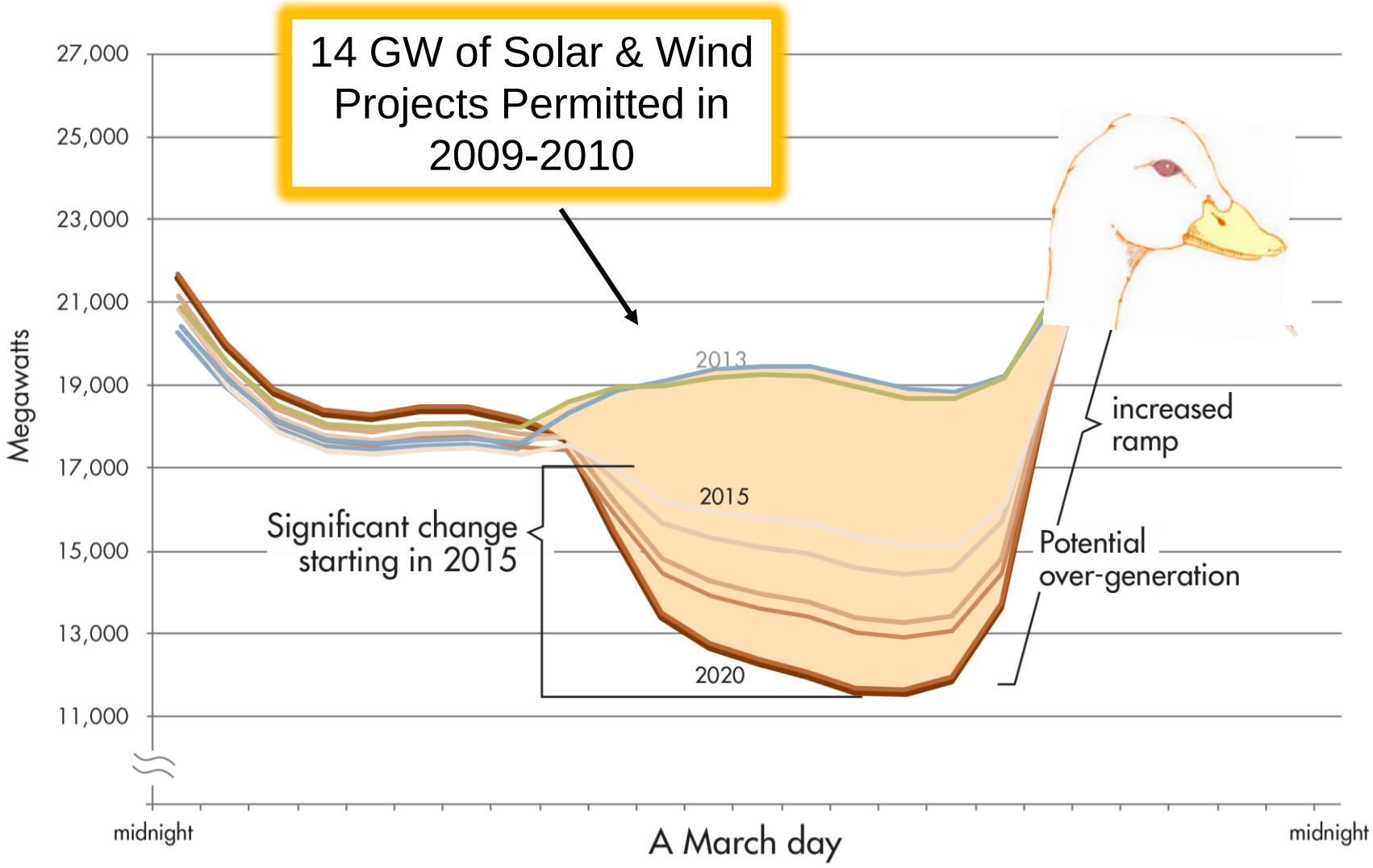
Advanced Microgrid Solutions

IBEW

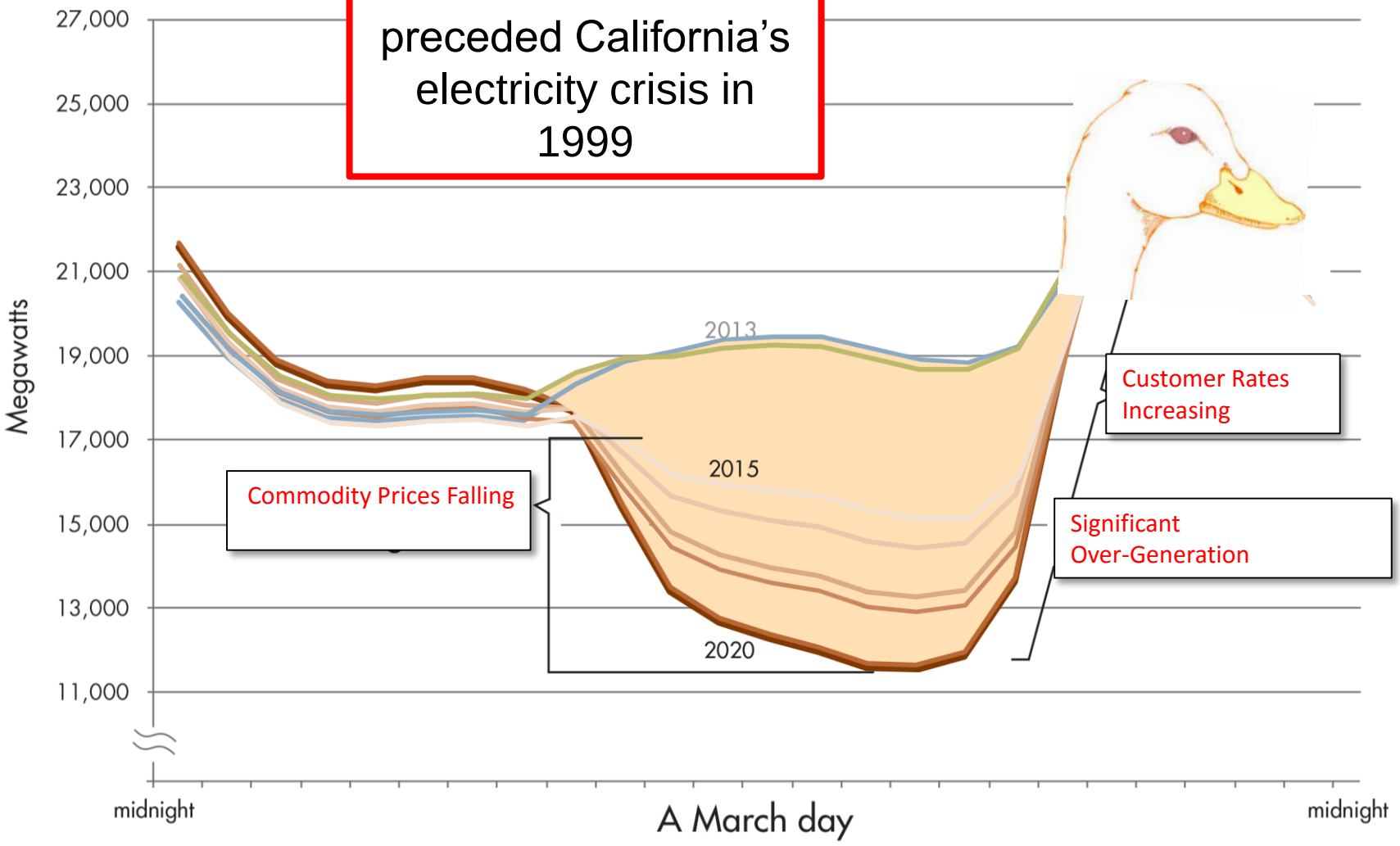
March 9, 2016

THE “DUCK”

