Chapter 3. Interconnection Standards for CHP with No Electricity Export

3.1 Overview

Standardized interconnection rules typically address the technical requirements and the application process for DG systems, including CHP, to connect to the electric grid.[50] Most CHP systems are sized to provide a portion of the site's electrical needs, and the site continues to remain connected to the utility grid system for supplemental, standby, and backup power services, and, in select cases, for selling excess power. A key element to the market success of CHP is the ability to safely, reliably, and economically interconnect with the existing utility grid system. However, uncertainty in the cost, timing, and technical requirements of the grid interconnection process can be a barrier to increased deployment of CHP.

Interconnection requirements for on-site generators have an important function. They ensure that the safety and reliability of the electric grid is protected, supporting the utilities' ultimate responsibility for system safety and reliability. For utilities and state regulators, there are three primary issues:

- The safety of the utility line personnel must be maintained at all time; utilities must be assured that CHP and other on-site generation facilities cannot feed power to a line that has been taken out of service for maintenance or as the result of damage.
- The safety of the equipment must not be compromised. This directly implies that an on-site system failure must not result in damage to the utility system to which it is connected or to other customers.
- The reliability of the distribution system must not be compromised.

There is no question about the importance and legitimacy of these basic requirements. However, non-standardized interconnect requirements and uncertainty in the timing and cost of the application process have long been seen as barriers to more widespread adoption of customer-sited DG. The following issues cause uncertainty for the end-user in the interconnection process and may add time and cost to CHP projects:

- The interconnection rules may not clearly establish requirements for timelines and fees.
- The interconnection rules may not be consistently applied by utilities in a state.
- Protection requirements and required protection equipment may not be commensurate with the size and potential impact of smaller generators.[51]
- Requirements for high-cost utility studies may also not be commensurate with the size of the generator.

As of November 2012, the Database of State Incentives for Renewables & Efficiency (DSIRE) has listed 43 states and the District of Columbia as having adopted some form of interconnection standards or guidelines, which are shown in Figure 5.[52] Not all of these states have standardized interconnection rules that include streamlined procedures, clear timelines, simplified contracts, and appropriate application fees.[53] State utility regulators strive to identify an appropriate balance between the needs of the utility and the needs of the customer in developing and approving the standardized interconnection rules.

[50] U.S. EPA. "Clean Energy-Environment Guide to Action: Policies, Best Practices, and Action Steps for States—Chapter 5. Energy Supply Actions." April 2006. www.epa.gov/statelocalclimate/resources/action-guide.html.

[51] The Federal Energy Regulatory Commission has "small generator" interconnection standards for three levels of interconnection—inverter-based systems no larger than 10 kW, systems up to 2 MW, other systems no larger than 20 MW.

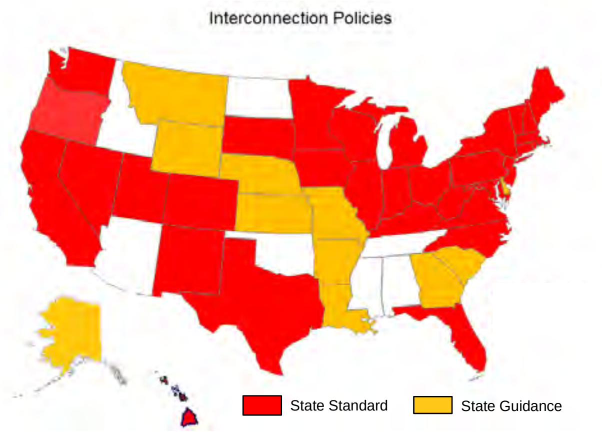
[52] DSIRE. Accessed September 2012. www.dsireusa.org.

[53] Some states use net metering rules to govern interconnection of smaller distributed generation systems. Also, some state net metering provisions are limited in scope. For example, net metering rules often apply only to relatively small systems, specified technologies, or fuel types of special interest to policymakers. Some rules lack detailed specifications and procedures for utilities and customers to follow and vary across utilities within the state. See www.epa.gov/statelocalclimate/documents/pdf/guide_action_full.pdf.

