EM&V Forum Webinar – Advancing the Regional Energy System with DR and Geotargeting

Efforts to Integrate Demand Response and Energy Efficiency Programs

September 8, 2016

Integration of Energy Efficiency and DR:
Integrated Demand Side Management (IDSM)

IDSM programs "…support two out of the three demand side technology types (EE, demand response, and distributed generation).

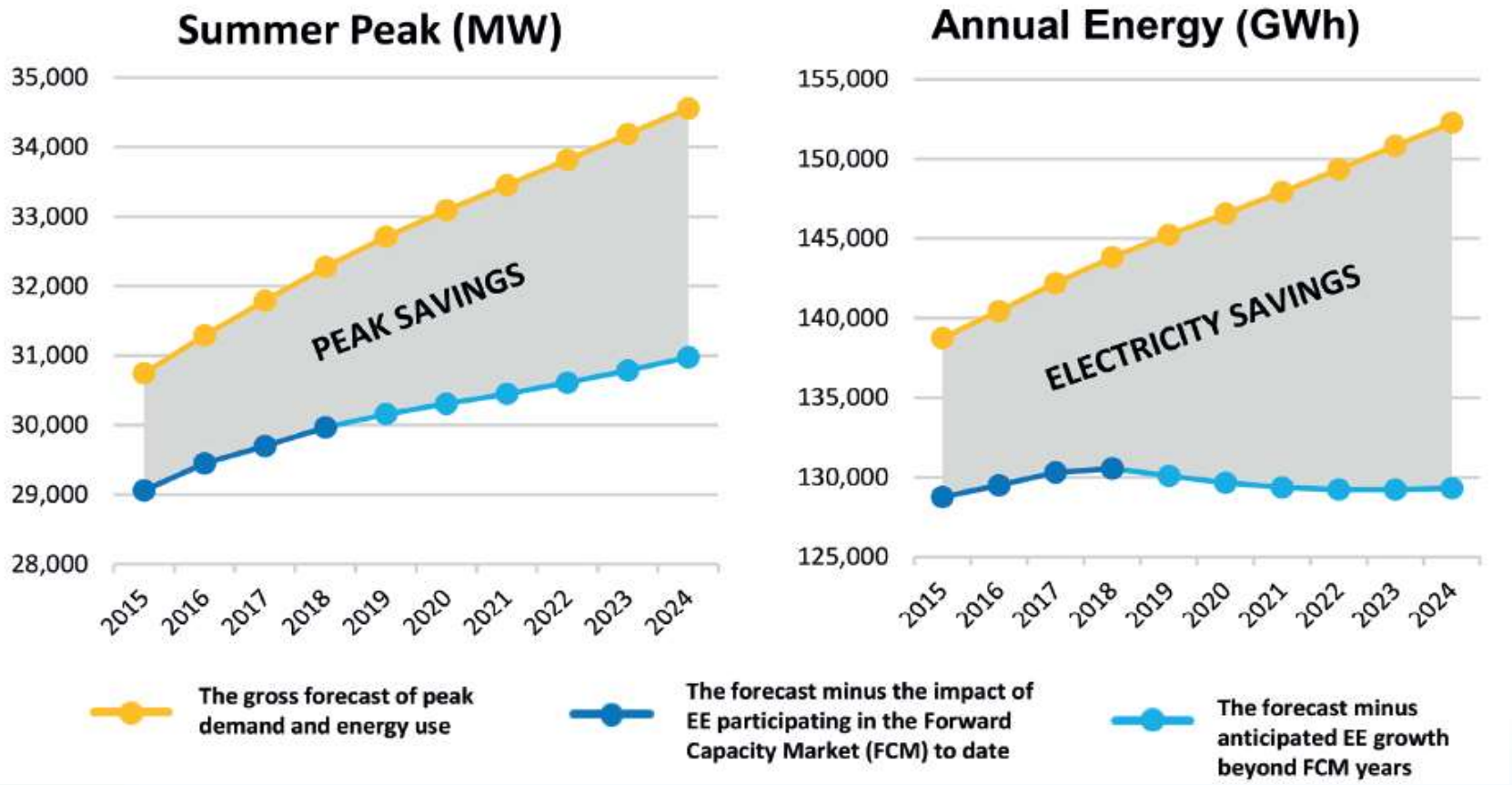
-California Public Utilities Commission

Outline:
Toward Integrated Demand Side Management (IDSM)

1. EE & DR Policy Drivers
2. DR Program Strategies
3. Integration of Energy Efficiency and Demand Response
4. Evaluating Benefits and Costs
5. Challenges and Opportunities
6. The Road Ahead

