Draft 2023 Photovoltaic (PV) Forecast

Distributed Generation Forecast Working Group

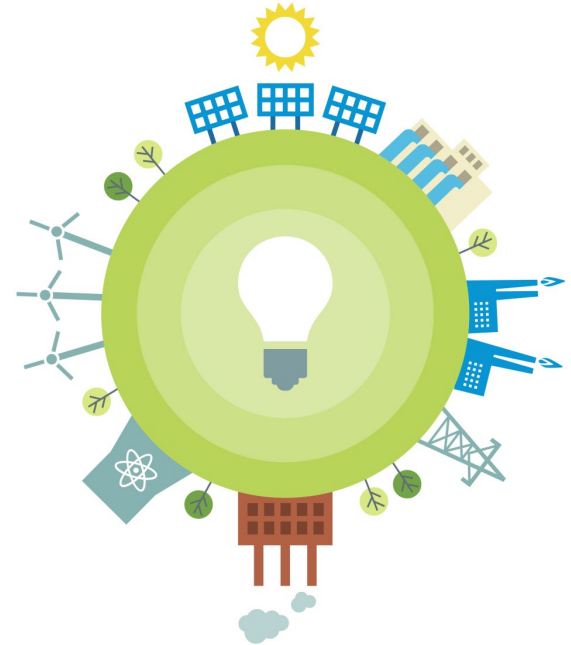## Jon Black

MANAGER, LOAD FORECASTING

ISO-NE PUBLIC

Outline

- Introduction

- 2022 Installed PV: Forecast vs. Reported

- Forecast Assumptions and Inputs

- Draft 2023 PV Nameplate Forecast

- Next Steps

INTRODUCTION

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 2023 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

PV Forecast Focuses on Distributed Generation

- The focus of the DGFWG is distributed generation (DG) 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)

- Large projects are generally accounted for as part of ISO's interconnection process and participate in wholesale markets

PV Forecast Incorporates State Policies

- The PV forecast is a projection of distributed PV resources to be used in ISO-NE System Planning studies, consistent with its role to ensure prudent planning assumptions for the bulk power system

- A policy-based forecasting approach is used to reflect the observation that trends in distributed PV development have tracked policy support by the New England states

- The ISO makes no judgment regarding state policies, but considers state policy information provided by the states in developing the forecast

Factors Influencing Development of Distributed PV

| Policy Drivers	Other Drivers
Feed-in-tariffs (FITs)/Long-term procurement	Role of private investment in PV development
State Renewable Portfolio Standards (RPS) programs	Future equipment and installation costs
Net energy metering (NEM) and retail rate structure	Future wholesale and retail electricity costs
Federal investment tax credit (ITC) and federal depreciation	Interconnection costs and issues
Federal trade policy	Siting issues

# 2022 INSTALLED PV

Forecast vs. Reported

2022 PV Nameplate Capacity Growth

- Comparison of the state-by-state 2022 forecast PV growth and the growth for 2022 reported by utilities is tabulated below
  - Values include FCM, EOR, and BTM PV projects

- Regionally, 2022 growth reported by utilities totaled 688.5 MW, which is 92.1 MW lower than the forecast growth
  - Results vary by state as tabulated

- "Over the past year, uncertainty related to solar tariffs, energy policy, supply chain bottlenecks and rising project costs due to inflation has resulted in delayed, or even cancelled, projects" – Woods Mackenzie

State	2022 Reported Growth	2022 Forecast Growth	Error
CT	102.7	113.4	-10.7
MA	335.8	448.8	-113.0
ME	169.5	107.8	61.7
NH	26.5	30.0	-3.5
RI	37.2	52.1	-14.9
VT	16.8	28.5	-11.7
Region	**688.5**	**780.6**	**-92.1**

