Energy Solutions

Chevron

Comprehensive Energy Services Program
RFQ No. C500206

Preliminary Assessment

Submitted to:

CAL STATE EAST BAY

California State University East Bay

Facilities & Service Enterprises
25800 Carlos Bee Boulevard
Hayward, CA 94542
Attn: Randy Gale

Submitted by:

Chevron Energy Solutions Company
A Division of Chevron U.S.A. Inc.

345 California Street, 18th Floor
San Francisco, CA 94104

May 8, 2006

Energy Solutions

Chevron Energy Solutions Company
A Division of Chevron U.S.A. Inc.
345 California Street, 18th Floor
San Francisco, CA 94104-2624

May 8, 2006

Mr. Randy Gale
Director, Facilities Management Department
California State University-East Bay
25800 Carlos Bee Boulevard
Hayward, CA 94542-3081

Dear Randy,

Chevron Energy Solutions Company (Chevron ES), a division of Chevron U.S.A., is pleased to submit the attached Preliminary Assessment for energy efficiency improvements and / or modifications to complement and enhance California State University-East Bay (CSUEB) campus' existing heating plant. The goal of this PA was to identify and develop on a preliminary basis cost-effective heating plant infrastructure alternatives offering increased system reliability and reduced maintenance and operation requirements to insure the lowest total operating costs on existing and future buildings served by the plant.

Chevron ES has a wealth of experience in the evaluation, design, development, and installation of a wide variety of control and mechanical systems as well as renewable energy projects for enhanced sustain-ability. We have delivered turnkey projects for public and private sector clients that have provided immediate and long-term financial and operational benefits, while meeting our clients' specific business requirements. Our energy solutions include a wide range of services, including analyzing and interpreting energy usage patterns; upgrading inefficient equipment; improving power quality and reliability; developing and installing photovoltaic solar and fuel cell projects; and developing customer-specific strategic energy plans.

Should there be any questions regarding the information presented in this response or if you need any additional information, please do not hesitate to contact us. Thank you for your consideration.

Sincerely,

Mark Schneider
Business Development Manager
(415) 733-4702
mrsj@chevron.com

Susan Pridmore
Business Development Manager
(415) 733-4502
spij@Chevron.com

Contents

1. Executive Summary

A written overview of the proposed project including existing operational background assumptions based on interviews with campus personnel, energy usage data and cost information obtained as part of the Assessment process, followed with the proposed energy measures and an estimation of the resultant avoided cost in energy operations expenses on an annualized basis.

1.1 Project Introduction

Chevron Energy Solutions (CES) is pleased to present the following Preliminary Assessment for California State University, East Bay (CSUEB) to provide energy efficiency improvement and/or modification solutions to best complement and enhance the campus existing aging heating plant. We are excited about the opportunity to work with CSUEB in an IGA phase of work to more fully develop the most optimal solutions for the campus, and to implement those options.

1.2 Preliminary Project Development Background

The campus buildings were originally served by a high-pressure steam central plant system. Less than 15 years ago, when faced with an investment decision on the central plant, the campus decided to shift to distributed boiler infrastructure design for a variety of reasons. At present day, the campus faces the same fork in the road decision to replace / upgrade the existing distributed boilers or to move back to a central plant due to a number of factors:

- Aging heating equipment requiring increasing repairs
- Energy and operationally inefficient systems
- Excessive maintenance and operation burden due to number of boilers and associated equipment, and placement of equipment spread across many buildings.
- Flue exhaust fumes noticeable by students, faculty and staff around buildings being served
- Difficulty in effectively managing and controlling all energy consuming equipment due to equipment spread across the campus

If this were a new campus being developed, we would unequivocally recommend installing a central plant and associated utility infrastructure for some of the following reasons:

- A central plant can be designed efficiently to take advantage of the diversity of loads in the buildings served and therefore be designed with less total capacity. When designed on a building-by-building basis, the campus needs a little more capacity in a system than the total campus requirement for heating or cooling at any given time. As a result, the more individual systems you have the more excess capacity you end up with.
- A distributed boiler arrangement creates a maintenance burden as well, especially when there are numerous pieces of equipment and they are spread all over a campus.

- With new construction, there is significant trenching due to burying of utilities including internet fiber. The incremental cost of laying pipe connecting the buildings for a central plant is not as significant as when the trenching is performed for this purpose alone.
- Shifting from a distributed arrangement to a central plant on a stand-alone project basis in a campus currently populated by students, faculty and staff requires significant additional analysis to determine the best approach for the campus

1.3 Project Development Process

In accordance with standard practices we employ on developing projects and with the California State University "Utilities Infrastructure Master Plan Guideline for CSU Campuses," the development, evaluation and selection of solutions fall into a sequence of steps:

(1) Identify and assess the condition, capacity, and loads of the existing heating infrastructure and associated utilities that support that infrastructure. Perform energy bill analysis, interview campus personnel, and review energy management system reports to understand how and when campus is consuming energy. In the detailed stage of work (IGA) confirm this as needed through available methods such as data logging, metering, etc.

(2) Review applicable Campus or Facility Master Plans, growth plans, and any current Campus Utility and Infrastructure Master Plans that may be in place. (In absence of the latter, this proposal process could form the foundation for one.) The purpose of this review is to evaluate and factor in planned changes to the campus through the addition, deletion, and renovation of buildings and their impact on campus heating (and cooling) loads and load diversity. Taking a larger view of the campus allows us to appropriately size the central plant to meet current demands and allow for easy future expansion if needed. Additionally, if the campus elects to move back to a central plant configuration, depending on future plans, it may make sense to at least lay CHW piping at the same time we trench and lay HHW pipe in order to mitigate some of the future expense of centralizing the chilled water plant.

    Standards and goals laid out in the Executive Order 917, currently in the process of being updated at the Chancellor Office level, are adhered to. A review of campus energy reports would reveal specific goals the campus may have for both energy efficiency and renewable energy that should be factored into the development and evaluation of design alternatives. Development of project criteria to be used to evaluate design alternatives is crucial to the integrity of the overall solution developed and selected, and may be ongoing throughout the preliminary (PA) and into the detailed (IGA) stages. Our intent is to develop and help the campus implement the best overall solution while balancing the needs to manage such things as:

    a. Initial cost
    b. Maintenance requirements
    c. Energy efficiency
    d. Operational efficiency
    e. Technical risk
    f. Campus safety and comfort

g. Environmental impact

An analysis of heating plant alternatives against potential criteria that the campus could use is included later in this section.

(3) Formulation and evaluation of alternatives including how to phase in planned building / campus additions. This is performed in consultation with the campus as heating and cooling for a campus can be accomplished in a variety of ways. This evaluation typically takes place in two stages: preliminary and detailed.

a. The preliminary stage includes high level analysis that can be factored into a high level life cycle cost formula that incorporates first cost, replacement cost, energy costs, operating and maintenance costs, regulatory costs (such as permitting) and applying net present value discounted factors to determine future costs on a present day cost basis. All alternatives are mapped against additional project criteria that the campus may use in making a final determination. Preliminary rebates or grants that may be available are also identified. Energy bill analysis, reviews of as-built drawings, site walks, interviews with campus personnel forms much of the foundation of this early analysis work. This is the analysis we performed for this report.

b. The detailed stage entails a far more detailed analysis (including life cycle cost analysis) with firm costs and savings, including data logging, computer modeling and Delta-T analysis to fine-tune central plant equipment and pipe capacities. Impacted buildings are finalized including plans for any buildings that may have a customized approach due to either their size or remoteness from the rest of the campus. All effort is made to minimize cost and campus disruptions due to construction. Scope and schedule are set. Documentation of the decision process is retained for future building design efforts and for campus management personnel.

1.4 Heating Plant Alternatives Considered

CES evaluated two options for replacing the existing aging, inefficient, and maintenance intensive boilers distributed throughout the campus, and performed preliminary review of two different central plant approaches:

(1) Construct one, high efficiency central heating hot water plant including, underground piping to all affected buildings

a. Central plant with centralized boilers, piping and associated equipment

b. Central plant with cogeneration, boilers and possibility of absorber chiller for heat recovery

(2) Replace existing standalone boilers with a reduced number of high efficiency, premium quality condensing boilers.

Option A.1: Central Heating Water Plant

Install state-of-the-art central heating water plant in order to increase heating efficiency, reduce maintenance and provide increased reliability. The new hot water boilers will be located in the building that originally housed the steam boilers and is currently used for storage. CES recommends the use of hydronic heat distribution in lieu of returning to a steam based system. Reasons include increased reliability, preferable economics, life cycle cost, simplicity of operation (unmanned central plant operation), and reduced maintenance burden. Also, the estimated cost associated with replacing the steam piping could be as much as twice the cost of hot water piping.

Central Plant Benefits:

- The new central heating plant will save the University approximately 300,000 therms annually over the existing campus heating plant
- Ability to reduce overall heating capacity for the campus through by taking advantage of load diversity
- Improved equipment efficiency
- Increased reliability of industrial quality equipment
- 40-year life expectancy
- Consolidation of equipment near facilities maintenance office improves operational and maintenance efficiency
- Greatly reduced number of pieces of equipment to maintain and operate
- Potential capacity to provide heating to future buildings based on effective planning
  - Based on effective planning, a central plant may be designed to more cost effectively add on future planned loads. The central plant could be designed to be able to operate efficiently over a broad range of operating conditions, with built in capacity to handle future loads. This would also be dependent on various other factors including availability of power and the capacity of existing piping infrastructure.
- Fewer pieces of equipment to control
- Elimination of flue gas smells around campus academic buildings
- Environmental?

Central Plant Features:

- Approximate size of 50,000,000 BTU/h, with either two or three water back fire tube boilers, with efficiency of 85% a 15 year warranty and an expected life expectancy of 40 years
- The hot water distribution system would consist of redundant variable speed base mounted horizontal split case pumps selected to operate at peak efficiency to minimize the impact on the campus electrical usage
- The hot water distribution would be variable flow for maximum pumping efficiency
- The multiple boiler design would provide the campus with equipment redundancy
- DDC controls
- Underground piping is assumed to be an insulated and jacketed direct buried piping system
- New HW to HW heat exchangers will be installed in each of the buildings to meet the domestic hot water needs of the building, keeping all of the combustion equipment located within the central plant

MEASURE	COST	ANNUAL SAVINGS
Central HW Plant	$2.5M–$3.5M	$200K–$250K
Intra-campus Underground Piping	$4M–$5M	

Option A.2: Central Heating Water Plant with Cogeneration

A high-level analysis and significant discussion was held around adding cogeneration to a central heating plant. In addition to the central plant benefits listed in Option 1.A, the following benefits could be gained by the campus:

Additional Central Plant Benefits:

- Generating power that could be fairly easily fed into the campus with the net result of reduced power purchases
- Increased electrical system reliability
- Increased campus based power capacity to support potential future growth
- Increased energy efficiency, based on heat recovery use

This option would however require serious thought due to the following critical project aspects:

Project Considerations:

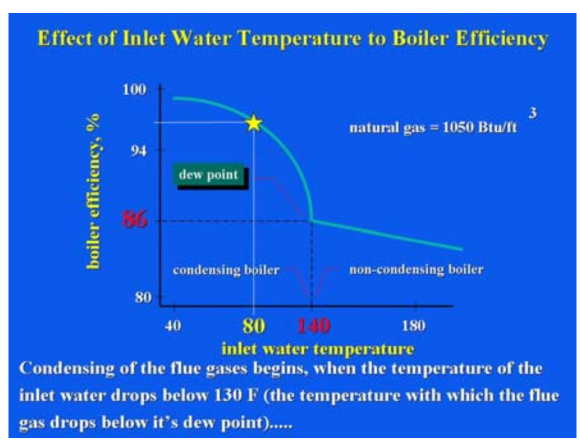
- It is increasingly difficult to see attractive economics on cogeneration projects due to increased material costs and increased gas costs
- Cogeneration systems introduces some level of technology risk (and net cost)

- Cogeneration systems carry high maintenance requirements, at least part of which would need to be outsourced for SGIP rebate purposes
- The utility SGIP rebate on cogeneration has been decreasing and is expected to continue that trend
- In future based analysis, the Chancellor’s Office is expecting that future contracted power prices will be decreasing over time; gas prices are expected to rise. This contributes to questionable project economics.
- The campus currently does not have a large heat load in order to effective use the heat recovery advantage cogeneration offers. This may require the addition of absorber chiller(s) in order to assist with the economics, but will add cost and complexity to the project. Due to current and expected power prices, it would be strongly recommended to size the cogeneration system to the base heat load.
- Controls have increased complexity
- Project commissioning much more complex and critical
- Additional permitting and approvals equating to additional cost and time for cogeneration approvals and net result of not being as environmentally clean a solution (hazardous waste?)

Due to extensive project considerations, we elected not to pursue pricing.

Option B: Distributed Heat Plan

If the campus decides not to install a central heating plant, CES recommends replacing the existing heating water and domestic hot systems within the buildings that currently have Lochinvar boilers. This option will replace the existing copper fin/tube boilers that have an actual operational efficiency of in the 65%–75% range (actual) and with a fewer number of highest quality condensing boilers with actual potential operating efficiencies in the 90% range (efficiencies above 90% are dependent on return water temperatures being less than 140 degrees F.). The disparity in the actual efficiency of the existing boilers to their “rated” efficiency is due to the fact that boilers are allowed to be tested at operating temperatures for published efficiencies that are not possible for day to day operations without destroying a copper fin/tube boiler. The boilers CES proposes to install have stainless steel heat exchangers suitable for condensing operation and are designed to operate in the 90% to 95% efficiency range. This option also includes:



- The correction of flue issues that currently exist on campus
- Replacement of maintenance-intensive boiler system
- Increase the efficiency of the heating systems. (energy efficiency? Operational efficiency?)

This measure will save CSU EB approximately 360,000 therms annually over the existing heating system with the following additional benefits:

- The hot water distribution system would consist of redundant variable speed base mounted horizontal split case pumps selected to operate at peak efficiency to minimize the impact on the campus electrical usage.
- The hot water distribution would be variable flow for maximum pumping efficiency
- The multiple boiler design would provide the campus with equipment redundancy.
- DDC controls
- Maximized equipment efficiency
- Greatly extended life expectancy – 25-year HX warranty
- Reduced maintenance costs (resulting from both, increased quality and reduced quantity, of equipment)
- If the central plant boilers have a 40-year life expectancy, what would we expect from the boilers here?
- Increased control capability? Ability to shut some building down when not in use?
- Faster installation?

MEASURE	COST	ANNUAL SAVINGS
Replace Existing Boilers in kind	$3M–$4M	$250K–$300K

What cost of therms are we assuming? Any rebates?

1.5 Recommended Heating Plant Scope

1.6 Additional Measures to Increase Heating Plant Efficiency

1.X Project Experience
We have some experience with the California State University system including the East Bay campus, and significant extensive experience with many community colleges, counties, cities and K–12 school districts throughout California that has involved their heating systems.

Section II. Facility Assessment Process

A written overview of the proposed project including existing operational background assumptions based on interviews with campus personnel, energy usage data and cost information obtained as part of the Assessment process, followed with the proposed energy measures and an estimation of the resultant avoided cost in energy operations expenses on an annualized basis.

Section II.a Existing Operational Background

Chevron ES has visited the campus at CSUEB on several occasions to evaluate the existing conditions of the various mechanical, electrical, lighting and control systems and to determine possible measures that will improve the campus's energy efficiency. The following is the result of both our observations and the input from the various maintenance staff personnel from those site visits.

Heating Systems:

The CSUEB campus buildings were originally heated by means of a central high pressure steam plant. The steam was piped underground to the various buildings on the campus. Each of the buildings had a steam to hot water heat converter that provided hot water to the air handlers and zone heating coils within the individual building.

In 1995 the central steam plant and the converters were removed at each building. In place of the converters, heating hot water boilers were installed. Each of the campus buildings now has one or more boilers that provide heating water to the mechanical equipment within the building, with the exception of the Music, Theater and Robinson Hall which are all served from a common mechanical room containing four boilers.

All of the existing boilers are copper fin tube manufactured by Lochinvar. Copper fin tube boilers are typically advertised to be 85% efficient, however, according to information published in the Boiler Systems Engineering magazine in June of 2005, boilers of this type are tested for efficiency utilizing inlet and leaving conditions at which the boilers can not operate for extended periods. This fact is causing the ASHRAE Standard 155P to reevaluate the actual operating efficiency of non-condensing boilers. The article contends that the operating efficiency of copper fin tube boilers is actually less than 75%. Also, the existing boilers do not have the ability to stage the burner down to lower firing rates during low load conditions, resulting in frequent on/off cycling. This frequent cycling with its start up purge and shut down venting cycle further reduces the overall thermal efficiency of the boilers.

The frequent cycling and the combination of materials used in the construction of copper fin tube boilers causes them to have a life expectancy of between 10 and 20 years depending on the actual operating conditions. As a result the installed boilers have become a huge maintenance burden to the facilities maintenance personnel after little more than 10 years of operation.

Another issue that has presented itself with the existing installations is that multiple boilers are connected with one common flue. Some of the flues are discharging combustion gasses too close to populated spaces. This is especially true in the

Administration building installation. The boilers have proven to be difficult to keep tuned to fire efficiently and as a result the odors from the inefficient combustion are pervasive on campus near these areas. According to maintenance personnel, complaints about the odors are frequent.

Cooling Systems:

The cooling systems at CSUEB consist of several independent chilled water systems that serve multiple air handing units in each of the buildings. Not all of the buildings have chilled water systems. Water-cooled chillers serve Meiklejohn Hall, Student Health Services, Admin/Library and Music/Theater/Robinson Hall. The Art and Education building is served by a small air cooled chiller. There are also many small split system air conditioning units that serve rooms with specific cooling requirements especially in buildings like North and South Science that do not have a central cooling system.

The two chillers in Meikeljohn Hall are Trane reciprocating compressor chillers. Each chiller is approximately 150 Tons of cooling capacity and is original to the building. The specific efficiency of the chillers is not known at this time but is estimated at1.0 kW/Ton or greater. These two machines appear to be well maintained but are nearing the end of their useful life and inefficient compared to modern machines which operate in the 0.5 kW/ton range.

The cooling system in the Student Health Services building consists of a Carrier reciprocating compressor water chiller of approximately 90 Tons capacity. The chiller is served by a forced draft cooling tower located inside the mechanical room and ducted to the outside. The cooling tower is currently out of service and is not likely to be repairable due to the corrosion that is present in the casing and fan systems. Inoperability of the cooling tower renders the chiller useless and leaves the building without cooling. The chiller utilizes refrigerant R-22 but is a model that is no longer manufactured. Replacement parts for the compressors are still available for maintenance and repair of the chiller, however, its efficiency is not even close to what is currently available. This machine along with the cooling tower that supports it are at the end of their useful life and should be replaced with newer more reliable and more energy efficient equipment.

The Admin/Library building chiller plant consists of two McQuay centrifugal chillers, approximately 480 Tons capacity each, that are about 10 years old. These chillers are constant speed and don’t have the maximum part load efficiency possible but are in good shape and of relatively good efficiency. The cooling towers are located within the building in an adjacent room and are ducted to the outside which makes it extremely difficult to replace them. Fortunately the cooling towers appear to be in good operating condition.

The Music/Theater/Robinson Hall mini central plant has a single Trane centrifugal chiller. This mini central plant serves the three buildings by means of underground heating and cooling system piping. The chiller is original to the construction of the campus and is nearly 30 years old and is very near the end of its projected useful life. The chiller also utilizes refrigerant R-11 which has been phased out of production. Newer model centrifugal chillers with optimally sized cooling towers are likely 50% more efficient than the existing machine.

Heating and Air Conditioning:

The heating and air conditioning systems in each of the buildings at CSUEB consist of several pieces of air handling equipment. There are three basic types of air handling and conditioning systems that supply heating and cooling to the buildings. The three main types of systems are double duct, multi-zone and single-zone.

Double duct systems utilize two sets of ducts, one with cooled air and one with warmed air. The two ducts join at a mixing box that blends the two conditioned air streams to achieve the required air temperature to satisfy the space heating or cooling requirements. Since the system is blending cooled and warmed air they are inherently very energy inefficient. These systems are not allowed to be installed under the current energy efficiency standards.

