MA ENERGY EFFICIENCY ADVISORY COUNCIL

→ CONSULTANT TEAM

INITIAL ASSESSMENT OF POTENTIAL FOR ACTIVE DEMAND MANAGEMENT (ADM)

EEAC Consultants

April 2018

www.ma-eeac.org

INTRODUCTION

- **Follow-up to energy efficiency assessment of potential, with a focus on demand management**
- **Early step in the planning process**
- **Assessment of Potential (AoP) estimates *potential* demand savings, which is one important input in goal-setting**
- **Consultant presentation will discuss:**
  - Potential for demand savings, with a focus on Active Demand Management (ADM)
  - Initial estimates of ADM costs and costs per unit
  - Estimates from two PA demand potential studies
  - EEAC Consultant initial analysis and estimates to date
- **Work to date and estimates within this presentation are limited by what we had to work with from the PAs**

KEY TAKE-AWAYS

- **The potential for Active Demand Management (ADM) through the programs is 245 to 295 MW in 2021 for all PAs, based on and extrapolated from the two PA ADM potential studies (NGrid & CLC)**
- **ADM potential is estimated at time of system peak for consistency**
- **Higher range includes 75 MW for energy storage (behind-the-meter)**
  - Extrapolated from CLC estimate of 3.6 MW BTM storage potential*
- **ADM potential could be higher – 437 MW – if the sector estimates from PAs showing the highest potential are applied to all PAs**
- **Demand savings, costs, costs per unit, and cost-effectiveness from the PA studies vary widely (and we need the Eversource study)**
  - More work is needed among PAs and with PAs on ADM savings and costs. Costs and $/MW currently are uncertain – evolving & declining.
- **Key question: how much ADM does MA need, when, and why? What ADM is needed/valuable in addition to system peak reduction?**

*BTM = behind the meter. CLC BTM storage includes both battery storage and thermal storage.

BACKGROUND ON DEMAND SAVINGS AND ACTIVE DEMAND MANAGEMENT

ACTIVE DEMAND MANAGEMENT VS. EE LOAD FOLLOWING DEMAND REDUCTION

- **Consultant assessment and PA potential studies focused on active demand management (ADM) rather than demand savings from load-following EE**

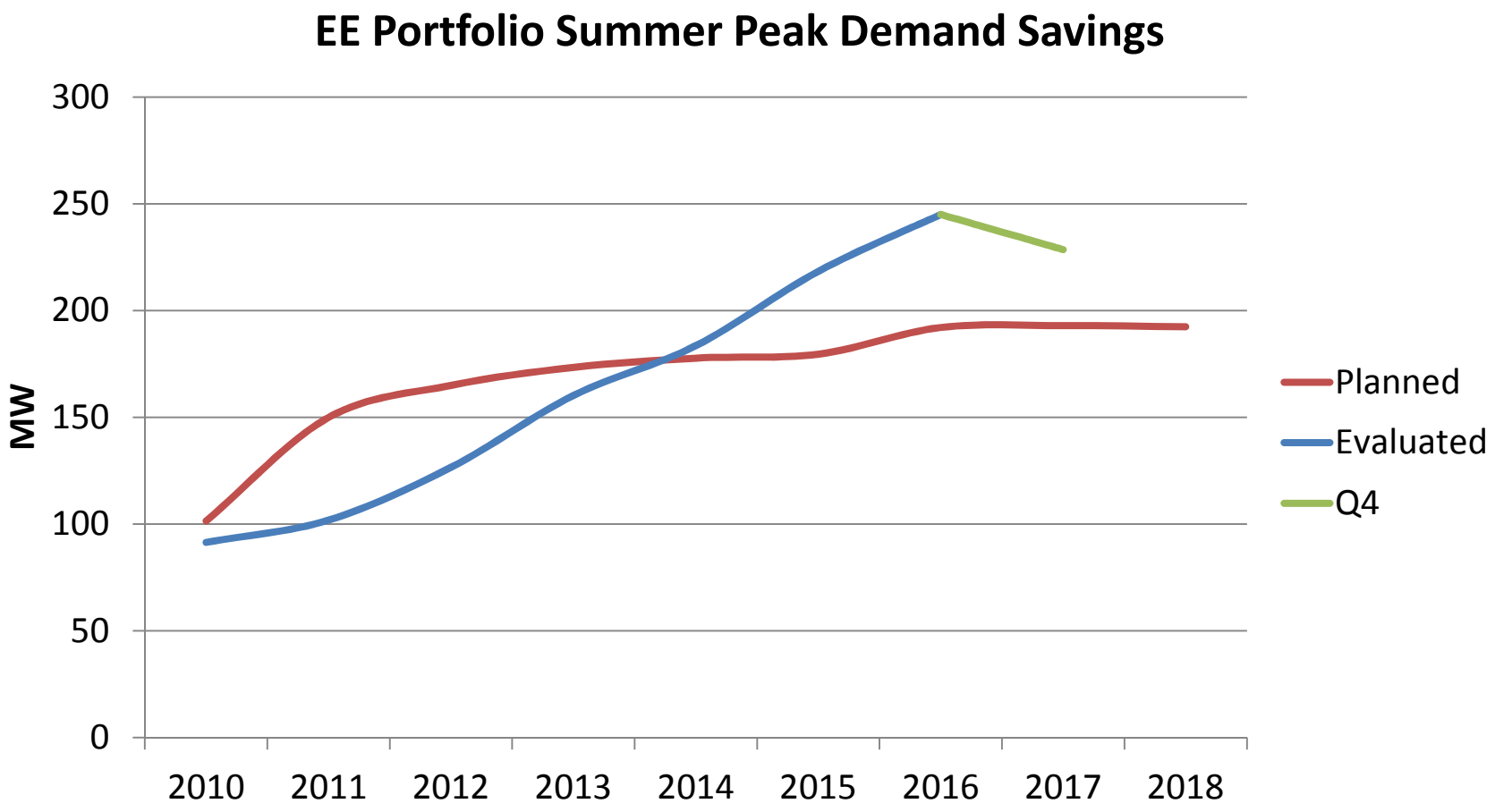
ADM

Encourages customers to reduce demand at specific times, such as demand response, load curtailment, or load-shifting

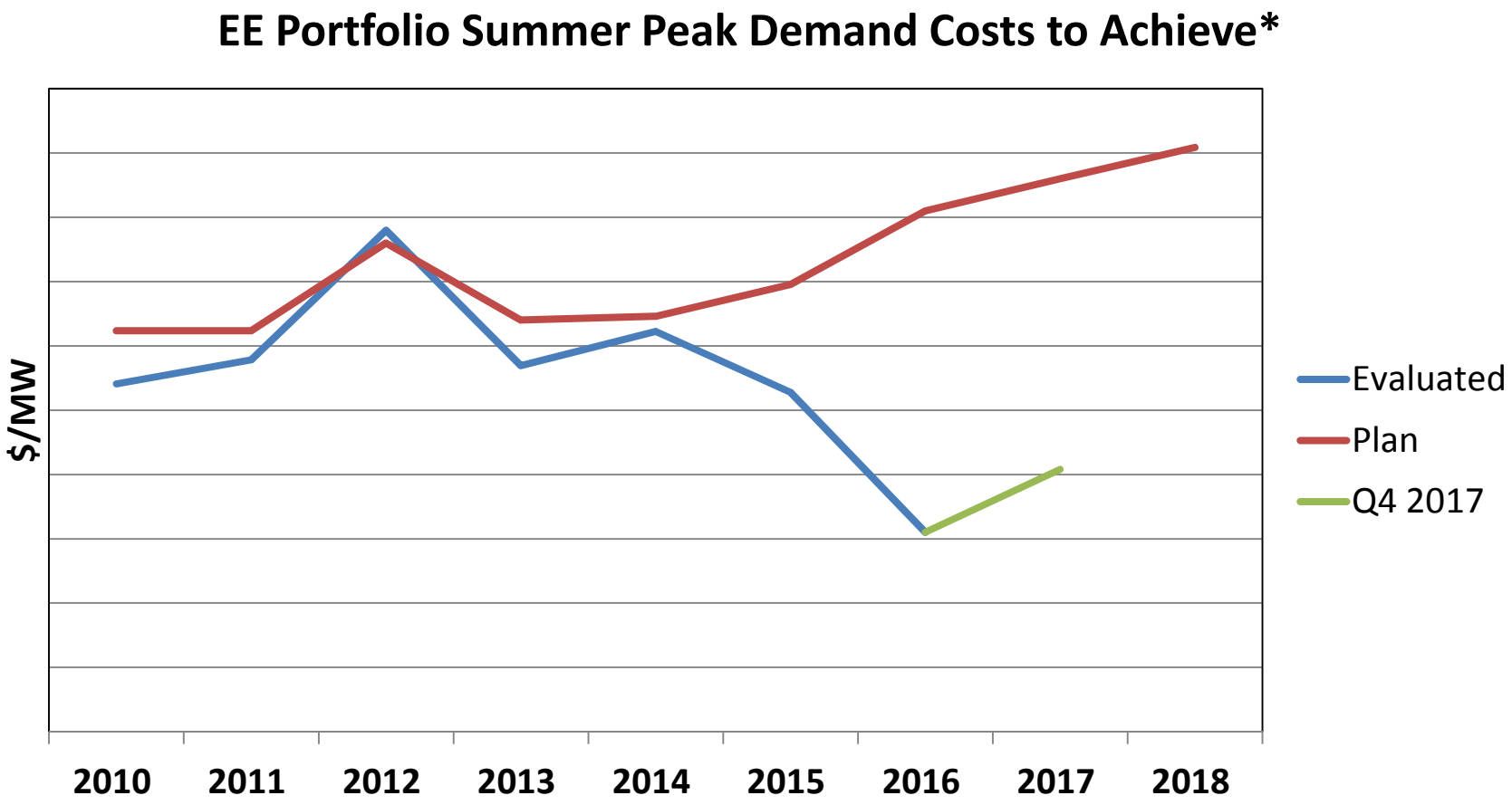
Load following (passive)

