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Memorandum

From the office of
Commissioner Andy Tobin
Arizona Corporation Commission
1200 W. WASHINGTON
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TO: Docket Control

DATE: August 4th, 2016

FROM: Commissioner Andy Tobin's Office

SUBJECT: Docket No. # E-00000J-16-0257

Attached please find Edward Burgess presentation entitled "Reducing Peak System Costs Workshop" for the Reducing System Peak Demand Costs Workshop on August 4, 2016.

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Arizona Corporation Commission
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CERTIFICATION OF SERVICE

On this 4th day of August, 2016, the foregoing document was filed with Docket Control as a correspondence from Commissioner Andy Tobin, and copies of the foregoing were mailed on behalf of Commissioner Andy Tobin to the following who have not consented to email service. On this date or as soon as possible thereafter, the Commission's eDocket program will automatically email a link to the foregoing to the following who have consented to email service.

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Arizona Corporation Commission

Reducing Peak System Costs Workshop

August 4, 2016

ASU LightWorks

ASU Energy Policy Innovation Council

Today's Topics

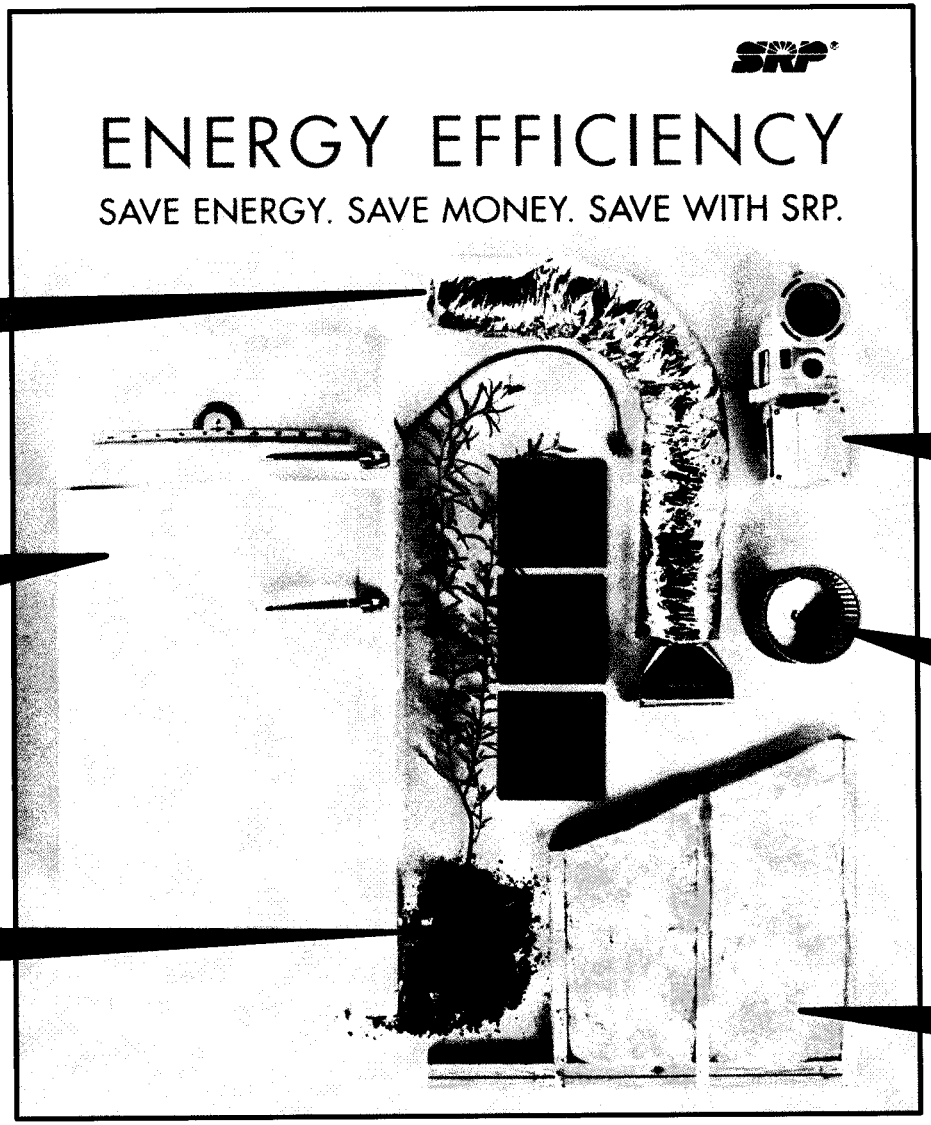
- Demand-Side Management (DSM)
  - Energy Efficiency (EE)– to reduce energy use and peak demand
  - Demand Response (DR) – to reduce peak demand (generally for short periods)
- Energy Storage (ES) – to store energy for later use (can help reduce peak demand)

