Status of Net Metering: Assessing the Potential to Reach Program Caps

J. Heeter, R. Gelman, and L. Bird
National Renewable Energy Laboratory

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September 2014

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Prepared under Task No. SM13.1595

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Acronyms

CPUC	California Public Utilities Commission
DG	distributed generation
DML	Daily minimum load
DPU	Department of Public Utilities
EIA	Energy Information Administration
HECO	Hawaiian Electric Companies
IOU	investor-owned utility
kW	kilowatt
LIPA	Long Island Power Authority
PSC	Public Service Commission
MassACA	Massachusetts System of Assurance of Net Metering Eligibility
MW	megawatt
NEM	net energy metering
PG&E	Pacific Gas & Electric
PUC	Public Utilities Commission
PV	photovoltaics
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
SEIA	Solar Energy Industries Association

Executive Summary

Several states have recently addressed—or are currently addressing—the issue of net metering program caps, which limit the total amount of net metered generating capacity that can be installed in a state or utility service territory. In this analysis, we examined net metering program caps to forecast how long net metering would be expected to be available in various jurisdictions under current policies. We also surveyed state practices and experience to understand important policy design considerations. Key findings include:

- **Just over half of states with net metering policies today include caps on net metered capacity; several states without caps have triggers that when reached enable net metering to be reviewed.** Of the 44 jurisdictions with net metering, 25 (57%) have some type of restriction on total eligible capacity, 16 (37%) have no restrictions, and 3 (7%) have notification or trigger policies. The level of net metering caps generally ranges from 0.2% to 9% of peak demand; two jurisdictions have substantially higher caps of 15% and 20%.
- **Currently, most states are substantially below their net metering caps or trigger levels, with the exception of New Jersey and Hawaii. Some utilities in Massachusetts and Vermont recently reached caps, prompting legislative action.** New Jersey has exceeded its trigger level, where a review of net metering could be undertaken, but there is no binding net metering program cap. Hawaii has placed restrictions on the availability of net metering and makes the determination based on penetrations at individual circuits.
- **Based on projections of near-term distributed PV capacity additions, a handful of states could reach current cap levels by 2018**. Assuming caps remain fixed at currently established levels, states that could reach or exceed the net metering cap in this timeframe include California, Delaware, Nevada, and New York.
- **Considerations for setting and adjusting net metering cap levels may include interaction with other policies as well as potential rate and grid impacts.** In setting cap levels, some policymakers have considered the interaction of net metering with state or local policy goals for distributed generation as well as federal policies. Another consideration is the potential financial impact on the utility and ratepayers.
- **Communication about the status of net metering when installations are nearing the level of the cap is important for providing certainty to solar customers and project developers.** Uncertainty about the availability of net metering can impede the PV market.
- **Clear definitions of caps and data sources are important for providing accurate information to the market about progress toward reaching a cap.** Imprecise or ambiguous definitions in legislation have led to challenges in a few commissions and delayed implementation.

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1 Introduction

As increasing amounts of distributed solar are installed, there has been heightened interest in the policies that support such development. Net metering—which allows customers with on-site generation to offset the electricity they use—is once such policy. Net metering is a billing arrangement for the electricity exported by a behind-the-meter system. As of May 2014, 43 states and Washington, D.C. have adopted net metering policies. However, no two net metering policies are the same. Policies differ in the technologies eligible to net meter, the system sizes allowed, how net excess generation is credited, and, as is the topic of this paper, the aggregate capacity limit allowed. Net metering program caps—as opposed to eligible system size caps—place limits on the total amount of net metering that can be installed in a state or utility service territory.[1]

Substantial increases in net metered capacity in several states have placed increasing attention on program caps. The number of electricity customers who use net metering increased exponentially from fewer than 7,000 in 2003 to more than 450,000 in 2013 (Figure 1). Growth has continued in 2014, with more than 75,000 additional net metered customers reported through May 2014. However, despite this growth, in 2013 these customers represented only 0.3% of the more than 145 million electricity consumers in the United States (Energy Information Administration [EIA] 2013).[2]

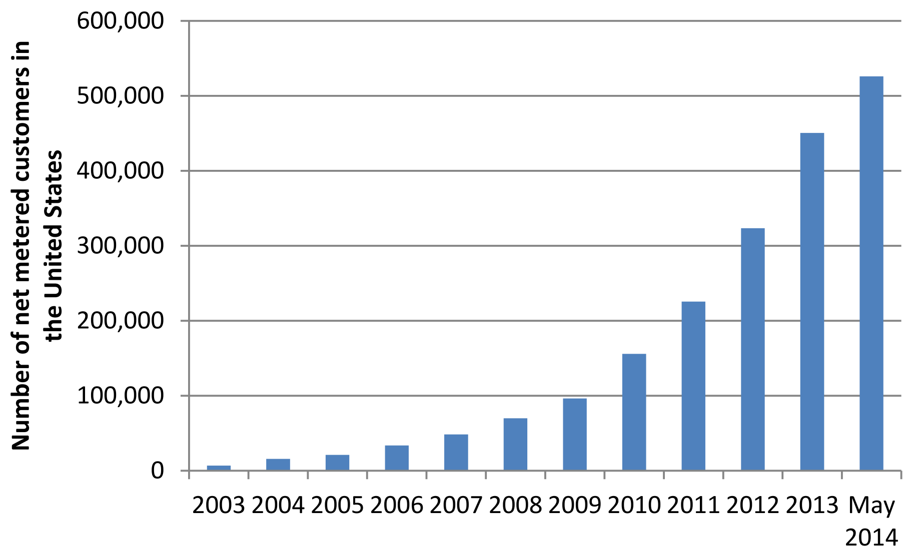


Figure 1. Number of net metered customers in the United States

Source: EIA (2014)

As the solar market continues to expand, some utilities and regulators are considering how to transition rates and incentive programs, including net metering. Capping the availability of net

[1] Net metering program caps are also referred to as *aggregate capacity limits*.

[2] Data from 2013 and May 2014 are from EIA's Form 826, which represents a subset of respondents; therefore, these figures underestimate the total number of net metered customers.

metering can be viewed as a way to limit a utility's risk to loss of revenue from net metering customers. Utilities have expressed concerns about the ability to fully recover fixed costs under net metering tariffs for distributed generation (Kind 2013; Bird et al. 2013).

Fitch Ratings (2013) argues that increasing distributed generation (DG) could have financial impacts for utilities and recommends that regulators cap aggregate net metering installations, as one of many changes. Capping the availability of net metering might also be viewed as a way for the public utilities commission (PUC) to engage in increased dialogue with stakeholders about the value of DG, a dialogue that is occurring in an increasing number of states. In Louisiana, the PUC is evaluating net metering after several utilities noted that current net metering exceeds the 0.5% threshold; though there is disagreement about the method for calculating the threshold.

The availability of net metering also has implications for photovoltaic (PV) project economics; research shows that net metering is an important market driver for solar PV (Steward et al. 2014). The Freeing the Grid rankings, which grade states according to their net metering and interconnection policies, finds that best practice is to not have a net metering program cap. Freeing the Grid 2012 notes that "Capacity limits artificially restrict the expansion of on-site renewable generation and curtail the market for new renewable energy systems" (Interstate Renewable Energy Council (IREC) and The Vote Solar Initiative 2013, p. 17).

Many states have modified their aggregate net metering capacity limits in recent years. In some cases, legislatures and PUCs have made these changes to align with solar policy goals and/or in anticipation that the net metering program cap would be reached soon. In 2014, legislators in Massachusetts, South Carolina, and Vermont have sought to revise net metering program caps, while regulators in Louisiana are examining how the cap is calculated.

This report provides objective analysis on issues related to establishing and implementing net metering program caps. Information was obtained through interviews with state PUC staffs regarding cap design and implementation. Section 2 discusses how net metering program caps are defined and have evolved over time. Section 3 analyzes net metering penetrations at the state level and when net metering program caps may be reached in the future. Data for analyzing current net metering caps are primarily derived from state Public Utility Commission staff or websites, utility filings, and public or industry market data. Finally, Section 4 discusses implementation issues that state legislatures and PUCs may decide to consider.

2 Defining the Net Metering Program Cap

There are a variety of methods of instituting caps on net metering programs (see Figure 2, Table 1, and Appendix A). As of August 2014, of the 44 jurisdictions with net metering, 25 (57%) have some type of restriction, 16 (37%) place no restriction on the aggregate capacity, and 3 (7%) have notification or "trigger" policies. Trigger policies establish a threshold after which the utility and/or PUC can take action to modify net metering but do not require that action be taken.

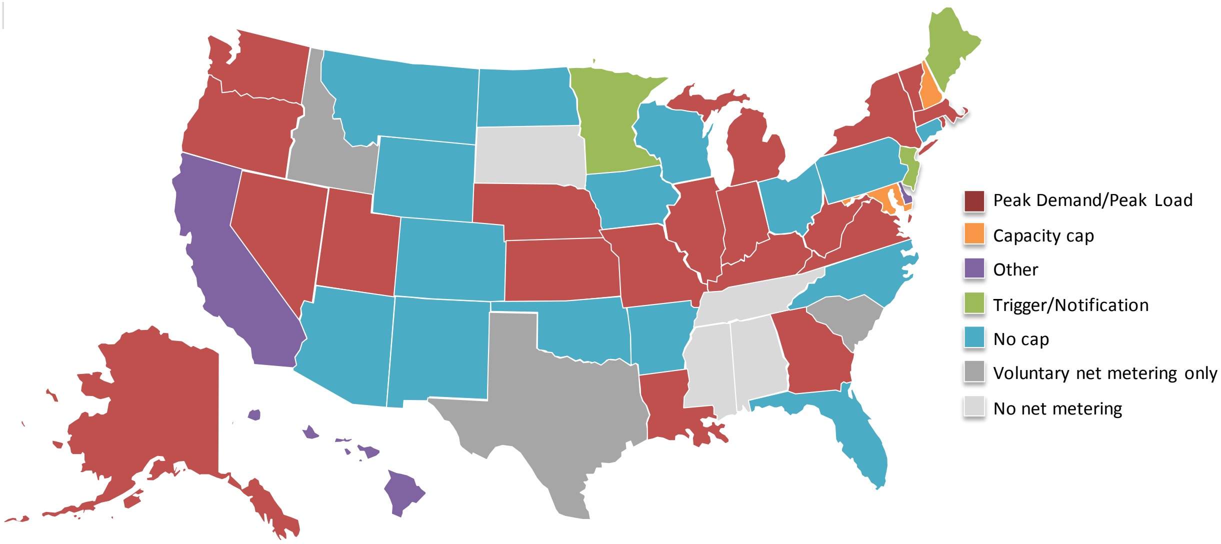


Figure 2. State net metering program cap policies

States have addressed net metering program caps or triggers in the following ways:

- **Percent of peak demand, capacity, or load.** The most common program cap is based on a percentage of the utility or state's peak demand, capacity, or load in a given reference year (e.g. the previous year) (see Figure 2). Twenty states have a program cap of this nature. The percentage allowed under a peak demand cap is 0.2%–9%, with two notable exceptions: Vermont's cap was recently raised to 15% and Rocky Mountain Power in Utah has a cap of 20%.
- **Megawatt (MW) cap.** Some states have established caps at a fixed number of MW. Maryland caps net metering at 1500 MW and New Hampshire caps net metering at 50 MW.
- **Percent of non-coincident customer peak demand or aggregated customer monthly demand**. Non-coincident peak demand is the sum of individual customer peak demands, used by California. Delaware uses "aggregated customer monthly demand," though the exact definition has not been specified.
- **Trigger mechanism.** Three states (Maine, Minnesota, and New Jersey) have implemented trigger mechanisms, rather than binding caps. Maine and New Jersey base their trigger mechanisms on a percentage of peak demand, while Minnesota bases the trigger on a percentage of retail sales.