IDSM Policy Drivers:
Declining Load Factor

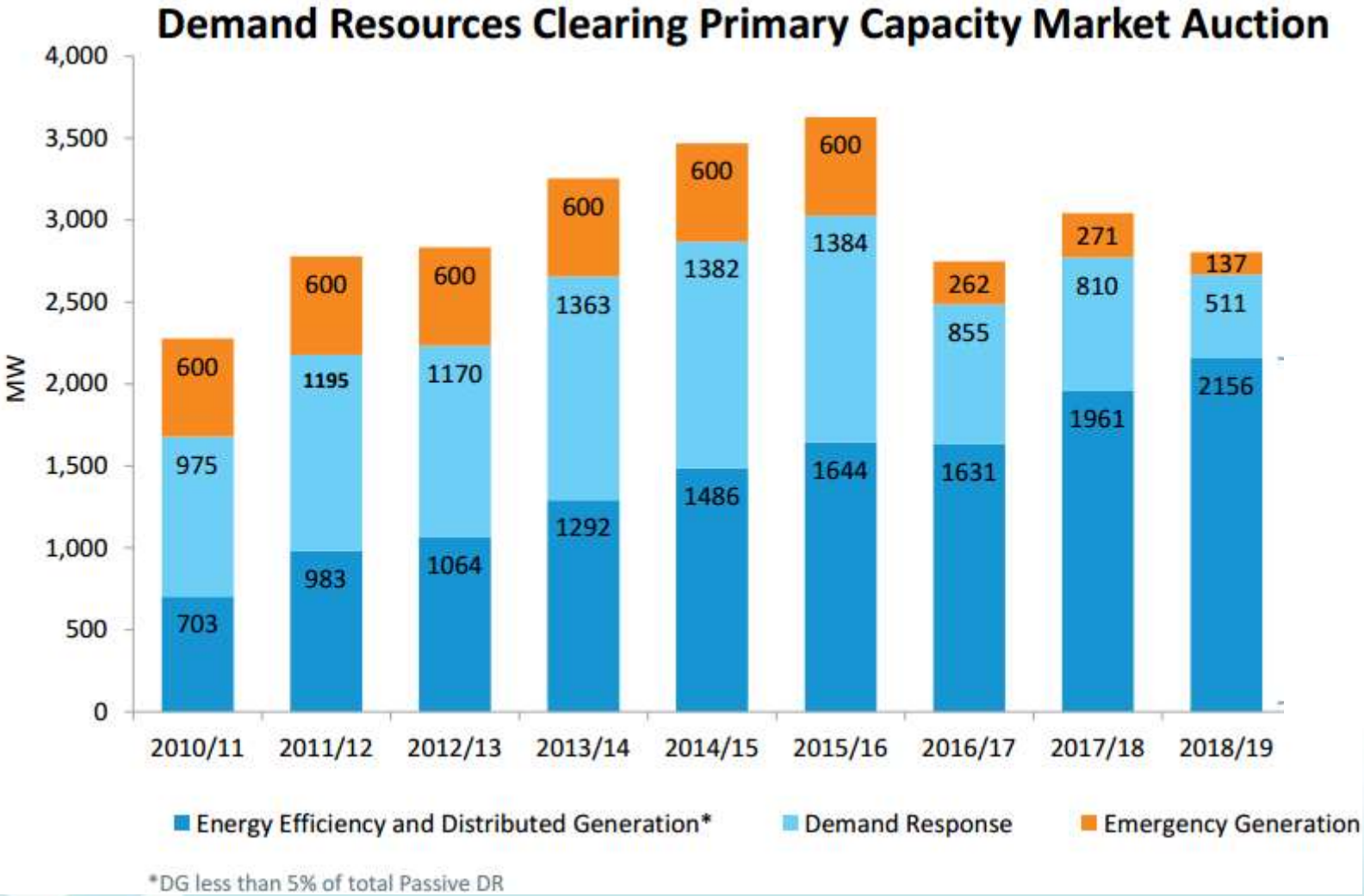
In ISO-NE, investment in energy efficiency will decrease overall load growth, but peak demand continues to grow spreading MW costs over fewer MWhs.



Forward looking program administrators are targeting system peaks on a temporal and locational basis through focus on peak coincident energy efficiency measures, demand response, and geo-targeting.

Source: ISO-NE RSP 15

IDSM Policy Drivers:
Declining DR Bids in Wholesale Markets



Source: Eric Winkler, ACEEE 2015 Intelligent Efficiency Conference

IDSM Policy Drivers:
A Revolution in Customer Engagement

Moving beyond switches, toward a proliferation of connected devices

- Smart Phones, T-Stats, Hot Water Heaters, Heat Pumps, EMS, ARTUs, CALCs, PEVs, energy storage, etc.

