

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

First Annual Program Report

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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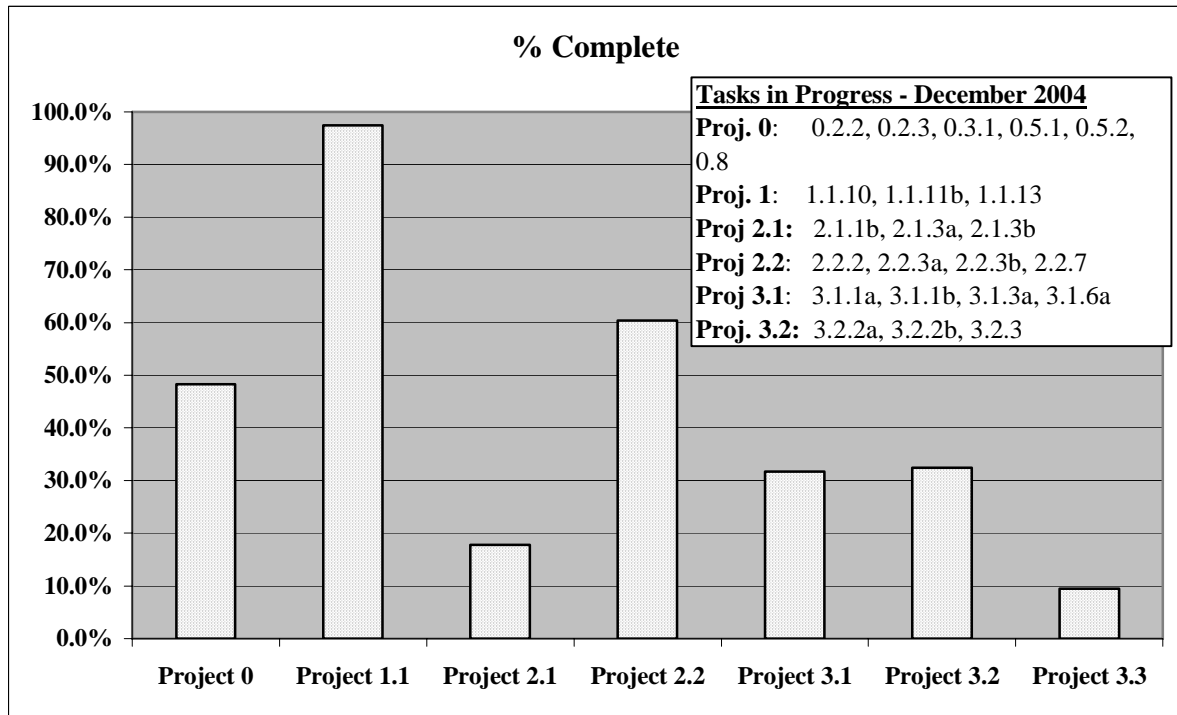
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Executive Summary

During the first annual reporting period, many deliverables were completed beginning in Mid-June 2002 through December 2004, as shown in Figure ES-1. Two of the PIER Commerce Energy (CE) Projects, were issued stop work orders: Project 2.1 was discontinued due to a timeline that was necessary to be met by the landfill and which could not be met if the bioreactor was to be included. 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.

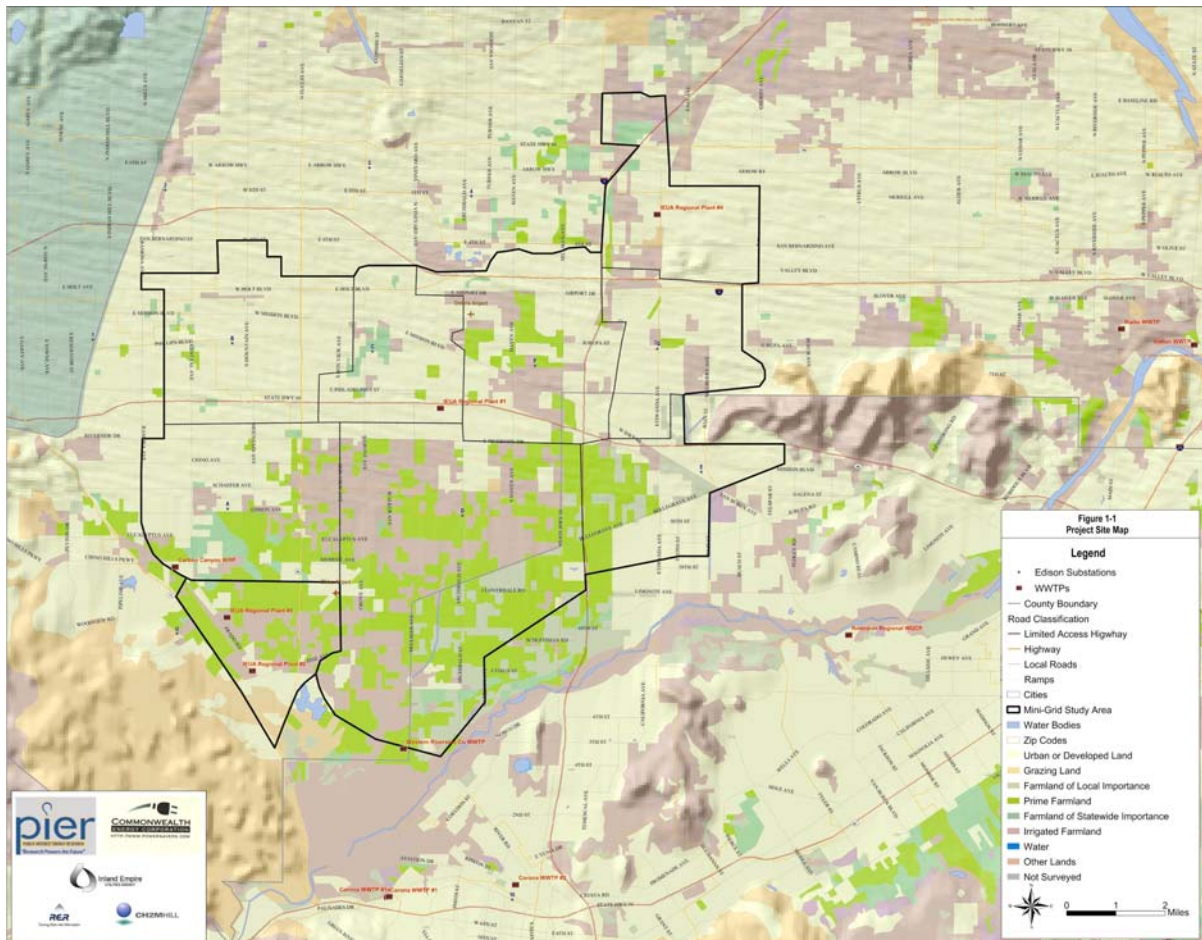
Figure ES-1 Summary of Program and Project Status



Project 0: *Program Administration*, was approximately half-way complete at the end of 2004. Major tasks completed include monthly status and program reports from June 2002 through December 2004, a prominent PIER CE website to display the Program results (<http://www.pierminigrd.org>), identification, recruitment and finalization of the Renewables Program Advisory Committee (RPAC) members and Project Technical Advisory Committee (TAC) members, and the finalization of CE Team sub-contractor agreements.

Project 1.1, *Program Planning and Analysis*, was close to completion at the end of 2004. Under Project 1.1, the Program mini-grid was defined, crucial data compiled, potential renewable energy sources were quantified, generation profiles created, and potential projects were prioritized by market potential. This work was fundamental to Projects 2.1, 2.2, 3.1, 3.2, and 3.3, which could not be implemented until Project 1.1 results were obtained. The Program mini-grid is outlined in black on the map in Figure ES-2.

Figure ES-2: Mini-Grid Map



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 deliverable, the *Landfill Feedstock Characterization Report*, was completed prior to this decision. A meeting was held with the Project 2.1 TAC members after this decision was made in order to discuss lessons learned and why the project was closed. 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 50 percent complete at the end of 2004. Work completed includes selection of the technologies to test that will enhance anaerobic digestion and that will clean the biogas, selection of the sites for the tests, development of the test plan for each technology, development of the gas cleaning systems and ultrasound systems designs, and installation of the ultrasound systems. The gas cleaning systems installation and baseline testing for the ultrasound and gas cleaning tests also began. It was decided 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.

Project 3.1, *Dairy Waste to Energy*, was about 30 percent complete at the end of 2004. Work completed includes a report comparing plug-flow to completely mixed reactors for dairy digestion, selection of the technologies to test, selection of the site for the test, development of a *Tactical Marketing Plan*, development of the test plan for each technology, and an evaluation of the environmental benefits of the project. It was decided that a completely mixed reactor would be better suited for the test because they are more common in California. Manure and industrial food waste and biosolids and industrial food waste would be co-digested at IEUA RP-1. An environmental benefits model was developed that quantified the reduction in greenhouse gases and corresponding carbon credits, renewable energy credits, reduction in ammonia emissions, and the reduction in nitrates entering the groundwater and surface water as a direct result of this project. Work continues on estimating a conversion factor for ammonia to particulate matter 10 μm in diameter and smaller (PM_{10}) because credits for reduced PM_{10} emissions are expected to be a major economic benefit in future dairy waste to energy projects in the South Coast and Central Valley areas of California.

Project 3.2, *Building Integrated Photovoltaics (BI-PV) Testing and Evaluation*, was about 30 percent complete at the end of 2004. Work completed included selecting the PV systems to test, designing the test plans for the systems, selecting the sites for the tests, holding an installation training workshop at IEUA, installing the systems, beginning testing, and streaming data to the PIER website database. It was decided that the large PV systems (60 kW) would be tested at IEUA and the small systems (20 kW) would be tested at PVUSA. The systems would be monitored for one year under this PIER Program and the data would

be incorporated into a *Consumer Confidence Guidelines* report to provide information to future PV consumers.

Project 3.3, *Building Integrated Photovoltaics (BI-PV) On Public Facilities*, was approximately 10 percent complete at the end of 2004. Work completed included developing a database containing public sector agencies, developing a database containing the manufacturers and distributors of BI-PV equipment, developing a *BI-PV Evaluation Tools Package (ETP)* and using the *ETP* to prioritize project sites. At the end of 2004, REDI and Spectrum Energy were waiting for a response to their report on the status of overall project work and costs incurred to date, which was requested by Energy Commission staff in November 2004, before proceeding with the remaining project tasks.

1

Introduction

1.1 Annual Program Report Purpose and Objectives

The primary purpose of the PIER Commerce Energy First 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 June 2002 through December 2004. Additionally, this report will outline the anticipated Program accomplishments by Project for contract year 2005.

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

Each of the projects in the Commerce Energy Program are described in greater detail in Section 1.4 below.

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 planned accomplishments for the PIER Commerce Energy Program through the first 28 months (i.e., June 2002 through December 2004). The sections that follow elaborate upon planned accomplishments on a project-by-project basis.

2.2 Planned Project Accomplishments

2.2.1 *Project 0: Program Administration*

During the first 28 months of the program, the Project 0 team planned to lay the framework for the general administration of the program. In 2002, the Project 0 team planned to hold a program kick-off meeting and document the initial results of the kick-off meeting in the form of a written scope of work and schedule of deliverables. In 2002, the Project 0 team additionally planned to create a website for public and private use. This website would be used as a forum for exchanging information between the PIER Commerce Energy project teams, as well as a means for disseminating general information on the overall program to the public. Finally, in 2002, the team planned to submit reports on a monthly basis that summarize planned and actual program accomplishments for each project.

In 2003, the Project 0 team planned to identify and recruit members for a Renewables Program Advisory Committee (RPAC). The team planned to submit the final list of RPAC members, their contact information, and proposed roles in the program to the Commission in early 2003. The project team also planned to submit a list of permits that would be required to complete project work in 2003.

In 2004, Contract Invoices #7, #8, #9, #10, #11, and #12 were to be submitted along with the Match Funds documentation. The Project 0 team will continue to coordinate activities of the PIER program team members, the RPAC, and the TAC, and will continue to work with the Commission to ensure that all program deliverables are submitted in a timely fashion and within budget.

2.2.2 Project 1.1: Planning and Analysis

Project 1.1 was designed to yield four primary products:

- An assessment of the potential to meet subregional needs with integrated local renewable resources for up to two areas within California,
- 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,
- Estimates of economic and environmental benefits, and
- A detailed plan for developing specific biogas and solar photovoltaic (PV) generation facilities in at least one of the targeted areas.

In 2002, the Project 1.1 team planned to complete a significant portion of activities required to generate information for the deliverables described above. The team planned to define and map the mini-grid and review existing biogas and PV technical and market assessments in California. Additionally, the Project 1.1 team planned to develop the database structure for the sewage treatment and landfill facilities to be considered as potential host sites. The landfill database and inventory reports were expected to be submitted to the Commission in 2002. The sewage treatment plant inventory report, in geographical information system (GIS) format, was expected to be submitted to the Commission in late 2003 and the final agricultural facilities database was anticipated to be submitted in early 2003. The final report for the PV system analysis, which identifies potential candidate sites for commercial PV systems, was expected to be completed and finalized in 2003.

