Continued EE Education

Market Implementation Committee

January 10, 2025

Acronyms

Acronym	Term & Definition
BRA	**Base Residual Auction**
DY	**Delivery Year** is defined as the 12 months beginning June 1 and extending through May 31 of the following year. Delivery Year may also be referred to as Planning Year or Planning Period.
EDC	**Electric Distribution Company**
ICAP	**Installed Capacity** is defined as a MW value based on the summer net dependable capability of a unit and within the capacity interconnection right limits of the bus to which it is connected.
UCAP	**Unforced Capacity** is defined as the MW value of a capacity resource in the PJM Capacity Market. For generating unit, the unforced capacity value is equal to installed capacity of unit multiplied by (1- unit's EFORd). For demand resources and energy efficiency resources, the unforced capacity value is equal to demand reduction multiplied by Forecast Pool Requirement.
EE	**Energy Efficiency** is a project that involves the installation of more efficient devices/equipment, or the implementation of more efficient processes/systems, exceeding then-current building codes, appliance standards, or other relevant standards, at the time of installation

PJM Glossary

Acronyms

Acronym	Term & Definition
LDA	**Locational Deliverability Area** is a sub-region used to evaluate locational constraints.
VRR	**Variable Resource Requirement** is a demand curve used in the clearing of the Base Residual Auction that defines the price for a given level of Capacity Resource commitment relative to the applicable reliability requirement.
M&V	**Measurement & Verification Plan** is a plan submitted by EE participants which defines projects which will be submitted for an RPM Auction
PIMV	**Post-Install Measurement & Verification** Report is a report that is required prior to the delivery year, which verifies any installed EE
TRM	**Technical Reference Manual** Manual published by states or regions, used to determine proper EE savings calculations

PJM Glossary

Market Share of EE Projects

- In order to calculate the market share of EE projects in the 2024/2025 BRA, PJM used the approved M&V Plans for the auction.
- Members break down their EE installations by Type in the M&V Plans, so while this breakdown does not show the total number of Cleared Auction MWs by type, it shows the total percentage of approved MWs by Type.
  - Some members submit their numbers as portfolio values as they do not have a complete breakout of expected MWs by type at the time of the M&V submittal.

PJM Nominated EE Value Template

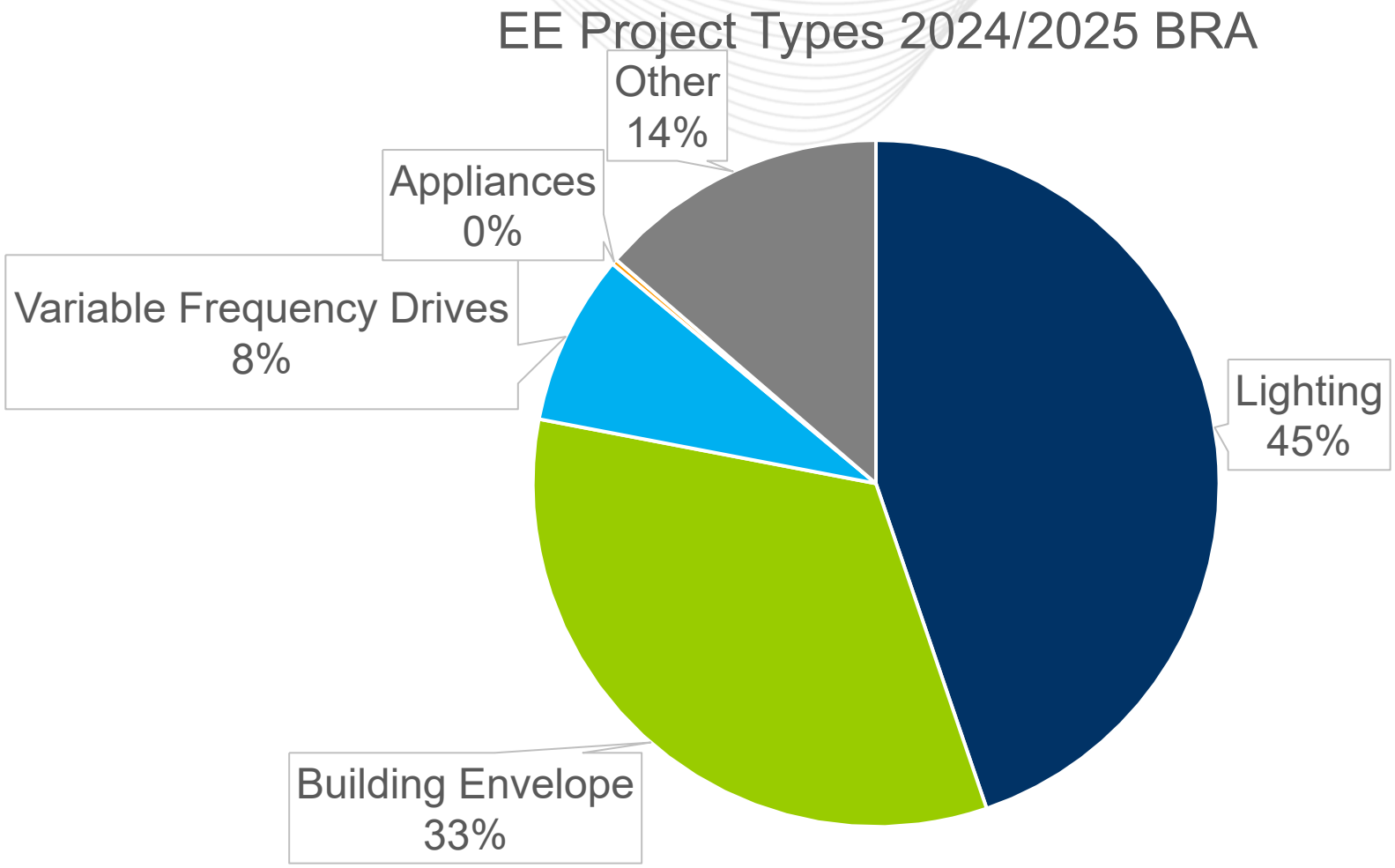
TEMPLATE TO PROVIDE NOMINATED ENERGY EFFICIENCY VALUE & CAPACITY PERFORMANCE VALUE