Encourages customers to reduce overall demand, without a specified time period, such as through energy efficiency or certain behavioral programs

EE PORTFOLIO: TRENDS IN SUMMER PEAK DEMAND SAVINGS

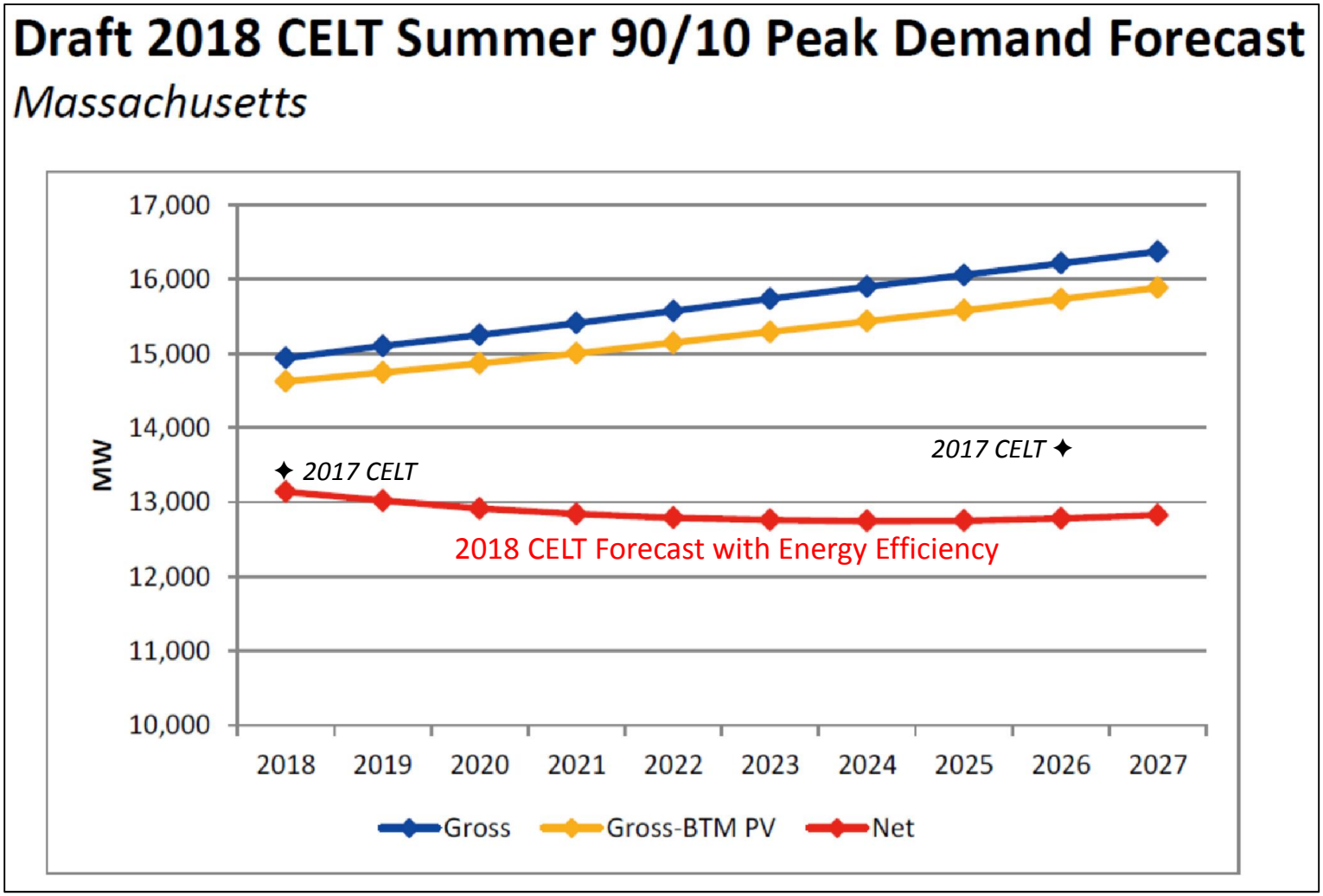


EE PORTFOLIO: TRENDS IN DEMAND COSTS TO ACHIEVE



The EE program costs purchase (MW) benefits in addition to energy savings and other benefits.

ISO-NE DEMAND FORECAST SHOWS DECLINING PEAK DEMAND IN MA



WHY MANAGING DEMAND IS STILL IMPORTANT EVEN WITH DECLINING DEMAND

- **Energy system has needs and faces risks even with flat or declining peak demand**
- **Uncertainty re: power plant retirements (potential for supply shortages)**
- **System needs for T&D, too**
  - Not just for generation
- **System needs are not just at times of peak demand**
  - Ramping, operational needs
- **Economic benefits (markets)**
- **Customer value**
- **ADM as reliability insurance**

ACTIVE DEMAND MANAGEMENT IS THE FOCUS FOR THIS PRESENTATION

▶ Types of ADM include:

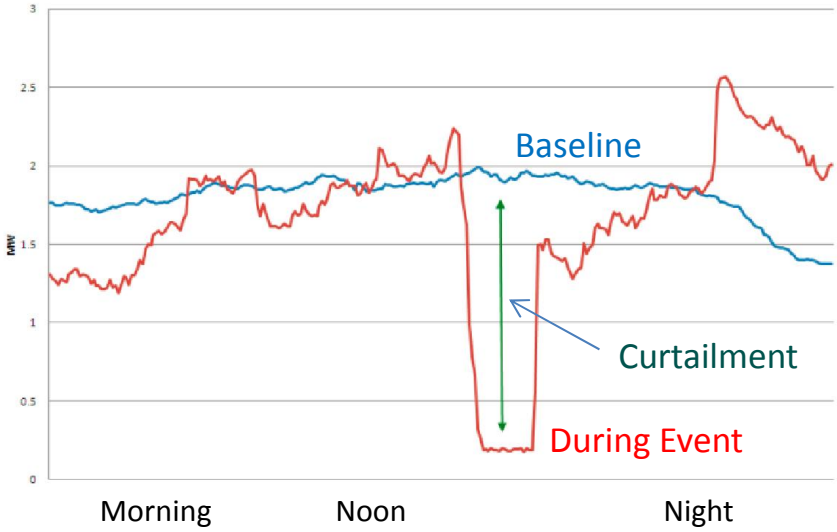
Curtailment	• PAs request that participating customers reduce energy use during times of peak demand in exchange for lower energy rates or incentives
Thermostats	• PAs or software manages air conditioner or equipment demand using thermostats, with incentives for customers
Direct Load Control	• PAs remotely manage electric demand by directly adjusting customer devices such as pool pumps, hot water systems, and air conditioners
Behavior	• Relies on changes in consumer behavior based on messaging, performance reporting, and social benchmarking

EXAMPLES OF ACTIVE DEMAND MANAGEMENT (ADM)

- **Examples of ADM (two examples from National Grid)**
  - C&I Curtailment (demand response)
  - Residential thermostats and direct load control (DLC)
  - Others, including energy storage

Commercial and Industrial Customers

"Performance Based" – Customer Incentive of about $35 per kW per Year



Residential and Small Commercial Customers

"Pay for Connected Device" – Customer Incentive of about $30 per Thermostat per Year

Supported devices so far:

