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BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking Regarding Policies, Procedures and Rules for the California Solar Initiative, the Self-Generation Incentive Program and Other Distributed Generation Issues.	Rulemaking 10-05-004 (Filed May 6, 2010)

COMMENTS OF TECOGEN INC. ON STAFF PROPOSAL REGARDING MODIFICATIONS TO THE SELF-GENERATION INCENTIVE PROGRAM

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In accordance with the September 20, 2010 Administrative Law Judge's Ruling ("ALJ's Ruling") Requesting Comments on Staff Proposal Regarding Modifications to the Self-Generation Incentive Program ("Staff Proposal"), Tecogen Inc. is pleased to submit these comments.

1. Introduction

Tecogen is a leading national manufacturer, installer, and servicer of small, "microengine"-based combined heat and power ("CHP") packages and gas engine-driven chillers, founded in 1982, with headquarters in Waltham, Massachusetts.

Tecogen is a member of the California Clean DG Coalition ("CCDC") and fully supports CCDC's comments in this proceeding, but wishes to provide additional perspectives through these separate comments.

Tecogen's CHP customers are primarily public or non-profits end-users. They include small commercial and institutional users, such as schools, hospitals, nursing homes, residential apartments, YMCA's, athletic clubs, municipal pools, retirement communities, and colleges. Such small customers have steady electrical and thermal loads. They use CHP to reduce their operating costs and carbon footprints. In this proceeding, Tecogen is attempting to address issues related to our customers' use of CHP distribution generation.

Tecogen's small microengine-based CHP modules are available in sizes of 60, 75, and 100 kW. They are modular, so are occasionally installed in multiples to make systems as large

as 500 kW. Tecogen has over 1000 installations throughout the United States, including many in California. Tecogen maintains an established service infrastructure throughout the United States, staffed by trained factory service technicians.

Tecogen is directly or indirectly responsible for many jobs in California. These include those employed full-time at its factory service offices in Northern and Southern California, as well as those of people it works with, such as installing contractors, salespeople, consulting engineers, energy service companies, and third-party maintenance providers.

The high overall capacity factors and operating efficiencies actually being realized by these systems in the field demonstrate the reliability of microengine-based CHP systems, when properly applied and serviced. Their success also shows the benefits of implementing CHP at sites that have consistent thermal profiles and of sizing conservatively.

2. <u>A utility GHG emissions benchmark consistent with other programs should be used</u>

We believe that the utility power plant and system T&D GHG benchmarks used in SGIP should be consistent with those used in other programs (including the recently concluded QF settlement, CPUC-sponsored energy efficiency programs, AB 1613 process, renewable programs, etc.). To do otherwise would send an inconsistent message, and skew policymaker and customer decision-making.

The Commission should not hold SGIP to a higher standard than is applied under other programs. The same assumptions that are used elsewhere should be used in SGIP (e.g., regarding CO_2 per MWH emitted by the default utility system). Everyone should be using the same yardstick. Applying a different, harsher GHG standard to SGIP alone is illogical and unfair.

3. <u>SGIP technology definitions should be expanded or amended to address microengines</u>

IC engines cover a diverse range of applications, based on sizes from 25 kW to 2500 kW, rich-burn and lean-burn, turbocharged vs. non-turbocharged, etc. The most meaningful and accurate differentiator is size, however, which does a pretty good job of capturing all of the above distinctions.

We recommend therefore possibly creating a separate technology category in the SGIP (or at least a subcategory within engines) called "microengines" (i.e., those sized under 200 kW, or maybe under 500 kW).

This would be similar to what has been set up in SGIP for microturbines, so there is precedent for this kind of distinction in SGIP. Microengines can be differentiated from larger engines in SGIP, similar to how microturbines have been differentiated from larger gas turbines. Microengine systems also employ emerging technology, and differ from larger engines in key respects: capacities, technology, packaging, economics, market penetration, application types, level of technological maturity, etc. Microengine issues are not always addressed accurately when they are lumped together with much larger engines, so some separate evaluation is warranted.

4. <u>IC engines should again qualify for SGIP</u>

The report erroneously evaluates all types of IC engines, large and small. It mistakenly calculates an overall IRR for engines that is too high to qualify for SGIP, and GHG reductions that are too low to qualify (especially for what it calls "rich-burn" engines).

With the proper assumptions used instead, the IRR for all engines (including microengines) will fall below the required 15% maximum presented in the report, like the IRR's for most of the other technologies.

Similarly, with the proper assumptions, GHG savings can be proven for all types of engines (including microengines). The GHG reductions that are achievable by all IC engines are at least as positive as those calculated for most if not all of the other technologies listed.

a) <u>IC engines truly have a need for incentives (staff report's IRR analysis is faulty)</u>

We first wish to state we support the view of CCDC and numerous participants at the November 1 workshop that applying a 15% IRR cutoff, as the staff proposes, is not realistic. Numerous market studies (and our years of project experience) have taught us that delivering a 6-year payback will not result in much market activity. A customer payback of 3-4 years is a much more realistic requirement, given perceived risks, market barriers, competing measures, and scarcity of capital.

Secondly, the staff's report grossly mischaracterizes the economic return (IRR) for IC engines. The report calculates an IRR of 15.98% for IC engine-based CHP, which the report also says should make engines ineligible, based on the (somewhat arbitrary) 15% maximum IRR cut-off.

However, many flawed economic assumptions were used in the staff's analysis. The true IRR for IC engine CHP does not exceed 15%, contrary to the staff analysis. If valid assumptions are used instead, the IRR for engine-based projects drops to well below 15%, especially in the case of small "microengine" systems. Therefore, IC engine systems should again become eligible, using the report's criteria.

As supporting documentation, Attachment A provides specific recommendations as to how the staff's financial analysis tool should be modified to incorporate corrected inputs.

Attachment B provides "case study" data from nine (9) actual existing small IC engine CHP projects. This detailed historic project data is consistent with our recommendations.

Invalid assumptions used in the staff report include:

- Installed cost ($/kW) – The report assumes a uniform installed cost of $2322/kW for all IC engine systems. However, for "microengine" systems (e.g., <500 kW) in particular, actual installed costs are much higher than this, typically around $3200/kW.

  Note that this microengine installed cost figure is nearly identical to that used in the staff report for microturbines ($3293/kW).

  The above figures are consistent with the prior SGIP cost data for microengine and microturbine systems in this size range. The SGIP installed cost data summarized by Itron previously showed that historic installed costs for both microengines and microturbines in the size range of 30-100 kW were approximately $3500/kW. In the size range of 101-500 kW, installed costs were approximately $3000/kW for both technologies.

