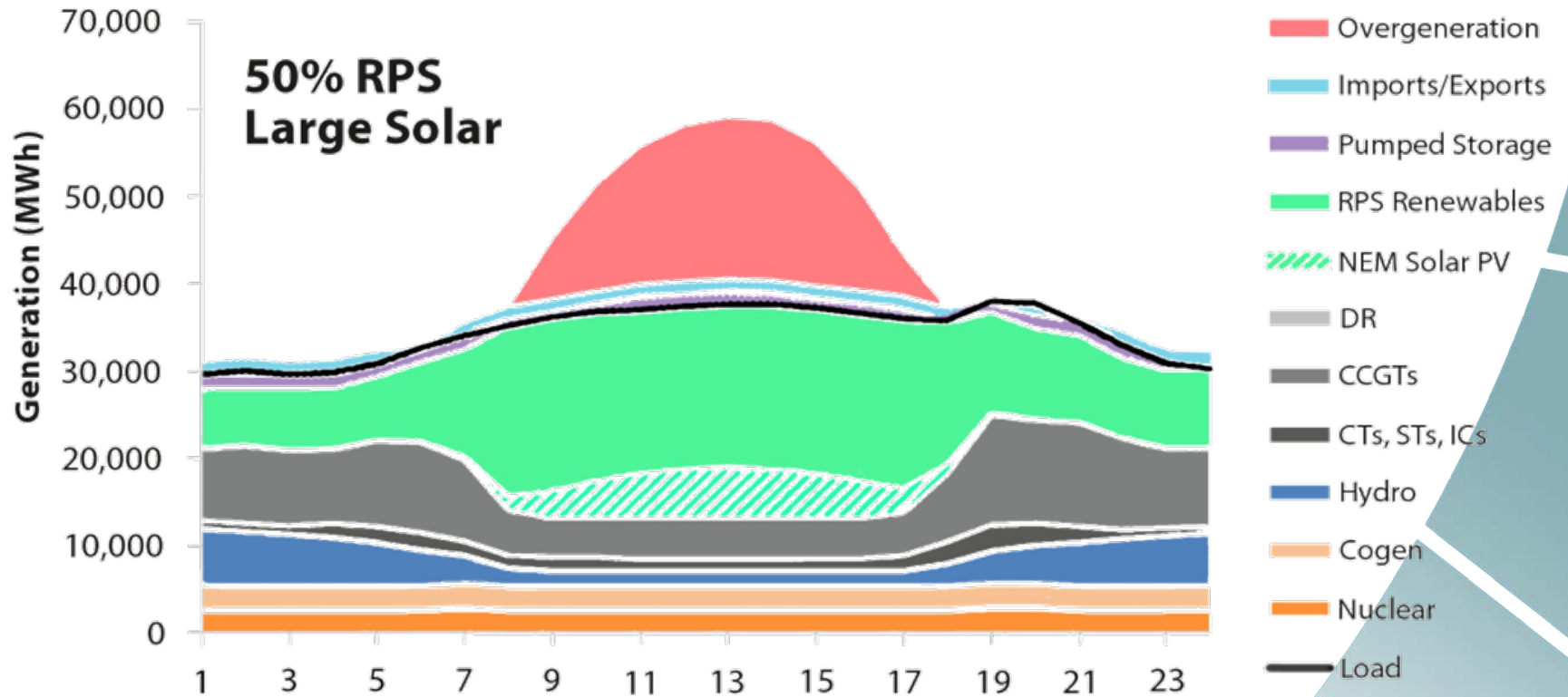


# Beyond 2020

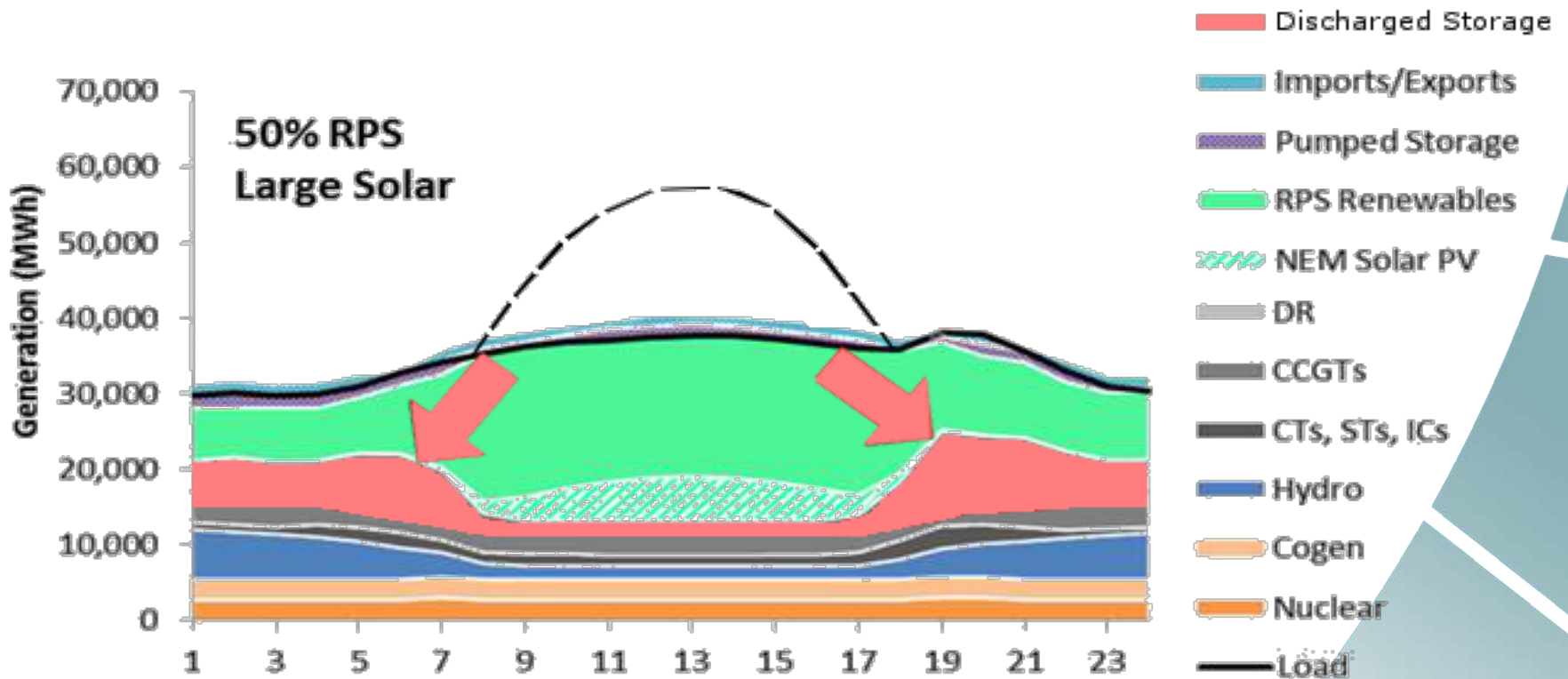




# Beyond 2020



# Beyond 2020



*As solar energy becomes increasingly significant part of California's generation resources, storage will become critically important.*



# CALIFORNIA'S ENERGY STORAGE MANDATE: AB 2514



## AB 2514: CALIFORNIA'S ENERGY STORAGE MANDATE

- AB 2514 directed the CPUC to establish procurement targets and effective policies for energy storage systems within the territories of PG&E, SCE and SDG&E
- Last year, CPUC set the procurement target of 1.325 GW of storage by 2020, the largest of its kind worldwide
- The ruling noted that the storage procurement policy should be guided by 3 purposes: grid optimization, renewable integration & GHG reduction