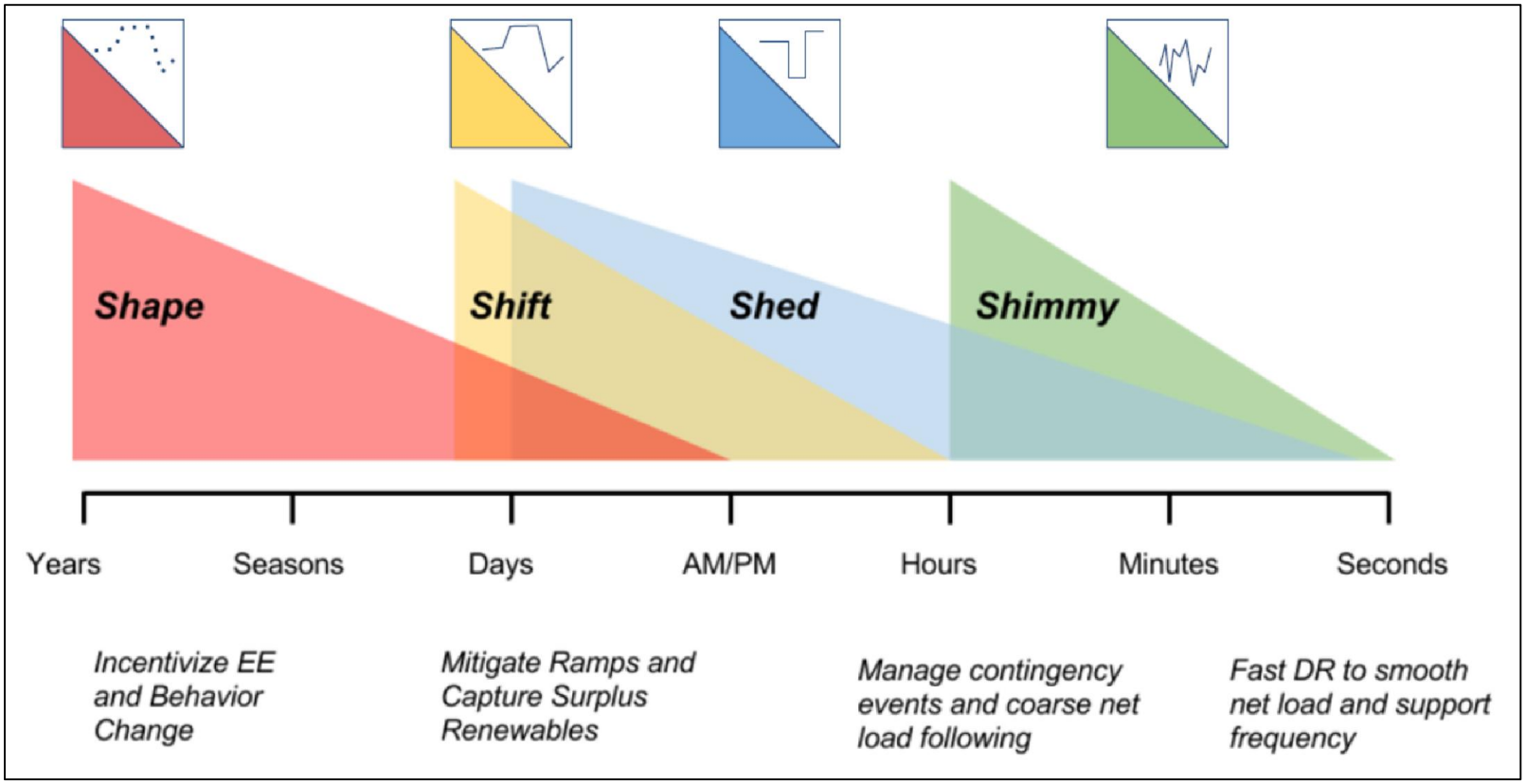
Honeywell

ecobee

Nest

HOW CAN ADM BE USED, FOR WHICH OBJECTIVES AND PURPOSES?

ADM Service Types Across Timescales and Objectives to Meet Grid Needs



Source: 2025 California Demand Response Potential Study, LBL, March 2017

ADM STRATEGIES AND PURPOSES: WHAT SHOULD BE IN 2019-2021 PLAN?

- **The 2019-2021 Plan should include several kinds of active demand management (ADM), to address several demand-related objectives and purposes**
  - Not limited solely to peak demand reductions; ADM also useful for ramping, operational needs, shortage events
  - Not limited solely to products bid into markets
  - Also not just for summer periods; winter also important
- **Automation and advances in technology make it possible to manage customer load in new ways, with new strategies and new agreements with customers**
- **The PA potential studies appeared to focus on MW demand reductions at the time of system peak**
  - Consultant calculations of MW potential as a % of system summer peak demand also focus on system peak
- **Plan will need to consider new and broader purposes**

BENEFITS AND AVOIDED COSTS FOR ADM

- **Active demand management measures operate for a small number of hours (often less than 1% of all hours, or less than 88 hours a year)**
  - Therefore, even very significant differences in avoided peak *energy* costs may have a relatively small effect
- ***Capacity* avoided costs matter most, and were a core task in the 2018 AESC study**
  - Resources bid into the Forward Capacity Market (FCM)
  - Resources not bid into the FCM, but that affect the Installed Capacity Requirement (ICR) and future forecasts
  - T&D capacity avoided costs
- **Capacity price effects (DRIPE) are also important**
  - Capacity DRIPE avoided costs capture the price effects of demand reductions and active demand management

BACKGROUND ON ADM COSTS

- **kW reduction or capability over the life of the ADM measure**
  - $/kW-year
  - $/levelized kW
- **Crucial to know ADM measure or strategy life**
  - Life of equipment, contract with customer, or program?
- **Integrated delivery of EE & ADM can share costs, reducing costs for both**
  - Consultants recommend integrated delivery, cost sharing, and co-benefits

Table 7: Summary of DR technology co-benefits. Co-benefits reduce the cost of the technology by a defined fraction of the initial cost.

End-Use and DR-Enabling Tech	Initial DR Technology Cost Reduction from Co-Benefit	Potential sources of Co-benefits
Commercial and Residential HVAC (EMS and Smart Thermostat)	30%	Energy efficiency and kW reduction
Refrigerated Warehouses	30%	Energy efficiency and kW reduction
Batteries	50%	Consumption optimization, kW reduction, backup energy supply
Agricultural Pumps	75%	Energy efficiency, kW reduction and controllability
Wastewater Process and Pumping technologies	75%	Energy efficiency, kW reduction and controllability
Commercial and Residential BEV and PHEV Level 1 and 2 charging (Fleet and Public)	75%	Fast Charging and controllability
Lighting (Luminaire-level and Zonal)	75%	Energy efficiency and kW reduction

Source: 2025 CA Demand Response Potential Study, LBL, March 2017

ASSESSMENT OF POTENTIAL FOR ACTIVE DEMAND MANAGEMENT (ADM)

APPROACH AND METHODOLOGY

- **Consultant Assessment of Demand Potential uses PA demand potential studies informed by trends and market knowledge as starting point**
- **As of this presentation, ADM potential studies were provided by PAs only for National Grid and CLC**
- **Consultants identified adjustments to PA estimates based on additional analysis of key areas of focus and consultant assessment of ADM opportunities**
- **Extrapolation to all PAs using two PA studies**

- ***Focus is on active demand management (ADM), and not on passive demand reduction from EE***

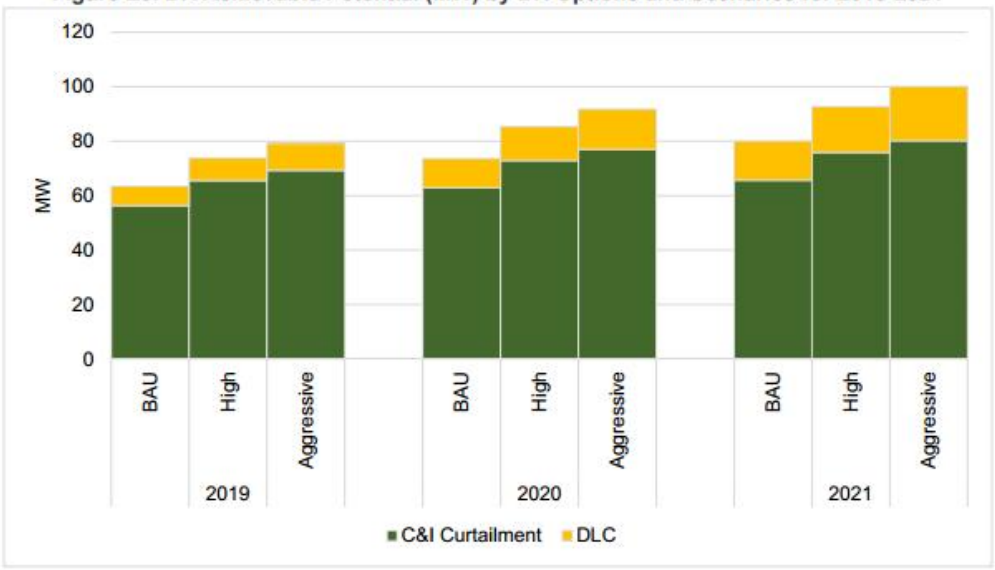
PA POTENTIAL STUDIES OVERVIEW AND STATUS

	NGrid	Eversource	CLC	Unitil	DOER
Lead Author	Navigant	Navigant	ODC/ Dunsky	N/A	Several
Received	2/28	TBD	1/15	N/A	2016-18
Includes:					
C&I Curtailment	X		?		
Res Thermostats	X		X		
Res DLC	X		X		
Thermal Storage			X		
Battery Storage			X		X
Behavioral	X (long term)				
EV Charging			X		

DEMAND POTENTIAL SCENARIO USED – NATIONAL GRID

- National Grid (Navigant) study considered three scenarios: Business-as-Usual, High, and Aggressive
- Consultants used Aggressive scenario as starting point for ADM demand potential (consistent with GCA)
- Less variation in different scenario results than for EE

Figure E3. DR Achievable Potential (MW) by DR Options and Scenarios for 2019-2021



Source: Navigant Analysis, 2018

CONSULTANT THOUGHTS ON PA POTENTIAL STUDIES

- **Limited set – demand potential studies from two PAs**
- **Different measures included**
  - Only CLC included storage and EV charging
- **Range of scenarios, range of aggressiveness**
  - We used the aggressive scenario from National Grid study
- **Different estimates of potential and costs across PAs**
  - Wide range of estimated demand potential (MW)
  - Different costs and costs per MW
  - Inconsistent conclusions for cost-effectiveness
- **Inconsistent treatment of MW and costs**
  - Levelized kW-year vs. single year (and yearly vs. average)
  - Levelized cost/kW-year vs. first-year costs (and other issues)
- **Will need work among PAs and with PAs to resolve**

