Energy Efficiency as a Resource

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Alberta Climate Summit
Pembina Institute

September 28, 2017

Energy Futures Group Consulting

EE/RE Areas of Expertise

- Policy
- Market Analysis
- Program Design
- Evaluation

Range of Clients

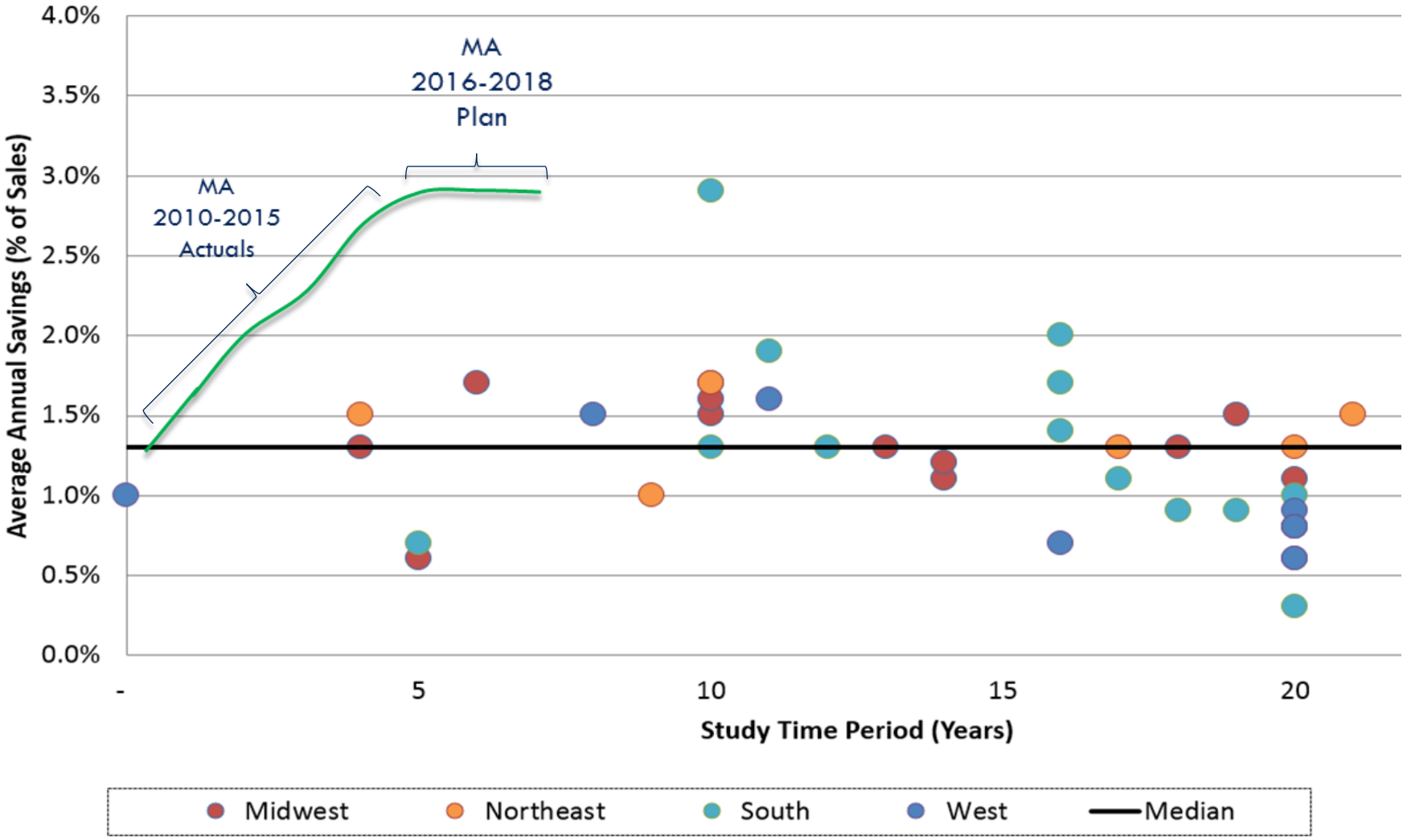
- Regulators
- Government Agencies
- Advocates
- Utilities

Clients in more than 25 states, 5 Canadian provinces, Europe & China.

