

FACILITATING PV AGGREGATION THROUGH A PV REGISTRY

Presented at Solar 2004, Portland, OR, July 13, 2004

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ABSTRACT

Photovoltaic (PV) system owners can receive an additional revenue stream for the environmental attributes associated with their clean energy production, which are called Renewable Energy Certificates (RECs). The PV Registry facilitates aggregation and sales of PV RECs by providing a central point to track RECs, including REC creation, transfer, and retirement. The integrity of the certificate market is maintained by having an electronic registry track RECs based on verified meter readings. PV participation in the larger renewable energy certificate markets is increased with the ability to aggregate output from multiple PV systems into MWh-sized REC products. This paper describes the PV Registry, including the benefits it provides PV owners and the market as a whole, how it works, metering standards, and verification and attestations. A PV Registry has been built and is administered by Clean Power Markets, Inc. to support the New Jersey S-REC (Solar-REC) Program. A brief description of the registry developed for this program is included in this paper.

1. INTRODUCTION

Photovoltaic (PV) system owners can receive an additional revenue stream for the environmental attributes associated with their clean energy production, which are called Renewable Energy Certificates (RECs). Electricity produced by PV systems is broken into two products: 1) the electricity production that is used on-site or delivered to the grid, and 2) the positive environmental attributes associated with this clean energy production. For the last couple of years, the Pace Energy Project has sponsored work investigating how PV certificates can be more actively integrated into the overall renewable energy certificate market. Results of previous work¹ examined metering issues, disclosure requirements, and production verification

needs. That work has led to the next step, which is the establishment of a PV Registry.

The PV Registry is a web-based, electronic database that facilitates aggregation and sales of PV RECs, providing an additional cash flow to PV system owners. Typically, RECs from renewable facilities are sold in increments of one megawatt-hour. Since PV systems are small, it can take a long time for a system to produce enough kWh to produce one REC. However, by aggregating RECs with other PV systems, a sufficient number of PV RECs can be produced to be of interest to buyers.

Because PV systems are typically smaller than 1 MW and many are metered on the customer-side of the meter, their total AC output is not measured by utilities or ISOs (Independent System Operators) in contrast to other renewable or non-renewable facilities. The PV Registry can operate where there is an existing ISO or certificate tracking system to specifically provide the tracking and verification of PV output and PV certificates in an official capacity.

As part of the PV Registry development, a set of standards have been developed and reviewed by PV stakeholders. These were developed to provide a consistent methodology for aggregating PV systems to sell PV RECs. The standards provide templates for aggregators or wholesale purchasers. They cover the areas of production measurement, production verification, attestations, marketing guidelines, and contract terms and conditions.

This paper describes the PV Registry, addressing the following subjects:

- Benefits of the PV Registry, including the value to PV owners and the advantages to the market as a whole
- How the PV Registry Works
- Production Measurement Standards
- Verification / Attestations

A PV Registry has been built and is administered by Clean Power Markets, Inc. to support the New Jersey S-REC (Solar-REC) Program. A brief description of the registry developed for this program is included in this paper.

2. BENEFITS OF THE PV REGISTRY

2.1 Value to PV Owners

The advantage of a PV Registry to *PV system owners* is clear – this makes it easy for them to get extra economic value out of their systems. They can more easily sell their certificates, offer a verified product to their potential buyers, and have their certificates aggregated with others.

For *renewable certificate wholesalers, PV aggregators, and utility companies*, a PV Registry provides a source of verified and audited certificates, that can meet RPS, green pricing, Green-e, or other standards required by their ultimate customers.

Finally, for *PV certificate buyers*, the PV Registry provides the assurance that the PV certificates they are purchasing have been accurately measured and verified, providing the integrity that the market needs for this emerging product.

Thirteen states have enacted renewable portfolio standards (RPS), which is a requirement that a certain percentage of the electricity delivered by utilities (or other load-serving entities) is sourced from renewable facilities. At this time, three states have specific PV requirements as part of their RPS: New Jersey, Nevada, and Arizona. New Jersey has also enacted an “alternative compliance payment” for solar of \$300/MWh (\$0.30/kWh), which a load-serving entity would be required to pay if they do not include the required percentage of PV in their electricity product. This provides one data point for the potential value of solar RECs, at least in New Jersey. Table 1 illustrates the potential revenue potential for solar owners based on system size and solar REC value in New Jersey.