Definitions

- **Demand Resource (ISO-NE)**: A source of capacity whereby a customer reduces the demand for electricity from the bulk power system, such as by using energy-efficient equipment, shutting off equipment, and using electricity generated on site.
  - **Active Demand Resource**: Real-Time Demand Response and Real-Time Emergency Generation
  - **Passive Demand Resource**: Energy Efficiency

- **Energy Efficiency (EIA):** Refers to programs that are aimed at reducing the energy used by specific end-use devices and systems, typically without affecting the services provided.
- **Demand Response Programs (EIA):** Demand response programs encourage electric power customers to temporarily reduce their demand for power at certain times in exchange for a reduction in their electricity bills. Some demand response programs allow electric power system operators to directly reduce load, while in others, customers retain control.

Energy Efficiency Technologies



HVAC

Appliances

Shading

Motors

Lighting

Building Envelope

Source: SRP 2014 Energy Efficiency Annual Report

DSM Portfolios, Programs, and Measures in AZ

AZ DSM Portfolios

UNS Energy Corp.

[Others]

Example Programs: TEP

Residential Programs:

- Low-income Weatherization
- Residential New Construction
- Shade Tree Program
- Efficient Products
- Existing Homes Retrofit and Audit Direct Install
- Multi-Family
- Appliance Recycling

Non-Residential Programs

- C&I Comprehensive
- Small Business/Schools
- Commercial New Construction
- Bid For Efficiency
- Retro-Commissioning
- Combined Heat and Power (CHP)

Behavioral Sector

- Behavioral Comprehensive

Support Sector

- Consumer Education and Outreach
- Energy Codes and Standards

Utility Improvement Sector

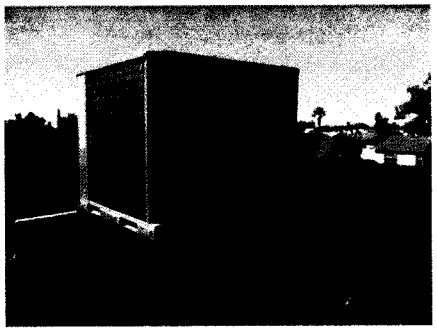
- Conservation Voltage Reduction
- Generation Improvement and Facilities Upgrade
- C&I Direct Load Control Program

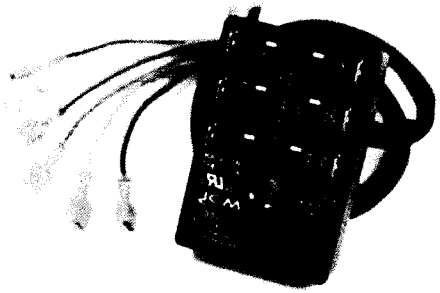
Example Measures: Small Business/Schools

1. 14/15/16 SEER Packaged and Split AC's
2. 14/15/16 SEER Packaged and Split HP's
3. Advanced Power Strips, Load Sensors, Occupancy Sensors, Timer Plug Strip
4. Anti-sweat Heater Controls
5. Beverage Controls
6. Daylighting Controls
7. De-lamping
8. Energy Efficiency Exit Signs
9. Evaporative Fan Controls
10. Hard Wire CFL
11. HIDs to T8/T5
12. High Efficiency Evaporator Fan Motors
13. Induction Lighting Interior
14. Integral Screw In CFL
15. Integrated Case Control and Motor Retro-fit
16. LED Interior
17. Occupancy Sensors
18. Outdoor CFL
19. Programmable Thermostats
20. Refrigerated Display Automatic Door Closers
21. Strip Curtains
22. Variable Speed Drives

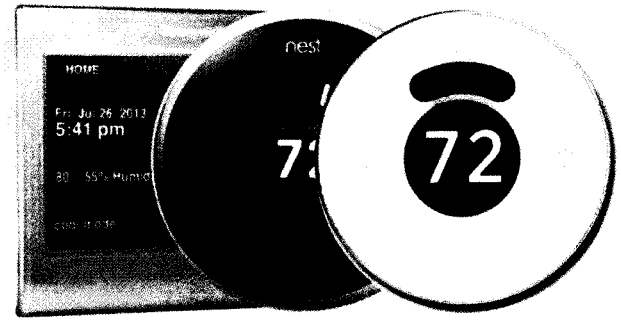
New DSM Technologies Recently Introduced in AZ

