

EERs in PJM: Status and Potential Changes

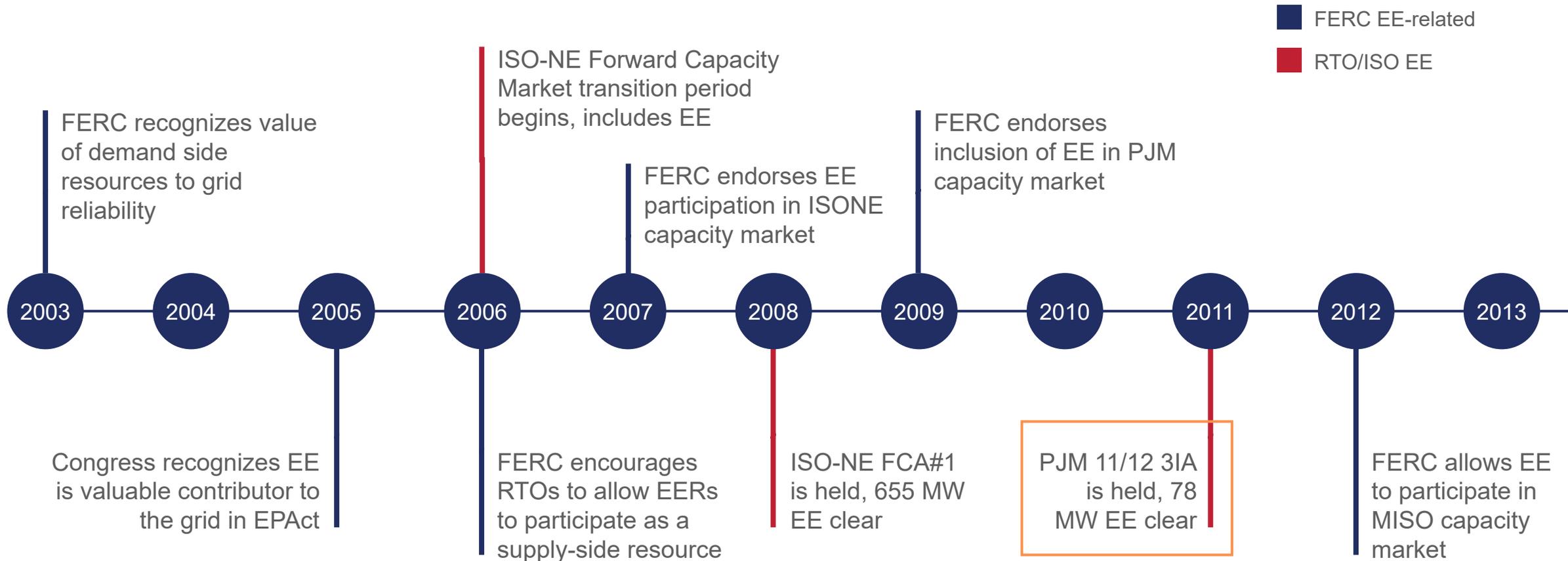
February 2024 MIC

When we get this right, Energy Efficiency will be more impactful

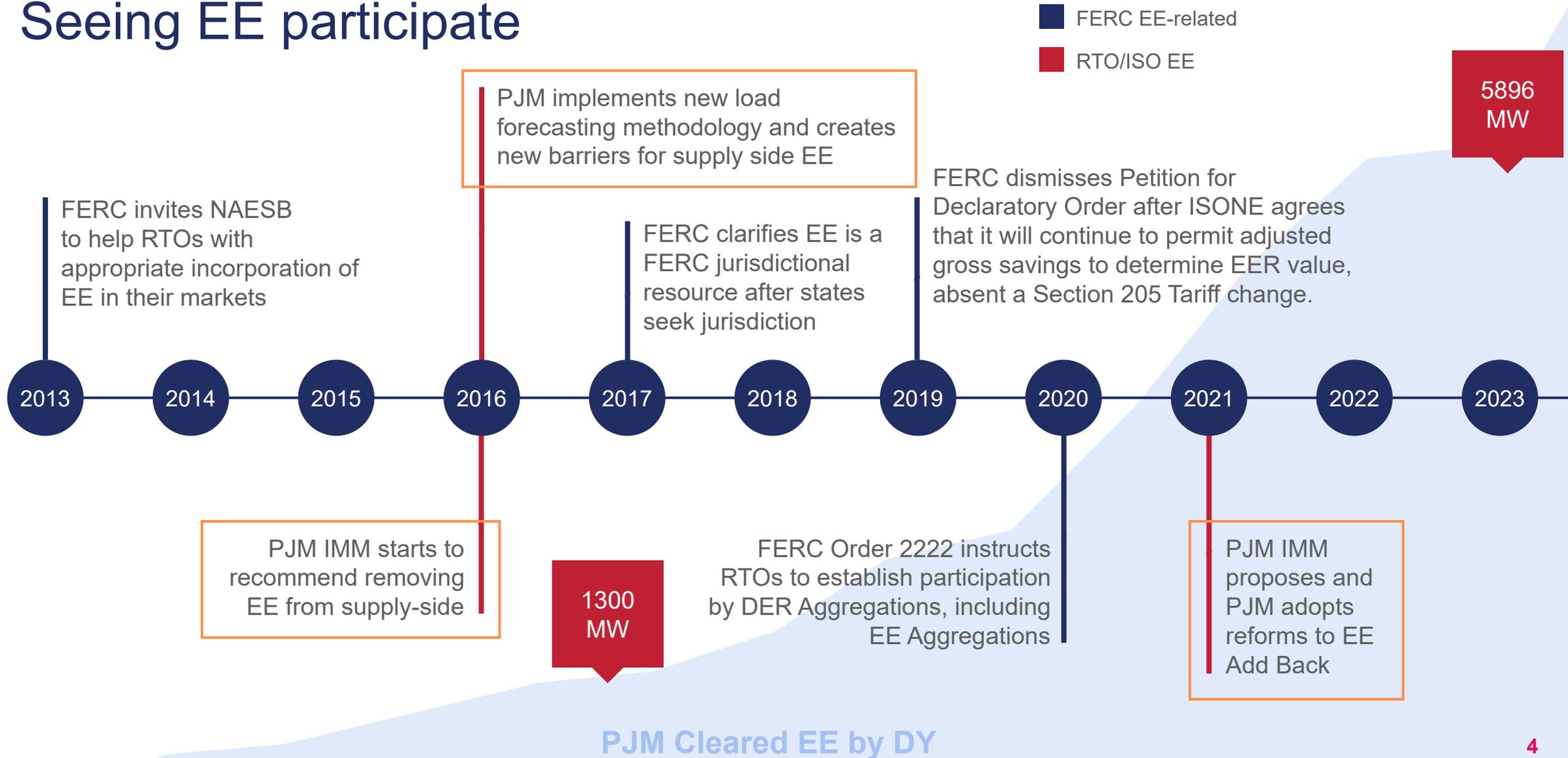
- “...energy efficiency is a **critical part of efficient energy markets**, and should be treated comparably to other types of resources, by being allowed to participate in base residual auctions and be paid the auction clearing price when they are accepted in the auction.” (126 FERC ¶ 61,275, P. 130 (2009))
- Energy Efficiency is a “reduction in electric energy consumption at the End Use Customer’s retail site ... that is **not reflected in the peak load forecast used for the Auction Delivery Year** for which the EE Resource is proposed.” (Manual 18)

Reconciling these two things will make EE more impactful while enhancing PJM’s reliability.

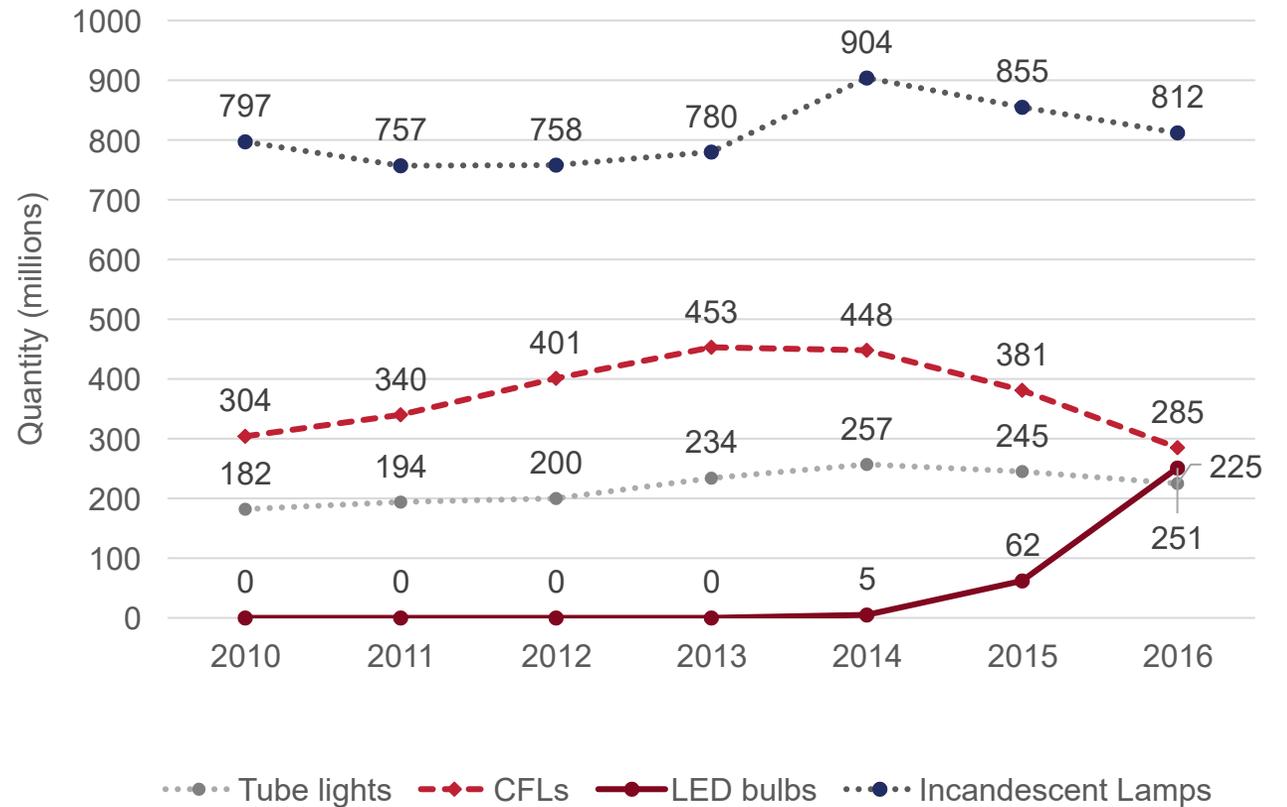
The first 10 years: Paving the way for EE



The second 10 years: Seeing EE participate



When FERC first endorsed EE's entry to this PJM Market (DY 11/12 3IA), the name of the game was CFL lighting



PJM adopted a set of rules for EE participation

PJM adopted rules to measure, verify and aggregate small efficiencies that could enhance PJM's reliability.

