Energy Efficiency as a Transmission and Distribution Resource

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EFFICIENCY AS A T&D RESOURCE

Regulatory Assistance Project Webinar

June 28, 2012

Chris Neme, Energy Futures Group

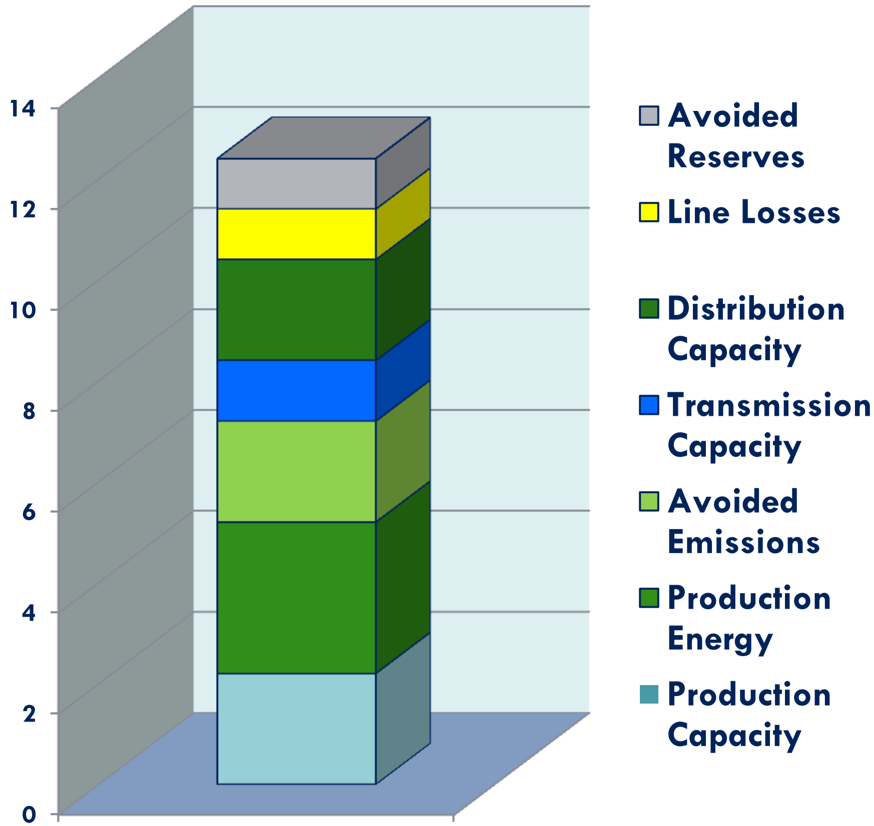
Presentation Overview

1. Introduction
2. “Passive Deferral”
3. “Active Deferrals”
4. Recommendations

Introduction

System Benefits of Energy Efficiency

- Production Energy Costs
- Production Capacity
- Avoided Emissions
- Transmission Capacity
- Distribution Capacity
- Line Loss Reduction
- Avoided Reserves

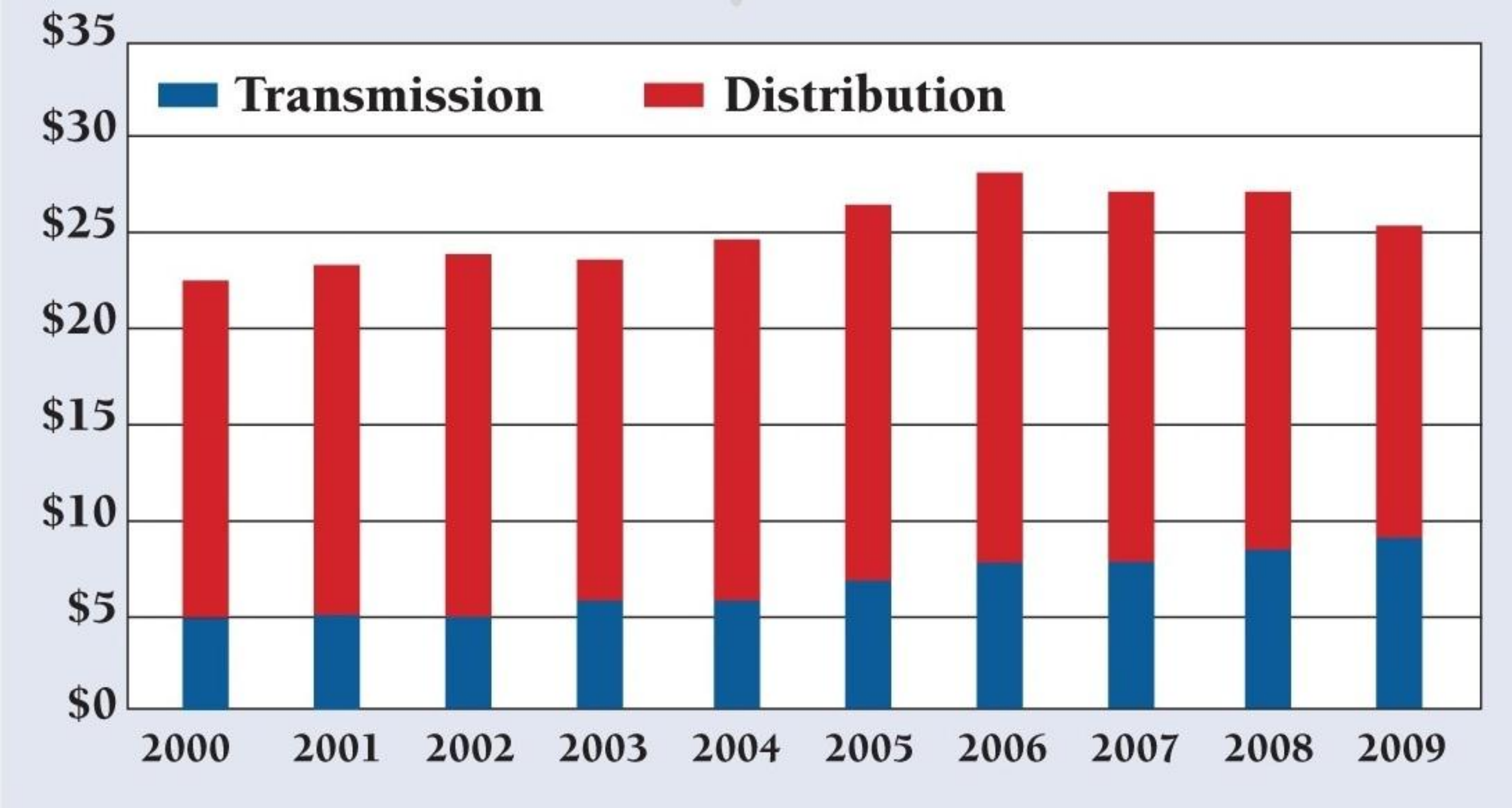


Plus "Non-Energy" Benefits:

- Other resource benefits (e.g. water)
- Building durability
- Health & safety
- Etc.

Note: Numbers in graph are only illustrative.

