Future Representative Capacity Requirements for 2020/21 – 2024/25

- *Net Installed Capacity Requirements (Net ICR)*
- *Capacity Requirement Values for the System Demand Curve*
- *Local Sourcing Requirements (LSR)*

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Objective of This Presentation

- Present the Representative Installed Capacity Requirement (ICR) Values for the forecast period of 2020/21 through 2024/25*
  - ➢ Representative Net ICR
  - ➢ Representative Capacity Requirement values for the System-Wide Capacity Demand Curve (1-in-5 and 1-in-87 LOLE)
  - ➢ Representative values for the Southeast New England (SENE) Capacity Zone (combined Load Zones of NEMA/Boston, SEMA and RI):
    - Local Resource Adequacy (LRA) Requirements
    - Transmission Security Analysis (TSA) Requirements
    - Local Sourcing Requirements (LSR)
- No zones were modeled as export constrained for FCA10; therefore Representative Maximum Capacity Limits (MCL) were not calculated

*This presentation is an update to the Indicative Net ICR values presented to the Planning Advisory Committee (PAC) on April 28, 2015 (see slide No.3)

Background

- **Indicative ICR values were presented to the Planning Advisory Committee (PAC) on April 28, 2015**
  - Indicative ICR Values for 2020/21 through 2024/25 were developed using a reserve margin multiplier
  - This multiplier was developed by using the average % resulting reserves associated with the representative Net ICR values for 2019/2020 through 2023/2024 presented to the PAC in January 2015
  - Values for the FCA10 (2019/20) were reported as "*to be determined*"
- **PAC Presentation available at:**
  - http://www.iso-ne.com/static-assets/documents/2015/04/a2_rsp15_resource_adequacy_and_related_studies.pdf

Actual ICR Values for 2016/17 – 2019/20

- The actual ICR, Net ICR, LSR, MCL and Demand Curve Capacity Requirement values (collectively called the ICR Values) are included in this presentation for reference purposes

- The Reliability Committee (RC) presentation of the ICR Values for the:
  - 2016/17 3rd Annual Reconfiguration Auction (2016/17 ARA3)
  - 2017/18 2nd Annual Reconfiguration Auction (2017/18 ARA2)
  - 2018/19 1st Annual Reconfiguration Auction (2018/19 ARA1)

  available at: http://www.iso-ne.com/static-assets/documents/2015/10/a9_icr_values_for_ara.pdf

- The RC presentation of the ICR Values for the:
  - 2019/20 Forward Capacity Auction (FCA10)

  available at: http://www.iso-ne.com/static-assets/documents/2015/09/a9_icr_results.pdf

- All of the actual ICR Values presented here were vetted with the RC and Participants Committee (PC) and accepted by the FERC
  - FCA10 ICR values were accepted by the FERC on January 8, 2016
  - The ICR Values associated with the ARAs were accepted by the FERC on January 29, 2016
  - A summary of all ICR Values can be found at: http://www.iso-ne.com/static-assets/documents/2015/12/summary_of_icr_values_vii.xlsx.

Methodology

- The ICR Values (actual and representative) are calculated according to Market Rule 1 Section III.12 *Calculation of Capacity Requirements,* [*http://www.iso-ne.com/static-assets/documents/2014/12/mr1_sec_1_12.pdf*](http://www.iso-ne.com/static-assets/documents/2014/12/mr1_sec_1_12.pdf)

- The assumptions used to calculate Representative ICR Values for 2020/21 – 2024/25 were the same load forecast and resource* assumptions used to calculate the 2019/20 ICR Values

*The retirement of the Pilgrim Nuclear generator is reflected in Representative ICR Values