Submission Date:		
	RPM Auction	**Delivery Year**
M&V Plan Submittal for:		
Company Name:		
Company Shortname in eSuite:		
Name of Company Contact:		
Phone Number:		
Email Address:		

PROVIDE NOMINATED EE VALUE & CP VALUE BY EE INSTALLATION TYPE, INSTALLATION PERIOD, & ZONE:

Type of EE Installation	f Type = Other, List Type of EE Installatio	Installation Period	Zone/sub-zone*	Nominated EE Value (MW)**	CP Value (MW)***
Appliances					
Building Envelope					
Building Management System Upgrades and Controls					
Heating, Ventilation, and Air Conditioning (HVAC)					
Lighting (commercial/industrial)					
Lighting (residential)					
Motors					
Refrigeration					
Variable Frequency Drives					
Other					

Market Share of EE Projects



EE Technical Reference Manuals

- The Department of Energy released a guide for states to create their own technical reference manuals in June 2017.
- A **TRM** is a technical resource that contains energy-efficiency measure information used in program planning, implementation, tracking and reporting, and evaluation.
- PJM uses these TRMs to evaluate if members are using pre-determined and approved measure and verification algorithms
  - If a project type is defined within a TRM, it does not guarantee that PJM will accept that type of project for PJMs EE program.
- Mid-Atlantic TRM, published by Northeast Energy Efficiency Partnerships - https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V7_FINAL.pdf

Use Case: Residential Lighting

- Annual Energy Savings Algorithm[1]
  - ΔkWh = ((WattsBase - WattsEE) /1,000) * ISR * HOURS * (WHFeHeat + (WHFeCool – 1))
    - WattsBase = Connected Load of baseline lamp
    - WattsEE = Connected Load of efficient lamp
    - ISR = In Service Rate or percentage of units rebated that get installed
    - Hours = Average hour of use per year
    - WHFeHeat = Waste Heat Factor for Energy to account for electric heating savings from reducing waste heat from efficient lighting
    - WHFeCool = Waste Heat Factor for Energy to account for cooling savings from cooling savings from reducing waste heat from efficient lighting

[1]https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V7_FINAL.pdf Pg 20-27

Use Case: Residential Lighting

- Summer Coincident Peak kW Savings Algorithm[1]
  - ΔkW = ((WattsBase - WattsEE) /1000) * ISR * WHFd * CF
    - WHFd = Waste Heat Factor for Demand for cooling savings from efficiency lighthing
    - CF = Summer Peak Confidence Factor for Measure

[1]https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V7_FINAL.pdf Pg 20-27

