Draft 2021 Photovoltaic (PV) Forecast

Distributed Generation Forecast Working Group

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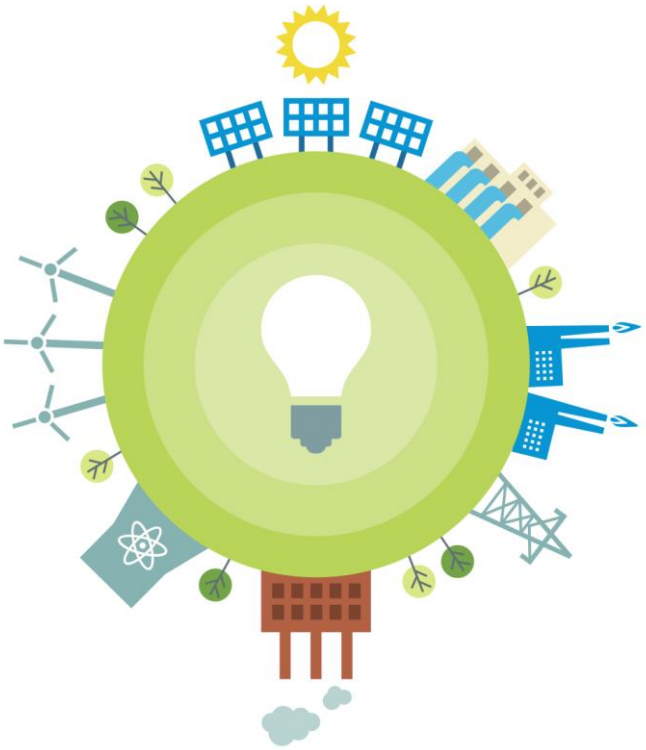
Outline

- Introduction and Background
- 2020 PV Growth: Forecast vs. Reported
- Forecast Assumptions and Inputs
- Draft 2021 PV Forecast - Nameplate
- Next Steps for the 2021 Capacity, Energy, Loads, and Transmission (CELT) Forecast