- Western Cooling Control Optimizer

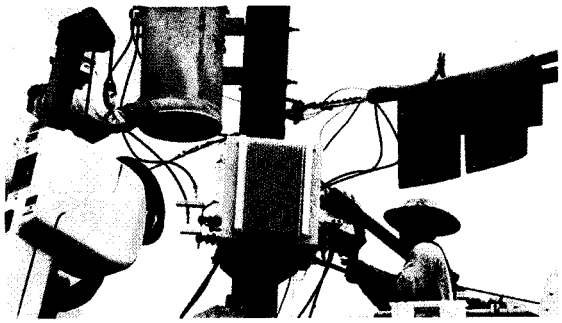




- Smart Thermostats



- Conservation Voltage Reduction



Examples of Peak Demand Reduction from EE Technologies

Measure (Technology)	Sector	Description	Demand Savings, W/unit	Coincident Peak Savings, W/unit (% of measure savings)
LED 100 W Replacement	Residential	Replacement of 100 W bulbs with LED equivalent	50 W	2.5 W **(5%)**
Premium T8/T5	Non-Residential	Replacement of T12 lamps and ballasts with T5 or T8 lamps with electronic ballasts	13-23 W	6-10 W **(44%)**
Daylighting Controls	Non-Residential	Installation of photo sensors that control dimming ballasts or dimming systems on interior lighting equipment	Varies with connected load	Varies **(37%)**
Refrigerated Case LEDs	Non-Residential	Replacement of fluorescent lamps with LEDs in refrigerated and freezer cases	51 W	38 W **(75%)**
HVAC Replacement	Residential	Replacement of AC or heat pump >10 yrs old with a new system using Quality Installation Standards	622 W	622 W **(100%)**

Source: APS 2015 DSM Technical Reference Manual (calculations performed by ASU)

Examples of Peak Demand Reduction from EE Programs (APS)

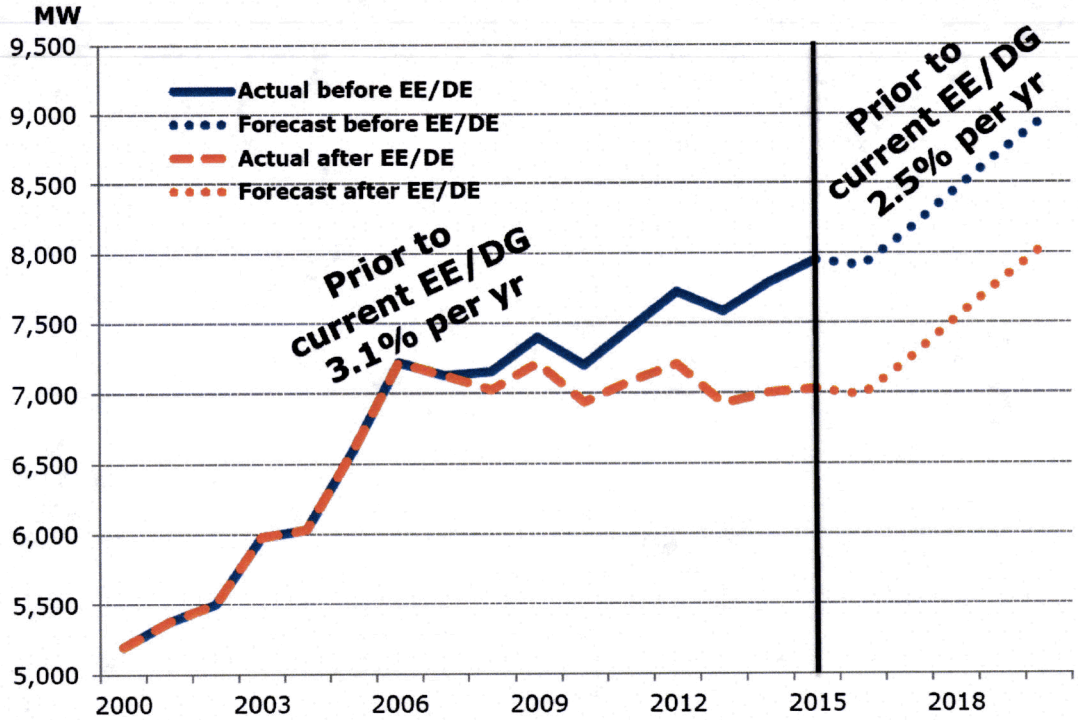
Sector	Program	Peak MW Savings Achieved in 2015	Cumulative Peak MW Savings (2005-2015)	Planned MW Savings for 2016
Residential	Consumer Products	11.6	135.5	13.5
Residential	Existing Homes HVAC	14	66.3	10.2
Residential	Existing Homes - Home Performance	2.6	19.0	5.1
Residential	New Construction	5.8	47.6	5.5
Residential	Appliance Recycling	1.2	9.2	1.4
Residential	Conservation Behavior	12	28.4	6.5
Residential	Multi-Family	1.6	4.0	1.4
Residential	Shade Tree	--	1.1	--
Residential	Prepaid Conservation	0.4	0.4	0.5
Residential	Limited Income	0.3	2.2	0.2
Non-Residential	Large Existing Facilities	32.7	169.8	26.7
Non-Residential	New Construction	7.7	36.2	5.6
Non-Residential	Small Business	4.1	27.1	2.4
Non-Residential	Building operator training	--	0.1	--
Non-Residential	Energy Information Services	2.1	8.6	5.8
Non-Residential	Schools	3.8	21.9	2.7
Support	Codes & Standards	11.9	23.9	7.0
Support	System Savings	0.1	0.1	12.9
Total		***111.9***	***601.4***	***107.4***