The structure and definition of net metering program caps are important because how the cap is defined impacts the total amount of net metering that will be deployed in the state. The cap definition can have a large impact; for example, in Vermont, utilities reached the previously enacted 4% of peak demand program cap, but when measured on an energy basis, the utilities obtain less than 1% of total energy from distributed resources. The California Public Utilities Commission's (CPUC) clarification of the net metering program cap led to approximately a doubling of the allowed net metering capacity (see Text Box 5 for more on California). Because many states have solar carve-out targets or other solar program goals, policymakers may decide to consider how these separate policies interact if they are instituting or revising a net metering program cap.

Table 1. State Net Metering Program Caps or Triggers by Type

Current net energy metering (NEM) aggregate cap	State	Percent	Reference year
Peak demand/capacity/load	Utah	20%	2007
	Vermont	15%	Greater of 1996 or most recent calendar year
	Illinois	5%	Previous year
	Missouri	5%	Previous year
	New York	3% for non-wind; 0.3% for wind	2005
	Massachusetts	5% for governmental customers; 4% for all other customers***	Highest historical
	Nevada	3%	Not mentioned
	West Virginia	3%	Previous year
	Rhode Island	3%	Not mentioned
	New Jersey*	2.5%	Not mentioned
	Alaska	1.5%	Not mentioned
	Nebraska	1%	Not mentioned
	Kansas	1%	Previous year
	Indiana	1%	Most recent
	Virginia	1%	Adjusted forecast for previous year
	Kentucky	1%	Previous year
	Maine*	1%	Not mentioned
	Michigan	0.8%	Previous year
	Washington	0.5%	1996
	Oregon	0.5%	Historic
	Louisiana	0.5%	Not mentioned
	Georgia	0.2%	Previous year
Megawatt (MW) cap	Maryland	1500 MW	N/a
	New Hampshire	50 MW	N/a
Retail sales	Minnesota*	4%	Not mentioned
Aggregated customer monthly demand	Delaware	5%	During a calendar year
Varies by utility**	Hawaii	N/a	N/a
Sum of non-coincident customer peak demand	California	5%	During any calendar year

Source: Compiled from data provided to NREL by Keyes, Fox & Wiedman (2014)
* Trigger only; not a cap.
** Effectively no cap for HECO. For KIUC, 1% of the utility's peak demand, 50% of this amount reserved for systems 10 kW or smaller.
*** Smaller systems are exempted from the cap: On single-phase service, systems <10 kW are exempt, on three-phase service, systems <25 kW are exempt.
No cap: Arizona, Arkansas, Colorado, Connecticut, Washington, D.C., Florida, Iowa, Montana, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Wisconsin, Wyoming.

There are advantages and drawbacks to different net metering program cap structures:

- Most states use some metric of peak demand or peak load; however, there are differences in terms of what reference year is used as the baseline. A current year baseline could allow utilities to exceed the cap without knowing it, because the reference year capacity might not be known until the end of the year. Utilities using a current year baseline, that also see peak demand or peak load decline, would see the aggregate net metering cap decline, allowing for fewer net metered systems than currently exist.
- Using a capacity cap can be more straightforward, because it does not require calculation based on a reference year; however, capacity caps do not take into account the relative penetration of net metering on the grid.
- Triggers or notification measures can prompt a regulatory discussion about the status of net metering, without requiring the utilities to suspend net metering.

Some states have unique approaches to specifying the program cap. Delaware and California use percentages of aggregated customer demand, though in Delaware, the exact definition has not been specified. In California, net metering is capped at 5% of non-coincident peak demand during any calendar year. Utilities in Hawaii previously had caps based on a percent of peak demand, but those caps were replaced with interconnection study requirements for circuits that have reached specific penetration levels (discussed later in Text Box 4).

Another consideration is whether to include community solar or virtual net metered facilities (also referred to as *aggregated net metering*) in the overall net metering cap. Virtual net metering refers to the practice of having several customers net meter the output of a single PV system. For example, some states allow PV systems installed on apartment buildings to be net metered by building occupants. Other states allow different financial arrangements. These types of systems can be larger than typical residential systems and can affect the speed at which caps are reached, where allowed. Text Boxes 1 and 2 discuss the potential impact of community solar, virtual net metering, and value of solar programs on net metering program caps.

Text Box 1. Examples of Availability and Impacts of Community Solar and Virtual Net Metering on Program Caps

Virtual net metering enables electricity consumers not located in the same site to use net metering. Virtual net metering is typically used as part of a community solar program, where customers can purchase solar panels from a larger array and receive the benefits of net metering, just as if the solar panels were located at their home. States with virtual net metering include: Colorado, Connecticut, Delaware, Maine, Massachusetts, Minnesota, and Vermont, though Colorado, Connecticut, and Maine do not have aggregate net metering program caps or triggers. However, virtual net metering legislation is not required for a community solar project to be developed. Community solar projects have also been developed in Arizona, California, Florida, Georgia, Kentucky, Maryland, Michigan, North Carolina, New Mexico, Oregon, Utah, Virginia, and Washington.

In some cases, solar arrays installed as part of a virtual net metering or community solar program may contribute toward the state or utility net metering program cap. In Vermont, for example, a single 150-kW virtual net metering project has the potential to contribute significantly to the total net metered capacity in many of the state's small utility service territories.

In Massachusetts, neighborhood aggregation is allowed, and with system caps of up to 2 MW for solar facilities, there is potential for one system to influence the smaller utility program caps. For example, before net metering program caps were raised by Senate Bill 2214 in August 2014, the private net metering cap in Unitil's service territory was 3 MW. Given that Unitil had 2.6 MW interconnected or reserved as of August 2014, a single neighborhood aggregation of 2 MW would have put the utility over its cap. Massachusetts' guide to community solar notes that the state's net metering caps may inhibit community solar developers; the level of resources required to apply for the System of Assurance for net metering may be large enough to discourage those considering developing a community solar project (MA DOER and Cadmus n.d.).

Text Box 2: Minnesota's Value of Solar and Community Solar Programs

Minnesota's H.F. 729, passed in 2013, established a process for creating a value of solar tariff as well as community solar programs. However, the law left unclear whether solar projects under these programs would use net metering, and thus fall under Minnesota's net metering trigger.

Minnesota's net metering trigger, passed as part of H.F. 729, allows utilities that have reached 4% net metering penetration, on a retail sales basis, to petition the PUC to limit additional net metering. The PUC may limit additional net metering only if it would cause "significant rate impact, require significant measures to address reliability, or raise significant technical issues" (Minnesota Statutes 2012, section 216B.164, Subd. 4b) (Office of the Revisor of Statutes, State of Minnesota 2013).

However, because projections for the solar standard, given exemptions and bonuses, are less than 1% of retail sales, even if both the community solar programs and value of solar installations do use net metering, it is unlikely that utilities in Minnesota will reach the trigger in the near term.

2.1 Program Caps Have Increased Over Time

Many PUCs and state legislatures have modified net metering program caps over time. In the early 2000s, program caps were generally at 1% or less of peak demand, while today, a much wider range of program caps exist, with a number of caps at 5% of peak demand or more (Figure 3). Although states define program caps in numerous ways, Figure 3 shows that caps, once instituted, have always increased over time. In addition, a number of states that had policies initially without caps have instituted them over time. Text Box 3 highlights a number of recent efforts to expand net metering program caps; other ongoing efforts to limit net metering have focused on how net metered systems are compensated, rather than on the program cap. For example, Arizona Public Service in 2013 proposed adding a fixed fee to net metered customers' bills. Kansas and Oklahoma enacted legislation in 2014 that could add charges to net metered customers' bills (H.B. 2101 and S.B. 1456, respectively).

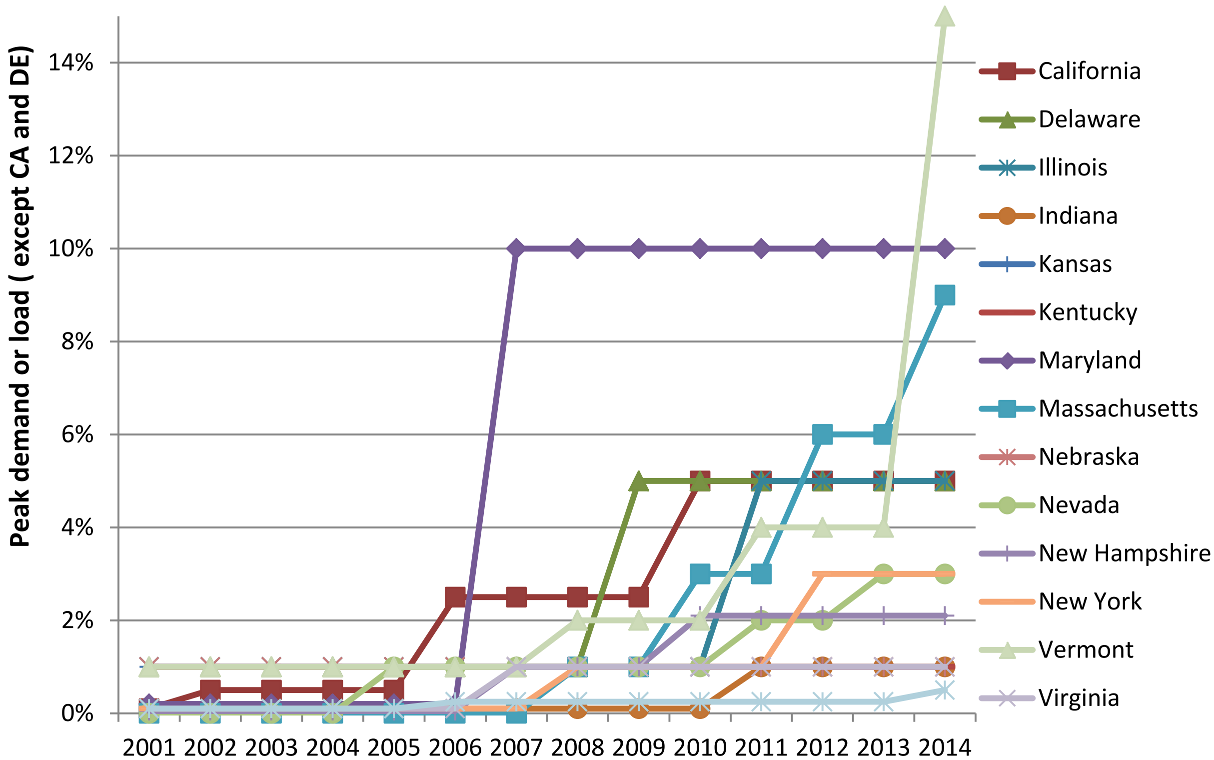


Figure 3. Major revisions to net metering program caps, 2001–2014

Notes: States that have not made revisions: Alaska, Georgia, Kansas, Kentucky, Louisiana, Michigan, Missouri, and West Virginia. See Table 1 for program caps in those states.
Massachusetts has separate caps for private (4%) and public (5%) sectors.
New Hampshire and Maryland capacity caps were converted to peak demand caps; California and Delaware use non-coincident peak demand and aggregate customer monthly demand, respectively.

In 1998, California's cap was revised from 0.1% of the utility's 1996 peak demand forecast to 0.1% of aggregate peak customer demand (AB 1755). In 2012, aggregate customer peak demand was interpreted by the PUC to mean the sum of customers' non-coincident peak demands (CPUC Decision 12-05-036, Docket 10-05-004).