INTRODUCTION & BACKGROUND

Introduction

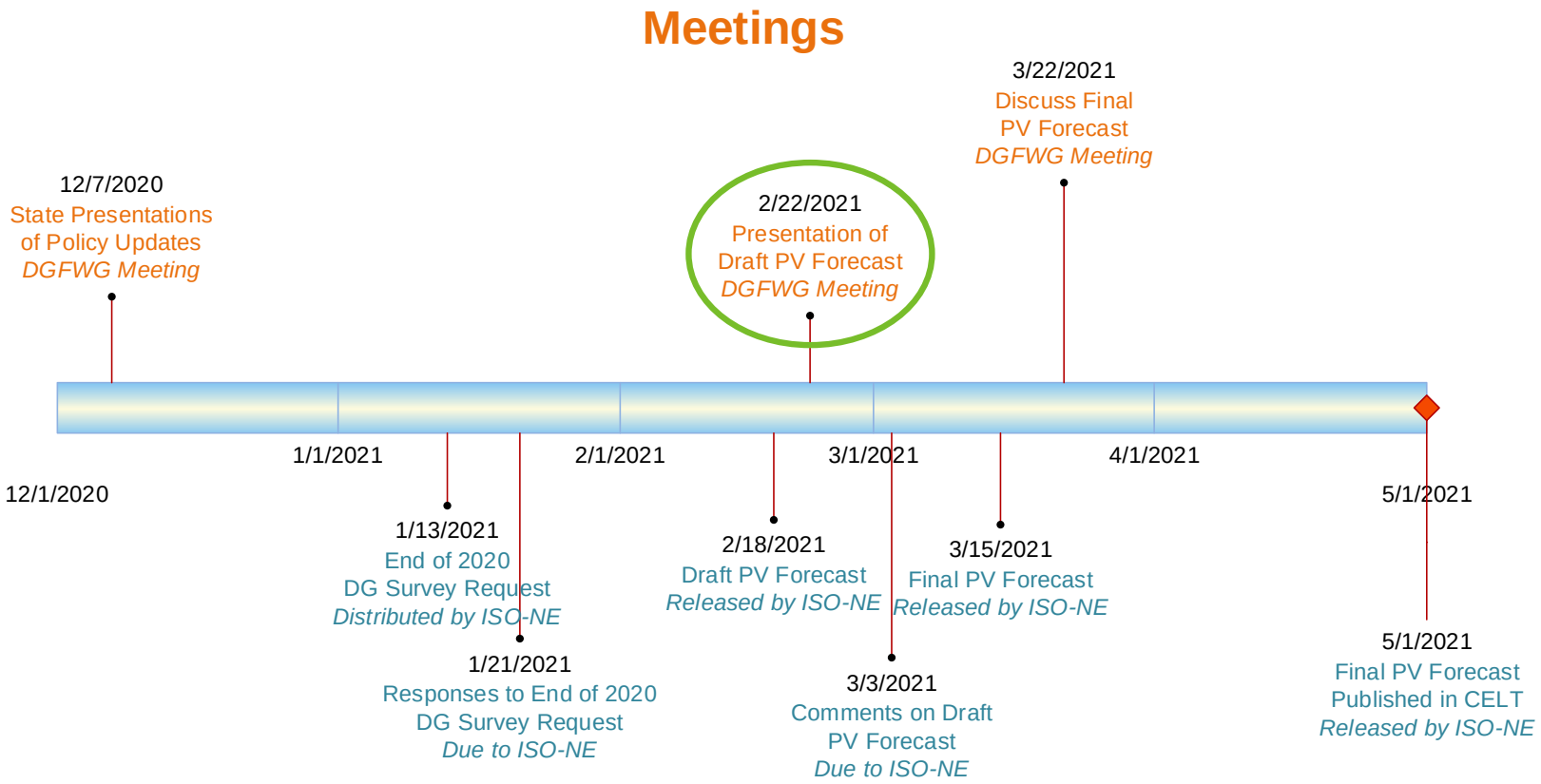
- The majority of state-sponsored distributed PV does not participate in wholesale markets, but reduces the system load observed by ISO
- The long-term PV forecast helps the ISO determine future system load characteristics that are important for the reliable planning and operation of the system
- To 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 2021 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*

2021 PV Forecast Schedule



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

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 2021 PV Forecast

- The 2021 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 562 MW of PV development occurred in 2020, totaling about 3,994 MW installed across the region
  - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- Approximately 6,037 MW of PV development is projected from 2021 through 2030 for a total of 10,031 MW in 2030
  - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- In 2029, the draft 2021 PV nameplate forecast is 1,876 MW higher than the 2020 PV forecast due to the following considerations:
  - Effects of increased policy support reflected in MA and ME)
  - Two-year extension of the federal Investment Tax Credit
  - Existence of significant PV development in the utilities' interconnection pipeline

2020 PV GROWTH: FORECAST VS. REPORTED

2020 PV Growth

Total Nameplate Capacity

- Comparison of the state-by-state 2020 forecast PV growth and the growth for 2020 reported by utilities is tabulated below
  - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- Regionally, 2020 growth reported by utilities totaled 562.2 MW, which is almost 30 MW higher than the forecast growth
  - Results vary by state

State	2020 Reported Growth	2020 Forecast Growth	Difference
CT	115.8	99.8	16.0
MA	321.9	319.6	2.3
ME	10.6	14.2	-3.6
NH	20.1	20.3	-0.2
RI	64.1	49.1	15.0
VT	29.8	29.5	0.3
Region	562.2	532.5	29.7

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	0	0
NH	-	-
RI	9	64.1
VT	-	-
Total	**12**	**130.5**

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
  - Congress extended the ITC for two years in December 2020
- Department of Energy guidance is available for both the Residential ITC and Business ITC

Residential ITC

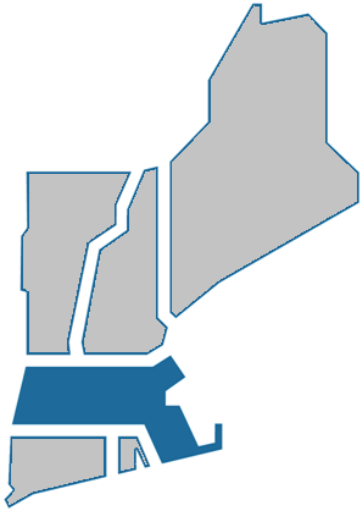
Maximum Allowable Residential ITC	
Year	**Credit**
2020	30%
2021-2022	26%
2023	22%
Future Years	0%