Nameplate Capacity of Reported Annual PV Growth

Small (<= 25kW), Medium (25-<1,000kW), and Large (>=1,000kW) Projects
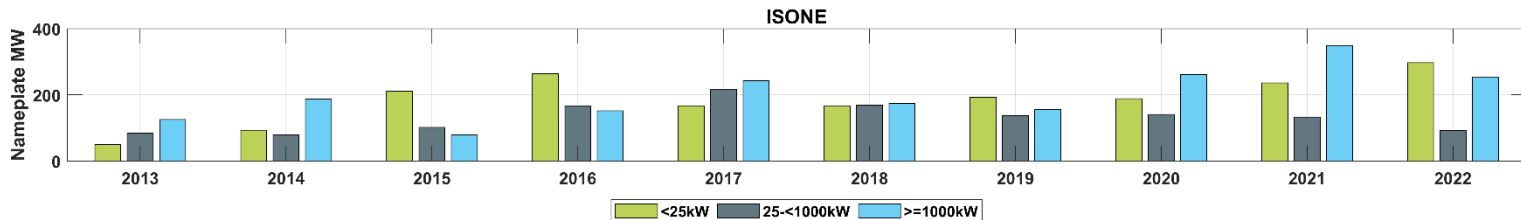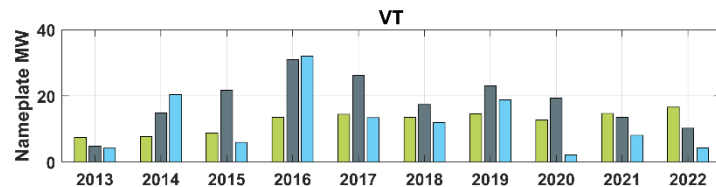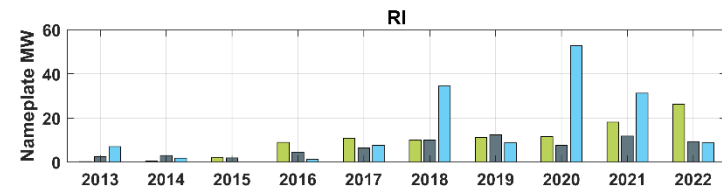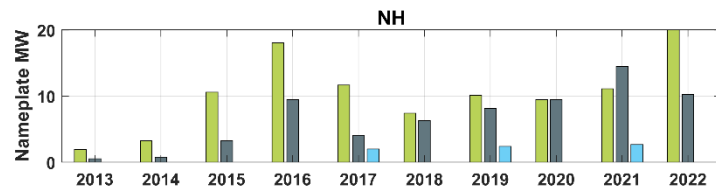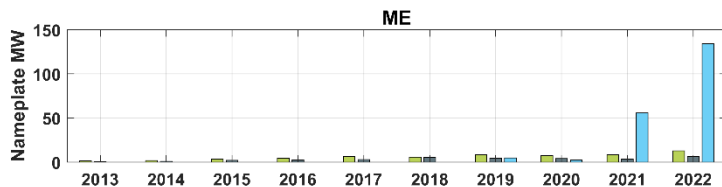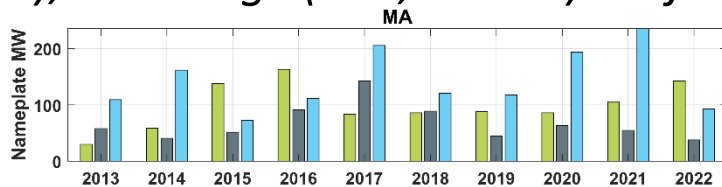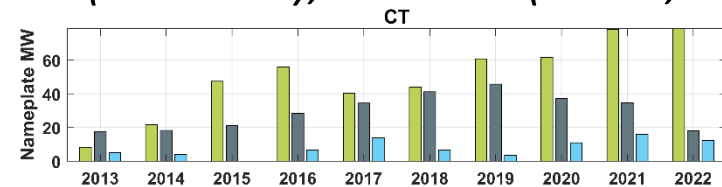
Larger-Scale PV

Projects >5 MW$_{ac}$

- Tabulated 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 accounting, and are excluded from installed PV totals reported herein

State	# Projects Listed	Total Nameplate (MW$_{ac}$)
CT	4	81.4
MA	-	-
ME	3	34.0
NH	-	-
RI	16	124.0
VT	-	-
Total	**23**	**239.4**

TOTAL PV NAMEPLATE CAPACITY FORECAST

Assumptions and Inputs

Federal Investment Tax Credit

- The federal Investment Tax Credit (ITC) has been a key driver of PV development in New England

- Business ITC
  - The federal Inflation Reduction Act (IRA) of 2022 (H.R. 5376) made several significant changes to this tax credit, including extending the expiration date, modifying the scheduled step-down in its value, providing for new bonus credits, and establishes procedures for other parties to monetize the credit (e.g., non-taxable entities).
  - The IRA also establishes new criteria to qualify for the full credit.