Text Box 3. Recent Efforts Expanding Net Metering Program Caps

- In 2014, Vermont passed H 702, increasing the net metering program cap from 4% of retail sales to 15% of retail sales. The bill was supported by the Governor as well as the state's largest utility, Green Mountain Power.
- In August 2014, Massachusetts passed Senate Bill 2214, increasing net metering caps from 3% for the private sector and 3% for the public sector to 4% for the private sector and 5% for the public sector. The bill also establishes a task force to study the long-term viability of net metering in Massachusetts; the task force will assess and report on the costs and benefits of existing net metering. Other bills – one to remove net metering caps entirely and one to charge net metering customers a fixed fee – did not pass the legislature.
- The Louisiana Public Service Commission (PSC) issued a Request for Proposals in March 2014 for an evaluation of the benefits and costs of net metering. The process is part of an ongoing discussion at the PSC about the value of solar. Several utilities have noted that current net metering exceeds the 0.5% threshold, though stakeholders have disagreed about the method for calculating the threshold. One PSC commissioner suggested dropping the program cap in exchange for providing lower compensation to distributed generation, depending on the results of the evaluation. The evaluation must be submitted to the PSC by November 31, 2014 (Testa 2014).

Some state PUCs have the authority to adjust the cap, either for an individual utility or for all utilities; in other states, legislative action is required to modify the cap. If the state PUC has authority, it may be able to make modifications faster than if the changes require legislative approval. Legislative action requires subsequent PUC rulemaking, which can delay the process.

In many cases, program caps are adjusted by state legislatures or PUCs in response to utilities approaching the existing cap, or in conjunction with new DG or solar targets. For example, if a state legislature is implementing a solar target, it may decide to examine how the net metering program cap may impact the future target. A few examples follow.

Utilities Approaching the Current Cap

- In 2012, Central Hudson Gas & Electric asked the New York PSC to increase the net metering program cap, noting that it had reached the cap, was suspending new net metering applications, and would not be able to meet the goals of the NY-Sun Initiative if the cap were not raised. The PSC raised the cap for Central Hudson Gas & Electric and subsequently for other utilities in New York. (NY PSC 2012).
- In spring 2014, legislation (H.B. 702) was adopted in Vermont to increase the cap from 4% to 15% of peak demand in response to some utilities reaching the cap and no longer accepting new net metering customers.
- In California, one of the initial increases in the program cap took effect in 2005, when legislation increased the cap for San Diego Gas & Electric (SDG&E), one of three investor-owned utilities (IOUs) in the state (AB 816). SDG&E was approaching its cap and required an increase to enable the City of San Diego to reach its own DG goal of 50 MW.

New Distributed Generation or Solar Targets

In some cases, the goals of new solar policies encouraging or requiring increased solar penetration would not be fulfilled if program caps were not modified. New solar policies often, though not always, utilize net metering. In some cases, for example, in Georgia, solar systems will use an incentive program rather than net metering to fulfil Georgia's solar goals (see Section 3.2.3.3).

- In 2007, Maryland increased its program cap from approximately 35 MW to 1,500 MW. The adjustment was made at the same time as the institution of Maryland's Renewable Portfolio Standard solar carve-out, which requires that 2% of total electricity generated come from solar by 2021. SRECTrade estimates that the 2% requirement in 2021 is equivalent to 1,230 MW, which falls below the net metering cap (SRECTrade 2014). In addition, a portion of the 1,230 MW will come from non-net metered systems.
- Delaware amended its net metering law in 2009 to support the Sustainable Energy Utility's goal of 300 MW of distributed renewable energy, including 100 MW of customer-sited PV by 2019 (Delaware Senate Bill 85 2009).
- In 2008, Massachusetts passed the Green Communities Act (S. 2768), which gave the Department of Energy Resources (DOER) the authority to create the state's solar carve-out. The Act established the initial program cap of 1% of a utility's peak load.
- In December of 2013, the New York Public Service Commission adopted a new MW Block Program for solar PV that anticipates adding over 3 GWs of capacity within the next 10 years. The new Reforming the Energy Vision proceeding (14-M-0101) in New York will consider ways to either extend net metering to cover the additional anticipated capacity or replace it with a tariff system that values the contributions to distribution and environmental goals.

Text Box 4: Case Study: Hawaii's Program Cap Evolution

The net metering cap in Hawaii has evolved over time. The initial cap was established in 2006 as 0.5% of system-wide peak demand. In 2008, the Hawaii PUC increased the cap to 1% and then to 3%–4% of peak demand (Hawaii PUC 2008).

In 2011, the system-wide cap was removed, and a distribution level cap of 15% of circuit peak demand was established for circuits of 12 kV or lower. The distribution level cap functions more like a trigger, in that utilities can analyze the circuit to determine if the limit can be increased (through an Interconnection Requirements Study [IRS]).

The 15% of circuit peak demand remains in effect; however, the Hawaiian Electric Companies (HECO) have been allowing exceptions, through circuit-specific analysis. In November 2011, a "Supplemental review" process was created to streamline the interconnection process. This process involved determining within 20 days if interconnection could continue without conducting an IRS.

As of September 2013, HECO was not requiring an IRS for circuits that are below 100% of daytime minimum circuit load. HECO provides an address search tool, as well as maps indicating the percent of daytime minimum load on each circuit (Figure 4). The search tool is available at www.heco.com/portal/site/heco/lvmsearch.

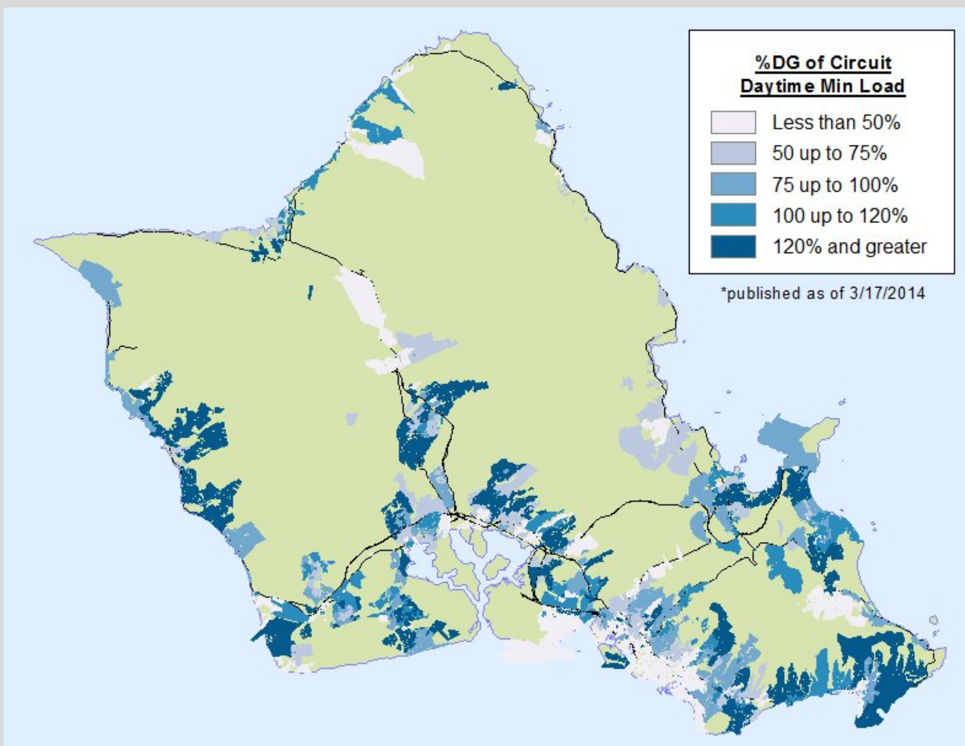


Figure 4. DG as fraction of circuit daytime minimum load, HECO

For circuits that are at or above 100% of the daytime minimum load, HECO is conducting "representative studies" rather than examining each circuit individually.

3 Projections of Net Metering Penetration

As distributed PV penetrations have increased, a few states and utilities have approached their net metering caps or triggers. Others could reach caps in coming years, depending on the rate of future installations. For the solar industry and customers interested in installing PV, the availability of net metering is an important consideration for project economics. Net metering has also been found to be a statistically significant driver of the solar market (Steward et al. 2014). For utilities, the availability of net metering may be a concern from a revenue erosion or reliability perspective.

This section uses the best available data to assess the current percentage of net metering program caps that have been met to date. We also examine when states may reach their program caps in the future. This information is useful to state policymakers, regulators, utilities, and solar installers. Knowing when the caps may be reached can help these stakeholders engage in meaningful dialogue about future solar policy. We focus on a subset of all states: those with program caps or triggers that also have or may have significant solar targets.

3.1 Current Status

We estimate the net metering cap/trigger (MW), the current state of net metering (MW), and the percent of cap met (Table 2) using data available from utilities, PUCs, EIA, and other sources (see Table 3). We examine states that have a net metering cap or trigger and that have a solar policy in place that is anticipated to drive future net metering installations. Based on data available as of March 2014, New Jersey is the only state that has surpassed its statewide trigger, though other states are approaching their caps and have seen individual utilities meet their caps. Before the passage of HB 702 in Vermont, the state had filled 92% of the statewide cap. However, with the cap now increased from 4% to 15% of peak demand, the state has filled less than 25% of its cap.

Table 2 includes the latest authoritative data on each state's progress toward reaching its net metering cap/trigger available as of March 2014. Because state peak demand data are not currently available in a central location, peak demand figures were gathered from contacts at PUCs and commerce departments, among other sources. Net metering caps and triggers are well documented online in the Database of State Incentives for Renewables & Efficiency (2014). PUCs and commerce departments were also imperative to gather the current net metering capacity by state, although increasingly net metering reports from individual utilities are becoming publically available.

Table 2. Current Status of Net Metering

State	Applicable Utilities	Net Metering Program Cap/Trigger	Peak Demand (MW)	Net Metering Cap/ Trigger (MW)	Current State of Net Metering (MW)	% of Cap Met	Net Metering Data Collection Date
CA	All except the Los Angeles Department of Water and Power	5% of peak demand	105,163	5,258	1,882	35.8%	Dec. 2013
DE	All Utilities	5% of monthly peak demand	1,084	54	18	33.5%	Dec. 2013
IL	State IOUs and Alternative Retail Electric Suppliers	5% of peak demand of previous year	24,715	1,236	6.5	0.5%	Dec. 2013
MD	All Utilities	1,500 MW	15,000	1,500	102	6.8%	Jun. 2013
MA	All Electric Suppliers	Public cap: 5% of peak demand	22,194	556	229	41%	Aug. 2014
		Private cap: 4% of peak demand		444	318	72%	
MN	All Utilities	4% of annual retail sales	67,100,000 megawatt-hour (MWh)	2,684,000 MWh	26,840 MWh est.	1.0%	Dec. 2012
NV	State IOUs	3% of peak demand	7,556	227	51	22.6%	Dec. 2013
NJ	State IOUs and Electric Suppliers	No set cap, but the Board of Public Utilities may limit to 2.5% of peak demand	19,928	499	869	174.1%	Dec. 2013
NY	State IOUs	3% of utility's 2005 demand for solar, farm-based biogas, fuel cells, micro-hydroelectric, and residential micro-CHP	24,309	729	112	15.3%	Sep. 2013
	State IOUs	0.3% of utility's 2005 demand for wind	24,309	73	3	4.3%	Sep. 2013
	Long Island Power Authority (LIPA)	150 MW for solar, agricultural biogas, residential micro-CHP and fuel cells		150	40	26.6%	Sep. 2013
	LIPA	0.3% of utility's 2005 demand for wind	5,100	15.3	0.4	2.3%	Sep. 2013
VT	All Utilities	15% of peak demand	1,045	157	38	24.4%	Jan. 2014

