Load Management Leadership

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

Steve Cowell, E4 The Future; Tiger Adolf, PLMA; Brenda Chew, SEPA; Marie Schnitzer, National Grid; Damei Jack, Con Edison; Sarah Arison, Bonneville Power Administration

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:

PLMA™
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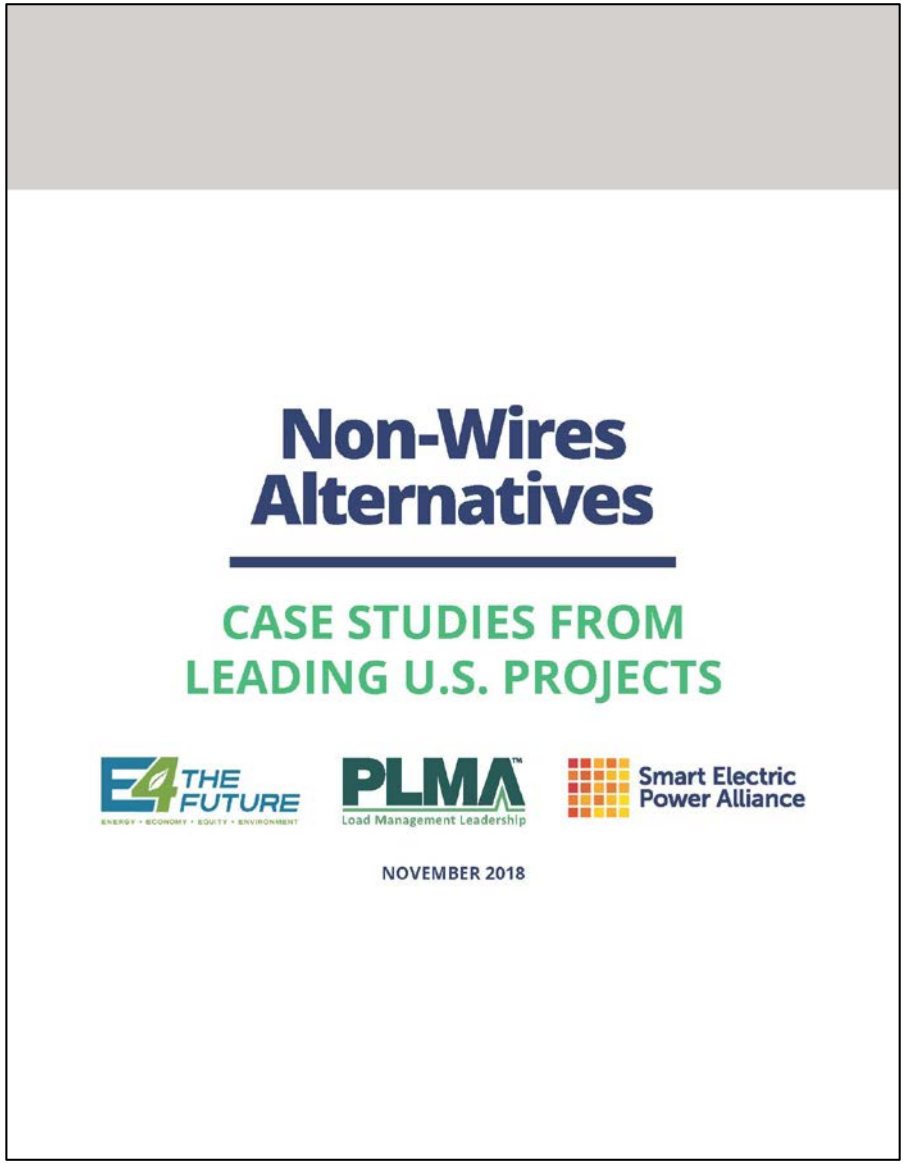
Additional Research and Report by:

Smart Electric Power Alliance

www.peakload.org/nwa-research-from-e4thefuture--plma--sepa



Non-Wires Alternatives

CASE STUDIES FROM LEADING U.S. PROJECTS

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NOVEMBER 2018

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

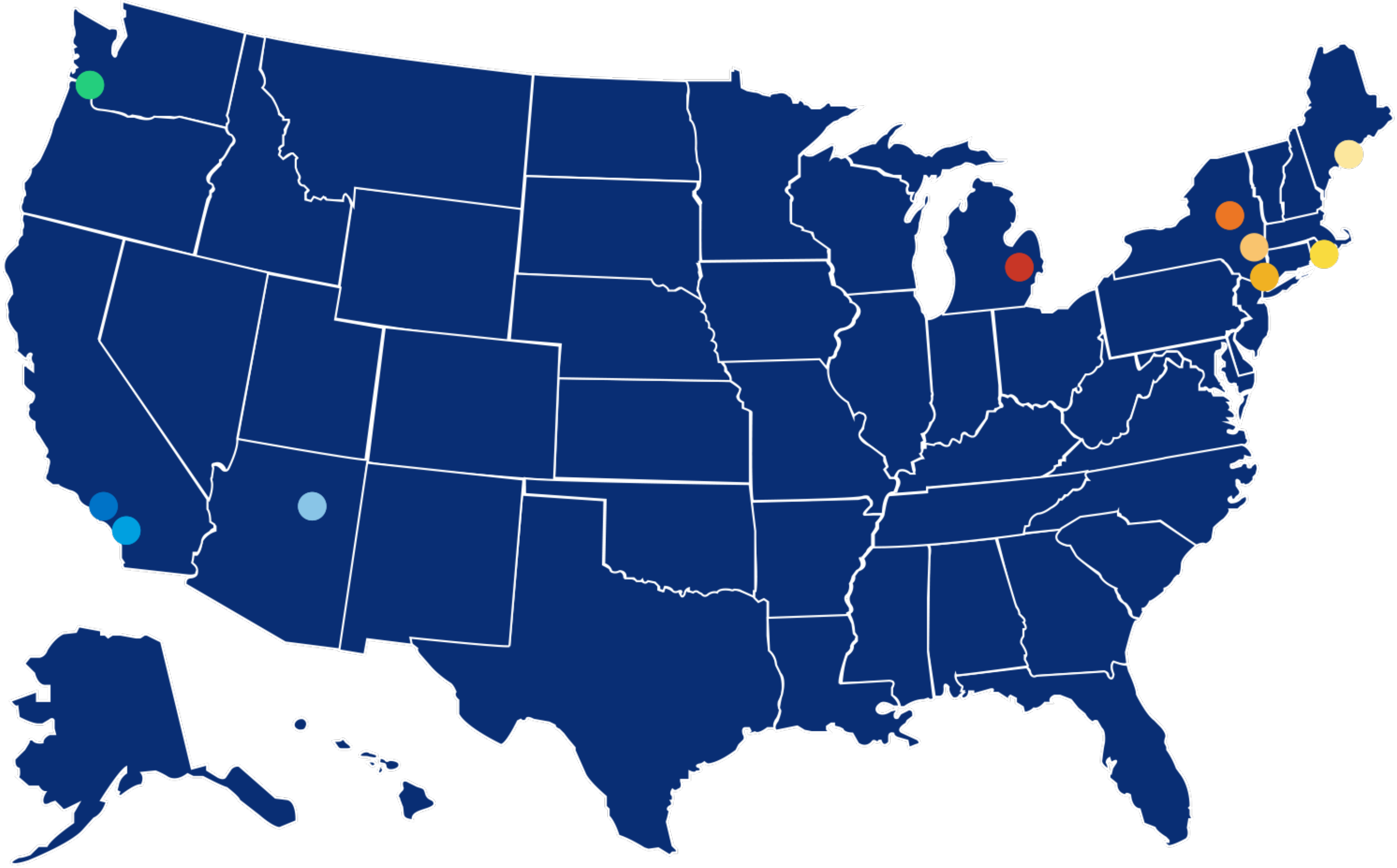
Dave Hyland, Zen Ecosystems

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

Alan Harbottle, Arizona Public Service

Tom Spence, Arizona Public Service

Lee Hall, Bonneville Power Administration

Sarah Arison, Bonneville Power Administration

Mark Sclafani, Central Hudson Gas & Electric

Damei Jack, Con Edison

Mark Luoma, Consumers Energy

Kitty Wang, Energy Solutions

Rich Silkman, GridSolar, LLC

Matthew Chew, National Grid

George Cruden, National Grid

Loic Gaillac, Southern California Edison

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.

Central Hudson – Peak Perks Targeted Demand Management

Description: Resolve distribution grid constraint as part of NY REV

Goal: Defer new infrastructure in three targeted zones for five to 10 years, reduce future bill pressure for customers, and create additional earnings opportunities for CenHud

Approach: Incentive-based model, 70% of benefits go to customers through rate moderation, and 30% of benefits go to the utility as an incentive for running the program effectively.

Challenge/Opportunity: Distribution grid constraint

Sourcing: Customer program

Technology, Size, and Location

- Demand response
- 16 MW in New York State's Mid-Hudson River Valley

Drivers

- Regulatory mandate (NY REV)

Outcomes

- Exceeded the total, first-year MW target for all three zones, achieving 5.9 MW of load reduction compared to the target of 5.3 MW.
- Achieved its 50% load reduction milestone of 8.0 MW in October of 2017 with approximately 3,000 active devices deployed, nine large C&I customers enrolled, and a 40% adoption rate within the Fishkill 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

Consumers Energy

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.