There was no addback.

EE growth was facilitated by capacity market participation.

The end-consumer benefit was (and is) ~98% energy bill savings.

pjm Use Case: Residential Lighting

- Annual Energy Savings Algorithm¹
 - $\Delta kWh = ((WattsBase - WattsEE) / 1,000) * ISR * HOURS * (WHFeHeat + (WHFeCool - 1))$
 - 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

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

pjm Use Case: Residential Lighting

- Summer Coincident Peak kW Savings Algorithm¹
 - $\Delta kW = ((WattsBase - WattsEE) / 1000) * ISR * WHFd * CF$
 - WHFd = Waste Heat Factor for Demand for cooling savings from efficiency lighting
 - CF = Summer Peak Confidence Factor for Measure

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

pjm Use Case: Residential Lighting

- Retrofit a standard BR30-type incandescent downlight light bulb

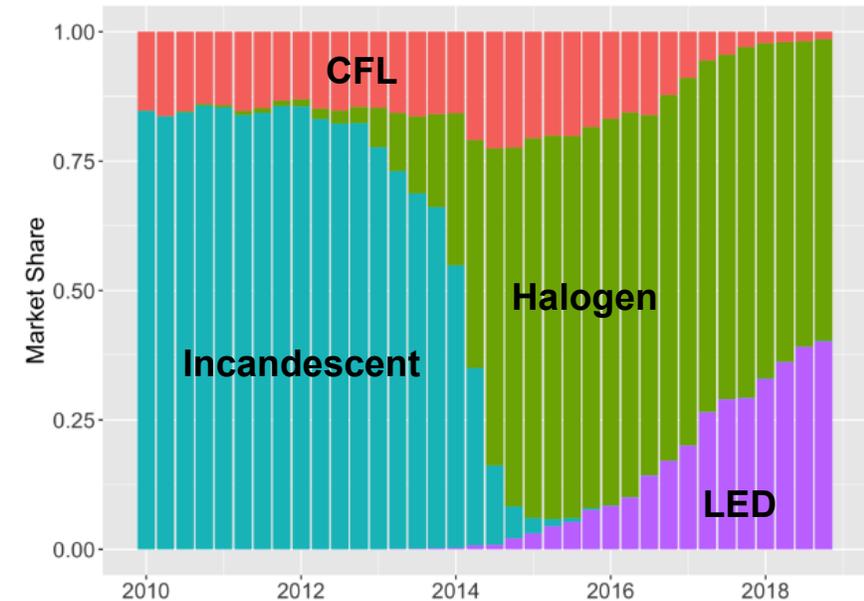
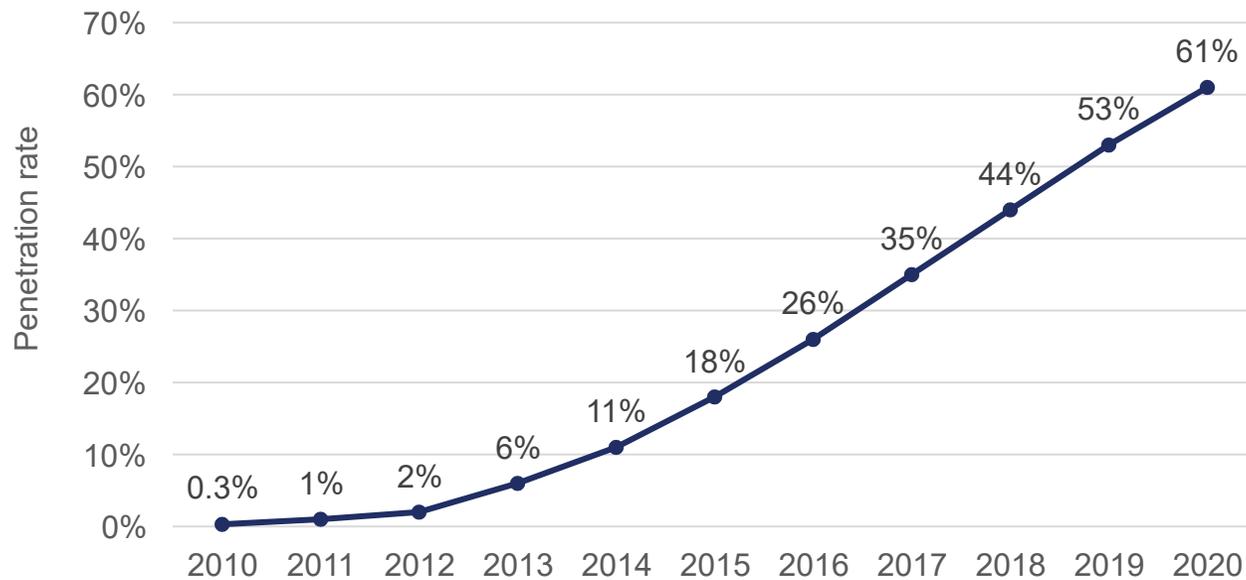
- Annual Energy Savings
 - $\Delta kWh = ((WattsBase - WattsEE) / 1,000) * ISR * HOURS * (WHFeHeat + (WHFeCool - 1))$
 - $\Delta kWh = ((65 - 9.2) / 1,000) * 1.0 * 920 * (0.899 + (1.077 - 1)) = 50.1 kWh$
- Summer Coincident Peak kW Savings
 - $\Delta kW = ((WattsBase - WattsEE) / 1000) * ISR * WHFd * CF$
 - $\Delta kW_{PJM} = ((65 - 9.2) / 1,000) * 1.0 * 1.17 * 0.084 = 0.0055 kW$

\$5/yr energy savings
\$0.10 capacity value

The efficient lighting industry grew *and changed*

M&V standards naturally became more stringent to facilitate LED lighting adoption, and now the market is transforming, as evidenced by the Load Forecast lighting assumptions and represented in the Capacity Market EE participation.

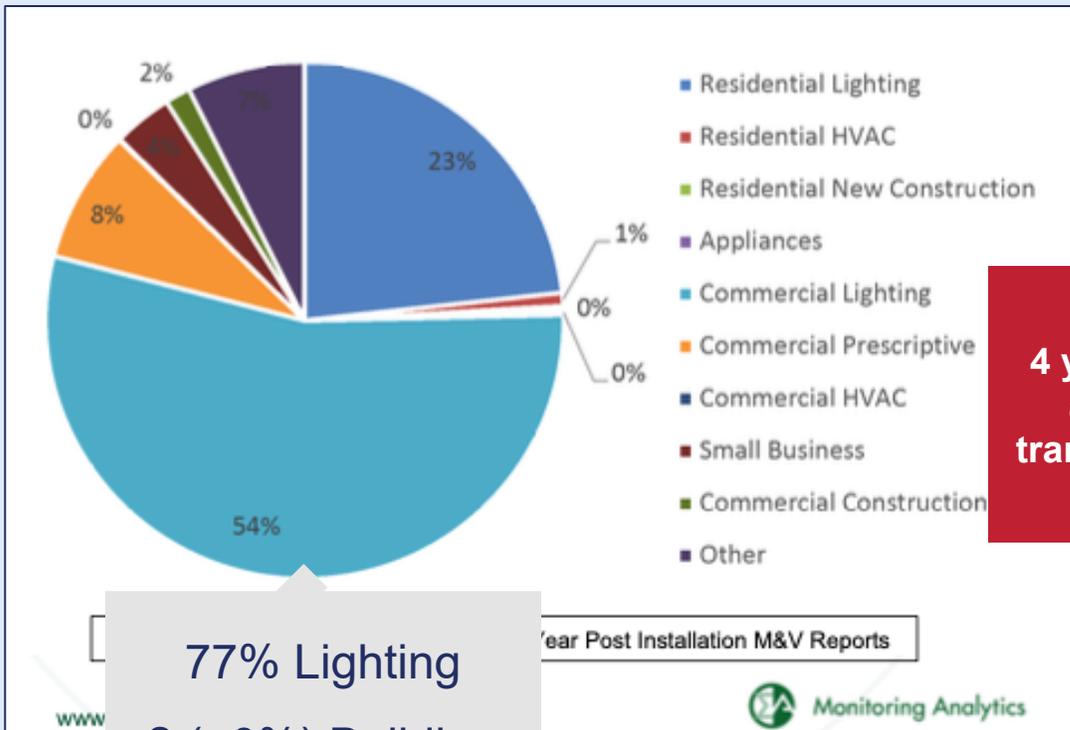
Estimated LED penetration of the global lighting market from 2010 to 2020