- Residential ITC
  - The IRA extended the expiration date and modified the phase down of the tax credit.

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

Overall Outlook

Tailwind Factors	Headwind Factors
Federal Inflation Reduction Act (IRA) extension of ITC for projects that begin construction before 2034, bringing longer-term certainty to renewables development	Interconnection constraints are becoming more prevalent as PV penetrations increase, especially for larger projects
State-level policy incentives	For larger projects in more rural areas, availability of land in proximity to adequate distribution infrastructure
Higher retail electric rates	Higher prices due to supply-chain constraints, high commodity and labor inflation, and increasing demand for clean energy
Corporations' increasing focus on environmental, social, and governance (ESG)	Finance in a time of inflation, higher interest rates, and a possible recession

Sources:

Opportunity and Complexity: U.S. Clean Energy Financing in 2023, CohnReznick and CohnReznick Capital, 2023.
U.S. Solar Surge Collides With Higher Rates and Shifting Economics, via Bloomberg LP, accessed February 15, 2023.

Massachusetts Forecast Assumptions
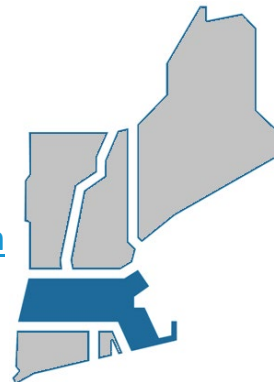
- Policy information is contained in the MA Department of Public Utilities (MA DPU) [presentation](#) to the DGFWG on December 5, 2022

- MA Distribution Owners reported a total of 3,289.2 MW_{AC} installed through 12/31/2022, including 335.8 MW_{AC} in 2022

- Solar Massachusetts Renewable Target (SMART) Program has a program goal of 3,200 MW_{AC}
  - 1,000 MW_{AC} installed by end of 2022
  - Additional 2,200 MW_{AC} installed to reach program goal by 2028 as tabulated below

- Post-policy development (i.e., red cells below) assumed to occur such that a total of 366.7 MW is carried forward from 2029 onward at constant rate throughout the remaining years of the forecast period, and post-policy discount factors are applied

MA Forecast Inputs

| Year	Thru 2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Annual % of SMART Program	31.3%	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%	0%	0%	0%	0%
Annual SMART Program MW	1000	366.7	366.7	366.7	366.7	366.7	366.7	366.7	366.7	366.7	366.7

Connecticut Forecast Assumptions
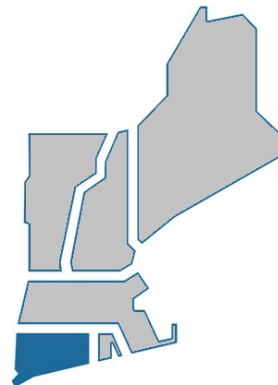
- Policy information is contained in the CT Department of Energy & Environmental Protection (CT DEEP) presentation to the DGFWG on December 5, 2022

- CT Distribution Owners reported a total of 911.8 MW_{AC} installed through 12/31/2022, including 102.7 MW_{AC} in 2022 (totals do not include projects > 5MW)

- Annual state MW forecast inputs tabulated below result from the following state programs:
  - Existing Low- & Zero-Emission Renewable Energy Credits (LREC/ZREC) program
  - Shared Clean Energy Facilities (SCEF) program
  - Renewable Energy Tariff, Residential Renewable Energy Solutions (RRES) program
  - Renewable Energy Tariff, Non-Residential Renewable Energy Solutions (NRES) program