# Storage Procurement Targets for California's IOUs

**Table 1 – Initial Proposed Energy Storage Procurement Targets (in MW)**

Use case category, by utility	2014	2016	2018	2020	Total
<b>Southern California Edison</b>					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
<b>Subtotal SCE</b>	<b>90</b>	<b>120</b>	<b>160</b>	<b>210</b>	<b>580</b>
<b>Pacific Gas and Electric</b>					
Transmission	50	65	85	110	310
Distribution	30	40	50	65	185
Customer	10	15	25	35	85
<b>Subtotal PG&amp;E</b>	<b>90</b>	<b>120</b>	<b>160</b>	<b>210</b>	<b>580</b>
<b>San Diego Gas &amp; Electric</b>					
Transmission	10	15	22	33	80
Distribution	7	10	15	23	55
Customer	3	5	8	14	30
<b>Subtotal SDG&amp;E</b>	<b>20</b>	<b>30</b>	<b>45</b>	<b>70</b>	<b>165</b>
<b>Total - all 3 utilities</b>	<b>200</b>	<b>270</b>	<b>365</b>	<b>490</b>	<b>1,325</b>

Note: Of the 1.325 GW, **200 MW** is allocated for customer-sited systems

A gold-colored silhouette of the state of California is positioned on the left side of the slide, partially overlapping a dark grey horizontal band.

# SELF-GENERATION INCENTIVE PROGRAM (SGIP)



## Storage and the Self-Generation Incentive Program (SGIP)

- Provides cash incentives for the installation of clean and efficient distributed generation technologies that are installed on the customer's side of the utility meter
- Ratepayer funded and overseen by the CPUC
- One of the longest running incentive programs in the country and has incentivized distributed generation technologies since 2001; authorized funding through 2020
- The only program in California that provides rebates for distributed energy storage systems installed on the customer side of the utility meter
- Now, SGIP plays a key role in realizing the goals of AB 2514

# Storage and the Self-Generation Incentive Program (SGIP)

## Eligible Technologies and Incentive Levels

<b>Technology Type</b>		
<b>Incentive (\$/W)</b>	<b>2014 Rates</b>	<b>2015 Rates</b>
Renewable and Waste Energy Recovery		
Wind Turbine	\$1.13	\$1.07
Waste Heat to Power	\$1.13	\$1.07
Pressure Reduction Turbine	\$1.13	\$1.07
Non-Renewable Conventional CHP		
Internal Combustion Engine - CHP	\$0.46	\$0.44
Micro-turbine – CHP	\$0.46	\$0.44
Gas Turbine – CHP	\$0.46	\$0.44
Emerging Technologies		
Advanced Energy Storage	\$1.62	\$1.46
Biogas Adder	\$1.62	\$1.46
Fuel Cell – CHP or Electric Only	\$1.83	\$1.65