Business ITC

ITC by Date of Construction Start	
Year construction starts	**Credit**
2020-2022	26%
2023	22%
Future Years	10%

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

Massachusetts Forecast Assumptions

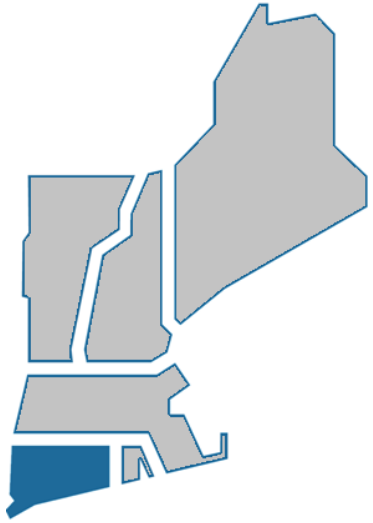


- MA DPU's 12/7/20 DGFWG presentation serves as primary source for MA policy information
- MA Distribution Owners survey results:
  - 2,502.3 MW_{AC} installed by 12/31/20
- Solar Carve-Out Renewable Energy Certificate (SREC) program
  - All SREC projects were in service by the end of 2020
- Solar Massachusetts Renewable Target (SMART) Program
  - Expanded program goal of 3,200 MW_{AC} goal achieved over the period 2020-2026 (7 years)
  - 386.7 MW_{AC} installed by end of 2020; 2,813.3 MW_{AC} remaining
    - Assume program capacity is divided over years as tabulated below

Year	Thru 2020	2021	2022	2023	2024	2025	2026	Total
% Remaining		17	17	17	17	17	15	100
MW	386.7	478.3	478.3	478.3	478.3	478.3	422.0	3,200

- Post-policy development assumed to occur such that 422 MW is carried forward from 2027 onward at constant rate throughout the remaining years of the forecast period, and post-policy discount factors are applied

Connecticut Forecast Assumptions



- CT DEEP's 12/7/20 DGFWG presentation serves as primary source for CT policy information
- CT Distribution Owner survey results
  - 682.3 MW_{AC} installed by 12/31/20
- LREC/ZREC program assumptions
  - Assume a total of 196.6 MW divided over 3 years, 2021-2023, as tabulated below
  - LREC/ZREC successor programs will result in 31.2 MW/year over the period 2023-2028

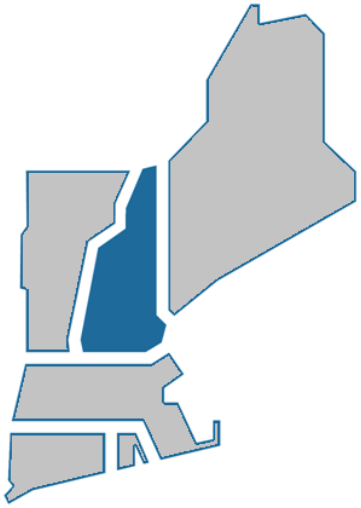
Year	2021	2022	2023
MW	62.7	66.4	66.4

- Combination of Residential Solar Investment Program (RSIP) and net-metering extension (Public Act 19-35), and related successor programs, will promote 51 MW/year through year 2028
- Shared Clean Energy Facility (SCEF)
  - Pilot Program: Two projects totaling 3.8 MW reach commercial operation in 2022
  - Successor SCEF program: Promotes 25 MW/year over the period 2021-2027
- All MWs from successor programs are carried forward until 2030 at a constant rate, and post-policy discount factors are applied

