# RENEWABLE DISTRIBUTED GENERATION MARKET DEVELOPMENT PROGRAMS

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## ABSTRACT

A growing number of states and regional entities have recently initiated renewable energy programs that are designed to promote and/or support the distributed generation market. These new initiatives include direct incentives/rebates/buydowns, supply-side/market development support, below-market financing, Renewable Portfolio Standards, and technical/consulting expertise, among other forms of support. This paper provides a brief regional overview of existing programs and renewables industry support activity and needed improvements to their markets and programs.

***Objective.*** The main objectives of this paper are to: 1) present a multi-regional perspective of current renewable distributed generation programs using various market development strategies, 2) describe the key barriers to sustainable market development, and 3) address the perceived needs for improvements to these existing programs to further their positive impacts on the distributed generation market so that others can benefit from the knowledge gained in these early programs' successes and failures.

***Why This Paper is Valuable.*** Market development support program activity is increasing around the US in response to major energy issues of recent years and now from the states that are instituting Renewable Portfolio Standards. In California there are two major (>$100 million) Programs supporting renewable distributed generation that have now been operating for two and five years, respectively. The market development needs and program support issues discussed in this paper will help to inform others that are currently or will soon need to design and implement Renewable Energy Programs, in response to legislation from their state-level policy decision makers.

## Introduction and Overview

A number of states and other regional energy entities have now initiated renewable and/or clean energy market development programs designed to promote and/or support *environmentally friendly* distributed generation (DG) technologies. These initiatives include direct incentives in the form of rebates or installed equipment capital cost "buydown", various forms of clean energy supply-side/industry market development support, below-market financing, Renewable Portfolio Standard requirements, technical assistance and consulting expertise, among other forms of support. The areas of the US with the greatest renewable energy DG market activity to date have been driven primarily by direct capital cost buydown incentives in order to stimulate significant levels of market response. The regions of the country with significant clean distributed generation development activity include the southwest (most notably California with its Renewable Energy and Self-Generation Programs), the northeast (i.e., New York, CT, MA) and the mid-west (Wisconsin).

This paper provides a brief regional overview of existing program offerings of renewable industry support activity, identification of the key barriers to increased market penetration and needed actions that have been identified to improve some of the existing programs and their expected impacts on the renewable and clean energy DG market.

# Discussion of Key Barriers to Sustainable Market Development

A primary goal of developing a sustainable market for distributed generation through the use of program interventions is to identify and reduce the major barriers to market adoption. While some barriers are shared across technologies, and shared even with nonrenewable-fueled DG systems, others are technology specific. The following is a brief description of some of the key barriers to adoption of clean DG technologies.

***Interconnection Requirements***. Connecting to the electric grid can be a complex and in some cases an expensive procedure. Utilities work to ensure the safety of the grid and the reliability of the electric power system and to protect valuable equipment. Connecting to the grid may involve additional equipment at the customer's site, permits, and studies. Completing the task may be time consuming and expensive for the customer.

***Utility Tariffs.*** Expected charges and/or uncertainty regarding additional imposed charges may make a project economically unfeasible. These may consist of back-up tariffs, standby charges and competitive transition charges to recover utility stranded costs.

***Maintenance Costs.*** Maintenance costs for fuel cell and microturbine cogeneration technologies may be high and/or uncertain.

***High System Installation Costs.*** Without program incentives, the payback times for some technologies, photovoltaics and wind in particular, may not be economically feasible.

***Waste Heat Recovery.*** Cogeneration systems funded under the SGIP must meet state-mandated waste heat recovery requirements and overall system efficiency standards.

***Lack of Consumer Awareness.*** Recent program evaluation market research results show that consumers are still largely unaware of the benefits and costs associated with distributed generation systems.

***Insurance Costs.*** Liability insurance required by Programs can be both confusing (responsibility of third parties and host customers) and costly.

***Consumer Confusion Surrounding Net Metering.*** According to recent evaluation results, utilities are not yet able to communicate well to customers and install net generation output meters in a timely manner, causing customers to perceive reduced benefits from photovoltaic and small wind systems. Moreover, billing documentation is often hard to decipher, leading to more frustration and confusion surrounding this process.