Multi zone units operate similarly except that the blending occurs at the air handling unit which utilizes a mixing damper and separates the air streams into several smaller ducts or zones that each have a controller linked to a small portion of the mixing damper. A single duct leaves the air handler and supplies air to the space. Usually these systems have mechanically heated air in one deck and mechanically cooled air in the other deck of the air handler that is blended by the mixing dampers. This is not true for the Science Buildings where there is no mechanical cooling available and the cold deck consists only of unconditioned air. The Science Building systems have also been retrofitted with variable air volume boxes in the building and a variable speed controller on the air handler to vary the air flow throughout the building.

Single zone units can be heating and/or cooling or both depending on the configuration of the heating and cooling coils. Regardless of their configuration and duty, single zone units have a single duct that serves an entire area with air that is the same temperature. Often heating coils are installed in the distribution ductwork to reheat the air somewhat to satisfy a specific areas temperature requirements.

Many of the buildings are a mixture of systems with several double-duct or multizone systems and a few smaller single zone units. The major exception to this is the gymnasium which has several large single zone units serving the main gym and a multizone downstairs that serves many of the smaller areas of the building like the locker rooms. The gymnasium air handlers have had VFD’s installed but currently have no controls that allow the fans to modulate speed, thus they are still acting as constant speed fans.

Controls:

The existing Siebe/Robert Shaw Energy Management System (EMS) at CSUEB is almost obsolete which places the University in a very tentative position. From observation of equipment and staff interviews, some replacement parts are no longer available and it is not possible to reload programming into controllers if lost. Most of the existing controls are functional, but are generally limited to scheduling buildings as a whole. The current focus on scheduling leans toward comfort (i.e. longer runtimes versus tight schedules).

The majority of buildings use multizone air handling systems (some with fresh air only for cooling), though some use double duct air handlers to supply mixing boxes at the zone level. The existing EMS uses DDC controllers and sensors to start and monitor the air handlers, but all control is accomplished by pneumatic output and actuators, and all zone level controls are pneumatic. There are several air handlers with VFD's installed on campus that serve constant volume systems and all appear to be running at nearly full speed. This is primarily true of the air handling units in the gymnasium and the theatre that have VFD’s installed on the main air handlers but the controls were not engineered and, as a result, they are currently operating in manual control.

A more all encompassing project is needed to effectively control the various building and environmental systems in order to maximize energy savings on campus. Please see Section IX for further discussion.

Lighting:

The campus lighting system represents multiple technologies and various levels of energy efficiency which is mostly dependent on the building age and/or remodel status. As part of a four-campus lighting retrofit project funded through the CSU/UC/IOU Energy Efficiency Partnership Program, Chevron ES completed a partial lighting retrofit at CSUEB within the last 30 days. The initial site survey on the balance of the campus revealed a typical installation of T-12 lamps with electronic ballasts, so while standard energy efficient lighting is already in place, there is room for significant improvement in lighting efficiency. This is consistent with discussions with Staff which referred to a large lighting project several years back in which most of the campus went to electronic ballasts.

Facility Assessment Process

Section II.b Facility Assessment Process

The assessment was performed by various Chevron ES and Contractor Personnel. This assessment process consisted of the following steps:

- Chevron ES' involvement in CSUEB's MEA process December 17, 2005
  - This meeting was attended by Mark Schneider and Bruce Dickinson of Chevron ES; Len Pettis of the CSU Chancellor's office and Richard Metz of CSUEB. This meeting discussed the possibility of Chevron ES joining the MEA process at CSUEB.

- First pre-proposal meeting February 14, 2006
  - This meeting included Mark Schneider, Raymond Wong, Stephan Rank and Susan Pridmore of Chevron ES; and Randy Gale, Dan Franke, Mike Tadevich from CSUEB. The purpose of this meeting was for Chevron ES to develop an understanding of the project background and University's project goals.

- First site walk to campus buildings with contractors March 9, 2006
  - This meeting was attended by Stephan Rank, Craig Shulenberger, James Kozelka, Mike DeVries and Patrick Yost of Chevron ES; Dan Franke and Mike Tadevich of CSUEB; Thai Pham of Critchfield Mechanical, Matt Greco of Bay City Boiler; Brook Sheifer of Sun Industries and Robin James of Syserco. Chevron ES and contractors were able to walk most of the buildings included in the PA scope of work.

- Second pre-proposal meeting March 16, 2006
  - This meeting included Raymond Wong and Stephan Rank of Chevron ES and Dan Franke of CSUEB. This meeting covered campus objectives, general facilities questions and the possibility of a central plant for the University.

- Second site walk March 18, 2006
  - Detailed site walk attended by Jim Kozelka, Craig Shulenberger and Patrick Yost of Chevron ES; Matt Greco of Bay City Boiler and Mike Tadevich of CSUEB. The purpose of the site walk was to have a better understanding of the University's mechanical systems.

- Third site walk April 5, 2006
  - Site walk attended by Jim Kozelka, Craig Shulenberger and Patrick Yost of Chevron ES; and Rob Edelstein of Bottom Line Utility Solutions. The site walk investigated water conservation possibilities for the University and general building questions.

- There have been numerous subsequent conversations and meetings between Chevron ES and Randy Gale, Mike Tadevich and Dan Franke for clarification and further information. Every attempt was made to use the time available with campus personnel as efficiently as possible, while securing adequate information to develop a responsive proposal.

Facility Assessment Process

- Through the course of this proposal development process, there have been multiple conversations between Chevron ES and Critchfield Mechanical, Bay City Boiler, Syserco, Sun Industries and Bottom Line Utility Solutions for clarification and further information in order to best facilitate a flow of information to these contractors without over-taxing campus resources.

Section II.c Proposed Heating Plant Alternatives

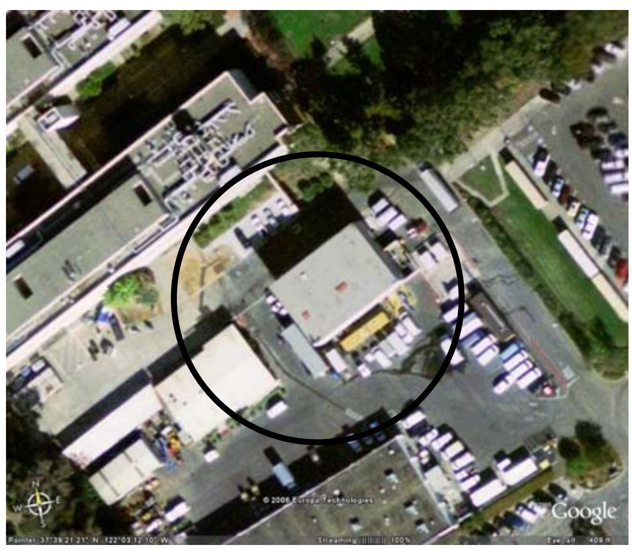
Chevron ES evaluated three alternatives for replacing the existing aging, inefficient, and maintenance intensive boilers distributed throughout the campus, including two different central plant approaches:

1. Construct one, high efficiency central heating plant with two or three high efficiency, industrial grade boilers, primary/secondary pumping, underground piping and associated equipment.
2. Construct one, high efficiency central heating plant per above with cogeneration option providing additional energy savings thru heat recovery and power generation.
3. Replace existing distributed boilers with a reduced quantity of highest efficiency, premium quality, condensing boilers

We look forward to working with CSUEB to determine which alternative is best aligned with the Campus Infrastructure Master Plan and associated risk tolerance.

ALTERNATIVE #1: CENTRAL HEATING PLANT

This alternative will provide a state-of-the-art central heating water plant in order to increase heating efficiency, reduce maintenance and provide increased reliability. The new hot water boilers will be located in the building that originally housed the steam boilers and is currently used for storage. Chevron ES recommends the use of hydronic heat distribution in lieu of returning to a steam based system due to increased reliability, preferable life cycle cost, simplicity of operation (certified steam boiler operator not required), and reduced maintenance burden. Also, the estimated cost associated with replacing the underground steam piping could be as much as twice the cost of underground hot water piping.



Central Heating Plant Features:

- **Boiler Size and Type:**
    - o Packaged water back fire tube boilers with fully modulating, forced internal recirculation burners and 6:1 turn down.
    - o Total capacity of 40MMBH - 50MMBH
    - o Up to 85% efficiency
    - o Low NOx <20ppm – BAAQMD permit and annual certification required.
    - o 15 year warranty and 40+ year life expectancy

- **Variable Flow Hot Water Distribution:** redundant variable speed base mounted horizontal split case pumps with premium efficiency motors selected to operate at peak efficiency

- **Redundancy:** multiple boilers designed to provide equipment redundancy and operational flexibility.

- **DDC Controls:** to facilitate and ensure optimized central plant operation while maintaining comfort campus wide.

- **Underground Piping:** pre-engineered, pre-fabricated, pre-insulated and HDPE jacketed, direct burial piping system with life expectancy of up to 50 years with properly maintained water treatment.

- **Domestic Hot Water: Either** new HW to HW heat exchangers will be installed in each building to meet the domestic hot water needs of that building, keeping all of the combustion equipment located within the central plant **OR** new instantaneous water heaters will be installed at each building, depending on which option CSUEB prefers after closer analysis in the IGA phase.

Central Heating Plant Benefits:

- **Energy Efficiency:** The efficiency of the new central heating plant will save the University approximately 300,000 therms annually over the existing campus heating plant.

- **Optimized Boiler Capacity:** The overall boiler capacity for the campus can be reduced 10%-20% from the present distributed boiler aggregate total capacity by accounting for load diversity, resulting in lower boiler first cost.

- **Sustainability:** Increased reliability and durability of 40+ year life industrial quality equipment. (The Aerco boilers we are proposing for the distributed boiler option are industrial quality as well. However, keeping two or three boilers properly operating is easier than keeping 30 properly tuned.)

- **Operational Cost**: Consolidation of equipment near facilities maintenance office will improve operational and maintenance efficiency.

- **Future Expansion:** The central plant and underground piping distribution will be designed to operate efficiently over a broad range of operating conditions and to best accommodate future planned loads.

- **Air Quality:** Consolidation of fuel burning equipment exhaust gasses at a location away from student and faculty traffic patterns with the cleanest burning, most efficient equipment available.

Central Heating Plant Considerations:

- **Central Cooling Plant:** Should CSUEB choose to implement the Central Heating Plant, we recommend considering a central cooling water system as well. Central chilled water systems have far greater efficiencies than distributed chilled water systems can achieve. Please see Section IX for further discussion on this option.

- **Thermal Energy Storage:** A smart energy savings addition to the Central Cooling Plant option. Please see Section IX for further discussion.

- **Bay Area Air Quality Management District:** Since the boilers will be larger than 10MMBH each, they will be required to meet local air quality permitting standards set by BAAQMD including annual certification.

- **Underground Piping:** Chevron ES has extensive experience managing construction of underground piping systems and an unparalleled safety record. However, this type of work inherently presents unknowns, disruption and hazards. The campus will be significantly impacted during the construction phase of the trenching activities for a significant duration (3-6 months)

ALTERNATIVE #2: CENTRAL HEATING PLANT WITH COGENERATION

This alternative will install a cogeneration system to work in concert with the above central heating plant. This is a complex option that warrants close scrutiny and thoughtful consideration. We have in-house staff with significant experience (please see Section VIII) with numerous successful cogeneration projects of all types and sizes. We will work diligently with CSUEB in the IGA phase to determine if this option is aligned with the campus Utilities Infrastructure Master Plan and the CSU's global risk tolerance.

In addition to the features, benefits, and considerations associated with Alternative #1, a cogeneration system offers the following:

Cogeneration System Features:

- **Overall Efficiency:** Power generation combined with heat recovery is inherently more efficient than stand-alone heating and utility power sources. Overall system efficiencies often exceed 82%, while standalone heating systems are typically in the 70% to 85% range and utility power after transmission losses is in the 30 to 40% range.

- **Capacity:** The system size will be in accordance with campus heating load. Sizing at less than annual minimum load offers the significant advantage of simplifying installation and operation, with the ability to run the cogeneration system at full load through out the year.

- **Type:** There are four possible types of natural gas fired cogen technology to consider:

    - **Microturbine**
    - **Recipricating Engine**
    - **CombustionTurbine**
    - **Fuel Cell**

- **Waste Heat Recovery Approaches:** Cogeneration by definition uses the waste heat from the prime mover (see types above) for beneficial use. Again, given the current fundamental economics of cogeneration, it is imperative that the waste heat is utilized to a great degree. Different prime mover techonlogies have different waste heat characteristics. These charactheristics (temperature, flow) typically provide direction on the selection of the prime mover technology. Various options for the utilization of the waste heat include:

  - **Absorption or Adsorption Cooling:** the use of heat in the form of direct exhaust, steam, or hot water to generate chilled water through the use of an absorption chiller. Either technology is well established, and allows for excellent utilization of waste heat when inadequate heating loads are available for offset.
  - **Steam Production:** If the exhaust temperature is adequate from the prime mover, then low to medium pressure steam can be generated. For some techologies, primarily microturbines, the exhaust temperatures can be too low to generate steam.
  - **Direct Process Use:** Typically found in industrial settings, the prime mover's exhaust can be directly applied to an existing process. Examples of recent Chevron ES industrial projects include using exhaust to supplement a gas fired furnace at a chemical plant, or heating a process oil used at a natural gas processing facility.
  - **Hot Water Production:** By far the most common use of prime mover exhaust in a cogeneratoin system is the procution of hot water, typically in the 180 to 200 degF range. Hot water generated can be used to displace boiler loads, feed absorption chillers and heat swimming pools. Chevron ES has implemented several project in which hot water is generated for use directly for heating loads at night, and then in an absorption chiller for daytime loads. This allows the utilization of the prime mover's thermal output to be near 100%.

Additional Central Plant with Cogeneration Benefits:

- **On-site Power Generation:** resulting in reduced power purchased from serving utility.

- **Reliability:** potential for increased reliability of campus electrical system reliability. Also, the cogeneration system may serve as an additional source of power to offset utility power shortages (brownouts).

- **Capacity:** potential for increased campus based power capacity to support potential future growth.

Cogeneration Considerations:

- **Economics** – The cost/benefit associated with cogeneration has recently become less attractive due to reduced incentives, and the volatility and rising cost of natural gas relative to the cost of electricity. (This relative cost is also known as “spark spread”). The Chancellor’s Office has indicated it is expecting that future contracted power prices may be decreasing over the next couple years while natural gas prices are expected to rise.

- **Maintenance** – With the exception of microturbines, cogeneration systems are generally maintenance intensive with maintenance performed by a third party requiring greater commitment and perhaps exposure from CSUEB

- **Thermal Load** – Given the current state and possible future of “spark spread”, we strongly recommended matching the size of the cogeneration system with the campus base heating load in order to optimize savings. This is somewhat challenging given the limited campus operating hours. We may find in the IGA phase that implementing a cogeneration system consisting of microturbines at the swimming pool complex (which has a nearly 24/7/365 heating load) is the best application for a cogen system on campus.

- **Controls** – Cogeneration systems present manageable but increased complexity which makes commissioning and subsequent operation challenging.

- **Regulatory / Permitting and Approvals** – Cogeneration systems are subject to review, permitting and approval by the serving utility(s) and BAAQMD which present additional cost and schedule impact.

Due to extensive considerations, Chevron ES has elected to pursue pricing for this alternative in the IGA phase once this option is determined desirable by CSUEB.

ALTERNATIVE #3: DISTRIBUTED HEATING PLANT

If the campus decides not to install a central heating plant CES recommends replacing the existing heating water and domestic hot systems within the buildings that currently have Lochinvar boilers. This option will replace the existing copper fin/tube boilers that have an actual operational efficiency in the 65%-75% range with a fewer number of highest quality condensing boilers with actual operating efficiencies in the 90% - 95% range (efficiencies above 90% are dependent on return water temperatures being less than 140ºF).

The boilers Chevron ES proposes to install have stainless steel heat exchangers suitable for condensing operation and are designed to operate in the 90% to 95% efficiency range. Currently, total installed capacity is roughly equivalent to 50MMBH. We expect our comprehensive energy analysis in the IGA phase will result in a reduced total installed capacity.

The boilers we are recommending for the distributed boiler option will reduce the total number of pieces of equipment to maintain by installing fewer boilers with greater capacity and excellent turn down capabilities. There will be approximately 33 total new boilers and domestic hot water heaters installed in place of the 49 units currently installed. Also, these boilers have a very low minimum flow requirement and therefore do not require a separate pump in addition to the building pump. This eliminates the associated pump electrical load and maintenance burden. If this option is selected, Chevron ES will analyze the heating requirements of each building in detail to more optimally size the heating equipment in each building.

<u>Distributed Boilers System Features:</u>

- **Boiler Size and Type:**
  - Condensing, stainless steel fire-tube boiler
  - Capacity, in 1MMBH increments up to 3MMBH, customized with building simulation analysis to meet individual building heat load
  - Up to 96+% efficiency on HHW boilers and 98% on domestic water heaters
  - Fully modulating burner with 20:1 turn down
  - Low NOx < 20ppm – BAAQMD permit and annual certification NOT required
  - 5 year warranty and 25+ year life expectancy

- **Variable Flow Hot Water Distribution:** Convert existing constant flow distribution by installing VFDs and 3-way to 2-way valve conversion.

- **Redundancy:** Reduced quantity of boilers from existing while maintaining redundancy at each building. For example where there are presently four boilers we propose installing only two new boilers.

- **DDC Controls:** To facilitate and ensure optimized boiler and heating system operation at each individual building

- **Domestic Hot Water:** Install high efficiency (98%) tankless, instantaneous domestic water heaters in all buildings which have very minimal domestic hot water usage.

- **Reduced Maintenance Costs:** As compared to present distributed boiler system resulting from both reduced quantity and increased quality of new boilers.

<u>Distributed Boilers System Benefits:</u>

- **Reduced Maintenance:** As compared to the existing distributed boilers due to (1) new high quality heating equipment requiring less maintenance, and (2) partial consolidation of existing equipment

- **Increased Efficiency:** The proposed boilers for the option can operate at higher efficiencies than large water back fire tube boilers and will also eliminate the need for large system pumps to distribute water throughout the campus. This measure will save CSUEB approximately 360,000 therms annually over the existing heating system.

- **Elimination of Boiler Combustion Odors:** Correction of current flue installation issues that currently exist on campus and properly tuned boilers will eliminate the smell associated with incomplete combustion that is occurring with the current boilers.

Distributed Boilers System Considerations:

- **Maintenance:** This alternative is considerably more maintenance intensive due to the significant additional time it takes for maintenance personnel to get to each building and the increased number of pieces of equipment to maintain. An example of this impact is in the area of water treatment. Distributed boilers require water treatment at each building because the systems are not interconnected.

- **Operational Efficiency:** The disbursement of boilers across the campus in various buildings reduces operational efficiency from a manpower perspective. This configuration also eliminates any campus ability to take advantage of load diversity across the campus. The net result is that the campus heating plant is forced to carry more total capacity than it requires at any given point of the day.

- **Expansion:** Since the new boiler capacity will be customized for each building so as to minimize installed capacity, any expansion or new buildings will likely require additional or upsized boilers for the additional load.

- **Controls:** The cost for controls will be somewhat higher with this option due to the increased equipment being controlled.

Section II.d Proposed Mechanical Scope of Work

Chevron Energy Solutions has investigated the options for renovating the heating and cooling systems to provider greater reliability and energy savings and developed the following preliminary scopes of work for this PA effort.

Heating and Cooling Systems (Central Chiller and Boiler Plant Option):

Provide separate pricing for each portion of this option including separate pricing for heating and cooling systems as they University may opt to only install central heating capacity.

1. Central Plant

    Demolition:

    a) Remove existing materials and equipment from the old steam boiler plant building to prepare for new construction.
    b) Remove the existing boilers from each of the campus buildings.