TABLE 1. POTENTIAL REC VALUE IN NEW JERSEY

System Size (kW AC)	Estimated Annual Production (kWh)	Annual Whole RECs (1 REC = 1 MWh)	Annual REC Value at \$100/MWh	Annual REC Value at \$250/MWh
2	2400	2	\$ 200	\$ 500
5	6000	6	\$ 600	\$ 1,500
10	12,000	12	\$ 1,200	\$ 3,000
25	30,000	30	\$ 3,000	\$ 7,500

2.2 Advantages to the Market

A centralized PV registry provides a number of advantages to the market as a whole. First, it can be used to *meet regulatory objectives*, such as RPS compliance. The PV Registry first issues the RECs to the PV system owners based on the meter readings, then is used to transfer RECs to the entity requiring RPS compliance. New Jersey has instituted a PV Registry specifically for this purpose as this assures accurate tracking of REC creation and retirement.

Second, it requires that certain *standards* be met for *measurement, verification, and data collection* from PV systems, thus assuring that the information is accurate. A buyer of a PV REC must be assured that the associated electrical production of the PV system actually occurred to create the REC.

Third, a centralized PV registry *prevents double counting* of RECs, thus assuring the buyer that they are the only owner of that particular REC. Each REC carries a unique serial number that buyers and sellers can rely on to verify the authenticity and ownership.

Fourth, the registry allows PV RECs to be transferred efficiently and securely into other renewable energy certificate tracking systems that are currently operating (Wisconsin, New England, and Texas) or under discussion (Western States, PJM, New York), some of which do not track renewable resources less than 1 MW in size. Hence the PV Registry allows PV to more actively participate in these larger systems.

Fifth, the Registry can provide a *bulletin board* function to allow REC owners to find buyers for their RECs, with the Registry serving as the neutral tracking source.

2.3 The Role of the Aggregator

Individual PV owners can establish accounts in the PV Registry and actively participate. However, they may find it easier to work with an aggregator, which will represent a number of small PV owners, grouping their RECs into MWh REC products. Large REC buyers might find it burdensome to deal with hundreds of homeowners to acquire the number of RECs they need. However, an aggregator can group a number of PV systems into their aggregator account in the PV Registry to make it easier for both the large buyers and the small sellers.

As part of the service of the PV Registry, standard contract templates are available for aggregators and PV system owners that specify the rights of each party, and the

metering and reporting requirements. This is part of the effort to provide consistent standards across the industry.

3. HOW THE PV REGISTRY WORKS

3.1 Setting up Accounts

The PV Registry is a web-based database system that can be accessed from a computer. Solar system owners, aggregators (representing PV system owners), utilities, load-serving entities, brokers, and other interested parties can set up an account through a web page. The account holder can access their account through a secure login and password.

Similar to a bank account, the Registry allows account holders to:

- view their REC balances;
- transfer RECs in or out of their account upon purchase or sale;
- transfer PV RECs to other renewable tracking systems;
- retire PV RECs to meet regulatory or other requirements.

RECs are created and deposited into PV system owners accounts based on verified meter readings. One REC is created each time 1000 kWh has been generated from a particular solar system. If a PV system owner has a designated aggregator, their RECs will be transferred into the aggregator's account. If so desired, the aggregator's account can combine fractional RECs from several PV systems into whole RECs. Each REC will have a unique serial number assigned that will carry information as to where and when it was generated.

A REC is "retired" when it has been used to meet a regulatory requirement (such as an RPS). RECs can also be retired when corporations or individuals purchase them as a means of supporting renewable power. When a REC is retired, it is out of circulation for any purpose.

Some organizations may need RECs that represent less than 1000 kWh of generation (typically 100 kWh). In those cases, fractional RECs can be created, with the serial number reflecting its fractional size.

3.2 Type of Information Tracked

A summary of the type of information maintained in the PV Registry database is shown in Table 2. Individual account holders can access this information about their own accounts. Aggregate information about the REC activity can be shown in publicly available reports on the website.

3.3 Bulletin Board Function

The PV Registry has a bulletin board function as a service to those REC account holder who want to buy or sell RECs. The Registry does not take a position in the market, as its prime purpose is to provide tracking and verification. However, if an account holder has RECs they wish to sell, they can indicate that they have RECs for sale, along with their contact information, on the bulletin board. Other account holders who want to buy RECs can contact them. All buy and sell transactions are made outside of the Registry. After a transaction is completed, the seller uses the Registry to transfer the sold RECs to the buyer. Both the seller and the buyer confirm the transfer before the RECs are moved from one account to the other.

TABLE 2. PV REGISTRY INFORMATION

PV System Owner Information
PV System Information:
- Date of Initial Operation
- System Specifications:
- Modules
- Inverters
- Siting Characteristics
Meter Readings
Account Holder Information (aggregator, LSE, other)
REC Owner Information
REC Serial Numbers
- REC Date of Issue
- REC Date of Expiration
REC Status
REC Transactions

There are many in the solar industry who are interested in having the Registry post price information for REC sales. Others are concerned that this kind of information will commoditize RECs, and remove the personal touch that comes with knowing exactly who produced the RECs someone purchases. Where PV RECs are traded in relatively high volumes because of mandatory regulatory requirements, there is greater support for price transparency. Where PV RECs are part of a voluntary market, there is less interest in having price information public.