## Alternative Market Support Strategies

In California, the Self-Generation Incentive Program has targeted outreach efforts predominantly toward third parties including Energy Service Companies (ESCOs) and vendors. These third parties, in turn, have had the most success in marketing to customers and bringing them into the program. This strategy seems to be more successful than direct consumer outreach by the program administrator or utility, as evaluation results suggest most participants in the program heard about it through a third party. In addition, while a significant percentage of nonparticipant customers reported receiving utility bill inserts or hearing about the program from a utility representative, the contact did not persuade them to participate in the program. The Energy Commissions Emerging Buydown Program continues to reach out to both third party suppliers and potential end-users or purchasers of small PV and wind systems.

In New York, efforts have focused on a combination of various forms of supply infrastructure support, including installer training, and direct project financial support in the form of capital cost Buydown. In Wisconsin, Focus on Energy offers a Renewable Energy Program for residential and business customers that provide free telephone consultation and a 75% discount on a small business site assessment for solar and wind projects.

## Effectiveness of Existing Programs

Recent program reporting and evaluations have shown that the major clean energy market development programs are generally performing successfully by getting projects on-line to reduce peak electric load on the grid. In addition, both customers and third party suppliers/project developers report high ratings of overall satisfaction with rebate/buydown programs. The following discussion and information includes some of the key accomplishments of these Programs to date.

***California Self-Generation Incentive Program (SGIP).*** During its initial 18 months of operation beginning in mid-2001 through the end of 2002, the program received 663 applications for project funding. Of these, 34 were complete and 340 were still active as of January 2003. Of these, roughly 62% of the completed and half of the active projects are for solar photovoltaic (PV) projects. The remaining 38% of the completed projects include cogeneration applications involving fuel cells, microturbines, and internal combustion engines. These completed and active projects represent nearly $155 million in program incentives and over 112 MW of gross generation capacity. The summary of SGIP Program applications under review, conditional reservations, confirmed reservations, suspended and active reservations for PY2001 and PY2002 projects as of January 31, 2003 are summarized in Table 1 and Table 2.

**Table 1: Summary of Active PY2001 Projects as of January 2003[1]**

| Incentive Level | PY2001 Active Projects as of January 2003 (All Administrators) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RRF Under Review | | | Conditional Reservation | | | Confirmed Reservation | | | Suspended | | | Total Active | | |
| | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) |
| Level 1 | 0 | 0 | $0 | 0 | 0 | $0 | 12 | 2,291 | $7,979,166 | 0 | 0 | $0 | 12 | 2,291 | $7,979,166 |
| Level 2 | 0 | 0 | $0 | 0 | 0 | $0 | 1 | 200 | $367,632 | 0 | 0 | $0 | 1 | 200 | $367,632 |
| Level 3N | 0 | 0 | $0 | 3 | 554 | $326,543 | 40 | 14,898 | $9,579,961 | 0 | 0 | $0 | 43 | 15,452 | $9,906,503 |
| **Total** | **0** | **0** | **$0** | **3** | **554** | **$326,543** | **53** | **17,389** | **$17,926,759** | **0** | **0** | **$0** | **56** | **17,943** | **$18,253,301** |

**Table 2: Summary of Active PY2002 Projects as of January 2003**

| Incentive Level | PY2002 Active Projects as of January 2003 (All Administrators) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | RRF Under Review | | | Conditional Reservation | | | Confirmed Reservation | | | Suspended | | | Total Active | | |
| | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) | Projects | kW | Incentives ($) |
| Level 1 | 25 | 4,937 | $14,756,552 | 69 | 13,085 | $45,561,767 | 57 | 6,591 | $19,815,142 | 6 | 2,263 | $7,025,368 | 157 | 26,875 | $87,158,828 |
| Level 2 | 0 | 0 | $0 | 0 | 0 | $0 | 1 | 600 | $1,500,000 | 0 | 0 | $0 | 1 | 600 | $1,500,000 |
| Level 3N | 23 | 10,626 | $5,662,714 | 64 | 30,047 | $17,358,737 | 28 | 14,782 | $9,351,221 | 3 | 2,170 | $1,307,780 | 118 | 57,625 | $33,680,452 |
| Level 3R | 1 | 300 | $146,600 | 6 | 1,145 | $1,175,833 | 0 | 0 | $0 | 1 | 140 | $140,000 | 8 | 1,585 | $1,462,433 |
| **Total** | **49** | **15,863** | **$20,565,866** | **139** | **44,277** | **$64,096,337** | **86** | **21,973** | **$30,666,363** | **10** | **4,573** | **$8,473,148** | **284** | **86,685** | **$123,801,714** |