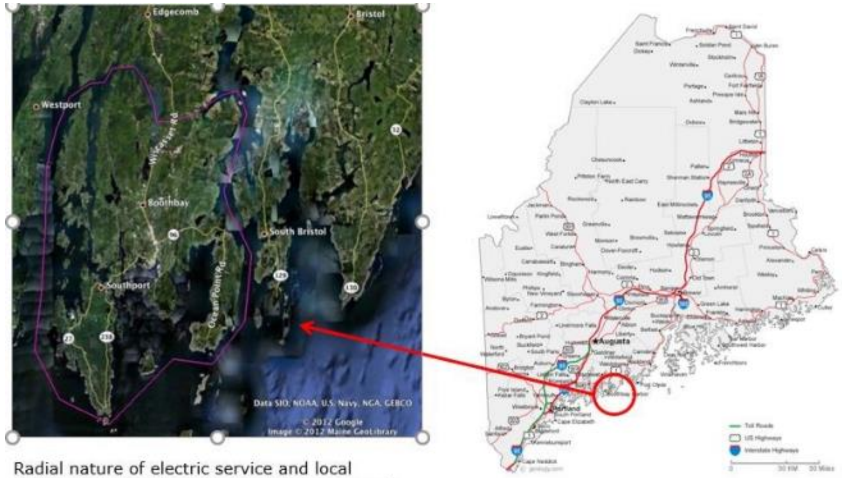
Traditional: $1 Billion Transmission Line Project (environmental concerns)

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.

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.

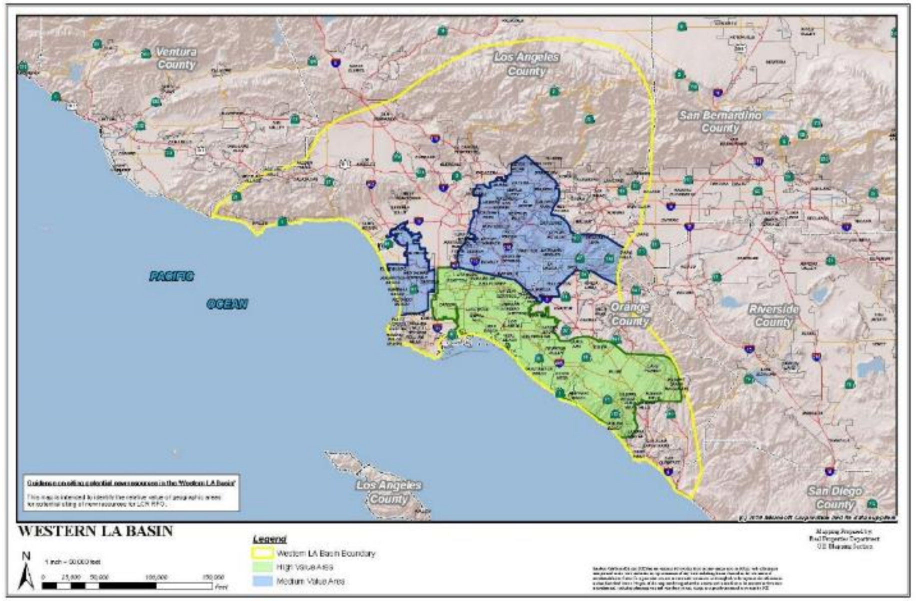
Goal: CPUC authorized procurement 1,400 to 1,800 MW of electrical capacity in WLAB local reliability sub-area by 2021 to meet long-term local capacity requirements (LCR).

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.

Overview and Commonalities

- Project sizes: ranged from 300 kW to 85 MW (distribution level) to 100 MW of load relief (transmission level)
- Status of projects: ranged from complete, currently active, and early procurement phases
- Technologies and programs: included behind-the-meter and front-of-the-meter solutions

UTILITY, KEY PROJECT IMPLEMENTER—PROJECT NAME	PROJECT SIZE	STATUS	ENERGY EFFICIENCY	DEMAND RESPONSE	SOLAR PV	ENERGY STORAGE	GENERATION	BACKUP GENERATORS	FUEL CELLS	COMBINED HEAT AND POWER	CONSERVATION VOLTAGE OPTIMIZATION	NOTES
ARIZONA PUBLIC SERVICE—PUNKIN CENTER	2 MW, 8 MWh	A: Q1 2018				●						
BONNEVILLE POWER ADMINISTRATION—SOUTH OF ALLSTON	200 MW Inc. 200 MW Decr. 100 MW Relief	A: July 2017 T: Sept. 2018		●			●					
CENTRAL HUDSON GAS & ELECTRIC—PEAK PERKS DEMAND MANAGEMENT PROGRAM	16 MW	A: 2016		●				●				
CON EDISON—BROOKLYN QUEENS DEMAND MANAGEMENT (BQDM) PROGRAM	52 MW	A: 2014	●	●	●	●			●	●	●	
CONSUMER ENERGY—SWARTZ CREEK ENERGY SAVERS CLUB	1.4 MW	A: Oct. 2017	●	●								
GRIDSOLAR—BOOTHBAY	1.85 MW	A: Q4 2013 T: Q2 2018	●	●	●	●		●				Thermal and electric storage
NATIONAL GRID—OLD FORGE	19.8 MW, 63.1 MWh	In development				●						
NATIONAL GRID—TIVERTON NWA PILOT	330 kW	A: 2012	●	●								
SOUTHERN CALIFORNIA EDISON—DISTRIBUTION ENERGY STORAGE INTEGRATION (DESI) 1	2.4 MW, 3.9 MWh	A: May 2015			●							
SOUTHERN CALIFORNIA EDISON—VIRTUAL POWER PLANT (VPP)	85 MW	A: Dec. 2016		●		●						Storage systems applied as DR

