Campus Planning & Facilities Management

# STRATEGIC ENERGY MANAGEMENT PLAN

*FY20-21 Edition*

Prepared by:

University of Oregon

Energy Management Program

1/16/2020

## PREFACE

The intent of this Strategic Energy Management Plan (SEMP) is to outline energy management practices, activities and programs at the University of Oregon (UO), and to establish energy management goals for the UO Energy Management Program. This document is intended to be updated annually over the course of plan implementation to incorporate new information from time-to-time.

The SEMP is sponsored and endorsed by the UO Campus Planning & Facilities Management (CPFM) Energy Team.

- The team reports to the Associate Vice President and University Architect, CPFM

Team members currently include:

- Director, Finance and Administration Shared Services
- Director, Facilities Services
- Associate Director, Facilities Services
- Director of Sustainability
- Assistant Director of Engineering and Utilities, Design & Construction
- Director, Utilities and Energy
- Energy Manager, Utilities and Energy

The Energy Team has been instrumental in developing the programs and procedures that form the foundation of the UO Energy Management Program described in this SEMP. Background documents are included in the Appendices for reference.

Economic performance estimates associated with the opportunities and actions presented in this SEMP are preliminary and are believed to be reasonably accurate for high level planning purposes. Actual results are likely to be somewhat different. All measure descriptions, savings and cost estimates in the SEMP are preliminary and for informational purposes, and are not to be construed as design documents, details or guarantees.

## CONTACTS AND PREPARATION

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# 1 Executive Summary

The University of Oregon (UO) has been actively engaged in energy management for more than a decade and is currently re-focusing energy management efforts, with an aim to counteract upward pressures on utility cost and risk. Recent efforts have been significant and successful, however there is recognition that greater potential exists for use reduction, and that consolidation of practices into a cohesive enterprise-wide program could achieve greater effectiveness.

This document represents an evolutionary update and consolidation of previous energy management plans. Periodic course-correction updates to this document are planned, as a business plan is reviewed to monitor business performance and updated to keep it on track.

## 1.1 Background

UO has a recent track record of success in energy use reduction, however the overall energy savings potential for the UO Main Eugene Campus remains largely unrealized. The plans and processes presented in this document are designed to close this gap.

This Strategic Energy Management Plan (SEMP) has been developed based on recent and ongoing energy management efforts at UO initiated by the UO Utilities and Energy Department since 2015. This planning document contains:

1. Overview of strategic energy management planning
2. Summary of historical utility cost and use trends
3. Projection of anticipated utility consumption and cost over the next several years.
4. Description of UO's current Energy Management Program
5. Summary of recent accomplishments.
6. Energy management goals for FY20and beyond

## 1.2 SEMP Overview

The SEMP is initially focused on implementation of relatively lower cost O&M and Recommissioning measures that have a high potential for energy savings as well as planning activities needed to set and reach long term goals. Capital measures with sufficient financial performance are also under consideration for implementation.

**Purpose:** The Strategic Energy Management Plan (SEMP) summarizes the goals, actions, timeline and resource needs for effective operation of the UO enterprise Energy Management Program

**SEMP Goals & Objectives:**

- Establish and conduct an enterprise Energy Management Program.
- Develop utility metering and data management practices needed for efficient operation.
- Consolidate energy monitoring, accounting and reporting into a manageable format.
- Promulgate utility consumption data, program goals and methodology.
- Benchmark existing energy use conditions.
- Research and develop energy/cost saving opportunities.
- Establish reasonable short and long term energy use reduction goals.
- Promote Utilities master planning in support of long term energy management goals.
- Enhance the financial structure for funding ongoing energy conservation practices.
- Implement energy saving projects.
- Track progress toward goals.
- Periodically review and refine plans.

# 2 Energy Management Program

## 2.1 Strategic Energy Management

### Strategic Energy Management Methodology

Over the past 5-years or so, Campus Services/Facilities/Utilities has initiated use of strategic energy management planning (SEMP) to achieving significant levels of energy savings. This approach is based on the understanding that:

- The consequence of inaction is unmanaged growth in energy cost and risk.
- Existing energy cost cash flow can be used to boot-strap a comprehensive program to significantly reduce energy costs and risk over a number of years.
- Energy savings can be redirected back into the energy management activities through a dedicated revolving account.
- Strategic energy management is a successful and well-established practice used by many large educational institutions throughout the country, and has proven to be one of the most successful means of improving management of opportunity risk and cost associated with utility use.

The SEMP approach has become successful because it provides a method for funding energy projects from existing energy budget levels and cash flows. Under this approach, energy efficiency efforts are generally categorized in three areas:

1. Operation and maintenance (O&M) or Tune-up Measures. These are low cost improvements that can generally be implemented within normal operation and maintenance resources.
2. Re-commissioning (RCx) Measures. These measures typically involve more cost and technical resources, yet still have a fairly short payback and typically generate significant levels of energy savings. In general, the RCx process involves a detailed diagnostics and testing phase, an implementation phase and a verification phase.
3. Energy Efficiency Measures (EEMs) or Capital . These are more extensive, longer term capital intensive energy improvement projects that have more complex requirements for analysis, finance, design, planning and implementation. These types of projects may become more feasible when coupled with other building capital improvement or renewal projects.