3.2 Successful Implementation Approaches

Effective state standardized interconnection rules for DG/CHP systems with no electricity export often have the following characteristics:[54]

- Interconnection fees commensurate with system complexity[55]
- Streamlined procedures with simple decision-tree screens (allowing faster application processing for smaller systems and those unlikely to produce significant system impacts)[56]
- Practical and predictable technical requirements, often based on existing technical standards Institute of Electrical and Electronics Engineers (IEEE) 1547 and Underwriters Laboratories (UL) 1741[57]
- Standardized, simplified interconnection agreements
- Dispute resolution procedures to resolve disagreements
- The ability for larger CHP systems, and those not captured under net metering rules, to qualify under the standards[58]
- The ability for on-site generators to interconnect to both radial and network grids.[59]



Source: Database of State Incentives for Renewables & Efficiency (DSIRE). Accessed November 2012. www.dsireusa.org/documents/summarymaps/interconnection_map.pdf

Figure 5. States with established interconnection standards or guidelines

An overview of these characteristics is provided below.[60]

1. Appropriate interconnection fees. High application and technical study fees associated with interconnection, along with high insurance requirements, can easily impair CHP project economics. Thus, some states have turned to a more effective approach—setting upper and lower bounds on application and study fees commensurate with the size of the system and potential safety impacts on the grid, and sometimes waiving application fees for small

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[54] National Renewable Energy Laboratory. *Making Connections: Case Studies of Interconnection Barriers and their Impact on Distributed Power Projects*. 2000. www.nrel.gov/docs/fy00osti/28053.pdf. This report discusses a number of barriers to interconnection and includes "A Ten-Point Action Plan for Reducing Barriers to Distributed Generation." For a discussion of factors affecting interconnection of distributed generation, see Regulatory Assistance Project. *Survey of Interconnection Rules*. 2007. www.epa.gov/chp/documents/survey_interconnection_rules.pdf.

[55] Size is only one element that may affect the interconnection process and resultant cost. As an example, under Rule 21 in California there are eight screening steps in the "Initial Review" process, including the type of distribution grid (radial or network), whether power is exported, whether the interconnection equipment is certified, the aggregate capacity of the line in relation to peak line load, the line configuration, potential for voltage drop, and the potential for creation of a short circuit. www.energy.ca.gov/distgen/interconnection/application.html.

[56] Such as the FERC Small Generator Interconnection Procedures and Agreement.

[57] IEEE Standard for Interconnection Distributed Resources with Electric Power Systems (IEEE 1547) and Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources (UL 1741).

[58] FERC small generator interconnection standards include three levels of interconnection—inverter-based systems no larger than 10 kW, systems up to 2 MW, and all other systems no larger than 20 MW.

[59] IEEE 1547.6 Recommended Practice For Interconnecting Distributed Resources With Electric Power Systems Distribution Secondary Networks (finalized September 2011). This standard focuses on the technical issues associated with the interconnection of distribution secondary networks with distributed generation. The standard provides recommendations relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection. The standard gives consideration to the needs of the local electric power system to be able to provide enhanced service to the DR owner loads as well as to other loads served by the network. The standard identifies communication and control recommendations and provides guidance on considerations that will have to be addressed for such interconnections.

[60] For a discussion of recommendations for technical requirements, procedures and agreements, and emerging issues, see Regulatory Assistance Project. *Interconnection of Distributed Generation to Utility Systems*. 2011. www.raponline.org/document/download/id/4572.

CHP systems completely.[61] Costs are often apportioned between the applicant and the utility in a manner that state utility regulators deem appropriate. In general, interconnection fees should be just and reasonable and reflect the true costs of interconnection; this approach can mitigate rate impacts for non-participating customers.

2. Streamlined procedures with decision tree screens (allowing faster application processing for smaller systems and those unlikely to produce significant system impacts). A criticism of some state interconnection standards is the lengthy approval process and complicated application requirements. To facilitate rapid application turnaround, successful state interconnection standards have well-defined application processing timelines and simple decision trees that show, based on the system size and other characteristics, which interconnection procedures apply. Colorado has a streamlined process for systems up to 2 MW that involves several different screens to determine if more detailed review is needed.[62] If a proposed project fails one of the screening tests the owner may have to pay for additional tests or move to the next level analysis. Maine's level 2 and 3 interconnection processes (for systems up to 2 MW and 10 MW respectively) have timelines of 15 and 17 business days for the utility to approve the application.[63] Kentucky's Level 1 interconnection process requires that utilities notify the customer whether the interconnection application has been approved or denied within 20 business days.[64] Ohio provides for a checklist for applicants to determine whether they need to complete the "short form" or a standard interconnection form.[65]

3. Standardized Technical Requirements. Standardization of technical and safety requirements ensures consistent safety for the utility, lessens the complexity of the interconnection process, and helps reduce costs for some project developers by alleviating the need to hire expert consultants. States commonly specify technical requirements based on national safety standards—IEEE 1547 and UL 1741—or use these two standards as a basis for developing their own requirements. These two standards focus on the technical specifications for, and testing of, the interconnection itself. They provide guidelines relating to the performance, operation, testing, safety considerations, and maintenance of the interconnection and form the basis of many state standards. California's technical requirements are similar to those established in IEEE 1547, although Rule 21 is more specific on certain issues.[66] Also, some states exempt project types that meet IEEE and UL guidance from specific additional criteria. For example, New Hampshire does not require an external disconnect switch for inverter-based systems that comply with IEEE 1547 and UL 1741.[67] In Delaware, interconnection requests for systems up to 2 MW may be eligible for expedited review if they use lab certified equipment or field approved interconnection equipment.[68]