Note: Status indicates when project started. A: Active; T: Terminated.

Source: SEPA, PLMA, and E4TheFuture, 2018.

Overview and Commonalities

- Regulatory mandates and internal management decisions played significant roles in the 10 case studies
- Sourcing: direct procurement through single-source and competitive bidding processes as well as via existing customer programs

UTILITY, KEY PROJECT IMPLEMENTER—PROJECT NAME	T&D CHALLENGE	DRIVERS	SOURCING
ARIZONA PUBLIC SERVICE— PUNKIN CENTER	Thermal constraint on feeder	Regulatory Mandate, Internal Management Decision	Direct procurement (competitive bidding)
BONNEVILLE POWER ADMINISTRATION— SOUTH OF ALLSTON	Transmission grid constraint	Internal Management Decision	Direct procurement
CENTRAL HUDSON GAS & ELECTRIC— PEAK PERKS DEMAND MANAGEMENT PROGRAM	Distribution constraint	Regulatory Mandate	Customer Program
CON EDISON— BROOKLYN QUEENS DEMAND MANAGEMENT (BQDM) PROGRAM	Sub-transmission feeder constraint at substation	Regulatory Mandate, Internal Management Decision	Customer Program
CONSUMERS ENERGY— SWARTZ CREEK ENERGY SAVERS CLUB	Distribution constraint	Regulatory Mandate, Internal Management Decision	Customer Program
GRIDSOLAR— BOOTHBAY	Distribution constraint and reliability	Regulatory Mandate, Internal Management Decision, Public Input	Direct procurement (competitive bidding, sole-sourced)
NATIONAL GRID— OLD FORGE	Distribution constraint and grid resiliency	Internal Management Decision	Direct procurement (competitive bidding, sole-sourced)
NATIONAL GRID— TIVERTON NWA PILOT	Feeder substation upgrade deferral	Internal Management Decision	Customer Program
SOUTHERN CALIFORNIA EDISON— DISTRIBUTION ENERGY STORAGE INTEGRATION (DESI) 1	Distribution constraint	Internal Management Decision	Direct procurement (competitive bidding, sole-sourced)
SOUTHERN CALIFORNIA EDISON— VIRTUAL POWER PLANT (VPP)	Long term local capacity constraints	Internal Management Decision with Regulatory Mandate	Direct procurement (competitive bidding, sole-sourced)

Note: In a majority of case studies, NWA solutions were procured through competitive solicitations (e.g., RFI and RFPs). A subset of these case studies leveraged existing customer programs (e.g., EE and DR) to help meet NWA objectives.

Source: SEPA, PLMA, and E4TheFuture, 2018.

Case Studies - Lessons Learned

Planning and Sourcing

- Open and technology-agnostic approach to procurement
- Procurement processes and bidding responses require more time
- Load growth uncertainty
- Know as much about your service territory as possible to inform program recruitment

Project Implementation

- Plan for internal development
- Community outreach helps overall reception and likelihood of project success
- Recruitment and customer engagement requires a multipronged approach

