Installed Capacity Caps for Distributed Photovoltaics and their Impacts on Compensation Mechanisms

As jurisdictions around the world initiate or revise distributed photovoltaic (DPV) policies and regulations amid changing market conditions, they may benefit from understanding the interaction of *compensation mechanisms* and *installed capacity caps*—two important aspects of DPV program design. This brief discusses common practices, design options, and lessons learned pertaining to these two topics. It includes examples largely derived from the experience of U.S. jurisdictions.

When it comes to compensation mechanisms for DPV projects, the only constant is change. Compensation mechanisms refer to the way distributed solar generation is paid for, whether through bill credits or cash payments.[1] The type of mechanism in place is a key component to the investment decision to install a solar energy system. The common compensation mechanisms include:

- Net energy metering (NEM)
- Net billing
- Buy-all and sell-all rates, which can include feed-in tariffs (FITs) and the value of solar tariffs.

As of October 2018, sixty-five policy actions related to compensation mechanisms and the value of DPV took place in the United States.[2] These occurred across dozens of states and other jurisdictions. And, they followed on the heels of 94 similar actions in 2017.[3] Outside the United States, FITs are subject to adjustments as installed capacity of distributed solar increases and the cost of solar decreases. Figure 1 shows the evolution of the German FIT over time as installed capacity in the country increased.[4]

The general trends for these policy actions related to compensation mechanisms primarily center on the following concerns:

- Over-subsidization of distributed solar as installed system costs continue to decrease
- Cross-subsidization across rate classes
- Potential grid impacts of higher levels of DPV penetration
- Loss of utility revenue and the ability of the utility to recover the costs of investments in the grid.

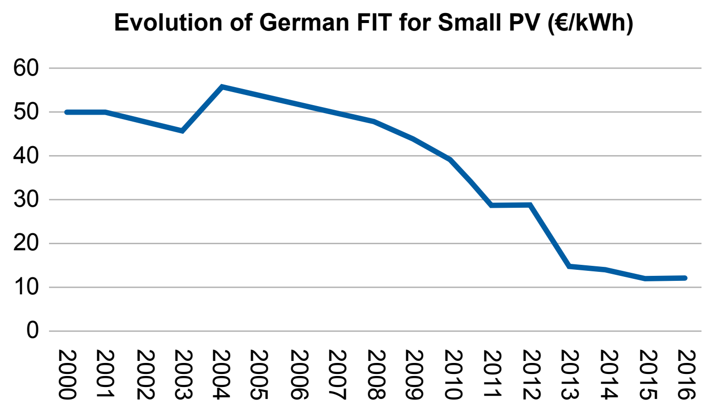

Figure 1. Evolution of German FIT for small-scale solar
€/kWh = euro cents per kilowatt-hour

Given these concerns, policymakers often build in program triggers or caps (which are not to be confused with system size caps—see Figure 2) to reevaluate existing policies to determine whether any adjustments are warranted. The primary triggers for reevaluating compensation structures and rate design are:

- When a jurisdiction hits its previously determined cap on aggregated DPV systems
- When a previously determined date in the future is reached
- When a utility requests a policy review
- Any combination of any of the above.

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1. Zinaman, Owen, Alexandra Aznar, Carl Linvill, Naïm Darghouth, Timon Dubbeling, and Emanuele Bianco. 2017. *Grid-Connected Distributed Generation: Compensation Mechanism Basics*. Golden, CO: National Renewable Energy Laboratory. NREL/BR-6A20-68469. https://www.nrel.gov/docs/fy18osti/68469.pdf.
2. Proudlove, Autumn, Brian Lips, and David Sarkisian. 2018. *50 States of Solar. Q3 2018 Quarterly Report*. Raleigh, NC: NC Clean Energy Technology Center, p. 8. https://nccleantech.ncsu.edu/2017/10/18/the-50-states-of-solar-report-for-q3-2017-now-available/.
3. Proudlove, Autumn, Brian Lips, David Sarkisia, and Achyut Shrestha. 2018. *50 States of Solar. 4Q17 and Annual Review.* Raleigh, NC: NC Clean Energy Technology Center, p. 12. https://nccleantech.ncsu.edu/2018/01/24/the-50-states-of-solar-report-2017-annual-review-q4-update-edition-now-available/.
4. Adapted from data contained in Wirth, Harry. 2018. *Recent Facts about Photovoltaics in Germany*. Freiburg, Germany: Fraunhofer Institute, 2018, p. 10. https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/recent-facts-about-photovoltaics-in-germany.pdf .

