How Self-generation Projects Can Work for ESCOs

Kevin W. Warren, P.E., C.E.M.
kW Engineering

ABSTRACT

This article examines the current market for customer-sited electricity generation, or "self-generation," activity in California and elsewhere as it relates to energy services companies (ESCOs). Solar photovoltaic (PV) and small combined heat and power (CHP) systems of less than 1 MW in commercial and institutional facilities are discussed. Incentive programs in several states that are contributing to brisk activity and the factors that seem most important to closing sales are also presented. While some CHP technologies can be sold on the basis of simple payback period, fuel cells and PV projects typically require more creative approaches. Several of the techniques that are used to justify PV projects are explained. The old sales adage that you "sell the sizzle, not the steak," meaning that you must sell the benefits rather than the attributes of a product, holds true for self-generation (SG) projects, but it is important to know which attributes are worth selling.

INTRODUCTION

There is currently a lot of talk about distributed generation, clean power, and renewable energy. The California energy crisis of 2001 transformed the public's view of energy. Suddenly you had barbers and doctors discussing terms and issues like stranded costs, renewable portfolio standards, and exit fees that would have previously been known only to energy experts. The regulatory atmosphere is also changing. Electricity transmission and capacity constraints have made some state public utilities commissions and utilities suddenly willing and occasionally even eager to promote self-generation. As a result, incentive programs in several states have been started or expanded, customers are more willing to consider technologies previously considered too expensive or complex, and SG activity is brisk in some areas.

Historically, the range of solutions that an ESCO energy engineer or project developer could provide his customer was largely confined to energy efficiency measures. CHP systems were considered only for very large customers or a few very specific facility types such as hospitals and municipal swimming pools. Solar PV systems and fuel cells were not considered at all. This attitude is changing as a number of ESCOs are taking advantage of the new climate to put SG projects side by side with energy efficiency projects. We will look at what is being installed and some of the approaches used to justify the projects.

AVAILABLE TECHNOLOGIES

Let us start by defining some terms and the scope of this article. There are many terms used to describe these systems including: customer-sited generation, self-generation, distributed generation, distributed resources, distributed energy, combined heat and power, cogeneration, renewable energy, clean power, and green power. Many of these terms are ill-defined and sloppily applied. We will use the term self-generation (SG) to describe any technology that is sited at a customer's facility and produces power primarily or exclusively for use on-site. This is the term used by the California incentive program, and it has been used less variably than some of the competing terms.

The SG market is a varied one, from 1 kW residential PV systems to 40 MW gas turbine cogeneration plants serving universities. This article is concerned with systems that are increasingly being developed by ESCOs. Systems of about 50 kW to about 1 MW are both large enough to cost-effectively develop and small enough to be appropriate for the end-users commonly targeted by ESCOs. The primary technologies of concern are PV, reciprocating engines, fuel cells, and microturbines.

I am not dismissing larger systems. Indeed, most of the CHP activity has historically been in facilities with large electrical and thermal loads. In the right application, these large systems where the primary technologies are gas turbines, large reciprocating engines, and steam turbines are extremely cost-effective. However, development of multi-MW plants is a complex undertaking, which is typically not performed in conjunction with energy efficiency measures, and requires a different skill set than exists in the typical ESCO office.

CURRENT ACTIVITY

The market for commercial-scale PV is growing rapidly, but current activity for the other technologies is mixed. According to Powerlight, a large-scale PV systems integrator, grid-connected PV installations have a phenomenal annual grown rate of 55% for the last 5 years [1].

It is much harder to estimate the CHP market in the 50 kW to 1 MW range of concern. Feedback from several sources suggests that the market for these systems nationwide is weak [2] and may have contracted slightly in the last year or two [3,4]. Customer concern over high gas prices, combined with the sluggish economy, appears to be causing customers to postpone decisions.

SG activity in California can be assessed based on applications to the California Self-Generation Incentive Program, which started in 2001. The following tables list the projects that had been installed as of January 2003 and those that were still actively pursuing an incentive but may not be eventually installed [5]:

Table 1. California SG Activity

Technology	*# Projects Completed*	*# Projects Active*
PV	21	168
Fuel Cell	1	3
IC Engine	7	119
Microturbine	5	50

The total capacity of completed projects in the California program is 8 MW. The total capacity of projects that were active as of January 2003 is 105 MW. New York provided incentives in 2001 and 2002 that supported approximately 16 MW of CHP installations of 1 MW and below [6]. Approximately 1 MW of PV systems larger than 10 kW had been installed under the New Jersey Clean Energy Program [7]. So far, fuel cells are a small part of the SG market.