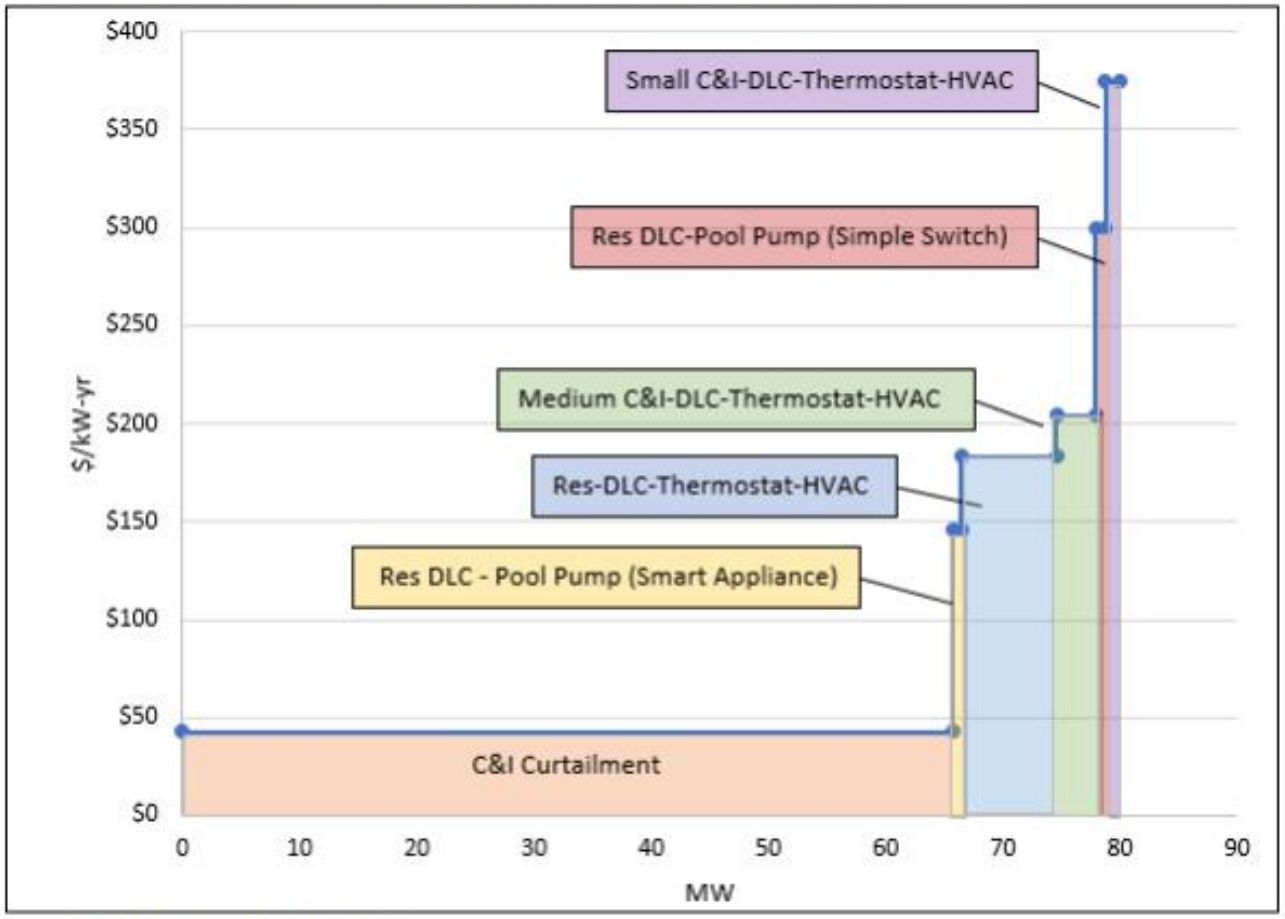
NATIONAL GRID ADM POTENTIAL STUDY RESULTS

	2019 MW Reduction	2020 MW Reduction	2021 MW Reduction	2021 % of *Sector* or Total Peak Demand	Statewide Extrapolation (MW)
Residential	8.0	11.1	14.5	*0.8%*	**35.3**
C&I	71.5	81.4	86.7	*4.2%*	**211.2**
Total	79.5	92.5	**101.2**	**2.6%**	**246.5**

246 MW is equivalent to 70% of the proposed NRG Canal 3 gas peaking plant (350 MW).

NATIONAL GRID SHORT-TERM SUPPLY CURVE (BAU)

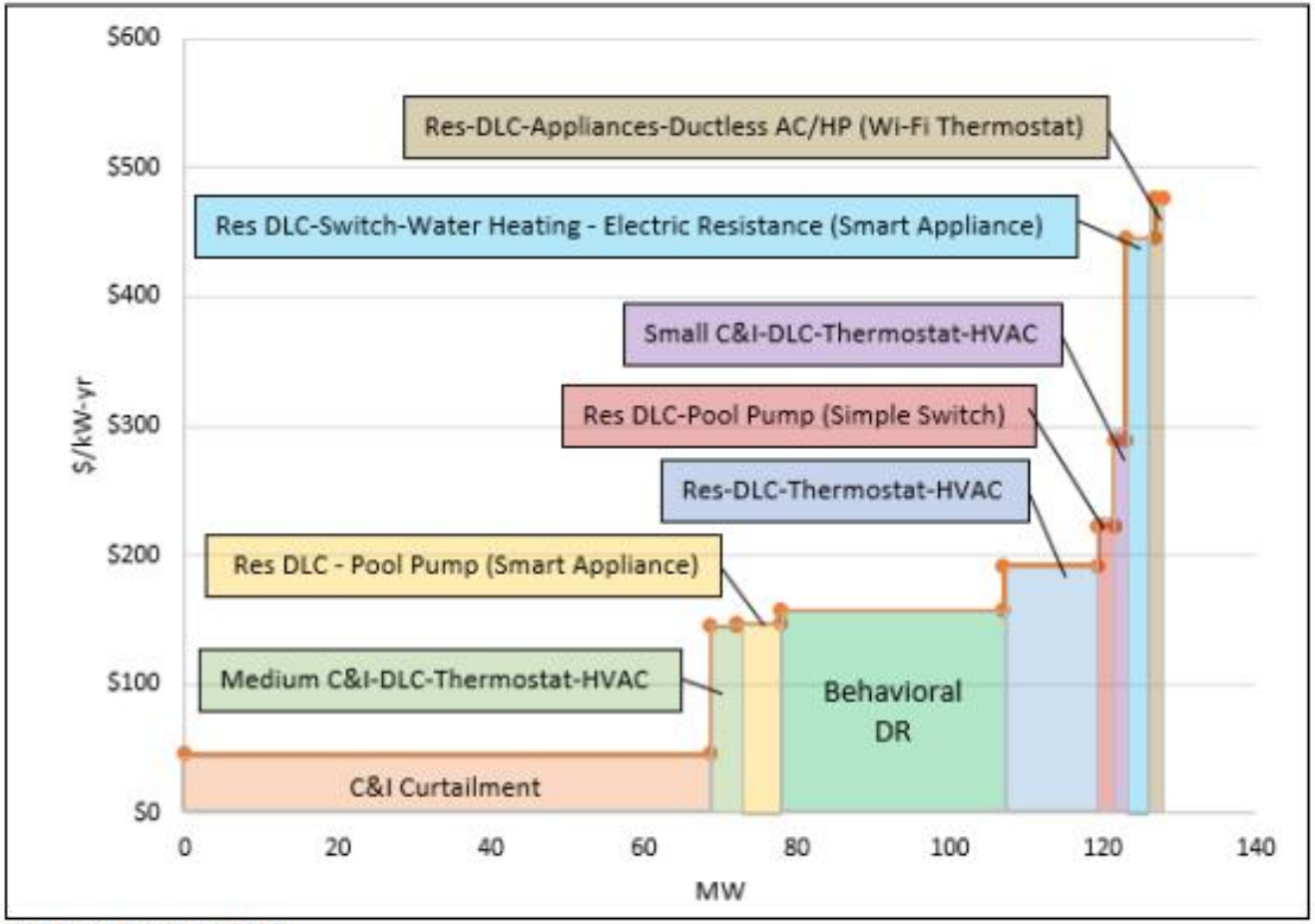
Figure E8. Short-Term Supply Curve (2019-2021 Levelized Costs vs. 2021 Achievable Potential)



Source: Navigant Analysis, 2018

NATIONAL GRID LONG-TERM SUPPLY CURVE (BAU)

Figure E14. Long-Term Supply Curve (2019-2028 Levelized Costs vs. 2028 Achievable Potential)



Source: Navigant Analysis, 2018

CLC ADM POTENTIAL STUDY RESULTS

- **Estimated ADM potential of 14 MW in 2021**
- **Demand program costs at $32M per year are greater than current EE spending ($29M in 2017)**
- **ADM costs estimated at $2322 per first-year kW**
  - Expressed as costs/one-year kW, not as levelized kW-year
- **CLC sent measure MW & costs as a supplement**
- **Eversource did not provide CLC peak load**

	2021 MW Reduction	2021 % of CLC Sector Peak Demand
Residential	11.3	4.7%
Low Income	0.5	3.5%
C&I	2.2	1.1%
Total	**14.0**	**3.1%**
Statewide Extrapolation = 295 MW		

CLC peak load was estimated as a portion of Eversource system peak load by taking Eversource peak load times the ratio of CLC energy sales to Eversource energy sales (using the Residential and C&I sector ratios).