- Avoided electric rate – The report assumes that CHP systems will offset an unrealistically high rate of $.118/kWh, which the report says was chosen to approximate PG&E's A-10 schedule. However, virtually none of the technologies

under consideration for SGIP would be installed at sites so small that this would actually be the normal applicable rate schedule. Instead, a rate such as PG&E's E-19 or E-20 (applicable to customers with demands >500 kW) would be the most common electric rate in effect at CHP sites. This is true for large gas turbines, large IC engines, and large fuel cells, and even for the majority sites that use the smaller microengines or microturbines. The report's IRR calculations therefore should have used a figure that's closer to $.095/kWh as the offset electric rate. This is a sample annual weighted average energy charge, without demand included, since demand savings are not always realized. By selecting an incorrect rate schedule, the report has overstated the value of electric generation for all the technologies in its IRR analyses.

- Investment tax credit – The report's IRR analyses assume that all CHP projects receive a 10% federal investment tax credit, including those using gas turbines, microturbines, and large and small IC engines.

  However, in our real-world experience, very few CHP projects are actually able to take advantage of this tax credit. The ITC should therefore not be figured into the IRR calculations for CHP systems involving engines, turbines, microturbines, or microengines (i.e., 0% should be assumed). This is because most CHP systems (and nearly all the small ones) are installed at facilities that simply cannot take advantage of the tax credit (such as government, schools, colleges, hospitals, nursing homes, YMCA's, community centers, athletic clubs, apartments, etc.).

  It is worth clarifying that certain other DG technologies (e.g., solar, wind, and fuel cells) are also eligible for tax credits, but theirs are much larger tax credits, at least 30%. This higher percentage of subsidy, coupled with those technologies' higher first-costs on a $/kW basis, means the absolute sizes of the tax credits (in dollars) available for those technologies are much larger. In fact, the tax benefits for these other technologies are large enough that they routinely attract third-parties who own and operate those projects for an otherwise ineligible owner on a "PPA" basis. The third-party is able to "harvest" the huge tax benefit windfall.

By contrast, with most CHP systems, the lower ITC percentage and project cost ($ per kW) has meant that third-party-ownership to capture the tax benefits has not caught on. The transaction costs and perceived disadvantages of third-party ownership are simply too high, relative to the small potential tax credits.

An invalid assumption has again been used in the report, which causes it to calculate an IRR for IC engine-based CHP that is unrealistically high, especially for small projects.

- Standby charges and departing load charges – The report's IRR methodology omits several significant expenses that must be paid by most if not all CHP projects. Specifically, the cost for any applicable standby charges and non-bypassable departing load charges should both be included in the report's IRR analyses. Together, these charges together can often exceed 1.5 cents/kWh for actual CHP end-users. For reference, detailed "case study" data on nine (9) actual small IC engine CHP projects is provided in Attachment B. These examples illustrate the magnitude of these two types of charges, which amount to approximately $0.011/kWh for departing load charges and $0.004/kWh for standby charges. These charges eat significantly into a site's net annual cash flow, and reduce the IRR for CHP projects. They are not inconsequential, so should be added as a line item in the staff's IRR spreadsheet. Certain technologies (e.g., solar, wind, fuel cells) may be exempted from paying some or all of these charges, but CHP is not, so this ongoing operating expense should be used in the report's IRR calculations.

- Separate IRR analysis is needed for smaller engines – The report concludes that all engines should be ineligible for SGIP, because the staff's model calculates an IRR of 15.98% for IC engines, just slightly above the staff's proposed 15% cut-off. However, this conclusion was based solely on a single staff analysis of a large 800-kW lean-burn engine. No analysis is given in the report for the IRR of a smaller engine, or what the report calls a "rich-burn" engine. If proper assumptions are used for a smaller engine case, the IRR will come out to well below 15%, and demonstrate a true need for an incentive. Two separate analyses (i.e., for two types of engines),

were run when evaluating their relative GHG emissions impacts (as discussed below), but only one type of engine was run in the economic case. This should be corrected.

b) <u>IC engines do truly reduce GHG gas emissions (staff report's analysis needs revision)</u>

As with the IRR calculations discussed above, we believe the staff report mischaracterizes IC engines in its GHG analysis, and draws a misleading conclusion about IC engines.

Provided in Attachment A are our specific recommendations on how the staff's GHG analysis tool should be modified to include different inputs.

First, we re-state our belief that a GHG benchmark consistent with what is used in other CPUC proceedings should also be used in SGIP. If the same yardstick that is used here, many of the SGIP technologies under consideration will show significant GHG reductions.

Even if we do use the stricter, new GHG benchmark that the staff proposes in its report to only apply to SGIP, the report concludes that GHG reductions are obtainable at least from what it calls "lean-burn" IC engines.

Unfortunately, the report claims that "rich-burn" type engines do not deliver GHG emissions reductions. However, we note that "rich-burn" engines just barely missed in the staff's analysis. (Note: Please see comments below regarding this "rich-burn" terminology; we believe that "small IC engines" or "microengines" would be a more accurate term.)

The staff's GHG analysis calculates that an overall efficiency of 62.7% is needed for "rich-burn" engines to achieve GHG reductions, whereas the staff report used a minimum standard for all CHP technologies of 62.0%. This means that rich-burn engines failed by just 0.7% of overall efficiency, less than one percent.

If the required minimum overall efficiency applicable to small engines is raised just slightly (for instance, to 64%), then all engines will yield positive GHG savings. We can support application of a slightly higher standard like this to ensure GHG reductions, since most properly applied small IC engine CHP projects operate at overall efficiencies well above this anyway.

This means that *all* types of IC engines should be able to deliver significant and positive GHG reductions to SGIP. Using corrected assumptions and a raised standard, engines of all sizes and types can be shown to reduce GHG emissions.

This change would also reflect more accurately how different types of engines are used in CHP applications. Electrical efficiency of engines varies somewhat by type, and type generally correlates with size. What is important to note is that engines that have a lower electrical efficiency at the same time often have a higher percent heat recovery (as in the case of small engines), so they can actually achieve higher overall efficiencies.

For simplicity and to lower maintenance costs, most small engines tend to be non-turbocharged. Non-turbocharged engines often have lower electrical efficiencies than larger turbocharged engines. (Note that size is a more meaningful way of differentiating engines than is distinguishing by "rich-burn" vs. "lean-burn" type, as the report does.) The good news is that smaller non-turbocharged engines also tend to maximize their heat recovery.

In fact, if applied properly, small engines can achieve the highest overall system efficiency of any CHP technology (i.e., >81% on HHV basis, or >91% on LHV basis). Microengines can have overall CHP efficiencies that are higher than large gas turbines, microturbines, and large IC engines.

Relative to large gas turbines, the electrical efficiency of small engines is fairly similar or a little lower, but small engines also are often able to achieve greater levels of heat recovery.

And, relative to microturbines, small non-turbocharged engines achieve both higher electrical efficiency and higher thermal efficiency. Small engines achieve electrical efficiencies around 27%, which is higher than those of microturbines (e.g., 25.3%), on an equivalent HHV basis. At the same time, small engines achieve higher heat recovery than microturbines (e.g., 55% recoverable heat for microengines, vs. 47% for microturbines). Together, this means microengines achieve higher overall efficiencies than microturbines do (e.g., 82% total for microengines vs. 72% for microturbines). Microengines provide both more electricity, and more heat recovery, per unit of fuel input than microturbines do.