Rationale for Efficiency Programs

- **Market barriers** prevent many cost-effective investments
  - Financial
  - Awareness/info
  - Risk
  - Transaction costs
- **Large, untapped, potential** that can be cost-effectively acquired
  - Studies typically estimate ~10-20% of energy use…
  - …But those estimates are inherently very conservative
  - Potential mostly constrained by policy – not technology or economics
- **30+ years experience** in leading jurisdictions
  - Typical program cost ~2-3 cents per kWh saved
  - "low hanging fruit" keeps growing back

Estimates of Max Achievable Well Below Leading Jurisdictions' Actual Achievements



The Bar Keeps Getting Raised

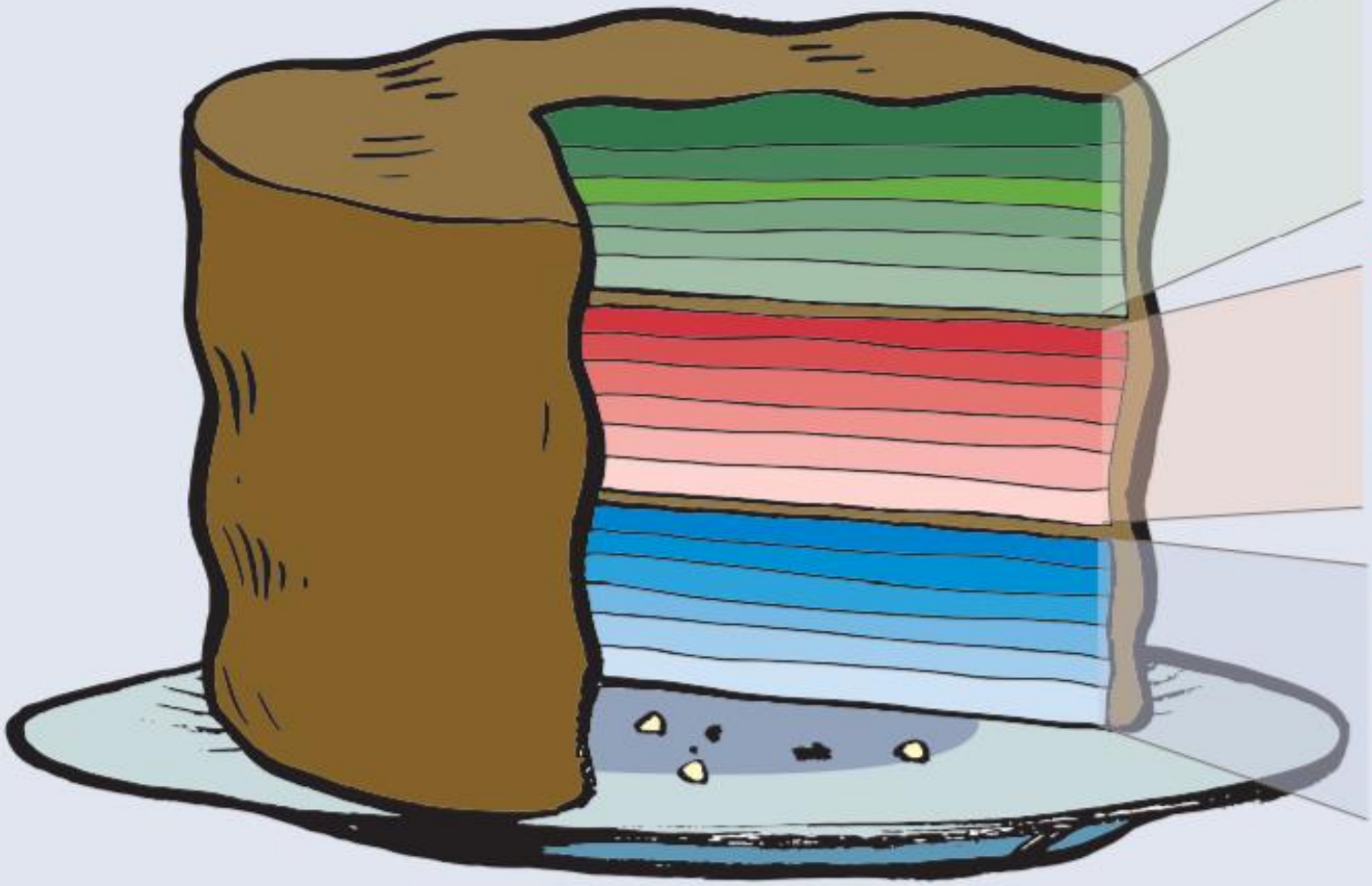
(annual savings as % of sales)

