[UNITED STATES] ISO (Independent System Operators) New England Capacity Market

About the measure

Policy instrument	Sector	Starting date and status
Market-based (Capacity market/auctions)	**All sectors**	**2010 – on-going**

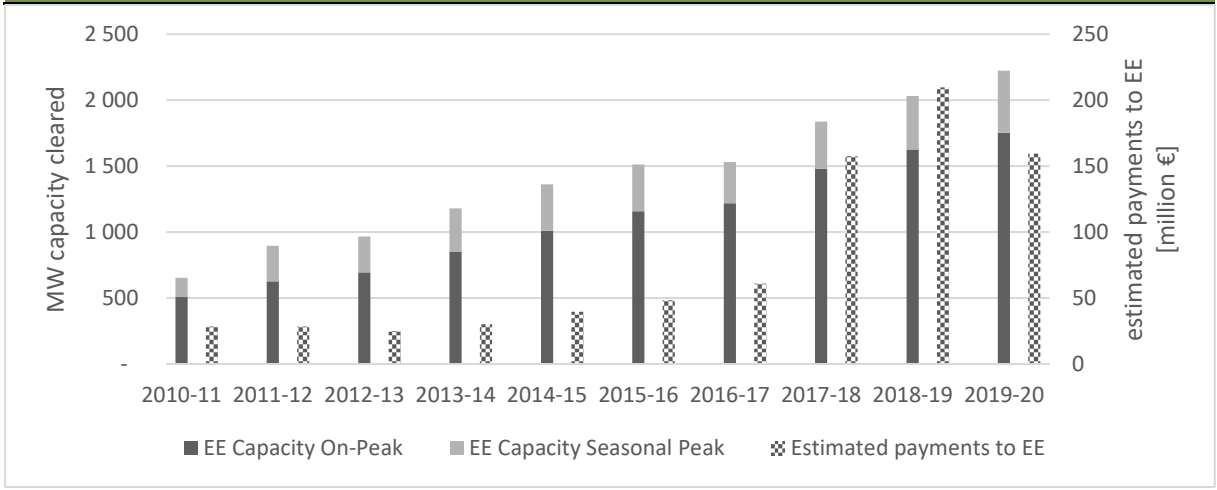
The **Forward Capacity Market** in New England ensures that the New England power system has sufficient resources to meet the future demand for electricity, particularly during peak periods. Capacity markets do not purchase energy, but seek to ensure that adequate capacity – the ability to meet peak demand and operating reserve requirements – will be available to reliably serve expected load. **Forward Capacity Auctions** are held annually, three years in advance of the delivery year. Resources compete in the auctions to obtain a commitment to supply capacity in exchange for a market-priced capacity payment.

The organisation running the Forward Capacity Market in New England, ISO New England (ISO-NE), is an independent, non-profit Regional Transmission Organization (RTO), serving Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. ISO-NE invites customer-based demand-side resources to compete against conventional generation resources. These **demand-side resources** fall into several categories: demand response, end-use energy efficiency and load management, and behind-the-meter distributed generation.

Actions saving final energy can be delivered in all sectors.

Expected energy savings in 2020	Benchmark
17 GW in 2020 from actions over 2010-2020 (cumulated capacity cleared in the auctions) (source: ISO-NE 2017; Liu 2017b)	Energy efficiency received more than 6% of all capacity payments awarded in the 2017 auction (source: ISO-NE, 2017; Liu 2017b)

Means and outputs



Source: data from (ISO-NE 2017; Liu 2017a, 2017b) (exchange rate used: 1 $ = 0.85 €)

Figure 1. Estimated capacity cleared (in MW) and payments to EE (million euros) per delivery year.

- **Capacity payments** are not officially reported, but estimated based on clearing price in different auctions and reported capacity cleared. These amounts include **incentive costs** (subsidies) and **administration costs** (verification, documentation, reporting).

The EPATEE project has received funding from the European Union's Horizon 2020 Research and innovation programme under grant agreement No 746265.