- At the end of SCEF, RRES, and NRES programs, all MWs from last year of each program are carried forward until 2032 at a constant rate, and post-policy discount factors are applied

CT Forecast Inputs

| Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Existing ZREC/LREC	40.0	40.0	40.0							
SCEF (incl. Successor)	25.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5	28.5
RRES	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
NRES	54.8	65.3	65.3	65.3	65.3	65.3	65.3	65.3	65.3	65.3

Rhode Island Forecast Assumptions
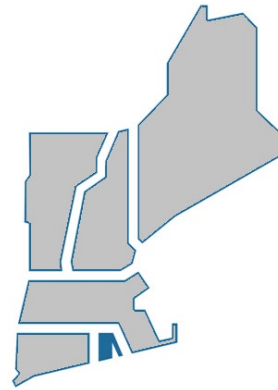
- Policy information is contained in the RI Office of Energy Resources (RI OER) presentation to the DGFWG on December 5, 2022

- RI Distribution Owner reported a total of 325.6 MW_{AC} installed through 12/31/2022, including 32.7 MW_{AC} in 2022
  - Totals do not include projects > 5MW

- Annual state MW forecast inputs tabulated below result from the following state programs:
  - Renewable Energy Growth Program (REGP)
  - Renewable Energy Fund (REF) program
  - Virtual New Metering (VNM) program

- At the end of REGP, all MWs from last year of the program are carried forward until 2032 at a constant rate, and post-policy discount factors are applied

RI Forecast Inputs

| Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
REGP	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9
REF/VNM	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0

Vermont Forecast Assumptions
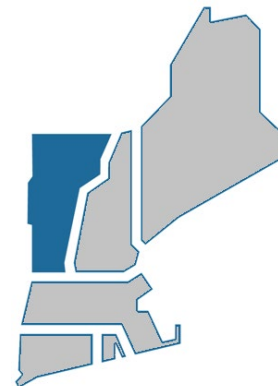
- Policy information is contained in the VT Department of Public Service (VT PSD) presentation to the DGFWG on December 5, 2022

- VT Distribution Owner reported a total of 451.1 MW_{AC} installed through 12/31/2022, including 16.8 MW_{AC} in 2022

- DG carve-out of the Renewable Energy Standard (RES) and its supporting policies (Standard Offer Program, net metering) drive distributed PV growth to match a growing share of VT's annual load energy, with the following assumptions:
  - All forward-looking renewable energy certificates (RECs) from Standard Offer and net metered projects will be sold to utilities and count towards RES DG carve-out
  - Load growth is assumed to reflect 2022 CELT net energy forecast (tabulated below)

VT Forecast Inputs

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Load Net Energy Growth (% of 2022)	0.1%	0.7%	1.3%	2.7%	4.6%	7.2%	9.7%	12.9%	16.2%	19.5%
Renewable Energy Standard	30.0	30.2	30.4	30.8	31.4	32.2	32.9	33.9	34.9	35.8

New Hampshire Forecast Assumptions
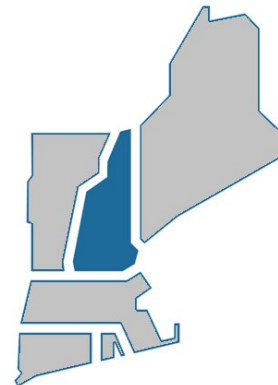
- Policy information is contained in the NH Department of Energy (NH DOE) presentation to the DGFWG on December 5, 2022

- NH Distribution Owners reported a total of 183.4 MW_{AC} installed through 12/31/2022, including 26.5 MW_{AC} in 2022

- Assume the Net Energy Metering Tariff continues to support the 2022 rate of growth throughout the forecast horizon as tabulated below

NH Forecast Inputs

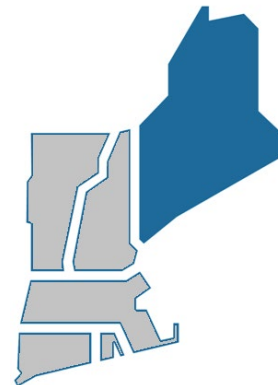| Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Net Metering MW	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5