PA POTENTIAL STUDY RESULTS BY SECTOR OR SEGMENT

	NGrid 2021 MW Reduction	NGrid % of Peak Demand	CLC 2021 MW Reduction	CLC % of Peak Demand	Combined 2021 MW Reduction	Combined 2021 % of Peak Demand
Residential and Low Income Total	**14.5**	***0.8%***	**11.8**	***4.7%***	**26.3**	***1.3%***
Thermostats & DLC	14.5	*0.8%*	8.2	*3.3%*	22.7	*1.1%*
Energy Storage (CLC)	---	---	3.6	*1.4%*	3.6	*0.2%*
C&I Total	**86.7**	***4.2%***	**2.2**	***1.1%***	**88.9**	***3.9%***
Small/Medium C&I Thermostats & DLC	6.5	*0.7%*				
Large C&I – Curtailment	80.2	*6.8%*				
Total Portfolio	**101.2**	**2.6%**	**14.0**	**3.1%**	**115.2**	**2.6%**

PA POTENTIAL STUDY *RESIDENTIAL* RESULTS BY OPPORTUNITY OR MEASURE

= Largest Res. Opportunities Per PA Studies	NGrid 2021 MW Reduction	CLC 2021 MW Reduction	Combined 2021 MW Reduction	Combined 2021 % of Res. Peak Demand
Thermostats	10.6	2.3	12.9	0.5%
Other HVAC	0.3	0.7	1.0	0.1%
Thermal Storage	N/A	1.6	1.6	0.0%
Pool Pumps	2.9	0.2	3.1	0.1%
Appliances	0.0	3.8	3.8	0.2%
Hot Water	0.8	0.5	1.3	0.1%
Battery Storage	N/A	2.0	2.0	0.1%
Electric Vehicles	N/A	0.2	0.2	0.0%
Total	**14.5**	**11.3**	**25.8**	**1.2%**

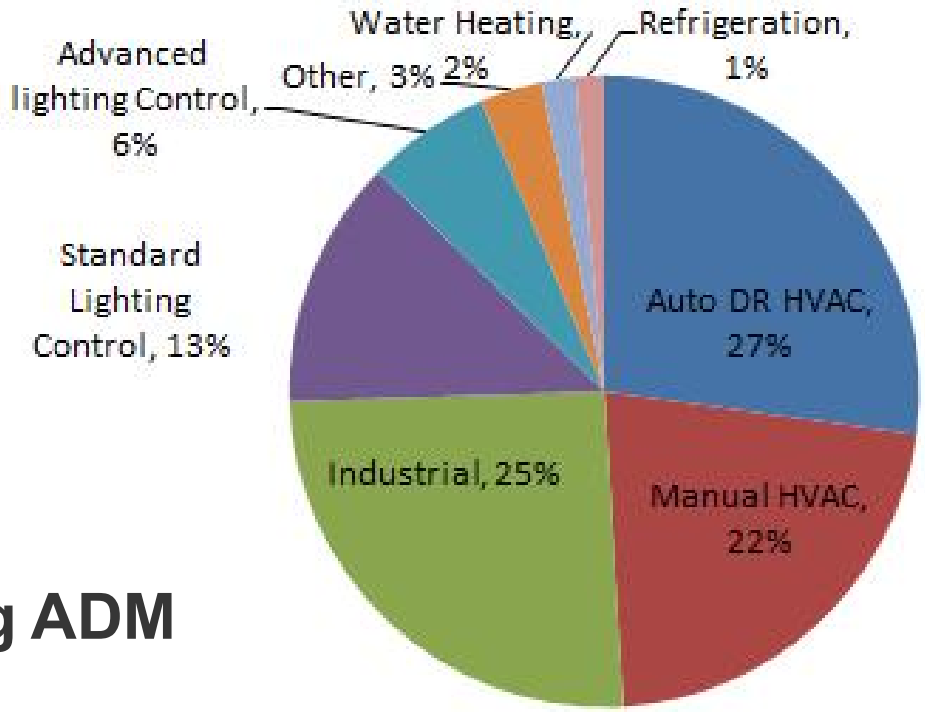
KEY AREAS OF FOCUS

- **Cross-cutting**
  - Widely varying results from PA studies
  - Short-term vs long-term perspectives
  - New AESC avoided cost values need to be used
- **C&I**
  - C&I curtailment/DR
  - C&I software and controls
  - Load management
- **Residential**
  - Res thermostats
  - Res load management
  - Storage (including CLC)

C&I ADM POTENTIAL

LARGE C&I CURTAILMENT

- **National Grid Large C&I Curtailment is largest source of ADM potential at 80.2 MW in 2021**
  - 93% of C&I potential in 2021
  - Least expensive option at $43 levelized cost per kW



- **CLC identified the following ADM measures**
  - WIFI Thermostats
  - Lighting Controls DR
  - Water Heater DR
  - Refrigeration DR

MEDIUM AND SMALL C&I ADM

- **Navigant term: Direct Load Control (DLC)**
- **HVAC thermostats provide almost all the remaining potential**
  - Medium C&I are 5% of C&I potential in 2021 at $260 levelized cost per kW
  - Small C&I are 2% of C&I potential in 2021 at $504 levelized cost per kW
- **CLC identifies the following as the primary measures**
  - DLC for lighting, HVAC, hot water, and refrigeration
  - Thermal storage
  - No breakout of potential or costs by measure

C&I PA POTENTIAL STUDY RESULTS BY OPPORTUNITY OR MEASURE

= Largest C&I Opportunities Per PA Studies	NGrid 2021 MW Reduction	CLC 2021 MW Reduction	Combined 2021 MW Reduction	Combined 2021 % of C&I Peak Demand
Thermostats/Thermal Storage	6.5	1.6	8.1	0.4%
Other HVAC	39.3	-	39.3	1.7%
Water Heating	1.4	0.0	1.4	0.1%
Refrigeration	1.2	0.5	1.7	0.1%
Lighting Controls	15.3	-	15.3	0.7%
Industrial Process	20.5	N/A	20.5	0.9%
Other	2.6	-	2.6	0.1%
Total	**86.7**	**2.2**	**88.9**	**3.9%**

C&I SOFTWARE AND CONTROLS, INTEGRATED EE AND ADM

- **Using software and controls, as opposed to manual action, could streamline ADM/demand response**
  - Higher up front costs to install/integrate controls
  - ADM could drive the installation of more controls through EE/ADM programs, especially during New Construction
  - ADM could result in more EE savings due to more controls

- **Shared costs for controls between EE and ADM could reduce the costs of both EE and ADM**
  - Integrating ADM with EE can also help reduce costs to achieve

C&I BEHAVIORAL DR

- **Strategic Energy Management (SEM) could increase energy awareness for large customers, leading to behavioral demand reductions**
- **When SEM is combined with an Energy Management Information System (EMIS) it creates a feedback loop that makes demand and energy use visible**
  - Site personnel can take action or shut off unnecessary equipment
- **Example: Policy of encouraging office occupants to close shades during hot days to reduce cooling loads**
  - “no sun on the sills”

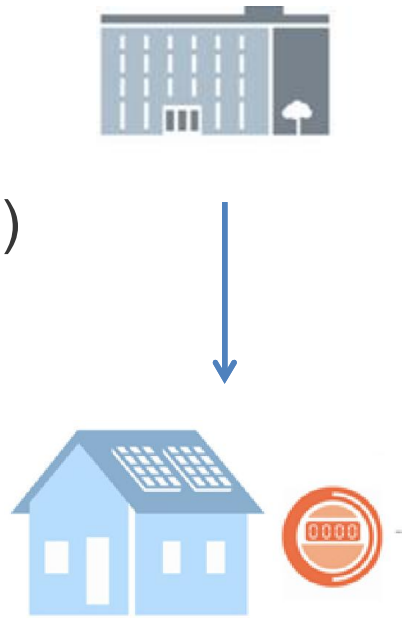
IMPACT OF ENHANCED ADM EFFORTS ON C&I DEMAND SAVINGS

C&I Adjustments	Impact on MW Savings
Integrated and connected lighting controls	+
Behavioral demand response	+
Demand-enabled new construction	+

RESIDENTIAL ADM POTENTIAL

RESIDENTIAL THERMOSTATS AND HVAC

- **HVAC/Thermostats represent the largest opportunities for residential ADM savings**
  - Almost 75% of residential potential for National Grid
  - Approximately 40% of residential potential for CLC
- **National Grid HVAC measures include:**
  - Central cooling temperature setpoint adjustment (3°)
  - Ductless air conditioner/heat pump temperature setpoint adjustment
- **CLC HVAC also includes thermal storage and window AC control**



Smart thermostats currently supported by PA programs at retail and through direct install