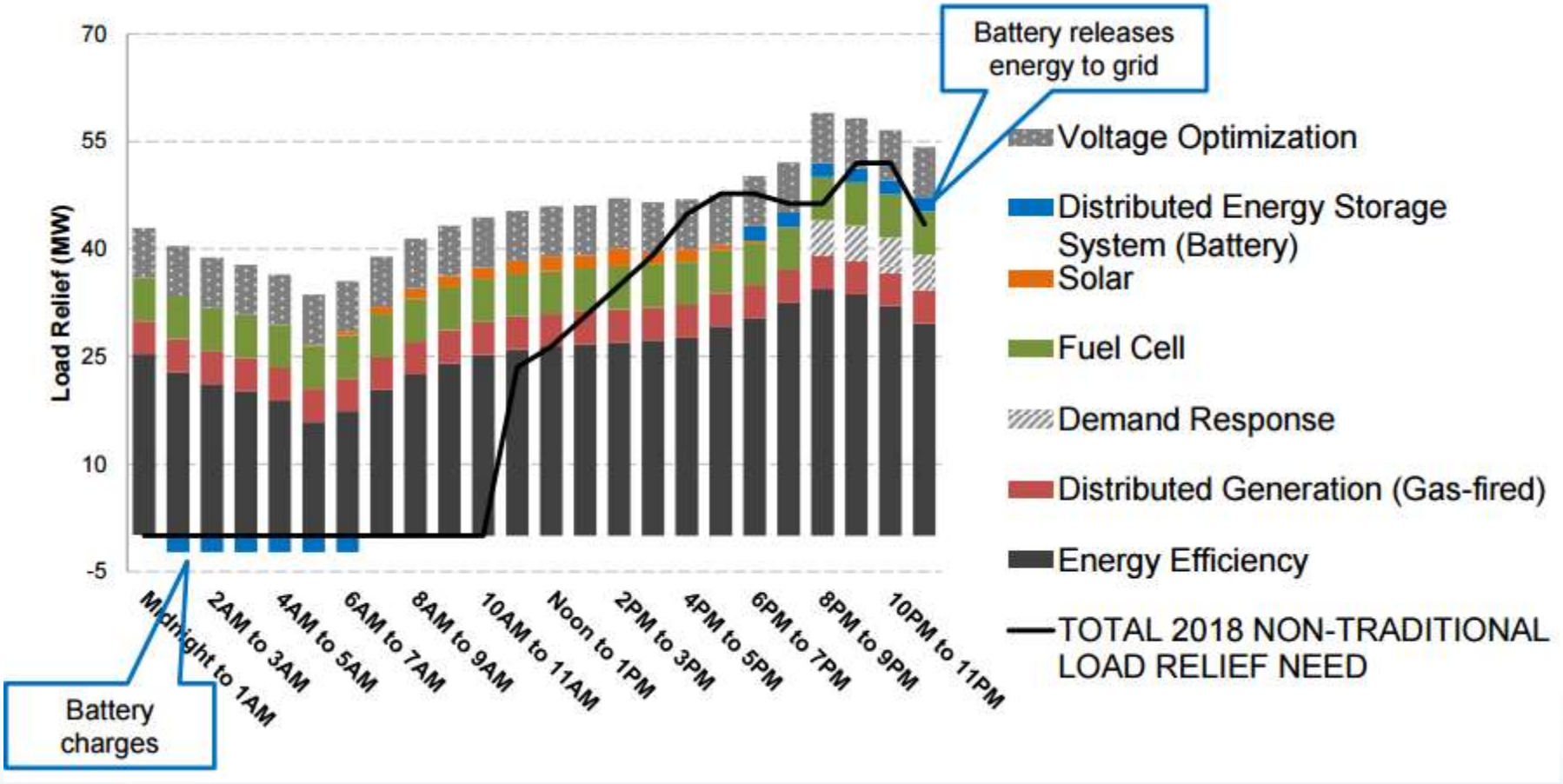
Program Administrators Offering Demand Response

- NWA/geo-targeting projects throughout the country
- Mass. 2016-18 Plan
- Conn. 2016-18 C&LM Plan
- Rhode Island LCP Plan
- Pennsylvania Act 129 Phase III
- NHEC Go Beyond the Peak
- Maryland BGE Smart Energy Rewards
- NY Dynamic Load Management Plans, Smart Home Rate in REV Track II Order

Why should utilities should get in the game? Survey Says…

- Those who are enthusiastic about smart tech identify as enthusiastic about EE; 52 percent, v. 27 percent of the general population
- Customers value connectivity almost as much as cost savings
- National Governor's Association report outlining opportunities
- Synergies between EE and RE at the technology level and program level

IDSM Policy Drivers:
Non-wire Alternatives



Region's IDSM DR Program Strategies

Overview

Program	Sector	Details
Manual Curtailment	C&I	• Based upon contractual commitments • 50-100kW usage reductions • Reservation v. voluntary enrollment • Opportunity for bonus payments
Direct Load Control (DLC)	Res./ Small C&I	• Based upon direct communication between a program administrator • Smaller usage reductions (~1kW)
Legacy DLC	Res./ Small C&I	• Switch based, one way signal • Cycling an A/C condensing unit, heat pump, pool pump, or hot water heater • Minimum verification required
Two-Way DLC	Res./ Small C&I	• Behind the meter information and communication technologies (ICT) transit data over HAN/Broadband
Behavioral Demand Response	Res.	• Based upon customer engagement • Can provide incentive or use behavioral triggers • AMI Required

Region's IDSM DR Program Strategies
Maryland

Maryland EmPOWER Demand Response Program (Baltimore Gas and Electric)

Program type	Direct load control (A/C condenser, heat pump)	Direct load control (Two-way thermostat pilot)	Direct load control (Winter water heater)	Behavioral (Smart Energy Rewards)
Sector	Residential	Residential	Residential	Residential
Total participants (final year)	356,000	2,600	29,000, plus 59,000 legacy devices	1,100,000
Capacity saved per customer/device (kW)	~1.2kW			0.22
Total capacity (MW)	413			309
Incentives per customer	Cycle 50%: $50 sign-on/annually Cycle 75% $75 sign-on/annually Cycle 100% $100 sign-on/annually	Pending	Cycle 100% $25 sign-on/annually	$1.25/kWh saved compared to similar weather day baseline
Program average annual incentives (2015)	$24,075,969			$40,566,666
Average annual non-incentive costs (2015)	$13,577,940			Unclear
Benefit/cost ratio (TRC)	3.3			1 (assumed)

Source: Baltimore Gas and Electric Semi-Annual Report for Third and Fourth Quarters — July 1 through December 31, 2015. (BGE 2016)

Region's IDSM DR Program Strategies
Pennsylvania

. Pennsylvania Act 129 Phase III Demand Response Programs (Projections)

Program type	Sector	Total participants (final year)	Energy saved per customer/ device (kW)	Total capacity (MW)	Incentives per customer	Average annual incentives (PY 2-5)	Average annual non-incentive costs	Benefit /Cost Ratio
Duquesne								
Direct load control BYOD	Residential	~6,000	0.35	2.2	$28/season	$182,498	$146,188	0.7
Manual curtailment	Large C&I	27	387.9	10.5	$32-$40/kW	$416,096	$823,565	2.3
Manual curtailment	Dual enrolled large C&I	108	387.9	31.4	$16-$20/kW	$624,144		2.1
Met Ed								
Behavioral DR	Residential and small C&I	50,000	0.07	3.5	$0	$0	$206,093	1.5
Manual curtailment	Large C&I	20	256	22.5	$6,127	$60,858	$88,670	1.7
Manual curtailment	Dual enrolled large C&I	2	256		$3,063	$13,524	$22,969	
Manual curtailment	Small C&I	57	801	202.9	$9,614	$547,722	$798,032	1.2
Manual curtailment	Dual enrolled small C&I	6	801		$19,228	$121,716	$202,077	

Source: Duquesne and Met Ed Act 129 Phase III Proposals (Duquesne 2015; Met Ed 2015).

