

Commerce Energy Biogas/PV Mini-Grid
Renewable Resources Program

***Making Renewables Part of an Affordable and
Diverse Electric System in California***

Contract No. 500-00-036

**Second Annual Program Report:
Contract Year 2005**

Project 0: Program Administration

Task 0.5.2 Final Report

Prepared For:
California Energy Commission
Public Interest Energy Research Renewable Program

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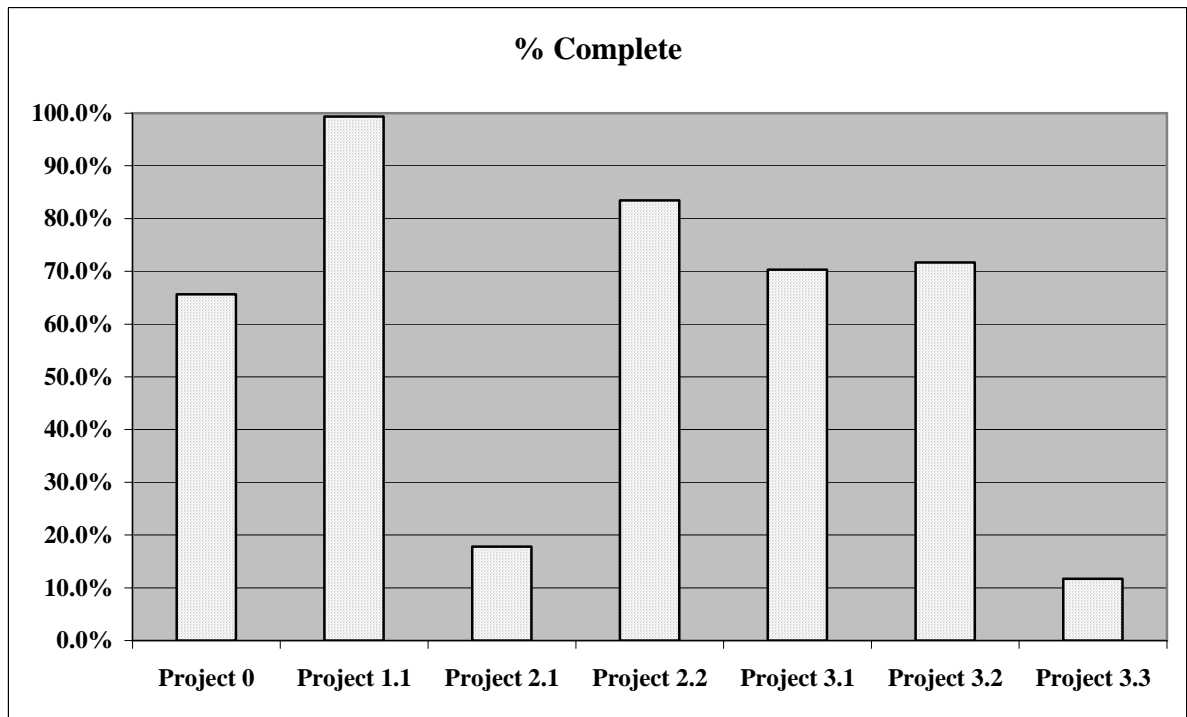
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Executive Summary

During the second annual reporting period, many deliverables were completed beginning in January 2005 through December 2005, as shown in Figure ES-1. One of the PIER Commerce Energy (CE) Projects, was issued a stop work order: Project 3.3 was significantly delayed due to numerous factors, including finding a replacement for the project manager at REDI and multiple reviews and revisions of the model that was developed. Projects 2.2, 3.1, and 3.2 have also experienced delays, but are now proceeding as planned. All deliverables that were not completed in 2005 will be completed by the Program end on March 31, 2006.

Figure ES-1 Summary of Program and Project Status



Project 0: *Program Administration*, was approximately 65 percent complete at the end of 2005. Major tasks completed include monthly status and program reports from January 2005 through December 2005,

Project 1.1, *Program Planning and Analysis*, was close to completion at the end of 2004. Project 1.1 preceded work on the other projects, and therefore the majority of the tasks were completed during the first annual reporting period. Final approval was received on Task 1.1.10 *Prepare Prioritized List of Pilot Projects for PV and Biogas Systems*. The only

remaining task is Task 1.1.13 *Preparation of Measurement and Evaluation Plans*. This is expected to be submitted in early 2006.

Project 2.1, *Enhanced Landfill Gas Production*, did not proceed past the planning stage due to the need for San Bernardino County to move forward with the liner extension project at Mid-Valley without the bioreactor elements in order to proceed on their timeline to accept waste by early 2005. This decision was reached in July 2004, and all work was stopped. One last task will be completed before the Program end in March 2006, and that is the *Measurement and Evaluation Report*, which will evaluate how similar projects can successfully be implemented in the future.

Project 2.2, *Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines*, was over 80 percent complete at the end of 2005. It was decided in the previous annual reporting period that two ultrasound systems would be tested at Riverside Wastewater Treatment Plant and gas cleaning systems would be tested at Inland Empire Utilities Agency (IEUA) Regional Plant 1 (RP-1). The gas cleaning systems to be tested included a biological hydrogen sulfide removal system, a refrigerated dryer that would remove moisture and reduce siloxanes concentrations, and a polymer and a graphite media to further reduce siloxane concentrations. In 2005, the gas cleaning system installation was completed; baseline data collection was completed, enabling testing of the ultrasound and gas cleaning systems to begin. Work also began on the *Quarterly Reports* which discuss the baseline and test data for the ultrasound and gas cleaning systems and the Project Team began on the *Final Project Report* and on the *Project Measurement and Evaluation*.

Project 3.1, *Dairy Waste to Energy*, was about 70 percent complete at the end of 2004. It was decided in the previous annual reporting period that manure and industrial food waste and biosolids and industrial food waste would be co-digested at IEUA RP-1 in a centralized anaerobic digester. Work completed in 2005 included an addendum to the *Tactical Marketing Plan* which analyzed the locations and distance between dairies and wastewater treatment facilities, and modifications to the gas handling system to ensure that it could safely manage the increased biogas production from co-digestion. The Project Team also began work on modifying an iron sponge to inject air and therefore increase the hydrogen sulfide removal efficiency, collecting data for an interconnection model and PSLF dynamic models, writing the *Final Project Report*, and developing survey guides for the *Project Measurement and Evaluation*. Work continued on quantifying a conversion factor for ammonia emissions to PM₁₀.

Project 3.2, *Building Integrated Photovoltaics (BI-PV) Testing and Evaluation*, was about 70 percent complete at the end of 2004. It was decided in the previous annual reporting period that the large PV systems (60 kW) would be tested at IEUA and the small systems (20 kW) would be tested at PVUSA. Throughout 2005, the output and ambient conditions of each PV

system were monitored. BEW presented three workshops and many project deliverables were completed, including the *Six- and Twelve-Month Exposure and Operation Reports* for the large and small systems. The project team also presented a paper at the ASES Solar World Conference 2005 conference. Work also began on the *Consumer Confidence Guidelines* and on the *Project Final Report*.

Project 3.3, *Building Integrated Photovoltaics (BI-PV) On Public Facilities*, was approximately 10 percent complete at the end of 2005. REDI and Spectrum Energy prepared a document outlining actual costs to date for work on this task for final invoicing and closure of this project, based upon direction by the Commission. A stop-work order was received for this Project on May 31, 2005.

1

Introduction

1.1 Annual Program Report Purpose and Objectives

The primary purpose of the PIER Commerce Energy Second Annual Report is to provide an overview of the program's objectives and goals, while summarizing by project: the planned and actual accomplishments, the challenges that were faced, milestones and specific task deliverables submitted, and summarize contract expenditures during the reporting period of January 2005 through December 2005. Additionally, this report will outline the anticipated Program accomplishments by Project January 2006 through contract end, March 31, 2006.

1.2 PIER Program Overview

In 1996, Assembly Bill 1890 was enacted. AB1890 required that at least \$62.5 million be collected annually from investor-owned utility ratepayers for public interest energy research, development, and demonstration (RD&D) efforts not adequately provided by competitive and regulated markets. The majority of these funds were to be transferred to the Energy Commission to administer specific RD&D projects, which could be linked to help diversify and improve affordability of California's electricity supply. Thus, the Public Interest Energy Research (PIER) Program was created to implement these projects.

In general, PIER Renewables Program funds are allocated by four "*emphasis areas*":

- Emphasis Area 1: Assessing and Targeting Renewable Electricity Development,
- Emphasis Area 2: Increasing Affordability by Improving Existing Renewable Energy Facilities,
- Emphasis Area 3: Expanding Affordability & Diversity Using Renewable Distributed Generation, and
- Emphasis Area 4: Developing Renewable Technologies for Tomorrow's Electricity System.

The goals and objectives of each of the emphasis areas mentioned above are described briefly in the paragraphs that follow.

Emphasis Area 1

To meet the objectives of Emphasis Area 1, the PIER Program seeks to support power flow modeling to identify existing or anticipated problems with electricity systems in targeted regions over the next five, ten, and fifteen years. Additionally, the PIER Program seeks to compile information on the availability and resource constraints associated with renewable and fossil resources in a target region. The PIER Program also seeks to establish cost and performance targets for specified renewable energy technologies, and to develop coordinated research and development efforts to achieve those targets.

Emphasis Area 2

To meet the objectives for Emphasis Area 2, the PIER program seeks to increase system operational efficiencies and lower operations and maintenance costs. Additionally, the Program seeks to establish new and diversified revenue streams, and to develop energy technologies to provide dispatchability, or peak generation capabilities.

Emphasis Area 3

For Emphasis Area 3, the PIER program seeks to develop low-emissions distributed generation technologies to match demand profiles in a targeted area, to defer investments in the local transmission and distribution system, and to provide power quality support. Through Emphasis Area 3, the PIER Program also seeks to integrate targeted technologies into mini-grids capable of providing affordable, reliable power with low environmental impacts. The performance of these technologies will be verified in the field to assess their potential for full-scale implementation.

Emphasis Area 4

Under Emphasis Area 4, the PIER Program supports the development of a renewable energy database to enhance customer awareness of available energy technologies. Additionally, through Emphasis Area 4, the PIER Program supports the development of small, modular renewable electricity products highly responsive to customer power demands, which can be integrated into other appliances or electricity generation technologies. Finally, under Emphasis Area 4, the PIER program supports the development of super-efficient, super-clean renewable energy technologies for use in industrial or utility system settings.

