



Draft 2019 ISO-NE Annual Energy and Summer Peak Forecast

Planning Advisory Committee

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LOAD FORECASTING



Objectives

- Discuss the 2019 draft energy, summer peak demand, energy efficiency, and photovoltaic forecasts for the region
- Discuss summer demand forecast performance issues identified this past summer
- Discuss modeling improvements implemented as part of this year's forecast and their impacts



Outline

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Introduction

Explanation of Gross and Net Forecasts

- The ISO annually develops 10-year forecasts of energy and demand that are published as part of the [Capacity, Energy, Loads, and Transmission \(CELT\) report](#);
- ISO first develops “gross” load forecasts that reflect a forecast of load without reductions from energy efficiency (EE) and behind-the-meter photovoltaic (BTM PV)
 - EE, BTM PV, and active demand resources are reconstituted into historical energy and demand used to estimate gross energy and demand models
- Net energy and demand forecasts are developed by subtracting EE and BTM PV from the gross forecasts
 - Active demand resources are reconstituted into historical energy and demand
 - Net energy and demand forecasts reflect the 2019 EE and BTM PV forecasts
- All forecasts described herein are draft and subject to change prior to publication in the 2019 CELT

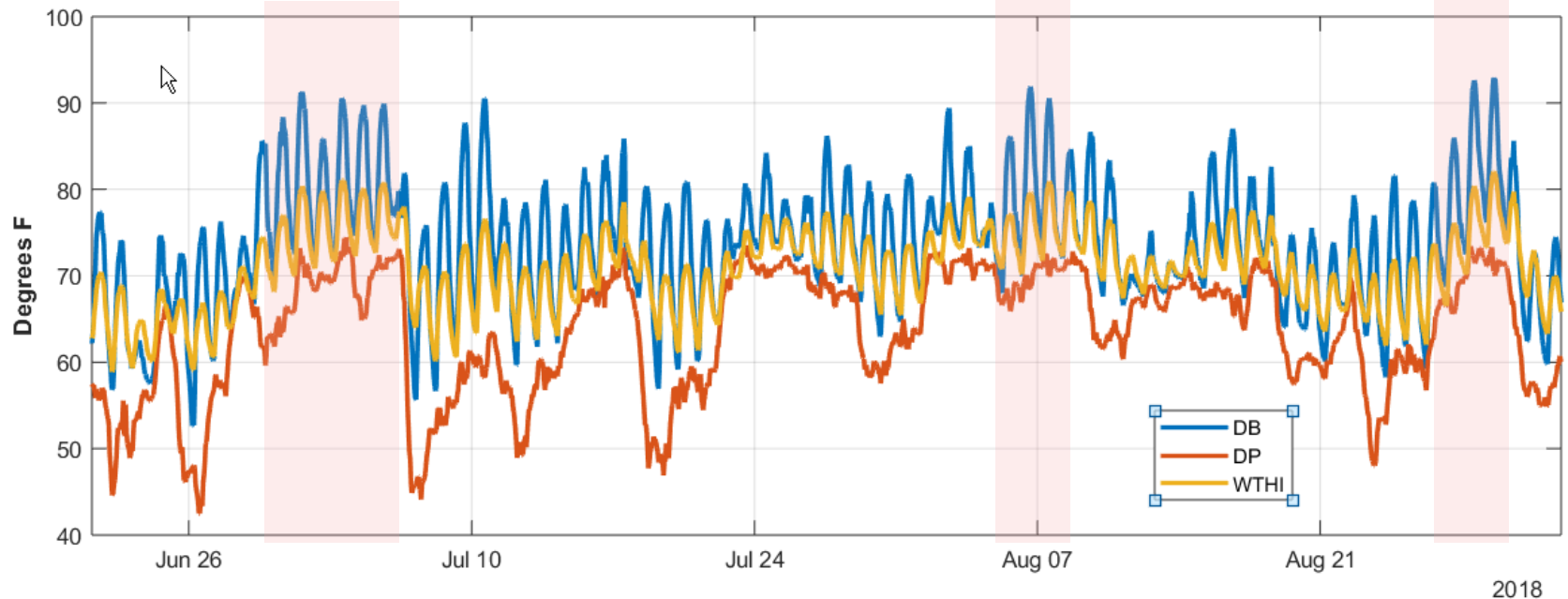


2018 SUMMER PEAK SEASON FORECAST PERFORMANCE

New England

2018 Summer Weather

- Several periods of consecutive extreme weather days occurred during this past summer and provided an opportunity to better understand the current regional peak load response
 - July 1-6 (impacted by the July 4th holiday, which occurred on a Wednesday)
 - August 5-7
 - August 27-29
- Plot below illustrates 8-city weighted dry bulb temperature (DB), dew point temperature (DP) and three-day weighted temperature-humidity index (WTHI)



2018 Summer Peak Demand

Forecast and Actual

Peak Day*	Type	Day of Week	Gross Peak	Net Peak	Peak Hour Gross (Net)	WTHI @ Gross Peak	BTM PV Peak Reduction**
CELT2018 90/10	Forecast	-	31,451	28,119	-	82.0	633
CELT2018 50/50	Forecast	-	29,060	25,728	-	79.9	633
8/29/2018	Actual	Wed	29,898	26,024	15 (17)	82.0	915
8/28/2018	Actual	Tue	29,133	25,600	16 (18)	80.4	574
8/7/2018	Actual	Tue	28,952	24,938	15 (16)	80.9	1,055
8/6/2018	Actual	Mon	28,527	25,049	17 (18)	79.6	518
8/2/2018	Actual	Wed	27,874	24,071	15 (17)	78.1	844

Notes:

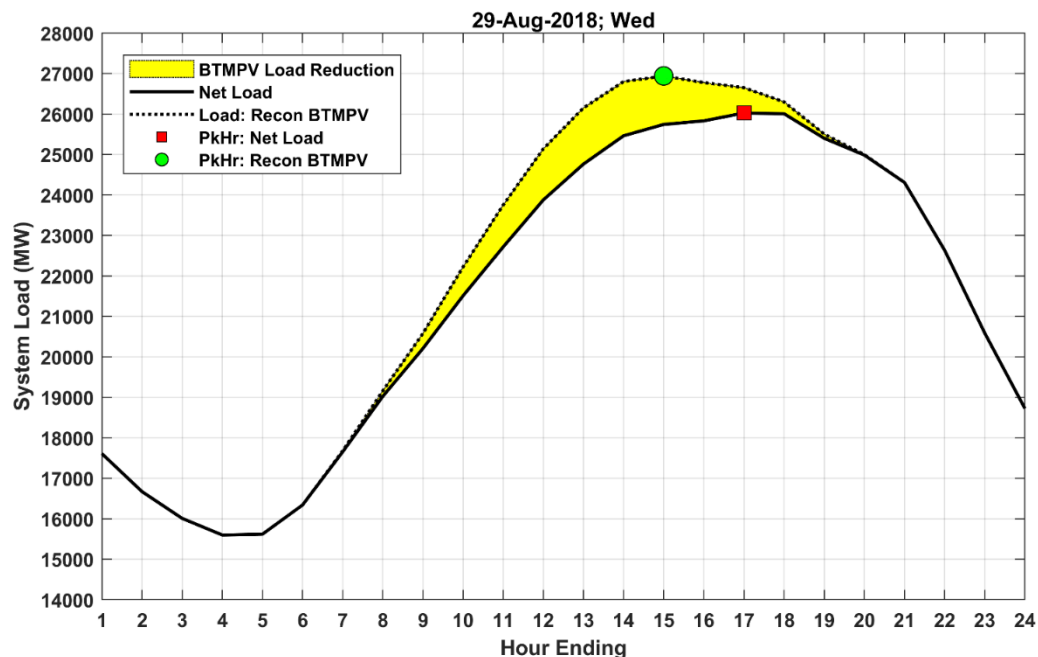
* Peak days during week of July 4th were removed due to holiday effects