DPV System Size Cap

- Sets the maximum individual system size that is eligible for a compensation mechanism (e.g., NEM)
- Can affect the customer class that is that is eligible for a compensation mechanism (e.g. NEM)
- Can be capacity or percentage-based

DPV Program Cap

- Limits the total amount of net-metered (or other compensation mechanism) distributed generation systems installed in a region or utility service territory
- Includes many types of caps
- Is political in nature

Figure 2. Difference between DPV system size caps and program caps

Aggregated net-metering caps are one of the more common triggers for reevaluating compensation mechanisms in the United States. The cap itself can be set in several ways,[5] including:

- **Percent of peak demand, capacity, or load met by net-metered PV generation**: The most common program cap is based on a percentage of the utility's or jurisdiction's peak demand, capacity, or load in a given reference year (e.g., the previous year). In U.S. states with program caps, caps were initially typically set at 5% or less, but not always, as illustrated below in the case of Vermont.
- **A fixed megawatt (MW) cap:** An example would be 100 MW of installed capacity of distributed solar.
- Some **other** trigger mechanism such as **percent of retail sales.**

In the United States, caps have historically been increased over time, as illustrated in Figure 3.[6]

Despite the preponderance of caps and utility concerns, there are arguments against having any aggregated caps at all.[7] For example, some have argued that caps may:

- Limit customers from generating their own electricity
- Stifle market growth
- Hinder jurisdictions from meeting their renewable energy goals.

In Hawaii, a systemwide cap of 4% was removed entirely in 2011 and the state initially migrated to a system of distribution circuit caps of 15% (of peak demand), but upon further testing, the Hawaiian Electric Companies raised its distribution circuit cap on distributed PV from 120% to 250% of minimum daytime load.[8] In 2013, California legislation established a net-metering policy cap for three of the largest investor-owned utilities in the state