Maine Forecast Assumptions

- Policy information is contained in the ME Governor's Energy Office (ME GEO) [presentation](#) to the DGFWG on December 5, 2022

- ME Distribution Owners reported a total of 294.6 MW_{AC} installed through 12/31/2022, including 169.5 MW_{AC} in 2022

- Annual state MW forecast inputs tabulated below result from the following state programs:
  - Net Energy Billing (NEB), 2-5 MW projects
    - Assume 750 MW total, minus 178.8 MW installed through 12/31/2022
  - NEB Successor, 2-5 MW projects
    - Assume 560 MW total program goal, minus 5% of program capacity assumed to be installed in Maine Public District (i.e., outside of ISO New England)
  - NEB, < 2MW projects

- At the end of NEB (2-5 MW), all MWs from last year of the program are carried forward until 2032 at a constant rate, and post-policy discount factors are applied

ME Forecast Inputs

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
NEB (2-5 MW)	271.3	271.3								
NEB (2-5 MW) - Successor			106.4	106.4	106.4	106.4	106.4	106.4	106.4	106.4
NEB <2MW	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0

Discount Factors

- Discount factors are:
  - Developed and incorporated into the forecast to consider a degree of expected uncertainty
  - 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 23) 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 are fulfilled*
Discounts for uncertainty associated with future market and grid conditions (maximum value of 15%)	**Generally higher discounts due to the greater uncertainty associated with future state policies, in addition to future market and grid conditions**

Discount Factors Used

Policy-Based

Forecast Year	Final 2022 Forecast	Draft 2023 Forecast
2023	10%	5%
2024	15%	10%
2025	15%	15%
2026	15%	15%
2027	15%	15%
2028	15%	15%
2029	15%	15%
2030	15%	15%
2031	15%	15%
2032	N/A	15%

Post-Policy

Forecast Year	Final 2022 Forecast	Draft 2023 Forecast
2023	31.1%	30.0%
2024	32.2%	31.1%
2025	33.3%	32.2%
2026	34.4%	33.3%
2027	35.6%	34.4%
2028	36.7%	35.6%
2029	37.8%	36.7%
2030	38.9%	37.8%
2031	40.0%	38.9%
2032	N/A	40.0%

Draft 2023 Forecast Inputs

Pre-Discounted Nameplate Values

States	Pre-Discount Annual Total MW (AC nameplate rating)											Totals
	Thru 2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
CT	911.8	180.3	193.8	193.8	153.8	153.8	153.8	153.8	153.8	153.8	153.8	2,556.4
MA	3289.2	366.7	366.7	366.7	366.7	366.7	366.7	366.7	366.7	366.7	366.7	6,955.9
ME	294.6	291.3	291.3	126.4	126.4	126.4	126.4	126.4	20.0	20.0	20.0	1,569.2
NH	183.4	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5	448.2
RI	325.6	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	874.4
VT	451.0	30.0	30.2	30.4	30.8	31.4	32.2	33.0	34.0	35.0	36.0	774.3
Pre-Discount Annual Policy-Based MWs	5455.6	949.7	963.4	798.6	759.1	759.7	760.5	306.1	170.8	171.8	107.5	11,202.7
Pre-Discount Annual Post-Policy MWs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	455.2	591.4	591.4	656.8	2,294.8
Pre-Discount Annual Total (MW)	5455.6	949.7	963.4	798.6	759.1	759.7	760.5	761.3	762.2	763.3	764.3	13,497.5
Pre-Discount Cumulative Total (MW)	5455.6	6,405.2	7,368.6	8,167.2	8,926.3	9,686.0	10,446.5	11,207.7	11,970.0	12,733.2	13,497.5	13,497.5