Source: APS 2015 DSM Progress Report, APS 2016 DSM Implementation Plan

Effects of EE and DG Technologies

Annual Peak Demand Outlook

Actual Load before and after EE/DG impacts



Growth Rates

	Before EE/DG	After EE/DG
2000-07	4.6%	4.6%
2008-15	2.0%	0.0%
2016-20	2.5%	TBD

Historical EE and DG

- EE demand impact ~(800) MW in 2015.
- DG demand impact ~(125) MW in 2015. *Customer decision making driven.*

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Source: APS IRP Stakeholder Workshop, February 9, 2016

AZ EE Portfolio Summary

Utility	2015 System Peak MW	Peak MW Savings from EE			
		Cumulative EE Through 2015	%	2015 Incremental EE	%
APS	7031	601	8.5%	112	1.6%
SRP	6716	434	6.5%	65	1.0%
TEP	2214	113	5.1%	25	1.1%
UNS	407	23	5.7%	5	1.2%
Total (APS, SRP, TEP & UNS)	***16,368***	***1,171***	***7.2%***	***211***	***1.3%***

Sources:

- System Peak from PNW 2015 Statistical Report, SRP FY15 Financial Report, & TEP/UNS 2015 Annual Reports to ACC.
- Cumulative/Incremental EE calculated from APS 2015 DSM Progress Report, TEP/UNS 2011-2015 DSM Progress Reports, & SRP FY14-FY15 EE Reports. Does not include demand response.

Resource Capacity Cost Comparison

Portfolio	Capacity Savings, MW*	Portfolio Costs*	$/kW
TEP Incremental EE (2015)	25	$15.0 M	$601
APS Incremental EE (2015)	112	$66.1M	$591

*Does not include demand response
Sources: TEP/APS 2015 Annual DSM Progress Reports

Resource	$/kW
Combustion Turbine (Aero)	$1,250
Combustion Turbine (Frame)	$800
Reciprocating Engine	$1,200
Small Modular Reactor	$6,400
Natural Gas Combined Cycle	$1,300

Source: TEP 2016 IRP

Peak Demand Reduction from Demand Response (DR)

- APS Peak Solutions:
  - Direct load control and manual load reduction
  - C&I customers in Phoenix and Yuma
  - Up to 25 MW available in 2016 for 80 event-hours during summer peak
- SRP PowerPartner:
  - Load curtailment
  - 2 events called in FY15
  - Program was recently sunset
- TEP C&I Direct Load Control
  - Load curtailment agreements with customers
  - 61 participating sites in 2015
  - Up to 40 MW available for 80 event-hours during summer peak

