instead of buying a solar system, a customer signs a long-term contract with a third-party who installs and owns a solar system on the customer's roof. This model has proven successful because the host does not have to put up initial capital, available tax credits and incentives are able to be more fully utilized (especially in the case where the property owner has limited tax liability), and the host has zero operations and maintenance costs. Given the success of this approach, it will be an important driver of a sustainable PV market. Faced with the possibility of these third-party owners being regulated as utilities, a few states have investigated the legality of this model. For example, in the summer of 2008, the Oregon Public Utility Commission ruled that third parties are not utilities and therefore are not regulated by the commission. The PUC ruled that, with third-party ownership, the system is installed on the customer's side of the meter and does not require the distribution system wires or ancillary services.[8]

Creating a metric that weights the amenability of a state toward third-party ownership is sufficiently nuanced and state-specific; therefore relative scoring is impractical. The treatment of the third-party model may also be outside the net metering regulations themselves. For the purposes of this report, a point is awarded for net metering rules that do not preclude the third-party ownership model within the net metering rules. A negative point is warranted for those states that expressly exclude third-party-owned systems from net metering. For example, where a state's net metering rule defines a net metering facility as a "customer-owned" facility, instead of using more neutral and flexible "customer-sited" terminology, the state's rule would be counted as an express exclusion of third-party owned systems from net metering.

Policy Points: Interconnection Procedures

Eligible Technologies

Points	Customers that Qualify
0	All customer-sited generators qualify
-1	Only renewable generators permitted

While public policy may emphasize renewable energy, the system and engineering impacts of a system should be evaluated solely on their own merits. To do otherwise introduces complexity and may restrict innovation. If a generator complies fully with the relevant technical standards, there is no operational or safety justification to deny interconnection.

Individual System Capacity

Points	System Capacity
0	Generators up to 20 MW permitted
-0.5	up to 10 MW permitted
-1	up to 2 MW
-2	up to 1 MW
-4	Less than 500 kW

Interconnection procedures should be less stringent for small, simple systems and more stringent as system size increases. However, standards should also permit systems that are sized to meet even large, on-site loads. Office parks, government buildings, military bases, hospitals or college campuses can potentially accommodate installations of 2 MW or more just to serve a portion of their load. Increasingly, forward-thinking states are facilitating this option.

"Breakpoints" for Interconnection Process

Points	Levels
+1	Four levels
0	Three levels
-1	Two levels
-2	No breakpoints, one process for all generators regardless of size
Bonus	
+1	Progressive standards that allow larger systems in any category

Many technical considerations and studies are relevant only for relatively large generators. It is most efficient to break a single overall interconnection process into separate "tracks" based on generator capacity, relieving complexity for the smallest systems

while preserving conservative and thorough studies for larger installations. The emerging consensus is to position applicants at four breakpoints in system size: 10 kW, 2 MW, 10 MW (non-exporting systems), and a track for systems 20 MW and larger.

Timelines

Points	Timelines
+1	Timelines are shorter than the FERC standards
0	Timelines are the same as the FERC standards
-1	Timelines are longer than the FERC standards

Time is money, and for a device like a rooftop PV system, where physical installation may take just two working days, paperwork and permits represent the single largest obstacle to quick installation. The FERC standards establish a timeline for each step of the application process, for each type of generator. There is room for improvement in this area, and some states have elected to trim the amount of time allowed for the different steps. Some states have a shorter time allotted for the read-through of an application with small generators using UL-listed equipment.

Interconnection Charges

Points	Fees
+3	Fees are waived for net-metered customers and interconnection charges are capped
+2	Fees are waived for net-metered customers
+1	Fees are lower than the FERC standards
+0.5	Scale or "breakpoint" based fees, which are generally lower than the FERC standards
0	Fees are the same as the FERC standards
-1	Fees are greater than the FERC standards
-3	Fees are generally double or more than the FERC standards

Interconnection application fees along with other fees can create challenges, especially if these fees are unknown at the onset of project development. Reasonable fee levels have been established in the FERC procedures and have been subject to an extensive compromise and negotiation process.

