



Draft 2020 Photovoltaic (PV) Forecast

*Distributed Generation Forecast Working
Group*

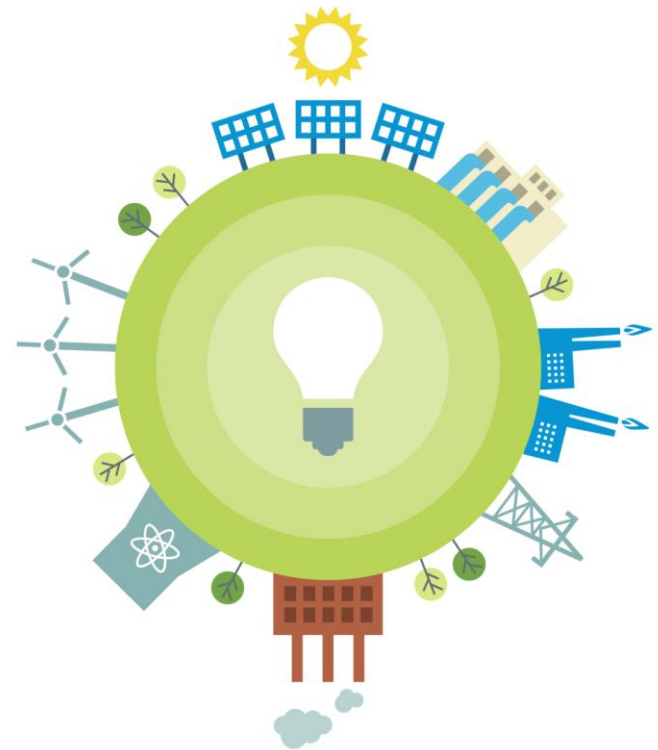
Jon Black

MANAGER, LOAD FORECASTING



Outline

- Introduction and Background
- 2019 PV Growth: Forecast vs. Reported
- Forecast Assumptions and Inputs
- Draft 2020 PV Forecast - Nameplate
- Next Steps for the 2020 Capacity, Energy, Loads, and Transmission (CELT) Forecast



INTRODUCTION & BACKGROUND



Introduction

- The majority of state-sponsored distributed PV does not participate in wholesale markets, but reduces the system load observed by ISO
- The long-term PV forecast helps the ISO determine future system load characteristics that are important for the reliable planning and operation of the system
- To properly account for PV in long-term planning, the finalized PV forecast will be categorized as follows:
 1. PV as a capacity resource in the Forward Capacity Market (FCM)
 2. Non-FCM Energy Only Resources (EOR) and Generators
 3. Behind-the-meter PV (BTM PV)

Similar to energy efficiency (EE), behind-the-meter PV is reconstituted into historical loads*