5. IC engines should be included in SGIP on a "pre-approved" basis (or on a "product-specific" basis at a minimum)

Despite the efficiency advantages of microengines described above, the staff report presents some flawed logic: it provides a route for microturbines to gain product-specific approval in the new SGIP ("on a per product basis"), yet does not do the same for the more efficient microengines. This should be corrected.

At the November 1 workshop, staff explained that the only reason its report did not mention that the product-specific approval route would also be applicable to IC engines was because the report had concluded that IC engines would be ineligible for SGIP (again, since staff's calculated IRR came out barely above 15%). Staff reassured workshop participants that the report's (flawed) IRR calculations would be fully reevaluated and, once that was complete, the logic about which technologies are eligible for product-specific approval would be fairly and consistently applied. Verbally, staff singled out IC engines for this reconsideration specifically, which we appreciate.

Preferably, small engines should again be included with all other engines in the SGIP program on a "pre-approved" basis. We believe this is justified, based on their ability to meet the three criteria presented in the staff report, namely: the need for incentives, positive GHG savings, and cost-effectiveness.

At a minimum, IC engines should be allowed to submit for product-specific approval, similar to what the report proposes for microturbines.

It is also critical that such product-specific approval process be kept reasonable and simple. The cost and complexity of obtaining an approval must not overwhelm good projects and applications or the magnitude of the incentive.

6. Applying a higher overall efficiency standard to all technologies may be acceptable, if necessary to ensure GHG reductions

We believe it would be acceptable for SGIP to apply a higher overall system efficiency standard to *all* types of CHP (i.e., including fuel cells, large turbines, large IC engines, microturbines, and microengines) than 62%. This will ensure that all technologies truly reduce GHG emissions. The SGIP could even apply slightly different higher standards to each technology, as each needs to assure GHG reductions.

7. **Hybrid performance-based incentive concept is acceptable, but some changes may be warranted as further details become known**

We support the adoption of a "hybrid" performance-based incentive (HPBI) conceptually similar to what has been proposed in staff's report. Many program details have yet to be defined, of course. The final result could therefore be good or bad, but we support the initial concept at least. A hybrid type of incentive structure will lessen the upfront capital requirements for owners, and ensure they continue to operate their systems efficiently over the long-term, two essential goals.

One suggestion we have would be to increase the initial proportion of the incentive from 25% to 50-60%, to make a bigger impact on owners' decision-making. Upfront capital requirements remain the biggest hurdle for most of the cash-strapped governments and non-profits we work with.

8. **An extended period for earning the HPBI should be allowed for highly efficient projects that have low capacity factors**

We believe that capacity factor is an imperfect indicator of a project's GHG reductions in Years 1 to 5 and beyond. This is because many CHP systems are designed from the start to maximize their efficiency, rather than their runtime, by carefully matching CHP operation with the end-user's thermal requirements.

A CHP project that always operates with maximum thermal utilization like this will have the highest possible efficiency (CHP's "sweet spot" for GHG reductions), but it may also have a lower capacity factor (e.g., <80%), if customer thermal loads are seasonal or variable.

Since the goal of SB 412 is GHG reductions, the emphasis in SGIP should be on overall efficiency and not so much on capacity factor. Capacity factor and GHG reductions do not necessarily correlate. While CCDC supports the hybrid PBI concept, we caution that capacity factor is an imperfect way to measure a system's effectiveness as far as GHG reductions go, so are is an imperfect basis for awarding incentive dollars in Year 1 to 5. A plant that runs 60% of the year at 80% efficiency may deliver more GHG reductions (certainly it does on a per kWh basis) than a plant that operates 80% of the year at 60% efficiency. The new SGIP should therefore not be overly reliant on capacity factor targets, or it will inadvertently incentivize sites to operate additional hours without heat utilization, simply to raise their capacity factors.

As a partial solution, we support one concept that was raised at the workshop. We support the idea that sites that achieve excellent overall efficiencies, but that have capacity factors below 80%, should be given an extended time period to earn their PBI incentive. If a site elects to operate its systems only at its maximum efficiency (which might depress its capacity factor somewhat), the site should not be punished. The site should be able to earn its incentive over a 6 or 8 year period, if the full amount has not been earned yet within 5 years.

Again, if this is not allowed, sites that have excellent efficiencies but capacity factors lower than the target will install heat dump capability, to allow them to operate even when site thermal loads are satisfied (while taking care to still keep the system's annual overall efficiency above the minimum required, of course). This does not seem completely desirable.

In reality, we believe that the GHG savings realized are as much a function of the CHP *application* as they are of the product used. In other words, GHG benefits are project-specific as much as product-specific. A less efficient product that gets used in an ideal CHP application can actually deliver more GHG savings than a nominally more efficient product that is applied poorly (e.g., with lots of heat dumping).

Raising the overall efficiency standard, and allowing sites an extended time if needed to earn their full incentive as mentioned above, will keep projects oriented toward maximizing their GHG reductions, consistent with the goals of SB 412.

Another important distinction to keep straight is between capacity factor and availability. We believe that underperforming projects are actually characterized by low availability, not necessarily by low capacity factor. Low availability means the system is broken and not able to run if called upon. By contrast, a sample system that is kept in tip-top shape, well maintained and highly efficient, would have a very high availability, even if it directed to run only 2/3 of the time. This may be the most efficient way to run the plant, in response to thermal loads.

Another way the SGIP could address these issues would have the HPBI in the years after startup simply equal 1/5 of the remaining incentive during each of the 5 years. The HPBI would be received provided the system is able to demonstrate it has achieved a high availability during the year and met the minimum annual overall efficiency required by SGIP.

9. <u>Convert M&O dollars into actual incentives</u>

The report acknowledges that certain "barriers" exist that make deployment of CHP in California difficult, as almost anyone active in the CHP industry (large and small) can confirm. The report recommends expanding the Commission's "Marketing & Outreach" (M&O) efforts to "identify and address" these barriers.

The report specifically encourages the Commission "to consider providing non-incentive support of highly-efficient, small CHP".

We appreciate the acknowledgement that barriers exist, and especially that highly efficient small CHP is worthy of support in particular. However, we believe that such M&O activity would not have much impact in the marketplace. We feel that far more tangible results will be achieved when project owners receive actual incentives for choosing to install efficient CHP systems in their facilities. Separate Commission efforts to remove barriers could still be quite worthwhile, of course, it's just that they should not substitute for restored incentives.

10. <u>The new SGIP should remain focused on GHG reductions, but all the CHP technologies provide low NOx emissions as well.</u>

The report notes that "microturbines may have advantages over other combustion technologies in terms of producing fewer emissions of NOx and other criteria pollutants". The report then mentions SB 412's focus on GHG gas emissions reductions.