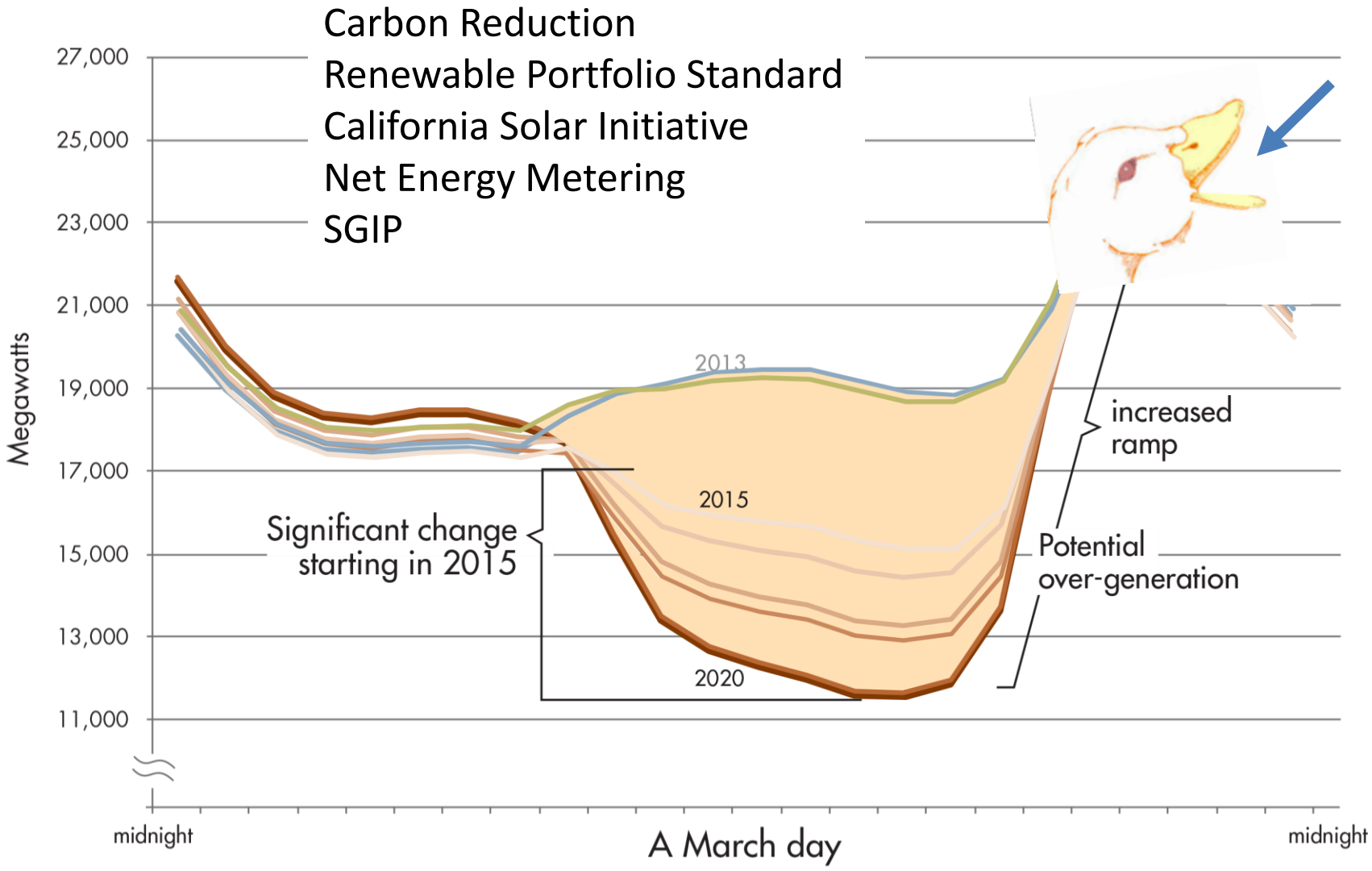

14 GW of Solar & Wind Projects Permitted in 2009-2010
27,000
25,000
23,000
21,000
19,000
17,000
15,000
13,000
11,000
Megawatts
2013
2015
2020
Significant change starting in 2015
increased ramp
Potential over-generation
midnight
A March day
midnight

THE “RE-DUCK”

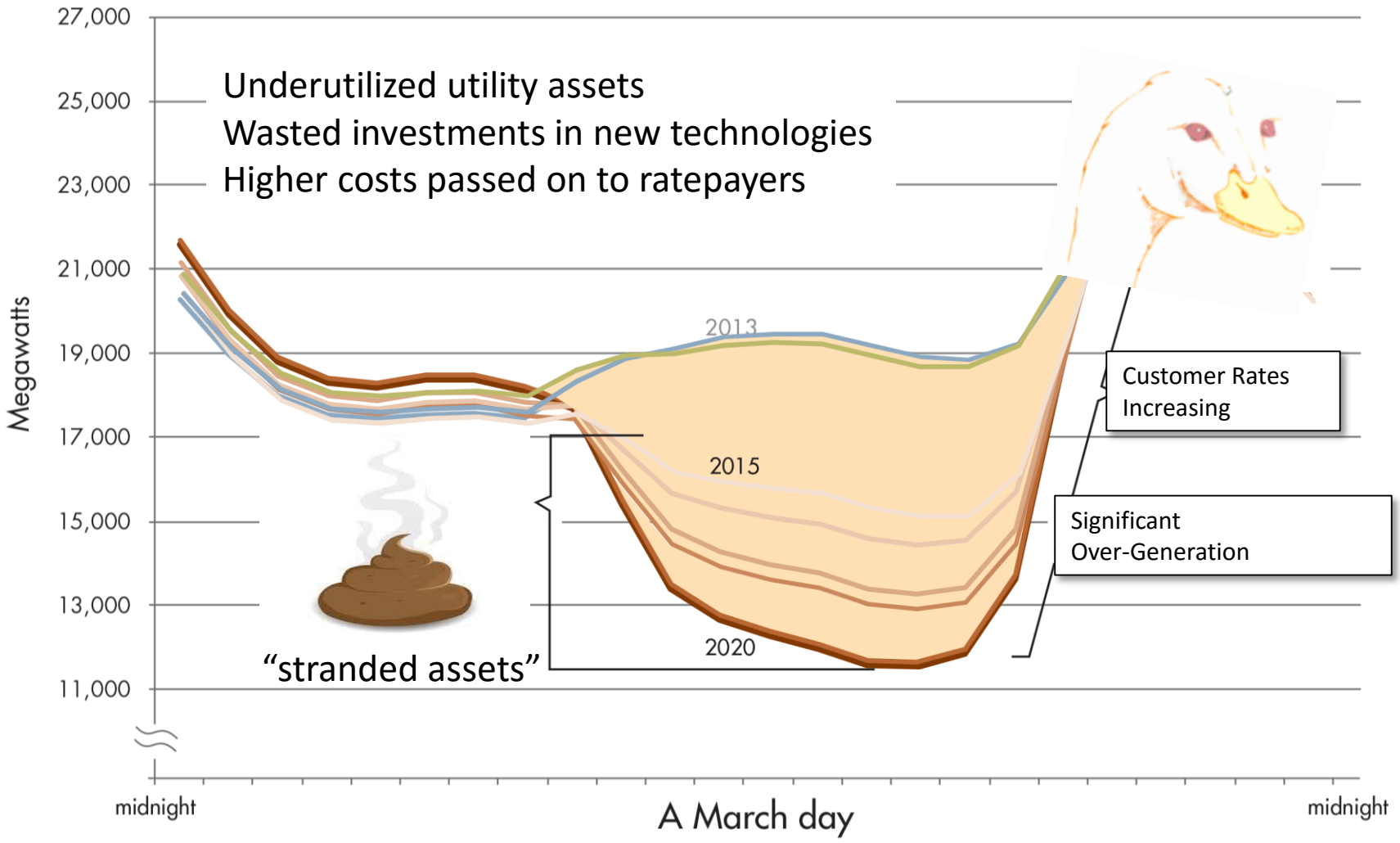
Same Conditions that preceded California’s electricity crisis in 1999