Table 3. Sources and Assumptions for Net Metering Cap Calculations

State	Applicable Utilities	Sources and Assumptions	
		Peak Demand (MW)	**Current State of Net Metering (MW)**
CA	All except LADWP	(Sorooshian et al. 2012). Includes SCE[a], SDG&E, and PG&E[b] only, not SMUD or other small utilities	SCE, SDG&E and PG&E websites: PG&E 2014, SDG&E 2014, SCE 2014
DE	All Utilities	Delmarva's total default service responsibility, as of November 2013 (The Liberty Consulting Group, Inc. 2014)	Delmarva's installed net metering capacity only (DP&L 2014)
IL	State IOUs	2013 peak for Ameren Illinois and MidAmerican Energy Company from Net Metering Reports, filed with the Illinois Commerce Commission; Ameren Illinois 2014 and MEC 2014. Commonwealth Edison 2013 peak from PJM hourly load data (PJM 2014)	2013 net metering capacity from Ameren Illinois, ComEd, and MidAmerican Energy Company's Net Metering Reports, filed with the Illinois Commerce Commission. ComEd 2014, Ameren Illinois 2014, MEC 2014
MD	All Utilities	Report on the Status of Net Energy Metering in the State of Maryland (MD PSC 2013)	Report on the Status of Net Energy Metering in the State of Maryland: MD PSC 2013
MA	State IOUs	Calculated from www.massaca.org/ and the Database of State Incentives for Renewables & Efficiency (2014)	Interconnected and reserved capacity, from: http://www.massaca.org/
MN	All Utilities	Steve Loomis, Minnesota Department of Commerce	Steve Loomis, Minnesota Department of Commerce. Estimated to be 0.04% of peak demand, converted to MWh by using 17 MW of installed net metering capacity and applying capacity factors
NV	State IOUs	July 2, 2013: Peak load for NV Power was 5,850 MW and 1,706 MW for Sierra Pacific, from Mark Harris at the Nevada PUC	Total connected net metering agreements, estimated by Jeff Healion at NV Energy
NJ	State IOUs and Electric Suppliers	2013 peak for Public Service Electric and Gas, Jersey Central Power and Light, Atlantic City Electric, Rockland Electric from PJM hourly load data (PJM 2014)	Net metering and interconnection reports available on New Jersey's Clean Energy Program (2014) website[c]
NY	State IOUs	Source: Jason Pause at the NY PSC	Source: Jason Pause at the NY Public Service Commission, connected capacity only
	LIPA	Source: Jason Pause at the NY PSC	Source: Jason Pause at the NY PSC, connected capacity only
VT	All Utilities	Andrew Perchlik and Michael Kundrath, Vermont PSD. 2012 peak demand reported.	Andrew Perchlik and Michael Kundrath, Vermont PSD. Data as of January 2014.

[a] Southern California Edison; [b] Pacific Gas & Electric
[c] We use data from interconnection and net metering reports provided by the EDCs in their semi-annual reports, though these figures differ from data reported by the New Jersey Clean Energy Program through its incentive programs.

Figure 5 graphically depicts each state's progress toward reaching its net metering cap or trigger, split by utility or technology group as designated by the net metering policy. Although New Jersey has surpassed its trigger of 2.5% of peak demand, the Board of Public Utilities has not authorized electric suppliers to cease offering net metering. The state closest to meeting its cap is Massachusetts, and the graphic below displays interconnected capacity only as a percent of the cap. The remaining states are more distant from their current net metering caps, ranging from approximately 35% to less than 1% of total allowable net metering capacity installed.

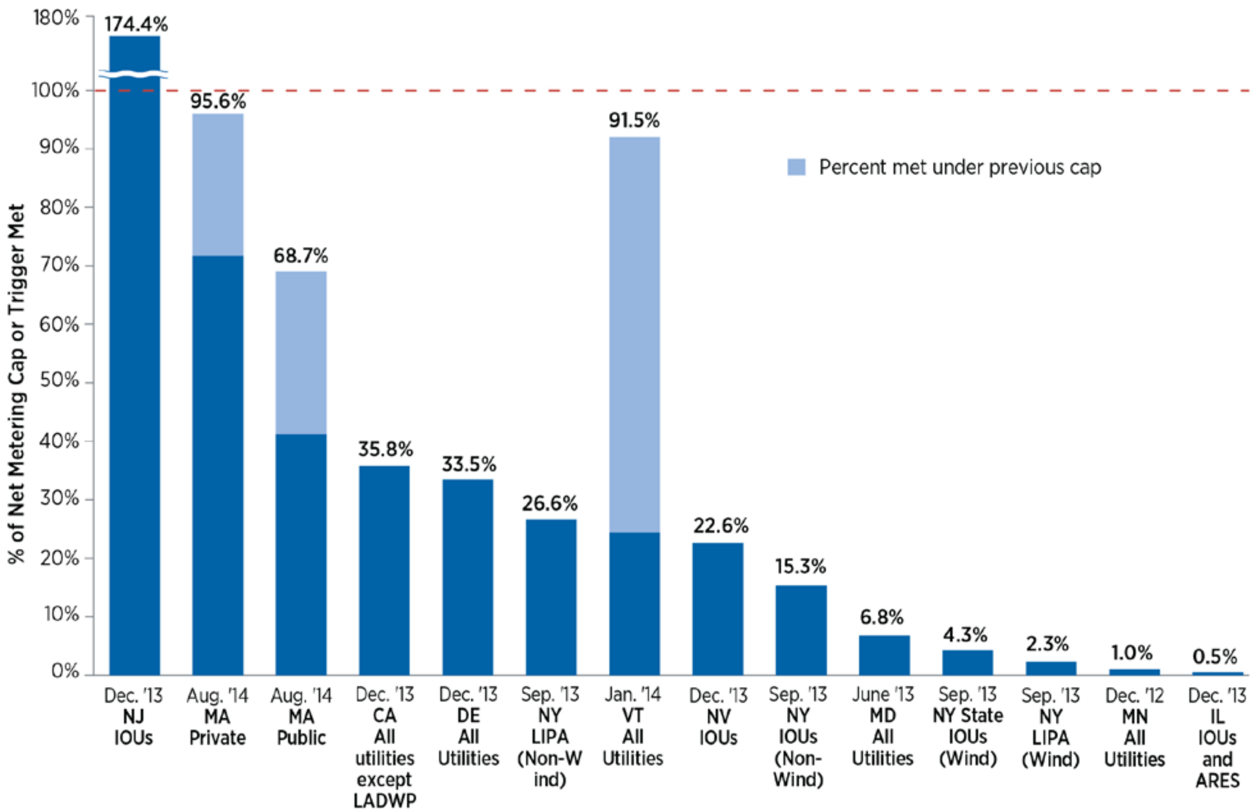


Figure 5. Progress toward reaching net metering program cap or trigger

Note: Data updated as of August 2014. Percentages represent the latest data available at the time of data collection. New Jersey has a trigger and not a cap.

As discussed in Text Box 4, Hawaii has no net metering cap for circuits that are below 100% of daily minimum load (DML); for circuits above that level, HECO is performing additional studies. Figure 6 shows the proportion of circuits that are above 100% DML. Hawaiian Electric has the largest number of circuits (416), and of those, 27% were at greater than 100% DML, and 11% were at 75% or greater DML. Hawaii Electric Light has 134 circuits, and of those, 18% were greater than 100% DML, and 15% were at 75% or greater DML. Sixteen percent of Maui Electric's 143 circuits were greater than 100% DML, and an additional 16% were at 75% or greater.

Instituting additional studies, as HECO has done, has left some solar customers waiting for a year, according to ProVision Solar, a local installer (Wesoff 2014). Customers located on a circuit that requires a study may also be paying for both their solar installation and their regular electricity bills, if their solar systems are installed but not interconnected. Going forward, HECO advises potential solar customers to first check the company's locational value map tool to determine the status of their circuits; however, HECO notes that a net metering application needs to first be approved before a spot in the queue is confirmed (HECO 2014).

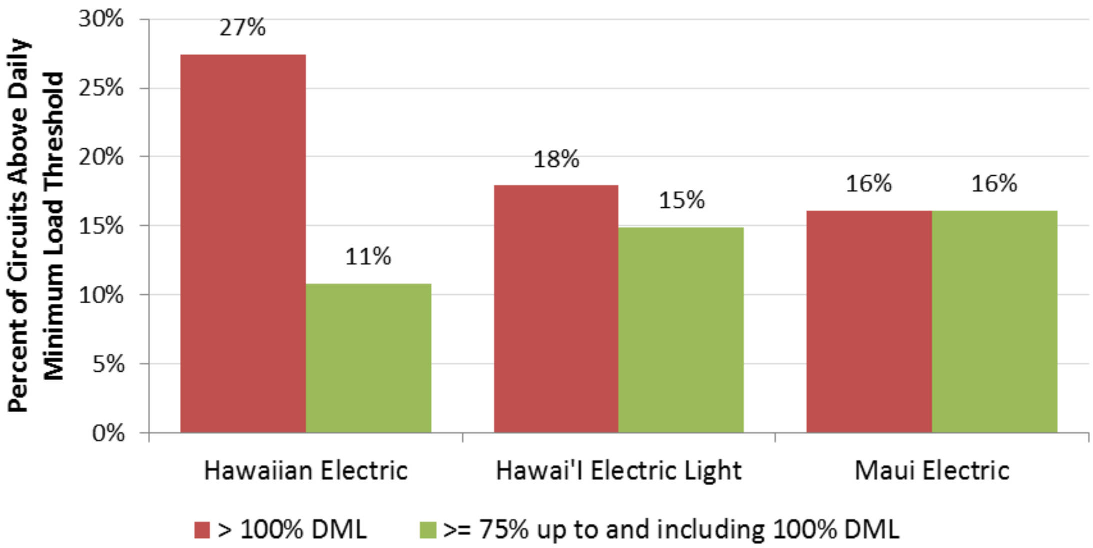


Figure 6. Hawaii circuit integration levels by utility (as of February 28, 2014)

Source: Heeter (2014c)

3.2 Future Projections

As distributed generation increases, states and utilities may approach existing net metering caps. This section focuses on those states that are projected to be closest to meeting or exceeding their net metering caps by 2019, based on projections. Note that in some states, caps are defined on a utility specific basis; as a result, and due to different net metering adoption rates in different service territories, different utilities in a given state may reach their caps at different times.

To forecast future potential to meet statewide caps, we use data sources described in Table 3 for 2013 net metering capacity. Data on current net metering were obtained from EIA, PUC and utility reports as well as from PUC staff.

External estimates of future net metering penetration are largely unavailable. Forecasts of future residential and non-residential PV do not necessarily correlate with net metered capacity. Net metered capacity may be limited to projects smaller than a certain size (e.g., 2 MW), or in the case of Massachusetts, net metered capacity covered under the program cap excludes qualified renewable projects up to 10 kW on a single-phase circuit and up to 25 kW on a three-phase circuit. Given these variations, we have adjusted forecasted residential and non-residential PV installation capacity (from GTM Research/ Solar Energy Industries Association/ [GTM/SEIA] 2014) where necessary. These adjustments are described in detail in the state summaries below. In figures 8-10 we show GTM/SEIA data in green and our adjusted forecast in blue.

