

Ex Ante Phase II Review Findings

Table 1-1: Project Information

IOU	PG&E
Application ID	NC0122166
Application Date	March 2012
Program ID	PGE21031
Program Name	Customized Calculated Agricultural Incentives New Construction Program (Savings By Design)
Program Year	2012
Itron Project ID	X229
IOU Ex Ante Savings Date	8/19/2013
ED Measure Name	Greenhouse Energy Efficiency Measures
Project Description	Implementation of energy efficiency measures in a new construction greenhouse (phases 3 & 4)
Date of ED Review(s)	8/29/2013
Primary Reviewer and Firm	Shamus Cunningham/ERS
Review Supervisor and Firm	Betsy Ricker/ERS & Joseph Ball/Itron
ED Project Manager	[REDACTED]
ED Policy Authorization (as needed)	
Type of Review (Desk, On-site, Full M&V, Tool)	Desk
ED Recommendation	ED approves PG&E's latest savings values of 3.944 MWh and -13 kW, pending post-install IR, M&V, and IOU true-up. If the utility-estimated savings after post-installation M&V and true-up change by more than twenty percent of the ED-approved savings, then ED may elect further review at that time. In such case, PG&E will inform ED.

Measure Description

This project proposes the implementation of one energy efficiency measure in a new construction greenhouse. The proposed measure (high efficiency fans and pumps) includes the following energy efficiency actions for this 32.5 acre greenhouse:

- Transport Pumps (15 kW & 18.5 kW)
- Air Handling Unit (AHU) Fans
- Horizontal Air Flow (HAF) Fans
- Ventilation Fans
- CO₂ Fans

Energy savings have been calculated using Excel analyses of one full year of trended data from a nearly identical greenhouse that is already installed at the site.

Summary of Review

ED reviewed the following documents as part its Phase I ex ante review of this project:

- Energy savings report
(*Draft OA Report CNC 122611 (XXXXXXXX Ranges Phase 3 and Phase 4).doc*)
- ED data request response
(*EnergyEfficiencyOIR-Post-2008_DR_ED_281_EEGA_2474.doc*)
- Energy savings calculations spreadsheet
(*Pre Calculations (111207 XXXXXXXX Phase 3&4).xls*)
- Details on trended pump and fan energy use
(*FW XXXXXXXX energy consumption data.msg*)
(*All Phase 1 Fan Data.xlsx*)
- Project application and additional analysis details
(*CMT 24220 - XXXXXXXX Farms - Greenhouse phase 3 4 – CNC.msg*)
- Trended weather data from site
(*RE Climate Data Excel Spreadsheet.msg*)
- PG&E response to ED questions and requests for clarification
(*XXXXXX Farms PGE ERS Response 08-06-2013.pdf*)
(*FW: NC0122166 X229 - NC greenhouse - PG&E Response.msg*)

ED reviewed the above files, which included a PDF report with detailed responses to ED's data requests and questions posed in the last EAR and excel files that included the energy savings calculations for the project and a full year's worth of trended fan speed data. ED noted that the information provided in response to their data request was extensive and very informative in understanding the CFD calculations which formed the basis for key analysis assumptions and energy savings calculations. The documents provided by PG&E provided further detail on the analysis assumptions.

According to the PG&E documentation the following system descriptions apply:

- The baseline heating system is a central boiler that supplies hot water to an under-bench heating system using constant speed pumps and horizontal airflow fans to circulate air throughout the greenhouse. Cooling is provided via ventilation fans that introduce outdoor air into the greenhouse and is circulated by the horizontal air fans. CO₂ injection via the greenhouse boilers is not included in the baseline calculations.
- The proposed greenhouse utilizes a central boiler plant that supplies hot water to heating coils in air handling units (AHUs) and hot water radiant heating rails via pumps with variable frequency drives (VFDs) and secondary constant speed pumps. Individual greenhouse growers determine if heat is delivered to the plants via the AHUs or hot water rails. Each of the air handler fans is equipped with a VFD. The AHUs also supply the greenhouse with cooling via an evaporative cooling system. In addition, an electric penalty is applied for the fans needed to operate the greenhouse's CO₂ injection system. There are no horizontal airflow or ventilation fans assumed in the proposed case.

Table 1-2 (below) summarizes the key analysis assumptions from the PG&E savings calculations. ED's notes on the PG&E assumptions, baseline selections, and calculations are also included in the table below. In total, fan savings account for 90% of the claimed annual kWh savings for the project and pump savings contribute 10% of the claimed annual kWh savings.