THE DUCK: PROGENY OF GOOD PUBLIC POLICY

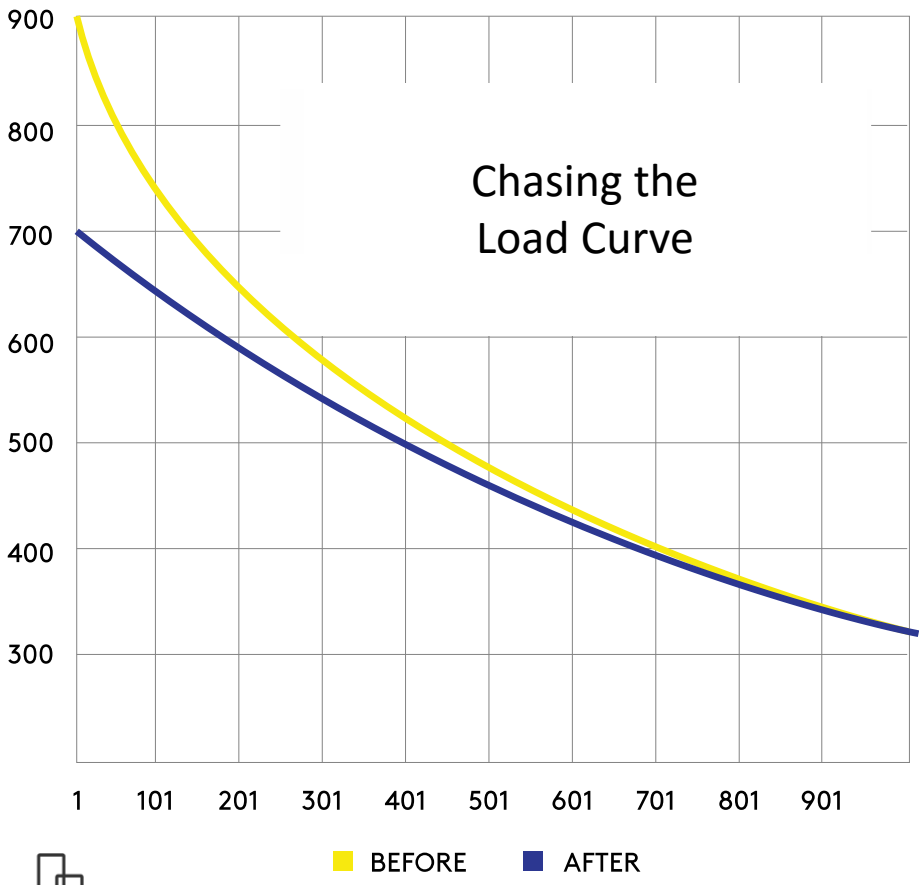


EVEN GOOD POLICIES MUST BE CONSTANTLY CURATED TO MAINTAIN FOCUS ON DESIRED OUTCOMES



ROLE OF DISTRIBUTED ENERGY RESOURCES

Utilities in the US will spend $1 trillion dollars over the next decade to manage changes in the distribution grid.



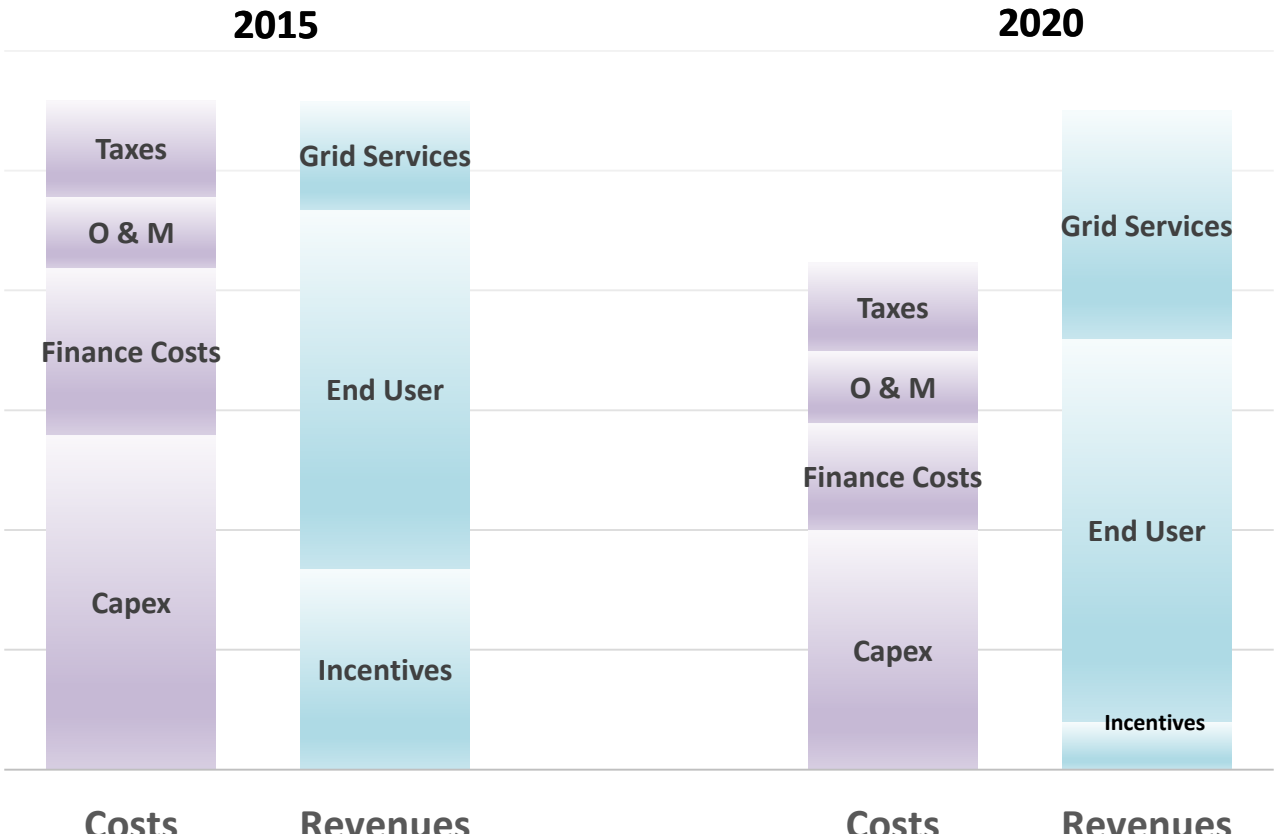
Energy Storage is the Only Technology that Creates Multiple, Combined Value Streams on Both Sides of the Meter

- ✓ Cost reduction
- ✓ Avoided distribution upgrades
- ✓ Enhanced reliability & power quality
- ✓ Renewable Integration
- ✓ Economic incentives for customers