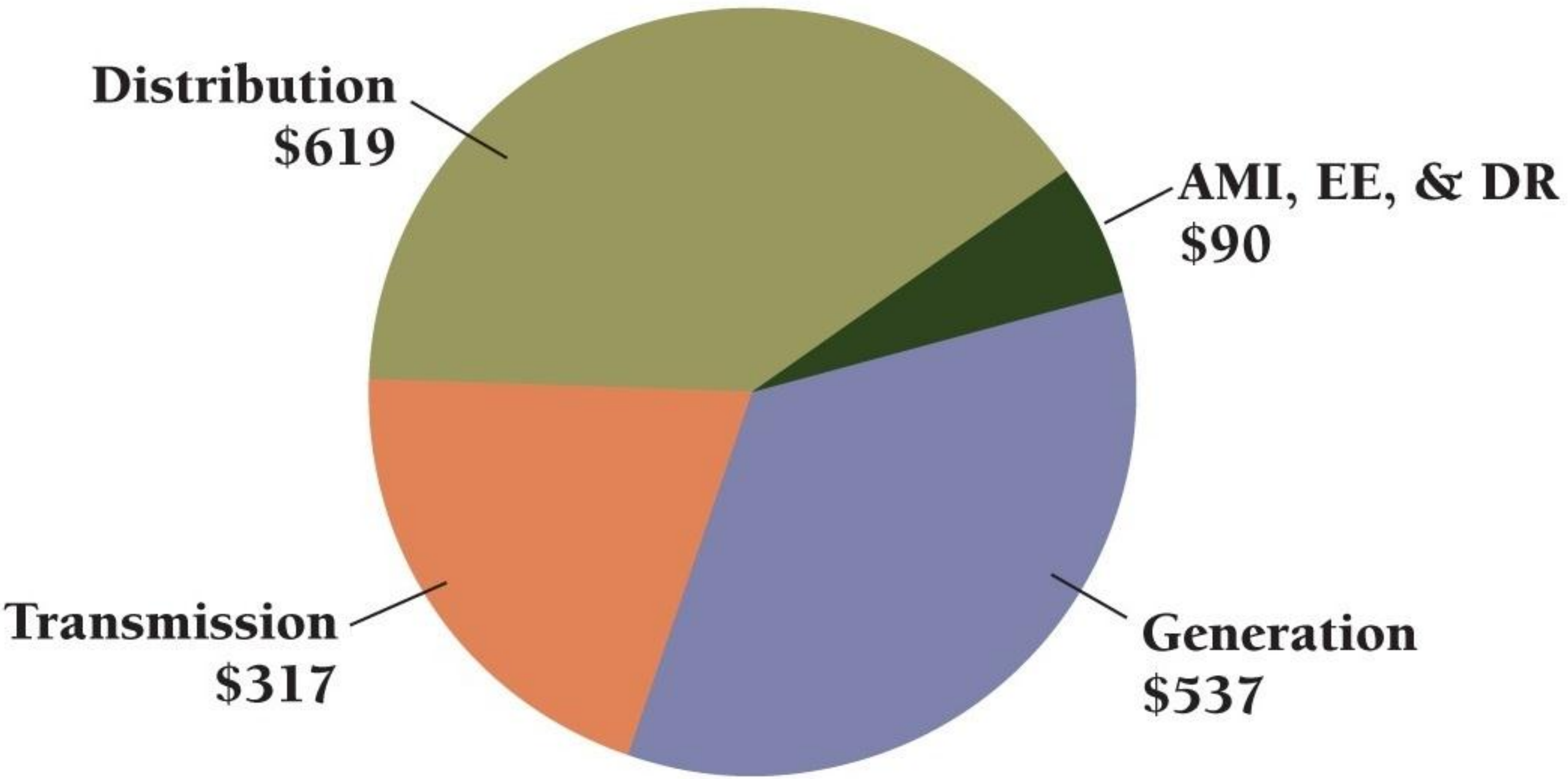
Historic T&D Investments by U.S. IOUs
(Billions of 2009 dollars)



Source: EEI's Statistical Yearbook of the Electric Power Industry 2009 Data, Table 9.1

Forecast T&D Investments: 2010-2030

(Billions of 2009 dollars)



Source: Chupka, Marc et al. (The Brattle Group), "*Transforming America's Power Industry: The Investment Challenge 2010-2030*", prepared for the Edison Foundation, November 2008.

Efficiency as a T&D Resource

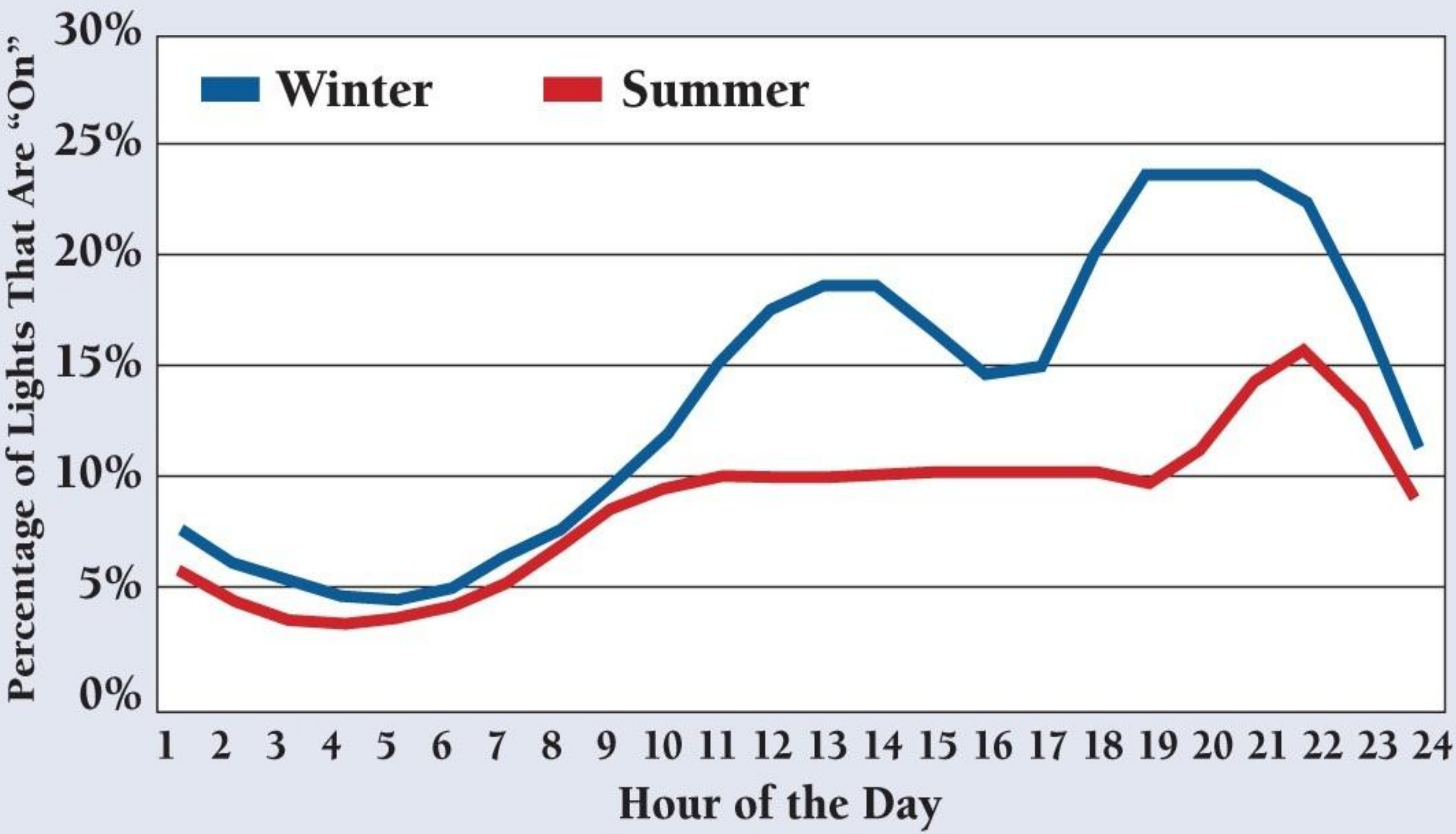
- Only affects growth-related T&D investment
  - Not all T&D investment is growth-related
- Can happen both "passively" and "actively"
  - Passive: by-product of system-wide efficiency programs
  - Active: by design, through geo-targeted programs

Passive Deferrals

Explaining Passive Deferral

- Different T&D elements experience peak at different times
  - Different seasons (summer and/or winter)
  - Different hours of the day (morning, afternoon or evening)
- Most EE programs/measures save energy at every hour
  - Not true for every participant…
  - …but true for large groups of participants as a whole
  - Exception 1: street light programs (night only)
  - Exception 2: programs addressing only cooling or heating
    - Only seasonal savings, but all T&D peaks are cooling or heating-driven
- Thus, most efficiency programs provide some T&D deferral

Average Hourly CFL Usage Patterns



Key Passive Deferral Questions

- Which T&D systems will be affected?
  - All or most affected if a broad enough portfolio of programs
- How far into future will deferral occur?
  - A function of aggressiveness of portfolio/programs
  - Earlier deferrals possible with more aggressive programs
- How much deferral will occur (i.e. for how many years)?
  - A function of both load growth and efficiency aggressiveness
  - Longer deferrals possible with more aggressive programs

Peak Time, Savings Mix Matter

Hypothetical DSM Portfolio Savings per Year (MW)

	Peak Season	Peak Time	Res. CFLs	Res. A/C Retrofits	Com. HPT8 Retrofits	Total
Substation A	Summer	3:00 PM	0.4	0.9	0.7	2.0
Substation B	Summer	7:00 PM	0.4	1.4	0.3	2.1
Substation C	Winter	7:00 PM	0.9	0.0	0.4	1.3

Note: savings values are illustrative only.

