7.3 Interconnection and Net Metering Standards

Policy Description and Objective

Summary

Standard interconnection and net metering rules for distributed generation (DG) systems, such as renewable energy and combined heat and power (CHP), are policies used by states to accelerate the development of clean energy supply. Grid-connected DG systems can meet some or all of their host's electricity needs. Renewable energy systems potentially offer reliable, but intermittent, zero emissions energy at or near the point of energy use. CHP offers an efficient, clean, and reliable approach to generating both power and thermal energy from a single fuel source by recovering the waste heat for another beneficial purpose (for more information about CHP, see Chapter 6, "Policy Considerations for Combined Heat and Power"). DG system requirements for grid connections are also important because they involve electrical system safety and reliability.

Interconnection standards are processes and technical requirements that govern how electric utilities will treat distributed generation systems that customers seek to connect to the electric grid.

Net metering is a method of compensating customers for electricity that they generate on site in excess of their own consumption—essentially giving them credit for the excess power they send back to the grid. Depending on individual state or utility rules, net excess generation may be credited to the customer's account or carried over to a future billing period.

Standard interconnection rules stem from state legislation that directs state public utility commissions (PUCs) to establish uniform processes and technical requirements for grid-connected electric generators. These rules address the type and size of systems; they also define required safeguards, grid upgrades, operating restrictions, and application procedures that system applicants must meet. In some states, municipally or cooperatively owned utilities may be exempt from state regulations. State interconnection rules typically address larger DG projects connecting to the distribution grid, whereas the Federal Energy Regulatory Commission (FERC) has jurisdiction over project interconnection at the transmission level.

State interconnection policies can sometimes create unintended barriers for DG projects. Although their impact on the utility grid is likely to be significantly lower, smaller scale DG systems in some states are often subject to the same, frequently lengthy interconnection procedures as larger systems. If interconnection procedures are excessive or expensive in proportion to the size of the project, they can overwhelm project costs to the point of making clean DG uneconomical.

State legislation is also used to require the development of standard net metering rules. Net metering policies allow DG systems to receive credit for electricity generated on site that is exported to the utility grid. In effect, customers can bank exported generation, usually on a billing cycle basis, to offset future electricity use that they would otherwise have to purchase from the utility. Net metering policies often rely on the use of a single bi-directional utility meter to measure, or "net" out, the use and flow of electricity to and from the electric grid. Net metering policies generally place several limitations on eligible onsite generators, including maximum system size restrictions and the period that customers can roll over net metering credit into the future (i.e., year-to-year).

Today, most states have existing interconnection and net metering policies in place. However, many of these policies could be improved to meet best-in-class practices. States may wish to consider evaluating their existing rules against model policies considered to represent best practices. See the information resources at the end of this section for links to some best practices.

States have found that standardized interconnection and net metering rules are important components of promoting clean DG and are often most successful when coupled with other policies and programs. Consequently, states generally promote clean DG through a suite of related policies, including standardizing interconnection and net metering rules, addressing utility rates for standby and exit fees, creating renewable portfolio standards (RPSs), and enacting other initiatives.[85]

Objective

A key objective of standard interconnection and net metering rules is to encourage the connection of clean DG systems, such as renewable energy and CHP, to the electric grid to obtain their benefits without compromising safety or system reliability.

Benefits

Standardized interconnection and net metering rules can support clean DG development by providing clear and reasonable requirements for connecting clean energy systems to the electric utility grid and for crediting onsite generation that DG systems export back to the grid. By developing standard interconnection and net metering requirements, states make progress toward leveling the playing field for clean DG relative to traditional central power generation. Standard interconnection rules can help reduce uncertainty and prevent excessive time delays and costs that small DG systems sometimes encounter when obtaining approval for grid connection.

The benefits of increasing the number of clean DG projects include reducing peak electrical demand on non-DG generators, increasing capacity, reducing the environmental impact of power generation, improving infrastructure resiliency, and avoiding energy losses along transmission and distribution lines. DG application in targeted load pockets can reduce grid congestion, potentially deferring or displacing transmission and distribution infrastructure investments. A 2013 study found that strategically sited DG yields improvements to grid system efficiency and provides additional reserve power, deferred costs, and other grid benefits (Crossborder Energy 2013). Widespread DG deployment can slow the growth-driven demand for more power lines and power stations.

States with Interconnection and Net Metering Standards

States typically regulate DG interconnections that do not involve power sales to third parties (i.e., interconnections that only send excess power back to the local utility). FERC regulates DG interconnections used to export power or for interstate commerce.[86] Because most DG is used to serve electric load at the customer's site, states approve the interconnection standards used for the majority of interconnections for smaller, clean DG systems.

Forty-five states (plus Washington D.C.) have adopted standard interconnection requirements for distributed generators as of March 2015 (see Figure 7.3.1). While these standards often cover a range of generating technologies, most include interconnection of renewable and CHP systems. In some cases, net metering provisions can be considered a subset of interconnection standards for small-scale projects. As of March 2015, 44 states (plus Washington D.C.) have rules or provisions for net metering (see Figure 7.3.2) (DSIRE 2015b). Currently, most states find that smaller DG systems are more likely to produce power primarily for their own use; exports to the grid tend to be incidental. The Solar Energy Industries Association estimates that solar DG

[85] For additional information on these policies, please see Chapter 5, "Renewable Portfolio Standards," and Section 7.4, "Customer Rates and Data Access."

[86] FERC does not have jurisdiction in Texas, Hawaii, or Alaska; http://www.ferc.gov/industries/electric.

systems export on average 20 to 40 percent of the total energy output of the system to the utility grid (SEIA 2014). Under net metering, when a DG system's output exceeds the site's electrical needs, the utility may credit the customer for excess power supplied to the grid. Some states require that the customer's credit surplus account be reset periodically, often on a monthly or annual basis. Additionally, states often cap the output of individual net metered systems or in aggregate at the grid level.

To encourage DG, many states have adopted simplified processes under net metering rules. Some of these state provisions are limited in scope—for example, applying only to relatively small systems,[87] specified technologies, or fuel types of special interest to policy-makers. More comprehensive net metering and interconnection policies provide detailed specifications and procedures for utilities and customers to follow, provide consistent rules for all utilities within the state,[88] and cover a complete range of system and fuel types, interconnection processes, and requirements.[89]

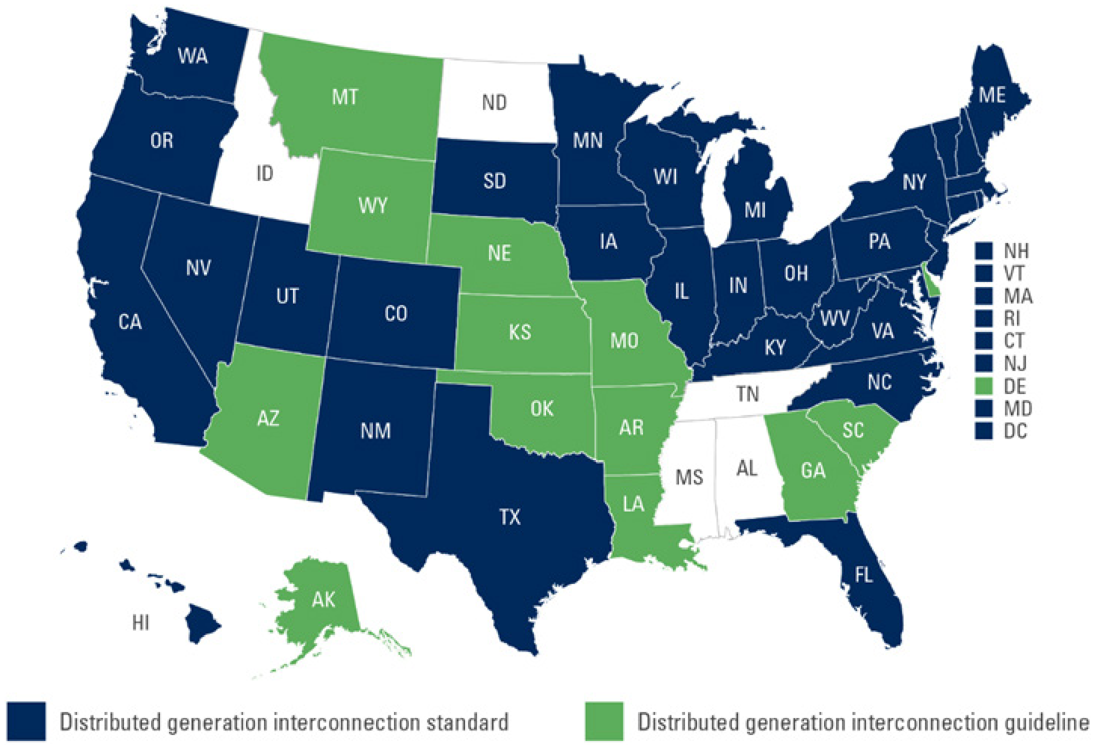
States consider a number of key factors when designing effective standard interconnection and net metering rules that balance the needs of DG owners, the utility company, and the public. This includes promoting broad participation during standards development, addressing a range of technology types and sizes, and considering current barriers to interconnection. In addition, it is important to consider state and federal policies that might influence the successful development and effective implementation of interconnection and net metering standards.