In the California SG program, which is open to systems between 30 kW and 1 MW, the average sizes of active projects are shown below [5]:

Table 2. Mean Project Capacity

Technology	*Average Size*
PV	170
Fuel Cell	400
IC Engine	540
Microturbine	200

ESCOs are only interested in projects that can be installed profitably, and these projects can be large. The typical PV project size is increasing according to one ESCO interviewed [19]. A 300 kW PV installation is no longer an unusually large system and has a capital cost of about $2.5 million. This is a substantial performance contract project. Interestingly, the New Jersey program provides negligible incentives for the portion of a project in excess of 500 kW [7].

MARKET POTENTIAL

There appears to be nearly unanimous agreement that the PV industry will continue to grow, at least in the short term and as long as incentive programs remain. One source estimates that the grid-connected PV market will exceed $3 billion by 2010 [1]. The PV industry has set a goal for itself of 25% annual growth in the total capacity of panels produced domestically [21].

According to the Energy Information Administration, there is economic and technical feasibility for 17 GW of building-sited CHP by 2010 [8]. Since the retrofit market is typically of more concern to ESCOs, it is interesting to note that more than half of the potential is in existing facilities as opposed to new construction. Also, about half of the potential is in installations of less than 1 MW, the size of concern in this article. Office buildings accounted for nearly half of the potential, with hospitals and colleges accounting for the bulk of the remaining potential in building-sited applications. Much of the growth in the office sector is based on systems involving absorption chillers. It should be noted that the study used a 10 year payback as its cost-effectiveness threshold and that the assumed installed costs are significantly lower than the costs reported in the California SG program, so these projections may be overly optimistic.

The Federal Energy Management Program (FEMP) estimates that 9% of federal facilities could install CHP systems at an average simple payback period of 7 years [9].

Results for a CHP market potential study for New York showed technical potential for nearly 20,000 new CHP installations in commercial facilities with systems less than 1 MW [6]. The total technically feasible projected capacity is nearly 3 GW in this sector and size. Once economics are considered, however, the projections drop to about 200 MW of potential in sub-1-MW commercial installations by 2012. This sector accounts for only about 1% of the installed base of CHP installations in the state, or about 50 MW. The economically feasible projections thus suggest the possibility for a significant expansion of CHP systems in the commercial sector.

BARRIERS TO INSTALLING SELF-GENERATION

There are significant opportunities for ESCOs to develop SG projects. There are also formidable barriers.

People who attended a workshop on the California program but did not install a SG system most often pointed to high initial system costs as the reason they did not participate.

The major barriers reported by those who participated in the program were different [5]:

- Interconnection
- Air pollution permitting
- Building permitting
- Installation of net meters

It is interesting that interconnection remains a significant barrier in California despite significant statewide efforts to streamline the process. In states without statewide interconnections standards, an intransigent local utility can make it nearly impossible to install any sort of SG.

Charges for standby power and exit fees can be a serious hurdle. Under the current tariffs in New York, the market study discussed earlier predicts negligible growth in systems less than 500 kW. According to NYSERDA (New York State Energy Research and Development Authority), significant growth is expected if these regulatory barriers are lowered [6].

Solar advocates are actively pressing for net metering laws. However, these are more of an issue with residential sized systems than commercial. In residences, the time of peak solar output corresponds with very low building loads because no one is home. Some state's net metering laws apply to all systems but many apply only to residential-sized systems.

REASONS FOR INSTALLING SELF-GENERATION

Despite the barriers, significant SG activity is occurring, The reasons that customers install SG projects are different for different technologies. Participants in the California program were surveyed to determine the factors that were influential in their decision to install SG. Table 3 shows average participant responses on a scale where 5 is very influential and 1 is not at all influential [5].

Table 3. Reasons for Installing Self Generation

Technology	*Utility Bill Savings*	*Concern for the Environment*	*Improve Business Image*
PV	4	4	3
Fuel Cell	4	5	4
IC Engine	5	3	3
Microturbine	5	3	2

Reciprocating engines and microturbines are not viewed as being as "green" as are PV and fuel cells. Reciprocating engines and microturbines are being installed primarily because they are viewed as a cost-effective way to reduce utility bills. Interestingly, concern for the environment ranked higher than improving the image of the business for all but reciprocating engines. This may indicate that the selling power of "greenness" has more to do with the values of the organization or decision maker than it does with public relations benefit. It would be instructive to know how energy efficiency measures would rank on the same scale.