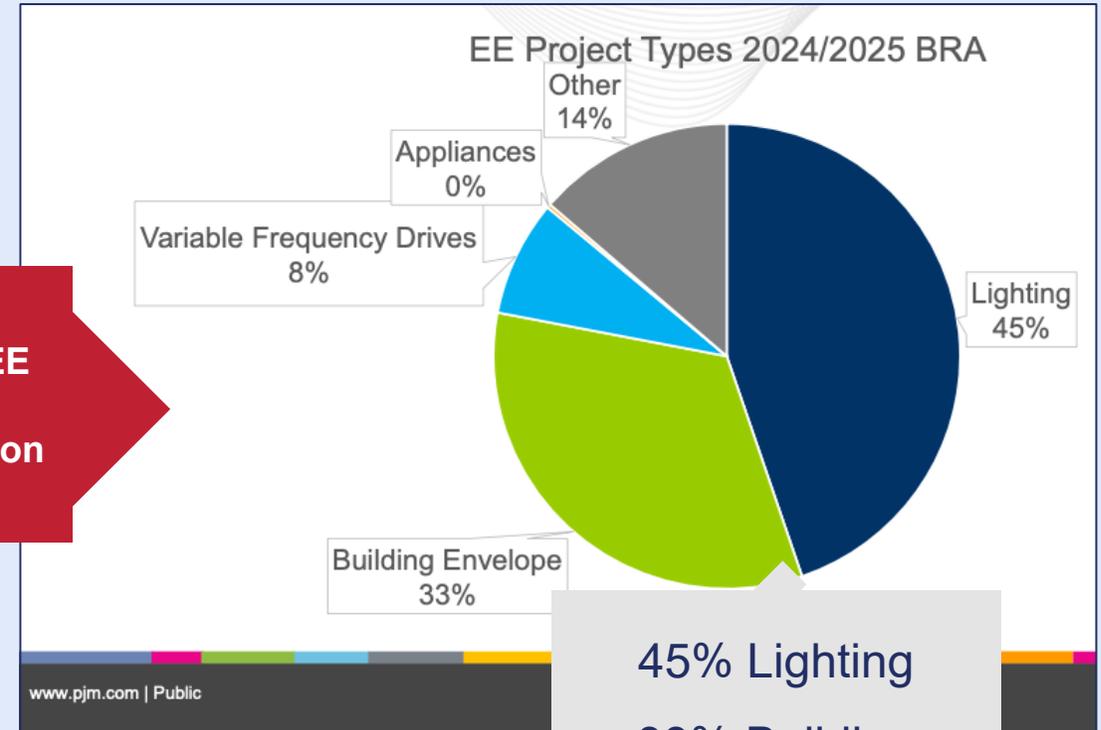
Note: This figure comes from "Technology Adoption and the Timing of Environmental Policy: Evidence from Efficient Lighting" by Sarah Armitage and was constructed by Armitage using Nielsen scanner data which covers over half of total national sales at grocery stores and drug stores, and about one-third of sales at mass market retailers, with some heterogeneity by geographic area. As Armitage discusses in the paper, national level shipment data from the National Electrical Manufacturers Association show a slightly higher market share for CFLs, but a very similar overall transition pattern. See the paper for details.

The same thing that happened with lighting is happening again. Market Energy Efficiency is changing quickly

DY 20/21 from IMM MIC Presentation



DY 24/25 from PJM MIC Presentation



4 years of EE adoption transformation

77% Lighting
? (~0%) Building Envelope

45% Lighting
33% Building Envelope

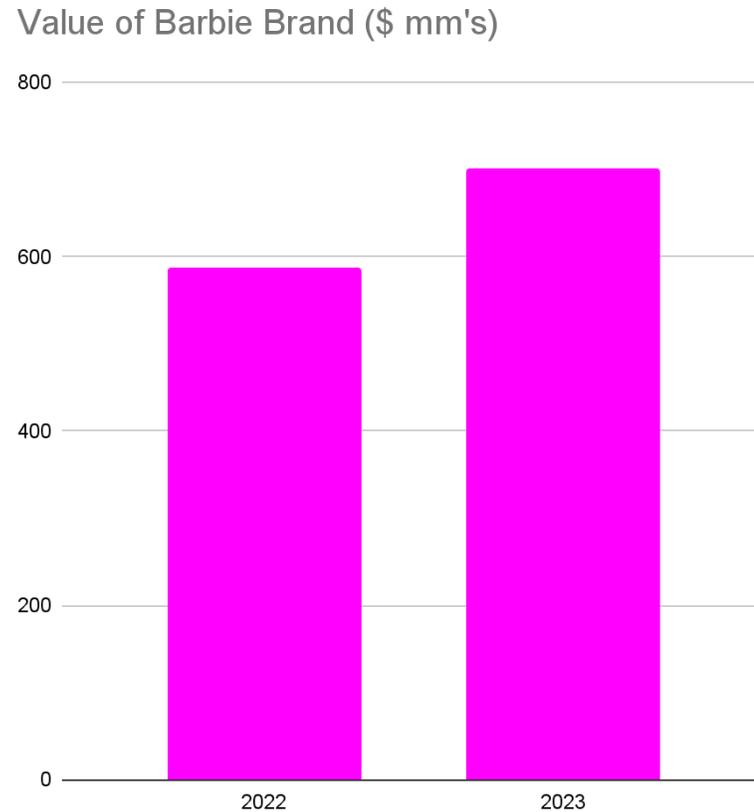
FERC mandated EE's inclusion. PJM implemented it. Now 15 years later...

1. What's next?
2. With 15 years of hindsight and growth how do we update the rules to realize all of the benefits of EE?

We are figuring out what works

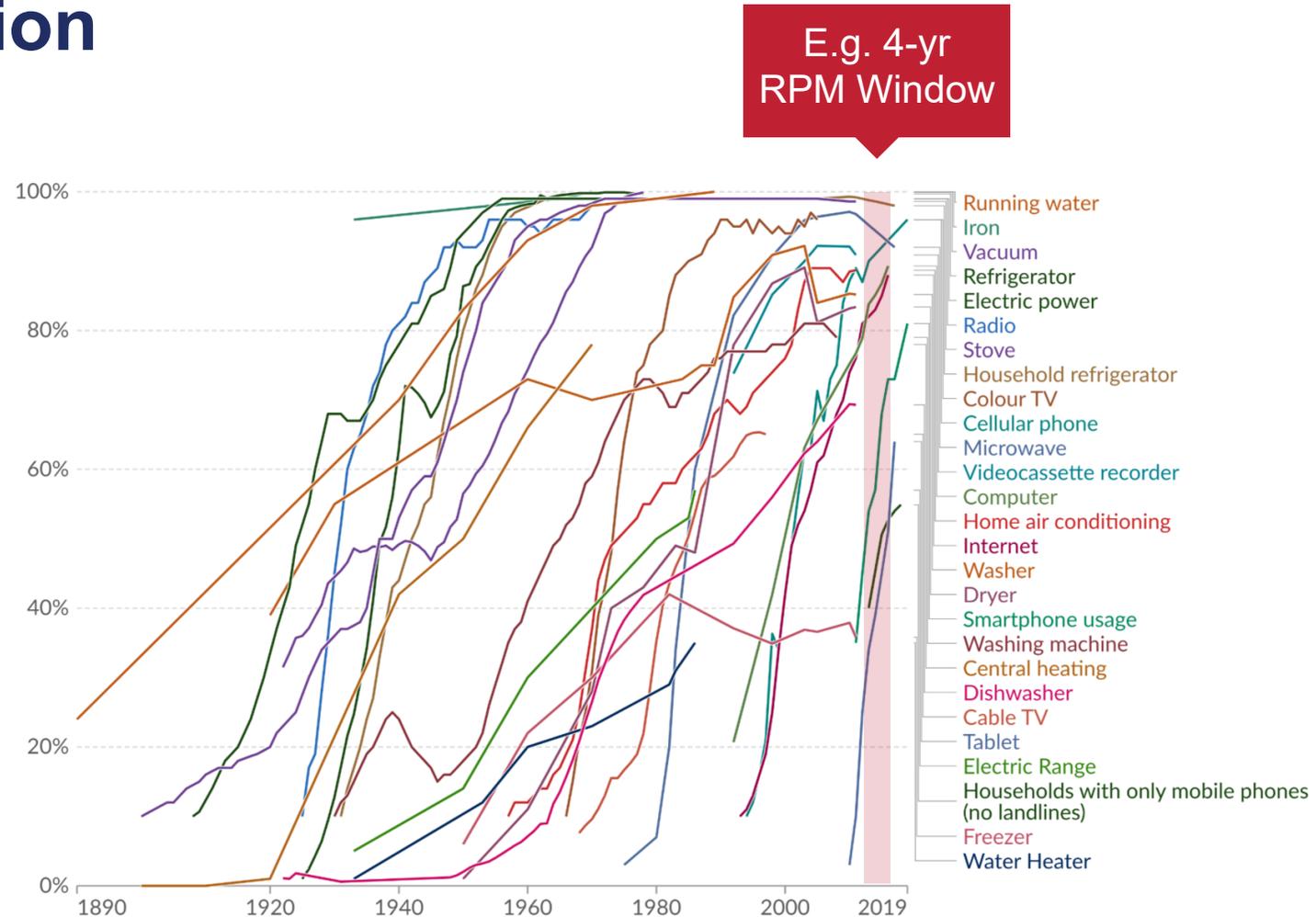
Why did Barbie sales leap in 2023?

The answer: Margot Robbie, Ryan Gosling and Greta Gerwig made a popular movie



Technology Adoption is Unpredictable but Trending Toward Faster Mass Market Penetration

Share of United States households using specific technologies



Data source: Horace Dediu; Comin and Hobijn (2004); other sources collated by Our World in Data
 OurWorldInData.org/technological-change | CC BY

For the MIC, the question is “how do we best deliver and predict the future while improving reliability?”