2006		2015	
1.2%:	CT, RI	≥2.7%:	MA, RI
≥1.0%:	3 states	≥1.0%:	16 states
≥0.5%:	12 states	≥0.5%:	34 states

6 states have EERS ≥2.0% savings in the future

Sources: ACEEE 2008 and 2016 State Energy Efficiency Scorecards

“Layer Cake” of Efficiency Benefits



Utility System Benefits
- Power Supply
- T&D Capacity
- Environmental
- Losses and reserves
- Risk
- Credit and Collection

Participant Benefits
- Other Fuels
- Water, Sewer
- O&M Costs
- Health Impacts
- Employee Productivity
- Comfort

Societal Benefits
- Air Quality
- Water
- Solid Waste
- Energy Security
- Economic Development
- Health Impacts

Source: Jim Lazar & Ken Colburn, *“Recognizing the Full Value of Energy Efficiency”,* Regulatory Assistance Project, Sept. 2013

Efficiency as a Resource - Energy

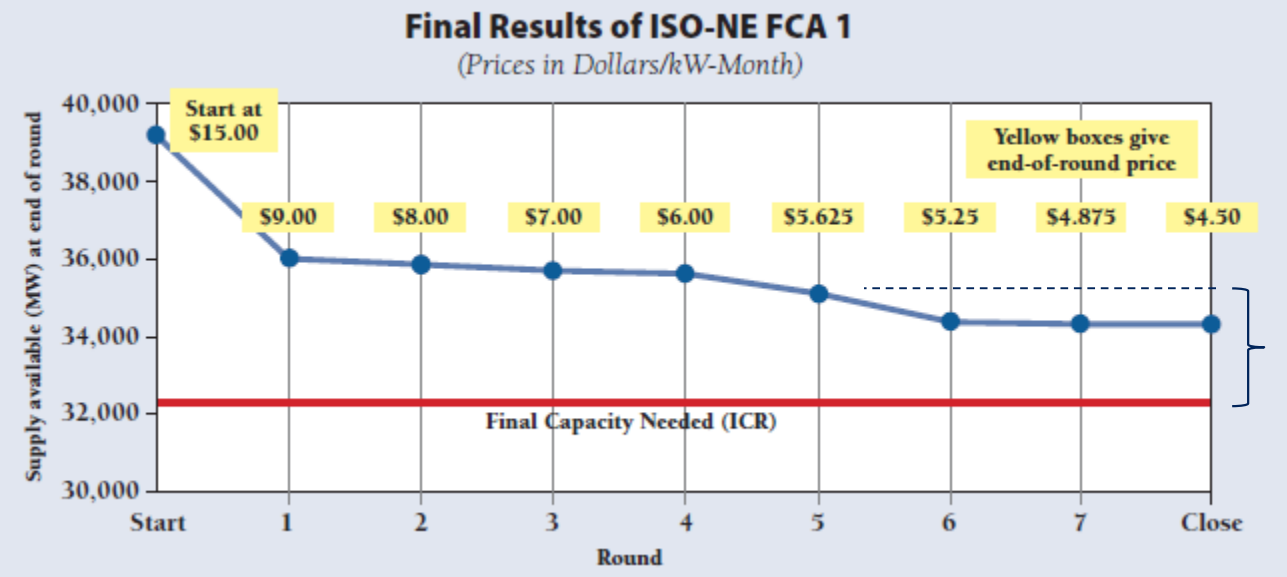
Massachusetts Example

- Mandate to acquire "all cost-effective" efficiency
- Spending >6% of electric revenue on EE programs
- Will meet >20% of electric energy needs in 10 yrs