INCENTIVE PROGRAMS FOR PV

By reducing the installed cost of the systems, incentive programs are a main driver of the increased activity in commercial scale PV projects. A number of states have programs aimed at the residential sector, but a smaller number include commercial-scale systems. The following states have programs that are available to commercial scale systems [10]:

- California
- Connecticut
- Delaware
- Illinois
- Massachusetts
- New Jersey
- New York
- Rhode Island

A sample of programs is described below in order to provide a feel for the types and scope of programs that are available. Program rules, incentive levels, and funding availability change frequently so be sure to get current information before making investment decisions.

California

The California Self-Generation Incentive Program is authorized to spend $125M annually through 12/31/2004. Systems between 30 kW and 1 MW are eligible. California incentives include [11]:

- Up to 50% of project cost
- $4.5/watt (soon to decrease)
- 15% state tax credit (<200 kW)
- Standby fees waived
- Exempt from Exit Fees
- An additional $100M is available through a separate program for systems less than 30 kW.

New Jersey

The New Jersey program features a tiered rate structure where smaller systems receive a higher incentive rate than larger projects. The incentive structure is [7]:

- Up to 50% of project cost
- $5.50/watt for the first 10 kW
- $4.00/watt for the next 90 kW
- $3.75/watt for the next 400 kW
- only $0.30/watt for 500-1000 kW

Oregon

There are two incentives available in Oregon. The Energy Trust of Oregon offers an incentive for commercial PV systems less than 25 kW at $1.75/watt, but it is capped at only $20,000 [12]. More important is the Business Energy Tax Credit (BETC) for 35% of the installed cost. The BETC program includes a pass-through option whereby tax-exempt entities can pass the credit to a partner that has a tax liability [13].

New York

New York has several programs for PV. Key incentives are [14]:

- $4 to $5/watt for <15 kW
- $5/watt for >15 kW
- State tax credit for some installations
- New construction incentive for building-integrated PV

Tax Credits

Though typically of lesser value, tax credits supplement cash incentives from utilities. The Federal Investment Tax Credit allows customers to take 10% of the installed system cost against their federal tax burden. In addition, several states have tax credits, with Oregon's being particularly generous.

INCENTIVE PROGRAMS FOR FUEL CELLS

Historically the federal government has been the primary source of support for fuel cell projects. This is in stark contrast to energy efficiency and PV where support has been primarily at the state level and federal support has been lacking. The Climate Change Fuel Cell Program offers up to $1.0 per watt and 33% of project cost [15].

A number of states have programs to support fuel cells, including:

- California
- Connecticut
- Illinois
- Ohio
- Massachusetts
- Michigan
- New Jersey
- New York
- Oregon

As an example, the California program offers an incentive of $2.50 per watt up to 40% of eligible costs [11]. The New Jersey Clean Energy Program originally offered incentives higher than California's for fuel cells powered by natural gas but currently seems to cover only fuel cells operating on renewable fuels such as landfill gas [7].

INCENTIVE PROGRAMS FOR OTHER COMBINED HEAT AND POWER TECHNOLOGIES

Incentive programs are rare for technologies other than PV and fuel cells. Support for reciprocating engine and microturbine CHP seems to be confined to California, New York, and Oregon. California offers incentives of $1.00 per watt that cover up to 30% of the cost of microturbines and reciprocating engines running on natural gas [11]. Oregon's Business Energy Tax Credit provides a credit for 35% of the installed cost of systems that exceed 56% total efficiency [13]. Note that this is not the standard PURPA efficiency that includes only half of the thermal output. New York provides incentives for CHP demonstration projects of up to $1M per installation that can cover up to 50% of the project cost, but projects are selected competitively [14].

Fortunately for developers of these systems, though incentive programs are much less common for reciprocating engines and microturbines, these technologies require less support in order to be cost-effective. Even without incentives, payback periods can be short for CHP applications where a large percentage of the waste heat can be effectively recovered. This is less true of fuel cells.

