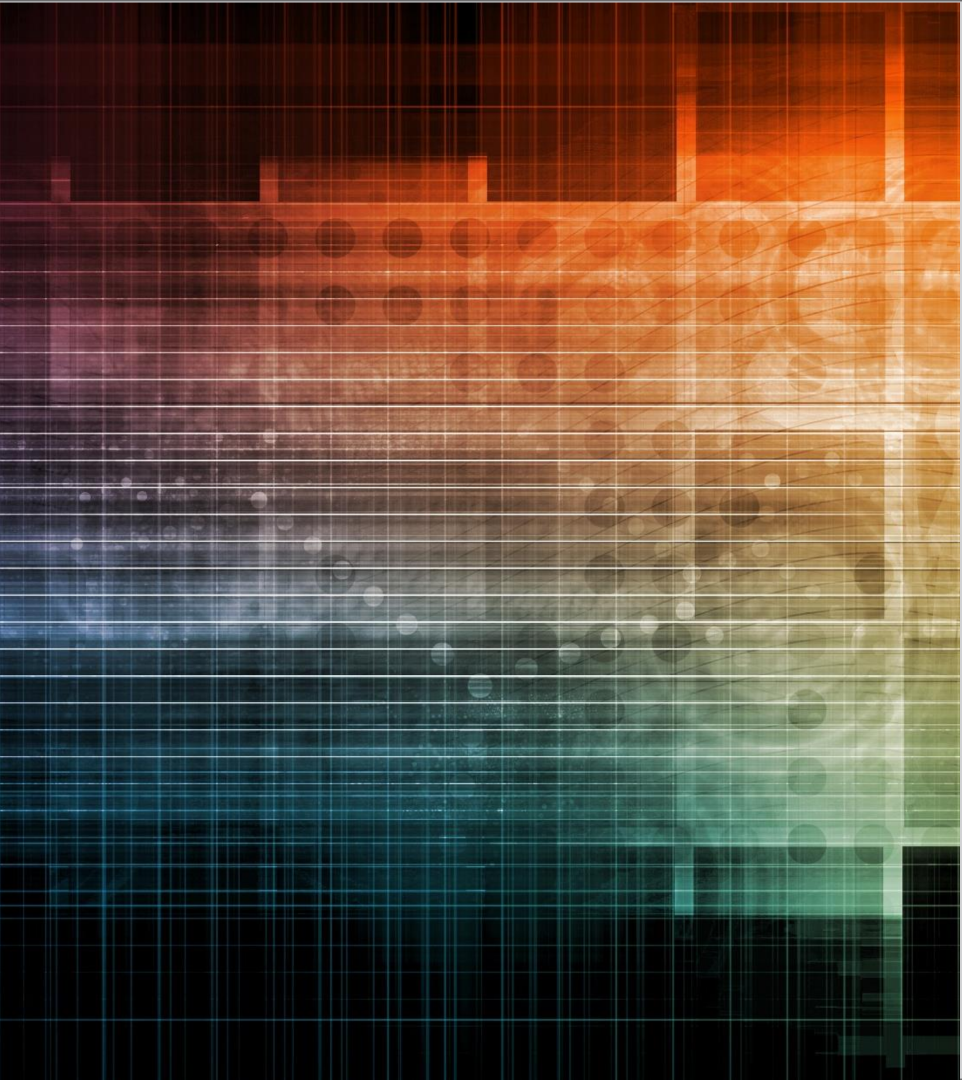

E4 THE FUTURE PLMA Load Management Leadership Smart Electric Power Alliance

Non-Wires Alternatives: Insights from the Nation's Leading NWA Projects

Thursday, December 6, 2018

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Smart Electric Power Alliance