Table 1-2: Baseline & Proposed Measure Assumptions & Review Notes

Equipment Description	Baseline Description	Proposed Greenhouse Description	ED Notes
Transport Pumps (15 kW & 18.5 kW)	<p>Equipment type & qty: 4 x 20 hp pump</p> <p>Equipment schedule of operation: 0% flow for 30% of the year, running at 100% speed for the remaining 70% of the year.</p> <p>Equipment operating setpoint: Each pump operating at between 12 and 14 kW at 0% speed and 14 and 18 kW at 100% speed.</p>	<p>Equipment type & qty: 4 x 20 hp pump</p> <p>Equipment schedule of operation: Flow varies based on load. Percent flow of pump calculated from trended Phase I system data.</p> <p>Equipment operating setpoint: Based on 8,000 data points, typical pump operation between 16% and 36% speed (1.4 and 3.3 kW, average of ~ 1.4 kW).</p>	
Air Handling Unit (AHU) Fans	N/A	<p>Equipment type & qty: 1,055 fans per range operating at a peak of 1.55 kW/fan, 2 ranges (16 total fans)</p> <p>Equipment schedule of operation: Flow varies based on load. Percent flow of pump calculated from trended Phase I system data.</p> <p>Equipment operating setpoint: Based on one year of trended data, typical fan operates between 30% and 80% speed (0.4 and 0.8 kW, average of ~0.2 kW).</p>	
Horizontal Air Flow (HAF) Fans	<p>Equipment type & qty: 60 bays per range, 31.5 ft x 856 ft per range = 1,612,598 sq ft. per range; 2 cfm/ft² of range floor area = 3,225,000 cfm of ventilation. Fan Efficiency = 8.5 cfm/watt; For two</p>	N/A	The baseline greenhouse floor area was increased by 15% in PG&E calculations to account for the additional floor area

	<p>ranges, total wattage = 756 kW. Equipment schedule of operation: 8,760 hrs/yr Equipment operating setpoint: 100% kW at all times</p>		<p>needed to meet the increased production possible at the higher production/sq.ft with the proposed system. The number of baseline HAF fans was also increased accordingly. CFD analysis was used to show that all HAF fans need to be in operation 8760 in order to maintain minimum air speed around plants to promote growth and prevent disease</p>
<p>Ventilation Fans</p>	<p>Equipment type & qty: Baseline range sq.ft. as per HAF fan calculations (1,612,598 sq ft./range); 1 cfm/ft² = 1,612,598 cfm of ventilation. Fan efficiency = 13.9 cfm/watt; For two ranges, total wattage = 231.9 kW Equipment schedule of operation: 6578 hrs/yr Equipment operating setpoint: 100% kW at all times</p>	<p>N/A</p>	<p>The baseline greenhouse floor area was increased by 15% in PG&E calculations to account for the additional floor area needed to meet the increased production possible at the higher production/sq.ft with the proposed system. The number of baseline ventilation fans was also increased accordingly. Annual hours of operation were passed on a scaled calculation of the full load hours required to provide the same ventilation as the existing VFD controlled system.</p>

CO ₂ Fans	N/A	Equipment type & qty: 4 x 50 hp fans Equipment schedule of operation: 93% efficient motor. 4,660 hrs/yr of CO ₂ dosing. Equipment operating setpoint: Motor estimated to be 80% loaded.	
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PG&E utilized trended data from the site’s existing greenhouses to calculate the energy use of the proposed pump and fan systems. The baseline system operation and energy use was projected based on industry practice assumptions and verified using CFD analysis. ED reviewed the industry standard practice assumptions applied by PG&E and noted the following concerns:

- The energy savings calculations are based on the greenhouse that is currently located at the site. The proposed greenhouse is expected to have a construction and intended operation that is very similar to the existing greenhouse. The proposed greenhouse technology is relatively new and the existing greenhouse, which employs the newer technology, has required some tuning as it has been brought up to speed over the last 12+ months. This has led to AHU operations and plant conditions that may not reflect how the greenhouse will be operated long-term or necessarily be indicative of the way that the proposed greenhouse will be operated after construction and commissioning. Given the challenges associated with optimizing the operation of the greenhouse systems, it is hard to say how closely the proposed greenhouse will mirror the existing one. ED recommends that PG&E inspect the proposed greenhouse operation after construction to determine ensure the existing greenhouses remain an appropriate basis for energy savings calculations or if adjustments are necessary due to significant differences in greenhouse operation and design.