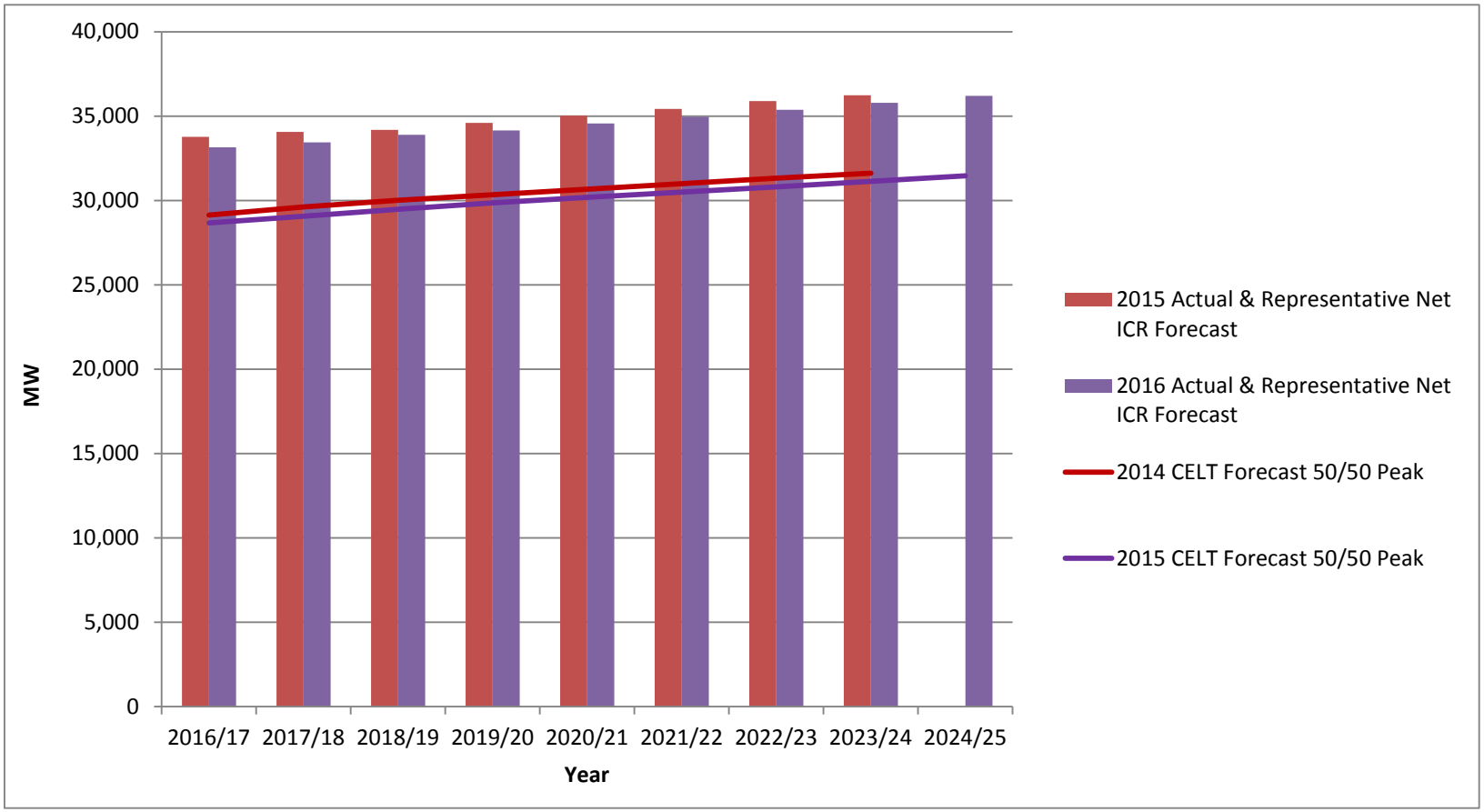
Net Installed Capacity Requirements

Status	Year	2015 CELT Forecast 50/50 Peak (MW)	Actual and Representative Future Net ICR (MW)	Annual Resulting Reserves (%)
A	**2016/17**	28,673	33,152	15.6
A	**2017/18**	29,066	33,442	15.1
A	**2018/19**	29,483	33,883	14.9
A	**2019/20**	29,861	34,151	14.4
R	**2020/21**	30,182	34,571	14.5
R	**2021/22**	30,487	34,964	14.7
R	**2022/23**	30,804	35,370	14.8
R	**2023/24**	31,131	35,789	15.0
R	**2024/25**	31,454	36,198	15.1

- **Status:**
  - **A = Actual Values**
  - **R = Representative Values**

- **Net ICR values for 2016/17 to 2019/20 are the values filed with the FERC in November and December 2015. FCA10 ICR Values were accepted by FERC on Jan 8, 2016. ARA ICR Values were accepted by the FERC on Jan 29, 2016.**

Comparison of This Year's and Last Year's Net ICR Forecasts



This chart compares the Representative Net ICR forecast presented last year to the PAC on Jan 21, 2015 with this year's forecast. Decrease in ICR can be attributed mainly to the decrease in the load forecast.

