Draft 2019 Photovoltaic (PV) Forecast

Distributed Generation Forecast Working Group

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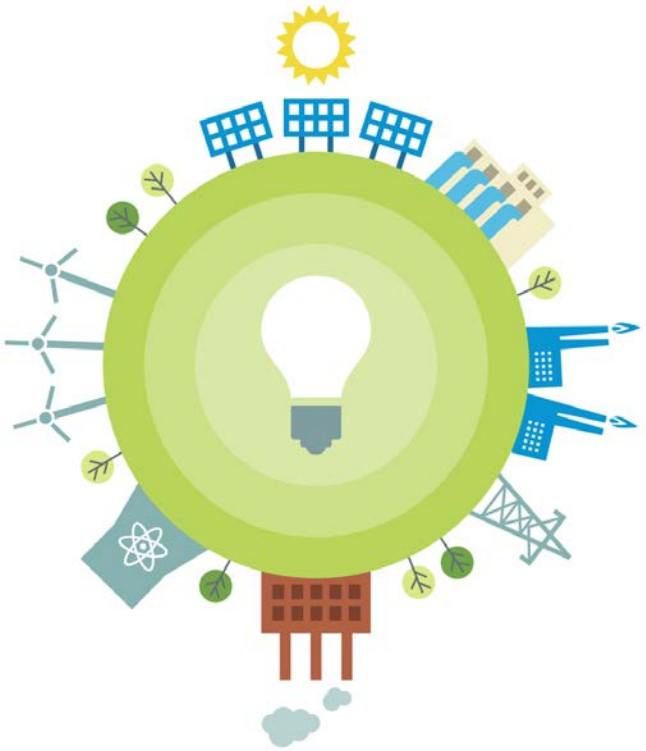
MANAGER, LOAD FORECASTING

Outline

- Introduction and Background
- 2018 PV Growth: Forecast vs. Reported
- Forecast Assumptions and Inputs
- Draft 2019 PV Forecast - Nameplate
- Next Steps for the 2019 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*

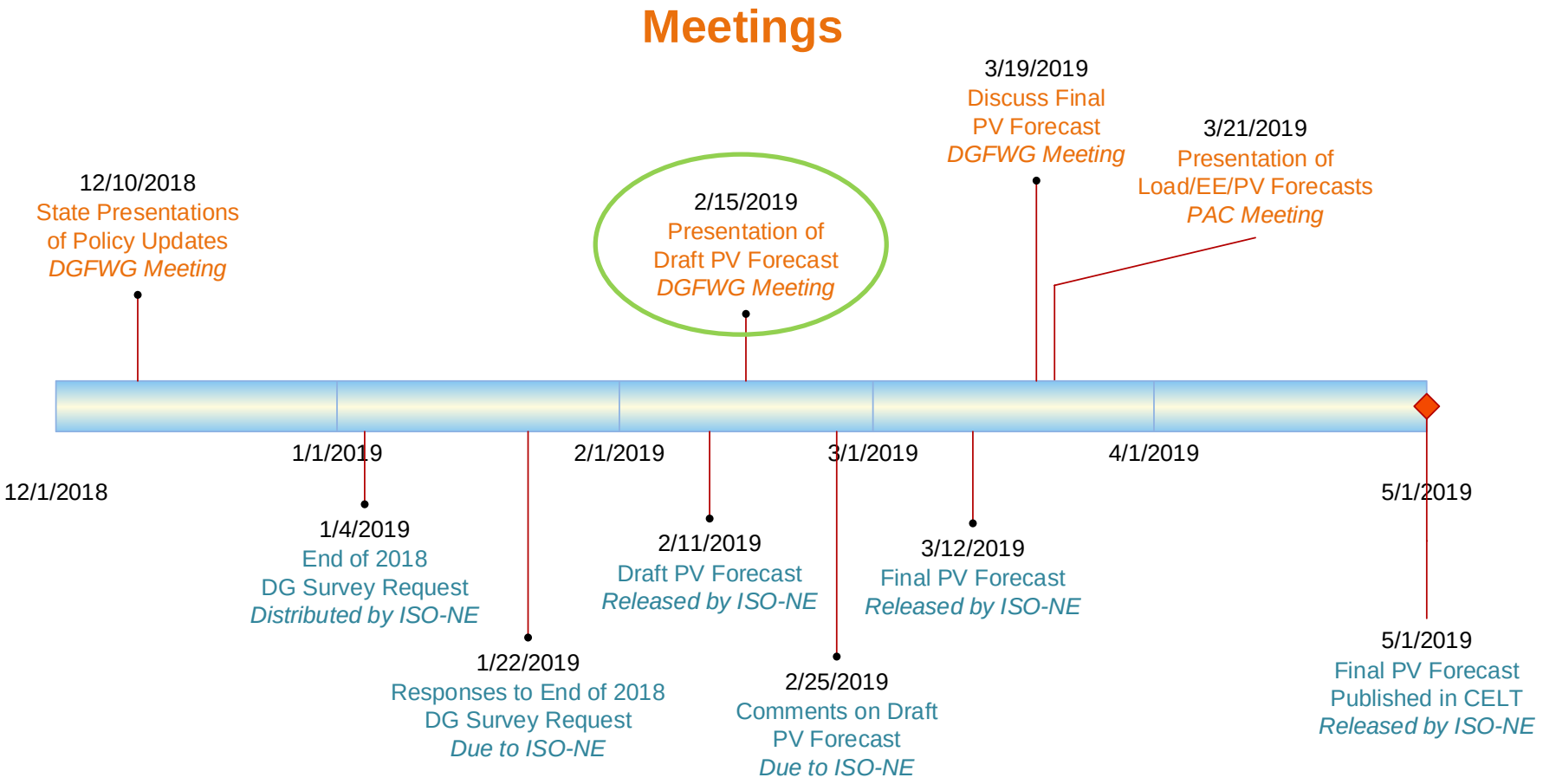
The 2019 gross load forecast reflects loads without PV load reductions