Advanced Microgrid Solutions

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

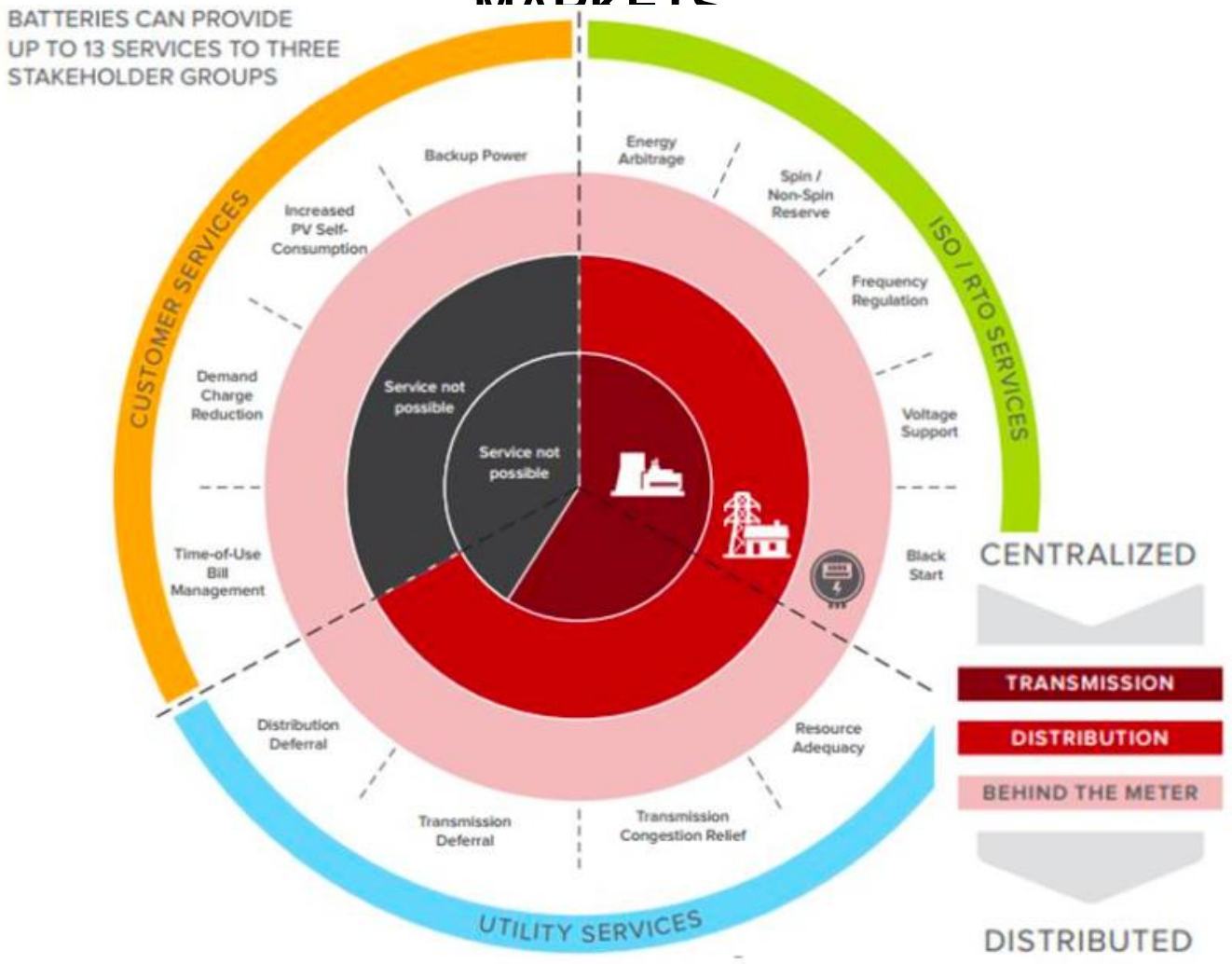
STORAGE ECONOMICS
SUBSIDIES MUST BE REPLACED WITH GRID SERVICES



Advanced Microgrid Solutions

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

THE COST EFFECTIVENESS OF ENERGY STORAGE CORRELATES WITH MATURATION OF TWO PRODUCT MARKETS

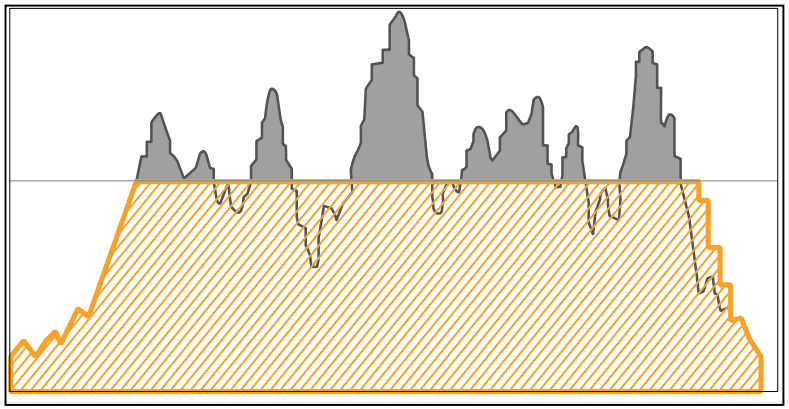


Source: Rocky Mountain Institute

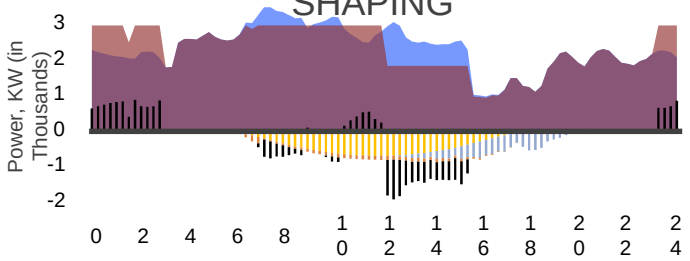
© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

MULTIPLE BENEFITS BEHIND THE METER

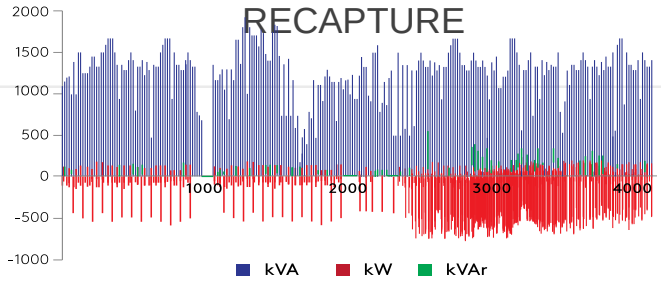
PEAK DEMAND REDUCTION



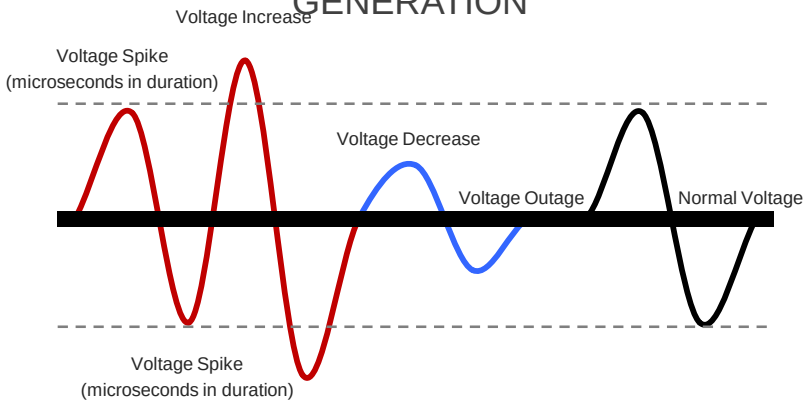
LOAD SHIFTING | SHAPING



NEGATIVE DEMAND RECAPTURE



POWER QUALITY | BACK-UP GENERATION



EV CHARGING

Advanced Microgrid Solutions

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

MULTIPLE BENEFITS TO GRID

Capacity
Load Following / Renewable Integration
Voltage Regulation/ Reactive Power
Conservation Voltage Reduction