This approach carries certain limitations. GTM/SEIA (2014) assume that net metering caps continue to be expanded, or that policies are revised so that they do not create a market barrier. This assumption is critical to our analysis, as it allows us to compare caps today to installations that are forecast assuming program caps are not an issue. GTM/SEIA (2014) also assume that (1) the investment tax credit (ITC) remains in place through 2016, (2) financing terms improve incrementally over the analysis period, (3) state RPSs remain mostly fixed, (4) no national RPS is adopted, (5) net metering caps continue to be expanded, and (6) solar system prices will decline at a rate forecasted by GTM Research.

In addition to the assumptions used by GTM/SEIA (2014), there are uncertainties around how much of the residential and non-residential future capacity will be net metered in each state. We have done our best to estimate the fraction of future capacity that will be net metered; however, future market and policy changes may impact these results.

Figure 7 provides an estimate of when conditions in these states may reach their net metering caps. We provide a three year range for each state, given the uncertainty in future net metering penetration. We find that states that have already met their cap or trigger include New Jersey and Hawaii. Massachusetts and Vermont saw some individual utility caps met, and overall were projected to meet caps in 2015 and 2014, respectively, before 2014 legislative action increased caps in both states. With legislative changes, we anticipate Massachusetts will meet its statewide cap around 2017, and Vermont will not meet its cap until around 2019. Delaware may reach its cap in the mid-term (2015–2016), and California, Nevada, and New York may reach their caps shortly thereafter (around 2017). Illinois, Maryland, and Minnesota will likely not reach their caps until 2019 or later (see Figure 7).

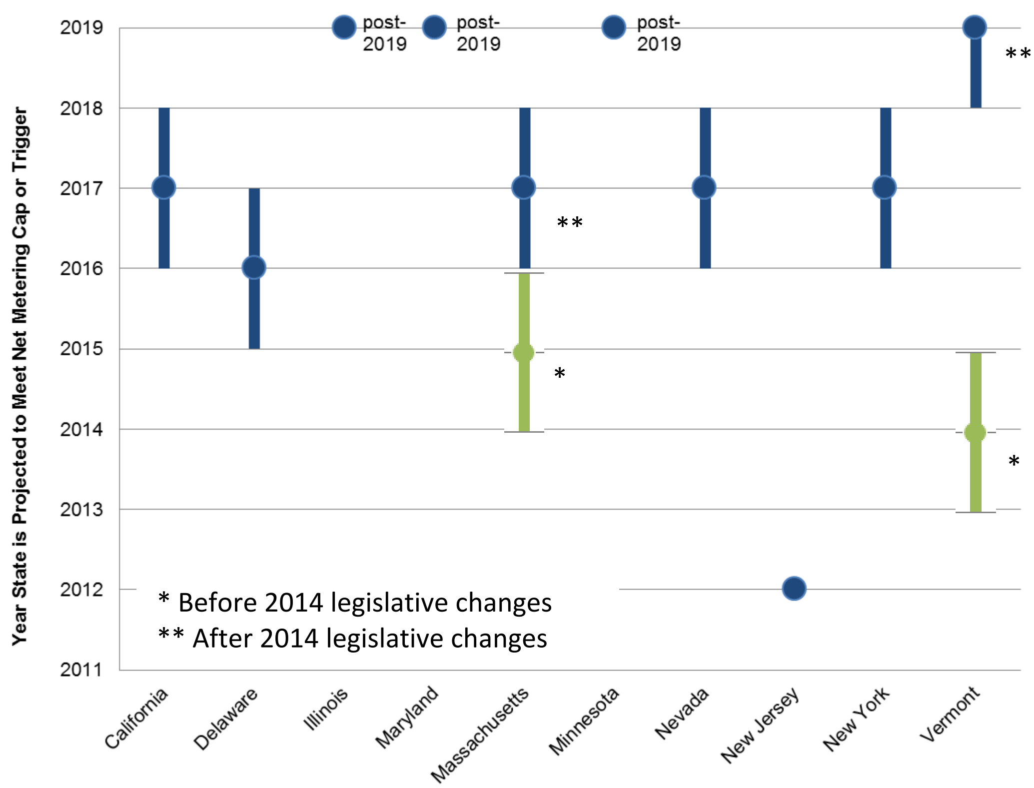
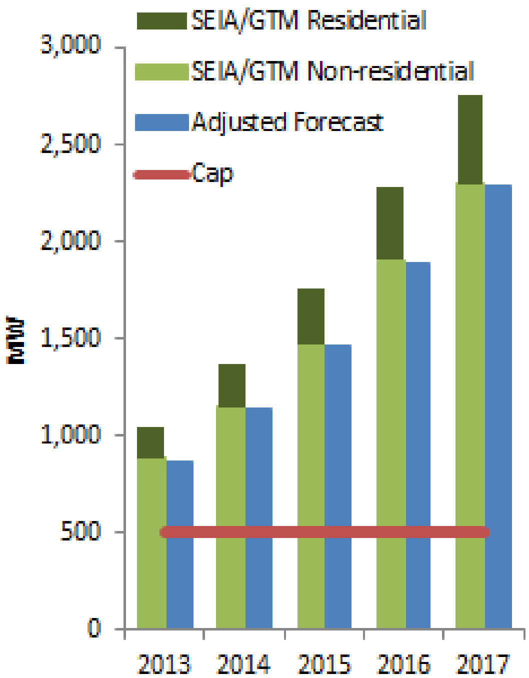


Figure 7. The range of years when states are predicted to reach net metering caps or triggers

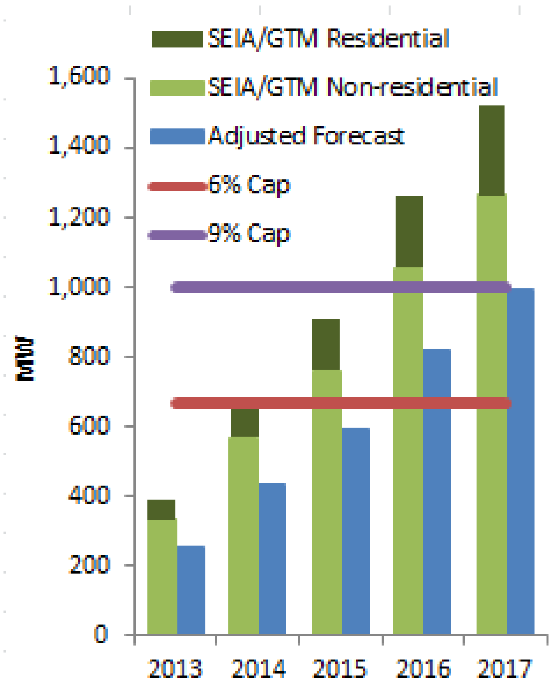
For the states covered below, we explain specific assumptions in calculating the net metered capacity and cap as well as state-specific considerations or uncertainties.

3.2.1 States Recently at or Near Statewide Net Metering Caps or Triggers

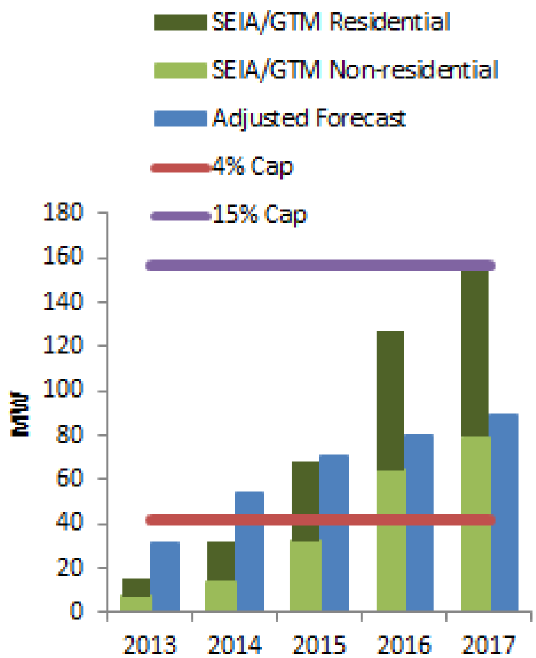
This section discusses three states—New Jersey, Massachusetts, and Vermont—that we have identified as being recently at or near their statewide net metering cap or trigger. In Massachusetts and Vermont, some service territories approached caps in 2014; subsequently, caps in those states were raised. Hawaii is not discussed in further detail here because its net metering limits are based on individual circuit penetration levels and present additional challenges.



(a) New Jersey



(b) Massachusetts



(c) Vermont

Figure 8. Current and projected net metering capacity and program cap or trigger in New Jersey, Massachusetts, and Vermont (2013–2017)

Sources: PJM (2014); EIA (2014); GTM/SEIA (2014); MassACA (2014); ISO-NE (April 2014); Heeter (2014a); Gelman (2014b)

3.2.1.1 New Jersey

In New Jersey, the program cap trigger is set at 2.5% of peak demand. Using the 2012 peak demand for Public Service Electric and Gas, Jersey Central Power and Light, Atlantic City Electric, and Rockland Electric, from PJM hourly load data, we calculate the statewide cap at 498 MW (Figure 8). As of December 31, 2013, 805 MW of net metered capacity were installed in the state, according to EIA 826 data reported by Public Service Electric and Gas, JCP&L, Atlantic City Electric, and Rockland Electric. Data for 2014–2017 are adjusted estimates from GTM/SEIA discounted at the ratio of actual NEM in 2013 to GTM/SEIA residential and non-residential solar capacity (0.77). We adjusted the data by this ratio to account for the fact that GTM/SEIA estimates of future capacity include solar that may not be net metered.

Despite reaching the program trigger, to date, the Board of Public Utilities has not authorized electric suppliers to cease offering net metering.

3.2.1.2 Massachusetts

Several distribution companies in Massachusetts were approaching their net metering caps in 2014. As of August 2014, Unitil had reached its private cap; National Grid had 34 kW available and 35.3 MW on a waiting list. Senate Bill 2214 raised the public sector cap from 3% to 5%, and the private sector cap from 3% to 4%. We project that the state as a whole is projected to reach the net metering cap around 2017 (Figure 8).

The interconnected net metering capacity subject to the cap, as of August 2014, totaled 397 MW, with an additional 150 MW reserved (Table 4). Because the cap in Massachusetts excludes systems smaller than 10 kW on single-phase circuits and systems smaller than 25 kW on three-phase circuits, we have discounted GTM/SEIA’s forward projections. We used data from OpenPV (NREL 2014) to determine that systems smaller than 25 kW represent 35% of the total capacity of systems smaller than 2 MW, which is the system size cap for most net metered facilities in Massachusetts. Using this adjusted projection, the cap is expected to be reached on a statewide level sometime in 2017, though because installations are not uniformly distributed among service territories, some distribution utilities will likely meet the private and/or public cap before 2017.

We estimate the revised total capacity cap at 999 MW (444 MW for the private cap and 555 MW for the public cap). As of August 2014, there were 229 MW interconnected or reserved under the private cap and 318 MW interconnected or reserved under the public cap (Table 4).