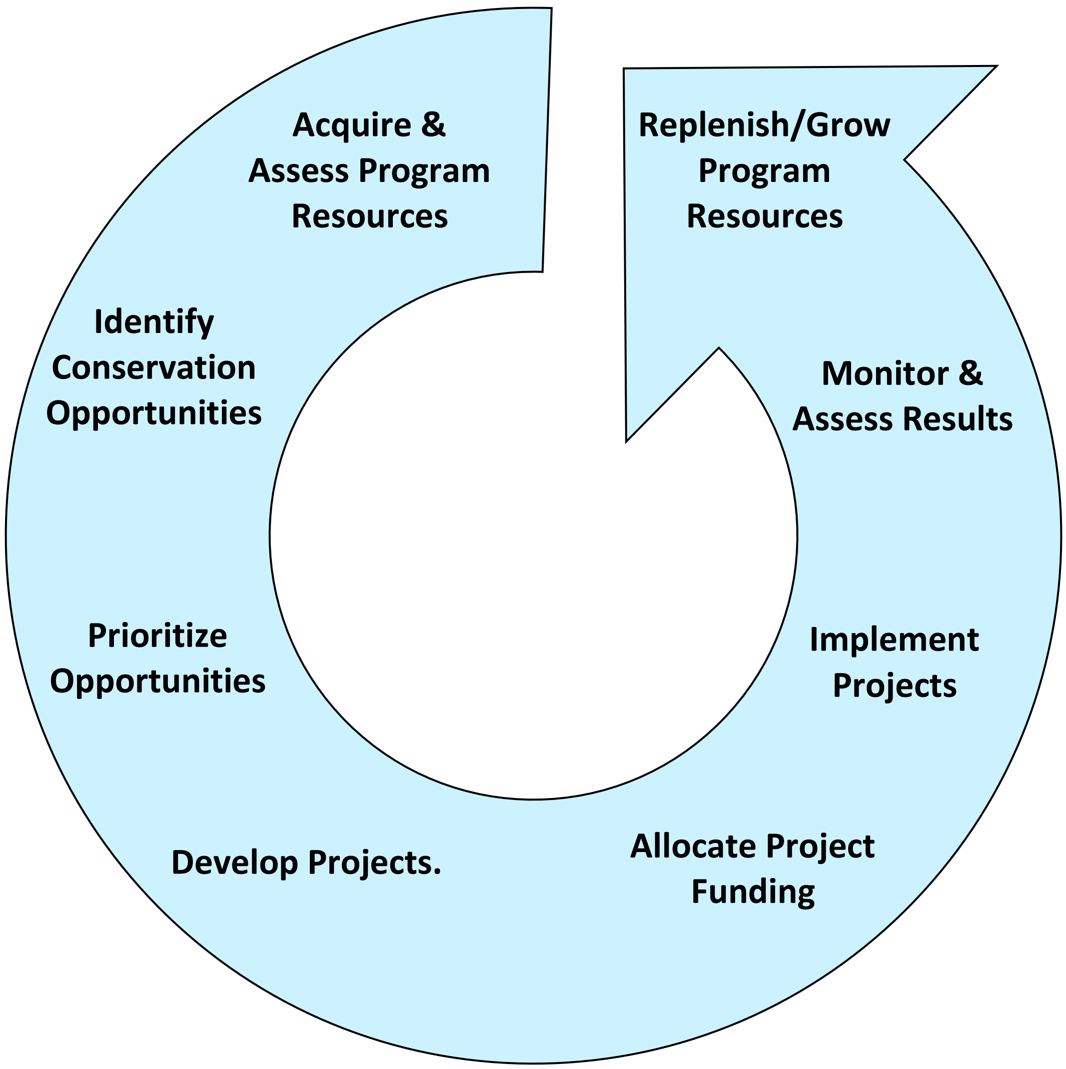
Avoided utility costs (savings) generated by early low cost measures are used to fund more expensive measures as energy savings accrue. As the plan progresses, measures typically become progressively less cost effective and additional investment is often needed to implement the more capital intensive measures.

### SEMP Cycle

The core functions of the iterative strategic energy management cycle are illustrated in Figure 1 below.

- Secure Program Resources.
- Identify / Prioritize Conservation & Cost Reduction Opportunities.
- Develop Projects in Strategic Sequence.
- Allocate Project Funding.
- Implement Projects.
- Monitor & Assess Results
- Replenish/Grow Program Resources.

***Figure 2***




Projects with the best financial return are implemented first to accumulate savings and build resources for funding successive implementation of more capital intensive projects.  This generally translates into a sequence of project implementation that begins with no-cost/ low-cost Tune-up and O&M measures, progresses into more resource intensive and complex re-commissioning measures and then takes on more expensive capital intensive measures after a base of savings has been developed.

## 2.2 Program Overview

The primary goal of the UO Energy Management Program (Program) is to manage cost, risk and opportunity associated with production, delivery and use of steam, chilled water, electricity, and other utilities, and to support University management with utility related data products. The program is managed by the Energy Manager under supervision of the Director of Utilities and Energy. Progressive expansion and coordination of strategic energy management across all UO campuses and facilities is planned.

The Utilities and Energy Department has enhanced the existing Energy Revolving Fund (ERF) created by the Vice President for Finance and Administration to help finance implementation of efficiency measures. This kind of financial instrument essential to the effectiveness of the strategic approach to energy management, further discussed in Section 3.6, which is an essential part of the Program.