Some interests to consider:

1.

How can we improve the participation model for EE?

2.

What new requirements do the Manuals need for demonstrating EE ownership in order to ensure reliability?

3.

How do we reconcile the Market EE with the Load Forecast so we can eliminate or repair the “addback?”

4.

Should we require 3rd party review with each new product category submission to reduce PJM staff burden?

Contact Info:
luke@americanefficient.com

Appendix / Deeper Dive

IMM: EE's property rights are ill defined

The IMM is right.

Unchanged, there is a risk that EERs could be claimed by more than one EE provider.

► **OPPORTUNITY:**

Create new ownership requirements that mitigate the the potential for overlap in ownership.

Content from IMM MIC Presentation

Property Rights to EE Capability

- Eligibility requirements to claim property rights are poorly defined
- The EE Provider can satisfy this requirement by
 - submitting to PM a written sworn, notarized statement of a corporate officer certifying that the EE Provider has the legal authority to claim the demand reduction associated with the E installations that constitute the E Resource for the applicable delivery year or,
 - including a statement, prepared by PJM and included in the template instructions, that they have legal authority to claim the demand reduction associated with the installations that constitute the EE Resource for the applicable DY.

IMM: EE should not be eligible for PAI bonuses

The IMM accurately characterizes status quo rules related to PAI and performance to date. Note: EE could face non-performance charges if short.

PJM has filed for a change that would remove future bonus eligibility for EE but still allow EE to be assessed non-performance charges.

► **OPPORTUNITY:**

Properly counted EE reduces the likelihood of future PAI's. Allow for that value to be internalized.

M18: Performance Measurement and Penalties

- Commitment Compliance
 - RPM committed MW (sold in capacity market; "expected") compared to PJM accredited MW ("actual")
- Performance Assessment
 - Actual performance compared to expected performance. Actual performance is determined prior to the start of the Delivery Year based on the Post Installation M&V Report
- M&V Audit option
 - PJM or an independent third-party audit, at the EE Provider's expense, of the EE installation, conducted prior to or during the Delivery Year.

Content from IMM MIC Presentation

EE Payments: Winter Storm Elliott

Day	Expected		Actual		Bonus MW Percent of	
	Performance MW	Performance MW	Shortfall MW	Bonus MW Expected	Expected Performance	Bonus Credits
23 Dec 22	4,987.5	6,698.3	0.0	1,710.8	34.3%	\$22,167,952.78
24 Dec 22	4,987.5	6,698.3	0.0	34.3%	34.3%	\$67,324,985.48

- Actual performance is not measured during a PAI. Actual based on assumptions; calculated prior to the Delivery Year.
- Approved MW in excess of the resource's committed MW received bonus payments. (See IMM SOM; pre settlement data.)
- No EE resources were assessed a nonperformance charge during Winter Storm Elliott.

IMM: Since 2016, all EE has been in the load forecast

The IMM implies that the load forecast captures all EE. Brattle and others disagree.

If all of the EE in the market is in the load forecast, it is appropriate to reconcile the load forecast and Market EE.

- ▶ **OPPORTUNITY:** Quantify the overlap between the Market EE and the load forecast EE. Change the rules responsively.

EE Inclusion in PJM Load Forecast

- PJM modified load forecast method in April 2015
 - Revisions to the PJM load forecast to incorporate energy efficiency were endorsed at the November 19, 2015, MRC.
 - Included improvements to more comprehensively incorporate energy efficiency based on U.S. Energy Information Administration (EIA) data.
 - Beginning with auctions conducted in 2016, PJM began use of add back method to reflect the inclusion of EE in the peak load forecast.
- Prior approach to EE was based on historical cleared energy efficiency quantities.

EE Inclusion in PJM Load Forecast

- The PJM load forecast model captures energy efficiency impacts through incorporation of projections from EA Annual Energy Outlook (AEO).
- The AEO forecast is based on a set of end use models for the residential, commercial, and industrial sectors.
- EA accounts for state and utility efficiency programs by mapping regional EE program expenditures to end uses
- EIA tracks number of units sold and associated efficiency information on an ongoing basis

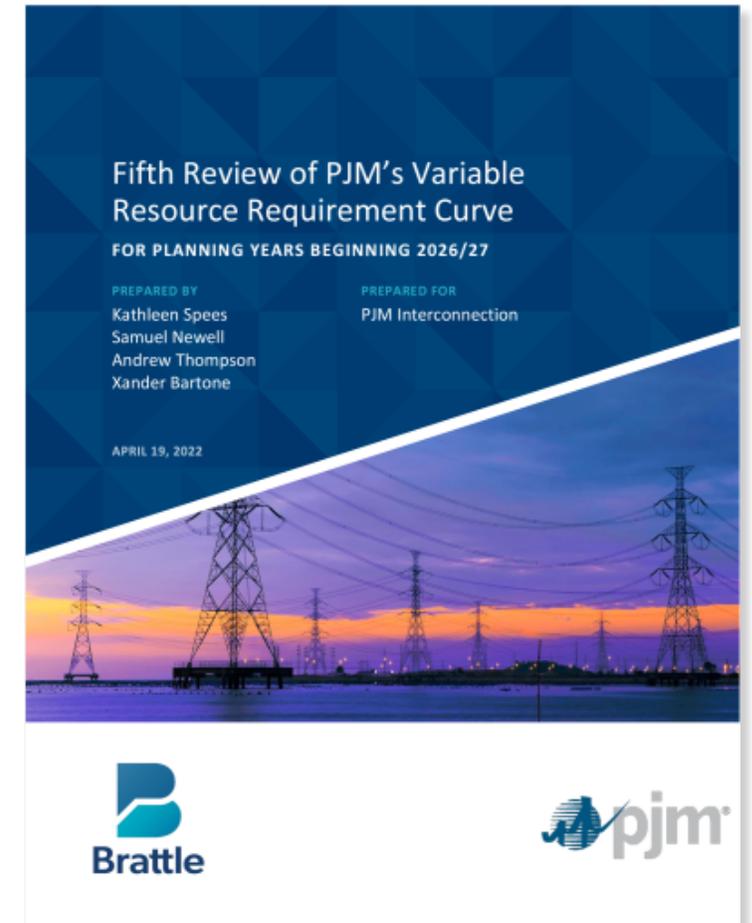
Content from IMM MIC Presentation

Brattle: All Energy Efficiency Cannot Realistically be Predicted in the Load Forecast

“Align the Energy Efficiency (EE) resource participation model with the load forecast. Acknowledge that **a centralized load forecast cannot realistically predict all EE activity across the PJM footprint.** Therefore, we suggest that PJM reverts to the original concept for EE, namely, that supply-side EE can participate in the RPM **if it demonstratively displaces the need for capacity that would otherwise be procured.** Under this approach, PJM could develop the most accurate possible load forecast based on historical data, projected technology penetration rates, laws/regulations, and other predictors. This forecast would determine baseline assumptions with respect to the anticipated level of EE.

At the same time, market participants could **qualify energy efficiency as supply-side resources in the capacity market if they demonstrate that the EE measures are not already accounted for in the load forecast.** EE resource UCAP ratings would decline over time as the baseline level of EE incorporated into the load forecast increases (declining to zero at the earlier of the EE measure life or when the load forecast is able to fully incorporate the measure). The EE add-back would then be eliminated from explicit consideration in the VRR Curve, thus simplifying the VRR Curve and eliminating the need for iterative auction clearing associated with the EE add-back.”

(Fifth Review of PJM’s Variable Resource Requirement Curve. April 19, 2022, pg vi.)



IMM: The addback removes EE's contribution to the Reliability Requirement and looks like uplift

The IMM is right that the addback potentially undermines EE's ability to lower price and increase reliability.

- ▶ **OPPORTUNITY:** Eliminate or repair the addback

EE Addback in RPM Auctions

- The EE addback method is described in Manual 18, section 2.4.5 (See also IMM BRA reports.)
- EE addback mechanism uses an iterative approach such that the EE addback MW quantity ultimately applied to an RPM auction matches the MW quantity of EE Resources cleared in the auction
 - With the EE addback MW quantity equal to the cleared EE Resource MW quantity, the target impact on the clearing price is zero
- Current add back method adopted with 2023/2024 DY
 - Followed IMM recommendation

Costs to Load

- While EE does not affect the clearing price when the EE addback is done correctly, customers do pay for the cleared quantity of EE at market clearing prices.
- EE does not contribute to meeting the RPM Reliability Requirement.

Content from IMM MIC Presentation

IMM: Plans don't require contracts

The IMM is right that Energy Efficiency providers do not own all bid EER's at the time of the auction.

It is also true that EER's only have a maximum of 4 years of eligibility and the some of the nominated EE is delivered through contracts that already exist at the time of Plan submission. All planned EE (not yet owned) requires Financial Assurance.

- OPPORTUNITY:** This is a forward
- ▶ market. If the Financial Assurance is not adequate for not-yet-owned assets, change it.

Basic Requirements for RPM Participation

Content from IMM MIC Presentation

- Submit Initial M&V Plan and Nominated EE Value Template no later than 30 days prior to RPM Auction
 - No contracts required
 - Marketing plan
- Establish credit with PJM prior to RPM Auction
- Submit Post-Installation M&V Report by 15 business days prior to each Delivery Year for which the EE Resource is committed

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IMM: EE has limited performance hours (4.7% of year)

The IMM mischaracterizes the performance period stipulated in the Manuals for EE. Year-round performance is required.

If these hours are wrong we don't know how much EE is improving reliability.

- ▶ **OPPORTUNITY:** Study to establish appropriate hours for Performance.