Table 4. Net Metering Status by Utility in Massachusetts

Company	Interconnected (a)	Reserved Cap Allocations (b)	Pending Cap Allocations (c)	Revised Net Metering Cap (August 2014)	Capacity Available under Revised Cap (d)
Private Cap (values in kW)					
NGrid	102,332	31,849	10,681	205,240	60,378
NStar	71,060	8,334	1,631	199,120	118,095
WMECO	7,980	4,021	42	33,800	21,757
Unitil	1,556	1,061	0	4,080	1,463
NGrid-Nantucket	350	0	0	1,632	1,282
Total Private	**183,277**	**45,265**	**12,354**	**443,872**	**202,976**
Public Cap (values in kW)					
Company	**Interconnected (a)**	**Reserved Cap Allocations (b)**	**Pending Cap Allocations (c)**	**Revised Net Metering Cap (August 2014)**	**Capacity Available under Revised Cap**
NGrid	115,219	38,678	0	256,550	102,653 (e)
NStar	83,247	57,564	1,929	248,900	106,160
WMECO	14,534	6,071	0	42,250	21,645
Unitil	292	2,768	0	5,100	2,040
NGrid-Nantucket	0	0	0	2,040	2,040
Total Public	**213,292**	**105,081**	**1,929**	**554,840**	**234,538**
Total Private and Public	**396,569**	**150,346**	**14,283**	**998,712**	**437,514**

Source: MassACA (2014); NREL estimates

[a] Includes (1) facilities reported by the distribution companies as interconnected as of January 24, 2013, including grandfathered facilities, (2) facilities with Transitional Cap Allocations, and (3) facilities that received Cap Allocations through the System of Assurance.
[b] Includes facilities with cap allocations under a "Reserved" or "Complete" status. Allocations may be revoked or withdrawn.
[c] Includes Applications for Cap Allocation "Submitted" under review by the Administrator, and cap allocations or applications under dispute per Section 10, D.P.U. 11-11-A, Appendix A (10/25/13). Cap allocations which are determined to be incomplete or are revoked by the administrator are included for 15 days after the finding are also included in this estimated number.
[d] Capacity available under the Caps less Reserved and Pending Allocations.
[e] Capacity available in NGrid under the Public cap is reduced to 67,400 kW if kW on the Waiting List are also subtracted from the available capacity.

3.2.1.3 Vermont

Vermont was close to reaching its cap in early 2014; however, House Bill 702, signed into law in April 2014, increased the net metering program cap in Vermont from 4% of peak demand to 15% of peak demand. The new law increases the statewide program cap from 42 MW to 156 MW. The cap of 156 MW is projected to be reached around 2019, when the Vermont Public Service Department (VPSD) will be required to have developed a new policy.

Data on peak demand come from the VPSD. As of March 2014, the state had 38 MW of net metering capacity, meaning that overall it has reached 3.7% of peak demand. A number of utilities were at or near the previous 4% of peak demand cap (Table 5).

Table 5. Net Metering Status by Utility in Vermont

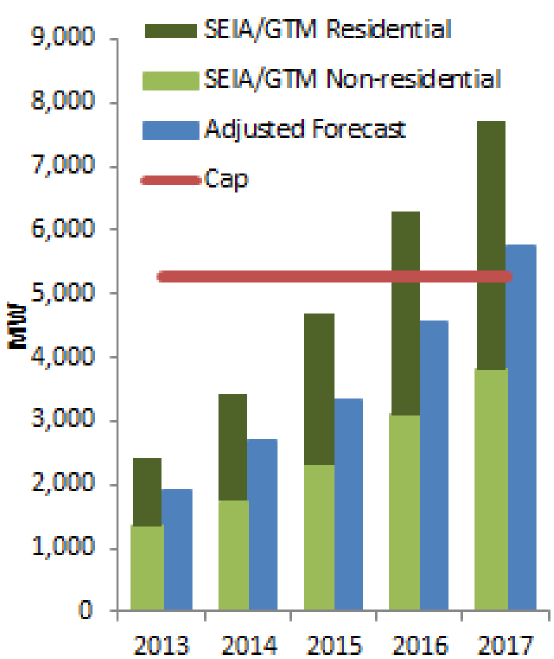
	2012 Peak Demand (kW)	Total Net Metered Capacity (kW)	% of Peak Demand
Washington Electric Cooperative	15,373	1,287	8.4%
Morrisville	8,320	491	5.9%
Hardwick	6,788	336	4.9%
Vermont Electric Cooperative	77,777	3,125	4.0%
Green Mountain Power and Central Vermont Public Service	808,000	30,366	3.8%
Burlington Electric Department	62,687	2,003	3.2%
Lyndonville	12,614	232	1.8%
Stowe	18,432	236	1.3%
Enosburg	4,484	44	1.0%
Jacksonville	1,057	6	0.6%
Swanton	10,576	14	0.1%
Barton	0	29	0.0%
Northfield	0	74	0.0%
Johnson	2,561	0	0.0%
Ludlow	12,086	0	0.0%
Total	1,045,077	38,265	3.70%

Source: Heeter (2014a); Gelman (2014b)

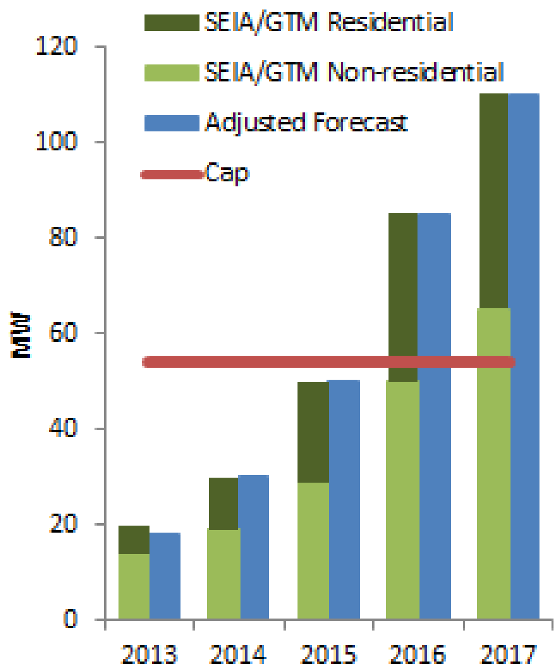
Note: Data on peak demand for Barton, Northfield, and Lyndonville are unavailable.

3.2.2 States That May Reach Caps in the Near Term

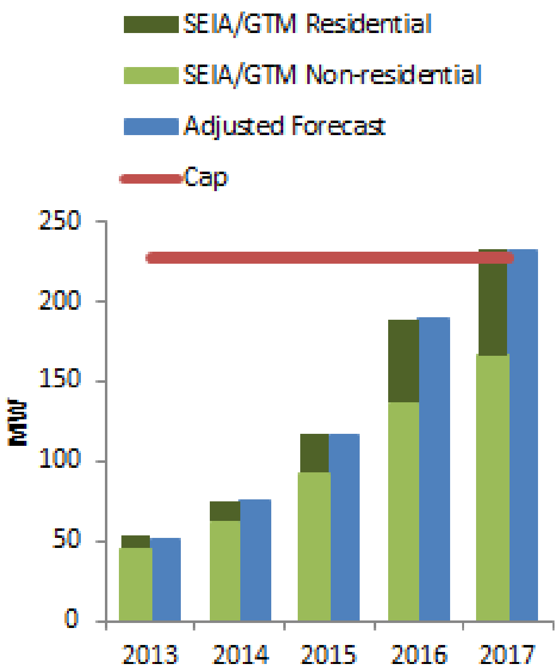
This section discusses the four states—California, Delaware, Nevada, and New York—that we estimate could reach statewide net metering caps in the near term (see Figure 9).



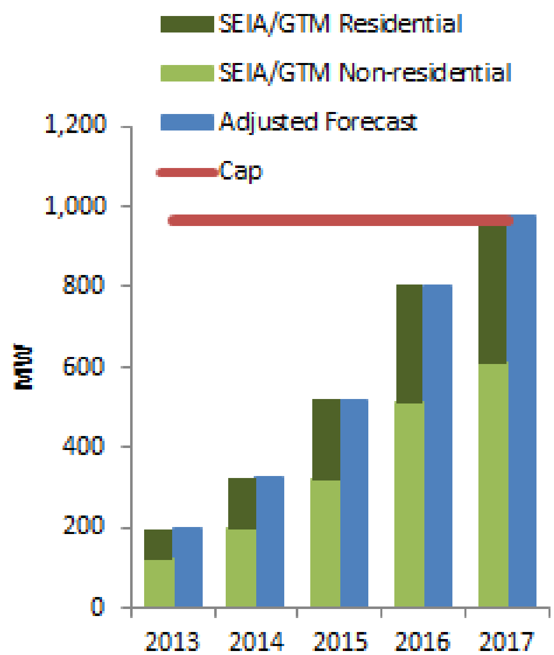
(a) California



(b) Delaware



(c) Nevada



(d) New York

Figure 9. Current and projected net metering capacity and program cap in California, Delaware, Nevada, and New York (2013–2017)

Sources: SDG&E (2014); SCE (2014); PG&E (2014); GTM/SEIA (2014); DP&L (2014); Gelman (2014b); NY PSC (2012)

3.2.2.1 California

California's net metering capacity is capped at 5% of total aggregate (or "non-coincident") peak demand. IOUs post their demand calculations, along with updated net metering installation data, online. Using the most recently available figures, we calculate the program cap at 5,258 MW.

Table 6. Net Metering Status by Utility in California

Utility	Date	Aggregate Peak Demand	Net Metering Installations	Estimated Percent of Aggregate Peak Demand
PG&E	31-Dec-13	48,177 MW	982.4 MW	2.04%
SDG&E	28-Feb-14	12,134 MW	240.0 MW	1.98%
SCE	28-Feb-14	44,807 MW	689.5 MW	1.54%

Net metering installations totaled 1,992 MW, as of the end of February 2014 (SDG&E and SCE) and end of December 2013 (PG&E) (see Table 6). Looking forward, we adjust GTM/SEIA 2014–2017 projections by the ratio of 0.79. This is the ratio of net metered installations reported by the IOUs (1,992 MW) to GTM/SEIAs 2013 total residential and non-residential installations (2,428 MW).

California is thus expected to reach its cap sometime in 2017. This timing coincides with AB 327, which specifies that utilities must offer net metering until it reaches the program cap, or July 1, 2017, whichever is earlier. After that time the utility must offer a standard contract or tariff (which may include net energy metering), which AB 327 requires the CPUC to develop (CPUC 2014). The CPUC initiated a new proceeding (R.14-07-002) and held workshops in April and August 2014.

3.2.2.2 Delaware

Delaware caps net metering at 5% of a utility's aggregated customer monthly demand during a calendar year. Although the interpretation of "aggregated customer monthly demand" is unclear, we use a conservative interpretation, examining the percent of peak demand. We use Delmarva's total default service responsibility, of 1,084 MW, as Delmarva is the largest supplier in the state. This calculation results in a net metering cap of 54 MW, compared to the 18 MW of net metering PV capacity installed as of December 2013.

For 2014–2017, we use GTM/SEIA estimates, as they were consistent with estimates of net metering in the state.

Using this methodology, Delaware may reach its program cap in 2016; however, "aggregated customer monthly demand" might be defined differently from "peak demand." If this is the case, Delaware may not reach its cap until a later date.

3.2.2.3 Nevada

Nevada's net metering program cap is 3% of total peak capacity of all utilities. Using July 2, 2013 peak load data for NV Power and Sierra Pacific of 5,850 MW and 1,706 MW, respectively, we calculate the net metering program cap as 227 MW. As of the end of December 2013, there were 51 MW of net metering capacity installed in Nevada (Gelman 2014a).

For 2014–2017, we use GTM/SEIA estimates, as they were consistent with estimates of net metering in the state. Thus, Nevada may reach its cap in the 2017 timeframe.