Region's IDSM DR Program Strategies

New York

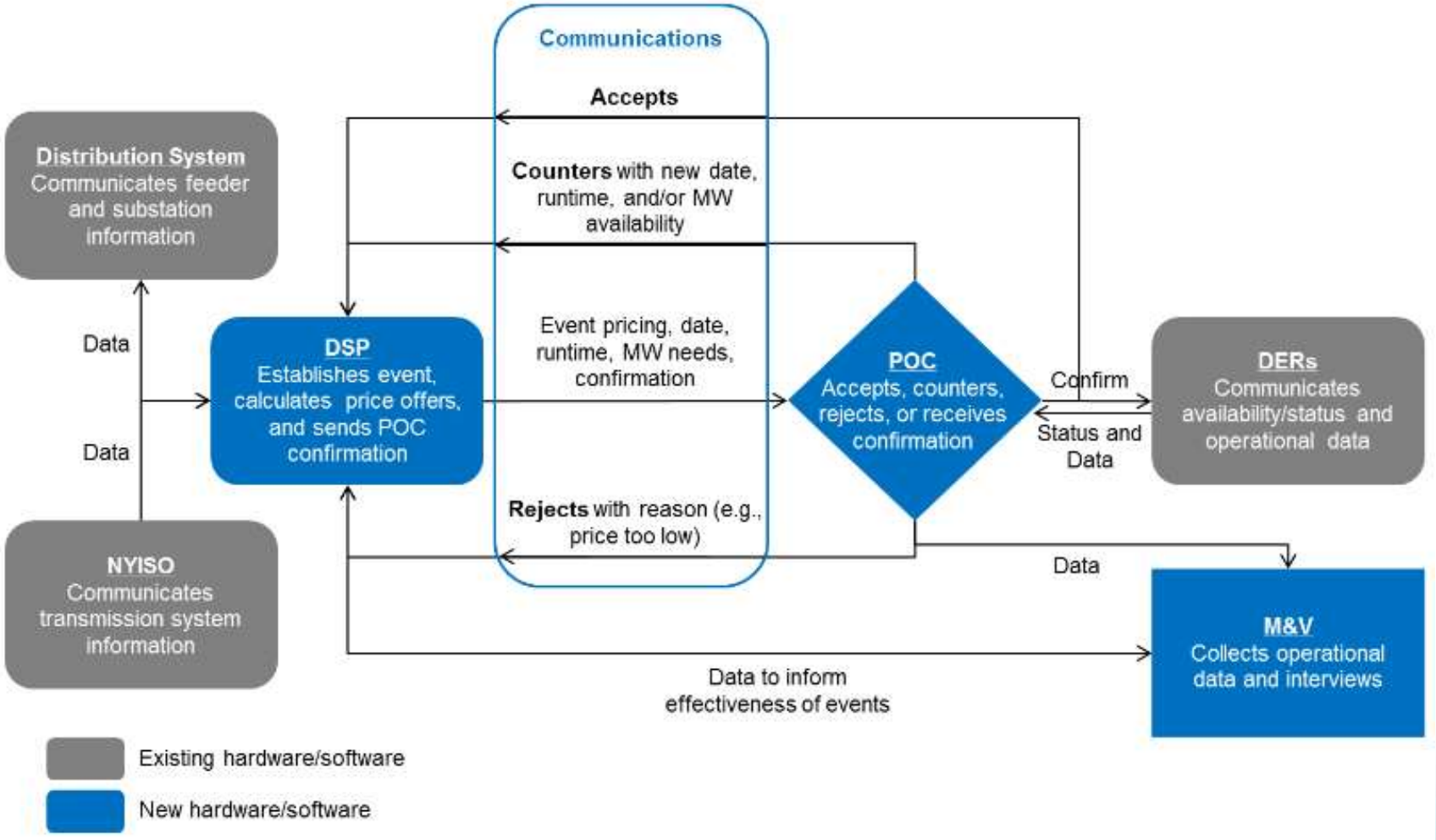
New York Dynamic Load Control Demand Response Programs

Program type	Total participants	Total capacity (MW)	Incentives per customer	annual program incentives	annual non-incentive costs	Benefit /Cost Ratio
NYSEG						
C&I Manual curtailment distribution load relief program	none	TBD	Reservation Payment Option: $2.75/kW Month + $.15/kWh Bonus Payment= $.30kWh Voluntary Option: $.15kWh	$0	$10,640	4.419
C&I Manual curtailment commercial system relief program	8	1.2	Reservation Payment Option: $2.75-3.00/kW Month + $.15/kWh Voluntary Option: $.15/kWh	$3,678	$28,577	
Residential/small business direct load control	31	TBD	Free Load Control Device $25 sign up (Electronic Gift Card) $25/year for 80% of event hours	$1,375	$114,192	.005
Orange and Rockland (O&R)						
C&I Manual curtailment distribution load relief program	9	1.47	Reservation Payment Option: $3.00/kW Month + $0.50/kWh Voluntary Option: $1.00kWh	$12,824	$34,121	1.02
C&I Manual curtailment commercial system relief program	8	1.2	Reservation Payment Option: $4.00-5.00/kW Month + .50-1.00/kWh Voluntary Option:$1.00-1.50/kWh	$11,708	$33,967	
Residential/Small Business Direct load control	286 Customers 375 Devices	TBD	Direct Install: free smart t-stat BYOT: $85 sign up, $25/year	$31,875	$82,065	1