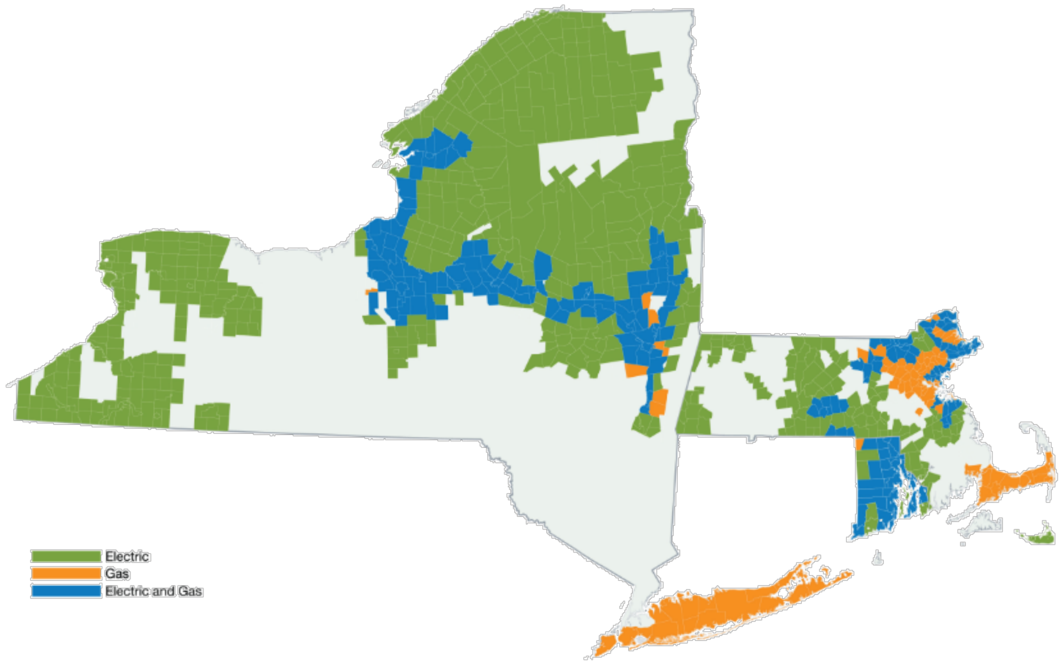
Tiverton, RI and Old Forge, NY Non-Wires Alternative Projects

National Grid's Case Study Review

Presented by Marie Schnitzer, Lead Project Manager

National Grid

- Based in the UK and Northeastern US
- We play a vital role in delivering gas and electricity to millions of people safely, reliably and efficiently
- One of the world's largest investor-owned utilities (2nd largest in the US)
- Headquartered in London; US headquarters in Waltham, MA
- Almost 28,000 employees
  - 63% work in the US; 37% work in the UK
- We supply electricity to approximately 3.4 million customers in the US



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National Grid - Old Forge, NY

PROJECT DESCRIPTION

Size: 19.8 MW, 63.1 MWh

Upstate New York

RFP issued early 2017

8 of 9 proposals: BESS

Challenges:

- Siting
- Equipment cost
- Adirondack Park Agency regulations
- Interconnection costs
- Overall project cost and financing

Status: In Development

LESSONS LEARNED

- Interconnection costs become a significant cost barrier
- Utility is continuing to learn from each NWA RFP
- Market for services at distribution level is developing
- System and Project Data Availability – Data Portal

  https://ngrid.apps.esri.com/NGSysDataPortal/NY/index.html

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National Grid - Tiverton, RI

PROJECT

Size: 1 MW

NWA Pilot 2012-2017

Energy Efficiency and Demand Response

Original goal: Defer a $2.9 million feeder project for 4 years.

RESULTS

- Project Deferred in conjunction with other projects
- 2017 National Grid implemented automatic meter reading as well as time of use rates
- 2017: released another RFP
- Tiverton-Little Compton NWA project identified in 2019 System Reliably Procurement Report

LESSONS LEARNED

- Difficult to cost a seasonal need
- Thermostats for central AC and heat pump water heaters were effective
- Smart plugs operating window AC units were not effective
- Rhode Island System Data Portal: https://ngrid.apps.esri.com/NGSysDataPortal/RI/index.html

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National Grid Lessons Learned

- Improved information about project needs in the problem statement
- Provide the value of deferred traditional solution to better compare with NWA solution costs
- Development of Joint Utilities NWA and REV Connect pages
- RFP Improvements:
    - Clarification that NWA providers should include real property acquisition (or lease) as part of their solutions and the cost
    - Development of a template for bidders to present pricing structure in proposals
    - Additional electrical system information to help bidders develop more complete proposals
    - Use of a standard template to provide a common format across all RPFs
    - Inclusion of sample terms and conditions
- Continued improvements to the BCA tool to ensure NWA benefits are appropriately considered
- Creation of a shared mailbox for communication: Non-WiresAlternativeSolutions@nationalgrid.com