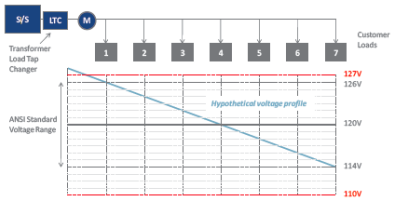


Figure 1. Hypothetical Feeder Voltage Profile with an LTC

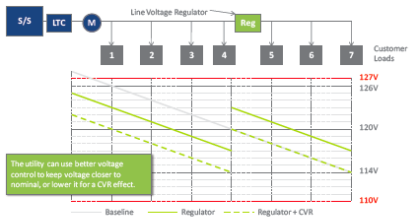
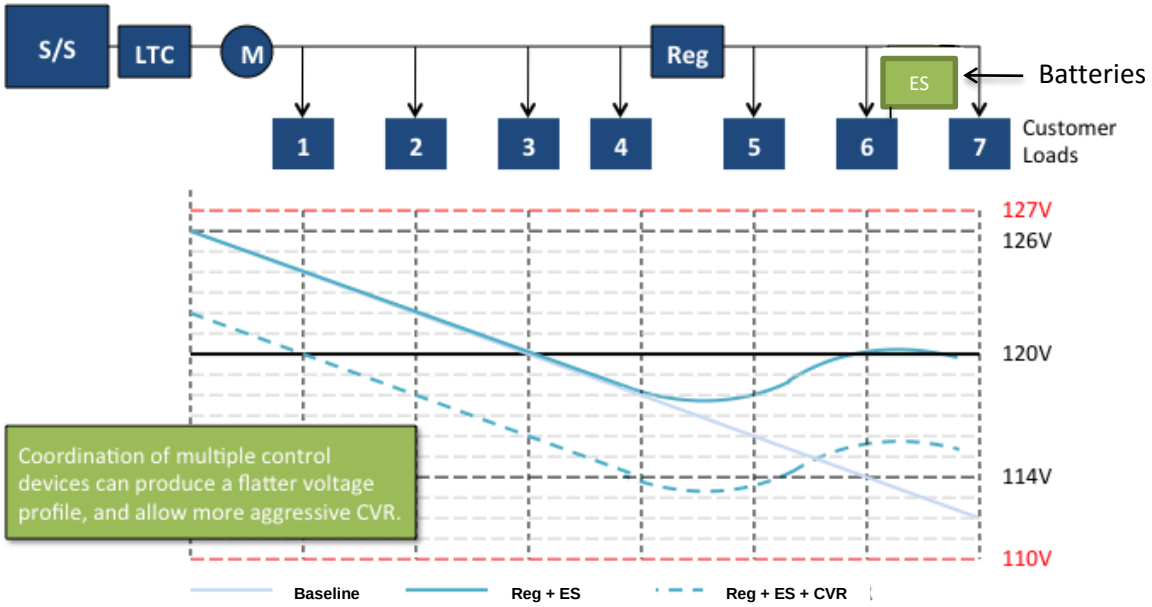


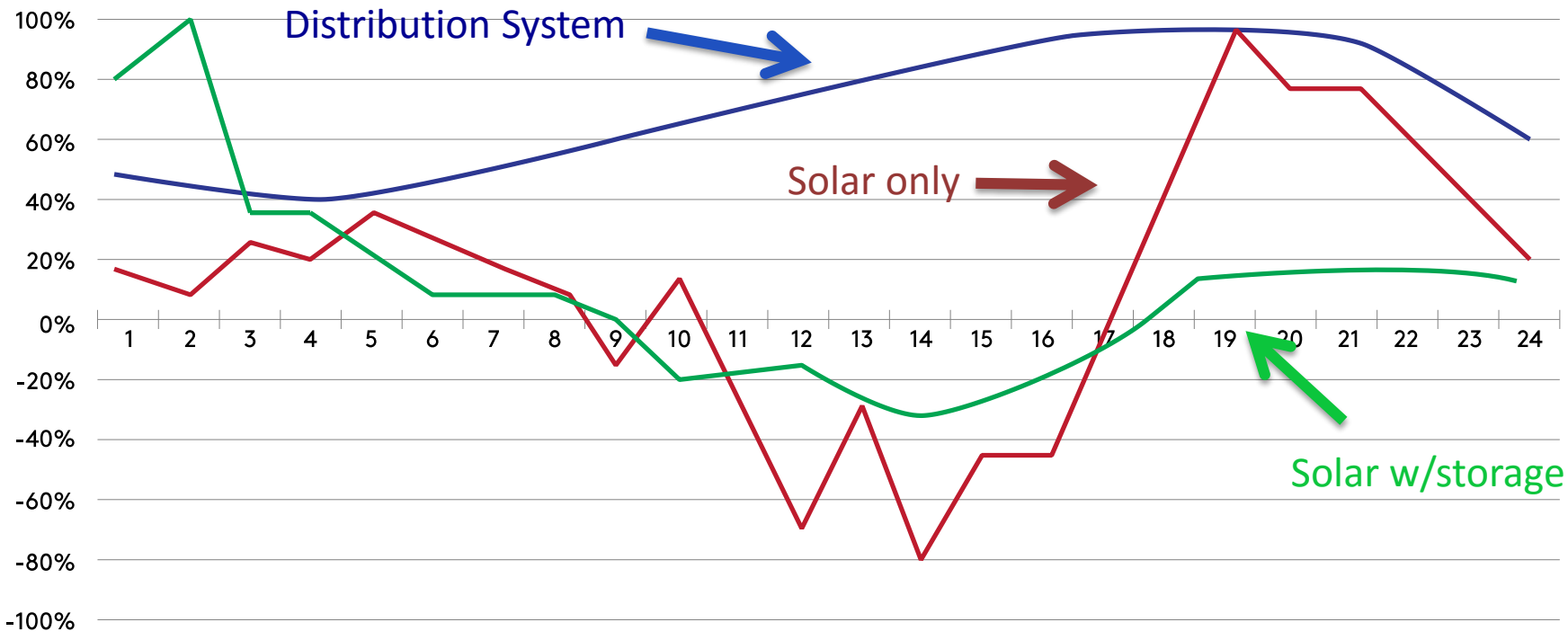
Figure 2. Hypothetical Feeder Voltage Profile with an LTC and Voltage Regulator

Figure 3. Feeder Voltage Profile with LTC, Voltage Regulator and Capacitor Bank



Source: Adapted from Application of Automated Controls for Voltage and Reactive Power Management – Initial Results. DOE – Smart Grid Investment Grant Program, December 2012

STORAGE ENABLES A NEW DISTRIBUTION SYSTEM PLANNING PARADIGM



CUSTOMER LOAD PROFILE (DISTRIBUTION SYSTEM VIEW)

CUSTOMER WITH SOLAR

CUSTOMER WITH SOLAR WITH ENERGY STORAGE

Advanced Microgrid Solutions

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

SCALED AGGREGATION IS KEY

UTILITY/GRID OPERATORS

END USE CUSTOMER

DISTRIBUTED RESOURCE AGGREGATOR

Asset Management, O&M, NOC,

DISTRIBUTION LEVEL SERVICES

Firm Dispatchable Capacity

Dynamic Load Mgmt.

Volt/VAR Optimization
Conservation Voltage Reduction

Wholesale Energy Market Products
-Day Ahead
-Real-time
-Frequency

GRID EDGE SERVICES

Peak Shaving (GHG Reduction)

Energy Cost Reduction

Energy Islanding/ Critical Loads

Demand Response Revenue Generation

Solar Integration

EV Charging Integration

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

SOUTHERN CALIFORNIA EDISON®

An *EDISON INTERNATIONAL*® Company

SCE Signs Contracts for 2,221 Megawatts That Could Power 950,000 Homes in Southern California

ROSEMEAD, Calif.--(BUSINESS WIRE)--Southern California Edison (SCE) announced that it has signed contracts for 2,221 megawatts of power from diverse new resources to meet its customers' long-term electricity needs. The 2,221 megawatts will represent roughly 10 percent of SCE's current total customer peak usage and is enough to power about 950,000 average homes.

"These projects will provide energy solutions to meet the reliability and affordability needs of electricity customers."

The new contracts result from a plan recommended by SCE in response to state forecasts of local reliability needs due to the closure of the San Onofre Nuclear Generating Station and anticipated retirement of older, natural gas generation plants along the Southern California coastline that rely on ocean water for their cooling needs.

In this solicitation, SCE received more than 1,800 final offers and, for the first

greentechmedia:

Inside SoCal Edison's Groundbreaking 2.2GW Grid Modernization Plan

A new model let
distributed solar,
energy storage a
efficiency stand
power plants as
resources.