4. Standardized, simplified application forms and contracts. Providing standardized and readily accessible interconnection application and contract forms to end-users and project developers is important. Standardized forms used by all utilities in the state helps state regulators assess the interconnection process and handling disputes, and also make it easier for project developers to comply with requirements. For example, Maryland's interconnection application forms are limited to eight pages.[69] Massachusetts proposed the creation of a uniform on-line interconnection application form,[70] and California has a model interconnection application in investor-owned utilities to adopt.[71] Illinois offers a standardized interconnection agreement applicable to all system sizes.[72]

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[61] Regulatory Assistance Project. *Survey of Interconnection Rules*. 2007. www.epa.gov/chp/documents/survey_interconnection_rules.pdf. State interconnection application process information begins on page 23.

[62] DSIRE. Colorado Interconnection Standards. Accessed January 10, 2013.

[63] DSIRE. Maine Interconnection Standards. Accessed January 10, 2013.

[64] DSIRE. Kentucky Interconnection Standards. Accessed August 30, 2012. Applies to systems up to 30kW.

[65] DSIRE. Ohio Interconnection Standards. Accessed August 30, 2012.

[66] DSIRE. California Interconnection Standards. Accessed August 30, 2012.

[67] DSIRE. New Hampshire Interconnection Standards. Accessed August 30, 2012. "Systems that connect to the grid using inverters that meet IEEE 1547 and UL 1741 safety standards do not require an external disconnect device. However, the customer-generator assumes all risks and consequences associated with the absence of a switch."

[68] DSIRE. Delaware Interconnection Standards. Accessed January 10, 2013.

[69] Maryland Public Service Commission. http://webapp.psc.state.md.us/intranet/electricinfo/home_new.cfm. Applicable up to 1 MW.

[70] DSIRE. Massachusetts Interconnection Standards. Accessed August 30, 2012.

[71] DSIRE. California Interconnection Standards. Accessed August 30, 2012.

[72] DSIRE. Illinois Interconnection Standards. Accessed January 10, 2013.

5. Defined process to address disputes. A defined process to address interconnection disputes between an end-user and a utility if an impasse is reached is important. Con Edison appointed a Distributed Generation Ombudsperson in 2002 in response to increased customer interest and the role was formalized in a 2005 order (CASE 04-E-0572) from the New York State Department of Public Service. Massachusetts has proposed requiring that an arbitrator is hired to resolve any disputes in its interconnection process. Other states have dispute resolution clauses in their interconnection standards including Hawaii, Colorado, and Maryland.[73] For example, Hawaii standardized rules include a timeline for dispute resolution—a meeting to resolve disputes must be scheduled within 15 days of a written request being submitted.

6. The ability for larger CHP systems and those not captured under net metering rules to qualify under the interconnection standards. Some states only allow for relatively small systems to interconnect under streamlined standards,[74] often assuming that smaller DG systems are more likely to produce power primarily for their own use. In states with a multi-tiered interconnection process, small 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. However, restricting capacity limits for streamlined interconnection standards to only small systems does not help facilitate broad investment in all sizes of CHP in applications where it makes economic sense. State regulators can consider the size threshold for streamlined standards that is appropriate for their states.

A number of states have established standardized interconnection for medium and large systems. Connecticut allows for systems up to 20 MW in size to interconnect.[75] California and a handful of other states have set interconnection capacity limits at 10 MW.[76] FERC initially adopted interconnection standards for facilities larger than 20 MW in 2003, then adopted interconnection standards for smaller DG units up to 20 MW in 2005. The FERC standards apply only to facilities subject to the jurisdiction of the commission—these facilities mostly include those that interconnect at the transmission level. However, FERC has noted that its interconnection standards for small generators should serve as a useful model for state-level standards.[77]

7. Allow CHP systems to interconnect to both radial and network grids.[78] Network grids are present in many large cities where a significant amount of CHP potential exists. Interconnection, particularly in network or local distribution networks, present protection and grid operational challenges to address inadvertent back feed into the local grid that can cause safety concerns and failure to serve loads. However, with careful operational planning and system protection review, DG can be accommodated. It is important to allow interconnection to both radial and network grids, with protections in place to minimize system impacts, in order to realize the full potential of CHP. For example, New York's interconnection standards first adopted in 1999 allowed for DG systems up to 300 kW in size to connect to radial distribution systems.[79] In 2005, New York modified its interconnection requirements to allow for DG systems up to 2 MW in size to interconnect to radial and secondary network systems. In 1999, the Texas Public Utility Commission adopted standardized rules that allow for the interconnection of systems that are 10 MW or less in size to connect to distribution-level voltages at the point of common coupling. These rules apply to both radial and secondary network systems. Note that IEEE Standard 1547.6 includes recommended practices for interconnecting distributed resources with distribution secondary networks. This standard focuses on the

[73] DSIRE. Hawaii, Colorado, and Maryland Interconnection Standards. Accessed August 30, 2012.