Savings Depth Matters

Scenario	Net Growth Rate	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
no DSM	3.0%	95	98	101	104	107	110	113	117	120	124
0.5% savings/year	2.5%	95	97	100	102	105	107	110	113	116	119
1.0% savings/year	2.0%	95	97	99	101	103	105	107	109	111	114
2.0% savings/year	1.0%	95	96	97	98	99	100	101	102	103	104

Hypothetical scenario:

- existing substation load = 95 MW
- max capacity = 100 MW
- initial upgrade increases capacity to 120 MW
- second upgrade increases capacity to 140 MW

Valuing Passive Deferrals

- Deferral benefits should be in avoided T&D costs
- Some jurisdictions assign value in this way:
  - New England: ~$55 to $120/kW-year
  - CA/Northwest: ~$30 to $105/kW-year
- But many others do not (or use very conservative values)
- Con Ed takes most sophisticated approach
  - Forecasts EE savings separately for 91 network areas
  - More on this later…

Active Deferrals

Assessing Active Deferral Potential

- Forecast demand growth & related T&D needs
  - adjusted for impacts of system-wide efficiency programs
- Estimate additional savings needed for deferral
  - Several scenarios of savings levels, deferral timelines
- Estimate benefits of deferral
- Estimate cost of added savings
- Are benefits greater than costs?

Different Approaches to Acquiring More Efficiency in Targeted Areas

- Accelerate uptake of existing programs in target areas
  - More intensive marketing in those areas
  - High financial incentives in those areas
- New measures/programs
- RFPs / Performance contracts
- Combinations (2 or more of the above)

Note: Efficiency does not have to be 100% of the answer. It can be married with demand response, distributed generation and/or other options as part of a multi-faceted strategy.

Barriers to Addressing T&D w/Efficiency

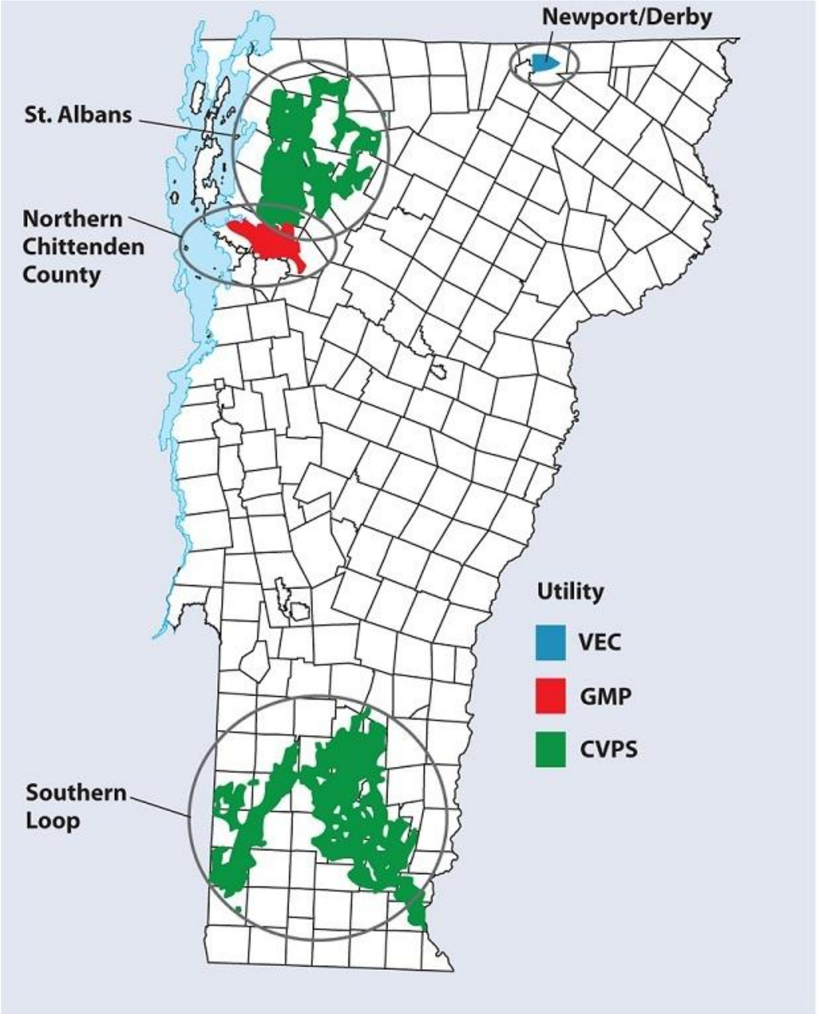
- Utility $ incentives – more profit from "poles & wires"
- Efficiency's multiple benefits – requires holistic perspective
- System planning is very technical
- System engineers don't trust demand resources
- Risk aversion – utilities are traditionally conservative
- Transmission costs socialized regionally, alternatives aren't
- Responsibility for transmission planning is diffuse

…but Several "Active Deferral" Examples

- Pacific Gas & Electric (CA, early 1990s)
- Portland General Electric (OR, early 1990s)
- Bonneville Power Authority (WA, early 1990s)
- Green Mountain Power (VT, mid-1990s)
- NV Energy (NV, late 2000s)
- Con Ed (NY, early 2003 to present)
- Efficiency Vermont (VT, 2007 to present)
- Central Maine Power (ME, under development)
- National Grid (RI, under development)
- Bonneville Power Authority (WA/OR/ID, under consideration)
- Others?

Efficiency Vermont Example

- Spurred by 2005 legislation (Act 61)
  - Eliminated efficiency spending cap
  - T&D deferral a key for new budget
  - 10 year T&D needs forecasts & plans
- Set in motion by regulators in 2007
  - Large budget increase (66% in 2008)
  - All new $ focused on 4 areas
  - Savings goals 7-10 times historic levels
- Two-part strategy:
  - Aggressively market existing programs
  - Launch new small C&I DI program



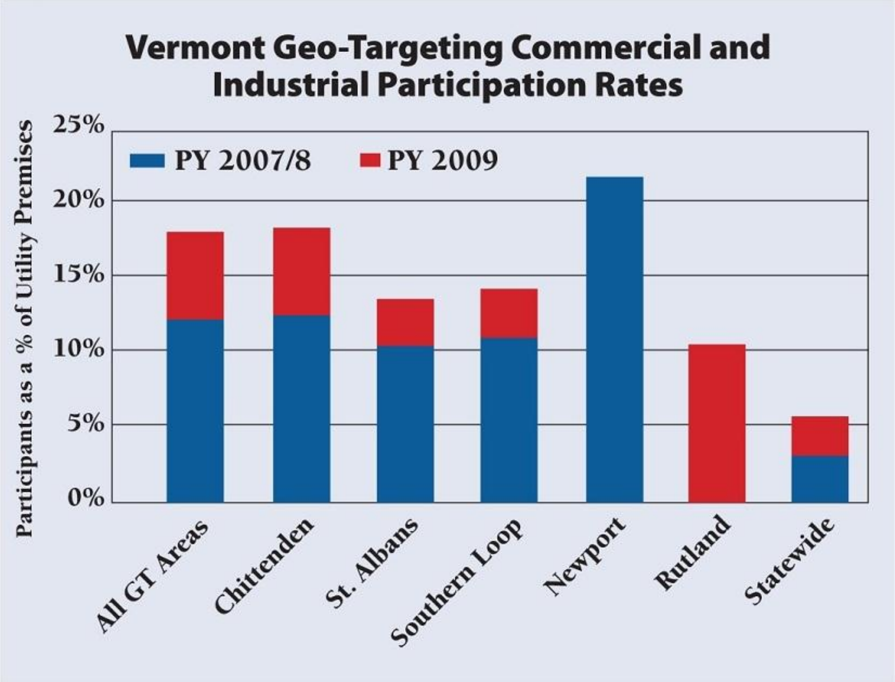
Initial Vermont Targeted Areas

	Urban vs. Rural	Size of Area	C&I Sales %	Large C&I Customers	Peak Period	2007 Peak (MW)	Annual Load Growth w/o DSM	Projected Load Growth w/ Targeted DSM
N. Chittenden	Urban	Small	65%	72	Summer	64	4.3%	1.2%
Newport	Urban	Small	64%	15	Both	18	1.7%	-0.5%[50]
St. Albans	Urban	Moderate	64%	42	Summer	29	3.4%	-3.3%
Southern Loop	Rural	Large	48%	38	Winter	70	3.4%	-3.4%

Vermont Results

2007-09:

- Summer savings only 70% of goal
- But still substantial
  - ~3-4 times higher participation
  - ~25% more savings per participant



2009-11:

- Met or exceeded savings goals

T&D System:

- Most T&D upgrades have been deferred
  - Southern Loop & Rutland upgrades no longer needed
  - Chittenden upgrade proceeding, but next upgrade deferred
  - Newport substation rebuilt – but only because of unexpected flooding

Vermont T&D Deferral Evolution

- Rigorous vetting process for selecting targeted areas
  - Responsibility assigned to Vermont System Planning Committee
  - 10 year forecasts of T&D needs
  - Regular analysis of efficiency potential for 16 zones in state
  - Criteria for identification of possible targets:
    - Need driven by load growth
    - Need is 3-10 years out
    - Enough efficiency potential to defer
  - More detailed assessment of those meeting criteria
  - Recommendations to Public Service Board for approval
  - List reviewed every year
- Maybe different T&D avoided costs for system wide programs
  - Custom projects, constrained area avoided costs
  - Custom projects, unconstrained areas avoided costs
  - Prescriptive measures, statewide average avoided costs