Jeff St. John
November 21, 2014

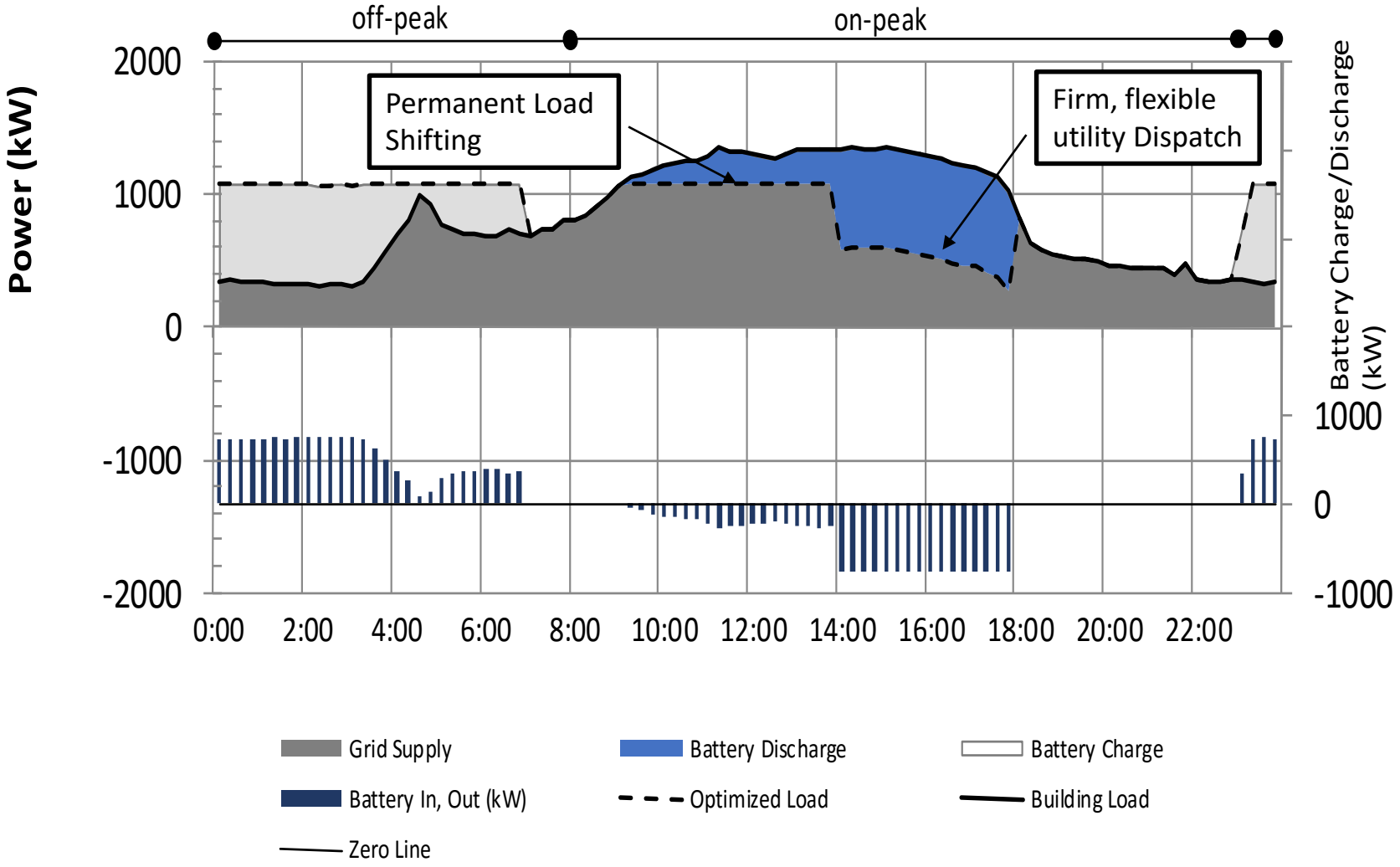
Two weeks ago, utility Southern California Edison launched a real-world experiment in grid-edge economics, one that's going to unfold in real time and at gigawatt scale.

In a first for the utility industry, SCE announced it would buy hundreds of megawatts of distributed solar, behind-the-meter batteries, automated demand response and targeted energy efficiency as part of its 2,200-megawatt Local Capacity Requirement (LCR) procurement for its grid-stressed West Los Angeles Basin region.

AMS
50 Megawatts

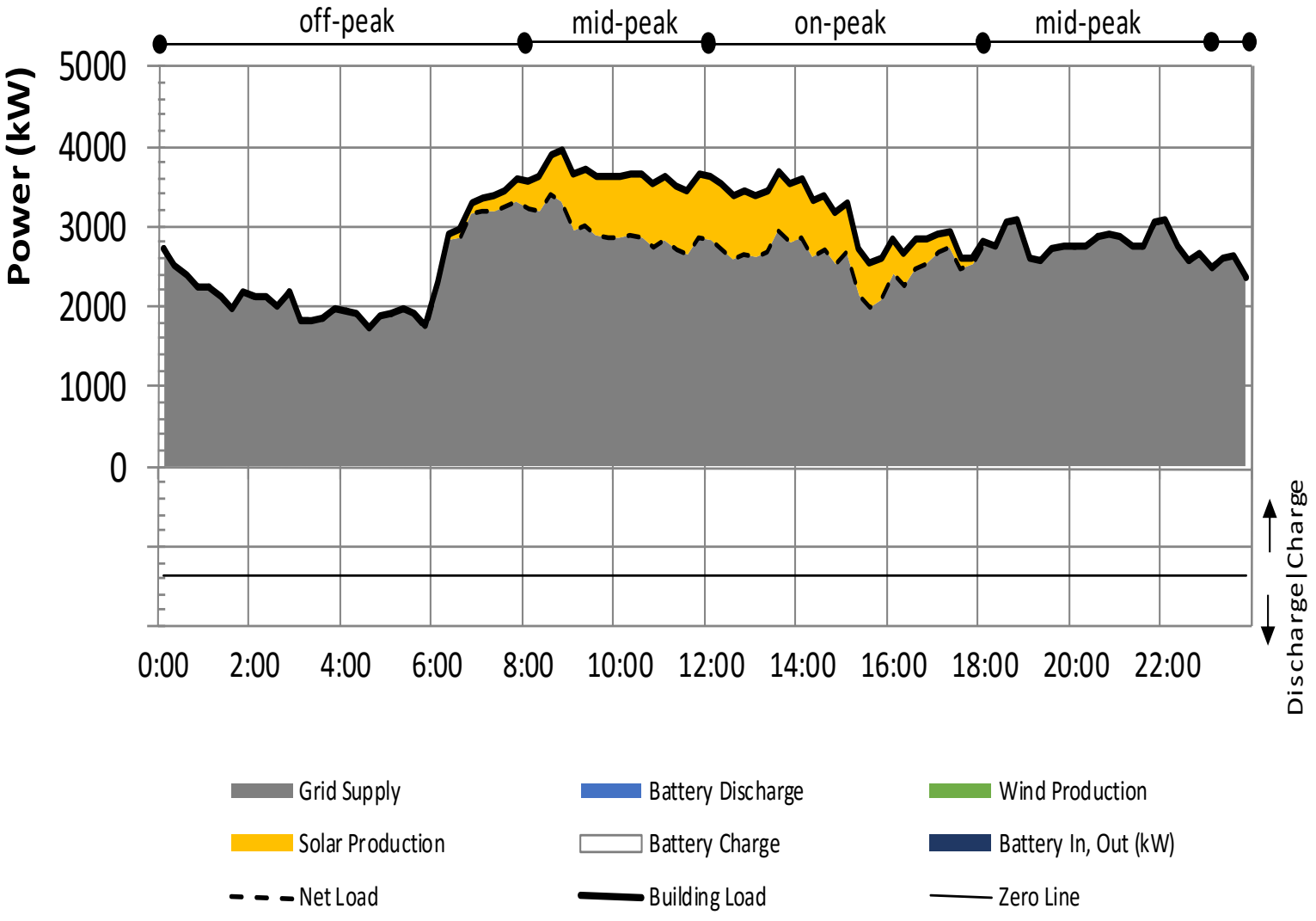
© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