    New Work:

    Boilers

    a) Provide and install two new Johnston Boiler Company 750 BHP natural gas HHW boilers. Install boilers according to the manufacturer's recommendations. Including all necessary housekeeping pads and seismic anchorages.
    b) Provide and install two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
    c) Provide and install new disconnects and wiring. Demolish existing motor contactor. If necessary, replace existing breaker with one that includes proper thermal protection.
    d) Install a new diaphragm style expansion tank.
    e) Install all miscellaneous devices applicable to the new heating water system.
    f) Provide and install new water treatment pot feeder on HHW system.
    g) Provide and install a new water Spirotherm air and dirt separator for the system.
    h) Including all piping, insulation for a fully functioning system.
    i) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
    j) Mechanical interlocks between the boiler and the hot water pumps.
    k) Complete commissioning of heating water systems, and provide boiler local control training for new system.
    l) Provide and install two Aerco WWDW24/1/E domestic water heat exchangers including new circulating pump in each of the building mechanical rooms where the boilers have been removed.
    m) Provide and install two Aerco WWDW68/1/E domestic water heat exchangers including new circulating pump in pool house mechanical room.
    n) Provide and install a plate and frame heat exchanger between the HHW system and the pool heating pump and piping.

o) Including costs necessary to obtain boiler operating permits if required.
p) Factory representative startup for boilers.

Chillers

a) Provide and install two new 500 Ton chillers. Install chillers and accessories in accordance with all local building codes and in accordance with the manufacturer's recommendations. Chillers shall be variable speed centrifugal chillers as manufactured by Carrier, McQuay, Trane or York.
b) Provide and install two Baltimore Aircoil series 3000 cooling towers sized to supply maximum 80 F. condenser water to the chillers at ASHRAE .05 design conditions for Hayward, California.
c) Provide and install two new chilled water pumps with variable speed drives including all new associated devices (shut off valves, check valves, gauges, thermometers, Pete's plugs etc. One pump shall act as backup to the other and be sized for the full flow of both chillers at 100% loading.
d) Provide and install three new condenser water pumps (one pump shall act as backup to the other two) including all new associated devices (shut off valves, check valves, gauges, thermometers, Pete's plugs etc.
e) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
f) Completely flush new chilled and condenser water piping, and balance system within the plant, providing full test and balance report.
g) Provide mechanical interlocks between the chillers and the chilled and condenser water pumps.
h) Provide and install a new refrigerant leak detection system MSA Chillguard or equal. Monitor shall be selected to detect the specific refrigerant used in the chillers and shall have both visual and audible alarms and be compliant with the most current building codes.
i) Provide and install an exhaust system to provide code required ventilation and purge of mechanical room upon detection of a refrigerant leak. Fan shall be enabled into purge mode by the refrigerant leak detection system.
j) Including complete commissioning of chilled water systems, and provides boiler local control training for new system.
k) Factory representative startup for chillers

Underground Piping

a) Provide and install pre-insulated underground piping from the new central plant to each of the campus buildings. Piping shall be schedule 40 steel with polyurethane insulation and an outer jacket of HDPE or FRP. Piping shall be as manufactured by Perma Pipe, Thermacor or Rovenco. HHW mains shall be 10" diameter to the first building branch and the CHW piping mains shall be 12" to the first building branch. Piping mains shall be reduced in size after the branch take-offs to each building however piping shall be sized such that velocity within the pipe never exceeds 8 FPS.
b) Piping shall be installed per manufacturer's recommendations.
c) Pressure test and clean piping systems prior to filling systems for use.
d) Including all excavation and backfill

e) Repair of walkways, paving and landscaping as required to restore the campus to a condition equal or better to the condition that existed prior to beginning construction.

Heating and Domestic Hot Water Systems (Distributed Boiler Option):

2. Meiklejohn Hall

Boiler Demolition:

a) Remove two existing Lochinvar boilers and one Lochinvar domestic water heater. Including disposal in accordance with all codes.
b) Demolish the existing hot water pumps.
c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of two new Aerco 2.0 low NOx Benchmark 2 MMBH natural gas HHW boilers to replace the existing. Installation of boilers according to the manufacturer's recommendations.
b) Provide and Installation of one Aerco KC1000GWWLN domestic water heaters including new circulating pump.
c) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
d) Replace the existing expansion tank with a new diaphragm style expansion tank.
e) Reuse the existing miscellaneous devices applicable to the new heating water system.
f) Provide and Installation of new water treatment pot feeder on HHW system.
g) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
h) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
i) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
j) Provide and Installation of new sealed flue piping suitable for condensing application.
k) Provide mechanical interlocks between the boiler and the hot water pumps.
l) Complete commissioning of heating water systems, and provide boiler local control training for new system.
m) Costs necessary to obtain boiler operating permits if required.
n) Factory representative startup for boilers.

3. Student Health Center

Boiler Demolition:

a) Remove two existing Lochinvar boilers and two Lochinvar domestic water heaters located in the basement of the Student Health Center Building. Including disposal in accordance with all codes.
b) Demolish the existing hot water pumps.

c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of one new Aerco 2.0 low NOx Benchmark 2 MMBH natural gas HHW boiler to replace the existing. Installation of boiler according to the manufacturer's recommendations.
b) Provide and Installation of one Aerco KC1000GWWLN domestic water heater including new circulating pump.
c) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
d) Replace the existing expansion tank with a new diaphragm style expansion tank.
e) Reuse the existing miscellaneous devices applicable to the new heating water system.
f) Provide and Installation of new water treatment pot feeder on HHW system.
g) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
h) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
i) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
j) Provide and Installation of new sealed flue piping suitable for condensing application.
k) Provide mechanical interlocks between the boiler and the hot water pumps.
l) Including complete commissioning of heating water systems, and provide boiler local control training for new system.
m) Costs necessary to obtain boiler operating permits if required.
n) Factory representative startup for boilers.

4. Science North

Boiler Demolition:

a) Remove four existing Lochinvar boilers and two Lochinvar domestic water heaters including flue piping. Disposal in accordance with all codes.
b) Demolish the existing hot water pumps.
c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of two new Aerco 2.0 low NOx Benchmark 2 MMBH natural gas HHW boilers to replace the existing. Installation of boilers according to the manufacturer's recommendations.
b) Provide and Installation of one Aerco KC1000GWWLN domestic water heaters including new circulating pump.
c) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
d) Replace the existing expansion tank with a new diaphragm style expansion tank.

e) Reuse the existing miscellaneous devices applicable to the new heating water system.
f) Provide and Installation of new water treatment pot feeder on HHW system.
g) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
h) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
i) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
j) Provide and Installation of new sealed flue piping suitable for condensing application.
k) Provide mechanical interlocks between the boiler and the hot water pumps.
l) Including complete commissioning of heating water systems, and provide boiler local control training for new system.
m) Costs necessary to obtain boiler operating permits if required.
n) Factory representative startup for boilers.

5. Science South

Boiler Demolition:

a) Remove four existing Lochinvar boilers and two Lochinvar domestic water heaters and flues. Disposal in accordance with all codes.
b) Demolish the existing hot water pumps.
c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of two new Aerco 2.0 low NOx Benchmark 2 MMBH natural gas HHW boilers to replace the existing. Installation of boilers according to the manufacturer's recommendations.
b) Provide and Installation of one Aerco KC1000GWWLN domestic water heaters including new circulating pump.
c) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
d) Replace the existing expansion tank with a new diaphragm style expansion tank.
e) Reuse the existing miscellaneous devices applicable to the new heating water system.
f) Provide and Installation of new water treatment pot feeder on HHW system.
g) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
h) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
i) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
j) Provide and Installation of new sealed flue piping suitable for condensing application.
k) Provide mechanical interlocks between the boiler and the hot water pumps.

l) Including complete commissioning of heating water systems, and provide boiler local control training for new system.
m) Costs necessary to obtain boiler operating permits if required.
n) Factory representative startup for boilers.

6. Art & Education

Boiler Demolition:

a) Remove two existing Lochinvar boilers and one Lochinvar domestic water heater including flues. Disposal in accordance with all codes.
b) Demolish the existing hot water pumps.
c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of two new Aerco 2.0 low NOx Benchmark 2 MMBH natural gas HHW boilers to replace the existing. Installation of boilers according to the manufacturer's recommendations.
b) Provide and Installation of one Aerco KC1000GWWLN domestic water heaters including new circulating pump.
c) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
d) Replace the existing expansion tank with a new diaphragm style expansion tank.
e) Reuse the existing miscellaneous devices applicable to the new heating water system.
f) Provide and Installation of new water treatment pot feeder on HHW system.
g) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
h) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
i) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
j) Provide and Installation of new sealed flue piping suitable for condensing application.
k) Provide mechanical interlocks between the boiler and the hot water pumps.
l) Including complete commissioning of heating water systems, and provide boiler local control training for new system.
m) Costs necessary to obtain boiler operating permits if required.
n) Factory representative startup for boilers.

7. Theater, Music and Robinson Hall

Boiler Demolition:

a) Remove four existing Lochinvar boilers and two Lochinvar domestic water heaters including flue piping. Including disposal in accordance with all codes.
b) Demolish the existing hot water pumps.
c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of two new Aerco 3.0 low NOx Benchmark 3 MMBH natural gas HHW boilers to replace the existing. Installation of boilers according to the manufacturer's recommendations.
b) Provide and Installation of one Aerco KC1000GWWLN domestic water heaters including new circulating pump.
c) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
d) Provide and Installation of new disconnects and wiring. Demolish existing motor contactor. If necessary, replace existing breaker with one that Includes proper thermal protection.
e) Replace the existing expansion tank with a new diaphragm style expansion tank.
f) Reuse the existing miscellaneous devices applicable to the new heating water system.
g) Provide and Installation of new water treatment pot feeder on HHW system.
h) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
i) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
j) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
k) Provide and Installation of new sealed flue piping suitable for condensing application.
l) Provide mechanical interlocks between the boiler and the hot water pumps.
m) Including complete commissioning of heating water systems, and provide boiler local control training for new system.
n) Costs necessary to obtain boiler operating permits if required.
o) Factory representative startup for boilers.

8. Physical Education

Boiler Demolition:

a) Remove four existing Lochinvar boilers and one Lochinvar domestic water heater including the storage tank and flue piping. Including disposal in accordance with all codes.
b) Demolish the existing hot water pumps.
c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of two new Aerco 3.0 low NOx Benchmark 3 MMBH natural gas HHW boilers to replace the existing. Installation of boilers according to the manufacturer's recommendations.
b) Provide and Installation of a plate and frame heat exchanger between the new boiler system and the pool with a separate pump to provide circulation to the pool heating loop.
c) Provide and Installation of three Aerco KC1000GWWLN domestic water heaters including new circulating pump.

d) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
e) Replace the existing expansion tank with a new diaphragm style expansion tank.
f) Reuse the existing miscellaneous devices applicable to the new heating water system.
g) Provide and Installation of new water treatment pot feeder on HHW system.
h) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
i) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
j) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
k) Provide and Installation of new sealed flue piping suitable for condensing application.
l) Provide mechanical interlocks between the boiler and the hot water pumps.
m) Including complete commissioning of heating water systems, and provide boiler local control training for new system.
n) Costs necessary to obtain boiler operating permits if required.
o) Factory representative startup for boilers.

9. Library, Warren Hall & Administration

Boiler Demolition:

a) Remove six existing Lochinvar boilers and two Lochinvar domestic water heaters and storage tank including related flues and stack and stack fans. Including disposal in accordance with all codes.
b) Demolish the existing hot water pumps.
c) Demolish piping and flue as required to complete new connections

New Boiler Work:

a) Provide and Installation of three new Aerco 3.0 low NOx Benchmark 3 MMBH natural gas HHW boilers to replace the existing. Installation of boilers according to the manufacturer’s recommendations.
b) Provide and Installation of one Aerco KC1000GWWLN domestic water heaters including new circulating pump.
c) Provide and Installation of two new heating hot water pumps with variable speed drives and the associated devices. All new pumps shall have premium efficiency motors.
d) Provide and Installation of new disconnects and wiring. Demolish existing motor contactor. If necessary, replace existing breaker with one that Includes proper thermal protection.
e) Replace the existing expansion tank with a new diaphragm style expansion tank.
f) Reuse the existing miscellaneous devices applicable to the new heating water system.
g) Provide and Installation of new water treatment pot feeder on HHW system.

h) Provide and Installation of a new water Spirotherm air and dirt separator for the system.
i) All piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
j) Completely flush new heating water piping, and balance entire system, providing full test and balance report.
k) Provide and Installation of new sealed flue piping suitable for condensing application.
l) Provide mechanical interlocks between the boiler and the hot water pumps.
m) Complete commissioning of heating water systems, and provide boiler local control training for new system.
n) Costs necessary to obtain boiler operating permits if required.
o) Factory representative startup for boilers.

A. Heating Systems (Distributed Boiler Option B):

1. All Buildings as outlined in Option A

Boiler Replacement Deduct Alternate:

a) Deduct Alternate Price to complete the work outlined in Section A above with the substitution of the Aerco boilers with either Cleaver Brooks (Clearfire or Truefire), or Bryan HECLM boilers for the HHW systems.
b) Provide and Install multiple Takagi AT-M1 (or approved equal) tankless domestic water heaters in lieu of the Aerco KC1000GWWLN water heaters.

B. Cooling Systems (Distributed Chiller Option):

1. Meiklejohn Hall

Chiller Demolition:

c) Remove two existing Trane chillers. Including disposal of refrigerant and equipment in accordance with all codes.
d) Remove and dispose of the existing cooling tower and associated devices.
e) Demolish the existing chilled water and condenser water pumps.
f) Demolish piping as required to complete new connections

New Chiller Work:

a) Provide and Installation of two new 150 Ton chillers to replace the existing. Installation of chillers and accessories in accordance with all local building codes and in accordance with the manufacturer's recommendations. Chillers shall be McQuay Model WMC Magnetic Bearing variable speed centrifugal chillers.
b) Provide and Installation of a Baltimore Aircoil series 3000 cooling tower sized to supply maximum 80 F. condenser water to the chillers at ASHRAE .05 design conditions for Hayward, California. Motor shall be equipped with a variable speed drive.
c) Provide and Installation of two new chilled water pumps with variable speed drives including all new associated devices (shut off valves, check valves, gauges, thermometers, Pete's plugs etc.

d) Provide and Installation of two new condenser water pumps including all new associated devices (shut off valves, check valves, gauges, thermometers, Pete's plugs etc.
e) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
f) Completely flush new chilled and condenser water piping, and balance system within the plant, providing full test and balance report.
g) Provide mechanical interlocks between the chillers and the chilled and condenser water pumps.
h) Including complete commissioning of chilled water systems, and provide boiler local control training for new system.
i) Factory representative startup for chillers

2. Theater, Music & Robinson Hall

Chiller Demolition:

a) Remove existing Trane chiller. Including disposal of refrigerant and equipment in accordance with all codes.
b) Remove and dispose of the existing cooling tower and associated devices.
c) Demolish the existing chilled water and condenser water pumps.
d) Demolish piping as required to complete new connections

New Chiller Work:

a) Provide and Installation of two new 175 Ton chillers or a single 350 Ton centrifugal chiller to replace the existing 350 ton chiller. Installation of chillers and accessories in accordance with all local building codes and in accordance with the manufacturer's recommendations. Chillers shall be McQuay Model WMC Magnetic Bearing variable speed centrifugal chillers.
b) Provide and Installation of two (or a single series 3000) Baltimore Aircoil series 1500 cooling towers sized to supply maximum 80 F. condenser water to the chillers at ASHRAE .05 design conditions for Hayward, California. Motors shall be equipped with variable speed drives.
c) Provide and Installation of two new chilled water pumps with variable speed drives including all new associated devices (shut off valves, check valves, gauges, thermometers, Pete's plugs etc.
d) Provide and Installation of two new condenser water pumps including all new associated devices (shut off valves, check valves, gauges, thermometers, Pete's plugs etc.
e) Including all piping, insulation, and line voltage and low voltage electrical modifications for a fully functioning system.
f) Completely flush new chilled and condenser water piping, and balance system within the plant, providing full test and balance report.
g) Provide mechanical interlocks between the chillers and the chilled and condenser water pumps.
h) Including complete commissioning of chilled water systems, and provide boiler local control training for new system.
i) Factory representative startup for chillers

Thermal Storage System Work:

a) Add alternate to provide and Installation of a thermal storage and chiller system in lieu of the system described above. The system shall Including the following:
   1) Two (2) BAC TSU-761M modular ice storage tanks
   2) One (1) BAC Model 15176-W/Q open cooling tower
   3) One (1) Plate and Frame Heat Exchanger 367 GPM, 36/56 cold side 40/60 hot side
   4) One Glycol Chiller 145 Tons at 26 degree LWT
   5) CHW and CW pumps, piping and accessories

Section II.e Asbestos Impact Summary

As explained by CSUEB's Asbestos Containing Material Report, February 2006, asbestos containing construction materials (ACCM) are found in many buildings on the CSUEB campus. These asbestos containing materials are currently listed in good condition and do not pose any threat of exposing building occupants at this time. However, if retrofit projects are to take place in areas that ACCM exists, then the material may have to be abated. The estimated pricing in the PA does not include asbestos abatement for any project and will be investigated during the IGA phase.

The seven sources of ACCM that are most likely found in buildings that could be impacted by energy saving retrofits are: floor tiles, drywall joint compound, piping insulation, tank insulation, ceiling tiles, acoustical insulation and fireproofing. The two largest sources of ACCM on the campus are floor tiles and drywall joint compound, which are found in classrooms, hallways, mechanical rooms and restrooms, in most buildings. The floor tiles and drywall joint compound may be disturbed during any retrofit project which will reroute piping, electrical conduit or ductwork. Also, found throughout many of the campus buildings is piping and tank insulation, which will be affected if any modifications are necessary to the piping or tank that it is insulated. The tank insulation is isolated to mechanical rooms but piping insulation can be found in classrooms, hallways, mechanical rooms and restrooms. The final three ACCM, ceiling tiles, acoustical insulation and fireproofing are found in a limited amount of buildings. These ACCM will only need to be disturbed if they are blocking areas that need to be accessed or if piping, conduit or ductwork needs to penetrate the material. In the Asbestos Containing Material Report, there were five materials that were assumed to be ACCM in all campus buildings: grout ceramic tile, vapor barriers, mirror mastic, fire door/frames and black lab countertops. The grout ceramic tile, vapor barriers, and mirror mastic are only found in restrooms and will only be disturbed during a restroom remodel. The asbestos containing fire door/frames and black lab countertops will only be affected during a classroom remodel.

	Floor tile/Mastic	Pipe Insulation/Lagging	Tank Insulation	Drywall Joint Compound	Ceiling Tiles	Fireproofing	Acoustical Insulation
Art and Education	CR, HW	CR,HW,MR	CR,HW,MR	CR		MR	
Field House	CR	MR	MR	CR			
KPE	CR, HW, RR	CR, MR			CR,HW,RR		
Library	CR, HW			CR, HW		All levels	
Meiklejohn Hall	CR, HW, RR	CR, MR		CR	CR		
Music and Business	CR, HW, RR	MR		CR			CR
Old Boiler Plant	MR						
Robinson Hall	CR, HW	MR		CR, HW			
Science Buildings	CR, HW	CR,HW, MR, RR			HW	MR	
Student Health Center	CR, HW, RR			CR, HW, RR			
Student Services	CR, HW			CR, HW, RR			
Theatre	CR, HW	MR		CR	CR, HW		
University Union	CR, HW	MR	MR				2nd/3rd Level
Warren Hall	CR, HW, RR	MR		CR, HW, RR		CR, HW, MR, RR	

CR – Classrooms, HW – Hallways, MR – Mechanical Rooms, RR - Restrooms

Section II.f Energy Resource Manager Offering

As part of an ongoing commitment to CSU East Bay, Chevron ES proposes an Energy Resource Manager (ERM) to work with the campus on an ongoing basis to meet and exceed the requirements of Executive Order 917. We currently provide this service to several California Community College campuses including Mt. San Antonio Community College District, Compton Community College District and two colleges in the Los Angeles Community College District-Los Angeles City College and Los Angeles Valley College.

In general, the goals of this position will be to identify project opportunities that maximize campus energy and operational efficiency and power reliability, expand CSUEB's leadership in renewable energy resource utilization as appropriate, and secure all rebates and grants available. The intent of this role is to augment current campus efforts and build on its existing capabilities.