[87] Thirty-four of 39 states that have net metering rules limit system sizes to 100 kilowatts or less.

[88] States that have variable utility net metering policies that differ for investor-owned utilities, municipally owned utilities, cooperatively owned utilities, or alternative retail electric suppliers include Arizona, Florida, Idaho, and Illinois.

[89] Some states (e.g., New Hampshire and New Jersey) have developed standard interconnection processes and requirements as part of their net metering provision.

Figure 7.3.1: States with DG Interconnection Standards

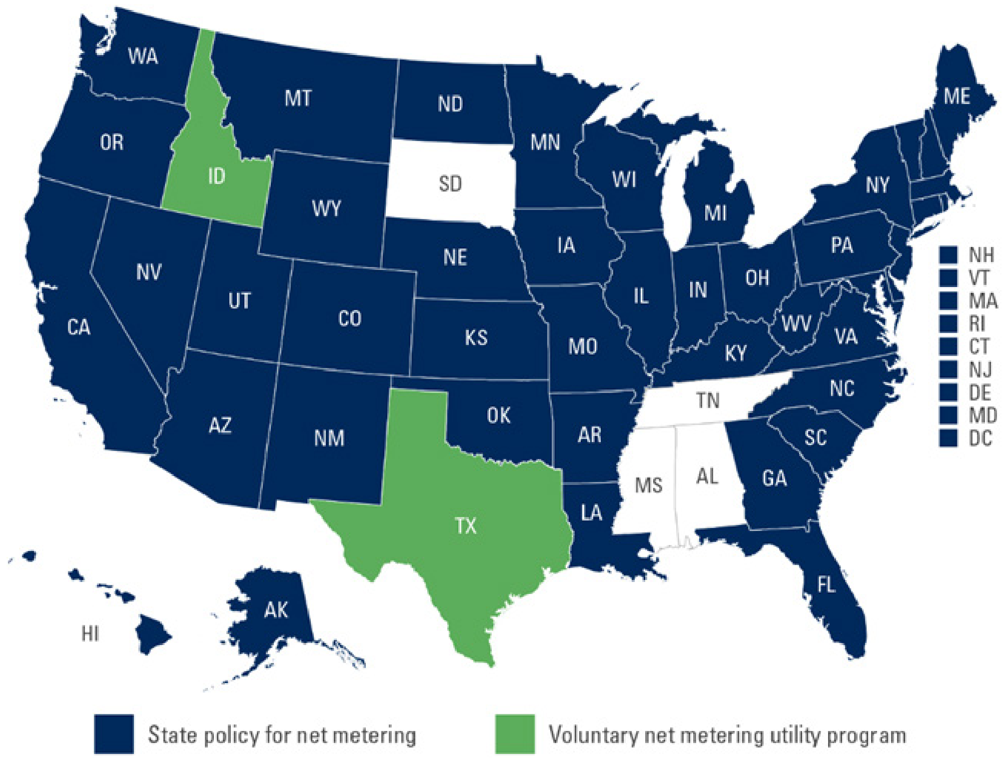


Maximum System Size for a State Interconnection Standard							
CA	None	KY*	30 kW	NJ	None	SD	10 MW
CO	10 MW	MA	None	NM	80 MW	TX	10 MW
CT	20 MW	MD	10 MW	NV	20 MW	UT	20 MW
DC	10 MW	ME	None	NY	2 MW	VA	20 MW
FL*	2 MW	MI	None	OH	20 MW	VT	None
HI	None	MN	10 MW	OR	10 MW	WA	20 MW
IA	10 MW	NC	None	PA*	5 MW	WI	15 MW
IL	None	NH*	1 MW	RI	None	WV	2 MW
IN	None						

* Denotes that policy only applies to net metered systems.
kW= kilowatts; MW= megawatts
Note: Certain states have different limits for residential and non-residential customers, while others have tiered limits.

Source: DSIRE 2015a

Figure 7.3.2: States with Net Metering Rules



Net Metering System Size Limit (kW)					
AK*	25	KY*	30	NV*	1,000
AR	25/300	LA	25/300	NY*	10/25/500/1,000/2,000
AZ	125% of demand	MA*	60/1,000/2,000/10,000	OH*	None
CA	1,000	MD	2,000	OK*	100
CO	120% of demand (for co-ops and munis: 10/25)	ME	660 (co-ops and munis, 100)	OR*	25/2,000
CT	2,000/3,000	MI*	150	PA*	50/3,000/5,000
DC	1,000/5,000/120% of demand	MN	40	RI*	5,000
DE	25/100/2,000 (co-ops and munis, 25/100/500)	MO	100	SC*	20/1,000
FL*	2,000	MT*	50	UT*	25/2,000
GA	10/100	NC*	1,000	VA*	20/500
HI	100	ND*	100	VT	20/250/2,250
IA*	500	NE	25	WA	100
IL*	40	NH	1,000	WI*	20
IN*	1,000	NJ*	None	WV	25/50/500/2,000
KS	15/100/150	NM*	80,000	WY*	25

* Denotes that policy only applies to certain types of utilities (e.g., investor-owned utilities).
Note: Certain states have different limits for residential and non-residential customers, while others have tiered limits.

Source: DSIRE 2015b

Designing Effective Interconnection and Net Metering Standards

Participants

Key stakeholders who can contribute to the process of developing effective interconnection and net metering standards include:

- *Electric utilities.* Utilities are responsible for maintaining the reliability and integrity of the grid and ensuring the safety of the public and their employees.
- *State PUCs.* PUCs have jurisdiction over investor-owned utilities (IOUs) and, in some cases, cooperatively and municipally owned utilities. They are often instrumental in setting policy to encourage onsite generation.
- *Developers and owners/operators of renewable energy and CHP systems as well as their respective trade organizations.* Developers and the customers that will rely on these systems can provide valuable technical information and real-world scenarios.
- *Technical allied organizations.* Organizations such as the Institute of Electric and Electronic Engineers (IEEE) and certifying organizations like the Underwriters Laboratories (UL) have been active in establishing interconnection protocols and equipment certification standards nationwide. In addition, organizations such as the Interstate Renewable Energy Council (IREC) help to develop national standards related to interconnection and net metering policy and to advance regulatory policy innovation.
- *Regional transmission organizations (RTOs).* These organizations may have already implemented interconnection standards using FERC requirements for large non-utility generators generally above 10 megawatts (MW).
- *Other government agencies.* Federal (e.g., FERC) and state environmental and public policy agencies—including state consumer advocates—can play an important role in establishing and developing interconnection and net metering standards.

Some states are bringing key stakeholders together to develop state-based standards via collaborative processes. For example, in Massachusetts, the DG Collaborative successfully brought together many diverse stakeholders to develop the interconnection rules now used by DG developers and customers in Massachusetts.