HYPOTHETICAL STAND-ALONE PV PROJECT

Some of the state and utility incentive programs offer the possibility of large incentives for PV, but are the incentives large enough to make the projects economically attractive? The answer depends primarily upon the project location and upon how "attractive" is defined. Table 4 shows the economics for a hypothetical PV project. The application is a 100 kW array mounted flat on an office building, an increasingly popular PV application. The table shows the same installation located in California, New Jersey and New York. All three analyses were performed using the clean power estimators provided on each state's website [16,17,18]. The common assumptions are

- Customer is a for-profit enterprise with a tax liability
- Customer pays cash for the system
- Installed cost is $8,000 per kW
- Electricity price escalation is 2%

Table 4: Hypothetical PV Installation

State	*State Incentive*	*State Tax Credit*	*Federal Tax Credit*	*Net Cost*	*Annual kWh Produced*	*Year 1 Bill Savings*	*Simple Payback (years)*	*Net Present Value*
California	$400,000	$54,000	$40,000	$306,000	162,069	$31,197	10	$81,284
New York	$500,000	$13,500	$30,000	$256,500	108,696	$12,375	21	$8,836
New Jersey	$415,000	N/A	$38,500	$346,500	113,550	$9,237	38	$(88,170)

Note that while the simple payback periods are long, the net present value (NPV) of the investment is positive for both California and New York due to the long life of the equipment and the inclusion of depreciation in the analysis. The NPV can be made positive for the New Jersey example if the cost is changed to $6,500 per kW (the average for the NJ Program) and the electricity price escalation is changed to 3.5%.

The New York example has worse economics than that of California's despite New York's more generous incentive due to less sunshine and lower electricity rates in New York. All three projects include large incentives. It should be clear from this analysis that the economics are challenging, to put it kindly, in states lacking incentives.

PRIMARY BENEFITS USED TO SELL PV

Given that the economics of CHP in proper applications can be quite attractive, it is hardly surprising that there is a sizable market for the technologies. In contrast, we have seen that the economics of PV projects are not compelling in a payback sense when compared to the 4-year payback lighting projects with which the ESCO industry is comfortable. We have also seen that activity is brisk despite this. How can this be so? For one thing, no one uses simple payback to sell a PV project. Some benefits that are commonly used to sell PV are:

- Utility cost savings
- Reduced exposure to price volatility
- Reliability
- Low maintenance
- No emissions
- Output coincident with highest power prices
- Public relations value
- Fulfilling organizational goals

Some of the less obvious and more compelling methods for justifying PV projects are presented below.

Fulfilling Corporate or Agency Sustainability Goals

SG projects can go beyond simply reducing operating costs and can help meet the goals of an organization. More and more corporations and public agencies are establishing sustainability goals, commitments, guidelines, and policies. Johnson and Johnson, for example, has a goal of reducing its carbon dioxide emissions to a level 7% below their 1990 levels. The cities of San Francisco and recently San Diego have made high-profile commitments to increasing their use of renewable energy. Installing a small PV system on the roof of the new firehouse, or a 1 MW system on the roof of a convention center in San Francisco's case, is a tangible way for them to show that they are doing their part.

For better or worse, PV is seen as more of a contributor to sustainability goals than are energy efficiency measures or CHP. With their low emissions, fuel cells are viewed as nearly as green as PV, but microturbines and particularly reciprocating engines are a much lighter shade of green to most customers.

A Hedge against Price Volatility

PV offers a way to reduce the customer's exposure to future price volatility. Installing a PV system is effectively prepaying a portion of your future electricity use at a known price. The volatility in the total utility cost for the facility is thus reduced [19].

The power of this concept is perhaps not evident to those of us accustomed to thinking in terms of paybacks and rates of return. It can, however, be a powerful selling point for the person responsible for paying and budgeting for next year's utility budget. The utility bills for a large hotel in California increased 80% after the 2001 crisis. This is not a California-only phenomenon. Presumably, thousands of energy managers went to their CFOs, school boards, or county boards of supervisors, blamed the bad news on Pete Wilson or Gray Davis, and requested increases to their budgets. The crisis-like conditions allowed these people to rightfully claim that the increases were largely unforeseen. Should they go back to the board with the same story in two year's time, however, they may worry that they will be less well received.

This same argument is seldom made for energy efficiency installations though it is no less true for energy efficiency measures than for PV. Perhaps it is the generating nature of PV that encourages buyers to think in terms of the price of generated power more than the price of saved power.

Dividing the installed cost of a PV system by the lifetime energy production yields costs of produced power less than $0.10/kWh in the hypothetical installation described above. This price compares favorably with the current cost of utility power in these states and is a reasonable price to "lock-in" for a portion of their electricity needs.