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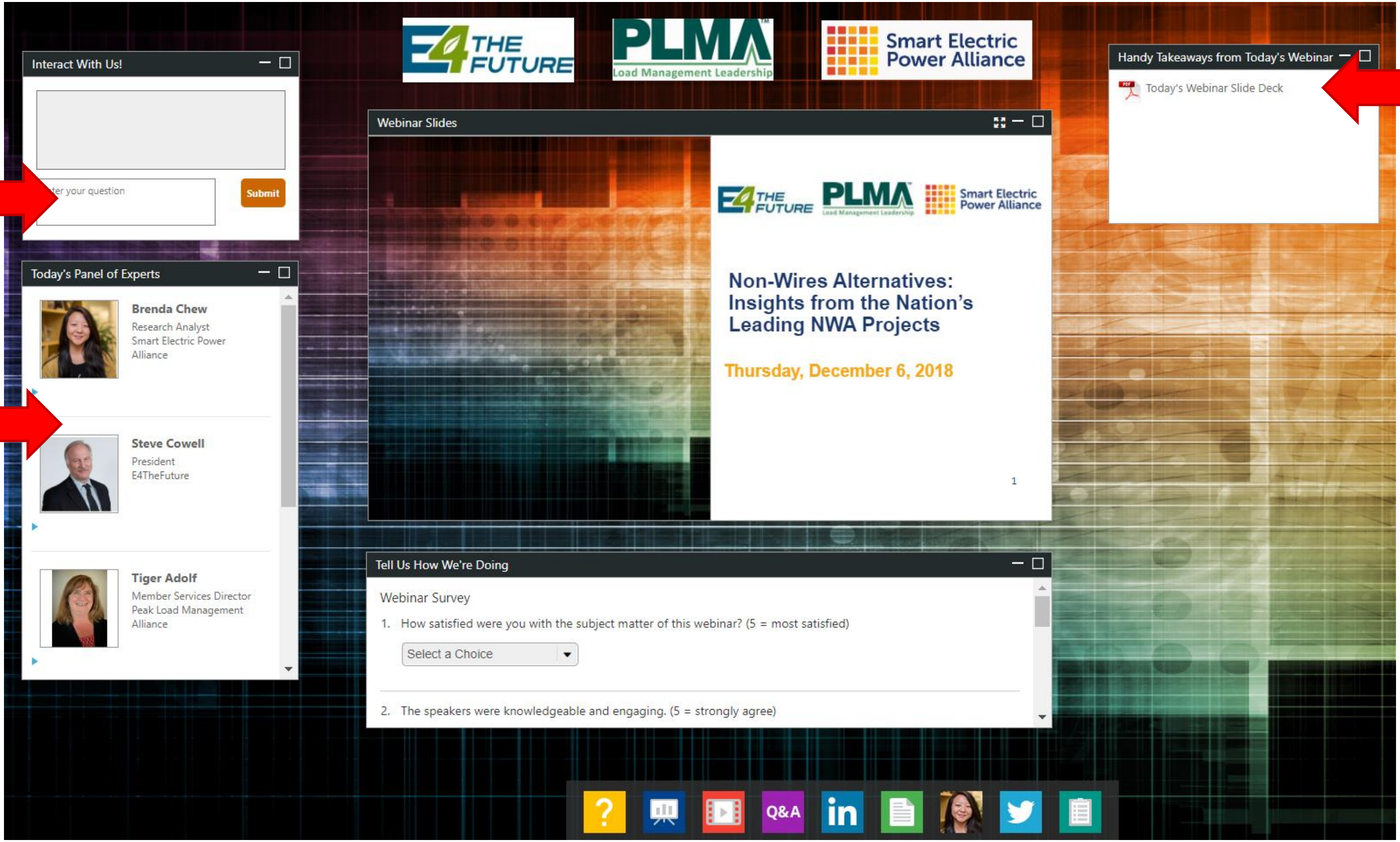

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Upcoming Events

Solar Power New York

December 13 - 14 | New York, NY

Register at https://events.solar

2019 National Home Performance Conference

April 1 -4 | Chicago, IL

39th PLMA Conference

May 13 – 15 | Minneapolis, MN

Todays Moderator & Speakers

Brenda Chew

Analyst, Research

SEPA

Today's Moderator

Tiger Adolf

Member Services Director

Peak Load Management Alliance

Steve Cowell

President

E4TheFuture

Mark Sclafani

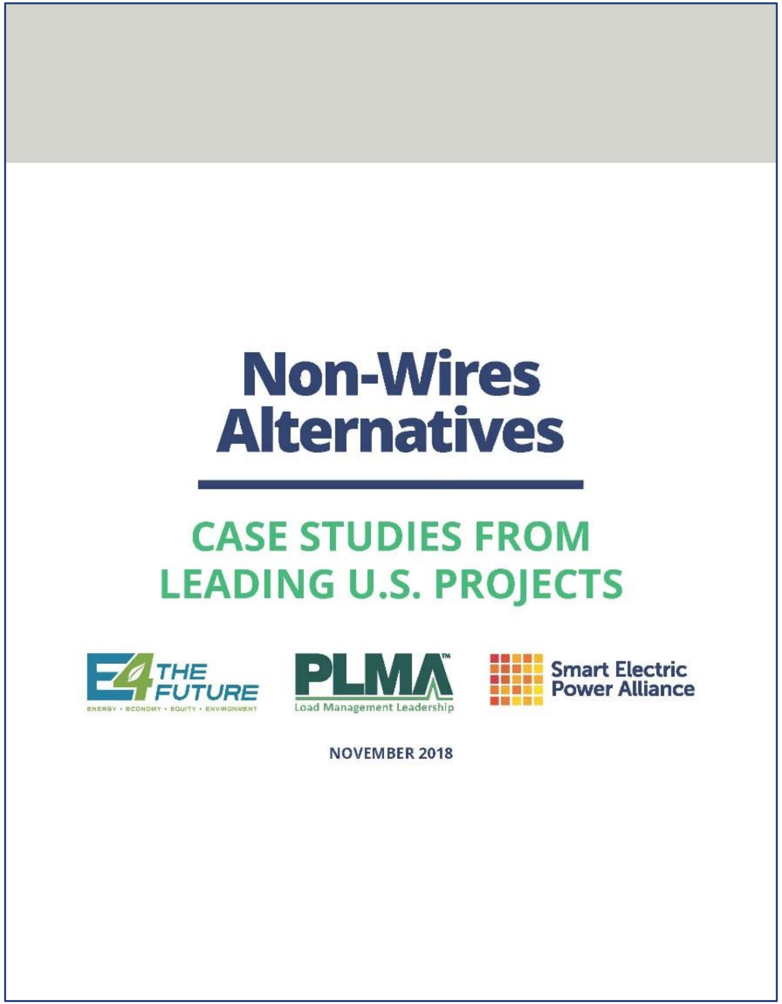
Senior Program Coordinator, Demand Response

Central Hudson Gas & Electric

Sarah Arison

Project Manager | SOA Non Wires

Bonneville Power Administration


Non-Wires Alternatives

CASE STUDIES FROM LEADING U.S. PROJECTS

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NOVEMBER 2018

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The need to replace aging electric grid infrastructure amidst rapidly evolving utility roles, customer demands and improved distributed energy resource (DER) technology is clear. Utilities – and others – are exploring lower cost, higher consumer and environmental benefit solutions with non-wire alternatives (NWA).