Vermont Forecast Assumptions

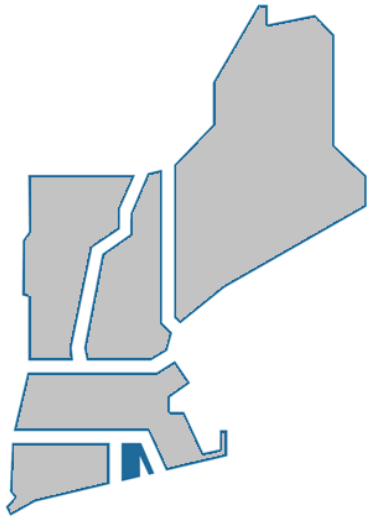
- VT DPS' 12/7/20 DGFWG presentation serves as the primary source for VT policy information
- VT Distribution Owner survey results
  - 393.9 MW_{AC} installed by 12/31/20
- DG carve-out of the Renewable Energy Standard (RES)
  - Assume ~85% of eligible resources will be PV and a total of 26 MW/year will 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
  - 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
- A total of 26 MW/year is forecast in VT due to the RES DG carve-out and other supporting policies

New Hampshire Forecast Assumptions



- NH PUC's 12/7/20 DGFWG presentation serves as the primary source for NH policy information
- NH Distribution Owners survey results
  - 125.3 MW_{AC} installed by 12/31/20
  - 20.1 MW_{AC} installed in 2020
- Assume the Net Energy Metering Tariff continues to support the 2020 rate of growth throughout the forecast horizon
  - No limit on state-wide aggregate net metered capacity

Rhode Island Forecast Assumptions



- RI OER's 12/7/20 DGFWG presentation serves as the primary source for RI policy information
- RI Distribution Owner survey results
  - 223.8 MW_{AC} installed by 12/31/20
  - 64.1 MW installed in 2020 (not including projects > 5 MW nameplate capacity)
- 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 3.6 MW_{AC} of cancelled/terminated from previous program procurements; assumed 50% of capacity goes into service in each of next 2 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 of projects < 5 MW in size over the forecast horizon

Maine Forecast Assumptions

- ME PUC's 12/7/20 DGFWG presentation serves as the primary source for ME policy information
- ME Distribution Owner survey results
  - 66.9 MW_{AC} installed by 12/31/20
  - 10.6 MW installed in 2020
- Net Energy Billing (NEB) Rule (per L.D. 1711) assumptions:
  - Of the 1169 MW in the NEB queue (see slide 7 of ME PUC presentation), assume a 50% attrition rate
  - The remaining 584.5 MW will be developed according to the timeline tabulated below
  - NEB will continue to support 15 MW/year of growth starting in 2025

Year	Thru 2020	2021	2022	2023	2024
%	1.5	25	25	25	23.5
MW	9	146	146	146	137

- 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 according to the following tabulated timeline:

Year	2022	2023	2024	2025
%	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 24) to determine total nameplate capacity for each state and forecast year

Policy-Based *PV that results from state policy*	**Post-Policy** *PV that may be installed after existing state policies end*
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 2021 Forecast

Policy-Based

Forecast	Final 2020	Draft 2021
2021	10%	5%
2022	15%	10%
2023	15%	15%
2024	15%	15%
2025	15%	15%
2026	15%	15%
2027	15%	15%
2028	15%	15%
2029	15%	15%
2030	N/A	15%

Post-Policy

Forecast	Final 2020	Draft 2021
2021	36.7%	35.0%
2022	38.3%	36.7%
2023	40.0%	38.3%
2024	41.7%	40.0%
2025	43.3%	41.7%
2026	45.0%	43.3%
2027	46.7%	45.0%
2028	48.3%	46.7%
2029	50.0%	48.3%
2030	N/A	50.0%