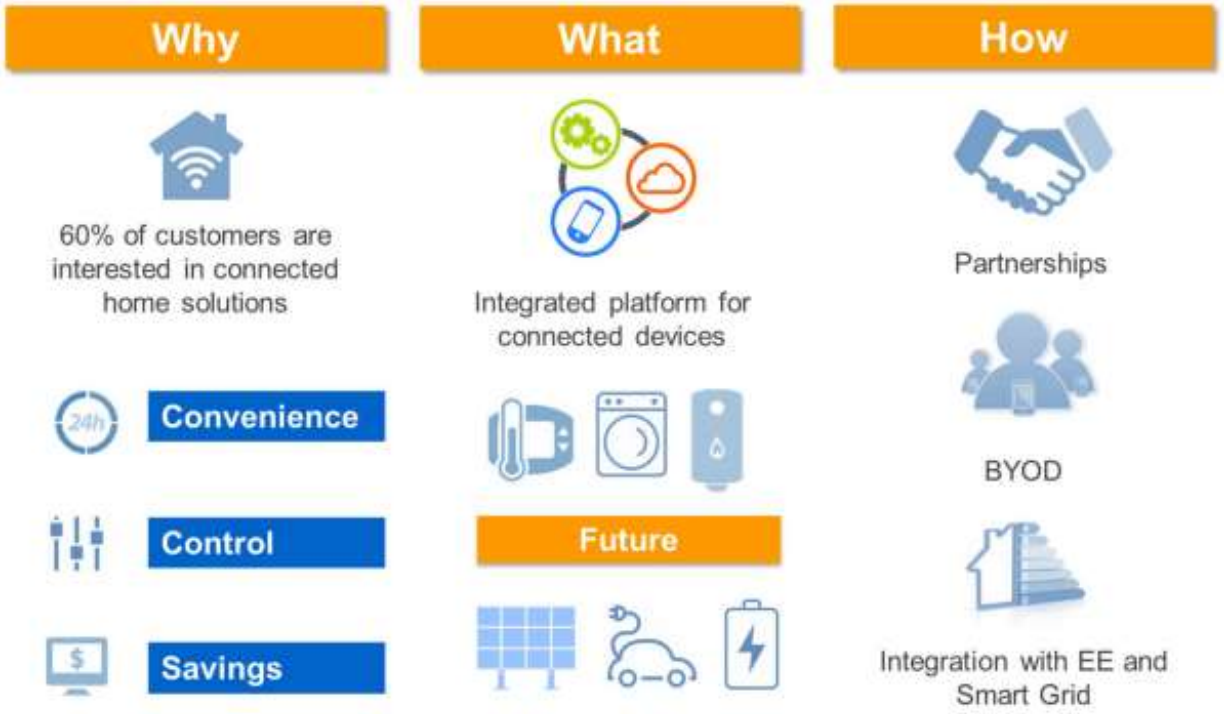
Source: O&R and NYSEG Dynamic Load Management Annual Reports (O&R 2015; NYSEG 2015)

Region's IDSM DR Program Strategies

New York's Move Toward LMP+D+E



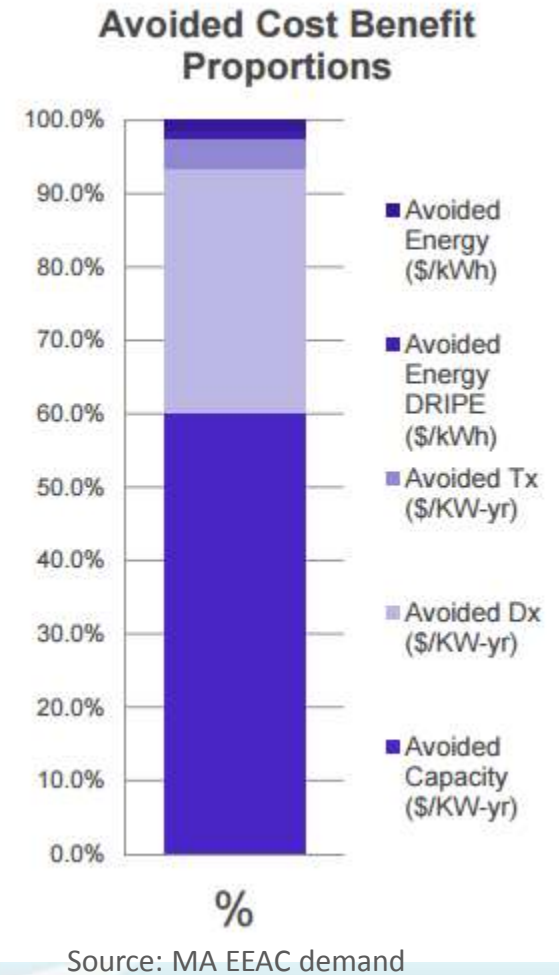
Integrated Demand Side Management
Synergies for Energy Efficiency and Demand Response



Combined program marketing efforts to save costs and reduce customer confusion

- Bring Your Own Device (BYOD) programs where DR-enabled technology leverages EE incentive
- Identify those who are unenrolled in an event as leads for weatherization efforts

Integrated Demand Side Management
Cost-Effectiveness/Program Design Considerations



Source: MA EEAC demand savings sub-committee

- Program overlap and attribution
- Lifecycle
- Customer motivation and incentive ranges
- Weather variability
- Enrollment v. control
- FCM v. ICR
- Are the incentives to customer a transfer payment or a cost?