Additionally in 2002, the Project 1.1 team planned to collect local transmission and distribution (T&D) data from Southern California Edison (SCE) and begin developing the local T&D model. The team also planned to develop PV, wastewater, landfill, and dairy waste electricity generation profiles. The team envisioned that a report would be compiled to describe the process of generating profiles for each of these technologies.

In 2003, the Project 1.1 team planned to meet with NIRAS, a Danish firm with biogas experience, to discuss European experiences with these projects. The project team planned to tour dairy manure projects in the mini-grid area, and to complete the *Inventory Report for Agricultural and Food Processing Waste Resources*. The project team planned to finalize data collection for the mini-grid T&D model, and to complete the PSLF local T&D database in 2003 and submit the final reports for the analyses.

In 2004, the Project 1.1 team anticipated that the final *Market Potential Assessment Report*, final *Develop Generation Profiles Report*, and final *Prioritization Report* will be completed and submitted to the Commission for review. Inputs from these reports will be incorporated

into the *Project 1.1 Final Report*. All of these reports will be revised to prioritize projects and integrate the Commerce Energy Business Plan.

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 of methane emissions, indirect reductions of 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 would include guidelines for future projects and a methodology for calculating the economic value of the project's environmental benefits. The second report would summarize the bioreactor design and installation and would present pertinent installation, operation, and maintenance costs.

Efforts in the first 28 months of the program included clarification of research objectives and laying the groundwork for design and installation of the bioreactor pilot projects. It was decided that funds would be more effectively used if focused on only one bioreactor project. The Project 2.1 team planned to select an optimal site for the bioreactor and develop a *Waste Characterization Report* for the proposed site. The Mid-Valley landfill located in Fontana, San Bernardino County was chosen to host the project. In 2003, the project team planned to meet with San Bernardino County staff, Commission staff, and those familiar with the bioreactor development and approval process at Yolo County. By coordinating research activities with the Yolo County team, the Project 2.1 team hoped to expedite bioreactor design, approval, and development processes at the San Bernardino site.

In 2003, the project team planned to develop conceptual design information for the Mid-Valley bioreactor project, and to prepare a *Memorandum of Understanding* for San Bernardino County outlining the responsibilities of the County and PIER Commerce Energy project team on the bioreactor project. Additionally, the team planned to submit the *Waste Characterization Report* in 2003.

In 2004, the Project 2.1 team planned to complete the *Conceptual Design Report* and submit it to the Commission for review and comment. Findings and results of these reports will be reviewed as to how they relate to future bioreactor projects. The project team will also construct a *Memorandum of Understanding* outlining the project goals and the responsibilities of San Bernardino County and the Commerce Energy staff. San Bernardino County will begin obtaining the permits relating to the match fund activity and the

documentation required by the California Environmental Quality Act. Also, a meeting will be scheduled with the Technical Advisory Committee (TAC).

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

Project 2.2 will entail the development and optimization of gas cleanup systems. The environmental benefits for each of the systems 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 microturbine gas cleaning systems. The results of this work are to be documented in a report that evaluates the cost and effectiveness of the various gas cleanup systems for each of the microturbines considered.

For the digester gas production improvement processes, the project team planned to evaluate the systems, including impact on gas production, biosolids reduction rate and dewatering characteristics, and cost effectiveness. A detailed evaluation and quantification of environmental benefits for each of the systems was also to be developed.

Preliminary efforts for microturbine and gas cleaning system development were scheduled to be undertaken in 2003. The project kick-off meeting was scheduled for early 2003 and the Project 2.2 team planned to discuss the project work scope and findings of Project 1.1 that were likely to affect Project 2.2 development. The project team planned to complete the *Process Selection Report* and the *Site Selection and Test Plan* in December 2003. The *Site Selection and Test Plan* was intended to discuss how the individual project elements would tie together, and to provide a revised schedule for Project 2.2. The project team planned to present sufficient detail in the *Site Selection and Test Plan* so that the TAC could provide feedback on the Program's direction and so that vendors could begin fabrication on the long lead-time equipment to be used in the project. The Project 2.2 team envisioned that construction and site/civil drawings for the microturbine and gas cleanup systems would be completed in late 2003.

In 2004, the Project 2.2 Team anticipates that data collection and analysis efforts will continue for the technologies outlined in the *Process Selection Report* and plans to finalize the *Site Selection and Test Plan* report, emphasizing on coordination with vendors to ensure that the six-month testing period can begin in a timely manner. The Project 2.2 team will continue coordinating project development efforts with Inland Empire Utilities Agency (IEUA) and Riverside County and will refine the *Memorandum of Understanding*. The Team plans to install the two ultrasound systems at the Riverside County facility and the gas cleaning systems at the IEUA regional plant one (RP-1) site. The possibility of using an empty tank at another IEUA facility for the biological gas cleaning system at IEUA RP-1 will be investigated. Baseline and system testing will be planned and initiated and

documentation certifying that the installation was finalized will be submitted. The baseline data will be reviewed and the *First Quarterly Report* will be submitted. Also, the Project Team intends to participate in the Critical Program Review (CPR) meeting.

2.2.5 Project 3.1: Dairy Waste to Energy

As mentioned previously, Project 3.1 was designed to 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 of the project, process flow diagrams, facilities location plans, test protocol plans, performance specifications, and site drawings.

In 2003, the Project 3.1 team planned to assess European and North American technologies to determine which could most effectively convert collectable manure to energy. Additionally, the project team planned to review information from the Project 1.1 inventory reports, from vendors, and from other organizations involved in animal waste electric generation projects. Ultimately, the project team planned to submit the *Technical Memorandum Comparing Complete-Mix and Plug-Flow Digesters* in 2003.

NIRAS held a presentation and recommended use of biological rather than chemical processes for treating the gas and water streams from manure to energy projects whenever possible. Afterwards, the project team planned to compare different approaches employed in European and North American technologies and NIRAS work. The project team planned to submit a technical memorandum in late 2003 which would compare the existing digesters at IEUA RP-1 and IEUA RP-5 to other complete-mix and plug-flow projects. The project team also planned to consult with the Environmental Protection Agency (EPA) and state agencies to address economic and environmental issues.

In 2003, the project team planned a site visit to Langerwerf Dairy in Durham, California, which has been successfully operating for over 20 years. This dairy was thought to be a valuable reference point for future on-farm projects. The team also planned to identify an approach to monetizing environmental benefits of digesters to improve the economic performance. Finally, the project team planned to submit test plans and protocols to the Commission so that they could be used in completing the *Project 1.1 Prioritization Report*.

In 2004, a meeting would be held with the CE Team and the Commission staff to review the future direction of Project 3.1 and incorporate the Commerce Energy Business Plan objectives. The Project 3.1 team will finalize the *Project Implementation Plan*, which will describe the implementation process and its interaction with the Commerce Energy Business Plan objectives. The Team also intends to analyze how various project options can help

Commerce Energy achieve their objectives related to green energy sales and community aggregation. The *Digester Comparison Report* and the *Test Plans and Protocols* report will be finalized, incorporating the Commerce Energy's Business Plan objectives where appropriate. The team will prepare for the Environmental Benefits Peer Review Team workshop in February, and will incorporate comments from the workshop as well as the new SCAQMD rules into the Task 3.1.6 deliverable. A project prioritization decision-making framework will be developed and the draft *Process Recommendation Report*, the Task 3.1.1 *Interim Report*, the *Tactical Marketing Plan*, and a detailed cost estimate for individual elements of the bioreactor will be submitted. A co-digestion plan for RP-1 will be developed, enabling the testing of various feedstocks in order to maximize digestion and increase gas potential. The Project Team will coordinate with IEUA staff working with potential suppliers of feedstocks for co-digestion mixtures and options. The Project Team also plans to hold a scope review meeting to discuss future implementation activities and coordinate with IEUA staff for the *Co-Digestion Bench Scale Testing*.

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

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

In 2002, efforts focused on selecting sites for the BI-PV installations and preparing preliminary specifications for proposed equipment. The Project 3.2 team planned to hold a project kick-off meeting, to prepare the draft *BI-PV Evaluation Test Plan*, and to select TAC members. Additionally, the project team planned to begin sketching out equipment specifications and data acquisition system (DAS) drawings for the large and small systems, and to begin procurement of the required equipment. The project team also hoped to work on siting the large and small systems in late 2002.

In 2003, IEUA was identified as a candidate for one of the 60 kW BI-PV systems and the Project 3.2 team planned to obtain written approval from IEUA to site the 60 kW system at its new headquarters. The project team also planned to obtain equipment pricing information and begin procuring equipment for the installation. Additionally, the project team planned to submit a DAS letter of notification, initial characterization reports for the small and large system testing, and an initial design for the Project 3.2 web page.

In 2004, the Project 3.2 team planned to resolve the problem with the PowerLight array identified in late 2003 and submit the *Initial Characterization Report* for the 20 kW PowerLight array. The project team anticipates receiving approval of the system incentive reservation request under the Self-Generation Incentive Program, and once approval has been received, the interconnection agreement for the 60 kW large systems will proceed. Once the systems are installed, the project team will begin monitoring and recording BI-PV system performance. The agreement with NUON for the three PV systems and DAS to be installed at PVUSA will also be finalized. Installation of these systems will be completed.

Endecon anticipated the startup of system monitoring and streaming data to the web for review; the small and large PV systems will be monitored throughout 2004 and the website will be restructured to assist in data comprehension. Also, a teleconference will be held with the Industry Advisory Committee to review the on-line data. Endecon planned to submit the *Small Systems Initial Characterization Report* and the *Multi-Array Characterization Report* to the TAC and the Commission, and to work on the *Six-Month Exposure and Operation Report* for the large systems.

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

Project 3.3 was designed to yield up to four public sector BI-PV projects ranging in size from 10 kW to 150 kW. Each project would address an infrastructure or commercialization barrier. These projects were 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 was 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.

In 2002, the Project 3.3 team planned to complete testing and experimentation with the selected data logger to remotely transmit information. The project team planned to compile an inventory of existing BI-PV evaluation tools, and to begin drafting a report outlining the proposed evaluation tool(s). The project team planned to initiate contacts with potential sites and to develop an ownership model for deploying the first public sector BI-PV system. Additionally, the project team planned to conduct site visits to public sector facilities and gather site load data. The project team planned to complete the draft BI-PV energy audit guidelines in late 2002.

The Project 3.3 team planned to continue development efforts for the BI-PV software evaluation tool package in 2003. The team planned to incorporate eQuest building performance modeling data into the evaluation tools package and to run case study tests to

verify system performance. The project team was to submit the final version of the software package and technical assistance booklet in 2003. Additionally, the project team planned to submit the final *Evaluation Tools Package (ETP)* in 2003. The project team planned to develop and evaluate BI-PV project proposals for identified sites. The team intended to develop an ESP funding mechanism for public sector BI-PV projects implemented under the program and complete project assessment reports for 10 BI-PV proposed locations.

In 2004, the Project 3.3 team anticipates receiving final approval of the *ETP* from the Commission. The team will use the *ETP* to complete its review of the BI-PV demonstration sites and will report on the results of the analyses. REDI and Spectrum Energy will continue the financial analysis on potential BI-PV sites and begin preparing a report of six to 12 candidate sites. Additionally, the Project 3.3 team intends to continue working with representatives of the pilot project sites. REDI plans to meet with ESP third party financing representatives to further develop matching funds for the project. A revised budget for Task 3.3.4 is expected to be finalized; the change will only reallocate funds within the Task and does not affect other tasks or projects.

3

Program Actual Accomplishments

3.1 Overview of Program Accomplishments

Within the first 28 months of the PIER Commerce Energy Program (June 2002 to December 2004), the Commerce Energy (CE) team completed numerous task deliverables, preparing a strong foundation for the project tasks to be completed within calendar year 2004 and through the PIER Commerce Energy Program (Program) completion. The Program defined the market-oriented potential, while addressing the environmental effects from implementing reliable and affordable renewable energy services and products. Projects 2.2, 3.1, and 3.2 were implemented and data collection began. Project 2.1 was discontinued in July 2004. Listed below are the individual project accomplishments from the start of the Program in June 2002 through December 31, 2004.

3.2 Project Accomplishments

3.2.1 Project 0: Program Administration

In this reporting period, the Program Administrative Team selected a Renewables Program Advisory Committee (RPAC) and finalized a program report, invoice templates, and Program administration guidelines. The Program Administrative Team coordinated with other members of the CE team to draft and finalize sub-contractor agreements. Teleconference meetings involving the Commerce Energy Program Director, Commission staff, and CE Team were held to discuss potential redirection and revisions to Project work plans, scope, and focus for Projects 2.1, 2.2, and 3.1. A meeting was held in Sacramento to present and review the Commerce Energy Business Plan. Contract Invoices #7, #8, #9, #11, and #12 were completed and submitted. Match fund documentation requested by the Commission Project Manager in conjunction with Contract Invoice #13 was partially received. Also, work began on the *First Annual Report*.