[1] Proof of Project Advancement approval was delayed for one of the PY2001 projects at the Conditional Reservation stage due to changes in system ownership midway through the application process, which delayed the host customer's submittal of the Project Cost Breakdown worksheet, which was the only requirement the host customer had not fulfilled for Proof of Project Advancement. The host customer recently submitted this worksheet, underwent successful field verification, and submitted an incentive claim form. Another of the PY2001 projects at the Conditional Reservation stage was not able to achieve Proof of Project Advancement approval since the host customer had been unable to provide Proof of Professional Liability Insurance. The reservation was not cancelled since all other requirements for Proof of Project Advancement had been met. The host customer was further delayed by the departure of the system's installation contractor from the market. The Program Administrator is considering requesting that the host customer withdraw the PY2001 reservation and re-apply as a PY2003 project, pending review of retroactive eligibility requirements. The final PY2001 project at the Conditional Reservation stage was withdrawn and re-submitted as a PY2003 project. The project had been delayed for various reasons, such as departure of the previous project manager and subsequent changes in the internal management of the host customer firm. Proof of Project Advancement requirements for the re-submitted PY2003 project have been met and approved by the Program Administrator.

The status of all completed PY 2001 and PY 2002 projects as of January 31, 2003 are summarized in Table 3 and Table 4 below. Note that nearly 8 MW of DG (including over 5.4 MW of Level 3-N technology) have been installed as of this period.

## Table 1: Status of All Completed PY2001 Projects as of January 2003

| Incentive Level | 2001 Completed Projects as of January 2003 (All Administrators) | | |
|---|---|---|---|
| | Projects | kW | Incentives ($) |
| Level 1 | 9 | 1,182 | $4,894,765 |
| Level 2 | 1 | 200 | $500,000 |
| Level 3N | 11 | 4,394 | $2,410,240 |
| **Total** | **21** | **5,776** | **$7,805,005** |

## Table 2: Status of All Completed PY2002 Projects as of January 2003

| Incentive Level | 2002 Completed Projects as of January 2003 (All Administrators) | | |
|---|---|---|---|
| | Projects | kW | Incentives ($) |
| Level 1 | 12 | 1,118 | $4,502,539 |
| Level 2 | 0 | 0 | $0 |
| Level 3N | 1 | 1,063 | $459,880 |
| Level 3R | 0 | 0 | $0 |
| **Total** | **13** | **2,181** | **$4,962,419** |

A preliminary impacts analysis assessment completed in early 2003 indicated that cogeneration system electric output during the hour of the 2002 California electric system peak was equal to approximately 0.8 kW per kW of rebated system capacity. Analysis of available 15-minute interval data indicated an average capacity factor equal to 43%. This factor represents the ratio of actual metered energy production to total energy that would have been produced had the system operated continuously at the rebated power output level. Several systems experienced prolonged periods of downtime. A more rigorous assessment of system reliability and overall system efficiency will be completed in future rounds of impacts analysis. Future impacts assessments will also include interval-metered data from dozens of photovoltaic systems located throughout California. Energy impacts will be examined, as will coincidence of solar electric system power output with periods during which electric system loads reach their maximum values.

The status of PY 2001 through PY2003 active SGIP projects as of September 2003 is summarized in Tables 5 through Table 7 below. There are 222 active Level 1 and 2 Level 2 projects while there are 14 Level 3-R (renewable-fueled Projects) that remain active as of September 30, 2003.

**Table 3: Summary of Active PY2001 Projects as of September 2003**

| | PY2001 Active Projects as of September 2003 (All Administrators) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Incentive | RRF Under Review | | | Conditional Reservation | | | Confirmed Reservation | | | Suspended | | | Total Active | | |
| Level | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) |
| Level 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1,043 | $ 2,415,008 | 0 | 0 | 0 | 2 | 1,043 | $ 2,415,008 |
| Level 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | $ - | 0 | 0 | 0 | 0 | 0 | $ - |
| Level 3 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 5,324 | $ 3,320,031 | 0 | 0 | 0 | 15 | 5,324 | $ 3,320,031 |
| **Total** | **0** | **0** | **0** | **0** | **0** | **0** | **17** | **6,367** | **$ 5,735,039** | **0** | **0** | **0** | **17** | **6,367** | **$ 5,735,039** |

