# ANALYSIS OF U.S. INTERCONNECTION AND NET-METERING POLICY

Chris Cook
Interstate Renewable Energy Council
6763 North 25th Street
Arlington, Virginia 22213
chris@sunedison.com

Rusty Haynes
North Carolina Solar Center
North Carolina State University, Box 7902
Raleigh, NC 27695-7902
rusty_haynes@ncsu.edu

ABSTRACT

Historically, the absence of interconnection standards has been one of the primary barriers to the deployment of distributed generation (DG) in the United States. Although significant progress in the development of interconnection standards was achieved at both the federal and state levels in 2005, interconnection policy and net-metering policy continue to confound regulators, lawmakers, DG businesses, clean-energy advocates and consumers. For this reason it is critical to keep track of developments related to these issues. The North Carolina Solar Center (NCSC) is home to two Interstate Renewable Energy Council (IREC) projects -- the National Interconnection Project[i] and the *Database of State Incentives for Renewable Energy* (DSIRE)[ii] -- that fulfill this task. This paper will present the major federal and state-level policy developments in interconnection and net metering in 2005 and early 2006.[iii] It will also present conclusions based an analysis of data collected by these two projects.

## 1. INTRODUCTION

The federal Public Utility Regulatory Policy Act (PURPA) of 1978 opened the door for the interconnection of DG to the grid. Ensuing frustrations experienced by DG developers led some states to create standards to facilitate the interconnection process. Moreover, states also began to enact net-metering laws in the early 1980s. In 2003, the publication of the IEEE 1547 standard addressed the long-lingering technical specifications of and testing requirements for interconnection, allowing regulators to proceed with the finalization of policy issues. In May 2005 the Federal Energy Regulatory Commission (FERC) adopted interconnection standards for three levels of generators up to 20 megawatts (MW) in capacity. The federal Energy Policy Act of 2005, enacted in August, requires all states and non-state-regulated utilities to consider adopting interconnection standards based on IEEE 1547, and to consider adopting a net-metering standard. Although many states have already adopted DG interconnection standards and net-metering rules, it is likely that these federal policy actions will significantly impact state policy.

## 2. BEST NATIONAL INTERCONNECTION MODEL FOR SMALL GENERATORS

The IREC interconnection team, under direction of the IREC Interconnection Advisory Board in late 2005, completed the most recent update to its model interconnection rules, which have been published and publicly available for several years. This updated version includes model interconnection agreements and application forms, and technical interconnection procedures. This complete interconnection model, one of the very few complete small-generator interconnection models, is promoted by IREC as the best model for states and regional entities to use in crafting interconnection rules that promote expedited and low-cost DG interconnection.

These rules are the compilation of the best practices from state and federal actions on small generator interconnection. While some of the IREC model is based on the rules and agreements found in FERC Order 2006, the model is intended for state use, and the language is expressed in a format typically found in state rules. The remainder of the model is derived mostly from the New Jersey small-generator interconnection rules, and from some of the best practices from Massachusetts, Colorado and Texas. IREC largely ignored the California Rule 21, as California's approach has been not to draft model rules that focus on expediting small generators, but instead to allow exceptions to a more complex interconnection rule for solar and other renewable generators.

The interconnection procedures contained in the IREC model are divided into four areas:

Level 1: 10 kilowatts (kW) and smaller for certified inverters (residential-sized systems)
Level 2: 2 MW and smaller, certified (commercial net metering and other systems)
Level 3: 10 MW and smaller, certified, non-exporting (designed for combined-heat-and-power facilities)
Level 4: All others up to 10 MW, including generators that attempt but do not qualify for other, more expedited standards

The concept behind the rules is to categorize the possible generator interconnections from least complex to most complex. Under such segregation, the fees and time to process an interconnection application can be minimized for each grouping while simultaneously maintaining the highest level of safety and reliability. IREC's approach has been to design a rule that eliminates as many barriers as possible in order to provide a model that truly allows small renewable generation to flourish. Compromises that some state rules have included that are not consistent with the concept of promoting DG have been excluded.