Funding provided by:

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Case Studies Developed by:

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Load Management Leadership

Additional Research and Report by:

Smart Electric Power Alliance

Non-Wires Alternatives:
Case Studies from Leading U.S. Projects

Background and Methodology

- Launched an industry-wide call for NWA case studies
  - Received more than 25 project nominations
- A peer review team of ~40 volunteers scored case study nominations based on:
  - Applicability
  - Challenges identified and lessons learned
  - Cross-sectional representation

Non-wires alternatives is defined as "an electricity grid investment or project that uses non-traditional transmission and distribution (T&D) solutions, such as distributed generation (DG), energy storage, energy efficiency (EE), demand response (DR), and grid software and controls, to defer or replace the need for specific equipment upgrades, such as T&D lines or transformers, by reducing load at a substation or circuit level." (Navigant, 2018)

Peer Review Group – Scored and/or Reviewed

Bruce Humenik, Applied Energy Group

Frank Brown, Bonneville Power Administration

Tom Brim, Bonneville Power Administration

Melanie Smith, Bonneville Power Administration

Mark Sclafani, Central Hudson

Damei Jack, Con Ed

Derek Kirchner, DTE Energy

Rich Philip, Duke Energy

Keith Day, E.ON

Ryan Brager, Eaton

Kitty Wang, Energy Solutions

Ron Chebra, EnerNEX

Rich Barone, Hawaiian Electric

Jason Cigarran, Itron

Bill Steigelmann, Lockheed Martin

Brett Feldman, Navigant

Elizabeth Titus, NEEP

Ashley Van Booven, New Braunfels Utilities

Michael Brown, NV Energy

Ahmed Mousa, PSEG

Mark Dyson, Rocky Mountain Institute

Ross Malme, Skipping Stone

Eric Winkler, Winkler Consulting

Joe Peichel, Xcel Energy

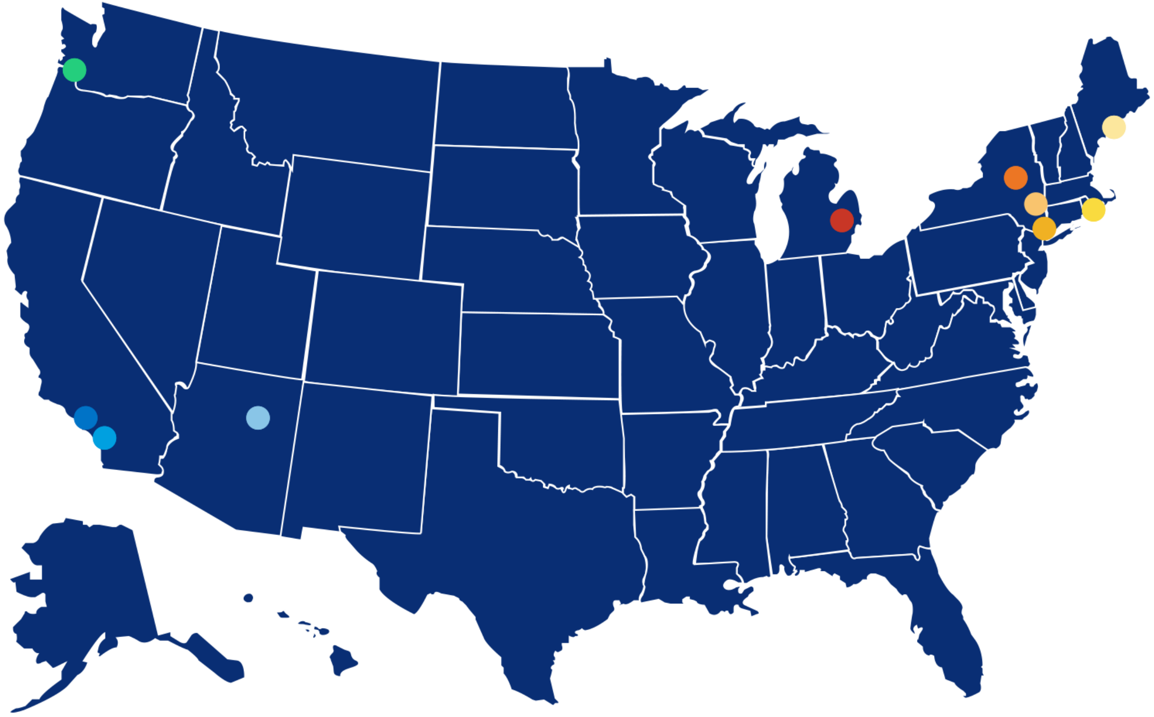
Dave Hyland, Zen Ecosystems

Eric Smith, Zome

Alana Lemarchand, Demand Side Analytics

David South, West Monroe Partners

Featured Case Studies



- **BPA—SOUTH OF ALLSTON**
  ALLSTON, WA
- **SCE—VIRTUAL POWER PLANT**
  LOS ANGELES, CA
- **SCE—DESI 1**
  ORANGE, CA
- **APS—PUNKIN CENTER**
  PUNKIN CENTER, AZ
- **CONSUMERS ENERGY—SWARTZ CREEK ENERGY SAVERS**
  SWARTZ CREEK, MI
- **NATIONAL GRID—OLD FORGE**
  OLD FORGE, NY
- **CENTRAL HUDSON GAS & ELECTRIC—PEAK PERKS PROGRAM**
  MID-HUDSON RIVER, NY
- **CON ED—BROOKLYN QUEENS DEMAND MANAGEMENT**
  BROOKLYN, NY
- **NATIONAL GRID—TIVERTON NWA PILOT**
  TIVERTON/LITTLE COMPTON, RI
- **GRIDSOLAR—BOOTHBAY PILOT**
  BOOTHBAY PENINSULA, ME

Source: SEPA, PLMA, and E4TheFuture, 2018.

Case Study Lead Authors

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Matthew Chew, National Grid

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Patty Shaw, Stem

Grant Davis, Southern California Edison

Arizona Public Service – Punkin Center

Description: Address load growth and consequent thermal constraints on Punkin Center feeder

Traditional: Rebuild 17 miles of distribution lines over rough terrain

NWA: Battery energy storage system (BESS)

Challenge/Opportunity: Rural location with difficult geography and thermal conditions in both summer and winter