**Existing BTM PV decreases the historical loads seen by the ISO, 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

2019 PV Forecast Schedule



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

- The PV forecast process is informed by ISO analysis and by 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 2019 PV Forecast

- The 2019 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 493 MW of PV development occurred in 2018, totaling about 2,884 MW installed across the region
  - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- Approximately 3,716 MW of PV development is projected from 2019 through 2028 for a total of 6,599 MW in 2028
  - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- Overall, the draft 2019 PV forecast projects steadier PV growth over the forecast horizon than last year's forecast

Background and Forecast Review Process

- The draft 2019 forecast will be discussed today
- Stakeholders provided comments on the draft forecast are due by February 25, 2019
- The final PV forecast will be discussed at the March 19th DGFWG, and will be published in the 2019 CELT (Section 3):
  - See: https://www.iso-ne.com/system-planning/system-plans-studies/celt/

2018 PV GROWTH: FORECAST VS. REPORTED

2018 PV Growth

Total Nameplate Capacity

- Comparison of the state-by-state 2018 PV growth and the reported growth for 2018 reported by utilities is tabulated below
  - Values include FCM, EOR, and BTM PV projects < 5 MW_{ac} in nameplate capacity
- Regionally, 2018 growth reported by utilities totaled 493.3 MW, which is 18 MW higher than the forecast growth
  - Results vary by state

State	2018 Reported Growth	2018 Forecast Growth	Difference
CT	98.7	88.6	10.1
MA	269.0	296.7	-27.7
ME	7.9	10.2	-2.2
NH	14.2	13.8	0.3
RI	54.4	34.5	19.9
VT	49.1	31.5	17.6
Region	493.3	475.3	18.0

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 2017 forecast

Residential ITC

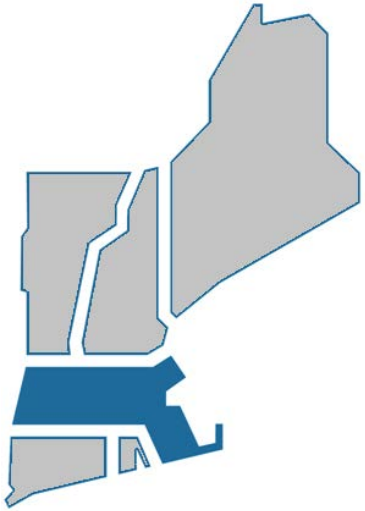
Maximum Allowable Residential ITC	
Year	Credit
2016	30%
2017	30%
2018	30%
2019	30%
2020	26%
2021	22%
Future Years	0%

Business ITC

ITC by Date of Construction Start	
Year construction starts	Credit
2016	30%
2017	30%
2018	30%
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 Methodology and Assumptions