Engineering Charges

Points	Fees
+1	Engineering fees are fixed
0	Engineering fees are not fixed

An interconnection standard may require an engineering review for certain systems; where it does, it is important for the parties involved to know what the fees are beforehand. The engineering charges are commonly a fixed dollar per hour rate or a dollar per study rate.

External Disconnect Switch

Points	Requirement
+1	Redundant external disconnect switch prohibited for all systems
+0.5	Redundant external disconnect switch prohibited for systems under 10 kW
0	Redundant external disconnect switch not addressed
-1	Redundant external disconnect switch at utility's discretion
-2	Redundant external disconnect switch required

In theory, a grid-tied DG system presents a safety hazard if the grid goes down and the system continues to produce power without the utility's knowledge (a situation utilities call islanding). Potentially, line workers could come into contact with an unexpectedly energized line. Many utilities cite these safety concerns as justification for requiring owners of grid-tied DG systems to install and test an external

disconnect switch. However, the practical effect is that, like hidden interconnection fees, requiring an additional external disconnect switch only adds unnecessary costs and discourages customers from investing in renewable energy systems.[9]

External disconnect switches are unnecessary because all inverters that meet IEEE standards have automatic shut-off capabilities integrated within the systems.[10] In the event of grid failure, a DG system's inverter will detect the loss of power and shut themselves off.[11] It is important to note that not one accident resulting from the islanding of net-metered renewable energy systems has been reported.[12] More importantly, utility workers are trained to treat all lines as live, and a variety of other safety precautions are required as part of standard operating procedures.[13] An external disconnect switch represents a fourth or fifth level of redundancy that is only relevant if a utility worker ignores his or her training. If a utility worker is following proper protocol, none of the levels of safety measures preceding an external disconnect switch will ever be used, much less the switch itself.[14]

Certification

Points	Standard
+1	UL 1741 / IEEE 1547 standards are used in addition to other options (e.g., self-certification)
0	UL 1741 / IEEE 1547 standards are used
-1	UL 1741 / IEEE 1547 standards are not used, or modified elements of IEEE 1547 are used
-4	Standard used is in conflict with, or in excess of IEEE 1547

The electrical safety and operation of the grid must be a primary concern in the development of any interconnection procedure, and must remain an engineering standard, not a policy determination. Utilities, equipment manufacturers, national laboratories and testing facilities, and governmental representatives have developed the relevant technical standards jointly.

While some states have provided for additional options (e.g., the reuse of certification on equipment individually type-tested by utilities), others have used conflicting technical standards—a critical flaw that may in fact affect the safety and security of the grid. Still others have added idiosyncratic or unspecified blanket clauses that introduce uncertainties. In such cases, potential investors in DG systems do not know when such a clause might arise to disqualify them.

Technical Screens

Points	Screen
0	The FERC standards' screens are used
-1	There is partial adoption of screens
-2	No screens are used or it is at the utility's discretion
Penalty	A more conservative screen(s) than the FERC standards is used = -1 for each
Bonus	One or more of the FERC standards' screens that do not affect safety have been dropped, or a more liberal screen element that does not affect safety is used = +1 for each

Every interconnection is different, but all interconnections share some fundamental characteristics. These relate to, among other things, the size of the generator relative to the section of the grid to which it connects and the ratings of the protective equipment installed. These factors determine how complex the interconnection process needs to be.

The FERC standards provide a thorough set of technical screens that has been copied by many jurisdictions; any significant revision to these widely used benchmarks introduces difficulties to the process

and may increase system costs, as configurations or programming must be adjusted to comply with novel regulations.