We support the staff's focus on GHG reductions, consistent with SB 412.

However, we wish to clarify that *all* the SGIP technologies (including large turbines and all sizes of engines), and not just microturbines, deliver very low emissions of NOx and other pollutants. Pollutant emissions are fairly comparable from all these technologies. Extremely low NOx levels have historically been a requirement of SGIP participation as well. So the distinction mentioned in the report regarding microturbines is not meaningful.

11. <u>Proposed energy audit requirement is unnecessary and should be eliminated from SGIP</u>

The staff's proposal that a customer must obtain an energy efficiency audit before receiving an SGIP incentive presents yet another unnecessary and costly obstacle to the implementation of efficient CHP.

First, most CHP end-use customers are already very efficiency oriented. Most have already received various types of facility energy audits and given their recommendations serious

consideration. A visit to any such building will reveal quickly that most have already evaluated and implemented a wide variety of efficiency measures during the past 25 years. Requiring a redundant audit now as an eligibility requirement for SGIP would serve no useful purpose for such customers.

It is also worth noting that, after the new hybrid PBI concept is in place, CHP project designers will have a greater incentive to size their CHP systems conservatively, e.g., to meet the lesser of electrical and thermal loads. Planning to serve with CHP waste heat a thermal load that could go away someday will not be rewarded by SGIP. Responsible CHP project owners already size their systems to take into account potential reductions in load due to additional future efficiency measures. The proposed new SGIP incentive structure provides sufficient additional assurance of this.

Since efficiency is highest in the loading order (where we agree it belongs), by the staff's logic, a new overall energy audit should be a pre-requirement of literally every other incentive program offered by utilities, including load management, demand response, solar water heating, etc. This obviously is not practical and we don't believe it is being consistently applied.

We support efficiency – that's what small CHP is about, after all. We do not agree that having SGIP requiring costly additional energy efficiency audits will result in notable changes in the size of CHP systems and improved efficiency. An audit requirement is just a new barrier, one we have not seen before. If anything, we feel the extra hassle and audit expense imposed on customers may actually discourage some sites from implementing efficient CHP, so the audit requirement could actually undermine the goal of efficiency. Since it creates a needless and complicated new barrier, we request that the Commission remove the staff's proposed requirement for a costly energy efficiency audit as a pre-condition of receiving SGIP incentives.

12. <u>Metering requirements should be kept reasonable and appropriate for a project's size and type</u>

The type and complexity of the metering required under the SGIP should scale with the size of the project. Otherwise, at least for small projects, much of the incentive will get eaten up simply by metering costs. The sample metering costs shown would be a huge burden for small projects. For instance, the staff report shows:

Tariff-related	$ 1,439
Electricity output	$ 4,300
Waste heat output	$ 17,000
Fuel input	$ 7,500
Total	$ 30,239.

This level of metering expense would eat up a big chunk of any incentive that a small customer receives. The cost of metering should not swamp/ overwhelm the amount of the incentive, of course.

As just one dramatic example, suppose that a sample efficient 60-kW CHP project gets an SGIP incentive of $600 to 1000/kW (please note that this is just a placeholder amount, for illustration purposes only; we would actually recommend a larger incentive rate, including an adder for small projects, as proposed by CCDC in January). This would work out to a $36,000 to $60,000 incentive for this hypothetical customer. Under the staff's proposed hybrid PBI structure, only 25% of the total incentive would be available in the first year, or $9,000 to $15,000. This first-year incentive amount would not even cover the initial metering costs, which are 2 to 3 times larger. This incentive amount would literally leave nothing to help reduce the actual project cost in the first year.

As a solution, the SGIP should allow applicants to install types of metering that are appropriate for the project type and size. The type of metering required by the SGIP should not be prescriptive and "one size fits all". Several types of perfectly adequate metering solutions exist that are technically valid and reasonable in cost and should be allowed.

As an example, in the case of thermal metering for smaller projects (e.g., <500 kW), it should be sufficient to perform a one-time verification measurement of the water flow rate, used in conjunction with ongoing readings from various temperature sensors, to provide annual thermal utilization data. Such temperature split data can be regularly logged by a microprocessor. This should suffice in lieu of installing actual Btu meters at every site. Based on our years of project experience, we have found Btu meters often to be expensive, difficult to keep in calibration, failure-prone, and maintenance-intensive. Instrumentation that is expensive to install and maintain and gives unreliable data over the long haul would not seem to be a good

investment for either the customer or the SGIP program, especially when more practical and affordable alternatives exist.

SGIP should also not require that electrical, thermal, and/or fuel use be tracked in 15-minute increments, especially for smaller CHP sites. We note that the utility's "Net Generation Output Meter" (installed at the CHP customer's expense, to help the utility assess the customer for departing load charges) that is typically installed on most CHP projects in California is not required to provide the utility with 15-minute interval data. The SGIP should not require a whole separate electric meter to do that either.

Cumulative data-logging and annual reporting, based on existing and reasonable metering, should be sufficient to verify annual compliance with SGIP efficiency requirements, at least for small projects. This would impose less of a first-cost, maintenance, and administrative burden on all parties, and better match the needs and characteristics of smaller projects.

13. Natural Gas IC Engine-based CHP appears to be highly cost-effective on a TRC basis, based on Itron's preliminary analysis

To determine a technology's eligibility for future SGIP incentives, the staff in its report proposes to apply three tests to each technology. One test is "cost-effectiveness" which we have understood to mean the Total Resource Cost (TRC) test. At the November 1 workshop, Itron presented the preliminary results from its SGIP cost-effectiveness model.

Based on these initial Itron results, natural gas IC engine CHP appeared to achieve very high TRC marks, with Societal TRC's well greater than 1.00 (e.g., TRC's of 130% or higher, in fact).

By contrast, we notice that certain other technologies, such as natural gas-fueled electric-only fuel cells and energy storage, did not pass the TRC, according to Itron's initial results. Given that these other technologies may not even involve generation (as in the case of stand-alone energy storage, which may in addition already be eligible for other load management and demand response programs), we would recommend that SGIP funds be reserved for efficient and deserving generation technologies, including IC engine CHP, which can satisfy the staff's three proposed criteria and are more consistent with the original intent of SB 412.

14. Conclusion

Tecogen appreciates the opportunity to submit these comments to the Commission for its consideration, in particular on behalf of our small non-profit and government customers. Tecogen respectfully requests that the Commission adopt these recommendations for SB 412 implementation.

TECOGEN Inc.