1.3 Commerce Energy Program Overview

The Commerce Energy Biogas/PV Mini-Grid Renewable Resource RD&D Program is just one of the renewable energy programs supported by PIER Program funds. The specific goals and objectives of the Commerce Energy (CE) Program are:

- To develop and implement an approach to tailor resource development to the specific needs and resources of local mini-grids,
- To increase landfill gas production, accelerating biodegradation and decreasing landfill generation lifecycle costs,
- To lower costs associated with digester gas energy production,
- To improve the economics of producing energy from animal waste,
- To demonstrate the use of proper systems integration to enhance photovoltaic system performance,
- To create a basic rating system for photovoltaic system performance, and
- To demonstrate the potential to take advantage of cost economics by installing relatively large PV systems under common ownership agreements.

In a broader sense, the Commerce Energy Program was designed to achieve certain specific objectives outlined in three of the four Pier Program Emphasis Areas, as follows:

Table 1-1: Commerce Energy Projects by PIER Program Emphasis Area

PIER Program Emphasis Area	Commerce Energy Program Project
	Project 0: Program Administration
Emphasis Area 1: Assessing and Targeting Renewable Electricity Development	Project 1.1: Program Planning and Analysis Project
Emphasis Area 2: Increasing Affordability by Improving Existing Renewables Investments	Project 2.1: Enhanced Landfill Gas Production Using Bioreactor Project
	Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Project
Emphasis Area 3: Expanding Affordability and Diversity Using Renewable Distributed Generation	Project 3.1: Dairy Waste and Biosolids to Energy Project
	Project 3.2: Building Integrated PV Testing and Evaluation Project
	Project 3.3: Building Integrated PV on Public Facilities Project
Emphasis Area 4: Developing Renewable Technologies for Tomorrow’s Electricity System	None

1.4 Commerce Energy Program Project Overview

Project 0: Program Administration

Project 0 is managed by Itron. The goal of Project 0 is to coordinate and integrate the technical and administrative elements of all of the Commerce Energy Program projects. Under Project 0, Itron coordinates R&D efforts to ensure that Commerce Energy Program deliverables meet PIER guidelines for technical and economic performance, and to ensure that deliverables are submitted within budget and schedule. Coordination activities include the creation of a Renewables Program Advisory Committee (RPAC), documentation of match funds committed and received, and identification and receipt of all required permits, facilitation of critical project review (CPR) and RPAC meetings, creation and maintenance of a program website, and preparation of monthly and annual program reports.

Project 1.1: Program Planning and Analysis

Project 1.1 is managed by Itron. The overall goal of Project 1.1 is to develop a formal means to assess the potential for meeting sub-regional needs with local renewable resources for one or two targeted areas within California, and to apply this approach to the development of biogas and solar photovoltaic generation facilities for at least one of those areas. The project will cover assessments of regional energy needs, assessments of biogas and solar resources, and the evaluation of regional grid conditions through power flow modeling. The objectives of Program Planning and Analysis project are to:

- Determine the most appropriate renewable resources in the region of interest to fully serve the electric distribution grid,
- Determine the most appropriate geographic and electric system boundaries of the electric distribution mini-grid,
- Assess the technical and market electricity potential of these identified resources within the specified markets in the mini-grid,
- Estimate the electric system public benefits of the full development of these renewable resources within the region of interest over the next 5 and 10 years, and
- Identify candidate sites to participate in the team's RD&D pilot program activities.

The primary deliverables of Project 1.1 include: (1) an assessment of the potential for meeting subregional needs with integrated local renewable resources for up to two areas within California, (2) a preliminary evaluation of the benefits of tailored development in those areas and in the state, (3) estimates of economic and environmental benefits, and (4) a detailed plan for developing specific biogas and solar photovoltaic generation facilities in at least one of the targeted areas.

Project 2.1: Enhanced Landfill Gas Production

Project 2.1 is managed by CH₂M Hill. The overall goals of Project 2.1 are to:

- Advance the state of knowledge using bioreactors at landfills to increase landfill gas production and accelerate reclamation,
- Work with environmental regulators to develop and implement a strategy for developing bioreactors while meeting applicable groundwater and other environmental standards, and
- Establish the economic and environmental benefits of landfill bioreactors.

To achieve these goals, Project 2.1 was designed to develop two types of landfill bioreactors (one fueled by municipal solid waste or source-separated organic waste materials, and one fueled by municipal solid waste or source-separated organic waste materials and supplemented by food or animal waste). Under Project 2.1, environmental and landfill operating life (e.g. through compaction) benefits of bioreactors were also to be documented.

Performance metrics for Project 2.1 were to include changes in methane (CH₄) production, reductions in CH₄ emissions and indirect reductions in other criteria air emissions associated with displaced conventional generation, and changes in lifecycle costs of landfill gas generation. Two reports were to be developed to summarize the results of Project 2.1. One report was to summarize the regulatory issues addressed in the course of developing Project 2.1. This report was to include guidelines for future projects and a methodology for calculating the economic value of environmental benefits of the project. The second report was to summarize design and installation engineering work performed in support of Project 2.1, and to document installation, operation, and maintenance costs incurred. Project lifecycle costs were to incorporate engineering issues as well as the value of environmental benefits presented in the first report.

Unfortunately, Project 2.1 was cancelled in July 2004 due to the need for the selected landfill site to meet a timeline with a liner-extension project by early 2005. The bioreactor could not be implemented because this would prevent the landfill from meeting this timeline.

Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines

Project 2.2 is managed by CH₂M Hill. The overall goals of Project 2.2 are to:

- Increase and optimize digester gas production through thermal hydrolysis and ultrasound processes,
- Develop and optimize cost effective gas cleanup systems,

- Evaluate and quantify environmental benefits from microturbines installed at sewage treatment plants, and
- Document operational performance and cost characteristics to further the state of knowledge regarding microturbine cost and reliability.

Under Project 2.2, the impacts of thermal hydrolysis and ultrasound processes upon gas production were to be analyzed and documented. Additionally, digester gas production and quality, biosolids reduction rate, and dewatering characteristics of these processes were to be examined. Furthermore, the cost-effectiveness of these technologies was to be analyzed. The cost-effectiveness analysis was to include a detailed evaluation and quantification of environmental benefits for each of the systems.

Additionally, under Project 2.2, at least three gas cleaning systems were to be defined and optimized. One of these systems was expected to involve hydrogen sulfide removal, gas drying, and siloxane removal. A second system was expected to involve gas drying and siloxane removal. Finally, a third system, with parameters not yet defined, was expected to be formulated. The installed and operating cost for each of these systems was to be determined for the full project lifecycle. Additionally, the environmental benefits associated with each of these systems were to be identified and quantified relative to the Capstone microturbine.

Finally, under Project 2.2, a report was to be prepared to document the cost-effectiveness analysis results for the various microturbine gas cleanup systems evaluated. The cost-effectiveness of these systems was to be evaluated based on the value of electricity produced and waste heat recovered and used at the sewage treatment plant. Various alternatives were to be compared through an examination of the net present value of different systems and the rate of return based on funds utilized.

Project 3.1: Dairy Waste to Energy

Project 3.1 is managed by CH2M Hill. The overall goals of Project 3.1 are to:

- Develop technologies to maximize recovery of energy from animal waste,
- Develop and evaluate pilot projects at existing treatment plants and individual and clusters of dairies, and
- Evaluate and test the effectiveness of technologies developed in North America and Europe for the collection, processing, and recovery of energy from animal waste.

Under Project 3.1, CH2M Hill managed the design, construction, and operation of animal waste to energy pilot plants. CH2M Hill was also to summarize and evaluate the economic and environmental costs and benefits associated with developing such facilities.

The deliverables for Project 3.1 include process flow diagrams and preliminary location plans depicting conceptual layouts of the pilot plants. Additionally, Project 3.1 deliverables include pilot plant test protocol plans, performance specifications, site drawings, and operating reports documenting plant performance and required modifications.

Project 3.2: Building-Integrated Photovoltaic (BI-PV) Testing and Evaluation

Project 3.2 is managed by BEW Engineering (formerly Endecon Engineering). The overall goals of Project 3.2 are to:

- Address the gap between future third-party certified PV component and system performance results and currently available information from manufacturers,
- Provide an independent comparative evaluation of PV systems critical to Project 3.3 and to the Commission Buydown Program,
- Provide decision-making information on those PV systems, and
- Improve the quality of systems installed in Project 3.3 through directed training.

To achieve these objectives, BEW Engineering was to select, procure, install, and evaluate three candidate systems for implementation in Project 3.3. Flaws and weaknesses in design features were to be evaluated, and suggestions for improvement were to be provided. Additionally, BEW Engineering was to identify issues affecting life-cycle costs including ease of installation and comparative system performance. After implementation, the PV systems were to be monitored for 12 months. Results from the monitored data would be used to develop recommendations for future system purchases.

Ultimately, Project 3.2 was designed to yield a Consumer Reports-type rating manual that could be used by manufacturers, system integrators and customers to guide the selection and design of building-integrated photovoltaic systems. This manual would demonstrate the use of proper systems integration to enhance the performance of photovoltaic systems, and to demonstrate the use of a basic rating system to improve the flow of information on photovoltaic system performance.

Project 3.3: Building-Integrated Photovoltaic (BI-PV) on Public Facilities

Project 3.3 is managed by REDI. Under Project 3.3, a number of BI-PV pilot projects were to be installed on public facilities. The primary purpose of these pilot demonstrations was to validate development and installation mechanisms for energy service providers (ESPs), public entities, or building owners. These mechanisms were expected to: 1) improve consumer affordability for these higher cost systems, 2) reduce installed PV costs per peak

watt (and per life cycle kWh), and, 3) identify methods to add value to the PV system installation over its life (i.e., through dual- or tri-use applications of the system).

Project 3.3 was expected to yield a set of specific photovoltaic facilities ranging in size from 10 kW to 150 kW. Each facility was to address an infrastructure or commercialization barrier. At least one relatively large PV system was expected to be installed under a common ownership agreement. The cumulative capacity of BI-PV systems expected to be procured and installed under this program element ranges from 120 to 300 kW.

1.5 Program / Project Linkage

Project-to-project and overall Program Linkage is a crucial component to the Commerce Energy Program's success. Each project's task deliverables, and in turn their results, have a direct impact on one or more of the Program's other projects. The added value of linking projects to one another is summarized as follows:

- Improves ability to assess system T&D benefits under various distributed generation size and resource scenarios, including biogas and PV resource and various market penetration levels,
- Evaluates environmental benefits/trade-off between different combinations of biogas and PV resource development,
- BI-PV systems testing projects assist in the selection of a demonstration application, a module manufacturer, and system components and integration, and
- PV and biogas distributed generation projects implemented jointly demonstrate ESP market viability and an appropriate mix of resources to maximize value from ESP and LDC perspectives.