** Calculation of BTM PV peak reduction values illustrated on next slide

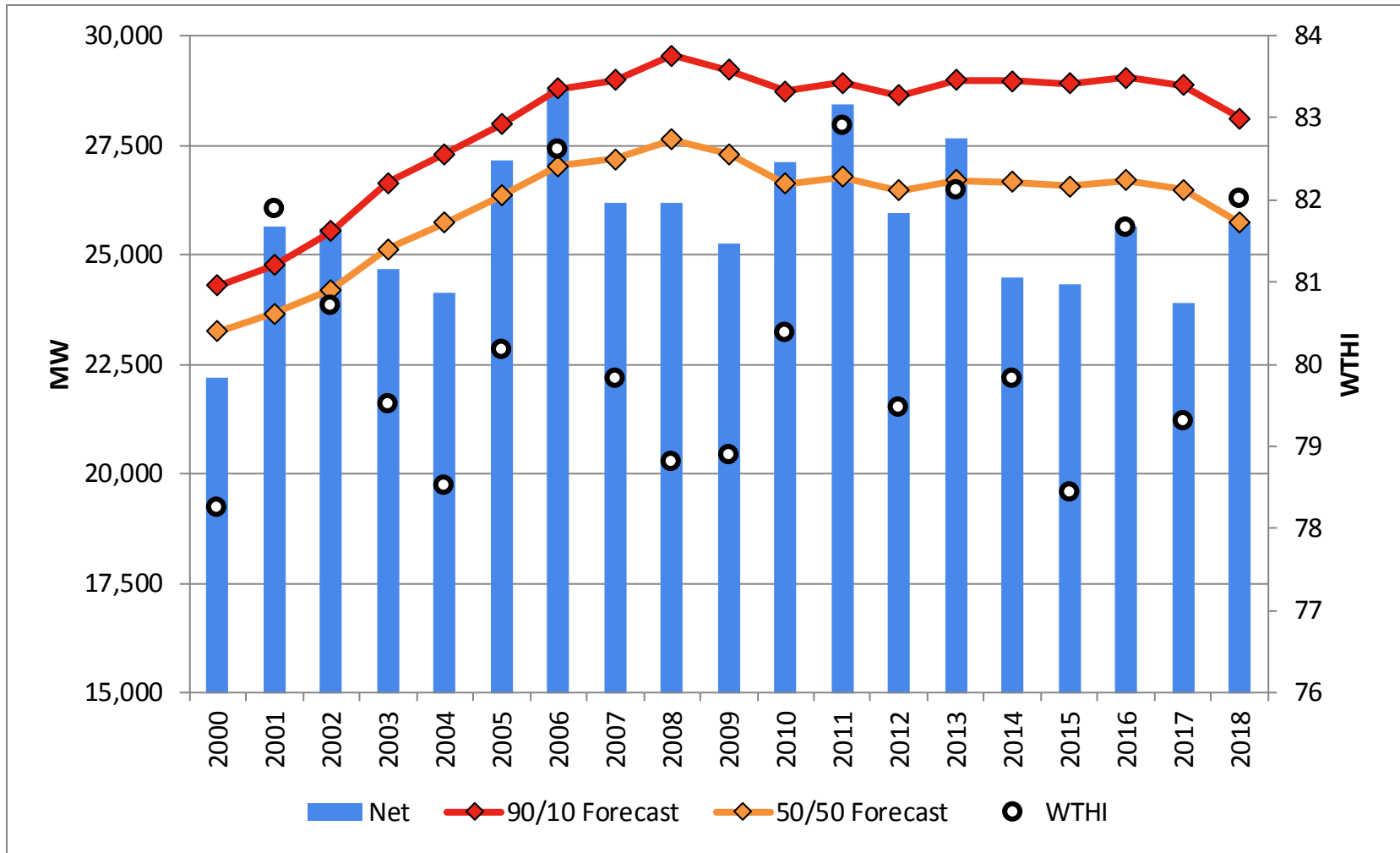
Example of BTM PV Impact on Summer Peak Day

August 29, 2018

- The figure below illustrates the calculation of BTM PV peak load reductions (tabulated on slide 6) for the summer peak day, August 29, 2018
 - BTM PV peak reduction is the difference between the peak after BTM PV is reconstituted (green circle) and the peak net of BTM PV (red square)



ISO-NE Net Summer Peaks and Weather



FORECAST MODELING CHANGES

Model Changes in CELT 2019 Forecast

- Gross Energy Modeling
 - Separate monthly energy models were developed instead of annual models to better capture shifts in seasonal trends
- Summer Gross Demand Modeling
 - As part of ISO's efforts to address the demand forecast performance issues identified this past summer, the following changes were implemented:
 1. **Model Specification** – Incorporated a second weather variable, cooling degree days (CDD), in addition to WTHI
 2. **Model Estimation Period** – Daily peak load and weather for the historical period covering 2004-2018 (2003-2017 used last year)
 3. **Weather History** – Historical weather period used to generate probabilistic forecast shortened from 40 years to 25 years
 - New 25-year period covers 1991-2015 (1975-2014 used last year)

Categorization of Forecast Changes

ISO-NE Summer Demand

- Changes reflected in the 2019 summer demand forecast relative to the 2018 CELT can be divided into the following categories:
 1. Gross load forecast changes:
 - a) Updated macroeconomic forecast from Moody's
 - b) Updated model estimation period
 - c) New model specification
 - d) New weather history
 2. Changes to the BTM PV forecast
 3. Changes to the EE forecast

2019 CELT Forecast Highlights

Changes Relative to 2018 CELT Forecast

- Macroeconomic outlook forecasts slightly stronger economic growth in New England relative to last year's forecast
- Gross forecasts
 - Annual energy is approximately 3.0% higher in 2027
 - Summer 50/50 is approximately 1.8% lower in 2027
 - Summer 90/10 is approximately 3.2% lower in 2027
- BTM PV forecast is approximately 1.0% lower in 2027
- EE forecast is relatively unchanged in 2027
- Net forecasts
 - Annual energy forecast is approximately 4.6% higher in 2027
 - Summer 50/50 forecast is approximately 2.3% lower in 2027
 - Summer 90/10 forecast is approximately 3.9% lower in 2027

Impact of Summer Peak Demand Model Changes

New England

- The 2019 summer peak demand model performs much better than last year's model
 - A comparison of *out-of-sample* mean absolute percent error (MAPE) during 2018 summer (July/August, non-holiday) days is tabulated
- Approximate attribution of decrease in the summer gross demand forecast to model changes is as follows:
 1. **Model Specification** – 80% of decrease
 2. **Model Estimation Period** – 20% of decrease
 3. **Weather History** – negligible impact

Model Performance, MAPE (%)