ICR Calculation Details (MW)

	Actual				Representative				
Total Capacity Breakdown	**2016/17 ARA3**	**2017/18 ARA2**	**2018/19 ARA1**	**2019/20 FCA**	**2020/21**	**2021/22**	**2022/23**	**2023/24**	**2024/25**
Generating Resources	30,803	29,944	30,954	30,654	29,977	29,977	29,977	29,977	29,977
Demand Resources	3,245	3,245	3,245	2,871	2,871	2,871	2,871	2,871	2,871
Imports/Export Delist & Import Deratings	1,853	1,830	1,730	(41)	(41)	(41)	(41)	(41)	(41)
Tie Benefits	1,847	1,870	1,970	1,990	1,990	1,990	1,990	1,990	1,990
OP4 - Action 6 & 8 (Voltage Reduction)	417	424	430	442	447	452	458	463	468
Minimum Reserve Requirement	(200)	(200)	(200)	(200)	(200)	(200)	(200)	(200)	(200)
Proxy Unit Capacity	-	-	-	800	2,000	2,400	2,800	3,200	3,600
Total Capacity & OP4 Actions	37,965	37,113	38,129	36,516	37,044	37,449	37,855	38,260	38,665

Installed Capacity Requirement Calculation Details	**2016/17 ARA3**	**2017/18 ARA2**	**2018/19 ARA1**	**2019/20 FCA**	**2020/21**	**2021/22**	**2022/23**	**2023/24**	**2024/25**
Annual Peak	28,673	29,066	29,483	29,861	30,182	30,487	30,804	31,131	31,454
Total Capacity & OP4 Actions	37,965	37,113	38,129	36,516	37,044	37,449	37,855	38,260	38,665
Tie Benefits	1,847	1,870	1,970	1,990	1,990	1,990	1,990	1,990	1,990
HQICCs	1,095	1,068	953	975	975	975	975	975	975
OP4 - Action 6 & 8 (Voltage Reduction)	417	424	430	442	447	452	458	463	468
Minimum Reserve Requirement	(200)	(200)	(200)	(200)	(200)	(200)	(200)	(200)	(200)
ALCC	2,378	1,371	1,780	116	206	212	206	189	182
Installed Capacity Requirement	**34,247**	**34,510**	**34,836**	**35,126**	**35,546**	**35,939**	**36,345**	**36,764**	**37,173**
Net ICR	**33,152**	**33,442**	**33,883**	**34,151**	**34,571**	**34,964**	**35,370**	**35,789**	**36,198**
Reserve Margin with HQICCs	19.4%	18.7%	18.2%	17.6%	17.8%	17.9%	18.0%	18.1%	18.2%
Reserve Margin without HQICCs	15.6%	15.1%	14.9%	14.4%	14.5%	14.7%	14.8%	15.0%	15.1%

$$Installed\ Capacity\ Requirement\ (ICR) = \frac{Capacity - Tie\ Benefits - OP4\ Load\ Relief}{1 + \frac{ALCC}{APk}} + HQICCs$$

- **ALCC is the "Additional Load Carrying Capability" used to bring the system to the 0.1 Days/Year Loss of Load Expectation (LOLE) Reliability Criterion**

1-in-5 LOLE Capacity Requirement Values (MW)
(Cap for the System Demand Curve)

Total Capacity Breakdown	FCA10 1-in-5	2020/21	2021/22	2022/23	2023/24	2024/25
Generating Resources	30,654	29,977	29,977	29,977	29,977	29,977
Demand Resources	2,871	2,871	2,871	2,871	2,871	2,871
Imports/Export Delist & Import Deratings	(41)	(41)	(41)	(41)	(41)	(41)
Tie Benefits	1,990	1,990	1,990	1,990	1,990	1,990
OP4 - Action 6 & 8 (Voltage Reduction)	442	447	452	458	463	468
Minimum Reserve Requirement	(200)	(200)	(200)	(200)	(200)	(200)
Proxy Unit Capacity	-	800	1,200	1,600	2,000	2,400
Total Capacity & OP4 Actions	**35,716**	**35,844**	**36,249**	**36,655**	**37,060**	**37,465**