During the first twenty-eight months of the Commerce Energy Program, Project 1.1's task deliverables have provided crucial input into *all* of the remaining projects.

1.6 Report Organization

An executive summary, which provides a high-level overview of the key results, is presented as the first section of this Annual Program Report. The remainder of the report is organized as follows:

- **Section 2** describes planned Program accomplishments for the reporting period.
- **Section 3** describes actual Program accomplishments achieved during the reporting period.
- **Section 4** compares Program accomplishments to Program plans.

- **Section 5** discusses significant problems encountered during the reporting period, and describes any significant changes to Program or project work scope or timelines resulting from these problems.
- **Section 6** describes expected Program accomplishments for the following Annual reporting period.
- **Section 7** presents an overview of Program status in terms of milestones reached and deliverables invoiced.

2

Program Planned Accomplishments

2.1 Overview of Planned Accomplishments

This section describes the expected accomplishments for the PIER Commerce Energy Program on a project-by-project basis from January 2005 through December 2005.

2.2 Planned Project Accomplishments

2.2.1 *Project 0: Program Administration*

During the second reporting period of the Program (January 2005 through December 2005) the Project 0 Program Administration team planned to complete the general administration of the program, finalize any and all contract amendments, subcontractor agreements, budget and work statement revisions, and prepare for and attend Renewable Program Advisory Committee (RPAC) Meetings and Project Technical Advisory Committee (TAC) meetings.

There were many Project 0 task deliverables that were planned to be completed during this reporting period; the documentation of the required permits, the submittal of the final Monthly Project Status Reports and Monthly Program Status Reports, the submittal of the Annual Reports, and numerous contract and project specific meetings

In March 2005, Contract 500-00-036 Amendment 1 was issued by the California Energy Commission (Energy Commission), providing a no-cost contract term extension, extending the contract through March 31, 2006. Subcontractor Agreement Amendment 1 was executed incorporating the extended contract term into each Commerce Energy (CE) team member's Agreements. In August 2005, Contract 500-00-036 Amendment 2 was issued by the Energy Commission providing Task/Deliverable Modifications, as a direct result of the earlier contract term extension, and newly created tasks. Contract Exhibit B (Budget) and Contract Exhibit A (Statement of Work) were revised to reflect the extended term, and newly created tasks under Project 3.1 were added to both Contract Exhibits.

2.2.2 *Project 1.1: Planning and Analysis*

Project 1.1 was designed to yield four primary products:

1. An assessment of the potential to meet sub-regional needs with integrated local renewable resources for up to two areas within California,
2. A preliminary evaluation of the benefits of tailored development, including estimates of generation potential in the targeted areas and in the state as a whole,
3. Estimates of economic and environmental benefits, and
4. A detailed plan for developing specific biogas and solar photovoltaic generation facilities in at least one of the targeted areas.

The CE Team anticipates receiving comments and/or approval from the Energy Commission on the *Prioritization Report* under Task 1.1.10 and the *Project 1.1 Draft Final Report* under Task 1.1.11b. Upon receiving approval, the task deliverables will be finalized and the CE Team will commence work on the *Project 1.1 Final Report* under Task 1.1.11c and the measurement and evaluation under Task 1.1.13.

2.2.3 Project 2.1: Enhanced Landfill Gas Production

The Project 2.1 team originally envisioned that this project would culminate in the successful operation of two bioreactor pilot projects. One bioreactor would be fueled by municipal solid waste (MSW) and source-separated organic waste materials; the other would be fueled by MSW or source-separated organic waste materials in addition to animal waste. The project team planned to compile performance metrics, including changes in methane production, direct reductions in methane emissions and indirect reductions in other emissions associated with displaced conventional generation, and changes in lifecycle costs of generation from landfill gas. Project efforts would culminate in the production of two reports. One report would summarize the regulatory issues that were addressed and satisfied in the course of developing the project, and would include guidelines to be used on future projects and a methodology for calculating the economic value of the environmental benefits of the project. The second report would summarize the design and installation work performed for the bioreactor, and would present pertinent installation, operation, and maintenance costs.

Activities are expected to be limited, with only the review of results and findings as they relate to future bioreactor projects in California, remaining. This *Key Learnings* effort identified in the project wrap-up meeting will be conducted as a component of the *Measure and Evaluation* activity for this Project.

2.2.4 Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines

Project 2.2 was originally envisioned to entail the development and optimization of an enhanced anaerobic digestion system and a gas cleanup system. The environmental benefits

for each system were to be quantified and presented in the context of the Capstone microturbine. The Project 2.2 team additionally planned to improve the efficiency and cost-effectiveness of the enhanced anaerobic digestion and microturbine gas cleaning systems. The results of this work were to be documented in a report evaluating the cost-effectiveness of the various gas cleanup systems for each of the microturbines considered. An evaluation of the digester gas production and quality, the biosolids reduction rate, and dewatering characteristics will be presented and a detailed evaluation and quantification of environmental benefits for each of the systems will also be developed.

Testing of the Sonico and IWe Tech ultrasound systems at the City of Riverside Wastewater Treatment Plant will continue into May 2005. Data from the first operating period for the ultrasound systems will be reviewed and any comments on the *First Quarterly Report* will be incorporated so that task can be completed. It is also anticipated that documents marking completion of the ultrasound installation task will be approved by the Energy Commission. Ultrasound operating data results will be included in the *Second Quarterly Report*, *Third Quarterly Report*, and *Fourth Quarterly Report*.

The CE Team anticipates that the installation of the gas cleaning system will be completed in 2005 and these systems can be started and tested. Modifications to piping and valves on the biological scrubber will be implemented as needed and additional start-up testing will be conducted to ensure the systems are implemented and modified cost-effectively. Challenges associated with the difficulties in installing the biological scrubbing system will be further tested. Baseline data for the gas cleaning tests will be summarized in the *First Quarterly Report*, *Second Quarterly Report*, *Third Quarterly Report* and *Fourth Quarterly Report*.

The CE Team anticipates beginning preparation of the *Final Project 2.2 Report*, and beginning the measurement and evaluation tasks in October. Weekly meetings/calls with IEUA will continue from March 2005 through the remainder of the Program in order to discuss the ongoing activities and to prepare for the annual technical meeting scheduled for November. The Project 2.2 annual technical meeting material will be incorporated into the *Final Project 2.2 Report*.

2.2.5 Project 3.1: Dairy Waste to Energy

Project 3.1 was designed to assess and evaluate selected technologies available for the conversion of animal waste to energy, to select a site for a pilot animal waste to energy plant, and to design, construct, and operate the plant. Expected outcomes from the project include a summary of economic and environmental costs and benefits associated with developing the pilot plant, process flow diagrams, facilities location plans, test protocol plans, performance specifications, and site drawings.

The revised work plan for Project 3.1, which documents the focus of the project as being co-digestion and gas cleaning, will be completed and submitted in 2005. It will clarify the project and facilitate co-digestion testing of manure with food processing waste and biosolids with food processing waste at IEUA RP-1. Implementation of the revised work plan is expected to begin in September 2005.

It is anticipated that a meeting will be held with Energy Commission staff, representatives of IEUA, and the Commerce Energy Team in April to go over comments on the submitted *Tactical Marketing Plan* and its relationship to the proposed co-digestion efforts. Comments received on the draft *Tactical Marketing Plan* and addendum will be incorporated. Supplemental information for the addendum to the *Tactical Marketing Plan* will be incorporated in May. It is also anticipated that given the extent of project activity to be completed between now and March of 2006 on Projects 2.2 and 3.1, increased coordination with IEUA will be needed. Additional meetings and regularly scheduled conference calls will be initiated. Meeting agendas and summaries will be provided to Energy Commission staff to facilitate their participation.

The Draft *Process Recommendation Report* will be submitted to the Energy Commission for review. Comments are anticipated on the Draft Task 3.1.1b report as well as the Draft Task 3.1.1.c report, and once received they will be integrated into the reports prior to submittal to the Energy Commission. Additionally, all activities related to the analysis of dairy waste technologies and *Process Selection* (Task 3.1.1) and the *Test Plan and Design* (Task 3.1.3) are planned to be completed once comments on the *Tactical Marketing Plan* are incorporated. Further coordination is anticipated with IEUA staff regarding the *Bench Scale Tests* and using the results in the design of the co-digestion systems and selection of appropriate food waste. Comments are expected to be received on the final *Process Recommendation Report* and the final *Bench and Full-Scale Test Plan and Protocols*. The *Bench Scale Testing* at the Orange County Sanitation District laboratory will be conducted and all analytical results will be analyzed.

On Task 3.1.2, *Site Selection* activities are to continue with a complete draft anticipated to be completed in May. This is expected to include finalization of the efforts to site all the co-digestion, power generation, and associated infrastructure for the project.

The co-digestion system will be installed and the different co-digestion feedstocks will be tested. Improvements to the materials handling and gas handling systems will be implemented by a specialty construction subcontractor, Ppc and Laboratories, and will be used for testing the effectiveness of the co-digestion processes. An enhanced iron sponge system involving air injection will be installed and tested.

It is anticipated that the final reports for Tasks 3.1.6(0) through Task 3.1.6(6), outlining the environmental benefits, will be submitted for Energy Commission review. These tasks will be planned in detail with the Commerce Energy Team subcontractors and will begin in August. On Task 3.1.7, work will begin on the *Project 3.1 Final Report*. On Task 3.1.9, the interconnection study will begin and high penetration scenarios will be developed. On Task 3.1.10, PV array and inverter performance data will be collected and reviewed and the preliminary dynamic evaluation will begin. Also, the project team will participate in the annual technical briefing in Sacramento.

2.2.6 Project 3.2: Building-Integrated Photovoltaics (BI-PV) Testing and Evaluation

Project 3.2 is designed to culminate in the installation and evaluation of three building-integrated photovoltaics (BI-PV) projects on public buildings. The weaknesses of these systems would be assessed and recommendations for improvement would be provided. The project team would additionally note issues impacting life-cycle costs of these systems, including the system selection and installation processes. System performance would additionally be monitored and recorded for the first twelve months of operation. Based on the results, the project team plans to develop a rating manual similar to Consumer Reports that could be used by manufacturers, system integrators, and customers to guide in the selection and design of BI-PV.

The monitoring of the output and ambient conditions from each of the small and large systems will continue throughout 2005. The Project Team will complete the *Six-Month Exposure and Operation Report* for the large and small systems. The paper for the American Solar Energy Society 2005 conference will be completed and presented. Endecon plans to complete the *Interim* report for the large system and to continue working on the small system *Interim* report. The *12-Month Exposure and Operation Report* for large systems will be submitted to the Energy Commission and the small system *12-Month Exposure and Operation Report* will be submitted to the TAC for review. The Team will present three of the four planned workshops on PV system design and will include their results in these workshops.