Data about energy savings

Unit	Main source of data
Scheme focused on load savings, in terms of capacity cleared (in MW)	Reports published by ISO New England

- Target of the scheme = ensuring balance between electricity supply and demand (ensuring resource adequacy). Therefore the **main indicators** monitored are the **capacity cleared** (see data in Figure 1 above) and the verified capacity performance.
- **Capacities cleared shown in Figure 1** are for EE resources successful in clearing auctions and with a contract to deliver committed capacity in relevant delivery years (**ex-ante assessment**).The cleared capacities are **then subject to measurement and verification** (M&V) in accordance with appropriate protocols for its performance of capacity delivery (see below).
- **Energy savings** of the projects included in the bids are not evaluated by the capacity market scheme. Indeed demand-side load management does not necessarily imply energy savings. However, as most of EE resources in the forward capacity market are part of a regulated utility EE obligation, their energy savings are evaluated under the regulatory framework of utility EE obligation instead.

Sources of uncertainties about energy savings

- errors in the calculations and reporting of the energy savings from deemed savings (addressed by random checks)
- uncertainties related to the use of deemed savings in standard projects (e.g., differences between estimated and observed energy consumption)
- uncertainties around the baseline used in customised projects with tailored M&V plan

Evaluation of the energy savings

Calculation method(s) and key methodological choices

- **Measurement and Verification Plan**: ISO-New England (ISO-NE) requires bidders to deliver a **detailed M&V plan** as part of the prequalification process. The plan needs to contain a description of the equipment or types of equipment for projects being installed and/or modified, as well as of the approach taken to monitoring and verification. ISO-NE has an **extensive M&V Manual** (ISO-NE, 2014) that document what efficiency resource providers must do to demonstrate that their resources can reliably deliver the committed load savings at relevant system peak. This manual summarises the methods that can be used to document savings and are consistent with the energy efficiency industry's **International Performance Measurement and Verification Protocols** (**IPMVP**, see EVO, 2012). In addition, the M&V manuals provide guidance on assumptions that can be used with regard to **baseline efficiency** (see below), specify **levels of statistical precision** that studies of peak savings impacts must have (see also below), specify how recent any studies being relied upon must be (e.g., no more than five years old for New England), and address a variety of other M&V issues (for more details, see *Focus on monitoring and verification*).
- **Baseline**: The baseline is defined depending on when the equipment is replaced:
  - For equipment **replaced before end of its operational lifetime**, the baseline is the average load of electrical equipment being replaced ("**before actual**");
  - For equipment **replaced after end of its operational lifetime**, or **new installation**, the baseline is the efficiency standard or industry standard practice ("**minimum performance standards**").

- **Calculation methods**: Depending on the project type a range of methods is permissible including **deemed savings** (**methods 3 and 4**), **metered savings** (**method 1**), and, to some extent, **engineering estimates** (**method 5**) if complemented with metered data. Market participants can use **alternative methods** not listed in the M&V manual if they can demonstrate that the alternative methodologies will be equivalent to one of the accepted methodologies and justify why a different approach was chosen.
- **Controlling statistical bias:** Market participants need to include a description of the methods used to mitigate and adjust for the potential types of bias resulting from statistical methods related to the accuracy and calibration of the measurement tools, sensor placement bias, and sample selection bias or non-random selection of equipment and/or circuits to monitor.

Ex-post verifications and evaluations

ISO-NE reviews the M&V plans provided by bidder applicants as part of qualifications packages to ensure that they comply with their M&V Manuals. Once resources clear the market and are being delivered, they review documentation from the project sponsors to ensure the reported load savings are consistent with the M&V plan and any M&V studies identified by the plan. In the past, expert M&V consultants have been hired to assist with this work. ISO-NE reserves the right to audit the load savings databases and related documentation of the efficiency project sponsors.

The requirements for demonstrating successful delivery of calculated capacity reductions are substantial. For example, Efficiency Vermont (energy efficiency utility administering utility energy efficiency programmes in Vermont) reports that **up to 30% of the revenue** received in the ISO-NE capacity auctions is taken up in the **administrative costs** of participating in the auctions and **demonstrating compliance** (Gottstein et al. 2010). However, it should be noted that revenues from the capacity auctions can be used as complementary funding to strengthen energy efficiency activities (e.g. for thermal measures mainly affecting natural gas use) or to reduce the levy on customer energy bills.

Other indicators monitored and/or evaluated

In the ISO-NE Forward Capacity Market, EE capacity is eligible to participate as long as it is operational. Therefore, capacity offer of existing EE resources needs to be updated in the application stage for each annual forward auction to account for changes in technical performance or operational practice. Apart from this, no particular other indicators are monitored or evaluated for the needs of the capacity market scheme. However, it should be noted that most of the EE in the ISO-NE Forward Capacity Market is also part of the portfolios of regulatory utility EE obligation. In this case, these resources are subject to other types of M&V (e.g. energy savings, cost effectiveness and additionality) as required by the relevant regulatory framework.