Sourcing: Direct procurement through competitive-bidding process

BESS at Punkin Center

Technology, Size, and Location

- Electric storage
- 2 MW/8 MWh in Punkin Center, AZ

Drivers

- Thermal constraint on distribution feeder
- Economic benefit for APS customers

Outcomes

- Reliable peak shaving service on the thermally constrained feeder during the summer of 2018.
- Cost-effective solution for APS to serve the rural community, compared to reconductoring of the line.
- Battery project designed with the capability to add energy capacity as the need arises over the next five to 10 years.

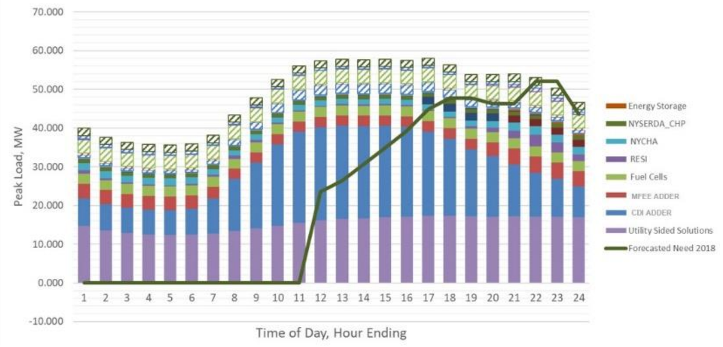
Con Edison – Brooklyn Queens Demand Management

Description: The Brooklyn Queens Demand Management program (BQDM) is one of the largest NWA projects in the U.S, with close to 52 MW of traditional and non-traditional resources. This project was designed to help delay the construction of a new substation beyond initial load-relief projections. This project demonstrates the ability to implement a diverse portfolio of distributed energy resources (DER) technology to drive demand reduction and defer traditional infrastructure upgrades that would require a large investment.

Challenge/Opportunity: Sub-transmission feeder constraint at a substation

Sourcing: Customer program

Example of Hourly Load Reduction Provided by the Different NWA Resource – BQDM Program Portfolio



Technology, Size, and Location

- Energy efficiency, demand response, distributed generation, electric storage
- ~ 52 MW in New York City

Drivers

- Internal management decision with regulatory mandate (NY REV)

Outcomes

- Project successfully deferred the need for a substation upgrade that would have cost $1.2 billion.
- Con Edison received an extension in 2017 to continue implementation of the BQDM program to defer additional traditional investments and deliver additional benefits to customers.
- The BQDM program also increased levels of engagement with customers and vendors. Some local employers have also referenced the program as a driver for new jobs in the area.

Consumers Energy – Swartz Creek Energy Savers Club

Description: Avoid or defer distribution system investments and provide cost savings for customers

Traditional: $1.1 million infrastructure investment

NWA: Residential air conditioner cycling and EE measures

Goal: Reduce load requirements below the 80% maximum summer capacity (reduce peak load by 1.4 MW by 2018 or 1.6 MW by 2019) and defer a $1.1 million infrastructure investment

Challenge/Opportunity: Distribution grid constraint

Sourcing: Customer program

Technology, Size, and Location

- Energy efficiency, demand response
- Up to 1.6 MW in Swartz Creek, MI

Drivers

- Internal management decision relative to regulatory mandate

Outcomes

- Project is helping to reduce demand through increased program participation, projected participation goals are currently below targets.
- The project is still active, and the team is currently exploring additional opportunities to meet targets, including deployment in another location.

GridSolar, LLC – Boothbay

Description: Mix of NWA solutions to address forecasted load concerns.