Capacity Requirement Calculation Details	FCA10 1-in-5	2020/21	2021/22	2022/23	2023/24	2024/25
Annual Peak	29,861	30,182	30,487	30,804	31,131	31,454
Total Capacity & OP4 Actions	35,716	35,844	36,249	36,655	37,060	37,465
Tie Benefits	1,990	1,990	1,990	1,990	1,990	1,990
HQICCs	975	975	975	975	975	975
OP4 - Action 6 & 8 (Voltage Reduction)	442	447	452	458	463	468
Minimum Reserve Requirement	(200)	(200)	(200)	(200)	(200)	(200)
ALCC	368	132	151	155	159	159
Capacity Requirement Value @ 1-in-5 LOLE	**33,076**	**33,461**	**33,839**	**34,234**	**34,631**	**35,030**
Reserve Margin without HQICCs	10.8%	10.9%	11.0%	11.1%	11.2%	11.4%

$$Installed\ Capacity\ Requirement\ (ICR) = \frac{Capacity - Tie\ Benefits - OP4\ Load\ Relief}{1 + \frac{ALCC}{APk}} + HQICCs$$

- **ALCC is the "Additional Load Carrying Capability" used to bring the system to the 0.1 Days/Year Loss of Load Expectation (LOLE) Reliability Criterion**

1-in-87 LOLE Capacity Requirement Values (MW)

(Foot for the System Demand Curve)

Total Capacity Breakdown	FCA10 1-in-87	2020/21	2021/22	2022/23	2023/24	2024/25
Generating Resources	30,654	29,977	29,977	29,977	29,977	29,977
Demand Resources	2,871	2,871	2,871	2,871	2,871	2,871
Imports/Export Delist & Import Deratings	(41)	(41)	(41)	(41)	(41)	(41)
Tie Benefits	1,990	1,990	1,990	1,990	1,990	1,990
OP4 - Action 6 & 8 (Voltage Reduction)	442	447	452	458	463	468
Minimum Reserve Requirement	(200)	(200)	(200)	(200)	(200)	(200)
Proxy Unit Capacity	3,600	4,800	5,200	5,600	6,400	6,800
Total Capacity & OP4 Actions	**39,316**	**39,844**	**40,249**	**40,655**	**41,460**	**41,865**

Capacity Requirement Calculation Details	FCA10 1-in-87	2020/21	2021/22	2022/23	2023/24	2024/25
Annual Peak	29,861	30,182	30,487	30,804	31,131	31,454
Total Capacity & OP4 Actions	39,316	39,844	40,249	40,655	41,460	41,865
Tie Benefits	1,990	1,990	1,990	1,990	1,990	1,990
HQICCs	975	975	975	975	975	975
OP4 - Action 6 & 8 (Voltage Reduction)	442	447	452	458	463	468
Minimum Reserve Requirement	(200)	(200)	(200)	(200)	(200)	(200)
ALCC	25	72	46	13	280	240
Capacity Requirement Value @ 1-in-87 LOLE	**37,053**	**37,518**	**37,949**	**38,390**	**38,858**	**39,307**
Reserve Margin without HQICCs	27.3%	24.3%	24.5%	24.6%	24.8%	25.0%

$$Installed\ Capacity\ Requirement\ (ICR) = \frac{Capacity - Tie\ Benefits - OP4\ Load\ Relief}{1 + \frac{ALCC}{APk}} + HQICCs$$

- **ALCC is the "Additional Load Carrying Capability" used to bring the system to the 0.1 Days/Year Loss of Load Expectation (LOLE) Reliability Criterion**

SENE LRA, TSA & LSR for 2019/20 – 2024/25 (MW)

Status	Year	LRA	TSA	LSR
	2016/17			
	2017/18			
	2018/19			
A	2019/20	9,584	10,028	10,028
R	2020/21	9,763	10,254	10,254
R	2021/22	9,899	10,425	10,425
R	2022/23	10,059	10,607	10,607
R	2023/24	10,212	10,769	10,769
R	2024/25	10,411	10,947	10,947

- Status:
  A = Actual Values
  R = Representative Values
- SENE LSR values for 2019/20 were accepted by FERC on Jan 8, 2016