## 2.3 Energy Management Program Elements

The Program consists of a variety of interrelated elements (see Figure 1, Business Process Schematic, on following page). Activities in all these areas contribute to effective management of energy and resource consumption, cost and risk. Organization of the Program into these specific, manageable elements aids in setting goals, developing actions, and tracking results. The Energy Management Team promotes coordination of these energy management activities with partners across the institution.

### 1. Administration:

A. **Program Administration:** General management, staffing, program documentation and resources. *Collaboration with Business School for assistance documentation of program business processes, etc*.

B. **Rates and Regulatory:** Monitor utility rates and ratemaking. Monitor and analyze impact of regulations and legislation. Includes review of legislation and issues that impact energy cost or use.

C. **Community Engagement:** Establish and maintain community engagement and communications. Promote efficient practices across units. Participate in related trade and professional associations. *Collaboration with Sustainability.*

D. **Energy Management Planning**: Ongoing strategic planning of activities needed to build and conduct an effective enterprise energy management program. *Collaboration with Campus Planning, Sustainability.*

E. **Utility Planning:** Analysis and planning in support of progressive improvement of campus utility plant and distribution efficiencies. *Collaboration with Campus Planning, Design and Construction.*

### 2. Finance & Accounting: *Ongoing collaboration with FASS.*

A. **Finances and Budgeting:** Monitor and manage Energy Revolving Fund (ERF) funding and utility incentives in coordination with capital maintenance and infrastructure projects to capture funding synergies. Management and support for utility incentive application and payment. Assist in development of annual budget for Utilities and Energy.

B. **Accounting**: Track utility resource consumption and utility bills. Support internal chargeback processes bill audits and payment of utility bills.

C. **Procurement Analysis and Support**: Tracking and analysis of wholesale energy markets, utility bills and utility rates. Analysis and support of energy procurement optimization.

### 3. Metering and Data: *Ongoing collaboration with FASS-IT and U&E Electrical Shop.*

A. **Utility Metering**: The energy management program invests a significant amount of analytical, planning and management resources in the construction, configuration, operation, maintenance and troubleshooting of the campus utility metering systems. Proper functioning of these metering systems is essential to successful energy monitoring and verification activities.

B. **Energy Management Information System**: The energy management program invests a significant amount of analytical, planning and management resources in development and maintenance of the Energy Management Information System (EMIS).

C. **Utility Data Warehouse**: Creation and maintenance of an accurate and robust archive of contemporary and historical utility use and billing data necessary for consistent operation and effective energy management.

D. **Energy Performance Monitoring, Evaluation and Benchmarking**: Facility energy use data is maintained for performance evaluation and as a basis for prioritization of reduction efforts. Energy use and cost data is provided to FASS for utility cost distribution and recovery. Ongoing monitoring and analysis of energy use and system performance based on trend data. Investigation and exploration of billing and use anomalies. *Collaboration with School of Design*

## 4. Take Action: *Ongoing collaboration with Facilities Service, Utilities & Energy, Design & Construction*

A. **Analysis** & **Opportunity Assessment:** Analysis of resource consumption issues, building system performance, energy efficiency opportunities, Scoping Energy Assessment is used to identify and validate opportunities for further investigation and analysis. Detailed energy analysis is strategically targeted at specific projects chosen for implementation. Includes research and assessment of relevant applicable technologies. *Collaboration with ESBL.*

B. **Opportunity Inventory:** Development of energy efficiency concepts into actionable project plans. Energy efficiency projects will be subject to suitable mechanical and electrical engineering efforts to ensure they meet appropriate engineering standards.

C. **Ongoing Program implementation & Support:** Where feasible, ongoing programs are developed that engage in recurring activities that contribute to Program goals.

D. **Energy Project Support**: Projects are selected for sponsorship and implementation when financial performance and funding requirements are met. Involvement and/or collaboration in sponsored projects where appropriate.

E. **Project Performance Verification:** Provide project performance verification reports for project stakeholders.

F. **Efficiency Standards**: Develop and promote Campus/organizational efficiency standards for energy and water consuming equipment and systems, as a means for incorporating best practice into O&M and capital projects.