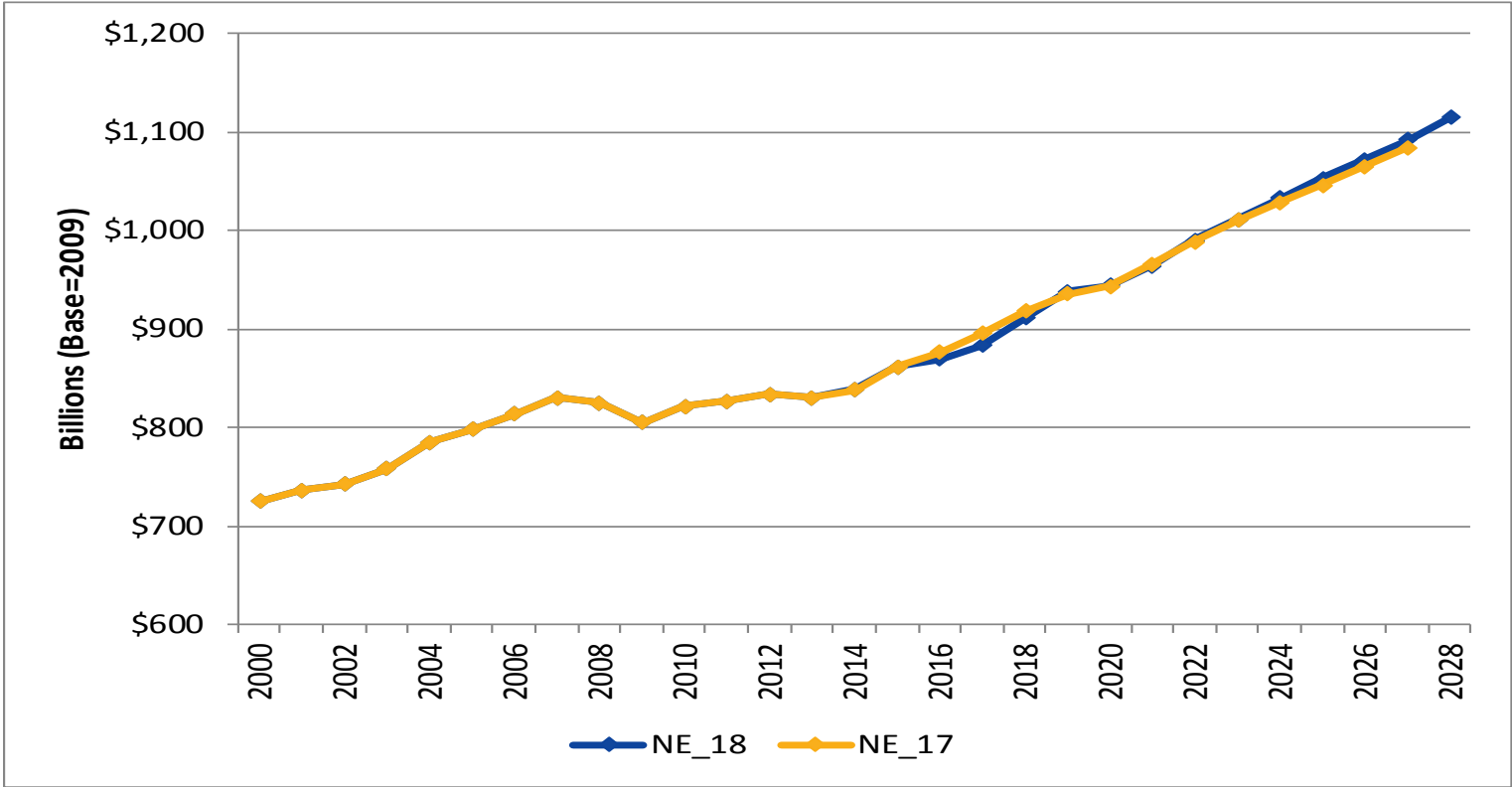
Model	All Non-Holiday Weekdays (42 days)	Highest 10 Demand Days
CELT 2018	3.4%	4.0%
CELT 2019	2.2%	1.5%

2019 ANNUAL ENERGY FORECAST

New England

Regional Macroeconomic Forecast—Moody’s Analytics

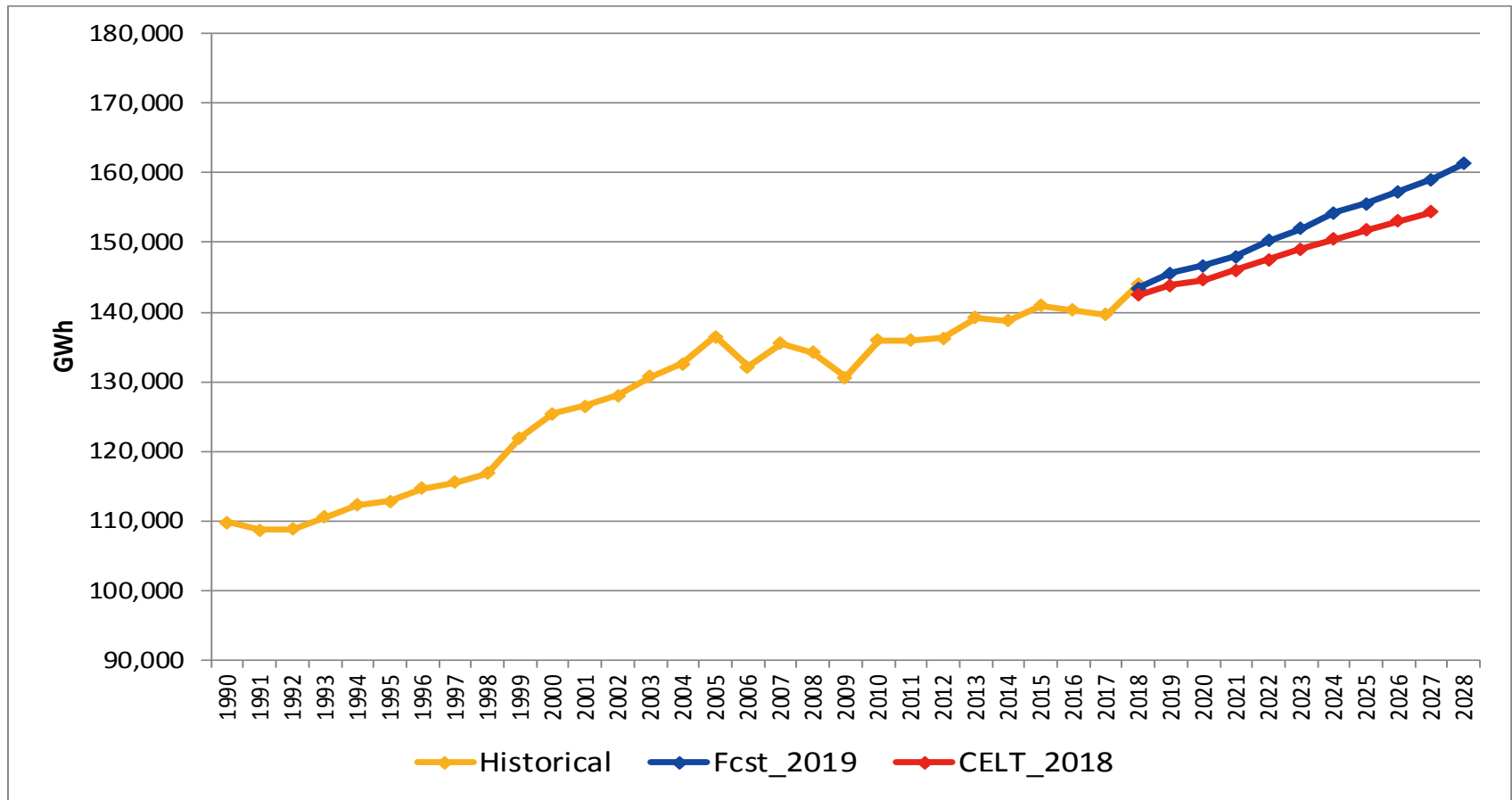
New England Gross Regional Product



Compound Annual Growth Rate (CAGR) forecast from 2018 thru 2027 of 2.03% slightly stronger than last year’s forecast of 1.86%. National CAGR forecast is 2.04%