[74] For example, the Alaska limit is 25 kW, Kentucky is 30 kW, and Nebraska is 25 KW (DSIRE. Accessed August 30, 2012). For this interconnection chapter, typically "small" refers to systems 25 kW and under, "medium" refers to systems up to 2 MW, and "large" is defined as systems up to 20 MW. FERC uses these size thresholds with the exception of the last simplified interconnection level which applies to systems up to 20 MW.

[75] DSIRE. Connecticut Interconnection Standards. Accessed August 30, 2012.

[76] DSIRE. California, Colorado, Delaware, District of Columbia, Illinois, Iowa, Maine, Maryland, Minnesota, Montana, Oregon, South Dakota, and Texas allow for systems up to 10 MW to interconnect, and in some cases may have established procedures for systems larger than 10 MW.

[77] DSIRE. "Federal Interconnection Standards for Small Generators." Last reviewed October 12, 2011. www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06R&re=1&ee=1.

[78] Regulatory Assistance Project. *Interconnection of Distributed Generation to Utility Systems*. September 2011. www.raponline.org/document/download/id/4572www.raponline.org/document/download/id/4572. Provides recommendations for technical requirements, procedures and agreements, and emerging issues. It also discusses how interconnection to radial and network grids has been approached by a variety of states.

[79] DSIRE. New York Interconnection Standards. Accessed August 30, 2012.

technical issues associated with the interconnection of distribution secondary networks with inverter-based distributed generation, and provides recommendations relevant to the performance, operation, testing, safety considerations, and maintenance of the interconnection. The standard gives consideration to the needs of the local electric power system to be able to provide enhanced service to the DG owner loads as well as to other loads served by the network.[80]

How the Criteria Are Addressed

Policy Intent. In some cases, distributed generation, including CHP, can delay or reduce the need for new costly infrastructure such as transmission and distribution upgrades. They can also help reduce peak demand on the system and lessen transmission losses. The overall policy intent is to encourage CHP deployment by providing project owners with a simple, easy to understand, and reasonable cost process and timeline for connecting to the grid, while ensuring that utilities are adequately compensated, safety requirements are met, and concerns of potential grid instability are addressed. Establishing the elements discussed in this chapter, including timelines and fees (application, technical study, and insurance), streamlined procedures, straightforward and commonly used technical requirements, and standardized simplified agreements help prevent interconnection barriers to CHP.

Market Signals. Interconnection policies that are unclear, have lengthy timelines, or have cost requirements that are not commensurate with the system size or risk can result in delays and unnecessary costs in developing CHP projects. An end-user interested in CHP may find the interconnection process too cumbersome, uncertain or costly, and may even abandon their plans. This may send the signal to the broad project development community that the state is not an attractive market for CHP.

Ratepayer Impact. The interconnection costs for project developers and the costs of review and processing incurred by the utility need to be cost of service based to hold the ratepayer indifferent. For example, the Massachusetts Department of Energy Resources may investigate whether the state's interconnection fees for applicants are consistent with actual utility cost to provide such services.[81] Ensuring cost-based services is necessary to protect both the applicant and the utility and its ratepayers.

3.3 Conclusions

Well-designed statewide CHP interconnection standardized rules are crucial to a project's success. While developing state standards or revising existing standards, the following elements have been used successfully by states across the country.

KEY IMPLEMENTATION APPROACHES: INTERCONNECTION STANDARDS

- Interconnection fees commensurate with system complexity
- Streamlined procedures with simple decision-tree screens (allowing faster application processing for smaller systems and those unlikely to produce significant system impacts)
- Practical and predictable technical requirements (often based on existing technical standards such as IEEE 1547 and UL 1741)
- Standardized, simplified application forms and contracts
- A dispute resolution procedure to resolve disagreements
- Allow for larger CHP systems (greater than 20 MW) to qualify under the standards

[80] Personal communication between ICF and Bill Ash, IEEE standards liaison, January 2013. IEEE Standard 1547.6 is finalized as of September 2011, however the website hasn't been updated yet to reflect that. http://grouper.ieee.org/groups/scc21/1547.6/1547.6_index.html.

[81] DSIRE. Massachusetts Interconnection Standards. Accessed August 30, 2012.