Use Case: Residential Lighting

- Retrofit a standard BR30-type incandescent downlight light bulb
  - Annual Energy Savings
    - ΔkWh = ((WattsBase - WattsEE) /1,000) * ISR * HOURS * (WHFeHeat + (WHFeCool – 1))
    - ΔkWh = ((65 – 9.2) / 1,000) * 1.0 * 920 * (0.899 + (1.077 – 1)) = **50.1 kWh**
  - Summer Coincident Peak kW Savings
    - ΔkW = ((WattsBase - WattsEE) /1000) * ISR * WHFd * CF
    - ΔkW_{PJM} = ((65 – 9.2) / 1,000) * 1.0 * 1.17 * 0.084 = **0.0055 kW**

EE Accreditation

- Members submit M&V Plans containing ICAP MW values by LDA for expected EE activity.
- PJM Approves M&V and inserts ICAP MW into Capacity Exchange
- To convert ICAP MW to UCAP MW, PJM uses the Forecast Pool Requirement value (FPR), since there is no EFORd for EE Resources.
- EE does not have a must-offer requirement, nor are they subject to MOPR or MSOC

Use Case: Boiler Pipe Insulation

- Annual Fossil Fuel Savings Algorithm - https://neep.org/sites/default/files/resources/Mid_Atlantic_TRM_V7_FINAL.pdf
  - ΔMMBtu = (((1/Rexist) – (1/Rnew)) * FLH_heat * C exist * L * ΔT) / ηBoiler /1,000,000
    - Rexist = Pipe heat loss coefficient of uninsulated pipe [(hr-°F-ft2)/Btu] = 0.5234
    - Rnew = Pipe heat loss coefficient of insulated pipe [(hr-°F-ft2)/Btu] = Actual (0.5 + R value of insulation)
    - EFLH_heat = Equivalent Full load hours of heating
    - L = Length of boiler pipe in unconditioned space covered by pipe wrap (ft) = Actual
    - Cexist = Circumference of bare pipe (ft) (Diameter (in) * π/12) = Actual (0.5” pipe = 0.131ft, 0.75” pipe = 0.196ft)
    - ΔT = Average temperature difference between circulated heated water and unconditioned space air temperature (°F)
    - ηBoiler = Efficiency of boiler = 0.84

Use Case: Boiler Pipe Insulation

Equivalent Full Load Hours of Heating

Location	EFLH
Wilmington, DE	848 [235]
Baltimore, MD	620 [236]
Washington, DC	528 [237]

Average Temperature Difference between circulated heated water and unconditioned space air temperature

Pipes location	Outdoor Reset Controls	ΔT (°F)
Unconditioned basement	Boiler without reset control	110
	Boiler with reset control	70
Crawlspace	Boiler without reset control	120
	Boiler with reset control	80

Use Case: Boiler Pipe Insulation

Insulating 15 feet of 0.75” pipe with R-3 wrap (0.75” thickness) in a crawl space in Wilmington, DE with a boiler without reset controls

$$\Delta MMBtu = (((1/Rexist) - (1/Rnew)) * FLH\_heat * C\ exist * L * \Delta T) / \eta Boiler / 1{,}000{,}000$$

$$= (((1/0.5) - (1/3.5)) * 848 * 0.196 * 15 * 120) / 0.85 / 1{,}000{,}000$$

$$= 0.63\ MMBtu$$

Use Case: Boiler Pipe Insulation

- MMBtu will need to be converted into kWh
  - EnergyStar has a Portfolio Manager Technical Reference with conversion values for kBTU to kWh - https://portfoliomanager.energystar.gov/pdf/reference/Thermal%20Conversions.pdf

Figure 2 – Quick Reference Multipliers

	Multiplier to get kBtu (US & Canada)	Multiplier to get GJ (US & Canada)
kWh (thousand Watt-hours)	3.412	0.00360
MWh (million Watt-hours)	3412	3.60
kBtu (thousand Btu)	1	0.00106
MBtu/MMBtu (million Btu)	1000	1.06
GJ (billion joules)	947.817	1

- These multipliers are standard conversion factors, independent of fuel-specific heat content that are used to convert between kWh, kBtu, and GJ.
- http://www.eia.doe.gov/basics/conversion_basics.html