2019 New England Gross Energy Forecast

Net + EE + BTM PV

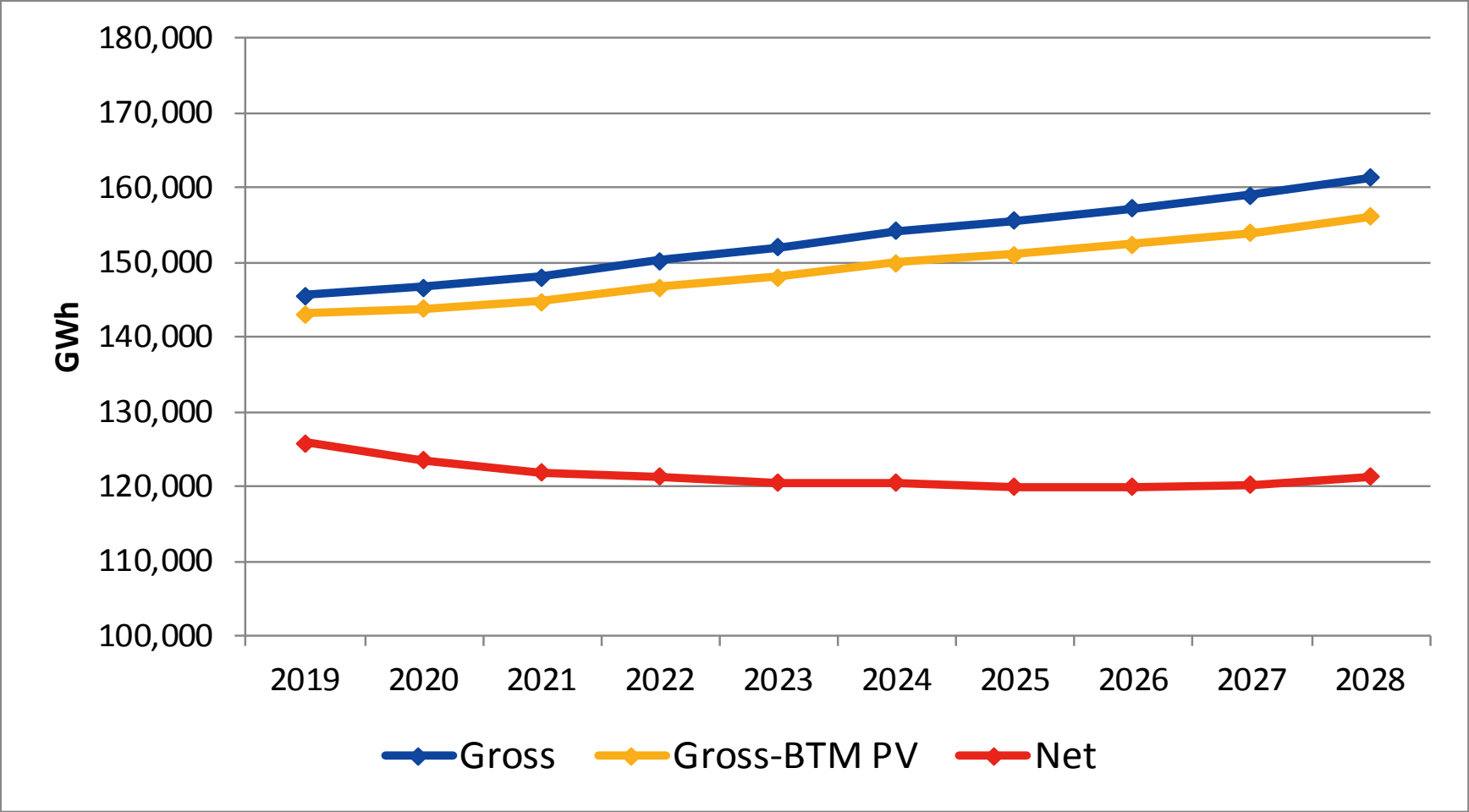


2019 (+1.2%, 1,790 GWh)

2023 (+2.0%, +2,916 GWh)

2027 (+3.0%, +4,635 GWh)

2019 New England Energy Forecast



Forecast Comparison: Annual Energy

Draft 2019 CELT (GWh)				
Year	Gross	BTM PV	EE	Net
2019	145,610	2,490	17,296	125,825
2020	146,650	2,849	20,240	123,561
2021	148,011	3,213	22,922	121,876
2022	150,201	3,549	25,363	121,288
2023	152,016	3,884	27,556	120,576
2024	154,243	4,210	29,488	120,545
2025	155,571	4,483	31,163	119,925
2026	157,253	4,749	32,587	119,917
2027	158,999	4,996	33,775	120,227
2028	161,312	5,222	34,753	121,337

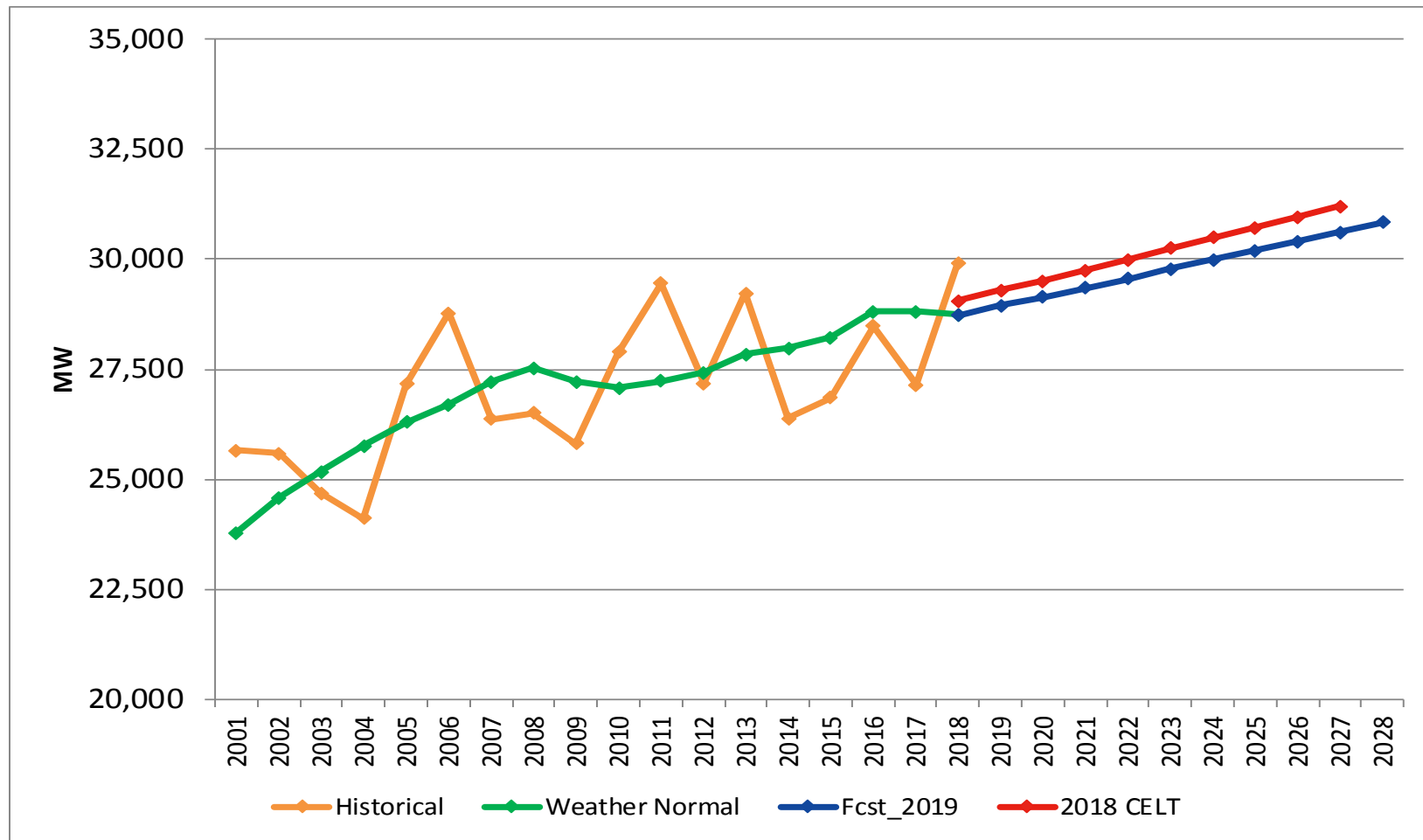
2018 CELT (GWh)			
Gross	BTM PV	EE	Net
143,820	2,558	18,764	122,498
144,634	2,906	21,332	120,395
146,009	3,233	23,827	118,949
147,538	3,540	26,128	117,870
149,100	3,834	28,228	117,039
150,485	4,115	30,121	116,249
151,766	4,361	31,811	115,594
153,072	4,575	33,302	115,196
154,364	4,783	34,601	114,981