By: William R. Martini /s/
William R. Martini

DATED: November 15, 2010

ATTACHMENT A

Input Assumptions for SB 412 GHG Analysis

Avoided GHG Emissions Rate		
CHP	**349**	
Storage (Charging)	**368**	
Storage (Discharging)	**567**	
T&D Line Losses	**7.8%**	
Conversion Factors	117	lbs. CO2 Equivalent/MMBTU
	0.05317	Tonne CO2E/MMBTU

Avoided GHG Emissions Rate Background		
Description	**Avoided GHG from Grid**	**Source**
	Kg/MWh	
BAU Avoided Emission Rate including 20% renewables (applicable to demand side programs)	**349**	**AB 32 Scoping Plan, modified by CPUC staff for customer generation**
ARB BAU Avoided Emission Rate	437	AB 32 Scoping Plan
Gas CCGT Emissions factor	368	MBCS staff review of AB 32 Scoping Plan Goals (from E3 GHG calculator)
Gas CT Emissions factor	575	MBCS staff review of AB 32 Scoping Plan Goals (from E3 GHG calculator)
Other	0	User defined

Natural Gas Fueled Distributed Generation

Generator Assumptions

Capacity Factor	80%
Electrical Efficiency Degradation	1%

Technology	Capacity (MW)	Electrical Efficiency (HHV)*	CHP Efficiency - AB 1613 (HHV)	GHG Reducing (Y/N)	Industry Est. CHP Efficiency (Reference Only)
Electric-only Fuel Cells	0.100	51.6%	0.0%	**Yes**	0
Fuel Cell CHP	1.000	37.9%	62.0%	**Yes**	NA
Gas Turbine	10.000	29.0%	62.0%	**Yes**	68.7%
Rich Burn Engine	0.100	27.1%	64.0%	**Yes**	81.0%
Lean Burn Engine	0.800	35.0%	62.0%	**Yes**	79.0%
Microturbine	0.065	25.2%	62.0%	**No**	71.5%
Combustion CHP Average	2.741	29.4%	62.0%	**Yes**	75.3%

Grid/Avoided Boiler Assumptions

GHG Emissions Factor (E)	349	Kg/MWH
T&D losses	7.8%	
Avoided Boiler Efficiency	80%	

Better category name to use would be "Small IC Engine-CHP" (or "Microengine-CHP")

Staff's original GHG spreadsheet concluded that overall efficiency of 62.7% would be needed for "rich-burn engine" to achieve GHG reductions, so it barely failed using a 62% standard.

If the required mimimum overall efficiency is raised just slightly (e.g., to 64%), GHG savings are shown.

Rich Burn Engine

Technology	Year	Capacity MW	Electrical Efficiency* %	Total System Efficiency (CHP only) %	Heat Rate Btu/kWh	Generation MWh	T&D Avoided MWh	Total Electricity Avoided MWh	Emissions Avoided (E) Tonne CO2E	Fuel Input MMBTU	Natural Gas - GHG Conversion Tonne/MMBTU	Emissions Produced Tonne CO2E	Heat Recovered MMBTU	Heat Recovery Rate MMBTU	Emissions Avoided (H) Tonne CO2E	Net Emissions Reduction Tonne CO2E
Rich Burn Engine	1	0.1	27.1%	64.0%	12,326	701	55	756	263	8,623	0.05317	458	3,256	50.0%	216	19
	2	0.1*	26.8%	64.0%	12,718	694	54	752	262	8,623	0.05317	458	3,288	50.5%	218	19
	3	0.1*	26.6%	64.0%	12,846	687	54	745	260	8,623	0.05317	458	3,303	51.0%	220	19
	4	0.1*	26.3%	64.0%	12,976	680	53	738	257	8,623	0.05317	458	3,327	51.3%	221	18
	5	0.1*	26.0%	64.0%	13,107	673	57	730	255	8,623	0.05317	458	3,350	51.3%	223	18
	6	0.1*	25.8%	64.0%	13,238	666	56	723	252	8,623	0.05317	458	3,373	51.5%	224	17
	7	0.1*	25.5%	64.0%	13,373	660	56	716	250	8,623	0.05317	458	3,396	51.7%	226	16
	8	0.1*	25.3%	64.0%	13,508	653	55	708	247	8,623	0.05317	458	3,418	51.8%	227	15
	9	0.1*	25.0%	64.0%	13,645	647	55	701	245	8,623	0.05317	458	3,441	52.0%	229	14
	10	0.1*	24.8%	64.0%	13,782	640	54	694	242	8,623	0.05317	458	3,463	52.2%	230	13
SubTotal (Sample Project)		0.100	25.9%	64.0%	13,178	6,701	567	7,268	2,536	88,234*	0.05317	4,692	33,606*	51.4%	2,234	76
1 MW		1	25.9%	64.0%	13,178	67,009	5,669	72,678	25,365	882,336*	0.05317	46,916	336,060*	51.4%	22,337	765

*CHP efficiency must be equal to or greater than 62.7% for Rich Burn Engines in order for these technologies to be GHG reducing at given electrical efficiencies

preadsheet:

Create new technology category for Small IC Engine-CHP ("Microengine-CHP").

Reduce ITC for CHP projects from 10% to 0%, to reflect the reality that most CHP projects do not receive ITC, due to customers' non-profit or public tax status, etc. (see comments).

Note: All inputs and assumptions should be manipulated on this tab.

= cells that have been changed

Inputs - Technology Specific		Cost		Federal Investment Tax Credit			Expected Performance			
Technology	Sample System Size (kW)	Installed Cost ($/kW)	O&M ($/kWh)	ITC (%)	Maximum ITC ($/kW)	ITC Eligible Size	Electrical Efficiency	Total System Efficiency	Capcity Factor	Incentive Amount ($/kW)
Wind Turbine	387	$3,096	$0.008	30%			NA	NA	20%	$ -
Fuel Cell - Electric Only	100	$9,608	$0.020	30%	$3,000	> 0.5 kW	46.0%	46.0%	80%	$ -
Fuel Cell - Electric Only (Biogas)	100	$12,108	$0.040	30%	$3,000	> 0.5 kW	46.0%	46.0%	80%	$ -
Fuel Cell - CHP	400	$7,288	$0.030	30%	$3,000	> 0.5 kW	41.2%	62.0%	80%	$ -
Fuel Cell - CHP (Biogas)	400	$9,768	$0.054	30%	$3,000	> 0.5 kW	41.2%	41.2%	80%	$ -
Gas Turbine - CHP	1000	$2,347	$0.020	0%		< 50 MW	29.0%	62.0%	80%	$ -
Gas Turbine - CHP (Biogas)	1000	$4,847	$0.054	0%		< 50 MW	29.0%	29.0%	80%	$ -
Microturbine - CHP	165	$3,293	$0.020	0%	$200		25.2%	62.0%	80%	$ -
Microturbine - CHP (Biogas)	165	$5,793	$0.086	0%	$200		25.2%	25.2%	80%	$ -
IC Engine - CHP	800	$2,322	$0.020	0%		< 50 MW	35.0%	62.0%	80%	$ -
Microengine - CHP	100	$3,200	$0.020	0%		< 50 MW	27.1%	64.0%	80%	$ -
IC Engine - CHP (Biogas)	800	$4,822	$0.054	0%		< 50 MW	35.0%	35.0%	80%	$ -
Organic Rankine Cycle	100	$2,858	$0.010	0%			NA	NA	80%	$ -
Pressure Reduction	100	$3,488	$0.010	30%			NA	NA	80%	$ -