Accreditation

- Despite the fact that a Capacity Performance EE Resource must be fully implemented at all times during the delivery year, without any requirement of notice, dispatch, or operator intervention,
- EE accreditation is based only on extremely limited days of the year and hours on those days.

EE Performance Hours

- Capacity Performance EE is required to demonstrate savings only during the EE Performance Hours:
 - the four hours from hour ending 15:00 through hour ending 18:00 EPT during June 1 through August 31 inclusive, that is not a weekend or federal holiday.
 - the four hours from hour ending 08:00 through hour ending 09:00 EPT and hour ending 19:00 through hour ending 20:00 EPT during January 1 through February 28 inclusive, that is not a weekend or federal holiday.
- For the 2023/2024 Delivery Year, the EE Performance hours comprise only 416 hours across 104 days.
 - 4.7 percent of all hours

Content from IMM MIC Presentation

IMM: Most EE is not directly measured, but based on studies and statistics

The IMM is right that most (by # of products) EE is not equipped with logging equipment.

- ▶ **OPPORTUNITY:** Verify that EE performance is consistent with EE studies and adjust accordingly.

Content from IMM MIC Presentation

Measurement and Verification

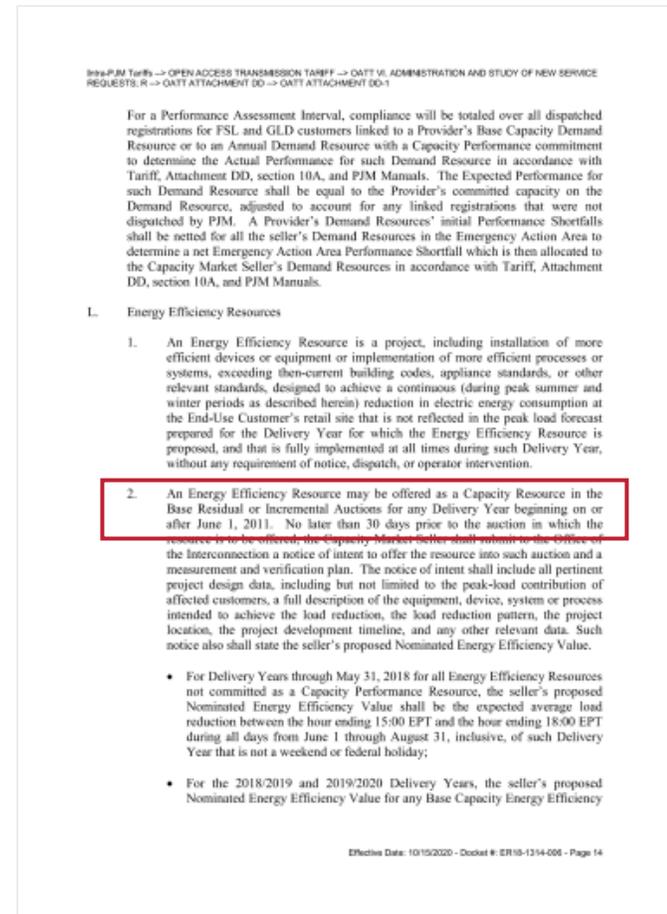
- Most EE MW are not directly measured. Savings are calculated based on an assumed installation rate and assumed usage level, compared to the assumed electricity usage of the default.
- The direct measurement and verification methods are inadequate and rely on assumptions and samples from limited periods.
- Many EE Providers rely on data from industry publications rather than their own measurements

When EE adoption rates are unpredictable and reliability is the mandate, M&V precision and Financial Assurance are critically important

	Load Forecasting	Market EE
Precision	Survey data for Mid-Atlantic	Receipts for all qualified sales within each zone / LDA
If wrong	No recourse	Financial Assurance and penalties
When to use	Well established EE that has been de-risked by the market and no longer eligible for Market participation	New EE, beyond what's in the Load Forecast

Energy Efficiency is a FERC-endorsed Supply Side Capacity Resource. FERC Has Not Endorsed the “Addback.”

Section L.2 of Attachment DD-1: “An Energy Efficiency Resource may be offered as a Capacity Resource in the Base Residual or Incremental Auctions for any Delivery Year beginning on or after June 1, 2011.”



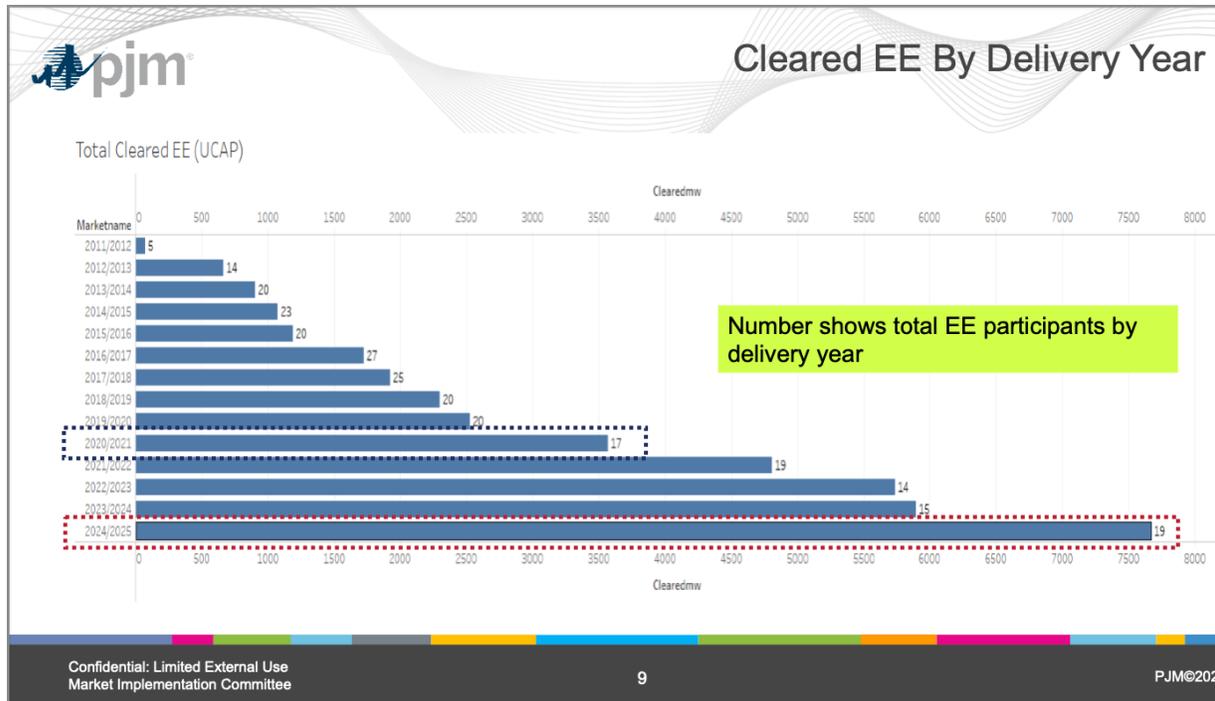
The Problem: Status quo rules are misaligned with current Market EE adoption

EE was defined to be incremental to the load forecast (in 2009). The load forecast was changed (in 2016) to incorporate an EE projection.

Rather than reconciling the load forecast with the Market EE, PJM elected the conservative approach of assuming that 100% of the EE was in the load forecast, a defensible but very conservative position until the Market EE became larger than the load forecast EE. When that happened, the status quo assumption (100% overlap) became mathematically impossible.

Market Energy Efficiency is Now Bigger and Different from the Load Forecast Energy Efficiency.

Market EE from PJM



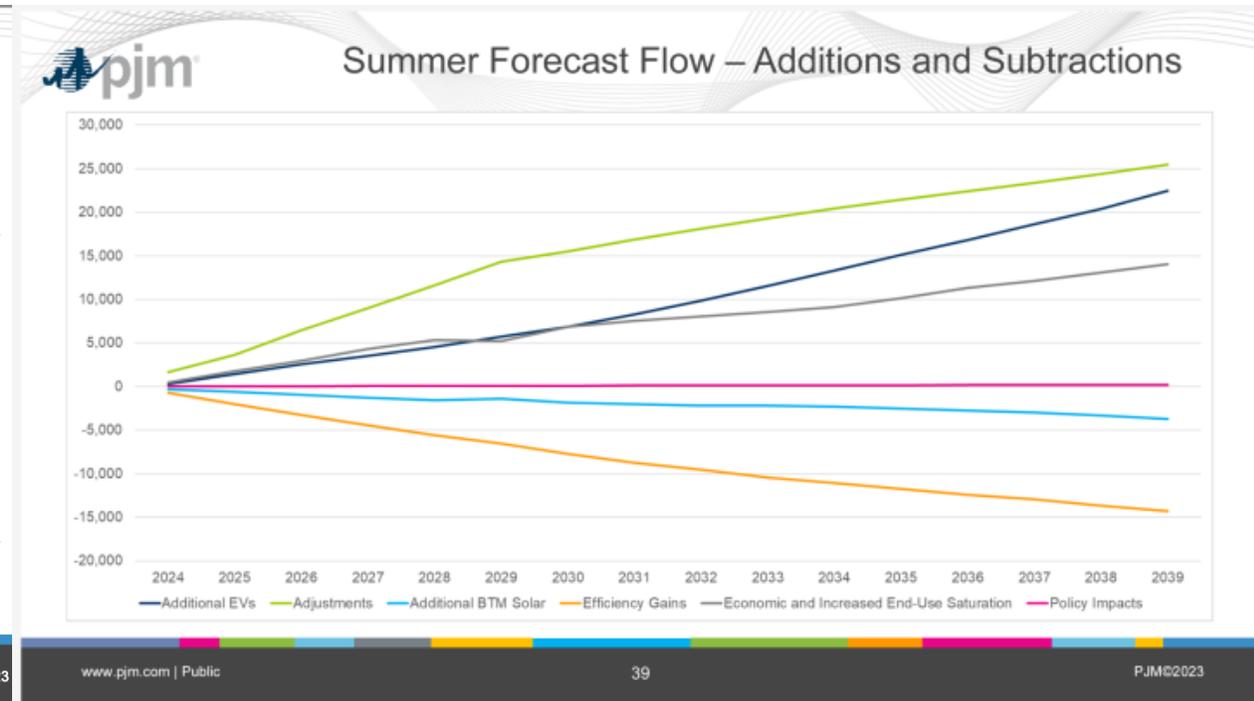
Confidential: Limited External Use
Market Implementation Committee