The Program Administrative Team also designed a program website, <http://www.pierminigrid.org>, where monthly project and program status reports will be posted after being reviewed by the California Energy Commission (Commission) Project Manager. Monthly Project and Program Status reports were completed throughout 2004 and placed on the PIER website.

3.2.2 Project 1.1: Planning and Analysis

Project 1.1 was close to completion at the end of 2004. The Program mini-grid was defined, crucial data was compiled, generation profiles were created, and potential projects were prioritized by market potential. The work completed under Project 1.1 was fundamental to Projects 2.1, 2.2, 3.1, 3.2, and 3.3. Most task deliverables were completed and final reports were submitted to the Commission as highlighted in Table 3-1 below:

Table 3-1: Project 1.1 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
1.1.1	Assessment Review Report and Initially Defined Mini-Grid Map	10/31/2002
1.1.2 a	Agricultural Waste in Southern California (targeting Chino Basin) Database	11/04/2003
1.1.2 b	Agricultural Waste GIS Inventory Report	11/04/2003
1.1.3 a	Landfill Database including data on landfills in Southern California	12/15/2002
1.1.3 b	Landfill GIS Inventory Report	12/15/2002
1.1.4 a.	Southern California Target Area Sewage Treatment Plant Database	12/15/2002
1.1.4 b	Sewage Treatment Plant GIS Inventory Report	12/15/2002
1.1.5	Commercial BI-PV Systems Database and PV Systems Potential Report	1/31/2003
1.1.6	T&D System Database	2/14/2003
1.1.7	Electricity Market Potential for the Mini-Grid Region Report	07/31/2003
1.1.8	Generation Profiles for each type of Biogas and PV resource	09/08/2003
1.1.9 a	Local Area T&D Model	2/13/2003
1.1.9 b	Summary & Detail Reports that document all pertinent studies included in this task and Two one-day technical reviews (within 2 weeks of report delivery)	2/13/2003
1.1.10	Prioritized List of Pilot Projects for PV and Biogas Report	09/30/2004
1.1.11 a	Outline of Final Report for Project 1.1	2/21/2003
1.1.11 b	Draft Final Report for Project 1.1	10/24/2004

Work on Project 1.1 commenced in June 2002 with a project meeting that addressed several multi-task integration issues, such as resource data collection, market potential, and mini-grid distribution/subtransmission power flow (T&D/PSLF) model development. The CE team worked closely with the Commission to define a local mini-grid, which became a crucial

component in the success of Project 1.1 and an integral factor in the start-up of several other Projects within the Program. It was determined that the mini-grid would be composed of the agricultural areas of the Chino Basin where dairy activities are concentrated. The mini-grid was defined and mapped with a resource legend using Geographic Information System (GIS) software. Itron researched and reviewed existing biogas and photovoltaic (PV) resource assessments for California, and the final report was submitted in October 2002. Renewable generation profiles were compiled and submitted for both biogas and PV and a database structure for biogas sites was developed in conjunction with PV database team members. \

For Tasks 1.1.2, 1.1.3, and 1.1.4, CH2MHill prepared an inventory report and an agricultural database on quantities of manure produced in the Chino Basin. They also collected information on food processing facilities in the Chino Basin. CH2MHill collected data for a potential bioreactor facility and sewage treatment facility sites, and finalized the database structure for potential bioreactor host facility sites. REDI provided photovoltaic (PV) specifications and technical potential data for wastewater treatment facilities, and this was added to the biogas resources database.

For Task 1.1.5, the Chino Basin biogas and building-integrated photovoltaic (BI-PV) inventory and technical potential were researched. A database was created by Regional Economic Research (RER) and Renewable Energy Development Institute (REDI) containing the following information: kWh consumption per square foot by building end-use type, Standard Industrial Classification (SIC) code, number of public agency buildings, expected growth rate of public agency facilities, regional planning assumptions and growth forecasts through 2025, regional demographics and forecasts, regional public finance and economics, local agency capital improvement program plans, regional GIS data, schedules for building new schools and modernizing existing schools that were reviewed for BI-PV opportunities, and planned growth. RER and REDI calculated the technical potential of BI-PV for public and private sector facilities, collected CEC forecast data of the electrical market potential for 2007-2012, and gathered regulatory data from permitting agencies. RER and REDI also calculated the technical potential of nonresidential BI-PV within the mini-grid.

For Task 1.1.6, Zaininger Engineering Company, Inc. (ZECO) collected proprietary data on substations in the greater Chino basin study area from Southern California Edison (SCE), including location, distribution circuit size, and load data for various classes of SCE customers. This was used to develop representative local T&D models for Task 1.1.9.

For Task 1.1.7, RER developed a cash flow model to evaluate the economic potential of BI-PV and biogas distributed generation. In 2003, Itron ran cash flow analyses for the low-, high-, and expected-case economic potential of nonresidential BI-PV prototypes and biogas from co-digestion of dairy and food waste, enhanced digestion of wastewater, and landfill bioreactors. Itron also used the market potential model to calculate internal rates of return for

each technology under each scenario. The *Market Potential Assessment* report was submitted in January 2004 and completed in August 2004. For Task 1.1.8, Itron worked to incorporate generation profiles with the market potential results from Task 1.1.7. Generation profiles and the mini-grid were incorporated into the *Develop Generation Profiles* report and the report was completed in August 2004.

For Task 1.1.9, a representative local electric T&D/PSLF model was developed for seven distribution systems in the mini-grid for different system configurations. ZECO ran the mini-grid PSLF model for 2007 and 2012. The analysis was completed in July 2003 and the results were presented at a CEC workshop on July 18, 2003.

For Task 1.1.10, CH2MHill began the draft *Prioritization Report* by evaluating potential sites, technologies, and biogas and PV inventories. The objectives of the Commerce Energy Business Plan were incorporated, and the mini-grid criteria were refined to prioritization activities, including the potential impact on Commerce Energy's planned community aggregation and on development of green tags in the Chino Basin and in California. A meeting was held with the Commission to obtain feedback on the Commerce Energy Business Plan, to discuss the decision-making framework (Task 1.1.10), and to preliminarily rank the biogas projects. The key results of the meeting, the PIER objectives, and the mini-grid analysis were incorporated into the Task 1.1.10 Report, *Prepare Prioritized List of Projects for PV and Biogas Systems*, which was submitted in October.

For Task 1.1.11, the focus of each Project was defined. Project 2.1 should build on knowledge gained in the Yolo County bioreactor project. Project 2.2 should focus on ultrasound and thermal hydrolysis technologies at the Riverside wastewater treatment plant. Project 3.1 should focus on dairy cluster sites, build on current projects, and define environmental and other factors that would drive current and future project implementation and economics. Microturbine and gas cleaning technologies should be implemented at Inland Empire Utilities Agency (IEUA) Regional Plant 1 (RP-1) since the site has experience with a variety of power generation and gas cleaning equipment. The key results of the meeting with the Commission were also incorporated into the draft *Project 1.1 Final Report*, which has been submitted and at the end of December 2004, awaits Commission approval.

3.2.3 Project 2.1: Enhanced Landfill Gas Production

Three primary conclusions were reached at a meeting in April 2003 with the Project Technical Advisory Committee (TAC), the CE Team, and the Commission: (1) The Bioreactor Project must achieve advancement of state-of-the-art bioreactor technology, (2) the CE Team should build on the success of the Yolo County bioreactor to assure that the project goals are achieved, and (3) project funds would be most efficiently used by focusing on one bioreactor project rather than two, as initially envisioned.

The CE Team identified 33 potential sites for landfill bioreactors within southern California, none of which were within the mini-grid. Table 3-2 highlights the top four preferred sites.

Table 3-2: Project 2.1 Preferred Landfill Bioreactor Sites

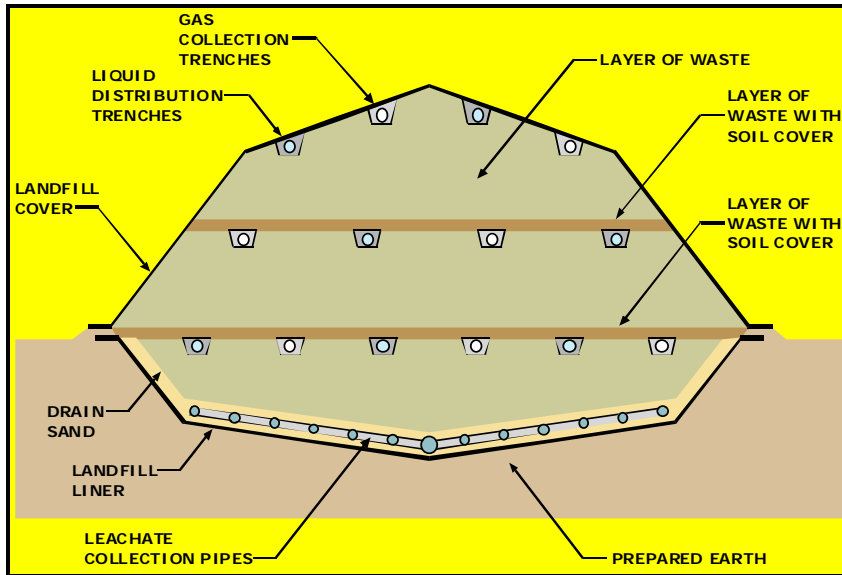
Landfill Name	Location	Owner	Waste In Place (tons)	Waste Acceptance Rate (tons/day)	Potential Power (MW)
Badlands Disposal Site	Moreno Valley	Riverside County	5,168,932	1,500	
El Sobrante	Corona	Western Waste Industries	8,000,000	4,900	
Fontana (Mid-Valley)	Fontana	San Bernardino County	2,800,000	3,000	8
San Timoteo	Redlands	San Bernardino County	880,000	500	2

The CE Team determined that the bioreactor would be developed in a portion of the Unit 3 cell at the Mid-Valley landfill. If successful, the bioreactor could eventually be expanded to include the entire cell. At the conclusion of 2003, the CE team was preparing an expedited conceptual design plan which would jointly implement the bioreactor project with a proposed expansion of the Unit 3 cell.

The first deliverable under this project, Task 2.1.1, the *Waste Characterization Report*, identified suitable amendment material for disposal at a bioreactor. In August 2003, San Bernardino County landfill data was supplemented with statewide data to create the *Task 2.1.1a Draft Report*, which was submitted for internal review and comment.

Additionally, work began on the Task 2.1.3 deliverable, the *Conceptual Design for the First Bioreactor*. Several meetings were held with San Bernardino County officials, the San Bernardino County Design Engineer, and a Regional Water Quality Control Board (RWQCB) representative, in order to design the Mid-Valley landfill site. Also, in October 2003, Bryan A. Serrat and Associates (BAS), who designed and permitted the Mid-Valley landfill, joined the CE Project Team. Figure 3-1 demonstrates the landfill conceptual design as presented at the RPAC meeting in 2003.

Figure 3-1: Landfill Bioreactor Conceptual Design



In addition to the design, an environmental review was undertaken to assess any environmental benefits and/or concerns that may be associated with the landfill bioreactor. Information on water availability, water distribution, gas collection, and other elements of the proposed bioreactor was presented at a meeting at the RWQCB.

The CE Team began the Conceptual Design for the First Bioreactor and the Waste Characterization Report in 2003. The Draft Conceptual Design for the First Bioreactor was submitted in December of 2003. In 2004, work continued on the Conceptual Design for the First Bioreactor and consultations between BAS and the CE Team were ongoing in order to link the bioreactor project with the Mid-Valley Landfill Unit 3 expansion. The CE Team provided an overall environmental permitting schedule and plan outlining how the match funding for construction and operations would be applied. The design effort was expanded to develop further information consistent with the need for a design suitable for the public bidding process, from which a contractor would be selected to implement the liner extension project and install the bioreactor elements at Mid-Valley. Commerce Energy initiated an additional \$20,000 in matching funds to develop an engineering and economic evaluation. CH2MHill worked on the Construction and Test Plans (Task 2.1.3b) and is preparing construction plans for the contractor. Also, a draft Memorandum of Understanding (MOU) was to be reviewed with San Bernardino County, outlining the goals, roles, and responsibilities of the County and the PIER project team.

In July 2004, San Bernardino County determined that it would 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 confirmed that Project 2.1 could not be implemented at Mid-Valley as planned and project work was stopped except for finalizing

the *Construction and Test Plan* and conducting a project evaluation near the end of the PIER Program. Tasks anticipated to be completed in 2004 that were discontinued included the *Memorandum of Understanding* and obtaining the necessary permits and documents required by the California Environmental Quality Act. A TAC meeting was scheduled to review lessons learned, reasons for closing the project, and how future projects could build on the planning, development, and design experiences of this project. Meeting comments will be reviewed as part of the measurement and evaluation activities.