AZ Demand Response (DR) Portfolio Summary

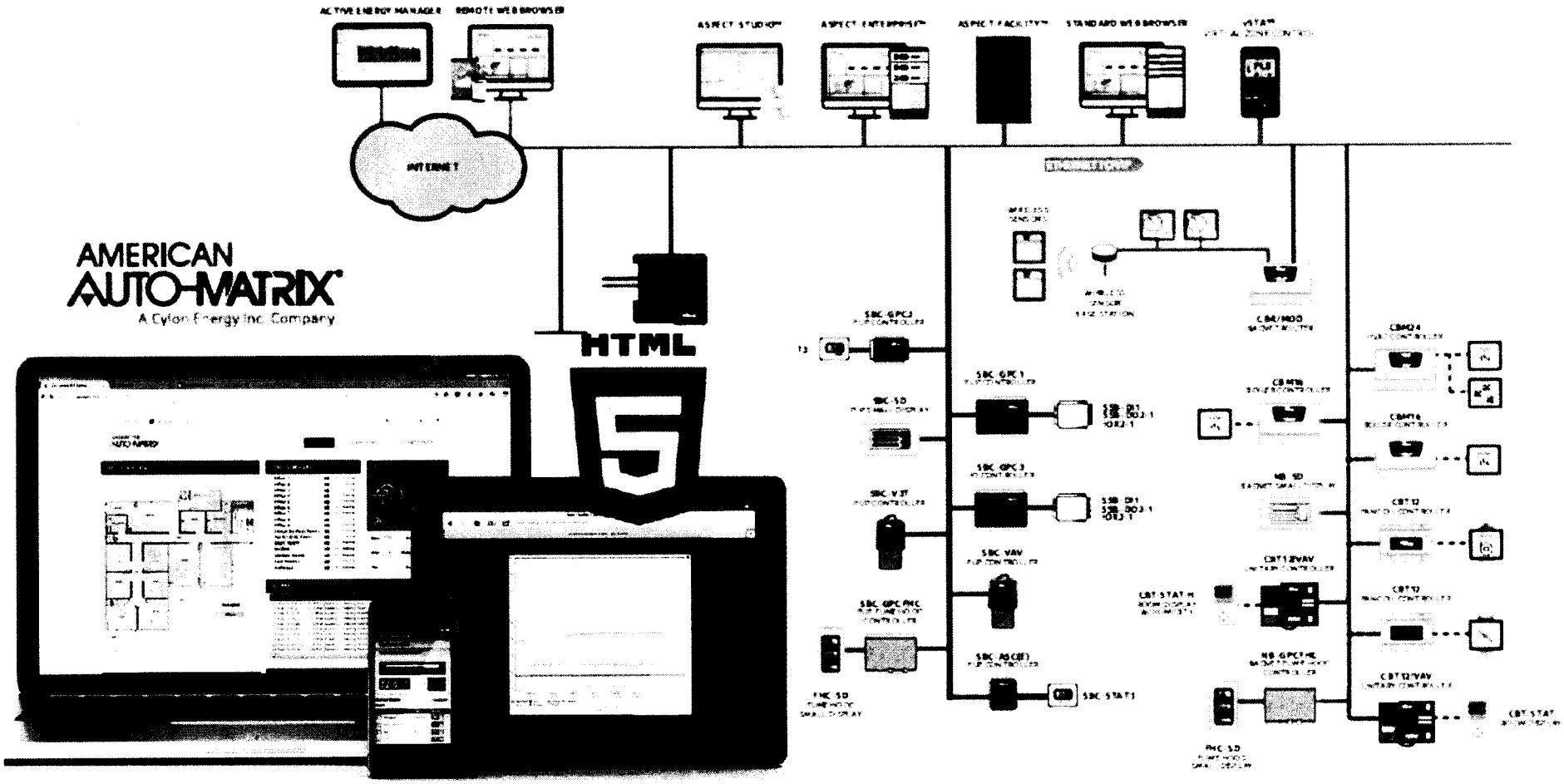
Utility	2015 System Peak MW	Peak MW Savings from DR	
		2015 DR Procurement	%
APS	7031	29	0.4%
SRP	6716	48	0.7%
TEP	2214	18	0.8%
UNS	407	4	0.9%
Total (APS, SRP, TEP & UNS)	***16,368***	***99***	***0.6%***

Sources:

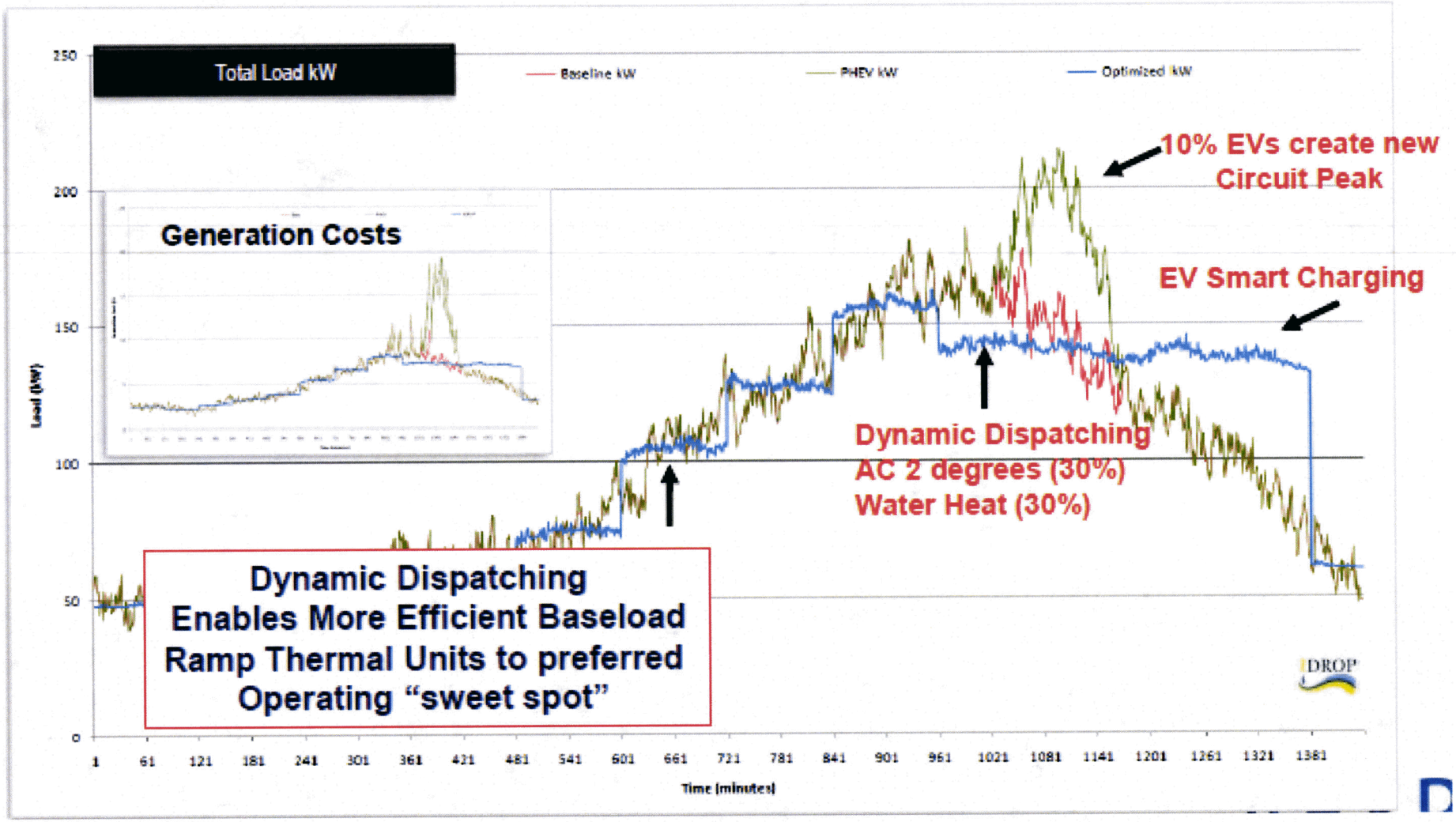
- System Peak from PNW 2015 Statistical Report, SRP FY15 Financial Report, & TEP/UNS 2015 Annual Report to ACC.
- Cumulative/Incremental EE calculated from APS 2015 DSM Progress Report, TEP/UNS 2011-2015 DSM Progress Reports, & SRP FY14-FY15 EE Reports. Does not include pricing measures (e.g. critical peak, peak time rebates, etc.)