The 2020 gross load forecast reflects loads without PV load reductions

**Existing BTM PV decreases the historical metered loads, which are an input to the gross load forecast*



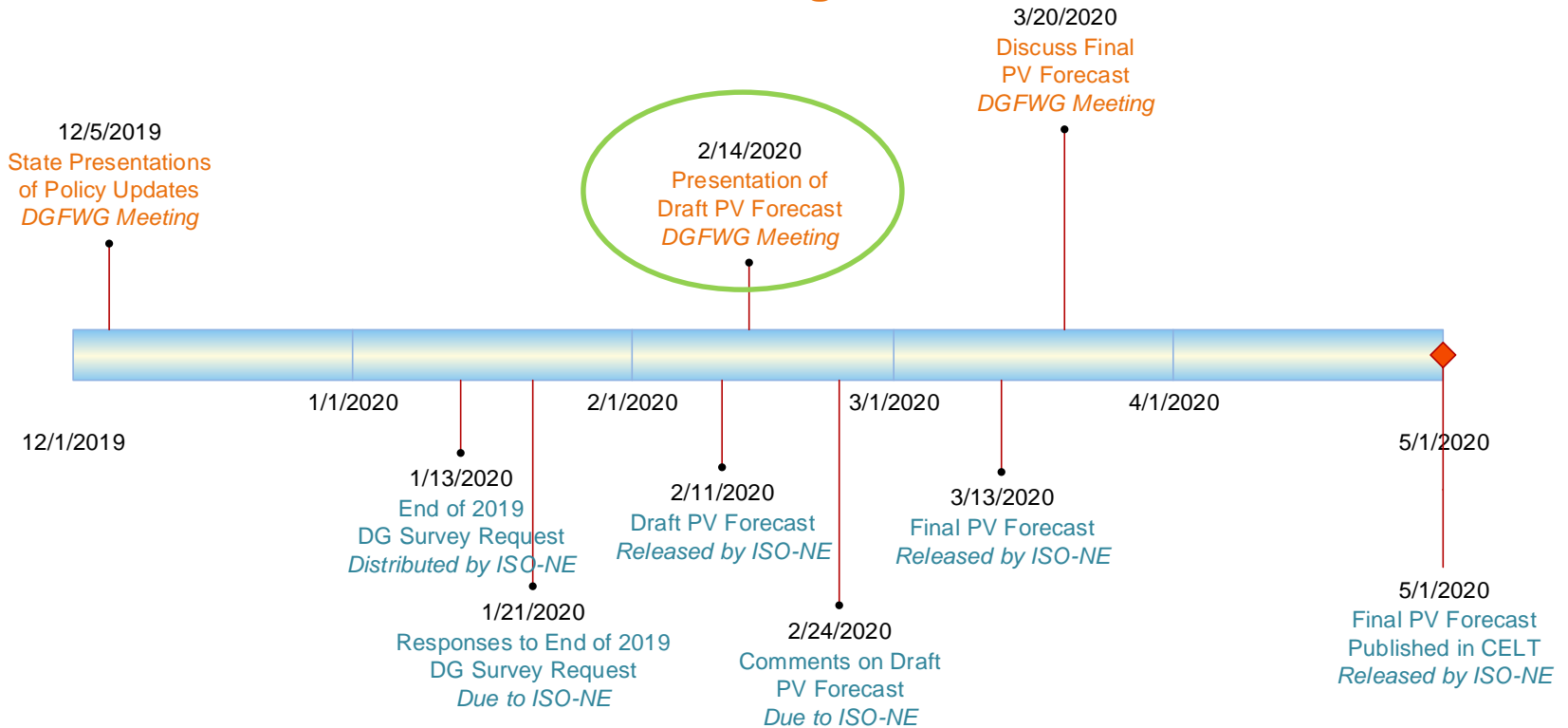
Background: PV Forecast Focuses on DG

- The focus of the DGFWG is distributed generation projects:
 - “...defined as those that are typically 5 MW or less in nameplate capacity and are interconnected to the distribution system (typically 69 kV or below) according to state-jurisdictional interconnection standards.”
- Therefore, the forecast does not consider policy drivers supporting larger-scale projects (i.e., those >5 MW)
 - E.g., projects planned as part of the three-state Clean Energy RFP
- Large projects are generally accounted for as part of ISO’s interconnection process and participate in wholesale markets



2020 PV Forecast Schedule

Meetings



Milestones



The PV Forecast Incorporates State Public Policies and Is Based on Historical Data

- The PV forecast process is informed by ISO analysis and input from state regulators and other stakeholders through the Distributed Generation Forecast Working Group (DGFWG)
- The PV forecast methodology is straightforward, intuitive, and rational
- The forecast is meant to be a reasonable projection of the anticipated growth of out-of-market, distributed PV resources to be used in ISO's System Planning studies, consistent with its role to ensure prudent planning assumptions for the bulk power system
- The forecast reflects and incorporates state policies and the ISO does not explicitly forecast the expansion of existing state policies or the development of future state policy programs



Forecast Focuses on State Policies in All Six New England States



- A policy-based forecasting approach has been chosen to reflect the observation that trends in distributed PV development are in large part the result of policy programs developed and implemented by the New England states
- The ISO makes no judgment regarding state policies, but rather utilizes the state goals as a means of informing the forecast
- In an attempt to control related ratepayer costs, states often factor anticipated changes in market conditions directly into policy design, which are therefore implicit to ISO's policy considerations in the development of the forecast