***Figure 1***

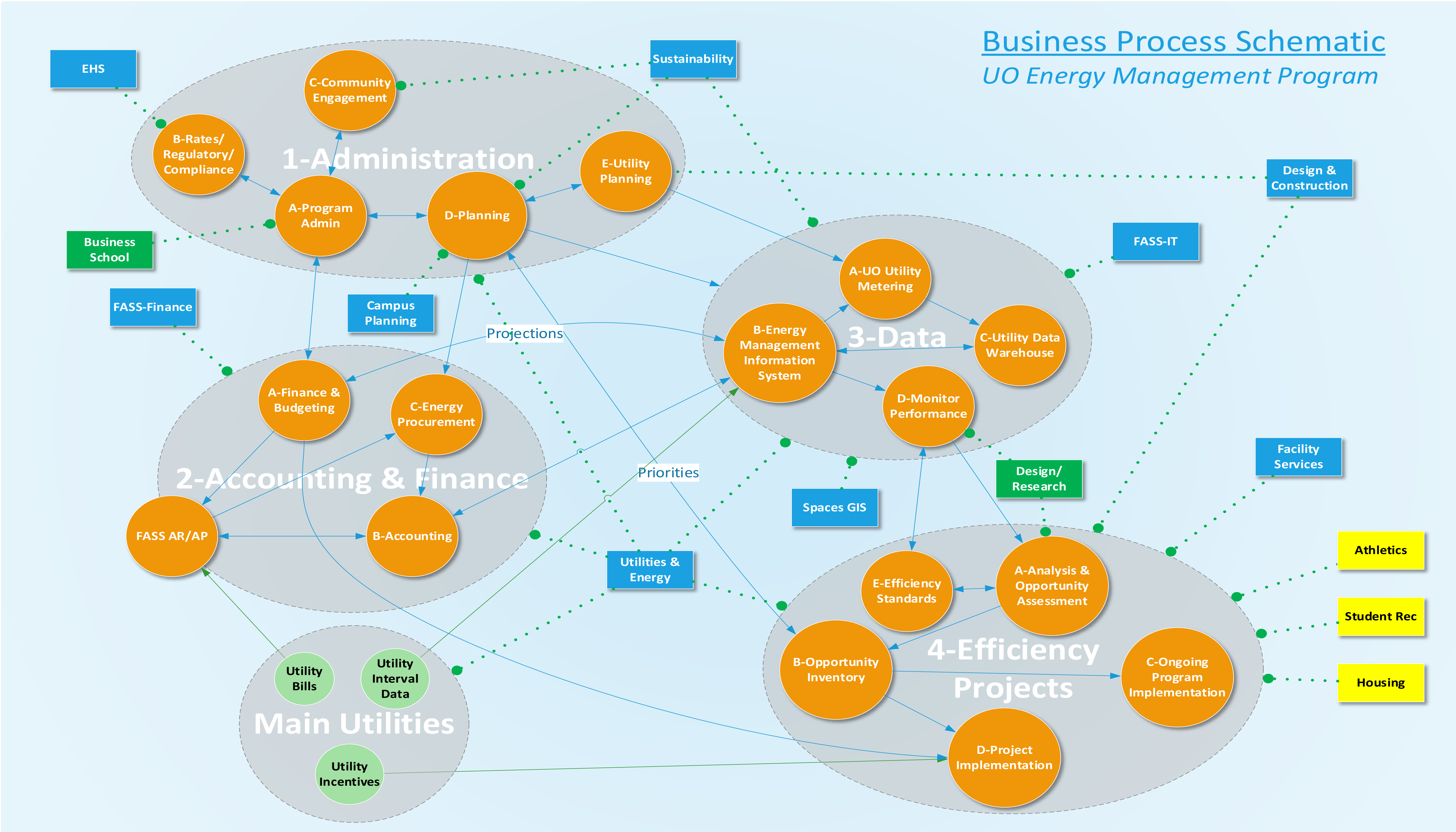
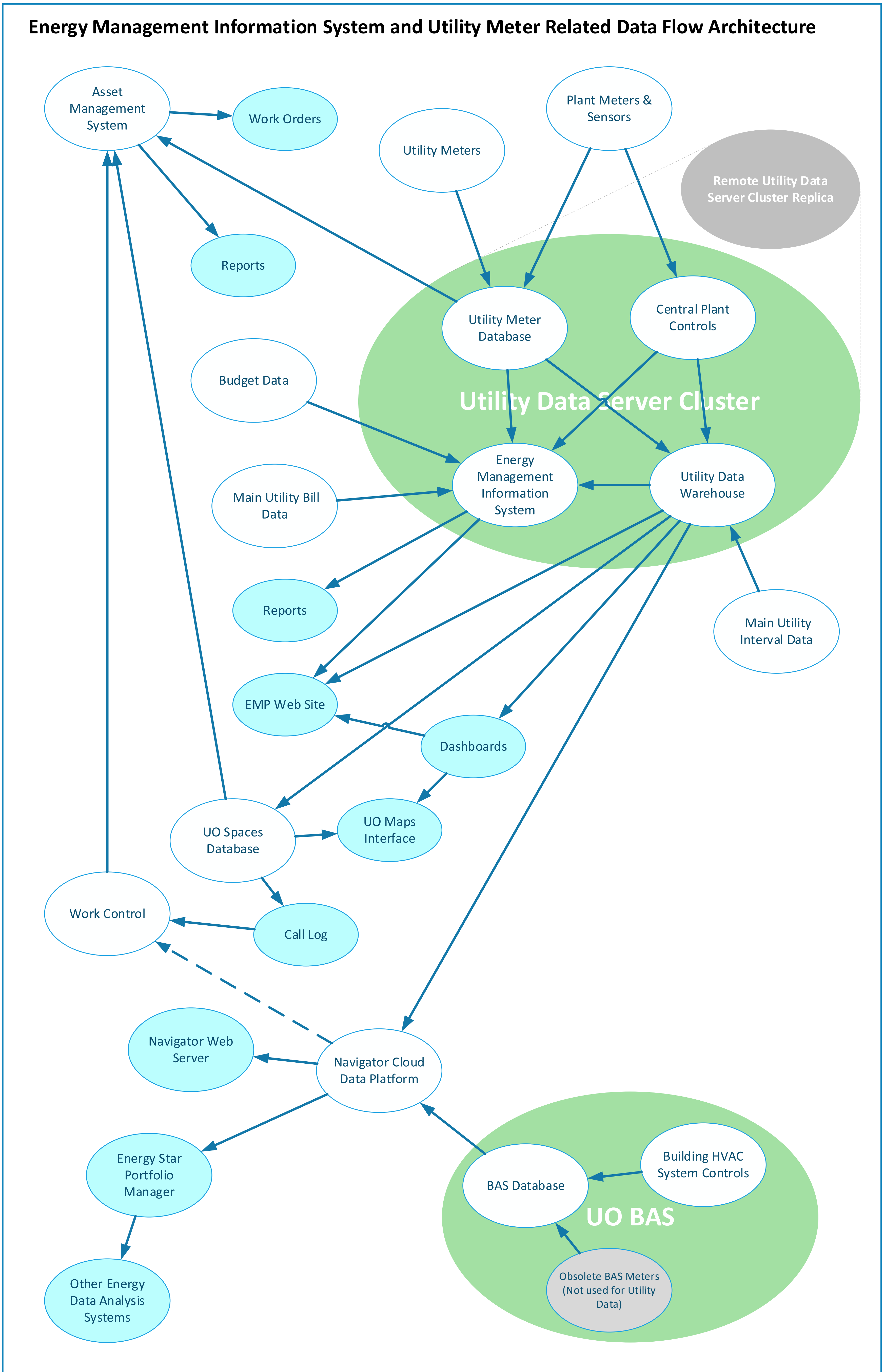