The IREC model uses as its core the recent IEEE 1547 standard (and associated UL 1741 testing standard) which allows a utility to expedite the review of many generator protective functions since these have already been reviewed and approved by UL or another equivalent testing laboratory. Each of the first three levels relies on some pre-review by an independent third-party testing laboratory.

The fourth and final category is the catch-all for generators that either require complete review of their custom protection equipment or do not meet any of the more stringent criteria for the other levels. This category also includes generators that are initially processed for interconnection under any of the three more expedited versions, but fail to qualify because of a technical issue.

While the IREC model is not incompatible with either the requirements under the Energy Policy Act of 2005 Section 1254 or FERC Order 2006, the rules are more comprehensive. Where there are departures from Order 2006, the departures are those that are supported by a certain state rule – a rule that is less cumbersome to the generator.

Procedures for the simplest class – the 10-kW residential-sized generator – are almost identical to those rules contained in FERC Order 2006, in Massachusetts and in New Jersey. Among the federal and state interconnection rules already in place, there appears to be the most consistency among this category. While some have debated the need or ability to raise the threshold of this category to a number greater than 10 kW (state rules range from 10 kW to 80 kW in this category), because of the general consistency, IREC chose to remain with the 10 kW limit. Future revisions of the model may revisit this issue particularly as technologies are developed that target larger generators for the residential class.

The 2-MW procedures provide for a more intensive review of the proposed generator but still are structured such that a qualified utility engineer should be able to complete the review in about three hours. Because all generators under this category must be listed by UL (or another laboratory) to the UL 1741 standard, all review of generator protection has been eliminated as redundant. Instead, the procedures employ a group of screening criteria designed to demonstrate that the generator is sufficiently small in comparison to the grid at the proposed point of interconnection, so that no in-depth study of the interconnection is warranted.

The key screen ensures the generator size (in aggregate with other DG) is small in comparison to the grid – less than 15 % of the peak load. The second most important screen checks to ensure the contribution from the generator to utility circuit fault current (which makes utility protective devices fail under excessive current) is less than 10% of that available.

A secondary check on fault current ensures that where circuits are already near their design limit and are presumably slated for upgrade, DG is not added that will exacerbate the problem. Whereas FERC has included a screen disallowing processing under the 2-MW procedures where circuit loading is at or above 87.5%, the IREC rule uses a limit of 90%. Since FERC's rule was the result of a compromise among the parties and is not technically based, IREC chose the more defensible 90% as the number most utilities use (although many are as high as 100%) for planning system upgrades based on fault current. A percentage lower than a particular utility's planning threshold can exclude generators from simple interconnection based on the invalid assumption that the generator should wait until the circuit is upgraded prior to interconnecting. To be most accurate, the percentage in a rule would be that same percentage that a utility uses for distribution upgrades.

IREC also chose to include a very conservative set of screens that allow simple interconnection to distribution networks, both spot and area. While IEEE is, at the time of this writing, considering additional elements to the 1547 standard to address networks, IREC did not believe there should be an absolute bar to simplified interconnection while those rules are being developed. Instead, the IREC rule allows for very small and inverter-based interconnections to allow a few small pilot installations to

proceed. In fact, these pilots may provide valuable information on the interaction and safety of generators on networks. IREC also felt it would be unwise to exclude from an interconnection model those urban areas (typically served by networks) that are likely to be the most valuable locations for DG.

The 10-MW rule completes an omission in FERC Order 2006 and provides for the simplified interconnection of larger generators, provided there is no export to the grid. This would accommodate both combined-heat-and-power (CHP) generators as well as large photovoltaic (PV) systems, especially where the 2-MW rule – which is an aggregate – has already been fully subscribed. Because there is no export to the grid (and reverse power relays or other devices will so ensure) a utility need only be concerned with fault current contribution. According to experts at PJM Interconnection (the independent regional transmission operator in the Mid-Atlantic states), every distribution circuit is sufficiently robust that any generator power fluctuations should not adversely affect the circuit. In other words, a generator could go from full power to no power, resulting in large power swings on a circuit, and there would be no adverse result. Because on-site generators are the only form of DG eligible under this category, the maximum power fluctuation is limited to a customer's load.