3.2.2.4 New York

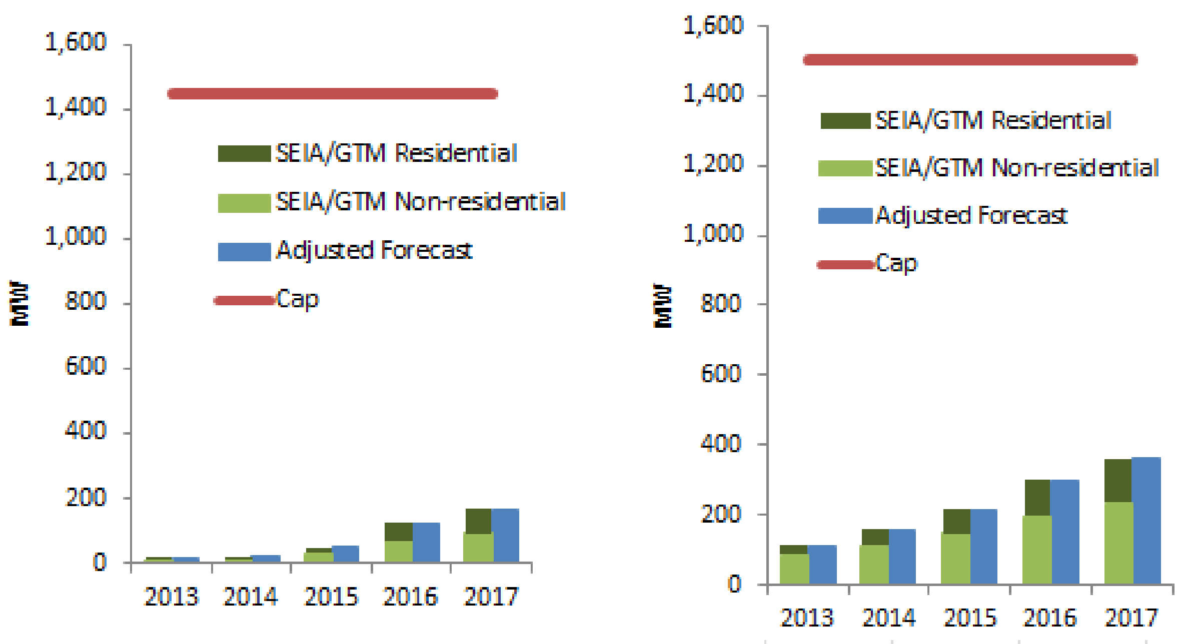
In New York, the net metering program cap is 3% of a utility's 2005 peak demand. Using data from the New York PSC, we calculate the program cap at 967 MW.

PSC data on installed PV net metered capacity, as of September 2013, show 155 MW of connected capacity. Given that this figure is similar to year-end 2013 GTM/SEIA residential and non-residential solar capacity, we do not adjust current or future estimates by GTM/SEIA.

Given these calculations, New York may be expected to reach its program cap in 2017. Given that the NY-Sun initiative is expected to install 3 GW of solar, the New York PSC noted that "We recognize that the current three percent (3%) cap most recently set by the Commission will not be sufficient to support the significantly expanded energy capacity goals of NY-Sun..." (NY PSC 2014).

3.2.3 States Unlikely To Reach Program Caps Before 2018

This section discusses three states—Illinois, Maryland, and Georgia—that we estimate will not reach statewide net metering caps by 2018 (see Figure 10). Other states are also not expected to reach caps in the near term based on current installations and cap levels, but we did not conduct detailed analysis for all states. Rather, we focused on states with the most significant solar policies and installed capacity.



(a) Illinois (b) Maryland

Figure 10. Current and projected net metering capacity and program cap in Illinois and Maryland (2013–2017)

3.2.3.1 Illinois

Illinois' net metering program cap has been raised multiple times, with the latest increase in 2011, to 5% of peak demand in the previous calendar year. At the time, there was not a significant amount of solar, nor was there projected to be, but the change was wrapped into a larger bill addressing electric utility industry topics in addition to net metering.

3.2.3.2 Maryland

In Maryland, the PSC is required to report annually on whether the program cap should be altered. In its latest report (2013), the PSC did not view the program cap of 1,500 MW as a barrier to development. Although there has been an increase in capacity in recent years, the PSC noted that the current rate of installation "does not indicate that the cap would be approached in the near future" (MD PSC 2013, p. 4).

3.2.3.3 Georgia

Georgia has seen little DG, with 2.1 MW of net metered systems as of July 2013 in Georgia Power's service territory. Georgia Power is the state's largest utility, and is required to increase the amount of DG dramatically over the next few years. In 2012, the Georgia PSC (GPSC) approved Georgia Power's Advanced Solar Initiative which seeks to procure up to 90 MW of DG. The GPSC also approved an additional 100 MW DG as part of Georgia Power's 2013 Integrated Resource Plan (IRP).

However, Georgia Power's new acquisitions will not use net metering; instead, they will use a standalone meter and receive a separate incentive under Georgia Power's Advanced Solar Initiative. Currently the Advanced Solar Initiative pays $0.13/kWh to DG solar facilities for solar production; customers continue to pay for their energy use at the applicable tariff rate (typically $0.10–$0.12/kWh). The price has not yet been determined for the next phase (2015 and 2016) of Georgia Power's Advanced Solar Initiative DG program; however, based on the PSC's 2013 IRP Order the price will be based on the most recent avoided cost determination and will be approved by the GPSC.

4 Design and Implementation Issues for States Approaching Program Caps

Given rapid deployment of distributed solar power, what issues might state policymakers, PUCs, utilities and the solar industry decide to consider when examining net metering program caps? This section outlines considerations for setting and revising program caps, establishing a guarantee or notification system, providing transparent data, and ensuring a clear cap definition.

4.1 Considerations for Setting and Revising Program Caps

Net metering caps currently range from 0.2%–20% of peak demand and other conventions have been used as well. Many states have increased their caps over time as distributed PV penetrations have increased, or modifications have been made to net metering laws. As discussed in Section 2.1, states and PUCs have previously expanded program caps as they were beginning to be reached. What is the process for setting a program cap? What lessons can be learned from experience? Stakeholders in the past have learned lessons from other states; however, because state contexts can vary widely, stakeholders may decide to consider additional analysis of ratepayer and utility impacts to better understand the implications of setting a proposed program cap. Some specific considerations include the following:

- Policy interactions: Policymakers might consider the interactions between the program cap and other related policies. If state or local DG targets have been established, policymakers might want information about the expected level of net metering deployment vis-à-vis those policies. This information can help policymakers make informed decisions about how the net metering program cap might help or hinder other policy goals. Some states have considered interaction with federal policies; for example, the impact of the expiration of the federal investment tax credit in 2017. In Vermont, raising the program cap from 4% to 15% is expected to allow for deployment of as much DG as possible before the ITC expires.
- Financial impacts: Policymakers might examine the potential rate or utility financial impact of the program cap. In the past, some states have raised the cap to a level where they have determined that rate impact will be minimal. For example, in New York, a high-level analysis of expanding Central Hudson's cap found rate impacts of 0.08%–0.16%. The New York PSC decided that "Given the limited expected impact to rates and the benefits discussed above, we conclude that an increase in the minimum net metering limitation in Central Hudson's territory is in the public interest" (NY PSC 2012).

  Policymakers may decide to consider the financial impact of increased DG on utilities and ratepayers. Barbose et al. (2014) examined the financial impacts to a prototypical southwestern utility from penetrations of PV. The analysis found that at 10% DG penetration, the utility's revenue requirement was reduced by 3.4% and its return on equity was reduced by approximately 25 basis points. The analysis also found that incremental changes to the utility business model (e.g. decoupling, having a higher fixed charge, or utility ownership of PV) could increase returns to shareholders, but at an increased cost to customers.
- Grid impacts: Policymakers may decide consider the grid impacts of increased DG penetrations. Bird et al. (2013) describe the costs and benefits of DG. Increased PV

penetrations can cause voltage issues that could exceed the tolerance levels of installed equipment. Interconnection rules have traditionally been designed to assume that these impacts would be negligible below 15% of peak load on a distribution circuit, although in some cases higher levels have been achieved with no impacts on the circuit (Coddington et al. 2012). Higher penetrations of PV can also have impacts on the bulk power system because of rapid changes in output at sunrise and sunset and the variability of the generation from changes in cloud cover. However, distributed systems are not all affected by clouds at the same time, so this variability tends to smooth out with a larger number of systems (Lew et al. 2013). PV variability can, however, affect unit commitment decisions and lead to stress on conventional units from increased cycling, although additional operations and maintenance costs were found to be small compared to overall system production cost savings in one recent study (Lew et al. 2013).

4.2 Establishing a Guarantee or Notification System to Minimize Market Uncertainty

Uncertainty surrounding the availability of net metering affects project economics and can disrupt the function of the solar market. An equitable and fair queuing system that provides clarity on whether customers will be eligible for net metering can provide increased market stability. Without a guarantee or sense of when caps will be reached, solar installers may leave the market.

Options for creating a queue include:

- **Providing a guarantee.** Establishing a queue system can provide a guarantee to solar adopters that their project will qualify for net metering.
- **Providing notification.** Absent a formal guarantee, providing notice of when the cap is likely to be reached can help solar adopters understand the likelihood that their projects will qualify for net metering. Net metering may be needed to make the solar project work financially.

Both states and utilities have used guarantee and notification mechanisms to date.

- In Massachusetts, the System of Assurance allows system owners to ensure they can net meter before they build their projects. The MassACA website (www.massaca.org) provides near real-time updates on the remaining capacity available under the program caps for each distribution company.

  A 2010 law required the Department of Public Utilities (DPU) to create the system. In September 2011, the DPU proposed the System of Assurance and adopted the final System of Assurance in May 2012, directing the state's distribution companies to issue a Request for Proposals for a third-party administrator. The companies selected, and the DPU approved The Cadmus Group as the third-party administrator for the System of Assurance. The system was estimated to cost approximately $970,000. The costs are recovered through an application fee of $100, paid when applying for a cap allocation, and a non-refundable reservation fee of $3.15/kW, paid when the application has been deemed complete (MA DPU 2012). The MassACA system has been operational since January 2013. Public education and transparency were keys to the system's success, as well as working closely with the third-party developer (Heeter 2014b). The system provides data on where the growth in the solar sector has been; these data could be useful to legislators seeking to modify solar-related policy in the future.

Other states have developed procedures to notify customers of the status of the cap, but none has gone as far as providing assurance that a project would be eligible for a cap.

- In California, IOUs provide quarterly updates on the NEM installed generating capacity, the aggregate customer peak demand, and the resulting estimate of the percent of aggregate peak demand met.
- New York's interconnection application guidelines specify a queuing process. If projects have been in the queue for 12 months with no movement, the project will be removed from the queue after a 30-day notice period. This queuing process provides the utility with information about projects that are not moving forward—something that previously was not available. The change to the queuing process was made after Central Hudson, one of the smaller utilities in New York, began approaching the 1% cap; the utility's calculation was based on all projects in the queue; if projects that did not move forward had been removed from the queue, the utility would not have reached the cap as soon.
- In Vermont, customer notification is required when utilities reach the cap, but the type of notification is not specified.

4.3 Providing Transparent Data

Providing transparent data on the status of the program cap can help the solar industry and homeowners and others wanting to net meter understand whether they may be running up against the cap. To date, transparency has been provided in a number of ways, and over varying timescales. Data transparency can be particularly important where program caps rely on data that may not otherwise be available. For example, in California, the IOUs must estimate non-coincident peak demand; non-coincident peak demand is not available any other way. In Minnesota, because the trigger is based on a MWh calculation, the PUC will need to provide guidance on how the MWh figure is metered or estimated.

Providing transparent data could also help alleviate communications challenges when one utility is reaching a cap while a neighboring utility may still be offering net metering. Residents in the same region, but different utility service territories, may be confused about whether net metering is available if they hear that it is no longer offered in a neighboring town. Proving timely, transparent data could help with this communications challenge.

Common metrics related to net metering program caps include:

- Current net metered capacity;
- Pending net metered capacity;
- Capacity eligible under the cap; and
- Remaining eligible capacity.