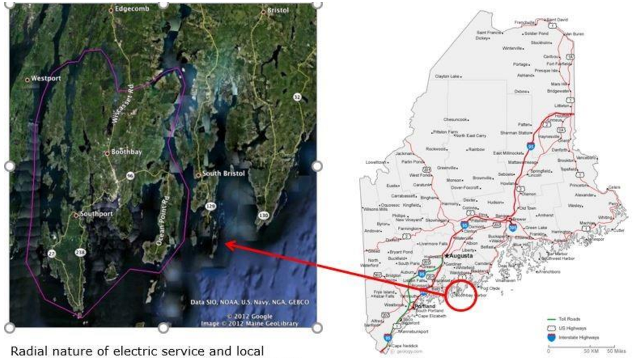
Traditional: $1 Billion Transmission Line Project (environmental concerns)

NWA: 500 kW, 3 MWh Convergent supplied battery energy storage system (BESS); 250 kW of Ice Energy's thermal storage units; 500 kW, diesel-fueled back-up generator; EE commercial lighting; Rooftop solar PV systems

Challenge/Opportunity: Sub-transmission constraint, reliability

Sourcing: Direct procurement (competitive-bidding and sole-sourced)

Project Area, Boothbay Peninsula



Radial nature of electric service and local distribution circuits on the Boothbay peninsula defines the electrical region for the Pilot Project – Total Peak load – Approx. 30 MW.

Technology, Size, and Location

- Energy efficiency, energy storage (battery and thermal), demand response, renewables, back-up generators
- 1.85 MW in Maine

Drivers

- Regulatory mandate

Outcomes

- Project demonstrated reliability benefits comparable to a transmission line
- Project ended in 2018 because electric load growth did not materialize as originally forecasted. Boothbay region load never reached forecasted levels, so full NWA deployment was not required.
- Maine ratepayers saved over $12 million compared to a stranded transmission asset that turned out was not needed.

National Grid – Tiverton NWA Pilot

Description: The Tiverton Non-Wires Alternative (NWA) Pilot utilized a customer-driven load curtailment program called DemandLink that focused on automated demand response (DR). The NWA pilot program included a wide variety of DR and energy efficiency (EE) resources, such as Wi-Fi thermostats, heat pump water heater rebates and installation, and window air conditioner (AC) replacement and recycling. Although the project never fully realized the goal of 1 MW of load reduction after five years, the Tiverton NWA Pilot did defer the Tiverton Substation and feeder upgrades.

Challenge/Opportunity: Distribution grid constraint

Sourcing: Customer program

Technology, Size, and Location

- Energy efficiency, demand response
- 1 MW in Tiverton and Little Compton, Rhode Island

Drivers

- Internal management decision

Outcomes

- Tiverton NWA Pilot deferred the $2.9 million feeder project over the five years. However, the project was not able to fully realize the 1 MW of 2017 summer load reduction goal.
- The effort has remained cost-effective over its life, with a benefit-cost ratio of 1.40. Each year also proved to be cost-effective aside from 2018.
- Despite the unrealized load reduction, the substation upgrade was further deferred due to slower than expected load growth and cooler summer temperatures in 2017.

National Grid – Old Forge

Description: National Grid's Old Forge project is currently still in development. It seeks to improve the reliability on a radial, 46 kV sub-transmission line that feeds five substations in three New York counties. National Grid issued an RFP in early 2017 that was open to all vendors and DER technologies. Eight out of nine proposals included a BESS technology. The utility is applying a BCA tool to short list proposals. A final decision is anticipated in Q1 2019.

Challenge/Opportunity: Distribution grid constraint and grid resiliency

Sourcing: Direct procurement

Technology, Size, and Location	Outcomes
• Electric storage • 19.8 MW, 63.1 MWh in upstate New York **Drivers** • Internal management decision	• The Old Forge project is still in the early phases of procurement. Results will be available later in the project timeline

SCE – Distribution Energy Storage Integration (DESI) 1

Description: Defer a distribution upgrade

NWA: Circuit load management with the deployment of a front-of-the-meter, grid-interactive compact, lithium-ion BESS installed on 1,600 square-foot easement at the customer's industrial facility.

Notable: Third-party maintenance - Compact customer location - Owned and operated by the utility as a grid asset

Challenge/Opportunity: Distribution grid constraint

Sourcing: Direct procurement through competitive-bidding process to identify sole source

SOUTHERN CALIFORNIA EDISON
An EDISON INTERNATIONAL® Company

Technology, Size, and Location

- Electric storage
- 2.4 MW, 3.9 MWh Orange, CA

Drivers

- Internal management decision

Outcomes

- DESI 1 team noted the project has "successfully dispatched multiple times to keep the circuit load from exceeding the limits and met its original objective."
- The BESS is capable of operating in other control modes, including reactive power dispatch for voltage regulation.
- SCE has used the system to validate distribution circuit voltage models and demonstrate reactive power capabilities.

SCE – Distribution Energy Storage Virtual Power Plant

Description: Closure of the San Onofre Nuclear Generating Station and anticipated retirement of natural gas plants in Southern California.