If selected, Chevron ES will assign an individual in its San Francisco offices to act as an ERM working in conjunction with Chevron ES resources including energy engineering and CSUEB facility management, staff and other campus personnel as appropriate. The ERM will have the time, opportunity, and in-depth knowledge of the buildings and systems that will facilitate ongoing recommendation for energy savings opportunities. Chevron ES will meet with campus personnel during the IGA phase of work to determine goals, scope of services, and term the services will be provided. A sample list of duties and responsibilities follows:

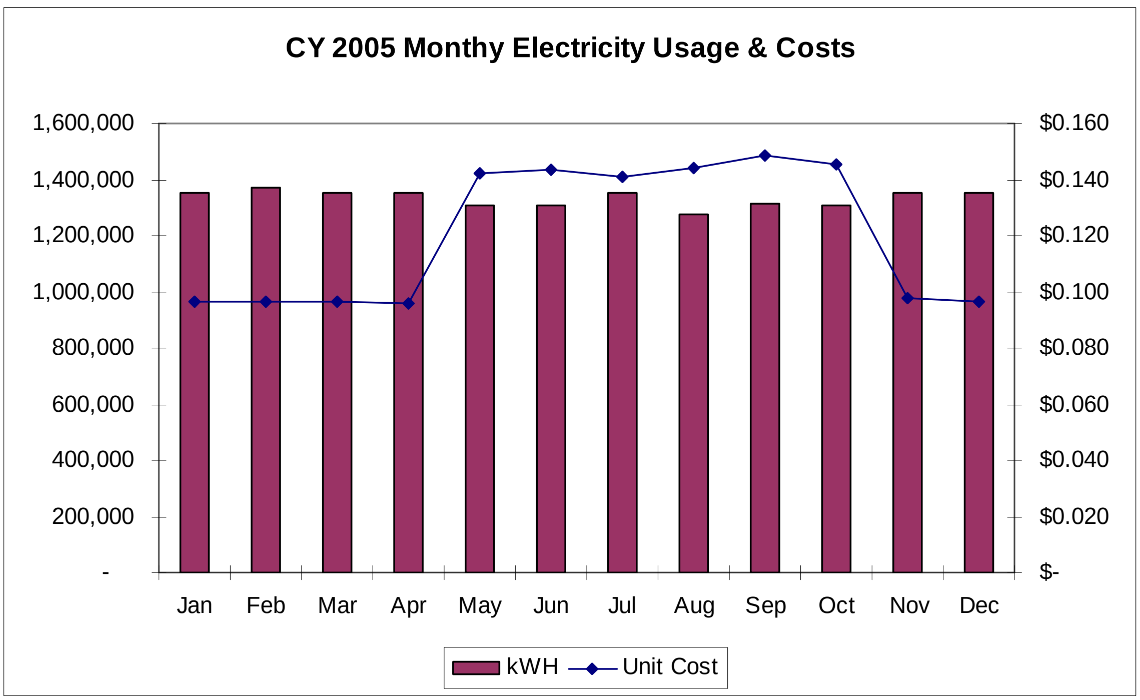
- On a monthly basis, review and analyze campus energy reports and request additional reports if needed in order to assess energy utilization campus-wide and on a building-by-building basis.
- As a result of rigorous analysis, identify and prioritize a portfolio of opportunities on an ongoing basis for campus review that meets campus and system-wide energy efficiency, power reliability and renewable/sustainability goals.
- Project opportunities could integrate monitoring based retro-commissioning efforts yielding low-cost building efficiency opportunities in order to streamline and focus efficiency efforts. Example: operating sequence optimization for energy savings.
- Review water usage and identify water saving opportunities.
- Provide preliminary application engineering for energy projects of interest to the campus.
- Provide design engineering, project financial / economic analysis, project management of the installation, and commissioning of approved energy projects.
- Work with CSUEB to investigate and make recommendations to resolve comfort and energy efficiency problems.
- Coordinate training and education for staff relating to the facility improvement measures installed, and to general energy conservative behaviors.

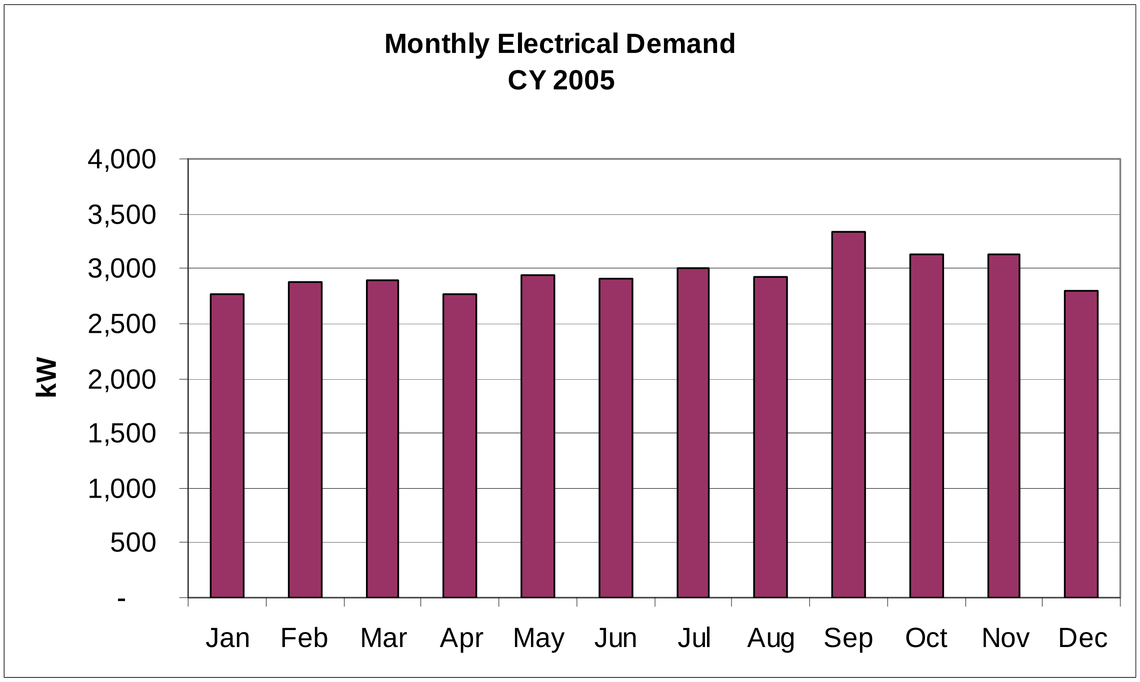
Cost for this service depends on many factors including specific roles and responsibilities ultimately assigned to the individual role.

Section III. Utility Tariff Analysis

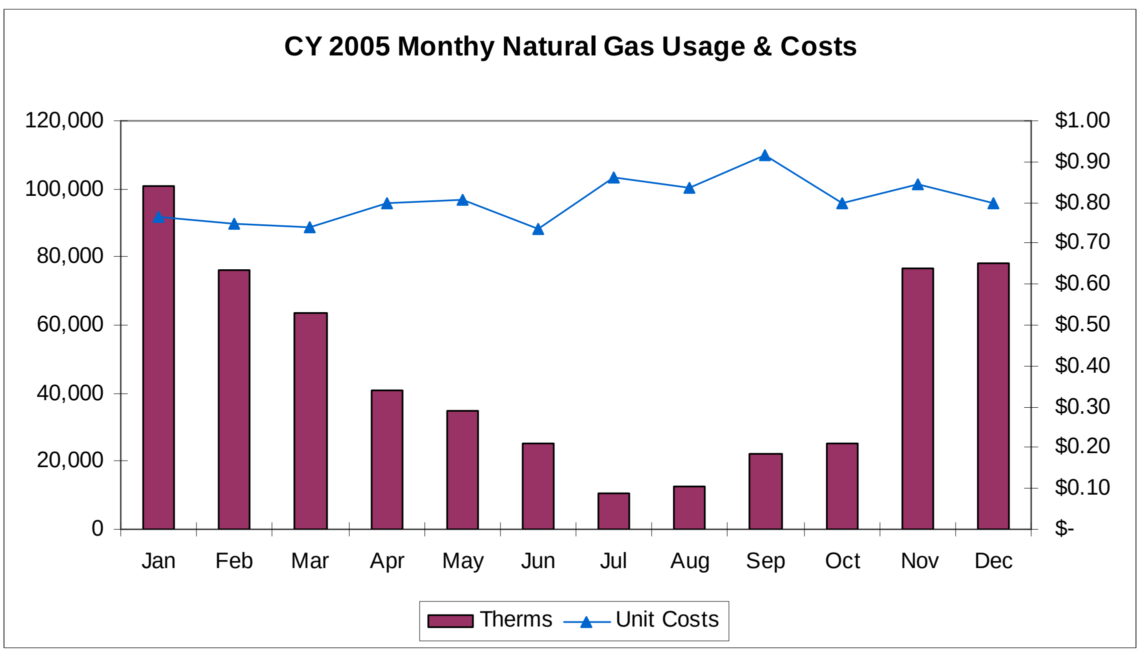
Examine utility bills for the past thirty-six (36) months and establish base year consumption for electricity, gas, steam, water, etc. in terms of energy units (kWh, kW, ccf, therms, gallons, or other units used in bills) and in terms of dollars. Describe the process used to determine the base year (averaging, selecting most representative contiguous 12 months, etc.). Consult with facility personnel to account for any anomalous billings that could skew the base year representation. Reconcile annual end-use estimated consumption with the annual base year consumption to within five percent (5%) for electricity (kWh), fuels and water. Also reconcile Electric Peak demand (kW) for each end use within five percent. The miscellaneous category can be no greater than five percent (5%). This reconciliation will place reasonable limits on potential savings.

The campus provided utility data in the form of paper copies of bills for the period of November 2004 through October 2005. Utilities included were electric, gas, sewer and water. For the purposes of this PA, only gas and electric data were used for a preliminary analysis. Following is a summary level graphical display of the primary utility usage at the site.





Both the electricity usage and demand charts reflect the installed ~1MW installed PV at the campus as summertime demand and usages are offset significantly by the rooftop systems.



Gas usage data follows with the mild summertime climate typical for the Hayward area.

Calendar year cost information is as follows:

Electricity Usage - CY 2005				
Date	**kWH**	**kW**	**Total Cost**	**Unit Cost**
Jan	1,350,000	2,770	$ 129,875	$ 0.096
Feb	1,369,045	2,879	$ 132,126	$ 0.097
Mar	1,350,000	2,900	$ 130,675	$ 0.097
Apr	1,350,000	2,762	$ 129,825	$ 0.096
May	1,310,000	2,940	$ 186,445	$ 0.142
Jun	1,310,000	2,904	$ 187,868	$ 0.143
Jul	1,353,001	2,998	$ 191,029	$ 0.141
Aug	1,276,578	2,920	$ 183,897	$ 0.144
Sep	1,312,340	3,340	$ 194,620	$ 0.148
Oct	1,310,000	3,137	$ 190,357	$ 0.145
Nov	1,350,000	3,137	$ 132,135	$ 0.098
Dec	1,350,000	2,803	$ 130,078	$ 0.096
	15,990,964		**$ 1,918,931**	**$ 0.120**

Natural Gas Usage - CY 2005			
Date	**Therms**	**Cost**	**Unit Costs**
Jan	100,885	$ 77,354	$ 0.77
Feb	76,114	$ 56,905	$ 0.75
Mar	63,697	$ 47,228	$ 0.74
Apr	41,000	$ 32,800	$ 0.80
May	34,963	$ 28,229	$ 0.81
Jun	25,270	$ 18,561	$ 0.73
Jul	10,775	$ 9,274	$ 0.86
Aug	12,624	$ 10,561	$ 0.84
Sep	22,149	$ 20,305	$ 0.92
Oct	25,000	$ 20,000	$ 0.80
Nov	76,865	$ 64,779	$ 0.84
Dec	78,323	$ 62,658	$ 0.80
	567,665	**$ 448,654**	**$ 0.79**

Section IV. Cost Benefit Analysis

The basis for a project cost must be presented in sufficient detail in a PA report so as to enable the campus, CSU Office of the Chancellor and its consultants to make an independent assessment of the reasonableness of the Service Provider's cost. Cost details must show associated item quantities, equipment costs, installation costs, engineering costs, construction management costs, commissioning costs, contingencies, Service Provider's project development costs directly applicable to the project, overhead and profit assumptions, campus dictated due-diligence costs resulting from campus review, and other costs as applicable to the specific project being developed. Equipment and installation costs must also be broken down by major sub systems where applicable.

Chevron ES proposes the following two heating plant alternatives, both of which are described in further detail in the Section IIc. As this project development effort is currently at an early stage, all quoted numbers are very preliminary and presented as ranges. If selected, Chevron ES will work closely with CSUEB, the Mechanical Review Board, and Chancellor's Office to select the best overall heating plant alternative for the campus, develop complete final costing, and finalize all rebate estimates. The following table includes "turn-key" price ranges.

Heating Plant Alternative	Estimated Price Range	Estimated Annual Savings*
Central Plant & HW Distribution	$12M - $15M	$200k - $250k
Distributed Boilers	$5M - $7M	$250k - $300k

*** energy savings only – no maintenance and labor savings included per Rider A.**

The overall economics of this project are attractive and provide several key benefits regardless of which alternative is selected such as:

- Implement needed heating plant infrastructure improvements
- Increase energy efficiency of equipment
- Reduce maintenance requirements
- Increase operational efficiency

Additional significant energy efficiency and cost savings opportunities exist on the campus that could be implemented. These were not part of the original scope called for in Rider A, and are therefore detailed in Section IX of this proposal with a project description and ranges for project cost and energy savings.

The following chart lists the major cost line items Chevron ES recognizes when developing final project pricing. Once scope is determined, Chevron ES will evaluate with the customer all constraints and risks that could impact the project and will develop a firm fixed price proposal. While it's difficult to project even the ranges at this early stage of project development, this chart provides some representative information for CSUEB's review. The percentage ranges detailed are typical percentages added to material and labor costs of the project cost.

Item	Central Plant	Distributed Boilers
Equipment	$4M - $5M	$1.5M - $2.5M
Installation	$4M - $5M	$1.5M - $2.5M
Engineering	6-10%	
Commissioning	3-5%	
Bonds/Warranty/Permits	2-4%	
Contingencies	8-12%	
M&V Equipment	Requirement TBD	
Project Management & Administration	2-6%	
Construction Management	6-8%	
Safety	2-3%	
Overhead	12-15%	
Profit	10-12%	

The following page presents very preliminary financial analyses of both alternatives using the mid-ranges for cost and savings for both options.

Section V. Savings Calculations

The basis for project savings must be provided in sufficient detail to enable the campus, CSU Office of the Chancellor and its consultants to make an independent evaluation on the reasonableness of the savings projections. Inclusion of maintenance and labor explicitly specified by the campus in the project specific solicitation. However, these may be presented as an information item for the Campus' consideration. Specifically, the savings estimates must state the following:

a. *Savings in natural gas or other fossil fuel resources.*
b. *Savings in electricity energy (kWh) and demand (kW) for the measure.*
c. *Savings as a percentage of historical (most recent year) use.*
d. *If demand savings is included, a narration of why it is valid to include demand savings in the estimate.*
e. *Current utility rates and time of use rates used in estimates and their conformity with actual rate schedules applicable to the building(s) at the time the proposal is developed.*
f. *The method by which savings was estimated.*
g. *How the existing energy use assumptions were estimated.*
h. *Calculations and equipment data sheets to substantiate Service Provider's estimates.*
i. *Future Savings Projections.*

5.1 Introduction

This section summarizes the methods used in evaluating the energy utility data of the California State University East Bay (CSUEB) Hayward campus. The energy usage and costs used for evaluating potential energy savings were provided by CSUEB in hard copy format for a duration of 11 months.

For the purposes of the PA, Chevron ES chose to utilize simple bin data based spreadsheet calculation methods to approximate the energy savings of the energy conservation measures evaluated. More detailed calculations will be made during the IGA phase utilizing Trane Trace 700 software or a similar DOE2 based energy analysis/building simulation program to refine actual energy consumption and energy savings.

Table 5.1 summarizes the existing natural gas consumption at each building at the site.

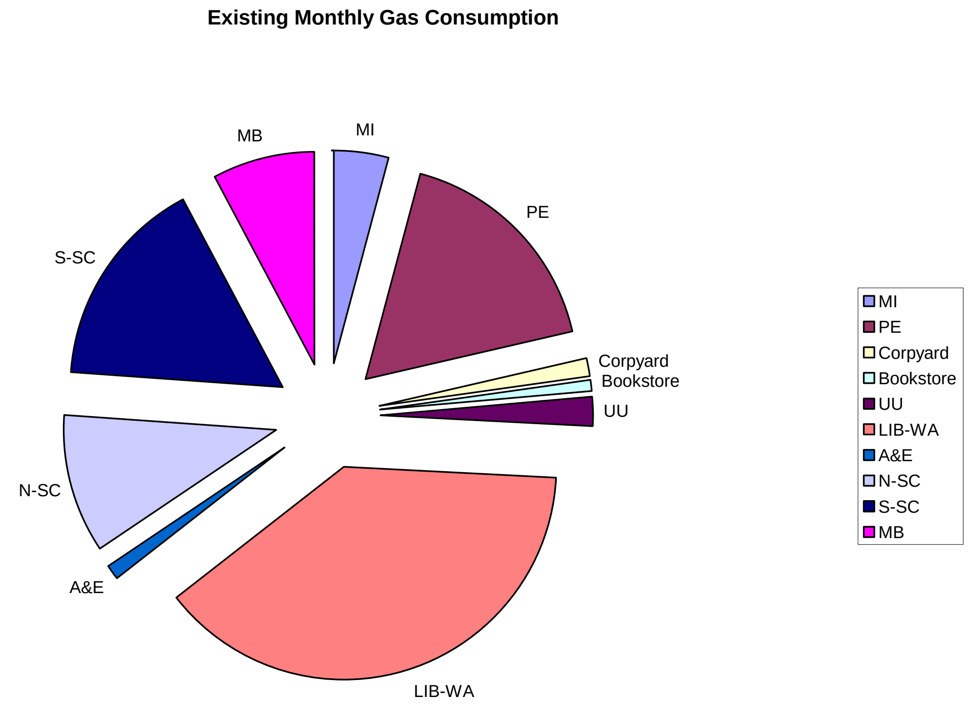
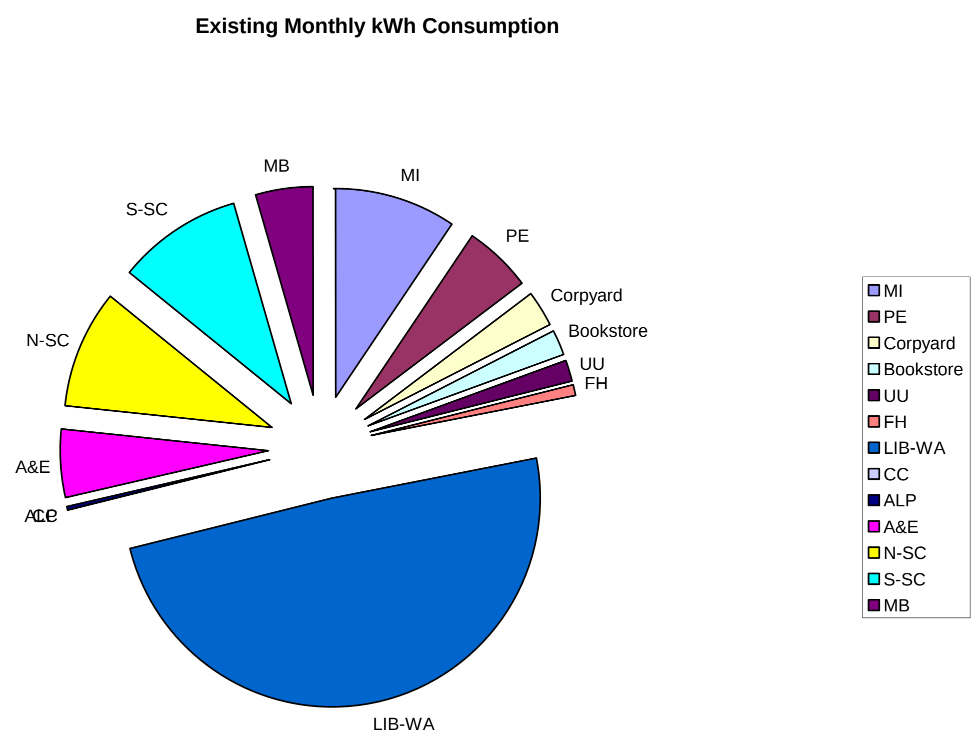


Table 5.2 summarizes the existing electrical consumption at each building at the site.