Massachusetts provides the most comprehensive information about its current net metering capacity. The MassACA website is updated in near real-time with information about the net metering cap, interconnected capacity, reserved cap allocations, pending allocations, and the remaining capacity available under the cap. The data are provided for each distribution company in the state.

California and New Jersey provide more limited data, but do update data quarterly and semiannually, respectively. California's IOUs provide online information about capacity of net metered installations and the resulting estimated percent of aggregate peak demand. The utilities also list the non-coincident aggregate customer peak, in MW, that is used in calculating the estimated percent of aggregate peak demand that has been reached.

In New Jersey, electric distribution companies (EDCs) report their net metering status to the Board of Public Utilities (BPU) semiannually.[3] The BPU centralizes the historical and most current reports on a webpage.[4] Although the EDCs report only the installed net metering capacity, the board's compilation of reports provides better access for stakeholders. Other states may have filing requirements, but stakeholders may have a difficult time finding data if they are contained exclusively in a PUC docket.

4.4 Ensuring a Clear Cap Definition

Although many states are not likely to approach their program caps for a number of years, ensuring that the cap definition is clear can help stakeholders come to an agreement about the current state of meeting the cap as well as when the cap may be met in the future. In cases where stakeholders may not agree on how the cap should be calculated, the PUC can assist by instituting a rulemaking or other regulatory process.

In most cases, the program cap is defined as a percent of peak load in a given reference year. However, there may be different interpretations of *peak load* as well as the specified reference year. In most states that we spoke with, there were not uncertainties with how the program cap was defined. However, a few states noted that there may be different interpretations as utilities come closer to meeting the cap.

Clarifications that may be needed:

- **What is the reference year for the peak demand?** In some cases, the reference year may not be specified in legislation. Although a common definition is the most recent year, this would need to be clarified. One alternative employed by some states is to use a historical peak demand year. Using this method, peak demand is calculated only once. Using the current year as a reference year could create uncertainty in the allowed net metering amount, and could allow the cap to be exceeded.
- **How is solar capacity calculated?** Solar capacity is typically calculated as the sum of the eligible net metered system installed capacity. However, in Vermont, the solar

[3] Before 2011, EDCs reported annually.
[4] Reports are available here: www.njcleanenergy.com/renewable-energy/programs/net-metering-and-interconnection.

capacity is calculated using the inverter capacity. The inverter capacity of a solar system is lower than the installed capacity. Thus, the modification in Vermont allows more solar to net meter than if it was using installed capacity to calculate the program cap.

- **How is aggregate customer peak demand calculated?** This issue is relevant to California and Delaware, which define program caps using this parameter (see Text Box 5). In Delaware, the program cap is based on aggregate customer monthly demand, though this has not been defined and is not a common industry term. The term could refer to the sum of individual customer monthly demand, similar to California's definition of non-coincident peak demand. Because utilities in Delaware are not approaching the cap, there has been no request for clarification.

Text Box 5: Case Study: California's Cap Definition Clarification

In 1998, AB 1755 revised the program cap from 0.1% of a utility's 1996 peak demand forecast to 0.1% of aggregate peak customer demand, which was increase to 0.5% of aggregate customer peak demand in 2002 (AB 58). In 2005, as SDG&E was approaching the 0.5% aggregate customer peak demand cap, a bill created a separate 50 MW cap for SDG&E, which was about 1.5% of the utility's aggregate peak demand. One year later, legislation (SB 1) increased the cap to 2.5% of aggregate customer peak demand for all utilities, and in 2010, the cap was raised to 5.0% of aggregate customer peak demand.

In 2012, the CPUC interpreted *aggregate customer peak demand* to be the highest sum of customers' individual non-coincident peak demands during any calendar year. This interpretation increased the available net metering capacity by approximately twofold. This change was codified by the legislature in 2013 (AB 327), along with other net metering modifications. The legislation also specified minimum MW capacity that would be available for each utility.

Because utilities do not have data on all individual customer peak demands, the CPUC adopted recommended methodology for calculating the non-coincident aggregate customer peak demand. The methodology relies on data from annual utility load research and 15-minute interval data (SDG&E n.d.).

IOUs in California maintain on-line information on how much of their net metering program caps have been reached. See for example, SDG&E's NEM Cap webpage, which indicates that as of February 28, 2014, 240 MW of NEM capacity were installed, or approximately 39% of the 5% cap (SDG&E 2014).

5 Summary and Conclusions

Net metering program caps have become increasingly of interest as net metered distributed PV capacity has grown rapidly in a number of states. Placing a cap or limit on the amount of eligible net metered capacity can be viewed as a way to limit a utility's or ratepayer's exposure to financial risks or a way for the PUC to engage in increased dialogue with stakeholders about the value of DG. A net metering cap is one way of addressing concerns about potential financial impacts, but of course, other methods exist. For instance, some jurisdictions are pursuing alternatives or modifications to net metering, such as value of solar tariffs or other forms of two-way rates. In this analysis, we examined net metering program caps to forecast how long net metering would be expected to be available in various jurisdictions under current policies. We also surveyed state practices and experience to understand important policy design considerations. Key findings include:

- **Just over half of the states with net metering policies today include caps on net metered capacity; several states without caps have triggers that when reached enable net metering to be reviewed.** Of the 44 jurisdictions with net metering, 25 (57%) have some type of restriction on total eligible capacity, 16 (37%) have no restrictions, and 3 (7%) have notification or trigger policies. The level of net metering caps generally ranges from 0.2% to 9% of peak demand; two states have substantially higher caps of 15% and 20%. Caps are most commonly based on utility peak demand, but in some cases are based on installed PV capacity or other metrics. For instance, Hawaii determines the availability of net metering based on the penetration of PV on particular distribution circuits because they have achieved high penetrations in some areas. A few states have implemented trigger mechanisms as opposed to binding caps, where net metering can be reviewed by the commission.
- **Many states have historically increased net metering caps.** In the early 2000s, caps on net metering were generally at about 1% of peak demand; today there is a significantly greater range. Over the past decade, 15 states have increased net metering caps, and several states have made multiple adjustments to the cap level over time. Often this has been done to align with solar policy goals or when utilities have reached the cap levels. In 2014, Massachusetts, South Carolina, and Vermont have sought to increase net metering caps, and Louisiana is examining how its cap is calculated. State policymakers and PUCs generally have not undertaken detailed analysis in setting the level of caps.
- **Currently, most states are substantially below their current net metering caps or trigger levels with the exception of New Jersey and Hawaii. Some utilities in Massachusetts and Vermont recently reached caps, prompting legislative action.** New Jersey has exceeded its trigger level, where a review of net metering could be undertaken, but has no binding cap on the level of net metered systems. Hawaii has placed restrictions on the availability of net metering and makes the determination based on penetrations at individual circuits. Vermont was close to reaching its cap this year, but the legislature increased it from 5% to 15% in spring 2014. A handful of states have reached 20%–35% of caps, but most states have had installations well below the levels of the net metering caps.

- **Based on projections of near-term distributed PV capacity additions, a handful of states could reach current cap levels by 2018**. Assuming caps remain fixed at currently established levels, states that could reach or exceed the net metering cap by 2018 include California, Delaware, Nevada, and New York. By law, California will cease offering the current framework of net metering in 2017, even if the cap is not reached, and will offer a new tariff that the CPUC is currently developing.

  Forecasting future net metering capacity has limitations. We modify GTM/SEIA's (2014) forecast of residential and non-residential PV capacity to better reflect expected net metering capacity. In this analysis we rely on external market projections of future PV capacity; a key limitation in our approach is the uncertainty regarding the fraction of projected future commercial systems that would be eligible to participate in net metering. Future PV capacity projections also make market and policy assumptions that may impact the results.

- **Considerations for setting and adjusting net metering cap levels may include interaction with other policies as well as potential rate and grid impacts.** Policymakers may choose to consider the interaction with state or local DG goals, as well as federal policies. Another consideration is the potential financial impact on the utility and ratepayers. Although most states have not analyzed these impacts when setting net metering caps, additional analysis of potential costs and benefits may be warranted if substantially higher levels of net metering are considered.

- **Communication about the status of net metering when installations are nearing the cap is important for providing certainty to solar customers and project developers and consumers.** Uncertainty about the availability of net metering can impede the PV market. Therefore, communication about the status of net metering when installations are nearing the cap is important for developers and consumers to be able to assess project economics. One mechanism for addressing potential uncertainty is to provide a guarantee of access to net metering for projects that are placed in a queue. Alternatively, a notification system and transparent data on project installations and how much more capacity is available under the cap can be used to inform project developers.

- **Clear definitions of caps and data sources are important for providing accurate information to the market about progress toward reaching a cap.** Imprecise or ambiguous definitions in legislation have led to challenges in a few commissions and delayed implementation. Clarity regarding the data sources and methods of calculating progress toward the cap at the outset can minimize market confusion. For instance, clearly defining the reference year for peak demand and how to calculate aggregate customer demand can provide greater market certainty.

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Appendix A

Table A-1. State Net Metering Program Caps

State	Current NEM aggregate cap
Alaska	1.5% of average retail demand.
California	5% of highest sum of non-coincident peak demands of the utility's customers during any calendar year, but not to be less than: 607 MW for SDG&E; 2,240 MW for SCE; and 2,409 MW for PG&E.
Delaware	5% of a utility's aggregated customer monthly demand during a calendar year.
Georgia	0.2% of previous year peak demand.
Hawaii	Effectively no cap for HECO utilities. For KIUC, 1% of the utility's peak demand with 50% of this amount reserved for systems 10 kW or smaller.
Idaho	Utility tariffs all limit to 0.1% of 1996 peak demand
Illinois	5% of total peak demand supplied in previous year.
Indiana	1% of most-recent summer peak load.
Kansas	1% of previous year's peak demand.
Kentucky	1% single-hour peak load during previous year.
Louisiana	0.5% of retail peak load.
Maryland	1,500 MW (statewide).
Massachusetts	5% of a utility's highest historical peak load for governmental customers; 4% of a utility's highest historical peak load for all other NEM facilities (i.e., 9% of highest historical peak load in total). However, facilities 10 kW or less on single-phase circuits and 25 kW or less on three-phase service are wholly exempt from the caps. For solar, capacity is determined as 80% of the DC rating at STC.
Michigan	0.75% of previous year's peak load.
Missouri	5% of single-hour peak demand during previous year. Annual new applications limited to 1%.
Nebraska	1% of average monthly peak demand.
Nevada	3% of total peak capacity of all utilities.
New Hampshire	50 MW (statewide).
New York	3% of a utility's 2005 peak demand for solar, farm-based biogas, fuel cells, micro-hydro, and residential micro-CHP; 0.3% of utility's 2005 demand for wind.
Oregon	No cap for IOUs; 0.5% of historic single-hour peak load for munis, coops, and PUDs.
Rhode Island	3% of peak load.
South Carolina	0.2% of previous year retail peak demand. (Voluntary tariffs.)
Utah	20% of 2007 peak demand for RMP; 0.1% of 2007 peak demand for other electrical corporations.
Vermont	15% of greater of utility's peak demand in 1996 or the most recent calendar year. (The PSB is authorized to raise the cap.)
Virginia	1% of utility's adjusted peak load forecast for previous year.
Washington	0.5% of utility's 1996 peak demand, with 50% of that reserved for NEM facilities that generate renewable energy.
West Virginia	3% of previous year peak demand.

* No Cap States: Arizona, Arkansas, Colorado, Connecticut, D.C., Florida, Iowa, Maine, Minnesota, Montana, New Jersey, New Mexico, North Carolina, North Dakota, Ohio, Oklahoma, Pennsylvania, Wisconsin, Wyoming.