Efficiency as a Resource - Capacity

New England ISO Capacity Market Example

- Demand resources (DRs), including EE, compete w/supply
- 11 annual auctions to date
- DRs and EE have lowered market clearing prices



~2300 MWh of DRs cleared; without them market clears at ~$1/kW-month higher price

Efficiency as a Resource - Transmission

New England Example

- ISO began integrating long-term forecast of EE programs into transmission planning in 2012
- Removed >$400 million in just Vermont/New Hampshire transmission projects from 10-year plan

Source: Chris Neme & Jim Grevatt (Energy Futures Group), *"Energy Efficiency as a T&D Resource"*, published by Northeast Energy Efficiency Partnerships, January 2015.

Efficiency as a Resource - Distribution

Con Ed (New York) Example

Passive Deferrals

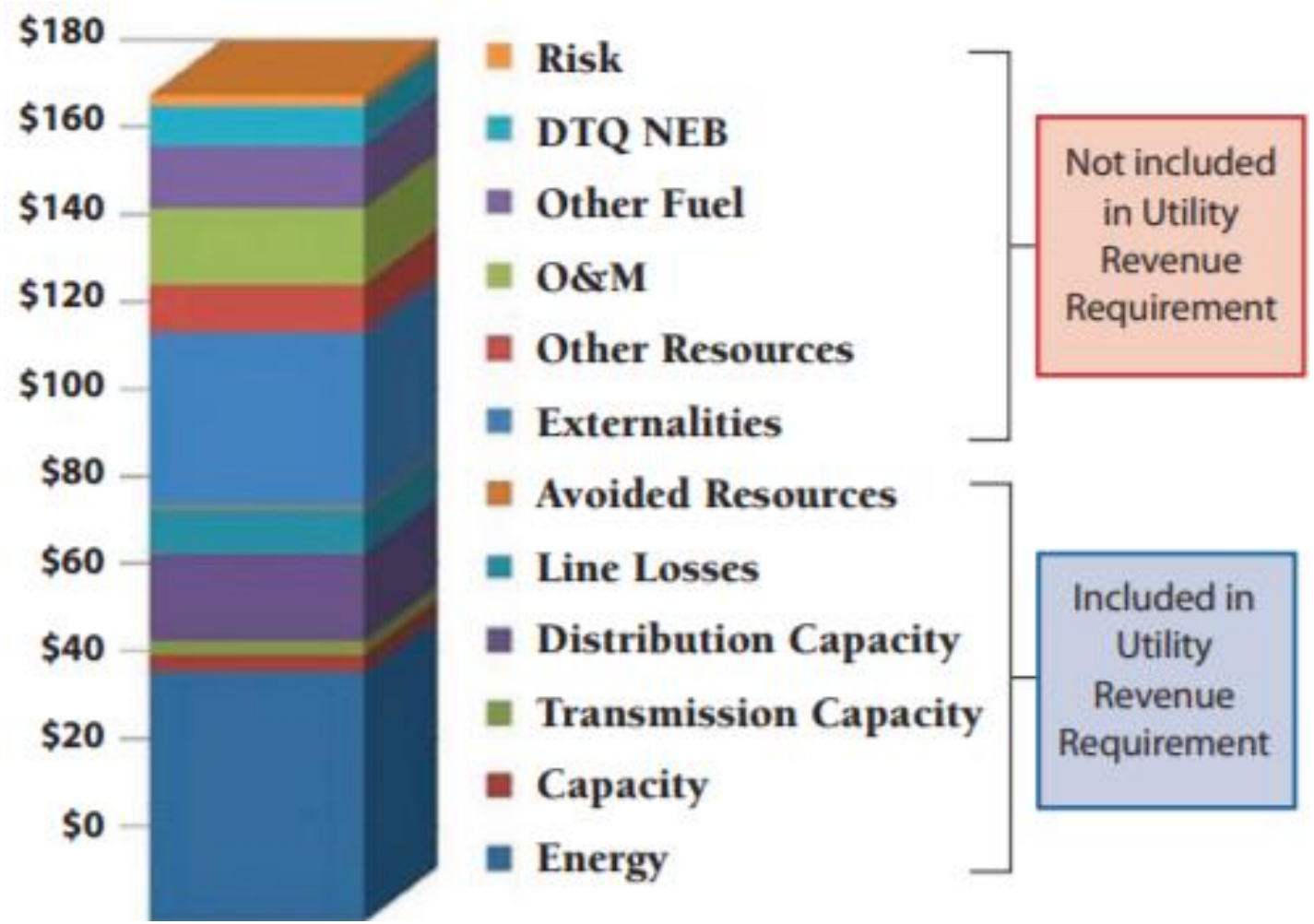
- Substation level forecasts of impacts
- >$1 billion reduction in 10-yr forecast