Many Factors Influence the Future Commercialization Potential of PV

Policy Drivers

- Feed-in-tariffs (FITs)/Long-term procurement
- State Renewable Portfolio Standards (RPS) programs
- Net energy metering (NEM) and retail rate structure
- Federal investment tax credit (ITC) and federal depreciation
- Federal trade policy

Other Drivers

- Role of private investment in PV development
- Future equipment and installation costs
- Future wholesale and retail electricity costs
- Interconnection costs and issues



Summary: Draft CELT 2020 PV Forecast

- The 2020 forecast reflects:
 - PV development trends in the region
 - Discussions with stakeholders and data exchange with the New England states and Distribution Owners
- According to data provided by Distribution Owners, approximately 548 MW of PV development occurred in 2019, totaling about 3,433 MW installed across the region
 - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- Approximately 4,293 MW of PV development is projected from 2020 through 2029 for a total of 7,726 MW in 2029
 - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- In 2028, the draft 2020 PV nameplate forecast is 684 MW higher than the 2019 PV forecast due to the following considerations:
 - Increased policy support reflected in 2020 forecast (e.g., in Maine)
 - Greater than expected growth observed in 2019
 - Existence of significant PV development in the utilities' interconnection pipeline

Background and Forecast Review Process



- The draft 2020 forecast will be discussed today
- Stakeholders may provide written comments on the draft forecast by February 24, 2020 @ 5:00 p.m.
 - Please submit comments to DGFWGMatters@iso-ne.com
- The final PV forecast will be discussed at the March 20th DGFWG, and will be published in the 2020 CELT (Section 3):
 - See: <https://www.iso-ne.com/system-planning/system-plans-studies/celt/>

2019 PV GROWTH: FORECAST VS. REPORTED

2019 PV Growth

Total Nameplate Capacity

- Comparison of the state-by-state 2019 forecast PV growth and the growth for 2019 reported by utilities is tabulated below
 - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- Regionally, 2019 growth reported by utilities totaled 548.6 MW, which is more than 85 MW higher than the forecast growth
 - Results vary by state

State	2019 Reported Growth	2019 Forecast Growth	Difference
CT	102.2	68.4	33.8
MA	309.2	292.0	17.2
ME	14.9	7.1	7.8
NH	21.4	12.7	8.7
RI	43.1	51.3	-8.2
VT	57.8	31.5	26.3
Region	548.6	463.1	85.5

Larger-Scale PV

Projects >5 MW_{ac}

- Tabulated below is a summary of in-service, larger-scale (i.e., non-DG) PV projects included as part of Distribution Owner survey data responses
- These projects are not included in the PV forecast, and are excluded from installed PV totals reported herein

State	# Projects Listed	Total Nameplate (MW _{ac})
CT	3	66.4
MA	-	-
ME	1	9.9
NH	-	-
RI	8	60.25
VT	-	-
Total	12	136.55

FORECAST ASSUMPTIONS AND INPUTS



Federal Investment Tax Credit

- The federal residential and business Investment Tax Credit (ITC) is a key driver of PV development in New England
 - There are no changes to the ITC since the 2019 forecast
- For the business ITC only, [IRS provisions](#) allow project developers two methods of pre-qualifying for the ITC by meeting commence construction standards, as long as the project is placed in service before 1/1/2024:
 1. Physical Work Test: Continuing work of a significant nature
 2. Five Percent Safe Harbor: Having paid or incurred 5% or more of the total cost of the project

Residential ITC

Maximum Allowable Residential ITC	
Year	Credit
2019	30%
2020	26%
2021	22%
Future Years	0%

Business ITC

ITC by Date of Construction Start	
Year construction starts	Credit
2019	30%
2020	26%
2021	22%
2022	10%
Future Years	10%

Sources: <http://programs.dsireusa.org/system/program/detail/658> and <http://programs.dsireusa.org/system/program/detail/1235>