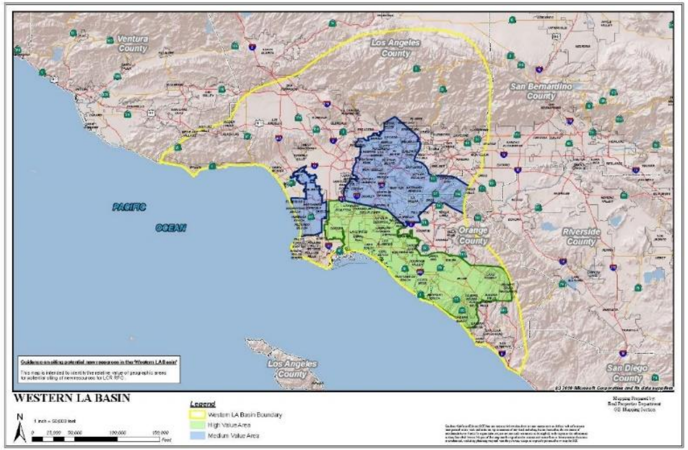
Goal: CPUC authorized procurement 1,400 to 1,800 MW of electrical capacity in WLAB local reliability sub-area by 2021 to meet long-term local capacity requirements (LCR).

Approach: Large-scale deployments of customer-sited distributed storage assets

Challenge/Opportunity: Long-term local capacity constraints

Sourcing: Competitive solicitation

Siting Location Map for Constrained Area, Western Los Angeles Basin (WLAB).



Technology, Size, and Location

- Electric storage
- 85 MW, Western Los Angeles Basin, CA

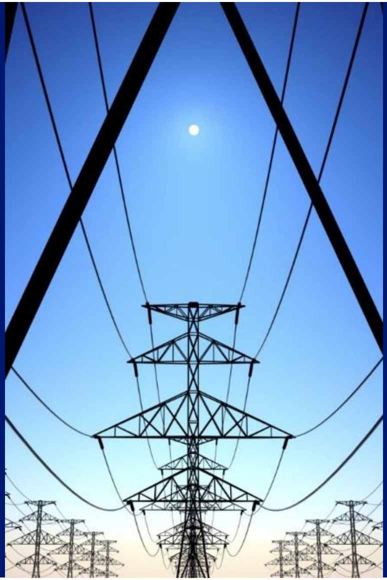
Drivers

- Internal management decision, regulatory mandate

Outcomes

- Stem dispatched the storage systems more than 24 times in 2017.
- Distributed storage assets are reliable, fatigueless, quickly dispatchable, and complement other energy resources to meet customer and grid needs.

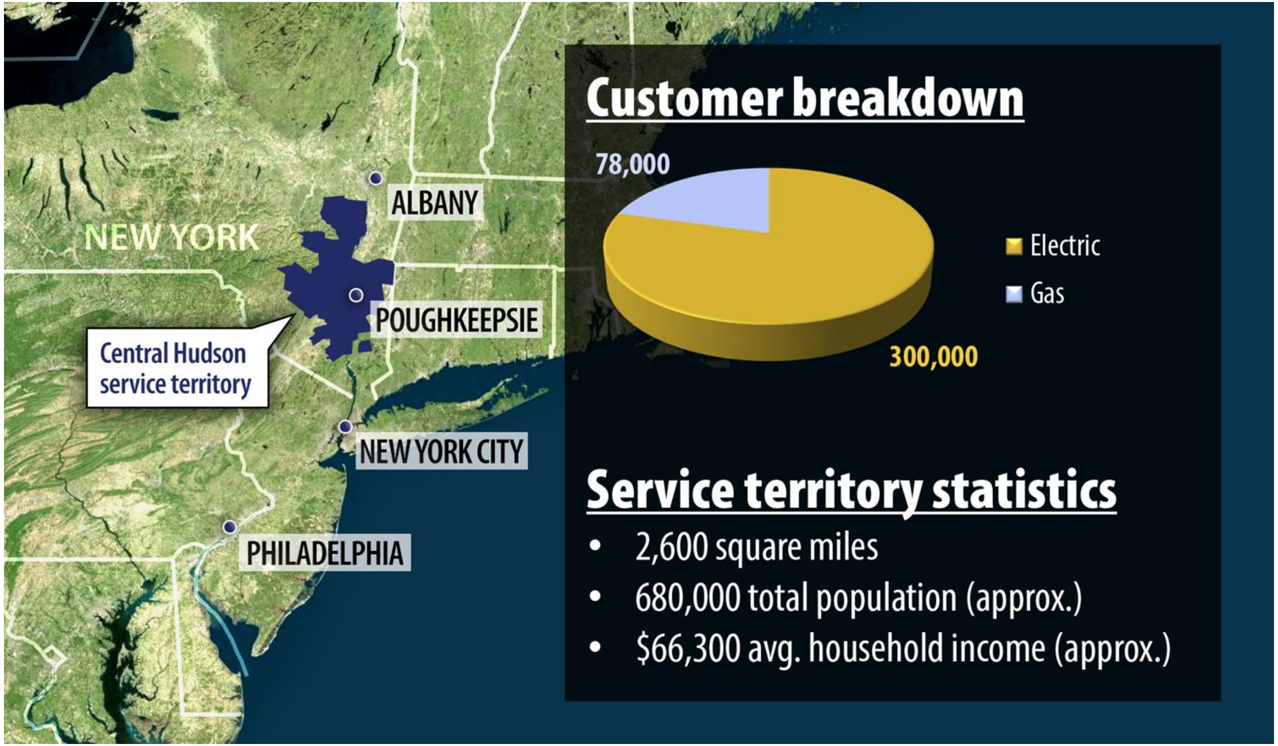
Central Hudson's Non-Wires Alternative



Mark Sclafani

Senior Program Coordinator

Central Hudson Gas & Electric



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NEW YORK STATE OF OPPORTUNITY. | Reforming the Energy Vision