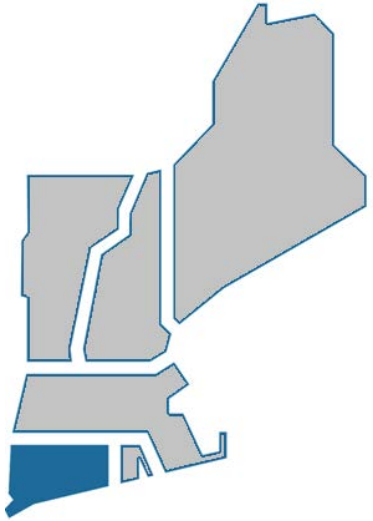


- MA DPU's 12/10/18 DGFWG presentation serves as primary source for MA policy information
- MA Distribution Owners survey results:
  - 1,871.3 MW_{AC} installed by 12/31/18
- Solar Carve-Out Renewable Energy Certificate (SREC) program
  - A total of 2,416 MW_{DC} will be developed as part of SREC-I and SREC-II
    - 2,306.4 MW_{DC} installed by 12/31/18
    - Remaining 106.9 MW_{DC} will be installed in 2019 (84.4 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)
    - Assume program capacity is divided over years as tabulated below

Year	2019	2020	2021	2022	2023	2024
%	15	20	20	20	20	5
MW	240	320	320	320	320	80

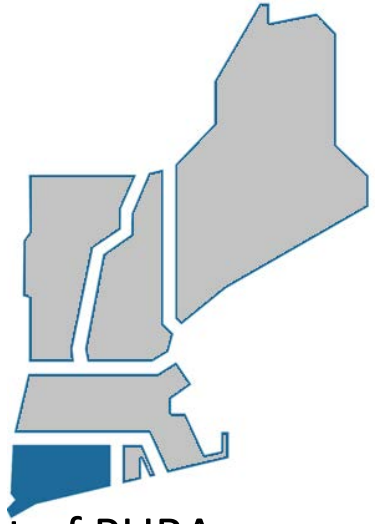
- Post-policy development assumed to occur such that 320 MW is carried forward from 2023 onward at constant rate throughout the remaining years of the forecast period, and post-policy discount factors are applied as necessary

Connecticut Forecast Methodology and Assumptions



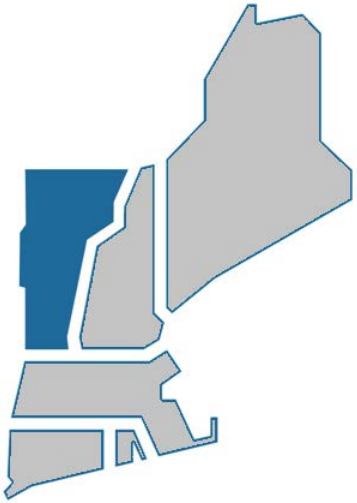
- CT DEEP's 12/10/18 DGFWG presentation serves as primary source for CT policy information
- CT Distribution Owner survey results
  - 464.3 MW_{AC} installed by 12/31/18
- LREC/ZREC program assumptions
  - 121.7 MW remaining, divided evenly over 4 years, 2019-2022
- Residential Solar Investment Program (RSIP) assumptions
  - Remaining 84 MW, divided evenly over 2 years, 2019-2020
- Other policy-driven projects:
  - DEEP Small Scale Procurement (< 5MW)
    - 4.98 MW project in service in 2020
  - Shared Clean Energy Facility (SCEF) Pilot Program
    - 3.62 MW project in service in 2019
    - 1.6 MW project in service in 2020

Connecticut Forecast Methodology and Assumptions *continued*



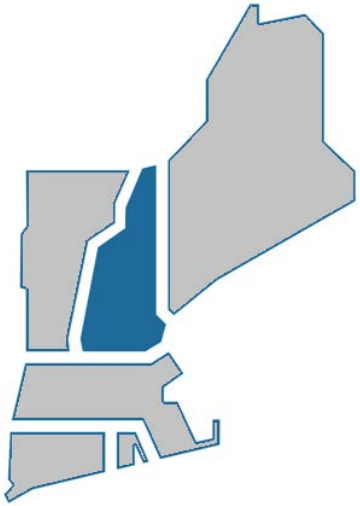
- CT WISE "Successor" programs
  - Design and implementation details of successor programs to SCEF, RSIP, and ZREC are currently being discussed as part of PURA Docket No. 18-08-33
  - Since these programs are not yet finalized, estimated MWs and start/end dates associated with these programs have been incorporated into the 2019 forecast, with post-policy discount factors applied