Business Process Schematic
UO Energy Management Program
EHS
Sustainability
C-Community Engagement
B-Rates/ Regulatory/ Compliance
1-Administration
E-Utility Planning
A-Program Admin
D-Planning
Business School
Design & Construction
FASS-IT
FASS-Finance
Campus Planning
Projections
A-UO Utility Metering
B-Energy Management Information System
3-Data
C-Utility Data Warehouse
D-Monitor Performance
A-Finance & Budgeting
C-Energy Procurement
2-Accounting & Finance
Priorities
Facility Services
Design/ Research
Spaces GIS
FASS AR/AP
B-Accounting
Utilities & Energy
Athletics
E-Efficiency Standards
A-Analysis & Opportunity Assessment
Student Rec
B-Opportunity Inventory
4-Efficiency Projects
C-Ongoing Program Implementation
Housing
Utility Bills
Utility Interval Data
Main Utilities
Utility Incentives
D-Project Implementation

***Figure 2***


Energy Management Information System and Utility Meter Related Data Flow Architecture
Asset Management System
Work Orders
Plant Meters & Sensors
Utility Meters
Remote Utility Data Server Cluster Replica
Reports
Utility Meter Database
Central Plant Controls
Budget Data
Utility Data Server Cluster
Energy Management Information System
Utility Data Warehouse
Main Utility Bill Data
Reports
Main Utility Interval Data
EMP Web Site
Dashboards
UO Spaces Database
UO Maps Interface
Work Control
Call Log
Navigator Web Server
Navigator Cloud Data Platform
Energy Star Portfolio Manager
BAS Database
Building HVAC System Controls
UO BAS
Obsolete BAS Meters (Not used for Utility Data)
Other Energy Data Analysis Systems

## 2.4 Program Resources

Current Program dedicated resources include:

- Staffing :
  - U&E: Energy Manager – 1.0 FTE
  - U&E: Energy Program Technician – 1.0 FTE
  - U&E: Intern (temporary) – 0.2 FTE
  - FASS-IT: Operating System Network Analyst – 0.8 FTE
  - FASS-IT: Utilities Business Analyst – 0.8 FTE
- Financial: Energy Revolving Fund (ERF): Funding for energy project implementation and other program needs (see program elements on the following page). ERF documentation included in Appendices.

Other resources include cooperation of Finance & Administration Shared Services, Design and Construction, Sustainability, Facilities Services, U&E Electrical Services, Operations and mechanical shops. At times these contributors play a significant role in conducting Program activities.

As the Energy Management Program evolves, additional resources may be needed to further develop and support program actions to increase energy management effectiveness. More specific program goals, activities, funding and budget will be developed in future SEMP Updates.

## 2.5 Program Goals

The primary goal of the Energy Management Program is management of cost, risk and opportunity associated with utility use on the Main Eugene Campus. Secondary and supporting goals include:

- Progressively improve quality, quantity and availability of comprehensive energy meter data.
- Support practices that maximize equipment energy performance and extend equipment life that are consistent with efficiency and sustainability goals.
- Improved operation and level of service from utility and related systems.
- Emissions & waste reduction.
- Promote an operations Culture of Efficiency.
- Promote implementation of improvements using internal labor and resources where feasible, when project requirements match available skillsets and adequate internal labor resources are available.
- Contribute to UO standards needed to ensure utility, construction and renovation projects incorporate appropriate energy efficiency features. For projects that impact energy consumption or systems, mechanical and electrical system design, specifications and equipment shall be provided for review and comment by the Energy Office.

Specific Program goals for FY20-21 are listed in Section 7.

# 3 Summary of Utility Expenditures

UO currently has utility expenditures of about $12M annually for the Core Eugene Campus. Primary utilities include electricity (EWEB), natural gas (Northwest Natural/IGI) and water/sewer (EWEB/City of Eugene). Secondary utilities include steam and chilled water generated at the Central Power Station (CPS) and distributed via campus piping systems. See Table 1 for a summary of annual utility costs.