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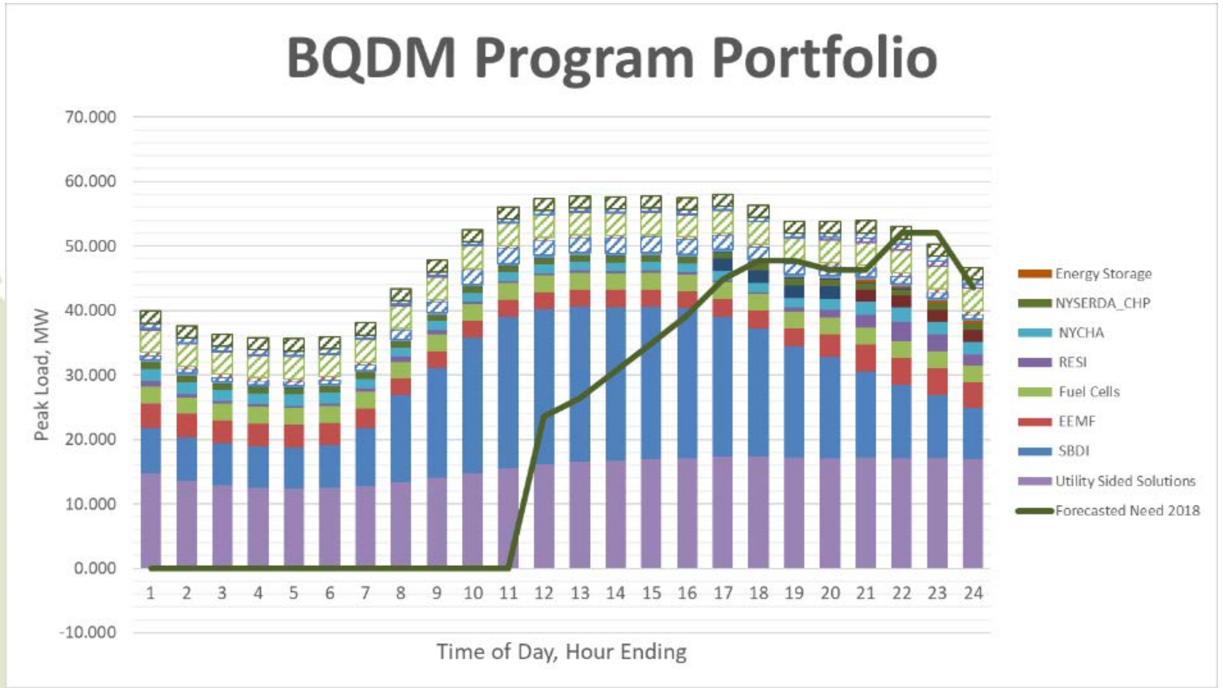
Non-Wires Solutions: BQDM and Other Opportunities

Damei Jack
Manager
Customer Energy Solutions

Brooklyn-Queens Demand Management Program (“BQDM”)

- Peak growth in 3 networks in Brooklyn-Queens
- 12 hour overload period. Nighttime peak.
- Would require ~$1 billion in capital upgrades
- In 2014 Con Edison authorized to spend $200 million through 2018 to enable deferral of upgrade
- In 2017 Con Edison authorized to extend BQDM Program timeline



Lessons Learned and Key Insights for Future Projects

Risks → Resources↓	Customer Acquisition	Electric Inter-connection	Gas Inter-connection	City Planning or Buildings Department	Fire Department	Budgetary Cycle and/or Lead Time
CHP	Medium	Medium	Medium	Medium	Medium	High
Fuel Cells	High	Medium	Medium	High	Medium	Medium
Demand Response	High	Medium	Medium	Medium	High*	Medium
Battery	High	Medium	N/A	High	High	High
Thermal Storage	High	Medium	N/A	Medium	Low	High
Solar	High	Medium	N/A	Low	Low	Medium
Energy Efficiency	Medium	N/A	N/A	Low	N/A	Medium
Residential EE	High	N/A	N/A	Low	N/A	High
Public Entity EE	Low	N/A	N/A	Low	N/A	High
C&I EE	Medium	N/A	N/A	Low	N/A	Medium

Key Insights for Future Programs

Market Communications

- Visit non-wires webpage
- Hosting Capacity Maps
- REV & Rate Case Dockets

Market Solicitations

- Focus in on project types and description
- Customer demographics
- Load profiles
- Evaluation criteria