To respond to these concerns, the PV Registry will attempt to collect price information only on REC sales in RPS-driven markets initially. The aggregate average sales price will be posted to provide guidance to those selling their RECs, but to protect the confidentiality of individual sales.

3.4 REC Pricing

Electricity produced by PV systems is broken into two products: 1) the electricity that is used on-site or delivered to the grid, and 2) the positive environmental attributes associated with this clean energy production (RECs).

The price paid for the electricity produced by the PV system should reflect the locational and time-of-use benefits of the PV energy production. For a net metered system, this is the equivalent retail rate; for a net billed system, this is the electricity purchase rate set by the utility; and for a central station PV facility, it is the bilateral contract price between the PV facility and the utility. The net metering or net billing electricity purchase price should reflect the transmission and distribution benefits of a residential or commercial rooftop system. Similarly, the electricity purchase price for the central station PV facility should reflect the on-peak value of the electricity, but not the avoided transmission and distribution costs.

The price for RECs will therefore not reflect the locational or time-of-use benefits of the electricity output from PV systems. However the price of PV RECs will reflect the market's valuation of the environmental attributes of PV compared to other renewable resources, such as wind, biomass, small hydro, and geothermal.

4. STANDARDS

4.1 Production Measurement (Meter Readings)

The AC kilowatt-hour production of a PV system is the measure that determines the number of PV certificates produced. Therefore, measuring the inverter's AC output is needed. Certificates should be issued for the total AC kWh production from the PV systems, even if some of the energy is then used to meet on-site loads and/ or the system is net metered.

There are competing goals in measurement, particularly for very small systems. It is critical to have an accurate measurement of the output as the buyers expect to receive the full value of the PV certificates, which can only be accomplished through accurate measurement. On the other hand, for very small systems, the cost of accurate measurement must be sufficiently less than the value of the certificates; otherwise there is no economic value in selling certificates.

Therefore the following metering methods are proposed, based on system size and under the suggested timetable:

System Size < 10 kW AC

Measurement Method:

- Cumulative Inverter Reading of AC kWh Production OR

- Revenue quality AC kWh Meter

Short-Term Reporting Method:

- Quarterly Meter Readings by PV System Owner

Long-Term Reporting Method (by 1/1/05):

- Quarterly Meter Readings Electronically Transmitted to PV Registry Database

Systems ≥ 10 kW AC and < 30 kW AC

Measurement Method:

- Dedicated Revenue Quality AC kWh Meter

Short-Term Reporting Method:

- Quarterly Meter Readings by PV System Owner

Long-Term Reporting Method (by 1/1/05):

- Quarterly Meter Readings Electronically Transmitted to PV Registry Database

Systems ≥ 30 kW AC

Measurement Method:

- Data Acquisition System

Short-Term Reporting Method:

- Monthly Meter Readings Electronically Transmitted to PV Registry Database

Long-Term Reporting Method (by 1/1/05):

- Monthly Meter Readings Electronically Transmitted to PV Registry Database

4.2 Production Verification

Verification that the PV production has occurred is achieved through meter readings. Under the measurement methods proposed above, small systems owners (< 30 kW) would report their own meter reads in the near term by reading their meter or inverter display. Aggregators should provide the verification by performing manual spot checks on at least 10% of the reported meter reads.

Over the long term however, an inexpensive method of electronically transmitting the meter readings of small systems directly to PV Registry database is needed. Although there are companies that provide fairly constant system monitoring for a few hundred dollars, all that is needed for the PV Registry is a quarterly download of cumulative system output, which should be significantly less expensive. This will provide 1) accurate measurement of PV system kWh production, and 2) verification that the system is operating. A relatively simple modem connection where the PV system owner's phone automatically calls and transmits the meter or inverter information once per quarter would meet the Registry's purposes. Therefore, the long-term requirement is for an inexpensive system to be developed that can perform this function, either within the inverter itself, or as a separate unit.

For systems > 30 kW, a data acquisition system that electronically transmits the AC kWh production information is necessary at this time and is typically included in this size installation. The additional cost for

this data acquisition is but a small part of the total system cost. Additionally, the volume of PV certificates that will be generated by systems of this size can easily justify the cost of the data acquisition system. More frequent reporting is also justified, as these larger systems will generate multiple certificates each month.