Lessons Learned (1)

- Geographically-targeted efficiency can defer T&D
  - NYC
  - Vermont
  - Portland, OR
  - Northern CA
- Efficiency deferrals can be very cost-effective – NYC
- Unexpected events can affect benefits
  - Both positively & negatively
- Sufficient lead time is critical
  - More time needed for larger projects

Lessons Learned (2)

- Smaller is easier
  - Easier to characterize
  - Fewer customers to treat
  - Requires less lead time
- Distribution is easier
  - Smaller
  - Less technically complex
  - Do not involve ISO (and related cost socialization issues)
- Cross-discipline communication is critical
  - T&D planners and efficiency program planners
- Integrate efficiency with other distributed resources

Recommendations

Recommendations

- Require least-cost T&D planning – VT, RI examples
  - all non-wires options, including combos, must be considered
- Institutionalize long-term planning horizon
  - At least 10 years
- Work to level playing field for wires & non-wires solutions
  - E.g., regional cost socialization applies to both or neither
- Collect more data on efficiency impacts
  - More, better load shape data should help w/T&D planners
- Start with pilot project(s)
- Leverage "smart grid" investments

Q&A

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Integrated System Planning & Targeted DSM

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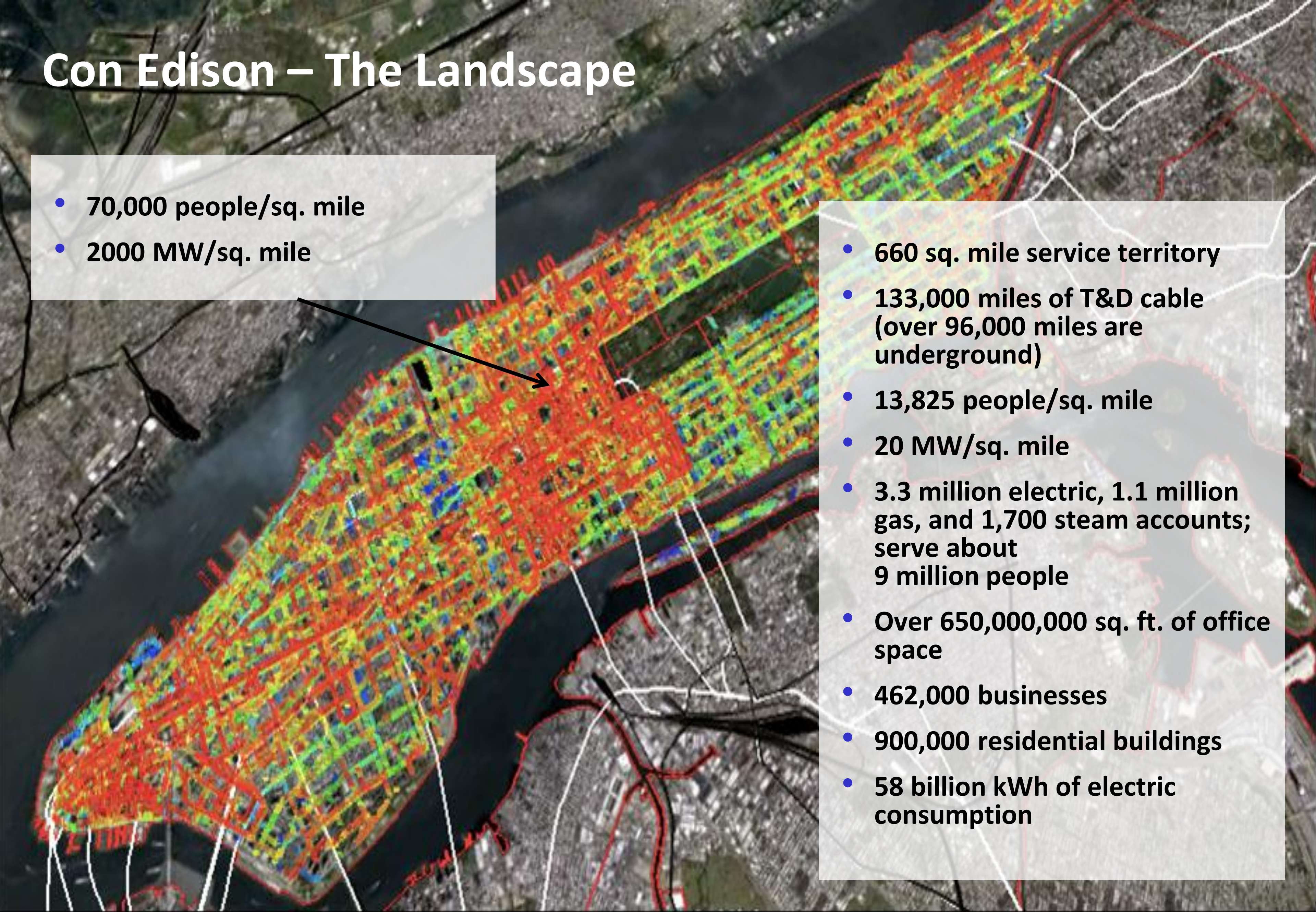
Michael Harrington

Agenda

- Current Landscape & Evolution
- Integration of DSM into System Planning
- Targeted DSM Deep Dive

Con Edison – The Landscape



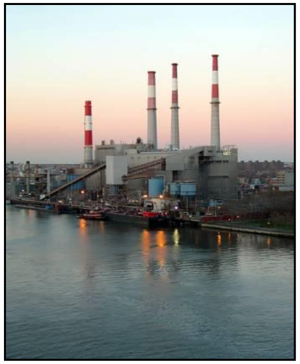
- 70,000 people/sq. mile
- 2000 MW/sq. mile

- 660 sq. mile service territory
- 133,000 miles of T&D cable (over 96,000 miles are underground)
- 13,825 people/sq. mile
- 20 MW/sq. mile
- 3.3 million electric, 1.1 million gas, and 1,700 steam accounts; serve about 9 million people
- Over 650,000,000 sq. ft. of office space
- 462,000 businesses
- 900,000 residential buildings
- 58 billion kWh of electric consumption