*DRIPE: Demand Reduction Induced Pricing Effect

Integrated Demand Side Management
Challenges and Opportunities

- Limit silos between programs; joint marketing efforts can provide cost-saving synergies with attribution being key consideration
- Consider piloting statewide initiatives through NWA programs
- Consider obligation for lifecycle longer than one year
- Consider wide range of technologies, including winter peaking in the northeast
- Ensure that incentive available upon initial device communication, not purchase
- Consider event specific incentives and quick cycle feedback, rather than singular seasonal incentive
- Opportunities for consistency and standardization of reporting to allow apples to apples comparison and further identification of regional benefits
- Interactive effects between efficiency and demand response

Integrated Demand Side Management
The Road Ahead

- Potential Studies- Monte Carlo potential analysis available for every state in Eastern Interconnect
- California EM&V Protocols provide foundation
- Pilot through NWA projects, then evolve into EE program planning process
- Further Resources
  - MA EEAC DR Presentations (Consultant/ISO-NE)
  - MA Study

Discussion

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PRESENTATION FOR

EM&V Forum

September 8th 2016

Advancing the Northeast's Energy System with Geotargeting and DR

Geotargeted DSM Cost-Effectiveness

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DUNSKY OVERVIEW

EXPERTISE

- Energy Efficiency
- Demand Management
- Distributed Energy Resources
- Sustainable Transportation
- Greenhouse Gas Reductions

SERVICES

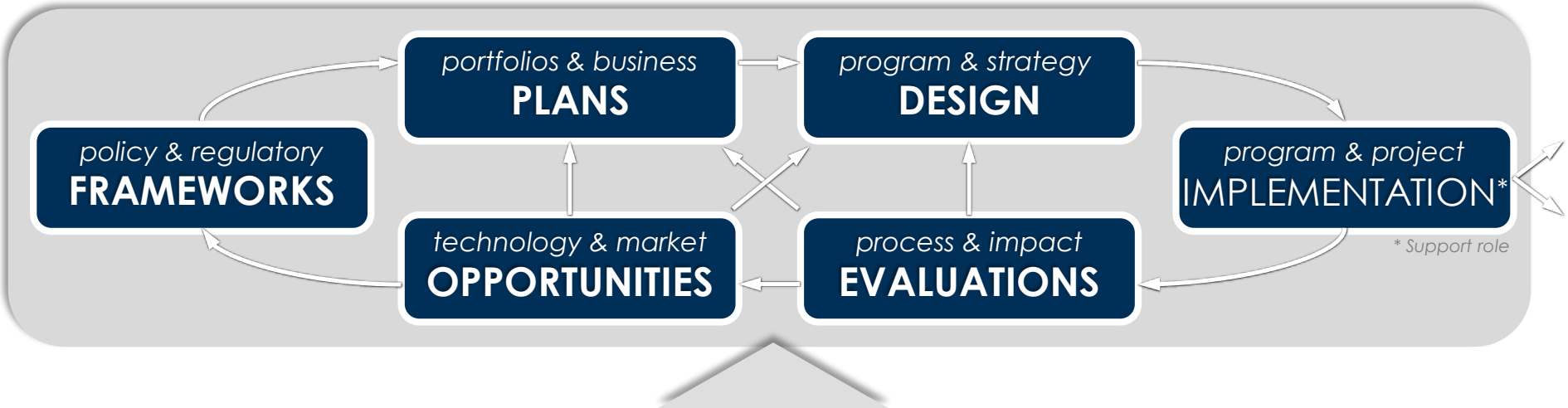
- Design and evaluation of programs, plans and policies
- Strategic & regulatory support
- Technical & analytical support
- Facilitation & consultation

CLIENTELE

- Utilities
- Governments
- Solution Providers
- Large consumers
- Non-profits

DUNSKY **SERVICE AREAS**

We focus on **six key service areas** that define the EE/RE cycle:



We service these areas through **rock-solid research and analysis**, including:

STRATEGIC & MARKET ASSESSMENTS

- Comprehensive Plans
- Program Design
- Best Practice reviews
- Gap Analyses
- Business Plans
- Strategic Evaluations
- Process Evaluations
- Benchmarking
- Market Research
- Stakeholder Engagement
- Regulatory Frameworks
- Regulatory Support

TECHNICAL & ECONOMIC ANALYSES

- Potential Studies
- Technology Assessments
- Measure Characterization
- Savings Algorithms
- Modelling
- Impact Evaluations
- Cost-Effectiveness Screening
- Financial Analysis
- Energy System Modelling
- Carbon Markets

BUILDING PERFORMANCE SERVICES

- Building Energy Assessments & Modelling
- Building Energy Performance Optimization
- Building Certifications (LEED, BOMA, ESPM, etc.)
- Related services

CONTENTS

MANDATE

NANTUCKET

UNDERSEA CABLE

- High load growth (3.6% vs 0.6% in MA) will require the building of a 3rd distribution cable by 2028