Energy management systems, controls, and automation

Building Automation and Energy Management

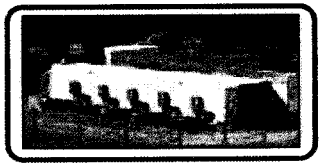
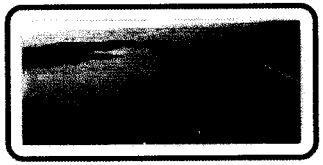


Demand management, analytics, and controls



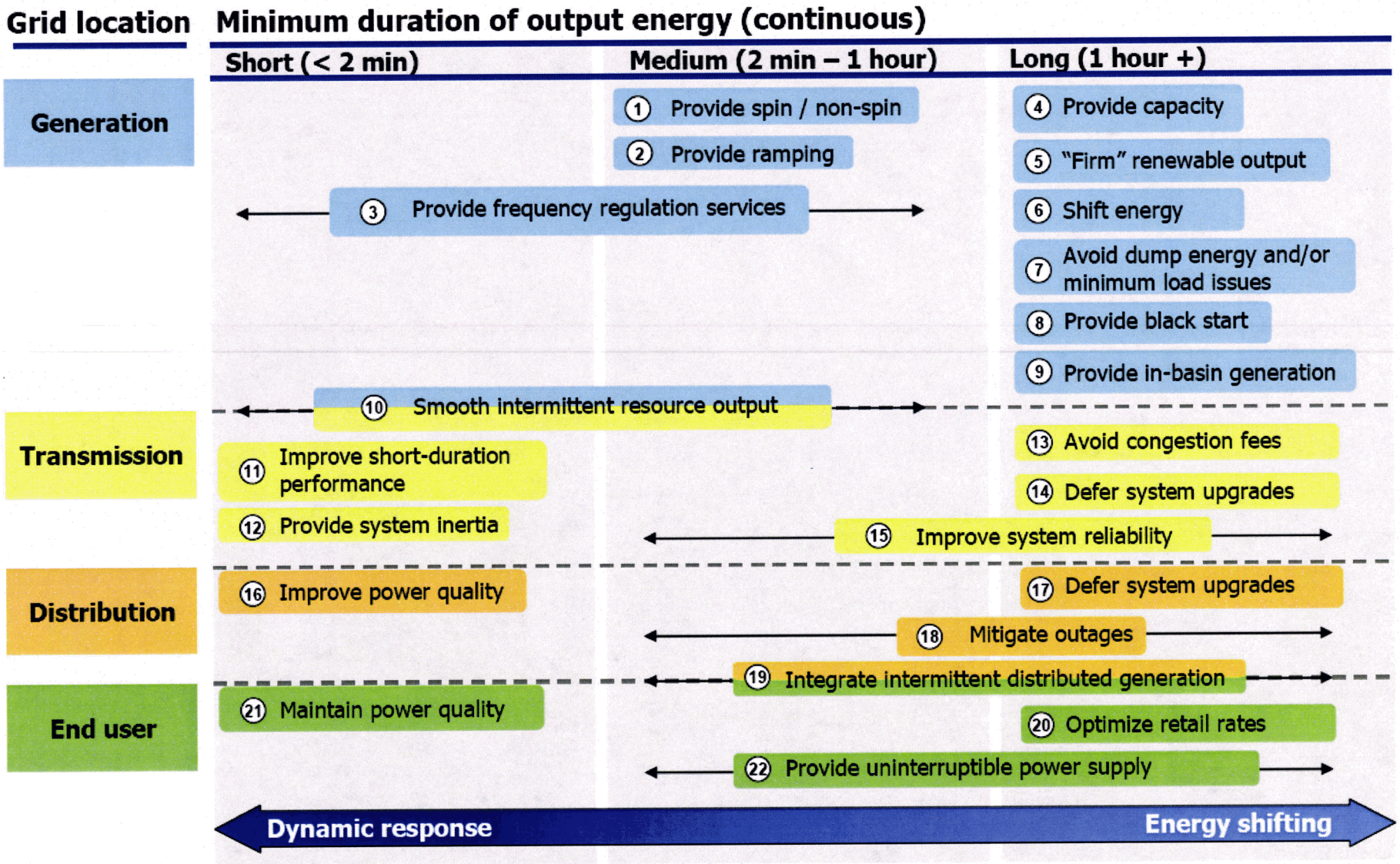
Source: Integral Analytics.