The final and most intensive category simply codifies what is a typical utility interconnection study process. The IREC rule does encourage the review to be expedited where possible, but leaves open the possibility of a full-blown interconnection study that may include massive upgrades to the utility grid. For most DG systems, such costly upgrades would make a project financially infeasible. Nonetheless, the model rule is designed to accommodate even these most complex interconnections.

An intentional cut-off at 10 MW was incorporated as a reflection of what appears to be a growing state/federal jurisdictional line. Because most (if not all) 10-MW and larger generators will impact the transmission grid, FERC's jurisdiction may be implied for this larger size class. While there may be some argument on a firm jurisdictional split, such a bright line would help small-generator developers know which interconnection rules would apply to their proposed system.

IREC's updated model also includes standard application forms for the initiation of an interconnection review. These are nearly identical to those included in FERC Order 2006, with modified language for states. The application forms were universally supported by all stakeholders in the FERC process. Standard form interconnection agreements are also included. The simplified version draws heavily on the National Association of Regulatory Utility Commissioners (NARUC) model interconnection agreement.

IREC's model is superior to the NARUC interconnection model because the NARUC model does not include the more recent developments from the FERC Order 2006 or state rulemakings on interconnection. While the Mid-Atlantic Distributed Resources Initiative (MADRI) interconnection model includes the 10-MW non-export standard, there are so many other departures harmful to small generators that this model should be rejected. (The opening comments included in the MADRI model indicate support from the utility community and strong objections from the small-generator community). The Environmental Law and Policy Center (ELPC) has recently released an interconnection model that has not been fully reviewed at the time of this writing. The ELPC model appears to support many of the propositions in the IREC model and hence may be a suitable alternative.

While there are no other complete model interconnection rules that provide an expedited process to remove barriers to the use of DG, FERC has indicated its rule could be used as a model. Colorado's recent promulgation of interconnection rules seems to have taken FERC up on its offer and is now a state rule that nearly identically tracks FERC Order 2006.

## 3. NEW STATE INTERCONNECTION RULES

Some states have adopted interconnection rules that apply only to DG systems that are not net-metered. Other states have adopted rules only for net-metered systems; these rules apply specifically to renewable-energy systems, for the most part. Several states have adopted rules for both types of systems.

In 2005 and early 2006, new interconnection rules were adopted by Colorado, Indiana, Louisiana and North Carolina. Significantly, Colorado is the first state to adopt interconnection rules that essentially mirror FERC's rules for small generators. Colorado's rules address three levels of interconnection: (1) certified, inverter-based systems up to 10 kW, (2) certified systems up to 2 MW, and (3) systems up to 10 MW that do not qualify for either of the first two levels. Colorado's rules include a standard interconnection agreement, a screening process for interconnection studies, and guidance for dispute resolution. Furthermore, utilities may not require customers to install an external disconnect switch, and network interconnection is generally permitted. The primary difference between Colorado's DG interconnection rules and FERC's rules is the maximum system size. Indiana's rules are also similar to FERC's rules. These rules include three levels of interconnection; the first two levels – for inverter-based systems up to 10 kW

other systems up to 2 MW – apply to systems that comply with IEEE 1547.

North Carolina adopted DG interconnection rules in 2005 for residential systems 20 kW and under, and for commercial systems 100 kW and under. Louisiana's interconnection rules apply only to net-metered systems and generally are not favorable for customer-generators. The rules apply to residential systems up to 25 kW and nonresidential systems up to 100 kW. It deserves mention that Louisiana's relatively simple interconnection and net-metering rules were adopted 29 months after legislation requiring their creation was enacted.