**Table 4: Summary of Active PY2002 Projects as of September 2003**

| | PY2002 Active Projects as of September 2003 (All Administrators) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Incentive | RRF Under Review | | | Conditional Reservation | | | Confirmed Reservation | | | Suspended | | | Total Active | | |
| Level | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) |
| Level 1 | 2 | 439 | $ 884,324 | 11 | 3,295 | $ 10,327,800 | 57 | 10,306 | $ 34,725,978 | 0 | 0 | 0 | 70 | 14,040 | $ 45,938,102 |
| Level 2 | 0 | 0 | $ - | 0 | 0 | $ - | 1 | 600 | $ 1,500,000 | 0 | 0 | 0 | 1 | 600 | $ 1,500,000 |
| Level 3R | 0 | 0 | $ - | 0 | 0 | $ - | 5 | 745 | $ 739,673 | 0 | 0 | 0 | 5 | 745 | $ 739,673 |
| Level 3N | 0 | 0 | $ - | 7 | 1,185 | $ 959,391 | 73 | 39,824 | $ 24,213,801 | 0 | 0 | 0 | 80 | 41,009 | $ 25,173,192 |
| **Total** | **2** | **439** | **$ 884,324** | **18** | **4,480** | **$ 11,287,191** | **136** | **51,475** | **$ 61,179,451** | **0** | **0** | **0** | **156** | **56,394** | **$ 73,350,966** |

**Table 5: Summary of Active PY2002 Projects as of September 2003**

| | PY2003 Active Projects as of September 2003 (All Administrators) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Incentive | RRF Under Review | | | Conditional Reservation | | | Confirmed Reservation | | | Suspended | | | Total Active | | |
| Level | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) | Projects | kW | Incentives($) |
| Level 1 | 23 | 5,206 | $ 17,390,001 | 94 | 17,100 | $ 63,681,713 | 33 | 2,121 | $ 8,538,908 | 0 | 0 | 0 | 150 | 24,426 | $ 89,610,622 |
| Level 2 | 0 | 0 | $ - | 1 | 1,000 | $ 2,500,000 | 0 | 0 | $ - | 0 | 0 | 0 | 1 | 1,000 | $ 2,500,000 |
| Level 3R | 1 | 1,030 | $ 959,224 | 5 | 1,890 | $ 2,096,794 | 3 | 600 | $ 697,974 | 0 | 0 | 0 | 9 | 3,520 | $ 3,753,992 |
| Level 3N | 10 | 5,995 | $ 4,392,580 | 53 | 28,800 | $ 16,834,255 | 18 | 10,833 | $ 6,875,393 | 6 | 3,683 | $ 2,048,648 | 87 | 49,311 | $ 30,150,876 |
| **Total** | **34** | **12,231** | **$ 22,741,805** | **153** | **48,790** | **$ 85,112,763** | **54** | **13,554** | **$ 16,112,275** | **6** | **3,683** | **$ 2,048,648** | **247** | **78,257** | **$ 126,015,490** |

The summary of all completed SGIP projects as of September 30, 2003 is summarized by Program Year applicant and incentive level in Tables 8 through Table 10 below.

**Table 8: Status of All Completed PY2001 Projects as of September 2003**

| | 2001 Completed Projects as of September 2003 (All Administrators) | | |
|---|---|---|---|
| **Incentive Level** | **Projects** | **kW** | **Incentives ($)** |
| Level 1 | 19 | 2,864 | $ 9,505,734 |
| Level 2 | 1 | 200 | $ 500,000 |
| Level 3 | 35 | 13,244 | $ 8,400,641 |
| **Total** | **55** | **16,308** | **$ 18,406,375** |

**Table 9: Status of All Completed PY2002 Projects as of September 2003**

| | 2002 Completed Projects as of September 2003 (All Administrators) | | |
|---|---|---|---|
| **Incentive Level** | **Projects** | **kW** | **Incentives ($)** |
| Level 1 | 61 | 5,785 | $ 16,366,642 |
| Level 2 | 0 | 0 | $ - |
| Level 3R | 1 | 420 | $ 485,013 |
| Level 3N | 10 | 5,940 | $ 2,600,253 |
| **Total** | **72** | **12,145** | **$ 19,451,908** |