Task deliverables were completed and final reports were submitted to the Commission as highlighted in Table 3-3 below:

Table 3-3: Project 2.1 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
2.1.1 a	Landfill Feedstock Characterization Report	01/26/04

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

Project efforts were initiated in January 2003 and focused on reviewing information previously collected on enhanced anaerobic digestion systems for the Task 1.1.4 *Sewage Treatment Database and Inventory Report*. Based upon preliminary findings, the CE Team focused on two technologies for increasing biogas production: (1) thermal hydrolysis and (2) ultrasound. Technology vendors were contacted and preliminary concepts were evaluated to confirm that the technologies were appropriate for increasing gas production and that wastewater treatment processes would be maintained or improved. The Commission and CE Team conducted site visits to Riverside and IEUA RP-1 and design concepts were discussed with IEUA and Riverside staff. The findings were incorporated into the Task 1.1.4 *Sewage Treatment Database and Inventory Report* and the Task 2.2.1 *Process Selection Report*, which had been previously submitted in October 2003. The CE Team continued to coordinate with vendors throughout 2004. Detailed plans for the test equipment at each site were analyzed and subcontracts were developed.

In 2004, CH2MHill continued to work on the *Process Selection Report* previously submitted, placing emphasis on the review and analysis of the presented technologies. Information from the *Process Selection Report* was incorporated into the *Site Selection and Test Plan*. The *Site Selection and Test Plan* report was submitted to the TAC and Commission and proposed a six-month test plan. A Critical Project Review (CPR) meeting was held in May 2004 to clarify the proposed test plan.

Consultations were held with Ingersoll-Rand (IR) regarding their new biogas fuel conditioning system. IEUA RP-1 was chosen as the test location for the IR gas cleaning

technology. Options were presented for installing the gas cleaning system and IR's design concepts were reviewed with IEUA. The improvement in biogas quality and quantity from using the IR system was estimated based on current IEUA biogas data. Also, NIRAS provided preliminary design information for the H₂S biological gas cleaning system. The gas cleaning technologies were evaluated by where they could be most effectively deployed and tested. The gas cleaning system design was submitted to the Commission in November 2004 and installation began in December.

The preliminary results of the *Process Selection Report* review of ultrasound and thermal hydrolysis technologies indicated that ultrasound has the most potential at the Riverside plant. Ultrasound research is rapidly advancing and it is more likely to be implemented in various locations within California than is thermal hydrolysis; therefore it was decided that efforts would focus on ultrasound and thermal hydrolysis would not be tested. The Riverside plant was chosen as the test site, and the CE Team worked with Riverside on a *Memorandum of Understanding*, which was completed in March 2004. The ultrasound design was submitted to the Commission in June 2004 and was updated as installation proceeded. The Sonico and IWe ultrasound systems were installed in parallel and baseline data collection (pre-ultrasound use) began in August 2004. The *First Quarterly Report*, discussing the collected baseline data, was reviewed internally.

Task deliverables were completed and final reports were submitted to the Commission as highlighted in Table 3-4 below:

Table 3-4: Project 2.2 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
2.2.1	Process Selection Report	01/26/04
2.2.2	Site Selection and Test Plan Report	05/07/2004
2.2.3b	Design Thermal Hydrolysis and Ultrasound System	11/18/2004

3.2.5 Project 3.1: Dairy Waste to Energy

Efforts on this Project were initiated in January 2003 and focused on the assessment of digestion and energy conversion systems applicable for dairy power projects. The CE Team compared North American and European technologies, and NIRAS, a Danish firm with extensive biogas expertise, was consulted. NIRAS held presentations with the Commission and two recommendations emerged: (1) the need to review co-digestion for the purpose of increasing gas production, and (2) the need to consider biological versus chemical processes for treating gas and wastewater streams whenever possible.

A meeting was held in February 2003 to review the project goals and scope. The CE Team and the Commission began working on the *Digester Comparison Report*, which compares plug-flow and complete-mixed digestion systems and how each could be utilized for the project. The CE Team determined that an economic and environmental analysis of these systems should be done in order to guide the Program toward the most advantageous pilot projects. To gain insight into existing dairy-waste-to-energy activities and the potential environmental impacts, the CE Team and Commission held a meeting with federal, state, and local environmental agencies and visited Langerwerf Dairy. The CE Team also worked with IEUA to present cost information for the proposed project at RP-5 in a form that could be compared to on-farm and centralized facilities in Europe and North America. The *Digester Comparison Report*, which reviews the above information from an on-farm and centralized dairy-cluster viewpoint, was drafted and submitted to the Commission. In response to comments, the CE Team included the length of operation of each facility to determine if the site could be deemed “fully operational.” The analysis was then redone, placing heavier weights on facilities with longer sustained normal operations, and integrated into the *Digester Comparison Report*. The *Digester Comparison Report* was finalized after integrating the Commerce Energy Business Objectives discussed at a meeting in March 2004.

The CE Team presented the evaluation of technologies used at dairy facilities at the September 2003 CPR meeting. Afterwards, in a meeting with the Commission, it was determined that technologies should be tested at a complete-mix digester which are more typical in California. As a result, all work related to the IEUA RP-5 site was ended and the CE Team focused on future testing at the RP-1 site only. It was further determined that primary efforts would include identifying environmental benefits, identifying dairy waste to energy opportunities, and developing and monitoring demonstration projects.

In December 2003, the CE Team proceeded with Task 3.1.6, *Conduct Economic and Environmental Assessment*. Site visits were held at various Chino Basin dairies, and the process for monetizing the environmental benefits associated with centralized digestion projects was discussed with IEUA. The draft *Conduct Economic and Environmental Assessment Report* was submitted in 2003. A workshop was held in February 2004 on the environmental issues associated with centralized anaerobic digestion (CAD) projects. The CE Team also consulted with the South Coast Air Quality Management District (SCAQMD) in 2004 to ensure that the project would meet the SCAQMD’s pending dairy emissions rules. The draft *Monitoring, Reporting, and Verification (MRV) Protocol*, which quantifies environmental benefits associated with CAD projects, was reviewed internally in 2004.

As previously mentioned, a meeting was held in March 2004 to review the Project priorities and future direction, and the Commerce Energy Business Plan was discussed. The primary conclusion was that the CE Team would concentrate fully on projects that are most aligned

with the Commerce Energy Business Objectives and that have the most potential within California. Project priorities were ranked and incorporated into Task 1.1.10, *Prepare Prioritized List of Projects for PV and Biogas Systems*. Project 3.1 would focus on co-digestion and gas cleaning, and the previously submitted *Test Plans and Protocols Report*, which included bench and pilot testing plans for biogas processes at IEUA RP-1 and RP-5, was revised to focus on these technologies at RP-1 only. A *Full-Scale Co-digestion Test Plan* was close to being finalized in December 2004. The Task 3.1.1 *Interim Report* was submitted to the Commission in August 2004 and allowed completion of the *Bench Scale Test Plan*. The IEUA staff was coordinated with to identify and preliminarily assess available co-digestion suppliers. Mixtures of feedstock and food waste were tested and cheese waste was identified as an optimal food waste for co-digestion. Also, an evaluation of the RP-1 biogas distribution system began in late 2004 in order to determine if the distribution system could handle the increased biogas production.

A revised Project 3.1 *Implementation Plan* was submitted for review in July 2004 and a scope review meeting was held in October 2004 to review the document and discuss future research and development. It was decided at this meeting that the CE Team would prepare a *Tactical Marketing Plan* to outline how the project results could be bring the tested technologies into the California market. The draft *Tactical Marketing Plan* was completed in December 2004 and submitted for internal review. Also, the draft *Process Recommendation Report* was finalized in December 2004 and will be submitted to the TAC and Commission for final review.

Task deliverables were completed and final reports were submitted to the Commission as highlighted in Table 3-4 below:

Table 3-5: Project 3.1 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
3.1.1a (1)	Technical Memorandum Comparing Plug Flow and Complete-Mixed Digestion Performance and Economics	11/18/2004
3.1.1a (2)	Preliminary Draft Process Recommendations Report and Detailed System Design, Energy and material balances for the identified processes	11/18/2004

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

Efforts on this project were initiated with a meeting in July 2002 where the CE Team and the Commission reviewed project goals and selected a TAC. The coordination of Project 3.2

activities with Project 3.3 activities was reviewed to ensure that both projects would be successfully integrated.

The CE Team submitted the *Building-Integrated Photovoltaic (BI-PV) Evaluation Test Plan Report* to the TAC and a conference call was held with the TAC in October 2002 to discuss the report. The TAC expressed a preference for 10 smaller systems to be selected for one of the three 20 kW PV systems to be evaluated. Also, four prospective roof/building large system configurations were provided to TAC members for review, and three options were chosen.

A meeting was held to review the siting and financing issues for the 60 kW large system evaluations. It was determined that the administrative building at the IEUA headquarters would be an ideal site for the large systems. CE was contacted regarding potential ownership of the large system to be installed at the IEUA facility. The CE Power Resources Director visited the IEUA facility and met with the CE Team to discuss generation potential and financial considerations. A contract was coordinated between CE and IEUA with CE committing the financial resources and IEUA providing written approval for the system to be sited at their building. A PV installation training workshop was held with IEUA staff to familiarize them with the large systems installation process and system operations. In May 2003, Steve Goddard of CE became project manager of the 60 kW project.

In March 2003, an agreement with CE was proposed to procure the small system to be installed at PVUSA. Both Kyocera and Sharp Solar agreed to a long-term loan of a system for the small-systems test. In 2004, discussions continued with NUON regarding the small systems testing at PVUSA and an agreement for the use of the PVUSA facility was finalized.

Progress was made on developing the data acquisition system (DAS) specifications. Draft DAS drawings were finalized and the equipment was purchased for both the large and small systems. Draft DAS documentation was submitted to the Commission for review and most DAS systems were installed along with the pyranometers in 2003. The CE Team completed testing on all systems during late 2003, with the exception of the PowerLight array, which had experienced a problem. The CE Team conducted trouble-shooting tests and the problem was resolved in early 2004. The large systems began running in March 2004. The RWE Schott and Kyocera small systems and their data acquisition systems (DAS) were installed at PVUSA in 2004.

Endecon monitored the small and large system data throughout 2004 to ensure that all systems were operating and gathering data. Data is being streamed to the PIER website and database; the website was repeatedly modified to improve the ability to understand the data. Endecon held a teleconference in May 2004 with the Industry Advisory Committee to review the online data.

Endecon received approval on the interconnection agreement application submitted in January 2004 for the whole large system. Also, in 2004, the Self-Generation Incentive Program confirmed that the submitted reservation request was approved and will be eligible for funding at the completion of the project.

Endecon presented a technical paper on this project at a statewide PV meeting held in May 2004. Endecon also submitted the *Multi-Array Initial Characterization Report*, the *Small Systems Characterization Report*, the *PowerLight Initial Characterization Report*, and compiled data for the small and large system *Six-Month Exposure and Operation Report*.

Task deliverables were completed and final reports were submitted to the Commission as highlighted in Table 3-4 below:

Table 3-6: Project 3.2 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
3.2.1	Draft and Final Building Integrated PV Testing and Evaluation Test Plan Reports	01/31/2003
3.2.2a (2)	Data Acquisition System (DAS) Letter of Notification	06/06/2003
3.2.2a (3)	Initial Characterization Report for the First System – Large Systems	06/11/2004
3.2.2a (4)	Initial Characterization Report for the Second System	05/07/2004
3.2.3(1)	Initial Web Page Design	05/07/2004
3.2.2b (2)	Data Acquisition System (DAS) Letter of Notification – Small Systems	08/18/2004
3.2.3 (2)	Web Page updates (updated and invoiced Monthly)	Began 08/2004 – ongoing to contract end
3.2.2a (5)	Initial Characterization Report for Third System	11/1/8/2004

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

Project efforts were initiated in July 2002 with a meeting that addressed the existing CEC databases, the review of initial tasks, and the CPR meeting. Following the meeting, REDI began developing the first two BI-PV databases and compiling the needed resources for the BI-PV evaluation tools.

A public sector database for Task 3.3.1a was developed containing the name, location, SIC code, and contact information for possible project sites located within the mini-grid. This list included awarded construction bids for San Bernardino County schools. Also, a global list of solar energy manufacturers, suppliers, and service providers was compiled for Task 3.3.1b

and contained contact and product information. Communication was initiated with these companies to request product or service information. Tasks 3.3.1a and 3.3.1b were completed in August 2002.