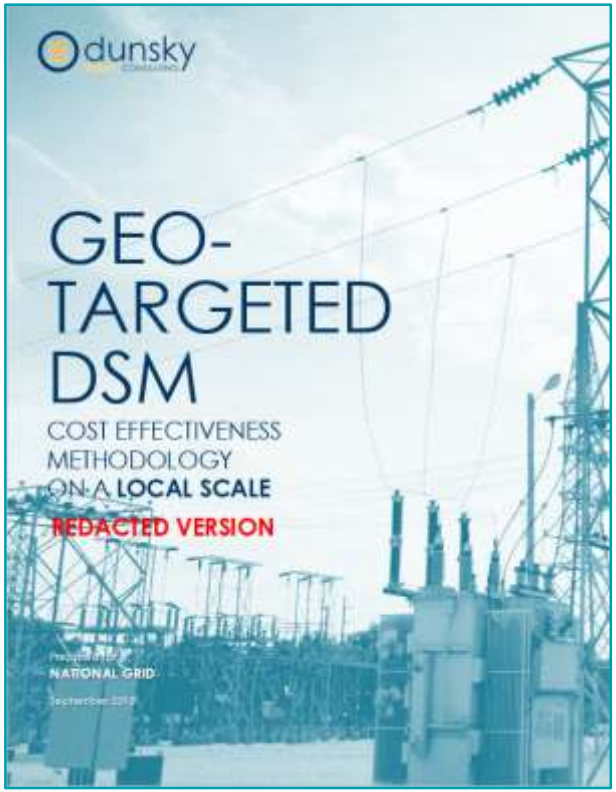
DIESEL GENERATORS

- Similarly, additional Diesel generators required to supplement peak capacity (4 in 2015, 12 in 2028)

NON-WIRE ALTERNATIVE

- EE/DR/DG to defer cable + incremental Diesel generation
- Tailor to promote additional projects (V/VAR optimization, solar)

REPORT



Our Report:

Geo-Targeted DSM – Cost Effectiveness Methodology on a Local Scale

is available on-line:

http://www.dunsky.com/wp-content/uploads/2016/09/NGrid-Geo-Targeted-DSM-Final-Redacted.pdf

BENEFITS

FROM GEO-TARGETED DSM

BENEFITS: OVERVIEW

LOOKING AT DSM WITH A **LOCAL LENS** UNLOCKS VALUE:

1. **DE-AVERAGED AVOIDED COSTS**
   T&D costs above all, but also gen. capacity and energy

2. **CUSTOMER TARGETING**
   Local load profiles, targeted marketing

3. **RESOURCE PLANNING BENEFITS**
   Local option value, DER optimization

DE-AVERAGED AVOIDED T&D COSTS

T&D CAPACITY

SCORECARD

INCREMENTAL?
YES

QUANTIFIABLE?
YES

COMPLEXITY?
MEDIUM

MATERIALITY?
HIGH

DESCRIPTION

Specific transmission and distribution (T&D) capacity capital investments deferrals from poles and wires to substations and service transformers
Targets high-value areas, and **defer costly T&D capacity investments**.
This benefit is considered a key added-value of geo-targeting.

INCREMENTALITY

This benefit is incremental relative to the average avoided T&D capacity cost approach employed in typical system-wide cost-effectiveness analyses.

QUANTIFIABILITY AND COMPLEXITY

Project-by-project basis (NPV of T&D and DSM ("non-wires") alternatives).
Complexity increases with granularity

MATERIALITY

Key driver for geo-targeted DSM

In its 2010 regulatory filing for targeted DSM, ConEd reported that local avoided T&D capacity costs represented 40% of accounted benefits.

DE-AVERAGED T&D COSTS

EXAMPLE

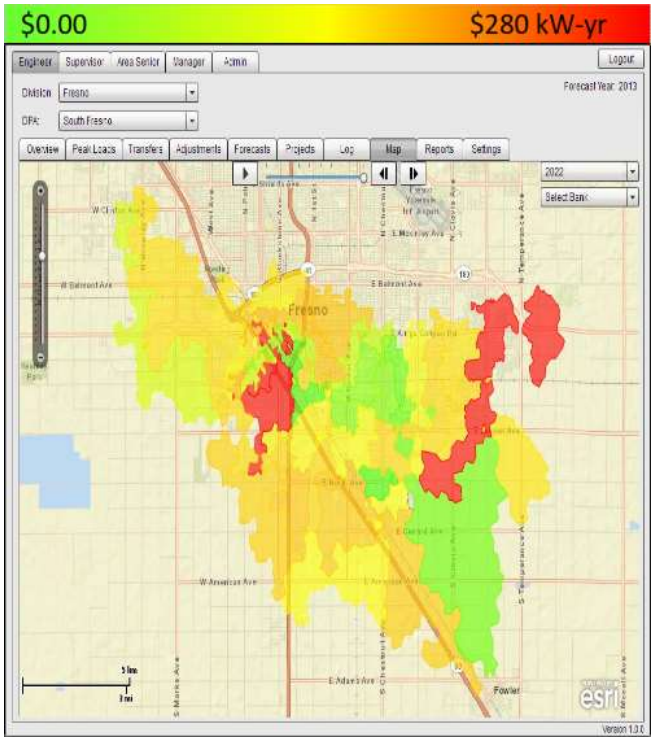


Image Courtesy of Integral Analytics

Avoided T&D Costs are highly concentrated.

Current Methodology spread out those benefits across the system, failing to capture the full benefit of a geo-targeted DSM initiative.