Massachusetts Forecast Assumptions

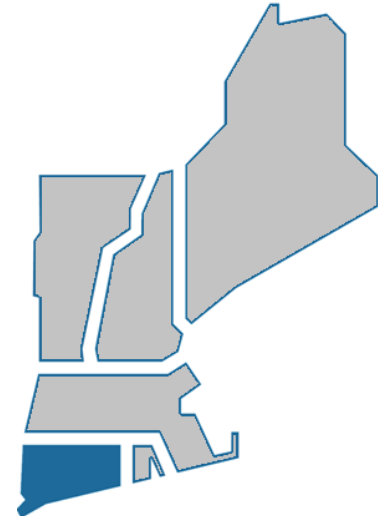


- [MA DPU's 12/5/19 DGFWDG presentation](#) serves as primary source for MA policy information
- MA Distribution Owners survey results:
 - 2,180.5 MW_{AC} installed by 12/31/19
- Solar Carve-Out Renewable Energy Certificate (SREC) program
 - A total of 2,412.5 MW_{DC} will be developed as part of SREC-I and SREC-II
 - 2,386.7 MW_{DC} installed by 12/31/19
 - Remaining 25.8 MW_{DC} will be installed in 2020 (21.5 MW_{AC} assuming an 83% AC-to-DC ratio)
- Solar Massachusetts Renewable Target (SMART) Program
 - Program 1,600 MW_{AC} goal achieved over the period 2019-2024 (5 years)
 - Approximately 200 MW_{AC} installed by end of 2019
 - Assume program capacity is divided over years as tabulated below

Year	2020	2021	2022	2023	2024
%	22.5	22.5	22.5	22.5	10
MW	315	315	315	315	140

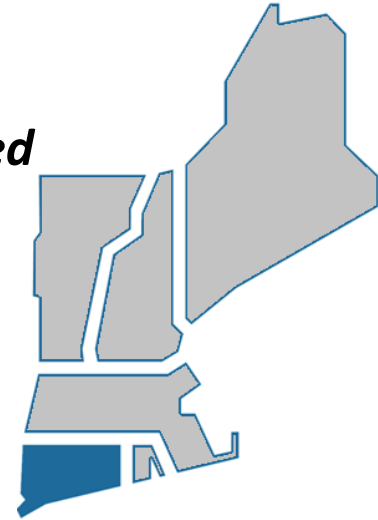
- Post-policy development assumed to occur such that 315 MW is carried forward from 2024 onward at constant rate throughout the remaining years of the forecast period, and post-policy discount factors are applied as necessary

Connecticut Forecast Assumptions



- [CT DEEP's 12/5/19 DGFWDG presentation](#) serves as primary source for CT policy information
- CT Distribution Owner survey results
 - 566.5 MW_{AC} installed by 12/31/19
- LREC/ZREC program assumptions
 - Assume a total of 630 MW are procured in Years 1-10 of program, and approximately 220 MW are in-service
 - Assume 45% attrition rate for remaining 410 MW, with a total of 226 MW divided evenly over 4 years, 2020-2023
- Combination of Residential Solar Investment Program (RSIP) and net-metering extension (Public Act 19-35) promote 42 MW in 2020, 32 MW in 2021, and 40 MW in 2022
- Other policy-driven projects:
 - Shared Clean Energy Facility (SCEF) Pilot Program
 - Two projects totaling 3.6 MW reach commercial operation in 2020
 - DEEP Small Scale Procurement (< 5MW)
 - 4.98 MW project in service in 2021

Connecticut Forecast Assumptions *continued*



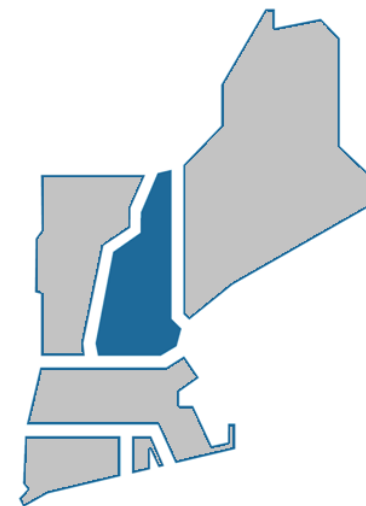
- CT “successor” programs
 - LREC/ZREC successor procurements begin in 2020
 - Result in 26.5 MW/year from 2022-2027
 - RSIP successor begins in 2022
 - Results in 42.5 MW/year from 2022-2027
 - SCEF successor begins in 2022
 - Results in 15 MW/year from 2022-2027
- All MWs from successor programs are carried forward until 2029 at a constant rate, and post-policy discount factors are applied