5.2 Method for Establishing Baseline Energy Consumption

In order to evaluate the energy savings resulting from each Energy Conservation Opportunity (ECO), a range of energy values must be chosen to serve as a baseline for each fuel type.

Based on the one year's energy utility data provided by CSUEB, an energy usage history for the site was developed.

5.2.1 Electricity Baselines

Electricity usage typically experiences a phenomenon called "creep" where the usage rises each year due to the addition of computers or other miscellaneous equipment. The best basis for comparison of electricity usage and savings is to select the usage values of the most recent 12 months.

5.2.2 Natural Gas Baselines

On a year-to-year basis, natural gas usage is highly weather-dependent, while electricity usage shows much less variation. To remove the variation in weather from year to year, the natural gas data is averaged for all data available. This average serves as the basis for comparison for the natural gas savings.

5.3 Method for Establishing Baseline Energy Costs

The energy savings achieved by this project can be measured and verified in different ways. However, the measurement and verification will demonstrate the savings in energy units—kilowatt-hours, kilowatts, and therms. In order to convert the energy savings achieved into dollars, energy rates must be used. The actual utility rates CSUEB pays are ever changing, and to eliminate the variations in energy costs and to provide for a conservative method of calculating utility cost savings from energy unit savings, we developed the methodology of blended utility rates. The blended rates will be used to refine the cost savings in the IGA phase.

5.4 Modeling Methods used in Investment Grade Audits

IGA Phase modeling methods will be dependent on the actual scope, saving requirements set by the customer, and rebate requirements. The first step in computer modeling is the compilation of all data collected during the Project Manager's, the lighting engineer's, and the HVAC engineer's surveys. Design heating and cooling load and air flow requirements are calculated using information gathered on the building's envelope, lighting system, occupants, miscellaneous equipment, and then entered into energy usage analysis program. The resulting loads are compared with the building's installed capacities and typical loads for the region in which the building is located. Any discrepancies between the calculated loads and installed capacities cause Chevron ES engineers to obtain additional information and/or revise existing information. New loads are then calculated and compared. This process is repeated until accurate and useful building loads are determined.

Local weather data is then selected and input into the energy usage analysis program The inputs are selected so that the weather program will produce an accurate set of data (including temperatures, solar patterns, and humidity conditions) simulating a typical year's worth of weather with all its seasonal and daily variations.

The information gathered on all the building energy usage devices is then compiled. During this compilation of data, information gathered by Chevron ES is cross checked against the building's plans, recorded documents, and interviews of building personnel and occupants. The data, after it is verified, is combined in a carefully selected set of inputs for Chevron ES energy analysis computer program. These inputs accurately define the energy using equipment control parameters, operating and unloading characteristics, as well as their daily and yearly schedules.

The programs are then combined and an initial energy run performed. The resulting output on this run is a month-by-month printout of the building's total energy use. The printout details electrical demand, electrical energy use, and fossil fuel use in several major usage categories.

The month-by-month computer simulation of energy use is compared against past utility bills. Discrepancies between Chevron ES computer simulation in energy use and the historic energy use of the building will cause Chevron ES engineers to reevaluate their information in order to calibrate the computer model. Additional information is obtained from building personnel through interviews and return site visits if necessary. Chevron ES will then review and revise the computer model where appropriate. A second run will be performed and compared to previous utility bills. This process will continue until Chevron ES computer simulation of energy use accurately tracks the building's historic energy use.

The calibrated computer model is the primary tool used to evaluate methods of reducing energy costs. Modifications to the building equipment and operation are modeled; and the results, including all interaction of the building's systems, are printed out. A computer simulation of any modification gives an accurate picture of all impacts of the modification on the building's energy use.

Each feasible energy conservation measure is evaluated using the computer model. The evaluation results in a month-by-month summary of energy savings in energy units (kW, kWh, MCF, etc.). The energy savings are then converted to dollar savings using actual utility rate structures.

5.5. Energy Savings

For the purposes of this PA in order to provide a level of comparison between the central plant (without cogeneration) and distributed generation alternatives, we performed some high level calculations for each option using the energy bills provided as a base year. In the IGA phase we will analyze bills over a 2-3 year period in order to finalize the base year that will be used for energy calculations. Below is a table providing some ranges of indicative energy savings that could be realized by the CSUEB Hayward Campus.

Heating Plant Alternative	Preliminary Savings Ranges
Central Heating Plant	$200k - $250k
Distributed Boiler Heating Plant	$250k - $300k

Preliminary savings have also been estimated for several additional Energy Conservation Measures found in Section IX.

5.6 Energy Savings Rate Assumptions

Based on the bills we received from CSUEB, we applied $0.12/kWh for power and $0.79/therm for gas. No direction was provided with regards to future utility pricing by CSUEB, so a 3% placeholder was used in the cash flow analysis included in Section IV (Cost Benefit Analysis)

Section VI. Grant / Rebate Incentive Applications

Describe your experience with administrating incentive programs. Provide examples of how you have provided these services to other customers. Describe your monitoring & verification process after implementation to insure project goals.

Rebate Incentives

Chevron ES has vast experience working with Utilities and other agencies, large and small, to secure energy incentives, tax credits and rate reductions. During both the PA and IGA phase, one of the key tasks undertaken by Chevron is to identify, apply for and secure the maximum amount of incentives that are available from the local utilities, state and federal government and other agencies.

Chevron ES has identified rebate opportunities for the projects being proposed in this PA and will confirm and calculate all utility rebates available that this project can qualify for in the IGA stage. At this stage of the PA, rebates appear to be available for the controls project, the lighting project, and high efficiency boilers and chillers. The current PG&E SPC rebate amount for lighting can be up to $0.05/kWh, and gas up to $1/therm. Chevron ES will continue to identify any and all rebates and grants during the IGA phase. Utility rebates are typically calculated based on the energy saved by the installation of a specific measure and will require further modeling and analysis by Chevron.

One recent example of where we've provided this service is the USPS project in San Francisco, where we helped our client to secure and receive over $2.5 million incentives from various rebate programs including SPC, SGIP and DOD climate change funding. Other examples are listed on the Project Experience Profile sheets found in the Project Experience tab.

Monitoring & Verification Process

General Approach to M&V

Energy savings are determined by comparing the energy use associated with a facility or certain systems within a facility before and after the installation of an ECM or other measure. The "before" case is the baseline. The "after" case is the post-installation or performance period. Baseline and post-installation energy use measurements or estimates can be constructed using the methods associated with M&V options A, B, C, and D, as described in the IPMVP. The challenge of M&V is to balance M&V costs, accuracy, and repeatability with the value of the ECM(s) or systems being evaluated, and to increase the potential for greater savings by careful monitoring and reporting.

M&V Options Summary	
M&V Option	**Performance Verification Techniques**
Option A Verifying that the measure has the potential to perform and to generate savings.	Engineering calculations (possibly including spot measurements) with stipulated values.
Option B Verifying that the measure has the potential to perform and verifying actual performance by end use.	Engineering calculations with metering and monitoring throughout term of contract.
Option C Verifying that the measure has the potential to perform and verifying actual performance (whole building analysis.)	Utility meter billing analysis using techniques from simple comparison to multivariable regression analysis.
Option D Verifying actual performance and savings through simulation of facility components and/or the whole facility	Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.

Option A is appropriate for ECMs that have energy use that can be readily quantified, such as the use of high efficiency lighting fixtures, high efficiency constant speed motors, and other standard engineering calculations.

Option B is appropriate for ECMs that require periodic or on-going measurements to quantify energy use; such as the use of variable speed drives on pump or fan motors.

Option C is used for ECMs for which the energy use or energy savings cannot be measured directly, such as building envelope modifications. Option C is based on the use of utility meters to quantify building energy use.

Option D is used for ECMs for which the energy use or energy savings cannot be measured directly, or savings for individual ECMs are heavily interdependent. Calibrated building simulation is used to separate the energy savings attributable to each ECM.

Since energy use at a facility is rarely, if ever, constant, another way to define M&V is as a comparison of a facility's post-installation energy use with its usage if the ECM or system had not been installed. This takes into account situations in which baseline energy use must be adjusted to account for changing conditions, such as changes in facility operation, occupancy, or use or external factors such as weather.

Post-Retrofit M&V Activities

There are two components associated with M&V of performance contract projects:

1. Verifying the potential of the ECM to generate savings, also stated as confirming that the proper equipment/systems were installed, are performing to specification and have the potential to generate the predicted savings.
2. Determining/verify energy savings achieved by the installed ECM(s).

Verifying the Potential to Generate Savings

Verifying baseline and post-installation conditions involves inspections (or observations), spot measurements, and/or commissioning activities. Commissioning includes the following activities:

- Documentation of ECM or system design assumptions.
- Documentation of the ECM or system design intent for use by contractors, agencies and operators.
- Functional performance testing and documentation necessary for evaluating the ECM or system for acceptance.
- Adjusting the ECM or system to meet actual needs within the capability of the system.

In the IGA phase of work, Chevron ES will work with CSUEB to determine what level of monitoring and verification (M&V) will be required for this project. Chevron ES can provide post-installation M&V verification on a one-time basis or ongoing at regular intervals to ensure that the proper equipment/systems that were installed are operating correctly and have the potential to generate the predicted savings. Verification methods may include surveys, inspections, and/or spot or short-term metering.

:

Section VII. Service Provider's Staff Experience

Provide resumes for each of the individuals who will be assigned to this project. Include name, current duties, specific relevant experience, and role this person will play on this project.

Chevron Energy Solutions Company (Chevron ES) is a division of Chevron USA, Inc., a wholly owned subsidiary of Chevron. Our mission is to help institutions and businesses improve their facilities through using less energy, paying less for energy, and ensuring reliable, high quality power for critical operations**.** For more information on Chevron ES, please visit our website at www.chevronenergy.com.

Chevron put together a strategic plan some years ago to become a truly comprehensive provider of energy, energy services and products. The move made Chevron the first petroleum company to offer a full range of energy services to firms and institutions in the U.S. market, which has an estimated yearly energy demand – excluding energy commodity sales – of more than $100 billion.

Industry Participation

Chevron ES's dedication to the industry goes beyond implementing projects. The commitment is shown in the involvement with the industry's organizations.

As a Charter Member of the **National Association of Energy Services Companies (NAESCO),** Chevron ES has played an active role in the development of the organization and the energy services industry. John Mahoney, COO of Chevron ES, is a member of the Board of Directors, and was elected president for 2002 and 2003. Some of Chevron ES' employees are ative committee members on some of NAESCO's committees such as International, Measurement & Verification, Model Legislation, Membership, Utility Restructuring, State Affiliates, and Federal Market.

Several years ago, the **Western Regional Coalition** was formed as a nonprofit organization composed of a network of experts from a wide range of organizations working together at the sate and local level to increase energy efficiency and building upgrades through energy savings performance contracting. This coalition was formed and concentrated on the western states of the nation with members being state energy officers and energy services companies. A Chevron ES Regional Sales Manager was elected president of this coalition at its inception and to-date, has been re-elected each years due to the coalition's continuing growth. The coalition has now become national and is know as the **Energy Services Coalition (ESC).** Several individuals from Chevron ES are members of this coalition as the membership is individual rather than by company.

Additionally, Chevron ES is a strategic partner of **Rebuild America**, a program of the Department of Energy (DOE) that focuses on energy solutions as community solutions; a **Energy Star Partner**, a dynamic EPA / government / industry partnership facilitating businesses and consumers to save energy and protect the environment; and an active member of the **Association of Energy Engineers (AEE)** dedicated to helping firms and clients to increase energy efficiency, utilize innovative energy service options, enhance environmental management programs, upgrade facility operations, and improve equipment performance. John Mahoney, Chevron ES COO, was awarded the **2000 AEE Energy Executive of the Year** due to the company's significant growth and contribution in the industry.

Chevron ES is also a member in good standing in the **U.S. Green Building Council**, the nation's foremost coalition of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable and healthy places to live and work. No other organization represents the entire green building industry with the breadth of stakeholders found in the USGBC. Chevron ES is participating in its **Leadership in Energy and Environmental Design (LEED)** for existing buildings initiative and is going through the process of having all Project Managers, Construction Managers, Engineers and Salespeople become LEED certified.

Lastly, Chevron ES has been an approved performance contractor for the United States **Department of Defense and the Department of Energy** for a number of years, and is a active member of the national and local chapters of the **American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).**

Types of Services Offered

Chevron ES' areas of expertise are rooted in our technical team that will be assigned to the project. We take great pride in the fact that we have a strong professional and technical in-house staff, which is capable and experienced in performing in-depth energy evaluations and engineering design, including mechanical electrical, lighting and water management. Our staff's areas of expertise include computer modeling, design and analysis, generation technologies, HVAC, energy management controls, contracting, test and balancing, EMCS commissioning, monitoring and verification, facility operations, finance, maintenance, and much more.

Core Professional and Technical Skills

Auditing. The Technical Energy Analysis (TEA) is the first, critical step in any of our projects. In essence, the analysis is the basis that allows Chevron ES to guarantee all project costs, and that there will be no change orders. In some cases, the audit will confirm that there will be no increase in either the Client's budget or the Client's tax rate due to the energy project.

Engineering Design. Our core competency is custom-engineered solutions delivered by our in-house engineering group dedicated solely to energy services. Chevron has close to one hundred engineers on staff with energy engineering experience. This expertise is subject to continuous improvement day in and day out, since our staff works exclusively on energy projects. Our work is accomplished in all areas of the country and for all types of projects, including large, small, traditional, cutting-edge, private, public, institutional, and governmental. We use conventional, cutting-edge, supply side, and user side technology with all energy sources. This intellectual capacity, developed to a high degree of specialty, is what sets Chevron ES apart from other energy services companies (ESCOs).

Energy Modeling. Our engineers incorporate industry standard energy simulation software programs, such as Simsys, Trane Trace, DOE2, Market Manager, PV Watts, or Solar Design Studio to provide a computer software model of the annual energy performance. A computer model is a defined set of calculations that provide a representation of an existing facility or site. The model is "built" by entering the data for all the construction, mechanical, and electrical characteristics of a site, as well as all the site operation patterns, into a modeling software program.

Design. Our design process includes the preparation of worldclass design and construction documents, including specificationsand submittals. This phase of the project starts after the solution alternatives have been reviewed and selected by the technical team. Our in-house engineers and CADD department prepare the documents to meet the needs of the specific project. We have the knowledge and experience to design even the most challenging projects. Once we have agreed on the specified solution to be implemented, we will proceed with the engineering and design activities that will be managed or performed by our registered engineers conforming to the laws and applicable codes and standards, as well as your requirements.

Project Management. Chevron ES is a single-source ESCO capable of developing and managing projects from $500,000 to $500 million. We have full capability to assess, develop, design, implement, commission and monitor a project completely – from start to finish. Our project management plan utilizes a team concept to provide energy audits and analyses, solution recommendations, design, construction and commissioning. Another important Chevron ES project management premise is continuity – the team assigned to the project will remain with it from conception through commissioning. Our project management skills and experience includes bidding out work to local subcontractors and suppliers. Our engineers and construction managers are knowledgeable and well versed in the operation and maintenance of all leading equipment manufacturers' products, and are not "locked" into any one manufacturer, model or type of equipment. In our projects, owner equipment preferences are strongly considered when specifying equipment. Further, we believe that standardization of equipment, where possible, maximizes the benefits associated with maintenance, employee training and parts procurement.

Construction Management. We have a highly qualified and experienced construction management staff which will implement a detailed construction plan for the project, so as to assure timely completion, close coordination with other construction activities, and minimal disruption of the work and learning environment. One of the keys to the success of our past projects is our construction manager's physical, on-site presence at the job currently in progress, and their reliability and responsiveness to problems that inevitably occur during construction. Their responsibilities, with oversight from the project manager, include construction scheduling, subcontractor and vendor coordination, safety and security, permits and licenses, and regular progress meetings with all stakeholders. Our construction managers inspect all work of the subcontractors for compliance to the job design and performance specifications, and also ensure that vendors and equipment manufacturers fulfill their obligations for supplying operation and maintenance manuals, accurate as-builts, and vendor training for personnel.

Commissioning. Commissioning is the customer's quality assurance process. Point-to-point examination of all installed equipment ensures that performance standards are met 100 percent. Our commissioning team follows-up the installation of equipment by all subcontractors to make sure it is working properly. This process places us in the position of a thirdparty advocate for the campus. Our commissioning teams have no special interest relationship toward any manufacturer. Chevron ES' only interest is in a long-term, mutually beneficial partnership with the Client.

Measurement and Verification. In any energy savings program, the selection of an appropriate measurement and verification (M&V) plan is key to the success of the program. We utilize the latest in technical resources and maintain a staff of highly trained engineers, energy mangers and energy monitoring technicians. Once the project is "in the ground," or completed from a construction/renovation standpoint, the key to success is monitoring. Expert M&V will ensure that the Client's facilities and equipment upgrades perform as specified.

UtilityVision®, our web-based monitoring tool, also allows our customers to manage their energy usage with the click of a mouse. UtilityVisionSM is an internet based energy information platform consisting of hardware located on the customer's premises, and user authenticated software executed using a standard web browser over the internet. With UtilityVision installed, energy consumption information is read automatically at each site, and is uploaded to our internet servers on a daily basis. Monthly energy savings reports are available within 24 hours of the end of the calendar month, and partial month reports are available for the current month. Energy savings are measured in the same way as with paper bills, the information is just available much sooner.
In addition, we provide our customers with easy-to-read monthly reports.

Customer Satisfaction. Chevron ES' commitment to quality service is second to none in today's energy services industry. We believe that CSUEB will find Chevron ES uniquely qualified to handle the Solar PV Generation project, and that you will be pleased with our performance at every step of the process. In an effort to make certain that our customer satisfaction is maintained at a quality level, a short survey form regarding the phases of our energy program is sent to the customer to fill out and return to us. Additionally, there may be several individuals within an organization that will receive a survey so that we can gain a full understanding of how our services are perceived by all customer levels with which we have contact. We have implemented a series of four (4) customer satisfaction surveys to be sent to customers at various stages of the project. These surveys are:

- Sales & TEA Phase: This survey is sent upon the completion of the TEA and is typically "triggered" by obtaining a signed implementation contract.
- Mid-Construction Phase: For use on larger projects, this form is sent mid-way through the construction phase.
- Construction Completed: This survey is sent at the completion of construction, and is "triggered" by execution of the Final Completion Certificates.
- Monitoring Phase: Sent periodically throughout the monitoring period.

Marketing Communications Project Support. In addition to the technical and project development expertise that Chevron ES brings to each and every project, our customers also have access to the communications resources at Chevron ES. The marketing communications team is composed of five members that have complimentary skill sets that not only help Chevron ES market its services but the team can also develop communication strategies on behalf of our clients. In the past the communications group has assisted our customers in developing a wide variety of communication tools including case study slicks, brochures, web pages, presentations, multimedia displays, informational kiosks and speeches. The group has also assisted with the organization of events such as ground breakings, mock check presentations, media interviews, press releases and awards ceremonies.

It is important to communicate the benefits of successful energy efficiency projects on behalf of our customers as communities and other stakeholders need to understand what exactly is going to be done at the facility and how that will affect them. To develop strong buy in and long term goodwill from stake holders a good communications strategy must be developed and the Chevron ES team has that experience to communicate the positive benefits of comprehensive energy efficiency projects.

Chevron ES will devote a group of highly qualified and experienced personnel to perform services for this project. All of the individuals have extensive experience with the development and implementation of central plants, distributed heating plants, co-generation systems, energy efficiency projects, and other technologies.

We strongly believe that the cumulative experience of these key personnel will provide CSUEB with a highly proficient team that can implement the necessary services as required under this proposal. In addition to these key personnel, Chevron ES will draw upon other employees skilled in engineering, finance, and project management, as needed.

Please see detailed resumes that follow.