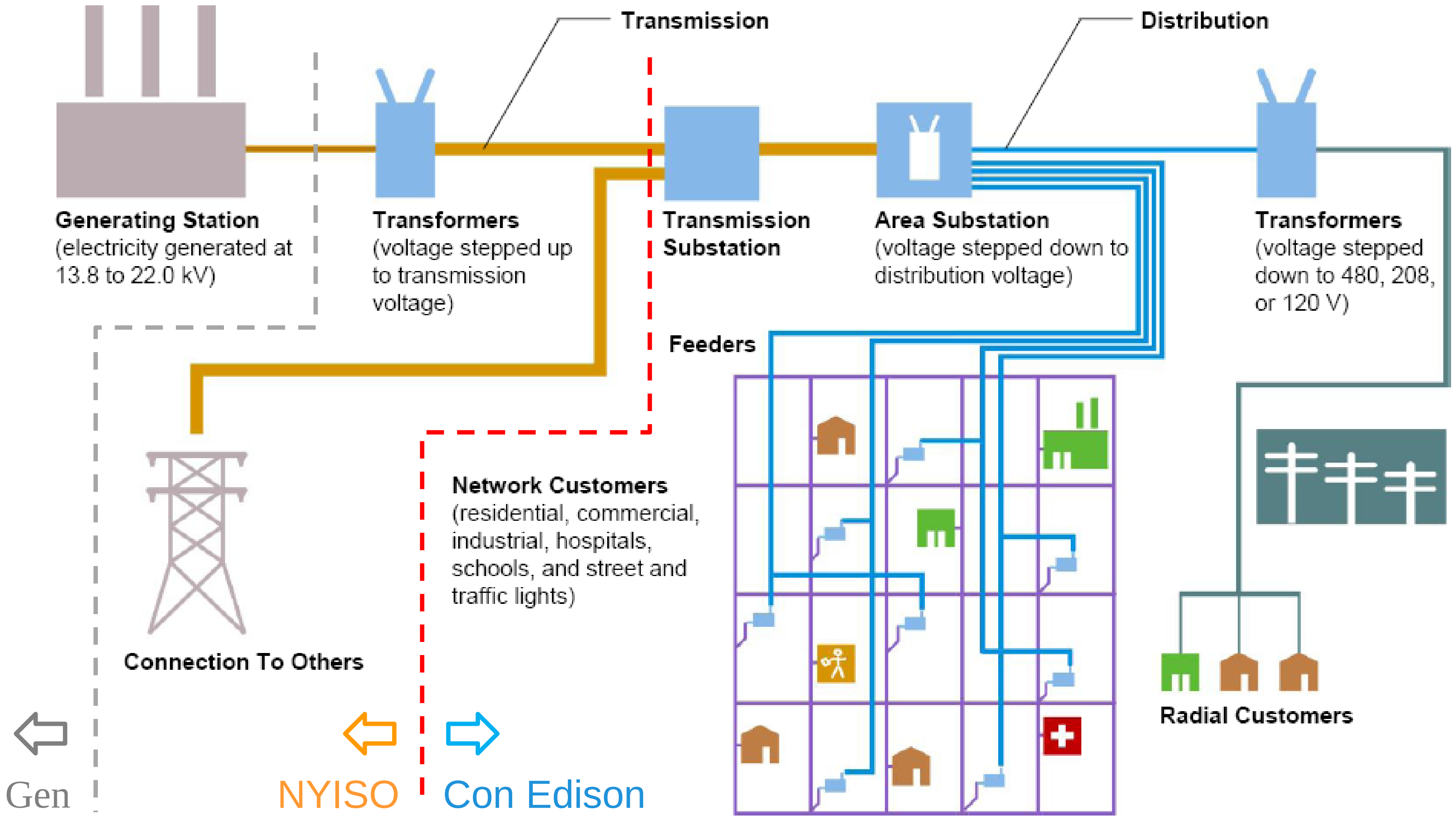
Capturing Value from Energy Efficiency

Energy Savings	T&D Savings	Line Loss Savings	Capacity Savings	Environmental Benefits




The Electric System - Restructured



Evolution…

2000
- Market Restructured
- Generation assets divested
- Transmission assets under NYISO
- Con Edison distribution only

2002-2004
- Targeted DSM Program begins
- Demand Response programs begin

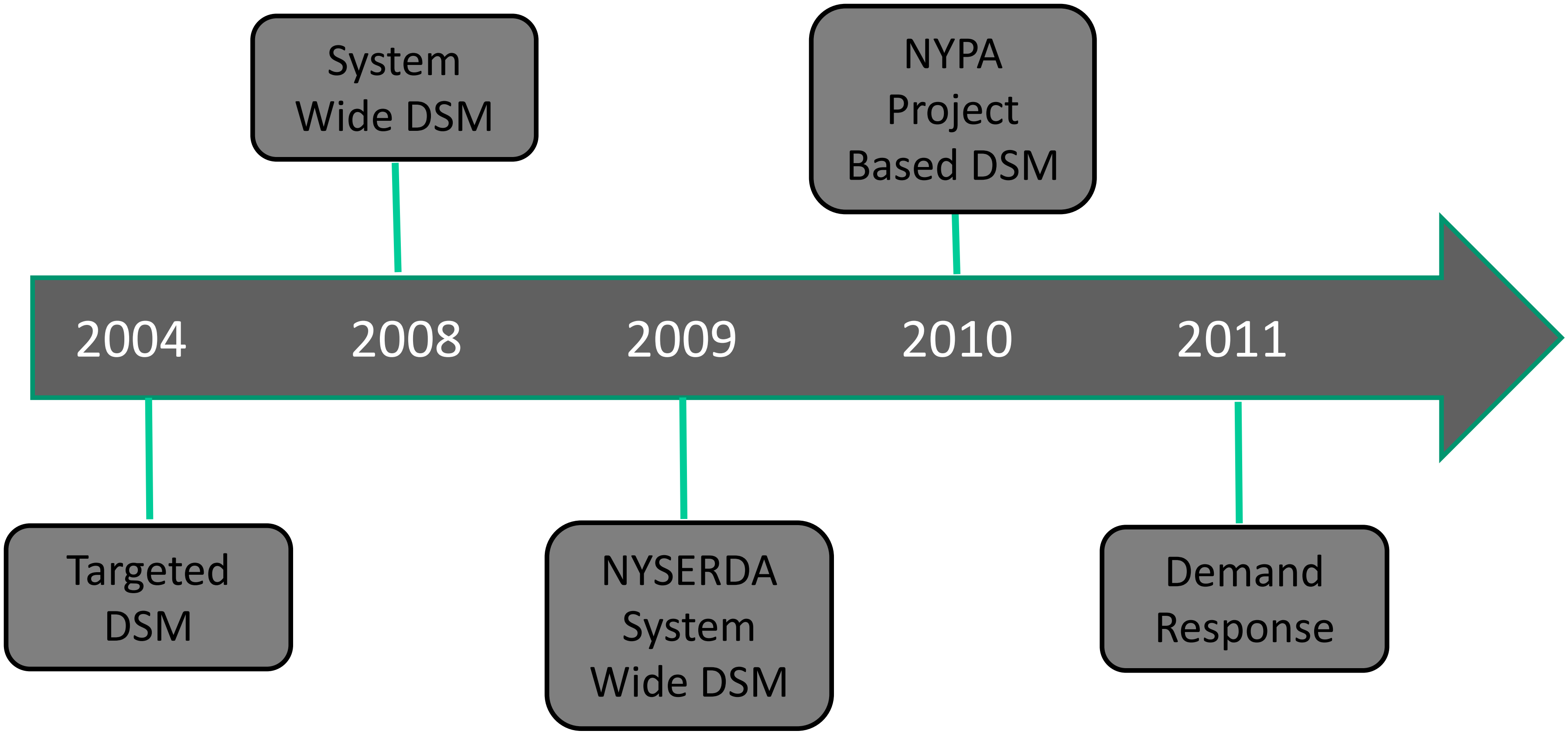
2005-2008
- Targeted DSM contracts for cap ex deferrals

2009-2010
- EEPS Programs begin

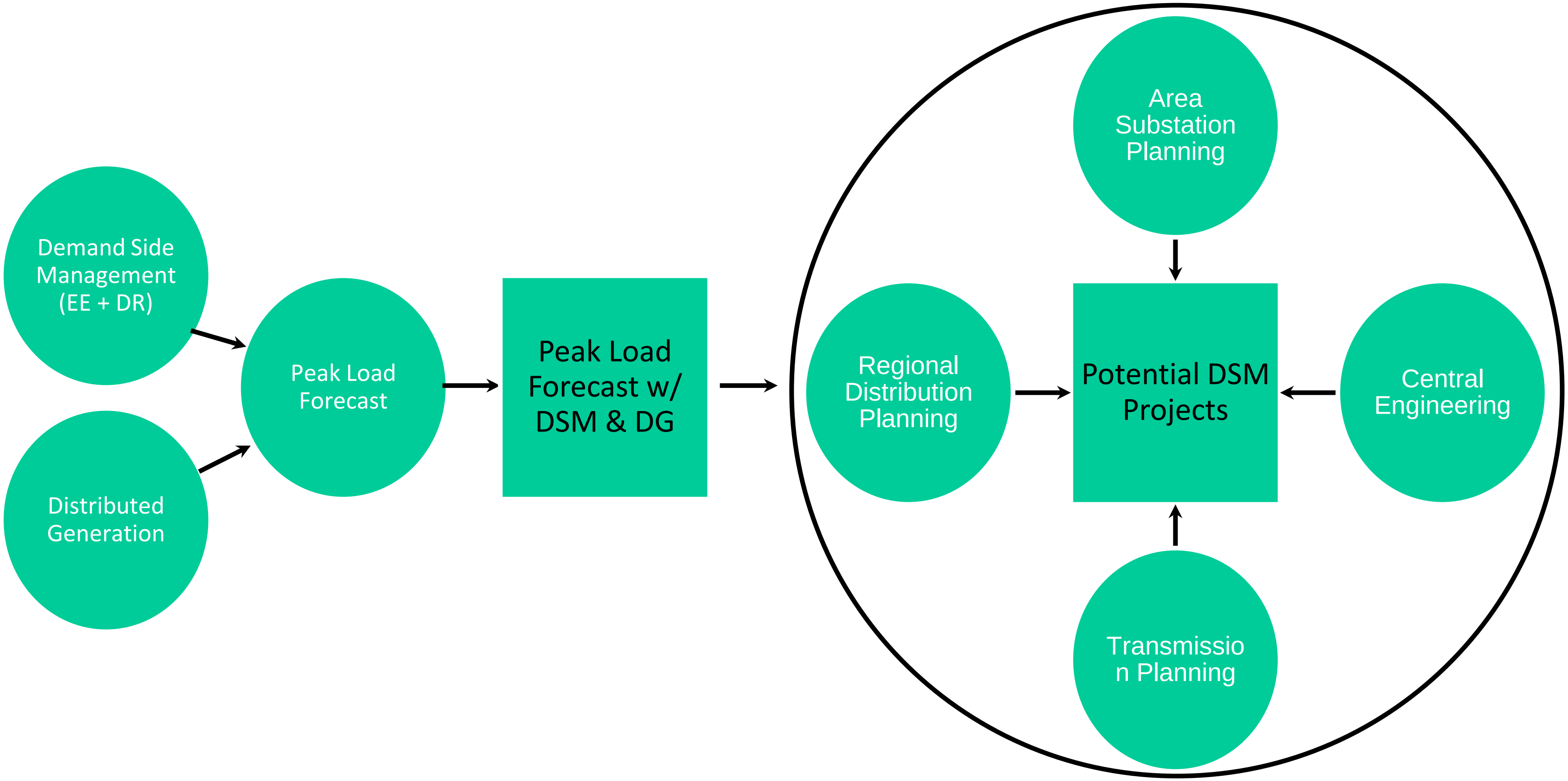
2011-
- Conservation Voltage Optimization
- 3G system design
- Portfolio approach
- Load Shaping