Draft 2021 Forecast Inputs

Pre-Discounted Nameplate Values

States	Pre-Discount Annual Total MW (AC nameplate rating)											Totals
	Thru 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
CT	682.3	113.7	146.2	173.6	107.2	107.2	107.2	107.2	107.2	107.2	107.2	**1,866.1**
MA	2502.3	478.3	478.3	478.3	478.3	478.3	422.0	422.0	422.0	422.0	422.0	**7,003.6**
ME	66.9	146.1	221.1	246.1	237.3	115.0	15.0	15.0	15.0	15.0	15.0	**1,107.6**
NH	125.3	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	20.1	**326.5**
RI	223.8	51.7	51.7	49.9	49.9	49.9	49.9	49.9	49.9	49.9	49.9	**726.1**
VT	393.9	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	**653.9**
Pre-Discount Annual Policy-Based MWs	**3994.4**	**835.9**	**943.4**	**994.0**	**918.8**	**796.4**	**640.2**	**218.2**	**193.2**	**111.0**	**111.0**	**9,756.5**
Pre-Discount Annual Post-Policy MWs	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**422.0**	**447.0**	**529.2**	**529.2**	**1,927.3**
Pre-Discount Annual Total (MW)	**3994.4**	**835.9**	**943.4**	**994.0**	**918.8**	**796.4**	**640.2**	**640.2**	**640.2**	**640.2**	**640.2**	**11,683.8**
Pre-Discount Cumulative Total (MW)	**3994.4**	**4,830.3**	**5,773.7**	**6,767.7**	**7,686.5**	**8,482.9**	**9,123.1**	**9,763.3**	**10,403.5**	**11,043.6**	**11,683.8**	**11,683.8**

Notes:

(1) The above values **<u>are not the forecast</u>**, but rather pre-discounted inputs to the forecast (see slides 15-21 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 2021 PV NAMEPLATE CAPACITY FORECAST

Includes FCM, non-FCM EOR, and BTM PV

Draft 2021 PV Forecast

Nameplate Capacity, MW_{ac}

States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	
CT	682.3	108.1	131.6	147.6	91.1	91.1	91.1	91.1	83.2	55.4	53.6	**1,626.0**
MA	2502.3	454.3	430.4	406.5	406.5	406.5	358.7	232.1	225.1	218.0	211.0	**5,851.5**
ME	66.9	138.8	199.0	209.2	201.7	97.8	12.8	12.8	12.8	12.8	12.8	**977.1**
NH	125.3	19.1	18.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	17.1	**299.4**
RI	223.8	49.1	46.5	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	**658.5**
VT	393.9	24.7	23.4	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	**618.8**
Regional - Annual (MW)	**3994.4**	**794.1**	**849.1**	**844.9**	**781.0**	**677.0**	**544.1**	**417.5**	**402.6**	**367.8**	**358.9**	**10,031.4**
Regional - Cumulative (MW)	**3994.4**	**4788.5**	**5637.6**	**6482.5**	**7263.5**	**7940.4**	**8484.6**	**8902.1**	**9304.7**	**9672.5**	**10031.4**	**10,031.4**

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

Final 2020 PV Forecast (For Comparison)

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	99.8	89.8	134.1	134.1	77.6	77.6	77.6	77.6	47.2	45.7	**1,427.6**
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**	**532.5**	**543.3**	**583.7**	**582.2**	**479.1**	**351.5**	**346.2**	**341.0**	**305.3**	**298.5**	**7,795.8**
Regional - Cumulative (MW)	**3432.4**	**3964.9**	**4508.2**	**5092.0**	**5674.2**	**6153.3**	**6504.8**	**6851.0**	**7192.0**	**7497.3**	**7795.8**	**7,795.8**

Notes:

(1) Forecast values include FCM Resources, non-FCM Energy Only Generators, and behind-the-meter PV resources