Emerging Approaches: Policy Variations to Net Metering

Some states have looked beyond standard net metering rules to employ innovative variations on these policies, which offer greater access to specific end consumer groups and end-use applications. For example, standard virtual net metering, meter aggregation, and community solar rules can allow customers to access self-generation and enjoy the benefits of net metering even if they are not able to directly host or invest in onsite generation. A common example of this is individually metered tenants within multi-unit housing buildings who, under newer meter aggregation rules, can share in the benefits of a centrally sited, onsite solar system across all tenant meters. In a few select cases, states and/or utilities have replaced standard net metering policies with new innovative approaches that seek to address utility concerns over cost recovery and ratepayer fairness issues. In 2013, the Minnesota State Legislature passed the first ever, statewide value-of-solar tariff, which many view as a more equitable and possibly more effective alternative to traditional net metering policies for onsite solar photovoltaic systems.[90]

---

[90] For more information on Solar Energy Legislation in Minnesota, see http://www.house.leg.state.mn.us/hrd/pubs/ss/sssolarleg.pdf.

Current Landscape of Interconnection for DG

Renewable energy and CHP systems used by commercial or industrial facilities are typically smaller than 10 MW in capacity. When designing and implementing standards for systems of this size, it is important to realize that the size of the system dictates how and by whom interconnection is regulated.

- *10 MW systems*. FERC has jurisdiction over developing standard interconnection rules for larger systems that are connected directly to the transmission grid. Historically, electric utilities owned most grid-connected generation systems. As a result of restructuring and other legislation (e.g., the Public Utility Regulatory Policy Act or PURPA), utilities were required to interconnect non-utility owned generators to the electric grid. States and regulatory agencies such as FERC have begun to develop or have already implemented standard interconnection rules for non-utility generators. However, these rules were historically applied to larger generating facilities (> 10 MW).
- *0.1 MW to 10 MW systems*. Systems in this size range still require regulatory attention in some states. This "intermediate" group represents systems that are interconnected to the distribution system but are larger than the systems typically covered by net metering rules and smaller than the large generating assets that interconnect directly to the transmission system and are regulated by FERC. In response to the mounting demands by customers and DG/CHP developers to interconnect generation systems to the grid, utilities have increasingly established some form of interconnection process and requirements. In addition, to increase utility confidence around DG systems, industry organizations such as the IEEE and UL have begun to develop standards that enable safe and reliable interconnection of generators to the grid. However, states need to establish standard interconnection rules for generation systems of all sizes.
- *< 100 kW (0.1 MW) systems*. Some states have developed provisions for the net metering of relatively small systems (i.e., < 100 kW). While these provisions are not typically as comprehensive as interconnection standards, they can provide a solid starting point for industry, customers, and utilities with respect to the connection of relatively small DG systems to the electric grid.

Typical Specifications

The specifications described below reflect typical elements found in existing state policies and compiled by other sources.[91] Effective interconnection standards often cover the following specifications:

Participants

- The breadth of customer classes covered under the policy. Effective state policies usually make all customer classes eligible.
- The breadth of state utilities covered under the policy. Effective state policies often cover investor, municipally, and cooperatively owned utilities.

Policy Design

- System size requirements. State policies do not typically establish individual system capacity limits and ensure that the policy applies to all state-jurisdictional interconnections.
- The type of technology that may be interconnected (e.g., inverter-based systems, induction generators, synchronous generators).
- The required components of the electric grid where the system will be interconnected (i.e., radial or network distribution, distribution or transmission level, maximum aggregate DG capacity on a circuit).

---

[91] Other sources include IREC's Model Net Metering Rules (2009) and Model Interconnection Rules (2013) (available at http://www.irecusa.org/publications/), ACEEE Interconnection Standards (ACEEE. 2013), and Freeing the Grid.org.

- Sensible limits on interconnection application fees. Effective policies keep application costs to a minimum, especially for smaller systems.
- Limitations on what utilities may require of systems, such as minimum metering requirements and an external disconnect switch for smaller, inverter-based systems. Effective policies would have the utility forgo requiring an external disconnect switch for smaller, inverter-based systems.
- Limitations on utility requirements of customers to purchase liability insurance (in addition to the coverage provided by a typical insurance policy) or to add the utility as an additional insured.

Process

- A standard agreement form that is easy to understand and free of burdensome terms.
- Sensible limits on procedural and administrative timelines for system interconnections. Effective policies ensure that these timelines are imposed and enforced.
- A review process. Best-in-class policies generally allow for different tiers with different levels of review to accommodate systems based on system capacity, complexity, and level of certification.
- Project technical screens to facilitate evaluation. Effective policies ensure that the technical criteria are both clear and transparent.
- A transparent and uniform dispute resolution process for affected stakeholders.

In addition, some states are developing different application processes and technical requirements for differently sized or certified systems. Since a DG system's size can range from a renewable system of only a few kilowatts (kW) to a CHP system of tens of MW, standards can be designed to accommodate this full range. Several states have developed a multi-tiered process for systems that range in size from less than 10 kW to more than 2 MW. Similar to the FERC guidelines, some states (Colorado, Florida, and North Carolina) have divided DG systems into three categories based on generator size. Other states use fewer (such as New York, Georgia, and West Virginia) or more (such as Delaware, Illinois, and Maine, where each have four) categories. States also define fees, insurance requirements, and processing times based on the category into which the DG falls. The level of technical review and interconnection requirements usually increases with generation capacity, although the requirements are ultimately driven by the applicant's impact on the grid as determined through the study process and the criteria identified in the application process.[92]

In states with a multi-tiered or screen interconnection process, smaller systems that meet IEEE and UL standards or certification generally pass through the interconnection process faster, pay less in fees, and require less protection equipment because there are fewer technical concerns. States that require faster application processing for smaller systems (< 10 to < 30 kW) include California, Connecticut, Massachusetts, Michigan, Minnesota, New York, Utah, and Wisconsin. For relatively large DG systems, processes and requirements may be similar or identical to those used for large central power generators. For mid-size systems, states may need to develop several levels of procedural and technical protocols to meet the range of needs for onsite generators, utilities, and regulators.

[92] Thus, it is possible for a larger system to have a fairly expedited process if it is not deemed to have a notable or negative system impact. Utah's interconnection rules provide an example of this approach (see slide 5): http://www.naruc.org/international/Documents/Campbell%20Connection%20to%20Power%20Grids%20May%2023%209%20am.pdf.

States can promote DG with comprehensive net metering standards that employ strategies such as the following:

- Avoid placing an aggregate or statewide capacity limit on net metering.
- Ensure that any individual system size limitation is based only on the host customer's load or consumption (e.g., Arizona and Colorado).
- Allow the owner of a net metered system to retain ownership of RECs produced by the system, unless transferred to the utility or another party in exchange for acceptable compensation.
- Provide options for indefinite rollover, effectively or actually credited at retail rate, for net metered customers. Some states require that customers be paid for annual net excess generation at a price no lower than the average daytime wholesale price for the prior year.
- Avoid requiring retail electric customers to purchase new metering equipment. States can require utilities to make smart metering and other digital technology for energy management available to solar and other customers on a non-discriminatory and open-access basis. Integrating smart meters or other advanced metering technologies can lead to more detailed and reliable meter data, which in turn can lead to more efficient planning and energy use.
- Allow all customers to participate in net metering.
- Provide options for virtual net metering and meter aggregation.