RESIDENTIAL DIRECT LOAD CONTROL (DLC) – OTHER END USES

National Grid

- Some additional potential from:
  - Pool pumps
  - Electric resistance water heaters
- Other measures didn't make BCR cutoff
- Storage and EVs not considered

CLC

- Approximately 60% of potential from:
  - Motors: Pool Pumps
  - Water heaters
  - Appliances: Refrigerator, Clothes Washer and Dryer
  - Other: Smart EV charging and storage

PA POTENTIAL STUDY RESIDENTIAL RESULTS BY OPPORTUNITY OR MEASURE

= Largest Res. Opportunities Per PA Studies	NGrid 2021 MW Reduction	CLC 2021 MW Reduction	Combined 2021 MW Reduction	Combined 2021 % of Res. Peak Demand
Thermostats	10.6	2.3	12.9	0.5%
Other HVAC	0.3	0.7	1.0	0.1%
Thermal Storage	N/A	1.6	1.6	0.0%
Pool Pumps	2.9	0.2	3.1	0.1%
Appliances	0.0	3.8	3.8	0.2%
Hot Water	0.8	0.5	1.3	0.1%
Battery Storage	N/A	2.0	2.0	0.1%
Electric Vehicles	N/A	0.2	0.2	0.0%
Total	**14.5**	**11.3**	**25.8**	**1.2%**

RESIDENTIAL BEHAVIORAL DEMAND RESPONSE

- **Only considered in National Grid assessment**
- **Tied to availability of AMI in 2023 and after**
  - Savings do not accrue during 2019-2021 Plan period
- **But savings are larger than combined DLC savings**
- **And inexpensive**
- **However…**
  - *"The estimated potential from Behavioral DR is less certain and firm than that from the other two DR options" -- Navigant*
- **Are there near-term opportunities to achieve Behavioral DR savings without AMI?**
  - Messaging to phones, tablets and computers

ADDITIONAL OPPORTUNITIES FOR RESIDENTIAL ADM

- Target and promote smart "appliances" with built-in Wifi capabilities in anticipation of ADM efforts
- Ensure program supported Wifi thermostats have ADM capabilities
- Bundle Wifi thermostats with central air and heat pumps
- Co-deliver efficiency and ADM whenever possible
- Assess Behavioral ADM opportunities prior to AMI roll out
- Develop and implement residential new construction ADM-enabled criteria
- Role for whole house control: Home energy management systems (HEMS)?
- Partnering opportunities with others selling HEMS capabilities?

IMPACT OF ENHANCED ADM EFFORTS ON RESIDENTIAL DEMAND SAVINGS

Residential Adjustments	Impact on MW Savings
Promote smart (connected) appliances	+
Behavioral demand response	+
Demand-enabled new construction	+
Bundle Wifi thermostats w/program CAC and HPs	+
HEMS Partnering opportunities	+

OTHER KEY AREAS OF FOCUS AND CONSIDERATIONS

ENERGY STORAGE

- Only CLC included battery and thermal storage, and only for Residential projects (no storage estimate from NGrid)
- Consultants extrapolated CLC-estimated storage potential to all PAs

	CLC MW in 2021	CLC MW as % of CLC Peak Demand	Extrapolation to All PAs (MW)
Battery Storage	2.0	0.44%	**42**
Thermal Storage	1.6	0.36%	**34**
Total Energy Storage	**3.6**	**0.80%**	**76**

- **Would contribute to MA goal of 200 MWh by 2020, & 600 MW by 2025**
- **DOER State of Charge report estimated 273 MW of BTM storage***

* Behind-the-meter share of 1,766 MW storage recommendation. State of Charge study, Table 3, Use Case (p. xvi).

OTHER KEY CONSIDERATIONS

- **Widely varying results from PA potential studies**
  - Analysis and resulting values for ADM savings, costs, and cost-effectiveness to be worked out with PAs and among PAs
  - Necessary especially for ADM costs and cost-effectiveness
- **Determine/clarify purpose(s) for ADM; which strategies**
- **Short-term vs long-term perspectives**
  - Economic value (cost-effectiveness) of ADM measures will depend on how long they perform, for which purpose(s)
  - Crucial to know the life of each ADM measure or strategy, e.g., life of equipment, agreement with customer, or program?
  - Higher ADM potential possible with accelerated implementation
- **New AESC avoided cost values need to be incorporated**
  - AESC 2018 study values are very different than 2015 values
  - Need to determine AESC implementation, coordinating with PAs

EEAC CONSULTANT TEAM INITIAL CONCLUSIONS ON ADM POTENTIAL FROM REVIEW AND ANALYSIS TO DATE

EEAC CONSULTANT TEAM ESTIMATE OF ADM POTENTIAL

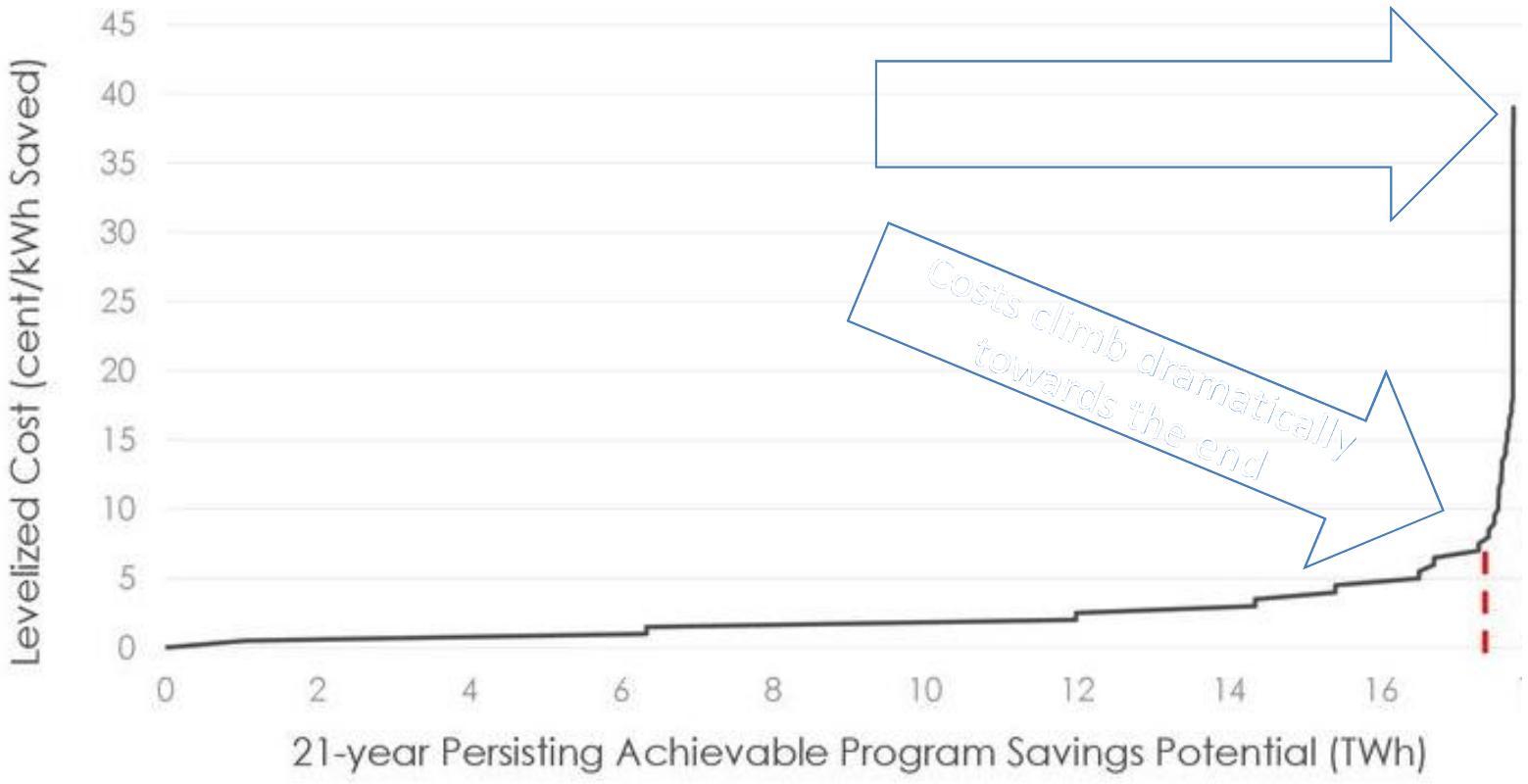
Consultants estimated ADM potential by taking the highest sector estimate (% of sector peak) from any PA and extrapolating it to all PAs

Sector Subtotals and Portfolio Total	2021 % of Sector or Total Peak Demand	2021 MW Reduction
C&I Statewide, Extrapolated from National Grid Study	***4.2%***	**241**
C&I Net Adjustments		+
Residential Statewide, Extrapolated from CLC Study	***3.3%***	**121**
Residential Net Adjustments		+
Storage Statewide, Extrapolated from CLC Study	**0.8%**	**75**
Storage Net Adjustments		+
Total Portfolio Potential Based on Extrapolations	**4.6%**	**437**