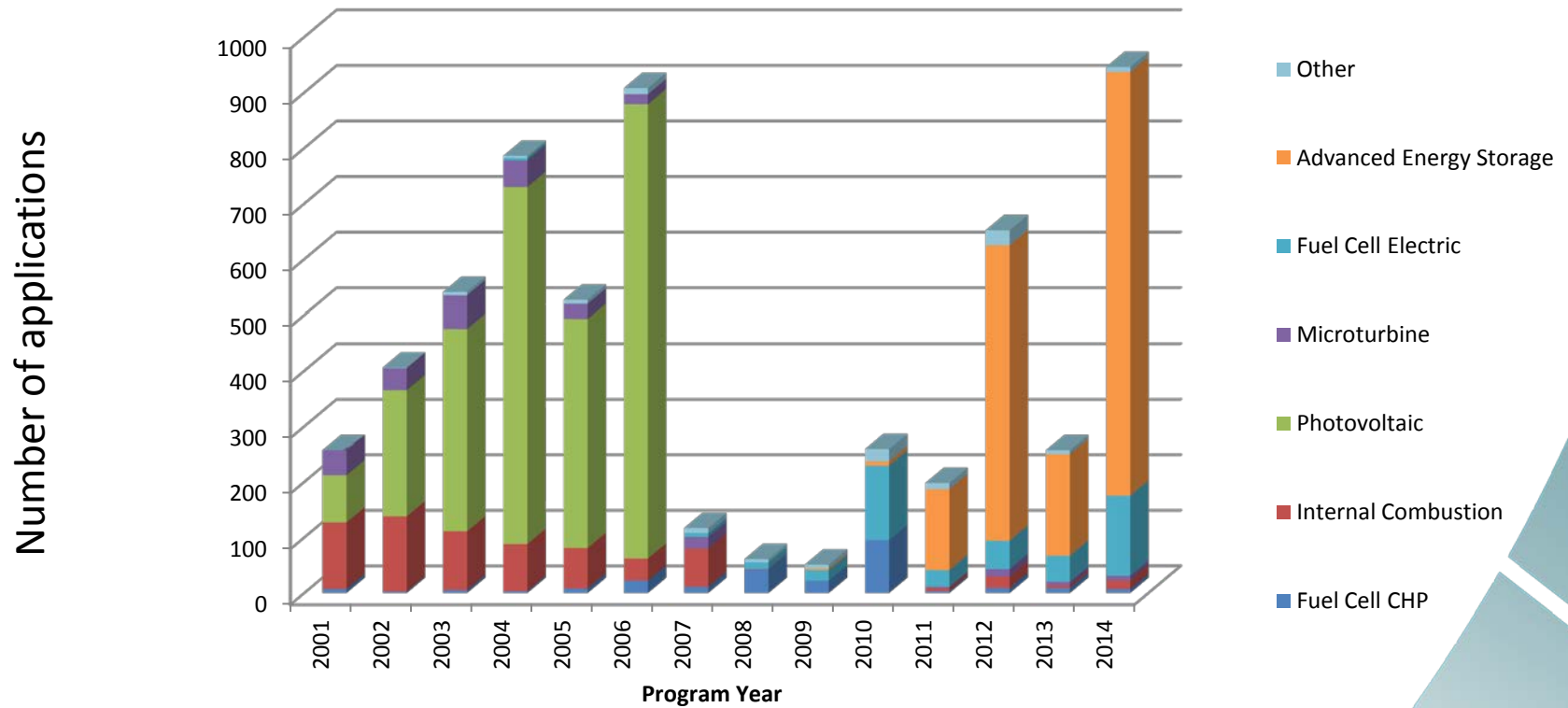
## Example Incentive Calculation

- 40 kWh discharged over 2 hours
- 20 kW SGIP capacity rating
- 20 kW x \$1.46/watt = \$29,200

Upfront  
Incentive for  
projects < 30  
kW

(SGIP pays up to 60% of total project cost. Minimum applicant investment of 40% is required)