4.3 Attestations Regarding Certificates

Another critical component is an attestation by the system owner that the certificates are not being sold to any other party, or unbundled with different components being delivered to different entities. For example, the greenhouse gas offset benefits of energy output, or other air benefits of PV output cannot be unbundled and sold to another entity. Furthermore, if the attributes are being counted toward a renewable portfolio standard, they cannot also be sold to another entity, as this would be double counting the RECs.

4.4 Marketing Guidelines

Most of the entities involved in PV certificates have clear language that describes the claims a PV system owner can make once they have arranged to sell their RECs. The key items include:

- a PV system owner who sells their RECs can claim they are “hosting” a renewable energy facility
- a PV system owner who sells their RECs cannot also claim that they are “green-powered”, “solar-powered”, or “renewable-powered”, just that they are hosting a PV system.

4.5 Standard Terms and Conditions

Table 3 suggests the contract terms and conditions to be included in a contract between a PV system owner who is selling their PV RECs and the entity (aggregator, utility) that is procuring the RECs.

5. THE NEW JERSEY S-REC PROGRAM

In January 2004, Clean Power Markets, Inc., along with the Pace Law School Energy Project, was awarded a contract to build and administer the “S-REC” (Solar Renewable Energy Credit) program for the New Jersey Board of Public Utilities’ Clean Energy Program. The S-REC program provides an electronic registry to track PV RECs to monitor compliance with the solar portion of New Jersey’s RPS. The S-REC program is the initial implementation of the electronic PV Registry concept.

PV system owners, load-serving entities (utilities and competitive retail suppliers), aggregators, brokers, and other interested parties maintain accounts in the S-REC system. This program resides on the www.njcep.com website.

A unique aspect of the New Jersey program are the rules which allow S-RECs to be created based on engineering estimates of solar production for PV systems less than 10 kW in size. Thus one S-REC, equivalent to one MWh of solar electricity, is deposited into each owner’s account based on verified meter readings (for systems ≥ 10 kW) or an engineering estimate of the solar production (for systems < 10 kW). Each S-REC has a unique serial number assigned to it which carries information as to what facility generated it and when it was generated. Clean Power Markets plans to work with the New Jersey Clean Energy Program to transition to metered output for all systems, regardless of size.

TABLE 3. SUGGESTED CONTRACT TERMS

<u>Mandatory Contract Items</u>
- Date of Agreement
- Identification of Buyer, including contact information
- Identification of Seller, including contact information
- Location of PV System
- kW size of PV System (DC and AC)
- Date Placed in Service
- Term of Agreement (start date and end date)
- Purchase Price for RECs (in ¢/kWh or \$/MWh)
- Payment Frequency (by x days after end of month, quarter, or year)
- Metering Requirements
- Production Reporting Frequency
- Permission and acknowledgement that system owner is transferring RECs to aggregator (or wholesale buyer)
- Statement of marketing claims rights of seller and buyer
- Attestation
- Defaults
- Termination (buyer or seller can terminate with or without cause upon __ days written notice)
- Signatures of both parties
<u>Optional Contract Items</u>
- Ability of buyer to publicize information about seller’s facility for publicity or marketing purposes
- Confidentiality of Information
- Dispute Resolution (location of governing law)
- Indemnification
- Assignment
- Notices
- Entire Agreement
- Force Majeure

Account holders access their accounts through a secure login and password on the website, and are able to view the S-RECs in their account, transfer S-RECs to others, and retire S-RECs to meet their RPS obligation. In the New Jersey program, S-RECs have a life of one year. S-RECs that have not been retired within the time required to meet the regulatory requirements will “expire” for purposes of meeting New Jersey’s requirements. However these solar RECs could be traded to an entity outside of New Jersey that is interested in including solar RECs in their retail product and does not have a similar REC-life constraint.

The S-REC program has a bulletin board function for S-REC owners and aggregators to find interested buyers of their S-RECs. All transactions are executed outside of the S-REC program. Once a sale has been made, the S-REC account holders log in to the system to effectuate the transfer of the S-RECs from the seller’s account to the buyer’s account.

All solar generators and LSEs in New Jersey participate in the S-REC program for purposes of complying with the solar portion of the RPS, as the S-REC registry is the only issuer of solar RECs.

Expansion of the New Jersey model is planned to offer the benefits provided by the PV Registry to other regions across the country.

6. CONCLUSIONS

The PV Registry facilitates aggregation and sales of PV RECs by providing a central point to track RECs, including REC creation, transfer, and retirement. The integrity of the certificate market is maintained by having an electronic registry track RECs based on verified meter readings. PV participation in REC markets is increased with the ability to aggregate output from multiple PV systems into MWh-sized REC products.

¹ Pepper, Janis C., “Renewable Certificates for Photovoltaics: A Model to Build Upon”, prepared under contract for Renewable Energy Technology Project, Pace Law School Energy Project, April 2002.