Vermont Forecast Assumptions



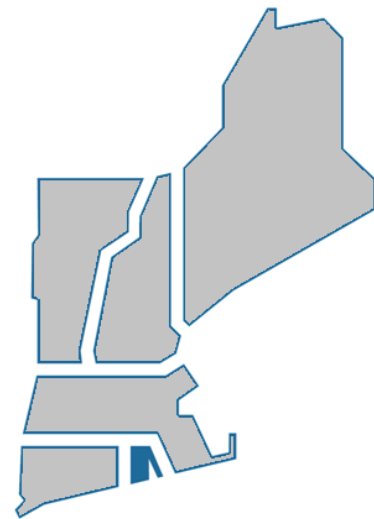
- [VT DPS' 12/5/19 DGFWDG presentation](#) serves as the primary source for VT policy information
- VT Distribution Owner survey results
 - 364.1 MW_{AC} installed by 12/31/19
- DG carve-out of the Renewable Energy Standard (RES)
 - Assume ~85% of eligible resources will be PV and a total of 26 MW/year will develop
- Standard Offer Program
 - Will promote a total of 110 MW of PV (of the 127.5 MW total goal)
 - All forward-looking renewable energy certificates (RECs) from Standard Offer projects will be sold to utilities and count towards RES DG carve-out]
- Net metering
 - In all years after 2020 (see below), all renewable energy certificates (RECs) from net metered projects will be sold to utilities and count towards RES DG carve-out, resulting in 26 MW/year as stated above
- For 2020, a total of 31 MW is forecast in VT, which is in excess of the 26 MW/year due to the RES DG carve-out
 - This reflects expectations that, similar to the past few years, PV development will be greater than that needed for compliance with the RES DG carve out for one more year

New Hampshire Forecast Assumptions



- [NH PUC's 12/5/19 DGFWDG presentation](#) serves as the primary source for NH policy information
- NH Distribution Owners survey results
 - 105.2 MW_{AC} installed by 12/31/19
 - 21.4 MW_{AC} installed in 2019
- Assume the Net Energy Metering Tariff continues to support the 2019 rate of growth throughout the forecast horizon
 - No limit on state-wide aggregate net metered capacity

Rhode Island Forecast Assumptions



- [RI OER's 12/5/19 DGFWG presentation](#) serves as the primary source for RI policy information
- RI Distribution Owner survey results
 - 159.7 MW_{AC} installed by 12/31/19
 - 43.1 MW installed in 2019
- DG Standards Contracts (DGSC) program
 - A total of 22.55 MW of PV is operational, and no further pending projects exist
- Renewable Energy Growth Program (REGP)
 - Assume REGP supports 36 MW_{DC}/year of PV throughout forecast horizon
 - Convert: 36 MW_{DC} = 29.88 MW_{AC} (83% AC-to-DC ratio assumed)
 - Approximately 6.488 MW_{DC} (~5.39 MW_{AC}) cancelled/terminated from previous program procurements; assumed 33.3% of capacity goes into service in each of next 3 years
- Renewable Energy Development Fund, Net Metering, and Virtual Net Metering (VNM)
 - No limit on state-wide aggregate net metered capacity
 - Significant VNM project interest activity over recent two years
 - Assumed to yield 20 MW/year over the forecast horizon