Vermont Forecast Methodology and Assumptions



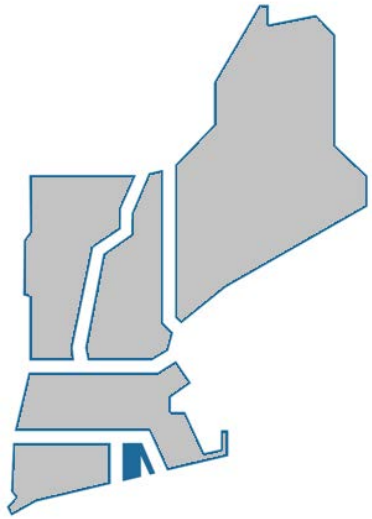
- VT DPS' 12/10/18 DGFWG presentation serves as the primary source for VT policy information
- VT Distribution Owner survey results
  - 306.3 MW_{AC} installed by 12/31/18
- DG carve-out of the Renewable Energy Standard (RES)
  - Assume 85% of eligible resources will be PV and a total of 25 MW/year will 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 2019 (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 25 MW/year as stated above
- For 2019, a total of 35 MW is anticipated in VT, which is in excess of the 25 MW/year due to the RES DG carve-out
  - This reflects expectations that, similar to the past couple of years, PV development will be greater than that needed for compliance with the RES DG carve out for one more year

New Hampshire Forecast Methodology and Assumptions



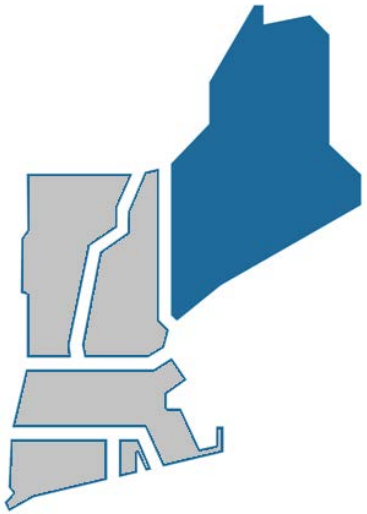
- NH PUC's 12/10/18 DGFWG presentation serves as the primary source for NH policy information
- NH Distribution Owners survey results
  - 83.8 MW_{AC} installed by 12/31/18
  - 14.2 MW_{AC} installed in 2018
- Assume the Net Energy Metering Tariff (NEM 2.0, effective September 2017), continues to support the 2018 rate of growth throughout the forecast horizon
  - No limit on state-wide aggregate net metered capacity

Rhode Island Forecast Methodology and Assumptions



- RI OER's 12/10/18 DGFWG presentation serves as the primary source for RI policy information
- RI Distribution Owners reported a total of 62.2 MW of growth in 2018
- DG Standards Contracts (DGSC) program
  - A total of 33.6 MW of 40 MW program goal will be PV
  - Approximately 11.1 MW cancelled/terminated, will be procured as part of 2019 REGP (see below) ; assumed 33.3% of capacity goes into service in each of next 3 years
- 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 10.4 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 Methodology and Assumptions



- ME PUC's 12/10/18 DGFWG presentation serves as the primary source for ME policy information
- ME Distribution Owners reported a total of 7.9 MW of PV growth in 2018
- Assume the new Net Energy Billing Rule (effective April 1, 2018), with gradually reduced rates of compensation, continues to support the 2018 rate of growth throughout the forecast horizon
  - No limit on state-wide aggregate net metered capacity

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 29) 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 2019 Forecast

Policy-Based

Forecast	Final 2018	Draft 2019
2019	10%	10%
2020	10%	10%
2021	15%	15%
2022	15%	15%
2023	15%	15%
2024	15%	15%
2025	15%	15%
2026	15%	15%
2027	15%	15%
2028	N/A	15%

Post-Policy

Forecast	Final 2018	Draft 2019
2019	36.7%	35.0%
2020	38.3%	36.7%
2021	40.0%	38.3%
2022	41.7%	40.0%
2023	43.3%	41.7%
2024	45.0%	43.3%
2025	46.7%	45.0%
2026	48.3%	46.7%
2027	50.0%	48.3%
2028	N/A	50.0%