Other aspects evaluated

For utility EE portfolios that bid into the ISO-NE forward capacity market, they are typically also subject to other types of evaluation than the peak savings verification. While these evaluations often do not affect the *ex post* peak demand reduction verification, they are valuable for understanding how the design and implementation of EE schemes can be improved and forecasting market trends and system operational needs. Examples of these evaluations are provided below.

Process evaluation – this type of evaluation complements impact evaluation (e.g. energy or peak savings) by focusing on the intervention logic, design and implementation of EE schemes. In other words, it opens the 'black box' between interventions (e.g. incentives) and final energy/peak impacts. While the specific scope of process evaluation may vary (e.g. depending on practical factors like the priority of evaluation), it may cover the theoretical/assumed 'pathways' whereby the scheme is supposed to work, processes of scheme operation, 'customer journey' (e.g. from initiation and how customers perceive the design and offer of scheme to participation and incentive provision) and so forth. The objective of process evaluation is to examine whether the assumed programme logic is valid and in what context and whether and how the design and implementation can be improved to achieve optimal outcomes (e.g. higher uptake of programme offers or participant satisfaction).

Market effects evaluation – this analysis focuses on the extent to which the programme outcomes (e.g. energy and peak savings) can be attributed to the scheme of interest rather than naturally-occurring market trend, which informs the estimation of *net* programme savings (i.e. after accounting for free-ridership and spill-over effects) and adjustment of programme strategies (e.g. target market segments and marketing approaches). For particular end-use categories, it may survey the market penetration of various technologies with different efficiency ratings (e.g. status of market transformation), analyse any new technical or programme developments, or forecast the pace of market transformation in the future. In the states covered by ISO-NE, there are joint efforts via the Northeast Energy Efficiency Partnership (NEEP) to monitor the market status for key end-use categories (e.g. residential lighting, heat pumps) (see http://www.neep.org/).

Energy efficiency forecast of ISO-NE – this process, starting in 2012, forecasts the load impacts of state-sponsored EE programmes in the medium future (i.e. 4-10 years beyond the 3-year timeframe of the Forward Capacity Market), due to the 10-year system planning horizon and the intention of ISO-NE states to grow their EE programmes. The energy efficiency forecast would be integrated into system planning studies, which does not affect the market activity of EE (e.g. eligibility of EE to participate in future capacity auctions). The analysis draws upon stakeholder inputs on the projected cost of energy savings, the budget for state-sponsored EE programmes and the assumed 'peak-to-energy' ratio (i.e. ratio of peak demand coincident with system peak and annual energy use, for a given electricity-using equipment or system).

Focus on monitoring and verification

Accuracy is particularly important where efficiency resources are enrolled in capacity reliability mechanisms in regional power markets. The system operators managing such systems depend on those resources to ensure reliable supply. For this reason, the **monitoring and verification rules** governing efficiency and demand response resources are very strict in those markets. Participants in the ISO-NE capacity market need to comply with the *ISO New England Manual for Measurement and Verification of Demand Reduction Value from Demand Resources* (ISO-NE 2014). The manual provides guidance and required criteria for the measurement and verification of performance of demand resources (including energy efficiency) participating in the ISO-NE capacity market. The measured and verified electrical energy reductions during defined peak hours are the basis of payments and charges to market participants – in the case of under-delivery, participants would face penalty for the shortfall.

ISO-NE approves **four approaches** for measuring and verifying the system peak demand reductions of EE projects (i.e. difference of baseline and post-installation load), **based on IPMVP** (EVO, 2012). Descriptions of these approaches are summarised below.

Table 1. Adaptation of the 4 M&V options as defined in IPMVP.

Approach	Description	Applicable when…
Option A: **Partially measured retrofit isolation/stipulated measurement**	• Spot measurement of proxy factors (e.g. wattage, operating hours), combined with established algorithm/factors, to estimate peak demand reductions	• Savings can be reliably estimated using correlation between metered proxy factors and electrical demand
Option B: **Retrofit isolation/metered equipment**	• Interval meters to measure electrical demand at the equipment- or system-level. • If temporal variations are expected, metering should be long enough to represent operation during system peak hours	• Electrical load impacted by EE project is small relative to whole-premise load • No interval meter for whole premise • End-use load data available from building energy management
Option C: **Whole facility/regression**	• Whole-premise interval meters to measure electrical demand impacts of implemented actions on the whole building or facility during system peak hours	• Load impacts of actions cannot be measured directly (e.g. insulation)
Option D: **Calibrated simulation**	• Use calibrated simulation model (e.g. DOE-2) to estimate peak savings of EE actions at component- and whole-premise-level	• Interactive effects are expected with other actions or systems • For new build premises where baseline is unavailable