Energy Storage: A Broad Asset Class

Technology Classes	Energy Storage Examples	
Chemical Storage	**Sodium Sulfur Battery** • Electrical energy is stored for later use in chemical form. Existing battery technologies are being improved, and new battery technologies are becoming available. • Example: 34 MW Sodium Sulfur Battery — 51 MW wind farm, Japan (NGK)	
Thermal Storage	**Ice Storage** • Air conditioners create ice at night, when power rates are low. This stored ice then runs a cooling system during the afternoon, when power costs are highest and the power grid is most stressed. • Example: 12 kW Thermal Storage — Napa Community College (Ice Energy)	
Mechanical Storage	**High Speed Flywheel** • Flywheels convert electrical energy to kinetic energy, then back again very rapidly. Flywheels are ideal for power conditioning and short-term storage. • Example: 3 MW Mechanical Storage for Ancillary Services — NE ISO (Beacon Power)	
Bulk Mechanical Storage	**Below Ground Compressed Air** • Electricity is used to compress air into small or large modular storage tanks or a large underground cavern. The compressed air is used to spin turbines when electricity is needed. • Example: 115 MW Compressed Air Energy Storage — McIntosh, Alabama	
Bulk Gravitational Storage	**Pumped Hydro** • Excess electricity is used to pump water uphill into a reservoir. When power is needed, the water can run down through turbines, much like a traditional hydroelectric dam. • Example: 1,532 MW Pumped Hydro — TVA's Raccoon Mountain	

Slide courtesy of Strategen Consulting

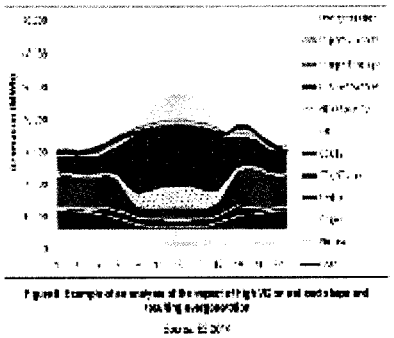
Operational Use Cases For Storage Systems



Source: SCE 2011, https://www.edison.com/content/dam/eix/documents/innovation/smart-grids/Energy-Storage-Concept-to-Reality-Edison.pdf

Major Drivers of Energy Storage in the U.S.

Renewable Energy Penetration

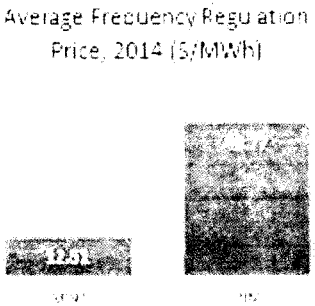


High penetration of renewable energy in some states has led to the need for additional integration solutions including energy storage.

Local Capacity Needs

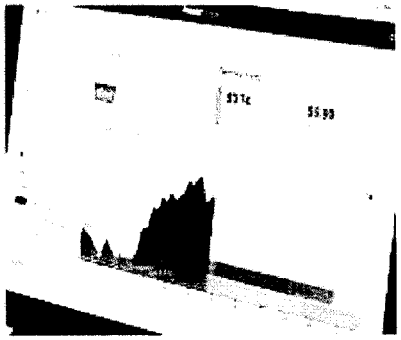
Storage is serving as a capacity resource in high-population areas where new generation or transmission are expensive to build.