CUSTOMER TARGETING

DE-AVERAGED LOAD PROFILES

SCORECARD

INCREMENTAL?
YES

QUANTIFIABLE?
YES

COMPLEXITY?
MEDIUM

MATERIALITY?
HIGH

DESCRIPTION

Local, highly granular load profiles.

1) classify the DSM value of given customers
2) achieve a more accurate load forecast.

Local load profiles can support geo-targeting DSM efforts to **high-value customers** and provide a **fairer assessment of avoided energy and capacity benefits**.

INCREMENTALITY

Complement the use of de-averaged capacity avoided costs, through a localized assessment of the load shape and peak coincidence factors.
Different and incremental to de-averaged energy and/or capacity avoided costs ($/kWh, $/kW).

QUANTIFIABILITY AND COMPLEXITY

Advanced metering infrastructure and **utility billing analysis, load shape studies.** can help build local load profiles, and support the prioritization of customers based on their specific marginal cost to serve.

MATERIALITY

Unlock prioritization of customers based on marginal cost to serve.

RESOURCE PLANNING BENEFITS

LOCALIZED OPTION VALUE

SCORECARD

INCREMENTAL?
YES

QUANTIFIABLE?
YES

COMPLEXITY?
HIGH

MATERIALITY?
HIGH

DESCRIPTION

Average estimates of avoided costs and market prices do not account for local uncertainties around load volatility, weather, price fluctuations, and other factors. Using local probability distributions along with covariance analysis (which measures how variables change together) can help **fully capture the true added value of DSM measures** (the concept of option value), on an equal footing with supply-side resource valuation techniques.

INCREMENTALITY

The concept of option value captures a number of benefits that are not addressed by the avoided cost method, including hedging benefits against low probability/high impact events, and the benefit of DSM to reduce the impact of reliability-based events.

QUANTIFIABILITY AND COMPLEXITY

This benefit relies on a highly quantitative methodology, which makes use of probabilistic distributions, covariance analysis, and real options analysis. Supply-side already does this.

MATERIALITY

The option value depends on the range of DSM options and uncertainty.

LOCAL OPTION VALUE

PRECEDENTS

Several utilities already consider option value in DSM filings, in more than 15 states.

California PUC endorsed option value for DSM in response to PG&E arguments in its 2007 filing. The PUC also requires the confidential use of option value modeling for all major renewable energy projects, supervised by Procurement Review Groups.

RESOURCE PLANNING BENEFITS

LOCALIZED OPTION VALUE

A simple analogy can help understand the concept a bit more clearly (both have same average load and price):

	Average Load and prices			Local + Hourly Load and prices		
Hour	MW	$/MWh	Total $	MW	$/MWh	Total $
1	2	$50	$100	1	$20	$20
2	2	$50	$100	1	$20	$20
3	2	$50	$100	2	$50	$100
4	2	$50	$100	3	$80	$240
5	2	$50	$100	3	$80	$240
Average	2	$50		2	$50	
Total			**$500**			**$620**

Making use of covariance analysis helps build the appropriate values for load (the MW column) and price (the $/MWh column) **for given time periods, in light of probabilistic distributions** (i.e. the uncertainty of the various variables that affect load and prices are built into these figures).

RESOURCE PLANNING BENEFITS

DER OPTIMIZATION

SCORECARD

INCREMENTAL?
YES

QUANTIFIABLE?
YES

COMPLEXITY?
HIGH

MATERIALITY?
HIGH

DESCRIPTION

Geo-targeted, DSM measures such as dispatchable DR can **help integrate intermittent and storage resources** by offering load-following, virtual storage, and load shifting capabilities at a local level, in replacement of the more inefficient operation of a supply-side resource.

INCREMENTALITY

The value derived from local, targeted load following energy resource such as geo-targeted DR is not quite captured in other benefits, although there are some overlaps.

QUANTIFIABILITY AND COMPLEXITY

The quantification of the value of dispatchable DR to support DER integration is complex, and not well established. A benefit valuation can be achieved by conducting a case-by-case cost comparison of demand- and supply-side approaches for DER optimization projects, using high-resolution models.

MATERIALITY

While the materiality depends on the case, interviews with select utilities (Duke, NVE) suggest that the magnitude of these benefits can be considerable.

PLANNING & IMPLEMENTATION

FOR GEO-TARGETED DSM

Case-By-Case Assessment

REACTIVE TO CAPITAL PROJECT

- Driven by Grid Planning Process
    1. Identify Constrained Area and Needs
    2. Assess capital project costs and timeline
    3. Develop Non-Wire Alternative
    4. Evaluate Cost-Effectiveness

- Incremental Approach to current practice

COST-EFFECTIVENESS CONSIDERATIONS

CASE-BY-CASE ASSESSMENT - REACTIVE

- Experience elsewhere: compare NWA costs vs deferral value of capital project
  - Exception to DSM cost-effectiveness analysis
  - Risk of double-counting benefits (when already accounted for in system-wide values)
  - Less complex
  - Focus on costs
- Proposed Approach: Assess NWA benefits
  - Integrates with other DER cost-effectiveness methodologies
  - Can address impact on state-wide assumptions for specific avoided costs
  - Require additional analysis to assess full value of NWA benefits

COST-EFFECTIVENESS CONSIDERATIONS

INTEGRATED APPROACH - PREDICTIVE

- New Analytical Tool: Integrates DSM with Grid Planning
  - DER cost-effectiveness fully integrated in the analysis
  - Location-based avoided costs, broken down by component type (for avoided T&D)
  - Can include option-value & DER optimization (integrated within analytical tool)
- Alternative cost-effectiveness methodology

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