Change (GWh)			
Gross Forecast	BTM PV	EE	Net
1,790	-68	-1,468	3,327
2,016	-57	-1,092	3,166
2,002	-20	-905	2,927
2,663	10	-765	3,418
2,916	51	-672	3,538
3,758	94	-633	4,296
3,805	122	-648	4,331
4,181	174	-715	4,721
4,635	214	-825	5,246

2019 GROSS SUMMER DEMAND FORECASTS

2019 New England Gross 50/50 Summer Peak Forecast

Net + EE + BTM PV



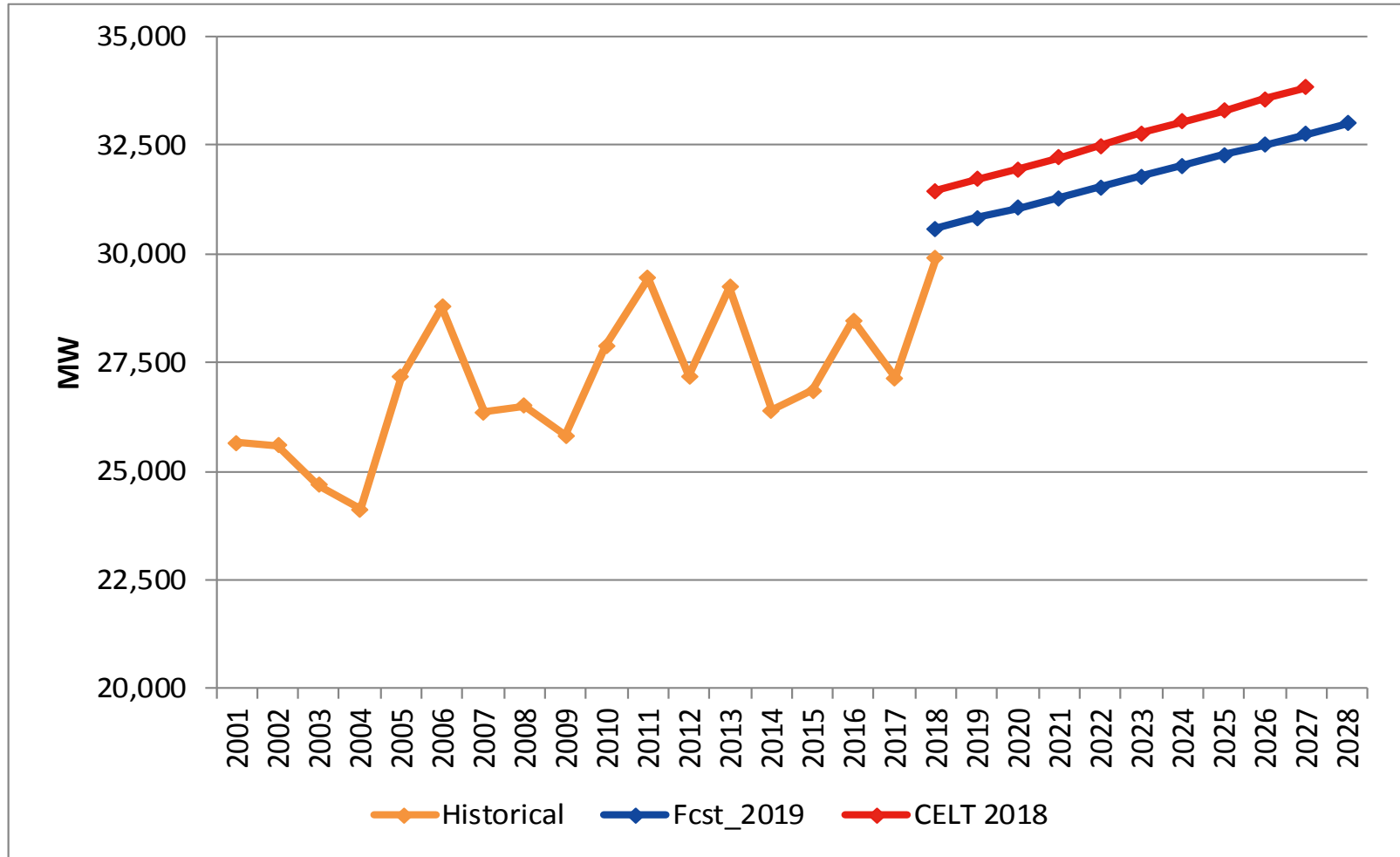
2019 (-1.2%, -355 MW)

2023 (-1.6%, -471 MW)

2027 (-1.8%, -576 MW)

2019 New England Gross 90/10 Summer Peak Forecast

Net + EE + BTM PV



2019 (-2.8%, -884 MW)

2023 (-3.0%, -987 MW)

2027 (-3.2%, -1.075 MW)