Maine Forecast Assumptions



- [ME PUC's 12/5/19 DGFWG presentation](#) serves as the primary source for ME policy information
- ME Distribution Owner survey results
 - 56.3 MW_{AC} installed by 12/31/19
 - 14.9 MW installed in 2019
- Assume the Net Energy Billing Rule (according to L.D. 1711) continues to support the 2019 rate of growth throughout the forecast horizon
 - No limit on state-wide aggregate net metered capacity
 - Commercial and Institutional net energy billing supported
 - System sizes up to 5 MW are eligible (increased from 660kW as part of L.D. 1711)
- Assume the new incentives established as part of Maine's "Act to Promote Solar Energy Projects and Distributed Generation Resources in Maine" (L.D. 1711) will support a total of 375 MW of additional installed PV by July 1, 2024 according to the following tabulated timeline:

Year	2021	2022	2023	2024
%	20	26.66	26.66	26.66
MW	75	100	100	100

Discount Factors

- Discount factors are:
 - Developed and incorporated into the forecast to ensure a degree of uncertainty in future PV commercialization is considered
 - Developed for two types of future PV inputs to the forecast, and all discount factors are applied equally in all states
 - Applied to the forecast inputs (see slide 26) to determine total nameplate capacity for each state and forecast year

<u>Policy-Based</u> <i>PV that results from state policy</i>	<u>Post-Policy</u> <i>PV that may be installed after existing state policies end</i>
Discounted by values that increase over the forecast horizon up to a maximum value of 15%	Discounted by 35-50% due to the high degree of uncertainty associated with possible future expansion of state policies and/or future market conditions required to support PV commercialization in the absence of policy expansion

Discount Factors Used in Draft 2020 Forecast

Policy-Based

Forecast	Final 2019	Draft 2020
2020	10%	5%
2021	15%	10%
2022	15%	15%
2023	15%	15%
2024	15%	15%
2025	15%	15%
2026	15%	15%
2027	15%	15%
2028	15%	15%
2029	N/A	15%

Post-Policy

Forecast	Final 2019	Draft 2020
2020	36.7%	35.0%
2021	38.3%	36.7%
2022	40.0%	38.3%
2023	41.7%	40.0%
2024	43.3%	41.7%
2025	45.0%	43.3%
2026	46.7%	45.0%
2027	48.3%	46.7%
2028	50.0%	48.3%
2029	N/A	50.0%

Draft 2020 Forecast Inputs

Pre-Discounted Nameplate Values

States	Pre-Discount Annual Total MW (AC nameplate rating)											Totals	
	Thru 2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029		
CT	566.5	102.1	93.4	140.5	140.5	84.0	84.0	84.0	84.0	84.0	84.0	84.0	1,547.0
MA	2180.4	336.5	315.0	315.0	315.0	315.0	315.0	315.0	315.0	315.0	315.0	315.0	5,351.9
ME	56.3	14.9	89.9	114.9	114.9	114.9	14.9	14.9	14.9	14.9	14.9	14.9	580.5
NH	105.2	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	319.2
RI	159.7	51.7	51.7	51.7	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	663.9
VT	364.1	31.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	629.1
Pre-Discount Annual Policy-Based MWs	3432.4	557.5	597.4	669.5	667.7	436.2	196.2	196.2	196.2	112.2	112.2	112.2	7,173.7
Pre-Discount Annual Post-Policy MWs	0.0	0.0	0.0	0.0	0.0	175.0	315.0	315.0	315.0	399.0	399.0	399.0	1,918.0
Pre-Discount Annual Total (MW)	3432.4	557.5	597.4	669.5	667.7	611.2	511.2	511.2	511.2	511.2	511.2	511.2	9,091.7
Pre-Discount Cumulative Total (MW)	3432.4	3,989.9	4,587.4	5,256.9	5,924.5	6,535.7	7,046.9	7,558.1	8,069.3	8,580.5	9,091.7	9,091.7	

Notes:

- (1) The above values **are not the forecast**, but rather pre-discounted inputs to the forecast (see slides 20-26 for details)
- (2) Yellow highlighted cells indicate that values contain post-policy MWs
- (3) All values include FCM Resources, non-FCM Settlement Only Generators and Generators (per OP-14), and load reducing PV resources
- (4) All values represent end-of-year installed capacities