Signifies values are not applicable for the year shown

SENE LRA Calculation Details

		Actual				Representative				
SENE Zone		**2016/17 ARA3**	**2017/18 ARA2**	**2018/19 ARA1**	**2019/20 FCA**	**2020/21**	**2021/22**	**2022/23**	**2023/24**	**2024/25**
$Resource_z$	[1]				11,194	10,517	10,517	10,517	10,517	10,517
$Proxy\ Units_z$	[2]				0	0	0	0	0	0
$Firm\ Load\ Adjustment_z$	[3]				1,482	Redacted				
FOR_z	[4]				0.0795					
LRA_z	[5]=[1]+[2]-([3]/(1-[4]))				**9,584**	**9,763**	**9,899**	**10,059**	**10,212**	**10,411**
Rest of New England Zone										
Resource	[6]				22,290	22,290	22,290	22,290	22,290	22,290
Proxy Units	[7]				800	1,200	1,600	2,000	2,400	2,800
Firm Load Adjustment	[8] = -[3]				-1,482	Redacted				
Total System Resource	[9]=[1]+[2]-[3]+[6]+[7]-[8]				34,284	34,684	35,084	35,484	35,884	36,284

- All values in the table are in MW except the Forced Outage Rate (FORz)
- The Firm Load Adjustment and FORz have been redacted to protect the confidential availability of the Pilgrim Nuclear generator

Signifies values are not applicable for the year shown

SENE TSA Calculation Details (MW)

SENE	Actual TSA Requirements				Representative TSA Requirements				
	2016/17 ARA3	2017/18 ARA2	2018/19 ARA1	2019/20 FCA10	2020/21	2021/22	2022/23	2023/24	2024/25
Sub-area 90/10 Load	-	-	-	13,342	13,499	13,652	13,816	13,961	14,121
Reserves (Largest Unit)	-	-	-	1,413	1,413	1,413	1,413	1,413	1,413
Sub-area Transmission Security Need	-	-	-	**14,755**	**14,912**	**15,065**	**15,229**	**15,374**	**15,534**
Existing Resources	-	-	-	11,194	Redacted				
Assumed Unavailable Capacity	-	-	-	-1,086					
Sub-area N-1 Import Limit	-	-	-	5,700	5,700	5,700	5,700	5,700	5,700
Sub-area Available Resources	-	-	-	**15,808**	**15,148**	**15,148**	**15,148**	**15,148**	**15,148**
TSA Requirement				**10,028**	**10,254**	**10,425**	**10,607**	**10,769**	**10,947**

$$\text{TSA Requirement} = \frac{\text{(Need – Import Limit)}}{\text{1 – (Assumed Unavailable Capacity / Existing Resources)}}$$

- The *Existing Resources* and *Assumed Unavailable Capacity* values have been redacted to protect the confidential availability of the Pilgrim Nuclear generator
- All values have been rounded off to the nearest whole number

▨ Signifies values are not applicable for the year shown

Conclusions

- The Representative Net ICR forecast for this year versus last year decreased by an average of approximately 500 MW
- This is mainly due to reductions to the 2015 CELT load forecast, both on the gross load forecast and with the incorporation of the forecast of BTMNEL PV resources which also reduced the load forecast
- Please feel free to voice comments on the continued value of this forecast, in person or by email at mscibelli@iso-ne.com

REPRESENTATIVE ICR VALUES CALCULATION ASSUMPTIONS

Load Forecast

- 2015 Capacity, Energy Loads and Transmission Report (CELT) Load Forecast was used to calculate all actual & Representative ICR Values in this presentation
- The load forecast used is net of the "*Behind the Meter Not Embedded in Load*" (BTMNEL) Photovoltaic (PV) resources forecast. The load forecast used is labeled in the 2015 CELT Report as "1.2 REFERENCE - With reduction for BTM PV"
- The Energy Efficiency forecast is not included since this is a forecast of passive Demand Resources which are expected to be part of the Forward Capacity Market (FCM) in the future and will, as such, be modeled as a supply-side capacity resource in the ICR calculations

Modeling of BTMNEL PV in ICR (MW)

Month	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25
Jun	228.0	306.4	339.0	367.1	391.0	411.7	425.1	437.9	449.5
Jul	236.6	309.4	341.7	369.2	393.1	412.9	426.3	438.9	450.6
Aug	245.1	312.5	344.3	371.4	395.2	414.1	427.5	439.9	451.8
Sep	254.6	315.8	347.3	373.8	397.5	415.4	428.8	441.1	453.0
Oct	0	0	0	0	0	0	0	0	0
Nov	0	0	0	0	0	0	0	0	0
Dec	0	0	0	0	0	0	0	0	0
Jan	0	0	0	0	0	0	0	0	0
Feb	0	0	0	0	0	0	0	0	0
Mar	0	0	0	0	0	0	0	0	0
Apr	0	0	0	0	0	0	0	0	0
May	304.0	336.9	365.4	389.3	410.7	424.2	437.1	448.6	460.7