Notes:
(1) The above values **are not the forecast**, but rather pre-discounted inputs to the forecast (see slides 15-20 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 2023 PV NAMEPLATE CAPACITY FORECAST
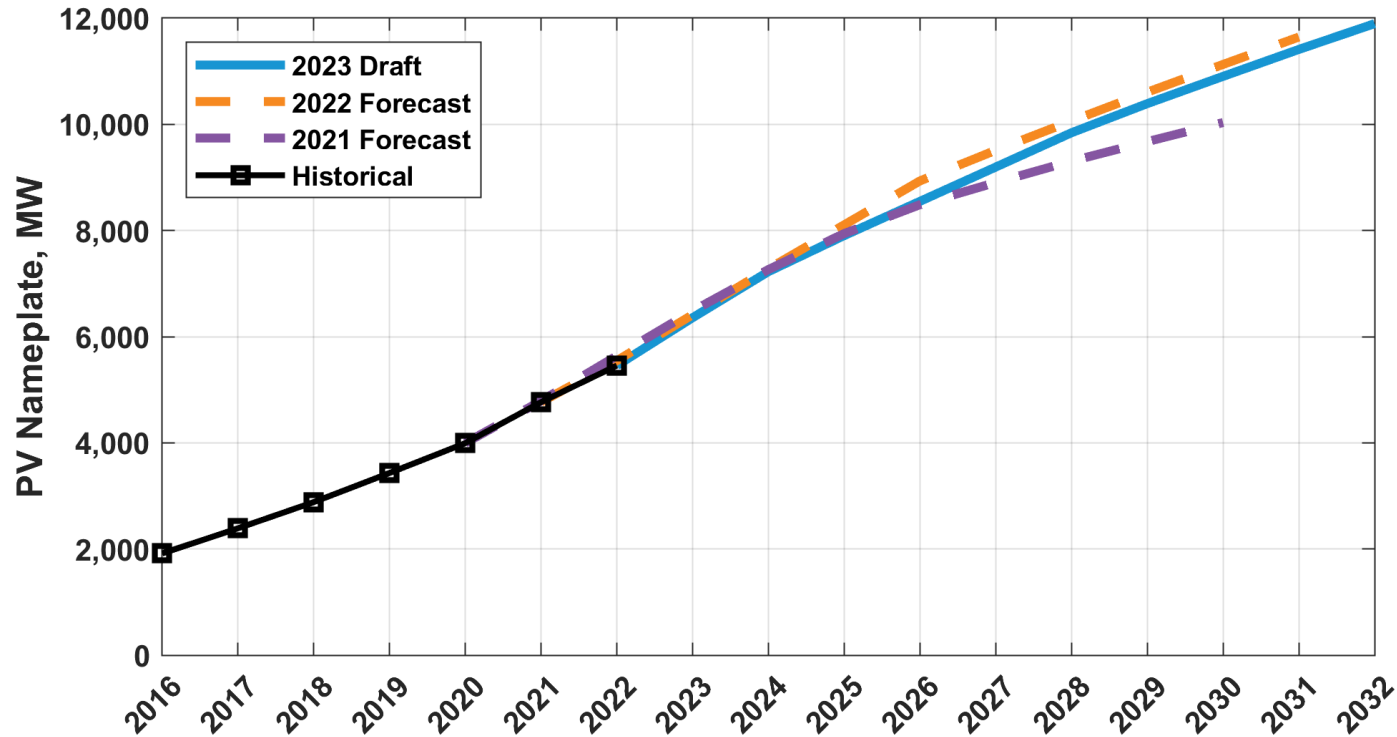
Draft 2023 PV Forecast

Nameplate Capacity, MW$_{ac}$

States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
CT	911.8	171.3	174.4	164.7	130.7	130.7	130.7	111.6	110.6	109.6	92.3	2,238.5
MA	3289.2	348.3	330.0	311.7	311.7	311.7	311.7	232.2	228.1	224.1	220.0	6,118.7
ME	294.6	276.8	262.2	107.4	107.4	107.4	107.4	107.4	83.2	82.0	80.8	1,616.8
NH	183.4	25.2	23.8	22.5	22.5	22.5	22.5	22.5	22.5	22.5	22.5	412.5
RI	325.6	52.1	49.4	46.6	46.6	46.6	46.6	46.6	39.8	39.5	39.2	778.9
VT	451.0	28.5	27.2	25.8	26.2	26.7	27.4	28.1	28.9	29.8	30.6	730.3
Regional - Annual (MW)	5455.6	902.2	867.0	678.8	645.2	645.7	646.4	548.4	513.2	507.5	485.5	11,895.5
Regional - Cumulative (MW)	5455.6	6357.7	7224.8	7903.6	8548.8	9194.6	9841.0	10389.4	10902.6	11410.1	11895.5	11,895.5