The Local Government Commission aided in identifying entities interested in BI-PV demonstration projects. An Office of Planning & Research/California Power Authority workshop was attended to discuss public sector PV projects. The California State Association of Counties, League of California Cities, California Special Districts Association, California Association of Sanitation Agencies, and Association of California Water Agencies were contacted to inform their Chino Basin members about BI-PV opportunities. Cities, counties, and airports in the Chino Basin were also contacted as potential candidates for the demonstration projects, and outreach materials were distributed to interested parties.

Numerous solar energy evaluation software applications were acquired and discussed with various engineers. Software was then developed to determine the solar array position to produce the maximum value of solar energy when used in conjunction with a utility TOU rate tariff. Economic analysis tools were developed based on Maui Solar Software: Solar Design Studio 5.0 and original REDI software. In December 2002, the CM BI-PV SAS tool was modified to become more “user-friendly.” eQuest was used to model energy efficiency benefits from BI-PV awning and roof shade applications. A draft outline of the *Evaluation Tools Package (ETP)* for Task 3.3.2 was created and revised to incorporate eQuest performance modeling, “building type” modeling, graphic features, integrated “demand savings” model, and a “mini-grid TMY” weather database. The *Energy Audit, Project Development Guidelines, Public Facilities Test Plan, and Technical Assistance Booklet* were created. The *ETP* then underwent an industry review before being submitted for an internal review in December 2003. The *ETP* was submitted to the Commission and approved in March 2004. The *Select Demonstration Project Sites* report is being updated using the *ETP* and will select the final four demonstration sites.

In December 2002, individual sites were assessed using mapping software, Internet satellite photos, and client site data. Potential sites included: IEUA sites, California Institute for Women, Riverside Community College, Ontario/Montclair School District, Chino Airport, Caltrans Maintenance Station, and Naval Weapons Center. In November, Caltrans Maintenance Station was removed from the list and the Planes of Fame Museum was added. REDI received plans from LAP Architects for the Bandera and Oaks school to assess BI-PV opportunities. Site visits were scheduled for January 2003 and third party BI-PV financing options were delivered to potential clients in the mini-grid area.

A PV analysis report for San Bernardino County was delivered in 2003. Site visits were held at Ontario Airport, Chino Airport, San Bernardino County Maintenance Yard, IEUA Ikea

project, WLC architects, Navy Research Lab, City of Norco, Corona Norco School District, California Department of Corrections, City of Ontario Police Department, and Commerce Energy. A local workshop was conducted in February 2003 with Assemblywoman McLeod for public sector clients to discuss reduction of energy costs through BI-PV projects. The cities of Chino and Chino Hills, the Ontario Montclair and Norco Corona School Districts, Ontario YMCA, and San Bernardino County public works were identified as potential public sector clients and follow-up site visits were planned. BI-PV public sector clients were assisted with system designs and bid solicitation documents for proposed projects. In 2004, site information, including rooftop measurements, preliminary layout design, and utility bills, was evaluated and two on-site meetings at high priority BI-PV sites were held. Work began on an economic analysis to determine the financial feasibility of each of the potential sites and a meeting was held with SCE. The draft *Identify and Select Demonstration Project Sites* report for Task 3.3.4a was submitted in July 2003 to the CE team.

Funding for BI-PV public sector clients was found to be available from California Power Authority, Energy Commission Energy Efficiency Loan program, and SAFE-BIDCO. Other issues addressed in 2004 included hiring a replacement for the Project Manager at REDI and reviewing the Task 3.3.4 change in scope and budget reallocation. Both were completed in October 2004.

Table 3-7: Project 3.3 Submitted Deliverables by Task

Task Number	Deliverable	Completion Date
3.3.1 a	Public Sector Agencies Database	12/31/2002
3.3.1 b	Manufacturers and Distributors of BI-PV Equipment Database	12/31/2002
3.3.2	BI-PV Evaluation Tools Package, Draft BI-PV on Public Facilities Test Plan, and Final BI-PV on Public Facilities Test Plan	03/31/2004
3.3.4a	Demonstration Site Selection Report	07/16/2003

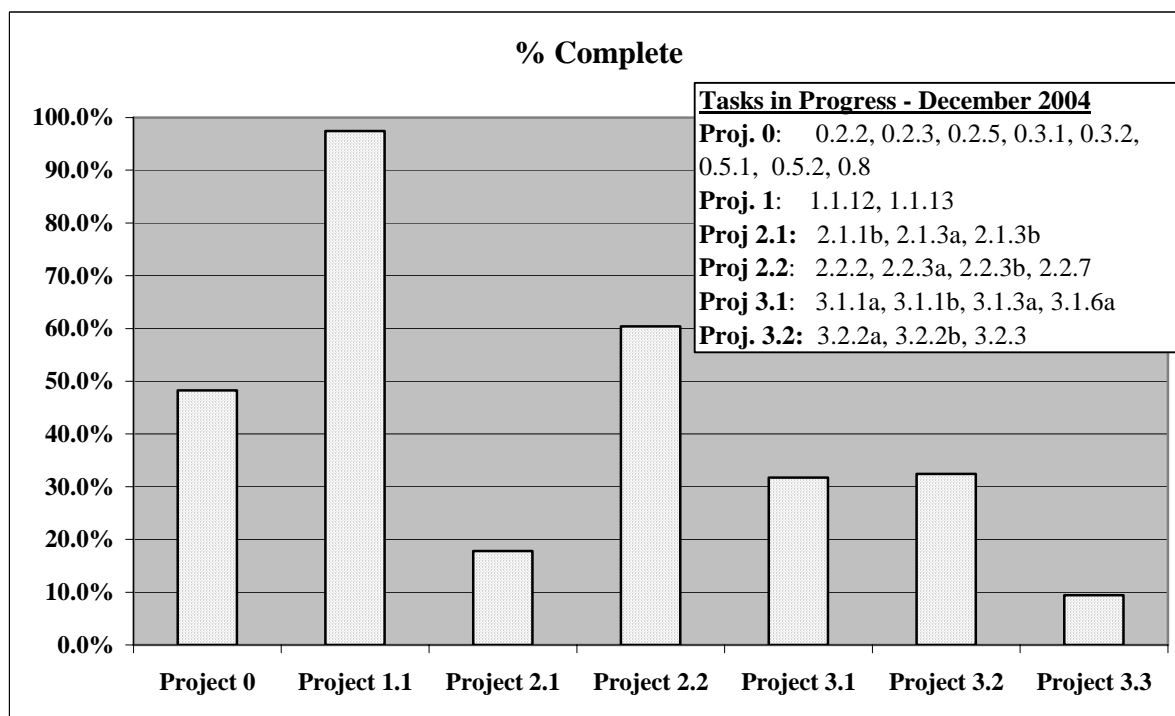
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Program Status Compared to Plan

4.1 Overview of Program Status

Figure 1 below summarizes the overall Commerce Energy Program status for each project and identifies the active tasks as of the end of the 2004.

Figure 1: Summary of Program and Project Status



Major setbacks for Project 2.1 included data collection taking longer than anticipated and waiting for the issuance of a research and development exemption from the United States Environmental Protection Agency (USEPA). In July 2004, a Stop Work order was issued for Project 2.1. The major setback for Project 2.2 was the additional coordination activities with ultrasound and gas cleaning system vendors. The major setback for Project 3.1 was a change in Task 3.1.3a to focus testing efforts at the Inland Empires Utility Agency (IEUA) regional plant one (RP-1) site only, instead of both the IEUA RP-5 and IEUA RP-1 sites. The major setback for Project 3.2 was siting the large PV systems. A key personnel redirection at

Renewable Energy Development Institute (REDI) delayed progress on Project 3.3 in 2004; this was resolved in October.

4.2 Project Status

4.2.1 Project 0: Program Administration

Table 4-1 below summarizes progress made during the first 28 months on the Project 0: Program Administration task deliverables.

Table 4-1 Summary of Project 0 Status

Task No.	Description	Task Start Date		Task Due Date		Status (%)
		Planned	Actual	Planned	Actual	
0.1	Program Kick-off Meeting	5/21/02	5/21/02	6/11/02	5/29/01	100%
0.2.1	Public Presentation	TBD	09/29/04	TBD	12/08/04	100%
0.2.2	Program Software Standardization/Website	5/21/2002	6/15/02	10/20/02	01/31/03	100%
0.2.3	Propose & Finalize RPAC	5/21/2002	5/29/02	10/28/02	In Process	89%
0.2.4	Document Match Funding	5/21/02	5/21/02	7/5/02	In Process	5%
0.2.5.a	Identify Required Permits for all Projects	6/5/2002	06/21/02	4/29/03	In Process	20%
0.3.1	Critical Program Review Meetings	05/28/02	09/24/03	05/27/05	09/24/03 (On-Going)	58%
0.3.2	RPAC Meetings	04/05/03	02/27/03	03/08/06	07/18/03 (On-Going)	58%
0.5.1	Monthly Project and Program Reports	06/21/02	06/21/02	03/16/06	In Process	60%
0.5.2	Two Annual Program Reports	09/18/02	On-Going	02/15/05	In Process	40%
0.8	Project Specific Administrative Tasks	06/05/02	06/05/02	04/12/04	In Process	60%

Task 0.3.1, Task 0.3.2, Task 0.5.1 and Task 0.5.2 are on-going projects and/or have multiple meetings. If an actual date has been provided it reflects the last meeting held in 2004.

The goals of Project 0: Program Administration, in 2002 through 2003 included laying the framework for the general administration of the program, holding a program kick-off meeting to discuss the scope of work and create a schedule for deliverables, developing a website for public and private Commerce Energy Team and Advisory Council Member use, submitting monthly project and program updates and posting them on the website, compiling

a Renewables Program Advisory Committee (RPAC), and compiling a list of permits required to complete work planned for 2003. All of the 2002 through 2003 goals were either completed or are in-process.

In 2004, planned work included submitting Contract Invoices #7, #8, #9, #10, #11 and #12 along with the Match Fund documentation, and the on-going coordinating of the activities of the PIER Program team members, RPAC, Technical Advisory Committee (TAC). Monthly program reports that had been approved but had not yet been posted on the website included June 2004, September 2004, and November 2004. Monthly project status reports that had been approved but had not yet been posted to the website included March 2004 and December 2004 for all projects and June 2004 for Project 3.1. All of the Contract Invoices were completed and submitted as anticipated.

4.2.2 Project 1.1: Planning and Analysis

Work on Project 1.1 began in June 2002 and the project was 96% complete at the end of 2004. Table 4-2 shows the planned and actual start and due dates for the Project deliverables that were to be accomplished during the first 28 months, and the status of each.

Table 4-2 Summary of Project 1.1 Status

Task No.	Description	Start Date		Due Date		Status (%)
		Planned	Actual	Planned ¹	Actual ¹	
1.1.1	Review previous CA technical & market potential assessments	6/5/02	6/5/02	8/4/02	10/31/02	100%
1.1.2a	Develop DB of Agricultural Facilities	6/19/02	7/20/02	01/17/03	11/04/03	100%
1.1.2b	Develop Ag GIS report	6/19/02	8/12/02	01/17/03	11/04/03	100%
1.1.3a	Develop Landfill DB	6/19/02	6/19/02	10/25/02	12/15/02	100%
1.1.3b	Develop Landfill GIS report	6/19/02	6/19/02	10/25/02	12/15/02	100%
1.1.4a	Develop WWT facility DB	6/19/02	6/19/02	10/31/02	12/15/02	100%
1.1.4b	Develop WWT GIS report	6/19/02	6/19/02	10/31/02	12/15/02	100%
1.1.5	Develop BIPV systems DB	8/5/02	8/5/02	12/03/02	2/5/03	100%
1.1.6	Develop T&D System DB	6/5/02	6/26/02	02/16/03	06/10/03	100%
1.1.7	Market Potential Assessment	11/10/02	9/13/02	08/01/03	DR: 7/31/03 FR: 8/05/04	100%
1.1.8	Develop Generation Profiles	12/11/02	8/15/02	09/08/03	DR: 9/08/03 FR: 8/05/04	100%
1.1.9 a	Conduct Power Flow Analysis (T&D Model)	10/14/02	09/23/02	02/16/03	06/10/03	100%

1.1.9 b	Conduct Power Flow Analysis (Summary Reports)	11/15/02	09/02/03	09/11/03	DR:09/12/03 FR: 11/28/03	100%
1.1.10	Prepare Prioritized List of Projects for PV and Biogas Systems	12/03/02	11/04/02	DR: 09/10/03	DR: 9/10/03 FR: 10/6/04	99%
1.1.11a	Prepare Draft Report Outline for Project 1.1	1/17/03	02/10/03	02/21/03	7/13/03	100%
1.1.11b	Prepare Draft Report for Project 1.1	3/08/03	04/18/03	09/26/03	FR: 10/6/04	99%
1.1.13	Develop M&E Plans	6/5/02	7/15/03	05/29/03	In Process	65%

Note 1: “Planned” dates per revised Program Schedule submitted to CEC on September 17, 2003. “Actual” Dates include both the draft report (DR) date (above) and final report (FR) submittal dates (below), where appropriate.