Use Case: Boiler Pipe Insulation

- 0.63 MMBtu * 1000 = 630 kBtu
- 630 kBtu / 3.412 = 184.6 Annual kWh

Multiply by Coincidence Factor to get to reportable kWh savings

ΔkW_{PJM} = 184.6 kWh * 0.084 = **15.6 kW**

Issues with TRMs

- Each state and even some outside consultants have created their own TRM, leaving members the ability to pick and choose which calculation may give them the best perceived kW savings
- Some of these TRMs are outdated
  - For example, the example used in this presentation for lighting assumes a baseline load of 65w for replacing of lightbulbs, whereas, PJM is recommending the use of CFL bulbs as the default value
  - This TRM was published May 2017

Additional Q & A

- Does PJM verify the installation of individual EE products?
  - No, PJM does not verify any installations, however, PJM has the right to request an audit of any EE Post-Install Measurement and Verification Report
- Do any post installment verifications take place?
  - No, there is no requirement for verify an end-user keeps the EE product installed after the actual installation period

Recap of Energy Efficiency Add-back in RPM Auctions

- To prevent double-counting EE as a resource and again as a load forecast reduction, an add-back mechanism was implemented in order to accommodate continued EE resource participation in RPM auctions when the new peak load forecast model was adopted.
- The EE Add-back accommodates capacity market participation by EE as a supply-side resource by preventing the adverse reliability impact associated with EE impacts already being accounted for in the peak load forecast that is used to develop the parameters of each RPM auction.
- The EE Add-back effectively returns the MW quantity of the proposed EE Resource to the peak load forecast that is used to develop the parameters for an RPM auction.

Energy Efficiency Clearing – Key Points

- EE resources will not directly affect clearing prices in the RTO or any LDA.
- Cleared EE resources are not used to meet Reliability Requirements for the RTO or any LDA in which they clear.
- If cleared in an RPM Auction, a Capacity Performance EE Resource will receive a Capacity Performance Resource Clearing Price for the LDA in which the EE Resource resides and a Summer-Period EE Resource will receive a Resource Clearing Price applicable to the EE Provider's cleared Seasonal Capacity Performance sell offer.
- Funds to compensate cleared EE resources are raised, or uplifted, through shifting the VRR curve to the right in the add-back process. This increases the cost to load serving entities by clearing additional supply offers against the shifted VRR curve. Costs are allocated across the RTO to each zone and then to load on a load-ratio basis.

Planning Parameters Impact

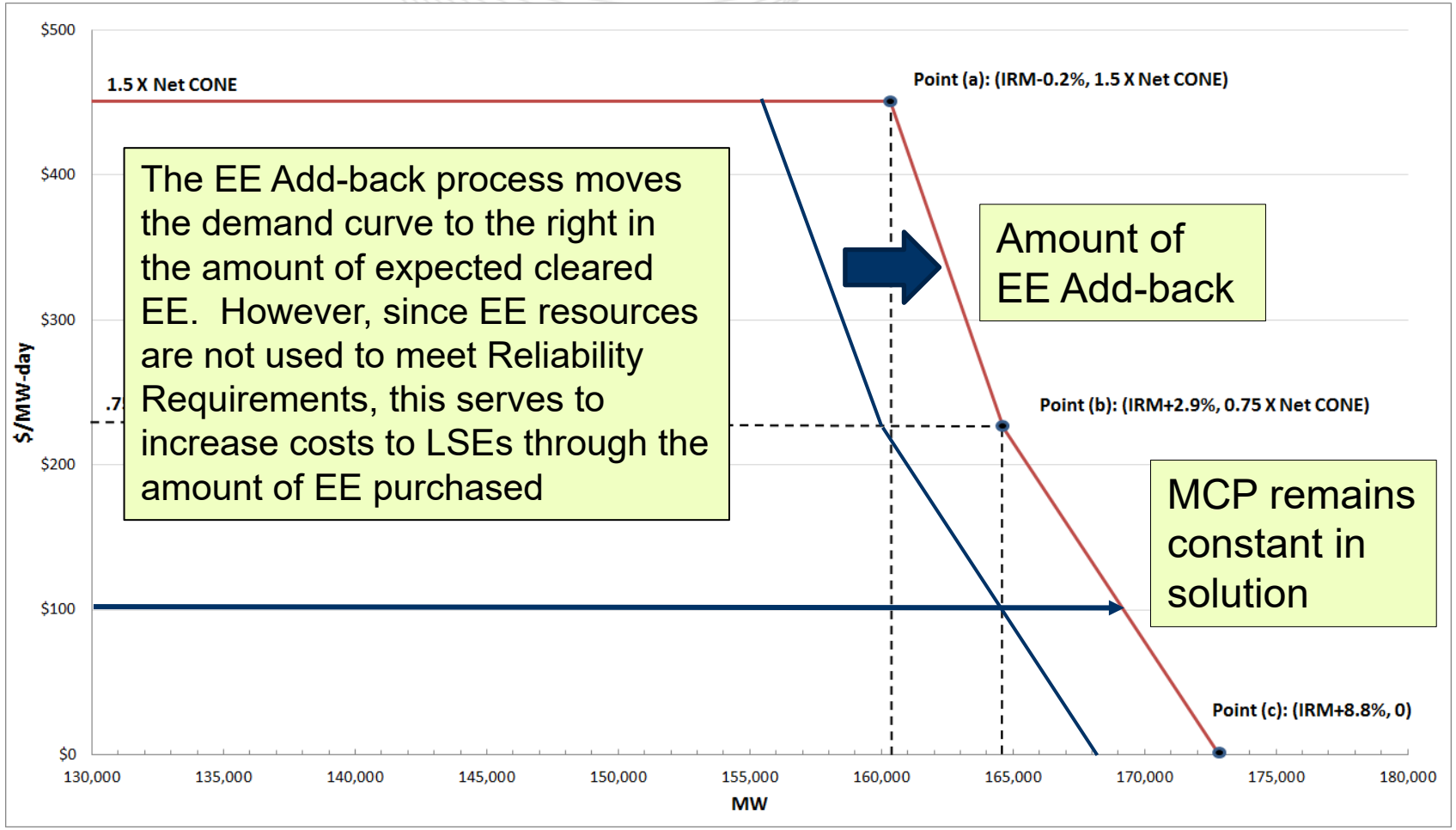
2024-2025 RPM Base Residual Auction Planning Parameters