- Regulatory proceeding to reform the electric distribution industry in New York
- REV's essential purpose is to:
  - Improve system efficiency
  - Empower customer choice
  - Encourage proliferation of distributed energy resources (energy efficiency, demand response, distributed generation)

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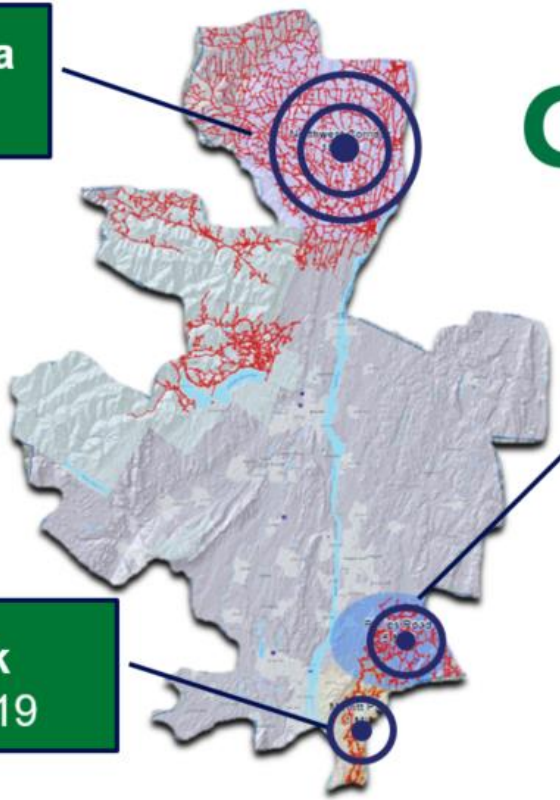
Non-Wires Areas

North West Area
10MW by 2019

CenHub
Peak Perks



Shenandoah/ Fishkill Plains
5MW by 2018

Merritt Park
1MW by 2019

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Demand Response Program

CenHub

Peak Perks

Itron

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Comprehensive Marketing Campaign

- Direct Mail
- Outbound calling
- Door-to-door sales
- Mining of public databases for likely central air customers

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Challenges

- Only 1/3 of Central Hudson customers have Central Air
- Limited Commercial & Industrial customer base within the targeted areas

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Whole Home Generator Program

- Existing backup generation is used as a DR resource
- Digital control units create automatic switchover
- Average 3.9kW/device
- Great incentives of $500 and $250/year

Targeted Lighting Initiative

- Existing EE Program covers ~50% of project cost
- 100% of cost covered in targeted areas
- Locational coincidence analysis for each region.
- Two programs split costs and benefits

Current Load Reductions

Population	Device	Active End Points as of 10/01/18	kW Factor per Device	Total MW Savings
Residential	Thermostat - A/C	1,075	1.295	1.392
Residential	DCU - A/C	2,593	0.949	2.461
Residential	DCU - Pool Pump	68	0.570	0.039
Residential	DCU - Generator	18	3.896	0.070
Small Commercial	Thermostat - A/C	120	2.215	0.266
Small Commercial	DCU - A/C	120	1.250	0.150
Large C&I	Curtailment	9	-	5.201
Commercial	Targeted Lighting	28	-	0.047
Total		**4,031**		**9.626**

How Does Central Hudson Benefit?

- Instead of investment ROI, an incentive-based model was implemented:

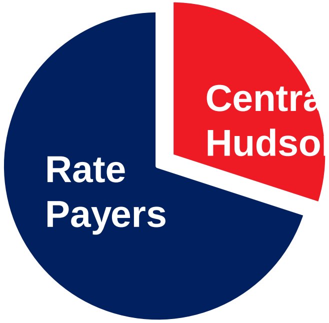
Estimated Cost of Traditional T&D Solutions

– Actual Cost of DR Solution

+ Actual Capacity Savings

= Program Financial Benefits

- Central Hudson shares program financial benefits with all customers:



70% of benefits go to rate payers by reducing future bill pressure

30% of benefits are provided to utility as incentive to achieve the program targets

Thank You.

Mark Sclafani

Senior Program Coordinator

Central Hudson Gas & Electric

For more information, visit

www.CenHubPeakPerks.com

South of Allston (SOA) Non-Wires Pilot

BPA's Case Study Review

Presented by Sarah Arison, Project Manager

Smart Electric Power Alliance

About BPA

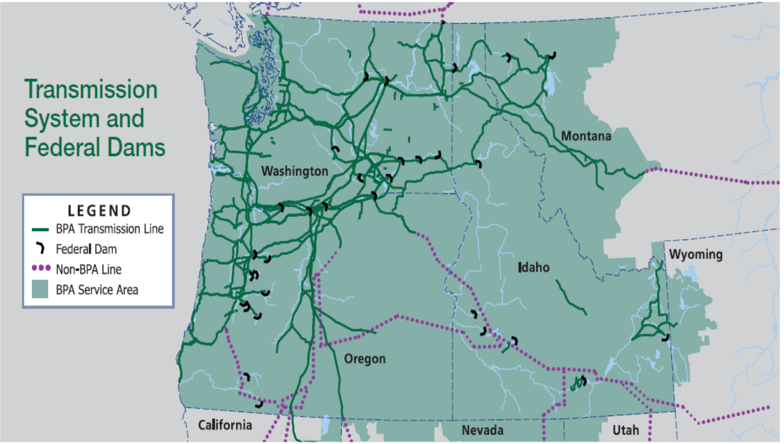
The Bonneville Power Administration was established in 1937. BPA is a nonprofit federal power marketing organization based in the Pacific NW.