***Table 1***

| **UO Campus Annual Utility Cost Summary - FY19** | | | | | | |
|---|---|---|---|---|---|---|
| | | **Annual Utility Cost, thousands** | | | | |
| **Site** | **Building Gross Area, sf** | **Electric** | **Natural Gas** | **Water/ Sewer/ Stormwater** | **Total** | **Status of Resource Management** |
| UO Core Eugene Campus. | 6,506 | $ 5,444 | $ 2,304 | $ 4,028 | **$ 11,776** | Focus of UO SEMP |
| Other/Leased Buildings | 1,770 | | | | | No active plan |
| **UO Total** | **8,276** | **$ 5,444** | **$ 2,304** | **$ 4,028** | **$ 11,776** | |
| | | | | | **$1.81** | **ECI, $/sf-yr** |

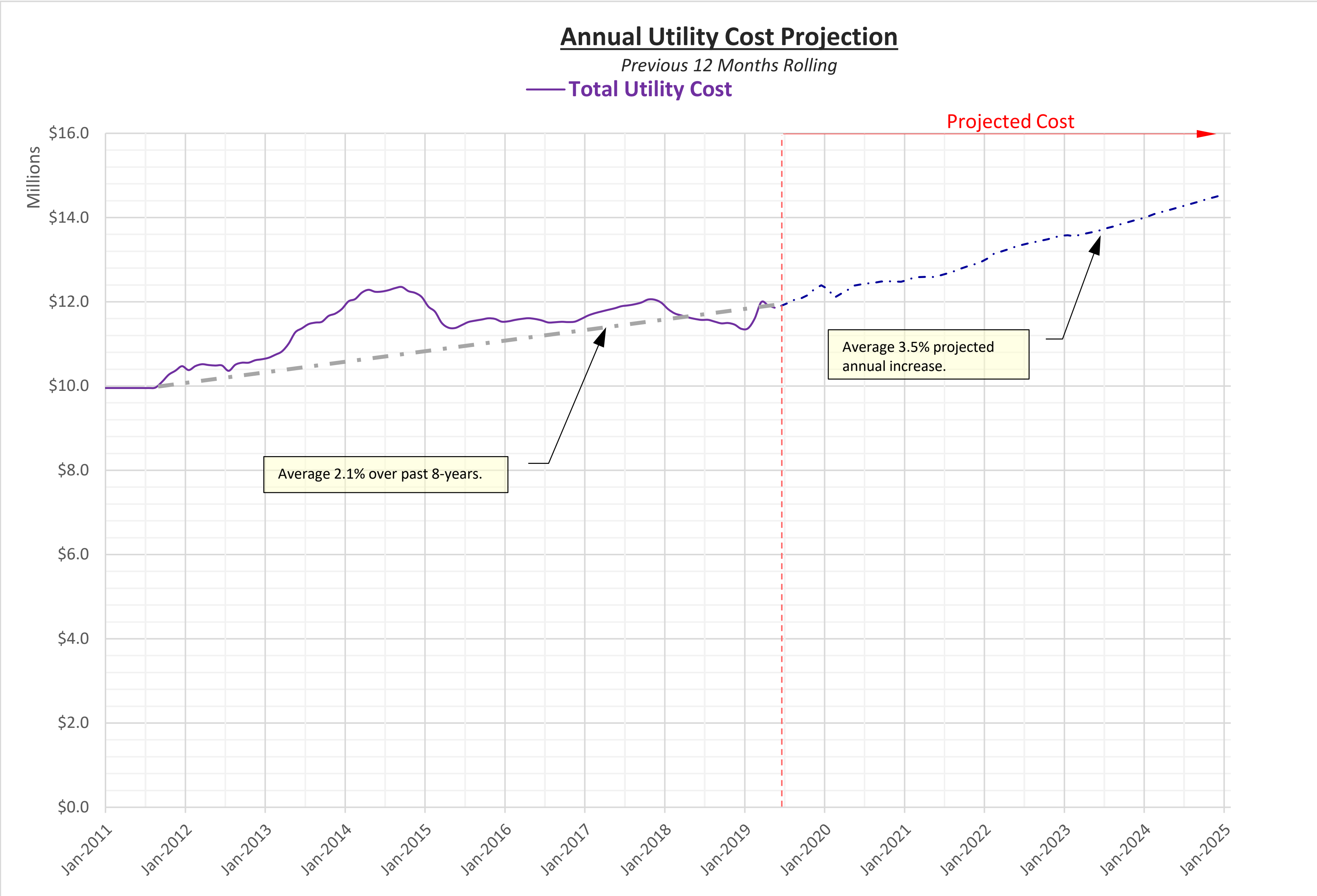
This SEMP focuses on planning for the UO Main Eugene Campus (green shading in table), which accounts for $11.8M of UO total annual utility cost paid for main electric, gas and water/sewer service. Future updates to the plan will progressively include additional energy management planning information for satellite campuses and facilities beyond the UO Core Eugene Campus perimeter.

Graphs on the following pages show historical Core Eugene Campus annual utility cost trends with projections through 2024.