	RTO	Notes:
Installed Reserve Margin (IRM)	14.7%	2021 IRM Study, endorsed at the October 20, 2021 M
Pool-Wide Average EFORd	5.02%	2021 IRM Study, endorsed at the October 20, 2021 M
Forecast Pool Requirement (FPR)	1.0894	2021 IRM Study, endorsed at the October 20, 2021 M
Preliminary Forecast Peak Load	150,640.3	2022 Load Report with adjustments for load served ou

	RTO	MAAC	EMAAC	SWMAAC
CETO	NA	-4,760.0	2,740.0	6,060.0
CETL	NA	5,965.0	8,594.0	7,947.0
Reliability Requirement	164,107.6	63,518.0	35,415.0	14,299.0
Total Peak Load of FRR Entities	29,421.6	0	0	0
Preliminary FRR Obligation	32,051.9	0	0	0
Reliability Requirement adjusted for FRR	**132,055.7**	**63,518.0**	**35,415.0**	**14,299.0**
Gross CONE, $/MW-Day (UCAP Price)	$348.94	$351.93	$355.14	$357.45
Net CONE, $/MW-Day (UCAP Price)	**$293.19**	**$294.06**	**$312.39**	**$261.07**
EE Addback (UCAP)	9,748.0	4,271.3	2,695.1	894.6
Variable Resource Requirement Curve:				
Point (a) UCAP Price, $/MW-Day	$439.79	$441.09	$468.59	$391.61
Point (b) UCAP Price, $/MW-Day	$219.89	$220.55	$234.29	$195.80
Point (c) UCAP Price, $/MW-Day	$0.00	$0.00	$0.00	$0.00
Point (a) UCAP Level, MW	140,422.1	67,124.8	37,739.6	15,044.0
Point (b) UCAP Level, MW	143,991.2	68,841.5	38,696.7	15,430.5
Point (c) UCAP Level, MW	150,783.9	72,108.7	40,518.4	16,166.0
Nominated PRD Value, MW	305.0	305.0	35.0	270.0

EE Addback amount is added to each of points A, B and C on the VRR Curve for the RTO and each LDA

Variable Resource Requirement (VRR) Curve



Contact

Chair:
Foluso Afelumo,
Foluso.Afelumo@pjm.com

Secretary:
Amanda Martin,
Amanda.Martin@pjm.com

SME/Presenters:
Ed Rich, Edward.Rich@pjm.com
Pete Langbein,
Peter.Langbein@pjm.com
Tim Bachus, Tim.Bachus@pjm.com

Energy Efficiency Continued Education

Member Hotline

(610) 666 – 8980

(866) 400 – 8980

custsvc@pjm.com