Name and Title	CRAIG SHULENBERGER, Lead Project Engineer
Years at CES / Overall years of experience in industry	1 / 26
Education-Degrees, schools and years obtained	University of California, Davis, BA Art/Architecture, 1977 LEED v2 Accredited Professional
Role I will play for CSU East Bay project	Developing energy conservation measures for the mechanical systems while making sure East Bay's needs are met. Provide Mechanical Engineering design and design review services for energy conservation measures implemented.
Current overall duties with CES	Duties include performing mechanical system surveys; this information is used to prepare detailed comprehensive energy conservation opportunity assessments for the facility. Perform cost analysis, modeling, HVAC retrofit design, and construction management.
Specific experience related to Higher Education Markets	Provided mechanical design services for institutions for over 15 years. Experience in energy conservation retrofit projects for Colleges, Counties and Cities throughout California. Involved in developing design/build and plan/spec retrofit projects.
At least two client references with name and number	**Los Rios Community College District**, Mike Goodrich, Director, Energy/Utility Resources (916) 856-3403 **U.C. Davis Medical Center**, Michael Lewis, Senior Engineer (916) 734-8685 **John Muir Medical Center**, Vince Scoccia, Director of Plant Services (925) 947-5306 **County of Marin**, Rich Wallace, Maintenance Supervisor (415) 499-6576
Short description of projects worked on in last five years	**Los Rios Community College District**: Developed and implemented a project to install hydronic boilers to supply a newly remodeled building. Currently developing the project to connect that heating water system to additional buildings on the campus. **US Postal Service**: Developed energy conservation retrofit projects at fifteen facilities in northern California. **San Ramon Unified School District:** Designed the mechanical systems for science and classroom buildings for the new Dougherty Valley High School in San Ramon with the architectural firm of Akol and Yoshi. **U.C. Davis Medical Center**: Design and construction supervision of the following: Underground steam distribution system to supply the main hospital from the new central plant. New chilled water and heating water supply to main hospital from the central plant distribution systems. Conversion of the chilled water and heating water systems to variable flow. **City of Sacramento**: Designed the replacement of the chilled water system for the Sacramento Convention Center. **County of Marin**: Designed the replacement of the chilled water plants for both the Administration Building and the Hall of Justice at the Marin County Civic Center, a historical Frank Lloyd Wright designed building.

Name and Title	STEPHAN RANK, Lead Project Engineer
Years at CES / Overall years of experience in industry	5 / 9
Education-Degrees, schools and years obtained	Cal Poly SLO, BS Mechanical Engineering, 1991
Role I will play for CSU East Bay project	Developing energy conservation measures for the CSU East Bay campus that meet the needs of the facility and staff. Work with the CES team and campus staff to ensure safe implementation of all work at the campus.
Current overall duties with CES	Duties include project management and project development for a wide range of customers included waste water treatment plants, water districts, various commercial/industrial customers and educational facilities.
Specific experience related to Higher Education Markets	Provided account management and project management services to Cal Poly SLO for a large lighting project in 2000/20001 while I was with a previous employer.
At least two client references with name and number	**City of Millbrae WPCP**, Dick York, Plant Superintendent, Water Pollution Control Plant (650) 259-2388 **Montara Water & Sanitary District**, George Irving, District Manager (650) 728-3545
Short description of projects worked on in last five years	**Millbrae WPCP Cogeneration Project**: Development and ongoing project management of a unique project which involves a new 250-kW Microturbine fired by methane gas produced at the host wastewater treatment facility. The project also involves significant civil improvements which will improve methane production as well as a grease receiving station which will receive kitchen grease trap waste to be injected into the plants digesters. This will result in a substantial increase in the amount of methane generated for use by the microturbine. **Inergy Services Cogeneration Project**: Conceptual design and project economics modeling for a 1.2 MW gas turbine project which utilizes a large duct firing heat recovery unit to heat the host facilities process thermal media (high temperature oil). **General Chemical Cogeneration Project**: Conceptual design and construction support, commissioning and training. The project utilized a 1.3 MW natural gas fired engine with exhaust used to supplement an existing thermal process at the sulfuric acid re-processing plant. **TRM Manufacturing Cogeneration Project**: Conceptual design and construction support of a 1.5 MW cogeneration project at a plastic products manufacturing plant in Corona, CA. **Chevron Corporation Energy Efficiency Projects**: Worked on a wide variety of energy efficiency projects at a variety of facilities. Main effort (ongoing) involves developing a new modeling tool that will simulate pumping energy so that the Chevron Pipeline company can better manage energy costs.

Name and Title	MIKE DeVRIES / Construction Manager
Years at CES / Overall years of experience in industry	7 / 22
Education-Degrees, schools and years obtained	Associate Degree in Electronic Communication, South Dakota Technical School, 1975
Role I will play for CSU East Bay project	Developing Chevron's energy savings plans with regard to HVAC controls and Energy Management Systems. During construction phase of project, act as liaison between contractors and campus to ensure needs are being met. At completion, commission all systems for quality and correctness.
Current overall duties with CES	Development of Energy Management Systems and savings. Coordination and Commissioning of contractor's work. Installation of web-based utility monitoring systems.
Specific experience related to Higher Education Markets	21 years of experience in the commercial buildings/energy management field, incorporating systems design, installation, and service in community, county and state educational facilities.
At least two client references with name and number	**Foothill-De Anza Community College District**, John E. Schultze, Director of Facilities Construction 408-949-6150 **Community College District of San Mateo**, Jose Nunez and Linda DaSilva, Directors of Facilities, 650-358-6836 and 6726
Short description of projects worked on in last five years	**Foothill-De Anza Community College District**: New Central Plants, new controls and mechanical upgrades to all buildings, solar and microturbine cogeneration. Over 3000 EMS points covering two million square feet over two campuses. **San Mateo Community College District**: New Central Plants, new controls and mechanical upgrades to all buildings, solar and natural gas cogeneration. Over 4000 EMS points covering two and a half million square feet over three campuses. **Los Angeles City College**: New Central Plant installation. Retrofit/upgrade all existing mechanical systems. Over 1800 points covering 1.3 million square feet. **Alameda County, Santa Rita Jail**: Conversion of central plant to variable flow, installation of 1 megawatt solar system and 1-MW fuel cell cogeneration system **Moscone Convention Center**: Recommissioning of entire energy management system, complete retrofit of lighting systems, installation of 500-kW solar system. **St. Mary's College**: Comprehensive retrofit of lighting, HVAC, and energy management systems.

Name and Title	**ROB EDELSTEIN, V.P. Business Development** **Bottom Line Utility Solutions, Inc.**
Overall years of experience in industry	6
Education-Degrees, schools and years obtained	Penn State University, BS, 1980
Role I will play for CSU East Bay project	Developing water conservation and efficiency measures while making sure CSU East Bay's needs are met. During construction phase of project act as liaison between CSU East Bay, Chevron ES and Bottom Line US staff.
Current overall duties	Business Development throughout western United States in all institutional markets
Specific experience related to Higher Education Markets	Business development for institutions for over 5 years. Experience in water efficiency projects for Apartments, Colleges, School Districts, Cities, Counties, Federal agencies, water utilities and others throughout the country. Involved in developing design/build water efficiency projects that increase the institution's bottom line. Experience in plumbing, irrigation, cooling systems, laundry, recycled water, and other water efficiency technologies and services.
At least two client references with name and number	**Kern County,** CA, Herb Rigdon, Maintenance Supt. (661) 391-7977 **Archstone Communities**, David Sonke, V.P. Construction (949) 455-4500
Short description of projects worked on in last five years	**Kern County Jail**: Develop and design/build of retrofit of 800 detention area and common area plumbing fixtures. As part of a larger energy services contract completed in 2003. Exceeded water savings estimates of 80,000 gallons per day. **Prescott School District, AZ**: Develop and design/build retrofit of 600 plumbing fixtures and irrigation retrofits at 10 school locations. Water savings have been achieved per estimates. **Fresno County Government Buildings**: Develop and design/build multiple retrofit water efficiency measures at Fresno County government complex. Plumbing retrofits, irrigation retrofits, cooling tower retrofits and laundry retrofits completed. **Archstone Communities**: Design/build irrigation projects for many west coast Archstone apartment communities, with over 50 sites completed to date. Water savings from retrofits are as estimated. **Western Nevada Community Colleges**: Develop and design/build plumbing and irrigation retrofits at college.

Name and Title	MARK SCHNEIDER, Business Development Manager
Years at CES / Overall years of experience in industry	5½ / 12
Education-Degrees, schools and years obtained	West Virginia University, BA, 1990
Role I will play for CSU East Bay project	Developing Chevron's offerings while making sure East Bay's needs are met. During construction phase of project act as liaison between Chevron and campus to insure quality of work is being met
Current overall duties with CES	Business Development throughout CA in the higher education sector
Specific experience related to Higher Education Markets	Business development for institutions for over 10 years. Experience in energy conservation for Community College Districts, Counties and Cities throughout California. Involved in developing design/build energy projects that affect an institution's bottom line economically. Experience in "green" renewable power as well as cogeneration and distributed generation.
At least two client references with name and number	**San Diego Community College District**, Richard Burkhart, Construction Manager, 619-388-6546 **College of the Canyons**, James Schrage, Dean Physical Plant, 661-362-3222
Short description of projects worked on in last five years	**California State Universities, Campus-wide Lighting Retrofit (4 campuses)**: Audit/design/construct a 2.5 million dollar lighting retrofit at 4 northern CA CSU campuses one of which was East Bay. Extreme deadline of June 30, 2006, needs to be met to ensure PG&E incentive money of $2 million dollars to pay for the project. **College of Canyons**: Complete bond-funded energy conservation program which included a pool cogeneration system and football stadium lighting retrofit. **San Diego Community College District**: Two campuses served. Two cogeneration projects. One campus is a 60-kW microturbine and the campus is a 1.5-MW cogeneration system. Both campuses also had electrical upgrades on their switchgear. **County of Santa Clara**: Energy audits of 120 facilities owned by the County which included two jails and a hospital. We have been doing construction work in four phases and we continue to get work from the County. We are currently in discussions with the County for a program of fuel cells, approximately seven fuel cells. **Albertsons Grocers**: Sold and completed an entire lighting retrofit of all 17 Albertsons Distribution Centers throughout the Country.

Name and Title	MATT GRECO, Project Engineer, Bay City Boiler & Eng., Co.
Years at Bay City Boiler & Engineering **Overall years of experience in industry**	August 1998 to present June 1996 to present
Education-Degrees, schools and years obtained	California Polytechnic State University, San Luis Obispo, CA, Bachelor of Science in Mechanical Engineering, 1996 Registered Professional Engineer in Mechanical Engineering, State of California, 1998
Role I will play for CSU East Bay project	Project Engineer overseeing project
Current overall duties with Bay City Boiler & Engrg.	Project Engineer, Design Engineer, Estimator
Specific experience related to Higher Education Markets	Ten years of experience as a design engineer and project engineer overseeing a wide variety of design-build and plan spec projects in the commercial and industrial mechanical and HVAC industries.
At least two client references with name and number	**Northrop Grumman Corporation, Marine Systems**, Gary Cherry, Marine Test Manager (408) 735-3162 **Chevron Energy Solutions**, Raymond Wong, Project Manager (415) 733-4616 **NASA Ames Research Center, Moffett Field**, Roger Miller, Deputy Chief of Facility Engineering (650) 604-3681 **San Mateo County Community College District**, Tony Gulli, Chief Maintenance Engineer (650) 738-4116
Short description of projects worked on in last five years	**University of the Pacific, Stockton, CA**: Labor and material to install high efficiency hydronic heating boilers. **San Mateo County Community College District**: Yearly Service Contract (2000 to present), District Wide Boiler Upgrades: Skyline College, College of San Mateo, Canada College; Labor and material to install Coen Micro Nox Burners on two 400 HP Cleaver Brooks hot water boilers at Skyline College. **Silicon Valley Power, City of Santa Clara, CA**: Labor and material to install high pressure valves & piping for steam turbine exhaust and cooling tower system. **USPS, San Francisco, CA**: Labor and material to replace chilled water system to include installation of three 250-ton York chillers, primary-secondary chilled water pumps and piping, condenser water pumps and piping, and Baltimore Air Coil cooling tower. **City of Richmond, Hall of Justice, CA**: Labor and material to replace hydronic heating & domestic hot water systems to include installation of two Bryan hot water boilers, one A.O. Smith domestic hot water heater, one Bryan steam boiler, primary-secondary hot water pumps and piping, steam & condensate return piping, and one Capstone microturbine. **NASA Ames Research Center, Moffett Field, CA**: Labor and material to install government furnished 250 HP Cleaver Brooks low pressure steam boiler and associated equipment in Building N211. **Northrop Grumman Corp., Marine Systems, CA**: Labor and material to retube Zurn Keystone 300,000 lb/hr highpressure steam boiler. **Woodlake Condominiums, CA**: Labor and material to install complete domestic hot water systems for six separate buildings in condominium complex to include high efficiency domestic hot water boilers, domestic hot water storage tanks, pumps, piping, electrical, and controls. **State of California, Department of Corrections**: Labor and material to upgrade controls on three 30,000 lb/hr Erie City Iron Works high pressure steam boilers.

Name and Title	RAYMOND WONG, Senior Project Manager
Years at CES / Overall years of experience in industry	8 / 12
Education-Degrees, schools and years obtained	University of California at Berkeley, BSME, 1994 Santa Clara University, MBA, 2005
Role I will play for CSU East Bay project	Overseeing the CSU East Bay project team making sure East Bay's needs are met.
Current overall duties with CES	Team leader for a team of 9 project managers, construction managers and project engineers.
Specific experience related to Higher Education Markets	Experience in energy conservation for Community College Districts, Counties and Cities throughout California. Projects include San Mateo CCD, Sacramento CCD, and Solano Community College.
At least two client references with name and number	**USPS, San Francisco**, Ted Chin, Facility Manager, San Francisco (415) 550-5442 **City of Richmond,** CA, Ralph Lloyd, Electric Shop Supervisor (510) 231-3033
Short description of projects worked on in last five years	**San Jose City College / Evergreen Valley City College**: HVAC and EMS design, Construction Management **City of Manteca**: Project development and management of a comprehensive energy services project consisting of lighting retrofits, new energy management system, water supply system upgrade (new SCADA system and new industrial VFD's and check valves for city's pump stations), waste water treatment plant retrofits (ultra fine bubbles diffusers, new aeration blowers, digester pumps and co-generation system). **City of Richmond:** Project development and management of a comprehensive energy services project consisting of lighting retrofits, new energy management system, central hot water plant repairs, modernization and variable flow pumping upgrades, central chilled water plant expansion and modernization, air handling system refurbishment and replacement, underground piping repairs, and the construction of two reciprocating engine based cogeneration system including medium voltage electrical system integration. **USPS San Francisco Processing Center and Postal Center:** Project development and management of a comprehensive energy services project consisting of lighting retrofits, new energy management system, air compressor system retrofit, modernization and variable flow pumping upgrades, central chilled water plant modernization, air handling system refurbishment and replacement, photovoltaic and cogeneration system (250-kW fuel cell)

Name and Title	THAI Q. PHAM, P.E., Project Manager, Critchfield Mechanical Inc.
Years at CMI / Overall years of experience in industry	9 / 9
Education-Degrees, schools and years obtained	California Maritime Academy, BS, 1997 U.S Coast Guard Engineering License, 1997 Registered Professional Engineer #M32204, 2002 LEED AP, 2004
Role I will play for CSU East Bay project	Project manager for the project.
Current overall duties with CMI	Project Manager, responsible for the overall project management, design and construction of HVAC system.
Specific experience related to Higher Education Markets	Cañada College Central Plant and Campus San Mateo College Central Plant and Campus Skyline College Central Plant and Campus De Anza College Foothill College Stanford University Museum
At least two client references with name and number	**Cañada College**, Danny Glass, Chief Engineer (650) 306-3100 **San Mateo College**, Diane Martinez, Facility Director (650) 574-6161 **Santana Row**, Tom Randall, Chief Engineer (408) 551-4611 **Stanford University Museum**, Art Wolf, Facility Director (650) 723-5455
Short description of projects worked on in last five years	**Cañada College Central Plant and Campus**: Design, installation and commissioning of 700-ton CHW Central Plant. Install CHW pipe loops for the campus. Refurbish and upgrade HVAC systems throughout the campus. **San Mateo College Central Plant and Campus**: Conversion of existing central plant to primary secondary system. Refurbish and upgrade HVAC systems throughout the campus. **Skyline College Central Plant and Campus**: Conversion of existing central plant to primary secondary system. Refurbish and upgrade HVAC systems throughout the campus. **Santana Row Central Plant and Campus**: Design, installation and commissioning of 7000-ton central plant, complete with campus loop pipes. **UCSF Moffit/Long Hospital**: Installation and commissioning of 330-ton chiller cooling system. **Foothill College**: Installation of 240-kW microturbines and heat recovery system. **De Anza College**: Installation of 240-kW microturbines and heat recovery system. **Stanford Museum**: Design, installation and commissioning of HVAC system for 140,000 ft^2 building.

Name and Title	BROOKS SHEIFER, Director of Project Development , Sun Industries
Years at CES / Overall years of experience in industry	Not with CES / 15 years in energy-efficient lighting industry
Education-Degrees, schools and years obtained	Bachelor of Science in Business Admin, Bucknell University, 1969
Role I will play for CSU East Bay project	Feasibility; project development and analysis
Current overall duties with Sun Industries	Director of Project Development; Information management of energy auditing, estimating, progress-tracking and as-builts
Specific experience related to Higher Education Markets	Directed feasibility studies and reported to the Chancellor's office for eight CSU campuses in 2005 (including CSU East Bay). Assisted with allocation of $2 million in special PG&E funds. Information Manager for Los Rios Community College District retrofit project, 2005 General Manager and Information Manager for retrofit of Solano Community College, 2001 General Manager, Information Manager and Project Developer for retrofit of Fresno Community College District, 2003 Project Developer for retrofit proposal of Kansas State University, 2003
At least two client references with name and number	**CSU Chancellor's Office**, Aaron Klemm (562) 951-4121 **Alameda Power & Telecom**, Meredith Owens (510) 748-3947 **Lighting Wizards**, Stan Walerczyk (925) 944-9481 **Chevron Energy Solutions** (Pasadena), Duane Crymes (626) 676-8018
Short description of projects worked on in last five years	**Equity Office Properties**: Project development of 54 office buildings in Marin and Sonoma Counties; development and coordination of 25 relamp projects in Northern CA. Construction ongoing. **Intel**: Project development and customer coordination of energy-efficient lighting retrofit of a 500K sq. ft. Santa Clara facility. Construction to start in May, 2006. **Orange Unified School District**: Project development of retrofit of three schools in a Phase 2 project. Approval pending **Baldwin Park Unified School District (LA County)**: Project development of retrofit of 22 schools. Approval pending. **US Postal Service**: Project development of several Processing and Distribution Centers including Stockton, West Sacramento, San Francisco, San Jose; and approximately a dozen regional postal facilities in Northern CA. **LA City Library**: Project development of main library occupying a full city block. **Long Beach Memorial Hospital**: Special consulting assignment to Southern California Edison to redesign lighting in the hospital's multipurpose banquet and training area. **Moscone Center, San Francisco**: Project development and coordination of lighting retrofit of all support areas in the North and South halls. **Mt Diablo Medical Center, Concord CA**: Audit and complete project development to re-retrofit a mid-1990s project and develop a synergistic strategy to deal with the multitude of renovations and designs implemented over the years. Project pending for July construction.