Constraints

Designing new DG interconnection and net metering rules could resolve recurring barriers encountered by applicants for DG system interconnection. These barriers have been well-documented (NREL 2000; Schwartz 2005). Four areas in which a DG developer typically confronts problems include:

- *Costly technical system requirements.* Utilities often require additional measures related to the safety and operation of DG systems and their compatibility with the grid. For example, customers may be faced with costly electric service and grid upgrades as a condition of interconnection. Another frequently cited and particularly costly (e.g., $1,000 to $6,000) technical requirement for smaller DG systems (e.g., up to 200 kW) is the installation of an exterior manual disconnect switch that can be accessed by the utility to isolate the system from the grid, despite the fact that many grid tied systems have anti-islanding features that make such manual disconnects redundant. States may consider limiting the types of additional requirements that utilities can require of systems integrators beyond that which is covered in interconnection or net metering policies.
- *Utility business practices.* States can set policy direction for the contractual and procedural interconnection requirements that are imposed on system developers to be equitable and commensurate with the size and complexity of the system seeking interconnection. Limiting the length of the application review periods or technical study requirements can reduce what are often high costs for smaller DG systems to interconnect to the grid.
- *Regulatory constraints.* Such constraints can arise from tariff and rate conditions, including the prohibition of interconnection of generators that operate in parallel with the electric grid.[93] In some instances,

[93] When a CHP system is interconnected to the grid and operates in parallel with the grid, the utility only has to provide power above and beyond what the onsite CHP system can supply.

environmental permitting or emission limits can also create barriers. For more information on the barriers posed to DG systems by tariff and rate issues, see Chapter 6, "Policy Considerations for Combined Heat and Power," and Section 7.4, "Customer Rates and Data Access."

- *Local permitting constraints.* System permitting requirements are sometimes not well-defined and are often not uniform.

Some states are beginning to address these areas of concern through a combination of policy actions and regulatory changes to remove or alter requirements that they believe are inappropriate for the scale of small DG units.

Interaction with Federal Policies

States have found that several federal initiatives can be utilized when designing their own interconnection standards:

- In 2006, FERC set standard terms and conditions for public utilities to interconnect new DG sources with Small Generator Interconnection Procedures (SGIP) and the Small Generator Interconnection Agreement (SGIA). These requirements were developed based on requirements in FERC Orders 2006, 2006-A, and 2006-B. They apply to FERC-jurisdictional interconnections that interconnect at the transmission level. The FERC standards generally do not apply to distribution-level interconnection, which is regulated by state PUCs. The SGIP contain technical procedures as well as standard contractual provisions. They provide three ways to evaluate an interconnection request. The SGIP require interconnection equipment to be certified according to IEEE Standards 1547 and UL 1741. The SGIP address interconnection to spot networks for inverter-based DG. They do not address other interconnections to spot and area networks. The SGIP also do not cover any external disconnect switch requirements. The SGIA was developed for all interconnection requests submitted under the SGIP and governs the terms and conditions under which the Interconnection Customer's Small Generating Facility will interconnect with, and operate in parallel with, the Transmission Provider's Transmission System.
- In November 2013, FERC adopted several updates to the SGIP through Order 792. Among other changes, these updates added energy storage to the list of resources eligible to interconnect under FERC procedures. States may want to consider how state interconnection rules accommodate storage assets and how they interact with existing FERC orders.[94] While FERC's updates are not binding for states, they can provide useful models for establishing provisions that anticipate and enable higher DG penetration. Ohio is an example of a state that recently adopted substantial portions of the SGIP.[95]
- Under the Public Utility Regulatory Policy Act (PURPA), utilities are required to allow interconnection by qualifying facilities. States have significant flexibility in administering PURPA, although amendments made in 2005 and FERC decisions have limited the applicability of PURPA in some regions, particularly for facilities larger than 20 MW. In 2010, FERC ruled that California's "multi-tiered" avoided-cost-rate structure for a feed-in tariff for CHP systems of up to 20 MW is consistent with PURPA. FERC affirmed that state procurement obligations can be considered when calculating avoided cost; for example, requirements that utilities buy particular sources of energy with certain characteristics (e.g., renewable energy) to meet procurement obligations.

[94] For more information on FERC's SGIA and SGIP, see http://www.ferc.gov/whats-new/comm-meet/2013/112113/E-1.pdf.

[95] http://www.irecusa.org/2013/12/ohio-joins-top-states-improving-interconnection-procedures-for-renewables/

- Section 1254 of the Energy Policy Act of 2005 (DOE 2007) required each state regulatory authority to determine whether to require interconnection service for any utility consumer who had onsite generation by August 8, 2007. The Distributed Energy Interconnection Procedures were developed as an outcome of this requirement. In the Procedures, the U.S. Department of Energy's (DOE's) Offices of Energy Efficiency and Renewable Energy and of Electricity Delivery and Energy Reliability encourage state and non-state jurisdictional utilities to consider best practices in establishing interconnection procedures.

Interaction with State Policies

Interconnection and net metering standards are critical policies that complement other clean energy policies and programs such as state RPSs (see Chapter 5, "Renewable Portfolio Standards"), clean energy fund investments (see Chapter 3, "Funding and Financial Incentive Policies"), and utility planning practices (see Section 7.1, "Electricity Resource Planning and Procurement"). Such standards can also help states achieve other related environmental, energy, and economic goals. For example, by providing incentives to site renewable energy on formerly contaminated lands, landfills, or mine sites, the state can help protect open space and transform blighted properties into community assets.[96]

Best Practices: Designing a Net Metering Standard

- Ensure the customer's right to generate electricity and connect to the grid without discrimination or undue process.
- Ensure that the value of DG electricity is quantified fairly and that DG customers are adequately compensated.
- Avoid unfair and discriminatory cost recovery practices. If the utility implements charges to recover embedded net fixed costs, ensure that these charges are applied only after accounting for all utility benefits and offset cost reductions due to DG.
- Ensure that net metering rules, regulations, and practices are applied equally statewide.
- Ensure that the policy provides transparent access to data, such as load data (including hourly profiles), so customers can understand the economic implications of adopting onsite clean energy technologies.
- Avoid restrictive total program or state (aggregate) capacity limits.
- Avoid restrictive individual system capacity limits beyond that of the host customer's load or electricity consumption.
- Ensure that the net metering system owner retains renewable energy certificate (REC) ownership unless the REC is transferred to another party in exchange for fair compensation.
- Ensure that monthly or annual "rollover" provisions provide the net metering customer compensation at a retail rate for excess generation sent to the grid.
- Provide virtual net metering and meter aggregation options to ensure that all customers are able to participate in net metering.

[96] For example, Vermont's Act 99 of 2014 included specific considerations that can facilitate solar installations on landfill sites, while New Jersey's Solar Act of 2012 (S.B. 1925) authorized a new incentive to cover the additional costs for deploying solar electric power generation facilities on brownfield sites. For more examples and resources regarding renewable energy development on contaminated lands, see EPA's RE-Powering America's Land initiative at www.epa.gov/renewableenergyland/.

Best Practices: Designing an Interconnection Standard

The following are a compilation of best practices derived from current literature or from existing state policy examples.[97]

Participants

- Ensure that all customer classes are eligible under the policy.
- Ensure that interconnection policies apply equally to all utilities (including municipally and cooperatively owned utilities) statewide.

Policy Design

- Work collaboratively with interested parties to develop interconnection rules that are clear, concise, and applicable to all potential DG technologies. This will streamline the process and avoid untimely and costly rework.
- Develop standards that cover the scope of the desired DG technologies, generator types, sizes, and distribution system types.
- Minimize related application costs, particularly for smaller systems.
- Avoid restrictive individual system capacity limits.
- Avoid restrictive requirements for external disconnect switches for smaller, inverter-based systems.
- Avoid restrictive requirements that place unnecessary mandates on customers to buy liability insurance or require customers to make the utility an additional insured party.
- Consider adopting portions of national models (such as those developed by the National Association of Regulatory Utility Commissioners, IREC, and FERC) and successful programs in other states, or consider using these models as a template in developing a state-based standard. Also, consistency within a region increases the effectiveness of these standards.
- Try to maximize consistency between the RTO and the state standards for large generators.
- Develop consistency among states based on common practices to reduce compliance costs for the industry.

Process

- Ensure that a standard form interconnection agreement be available and easy to understand.
- Establish that reasonable, punctual procedural timelines should be adopted and enforced.
- Address all components of the interconnection process, including issues related to both the application process and technical requirements.
- Develop an application process that is streamlined with reasonable requirements and fees. Consider making the process and related fees commensurate with generator size. For example, develop a straightforward process for smaller or inverter-based systems and more detailed procedures for larger systems or those utilizing rotating devices (such as synchronous or induction motors) to fully assess their potential impact on the electrical system.
- Create a streamlined process for generators that are certified compliant with certain IEEE and UL standards. UL Standard 1741, “Inverters, Converters and Charge Controllers for Use in Independent Power Systems,” provides design standards for inverter-based systems under 10 kW. IEEE Standard 1547, “IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems,” establishes design specifications and provides technical and test specifications for systems rated up to 10 MW. These standards can be used to certify electrical protection capability.
- Provide for a multi-tier (three to four separate levels) review process to accommodate systems based on system capacity, complexity, and level of certification.
- Identify and establish clear, transparent technical screens across all system tiers.
- Ensure that the interconnection rule includes a dispute resolution process for involved stakeholders.