At the time of this writing, new interconnection rules for DG are under development in several states, including Arizona, Pennsylvania, Vermont and Washington. Arizona's proposed rules resemble FERC's rules, and Pennsylvania's proposed rules are based on the MADRI model, which is less favorable for customer-generators than the FERC model. Proceedings already initiated to develop DG interconnection rules in Hawaii, Illinois, Iowa and Kansas are stagnant, and the Minnesota Public Utilities Commission (PUC) still has not approved Xcel Energy's interconnection tariff.

## 4. STATE INTERCONNECTION RULES REVISED

Several states revised existing interconnection rules in 2005 and early 2006. California's Rule 21 Working Group, which consists of parties interested in the ongoing development of the state's interconnection standard, meets periodically to create consensus among stakeholders to address revisions required by regulatory order. Among other issues, the Working Group is addressing dispute resolution and network interconnection. Hawaii enacted legislation in 2005 requiring the state PUC to develop interconnection rules for net-metered systems greater than 10 kW. In December 2005, the Massachusetts Distributed Generation Collaborative made several modifications to its model DG interconnection tariff, originally adopted in February 2004. Generally, these revisions are related to the interconnection process, meter ownership, network interconnection and the role of DG in distribution planning.

In early 2005, the New York Public Service Commission (PSC) approved utility tariffs that comply with a 2004 commission order requiring utilities to increase the maximum capacity of an individual interconnected system to 2 MW, and to include provisions for network interconnection. Later in 2005, the PSC modified its rules by extending interconnection to net-metered wind-energy systems up to 25 kW for residential turbines and 125 kW for farm-based turbines.

Increasingly, when developing new interconnection standards and when revising existing standards, states are considering including provisions for network interconnection, dispute resolution and standard agreements. Until recently, these issues received little attention.

## 5. NEW STATE NET-METERING RULES

In 2005 and early 2006, the public utilities commissions of Colorado, Louisiana, Michigan, North Carolina and the District of Columbia adopted new net-metering rules for renewable-energy systems. Colorado's new rules, which apply to systems up to 2 MW, rival New Jersey's rules as the best in the country. Significantly, utility support for net-metered systems up to 2 MW in capacity was largely driven by the solar carve-out provision in the state's renewable portfolio standard (RPS), enacted in November 2004. Net excess generation (NEG) is credited at the utility's retail rate to the customer's next bill. There is no limit on the total capacity of all net-metered systems in a utility's service territory.

Michigan's unique net-metering program was created after several failed attempts to enact net-metering legislation. In May 2005, the PSC approved a consensus agreement among several stakeholders (including 11 utilities) implementing a voluntary net-metering program that applies to systems up to 30 kW. NEG is credited at the utility's retail rate and carried over to the following month for one year. Customer-generators retain ownership of renewable-energy credits (RECs). New rules adopted by the District of Columbia PSC apply to renewable-energy systems, CHP systems, microturbines and fuels cells up to 100 kW.

Louisiana's net-metering rules, modeled on Arkansas's rules, apply to nonresidential systems up to 100 kW and residential systems up to 25 kW. Although there is no aggregate limit on net-metered systems and NEG may be carried over to the next month indefinitely, Louisiana's interconnection rules for net metering generally are not favorable to customer-generators. Similarly, North Carolina's net-metering rules, which apply to nonresidential systems up to 100 kW and residential systems up to 20 kW, contain several unappetizing provisions. Specifically, NEG is granted to the utility twice annually with no compensation for the customer, and customers may not use battery storage.

At the time of this writing, the Pennsylvania PUC is developing net-metering rules for systems up to 2 MW, as required by statute. Pennsylvania will become the third state to support 2-MW net metering.