Differences in schedule for Task 1.1.10 are due to an approximately four-month delay to allow for incorporation of the expanded Mini-Grid analysis, incorporation of the Commerce Energy Business Plan goals, and project prioritization framework within the Program. Differences in schedule for Task 1.1.11 were due to an approximately six-week delay to accommodate the completion of the *Agricultural Waste Database and Inventory Report*, and to allow for incorporation of the mini-grid transmission and distribution (T&D) impacts analysis and guidance of the RPAC. These changes are consistent with other aspects of the Program, all of which needed to await incorporation of the mini-grid analysis.

Additional work that was planned and completed during this reporting period included a meeting with NIRAS to discuss European experiences with biogas projects and a tour of dairies in the mini-grid area.

4.2.3 Project 2.1: Enhanced Landfill Gas Production

Work on Project 2.1 began in April 2003 and the project was 18% complete at the end of 2004. Table 4-3 on the following page shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished during the first 28 months and the status of each.

Table 4-3 Summary of Project 2.1 Status

Task No.	Description	Start Date		Due Date		Status (%)
		Planned	Actual	Planned	Actual	
2.1.1a	Characterize MSW and Source-Separated Organic Waste to be Placed in Both Bioreactors	01/10/02	1/24/03	05/31/02 08/21/03	DR: 08/20/03	100%
2.1.1b	Characterize Food or Animal Wastes to be Placed as Amendment in the Second Bioreactor	03/25/02		On Hold		
2.1.2	Identify Amendment Source Locations for the Second Bioreactor	05/26/02		On Hold		
2.1.3a	Prepare Conceptual Design for the First Bioreactor	09/28/02	1/20/04	12/18/03	4/22/04	100%
2.1.3.b	Prepare Construction and Test Plans for First Bioreactor	12/11/03	2/20/04	3/6/04	7/20/04	100%
2.1.6	Coordinate with RPAC/TAC	01/10/02	3/15/03	04/26/06	10/15/04	100%

Information for Task 2.1.1a took longer to collect than anticipated, as the primary data to be used was not available in an electronic format. Also, additional data was collected on the San Timoteo landfill at the recommendation of San Bernardino County because they thought it may be a better site for the bioreactor than the Mid-Valley landfill. This delayed progress, as the San Timoteo data had to be evaluated and compared to the Mid-Valley data to determine which site was optimal. The overall project schedule was also affected by waiting for the issuance of a research and development exemption from the EPA.

In addition to the work on the above deliverables, the project team planned to meet with San Bernardino County staff, Energy Commission staff, and those familiar with the bioreactor development and approval process at Yolo County; decide on a location for the bioreactors; construct a *Memorandum of Understanding* to outline the responsibilities of San Bernardino County and the CE Team; and assess environmental impacts. Several meetings were held with the above groups to design the bioreactor and with the Regional Water Quality Control Board (RWQCB) to discuss environmental benefits and concerns. The draft *Memorandum of Understanding* was submitted to San Bernardino County for review in December 2003. Planned work in 2004 included obtaining the necessary permits and documentation required by the California Environmental Quality Act, and scheduling a meeting with the TAC. Project 2.1 was terminated in July 2004, and so the *Memorandum of Understanding* was not completed and not all of the necessary permits were collected. A meeting was, however, still

held with the TAC to discuss lessons learned and how future bioreactor projects could benefit from knowledge gained during this project.

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

Work on Project 2.2 began in January 2003 and the project was 60% complete at the end of 2004. Table 4-4 shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished during the first 28 months, and the status of each.

Table 4-4 Summary of Project 2.2 Status

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	03/31/04	100%
2.2.3.a	Design Gas Cleaning System	02/15/02	11/10/03	11/24/03	11/12/04	95%
2.2.3.b	Design Ultrasound Systems	02/15/02	11/10/03	11/24/03	06/23/04	100%
2.2.4a	Install Gas Cleaning System	12/05/03	12/04/04	05/21/04		20%
2.2.4.b	Install Ultrasound System	12/05/03	06/01/04	05/21/04	11/09/04	100%
2.2.5.a	First Quarterly Report	06/20/04	06/01/04	08/20/04		90%
2.2.5.b	Second Quarterly Report	08/20/03	09/01/04	11/19/04		20%
2.2.7	Coordinate with TAC & RPAC	01/24/02	02/01/03	01/16/06		95%

Differences in schedule for Task 2.2.2 were due to the need for additional coordination activities with vendors for both the ultrasound and gas cleaning systems. Additional coordination will streamline Tasks 2.2.2 and 2.2.3 by having access to more detailed information from the vendors on their technologies. This will shorten the time needed to secure the long lead-time equipment items and improve the likelihood that demonstration pilot programs can be implemented efficiently, but it will delay the completion of Tasks 2.2.2, 2.2.3a, and 2.2.3b.

In addition to work on the above deliverables, the project team was to develop a report that would quantify the cost-effectiveness of the microturbines, the ultrasound system, and the gas cleaning systems. The report would also quantify environmental benefits including biosolids reduction rate and dewatering characteristics. In 2004, the *Memorandum of Understanding* was refined, various possibilities regarding the biological gas cleaning system were investigated, baseline and system testing began, and the Project Team participated in the Critical Program Review (CPR) meeting.

4.2.5 Project 3.1: Dairy Waste to Energy

Work on Project 3.1 began in January 2003 and the project was 31% complete at the end of 2004. Table 4-5 shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished during the first 28 months, and the status of each.

Table 4-5 Summary of Project 3.1 Status

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	08/06/04	100%
3.1.1a (3)	Draft Processes Recommendations Report	01/24/02		11/18/03		95%
3.1.1.b	Assess Evaluate, and Select Animal Waste to Energy Technology	01/24/02		01/17/04		90%
3.1.2a	Site Selection	01/24/02		12/20/03		70%
3.1.2 b	Tactical Marketing Plan	10/20/04	10/18/04	01/15/04		50%
3.1.3a	Bench Scale and Other Test Plan and Protocols	03/25/02	04/04/03	09/10/03		95%
3.1.3b	Conduct Bench Tests	07/14/03	10/18/04	12/5/03		30%
3.1.3c	Design Memorandum and Draft and Final Test Plans	11/20/03	09/16/04	04/08/04		20%
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		95%

Differences in schedule for the Project are due to delays in Task 3.1.3a. The *Test Plan and Protocols Report* was originally based on conducting tests at IEUA RP-1 and/or RP-5; however, due to comments received from the Energy Commission, Project efforts are now focused on testing at the RP-1 site only. The *Test Plan and Protocols Report* has been revised accordingly and will also be revised to be consistent with the Energy Commission Test Plan guidelines and the revised *Implementation Plan* for Project 3.1 that was prepared as a follow-up to discussions held in conjunction with the CPR meeting. Once the Energy Commission has accepted the revised *Implementation Plan* for Project 3.1, the remaining

tasks can proceed. The overall schedule for Project 3.1 will be revised once the plan is approved. Also, in 2004 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.

In addition to the work done on the Project deliverables, other planned work included a meeting with NIRAS; consulting the EPA and state agencies to address environmental and economic issues; visiting the Langerwerf Dairy, which could be a valuable reference point for on-farm projects; holding a meeting with the CE Team and Energy Commission staff to review the future direction of the project and incorporate the Commerce Energy Business Plan objectives; preparing for the Environmental Benefits Peer Review Team workshop in February 2004; preparing a detailed cost estimate for individual elements of the bioreactor; developing a co-digestion plan; holding a TAC meeting and scope review meeting

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

Work on Project 3.2 began in July 2002 and the project was 32% complete at the end of 2004. Table 4-6 shows the planned and actual start and due dates for the Project deliverables that were scheduled to be accomplished during the first 28 months, and the status of each.

Table 4-6 Summary of Project 3.2 Status

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	02/26/04	100%
3.2.2a (2)	LS: DAS Letter	07/05/02	07/05/02	03/03/03	05/16/03	100%
3.2.2a (3)	LS: 1 st System Char. Report	07/05/02	07/05/02	10/31/03	04/7/04	100%
3.2.2a (4)	LS: 2 nd System Char. Report	07/05/02	07/05/02	10/31/03	05/25/04	100%
3.2.2a (5)	LS: 3 rd System Char. Report	07/05/02	07/05/02	10/31/03	09/22/04	100%
3.2.2a (6)	6-Month Exposure and Operation Report	07/15/03		07/01/04		80%
3.2.2a (7)	Interim Report on Large Systems Progress	07/15/03		03/01/04		
3.2.2b (1)	SS: Site Selection, Permitting & Acquisition	08/04/02	08/01/02	11/17/03	04/16/04	100%
3.2.2b (2)	SS: DAS Letter	08/04/02	08/04/02	12/31/03	04/07/04	100%

Table 4-7 Summary of Project 3.2 Status

Task No.	Description	Task Start Date		Task Due Date		Status (%)
		Plan	Actual	Plan	Actual	
3.2.2b (3)	SS: 1 st System Char. Report	08/04/02	08/04/02	01/29/04	11/08/04	100%
3.2.2b (4)	SS: 2 nd System Char. Report	08/04/02	08/04/02	01/29/04	11/08/04	100%
3.2.2b (5)	SS: 3 rd System Char. Report	08/04/02	08/04/02	01/29/04	11/08/04	100%
3.2.3.1	Initial Web Design	07/05/02	01/01/04	10/31/02	04/7/04	100%
3.2.3.3a	Technical Paper #1	03/31/03	04/07/04	03/31/04	04/7/04	100%

The project schedule was delayed due to negotiations and contract approvals on the Commerce Energy-IEUA Power Purchase Agreement, and due to waiting for approval of the purchase orders and SGIP Incentives reservation request to SCE for the 60kW systems. Additionally, a problem with the PowerLight Array caused a slight delay in late 2003, but was resolved in January 2004. A key personnel redirection at REDI slightly delayed progress in 2004; however, this issue was resolved in October 2004.

In addition to work done on the project deliverables, other planned work included selecting a TAC, siting the large and small systems, obtaining written approval from IEUA to site a large system at its headquarters, consulting CE about purchasing and owning the large system to be sited at IEUA, developing a contract between CE and IEUA, obtaining equipment pricing information, obtaining equipment for installation, designing the Project 3.2 web page, receiving approval of the system incentive reservation request from the Self-Generation Incentive Program, constructing the interconnection agreement for the 60kW large system, finalizing the agreement with NUON for the three PV systems and the data acquisition system (DAS) to be installed at PVUSA, installing and monitoring the small and large systems, streaming the data to the PIER website, improving comprehension of the website, and holding a teleconference with the Industry Advisory Committee to review the on-line data. All planned work was completed.

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

Work on Project 3.3 began in July 2002 and the project was 10% complete at the end of 2004. Table 4-7 shows the planned and actual start and due dates for the Project deliverables that were to be accomplished during the first 28 months, and the status of each task.

Table 4-8 Summary of Project 3.3 Status

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	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	08/21/02	100%
3.3.2	Develop Evaluation Tools	8/19/02	8/19/02	9/12/03	03/02/04	100%
3.3.4a	Select Demonstration Project Sites	1/03/03	4/17/02 Restarted 09/15/04*	10/27/03	DR: 07/15/03	*75%
3.3.6	Coordinate with RPAC	06/20/02		03/31/06		20%

Schedule changes were due to continuing system design work on the BI-PV sites, solicitation preparation, and updating the site details for a final project report and presentation for the RPAC in early 2004. Task 3.3.2 deliverables have been delayed due to multiple outside technical reviews and revisions to the BI-PV *Evaluation Tools Package (ETP)*. The final draft deliverable has been revised and resubmitted to the Energy Commission. Additionally, the delays in the *Large Systems Testing* task under Project 3.2 have affected the schedule for Task 3.3.4. A key personnel redirection at REDI delayed progress in 2004; this was resolved in October 2004.

In addition to work done on the project deliverables, other planned work included testing data loggers; compiling an inventory of existing BI-PV evaluation tools; creating an ownership model for deploying the first public sector BI-PV system; conducting site visits to gather site load data; completing the BI-PV energy audit guidelines; developing the BI-PV software *ETP*, incorporating the eQuest building performance modeling data into the *ETP*, receiving final approval of the *ETP*, and running case study tests; developing an ESP funding mechanism; meeting with ESP third party financing representatives; completing project assessment reports for 10 proposed locations; working with representatives of the pilot project sites, and finalizing the revised budget for Task 3.3.4.

5

Program Challenges and Changes

5.1 Overview of Program Challenges and Changes

The majority of challenges faced during the first 28 months of the Commerce PIER Program resulted from contractual delays, difficulties encountered in data collection, faulty equipment, and changes in work scope or schedule attributable to delays in other projects. Since the individual projects in the Commerce PIER program are linked, results analyses from one particular project serve as inputs to analyses in another project. Thus, delays in one project caused delays in other projects.