**Table 10: Status of All Completed PY2003 Projects as of September 2003**

| | 2003 Completed Projects as of September 2003 (All Administrators) | | |
|---|---|---|---|
| **Incentive Level** | **Projects** | **kW** | **Incentives ($)** |
| Level 1 | 5 | 340 | $ 1,256,434 |
| Level 2 | 0 | 0 | $ - |
| Level 3R | 0 | 0 | $ - |
| Level 3N | 0 | 0 | $ - |
| **Total** | **5** | **340** | **$ 1,256,434** |

***California Renewable Energy Program - Emerging Buydown Element.*** This program incentivized new on-site renewable projects through the Emerging Renewable Resources Account element of the program. From March 1998 through March 2002, 2,342 systems were completed and an additional 1,099 remained active. These projects consist of photovoltaic, wind and fuel cell technologies which represent over $71 million in incentives and nearly 18 MW of rated gross capacity.

Interval-metered data were collected from a sample of 23 participating solar electric systems from mid-February 2000 through April 2001. PV system capacities actually observed at PTC conditions were found, on average, to be 27 percent less than rebated system capacities that were based on several engineering assumptions. While this situation maximized rebate magnitudes, it also created a risk that customer expectations might not be met. PV system energy production rates actually observed were an average of 24 percent lower than the average suggested in some program documentation. While information in this literature was well qualified, results of analysis of metered data could help place such

estimates in a more complete context. The variable nature of renewable energy system output is a characteristic that program participants may need assistance in order to adapt.

Between May 1999 and June 2002 132 systems were subjected to a verification visit during which site conditions and system performance were assessed. These visits revealed that information necessary to establish realistic solar electric system performance expectations and assess actual performance was lacking. This finding contributed to a recommendation that all such systems be required to include a basic energy meter. During this period, the cost of electricity was becoming an increasingly important factor in participant decision making. The earliest program participants tended to be relatively more concerned with reliability and environmental factors.

***New York State Energy Research and Development Authority (NYSERDA)*** **Energy Smart[SM]** ***Renewable Energy Deployment Program.*** Two pilot residential solar photovoltaic (PV) programs, initiated in 1998, have resulted in over 85 installed PV systems, totaling approximately 180 KW in gross generating capacity. The PV on Buildings Program is supporting PV on 11 new buildings that will provide 679 KW of capacity. Over 250 KW has been installed to date through this program.

***Wisconsin's Focus on Energy Renewable Energy Program.*** From it's beginning in January 2002 through March 2003, 103 completed and active projects were funded by the program including photovoltaics, wind, geothermal heat pumps, bio-energy, and small hydroelectric. These projects represent roughly 4 MW in gross generation capacity.

***New Jersey Clean Energy Program.*** This program has funded 132 projects through April 2003, including photovoltaic, wind, fuel cells, and biomass technologies. These projects represent roughly $26 million in incentives and 14 MW in generating capacity.

## Improvements to Program Effectiveness for Developing a Sustainable Market

Existing distributed generation programs are clearly bringing new capacity on line to reduce demand on the electric grid. However, the results from recent evaluations suggest additional steps can and should be taken to improve the long-term effectiveness of these program efforts. In particular, plans should be in place to transition from a subsidized market to one that is sustainable in the absence of state incentives funding.

In the case of photovoltaics, the current installation cost for these systems makes it economically unfeasible for most participants to undertake without a significant level of subsidy. The existence of incentive funds in certain regions of the US has encouraged the start up of hundreds of new suppliers over the past five years. However, even with half of the installation costs paid by program incentives, payback periods are often borderline or still too long for many businesses.

Experience in California suggests that there continues to be a risk that new owners of small photovoltaic and wind systems will hold unrealistic expectations of system performance. In particular, many program participants were surprised by the influence of photovoltaic module temperature on system performance. In the case of wind systems, it is important that program participants understand the influence of obstructions on system output. In the future, program implementers should help prospective participants assess system performance with a critical eye, and should provide prospective participants with existing information summarizing the actual performance of other installed systems.

During the early years of the California Emerging Renewables Buydown Program, small solar electric and wind systems were not required to be equipped with an energy meter, and most systems lacked instrumentation required to enable typical program participants to monitor system performance effectively. Findings yielded by program evaluation activities contributed to a change in program policy. Now, small renewable distributed generation systems rebated through this program are required to include basic energy metering capabilities. This experience suggests that other related renewable DG programs should include a similar requirement.

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