Active Deferrals

- >30 projects since 2003
- RFPs for DERs, but mostly EE won
- Many successful deferrals
- Also hedge vs. forecast uncertainty
  - bought time to determine some projects never needed

Source: Chris Neme & Jim Grevatt (Energy Futures Group), *"Energy Efficiency as a T&D Resource"*, published by Northeast Energy Efficiency Partnerships, January 2015.

Vermont's 2013 Estimated Value of Efficiency ($/MWh)



Source: Jim Lazar & Ken Colburn, *"Recognizing the Full Value of Energy Efficiency",* Regulatory Assistance Project, Sept. 2013

Q&A

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Multiple Benefits of Efficiency

Utility System Benefits

- Energy
- Generating Capacity
- T&D infrastructure
- Line losses
- Environmental Compliance
- RPS compliance
- Credit & Collection Costs
- Price Suppression
- Lower risk

Other Consumer/Societal

- Consumer Non-Energy Bens:
  - Comfort
  - Health & safety
  - Building durability
  - Water
  - O&M
  - Business productivity
  - Etc.
- Jobs/Economic Devt
- Environment
- Public Health
- Energy Security

Efficiency as a Resource – T&D

Passive Deferrals

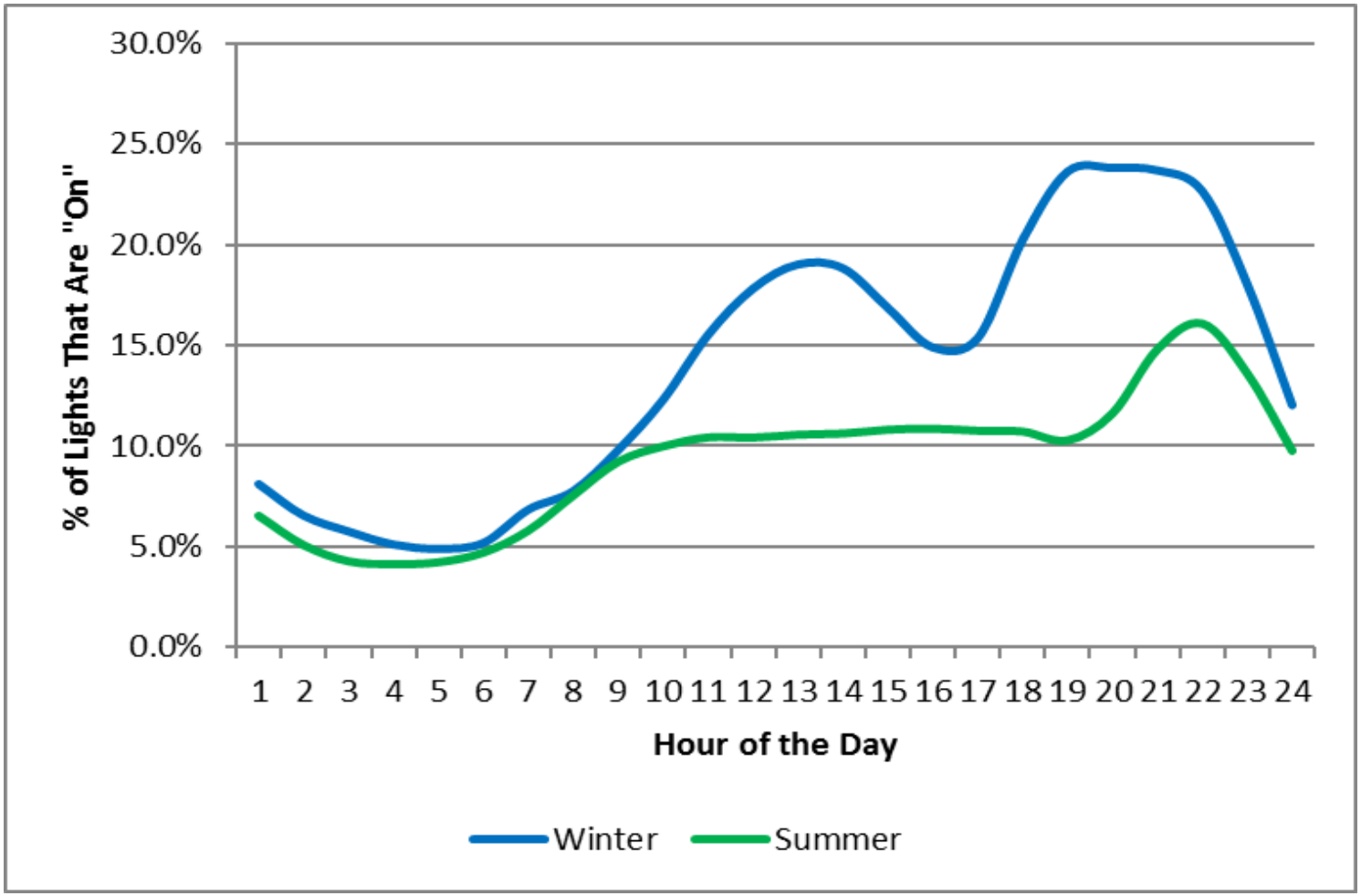
- Indirect, long-term impacts system-wide programs