“Value-Stacking” or “Benefit-Sharing” = Multiple uses of same battery



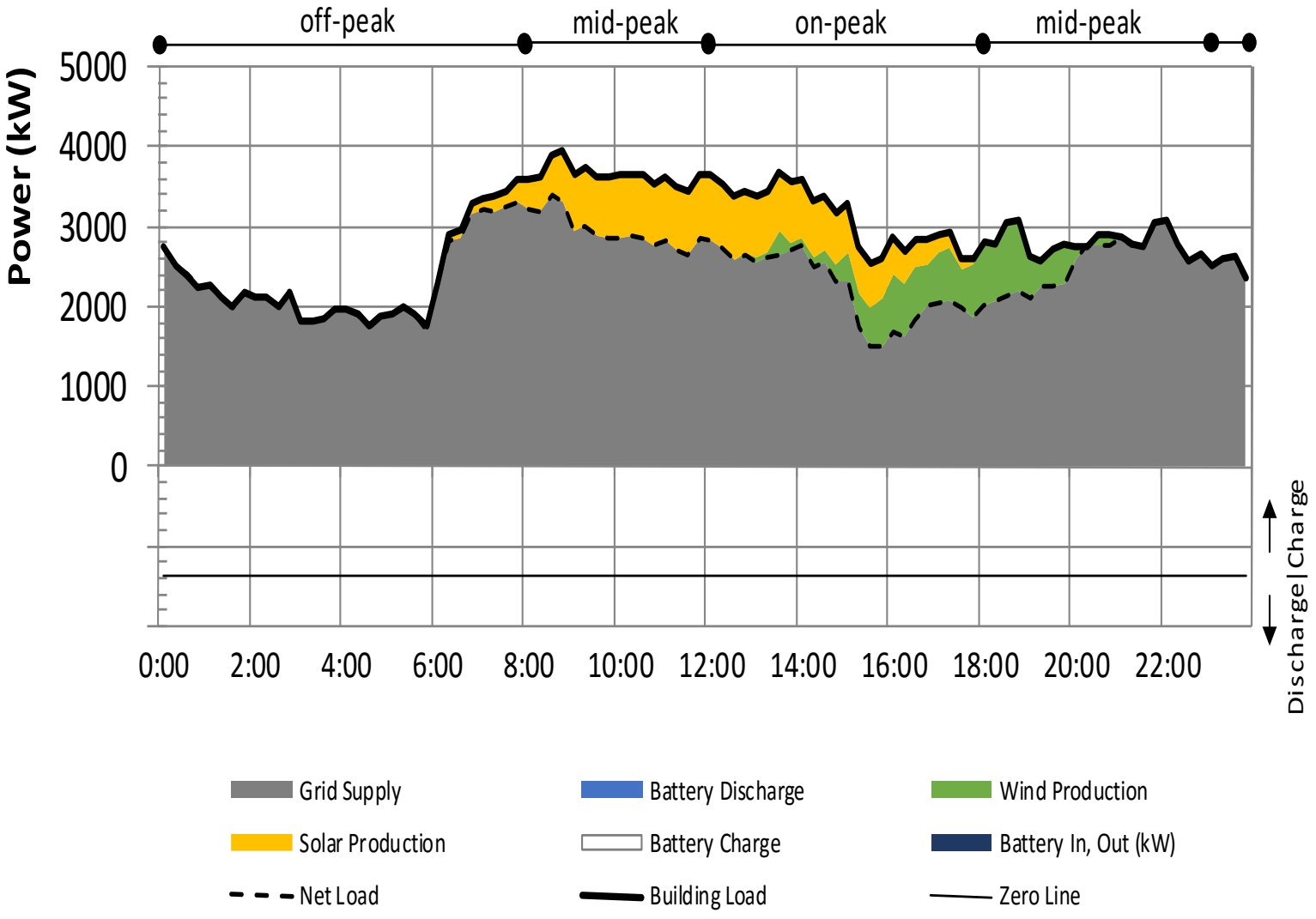
© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

Building Load with Solar



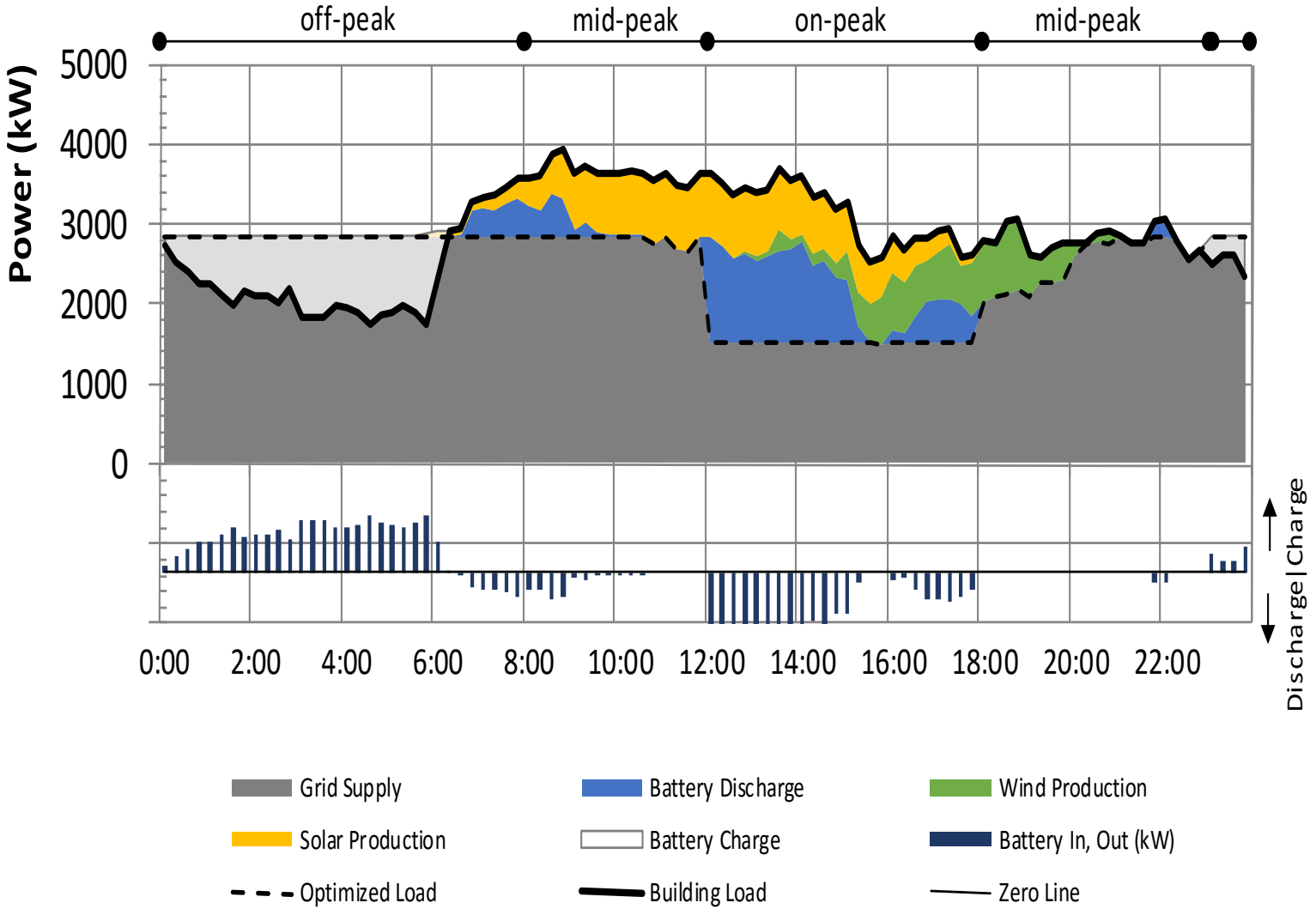
© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