Contractual delays consisted primarily of time spent generating and fulfilling information requests from the legal departments of parties involved in the various PIER Commerce contracts and subcontracts. Equipment purchase orders for systems to be implemented under the PIER Commerce program were delayed until the contracts could be finalized. Delays in issuance of purchase orders, in turn, led to delays in equipment installation. Labor resource constraints contributed to small lags in equipment installation. Additionally, faulty equipment at one of the large BI-PV systems led to delays while troubleshooting was performed to identify the cause of problems.

Additionally, data collection posed significant challenges. Confidentiality concerns and lack of facility owner interest in providing a site for a renewable energy pilot project affected customer willingness to share data. Furthermore, the discovery that the local T&D system in the study area was larger and more complex than originally envisioned created additional data collection requirements.

Finally, changes in work scope or schedule posed challenges for the PIER Commerce project teams during the first 28 months of the program. Results of the draft project prioritization report produced in Project 1.1, in conjunction with discussions with other interested parties, led to major changes in work scope for the other PIER projects. These results caused a shift away from installation of the plug-flow digester at the RP-5 facility and an increased focus on certain technologies identified as most desirable from the draft project prioritization report.

Significant challenges faced by the individual PIER projects, and major changes in the work scope or schedule of each of the projects, is discussed in greater detail in this section.

5.2 Project Challenges and Changes

5.2.1 Project 0: Program Administration

Challenges encountered in Project 0 during the first sixteen months of the program were primarily associated with contractual delays. Program inception was delayed by changes to the original work scope and schedule. Finalization of the work scope and schedule further delayed actual project work.

5.2.2 Project 1.1: Planning and Analysis Project

Primarily in 2002, data collection efforts posed a significant challenge for Project 1.1. Initially, the literature review for the renewable resources potential summary report revealed a large volume and broad scope of reports potentially applicable to the analysis. Additionally, the process of finalizing the boundaries of the mini-grid proved to be more time-consuming than was originally anticipated due to requirements for additional data. Regional substation location, voltage class, and circuit data was required for the project team to develop adequate comprehension of the resource limitations of T&D system power flow modeling efforts before project development could progress further. Ultimately, in 2002, the preliminary definition of the mini-grid was expanded to include potential bioreactor landfill and enhanced aerobic digestion projects at wastewater treatment plants, since the number of sites available for potential projects was limited.

Furthermore, after some discussion of the data requirements associated with Project 1.1, the project team determined that Southern California Edison (SCE) should be included in the program as soon as possible. Thus, the project team entered into discussions with SCE regarding T&D data collection requirements for the study area and the mini-grid. SCE tentatively agreed to participate in the Project 1.1 TAC, and ultimately provided the team with valuable data regarding the local T&D system.

Additionally, the Project 1.1 team encountered significant challenges in data collection for electrical loads at eight representative dairies since dairy owners commonly considered such information to be proprietary. Thus, the project team was compelled to initiate contact with the Milk Producers Council to attempt to develop a mechanism to calculate representative loads for selected dairies in the project database while maintaining participant confidentiality.

Furthermore, the Project 1.1 team encountered difficulty in collecting data since a number of sites did not want to be considered as potential hosts for a bioreactor pilot project. These delays in data collection, in turn, delayed database submittal efforts.

Another challenge encountered by the Project 1.1 team in 2002 arose from the need to prioritize pilot projects subject to locational constraints. This issue arose due to the results

generated in the STP inventory report, which identified potential projects that could be developed under project 2.2. According to the inventory report, those technologies identified as having the highest digester gas production were anaerobic digestion projects; however, those projects could most logically be located outside of the mini-grid. Furthermore, according to the inventory report, while there were other technologies that were more efficient within the mini-grid, those technologies were not originally anticipated to be developed through the Commerce Energy Program.

Thus, in order to assess the tradeoffs between employing certain technologies outside the mini-grid versus employing others in mini-grid, the Project 1.1 team met with Energy Commission staff to discuss prioritization of potential sites for demonstration projects. Results of the project prioritization process were to be incorporated into the project development processes of subsequent Commerce projects, causing a ripple effect in project delays.

Furthermore, the Project 1.1 team experienced delays in development of the local electrical T&D database and load flow model. The mini-grid area was found to contain seven separate distribution systems serving a total peak load of approximately 535 MW. Due to the size of the mini-grid area, each of the distribution subsystems could be considered a mini-grid. Furthermore, the complexity of the local electric T&D system required the development of 12kV feeder electrical data for 67 feeders to develop the load flow T&D model. Thus, characterization of the mini-grid's electric T&D system posed significant challenges to the project team.

Additionally, in 2002, the local T&D database and load flow model was augmented to include additional distribution system data. Data for a distribution substation outside the local area was added, which contained information on 12 kV feeders serving loads in the area north of Pine Street and east of Route 71. These loads were not served by the seven local distribution systems, which contained RP-5 and RP-2 loads. Data for an additional distribution substation outside the local area was also added to the T&D database and load flow model. This substation contained 12 kV feeders serving loads in the northeast region of the mini-grid north of Route 10 and east of Route 15 to Etiwanda Avenue. This area contained RP-4 and an Ikea warehouse.

One final challenge faced by the Project 1.1 team in the latter part of 2002 involved obtaining regulatory acceptance of bioreactor landfill project. In order to facilitate this process, the project team met with the CEC, the State Water Resources Board, the Integrated Waste Management Board, the Regional Water Quality Control Board, and others potentially or actually involved in the permitting process.

During this process, the Project 1.1 team learned of a R&D exemption that would potentially affect permitting of the bioreactor pilot research project. According to the EPA, this exemption would be issued in spring 2003. After learning of this potential exemption, the Project 1.1 team stayed abreast of regulatory developments in bioreactor permitting, including this exemption. While this change required some attention on Itron's part, it did not affect project progress in 2003.

However, one challenge that did affect progress in 2003 was the greater than expected difficulty encountered in data collection for biogas prototype development. Delays associated with data collection in turn delayed completion of the mini-grid market potential assessment. Start-up of the final report was also delayed to accommodate completion of tasks related to the agricultural waste database and inventory report.

Additionally, in 2003, the Energy Commission requested that project team address out-of-scope items concerning design implications and interconnection requirements of PV and biomass. These items were to be appended to the existing T&D impacts analysis statement of work. After some discussion with the Energy Commission, it was determined that those issues would be pursued in July 2003 after the Task 1.1.9b draft report was submitted, if Program resources allowed.

5.2.3 Project 2.1: Enhanced Landfill Gas Production Project

One major change in Project 2.1 scope occurred immediately after the project kickoff meeting. After the kickoff meeting, the team jointly decided that funding one bioreactor project would be more cost-effective than funding two bioreactor projects. Thus, efforts on the second bioreactor were placed on hold until further notice.

Other challenges faced by the project team in 2003 included data collection, communication requirements, and additional planning and design activity associated with preparing the bioreactor project for public bidding. Since data for the landfill feedstock characterization form was not available in electronic format, the data collection phase for that report required more time than was originally anticipated. Additionally, since numerous parties were involved in the development of the San Bernardino County landfill, it was necessary to maintain constant communication between all key stakeholders in the project. Major project stakeholders included San Bernardino County staff, the landfill operator, and engineer; the Regional Water Quality Control Board, the Santa Ana Regional Energy Commission, and other state and local entities.

Finally, with regard to the public bidding process, additional planning and design activity was required to prepare the bioreactor project. During this process, the Commerce Energy team worked closely with the San Bernardino County design engineer to develop a plan to

jointly implement the proposed expansion/bioreactor project. This plan included a permitting component and design efforts for the integrated public bidding effort. The proposed plan and funding allocation was presented to the Energy Commission and discussed via conference call. While these efforts posed a challenge for the project team, they did not create any significant delays in project progress.

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.

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

Originally, the project team envisioned that RD&D efforts related to Project 2.2 would involve one ultrasound and one thermal hydrolysis technology. However, based on the results of the process selection report, the Project 2.2 team, in conjunction with the RPAC, concluded that future efforts related to Project 2.2 in 2003 should focus on ultrasound technology instead. The project team felt that such an approach would render the findings of the analysis more relevant to the rest of California, and expand consumers' knowledge base in the rapidly evolving field of ultrasound technology.

As a result of this evolution in work scope, identification and recruitment of additional ultrasound vendors into the program was required. Such steps were necessary to ensure that the team could effectively and accurately document the mechanisms through which ultrasound technology could help increase gas production and improve the treatment process.

Subsequently, the project team concluded that vendors should be involved in the project planning phase to streamline the site selection and design tasks, and to focus future resources on project implementation. These actions increased the overall efficiency of project implementation; however, they delayed finalization of the site selection and test plan report.

Finally, in 2003, it was determined that site selection and test plan efforts would focus on integrating: (1) two ultrasound systems into the Riverside plant, and (2) gas drying, hydrogen sulfide removal and siloxane removal systems into the IEUA RP-1 site. Further development efforts in 2003 focused on implementing these action items.

5.2.5 Project 3.1: Dairy Waste to Energy Project

The kick-off meeting for Project 3.1 was held in late February 2003. During the meeting, the project team discussed the findings of Project 1.1 as they applied to Project 3.1, and discussed plug-flow versus complete mixed-digestion systems. Based on input received from

NIRAS at the meeting, the project team concluded that additional economic and environmental analysis of these systems should be undertaken earlier in the project than was originally planned. Project prioritization results were expected to affect how the project proceeded, so the schedule for Project 3.1 was adjusted to incorporate the results of the Project 1.1 power flow modeling and the results of the comparative analysis.

Initially, the draft prioritization report created under Project 1.1 envisioned that various technologies would be tested at the manure digestion facility at IEUA RP-5, which contains a centralized plug-flow digester. However, at the September 24, 2003 RPAC meeting, it was determined that modifications at RP-5 would not be appropriate since construction of a plug-flow digester and conversion to a complete-mix digester was not a likely scenario for future projects in California.

Thus, as a result of the RPAC meeting, and a subsequent meeting with the Energy Commission, the project team concluded that that it would be more appropriate to test technologies at a complete-mix digester more typical of what would exist elsewhere in California. Thus, all work related to RP-5 was terminated. Future Project 3.1 activities to test new technologies were to occur at RP-1 or in a new complete-mix digester at RP-5. The project team additionally concluded that the only future work to be conducted at RP-5 would potentially consist of monitoring activities. These decisions marked a major shift in work scope for Project 3.1.

Originally, test plans and protocols for Project 3.1 were developed for potential use at RP-1 or RP-5, with a focus on RP-5, as indicated in the draft prioritization report. However, with the shift in focus away from RP-5, efforts related to plan and protocol creation were shifted toward defining those test plans and protocols that could be better tested at RP-1.

Thus, a major change in project scope occurred for Project 3.1 in 2003. To summarize, the revised project 3.1 plan concluded that efforts should focus on:

- Monitoring, rather than developing new projects at the existing RP-5 digester,
- Identifying environmental benefits of centralized digestion projects,
- Identifying opportunities for other centralized anaerobic digestion projects in California,
- Developing demonstration projects to improve key processes to achieve economical centralized dairy projects, and
- Assembling findings so they could be applied at future projects in the Chino Basin and elsewhere in California.

Additionally, in 2004, the CE Team searched for cost information for centralized dairy waste to energy projects in an appropriate form. This specific topic is being addressed earlier than anticipated within the project, which along with the program focus redirection to co-digestion and gas cleaning has caused some minor delays while the CE Team has revised or researched necessary information.

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

Project 3.2 faced a number of significant challenges during 2003, including prolonged contractual negotiations and problems with faulty equipment. In the early part of 2003, contractual negotiations between Commerce Energy and the IEUA led to delays. The IEUA submitted numerous requests for information prior to executing the contract for the 60 kW PV system.

After Commerce Energy responded to all of the IEUA's information requests, the Commerce team expected to finalize the contract in February 2003. Thus, the final contract was presented to IEUA Board in April 2003, a month later than originally anticipated. The delay in Board approval, in turn, resulted in a day-for-day delay in project development since equipment could not be ordered until the contract was executed. Thus, a minimum two-week blackout period was expected to occur in late May 2003. During this time, the team would be unable to perform any activities on site.

Subsequently, shipping delays for equipment ordered from abroad delayed the progress of Project 3.2 by approximately one month. Equipment purchases were further delayed by information requests from the Commerce Energy legal department, who raised numerous questions regarding subcontracts for the installation of the 60 kW PV system. Delays in Commerce Energy approval, in turn, held up signatures for many of the purchase orders for some components of the large systems.

Additionally, resource constraints led to slight delays in equipment installation. Since IEUA electrical maintenance personnel supplied the bulk of the electrical installation labor, Project 3.2 progress was affected by the lack of sufficient IEUA resources. IEUA staff was compelled to address other pressing maintenance needs in 2003, which resulted in occasional delays in project progress.