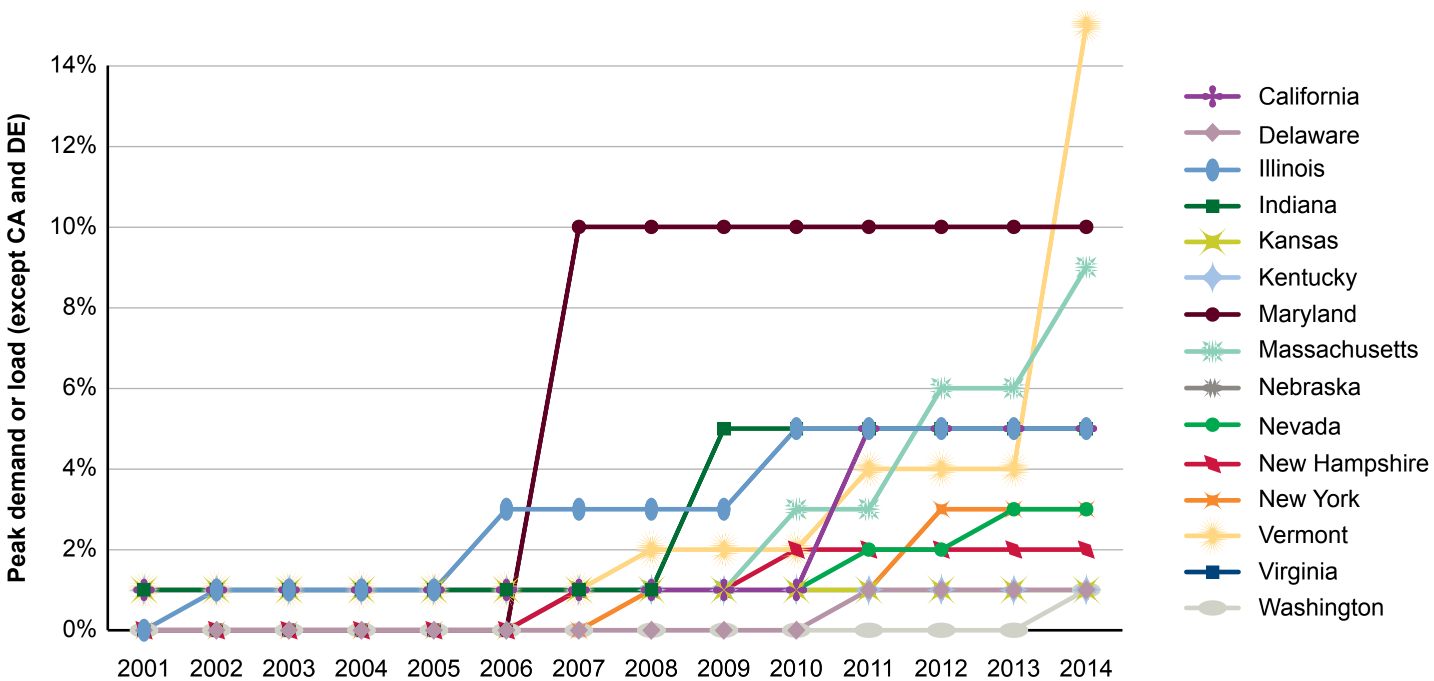

Figure 3. History of net-metering caps in the United States

5. Heeter, J., R. Gelman, and L. Bird. 2014. *Status of Net Metering: Assessing the Potential to Reach Program Caps*. Golden, CO: National Renewable Energy Laboratory, p. 3. https://www.nrel.gov/docs/fy14osti/61858.pdf.
6. Heeter, Gelman, and Bird. 2014, p. 8.
7. "Freeing the Grid 2017." Accessed May 21, 2018. http://freeingthegrid.org.
8. NREL. High Penetration PV: How High Can we Go? Golden, CO: National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy16osti/65591.pdf

such that either installed DPV capacity reached 5% of aggregate customer peak demand or a deadline of July 1, 2017 was reached, whichever came first (AB 327 2013).[9] In two instances, utilities reached their cap before the deadline, whereas in the third instance, the deadline was reached first.[10] In 2014, Vermont's aggregated net-metering cap increased from 4% to 15% of the distribution utility's prior year peak demand.[11] Upon reaching the previous 4% cap, utilities had obtained less than 1% of total energy from distributed resources. The cap was subsequently eliminated in 2017.[12] Alternatively, in Minnesota, when total net-metered generation reaches 4% of total utility sales, the utility can request a review by the utility regulator to see whether net metering should be limited.[13]

In Mexico, according to distributed generation regulations published in July 2017, policies were to be reviewed either by the end of 2018 or when aggregate installed DPV capacity in Mexico reaches 5% of total installed capacity, or before then if deemed necessary by the regulator.[14]

Colombia: New Distributed Renewable Energy Policy

In February 2018, the Colombian energy regulator (Comisión de Regulación de Energía y Gas) released its new distributed renewable energy policies.[16] They include a net-billing mechanism for exports to the grid along with an aggregated program cap for distributed renewable energy systems up to 1 MW in size. The aggregated program cap is when annual DG energy exports[17] reach 4% of the previous year's energy demand. Once this 4% exports to sales cap is reached, the regulator evaluates whether the level of compensation paid for exports to the grid under the net-billing mechanism should be modified. Given the current level of total electricity demand in Colombia, a 4% export trigger is equivalent to approximately 2,600 MW of installed distributed renewable energy.[18]

Design Considerations

The design of compensation mechanisms (including net-metering) affects both the amount of distributed generation deployed in a jurisdiction, and the timing of compensation mechanism evaluations. Policymakers should aim to:

- **Clearly define the cap:** Jurisdictions with established capacity caps need to ensure that the cap and all related terms are clearly defined to avoid confusion about when a cap has been met. Policymakers should provide guidance on how peak load or peak demand should be calculated, how a reference year is defined, and how solar capacity should be calculated. Capacity caps can be simpler than peak demand or peak load caps because they do not require calculations based on reference year; however, they also do not account for the relative penetration of net metering on the grid.[19] Understanding whether utilities have the data, tools, and methodologies to calculate the cap as defined is also important. Additionally, specifying whether systems installed via virtual net metering or community solar (if available) contribute to a cap is also important because these systems tend to be large—a single or several systems can contribute significantly (and quickly) to an overall program cap.[20] If a jurisdiction wants to allow virtual net metering, it might consider increasing the net-metering cap.
- **Clearly communicate progress toward reaching the cap:** Customers and industry need to understand whether their DPV projects are eligible for net metering. By regularly providing transparent data on program cap status, policymakers can minimize confusion and market uncertainty. For example, Massachusetts displays comprehensive, near real-time net-metering cap information online (Figure 4).[21] Other jurisdictions provide information less regularly (e.g., quarterly or semiannually).[22]