[97] Best practice examples taken from the following sources: IREC, FreeingTheGrid.org, and ACEEE Interconnection Standards (ACEEE. 2013).

Implementation and Evaluation

This section describes the implementation and evaluation of new interconnection standards and net metering practices, including best practices that states have found successful.

Administering Body

While individual states may develop interconnection standards that are then approved by the PUC, utilities are ultimately responsible for their implementation.

Evaluation/Oversight

By establishing clearly defined categories of technologies and generation systems, utilities are able to streamline the process for customers and lessen the administrative time related to reviewing interconnection applications. For example, some states create multiple categories and tiers for reviewing applications with established maximum review periods. Across these technology categories, the maximum processing time allowed can vary by more than a factor of five depending on the technical complexity and size of the interconnection. Several states (including California, Connecticut, Massachusetts, Michigan, Minnesota, New York, and Wisconsin) have created tiered application processes based on system size and other factors. This tiered approach streamlines the process for smaller systems while maintaining a standard process for larger systems.

- A streamlined process that applies to smaller[98] or simpler systems (e.g., inverter-based) could have lower fees, shorter timelines, and fewer requirements for system impact studies. In some cases, states (i.e., California and New York) have pre-certified certain devices. Other states (i.e., Connecticut, Massachusetts, Minnesota, New Jersey, and Texas) require compliance with UL 1741 or IEEE 1547 and other applicable standards to expedite approval.
- Systems in a standard process are subject to a comprehensive evaluation. Applicants for these systems are typically required to pay additional fees for impact studies to determine how the DG may affect the performance and reliability of the electrical grid. Because of the higher degree of technical complexity, fees are higher and processing times are longer.

Best Practices: Implementing an Interconnection or Net Metering Standard

The best practices identified below will help guide states in implementing interconnection or net metering standards. These best practices are based on the experiences of states that have implemented such standards.

- Consider working as a collaborative to establish monitoring activities that evaluate the effectiveness of interconnection or net metering standards and application processes.
- Periodically review and update standards based on monitoring activities, including feedback from utilities and applicants.
- Keep abreast of changes in DG/CHP and electric utility technology and design enhancements, since these may affect existing standards, such as streamlining the application process and interconnection requirements.
- Consider working with groups such as IEEE to monitor industry activities and to stay up-to-date on standards developed and enacted by these organizations.

[98] California, Connecticut, Massachusetts, Michigan, Minnesota, New York, and Wisconsin require faster processing of smaller system (< 10 kW to < 30 kW) applications.

State Examples

There is tremendous diversity among the key elements of interconnection standards recently established at the state level. In the examples presented below, application processes such as fees, timelines, and eligibility criteria differ in each state.

Greater similarities are emerging among states' technical requirements, and this consistency is making it easier to increase the amount of clean DG in the states.

Massachusetts

Massachusetts' initial net metering rules were created in 1982 by the state's Department of Public Utilities (DPU). These rules have been modified several times and in August 2009, the DPU issued its model net metering tariff so that customers in Massachusetts are subject to the same net metering tariffs regardless of utility. The state's IOUs must offer net metering. Massachusetts' interconnection standards apply to all forms of DG, including renewables, and to all customers of the state's three IOUs (Unitil, Eversource, and National Grid). Both fossil-fueled and renewably fueled CHP systems are eligible for standardized interconnection. However, renewably fueled CHP systems alone are eligible for net metering.

Massachusetts' interconnection and net metering policies stand out on the following merits:

- The state's Model Interconnection Tariff provides for three system interconnection options: a simplified process, an expedited process, and a standard process. The size and technical complexity of each system determines the interconnection pathway.
- Massachusetts' rules allow for a manual external disconnect switch to be required at the discretion of the utility.
- Utilities are required to collect and track information related to the interconnection process in order to improve and update the standards.
- Massachusetts' interconnection policy was designed to pay special attention to network systems found in dense urban areas, which required a transparent review and screening process for projects.
- The state's net metering policy is open to a wide variety of renewable and other DG technologies.
- The net metering policies are applicable to all IOUs within the state.
- There are three different classifications of net metered systems based on the size of the applicant system.
- System owners are afforded the ownership of all related environmental benefits such as RECs.
- Massachusetts' Solar Renewable Energy Credit program includes specific incentives for renewable energy on landfills and brownfields.
- Massachusetts also allows "neighborhood net metering" for neighborhood-based Class I, II, or III facilities that are owned by (or serve the energy needs of) a group of 10 or more residential customers in a single neighborhood and served by a single utility.
- The net metering laws establish various system capacity limits, such as 10 MW for municipal or government entities, 2 MW for all other Class III systems, 1 MW for all other Class II systems, and 60 kW for all other Class I systems.

Websites:
http://programs.dsireusa.org/system/program/detail/986
http://programs.dsireusa.org/system/program/detail/986
http://www.epa.gov/chp/policies/policies/mamassachusettsnetmeteringrules.html

Oregon

Oregon has three separate interconnection standards: one for its net metered systems made up of primary investor-owned (PGE and PacifiCorp), municipally owned, and cooperatively owned utilities; one for small generator facilities (non-net metered systems); and one for large generator facilities (non-net metered systems). The Oregon rules do not apply to customers of Idaho Power, which provides net metering to Oregon customers pursuant to rules adopted by the Idaho PUC (DSIRE 2014a). Both fossil-fueled and renewably fueled net metered systems, including CHP systems, are eligible for standardized interconnection. Oregon is one of few states to receive an "A" grade for both its interconnection and net metering policies in FreeingTheGrid.org's survey of state policies.

Oregon's interconnection and net metering policies stand out for the following reasons:

- The rules differentiate between system size classes, allowing for small, non-net metered generator facilities up to 10 MW.
- Oregon also requires that utilities provide for the use of a standard interconnection application, a standard agreement, and reasonable procedural timelines.
- All utilities must establish a single point of contact through which applicants can obtain basic information regarding the interconnection process.
- Oregon does not require a manual, external disconnect switch for systems smaller than 25 kW.
- Utilities may not require customers to purchase additional insurance or to name the utility as an additional insured party on the applicant's liability policy.
- Net metered systems have three levels of interconnection review with reasonable application fees.
- Oregon maintains an individual system capacity limit of 25 kW to 2 MW for non-residential applications.
- The state allows for net excess generation to be carried over monthly as a kilowatt-hour (kWh) credit for a 12-month period.
- Municipally owned utilities, cooperatively owned utilities, and public utility districts are required to offer net metering up to 25 kW for non-residential systems and 10 kW for residential systems.
- In 2008, Oregon authorized third-party ownership for renewable energy installations of net metered systems.
- Customers own all associated RECs from net metered systems.

Websites:
http://programs.dsireusa.org/system/program/detail/802
http://programs.dsireusa.org/system/program/detail/39
http://epa.gov/chp/policies/policies/ororegoninterconnectionstandards.html

Utah

Utah requires the state's IOU, Rocky Mountain Power, and cooperatively owned utilities serving greater than 10,000 customers to offer net metering to customers who generate electricity. In 2010, FreeingTheGrid.org gave Utah's interconnection and net metering policies an "A" ranking based on a scoring system that compares state rules against a standard best practice model policy. In Utah, renewable fuels such as waste gas and waste heat capture and recovery are eligible under the state's interconnection standards. Only renewably fueled CHP systems are eligible under the state net metering and interconnection standards.