Integration of DSM into System Planning

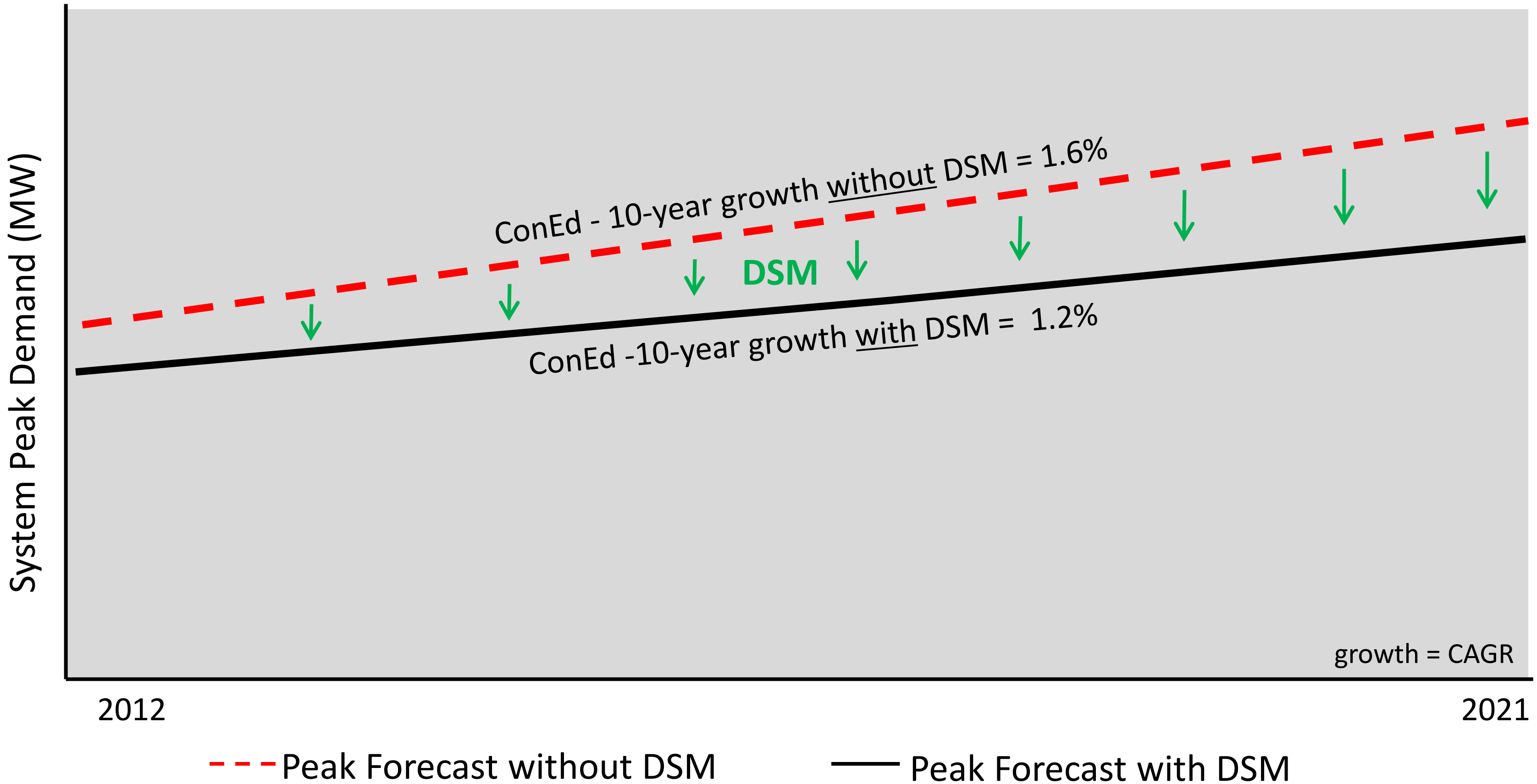
Evolution of DSM Integration



Planning Process and Internal Stakeholders



Long-Term Impact of DSM



Example: Ten Year Peak Load Forecast Substation "A"

(in MW)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Forecast	197	199	202	204	207	209	212	213	215	216
Less DSM	*(1)*	*(3)*	*(5)*	*(7)*	*(9)*	*(10)*	*(10)*	*(10)*	*(10)*	*(10)*
Net Demand	196	196	197	197	198	199	202	203	205	206
Capacity	200						250			

- Without DSM: demand is expected to exceed capacity by 2014
  - Capital investment needed to expand capacity.
  - Depending on the engineering solution, several years of lead time may be needed
  - Procurement/construction may start long before the impacts of EE are apparent.
- With DSM in forecast: project is deferred until 2018

Forecasting Approach: Overview

- Allocate expected energy savings to networks for each program
  - Con Edison has 91 networks/load areas, each with differing customer composition
  - Challenge is to estimate the geographic distribution of program participants by network (relative market penetration)
- Convert expected energy savings to coincident demand reductions
  - Program goals are expressed in energy—not demand—savings
  - Programs measures have differing load curves; networks peak at differing times
- Account for the variability of real outcomes (distribution uncertainty)
  - Grid reliability requires that the variance of the geographic distribution be estimated