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

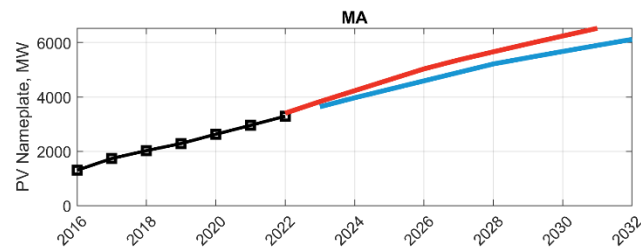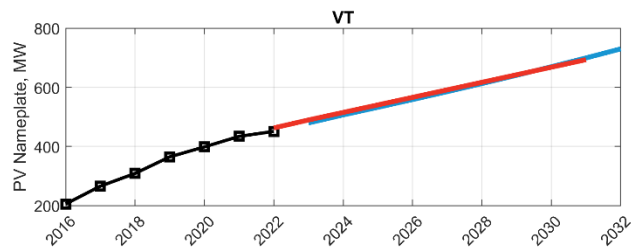(4) Forecast does not include forward-looking PV projects > 5MW in nameplate capacity
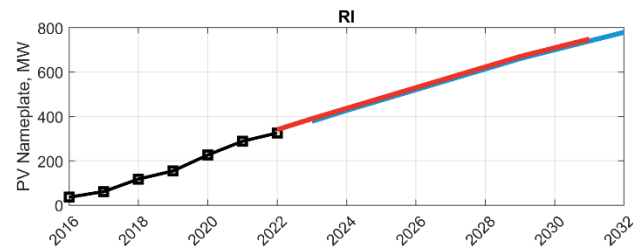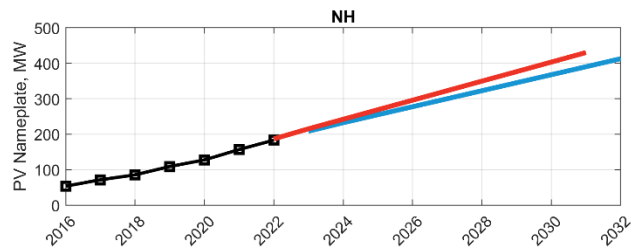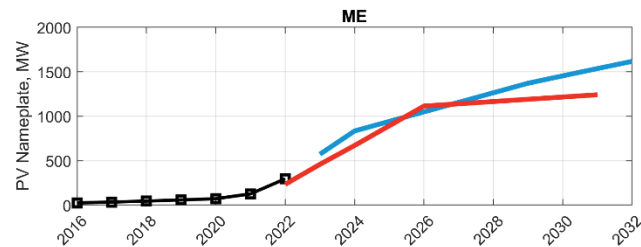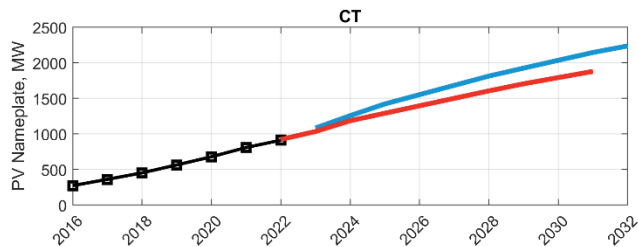
Regional PV Nameplate Capacity Growth