# Influx of Storage Applications in SGIP



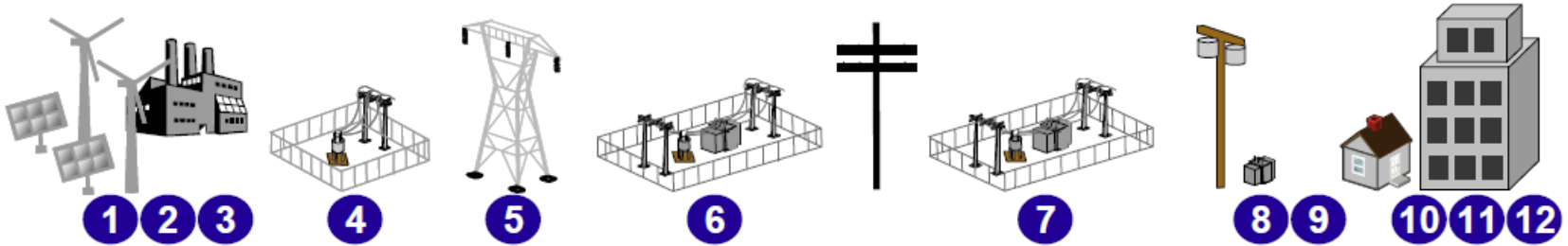
*From solar to storage*



# CUSTOMER-SITED STORAGE

# Energy storage is *most* valuable at the “edge” of the grid

## Application Location on the Grid



### Application

1

Off-to-on peak intermittent energy shifting & firming

2

On-peak intermittent energy smoothing & shaping

3

Ancillary service provision

4

Black start provision

5

Transmission infrastructure

6

Distribution infrastructure

7

Transportable distribution-level overload mitigation

8

Peak load shifting downstream of distribution system

9

Variable distributed generation integration

10

End user time-of-use rate optimization

11

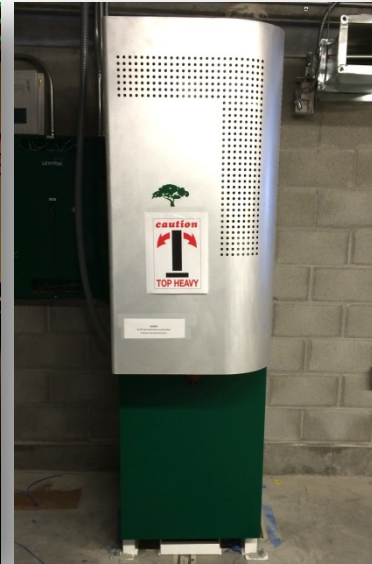
Uninterruptible power supply

12

Micro grid formation



# Storage Applications in SGIP



# AES Core Revenue Streams

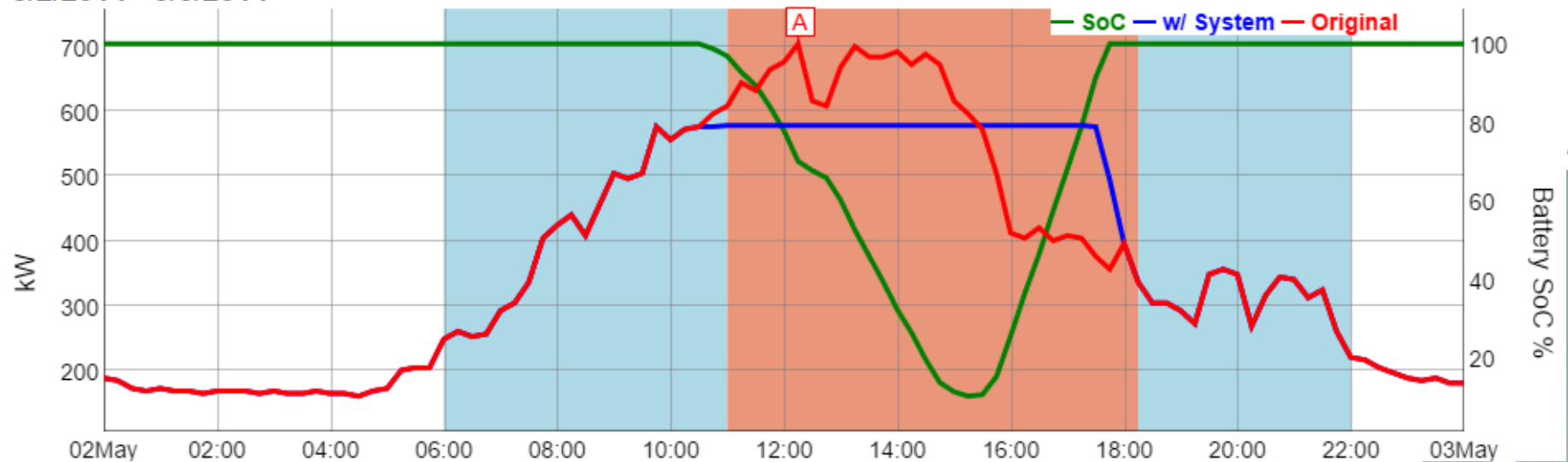
- Demand Charge Reduction
- Demand Response
- Ancillary Services
  