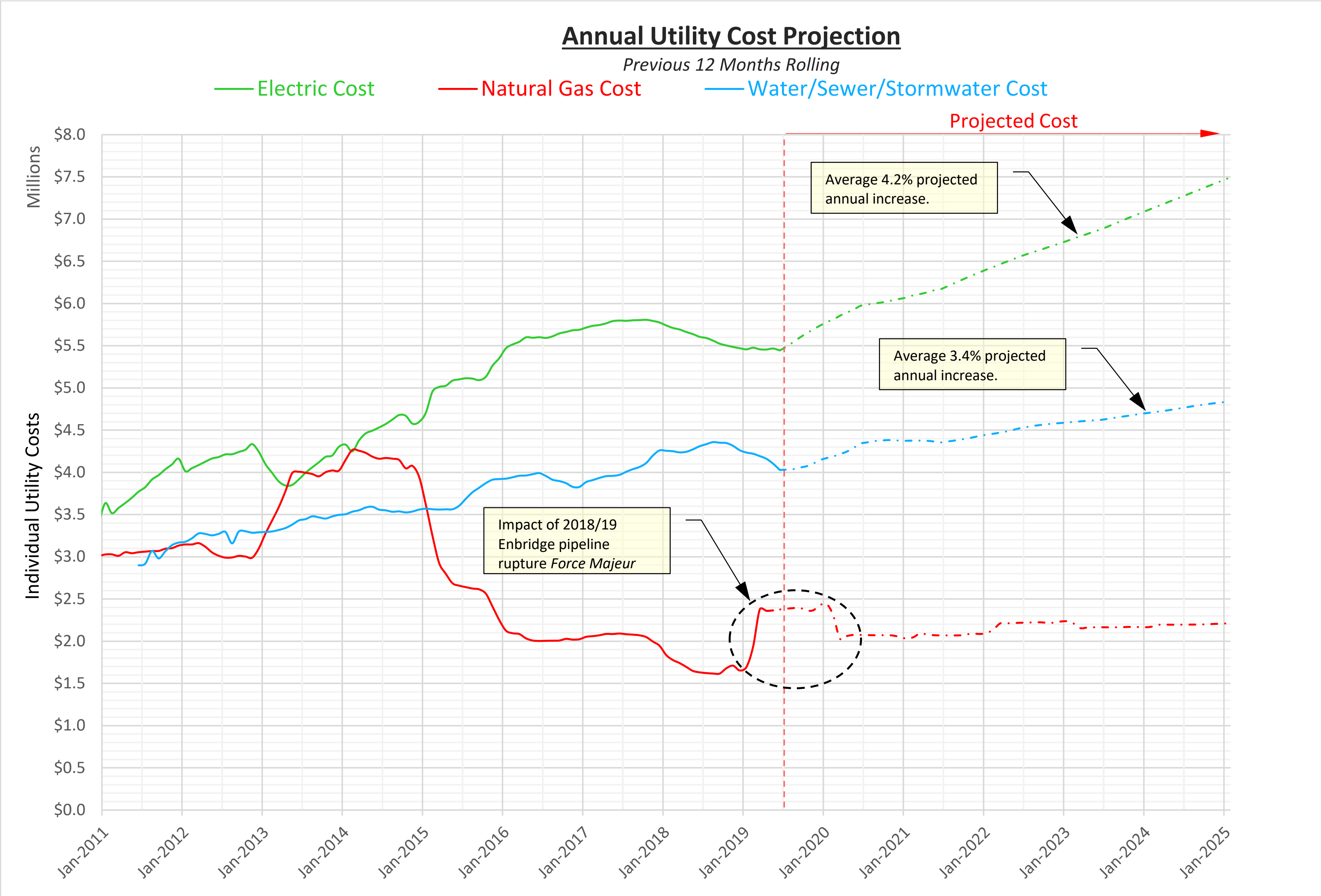
Graph 1 shows Core Eugene Campus total annual utility cost.

Graph 2 shows disaggregated Core Eugene Campus annual utility cost for electricity, natural gas and water/sewer/stormwater individually. It is notable that electric and water/sewer/stormwater costs are expected to have the highest escalation rates. The program will be progressively increasing efforts to manage both electric and water/sewer related costs over the next few years.

***Graph 1***


Annual Utility Cost Projection
Previous 12 Months Rolling
Total Utility Cost
Projected Cost
Millions
$16.0
$14.0
$12.0
$10.0
$8.0
$6.0
$4.0
$2.0
$0.0
Average 2.1% over past 8-years.
Average 3.5% projected annual increase.
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
Jan-2025

***Graph 2***


Annual Utility Cost Projection
Previous 12 Months Rolling
Electric Cost
Natural Gas Cost
Water/Sewer/Stormwater Cost
Projected Cost
Millions
Individual Utility Costs
$8.0
$7.5
$7.0
$6.5
$6.0
$5.5
$5.0
$4.5
$4.0
$3.5
$3.0
$2.5
$2.0
$1.5
$1.0
$0.5
$0.0
Average 4.2% projected annual increase.
Average 3.4% projected annual increase.
Impact of 2018/19 Enbridge pipeline rupture Force Majeur
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
Jan-2025

# 4 Facility Energy Use Overview

UO operates Academic, research, housing and related facilities at several sites. For the purposes of energy management, facilities are grouped into two site categories:

- UO Core Eugene Campus consisting of about 60 significant buildings. Total building area is about 6.5 million square feet (sf). The Core Eugene Campus is the original site established and occupied for the purpose of providing education associated with the present organization. This campus contains a significant number of old and historical buildings which present a variety of unusual operational, maintenance and energy management challenges.
- Other distributed facilities, consisting of about 40 buildings of various sizes and uses.