Finally, equipment problems led to delays in project development in late 2003. Specifically, in November 2003, a problem with the PowerLight array was identified. Intensive troubleshooting was required to pinpoint the source of the problem. Xantrex (the inverter manufacturer), PowerLight (the array supplier), and Sanyo (the module manufacturer) worked with the project team to identify the source of the problem. Ultimately, the problem

was traced to the incompatibility of the PV array with the inverter, rather than the field wiring. The array was determined to possess a capacitive nature that did not allow the inverter to function properly. In December 2003, Xantrex worked with the project team to develop a software solution to the problem. However, ultimately, the troubleshooting process for the PowerLight array interrupted the acceptance testing of the other PV systems.

Thus, delays in Project 3.2 progress in the first 28 months of the program were primarily caused by legal and contractual requirements, labor resource constraints, and faulty equipment. Delays in the large system siting incurred in 2002 were foreseen before the project's inception, due in part to delays in starting the overall PIER program.

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

As with the other projects, data collection posed a significant challenge in fulfilling the objectives of Project 3.3. In 2003, the project team encountered greater than expected difficulty in assembling project information for all ten of the identified potential demonstration sites. Delays in data collection in turn slowed progress toward the completion of the draft Task 3.3.4a report. Other challenges faced in submitting the draft Task 3.3.4a report included lengthy wait times for approval of the final evaluation tools package, response to comments by Energy Commission staff, and the independent peer review process.

In 2004, Task 3.3.2 continued to take much longer than anticipated to complete, due to multiple outside technical reviews and related revisions implemented to the *BI-PV Evaluation Tools Package*. The final draft deliverable was approved in March 2004 and work was able to resume. Additionally, the delays in the *Large Systems Testing* task under Project 3.2 have also affected the schedule for Task 3.3.4. In May through October 2004, a key personnel redirection limited task work while an appropriate replacement was determined.

6

Program Expected Accomplishments

6.1. Overview of Program Expected Accomplishments

This section describes the expected accomplishments for the PIER Commerce Energy Program on a project-by-project basis over the next reporting period, January 2005 through December 2005.

6.2. Project Expected Accomplishments

6.2.1 *Project 0: Program Administration*

It is anticipated that as the PIER Program continues into contract year 2005, the Commerce Energy Program Director will continue to provide ongoing support to the CE Team and Energy Commission Staff. This work will encompass participation in meetings, ongoing review and editing of task deliverables, management and oversight of Contract Exhibit B and any budget/task reallocations, coordination with Advisory Council members, CE Team members, and Energy Commission staff to ensure that individual project goals are not only being met, but are effectively linking to overall Program goals and objectives.

Project 0 task deliverable work will continue with primary focus centered on the PIER Program Annual Reports, Project Monthly Status and Monthly Program Reports, Permit Documentation, as well as the coordination of various RPAC and Critical Project Review Meetings. All task deliverables will be submitted to the Energy Commission for review and comments. While under review at the Commission, each draft deliverable will be placed on the private side of the PIER website, and once approval is received, the deliverable will be edited as required and moved to the public side of the PIER Mini-Grid Program Website.

The Contract Administrator will continue to provide ongoing support to the CE Team and Energy Commission staff, as project deliverables are presented for internal review prior to submittal to the Energy Commission. It is anticipated the first Contract Invoice for calendar year 2005 (#14) will present the match fund documentation required under Task 0.2.4 of the PIER CE contract.

6.2.2 *Project 1.1: Planning and Analysis Project*

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, both deliverables were submitted in 2004 however, as of December 2004, comments had not been received from the Energy Commission therefore these reports remain to be finalized. 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.

6.2.3 Project 2.1: Enhanced Landfill Gas Production Project

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.

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

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*.

6.2.5 Project 3.1: Dairy Waste to Energy Project

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 were 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. The documentation will be prepared to demonstrate that the installation work on the iron sponge systems and co-digestion systems is complete.

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.

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

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.

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

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.

7

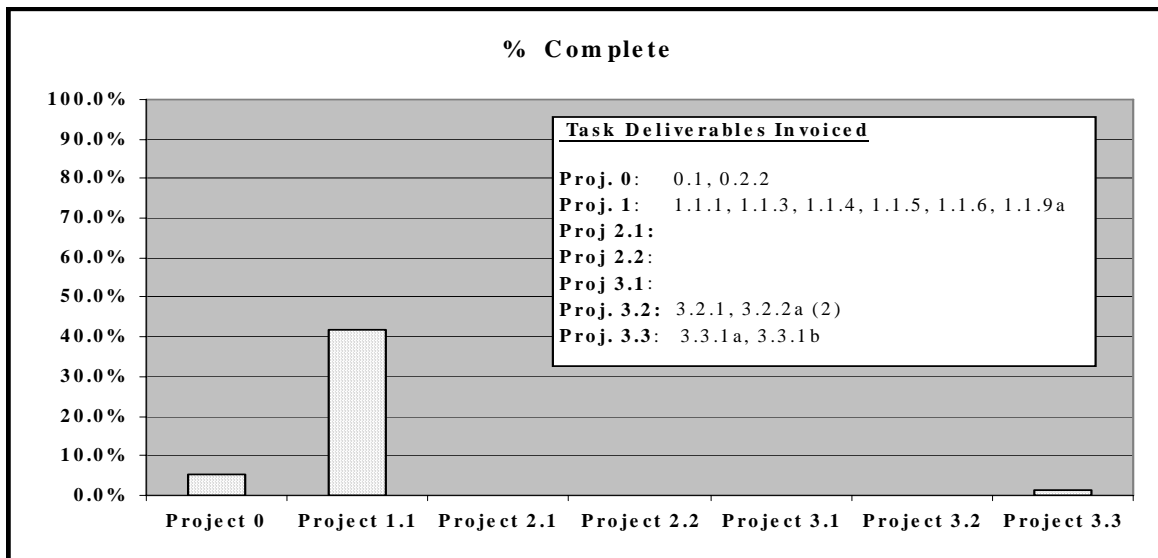
Program Milestones and Deliverables

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 28-month reporting period ending December 31, 2004. Additionally, Figure 7-1 and Figure 7-2 illustrate the percentage completed based upon task deliverables invoiced through December 31, 2004. Additionally, Table 7-1 through Table 7-7 detail deliverables by Project, as invoiced-to-date through December 31, 2004.

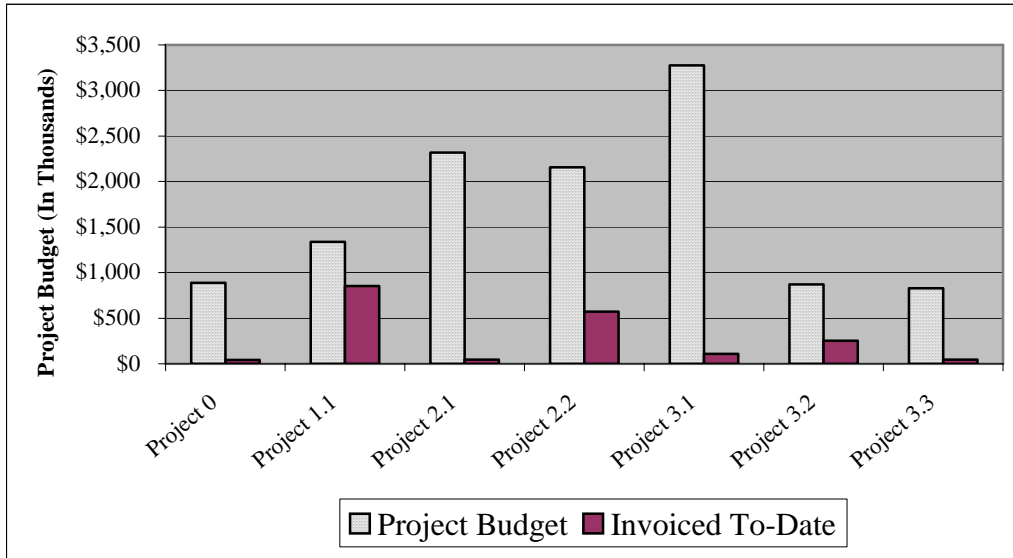
The overall contract budget for the PIER Commerce Energy Program is \$11,688,572. During this reporting period, \$2,133,379 in task deliverables were submitted and \$1,920,042 invoiced¹ through December 31, 2004, representing 16% of the total contract budget invoiced to date.

Figure 7-1: Percentage Complete based upon Invoiced-To-Date (through December 31, 2004)



¹ The \$213,337.90 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

Figure 7-2: Invoiced To-Date through December 2004



7.2 Project Milestones and Deliverables

7.2.1 Project 0: Program Administration

As shown in Table 7-1, two deliverables were invoiced for Project 0 during the first 28 months of the PIER Commerce Energy program.

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

Task No.	Deliverable	Task Budget	Contract Invoice #	Invoiced Date	10% Retention	Actual Invoiced
0.1	Kick-Off Meeting Notes, Revised Exhibits A & B	\$22,370	1	10/31/2002	\$2,237	\$20,133.00
0.2.2	Program Software Standardization	\$25,824	3	01/31/2003	\$2,582	\$23,242.00
TOTAL		\$48,194			\$4,819	\$43,375

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
1.1.1	Assessment Review Reports and Initially Define Mini-Grid Map	\$18,902	1	10/31/2002	\$1,890	\$17,012
1.1.2	Agricultural Waste in Southern California Database and GIS Inventory Report	\$186,124	7	01/26/2004	\$18,612	\$167,512
1.1.3	Landfill Database and Inventory Report	\$133,730	2	12/31/2002	\$13,373	\$120,357
1.1.4	Sewage Treatment Plant Database & Inventory Report	\$186,272	2	12/31/2002	\$18,672	\$167,600
1.1.5	PV Systems Technical Potential Report	\$85,780	4	03/26/2003	\$8,578	\$77,202
1.1.6	T&D System Database	\$98,840	6	06/10/2003	\$9,884	\$88,956
1.1.7	Electricity Market Potential for the Mini-Grid Region Report	\$96,896	11	08/18/2004	\$9,690	\$87,206
1.1.8	Generation Profiles for Biogas and PV Resources Report	\$26,363	11	08/18/2004	\$2,636	\$23,727
1.1.9a	Local Area T&D Model	\$37,040	6	06/10/2003	\$3,704	\$33,336
1.1.9b	Pertinent Studies Summary Report and technical reviews	\$59,134	7	01/26/2004	\$5,913	\$53,221
1.1.11a	Outline of Final Report for Project 1.1	\$18,540	7	01/26/2004	\$1,854	\$16,686
TOTAL		\$947,621			\$94,806.70	\$852,815

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
2.1.1a	Landfill Feedstock Characterization Report	\$52,117	7	01/26/2004	\$5,212	\$46,905
TOTAL		\$52,117			\$5,212	\$46,905

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
2.2.1	Process Selection Report	\$236,563	7	01/26/2004	\$23,656	\$212,907
2.2.2	Site Selection and Test Plan	\$182,543	9	05/07/2004	\$18,254	\$164,289
2.2.3b	Thermal Hydrolysis and Ultrasound System Design and Construction Drawings	\$215,842	12	11/18/2004	\$21,584	\$194,258
TOTAL		\$634,948			\$63,494	\$571,454

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
3.1.1a1	Technical Memorandum	\$48,000	12	11/18/2004	\$4,800	\$43,200
3.1.1a2	Preliminary Draft Process Recommendations Report	\$72,000	12	11/18/2004	\$7,200	\$64,800
TOTAL		\$120,000			\$12,000	\$108,000

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
3.2.1	BI-PV Testing & Evaluation Test Plan	\$9,460	3	1/31/2003	\$946	\$8,514
3.2.2a (2)	Data Acquisition (DAS) Letter of Notification	\$75,000	5	06/06/2003	\$7,500	\$67,500
3.2.2a4		\$32,500	9	05/07/2004	\$3,250	\$29,250
3.2.31		\$34,163	9	05/07/2004	\$3,416	\$30,747
3.2.34a		\$ 3,876	9	05/07/2004	\$388	\$3,488
3.2.2a3		\$32,500	10	06/11/2004	\$3,250	\$29,250
3.2.2b 2		\$50,000	11	08/18/2004	\$5,000	\$45,000
3.2.32		\$ 8,400	11	08/18/2004	\$840	\$7,560
3.2.25a		\$32,500	12	11/18/2004	\$3,250	\$29,250
3.2.3.2		\$ 2,100	12	11/18/2004	\$210	\$1,890
TOTAL		\$280,499			\$28,050	\$252,449

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
3.3.1a	Public Sector Agencies Database	\$5,000	2	12/31/2002	\$500	\$4,500
3.3.1b	Manufacturers and Distributors of BI-PV Equipment Database	\$5,000	2	12/31/2002	\$500	\$4,500
3.3.2	BI-PV Evaluation Tools Package and Test Plan	\$40,000	8	03/31/2004	\$4,000	\$36,000
TOTAL		\$50,000			\$5,000	\$45,000