Wholesale Market Opportunities



Storage can participate in organized wholesale markets, often by providing fast frequency regulation services.

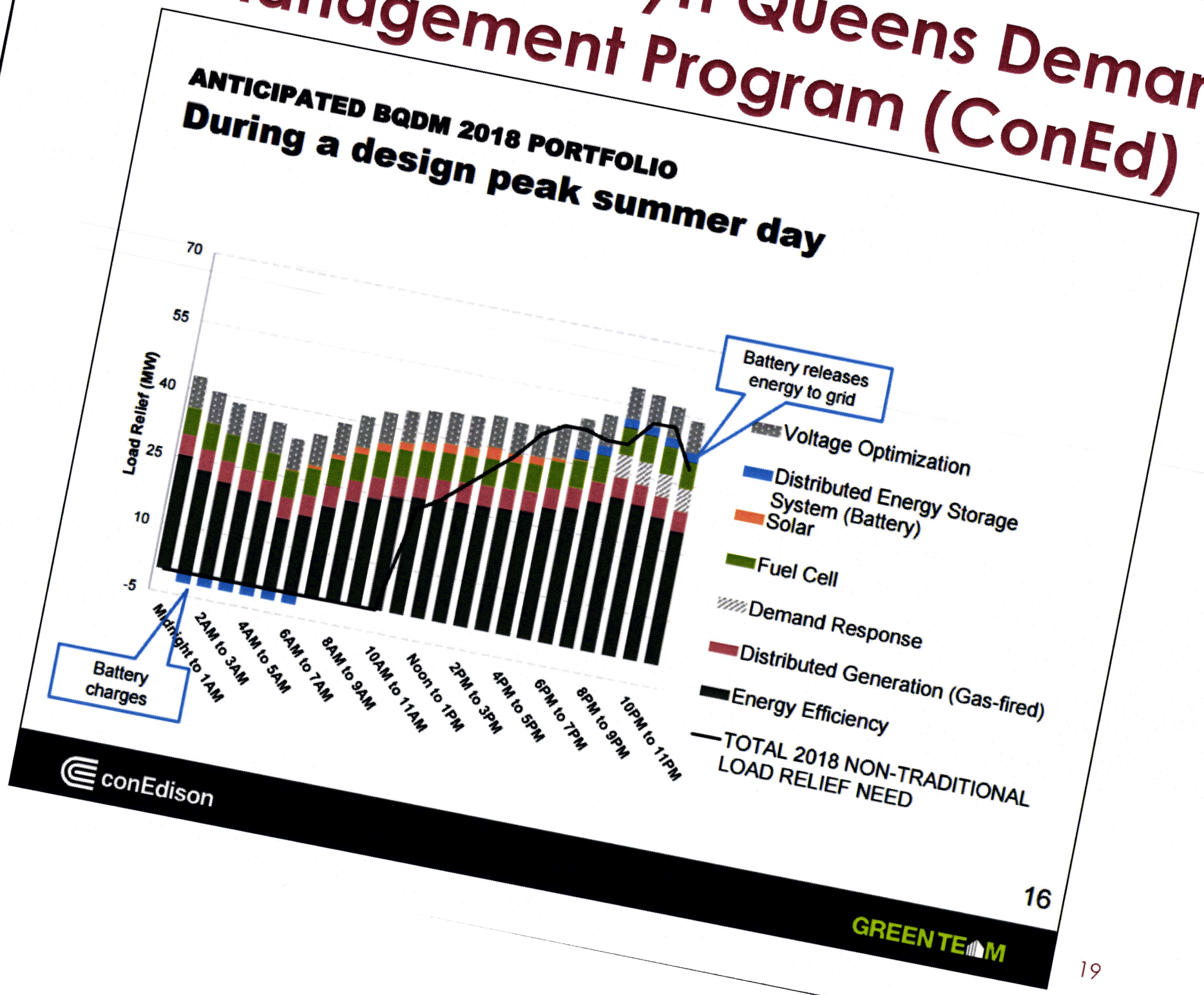
Retail Bill Management



Storage is being offered to C&I customers as a solution for demand charge management.

Slide courtesy of Strategen Consulting

Example: Brooklyn Queens Demand Management Program (ConEd)



Energy Storage in AZ

- TEP
  - Developing two 10 MW grid connected battery storage (Li-ion) facilities
  - Primary use cases: voltage and frequency regulation
- APS
  - Solar Innovation Study pilot program
    - 75 residential homes (25 with energy storage)
    - Studying integration customer-controlled equipment (e.g. solar, battery storage, smart thermostats) with demand-based rates
  - Solar Partner Program
    - 4 MWh of battery storage planned by end of 2016

Thank You!

Please contact us with questions, comments, feedback, etc.

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