Utah's interconnection and net metering policies stand out for the following reasons:

- Utah's interconnection rules are based on FERC's interconnection standards for small generators, adopted in May 2005 by FERC Order 2006.
- The state's interconnection requirements, standards, and review procedures are divided into three levels for systems up to 20 MW in capacity, based on system complexity. Level 1 applies to inverter-based systems under 25 kW. Level 2 applies to systems between 25 kW and 2 MW that fail to qualify under Level 1. Level 3 applies to systems under 20 MW that do not qualify for Level 1 or 2 interconnections.
- Utah's net metering policies apply equally to the state's IOUs and rural cooperatively owned utilities.
- Utah has set system capacity limits at 2 MW for non-residential and 25 kW for residential net metered systems.
- For Rocky Mountain Power, both residential and small commercial customers may accrue excess kWh credits against their next bill at retail rate on a kWh-for-kWh basis. Any credits remaining at the end of a 12-month billing cycle are granted to the utility.
- For Rocky Mountain Power, large commercial and industrial customers with demand charges may choose between valuing net excess generation at an avoided-cost-based rate or at an alternative rate based on utility revenue and sales contained in FERC Form No. 1.
- System owners own the RECs associated with the system.
- Utah authorizes meter aggregation for customers who have multiple meters on or adjacent to the same site.

Websites:
http://programs.dsireusa.org/system/program/detail/806
http://programs.dsireusa.org/system/program/detail/743
http://www.epa.gov/chp/policies/policies/ututahnetmeteringrules.html
http://epa.gov/chp/policies/policies/ututahinterconnectionstandards.html

What States Can Do

States have adopted successful interconnection and net metering standards that expedite the implementation of clean energy technologies while accounting for the reliability and safety needs of the utility companies. Action steps for both initiating a program to establish interconnection and net metering rules and for ensuring the ongoing success of the rules after adoption are described below. Importantly, the success of effective interconnection standards is enhanced by effective net metering standards in place. States have recognized the need for concurrent net metering standards by either incorporating net metering requirements or by establishing separate net metering standards.

Action Steps for States

States That Have Existing Interconnection and Net Metering Standards

A priority after establishing standard interconnection and net metering rules is to identify and mitigate issues that might adversely affect the success of the rules. Being able to demonstrate the desired benefits is critical to their acceptance and use by stakeholders. The following strategies demonstrate these benefits:

- Many states can improve upon existing interconnection and net metering rules by comparing them to established model rules and best practices. IREC and FreeingTheGrid.org are sources for model rules.
- Monitor interconnection applications to determine if the standards ease the process for applicants and cover all types of interconnected systems. States can also monitor utility compliance with the new standards or create a complaint/dispute resolution point of contact.
- If resources permit, identify an appropriate organization to maintain a database on interconnection applications and new DG systems, evaluate the data, and convene key interconnection stakeholders when necessary.
- Modify and change interconnection or net metering rules as necessary to respond to the results of monitoring and evaluation activities.

States That Do Not Have Existing Interconnection and Net Metering Standards

Public support can help establish standard interconnection rules. The following strategies foster support from public officials and other stakeholders:

- Ascertain the level of demand and support for standard interconnection and net metering rules in the state from both public office holders and key industry members (e.g., utilities, equipment manufacturers, project developers, and potential system owners). If awareness is low, consider implementing an educational effort targeted at key stakeholders to raise awareness of the environmental and, especially, economic benefits resulting from uniform interconnection rules. For example, demonstrate that DG can result in enhanced reliability and reduced grid congestion. A 2013 study found that strategically sited DG yields improvements to grid system efficiency and provides additional reserve power, deferred costs, and other grid benefits (Crossborder Energy 2013). If resources are available, perform an analysis of these benefits and implement a pilot project (e.g., similar to Bonneville Power Authority's "non-wires" pilot program [BPA 2005] or the Massachusetts Technology Collaborative's Utility Congestion Relief Pilot Projects [RET 2005]) that promotes DG along with energy efficiency and voluntary transmission reduction. While this type of analysis is not essential, states have found it to be helpful.
- Establish a collaborative working group of key stakeholders to develop recommendations for a standard interconnection process and technical requirements. Open a docket at the PUC with the goal of receiving stakeholder comments and developing a draft regulation for consideration by the state PUC.
- If necessary, work with members of the legislature and the PUC to develop support for passage of the interconnection and net metering rules.
- Remember that implementing interconnection standards may take some years. States have found that success is driven by the inherent value of DG, which eventually becomes evident to stakeholders.
- Consider existing federal and state standards while developing new interconnection procedures and rely on accepted IEEE and UL standards to develop interconnection technical requirements.

Related Actions

- Interconnection standards are most effective in combination with tariffs and regulations that encourage DG. If current tariffs and regulations discourage DG—for example, through high standby charges or backup rates—then interconnection standards may not result in DG growth. Tariffs that encourage DG growth may allow customers to sell excess electricity back to the utility at or near retail rates.
- More generally, utilities can offer certain financial incentives to discourage customers from making their own electricity and discourage DG deployment. This is especially true when utilities' revenues are tied to the volume of electricity they sell, which is known as the throughput incentive. Some states have implemented policies that help decouple revenue from sales volumes, thus reducing disincentives for DG. For more information about these policies and about utility financial incentives in general, see Section 7.2, "Policies That Sustain Utility Financial Health."
- Communicate the results to state officials, public office holders, and the public.
- Include key stakeholders (e.g., utilities, equipment manufacturers, project developers, potential customers, advocacy groups, and regulators) in the development of the standard interconnection rules. Stakeholders can also contribute to rule modification based on the results of ongoing monitoring and evaluation.

Information Resources

State-by-State Assessment

Title/Description	URL Address
Database of State Incentives for Renewables and Efficiency (DSIRE). This database provides information on state interconnection policies. It also provides comparative information on policies for each state.	http://www.dsireusa.org
dCHPP (CHP Policies and Incentives Database). This online database allows users to search for CHP policies and incentives on interconnection by state or at the federal level.	http://www.epa.gov/chp/policies/database.html
Eastern Interconnection States Planning Council EZ Mapping Tool. This resource allows users to query state policies on a wide variety of topics.	https://eispctools.anl.gov/policy_query

Federal Resources

Title/Description	URL Address
Distributed Generation Interconnection Collaborative. DOE's National Renewable Energy Laboratory (NREL) actively participates in many of the programs that create national standards for interconnection.	http://www.nrel.gov/tech_deployment/dgic.html
The Combined Heat and Power Partnership (CHPP). EPA's CHPP is a voluntary program that seeks to reduce the environmental impact of energy generation by promoting the use of CHP. The CHPP helps states identify opportunities for policy development (energy, environmental, economic) to encourage energy efficiency through CHP and can provide additional assistance to help states implement standard interconnection.	http://www.epa.gov/chp/
RE-Powering America's Land: Mapping and Screening Tools. This EPA website provides tools for evaluating the renewable energy potential for current and formerly contaminated lands, landfills, and mine sites. This initiative identifies the renewable energy potential of these sites and provides other useful resources for communities, developers, industry, state and local governments, or anyone interested in reusing these sites for renewable energy development. In particular, see the Solar and Wind Site Screening Decision Trees.	http://www.epa.gov/renewableenergyland/rd_mapping_tool.htm
The Effect of State Policy Suites on the Development of Solar Markets. This NREL paper uses statistical analysis and case studies to examine the effectiveness of state policies in fostering successful solar photovoltaic markets.	www.nrel.gov/docs/fy15osti/62506.pdf

National Standards Organizations

Title/Description	URL Address
IEEE 1547 Standard for Interconnecting Distributed Resources with Electric Power Systems. The IEEE Standards Association has developed standards relevant to many of the technical aspects of interconnection. In particular, Standard 1547 provides requirements relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection.	http://grouper.ieee.org/groups/scc21/1547/1547_index.html
UL 1741: Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources. UL also develops standards for interconnecting DG. In particular, UL 1741 will combine product safety requirements with the utility interconnection requirements developed in the IEEE 1547 standard to provide a testing standard to evaluate and certify DG products.	http://ulstandards.ul.com/standard/?id=1741