437 MW is equivalent to 125% of the proposed NRG Canal 3 gas peaking plant (350 MW).

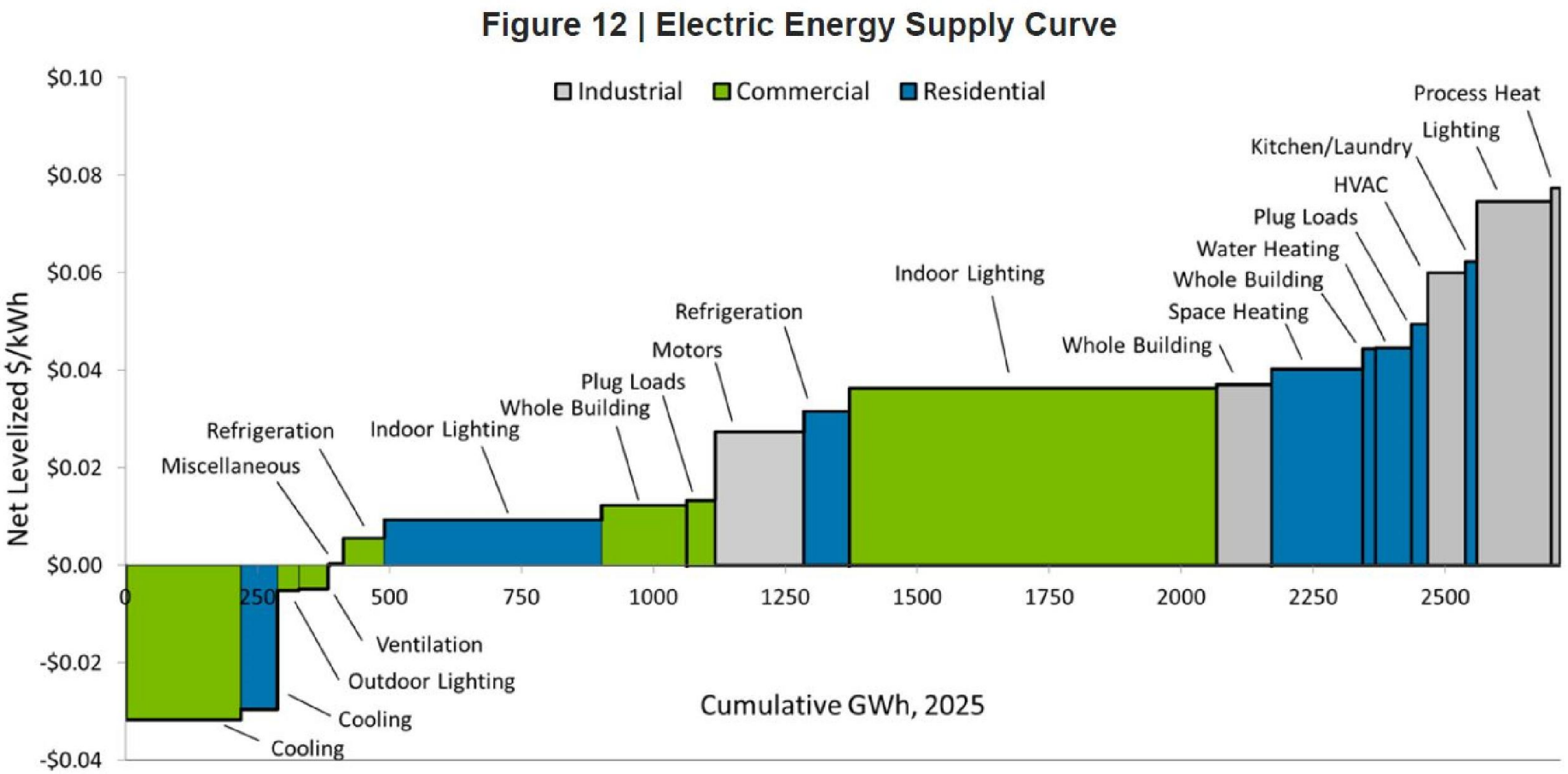
EEAC CONSULTANT TEAM UPDATE ON EE PROGRAM COSTS AND COST TO ACHIEVE ($/KWH)

ENERGY EFFICIENCY COST CURVES - ILLUSTRATIVE



Source: IESO presentation, "Module 3: Conservation and Demand Response Outlook." August 2016

ENERGY EFFICIENCY COST CURVES - ILLUSTRATIVE



Source: Optimal Energy, "Study of Potential for Energy Savings in Delaware," September 14, 2014.

PROCESS AND TIMELINE FOR EEAC REVIEW OF 2019-2021 PLAN

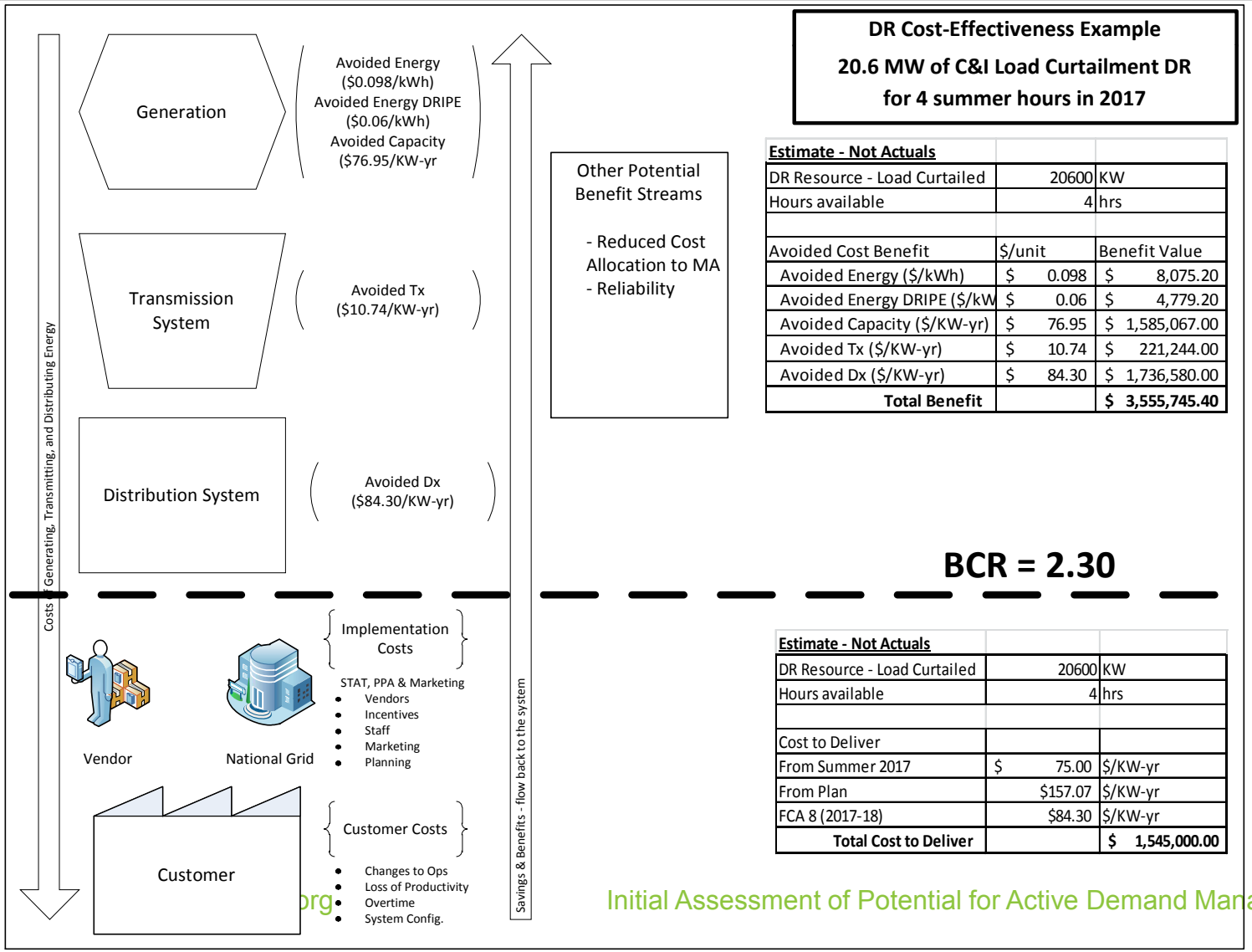
PROCESS AND TIMELINE FOR THE 2019-2021 PLAN

Process Steps	Date
PAs provide April 30 Draft Plan	**April 30**
EEAC review of Draft Plan	**May-July**
Council initial review	May 16
Council continued review, draft comments	June 20
Initial "key drivers" analysis of savings/goals and costs	May-July
EEAC final review and resolution on Draft Plan	**July 18 (July 31)**
Plan revisions and negotiations	**August-Sept.**
Finalize goals, costs, and term sheet	Sept. 19
PA provide Final Plan for EEAC review/approval	**October ?**
EEAC Resolution on the Final Plan for 2019-2021	**Oct. 17 (Oct. 31)**

THANK YOU

Questions?