Draft 2019 Forecast Inputs

Pre-Discounted Nameplate Values

States	Pre-Discount Annual Total MW (AC nameplate rating)											Totals
	Thru 2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	
CT	464.3	76.0	101.3	114.7	114.7	84.3	84.3	84.3	84.3	84.3	84.3	**1,376.5**
MA	1871.3	324.4	320.0	320.0	320.0	320.0	320.0	320.0	320.0	320.0	320.0	**5,075.7**
ME	41.4	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	7.9	**120.8**
NH	83.8	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	14.2	**225.5**
RI	116.7	57.0	57.0	57.0	49.9	49.9	49.9	49.9	49.9	49.9	49.9	**636.9**
VT	306.3	35.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	**566.3**
Pre-Discount Annual Policy-Based MWs	**2883.8**	**514.6**	**503.1**	**454.6**	**447.4**	**417.0**	**177.0**	**97.0**	**97.0**	**97.0**	**97.0**	**5,785.4**
Pre-Discount Annual Post-Policy MWs	**0.0**	**0.0**	**22.3**	**84.3**	**84.3**	**84.3**	**324.3**	**404.3**	**404.3**	**404.3**	**404.3**	**2,216.3**
Pre-Discount Annual Total (MW)	**2883.8**	**514.6**	**525.4**	**538.8**	**531.7**	**501.2**	**501.2**	**501.2**	**501.2**	**501.2**	**501.2**	**8,001.6**
Pre-Discount Cumulative Total (MW)	**2883.8**	**3,398.4**	**3,923.8**	**4,462.6**	**4,994.2**	**5,495.5**	**5,996.7**	**6,497.9**	**6,999.2**	**7,500.4**	**8,001.6**	**8,001.6**

Notes:

(1) The above values **<u>are not the forecast</u>**, 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

2018 PV NAMEPLATE CAPACITY FORECAST

Includes FCM, non-FCM EOR, and BTM PV

Final 2018 PV Forecast

Nameplate Capacity, MW_{ac}

States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	
CT	365.6	88.6	86.8	89.8	80.6	72.9	53.7	52.2	50.6	49.0	47.4	**1,037.3**
MA	1602.3	**296.7**	228.0	228.0	215.3	215.3	215.3	215.3	135.1	130.9	126.7	**3,608.9**
ME	33.5	10.2	10.2	10.2	9.6	9.6	9.6	9.6	9.6	9.6	9.6	**131.4**
NH	69.7	13.8	13.8	13.8	13.1	13.1	13.1	13.1	13.1	13.1	13.1	**202.7**
RI	62.2	34.5	34.5	31.4	29.6	29.6	29.6	29.6	29.6	29.6	29.6	**370.2**
VT	257.2	**31.5**	22.5	22.5	21.3	21.3	21.3	21.3	21.3	21.3	21.3	**482.5**
Regional - Annual (MW)	**2390.5**	**475.3**	**395.8**	**395.8**	**369.5**	**361.9**	**342.7**	**341.1**	**259.3**	**253.5**	**247.7**	**5,832.9**
Regional - Cumulative (MW)	**2390.5**	**2865.8**	**3261.6**	**3657.4**	**4026.9**	**4388.8**	**4731.4**	**5072.5**	**5331.8**	**5585.3**	**5832.9**	**5,832.9**

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

Draft 2019 PV Forecast

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	85.2	77.8	76.4	49.1	47.7	46.3	44.9	43.5	42.1	**1,046.0**
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**	**466.9**	**438.3**	**430.8**	**403.6**	**334.2**	**304.8**	**298.0**	**291.3**	**284.6**	**6,599.4**
Regional - Cumulative (MW)	**2883.8**	**3346.9**	**3813.8**	**4252.2**	**4683.0**	**5086.6**	**5420.8**	**5725.5**	**6023.6**	**6314.9**	**6599.4**	**6,599.4**

Notes:

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

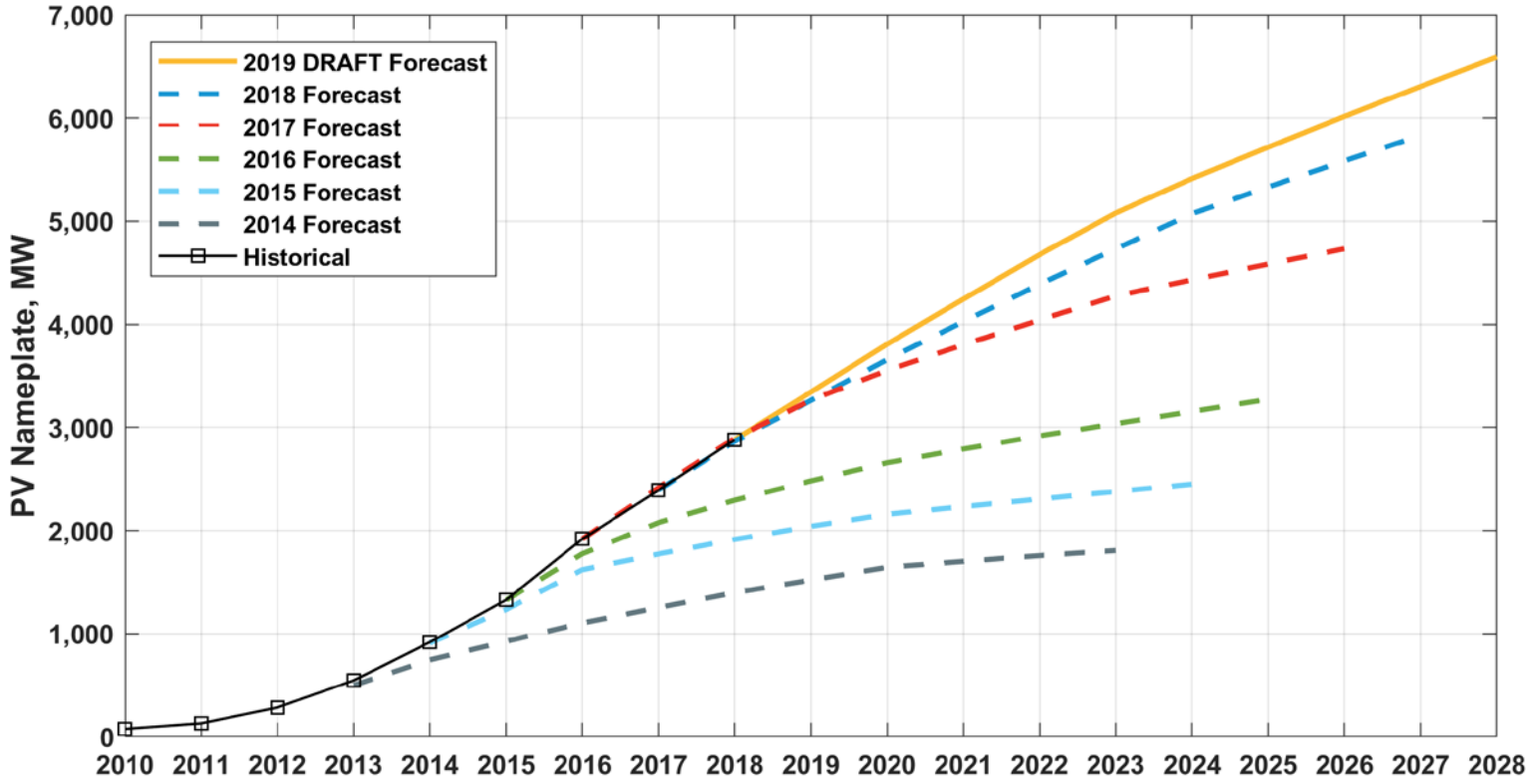
(2) The forecast values are net of the effects of discount factors applied to reflect a degree of uncertainty in the policy-based forecast

(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 2019 CELT PV FORECAST

Next Steps for CELT 2019

- Once the 2019 nameplate PV forecast is finalized, ISO will:
  - Break down the forecast by market participation category
    - For reference, approximately 63% of PV was behind-the-meter at the end of 2017; however, note that BTM shares differ across states
  - Create the PV energy forecast
  - Develop the estimated summer peak load reductions
  - Accounting for PV panel degradation will be same as last year
- ISO will reconstitute BTM 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 2019 PV forecast by February 25, 2019 @ 5:00 p.m.
- Please submit comments to DGFWGMatters@iso-ne.com

Questions