2.2.7 Project 3.3: Building-Integrated Photovoltaic (BI-PV) on Public Facilities

Project 3.3 is designed to yield up to four public sector BI-PV projects that would address an infrastructure or commercialization barrier and range in size from 10 kW to 150 kW. These projects are expected to provide access to PV electricity through shared-use multi-purpose community facilities, and to provide useful technical and financial information that could be used by public sector clients to evaluate potential BI-PV projects. This information is to be compiled in a software package that would be made available to public sector and industry

leaders. Performance of these systems would be monitored and reported upon through the technology transfer process.

REDI and Spectrum Energy plan to continue their work on identifying and establishing at least six candidate sites for BI-PV installations. REDI and Spectrum Energy will also circulate internally their documentation of actual costs to date for work on this task prior to submittal to the Energy Commission for review and for final invoicing and closure of this project. No further work will be done on this project, as a stop-work order was received on May 31, 2005.

3

Program Actual Accomplishments

3.1 Overview of Program Accomplishments

Within the second reporting period, January 2005 through December 2005, of the PIER Commerce Program, the Commerce Energy (CE) Team completed numerous task deliverables. A stop-work order was received in May for Project 3.3. Listed below are the individual project accomplishments for 2005.

3.2 Project Accomplishments

3.2.1 Project 0: Program Administration

Monthly Project and Program Status reports were completed through December 2005. During this reporting period, the Program Administrative Team continued to provide on-going support to the California Energy Commission (Energy Commission) staff and the CE Team, as many task deliverables were reviewed prior to being submitted to the Energy Commission. Contract Invoice # 14 through Contract Invoice # 19 were submitted, representing \$2,512,174.43 in 2005 PIER Funds Invoiced, including \$18,366 PIER Fund retention released on Project 3.3, which had been issued a stop work order in May 2005.

During this reporting period, the following Project 0 task deliverables were completed and submitted to the Energy Commission: Task 0.3.1, *Critical Program Review Meetings* and Task 0.5.1, *Month Program and Project Status Reports*.

Table 3-1: Project 0 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
0.2.1	Public Presentation(s)	10/31/2005
0.3.1a	Critical Program Review Meeting	10/31/2005
0.5.1	Monthly Project and Program Status Reports through December 2004	10/31/2005

3.2.2 Project 1.1: Planning and Analysis

Work was limited on this Project during 2005 as the majority of task deliverables were submitted and invoiced earlier. The CE Team received Commission approval of the Task 1.1.10 *Prioritization Report* and the Task 1.1.11b *Project 1.1 Draft Final Report* in April 2005.

Table 3-2: Project 1.1 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
1.1.10	Pilot Project Prioritization Report	04/12/2005
1.1.11b	Draft and Final Project 1.1 Report	04/12/2005

3.2.3 Project 2.1: Enhanced Landfill Gas Production

In 2005 there was very limited project activity because this project was discontinued in June. The CE Team continued to review the comments received at the October 2004 *Technical Advisory Committee Project Wrap-up Meeting* along with the findings of the project as they relate to future bioreactor projects within the State of California. This review work was conducted as part of the measurement and evaluation activity for this project.

Table 3-3: Project 2.1 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
2.1.3a	Conceptual Design for First Bioreactor	04/12/2005
2.1.3b	Prepare Test and Construction and Plans for the Second Bioreactor	04/12/2005

3.2.4 Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines

Efforts were focused on the gas cleaning system design, with installation activities that were begun in December 2004, continued through August. Design documents provided to and reviewed by equipment suppliers and delivery and installation arrangements were made. Efforts on the biological scrubbing continued in conjunction with Project 3.1, as the biological gas cleaning will be undertaken on gas produced by the manure digester and are a direct result of the European technology review conducted under Project 3.1.

Chillers were installed for the moisture and siloxane removal system. The water vapor and siloxane removal systems were largely installed although difficulties arose in the media placement and some valve and system modifications were required. The vessel for

housing the media was loaded and initial testing began in late May. The drying and siloxane removal systems went through some modifications in July and August as a result of problems found during startup testing conducted in May and June. Startup testing of all three components of the gas cleaning system occurred in September and continued through December. The test results of operating the siloxane removal, moisture removal, and biological scrubbing systems were collected and analyzed and modifications were made to optimize performance. Additionally, metering system improvements and overall improvements to the gas system were made. Findings from the testing were summarized and presented at the annual technical briefing in November. Weekly coordination meetings involving CE Team staff and the IEUA were initiated in August because of the high level of activity under both Projects 2.2 and 3.1 at RP-1 and continued through the remainder of the testing period. A site visit was held in October involving Energy Commission, Commerce Team and Inland Empire Utilities Agency staff. This site visit reviewed progress on the gas cleaning activities at RP-1 including observation of the siloxane removal systems, moisture removal system, and the biological scrubber. This activity was conducted in conjunction with the Project 3.1 site visit.

Final arrangements were made with the contractor so that installation of the biological scrubbing system could begin in March. However, installation of the biological scrubbing system was delayed because of problems with the tank and arrangements were made to obtain a replacement. In addition, the vendor installation costs of the biological scrubber increased because of difficulties connecting to the gas cleaning system and the system necessitated a more expensive system than planned. This will cause the overall budget for this task to be exceeded. The vendor, plant site personnel, and engineer were coordinated with in order to install the equipment as cost-effectively as possible. Installation alternatives were assessed that may reduce the cost. Fabrication of the vessel for the biological scrubber initiated in May was completed in July. This was undertaken by the contractor who installed the chiller and siloxane removal system.

The baseline data collection activities continued through July in order to establish baseline concentrations of siloxanes, hydrogen sulfide, and moisture for the gas cleaning systems, and volatile solids, biogas production, and dewatering baseline data for the ultrasound system. The CE Team worked closely with IEUA host facility staff to coordinate data collection activity with operations. The data indicated unusually high siloxane concentrations and the source of siloxane during this period was investigated. This lengthened the baseline data collection period. Additionally, metering system improvements were tested and analyzed.

Ultrasound system operational data continued to be collected into May for the Sonico unit. The poor operating performance of the IWe Tech system continued in January and it was determined that the unit could not operate reliably. The vendor was contacted and it was

concluded that additional efforts to improve performance were not warranted. Its operation was curtailed in February and plans initiated to remove the IWe Tech unit and concentrate the remaining tests on the Sonico unit. Tests have indicated that both units are not producing the additional solids destruction or biogas production that had been anticipated. Analysis of the ultrasound operational data continued through December.

In January 2005 the *Draft First Quarterly Report* was submitted to the Commission. Comments made by Energy Commission staff on the *First Quarterly Report* will also be included in the subsequent reports. The *Second Quarterly Report* was submitted internally in June. The *Third Quarterly Report* was submitted in November. Efforts on the *Fourth Quarterly Report* continued with emphasis placed on summarizing the operating data for the ultrasound systems and incorporating information on the gas cleaning systems.

Efforts began in October on the *Project 2.2 Final Report*, including preparation of the outline and initial activity on the draft report. Findings on the ultrasound testing summarized for the annual technical briefing were also used in the efforts on the *Project 2.2 Final Report*. Efforts began in November on the Project 2.2 survey tool which will be used to interview project team members as well as other wastewater treatment plant and biogas experts within California in order to evaluate this project.

Table 3-4: Project 2.2 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
2.2.3a	Microturbine and Gas Cleaning Design and Construction Drawings	04/12/2005
2.2.4b	As-Built Drawings for the Installed Thermal Hydrolysis and Ultrasound Systems	04/12/2005

3.2.5 Project 3.1: Dairy Waste to Energy

Information related to the co-digestion system, including the preliminary results related to the bench scale testing, was considered in February to finalize the *Process Recommendation Report*. The *Process Recommendation Report* was submitted to the Commission in July, completing all Task 3.1.1 work.

Efforts on Task 3.1.2 focused on siting the power generation system equipment. This involved working closely with vendors including Ingersoll-Rand, whose 250 kW microturbine is well suited for co-digestion projects. The *Site Selection* report was submitted in July.

The Project team and IEUA staff determined what would be needed to modify the existing infrastructure at RP-1 to handle the increase in biogas production from the co-digestion

demonstration. These modifications were completed in December, and included improvements to the gas metering systems, improvements to the gas handling system, and modifying the electrical and I&C systems associated with the iron sponge. Also, the amount of biogas that could be expected from the different food wastes was quantified in order to size the proposed power project and ensure that the *Final Design and Test Plan* reflects the most recent results of the bench scale tests. An updated draft of *Conducting the Bench Scale and other Tests* was submitted to the Commission. Work on the *Final Design and Test Plan* included integrating the bench scale test results.

In early 2005, the concepts presented in the *Draft Tactical Marketing Plan* were further developed. In April, a meeting with the Commerce Team, IEUA, and Commission was held to review the *Tactical Marketing Plan* and discuss options for completing Project 3.1. The key outcome was identifying the need to further evaluate the relative locations of dairies, food processing plants, and sewage treatment plants with unused digester capacity. The Commerce Team developed an approach for completing this work which would be included as an addendum to the *Tactical Marketing Plan*. Dairies and food processing facilities data was collected and GIS analyses were done. The addendum was then submitted to the Commission for review.

The findings of the environmental benefits work were summarized in a report and distributed to the Task 3.1.6 technical peer review group and Energy Commission staff for review in January. In June, all comments on the Task 3.1.6 report had been received and the report was finalized, submitted, and approved by the Commission. Efforts were undertaken by the Commerce team to initiate activity of subcontractors including ERT, Environ, and Bob Spurgin and Associates on three tasks: 1) overview and update on the current status of PM10 emission reduction credits and equivalency determinations, 2) update and expand the ammonia quantification methodology and develop emission estimates for 2003-2004 based on actual site-specific data and new measurements, and 3) developing equivalent methodology for PM10 reductions including general modeling protocol. A draft work plan for this effort, identified as Task 3.1.6c, was prepared and circulated within the project team and the Energy Commission for comment and approval. At the June project meeting, Energy Commission staff approved this additional work. Efforts were undertaken on the report including the outline and the initial draft of the final report. The results of the previous tasks 3.1.6.0 through 3.1.6.6, 3.1.6.A and B were integrated into the draft report. The report also includes an economic analysis of the costs and benefits. Once the work on project 3.1.6.C is completed it will be integrated into the final report under Task 3.1.6.8.