- Table shows the monthly sum of Seasonal Claimed Capability (SCC) of BTMNEL PV resources modeled in the actual and representative ICR model (includes 8% Transmission & Distribution Gross-up)
- Developed using 40% of PV nameplate forecast from the Distributed Generation Forecast Working Group (DGFWG); 40% value based on 3 years of historical PV resource ratings during reliability hours
- Modeled as a load modifier in GE MARS by Regional System Plan (RSP) 13-subarea representation for hours ending 14:00 – 18:00

Load Forecast Data – Applicable 50/50 & 90/10 Load Forecast for New England & Sub-areas (MW)

Peak Load Forecast	New England	Connecticut		NEMA/Boston		Maine	SEMA/RI	
Capacity Commitment Period	50/50	50/50	90/10	50/50	90/10	50/50	50/50	90/10
2016/2017	28,673	7,405	8,085	6,105	6,580	2,094	-	-
2017/2018	29,066	7,475	8,170	6,195	6,675	2,118	-	-
2018/2019	29,483	7,563	8,253	6,289	6,774	-	5,822	6,377

Peak Load Forecast	New England	SENE	
Capacity Commitment Period	50/50	50/50	90/10
2019/2020	29,861	12,282	13,342
2020/2021	30,182	12,434	13,499
2021/2022	30,487	12,572	13,652
2022/2023	30,804	12,706	13,816
2023/2024	31,131	12,851	13,961
2024/2025	31,454	12,991	14,121

- Load forecast assumed is the 2015 CELT Report load forecast
- Capacity Zone load forecasts are the values for the Regional System Plan (RSP) sub-areas used as proxies for the Load Zone values as the interface Transmission Transfer Capability (TTC) limits are calculated using the 13 RSP sub-area representation.
- 50/50 load forecast values shown for informational purposes. The GE Mars model sees a distribution of daily peak loads to calculate ICR and LRA.
- 90/10 load forecast values shown are a direct input into the calculation of TSA for import-constrained Capacity Zones.

Transmission Transfer Capability (TTC) Limits Used in the LSR & MCL Calculations (MW)

Capacity Commitment Period	Connecticut Import N-1	Connecticut Import N-1-1	Boston Import N-1	Boston Import N-1-1	SEMA/RI Import N-1	SEMA/RI Import N-1-1	Maine-New Hampshire Export N-1
2016/17	2,950	1,750	4,850	4,175	-	-	1,900
2017/18	2,950	1,750	4,850	4,175	-	-	1,900
2018/19	2,950	1,750	4,850	4,175	1,280	720	-

Capacity Commitment Period	SENE Import N-1	SENE Import N-1-1
2019/20	5,700	4,600
2020/21	5,700	4,600
2021/22	5,700	4,600
2022/23	5,700	4,600
2023/24	5,700	4,600
2024/25	5,700	4,600

- This table shows the TTC values for the applicable Capacity Zone locational requirements calculations
  - Connecticut Import is used to calculate Connecticut LSR
  - Boston Import is used to calculate NEMA/Boston LSR
  - SEMA/RI Import is used to calculate the combined SEMA & RI Capacity Zone LSR
  - Maine-New Hampshire interface is used to calculate the MCL for Maine
  - SENE Import is used to calculate LSR for the combined NEMA/Boston, SEMA & RI Capacity Zone
- For more detailed information on the RSP15 interface TTC analyses see a presentation from the June 17, 2015 PAC meeting (CEII clearance required): https://smd.iso-ne.com/operations-services/ceii/pac/2015/06/a8_rsp15_transfer_capability_assumptions_update.pdf.

Summary of Resource Assumptions for 2016/17 – 2024/25 (MW)

	Year	Generating Resources	Intermittent Power Resources	Demand Resources	Import Resources	Total Resources
New England	2016/17	29,854.237	949.163	3,244.804	1,853.000	1,853.000
	2017/18	29,881.702	979.229	3,518.808	1,723.758	36,103.497
	2018/19	29,031.031	979.229	3,518.808	1,668.752	35,197.820
	2019/20	29,604.850	919.119	2,871.265	88.800	33,484.034
	2020/21 - 2024/25	28,927.566	919.119	2,871.265	88.800	32,806.750