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- 900 MW/yr in DY 20/21
- 2,000 MW/yr in DY 24/25 (UCAP)

Load Forecast EE from PJM



www.pjm.com | Public

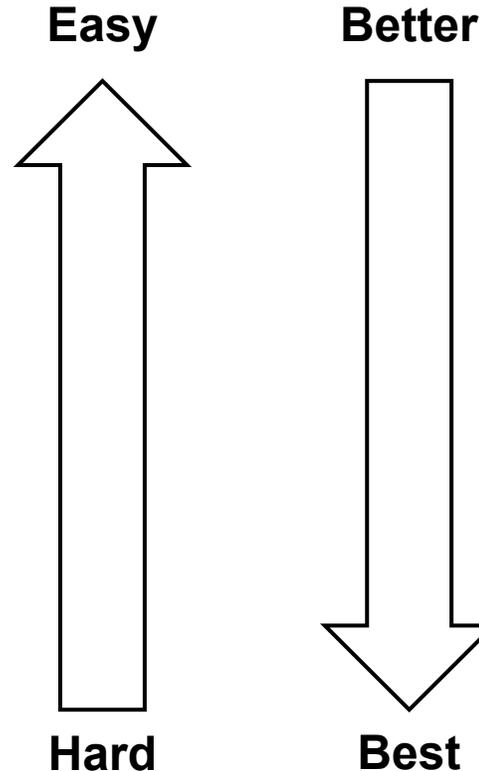
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- ~900 MW/yr of Efficiency Gains straight line through DY 32/33

There are Different and Better Ways to Solve the Problem

1. *Improve the Addback.* Even in the worst case scenario for double counting of the Load Forecast EE and the Market EE, only the lesser of the two values should be added back.
2. *Rely on the Market EE. Eliminate the Addback.* For the approved eligible life of EE Resources, use the Market EE. Eliminate the Load Forecast EE adjustment until the corresponding eligibility expires.
3. *Create new load forecast baselines. Eliminate the Addback.* Require that EE providers only submit EE that exceeds the PJM-established load forecast baseline standards.



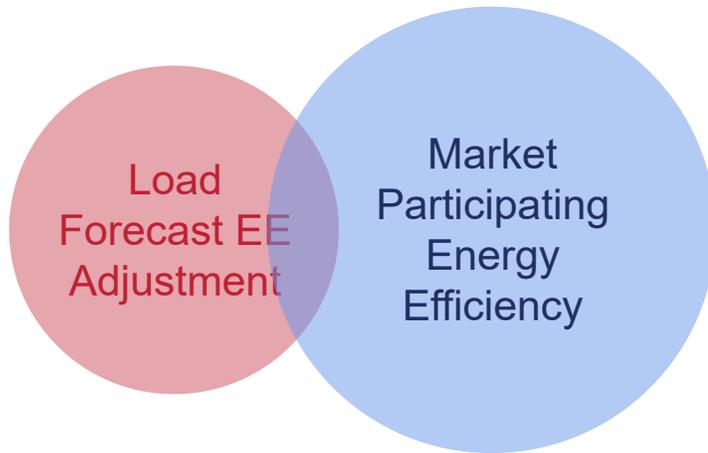
Why was the “addback” first introduced?

From Manual 18, 2.4.5, effective for RPM Auctions conducted after Jan 2016

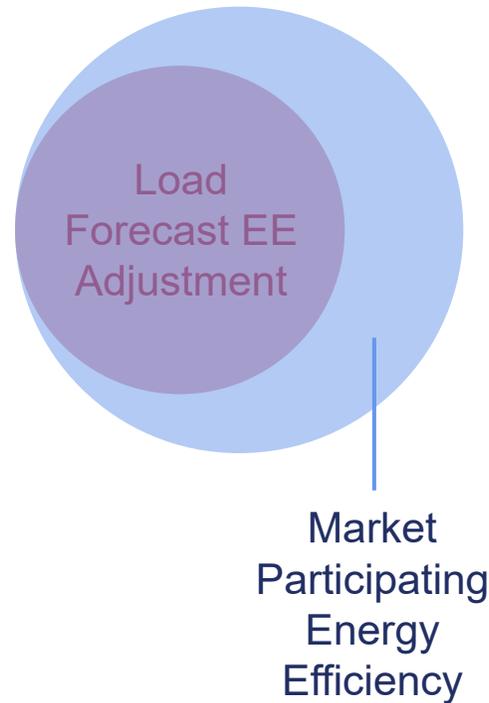
“Because energy efficiency measures are reflected in the peak load forecast for a Delivery Year for which an auction is being conducted, the auction parameters must be adjusted as described below for the EE Resource(s) that are proposed for that auction in order to avoid double-counting of the energy efficiency measures.”

There are 3 potential scenarios:

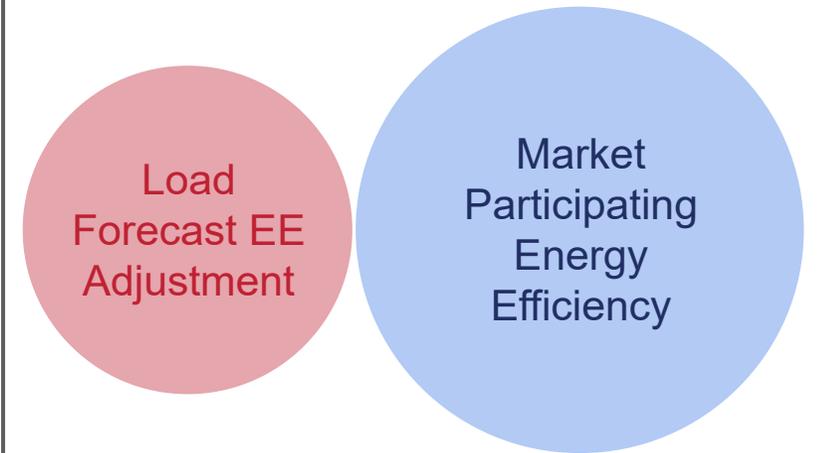
Some Overlap



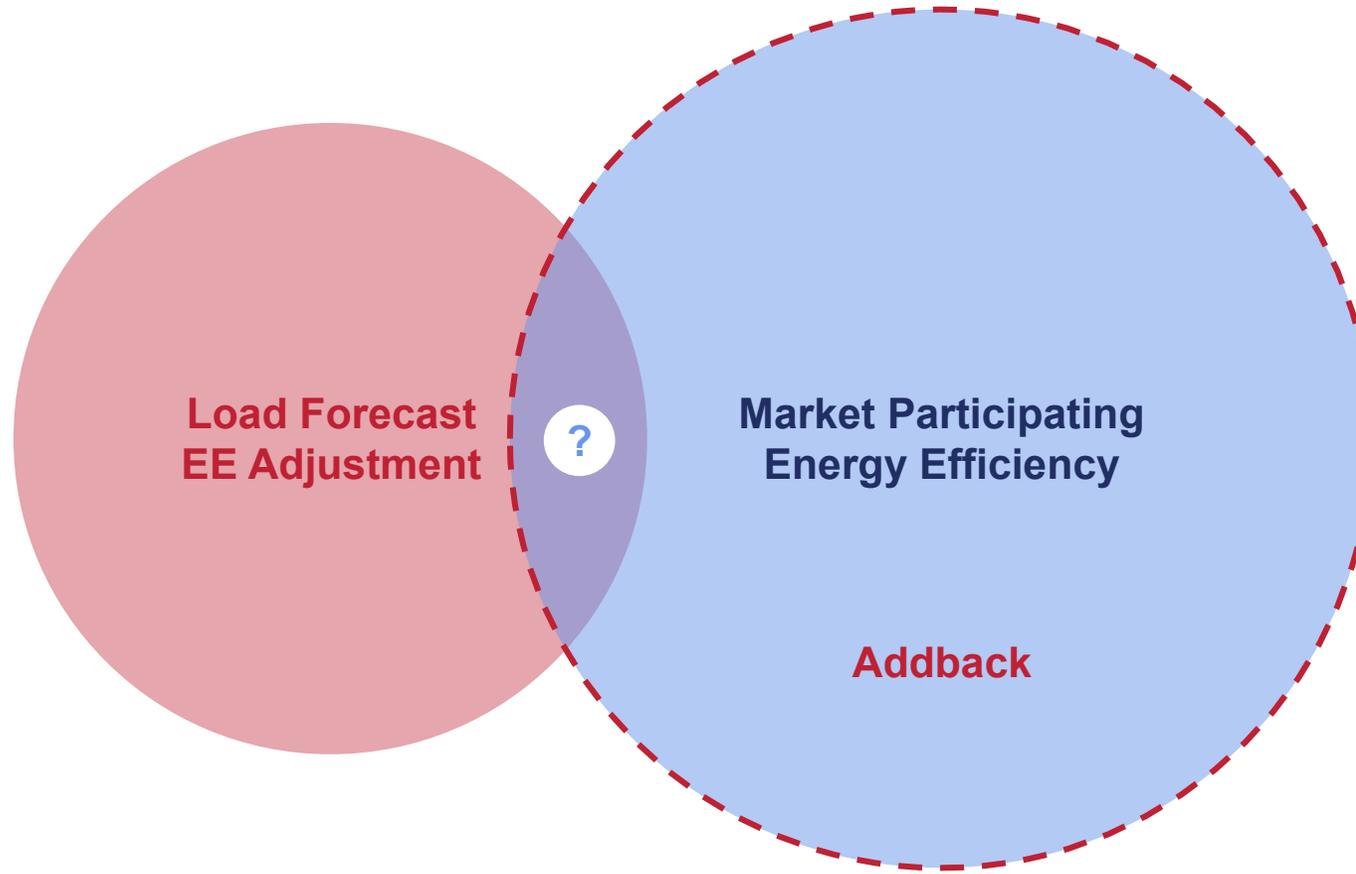
Complete Overlap



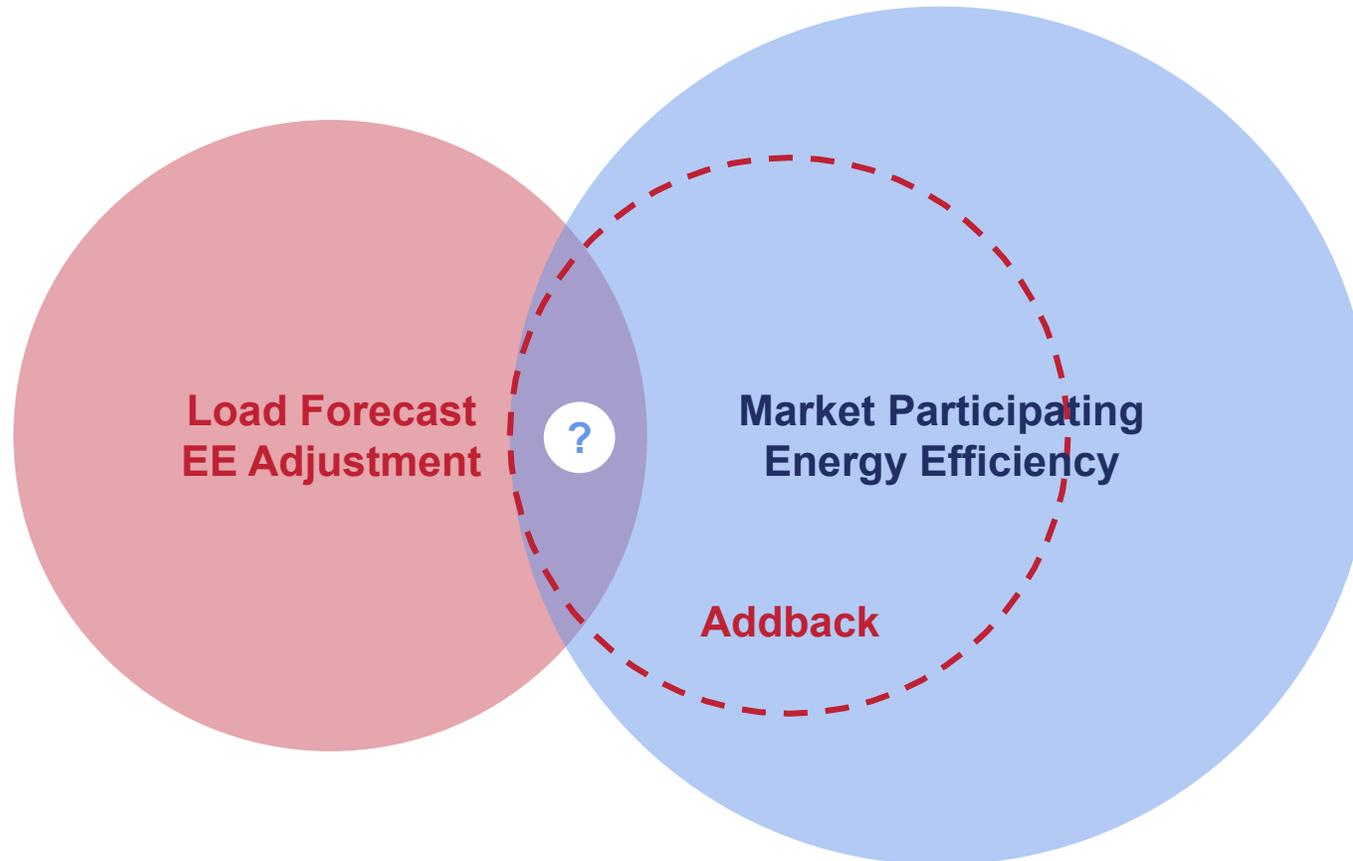
No Overlap



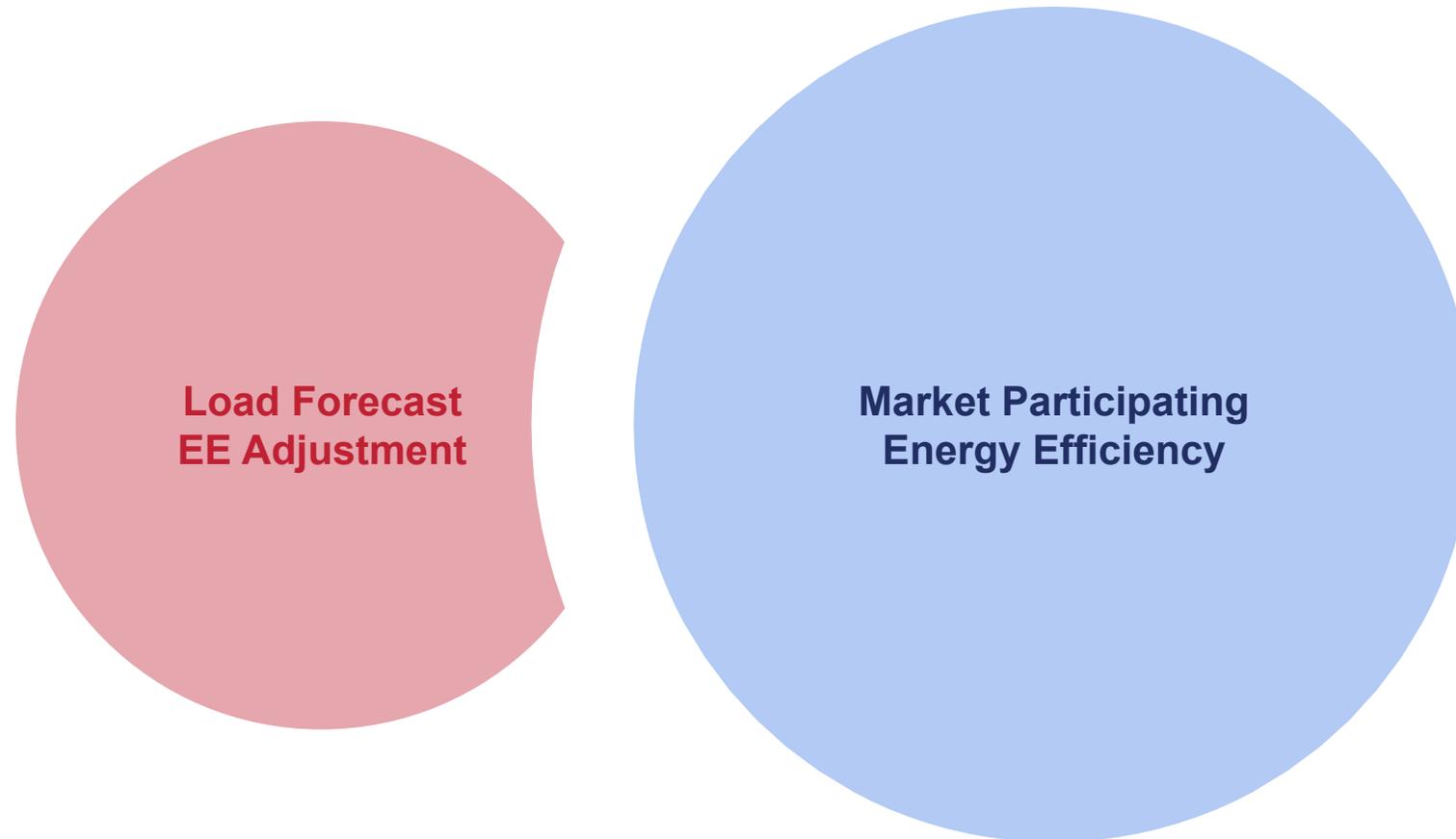
Addback Status Quo. Because of “?” we add back - - -