Program Development

System Reliability

Portfolio approach is key

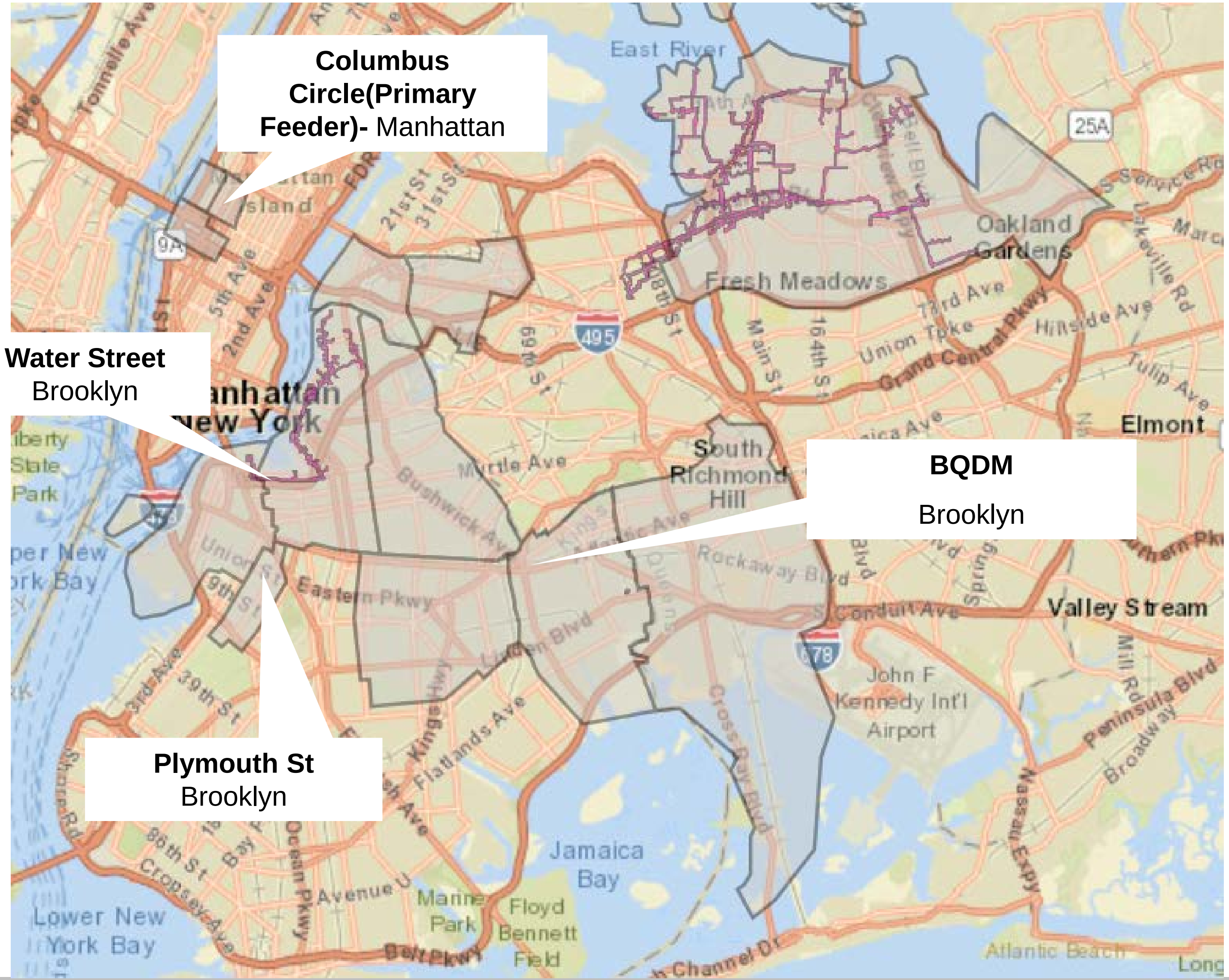
Technology agnostic

Timing is critical

Total Cost/Incentive requests

Other evaluation criteria (e.g. risks)