SENE	2016/17					
	2017/18					
	2018/19					
	2019/20	9,779.005	157.858	1,257.309	-	11,194.172
	2020/21 - 2024/25	9,101.721	157.858	1,257.309	-	10,516.888

- The retirement of the Pilgrim Nuclear generator is reflected in the generating resources values for 2020/21 – 2024/25 for New England and SENE

TSA Resource Assumptions

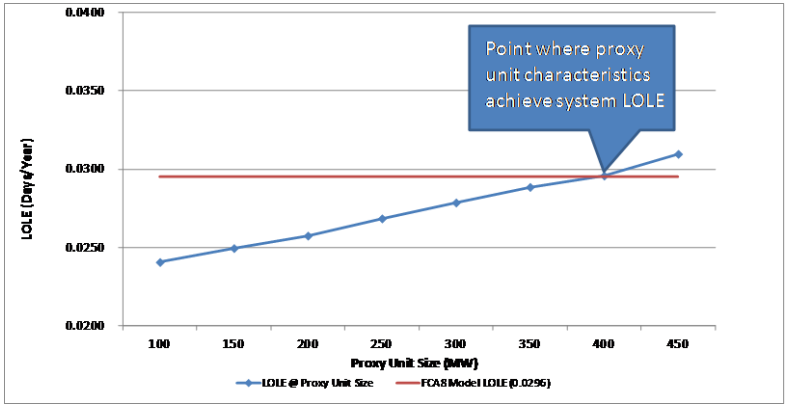
– Based on FCA10 Resource Assumptions

- Resource Data based on FCA10
  - 2019-20 Existing Capacity Qualification data as of June 4, 2015
    - Generating capacity: 9,937 MW*
      - Includes 9,237 MW of regular generation resources, 158 MW of intermittent generation resources and 542 MW of peaking generation resources
    - Passive Demand Resources: 1,039 MW
    - Non-RTEG Active Demand Resources: 180 MW
    - Real-Time Emergency Generation: 39 MW

**** Representative TSA values have the retirement of the Pilgrim Nuclear Generator reflected in the calculation***
NOTE: All values have been rounded off to the nearest whole number

Proxy Unit Characteristics

- Proxy unit characteristics based on a study conducted in 2014 using the 2017/18 FCA8 ICR Model
- Current proxy unit characteristics:
  - Proxy unit size equal to 400 MW
  - EFORd of proxy unit = 5.47%
  - Maintenance requirement = 4 weeks



- Proxy unit characteristics are determined using the average system availability and a series of LOLE calculations. By replacing all system capacity with the correct sized proxy units, the system LOLE and resulting capacity requirement unchanged.

  - The 2014 Proxy Unit Study was reviewed at the May 22, 2014 PSPC Meeting and is available at: http://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/relblty_comm/pwrsuppln_comm/mtrls/2014/may222014/proxy_unit_2014_study.pdf

Summary of Resource Availability Assumptions - Based on the FCA10 ICR Model

Resource Category	Summer MW	Assumed Average EFORd or FOR Weighted by Summer Ratings (%)	Assumed Average Maintenance Weeks Weighted by Summer Ratings
Total System Generation	**29,704.850**	**6.9**	**4.8**
Combined Cycle	13,279.210	4.0	5.4
Fossil	6,086.556	15.9	5.1
Nuclear	4,024.419	2.5	4.5
Hydro (Includes Pumped Storage)	2,903.266	4.9	4.4
Combustion Turbine	3,170.520	9.4	2.5
Diesel	190.124	7.3	1.0
Miscellaneous	50.755	16.1	3.8
Intermittent Power Resources	**919.119**	**0.0**	**0.0**
Import Resources	**88.800**	**0.0**	**0.1**
Total Demand Resources	**2,871.265**	**97.4**	**0.0**
On-Peak	1,797.021	0.0	0.0
Seasonal Peak	421.082	0.0	0.0
Real-time Demand Response	509.820	88.9	0.0
Real-time Emergency Generators	143.342	88.8	0.0

Notes:

- Generator EFORd is calculated as a 5-year average of the latest ISO submitted NERC GADS data
- Intermittent Power Resources are assumed as 100% available since their outage history is incorporated in their ratings
- Imports are modeled with historical tie line availability factors and deratings for firm capacity contracts
- FOR (for Demand Resources) is an assumed Forced Outage Rate based on historical performance of Demand Resources in summer & winter 2010 - 2014
- Representative ICR Values have the retirement of the Pilgrim Nuclear generator reflected in the calculation