As a result of the meetings held in April, May, and June involving Commission and CE Team staff, efforts continued on finalizing a revised work plan addressing co-digestion of manure and food processing waste, co-digestion of biosolids and food processing waste,

and gas cleaning. To better define this focus, several draft work plans were prepared, and Energy Commission comments incorporated. This revised statement of work also included the *Tactical Marketing Plan* and the additional environmental benefits work elements under Task 3.1.6. This was submitted to the Commission for approval. A draft report of all Project 3.1.3 elements was prepared for submittal to the Commission in July and in November the Task 3.1.3c *Final Dairy Waste to Energy Test Plan* was submitted. On August 19th, the Energy Commission indicated to the Commerce Team that the revised work plan could proceed without having to be brought before the policy committee. Once this decision was reached, it was recognized that considerable coordination activity was needed within the Commerce Energy Team and IEUA so that the Project implementation process could begin immediately. Coordination was also important because of potential air emission concerns attributed to the increased gas production from co-digestion. The testing approach was adjusted to ensure that air emission problems would not occur.

Project 3.1 began to be implemented in September in accordance with the revised statement of work. Modifications were made to the existing RP-1 facility to accommodate co-digestion activities, including adding tanks, piping, valves, and other changes to the manure digester and the other digesters processing biosolids to allow the injection of food waste. Operational and testing activities were undertaken in September and continued through December. These included baseline data collection for both the manure and biosolids testing programs and slug feeding some food wastes into the co-digestion process. Co-digestion suppliers were screened further and a preliminary assessment of the key parameters were reviewed and refined. Coordination activities were undertaken with the suppliers of the food waste being used in the co-digestion process, including wastes from salad oil and ice cream production. Discussions were held on both the amount and timing of the waste to be co-digested in order to avoid air emission problems related to increased gas production. Samples were collected and analyzed for the *Co-digestion Bench Scale Testing*.

The planned modifications to the iron sponge gas cleaning system were largely completed and media was placed in the system during a scheduled shutdown. Piping and other mechanical systems were installed and testing began. Construction plans for the electrical and I&C system were finalized and construction activities were undertaken by Ppc. Operational and testing activities were undertaken, including baseline data collection for both the manure and biosolids testing programs and slug feeding of some food wastes into the manure digestion process. Dewatering tests were also undertaken to assess the impact of co-digestion on overall process operation. Also, a site visit to IEUA's RP-1 was held in conjunction with activities on Project 2.2. Preliminary results were presented at the annual technical briefing in November.

For Task 3.1.9, pertinent interconnection practices and standards documents were reviewed and pertinent information was collected. In December, the draft Task 3.1.9a report was

submitted internally and the preliminary high penetration BI-PV and biogas scenarios were completed. Circuit maps and characteristics of mini-grid feeders were reviewed to select two feeders to enhance the model. The preliminary draft Task 3.1.9a report was written in November. In December, the detailed interconnection evaluation continued and efforts began on the draft Task 3.1.9b report. For Task 3.1.10, PSLF dynamic models were reviewed and typical data for machine and exciter representation was collected. Performance curves for PV arrays were collected and reviewed and information on large three phase inverters was looked for. The preliminary distribution system models for the dynamic study were developed and the dynamic evaluation began. Efforts also began on writing draft Task 3.1.10a report.

Efforts began in October on the report outline and the initial draft of the *Project 3.1 Final Report*. Efforts were initiated in November on the survey tool which will be used to interview the project team as well as wastewater treatment plants, dairies, and biogas experts within California in order to evaluate this project.

Table 3-5: Project 3.1 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
3.1.2	Site Selection Report	10/31/2005

3.2.6 Project 3.2: Building-Integrated Photovoltaics (BI-PV) Testing and Evaluation

Throughout 2005, the output and ambient conditions of the small and large PV systems were monitored. A problem was identified with the Xantrex 20208 inverters and Xantrex is working on a solution. Maintenance personnel at IEUA discovered that terminal boards mounted on the inductors in the two 20 kW Xantrex PV inverters were overheating and distorting. These connections were reworked but will likely need to be replaced in the next several months. The large and small system DAS were reprogrammed to not aggregate data in order to obtain data useful for analyzing inverter maximum power point tracking issues. The DAS were returned to original operating status after data was collected.

The *Six-month Exposure and Operation Reports* were submitted for both the small and large systems. The large system *12-Month Exposure and Operation Report* was submitted to the TAC and comments were received. A couple of rather probing questions have led to a more substantial distribution analysis that has taken time to reconcile. The small system *12-Month Exposure and Operation Report* and large system *12-Month Exposure and Operation Report* were both submitted for invoicing in November. Additionally, the project team submitted the *Small Systems Characterization Report* to the Commission for review. A paper for the ASES Solar World Conference 2005 conference was presented. The large system *Interim* report was refocused from a general status report to a topical report reviewing several

methods for improving the prediction of power output when computing the Performance index. The small system *Interim* report was refocused from a general status report to a topical report on maximum power point tracking control by inverters and was submitted to the TAC in December. The large system *Interim* report was submitted to for invoicing. Work continued on the *Consumer Confidence Guidelines* for the small and large systems.

Endecon presented Workshop #1 on advanced PV system design at the PVUSA solar power plant. Workshop #2 was held in November. Workshop #3 is now being held with Workshop #4 in November, and will be expanded to include a broader audience and the registration cost has been reduced per change order from the Energy Commission.

Table 3-6: Project 3.2 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
3.2.2a(6)	Six Month Exposure Report for Large Systems	04/12/2005
3.2.2b(3)	Initial Characterization Report for Small Systems	04/12/2005
3.2.3(2)	Web Page Updates – Monthly Through Contract End	03/01/2006
3.2.3(3)b	Technical Papers and Presentations	04/12/2005
3.2.2.b(6)	Six Month Exposure Report for Small Systems	07/08/2005
3.2.2a(9)	Consumer Confidence Guidelines for Large Systems	02/14/2006
3.2.2b (9)	Consumer Confidence Guidelines for Small Systems	02/14/2006
3.2.4.(1-2)	Project 3.2 Final Report	02/14/2006

3.2.7 Project 3.3: Building-Integrated Photovoltaic (BI-PV) on Public Facilities

REDI and Spectrum Energy awaited the Commission’s request to prepare a draft final report of six to 12 candidate sites for BI-PV installations. REDI and Spectrum Energy also prepared a document outlining actual costs to date for work on this task for final invoicing and closure of this project, based upon direction by the Commission. The stop-work order was received for this Project on May 31, 2005.

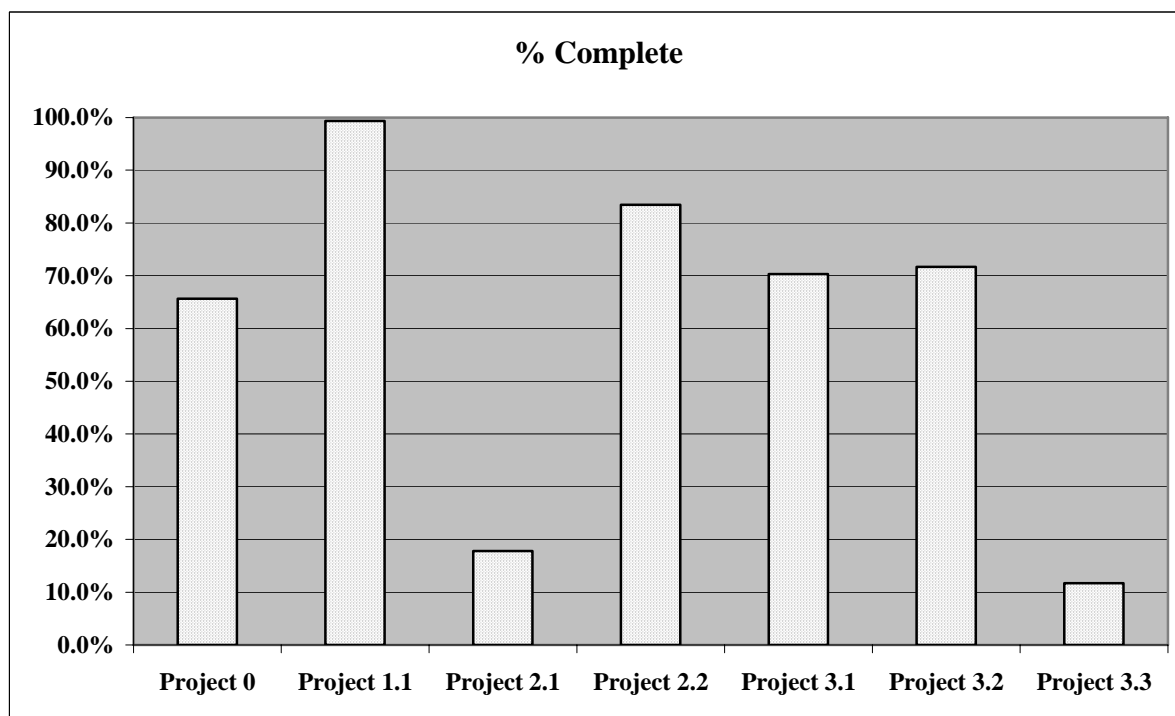
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Program Status Compared to Plan

4.1 Overview of Program Status

Figure 1 summarizes the overall Commerce Energy Program status for each project and identifies the active tasks as of the end of 2005.

Figure 1: Summary of Program and Project Status



4.2 Project Status

4.2.1 Project 0: Program Administration

At the end of 2005, this project was approximately 65% complete. Table 4-1 shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished between June 2002 and December 2005, as well as the status of each. The bolded tasks were completed and/or worked on in 2005.

Table 4-1 Overview of Project 0 Status by Deliverable

Task No.	Description	Start Date		Due Date		Status (%)
		Planned	Actual	Planned	Actual	
0.2.1	Public Presentation(s)	TBD	07/18/03	TBD	10/31/05	100%
0.2.5a	Identify Required Permits	06/05/02	11/01/05	11/26/03	In Process	10%
0.2.5b	Obtain Required Permits	06/05/02	11/01/05	11/26/03	In Process	5%
0.3.1a	Critical Program Review Meeting	06/05/02	12/01/03	11/26/03	10/31/05	100%
0.5.1	Monthly Project and Program Status Reports through December 2005	06/21/02	06/21/02	03/31/06	10/31/05	100%
0.5.2	2 Annual Reports	09/18/02	12/01/04	02/15/05	In Process	75%
0.8	Project Specific Administrative Tasks	06/02/02	06/02/02	10/31/05	In Process	95%

Planned work that was not completed included the documentation of the required permits and submittal of the Annual Reports. These deliverables, as well as any remaining deliverables will be completed in early 2006.

4.2.2 Project 1.1: Planning and Analysis

All of the Project 1.1 Task Deliverables were submitted during the reporting period.