Name and Title	JAMES L. KOZELKA, Project Manager
Years at CES / Overall years of experience in industry	1 / 27
Education-Degrees, schools and years obtained	Hobart College, Geneva, NY, BA, Math and Psychology HVAC Certificate, UC Berkeley Extension
Role I will play for CSU East Bay project	Manage all elements of project development, implementation and cost control of energy conservation measures for the CSU East Bay campus that are aligned with the CSU master plan and strategic energy reduction program Work with the CES team and CSU EB campus staff to ensure the highest overall project integrity and safe implementation of all work.
Current overall duties with CES	**Focus**: Leading project teams to analyze and implement energy efficiency and HVAC infrastructure upgrade projects. **Perform**: Manage all elements of project development and implementation involved with taking projects from conceptual design through construction and commissioning. **Responsibility**: On-budget, on-time completion of energy savings projects including duties such as: preliminary and detailed energy surveys, project engineering, purchasing, subcontracting, construction administration, scheduling and commissioning.
Specific experience related to Higher Education Markets	Provided mechanical design services for institutions for over 15 years. Experience in energy conservation retrofit projects for colleges, counties and cities throughout California. Involved in developing design/build and plan/spec retrofit projects.
At least two client references with name and number	**US Postal Service**, Joe Vandenberg, Environmental Specialist (562) 494-2272 **Solectron Corporation**, Rob Kolar, Sr. Facility Mgr. (408) 586-4025 **John Muir Mount Diablo Health System**, Vince Scoccia, Director of Plant Services (925) 947-5306 **Sutter Solano Medical Center**, James Brooks, Director of Facilities (707) 554-5209
Short description of projects worked on in last five years	**US Postal Service**: Manage all auditing, design/engineering and retrofit implementation of HVAC and lighting efficiency projects at multiple facilities. Scopes of work include replace central heating and cooling plants, upgrade HVAC systems and install new DDC control systems. **Solectron Corp.**: Manage all auditing, design/engineering and retrofit implementation of HVAC & lighting efficiency projects at multiple facilities. Scope of work includes lighting upgrades, compressor/dryer and motor replacement, new DDC controls installation. **John Muir Mount Diablo Health System**: Managed all auditing, design/engineering and retrofit implementation of HVAC efficiency projects. Scopes of work include unique project to add return/exhaust fans to existing packaged rooftop equipment to resolve gross building over-pressurization problem, upgrade central cooling plant and expand existing DDC controls system **Sutter Solano Medical Center**: Performed evaluation of HVAC systems and Primary Essential Power serving 40 year old hospital. Developed and wrote Master Plan including scopes of work and budget featuring replacement of central chiller and boiler plants, 700-kW Emergency Power System, operating room suite electrical and Air Handling Systems. **Multiple Cogeneration Systems, Greater SF Bay Area**: Performed all facets of project development, design/engineering and implementation including all Mechanical, Electrical and DDC Controls design for over 30 cogeneration projects.

Name	SYSERCO INC.
Year Business Started	1973
Locations	Fremont, California, and Rohnert Park, California
Number of Employees	83
Type of Business	Complete turnkey provider of Building Management Systems in the Greater San Francisco Bay Area, Monterey Bay Area and North Coast Region.
Affiliations	Alerton Representative since 1988 Signatory to IBEW – all locals in business area NECA (National Electrical Contractors Association)
Capabilities	Dedicated Service Division with 24/7 coverage UL Panel Fabrication Facility Certified to provide UUKL/UL864 Smoke Control Systems Premier BACnet Experts (installed first ever BACnet system in the world in 1997, and have since installed more than 350 BACnet systems locally.)
Specific experience related to Higher Education Markets	Provided complete Building Management Systems for Sonoma State University, San Francisco State University, CSU East Bay, City College of San Francisco, Santa Rosa Junior College, Chabot College, Las Positas College, Solano Community College, Pacific Union College
At least two client references with name and number	**Chabot / Las Positas CCD**, Jim Soles (510) 723-6769 **Santa Rosa Junior College**, Paul Bielen (707) 521-1606 **Solano Community College**, Lucky Lofton (707) 864-7000
Short description of selected projects worked on in last five years	**560 Mission Street, San Francisco**: 31 story high-rise office building that houses JP Morgan West Coast data and operations center. Critical 100% uptime mechanical system is controlled by our system. All electrical systems in building are interfaced and monitored by our system as well. **Sonoma State University, Salazar Building**: Controlling the building with Indirect Evaporative Cooling Units in conjunction with a photovoltaic system and solar load monitoring. Real-time control is accomplished using solar load data and electrical generation output to control the conditioned space with a goal of zero PG&E electrical consumption for the mechanical systems. **Davies Symphony Hall, San Francisco**: Retrofit of a Honeywell pneumatic system in a high visibility occupied building. Alerton UL864 smoke control system installed. **COPIA, The American Center of Wine, Food and the Arts, Napa**: Provided extremely stable temperature and humidity control to meet the Smithsonian museum's environmental requirements in order for historical artifacts from them to be on display at COPIA. **Santa Rosa Junior College, Library & Media Center**: Controlling and monitoring thermal storage system and implementing sophisticated pre-conditioning sequences to reduce peak electrical demand and consumption.

Name and Title	SUSAN PRIDMORE, Business Development Manager
Years at CES / Overall years of experience in industry	4 (total) / 17
Education-Degrees, schools and years obtained	Ohio University, BS, 1976 Project Management Certificate at University of Phoenix, 2006
Role I will play for CSU East Bay project	Developing Chevron's offerings while making sure East Bay's needs are met. During construction phase of project act as liaison between Chevron and campus to ensure quality of work is being met
Current overall duties with CES	Business Development throughout CA in the education and State of California sectors
Specific experience related to Higher Education Markets	Business development for institutions for over 17 years. Experience in energy conservation projects for several Community College Districts, K–12 school districts, and counties in northern California. Involved in developing design/build energy projects that affect an institution's bottom line economically, developing financial structures for the projects.
At least two client references with name and number	**Stockton Unified School District**, Mitch Slate, Mgr. Mechanical Division (209) 933-7050 **County of Calaveras**, Tom Mitchell, CAO (209) 754-6633
Short description of projects worked on in last five years	**Stockton Unified School District**: Energy Audit and project development for $12M project involving complete controls retrofit including web access; new rooftop units; and some lighting. **County of Calaveras**: $2.0M project converting small central plant to fully distributed with new equipment at each served building; small lighting project; and controls. **County of Sacramento**: $1.5M project for HVAC retrofit, lighting, and controls. Hot water solar was proposed but not implemented.

Name and Title	PATRICK YOST, Project Engineer
Years at CES / Overall years of experience in industry	1 / 1
Education-Degrees, schools and years obtained	California Polytechnic State University, San Luis Obispo, CA, Bachelor of Science in Mechanical Engineering, 2005 LEED v2 Accredited Professional
Role I will play for CSU East Bay project	Assist in development of energy conservation measures for mechanical systems and implementation of these measures to ensure CSU East Bay's needs are met.
Current overall duties with CES	Duties include design of mechanical systems and construction management duties at the San Mateo Community College District. Construction management duties include verification of energy conservation measures' implementation and management of contractors to ensure the client's needs are met.
Specific experience related to Higher Education Markets	Assistant construction manager for a large energy conservation retrofit project at the San Mateo Community College District. Involved in energy conservation projects from initial design to final construction.
At least two client references with name and number	**San Mateo Community College District,** Jose Nunez and Linda DaSilva, Directors of Facilities, 650-358-6836 and 6726
Short description of projects worked on in last five years	**San Mateo Community College District**: Managed construction of a central chiller plant, electrical infrastructure improvements and HVAC retrofits, including a retrofit at KCSM 's studios.

VIII. Service Provider's Project Experience

State the number of years your firm has provided services similar in size, scope and complexity. Provide a list of representative projects completed within the past five (5) years. Include a description of the firm including size, organizational structure and office locations.

Chevron Energy Solutions Company (Chevron ES) is a division of Chevron U.S.A. Inc., a wholly owned subsidiary of Chevron. It was formed through Chevron's acquisition of several premier legacy energy services companies with roots dating back to the early 1970s, and is today one of the largest providers of comprehensive, high-quality conservation performance projects in the country. Headquartered in San Francisco, Chevron ES has a large footprint specifically in California with a large number of successful public agency projects installed, particularly in education facilities. Scopes of work implemented includes energy management/controls installations and mechanical/ central plant renovations similar to what is being proposed by SFSU. Additionally Chevron ES has significant experience with power systems, cogeneration/distributed generation, photovoltaic solar, and fuel cell design and installation.

Project Title	Location	Project Description
Chevron Energy Solutions		
San Mateo Community College District *	San Mateo, CA	• Lighting retrofit campus wide • Campus-wide EMS system • Campus-wide chilled water piping • New chillers
Foothill-De Anza Community College District *	Los Altos Hills, CA	• New 170-ton chiller • Campus wide lighting retrofit • Economizers • Pool filtration and solar covers • EMS expansion
California State University, Northern CA Lighting Retrofit	Northern, CA	• 4 campus project (Sonoma, SF State, SJSU and East Bay) • Lighting retrofit for special PG&E incentive project • Project totaled $2.7 million dollars
St. Mary's College	Moraga, CA	• Campus-wide lighting retrofit • Water conservation measures • Window film on all classrooms • Economizer retrofits
United States Postal Service *	Multiple Facilities in Northern California	• 378 kW photovoltaic project, San Francisco • Central plant upgrades at multiple facilities • EMS control systems • Economizers • Variable flow conversions (air and water) • 300 kW photovoltaic project, San Jose • 250 kW fuel cell, San Francisco • Lighting retrofits

* Detailed descriptions of these projects appear on the following pages.

San Mateo County Community College District
Northern California
Energy Efficiency Improvement Project

BACKGROUND

The San Mateo County Community College District, which includes the College of San Mateo, Skyline College and Cañada College, serves more than 40,000 students who can earn Associate in Arts or Science degrees or receive Certificates of Proficiency in their chosen fields. The District was seeking to lower its overall energy costs through an economically sound energy infrastructure and efficiency program that would integrate with its Facilities Master Plan and support its educational mission.

SOLUTION

The District contracted with Chevron Energy Solutions, a ChevronTexaco subsidiary, to develop, engineer and install comprehensive efficiency upgrades. The company conducted extensive site audits to identify and select appropriate energy conservation measures in conjunction with District staff. The four-phase project, which will be completed in 2005, includes numerous improvements to the three campuses as well as the District's administration building. Chevron Energy Solutions employed San Mateo County–based contractors for most of the construction work.

Improvements during the first two phases consisted of lighting retrofits, lighting controls and circuit upgrades in buildings at the three colleges, including the gymnasiums; chiller replacement at Cañada College; and an energy management system installation at Skyline College.

During the third phase of the project, Chevron ES made underground hot water piping and insulation repairs, refurbished and repaired boilers, and installed UtilityVision® real-time metering at Cañada College, Skyline College, College of San Mateo, and the District administration building. Other district-wide improvements included lighting retrofits, lighting controls and circuit upgrades in 34 buildings; pumping retrofits; electrical distribution system repairs; refurbishment of nearly 300 air handling systems; installation of new core-level direct digital control (DDC) systems in 41 buildings; and expansion of a chilled water plant and installation of underground chilled water piping mains.

Chevron ES also made air conditioning system upgrades at the College of San Mateo's KCSM broadcasting studio and at the KCSM transmitter at Sutro Tower in San Francisco. Two natural gas-fired reciprocating engine-based cogeneration systems, installed at Skyline College (375 kW) and College of San Mateo (560 kW), will provide 45% to 50% of electricity consumed at the campuses and will save the District approximately $500,000 per year.

Phase IV improvements, to be completed in 2005, consist of new zone-level direct digital control systems in 41 buildings at Cañada College, Skyline College, College of San Mateo and the District administration building.

BENEFITS

The District will realize total annual savings of $1,008,508, including first-year operational savings. The cogeneration systems account for 53% of this amount and the energy efficiency improvements account for the remainder. The energy efficiency measures will reduce electrical usage by 22% (2,860,000 kWh) and natural gas usage by 15% (135,000 therms). This translates to a greenhouse gas reduction of 3,200 tons — the equivalent of planting 912 acres of trees. The infrastructure improvements not only reduce operating costs through energy savings, but provide a cleaner, more comfortable campus environment and a fully integrated, state-of-the-art energy management control system.

Foothill-De Anza Community College District
Northern California
Solar, Cogeneration and Energy Efficiency Project

BACKGROUND

The Foothill-De Anza Community College District, located in the Silicon Valley area of northern California, is one of the largest community college districts in the nation, serving about 44,000 students each quarter. As part of its effort to lower overall energy consumption and costs, the District sought facility improvements at its two campuses that would meet its power needs, increase energy efficiency, and benefit the environment.

SOLUTION

To generate on-site power and improve energy efficiency at Foothill College and De Anza College, the District contracted with Chevron Energy Solutions (Chevron ES) to install at each campus four 60-kW Capstone microturbines that produce electricity and a heat recovery system that heats each campus pool efficiently.

At De Anza College, Chevron ES installed a 201-kW (AC) solar electric shade system on the top level of a two-story parking structure. This system tracks the movement of the sun, which maximizes its electric generating capacity. A stationary 100–kW (AC) PowerLight solar electric shade system was also installed at Foothill College. Chevron ES designed, engineered and built all related structural, electrical and mechanical systems to support the new equipment, working with Atlas-Pellizzari Electric Inc. and Critchfield Mechanical Inc.

The total cost of the cogeneration and solar projects, $5.1 million, was offset by $2 million in state rebates secured through PG&E's Self Generation Incentive Program. The remainder is being paid from the energy savings resulting from the new equipment and Measure E funds.

Energy efficiency measures were installed for the District as part of an earlier project phase, including efficient lighting, air conditioning and energy management systems.

BENEFITS

The energy efficiency, solar and cogeneration improvements at Foothill and De Anza Colleges will lower the District's electricity purchases by 46% — more than 11 million kilowatt-hours a year — and will save the District as much as $800,000 annually. This reduced demand for purchased power translates to avoided local carbon dioxide emissions of more than 14 million pounds per year — the equivalent of planting 2,000 acres of trees. In addition, the on-site solar electric generation systems at both campuses provide pollution-free electric power. The combined 780 kilowatts of electricity generated from the solar and cogeneration equipment is enough to power about 700 homes.

This project demonstrates the District's willingness to make a forward-looking investment in efficient and sustainable energy infrastructure that not only improves campus operations and reduces costs, but also benefits the environment through reduced greenhouse gas emissions. In particular, the heat recovery systems associated with the cogeneration units help maximize energy efficiency, while the innovative design of the tracking solar panels at the De Anza College parking facility enhances the efficiency of that system. All of the improvements were designed and installed in keeping with the colleges' distinctive architectural and environmental integrity.

Through the District's responsible use of taxpayer funds, state rebates, and energy savings to fund this project, the local community is benefiting from a project that brings long-term cost savings and contributes to a cleaner environment.

U.S. Postal Service Mail Processing Facilities
San Francisco, California
Clean Energy Project

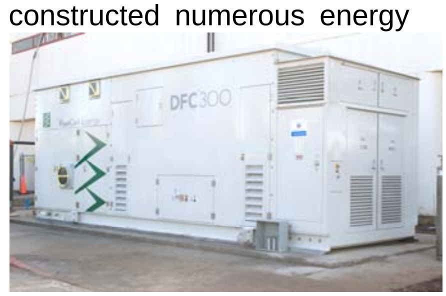
OVERVIEW

As part of the United States Postal Service's national program to optimize efficiency and conserve natural resources, Chevron Energy Solutions completed major energy efficiency upgrades and a unique hybrid alternative power plant – combining two solar photovoltaic (PV) technologies and hydrogen fuel cell generation – at the Postal Service's largest processing and distribution facilities in San Francisco.

Together the two mail facilities – the San Francisco Processing & Distribution Center (P&DC) and Embarcadero Postal Center (EPC) – comprise 1.2 million square feet, employ about 3,000 people and process 7.5 million pieces of mail daily. Both facilities operate 24 hours a day, 365 days a year.

IMPLEMENTATION

Chevron Energy Solutions developed, engineered and constructed numerous energy efficiency measures, including new energy management and compressed air systems, lighting retrofits and com-prehensive heating, ventilation and air conditioning system upgrades.



At the P&DC, a 680,000-square-foot facility, Chevron Energy Solutions also installed high-efficiency natural gas cooking equipment in the cafeteria, and a new hybrid solar/fuel cell power plant comprised of a 250-kilowatt high-temperature hydrogen fuel cell; a 185-kilowatt solar PV sun-tracking system mounted on a parking canopy; and a 100-kilowatt roof-mounted solar PV system composed of flexible, amorphous-silicon panels.

BENEFITS

The improvements at both facilities will lower total annual electricity purchases by $1.2 million or 10 million kilowatt-hours – a 46% reduction. In addition, the energy efficiency upgrades will reduce the P&DC's and EPC's heating needs by 69% and 28%, respectively.

The $15 million cost of the project was wholly funded by energy savings, contributions from the Postal Service's CFC refrigerant replacement program, and nearly $2.6 million in grants and incentives from the State of California and the U.S. Department of Defense Climate Change Fuel Cell Program.

The San Francisco project is part of a larger Postal Service contract with Chevron Energy Solutions to install energy efficiency improvements at mail facilities throughout

Northern California – improvements that will save the Postal Service more than $2 million per year in energy costs.

Chevron Cogeneration Projects

Fuel Cell	Location	KW
Chevron Texaco	San Ramon, CA	200
Chevron Texaco	Bellaire, TX	200
Alameda County Jail	Dublin, CA	1000
U.S. Postal Service	San Francisco, CA	250
Gas Turbine		
Chevron Texaco	Oak Point, LA	21000
Inergy Services	Tupman, CA	1200
Microturbine		
Pierce County	LA County, CA	360
Foothill College	Los Altos Hills, CA	240
De Anza College	Cupertino, CA	240
City of Richmond	Richmond, CA	60
Mesa College	San Diego, CA	60
Kings County	Kings County, CA	600
Millbrae Water Pollution Control	Millbrae, CA	250
College of the Canyons	Santa Clarita, CA	100
Pacific Choice	Fresno, CA	140
Laramie County School District	Wyoming	90
City of South Gate	South Gate, CA	60
Woodland Unified School District	Woodland, CA	240
Irvine Valley CC	Irvine, CA	240
Reciprocating Engine		
Chevron Texaco	Concord, CA	3000
Mount San Antonio CC	Walnut, CA	1400
College of San Mateo	San Mateo, CA	560
Skyline College	San Bruno, CA	375
Solano County	Solano County, CA	2850
Sunkist Growers Inc.	Tipton, CA	1500
Sunkist Growers Inc.	Tipton, CA	1200
Exar Semiconductor	Fremont, CA	940
Miramar College	San Diego, CA	550
General Chemical	Richmond, CA	1300
Fairfield Civic Center	Fairfield, CA	1300
Network Appliance	Sunnyvale, CA	1100
TRM Manufacturing	Corona, CA	1400
Oaks Christian School	Westlake Village, CA	870
Spa Casino	Palm Springs, CA	1400
North Island Credit Union	San Diego, CA	400
Casa Dorinda	California	200
VQS	California	200
Carson City Aquatic Center	Carson City, NV	140
	Total	47215

	KW	Incentives
Fuel Cell	1650	$1,450,000
Gas Turbine	22200	$1,200,000
Microturbine	2680	$2,590,000
Reciprocating Engine	20685	$20,545,000
Total	**47215**	**$25,785,000**

Section IX. Additional Energy Conservation Measures

ECM Number: 9.1

ECM Title: Replace Energy Management System

Buildings Involved: Entire Campus Envelope

This energy saving measure will replace the aging and partially obsolete Energy Management System on campus.

The existing Siebe/Robert Shaw Energy Management System (EMS) at CSUEB is aging and partially obsolete which places the University in a very tentative position. From observation of equipment and staff interviews, some replacement parts are no longer available and it is not possible to reload programming into controllers if lost. Most of the existing controls are functional, but are generally limited to scheduling buildings as a whole. The current focus on scheduling leans toward comfort (i.e. longer runtimes versus tight schedules).

The majority of buildings use multizone air handling systems (some with fresh air only for cooling), though some use double duct air handlers to supply mixing boxes at the zone level. The existing EMS uses DDC controllers and sensors to start and monitor the air handlers, but all control is accomplished by pneumatic output and actuators, and all zone level controls are pneumatic. There are several air handlers with VFD's installed on campus that serve constant volume systems and all appear to be running at nearly full speed. This is primarily true of the air handling units in the gymnasium and the theatre that have VFD’s installed on the main air handlers but the controls were not engineered and, as a result, they are currently operating in manual control.

It was observed and reported that many of the economizer dampers have mechanical issues that prevent proper operation. There are currently a few small projects planned by the facility to address some of these issues. A more all encompassing project is needed to effectively control the various building and environmental systems in order to maximize energy savings on campus. Chevron ES recommends the installation of a new campus wide EMS system to optimize operations and exploit energy savings potential at CSUEB.

Through the use of a state of the art energy management system all HVAC equipment (and other utilities if desired) can be monitored and controlled from a central location. Equipment run times and custom programming such as CHW and HHW reset can be easily and reliably implemented for optimized efficiency. Existing multi-zone systems will be re-controlled in a manner that reduces or eliminates blending of competing conditioned (hot and cold) air streams and minimizes wasting of energy inherent in the systems.

The existing EMS panels, wiring and wells can be reused, while the controllers and most of the control devices will be replaced. New EMS computers and software licensing are not included in this scope as we understand they are included in a CSUEB contract currently in progress. The new EMS will link each one of the EMS panels to each building's ethernet system which will communicate with the WEB enabled and BAC net based front end control.