BPA is part of the Department of Energy (DOE) however we are self-financed.

BPA markets power from 31 federal hydro dams, 1 nonfederal nuclear plant, and several nonfederal renewable resources across our service territory spanning 300,000 square miles.

BPA operates and maintains 75% of the high voltage transmission in our service territory covering: Idaho, Oregon, Washington, Western Montana, and small parts of California, Nevada, Utah and Wyoming.

BPA promotes energy efficiency, renewable resources and new technologies that improve our ability to deliver our mission.



DOE/BP-4831 • Updated May 2018

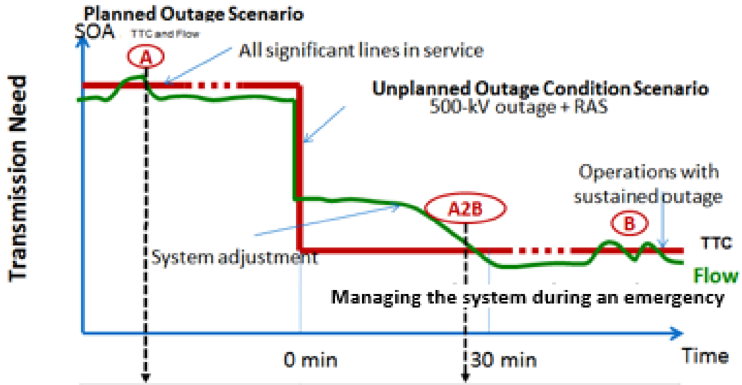
Today's discussion is about how BPA is transitioning from traditional construction approaches to managing transmission congestion toward embracing "a more flexible, scalable, and economically and operationally efficient approach for managing our transmission system."

Source: BPA Administrator, Elliot Mainzer's Letter to Region dated 5/17/17

Smart Electric Power Alliance

Project Background

Scope of need



Non-Wires

Non-Outage (A)	Outage (A2B)
Day Ahead Notice Incremental capacity, Decremental capacity, DSM/Demand Response	**Within Hour notice** used to manage the transmission system post contingency. This is outside of the scope of BPA's SOA Pilot.

- The SOA Pilot is designed to address the "A" scenario when all significant lines are in service. A forecasting tool was developed in-house to predict next day flow conditions.
- The "A2B" scenario is post-contingency and requires within hour notice.

- After a comprehensive look at the proposed 80-mile I-5 Reinforcement project costing over $1 billion to build, BPA decided not to build the project.
- Among other initiatives, BPA invested in a non-wires redispatch program known as the SOA Pilot to reduce up to 40 hours of summer peak flows on the SOA flowgate.
- The SOA Pilot ran for two years (summer 2017 through summer 2018) and was budgeted at $5M/year. The actual costs of the program were slightly less than the budget each year.
- The SOA Pilot product portfolio consisted of 200 MW of incremental capacity (south of the flowgate) and 200 MW of decremental capacity (north of the flowgate).
- Each event was deployed for a four hour block during late afternoon into the evening, during summer weekdays only.
- The SOA Pilot operated on a pre-schedule notice, posted on OASIS.

Acronyms: Remedial Action Schemes (RAS),Total Transfer Capability (TTC), Open Access Same-Time Information System (OASIS)

SOA Pilot Performance

- Analysis shows repeatability and reliability in performance across two years:
  - flow reduction goals were met under different operating conditions
  - solid performance results were measured, validated, and repeatable
  - targeted load reduction played a key role in lowering summer peak flows
  - redispatching a portfolio of geographically targeted non-wires adds-value
  - In aggregate, the average flow relief slightly increased in the second year

	Summer 2017 Relief			**Summer 2018 Relief**		
	Max	Avg	Min	Max	Avg	Min
Full Portfolio	-112	**-105**	-101	-117	**-109**	-85
Partial Portfolio	-82	**-75**	-71	-87	**-85**	-83

Note: relief is defined as "schedule informed" where impacts on flow reduction are calculated based on schedules before and during SOA Pilot events, including resupply schedules

Lessons Learned

- Overall, the SOA Pilot advanced BPA's understanding of how to translate technical requirements into commercial term sheets, how to establish new performance evaluation criteria, and how to develop a new flow prediction model to decide the optimal time to deploy events:
  - Procurement process and bidding evaluation took longer than expected
  - Understand billing system capabilities and payment options before contracting
  - Plan and budget for internal tool development and system integration
  - Build in more response time for bidders to price multiple offers and for the buyer to evaluate multiple offers
  - Relying on a single demand response resource can present a challenge
  - Establish data retention requirements before the project starts and data is lost
  - Take a year-round holistic view to planning and budgeting (e.g., battery storage)
  - Document lessons learned along the way to inform next generation program design options
  - Think ahead in terms of repurposing your program to other areas of need
  - Still researching how to overcome the traditional rate-based cost recovery model and modernize it to provide alternative revenue streams and incentives to promote non-wire development

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Thank you for joining us!

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