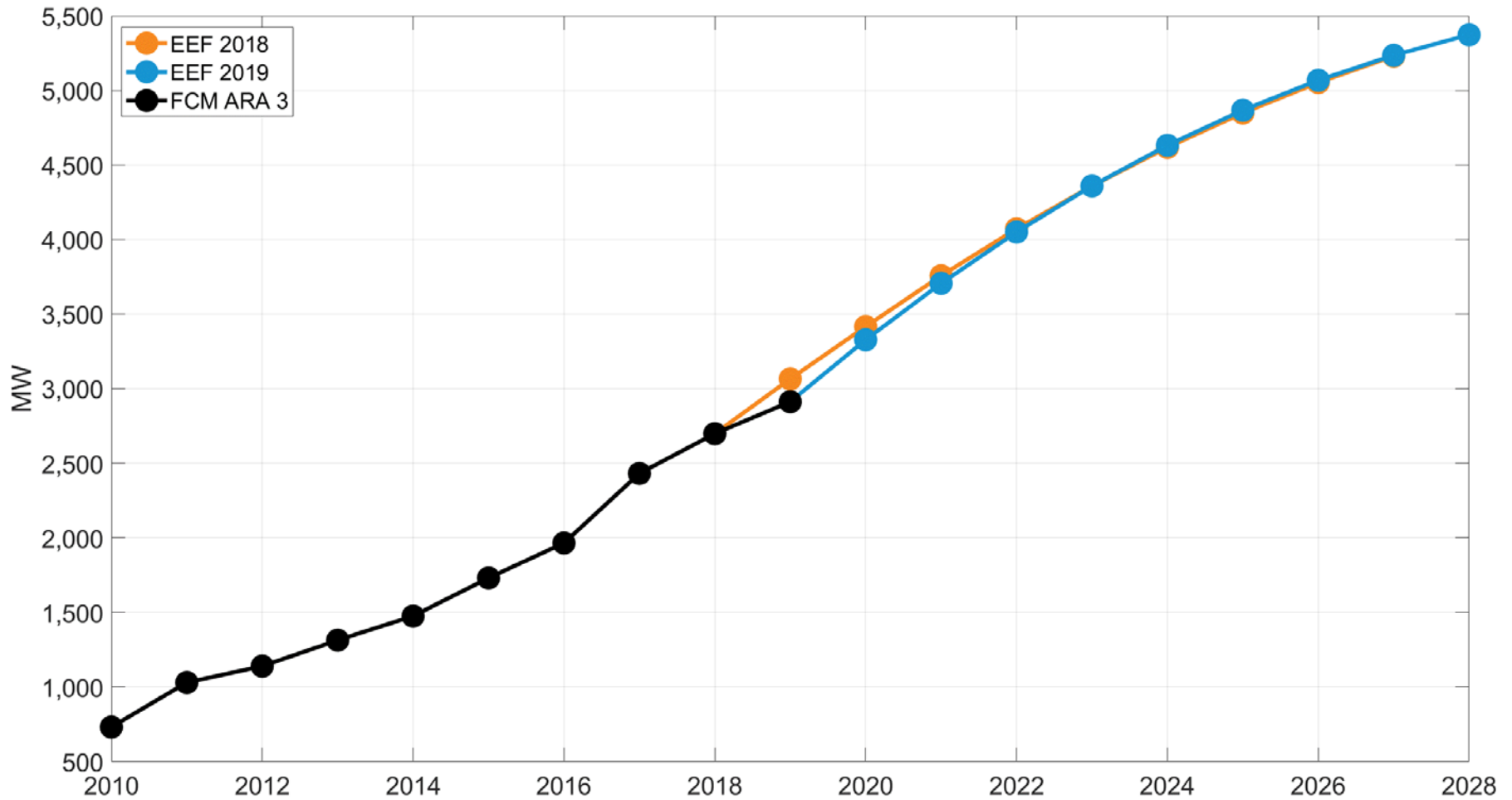
2019 ENERGY EFFICIENCY FORECAST

EE Forecast Model General Assumptions

- Annual EE budgets provided by the Commissions or representatives on their behalf are used in the model and held constant in years after the latest approved budget
- Peak-to-energy ratios are derived from a three-year average of recent performance and held constant through the forecast period
- Production cost baselines are derived from a three-year average of recent performance
- Production costs escalated at a 2% graduated rate that begins in the first year of the forecast
- Inflation rate was set at 2.5% per year
- The 2018 CELT energy forecast is used in conjunction with System Benefit Charges (SBC) to forecast SBC dollars

Summer Peak EE Forecast

New England



Energy and Summer Peak EE Forecast

New England

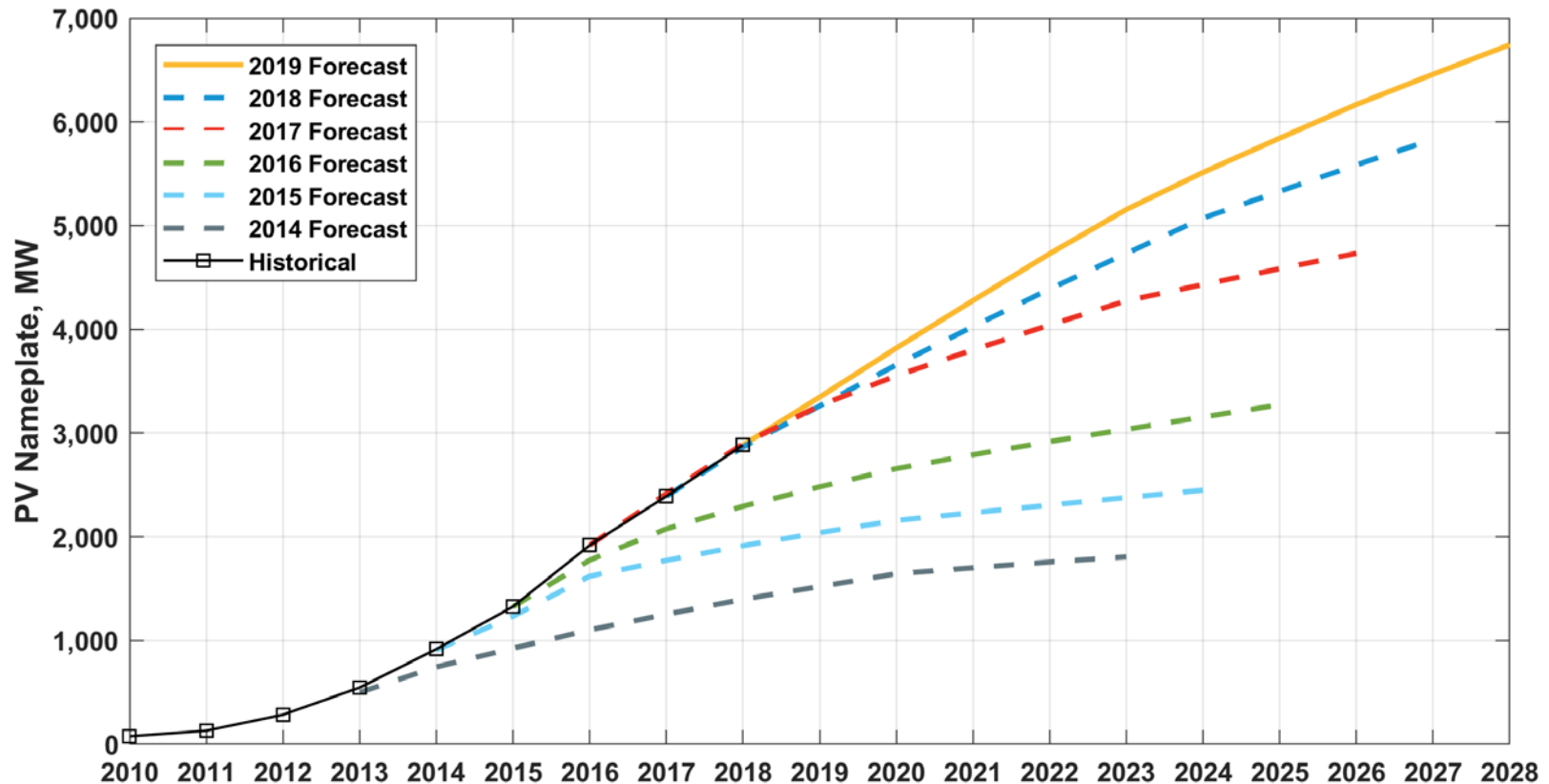
Energy Savings (GWh)								
	New England	MA	CT	ME	RI	VT	NH	
2020	2,944	1,792	454	151	256	147	144	
2021	2,682	1,626	412	139	236	138	130	
2022	2,441	1,474	370	127	225	127	118	
2023	2,193	1,323	333	113	204	114	107	
2024	1,933	1,166	293	98	180	101	94	
2025	1,675	1,008	254	84	157	90	82	
2026	1,424	856	215	71	134	77	70	
2027	1,189	715	180	59	112	64	58	
2028	977	586	147	48	93	55	48	
Total 2020-2028	17,457	10,547	2,658	891	1,597	914	850	
Average	1,940	1,172	295	99	177	102	94	
Demand Savings (MW)								
	New England	MA	CT	ME	RI	VT	NH	
2020	415	255	65	25	34	16	20	
2021	378	231	59	23	31	15	18	
2022	344	210	53	21	30	14	17	
2023	309	188	48	18	27	13	15	
2024	272	166	42	16	24	11	13	
2025	236	143	37	14	21	10	11	
2026	200	122	31	12	18	9	10	
2027	167	102	26	10	15	7	8	
2028	138	83	21	8	12	6	7	
Total 2020-2028	2,460	1,500	383	146	210	101	120	
Average	273	167	43	16	23	11	13	