- Back-up/Resiliency
  
- Solar Integration
- EV Charging
- Microgrids

# AES Core Revenue Streams

- Demand Charge Reduction
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- Ancillary Services
  
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# San Diego High School

5/2/2014 - 5/3/2014



Red = Original Building Load  
Blue = Reduced Demand with Storage  
Green = Battery State of Charge (%)

A = "Full Peak Shaved kW"

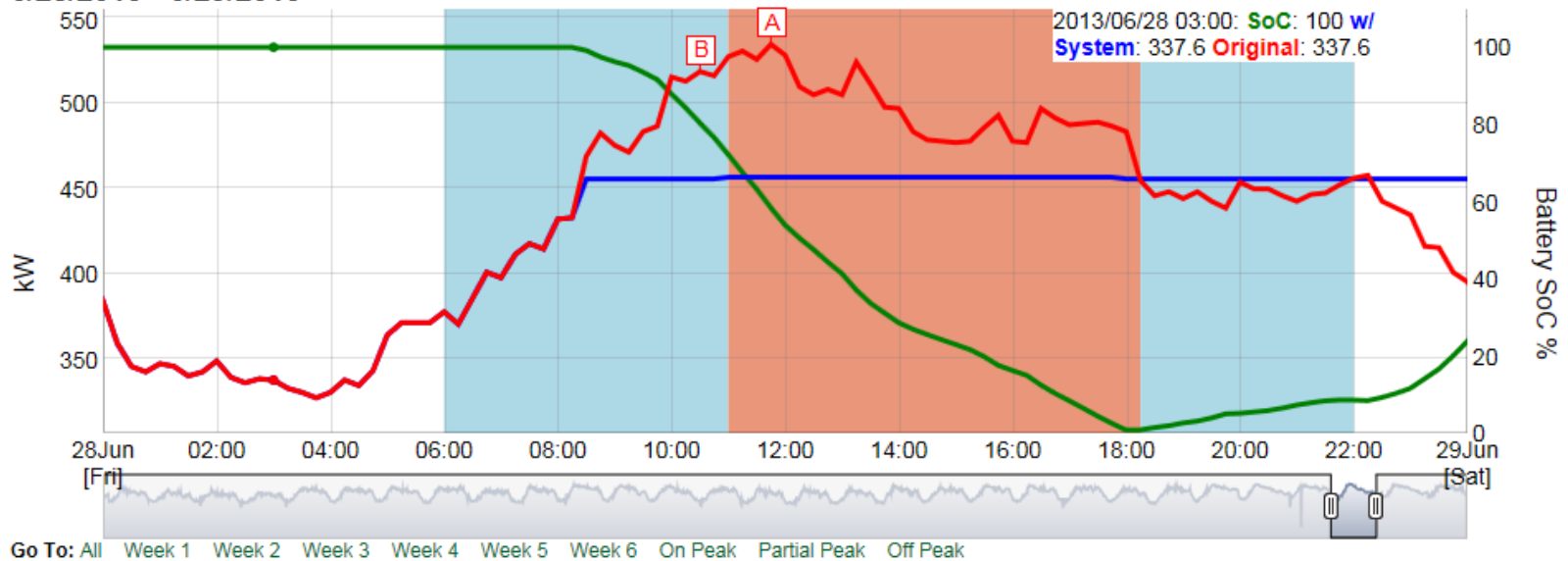
# San Diego High School

Bill End	Full Peak				Maximum Daily Peak				Monthly Savings
	Max Demand (kW)	Set Point (kW)	Demand Shaved (kW)	Tariff (\$/kW)	Max Demand (kW)	Set Point (kW)	Demand Shaved (kW)	Tariff (\$/kW)	
11/1/2013	504	329	175	\$7.14	772	671	101	\$20.77	\$3,344
12/1/2013	476	293	183	\$7.14	668	552	116	\$20.77	\$3,713
1/1/2014	440	273	167	\$7.14	516	415	101	\$20.77	\$3,287
2/1/2014	420	245	175	\$7.14	620	504	116	\$20.77	\$3,656
3/1/2014	404	246	158	\$7.14	616	520	96	\$20.77	\$3,119
4/1/2014	408	244	164	\$7.14	620	471	149	\$20.77	\$4,263
5/1/2014	464	286	178	\$7.14	716	614	102	\$20.77	\$3,387
6/1/2014	704	578	126	\$21.10	704	578	126	\$20.77	\$5,271
7/1/2014	396	293	103	\$21.10	396	293	103	\$20.77	\$4,308
8/1/2014	444	337	107	\$21.10	444	338	106	\$20.77	\$4,455
9/1/2014	788	670	118	\$21.10	788	671	117	\$20.77	\$4,916
10/1/2014	900	752	148	\$21.10	900	752	148	\$20.77	\$6,193

Past 12-Month Savings: **\$49,913**

# San Diego Hotel

6/28/2013 - 6/29/2013



Red = Original Building Load  
Blue = Reduced Demand with Storage  
Green = Battery State of Charge (%)

A = "Full Peak Shaved kW"  
B = "Part Peak Shaved kW"

# San Diego Hotel Savings

Billing End	Abs Original Max kW	Abs Reduced Max kW	Abs Demand Shaved	\$/kW Tariff at On Peak	Off Peak Max kW	SetPoint Off Peak kW	Demand Shaved Off Peak kW	\$/kW Tariff at Off Peak	Monthly Savings