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9. "AB-327 Electricity: Natural Gas: Rates: Net Energy Metering: California Renewables Portfolio Standard Program," California Legislative Information. Accessed May 21, 2018. http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201320140AB327.
10. "Former NEM Tariff," California Public Utilities Commission. Accessed May 23, 2018. http://www.cpuc.ca.gov/General.aspx?id=3800
11. "No. 99. An Act Relating to Self-Generation and Net Metering," State of Vermont. Accessed May 21, 2018. http://www.leg.state.vt.us/DOCS/2014/ACTS/ACT099.PDF.
12. "Vermont," NREL. Accessed May 21, 2018. https://www.nrel.gov/solar/rps/vt.html.
13. "Net Metering," DSIRE. Last updated March 19, 2018. http://programs.dsireusa.org/system/program/detail/282.
14. "Resolución 142. Capítulo 1.3. 2017." Mexican Energy Regulatory Commission (CRE). Accessed May 23, 2018. http://www.dof.gob.mx/nota_detalle.php?codigo=5474790&fecha=07/03/2017
15. "Resolución 30. Artículo 4. 2018," CREG. Accessed May 21, 2018. http://apolo.creg.gov.co/Publicac.nsf/1c09d18d2d5ffb5b05256eee00709c02/83b41035c2c4474f05258243005a1191/$FILE/Creg030-2018.pdf.
16. Within its net-billing policies, Colombia distinguishes between systems up to 100 kW and those between 100 kW and 1 MW.
17. Using an estimate of 50% self-consumption, 50% export
18. Pena, I. (CREG) March 2018. Phone interview.
19. Heeter, Gelman, and Bird. 2014, p. 6.
20. Heeter, Gelman, and Bird. 2014, p. 30
21. "*Provisional Application Activity and Remaining Capacity*," July 29, 2015. Massachusetts System of Assurance of Net Metering Eligibility. Accessed October 30, 2018. https://app.massaca.org/allocationreport/report.aspx.
22. Heeter, Gelman, and Bird. 2014, p. 30.

Private and Public, All Utilities (Values in kW-AC)	
	Capacity (kW)
Net Metering Cap	**1,667,250**
Interconnected	1,231,815
Reserved Cap Allocations	135,201
Pending Cap Allocations	1,810
Capacity Available under the Cap	**298,424**

Figure 4. Adapted from a screenshot of the Massachusetts System of Assurance of Net Metering Eligibility, as of October 29, 2018

kW-AC = kilowatts, alternating current

- **Understand how caps interact with other policies:** Sometimes clean energy or distributed energy goals or requirements cannot be met unless net-metering caps are modified. Program caps can also have implications for utility revenues and customer rates. Analysis can shed light on cap levels that minimize negative financial impacts. Similarly, high-penetrations of distributed PV can have both negative and positive grid impacts. Distribution circuit level caps could potentially mitigate adverse impacts.[23]
- **Consider how existing customers are influenced by compensation changes:** Reaching net-metering caps can trigger changes in compensation mechanisms. The decision to change the rules for existing solar customers can be contentious. In general, grandfathering existing DPV customers as well as those in the interconnection queue who made their investment decisions based on previous policies is common and allows those customers to benefit from the older policy. Determining how existing customers will be treated and making that information available when cap policies are created is a best practice.

Why Caps Can be Useful

Establishing caps can be critical to getting stakeholder support for a new policy such as net metering, net billing, or value of solar. Otherwise, open-ended policies might leave utilities concerned about getting locked into a long-term policy regime with little opportunity to adjust it as the DPV market matures and costs decrease. In some cases, upon reaching the cap, the policy actions result in less support for distributed solar projects. These actions can include a reduction in compensation for excess electricity exported to the grid and/or the adoption of fixed charges, demand charges, or fees to offset the perceived or real costs associated with DPV customers. For example, in 2017, New Hampshire reduced the level of compensation for net electricity exports. Existing solar customers were grandfathered under the old policy, and a study evaluating the use of a value of solar tariff was ordered.[24] In other instances, caps might increase after announcing the transition to a new policy, such as time-of-use or value-of-solar rates (e.g., Massachusetts in 2014).[25]

Caps or triggers, such as declining incentives based on installed capacity, are a way to track and adjust to changing market conditions. Static policies in a fast-growing industry like solar, which has seen rapid price decreases, may lead to governments and utilities paying more for solar than necessary. An orderly process by which existing policies are periodically revisited results in positive outcomes for solar consumers, solar companies, and investors in the sector.

23. Heeter, Gelman, and Bird. 2014, p. 30.
24. "State of New Hampshire Public Utilities Commission," State of New Hampshire. Accessed May 21, 2018. http://www.puc.state.nh.us/Regulatory/Orders/2017orders/26029e.pdf.
25. Heeter, Gelman, and Bird. 2014, p. 3.

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