4.2.3 Project 2.1: Enhanced Landfill Gas Production

At the end of 2005, this project was nearly 20% complete. Project 2.1 ceased in July 2004 due to the need for San Bernardino County to proceed with their liner extension at Mid-Valley on schedule. The last task to be completed is Task 2.1.7, *Measurement and Evaluation*, which will be completed in early 2006. Minimal work was done on this task during 2005.

4.2.4 Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines

At the end of 2005, this project was over 80% complete. Table 4-2 shows the planned and actual start and due dates for the Project task deliverables that were scheduled to be accomplished between June 2002 and December 2005, as well as the status of each. The bolded tasks were completed and/or worked on in 2005.

Table 4-2 Overview of Project 2.2 Status by Deliverable

Task No.	Description	Start Date		Due Date		Status (%)
		Planned	Actual	Planned	Actual	
2.2.1	Process Selection	01/24/02	01/24/03	09/04/03	11/10/03	100%
2.2.2	Site Selection and Test Plan	02/15/02	10/15/03	10/26/03	3/31/04	100%
2.2.3.a	Design Gas Cleaning System	02/15/02	11/10/03	11/24/03	11/12/04	100%
2.2.3.b	Design Ultrasound Systems	02/15/02	11/10/03	11/24/03	6/23/04	100%
2.2.4.a	Install Gas Cleaning System	12/5/03	12/4/04	5/21/04	In Process	95%
2.2.4.b	Install Ultrasound System	12/5/03	6/1/04	5/21/04	11/09/04	100%
2.2.5.a	First Quarterly Report	6/20/04	6/1/04	8/20/04	In Process	95%
2.2.5.b	Second Quarterly Report	8/20/03	9/1/04	11/19/04	In Process	95%
2.2.5.c	Third Quarterly Report	11/20/03	3/15/05	2/20/04	In Process	95%
2.2.5.d	Fourth Quarterly Report	6/20/04	7/5/05	8/20/05	In Process	80%
2.2.6	Final Report	10/10/03	9/20/05	12/17/05	In Process	50%
2.2.7	Coordinate with RPAC	01/24/02	2/1/03	01/16/06	In Process	95%
2.2.8	Evaluate Project	8/24/05	11/15/05	1/1/06	In Process	20%

Project deliverables that were not completed in 2005 will be completed in early 2006. Besides project deliverables, other planned work included testing the ultrasound systems, testing the challenges associated with installing the biological hydrogen sulfide scrubber, and continuing the weekly meetings with IEUA. All of this work was completed.

4.2.5 Project 3.1: Dairy Waste to Energy

At the end of 2005, this project was approximately 70% complete.

Table 4-3 shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished between June 2002 and December 2005, as well as the status of each. The bolded tasks were completed and/or worked on in 2005.

Table 4-3 Overview of Project 3.1 Status by Deliverable

Task No.	Description	Start Date		Due Date		Status (%)
		Planned	Actual	Planned	Actual	
3.1.1a(1)	Technical Memorandum Comparing Plug Flow and Complete-Mix Digestion Performance & Economics	01/24/02	04/04/03	06/27/03	06/27/03	100%
3.1.1a (2)	Preliminary Draft Process Recommendation Report	01/24/02	04/04/03	10/25/03	8/6/04	100%
3.1.1a (3)	Draft Processes Recommendations Report	01/24/02	10/30/04	11/18/03	In Process	95%
3.1.1.b	Assess Evaluate, and Select Animal Waste to Energy Technology	01/24/02	10/30/04	01/17/04	In Process	95%
3.1.2a & b	a) Site Selection and b) Tactical Marketing Plan	01/24/02		12/20/03	In Process	95%
		10/20/04	10/18/04	1/15/04	Process	95%
3.1.3a	Bench Scale and Other Test Plan and Protocols	03/25/02	04/04/03	09/10/03	In Process	95%
3.1.3b	Conduct Bench Tests	7/14/03	10/18/04	12/5/03	In Process	95%
3.1.3c	Design Memorandum and Draft and Final Test Plans	11/20/03	9/16/04	4/8/04	In Process	95%
3.1.4	Task 3.1.4: Construct Pilot (Demonstration) Plant(s)	5/13/04	5/28/05	8/16/05	In Process	95%
3.1.5	Task 3.1.5: Operate and Test Pilot (Demonstration) Plant(s)	7/12/04	9/12/05	9/1/05	In Process	75%
3.1.6.0 through 3.1.6.6	Conduct Economic and Environmental Assessment – Environmental Benefits Task	07/12/05	12/15/04	12/13/05	08/28/05	100%
3.1.6.A	Renewable Energy Credit Workshop	9/1/04	8/13/05	9/1/04	In Process	95%
3.1.6.B	Review Dairy Waste Methodology	12/1/03	5/17/05	6/1/04	In Process	95%
3.1.6.C	Ammonia/PM 10 Methodology	06/15/05	6/15/05	1/11/06	In Process	90%
3.1.6.7	Conduct Draft Economic and Environmental Analysis	9/15/05	9/15/05	1/15/06	In Process	0%

Table 4-3 Overview of Project 3.1 Status by Deliverable (continued)

Task No.	Description	Start Date		Due Date		Status (%)
3.1.7	Prepare Final Report for Project 3.1	11/30/05	9/1/05	3/10/06	In Process	40%
3.1.9	Perform Detailed Distribution Interconnection Study	9/5/05	12/31/05	3/12/06	In Process	0%
3.1.10	Dynamic Study of Three BI-PV and Biogas High-Penetration Scenarios	10/20/05	11/15/06	3/4/06	In Process	
3.1.11	Evaluate Project	11/15/05	11/15/05	3/10/06	In Process	20%

Delays in the previous reporting period include a lag time between report submittals due to the *Test Plan and Protocols Report* building on the *Digester Comparison Report*. The CE team began working with IEUA to seek cost information and environmental and economic benefits of the project. This is being addressed earlier than planned and will cause some minor delays in other tasks. Deliverables that were not completed in 2005 will be completed in early 2006.

Besides project deliverables, other planned work included submitting and implementing the revised work plan, holding a meeting to discuss the comments on the *Tactical Marketing Plan* and its relationship to proposed co-digestion efforts, holding weekly meetings with IEUA, installing and testing an enhanced iron sponge system, improving the materials and gas handling systems, and participating in the annual technical briefing. All of this work was completed.

4.2.6 Project 3.2: Building-Integrated Photovoltaics (BI-PV) Testing and Evaluation

At the end of 2005, this project was approximately 70% complete.

Table 4-4 shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished between June 2002 and December 2005, as well as the status of each. The bolded tasks were completed and/or worked on in 2005.

Table 4-4 Overview of Project 3.2 Status by Deliverable

Task No.	Description	Task Start Date		Task Due Date		Status (%)
		Plan	Actual	Plan	Actual	
3.2.1	BI-PV Evaluation Test Plan	6/20/02	07/01/02	07/20/02	12/20/02	100%
3.2.2a (1)	Large Systems Site Selection Permitting & Acquisition	7/5/2002	8/1/2002	08/31/03	2/26/04	100%
3.2.2a (2)	LS: DAS Letter	07/05/02	07/05/02	03/03/03	5/16/03	100%
3.2.2a (3)	LS: 1 st System Report	07/05/02	07/05/02	10/31/03	4/07/04	100%
3.2.2a (4)	LS: 2 nd System Report	07/05/02	07/05/02	10/31/03	5/25/04	100%
3.2.2a (5)	LS: 3 rd System Report	07/05/02	07/05/02	10/31/03	9/22/04	100%
3.2.2a (6)	6-Month Exposure and Operation Report	07/15/03	9/1/04	07/01/04	3/10/05	100%
3.2.2a (7)	Interim Report on Large Systems Progress	07/15/03	9/1/04	03/01/04	8/10/05	100%
3.2.2a (8)	12-Month Exposure and Operation Report	07/15/03	3/1/05	07/01/04	11/2/05	100%
3.2.2a (9)	Consumer Confidence Guidelines Report	08/30/05	08/30/05	12/30/05	In Process	99%
3.2.2b (1)	SS: Site Selection, Permitting & Acquisition	8/4/2002	8/1/2002	11/17/03	4/16/04	100%
3.2.2b (2)	SS: DAS Letter	08/04/02	08/04/02	12/31/03	4/07/04	100%
3.2.2b (3)	SS: 1 st System Report	08/04/02	08/04/02	1/29/04	11/08/04	100%
3.2.2b (4)	SS: 2 nd System Report	08/04/02	08/04/02	1/29/04	11/08/04	100%
3.2.2b (5)	SS: 3 rd System Report	08/04/02	08/04/02	1/29/04	11/08/04	100%
3.2.2b (6)	6-Month Exposure and Operation Report	01/29/04		06/02/05	06/02/05	100%
3.2.2b (7)	Interim Report on Small Systems Progress	01/29/04		11/1/05	In Process	99%
3.2.2b (8)	12-Month Exposure and Operation Report	09/29/04		10/1/05	11/30/05	100%
3.2.2b (9)	Consumer Confidence Guidelines Report	09/29/04		12/30/05	12/30/05	100%
3.2.3.1	Initial Web Design	07/05/02	08/01/05	10/31/03	4/07/04	100%
3.2.3.3a	Paper #1	03/01/03	03/01/03	04/07/04	4/07/04	100%
3.2.3.3b	Paper #2	03/31/03	03/31/03	2/28/04	3/09/05	100%
3.2.3.4a	Workshop #1	9/12/05	9/12/05	9/14/05	9/14/05	100%
3.2.3.4b	Workshop #2	11/3/05		11/5/05	11/5/05	100%
3.2.3.4c	Workshop #3	11/30/05	11/30/05	12/2/05	12/2/05	100%

Table 4-4 Overview of Project 3.2 Status by Deliverable (continued)

Task No.	Description	Task Start Date		Task Due Date		Status (%)
3.2.3.4d	Workshop #4	See 3.2.3.4c		See 3.2.3.4c		See 3.2.3.4c
3.2.4a	Draft Final Report	1/3/06	2/7/06	1/3/06	2/13/06	100%
3.2.4b	Final Report	2/7/06	2/7/06	3/17/06	In Process	99%
3.2.5	RPAC Meeting #3	03/28/06	03/28/06	3/28/06	In Process	50%
3.2.5	RPAC Meeting #4	03/30/06	03/30/06	3/30/06	In Process	50%

The project schedule was delayed in the previous reporting period due to negotiations and related contract approvals in relation to the Commonwealth-IEUA Power Purchase Agreement, as well as approval of the purchase orders and SGIP Incentives reservation request to SCE for the 60kW systems. This delay has had an effect on subsequent tasks within this project. A key personnel redirection at REDI delayed progress in 2004; this was resolved in October 2004. There were no delays in 2005. Project deliverables that were not completed in 2005 will be completed in early 2006.