Examples of Standard Interconnection Rules

Title/Description	URL Address
IREC Regulatory Reform. IREC has prepared a model interconnection rule and a guide to connecting DG to the grid.	http://www.irecusa.org/regulatory-reform/
Model Interconnection Procedures and Model Net Metering Program Rules. These documents provide state policy-makers with a clear baseline to measure the minimum adequacy of their interconnection procedures, along with guidance to improve those procedures.	http://www.irecusa.org/regulatory-reform/interconnection/ (interconnection) http://www.irecusa.org/regulatory-reform/net-metering/ (net metering)
Connecting to the Grid: A Guide to Distributed Generation Interconnection Issues. This guide provides a model for stakeholders to develop state-level interconnection standards.	http://www.solarelectricpower.org/media/8165/irecconnecting-to-the-grid09.pdf
Freeing the Grid. This website and annual report, co-produced by IREC and Vote Solar, provides information on the status of state interconnection and net metering policies. Also available on this site are best and worst practice approaches to policy development as well as model rules.	http://freeingthegrid.org/
Model Interconnection Tariff. Massachusetts adopted this model interconnection tariff to establish a clear, transparent, and standard process for DG interconnection applications.	https://sites.google.com/site/massdgic/home
Mid-Atlantic Distributed Resources Initiative (MADRI) Working Group. In a collaborative process, MADRI has developed a sample interconnection standard.	http://www.energetics.com/MADRI/
Model Distributed Generation Interconnection Procedures and Agreement. NARUC developed these documents for small DG resources.	http://www.naruc.org/grants/Documents/dgiaip.pdf
Chapter 3. Interconnection Standards for CHP with No Electricity Export. This *Guide to the Successful Implementation of State Combined Heat and Power Policies* informs state utility regulators and other state policymakers with actionable information to assist them in implementing key state policies that impact CHP. It discusses five policy categories, including interconnection, and highlights successful state CHP implementation approaches within each category.	https://www4.eere.energy.gov/seeaction/system/files/documents/publications/chapters/see_action_chp_policies_guide_chap_3.pdf

Other Resources

Title/Description	URL Address
Removing Regulatory Barriers to Distributed Generation. This report by the Oregon PUC addresses barriers for DG.	http://www.puc.state.or.us/meetings/pmemos/2005/030805/reg3.pdf
Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects. This NREL report studies the barriers projects have faced interconnecting to the grid.	http://www.nrel.gov/docs/fy00osti/28053.pdf
Optimal Portfolio Methodology for Assessing Distributed Energy Resources Benefits for the Energynet: CEC, PIER Energy-Related Environmental Research (CEC-500-2005-061-D). This project addresses whether DG, demand response, and localized reactive power sources, or distributed energy resources, can be shown to enhance the performance of an electric power transmission and distribution system.	http://www.energy.ca.gov/2005publications/CEC-500-2005-096/CEC-500-2005-096.PDF
Model Regulations for the Output of Specified Air Emissions from Smaller-Scale Electric Generation Resources. The Regulatory Assistance Project (RAP) prepared a Distributed Resource Policy Series to support state policy efforts, and facilitated the creation of a Model Distributed Generation Emissions Rule for use in air permitting of DG.	http://www.raponline.org/document/download/id/174
Designing Distributed Generation Tariffs Well: Fair Compensation in a Time of Transition. This RAP paper outlines current tariffs and considerations for regulators as they weigh the benefits, costs, and net value to DG adopters, non-adopters, the utility system, and society as a whole.	http://www.raponline.org/document/download/id/6898
Rate Design Pathways to Fair Utility Rates for Solar PV in a Distributed Energy Age. This article from ElectricityPolicy.com provides insights on how states can accommodate growth in the solar photovoltaic market.	http://www.electricitypolicy.com/articles/7530-rate-design-pathways-to-fair-utility-rates-for-solar-pv-in-a-distributed-energy-age
The CHP Association (CHPA). CHPA brings together diverse market interests to promote the growth of clean, efficient CHP in the United States. As a result, they have been stakeholders in states that have developed standard interconnection rules.	http://chpassociation.org/

State Resources

State	Title/Description	URL Address
California	California Interconnection Guidebook: A Guide to Interconnecting Customer-owned Electric Generation Equipment to the Electric Utility Distribution System Using California's Electric Rule 21. This guidebook, written for the California Energy Commission's Public Interest Research Program in 2003, is intended to help customers interconnect electric generators to their investor-owned electric utility Distribution System under the California Public Utilities Commission's approved utility interconnection Rule 21.	http://www.energy.ca.gov/reports/2003-11-13_500-03-083F.PDF
	Decision Adopting Settlement Agreement Revising Distribution Level Interconnection Rules and Regulations (Decision 12-09-018). This 2012 order by the California Public Utilities Commission reformed Electric Tariff Rule 21, which governs the interconnection by electric generating facilities to the distribution systems of California IOUs.	http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M028/K168/28168335.pdf
Connecticut	DPUC Investigation into the Need for Interconnection Standards for Distributed Generation—Area Network Interconnection Standards. This decision provides revised guidelines for the Connecticut Department of Public Utility Control's joint interconnection guidelines to bring them into alignment with FERC Order 2006.	http://www.dpuc.state.ct.us/dockhist.nsf/8e6fc37a54110e3e852576190052b64d/0802f9f14f6a0ab18525775100510969?OpenDocument
	DPUC Investigation into the Need for Interconnection Standards for Distributed Generation–2007 Revisions. This docket provides status updates on the research and development of standards for interconnection from Connecticut's investor owned utilities.	http://www.dpuc.state.ct.us/dockhist.nsf/8e6fc37a54110e3e852576190052b64d/55810423d6501987852573e800837054?OpenDocument
Delaware	Interconnection Standards for Delmarva Power & Light Company's Delaware Operating Territory. This 2011 filing contains Delmarva Power & Light Company's interconnection standard for its Delaware operating territory in compliance with the Delaware PUC's Regulation Docket No. 49 and Order Numbers 7832 and 7984.	http://www.dsireusa.org/documents/Incentives/DE05R.pdf
	In the Matter of the Adoption of Rules and Regulations to Implement the Provisions of 26 DEL. C. CH. 10 Relating to the Creation of a Competitive Market for Retail Electric Supply Service (Order No. 7984).This 2011 proceeding revises Delaware net metering rules to include single customers with multiple accounts and multiple customers and multiple accounts served by community energy generation facilities.	http://depsc.delaware.gov/orders/7984.pdf

State	Title/Description	URL Address
Hawaii	Instituting a Proceeding to Investigate the Implementation of Reliability Standards for Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited (Docket No. 2011-0206). This proceeding initiated an investigation to examine the implementation of reliability standards for utilities in the state of Hawaii, including interconnection of DG facilities.	http://dms.puc.hawaii.gov/dms/DocketSearch.jsp (Enter 2011-0206 in search box Docket No.)
	Decision and Order for Approval to Modify Rule 14H, Interconnection of Distributed Generating Facilities Operating in Parallel with the Companies Electrical Systems as Shown in Appendices I, II, and III (Docket No. 2010-0015). This 2011 decision updates Hawaii Electric Companies' Tariff Rule 14H, which governs the interconnection of distributed generating facilities, to facilitate the higher penetration of renewable distributed generating facilities.	http://www.dsireusa.org/documents/Incentives/HI01Rd.pdf
Massachusetts	Distributed Generation and Interconnection in Massachusetts. Massachusetts Department of Energy Resources Web page. This website provides resources and information on interconnection, net metering, and grid modernization in the state of Massachusetts.	https://sites.google.com/site/massdgic/
	Department Investigation on Distributed Generation Interconnection (Docket 11-75). This docket features an order approving an interconnection timeline enforcement mechanism, which requires the state's IOUs to file interconnection tariffs. The docket is also an ongoing investigation on DG interconnection.	http://web1.env.state.ma.us/DPU/FileRoom (Click Dockets/Filings and enter Docket #11-75 in search box to access materials)
	Inquiry into Net Metering and Interconnection of Distributed Generation (Docket 11-11). This 2011 docket establishes an inquiry into net metering and interconnection of DG.	http://web1.env.state.ma.us/DPU/FileRoom (Click Dockets/Filings and enter Docket #11-11 in search box to access materials)
Michigan	Customer Generation. Michigan Public Service Commission (PSC) Department of Licensing and Regulatory Affairs Web page. This page provides applications for interconnection and net metering, as well as generator interconnection procedures and parallel operating agreements.	http://www.michigan.gov/mpsc/0,1607,7-159-16393_48212---,00.html
	In the Matter, on the Commission's Own Motion, to Approve Procedure, Agreements, and Forms, for Use with the Category 1 and Category 2 Interconnection and Net Metering Programs (Docket No. U-15919). This 2012 case approves general interconnection procedures in the state of Michigan for projects up to 150 kW. Procedures are divided into two categories based on the aggregate generator size.	http://www.dleg.state.mi.us/mpsc/orders/electric/2012/u-15919_09-25-2012.pdf