2019 PV FORECAST

Introduction

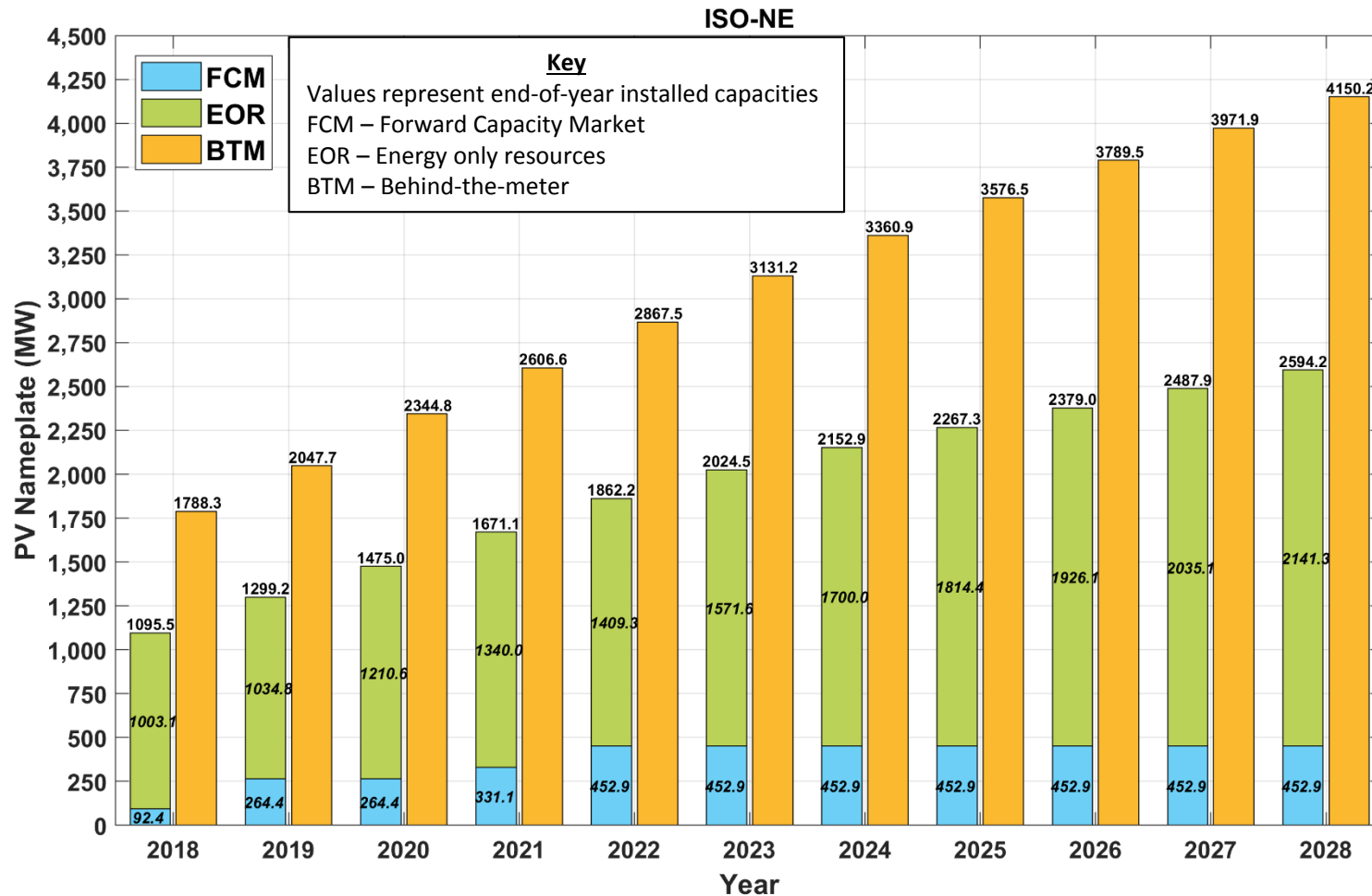
- The majority of state-sponsored distributed PV (i.e., < 5 MW nameplate capacity) does not participate in wholesale markets, but reduces the system load observed by ISO
 - The annual PV forecast supports the development of an accurate net load forecast
- The 2019 PV forecast reflects:
 - Updated PV installation data provided by Distribution Owners
 - Updated information from the New England states about PV policy drivers
 - Accounting for PV that is expected to participate in wholesale markets
 - Assumed impacts of PV panel degradation over the forecast horizon
 - Discount factors intended to capture uncertainty in the forecast
- Relative to the 2018 forecast, the 2019:
 - Total nameplate PV forecast is approximately 10.7% higher in 2027
 - BTM PV nameplate forecast is approximately 5.5% higher in 2027
 - BTM PV summer peak load reductions are approximately 1% lower in 2027
- Additional details about the 2019 PV forecast are available at:
 - https://www.iso-ne.com/static-assets/documents/2019/03/3_final-pv-forecast-2019-mar19.pdf

PV Growth: Reported Historical vs. Forecast



Classification of 2019 ISO-NE PV Forecast

Cumulative Nameplate, MW_{ac}



2019 BTM PV Forecast

July 1st Cumulative Estimated Summer Peak Load Reductions

States	Estimated Summer Peak Load Reductions - BTM PV (MW)									
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
CT	172.8	180.0	204.6	227.9	245.3	256.8	267.9	278.0	284.1	285.1
MA	345.0	392.0	422.8	446.5	468.2	485.8	495.4	501.3	505.7	509.1
ME	16.1	17.3	19.0	20.4	21.7	22.8	23.9	24.9	25.9	26.7
NH	31.1	34.1	36.7	38.3	39.4	41.2	42.9	44.5	45.9	47.3
RI	23.3	29.3	32.1	31.3	33.3	37.1	40.7	44.0	47.0	49.8
VT	119.3	124.3	126.4	127.0	127.3	128.4	129.7	130.8	131.7	132.6
Regional - Cumulative Peak Load Reductions (MW)	707.6	777.2	841.6	891.4	935.2	972.1	1000.5	1023.5	1040.3	1050.6
% of BTM AC Nameplate	35.2%	33.9%	32.5%	31.2%	29.9%	28.8%	27.8%	26.8%	25.9%	25.1%

Notes:

- (1) Forecast values are for BTM PV only
- (2) Values include the effect of diminishing PV production as increasing PV penetrations shift the timing of peaks later in the day
- (3) Values include the effects of an assumed 0.5%/year PV panel degradation rate
- (4) All values represent anticipated July 1st installed PV, and are grossed up by 8% to reflect avoided transmission and distribution losses
- (5) Different planning studies may use values different than these estimated peak load reductions based on the intent of the study

2019 NET SUMMER DEMAND FORECASTS

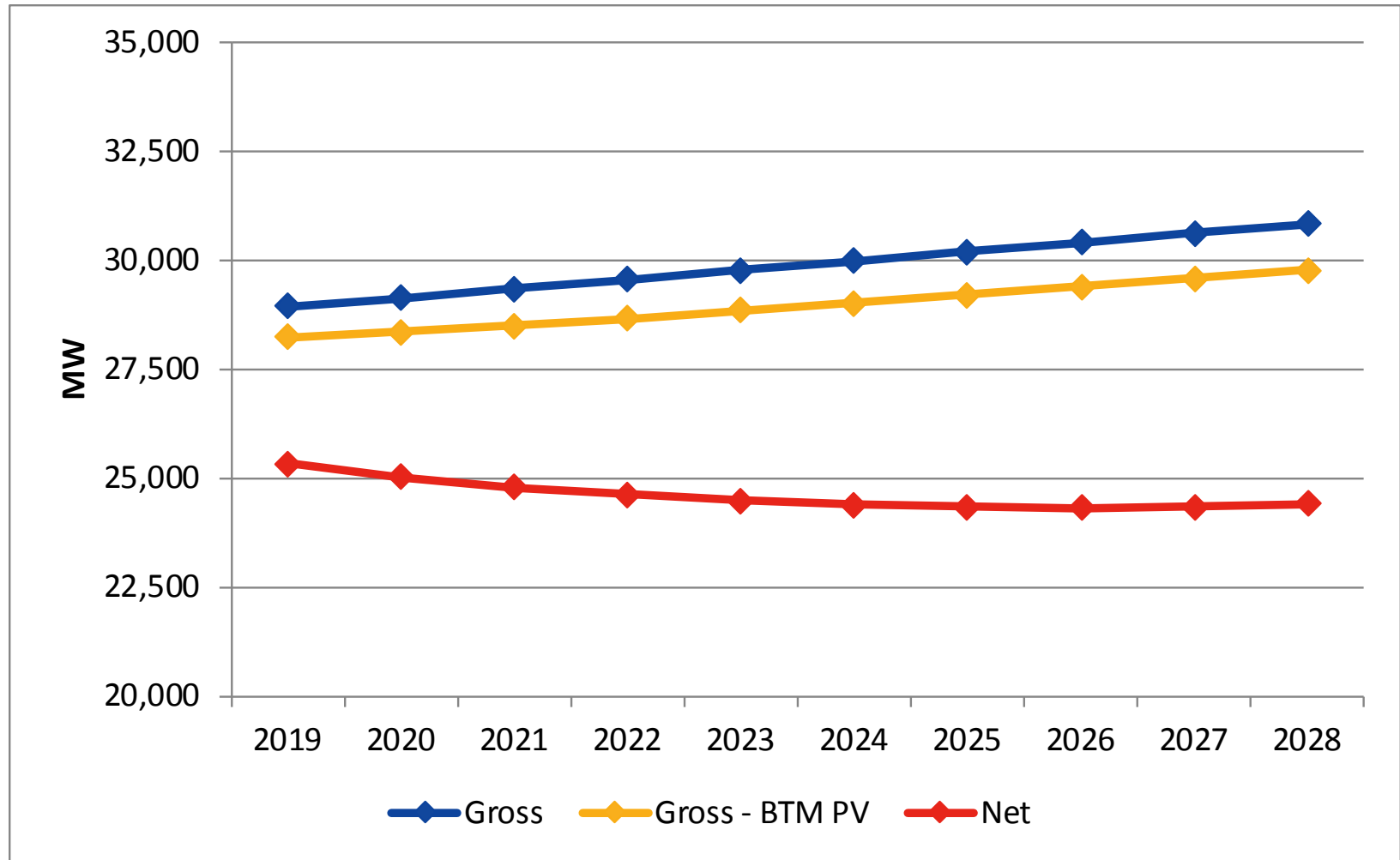
Draft 2019 CELT New England Summer Peak Forecast