## 6. STATE NET-METERING RULES REVISED

As technologies evolve, as markets for renewable energy and DG take form, as costs of fossil fuels vacillate, and as state energy policies begin to play out, some states have amended their net-metering laws accordingly. Several states took action in 2005 to modify their existing rules. In most cases, rules were expanded to accommodate additional technologies or larger systems.

California enacted three bills in 2005 related to net metering. These new laws extended the pilot program for net-metered biogas-energy systems and allowed as many as three biogas-energy systems up to 10 MW to net meter; extended a provision that allows net metering for fuel cells; and raised the aggregate capacity limit of net-metered systems in SDG&E's service territory to 50 MW.

Maryland altered its net-metering statute by adding biomass as an eligible resource and increasing the maximum individual system capacity from 80 kW to 200 kW. Furthermore, customer-generators may now petition the PSC to allow net metering for systems up to 500 kW. Similarly, Oregon enacted legislation in 2005 extending net metering to biomass systems and allowing the PUC to increase the capacity limit of a net-metered system above the current limit of 25 kW.

Legislation enacted in Nevada in 2005 imposed an aggregate capacity limit of 1% for net-metered systems in each utility's service territory. This law also increased the maximum capacity of a net-metered renewable-energy system from 30 kW to 150 kW, although some unfavorable conditions apply to "net-metered" systems greater than 30 kW. Likewise, the Virginia Corporation Commission raised the capacity of eligible non-residential net-metered systems from 25 kW to 500 kW in 2005.

## 7. FEDERAL DEVELOPMENTS

Section 1251 of the Energy Policy Act of 2005 (EPAct 2005) implements a national net-metering scheme, and Section 1254 requires interconnection based on the IEEE 1547 standard. While these sections do not *mandate* federal interconnection or net metering, they do direct states to undertake consideration and make a determination with respect to each standard. Where states regulate electric utilities, those regulatory bodies will be required to "consider" implementation of interconnection and net metering. Unregulated utilities that qualify under PURPA (there are some unregulated municipal and cooperative electric utilities that do not qualify) also must "consider" net metering and interconnection rules.

The essence of Section 1254 is to promote the standardization of interconnection procedures based on IEEE 1547. Whether fortuitous or by design, Congress's articulation on interconnection happens to fit nicely with the FERC's rules for small generators, issued in Orders 2006 and 2006-A. For generators that comply with IEEE 1547, FERC's rules allow the expedited interconnection of systems up to 10 kW and interconnection for systems up to 2 MW. The FERC rules apply only to transmission owners and those engaged in interstate commerce. The rules will require any utility that owns or operates transmission lines to include the new standard in their open access transmission tariffs (OATT). By that mechanism, small generators subject to FERC jurisdiction will have a federal interconnection standard based in part on IEEE 1547.

One (aggressive) interpretation of Section 1254 is that Congress sought to extend the FERC rules to all small generators and create the seamless standard FERC desires. Under this interpretation, there is little action required by states other than to adopt the FERC rules for state jurisdictional generators, perhaps with minor modifications. For states and utilities that do not adopt FERC's rules, FERC theoretically has the authority to apply the federal rule where state rules are found deficient. It is likely that a state or non-regulated utility that adopts an interconnection rule loosely based on IEEE 1547 (even if it differs from FERC Orders 2006 and 2006A) will survive a legal challenge.

Based on the general alignment between the consensus filing of the stakeholder parties in the FERC rulemaking process and FERC Order 2006, it is fair to assume that the Small Generator Coalition (SGC) would support a national scheme based on this order. Section 1254 promotes this goal by allowing DG advocates to argue, in proceedings states must undertake, that the state should adopt rules that parallel Order 2006. In fact, many of the utilities involved in state proceedings will already have filed a tariff (in compliance with Order 2006 and 2006-A) that includes FERC's interconnection rules.