DRAFT 2020 PV NAMEPLATE CAPACITY FORECAST

Includes FCM, non-FCM EOR, and BTM PV

Draft 2020 PV Forecast

Nameplate Capacity, MW_{ac}

States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
CT	566.5	97.0	84.1	119.4	119.4	71.4	71.4	71.4	71.4	43.4	42.0	1,357.4
MA	2180.4	319.6	283.5	267.8	267.8	221.1	178.5	173.3	168.0	162.8	157.5	4,380.2
ME	56.3	14.2	80.9	97.7	97.7	97.7	12.7	12.7	12.7	12.7	12.7	507.9
NH	105.2	20.3	19.3	18.2	18.2	18.2	18.2	18.2	18.2	18.2	18.2	290.3
RI	159.7	49.1	46.5	43.9	42.4	42.4	42.4	42.4	42.4	42.4	42.4	596.1
VT	364.1	29.5	23.4	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	593.8
Regional - Annual (MW)	3432.4	529.6	537.7	569.0	567.5	472.9	345.3	340.0	334.8	301.5	294.9	7,725.6
Regional - Cumulative (MW)	3432.4	3962.1	4499.8	5068.8	5636.3	6109.2	6454.5	6794.5	7129.2	7430.8	7725.6	7,725.6

Notes:

- (1) Forecast values include FCM Resources, non-FCM Energy Only Generators, and behind-the-meter PV resources
- (2) The forecast values are net of the effects of discount factors applied to reflect a degree of uncertainty in the policy-based forecast
- (3) All values represent end-of-year installed capacities
- (4) Forecast does not include forward-looking PV projects > 5MW in nameplate capacity

Final 2019 PV Forecast (For Comparison)

Nameplate Capacity, MW_{ac}

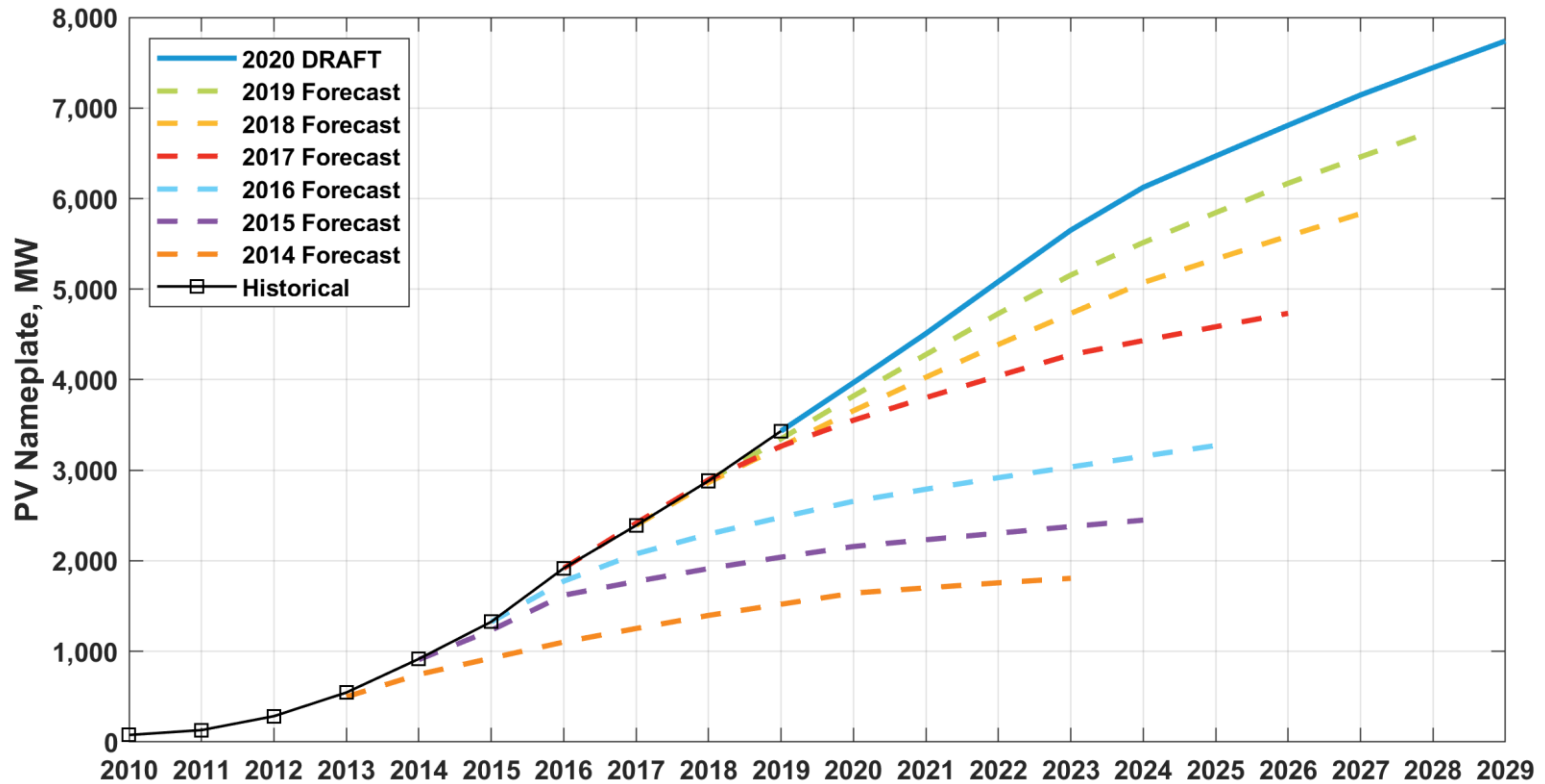
States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
CT	464.3	68.4	91.1	97.5	97.5	71.6	71.6	71.6	71.6	43.5	42.1	1,190.9
MA	1871.3	292.0	288.0	272.0	272.0	272.0	204.0	176.0	170.7	165.3	160.0	4,143.2
ME	41.4	7.1	7.1	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	109.7
NH	83.8	12.7	12.7	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	205.6
RI	116.7	51.3	51.3	48.5	42.4	42.4	42.4	42.4	42.4	42.4	42.4	564.6
VT	306.3	31.5	22.5	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	530.3
Regional - Annual (MW)	2883.8	463.1	472.8	458.0	451.9	426.0	358.0	330.0	324.7	291.3	284.6	6,744.4
Regional - Cumulative (MW)	2883.8	3346.9	3819.8	4277.8	4729.7	5155.7	5513.8	5843.8	6168.5	6459.8	6744.4	6,744.4