State	Title/Description	URL Address
Minnesota	Distributed Generation. Minnesota Department of Commerce's Web page. This website contains general information on DG in Minnesota, including resources from stakeholder workshops held in 2011–2014 on issues related to DG resources.	http://mn.gov/commerce/energy/businesses/clean-energy/distributed-generation/index.jsp
	In the Matter of Establishing Generic Standards for Utility Tariffs for Interconnection and Operation of Distributed Generation Facilities under Minnesota Laws 2001, Chapter 212. This 2004 order establishes guidelines for DG tariffs in Minnesota, and mandates that retail electric public utilities submit distribution tariffs consistent with the guidelines.	http://mn.gov/puc/portal/groups/public/documents/puc_pdf_orders/008982.pdf
New Hampshire	Net Metering for Customer-Owned Renewable Energy Generation Resources of 1,000 Kilowatts or Less. This code, enacted in 2001 and subsequently amended, establishes interconnection requirements for net energy metering.	http://www.puc.state.nh.us/Regulatory/Rules/PUC900.pdf
New Jersey	Net Metering and Interconnection. New Jersey Board of Public Utilities' Web page. This page explains net metering and interconnection requirements in the state of New Jersey.	http://www.njcleanenergy.com/renewable-energy/programs/net-metering-and-interconnection
	Interconnection of Class I Renewable Energy Systems N.J.A.C 14:8-5.1 et seq.). This administrative code, enacted in 2004, and subsequently amended, provides general interconnection provisions and lays out requirements for interconnection in the state of New Jersey.	http://www.lexisnexis.com/hottopics/njcode/ (Enter 14:8-5.1 into search box)
New York	Distributed Generation Information. New York PSC Web page. This page provides updated New York State standardized interconnection requirements.	http://www3.dps.ny.gov/W/PSCWeb.nsf/All/DCF68EFCA391AD6085257687006F396B?OpenDocument
	New York State Standardized Interconnection Requirements and Application Process for New Distributed Generators 2 MW or Less Connected in Parallel with Utility Distribution Systems. This document, updated in 2014, contains standardized interconnection requirements for DG in New York state.	http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/dcf68efca391ad6085257687006f396b/$FILE/ATTP59JI.pdf/Final%20SIR%202-1-14.pdf
Ohio	Interconnection Forms and Interconnection Applicant Checklist. The Public Utilities Commission of Ohio Web page. This page provides sample interconnection forms, including applications and interconnection agreements, for the state of Ohio.	http://www.puco.ohio.gov/puco/index.cfm/puco-forms/interconnection-forms/#sthash.Tfd4dojZ.dpbs
	In the Matter of the Commissions Review of Chapter 4901:1-22 Ohio Administrative Code Regarding Interconnection Services (12-0251-EL-ORD).This case, opened in 2012, is an ongoing review of the administrative code regarding interconnection services in the state of Ohio.	http://dis.puc.state.oh.us/CaseRecord.aspx?CaseNo=12-2051

State	Title/Description	URL Address
Oregon	Net Metering Rules (R. 860-039).This 2007 document presents rules for net metering in the state of Oregon.	http://arcweb.sos.state.or.us/pages/rules/oars_800/oar_860/860_039.html
	Small Generator Interconnection Rules (R. 860-082). This 2009 document presents rules for interconnection in the state of Oregon.	http://arcweb.sos.state.or.us/pages/rules/oars_800/oar_860/860_082.html
Texas	Certification and Licensing. PUC of Texas Web page. This page contains forms, documents, and legislation for DG in the state of Texas, including technical requirements for interconnection.	http://www.puc.texas.gov/industry/electric/business/dg/Dg.aspx
	Distributed Generation Interconnection Manual. This manual, developed by the PUC of Texas in 2002, provides a guide for the inclusion of DG into the Texas electric system.	http://www.puc.texas.gov/industry/electric/business/dg/dgmanual.pdf
	Substantive Rule § 25.211—Interconnection of On-Site Distributed Generation (DG).This rule by the PUC of Texas in 1999 states the terms and conditions governing the interconnection and parallel of onsite DG in Texas.	http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.211/25.211ei.aspx
	Substantive Rule § 25.212—Technical Requirements for Interconnection and Parallel Operation of On-Site Distributed Generation. This rule by the PUC of Texas in 1999 states the technical requirements for interconnection and parallel operation of onsite DG in Texas.	http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.212/25.212ei.aspx
Utah	Net Metering of Electricity (Utah Code § 54-15-101 et seq.). This code, enacted in 2002, outlines rules for the net metering of electricity in the state of Utah.	http://le.utah.gov/UtahCode/section.jsp?code=54-15
	Electrical Interconnection (Utah Admin Code R746-312). This code, enacted in 2010, outlines rules for the interconnection of DG facilities in the state of Utah.	http://www.rules.utah.gov/publicat/code/r746/r746-312.htm
Wisconsin	Distributed Generation Interconnection Procedure. PSC of Wisconsin Web page. This page provides materials for DG interconnection procedures in the state of Wisconsin, including guidelines, points of contact for electric providers, and forms.	http://psc.wi.gov/utilityinfo/electric/distributedGeneration/interconnectionProcedure.htm
	Chapter PSC 119: Rules for Interconnecting Distributed Generation Facilities. This 2004 text provides rules for interconnecting DG facilities in the state of Wisconsin.	http://www.legis.state.wi.us/rsb/code/psc/psc119.pdf

References

Title/Description	URL Address
ACEEE. 2013. Interconnection Standards. American Council for an Energy-Efficient Economy.	http://www.aceee.org/topics/interconnection-standards
Crossborder Energy. 2013. Evaluating the Benefits and Costs of Net Energy Metering in California. Prepared for the Vote Solar Initiative. Crossborder Energy Comprehensive Consulting for the North American Energy Industry.	http://votesolar.org/wp-content/uploads/2013/01/Crossborder-Energy-CA-Net-Metering-Cost-Benefit-Jan-2013-final.pdf
DOE. 2007. Distributed Energy Interconnection Procedures Best Practices for Consideration. Office of Energy Efficiency and Renewable Energy and Office of Electricity Delivery and Energy Reliability. U.S. Department of Energy.	http://www1.eere.energy.gov/solar/pdfs/doe_interconnection_best_practices.pdf
DSIRE. 2013. Utah: Interconnection Standards. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/806
DSIRE. 2014a. Massachusetts: Interconnection Standards. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/986
DSIRE. 2014b. Massachusetts: Net Metering. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/281
DSIRE. 2014c. Oregon: Interconnection Standards. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/802
DSIRE. 2014d. Oregon: Net Metering. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/39
DSIRE. 2014e. Utah: Net Metering. Database of State Incentives for Renewables and Efficiency.	http://programs.dsireusa.org/system/program/detail/743
DSIRE. 2015a. Summary Tables: Interconnection Policies. Database of State Incentives for Renewables and Efficiency. Accessed March 2015.	http://programs.dsireusa.org/system/program?type=14&category=2&
DSIRE. 2015b. Summary Tables: Net Metering. Database of State Incentives for Renewables and Efficiency. Accessed March 2015.	http://programs.dsireusa.org/system/program?type=37&category=2&
SEIA. 2014. Issues and Policies: Net Metering. Solar Energy Industries Association.	http://www.seia.org/policy/distributed-solar/net-metering