Based on ex ante interviews conducted by ED for the natural gas measures associated with this same greenhouse construction project, the NTGR for high efficiency fans & pumps will be assigned an NTGR of 0.41.

Review Conclusion

Gross project energy savings are approved following our extensive discussion of baseline fan equipment annual hours of operation. A post-installation inspection and savings true-up may be required if the constructed greenhouse contains any systems which are materially different than

the phase 1&2 greenhouses which formed the basis of these calculations. ED conditionally approves PG&E latest savings values of 3.944 MWh and -13 kW, pending post-install IR, M&V, and IOU true-up.

Summary of ED Requested Action by the IOU

No further IOU actions are required, unless during the post-install verification parameters used in this analysis have changed significantly, causing a greater than 20% change in savings.

Table 1-2 Review Findings

Reviewed Parameter	Analysis
Project Baseline Type (Early Replacement, Normal Replacement, Capacity Expansion, New Construction, System Optimization, Add-on Measures, Major Renovation) Note: For early retirement projects only, include RUL through EUL baseline)	IOU Proposal: New Construction
	ED Assessment: New Construction
	ED Recommendation: None
Project Baseline Technology (in situ equipment, Title 24 (specify year), other code or other efficiency level (specify), industry standard practice - ISP)	IOU Proposal: ISP – standard efficiency fans and pumps
	ED Assessment: Agree
	ED Recommendation: None
Project Cost Basis (Full Incremental, or Both. Note: For early retirement projects, include RUL through EUL cost basis treatment)	IOU Proposal: Incremental Costs
	ED Assessment: Incremental Costs
	ED recommendation: None
RUL (required for early retirement projects only, otherwise N/A)	IOU Proposal: N/A
	ED Assessment: N/A
	ED recommendation: N/A
EUL (for each measure)	IOU Proposal: 15 years
	ED Assessment: 15 years

Ex Ante Review Findings

Reviewed Parameter	Analysis
	ED Recommendation: None
Savings Assumptions	IOU Proposal: See Table 1-1 above
	ED Assessment: See Table 1-1 above
	ED Recommendation: None
Calculation Methods/Tool review	IOU Proposal: Excel spreadsheet model calculations
	ED Assessment: Method appropriate
	ED Recommendation: None
Pre- or Post-Installation M&V Plan	IOU Proposal: Not required for NC projects
	ED Assessment: Equipment and parameters should be checked post-installation to see if changes affect savings for a true-up.
	ED Recommendation: Conduct a post-install inspection report and true-up savings if parametric changes are greater than 20% different than the original proposal.
Net-to-Gross Review	IOU Proposal: Not provided
	ED Assessment: Based on interviews for NC natural gas measures for the same greenhouse project, NTGR is 0.41. This customer is a partial free-rider.
	ED Recommendation: NTGR = 0.41; for an early adopter in the greenhouse industry of innovation, ED encourages the IOU for future greenhouse projects to move this customer into the Emerging Technologies Program to showcase their forward-thinking concepts.

Table 1-3 Energy Savings Summary, Project Costs & Incentive

Description	IOU Ex Ante Claim	ED Recommendations
First Year kWh Savings	3,944,000 kWh	Accept
First Year Peak kW Savings	-13 kW	Accept
First Year Therms Savings	N/A	N/A
kWh Savings (RUL Period)	N/A	N/A
Peak kW Savings (RUL Period)	N/A	N/A
Therms Impact (RUL Period)	N/A	N/A
kWh Savings (RUL thru EUL Period)	3,944,000 kWh	Accept
Peak kW Savings (RUL thru EUL Period)	-13 kW	Accept

Ex Ante Review Findings

Description	IOU Ex Ante Claim	ED Recommendations
Therms Savings (RUL thru EUL Period)	N/A	N/A
Annual Non-IOU Fuel Impact (RUL Period)	N/A	N/A
Annual Non-IOU Fuel Impact (RUL thru EUL Period)	N/A	N/A
Project Costs for Baseline #1 (RUL or EUL)	\$7,816,003 (initial); costs may be adjusted by IOU	Accepted
Project Costs for Baseline #2 (EUL minus RUL period)	N/A	N/A
Project Incentive Amount	\$407,216 (estimated); adjusted incentive value not yet provided to ED	Not evaluated