Inputs - General	
Incentive Payment in 1st Year	25%
Incentive Payment Period (yrs)	5
California Adder?	Yes
Discount Rate (%)	5%
Avoided electricity price ($/kWh)	$0.095
Electricity price escalation (%/yr)	2%
Metering Cost - Tariff related ($/yr)	$1,439
Metering Cost - Electricity output ($)	$4,300
Metering Cost - Waste heat ($)	$17,000
Metering Cost - Fuel input ($)	$7,500
NG Cost ($/MMBtu)	$6.20
Hours of operation/yr	8,760
Performance degradation (%/yr)	1%
Avoided Boiler efficiency	80%
kW per Btu	3412
% of incentive paid for 1st MW	100%
% of incentive paid for 2nd MW	50%
% of incentive paid for 3rd MW	25%
Departing Load Charges ($/kWh)	$0.0114
Standby Charges ($/kWh)	$0.0035

Outputs			
Technology	Expected IRR (%)	Simple Payback (years)*	NPV ($)
Wind Turbine	6.41%	11.75	$288,603
Fuel Cell - Electric Only	#NUM!	#REF!	-$565,033
Fuel Cell - Electric Only (Biogas	-14.25%	#REF!	-$602,244
Fuel Cell - CHP	#NUM!	#REF!	-$1,554,251
Fuel Cell - CHP (Biogas)	-13.07%	#REF!	-$1,725,981
Gas Turbine - CHP	-5.28%	#REF!	-$869,208
Gas Turbine - CHP (Biogas)	-7.38%	#REF!	-$2,241,794
Microturbine - CHP	-18.09%	#REF!	-$353,793
Microturbine - CHP (Biogas)	#DIV/0!	#REF!	-$671,900
IC Engine - CHP	-2.34%	#REF!	-$513,292
Microengine - CHP	-14.30%	#REF!	-$233,514
IC Engine - CHP (Biogas)	-7.38%	#REF!	$895,010
Organic Rankine Cycle	23.48%	4.87	$264,756
Pressure Reduction	35.99%	3.84	$341,686

* "#REF!" indicates that the technology will not break even during the expected life

- Using corrected inputs, staff's financial analysis spreadsheet calculates IRR of <<15% for Microengine CHP. This establishes a clear need for incentive.

- IRR's for ALL the other technologies have also dropped here, due to the lower electric rate used. In addition, IRR's for CHP technologies have also dropped due to elimination of 10% ITC.

[Departing load & standby charges have been added to the IRR calculation here for the Microengine CHP case only (i.e., this part of the spreadsheet has NOT yet been updated for other technologies). Including them elsewhere as well would lower the IRR's for other technologies further.]

We believe these metering charges should be reduced, especially for smaller projects (see comments).

Use a lower avoided electricity rate, to reflect the actual type of customer electric rate that is most often offset by SGIP technologies. (For example, change from PG&E A-10 to PG&E E-19/ E-20's annual weighted-average energy-only rate; see comments.)

Add 2 new cost inputs, for departing load charges & standby charges, which CHP projects must pay.

Add 2 new cost lines to spreadsheet, to reflect the departing load charges and standby charges that CHP projects must pay.

Technology Type	Microengine - CHP	Installed Cost ($)	$348,800
Capacity (kW)	100	Installed Cost ($/kW)	$3,200
Incentive Amount - 1st MW ($/kW)	$0	O&M or Warranty Cost ($/kWh)	$0.020
Incentive Amount - 2nd MW ($/kW)	$0	ITC (%)	0.0%
Incentive Amount - 3rd MW ($/kW)	$0	Electrical efficiency	27.1%
Incentive Payment in 1st Year	25%	System efficiency	64.0%
Incentive Payment Period (yrs)	5	Electricity cost ($/kWh)	0.095
Discount Rate (%)	5.00%	Metering Cost ($/yr)	$1,439
Degradation (%/yr)	1.00%	Hours of operation/yr	8,760
Utility price escalation (%/yr)	2.00%	NG Cost ($/MMBtu)	$6.20
Capacity Factor	80.00%	Boiler Efficiency	80%
California Adder?	Yes	Heat Rate	12591
		kW per Btu	3412

Year	1	2	3	4	5	6	7	8	9	10
Electricity generated (kWh)	700,800	693,792	686,854	679,986	673,186	666,454	659,789	653,191	646,659	640,193
Value of avoided electricity	$66,576	$67,229	$67,887	$68,553	$69,224	$69,903	$70,588	$71,280	$71,979	$72,684
NG Consumed (MMBtu)	8,824	8,824	8,824	8,824	8,824	8,824	8,824	8,824	8,824	8,824
Heat recovered (MMBtu)	3,223	3,191	3,159	3,128	3,096	3,065	3,035	3,004	2,974	
Heat recovery rate (%)	50.6[illegible]%	50.11%	49.61%	49.11%	48.62%	48.14%	47.66%	47.18%	46.71%	46.24%
Avoided NG consumption (MMBtu)	4,070	4,029	3,989	3,949	3,910	3,870	3,832	3,793	3,756	3,718
Value of avoided NG	$25,234	$28,368	$28,880	$29,065	$29,322	$29,648	$29,926	$30,234	$30,532	$30,822
Cost of NG Consumed ($)	-$54,707	-$62,119	-$63,884	-$64,943	-$66,178	-$67,590	-$68,913	-$70,325	-$71,737	-$73,149
O&M Costs	-$14,016	-$13,876	-$13,737	-$13,600	-$13,464	-$13,329	-$13,196	-$13,064	-$12,933	-$12,804
Metering Cost - Tariff Based	-$1,439	-$1,439	-$1,439	-$1,439	-$1,439	-$1,439	-$1,439	-$1,439	-$1,439	-$1,439
Metering Cost - Electricity output	-$4,300									
Metering Cost - Waste heat	-$17,000									
Metering Cost - Fuel consumption	-$7,500									
Departing Load Charges ($/yr)	-$7,[illegible]									
Standby Charges ($/yr)	-$2,[illegible]									
1st MW payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2nd MW payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
3rd MW payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
SGIP Incentive Payment	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
California Adder	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
ITC Initial	$0									
ITC	$0									
Cash Flow	($355,952)	$18,160	$17,707	$17,636	$17,466	$17,193	$16,966	$16,686	$16,401	$16,114
Cumulative Cash Flow	($355,952)	($337,792)	($320,085)	($302,449)	($284,983)	($267,790)	($250,824)	($234,138)	($217,737)	($201,623)

Net Present Value	-$233,514
IRR	-14.30%
Break Even (yrs)	#REF!