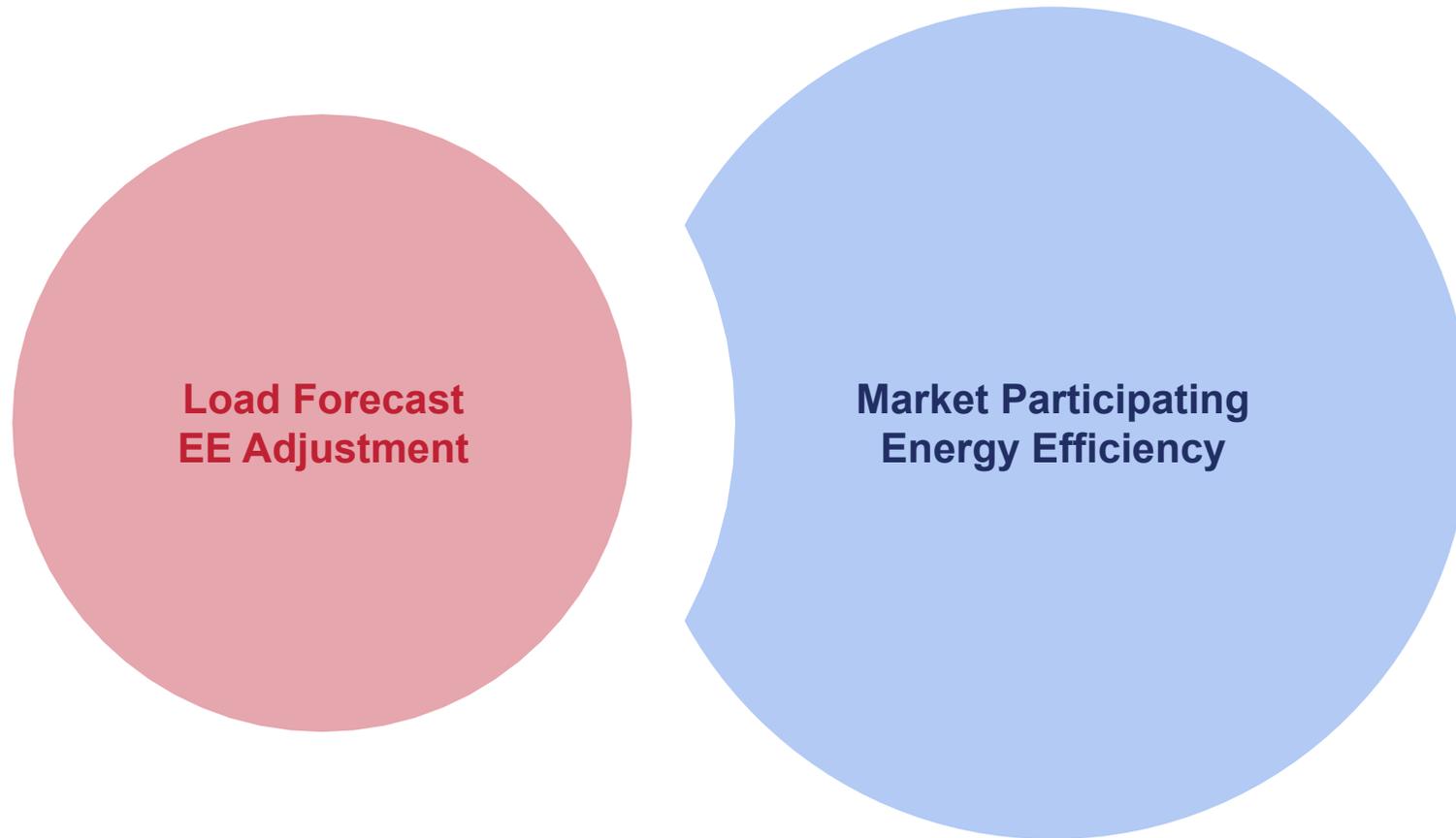
Option 1: Add back the lesser of the EE adjustment or the Market EE. Because of “?” we add back - - -



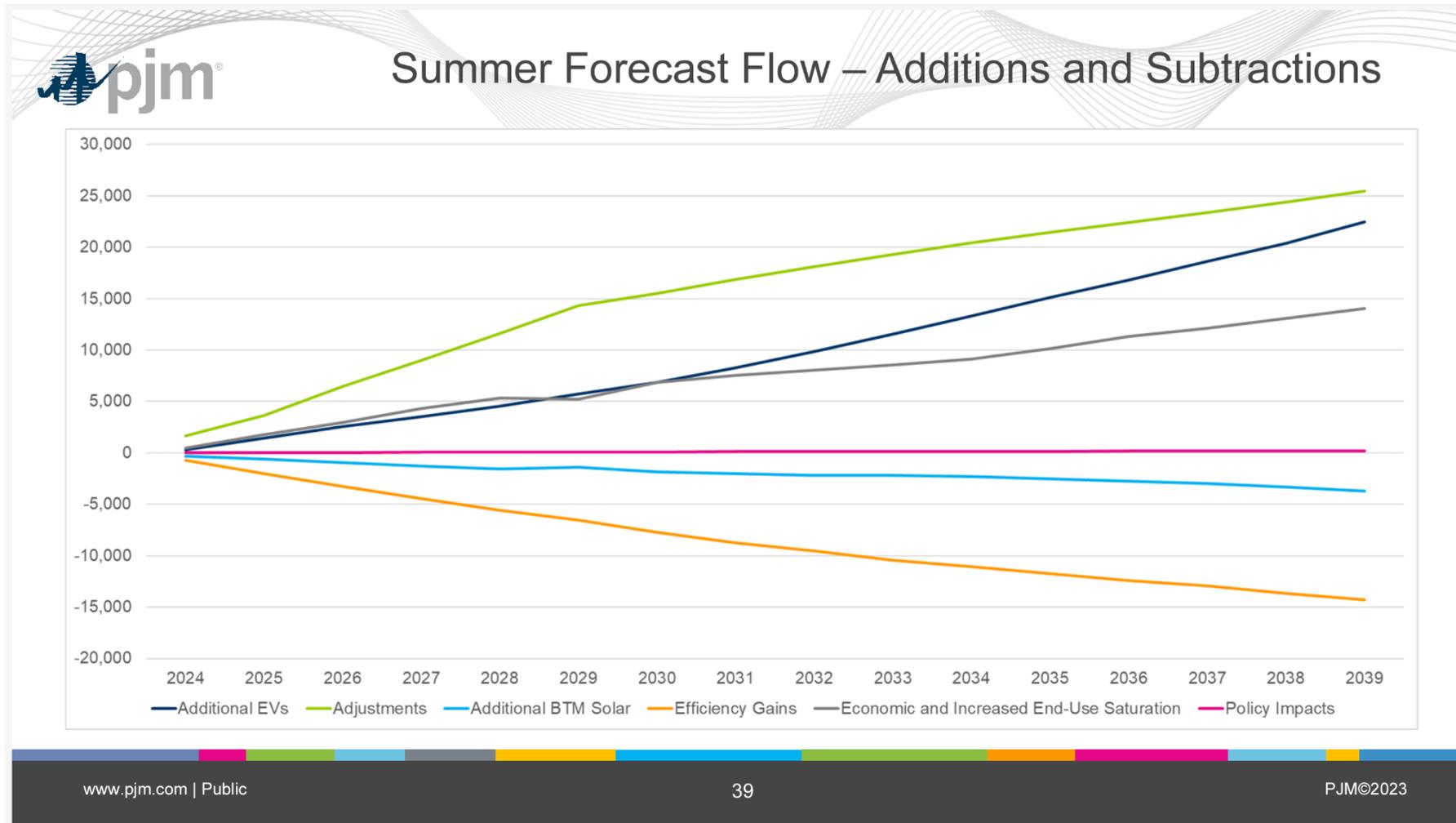
Option 2: Eliminate the Addback by Changing the Load Forecast EE Adjustment



Option 3: Eliminate the Addback by Limiting Market EE, using the Load Forecast EE as Baseline

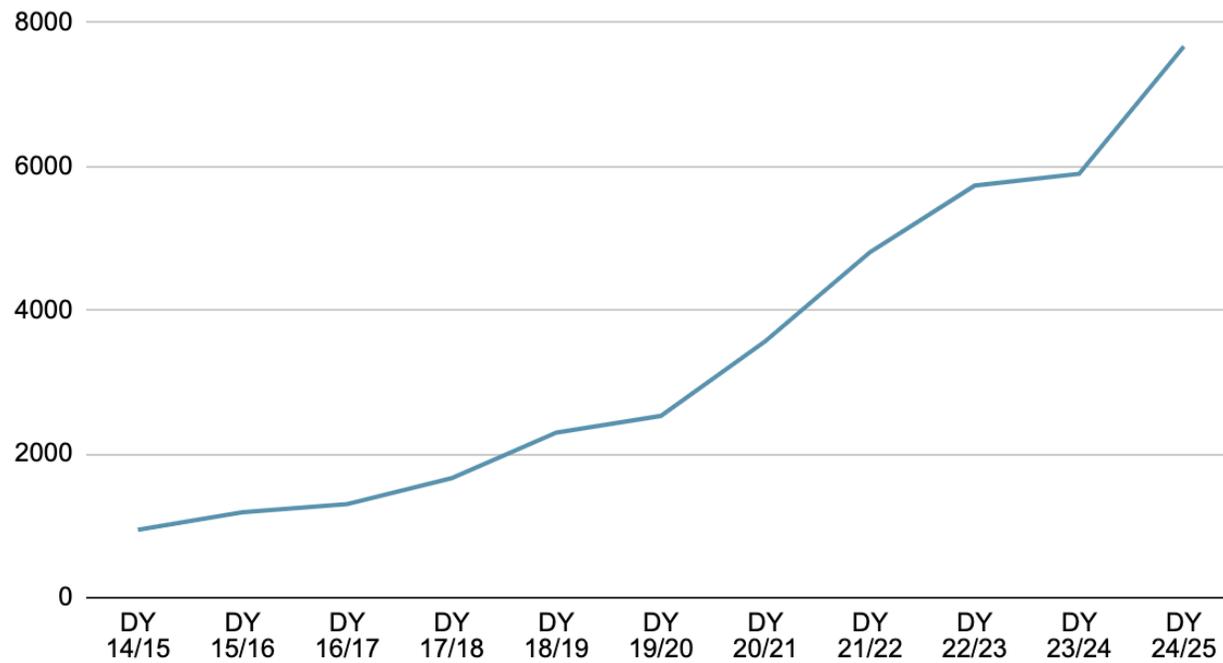


How much EE *is* in the Load Forecast? This is the best quantification we have so far:



How much EE has been in the Market over time?

Total Market EE Cleared by DY (MW)



DY	Total EE
DY 14/15	943.4
DY 15/16	1189.6
DY 16/17	1300.3
DY 17/18	1662.9
DY 18/19	2296.3
DY 19/20	2528.5
DY 20/21	3569.5
DY 21/22	4806.2
DY 22/23	5734.8
DY 23/24	5896.4
DY 24/25	7668.7