TSA Requirements Unavailability Assumptions – Based on FCA10 TSA Requirement Calculation

- Resource Unavailability Assumptions
  - Regular Generation Resources* - Weighted average EFORd
    - SENE sub-area: 10%
  - Peaking Generation Resources - Operational de-rating factor: 20%
  - Passive Demand Resources: 0%
  - Non-RTEG Active Demand Resources - De-rating based on performance factors
    - Boston sub-area: 17%
    - SEMA sub-area: 23%
    - RI sub-area: 17%
  - Real-Time Emergency Generation - De-rating based on performance factors
    - Boston sub-area: 10%
    - SEMA sub-area: 17%
    - RI sub-area: 9%

NOTE: All values have been rounded off to the nearest whole number

****Representative TSA values have the retirement of the Pilgrim Nuclear generator reflected in the calculation***

OP 4 Assumptions (MW)

- **Load Relief Available from 5% Summer Voltage Reduction (OP4 Actions 6 & 8)**

Year	Action 6 & 8 5% Voltage Reduction
2016/17	417
2017/18	424
2018/19	430
2019/20	442
2020/21	447
2021/22	452
2022/23	458
2023/24	463
2024/25	468

- Impact of implementing a 5% voltage reduction expressed as a percent of load is calculated using the ISO Operations value of 1.5%
- Calculated as [90-10 Peak Load Forecast] – [all Passive DR & Active DR] *1.5% with RTEG limited to 600 MW, if necessary

OP 4 Assumptions (MW)

- Tie Benefits

Year	Total	Québec - Phase II	Québec - Highgate	Maritimes	New York
2016/17	1,847	1,095	79	240	433
2017/18	1,870	1,068	83	492	227
2018/19	1,970	953	148	523	346
2019/20	1,990	975	142	519	354
2020/21	1,990	975	142	519	354
2021/22	1,990	975	142	519	354
2022/23	1,990	975	142	519	354
2023/24	1,990	975	142	519	354
2024/25	1,990	975	142	519	354

- Modeled with tie line availability assumptions

Summary of Resource and OP 4 Assumptions for 2016/17 - 2024/25 (MW)

Type of Resource/OP4 Action	2016/17 ARA3	2017/18 ARA2	2018/19 ARA1	2019/20 FCA10	2020/21	2021/22	2022/23	2023/24	2024/25
Generating Resources	29,854	28,995	30,004	29,735	29,058	29,058	29,058	29,058	29,058
Intermittent Power Resources	949	949	949	919	919	919	919	919	919
Demand Resources	3,245	3,245	3,245	2,871	2,871	2,871	2,871	2,871	2,871
Import Resources	1,853	1,830	1,730	89	89	89	89	89	89
Export Delist & Import Derating	-	-	-	(130)	(130)	(130)	(130)	(130)	(130)
OP 4 Voltage Reduction (Actions 6 & 8)	417	424	430	442	447	452	458	463	468
Minimum Operating Reserve	(200)	(200)	(200)	(200)	(200)	(200)	(200)	(200)	(200)
Tie Benefits	1,847	1,870	1,970	1,990	1,990	1,990	1,990	1,990	1,990
HQICCs (Included in Tie Benefits)	1,095	1,068	953	975	975	975	975	975	975
Proxy Units	-	-	-	800	2,000	2,400	2,800	3,200	3,600
Total MW Modeled in ICR	**37,965**	**37,113**	**38,128**	**36,516**	**37,044**	**37,449**	**37,855**	**38,260**	**38,665**

Notes:

- 2016/17 – 2018/19 ICRs were calculated using with Existing Qualified resources for the 2016/17 ARA2. The 2017/18 ARA2 model also included the 674 Footprint generating resource and the retirement of Brayton Pt generating station. The 2018/19 ARA1 model includes Medway Peaker, CPV-Towantic and Wallingford 6&7.
- 2019/20 – 2024/25 ICR calculations used the Existing Qualified resources for the 2019/20 FCA. Generating resources for 2020/21 – 2024/25 have the Pilgrim Nuclear generator removed, reflecting its retirement.
- Intermittent Power Resources have both the summer and winter capacity values modeled
- OP 4 5% Voltage Reduction includes both Action 6 and Action 8 MW assumptions
- Minimum Operating Reserve of 200 MW is the minimum Operating Reserve requirement for transmission system security

Questions