Cost Forecasts											
Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
NG	$6.20	$7.04	$7.24	$7.36	$7.50	$7.66	$7.81	$7.97	$8.13	$8.29	$8.45
Electricity	$0.0950	$0.0969	$0.0988	$0.1008	$0.1028	$0.1049	$0.1070	$0.1091	$0.1113	$0.1135	$0.1158

Using corrected inputs, the staff's financial analysis spreadsheet tool now calculates an IRR of <<15% for Small IC Engine CHP ("Microengines"). This establishes a clear need for incentive.

ATTACHMENT B

SMALL NATURAL GAS IC ENGINE
SAMPLE CHP PROJECT DATA

(Note: An abbreviated version of this data may also be included with CCDC's comments)

PROJECT #1:	COMMUNITY CENTER, N. CALIF.
System	
Capacity	150 kW (2 Tecogen natural gas 75-kW "microengines" with full heat recovery)
Cumulative Operating-Hours to Date	13,300 run-hours, since Feb 2009 startup
Thermal Loads Being Heated	Domestic Hot Water (DHW), space heat, pool, spas
CHP Operating Mode	100% thermal load-following (0% heat dump)
Actual Capacity Factor to Date	**89% (Note: To maximize efficiency, system is designed to only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	27% HHV (= 30% based on LHV)
Overall Efficiency	**81% HHV (= 90% based on LHV)**
Cost/ financial	
Received Investment Tax Credit (ITC)	No (because customer is non-profit)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$3,200/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E E-19S + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.011/kWh to PG&E
Utility Standby Charges	$4,024/year to PG&E (= approx $.003/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #2:	COLLEGE, N. CALIF.
System	
Capacity	300 kW (4 Tecogen natural gas 75-kW "microengines" with full heat recovery)
Cumulative Operating-Hours to Date	49,900 run-hours, since Dec 2003 startup
Thermal Loads Being Heated	Space heating, pool
CHP Operating Mode	Mostly thermal load-following (limited heat dump)
Actual Capacity Factor to Date	**83% (Note: To maximize efficiency, system is designed to mostly only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	27% HHV (= 30% based on LHV)
Overall Efficiency	**70% HHV (= 78% based on LHV)**
Cost/ financial	
Received Investment Tax Credit (ITC)	No (because customer is govt/ public)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$2,800/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E E-19P + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.011/kWh to PG&E
Utility Standby Charges	$8,017/year to PG&E (= approx $.004/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #3:	HIGH SCHOOL, N. CALIF.
System	
Capacity	75 kW (1 Tecogen natural gas 75-kW "microengine" with full heat recovery)
Cumulative Operating-Hours to Date	30,300 run-hours, since Oct 2005 startup
Thermal Loads Being Heated	Swimming pool
CHP Operating Mode	100% thermal load-following (0% heat dump)
Actual Capacity Factor to Date	**69% (Note: To maximize efficiency, system is designed to only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	27% HHV (= 30% based on LHV)
Overall Efficiency	**81% HHV (= 90% based on LHV)**
Cost/ financial	
Received Investment Tax Credit (ITC)	No (because customer is non-profit)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$3,400/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E E-19S + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.011/kWh to PG&E
Utility Standby Charges	$2,012/year to PG&E (= approx $.005/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #4:	HOSPITAL, N. CALIF.
System	
Capacity	120 kW (2 Tecogen natural gas 60-kW "microengines" with full heat recovery)
Cumulative Operating-Hours to Date	31,700 run-hours, since Oct 2006 startup
Thermal Loads Being Heated	Domestic Hot Water (DHW), space heating,
CHP Operating Mode	100% thermal load-following (0% heat dump)
Actual Capacity Factor to Date	**89% (Note: To maximize efficiency, system is designed to only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	26% HHV (= 29% based on LHV)
Overall Efficiency	**83% HHV (= 92% based on LHV)**
Cost/ financial	
Received Investment Tax Credit (ITC)	No (because customer is non-profit)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$3,200/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E E-20P + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.011/kWh to PG&E
Utility Standby Charges	$3,207/year to PG&E (= approx $.003/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #5: NURSING HOME 'A', N. CALIF.

System

Capacity	60 kW (1 Tecogen natural gas 60-kW "microengine" with full heat recovery)
Cumulative Operating-Hours to Date	34,500 run-hours, since Apr 2003 startup
Thermal Loads Being Heated	Domestic Hot Water (DHW), space heating
CHP Operating Mode	100% thermal load-following (0% heat dump)
Actual Capacity Factor to Date	**52% (Note: To maximize efficiency, system is designed to only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	26% HHV (= 29% based on LHV)
Overall Efficiency	**83% HHV (= 92% based on LHV)**

Cost/ financial

Received Investment Tax Credit (ITC)	No (because customer is non-profit)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$3,500/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E A-10S + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.012/kWh to PG&E
Utility Standby Charges	$1,610/year to PG&E (= approx $.006/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #6: NURSING HOME 'B', N. CALIF.

System

Capacity	60 kW (1 Tecogen natural gas 60-kW "microengine" with full heat recovery)
Cumulative Operating-Hours to Date	24,800 run-hours, since Dec 2004 startup
Thermal Loads Being Heated	Domestic Hot Water (DHW), space heating
CHP Operating Mode	Mostly thermal load-following (limited heat dump)
Actual Capacity Factor to Date	**48% (Note: To maximize efficiency, system is designed to mostly only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	26% HHV (= 29% based on LHV)
Overall Efficiency	**70% HHV (= 78% based on LHV)**

Cost/ financial

Received Investment Tax Credit (ITC)	No (because customer is non-profit)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$3,500/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E A-10S + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.012/kWh to PG&E
Utility Standby Charges	$1,610/year to PG&E (= approx $.006/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #7: NURSING HOME 'C', N. CALIF.

System	
Capacity	225 kW (3 Tecogen natural gas 60-kW "microengines" with full heat recovery)
Cumulative Operating-Hours to Date	35,100 run-hours, since Aug 2005 startup
Thermal Loads Being Heated	Domestic Hot Water (DHW), space heating
CHP Operating Mode	Mostly thermal load-following (limited heat dump)
Actual Capacity Factor to Date	**77% (Note: To maximize efficiency, system is designed to mostly only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	27% HHV (= 30% based on LHV)
Overall Efficiency	**78% HHV (= 87% based on LHV)**
Cost/ financial	
Received Investment Tax Credit (ITC)	No (because customer is non-profit)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$3,300/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E E-19P + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.011/kWh to PG&E
Utility Standby Charges	$6,013/year to PG&E (= approx $.004/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #8: APARTMENT BUILDING, N. CALIF.