Besides project deliverables, other planned work for 2005 included monitoring the output and ambient conditions of the small and large systems and presenting a paper at the American Solar Energy Society 2005 Conference. All of this work was completed.

4.2.7 Project 3.3: Building-Integrated Photovoltaic (BI-PV) on Public Facilities

At the end of 2005, this project was approximately 10% complete.

Table 4-5 shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished between June 2002 and December 2005, as well as the status of each task. The bolded tasks were completed and/or worked on in 2005.

Table 4-5: Summary of Project 3.3 Status by Deliverable

Task No.	Description	Task Start Date		Task Due Date		Status (%)
		Planned	Actual	Planned	Actual	
3.3.1.a	Compile Database of Public Sector Clients	6/20/02	6/20/02	7/20/02	DR: 08/06/02 FR: 08/21/02	100%
3.3.1.b	Compile Database of BI-PV Equipment Vendors and Service Provider	6/20/02	6/20/02	7/20/02	DR: 08/06/02 FR: 08/21/02	100%
3.3.2	Develop Evaluation Tools and Test Plan	8/19/02	8/19/02	09/12/03	DR: 08/28/03 FR: 03/02/04	100%
3.3.4a	Identify and Select Demonstration Project Sites	11/11/02	4/17/02 Restarted 9/15/04*	10/27/03	DR: 07/15/03	*95%
3.3.6	Coordinate with RPAC	06/20/02		03/31/06	In Process	20%

Note: "Planned" dates per revised Program Schedule submitted to Commission on September 17, 2003.

"Actual" dates include both the draft report (DR) date (above) and the final report (FR) date (below) where appropriate. Project 3.3.4a was restarted, and the percentage shown is based upon the "restart" date

The project was delayed in the previous reporting period due to multiple outside technical review and revisions to the *Evaluation Tools Package (ETP)*. The final draft deliverable has been revised and resubmitted to the Commission. Additionally, the delays in the *Large Systems Testing* task under Project 3.2 have affected the schedule for Task 3.3.4. A "stop-work" order was received for this Project in May 2005; therefore, the remaining tasks will not be completed.

5

Program Challenges and Changes

5.1 Overview of Program Challenges and Changes

Challenges in 2005 included operational problems with the ultrasound units, sampling and installation issues for the gas cleaning systems, co-digestion producing more biogas than expected, and Project 3.3 being discontinued.

5.2 Project Challenges and Changes

5.2.1 *Project 0: Program Administration*

Challenges encountered in Project 0 during the 12 months of this reporting period were limited and were associated with project and task budget reallocations: Exhibit B, revisions to the work scope: Exhibit A, and execution of the Prime Contract Change Order, which provided a time extension and the revisions to budget and scope. Any and all challenges were resolved, and did not unduly impact the effectiveness or the schedule of the Program.

5.2.2 *Project 1.1: Planning and Analysis Project*

There were no challenges or changes to Project 1.1 during 2005.

5.2.3 *Project 2.1: Enhanced Landfill Gas Production Project*

In July 2004, San Bernardino County chose to proceed with the construction of the Unit 3 liner project in order to ensure that the liner extension construction would occur this summer. As the County could not delay their decision, the PIER CE bioreactor project was stopped without including the bioreactor elements. *Measurement and Evaluation* is only remaining task on this project, and that will be completed in early 2006.

5.2.4 *Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Project*

The Sonico and IWE Tech ultrasound units, which were installed to enhance anaerobic digestion at Riverside, did not operate reliably. The IWE Tech unit was down 69 percent of the time and therefore plans were made to remove the IWE unit before testing was complete. The Sonico unit was more reliable than the IWE Tech unit. Another advantage for the

Sonico system was that a company representative was more accessible, however, IWE Tech is located in Germany and this made it more difficult to solve operational problems.

Difficulties were also encountered with the gas cleaning system, including an unforeseen increase in the siloxane levels during the baseline period and problems installing the H₂S biological scrubbing system. The baseline period was extended in order to establish a reliable baseline concentration for siloxane. The start-up of the biological gas scrubber system was delayed and vendor installation costs of the biological scrubber increased because of difficulties associated with interconnection into the gas cleaning system and the associated system requirements necessitated a more expensive system than planned. This caused the overall budget for this task to be exceeded.

5.2.5 Project 3.1: Dairy Waste to Energy Project

An addendum to the *Tactical Marketing Plan* was initiated in April and completed in May. The addendum included a proximity analysis of dairies and food processing facilities in relation to wastewater treatment plants.

The initial co-digestion test involved slug-feeding the food waste into the digester and this produced large spikes in biogas production because the operators slug-fed all of the food waste at once instead of gradually. This burdened the gas system, affected engine operation, and created problems associated with air emissions. The problem was solved by installing an automated feeder, however, air emission and safety concerns prevented the full-scale test from proceeding.

5.2.6 Project 3.2: Building-Integrated Photovoltaics (BI-PV) Testing and Evaluation Project

A change in focus on the *Interim* reports in June delayed completion. The Project 3.2 Team worked with contract administration in August to move funds from another project to Task 3.2.3 (2) *Web Updates* to allow monitoring the small and large systems and hosting the web site to continue. This activity should continue without delay. All other work is proceeding on schedule.

5.2.7 Project 3.3: Building-Integrated Photovoltaic (BI-PV) on Public Facilities Project

A delay in project timeline occurred while REDI and Spectrum Energy awaited a response to their report and the status of overall project work and costs incurred to date, information which was requested by the Energy Commission staff in November of 2004. Additionally, the Energy Commission was reviewing the overall project objectives along with the remaining time to determine the direction of the project and whether to conclude or to go forward with the project. In May 2005, a stop-work order was received and all work on this

project has ceased. Although the Project 3.3 Team was ready to move ahead with the project, many deliverables were held up in the review process, causing significant project delays, which would have prevented the project from being completed within the Program time-frame.

6

Program Expected Accomplishments

6.1. Overview of Program Expected Accomplishments

This section describes the expected accomplishments for the PIER Commonwealth Program on a project-by-project basis for January 2006 through the Program end, March 31, 2006. All remaining task deliverables will be submitted by March 31. The results of the deliverables expected to be accomplished in 2006 can be found at <http://www.pierminigrid.org>.

6.2. Project Expected Accomplishments

6.2.1 Project 0: Program Administration

Work will continue on the PIER Program *1st Annual Report* and *2nd Annual Report*. Project Monthly Status Reports will be drafted for all projects and Monthly Program Status reports will be submitted to the Commission and posted on the Commonwealth PIER Mini-Grid Program Web-Site. These reports will continue through March 2006. Work will begin on the Task 0.6 *Final Program Report*. Other Project 0 tasks that will be wrapped up include Task 0.2.5 *Identify and Obtain Required Permits*, Task 0.4 *Annual Technical Briefings*, and Task 0.8 *Project Specific Administrative Tasks*. Also, a *Final Program Meeting* will be held near the end of March.

Table 6-1: Project 0 Anticipated Submittal Dates for Deliverables by Task

Task Number	Deliverable	Anticipated Submittal Date
0.2.5	Identify, Obtain and Document Required Permits	03/01/2006
0.8	Program Specific Administrative Tasks Report	03/07/2006
0.5.1	Monthly Project and Program Status Reports through March 2006	03/16/2006
0.6.1	Final Program Report	03/13/2006
0.7	Final Program Review Meeting	03/28/2006
0.4	Annual Technical Briefing Report	03/20/2006
0.3.2	Two Public Workshops	03/30/2006

6.2.2 Project 1.1: Planning and Analysis Project

Task 1.1.13, *Measurement and Evaluation Plans*, is the only remaining deliverable for this Project. The Project Team plans to submit this report in January 2006 to enable *Measurement and Evaluation* tasks on the other projects to proceed.

Table 6-1: Project 1.1 Anticipated Submittal Dates for Deliverables by Task

Task Number	Deliverable	Anticipated Submittal Date
1.1.12	Critical Project Review Meeting	02/17/2006
1.1.13	Final Measurement and Evaluation Plans Report	03/07/2006

6.2.3 Project 2.1: Enhanced Landfill Gas Production Project

Activities will be limited, with only the review of results and findings as they relate to future bioreactor projects in California, remaining. This *Key Learnings* effort identified in the project wrap-up meeting will be conducted as a component of the Task 2.1.7 *Measurement and Evaluation* activity for this Project. Surveys will be drafted and interviews will be held with TAC members and project team members to evaluate the project.

Table 6-1: Project 2.1 Anticipated Submittal Dates for Deliverables by Task

Task Number	Deliverable	Anticipated Submittal Date
2.1.7	Measurement and Evaluation	03/24/06

6.2.4 Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Project

Remaining deliverables on this project include all of the *Quarterly Data Reports* under task 2.2.5, a *Final Project Report* for Task 2.2.6, and Task 2.2.8 *Measurement and Evaluation* report. Work began on each of these tasks in 2005 and will be completed by mid-March.

Table 6-1: Project 2.2 Anticipated Submittal Dates for Deliverables by Task

Task Number	Deliverable	Anticipated Submittal Date
2.2.4a(1)	Letter of Notification of Installation of Microturbine and Gas Cleaning systems	03/10/2006
2.2.5a	First Quarterly Report	03/06/2006
2.2.5b	Second Quarterly Report	03/06/2006
2.2.5c	Third Quarterly Report	03/20/2006

Table 6-1: Project 2.2 Anticipated Submittal Dates for Deliverables by Task (continued)

Task Number	Deliverable	Anticipated Submittal Date
2.2.5d	Fourth Quarterly Report	03/20/2006
2.2.5e	Fifth Quarterly Report	03/20/2006
2.2.6b	Draft Optimization of Anaerobic Digestion Report	03/10/2006
2.2.8	Measurement and Evaluation	03/24/06

6.2.5 Project 3.1: Dairy Waste to Energy Project

Many deliverables remain for Project 3.1. The *Assess, Evaluate, and Select Animal Waste to Energy Technology* and the *Prepare Pilot Plant Final Design and Dairy Waste to Energy Project Test Plan* will be updated and submitted. Task 3.1.4 *Construct Pilot Plant* letters of notification and site drawings will be submitted. Task 3.1.5 *Operate and Test Pilot Plant* bi-monthly reports will be completed. The Task 3.1.6 *Conduct Economic and Environmental Assessment* will be updated to discuss the conversion of ammonia emissions to particulates. A *Final Project Report* will be completed for Task 3.1.7. A *Detailed Distribution Interconnection Study* and a *Dynamic Study* will be completed for Tasks 3.1.9 and 3.1.10. Finally, surveys will be completed and interviews will be held in order to evaluate this project for Task 3.1.11.