Additional benefits include:

- Superior system reliability
- Simplified system adjustment
- Maximized equipment efficiency
- Reduced maintenance burden
- Improved indoor air quality

MEASURE	EST. COST	EST. ANNUAL SAVINGS
EMS System Building Level	$1.5M - $1.8M	$120K-$180K
Central Plant Controls	$450K - $550K	

Section IX. Additional Energy Conservation Measures

ECM Number: 9.2

ECM Title: Cooling Plant Alternatives

Buildings Involved:
Administration, Music/Theater/Robinson, Student Health Services and Meiklejohn Hall

<u>This energy saving measure has several options and will replace the aging and inefficient chillers throughout the campus.</u>

Option A: Central Cooling Plant

If the campus decides on installing a central heating plant CES would recommend installing a chilled water distribution system in conjunction with the construction of the heating water system. As a part of this scope of work a minimum of two chillers will be installed with connection points for the addition of a future third chiller. The chilled water plant will be configured to be variable flow to reduce associated pumping costs and maintain maximum chiller operating efficiency. The anticipated plant would be approximately 2000 tons of cooling capacity and would be connected to each of the buildings that currently have existing chillers. The work would save the University approximately 800,000 kWh annually and have the following additional benefits:

- Reduced number of pieces of equipment to maintain
- Greater than 40 year life expectancy
- Consolidation of equipment near facilities maintenance office
- Maximized equipment efficiency
- Ability to add cooling to existing buildings not already cooled
- Added capacity to provide cooling for additional and/or future buildings

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Central CHW Plant & Piping	$9M -11M	$110K-$120K

Option B: Distributed Cooling Plant

If the campus decides not to install a central plant CES would recommend replacing the existing chilled water systems within the buildings that currently have chillers older than 20 years of age. This would include the systems in the Music/Robinson mechanical plant the Student Health Center and Meiklejohn Hall. The chilled water systems will be configured to be variable flow to reduce associated pumping costs and maintain maximum chiller operating efficiency. The work would save the University approximately 360,000 kWh annually and have the following additional benefits:

- Greater than 30 year life expectancy
- Reduced maintenance costs
- Improved reliability
- Maximized equipment efficiency

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Replace (E) Chillers	$3M-$4M	$60K-$70K

Option C: Distributed Cooling Plant with TES

An additional option to the distributed chiller replacement plan would be the addition of thermal energy storage to the replacement chiller system in the Music/Robinson mechanical plant and possibly also in the Meiklejohn Hall chiller plant. A thermal storage system shifts the generation of the cooling capacity to the evening hours when electrical energy is less expensive. Shifting the operation to off peak utility periods also helps reduce peak demand charges for the campus. The total cooling capacity would remain unchanged but the demand on the electrical systems would move to a period of time when there is less electrical draw on the existing electrical infrastructure of the campus. The work would have similar energy savings to the option B above and have the following additional benefits:

- Renews plant for longer life expectancy
- Improved reliability and reduced maintenance compared to existing equipment
- Lower condensing temperatures for increased efficiency

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Replace (E) Chillers w/ addition of thermal storage	$4M - $5M	$80K-$100K

Section IX. Additional Energy Conservation Measures

ECM Number: 9.3

ECM Title: Lighting Retrofit

Buildings Involved: Miekeljohn Hall, Student Services Hub, Science North and South, Robinson Hall, Theater, Music, Library, Administration

The initial review of the campus indicates the potential for significant lighting retrofits. Summary level findings are as follows. Total estimated fixture count available for retrofit in the 5,000 to 10,000 range.

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Lighting Retrofit	$350K to $400K	$30K to $40K

Miekeljohn Hall

This large classroom building consists of lecture halls on the lower level, and offices and smaller classrooms on the 3 upper levels. The lecture hall would require substantial renovation to provide lighting energy savings, as the current system is fully-dimmable, theater-style. Hallway fixtures and office troffers are considered for retrofit.

Student Services Hub

This bi-level building is of modular construction and has an unusual ceiling-tile size, which would make renovation necessary if fixtures were to be changed. The existing fixtures appeared OK in condition and still have magnetic ballasts, providing for significant energy savings potential.

Science Bldgs North & South

The large science building complex consists of large and small labs, work rooms and offices. Most of the buildings have fixtures with 4 ft T12 lamps and electronic ballasts. Using 3100 lumen T8 lamps, these fixtures can be cost effectively retrofitted. Also, the end of building stairwells provide a savings opportunity via use of photocells.

Robinson Hall

Spaces typically include small angular offices and a classroom wing building. Limited retrofit opportunity with the existing difficult to access 8ft X 4-40 fixtures with T12 electronic ballasts in place.

Theater

Lighting in the theater was incandescent and halogen fully dimmable. Changing to another technology for energy-savings would require advanced lighting design and major renovation. No retrofit opportunity.

Music Building

The circular building has the same retrofit opportunity as other buildings with 2-F40T12 configuration with electronic ballasts. Another viable option is eliminating 40% of the hallway fixtures. These fixtures were previously retrofitted with 3-F32T8 and are significantly overlit. Simple elimination of the 2nd and 4th fixtures from the typical rows of 5 will provide a 40% load reduction.

Library

Although burn-times at the library are probably the highest on campus, no significant retrofit opportunity exists without major renovation. Much of the stack area has a timer system installed to reduce usage. The 2nd floor areas are poorly lit because stack aisles only haphazardly coincide with fixture placement.

Administration Building

As the building is undergoing a major renovation/reduction in height in the near future, only the bottom 5 floors were evaluated. Some savings appear to be present, included disconnection/removal of the mercury-vapor recessed cans in the buildings main lobby as they are redundant due to the new metal-halide pendant fixtures.

Section IX. Additional Energy Conservation Measures

ECM Number: 9.4

ECM Title: Air Side Economizer Upgrades

Buildings Involved: Entire Campus Envelope

This energy saving measure will repair and re-control the aging economizers on the air handling equipment in each building on campus.

Economizers:

The air handling equipment in the various buildings at the University are a mixture of single zone, multi zone and double duct systems. The common element in these systems is that most have economizers intended to maximize the use of outside air to minimize the need for mechanical cooling to condition the air ventilating the building. In order to operate effectively an economizer must have several features that function under a specific set of conditions. These features are:

- dampers that seal effectively
- linkages and controllers (motors) that operate the dampers
- a control system that monitors the ambient conditions and sends control signals that set the damper and valve positions

Many of the existing economizers throughout the campus are not functioning efficiently. The control system has aged to the point that replacement parts are not available and keeping it operational has become problematic. The damper seals are old and are not sealing the dampers effectively and their linkages are in need of repair or replacement. This measure will repair or replace the damper seals or if necessary the entire damper, repair/replace linkages to enable the dampers to move freely and replace the damper motors with reliable motors that will work in concert with an Energy Management System.

Economizer repair has a very good return on investment with paybacks typically less than 2 years. The specific cost to implement and the energy savings will be identified on an individual basis in the IGA phase. This energy conservation measure has the following additional benefits:

- Maximized equipment efficiency
- Reduced maintenance burden
- Improved indoor air quality

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Air Side Economizer Upgrade	$250K-$350K	$100K-$200K

Section IX. Additional Energy Conservation Measures

ECM Number: 9.5

ECM Title: Air Distribution Conversions and Motor Replacement

Buildings Involved: Entire Campus Envelope

This energy saving measure will replace or convert the air handling equipment in each building on campus to variable volume and/or replace the motors with new premium efficiency motors.

VAV Conversion and Motor Replacement:

The air handling equipment in the various buildings at the University are a mixture of single zone, multi zone and double duct systems. The Library/Warren Hall systems are primarily high pressure double duct. Double duct air systems are inherently energy inefficient because they blend heated and cooled air at the terminal units to satisfy the particular zone temperature. Since the majority of this building is scheduled to be demolished in a few short years, it is not cost effective to retrofit the air systems at this time. The remaining systems in the reconfigured building should be addressed as part of the demolition and reconstruction project.

The predominant type of air handling equipment throughout the campus is multizone. Like double duct, multizone air handlers blend heated and cooled air to get the desired zone temperature. This energy conservation measure will either replace or retrofit the existing multizone air handlers to make the systems variable volume. This measure will be accomplished by replacing the entire air handler where appropriate and installing VAV boxes in the existing distribution ductwork. In order to keep this conversion affordable, the VAV boxes will be located within the existing multizone duct runs at a location that is conducive and economical to pipe the heating coil and connect the controls.

Replacement of the air handler includes replacing the older and less energy efficient motors. The units that are either left in place and/or retrofitted and have an older standard efficiency motor one horsepower or larger will also have the motor replaced with a premium efficiency motor as a part of this measure.

The work will save the University approximately 180,000 to 250,000 kWh annually, reduce the heating load on the boilers and have the following additional benefits:

- Maximized equipment efficiency
- Reduced maintenance burden

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Convert Multizone Systems to VAV	$500K-$1M	$50K-$100K
Replace Motors	$200K-$250K	$30K-$35K

Section IX. Additional Energy Conservation Measures

ECM Number: 9.6

ECM Title: Coil Cleaning and/or Replacement

Buildings Involved: Entire Campus Envelope

<u>This energy saving measure will clean or replace the heating and cooling coils in the air handling units throughout the campus.</u>

Coil Cleaning and/or Replacement:

In order to heat and cool effectively the air handling units rely on efficient heat transfer from the coil inside the air handler to the air stream. Over time, even with good filtration, the coils build up fine debris that blocks the air flow through the coil and reduces the effectiveness of the coil to transfer heating or cooling to the air stream. The result is three fold:

1. the fan has to work harder to move air through the coil and in the process uses more electrical energy,
2. less energy is transferred to the air stream,
3. the control valve compensates by opening more and allowing more water flow through the coil to achieve the desired heating or cooling of the air stream but the temperature differential of the water stream is reduced. Since boiler and chiller efficiencies are directly related to the input temperature and its relationship to the desired leaving temperature this reduction in the water side delta-T negatively impacts the efficiency of the boiler and/or the chiller.

This measure will clean the cooling coils and heating coils and where appropriate and accessible the heating coils will be replaced with a deeper coil that will reduce the water flow requirements and increase the temperature differential on the water side in order to improve the boiler efficiency.

This work requires detailed calculations, individual inspection and assessment of each air handler to determine if cleaning is adequate or replacement is necessary. This evaluation will be completed on an individual unit basis in the IGA phase. The university can expect that this work if implemented will provide a return on investment of approximately 5 years and have the following additional benefits:

- Improved Chiller and Boiler equipment efficiency
- Reduced load on electric motors
- Additional air movement and quality

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Clean and/or Replace Coils	$50K-$150K	$25K-$50K

Section IX. Additional Energy Conservation Measures

ECM Number: 9.7

ECM Title: Installation of Fume Hood and Exhaust Fan Controls

Buildings Involved: North and South Science

This energy saving measure will install controls on each fume hood and the exhaust fans that serve them, in the North and South Science buildings.

The existing fume hoods in the North and South Science buildings operate at constant volume 24 hours a day, 7 days a week, which may be in use less than 50% of this time. To reduce the amount of energy used by the fume hoods, controls may be installed that operate the fume hoods in two modes, occupied and unoccupied. In occupied mode, the controls maintain the face velocity of the fume hood at 100 fpm, as required by laboratory safety standards. When the fume hood is not in use, unoccupied mode, the controls reduce the face velocity at the fume hood to the allowable value of 60 fpm. By reducing the face velocity of the fume hood, the controls allow for energy savings by reducing the required conditioned make-up air by 40% and by allowing the exhaust fan to operate at a lower speed.

Additional Benefits:

- Increased equipment life
- Reduced heating and cooling load

The cost and energy savings of this ECM will be investigated more completely in the IGA phase.

Section IX. Additional Energy Conservation Measures

ECM Number: 9.8

ECM Title: Variable Water Flow Conversion

Buildings Involved: Entire Campus Envelope

This energy saving measure will convert chilled water and hot water serving the air handling equipment in each building on campus to variable flow.

Variable Flow Chilled and Hot Water:

In order to maximize the operating efficiency of both the chillers and the boilers on campus the HHW and CHW distribution systems should be converted to variable flow. This conversion is accomplished by adding VFDs and controls and replacing 3-way control valves with 2-way control valves or by closing off the by-pass port where appropriate and by installing speed controllers on the pumps. The speed of the pump is varied dependant on a differential pressure transducer that is located at a suitable point near the end of the chilled or hot water loop. The systems can be either dual loop or single loop depending on the equipment involved and its ability to accept a variation in flow. Single loop variable flow has the added benefit of the reduction in pumping horsepower required because of the elimination of one of the pumps. Dual loop variable flow chilled water plants are a little more forgiving in terms of minimum flows through equipment. The determination of the system type implemented will be determined in the IGA phase.

This feature will be implemented in either a retrofitted heating hot water system and/or chilled water system and is not recommended for the systems currently in place on campus. Therefore the costs to implement and the energy savings associated with this feature have not been calculated separately. This feature adds the following additional benefits to the replacement chiller and/or boiler systems:

- Improved efficiency of chillers and boilers
- Reduced pumping energy
- Improved flow at equipment furthest from the pump

The cost and energy savings of this ECM will be investigated more completely in the IGA phase.

Section IX. Additional Energy Conservation Measures

ECM Number: 9.9

ECM Title: Transmission Level Substation

Buildings Involved: n/a

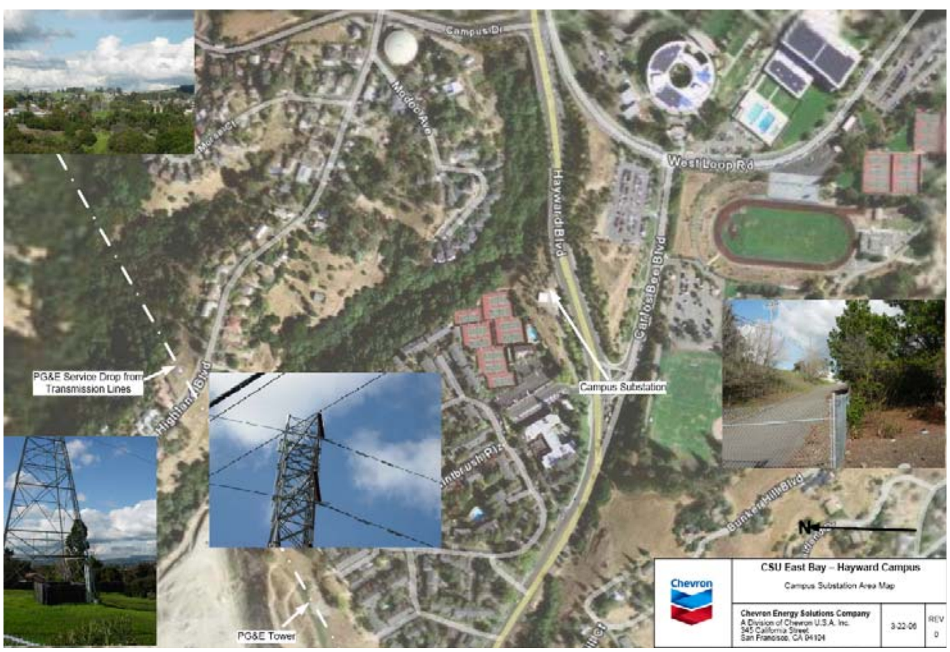
This measure involves upgrading the campus main utility switchgear to a transmission level substation.

Benefits include:

- Improved power reliability
- Potential for significant costs savings

MEASURE	EST. COST	EST. ANNUAL SAVINGS
New Substation	$4M to $6M	$100K to $400K

The basis of this opportunity is the nearby PG&E high voltage transmission lines which run along the North edge of the campus. Assuming terms with PG&E can be negotiated, a new campus owned high voltage substation can be built which will allow the campus to take service at E-20T rates instead of E-20P rates. The savings also depend on the decision of CSUEB to return to PG&E E-20T bundled rates in lieu of the current Direct Access provider as the return to bundled E-20T appears to have significant immediate economic benefit. Ownership and operation of the substation does require additional considerations such as ongoing maintenance and operational overview. Nonetheless, other campuses within the CSU system have done similar projects, notably Cal Poly San Luis Obispo.



Section IX. Additional Energy Conservation Measures

ECM Number: 9.10

ECM Title: Solar Heating System and VFD for Swimming Pools

Buildings Involved: Swimming Pool Complex

This energy saving measure has two options:

A. Install solar heating collectors to heat the swimming pools.
B. Install a VFD and controls to operate the pool filter pump more efficiently.

Option A.
The solar collectors will be installed on the roof of the pool mechanical building, the roof of the PE building or the surrounding pool area grounds. Typically these systems are sized to provide approximately 60-80 percent of the pool heating needs though the system could be sized and designed to contribute to the PE building hot water load as well, if determined economical. This project saves approximately 10,000 – 15,000 therms of natural gas annually.

Additional benefits include:

- Simple, reliable and robust technology
- Greater than 20 year life expectancy
- Clean and Renewable energy source
- Very low maintenance
- All but eliminates utility rate risk

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Solar Pool Heating	$220K to $270K	$10K - $15K

Option B.
This measure will install a VFD on the pool filter motor so it can be slowed during unoccupied periods resulting in increased equipment life and significant energy savings. Installing a VFD on the pump will allow the pump to operate at reduced capacity much of the time and may save up to 50% of the kWh currently used to keep the pool clean.

Other Benefits:

- Increased equipment life
- Improved analytical and control capability

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Filter pump VFD	$20K to $30K	$10K - $15K

Section IX. Additional Energy Conservation Measures

ECM Number: 9.11

ECM Title: Water Resource Conservation

Buildings Involved: Entire Campus Envelope

This ECM will implement two water efficiency upgrades designed to minimize water and sewer costs:

A. Plumbing retrofits, which include replacing urinals with waterless urinals and installing low flow sink aerators.
B. Irrigation retrofits, which include completing the University's current irrigation project of centralized irrigation control

Option A:
This measure will replace many of the older 1.5 gallon per flush urinals with Falcon waterless urinals and all 3.5 gallon per flush toilets with 1.6 gallon toilets. Also, all sinks with flow rates of 2.2 GPM or higher will have a 1.0 gallon aerator installed.

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Plumbing Retrofits	\$60K- \$70K	\$14K - \$18K

NOTE: Existing foot flush type toilets, which are predominant on campus, are not recommended for retrofit due to complexity of replacement and poor cost-effectiveness.

Option B:
This measure will complete and round out the Rain Master central irrigation system, with the following features:

- Replace the remaining stand alone controllers with central control capability controllers and integrate them into the central irrigation system
- Install an on-site weather station as part of the central control system so that all campus irrigation is based on local weather data and plant water needs
- Audit all irrigated areas to map station locations and chart soil types, plant conditions, sprinkler types and efficiency, sun/shade conditions and degrees of slope. These charts will be provided to site staff for maintenance use and integrated into central control programming
- Additional training and on-going service provided by local factory distributor

Additional benefits include:

- Reduced water run-off water resulting in less damage to streets, sidewalks and building foundations
- Properly watered plants are healthier and more drought resistant.
- Reduced liability issues from standing water and mud on walkways.
- Reduced labor, vehicle, fertilizer and related costs to manually schedule clocks as this function can be performed from one central point for the entire campus

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Irrigation Upgrades & Mapping	$140K - $170K	$25K - $30K

Section IX. Additional Energy Conservation Measures

ECM Number: 9.12

ECM Title: Add Vending Machine Controls

Buildings Involved: Entire Campus Envelope

This ECM will install VendingMisers on vending machines in order to reduce the run time of the machines.

Cold drink vending machines typically operate 8,760 hours per year, and these machines consume considerable amounts of electricity on a daily basis. A VendingMiser is a device that utilizes controls to reduce the power consumption of the machine by sensing when the surrounding area is unoccupied. The VendingMiser monitors the room temperature and automatically re-powers the vending machine at one to three hour intervals, independent of occupancy, to ensure that the vended product stays cold. This measure typically saves 50% of the electricity vending machines use.

The retrofit includes the following major components.

VendingMiser Power Control Unit
Passive Infrared Occupancy Sensor
Installation with Wire-Molding

MEASURE	EST. COST	EST. ANNUAL SAVINGS
Add Vending Machine Controls	$350/EA	$200/EA