System	
Capacity	60 kW (1 Tecogen natural gas 60-kW "microengine" with full heat recovery)
Cumulative Operating-Hours to Date	41,800 run-hours, since May 2005 startup
Thermal Loads Being Heated	Domestic Hot Water (DHW), space heating, pool
CHP Operating Mode	100% thermal load-following (0% heat dump)
Actual Capacity Factor to Date	**87% (Note: To maximize efficiency, system is designed to only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	26% HHV (= 29% based on LHV)
Overall Efficiency	**83% HHV (= 92% based on LHV)**
Cost/ financial	
Received Investment Tax Credit (ITC)	No (because customer is non-profit)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$5,000/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E A-10S + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.012/kWh to PG&E
Utility Standby Charges	$1,610/year to PG&E (= approx $.004/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

PROJECT #9:	MUNICIPAL POOL, N. CALIF.
System	
Capacity	60 kW (1 Tecogen natural gas 60-kW "microengine" with full heat recovery)
Cumulative Operating-Hours to Date	44,500 run-hours, since May 2004 startup
Thermal Loads Being Heated	Pool
CHP Operating Mode	100% thermal load-following (0% heat dump)
Actual Capacity Factor to Date	**79% (Note: To maximize efficiency, system is designed to only operate when site thermal loads require CHP waste heat)**
Actual Availability Factor to Date	**95%**
Electrical Efficiency	26% HHV (= 29% based on LHV)
Overall Efficiency	**83% HHV (= 92% based on LHV)**
Cost/ financial	
Received Investment Tax Credit (ITC)	No (because customer is govt/ public)
How Financed	100% from capital budget; site-owned
Total Installed Cost	$3,000/kW
O&M Cost	$.022/kWh
Utility Rate	PG&E E-19S + Standby S + E-DCG Departing Load
Utility Departing Load Charges	$.011/kWh to PG&E
Utility Standby Charges	$1,610/year to PG&E (= approx $.004/kWh)
IRR (without SGIP)	**<5%** (using corrected staff spreadsheet).

date: 11/15/2010

SMALL NATURAL GAS IC ENGINE
SAMPLE CHP PROJECT DATA

ADDITIONAL NOTES

Project #	1	2	3	4	5	6	7	8	9
Site:	COMM'Y CTR	COLLEGE	HIGH SCHOOL	HOSPITAL	NURSNG HOME 'A'	NURSNG HOME 'B'	NURSNG HOME 'C'	APT BLDG	MUNICPL POOL
startup date	2/15/2009	12/15/2003	10/15/2005	10/15/2006	4/15/2003	12/15/2004	8/15/2005	5/15/2005	5/15/2004
current date	11/1/2010	11/1/2010	11/1/2010	11/1/2010	11/1/2010	11/1/2010	11/1/2010	11/1/2010	11/1/2010
diff since s/u: days	624	2,513	1,843	1,478	2,757	2,147	1,904	1,996	2,361
years	1.7	6.9	5.0	4.0	7.6	5.9	5.2	5.5	6.5
months	20.5	82.6	60.6	48.6	90.6	70.6	62.6	65.6	77.6
hours	14,976	60,312	44,232	35,472	66,168	51,528	45,696	47,904	56,664
Current Cumulative System Run-Hours since Startup	**13,300**	**49,900**	**30,300**	**31,700**	**34,500**	**24,800**	**35,100**	**41,800**	**44,500**
Avg Capacity Factor since startup*	**89%**	**83%**	**69%**	**89%**	**52%**	**48%**	**77%**	**87%**	**79%**

*** Note that these systems are designed to *not* run fulltime. Rather, they are generally dispatched based on customer's actual thermal requirements, in order to maximize overall CHP efficiency.**

Manufacturer	Tecogen	Tecogen	Tecogen	Tecogen	Tecogen	Tecogen	Tecogen	Tecogen	Tecogen	
kW system size (bef parasitics)	150	300	75	120	60	60	225	60	60	
Approx kWh generated (bef parasitics) since s/u	1,995,000	14,970,000	2,272,500	3,804,000	2,070,000	1,488,000	7,897,500	2,508,000	2,670,000	
Customer's PG&E Elec Rate	E-19S	E-19P	E-19S	E-20P	A-10S	A-10S	E-19P	A-10S	E-19S	
Departing Load Charges										
PPP	$0.01115	$0.01045	$0.01115	$0.01092	$0.01169	$0.01169	$0.01045	$0.01169	$0.01115	
Nuclear Dec	$0.00029	$0.00029	$0.00029	$0.00029	$0.00029	$0.00029	$0.00029	$0.00029	$0.00029	Avg/ kWh
Total $/kWh	**$0.01144**	**$0.01074**	**$0.01144**	**$0.01121**	**$0.01198**	**$0.01198**	**$0.01074**	**$0.01198**	**$0.01144**	**$0.0114**
Annual Cost	$13,350	$23,352	$5,149	$10,531	$3,283	$3,031	$16,260	$5,494	$4,722	
Standby Charge ($/kw-mo)	$2.63	$2.62	$2.63	$2.62	$2.63	$2.63	$2.62	$2.63	$2.63	
Applied to % of rated capacity	85%	85%	85%	85%	85%	85%	85%	85%	85%	
Net charge	$2.24	$2.23	$2.24	$2.23	$2.24	$2.24	$2.23	$2.24	$2.24	
Annual Cost	$4,024	$8,017	$2,012	$3,207	$1,610	$1,610	$6,013	$1,610	$1,610	
Equivalent $/kWh	**$0.0034**	**$0.0037**	**$0.0045**	**$0.0034**	**$0.0059**	**$0.0064**	**$0.0040**	**$0.0035**	**$0.0039**	**$0.0043**
Total Departing Load + Standby ($/kWh)	**$0.0149**	**$0.0144**	**$0.0159**	**$0.0146**	**$0.0179**	**$0.0183**	**$0.0147**	**$0.0155**	**$0.0153**	**$0.0157** Total

CERTIFICATE OF SERVICE

I, Barb Taylor, hereby certify that I served a copy of the **COMMENTS OF TECOGEN INC. ON STAFF PROPOSAL REGARDING MODIFICATIONS TO THE SELF-GENERATION INCENTIVE PROGRAM** on November 15, 2010, on all known parties to Service List for **R.10-05-004** via electronic mail to those whose addresses are available and via U.S. mail to those who do not have an electronic address.

I declare under penalty of perjury under the laws of the State of California that the above is true and correct.

Executed on this 15th day of November 2010, at Sacramento, California.

Barb Taylor

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CERTIFICATE OF SERVICE

I, Barb Taylor, hereby certify that I served a copy of the **COMMENTS OF TECOGEN INC. ON STAFF PROPOSAL REGARDING MODIFICATIONS TO THE SELF-GENERATION INCENTIVE PROGRAM** on November 15, 2010, on all known parties to Service List for **R.10-05-004** via electronic mail to those whose addresses are available and via U.S. mail to those who do not have an electronic address.

I declare under penalty of perjury under the laws of the State of California that the above is true and correct.

Executed on this 15th day of November 2010, at Sacramento, California.

/s/ Barb Taylor
Barb Taylor

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