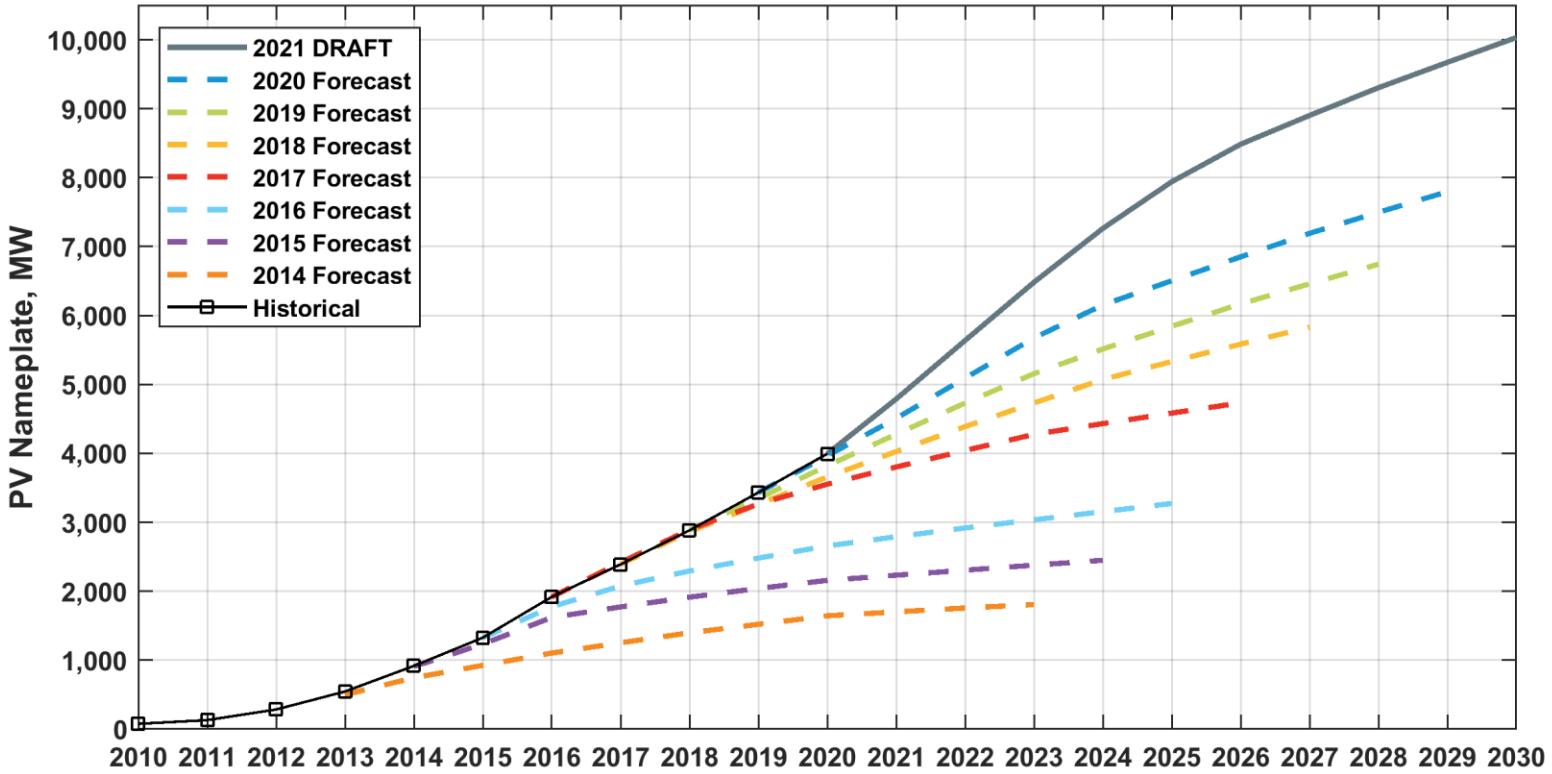
(2) The forecast values are net of the effects of discount factors applied to reflect a degree of uncertainty in the policy-based forecast

(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

Next Steps for CELT 2021

- Other components of the forecast can be developed once the 2021 nameplate PV forecast is finalized, including:
  - Breakdown of the forecast by market participation category
    - For reference, approximately 60% of PV was behind-the-meter at the end of 2020; however, note that BTM shares differ across states
  - PV energy forecast
  - Estimated summer peak load reductions
    - Discussion of the relevant methodology is available here: https://www.iso-ne.com/static-assets/documents/2020/04/final_btm_pv_peak_reduction.pdf
  - 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 2021:
    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 …

- Stakeholders may provide written comments on the draft forecast by March 3, 2021 @ 5:00 p.m.
  - Please submit comments to DGFWGMatters@iso-ne.com
- The final PV forecast will be discussed at the March 22nd DGFWG, and will be published in the 2021 CELT (Section 3):
  - See: https://www.iso-ne.com/system-planning/system-plans-studies/celt/

Questions