Active Deferrals

- Geographically-targeted programs intentionally designed to defer specific T&D projects

Most EE Programs Provide Some Savings at All Hours of Potential Interest

Residential Lighting Savings Load Shape



Depth of Savings Matters

Hypothetical Distribution Substation w/100 MW Capacity

Level of Savings	Net Growth Rate	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
No EE programs	3.0%	90	93	95	98	101	104	107	111	114	117	121	125	128
0.5% savings/year	2.5%	90	92	95	97	99	102	104	107	110	112	115	118	121
1.0% savings/year	2.0%	90	92	94	96	97	99	101	103	105	108	110	112	114
1.5% savings/year	1.5%	90	91	93	94	96	97	98	100	101	103	104	106	108
2.0% savings/year	1.0%	90	91	92	93	94	95	96	96	97	98	99	100	101

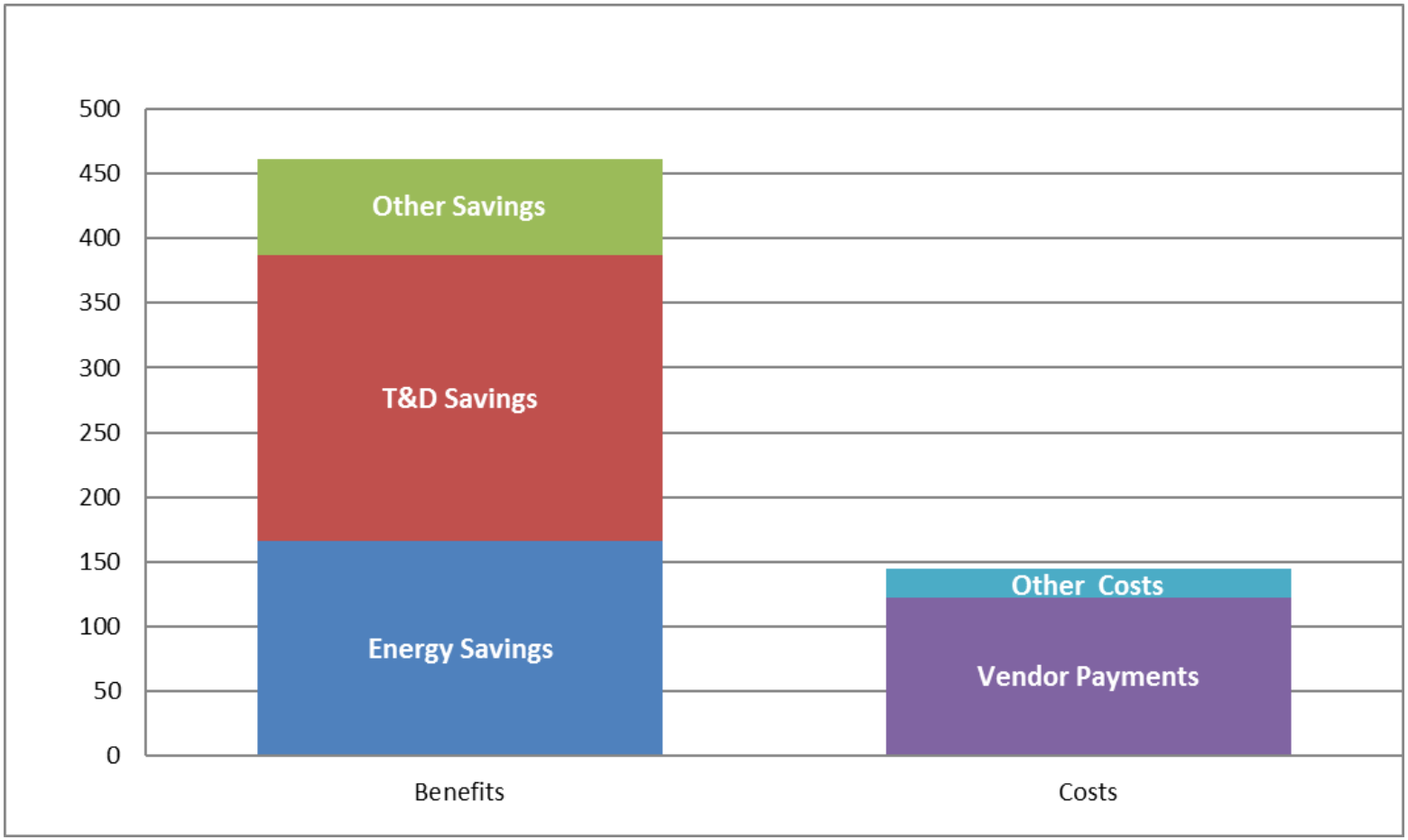
Season & Hour of T&D Peak Matter

Substation	Customer Mix	Peak Season	Peak Hour	Annual Peak MW Savings by Program			
				Residential CFLs	Residential A/C	Commercial Lighting Retrofits	Total