Gross Peak and Net Peak with BTM PV and EE

Forecast 2019 (MW)						
Year	Gross 50/50	Gross 90/10	BTM PV	EE	Net 50/50	Net 90/10
2019	28,943	30,832	708	2,913	25,323	27,212
2020	29,130	31,050	777	3,328	25,025	26,945
2021	29,341	31,291	842	3,706	24,793	26,744
2022	29,561	31,543	891	4,050	24,620	26,602
2023	29,774	31,786	935	4,359	24,479	26,492
2024	29,987	32,030	972	4,631	24,383	26,427
2025	30,196	32,271	1,001	4,867	24,329	26,404
2026	30,406	32,512	1,024	5,068	24,315	26,421
2027	30,616	32,753	1,040	5,235	24,341	26,478
2028	30,831	32,999	1,051	5,372	24,408	26,576
CAGR	0.70%	0.76%	4.49%	7.04%	-0.41%	-0.26%



2019 New England 50/50 Summer Peak Forecast



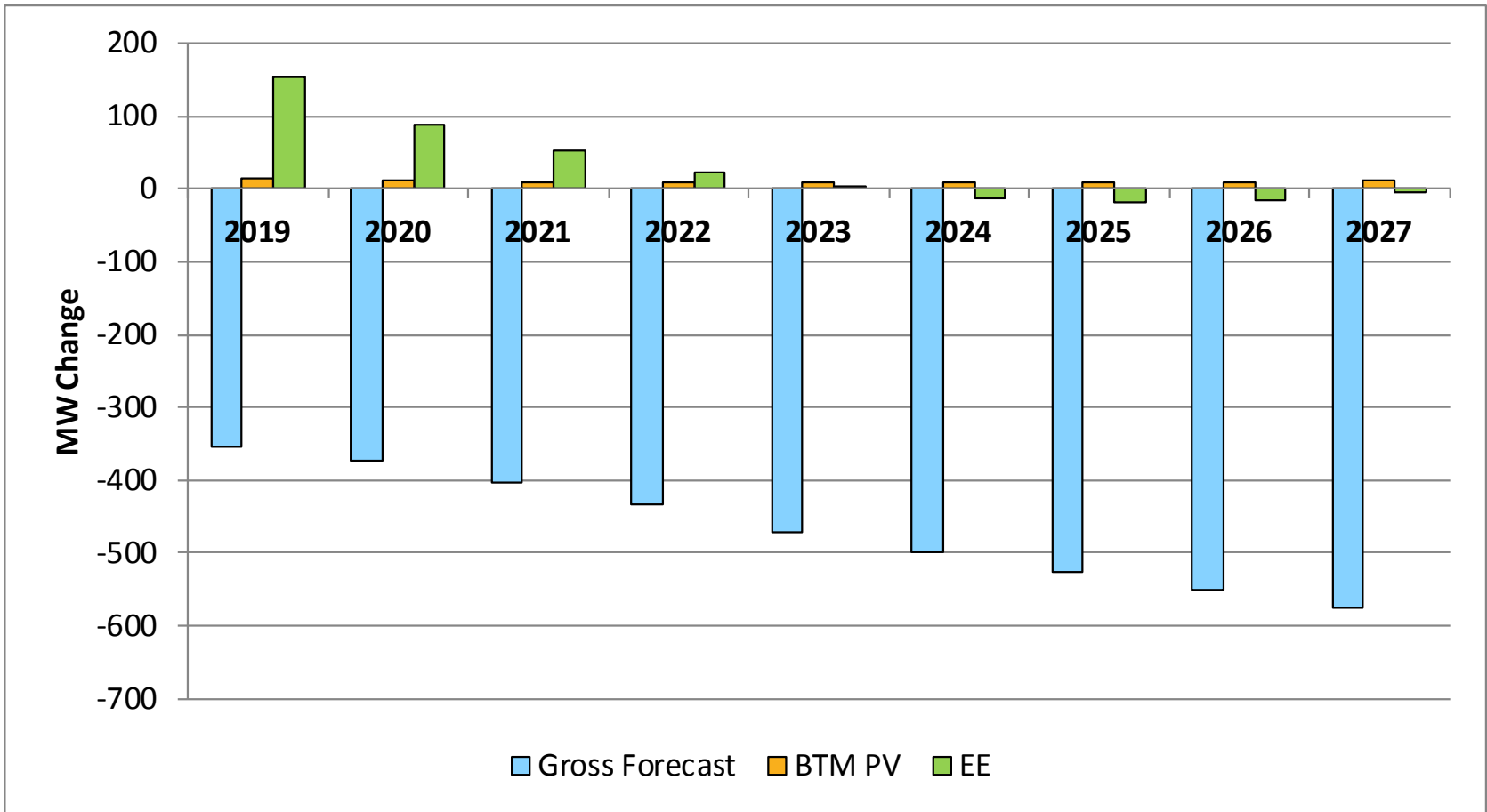
Forecast Comparison Table: Summer Peak

Draft 2019 CELT and 2018 CELT

	Net 50/50 Summer Peak				Net 90/10 Summer Peak			
	Fcst 2019	2018 CELT	Change	% Change	Fcst 2019	2018 CELT	Change	% Change
2019	25,323	25,511	-188	-0.7%	27,212	27,929	-717	-2.6%
2020	25,025	25,298	-273	-1.1%	26,945	27,744	-799	-2.9%
2021	24,793	25,136	-343	-1.4%	26,744	27,609	-865	-3.1%
2022	24,620	25,021	-401	-1.6%	26,602	27,521	-919	-3.3%
2023	24,479	24,941	-462	-1.9%	26,492	27,469	-977	-3.6%
2024	24,383	24,889	-506	-2.0%	26,427	27,444	-1,017	-3.7%
2025	24,329	24,864	-535	-2.2%	26,404	27,446	-1,042	-3.8%
2026	24,315	24,874	-559	-2.2%	26,421	27,483	-1,062	-3.9%
2027	24,341	24,912	-571	-2.3%	26,478	27,548	-1,070	-3.9%
2028	24,408				26,576			

Forecast Impact on Net 50/50 Summer Peak by Category

Change from 2018 CELT



NEXT STEPS

Next Steps

- Next LFC meeting is March 29, 2019
 - Final draft summer peak forecast will be discussed along with draft winter peak forecast
- PAC presentation on April 25, 2019
 - Discuss winter peak demand forecast and sub-regional forecasts
- The final forecasts will be published as part of the 2019 CELT by May 1st

Questions