Source: adapted from (EVO, 2012)

Besides these four approved approaches, ISO-NE also allows **1) engineering algorithms** supplemented with equipment specific data; and **2) load shape** derived from metering data, load research or simulation to estimate peak savings from EE actions during On-Peak and Seasonal Peak Hours. Studies supporting engineering algorithms and load shape should not be over five years old when the M&V plan is submitted. In the ISO-NE region, there are some cross-state efforts in undertaking research to support the update of engineering algorithms and load shapes for relevant actions (e.g. residential lighting, appliances) (see: http://www.neep.org/).

As demonstrated by the experience of Efficiency Vermont, ex post peak savings verification entails conducting independent evaluation based on M&V plans and ISO-NE protocols. The outcomes are **realisation rates,** i.e. the difference between capacity obligation and verified capacity value, see Parlin and Chiodo (2011), for various project/action categories, which are applied to the estimated peak savings of the portfolio of Efficiency Vermont for reporting to ISO-NE.

Non-residential projects are stratified by the type (e.g. new build, retrofit) and size (i.e. estimated kW savings) of projects – for those falling into randomly selected strata and very large projects, project documents are reviewed, and **metering** is arranged for (e.g. site-specific metering plan) to measure post-installation load and verify peak savings with appropriate M&V approaches. Some commercial lighting can use stipulated factors that are based on prior load shape studies for verifying savings, and thus are not metered.

Residential actions, which are typically prescriptive, are verified of their peak savings based on assumption factors developed from market and load studies (e.g. for lighting and appliance) and included in the **Technical Reference Manual** (TRM) that forms part of the M&V Plan. When new studies become available, relevant evidences are used to adjust the estimated savings through a calculated realisation rate. In other cases, errors in the application of assumed factors, if any, are corrected. For these residential measures, no dedicated metering is used.

Experience feedback from stakeholders

Interview with Henry Yoshimura, Director, Demand Resource Strategy at ISO New England (evaluation customer)

1. **What is the role of evaluation in the management of the scheme?**

We need to ensure that resources can provide capacity when needed to meet projected resource adequacy needs - this requires a robust EM&V system to demonstrate how load reductions from EE will be quantified to meet capacity needs. Before EE can participate in the capacity auction, a detailed M&V plan needs to be submitted. If qualified, a project enters the capacity auction. If it clears the auction, M&V is used to determine whether the project delivered the savings for which it received payments during the timeframes specified (peak period savings separated from non-peak period savings). Most projects are being evaluated as part of utility Energy Efficiency Obligations evaluations as they receive funding from both Energy Efficiency Obligations and the capacity auction - those utility evaluations also inform the M&V plans submitted to ISO-NE.

2. **What were the main lessons learnt from the evaluations (about the impacts of the scheme and what could be improved)?**

Flexibility is needed for M&V as projects are diverse and keep changing with innovation, which makes M&V challenging to an extent. The right balance has to be struck between strict M&V rules to ensure reliability and the need for flexibility to accommodate for the diversity of projects.

3. **In parallel of the ex-post evaluations, are there other evaluations or studies that provided insights about the impacts of the scheme and/or possible interactions with other policies or drivers (or barriers) for energy efficiency?**

I am not aware of any studies.

4. **What would you like to highlight about your experience related to the evaluations of the scheme?**

While the output of generators are directly measured with meters and outage rates can be forecast, reductions in load produced by energy efficiency is not as directly observable, which poses a challenge when considering energy efficiency for meeting resource adequacy.

Forecasting future capacity needs is more complex when energy efficiency can participate as a resource because the need for capacity is based on load forecasts, which will be impacted by successful energy efficiency programs. These impacts must be accounted for correctly in load forecasts to avoid under- or over-procuring capacity in future periods.

To go further

About the measure

- Web page of ISO-NE on the scheme:

https://www.iso-ne.com/markets-operations/markets/forward-capacity-market

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- Key statistics on ISO-NE and its Forward Capacity Market:

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- ISO-NE (2017): Forward Capacity Market (FCA 11) Result Report

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Other useful references

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