A	Primarily Business	Summer	3:00 PM	0.4	0.9	0.7	2.0
B	Primarily Residential	Summer	7:00 PM	0.4	1.4	0.3	2.1
C	Primarily Residential w/Electric Heat	Winter	7:00 PM	1.0	0.0	0.4	1.4

Con Ed Distribution Deferral Cost-Effectiveness

NPV of Net Benefits of Con Ed's 2003-2010 Non-Wires Projects

(millions $)



Institutionalizing Non-Wires Alternatives

Screening Criteria for Triggering Detailed Assessments of NWAs

	Must Be Load Related	Minimum Years Before Need	Maximum Load Reduction Required	Minimum T&D Project Cost	Source
Transmission					
Vermont	Yes	1 to 3 4 to 5 6 to 10	15% 20% 25%	$2.5 Million	Regulatory policy
Maine	Yes			>69 kV or >$20 Million	Legislative standard
Rhode Island	Yes	3	20%	$ 1 Million	Regulatory policy
Pacific Northwest (BPA)	Yes	5		$3 Million	Internal planning criteria
Distribution					
PG&E (California)	Yes	3	2 MW		Internal planning criteria
Rhode Island	Yes	3	20%	$ 1 Million	Regulatory policy
Vermont	Yes		25%	$0.3 Million	Regulatory policy