Building Load with Solar & Wind



© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

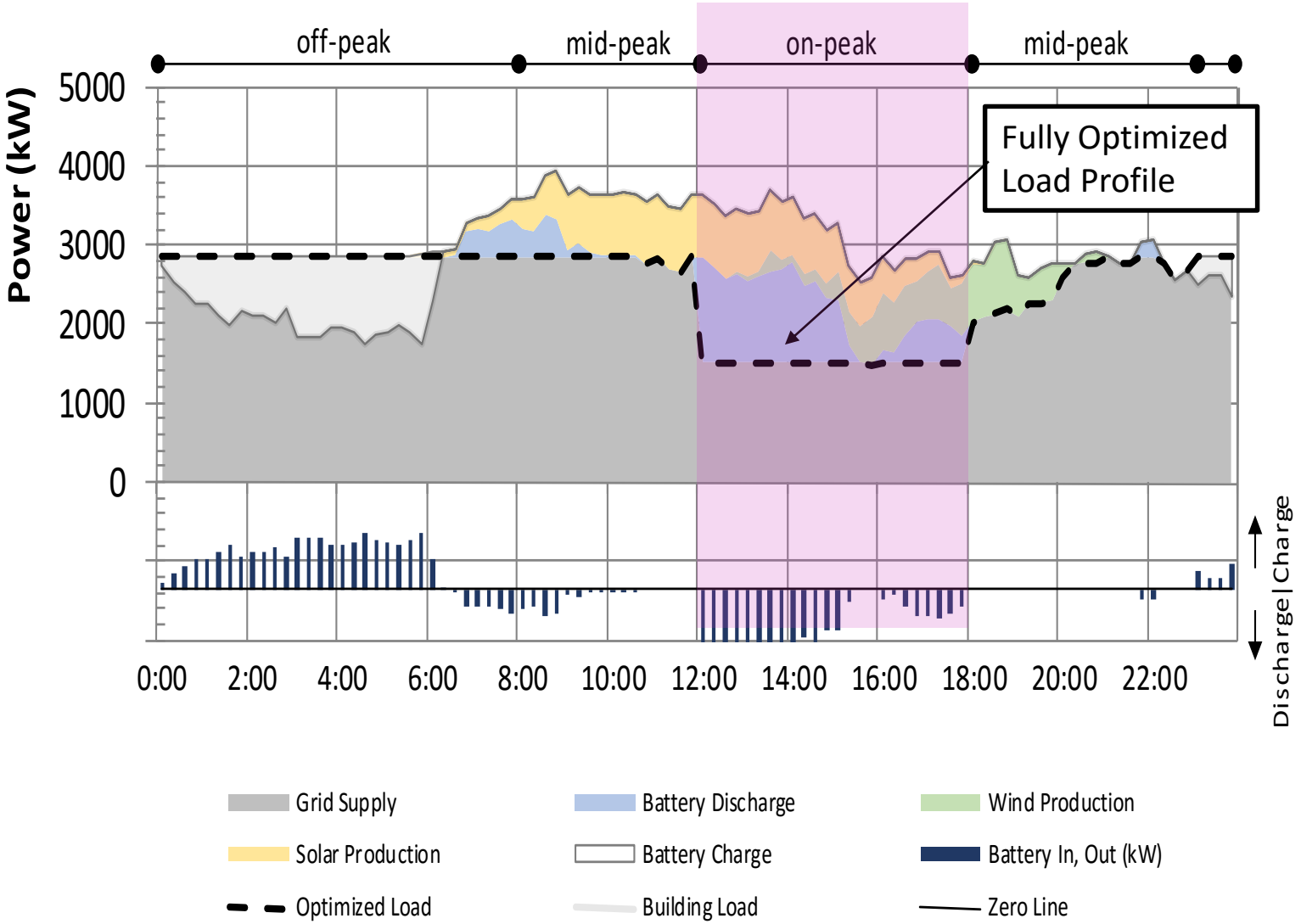
Lowest Cost Energy for Use During On-Peak



Energy Savings	%	Demand Savings	%	Total Before	Total After	Total Savings by $	Total Savings by %
$14,399	1%	$266,472	23%	$2,790,200	$2,509,328	$280,872	10%

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

Fully-Optimized Distributed Generation
The most cost-effective resource



Advanced Microgrid Solutions

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

10 MW HYBRID ELECTRIC BUILDING PROJECT

250kW / 1,500kWh
Energy Storage Systems

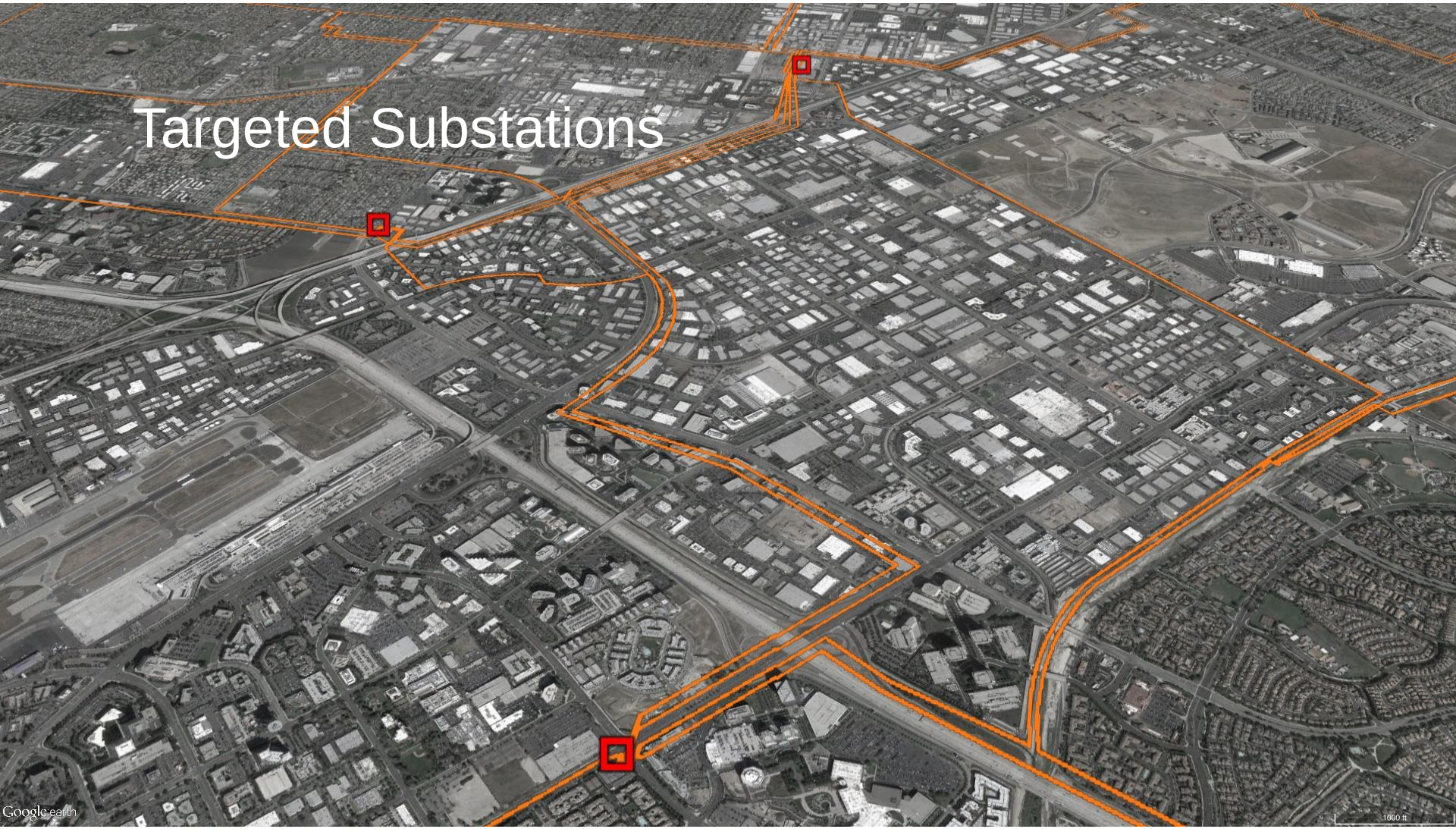
Harnessing Building Load as the Cleanest, Fastest Grid Resource

- **26** Office Buildings
- **25%** Peak Demand Reduction
- **20%** Reduction in GHG Emissions
- **10%** Reduction in Energy Costs
- **10 MW** Firm, Dispatchable Capacity
- **Zero** Emissions
- **Zero** Distribution Upgrades

Advanced Microgrid Solutions

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

Targeted Substations



© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

Dispatchable Building Clusters

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

Utility Scale
Dynamic Load Management

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential

HYBRID ELECTRIC BUILDING™

© 2015 Advanced Microgrid Solutions, Inc, | Proprietary and Confidential