BENEFITS & COSTS OF LARGE C&I LOAD CURTAILMENT (NGRID)



DR Cost-Effectiveness Example

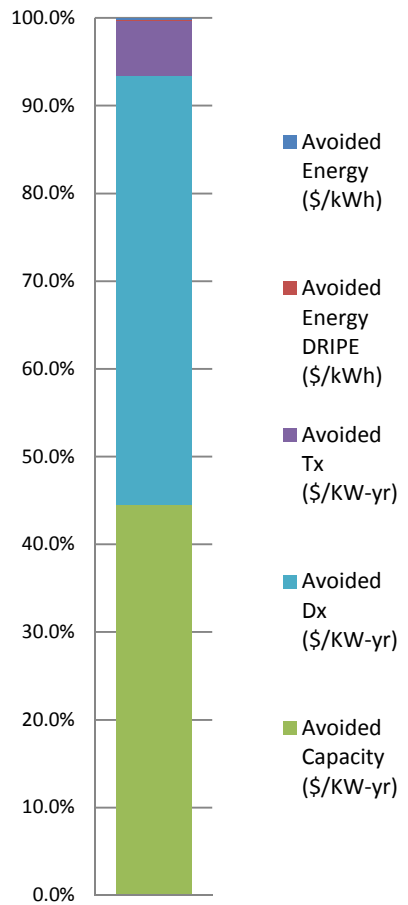
20.6 MW of C&I Load Curtailment DR for 4 summer hours in 2017

Estimate - Not Actuals		
DR Resource - Load Curtailed	20600	KW
Hours available	4	hrs
Avoided Cost Benefit	$/unit	Benefit Value
Avoided Energy ($/kWh)	$ 0.098	$ 8,075.20
Avoided Energy DRIPE ($/kW	$ 0.06	$ 4,779.20
Avoided Capacity ($/KW-yr)	$ 76.95	$ 1,585,067.00
Avoided Tx ($/KW-yr)	$ 10.74	$ 221,244.00
Avoided Dx ($/KW-yr)	$ 84.30	$ 1,736,580.00
Total Benefit		**$ 3,555,745.40**

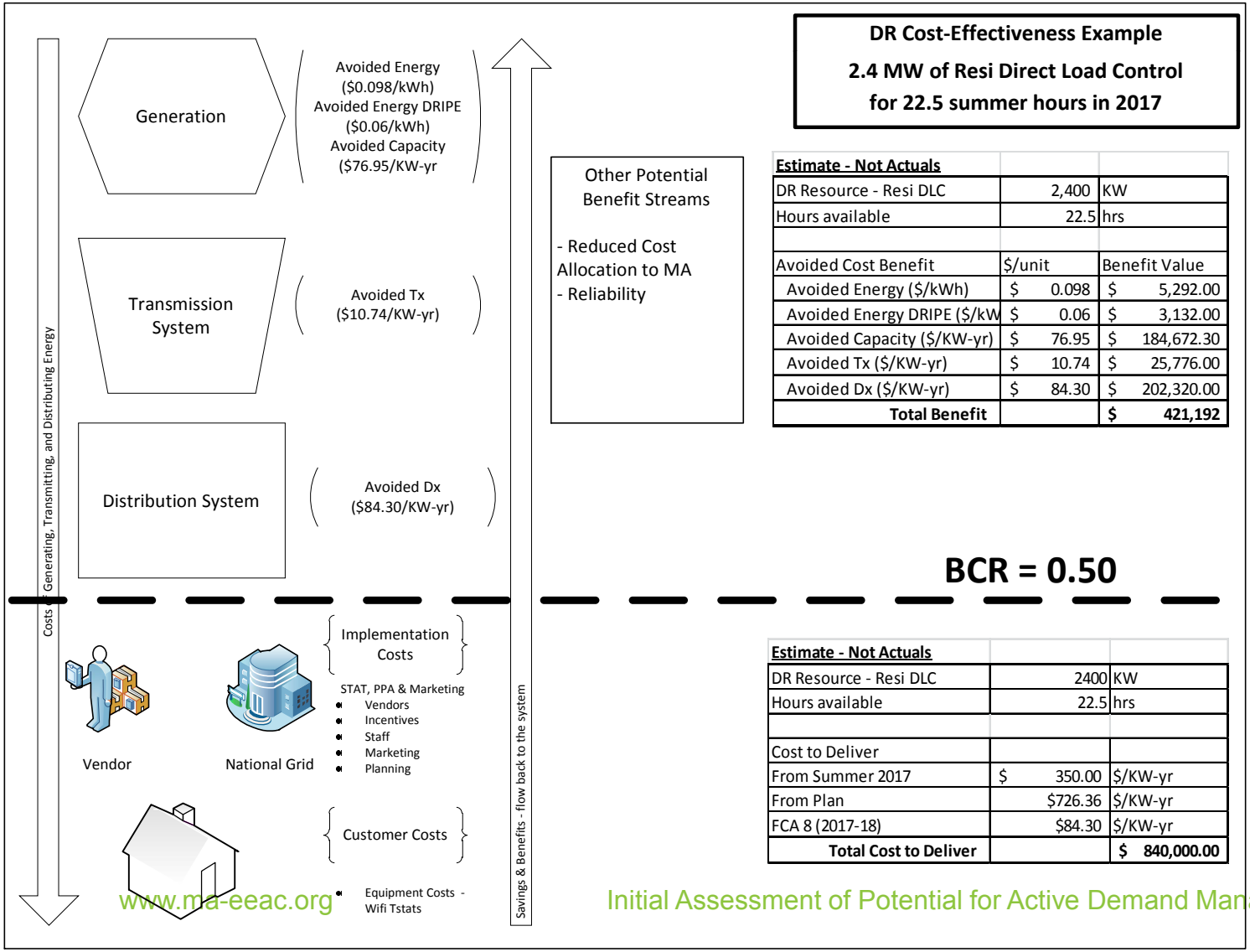
BCR = 2.30

Estimate - Not Actuals		
DR Resource - Load Curtailed	20600	KW
Hours available	4	hrs
Cost to Deliver		
From Summer 2017	$ 75.00	$/KW-yr
From Plan	$157.07	$/KW-yr
FCA 8 (2017-18)	$84.30	$/KW-yr
Total Cost to Deliver		**$ 1,545,000.00**

C&I Avoided Cost Benefit Proportions



BENEFITS & COSTS OF RESIDENTIAL THERMOSTATS (NGRID)



Other Potential Benefit Streams

- Reduced Cost Allocation to MA
- Reliability

DR Cost-Effectiveness Example

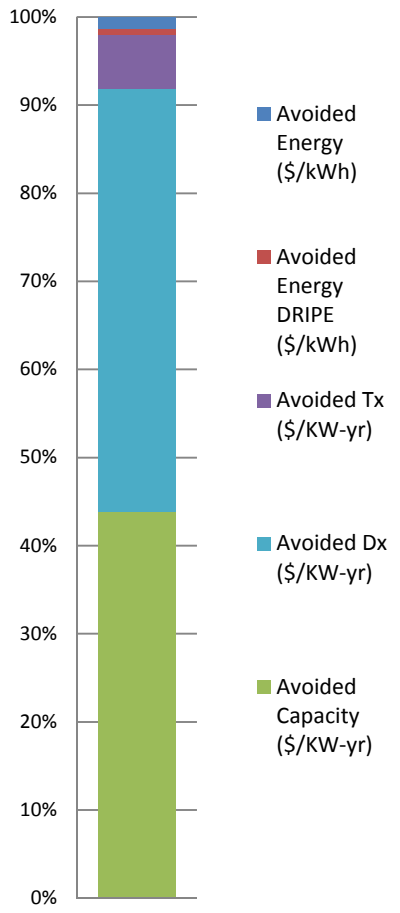
2.4 MW of Resi Direct Load Control for 22.5 summer hours in 2017

Estimate - Not Actuals		
DR Resource - Resi DLC	2,400	KW
Hours available	22.5	hrs
Avoided Cost Benefit	$/unit	Benefit Value
Avoided Energy ($/kWh)	$ 0.098	$ 5,292.00
Avoided Energy DRIPE ($/kW	$ 0.06	$ 3,132.00
Avoided Capacity ($/KW-yr)	$ 76.95	$ 184,672.30
Avoided Tx ($/KW-yr)	$ 10.74	$ 25,776.00
Avoided Dx ($/KW-yr)	$ 84.30	$ 202,320.00
Total Benefit		**$ 421,192**

BCR = 0.50

Estimate - Not Actuals		
DR Resource - Resi DLC	2400	KW
Hours available	22.5	hrs
Cost to Deliver		
From Summer 2017	$ 350.00	$/KW-yr
From Plan	$726.36	$/KW-yr
FCA 8 (2017-18)	$84.30	$/KW-yr
Total Cost to Deliver		**$ 840,000.00**

Residential Avoided Cost Benefit Proportions



COMPARABILITY OF CURRENT RESIDENTIAL ADM ASSESSMENTS

2021 Residential ADM Savings and Costs by End-Use

	HVAC		Pool Pumps	Hot Water	Appliances	Other	Total
	Central AC Temp Setpoint Adj	Ductless AC/HP Temp Setpoint Adj					
Savings (MW)							
CLC Residential	4.7		0.2	0.5	3.8	2.2	11.3
National Grid Residential	10.8		2.9	0.8	0.0	0.0	14.5
Percent of Total 2021 Residential ADM Savings							
CLC Residential	41%		2%	4%	33%	19%	
National Grid Residential	73%	1%	20%	6%			

- **Similar savings, but National Grid Residential sector is *much* larger than CLC's**
  - National Grid Residential electric demand is seven times more than CLC's