Historical vs. Forecast

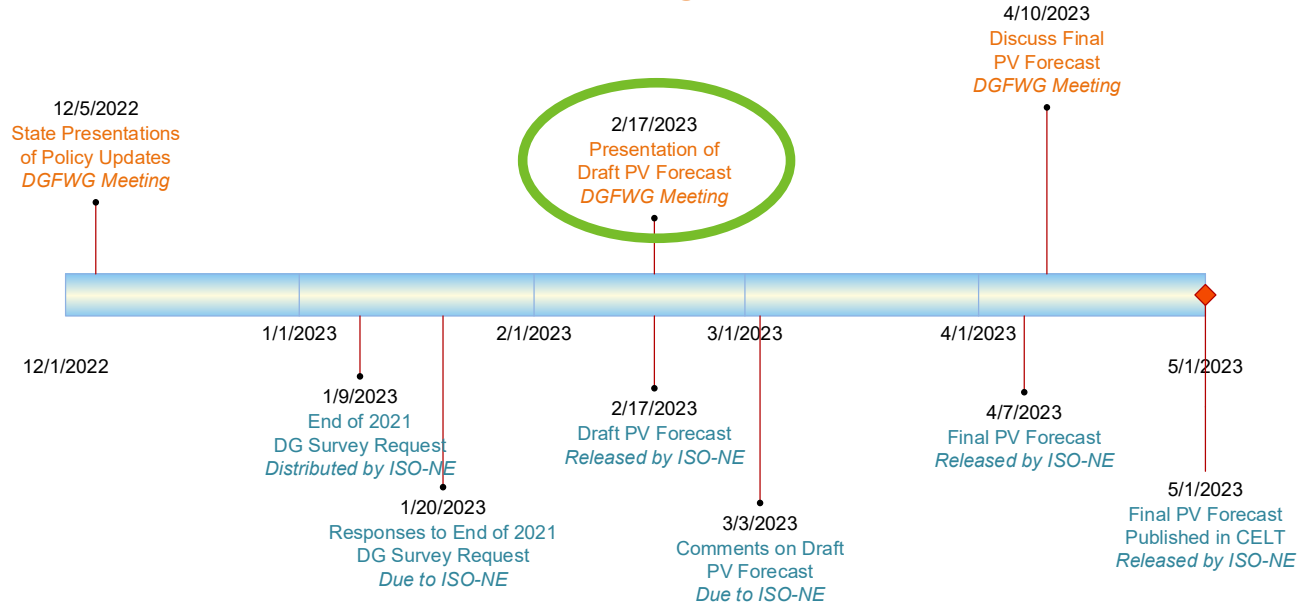# State PV Nameplate Capacity Growth

Historical vs. Forecast

NEXT STEPS

2023 PV Forecast Schedule

4/10/2023
Discuss Final
PV Forecast
DGFWG Meeting

12/5/2022
State Presentations
of Policy Updates
DGFWG Meeting

2/17/2023
Presentation of
Draft PV Forecast
DGFWG Meeting

12/1/2022

1/1/2023

2/1/2023

3/1/2023

4/1/2023

5/1/2023

1/9/2023
End of 2021
DG Survey Request
Distributed by ISO-NE

2/17/2023
Draft PV Forecast
Released by ISO-NE

4/7/2023
Final PV Forecast
Released by ISO-NE

1/20/2023
Responses to End of 2021
DG Survey Request
Due to ISO-NE

3/3/2023
Comments on Draft
PV Forecast
Due to ISO-NE

5/1/2023
Final PV Forecast
Published in CELT
Released by ISO-NE

Milestones

Next Steps for CELT 2023

- Other components of the forecast are developed once the nameplate PV forecast is finalized:
  - Breakdown of the forecast by market participation category (i.e., FCM, EOR, and BTM PV)
    - Approximately 57% of PV across the region was behind-the-meter at the end of 2021
  - PV energy forecast and estimated summer peak load reductions (based on methodology documented in this presentation)

- Section 3 of the ISO's 2023 Report on Capacity, Energy, Loads, and Transmission (CELT 2023), will include nameplate, energy, and estimated summer peak load reductions

- Additional BTM PV data for states, load zones, and Regional System Plan (RSP) subareas will be available in the annual Load Forecast Data workbook

Send Us Your Feedback

- Stakeholders may provide written comments on the draft 2023 forecast by March 3, 2023 @ 5:00 p.m.
  - Please submit comments to DGFWGMatters@iso-ne.com

- ISO thanks the DGFWG for its input

Questions