Presenting the Cost/Benefit for PV

SG project developers have several choices for presenting project economics including:

- Simple payback
- Cost of produced energy
- Net cash flow forecast
- Life cycle cost
- Net present value

According to several salespeople, simple payback is used as little as possible when selling PV. It is necessary to be able to discuss it, because operations-level personnel want to know it. It is the metric with which they are familiar, but financial decision makers rely on it much less heavily. The measures that successful developers seem to rely on most commonly are cash flow projections and estimates of the cost of produced power. Cost of produced power is particularly useful for marginally cost-effective projects. Demonstrating that a project's cost of produced power is lower than the utility tariff shows only that there are savings, not that the project provides an attractive return on invested capital. However, many people are apparently comfortable with paying the same price for clean power as they were paying the utility, even if they have to pay more initially to pay off the equipment.

COMBINING PV AND EFFICIENCY PROJECTS

One ESCO interviewed for this article has recently completed several projects involving PV. All of them combined energy efficiency and PV. There are several reasons why this approach makes sense. If a customer is interested in a long payback item like PV, there is an obvious benefit to packaging the measure with shorter payback measures like lighting in order to improve the economics of the project. There are also several less obvious reasons to combine PV and efficiency. In fact, relatively long-payback solar projects can actually help sell more cost-effective but more mundane efficiency projects.

Increased Project Size

Many of the costs associated with developing a performance contracting project are independent of the number of energy conservation measure (ECMs) and the cost of the package. Adding a SG project to an energy efficiency-based performance contract increases the total value of the project. In most cases, both the customer and the ESCO are better off with a larger capital project since the development costs can be spread more thinly.

Justifying Longer Loan Terms

Many customers are reluctant to extend the term of a loan for more than 10 years to finance traditional efficiency projects. Customers may be willing to consider longer terms for PV, largely due to the longer expected service life of the equipment [2]. With up to 25-year warranties on the PV panels, a 15-year loan term is not unreasonable. Increasing the loan term of a combined efficiency and PV project over 15 years offers substantial cash flow benefits.

The benefits of this approach are examined in the following hypothetical example. The base case is a typical energy efficiency performance contract project with a $1M installed cost, a 4 year simple payback, and a 10 year loan term. We wish to consider the impact of adding a 100 kW solar PV system. The loan term for the combined project has been increased to 15 years. The economics do not consider tax implications.

Table 5. Impact of Increased Loan Term

Performance Contract Options	*Annual Electricity Cost Savings*	*Initial Cost*	*Simple Payback*	*Annual Loan Payment*	*Net Cash Flow*
Efficiency Projects	$200,000	$1,000,000	5	$142,400	$76,600
PV Project	$12,400	$256,500	21	$28,200	($13,900)
Combined	$212,400	$1,256,500	6	$138,000	$106,900

The net cash flow is higher in the combined project than in the efficiency project alone. This is despite the very long simple payback period of the PV project. The improved cash flow is a result of the longer loan term, a longer term that may be justified by the inclusion of the PV.

Increased Attention from Decision Makers

It can be hard for a controls and lighting upgrade to get the interest of senior decision makers. SG gets attention. It is commonly accepted that a project has to have a "champion." Typically this has been an energy manager or facility manager who then coordinates approval at higher levels in the organization. With PV, there is often a higher-level champion. The owner of the company or a board member is more likely to become personally interested in the project when a technology like PV or a fuel cell is involved. Even a higher level champion, though, is typically constrained by organizational financial hurdles, and combining PV with more cost effective efficiency opportunities gets the total project over this hurdle.

THE OUTLOOK FOR SHORTER PAYBACKS

There has always been a lot of talk in PV circles about how prices fall as production increases. Indeed, the installed cost of a system is now only about 10% of the cost in 1975 [21]. Dan Shugar of Powerlight estimates that installed costs of PV systems will drop by 50% in 6 years and by 75% within 12 years [22]. If this holds true, decreasing costs will quickly allow for 10 year paybacks on PV projects in California without the current 50% incentive and will eventually drop post-incentive paybacks to the 10 year range in many states.

All SG technologies stand to gain from ongoing efforts to reduce the substantial time often required for the interconnection and permitting processes. As ESCOs gain experience with the technologies and increasingly combine their marketing with energy efficiency efforts, it may also be possible to reduce the substantial development costs.

SUMMARY

ESCOs should consider adding SG technologies to their portfolio of project options if they have not done so already. Large markets are projected for the technologies and ESCOs are positioned to play a significant role. More than with energy efficiency measures, determining the feasibility of the technologies for a given customer requires a careful examination of local incentives, requirements, and barriers. Selling the technologies may also require a different set of justifications than are used for the typical ESCO project.

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