Table 6-2: Project 3.1 Anticipated Submittal Dates for Deliverables by Task

Task Number	Deliverable	Anticipated Submittal Date
3.1.1b	Final Processes Recommendations Report	03/08/2006
3.1.3b	Bench Scale Test Results	03/08/2006
3.1.3c	Pilot Plans Design Memorandum	03/08/2006
3.1.4a (1)	Letter of Notification Pilot Scale Reactor Installed	03/03/2006
3.1.4a (2)	Letter of Notification Gas Recovery System Installed	03/03/2006
3.1.4c	Construction and Site Drawings for Pilot Plants	03/06/2006
3.1.5	July 2005 – December 2005 Monthly Co-Digestion Plant Operating Data Reports	02/27/2006 – 03/17/2006
3.1.6b	Dairy Emission Methodology Report	03/02/2006
3.1.6c(1-4)	Ammonia Methodology Report	02/24/2006
3.1.6a	Renewable Energy Credit Workshop	03/09/2006
3.1.6 (7)	Draft Economic and Environmental Analysis Report	03/14/2006
3.1.7b	Project 3.1 Draft Final Report	03/10/2006
3.1.8	Critical Project Review Meeting	03/22/2006
3.1.9a	Interconnection Requirements and Issues Report	02/09/2006

Table 6-2: Project 3.1 Anticipated Submittal Dates for Deliverables by Task (continued)

Task Number	Deliverable	Anticipated Submittal Date
3.1.9b	High-Penetration Renewable Scenario Report	02/21/2006
3.1.9c	Interconnection Study Results Report	03/02/2006
3.1.10a	Distribution System Characteristics Report	03/01/2006
3.1.10b	Dynamic Study Results Report	03/01/2006
3.1.11	Measurement and Evaluation	03/24/06

6.2.6 Project 3.2: Building-Integrated Photovoltaics (BI-PV) Testing and Evaluation Project

Remaining deliverables on this project include Task 3.2.2 *Consumer Confidence Guidelines*, Task 3.2.4 *Final Project Report*, and Task 3.2.6 *Measurement and Evaluation*. Each of these tasks was begun in 2005 and will be completed by mid-March.

Table 6-3: Project 3.2 Anticipated Submittal Dates for Deliverables by Task

Task Number	Deliverable	Anticipated Submittal Date
3.2.3(2)	Web Page Updates – Monthly Through Contract End	03/01/2006
3.2.2a(9)	Consumer Confidence Guidelines for Large Systems	02/14/2006
3.2.2b (9)	Consumer Confidence Guidelines for Small Systems	02/14/2006
3.2.4.(1-2)	Project 3.2 Final Report	02/14/2006
3.2.6	Measurement and Evaluation	03/24/06

6.2.7 Project 3.3: Building-Integrated Photovoltaic (BI-PV) on Public Facilities Project

No further work will be done on this project, as a stop-work order was received on May 31, 2005.

7

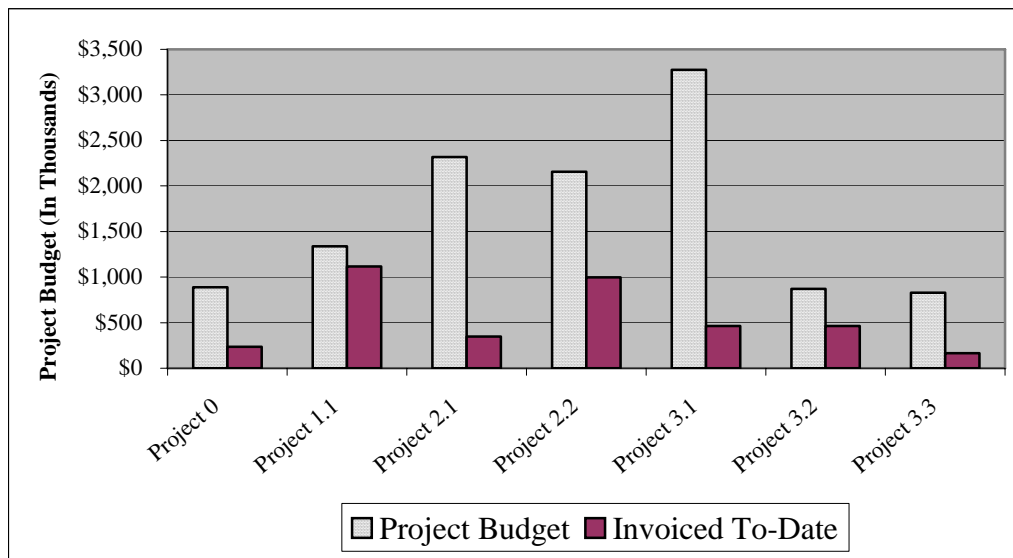
Program Milestones and Deliverables

7.1 Overview of Program Milestones and Deliverables

This section presents an overview of milestones reached and deliverables invoiced on a Program-wide level, and by project, for the 12-month reporting period ending December 31, 2005. Additionally, Figure 7-1 illustrates the completed task deliverables as invoiced through December 31, 2005. Additionally, Table 7-1 through Table 7-7 detail deliverables by Project, as invoiced-to-date through December 31, 2005.

The overall contract budget for the PIER Commerce Energy Program is \$11,688,572. During this reporting period, \$2,065,478 in task deliverables were submitted and \$1,858,931 invoiced¹ through December 31, 2005, representing 32% of the total cumulative contract budget invoiced *to date*. During the *reporting period*, 15.9% of the total contract budget was invoiced.

Figure 7-1: Invoiced To-Date through December 2005



¹ The \$206,548 difference represented the contractually required 10% withholding, which will be invoiced/release at either the completion of a specific project, and/or once the Annual Program report has been submitted, approved and invoiced

7.2 Project Milestones and Deliverables

7.2.1 Project 0: Program Administration

As shown in Table 7-1, four deliverables were invoiced for Project 0 during the 12- month reporting period ending December 31, 2005.

Table 7-1: Project 0 Program Administration – Task Deliverables Invoiced

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
0.2.1	Public Presentations	\$18,465	17	10/31/2005	\$1,846	\$16,619
0.3.1a	First Critical Program Review Meeting	\$67,462	17	10/31/2005	\$6,746	\$60,716
0.3.2a	2 RPAC Meetings	\$18,608	17	10/31/2005	\$1,861	\$16,747
0.5.1	Monthly Project and Program Status Reports through December 2004	\$108,158	17	10/31/2005	\$10,816	\$97,342
TOTAL		\$212,693			\$21,269	\$191,424

7.2.2 Project 1.1: Planning and Analysis Project

Table 7-2: Project 1.1 Program Administration – Task Deliverables Invoiced

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
1.1.10	Prioritized List of Pilot Projects Report	\$179,132	14	04/12/2005	\$17,913	\$161,219
1.1.11b	Project 1.1 Draft Final Report	\$114,046	14	04/12/2005	\$11,405	\$102,641
TOTAL		\$293,178			\$29,318	\$263,860

7.2.3 Project 2.1: Enhanced Landfill Gas Production Project

Table 7-3: Project 2.1 Enhanced Landfill Gas Production – Task Deliverables Invoiced

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
2.1.3a	Conceptual Design for First Bioreactor	\$243,578	14	04/12/2005	\$24,358	\$219,220
2.3.3b	Test and Construction Plans for First Bioreactor	\$92,334	14	04/12/2005	\$9,233	\$83,101
TOTAL		\$335,912			\$33,591	\$302,321

7.2.4 Project 2.2: Enhanced Energy Recovery through Optimization of Anaerobic Digestion and Microturbines Project

Table 7-4: Project 2.2 Enhanced Energy Recovery – Task Deliverables Invoiced

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
2.2.3a	Microturbine and Gas Cleaning System Design and Construction Drawing	\$242,995	14	04/12/2005	\$24,299	\$218,696
2.2.4b	As-Built Drawings for Installed Thermal Hydrolysis and Ultrasound System Design and Construction Drawings	\$229,585	14	04/12/2005	\$22,959	\$206,627
TOTAL		\$472,580			\$47,258	\$425,323

7.2.5 Project 3.1: Dairy Waste to Energy Project

Table 7-5: Project 3.1 Dairy Waste to Energy – Task Deliverables Invoiced

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
3.1.1a(3)	Draft Process Recommendations Report	\$120,706	14	04/12/2005	\$12,071	\$108,635
3.1.6.0-3.1.6.6	Identify Peer Review Group and Evaluate	\$91,910	16	07/08/2005	\$9,191	\$82,719
3.1.2	Site Selection Report	\$171,240	17	10/31/2005	\$17,124	\$154,116
TOTAL		\$383,856			\$38,386	\$345,470

7.2.6 Project 3.2: Building-Integrated Photovoltaics (BI-PV) Testing and Evaluation Project

Table 7-6: Project 3.2 Building-Integrated PV Testing and Evaluation – Task Deliverables Invoiced

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
3.2.2a (6)	Six Month Exposure Report for Large Systems	\$25,000	14	04/12/2005	\$2,500	\$22,500
3.2.2.b (3)	Initial Characterization report for First Small System	\$97,500	14	04/12/2005	\$9,750	\$87,750
3.2.3. (2)	Monthly WebPage Updates	\$14,700	14	04/12/2005	\$1,470	\$13,230
3.2.3.3 (b)	Technical Paper	\$18,000	14	04/12/2005	\$1,800	\$16,200
3.2.2.b (6)	Six Month Operational Report for Small Systems	\$25,000	16	07/08/2005	\$2,500	\$22,500
3.2.3. (2)	Monthly WebPage Updates	\$4,200	16	07/08/2005	\$420	\$3,780
3.2.2a (7)	Interim Report on Large Systems Progress	\$20,000	17	10/31/2005	\$2,000	\$18,000
3.2.2.a (8)	12-Month Exposure and Operational Report on Large Systems	\$25,000	17	10/31/2005	\$2,500	\$22,500
3.2.3. (2)	Monthly WebPage Updates	\$4,200	17	10/31/2005	\$420	\$3,780
TOTAL		\$233,600			\$23,360	\$210,240

7.2.7 Project 3.3: Building-Integrated Photovoltaic (BI-PV) on Public Facilities Project

Table 7-7: Project 3.3 Building-Integrated PV on Public Facilities – Task Deliverables Invoiced

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
3.3.4a	Demonstration Site Selection Report	\$133,659	15	06/02/2005	\$13,366	\$120,293
TOTAL		\$133,659			\$13,366	\$120,293