Current Programs Under Development and/or Implementation



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Damei Jack

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www.coned.com/nonwires

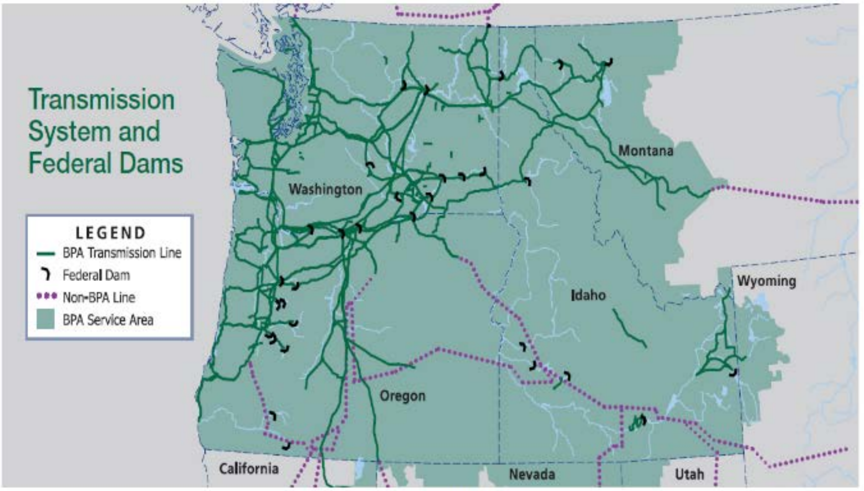
South of Allston (SOA) Non-Wires Pilot

BPA’s Case Study Review

Presented by Sarah Arison, Project Manager

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

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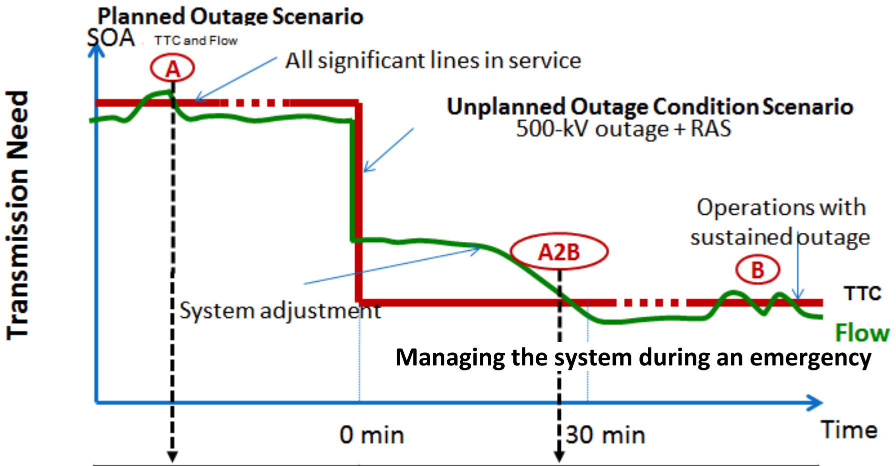
Project Background

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)

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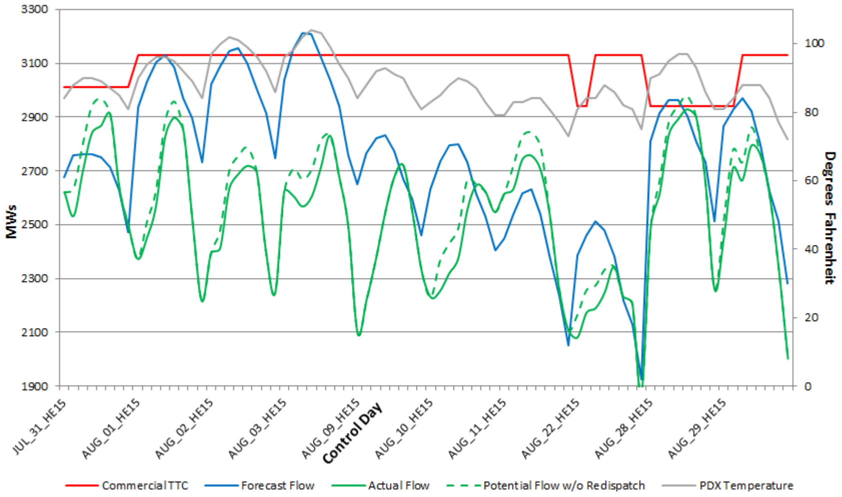
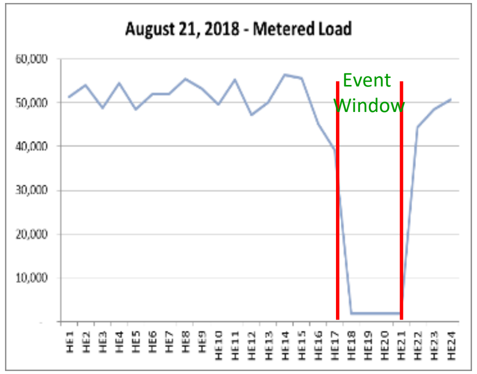
Performance Results

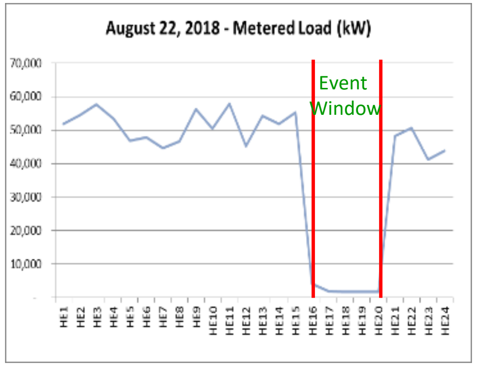
- BPA's post-event analysis shows strong year-to-year performance:
  - SOA performance results were repeatable and reliable from summer to summer
  - SOA flow reduction goals were met under different operating conditions
  - Demand response positively contributed to achieving the results
  - Average flow reduction slightly improved (105 MW in 2017 to 107 MW in 2018)

Overall, the chart below shows SOA flows were lower with the SOA Pilot than without it!



Demand Response in action!





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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

Learn More:

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

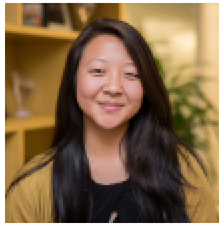
A joint E4TheFuture, SEPA & PLMA webinar, Thursday, December 6, 2018, 2:00 pm EDT

Presenters will include:

Steve Cowell
E4TheFuture

Sara Arison
Bonneville Power Administration

Mark Sclafani
Central Hudson Gas & Electric



Brenda Chew
SEPA

Tiger Adolf
PLMA

www.peakload.org/nwa-report-webinar

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