Existing state standards that closely resemble the FERC rule and incorporate the IEEE standard are undoubtedly safe under Section 1254. These include rules in place in New Jersey, Colorado and Indiana. Other states (such as Massachusetts) that have rules resembling FERC's rules but that deviate in a significant way (e.g., the peak load limit in Massachusetts is almost half that of the FERC rule) may be challenged if the state decides not to adjust the rules. California is the only state that could reject adoption of Order 2006 and still maintain its existing rule. Although California's interconnection rule (Rule 21) is different from FERC's model, the state could argue that its rule effectuates

interconnection in compliance with Section 1254 because it does not create unreasonable barriers to DG.

Unlike interconnection, there has been no significant federal action on net metering. With the exception of Swecker v. Midland, there is no FERC order or rule that requires any utility to offer net metering. All net-metering provisions in place are state creations or voluntary utility programs.

Although net metering is available *in some form* in 40 states, these rules and programs differ significantly in terms of eligible technologies, maximum system size, treatment of NEG and other conditions. There is a trend among states to allow larger systems to net meter, often in concert with an RPS that includes a specific solar requirement. Due to solar RPS requirements, New Jersey, Pennsylvania and Colorado allow (or will allow) systems up to 2 MW to net meter. Section 1251 does not set any parameters for state consideration of net metering and does not address any of the issues above. It is unclear how a state determination not to implement net metering (or to implement restricted net metering) will be viewed by FERC or the federal courts.

In Swecker v. Midland, FERC ordered an electric cooperative (Midland) to provide annual net metering to one of its customers (Gregory Swecker), who wanted to operate a 60-kW wind turbine. While FERC ruled that PURPA supported this decision, the commission did not indicate a qualifying system capacity limit. In an earlier decision in this docket, FERC noted that language similar to Section 1251 proposed in the Energy Policy Act of 2003 (which was not enacted) would have created a federal net-metering requirement. Based on this information, FERC could take a fairly aggressive approach to implementing net metering and could seek some level of standardization. Whether any aggressive FERC action on net metering would be upheld by the courts is another matter.
Significantly, because Midland was not subject to state regulatory jurisdiction, it was not required by Iowa law to implement net metering. The Swecker case may indicate that FERC will use Section 1251 to require "non-regulated" utilities to offer net metering (and interconnection under 1254). FERC could follow the net-metering standards in a state and apply them to non-state-regulated utilities under Section 1251. Or, FERC may develop its own standards to use in these cases.

FERC may use the need to develop net-metering standards for non-state-regulated utilities to propose a national net metering model, as was the case with small generator interconnection. If FERC undertakes an initiative that involves the states and other stakeholders, it might generate open debate on the proper limits for net metering and other guidelines. Because recent state actions to raise net-metering limits to 2 MW dovetail with the FERC limit for expediting small generator interconnection (also at 2 MW), FERC may push a national net metering model to a 2-MW limit. As there is little guidance on other net-metering issues, it is impossible to say how a national standard might address these. Unlike the comprehensive interconnection rule, a national net-metering model may include many discretionary decisions to be made by the various states.

The current net-metering landscape differs significantly from the situation for small-generator interconnection. Few states had comprehensive interconnection rules for small generators when FERC announced its intention to create rules that would apply to FERC-jurisdictional entities and would serve as a national model for states. Any effort to develop a national net-metering model will have to accommodate the significant and various rules, laws and guidelines of existing state rules. While federal interconnection standards simply fill a vacuum, a national net-metering effort will have to determine which states' standards are not working, and why they should be replaced by a national standard.

## 8. REFERENCES

(1) *Database of State Incentives for Renewable Energy (DSIRE)*, N.C. Solar Center, N.C. State University, 2006.
(2) National Interconnection Project, N.C. Solar Center, N.C. State University, 2006.

---

[i] See www.irecusa.org/connect/statebystate.html for state-by state tables of DG interconnection standards, net-metering rules and related utility programs.
[ii] See www.dsireusa.org for details on state interconnection standards, net-metering rules and related utility programs
[iii] Specifically, this paper addresses developments in interconnection and net-metering policy from January 2005 through February 2006.