Notes:

- (1) Forecast values include FCM Resources, non-FCM Energy Only Generators, and behind-the-meter PV resources
- (2) The forecast values are net of the effects of discount factors applied to reflect a degree of uncertainty in the policy-based forecast
- (3) All values represent end-of-year installed capacities
- (4) Forecast does not include forward-looking PV projects > 5MW in nameplate capacity

PV Nameplate Capacity Growth

Historical vs. Forecast



NEXT STEPS: FINAL 2020 CELT PV FORECAST

Next Steps for CELT 2020

- Other components of the forecast can be developed once the 2020 nameplate PV forecast is finalized, including:
 - Breakdown of the forecast by market participation category
 - For reference, approximately 61% of PV was behind-the-meter at the end of 2019; however, note that BTM shares differ across states
 - PV energy forecast
 - Estimated summer peak load reductions
 - An update to the 2016 analysis informing nameplate to peak load reductions will be discussed in the next presentation
 - Accounting for PV panel degradation using the same approach as last year
- ISO will reconstitute PV into the historical loads used to develop the long-term gross load forecast
 - Overall accounting in the net load forecast will be the same
 - As in prior forecasts, three PV categories will be used for CELT 2019:
 1. PV as a capacity resource in the FCM
 2. EOR
 3. BTM PV
- ISO will use the same approach as previous forecasts to estimate the geographic distribution of the PV forecast
 - Assumes future development is in existing areas of PV development

We Want Your Feedback ...

- Please share your comments today
- ISO requests written comments on draft 2020 PV forecast by February 24, 2020 @ 5:00 p.m.
- Please submit comments to DGFWGMatters@iso-ne.com

Questions