6/1/2013	500.8	432	68.8	\$21.10	480.8	431.3	49.5	\$20.77	\$2,880.65
7/1/2013	534.4	456.5	77.9	\$21.10	508.8	455.5	53.3	\$20.77	\$3,261.67
8/1/2013	595.2	484	111.2	\$21.10	562.4	484	78.4	\$20.77	\$6,147.71
9/1/2013	619.2	503.1	116.1	\$21.10	560	503.1	56.9	\$20.77	\$5,700.88
10/1/2013	640	521.1	118.9	\$21.10	545.6	509.5	36.1	\$20.77	\$4,978.34
11/1/2013	654.4	455.5	198.9	\$21.10	475.2	455.5	19.7	\$20.77	\$5,222.85
12/1/2013	723.2	524.3	198.9	\$21.10	723.2	524.3	198.9	\$20.77	\$5,200.72
1/1/2014	484.8	388	96.8	\$21.10	484.8	388	96.8	\$20.77	\$3,002.28
2/1/2014	480	384.1	95.9	\$21.10	465.6	384.1	81.5	\$20.77	\$3,047.13
3/1/2014	470.4	426.5	43.9	\$21.10	444.8	426.5	18.3	\$20.77	\$2,017.78
4/1/2014	515.2	427.3	87.9	\$21.10	515.2	427.3	87.9	\$20.77	\$2,838.13
5/1/2014	520	460.1	59.9	\$21.10	520	460.1	59.9	\$20.77	\$2,320.83
									\$46,618.97



# Customer-Sited Energy Storage Business Model

- Power Efficiency Agreement
  - Technology provider/investor finances, owns and maintains the energy storage system
- Demand charge savings are shared between vendor and host customer
- No technology risk to host customer
- No cost risk to host customer
- Off host customer balance sheet
- Vendor removes equipment at cost when contract ends



# CHALLENGES AND OPPORTUNITIES AHEAD



# Energy Storage in the Golden State: Key Takeaways

- Energy storage is essential to California's energy future
- Customer-sited storage is developing recognition as a necessary part of a well-functioning grid
- CA has the opportunity to lead on a national and global level
- Continued regulatory developments will be necessary for California to realize all the benefits storage has to offer.

# Thank you

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