Network Interconnection

Points	Spot/Area Secondary Networks
+2	Both spot and area network interconnections are allowed with flexible criteria based on customer load characteristics
+1	Either spot or area network interconnections are allowed at maximum capacity
0	Networks are allowed but limited to 50 kW for spot network and/or 500 kW for area network interconnection
+2	Bonus: Networks are allowed provided the generating facility is inverter-based and uses additional non-exporting protective schemes
+1	Bonus: Networks are allowed with a single protective feature
-1	Penalty: Spot and/or Area not addressed or allowed

A spot network is designed to serve a large single location, such as a corporate campus or high-rise building; an area network describes the power distribution system in an area dense with users, such as a downtown area. These types of networks are designed to increase reliability by creating more potential paths from generation to load. However, the types of systems that may be connected are usually restricted—often to those that are inverter based, as these networks are less tolerant of exported electricity.

Some jurisdictions have extended this concern to ban network interconnections completely. However, the very area networks that jurisdictions aim to protect are generally those most in need of the relief that DG can contribute. A more appropriate approach would be to create more stringent technical standards for networked systems or simply require that they install specified high-speed equipment that assures that area network generation will not exceed the load on the network at any time.[15]

Standard Form Agreement

Points	Form Style
+1	Standard agreement with friendly clauses
0	Standard agreement with standard clauses
-0.5	No standard agreement
-1	Standard agreement with excessively complex or hostile clauses
Bonus	
+1	Simplified form for all levels of interconnection
+0.5	Simplified form for systems under 10 kW

The point where the rubber meets the road in any interconnection framework is the agreement. Without a standard agreement, the interconnection process is immediately more complex. If the standard is overly complicated or includes clauses hostile to the customer—such as requiring the customer to indemnify the utility for a broad list of potential liabilities with no equivalent protection from the utility—then the standard loses much of its value.

Insurance Requirements

Points	Requirements
+1	No additional insurance required for non-inverter based systems under 50 kW or inverter-based systems under 1 MW
0.5	Additional insurance required, but not more than a typical customer would carry
0	Insurance is not addressed or is left to the development of the standard form agreement
-1	Utility is listed as additional insured or other restrictive requirements
-2	Additional and disproportionately burdensome insurance requirements for smaller systems

Because of potential personal injury and property damage liability risks associated with interconnection, many states allow utilities to impose liability insurance requirements on DG system owners. Some states require customer-sited generators to carry coverage to protect utilities from being held financially responsible for problems caused by interconnected systems.

However, to the authors' knowledge there has never been a documented case of a small, net-metered system causing electrical failure or creating potential personal injury or property damage liabilities for a utility. Renewable energy technologies manufactured and installed in compliance with technical interconnection guidelines significantly reduce the risk of potential safety issues.

Excessive insurance requirements only serve to discourage customers from investing in renewable energy systems and participating in net metering programs. Requiring customer-sited generators—especially those with relatively small DG systems—to obtain and maintain million-dollar insurance policies is impractical, because the high premiums will likely exceed the economic benefits of net metering.

Dispute Resolution

Points	Dispute Process
+2	Process in place (low or no cost, quick)
0	Not addressed, costly, or administratively burdensome
-1	Utility discretion

Inevitably, some requests for interconnection will result in disputes. The best standards provide a low-cost means of expert resolution, e.g., through a telephone call to a technical master employed by the state public utility commission. Other options are more administratively burdensome and more expensive. Of course, if the standard explicitly states that all disputes will be resolved through or by a utility's discretion, the standard becomes less reliable in the eyes of counter-parties.

Rule Coverage

Points	Utilities Covered
+1	Rules apply to all utilities
0	Rules apply to investor-owned utilities only

Interconnection procedures may cover all utilities in the state or just investor-owned utilities.

Miscellaneous

- Adverse system impact check required for systems under 2 MW = -1. This type of check is for the potential impact of a customer-sited generator on the grid. It should not be applied to small generators, for which it is largely irrelevant.
- Provide for local code official refusal when certificate of completion required = -1. Some states require that a local code official sign or certify documentation associated with the interconnection process. Since these officials do not generally certify documents other than their own inspections, they can be resistant to filling out an unfamiliar form, delaying or complicating the process.
- Interconnection process is significantly different from the FERC standards = -1. The overall framework of the FERC standards is well understood and should be the basic underpinning of any standard.
- Note: 7.5 points are added to interconnection scores to achieve grading parity with net metering scoring.