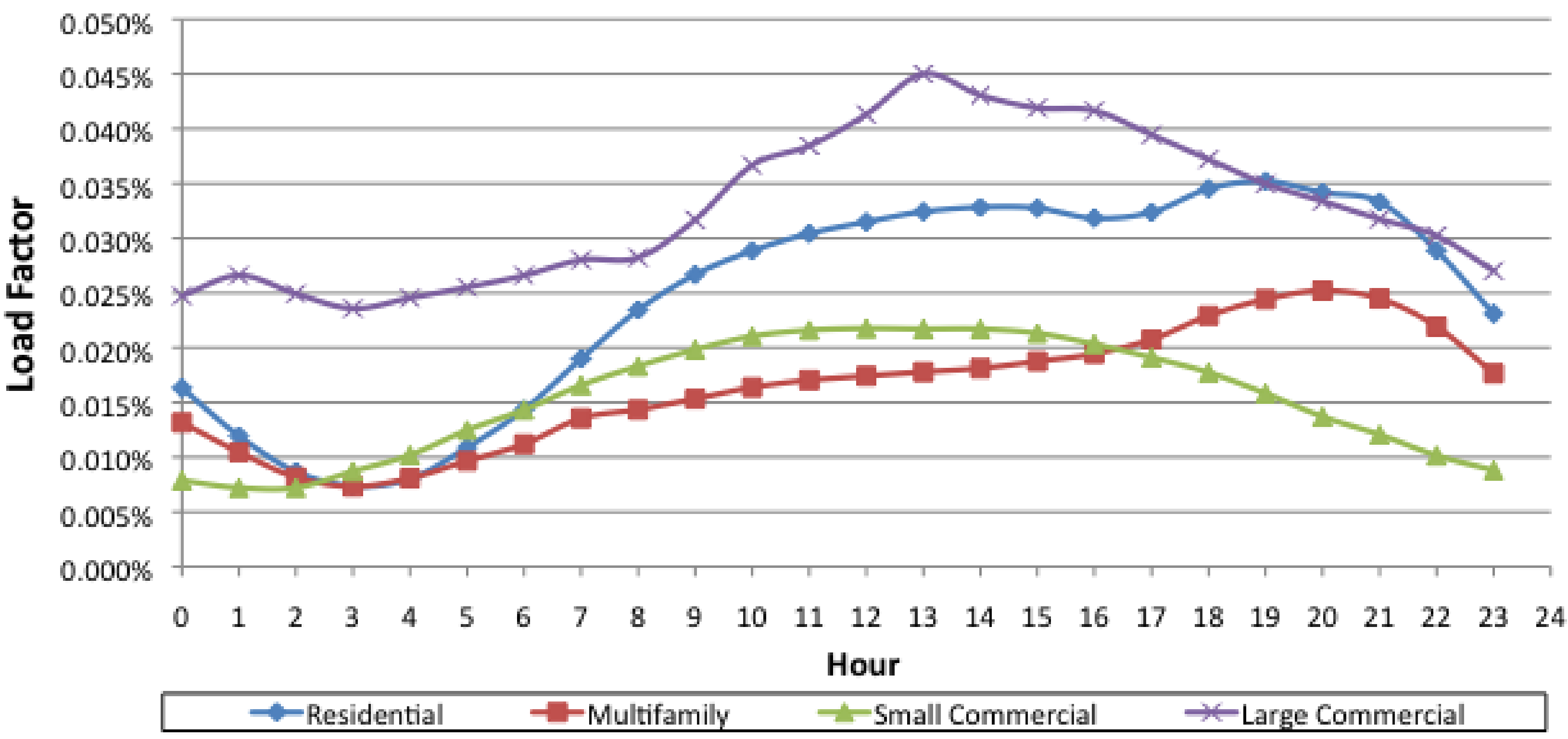
Allocating Energy Savings

- Program targets expressed as annual energy savings (kWh)
  - Started with realistic estimates of expected program achievements
- Use prior year consumption by customer type as a proxy function for the distribution of energy efficiency
- Map energy efficiency savings based on network-level consumption share of total consumption for each customer segment
  - Single (1-4) Family Residential
  - Multi (5+) Family Residential
  - Small Commercial
  - Large Commercial
  - NYPA and Other (N/A)

	A	B	L	M	N	O	P	Q
1			Share of Consumption					
2	Boro	Network	Single Family	Multi-Family <= 80	Small Commercial	Large Commercial	NYPA	Other Loads
60	MN	MN-Seaport_1-Bowling Green	0.01%	0.12%	2.11%	1.75%	0.56%	2.21%
61	MN	MN-Seaport_1-Cortlandt	0.00%	0.04%	0.07%	0.83%	0.15%	0.54%
62	MN	MN-Seaport_2-Fulton	0.01%	0.16%	2.03%	1.59%	0.77%	0.75%
63	MN	MN-Sherman_Creek-Washington Hgts	0.14%	4.13%	1.17%	1.11%	1.33%	0.33%
64	MN	MN-Trade_Center_1-Battery Park City	0.00%	0.07%	0.16%	0.51%	0.25%	0.02%
65	MN	MN-Unmatched-Radial	0.00%	0.00%	0.06%	1.50%	4.07%	1.46%
66	MN	MN-W_110_St_1-Harlem	0.22%	3.53%	1.07%	1.29%	2.71%	0.46%
67	MN	MN-W_110_St_2-Central Park	0.26%	4.49%	1.37%	1.11%	1.12%	0.77%
68	MN	MN-W_19_St-Chelsea	0.11%	1.95%	0.87%	2.99%	0.53%	1.55%
69	MN	MN-W_42_St_1-Pennsylvania	0.02%	0.49%	0.42%	2.83%	1.96%	2.44%
70	MN	MN-W_42_St_2-Columbus Circle	0.04%	1.11%	0.67%	1.61%	0.23%	2.58%
71	MN	MN-W_50_St-Hudson	0.01%	0.37%	0.17%	0.80%	0.22%	0.28%

Converting to Demand Reductions

- Generated 8760 load curves by program using Cadmus Portfolio Pro
  - Same tool used to design the programs
  - Sampled curves at each network's peaking hour to convert to demand



Addressing Variability

- Network specific demand reductions to this point are expectation values (P50)
- System planners need higher reliability
  - But this requires knowledge of the variance of the geographic distribution!
  - Until this can be measured, we reduced the expectation values by 50%
- Note that this reduction is not applied to the system forecast

Impact & Results

- DSM has proven to be a viable load relief option for system planning
  - Contributed to capital investment deferrals and reductions
- Improvements in the accuracy of forecasts has enhanced the way engineers view DSM
- Increased DSM awareness and its importance in system planning
- Positively impacted customer bills

Issues…Future Work

- Will the EE market penetration mirror consumption patterns within each segment?
  - Probably true for large enough aggregations of demand over the long term
  - Better than using past performance (distributions may shift as areas saturate)
  - But there will be short term variability (e.g., implementation contractors preferentially targeting areas for a variety of business reasons)
- Extension to secondary circuits (below network level)
  - Not currently attempted as random variability becomes overwhelming (e.g., a circuit could serve a single customer or single building)
  - (But they can be targeted!)

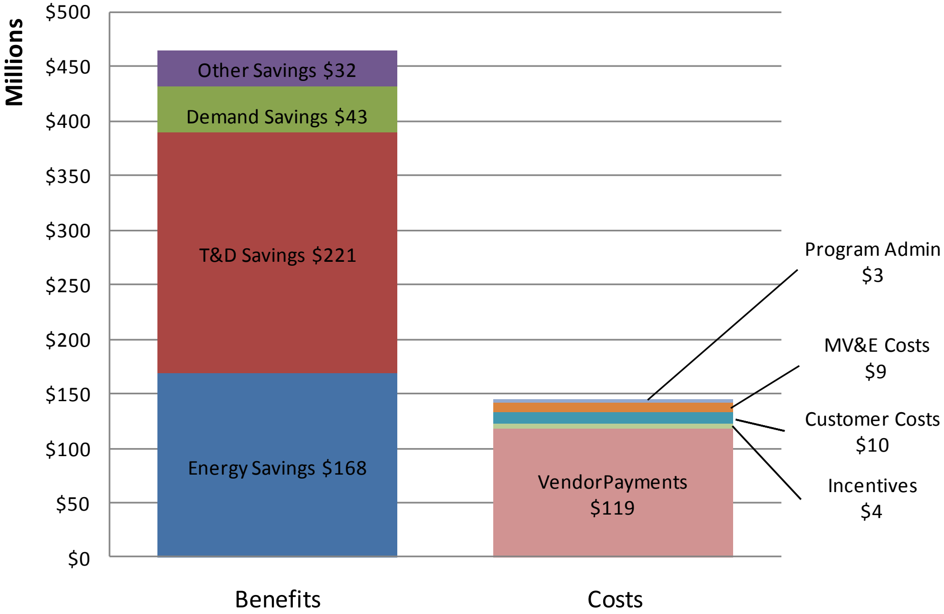
Targeted Demand Side Management (DSM) Program

Targeted DSM: History & Background

- Con Edison's "Targeted DSM" program has used EE proactively to reduce demand on specific circuits since 2004
- Contracted demand reductions in targeted networks included in 10 year peak load forecast, but…
  - No geographic uncertainty (ESCOs credited only for projects in targeted networks)
  - No coincidence uncertainty (ESCOs only allowed to include measures that would reduce consumption during the relevant network peak)
  - Only risk is ESCO non-performance: mitigated contractually via liquidated damage provisions that offset the costs of handling last minute capacity shortfalls

Targeted DSM: Achievements

- To date we have achieved approximately **107 MW** of demand reductions and **278 GWh** of annual energy savings
- The program has created **$464M** in net customer benefits, including **$221M** in avoided T&D capital, on **$145M** in total costs

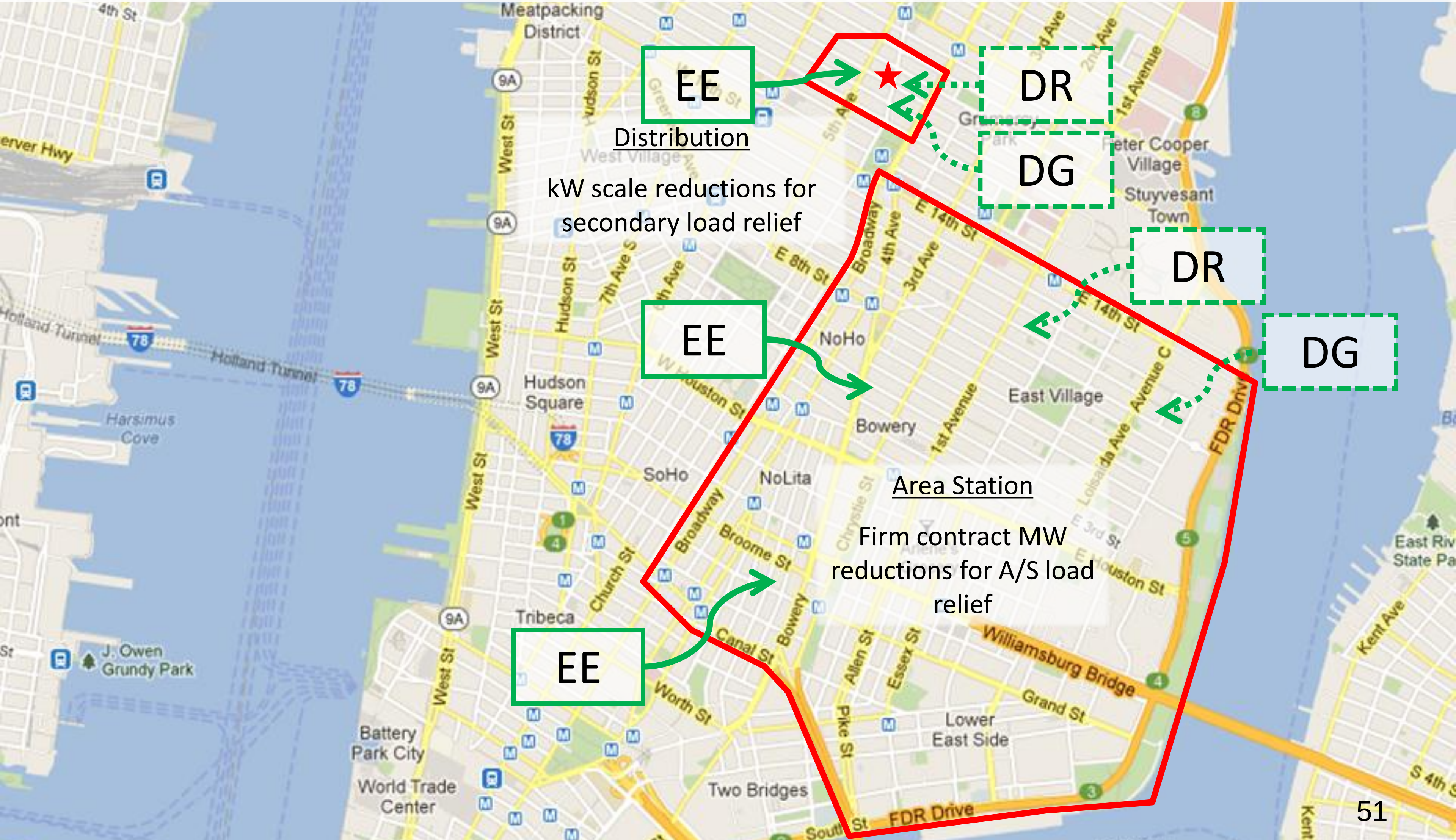


conEdison GREENTEAM

Targeted DSM: How It Works

- System planning identifies future network shortfalls (capacity – forecast)
- EE Department issues RFP for required DSM delivery schedule
- Markets (ESCOs) respond with bids
  - Markets determine the optimal portfolio of measures (EE, DG, etc.)
- Economic bids selected and contracted
  - DSM bids compared to project costs on a Total Resource Cost (TRC) basis
  - Project planning stops if DSM solution is selected
- Firm contracts and strict M&V ensure load reductions
  - Rigorous M&V regime to be certain of load reductions (100% pre- and post-)
  - Liquidated damage clauses motivate ESCOs and protect utility and customers

Targeted DSM: How It Works



Targeted DSM: Example Project

Project: Install 3rd transformer and 138 kV supply feeder

Cost: $29 million

Deferral: 2007 to 2010

Shortfall (MW)*	May 1 2006	May 1 2007	May 1 2008	May 1 2009	May 1 2010
Shortfall (Incremental)	0	3	4	4	3
Contracted (Cumulative)	0	3	7	11	14
Achieved (Cumulative)	2	4	8	12	14

RFP: Sept 2005

Contract: Nov 2005 – May 2010

Savings: $44 million ($13.5 T&D savings)

TRC: 2.6 (benefit/cost)

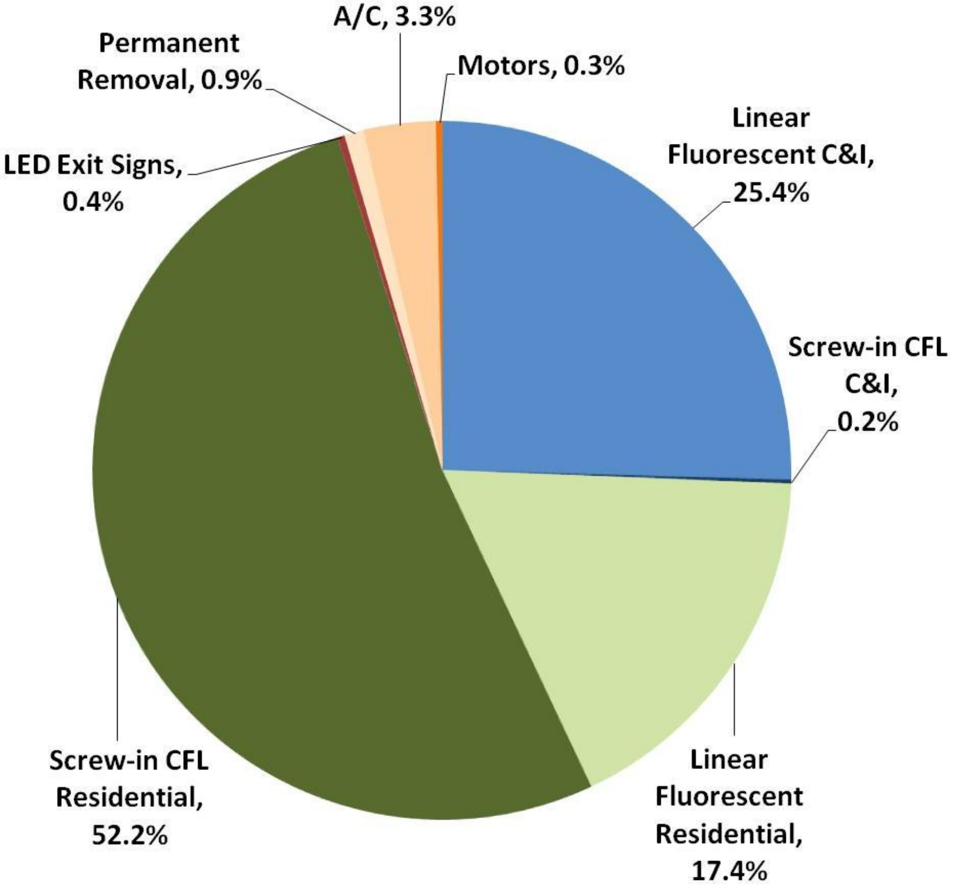
* Shortfalls, contracted, and achieved MW are as of May 1st each year (prior to the need each summer period)

Targeted DSM: Program Features

- Vendors fully responsible for all marketing and implementation
  - Con Edison did not initially lend its brand, but eventually did with success
- Rigorous M&V regime to assure real peak load reduction
  - 100% verification of existing and replacement equipment
- Security and Liquidated Damages
  - Upfront security & large financial penalties on ESCOs for missing goals
  - Proved important to driving ESCO performance
- Measures limited to those that reduced peak load
  - Fuel switching and DG allowed; residential and commercial peak differently
  - Mistake was to not applying coincidence factors in program design
- Physical Assurance for DG (but no projects actually done)

Targeted DSM: Participants and Measures

Participant End Use Sector	% of Total
Residential Apartment	40.3
Commercial	20.2
Residential Single Family	13.8
Office Building	7.8
Education	4.3
Hotel	3.2
Non-Profit	3.2
Manufacturing	1.9
House of Worship	1.6
Medical	1.5
Private Club	0.7
Theater	0.7
Government	0.5
Commercial Services	0.4
TOTAL	**100.0%**



Targeted DSM: Key Takeaways

- Formal coordination and communication with engineering and planning groups are essential
- Strong vendor management and contracts are key
- Need flexibility to review and adjust/modify/terminate contracts based on changing load relief needs
- Plan for coordination and communication with other DSM programs and company initiatives
- Utility branding and direct support makes a difference

Targeted DSM: Next Steps

- New $100 million Targeted DSM Program
- Adjusting program model and strategy based on delayed load relief needs at substation level (5+ years out)
- Looking at opportunities to leverage other existing EE and DR programs for targeted purposes
- Reviewing opportunities and challenges of extending the targeted DSM model to primary and secondary distribution
- Reviewing new, innovative technologies for potential targeted projects (e.g. storage, DG)

More Information

"Planning for Efficiency", Public Utilities Fortnightly, August 2011

http://www.fortnightly.com/uploads/08012011_PlanforEff.pdf

"Con Edison's Targeted Demand Side Management Program: Replacing Distribution Infrastructure with Load Reduction", ACEEE 2010

http://eec.ucdavis.edu/ACEEE/2010/data/papers/2059.pdf

Questions?

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The Regulatory Assistance Project (RAP) is a global, non-profit team of experts that focuses on the long-term economic and environmental sustainability of the power and natural gas sectors. RAP has deep expertise in regulatory and market policies that:

- Promote economic efficiency
- Protect the environment
- Ensure system reliability
- Allocate system benefits fairly among all consumers

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