A combination of utility meters and campus sub-meters are used as the basis for energy sub-metering, benchmarking, estimating savings and monitoring progress. Some gaps have historically existed in the campus utility sub-metering systems that have resulted in some uncertainty about distribution of energy use across campus facilities. Efforts are under way to substantially close these gaps and improve the quality of utility usage data available to the Energy Management Program and its customers.

***Table 2***

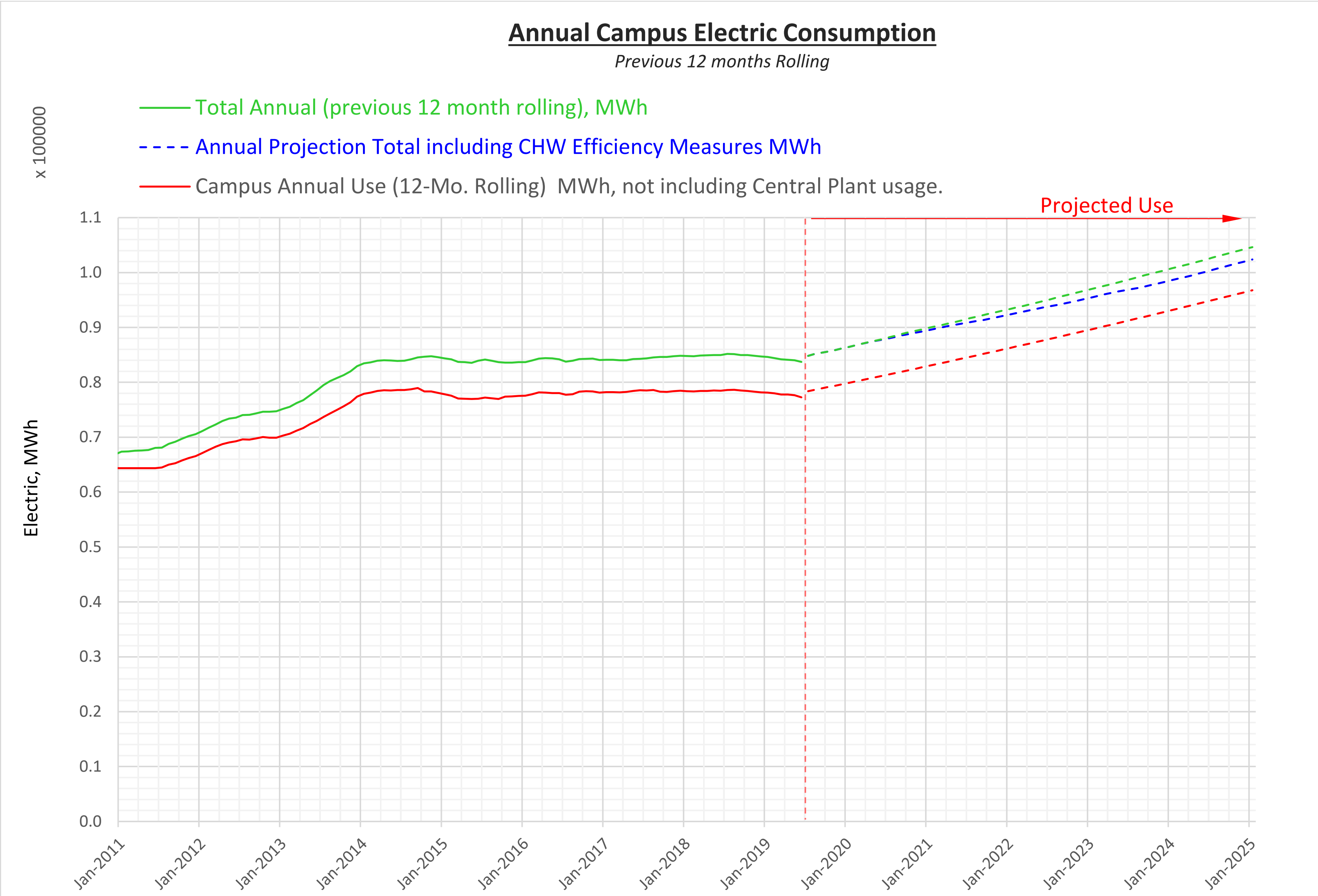
| **UO Campus Annual Energy Use Summary - FY19** | | | | | | |
|---|---|---|---|---|---|---|
| | | **Annual Energy Use Summary** | | | | |
| | **Building** | **Electric** | | **Natural Gas** | | |
| **Site** | **Gross Area, sf** | **MWh** | **MMBtu** | **Therms** | **MMBtu** | **Total MMBtu** |
| UO Core Eugene Campus. | 6,506 | 83,718 | 285,731 | 3,970,685 | 397,068 | 682,800 |
| | | | | **EUI, kBtu/sf-yr** | | **105** |

Aggregate Core Eugene Campus energy use intensity (EUI) is about 105 kBtu/sf-yr. which suggests a moderate potential for cost effective energy use reduction exists across the Campus.

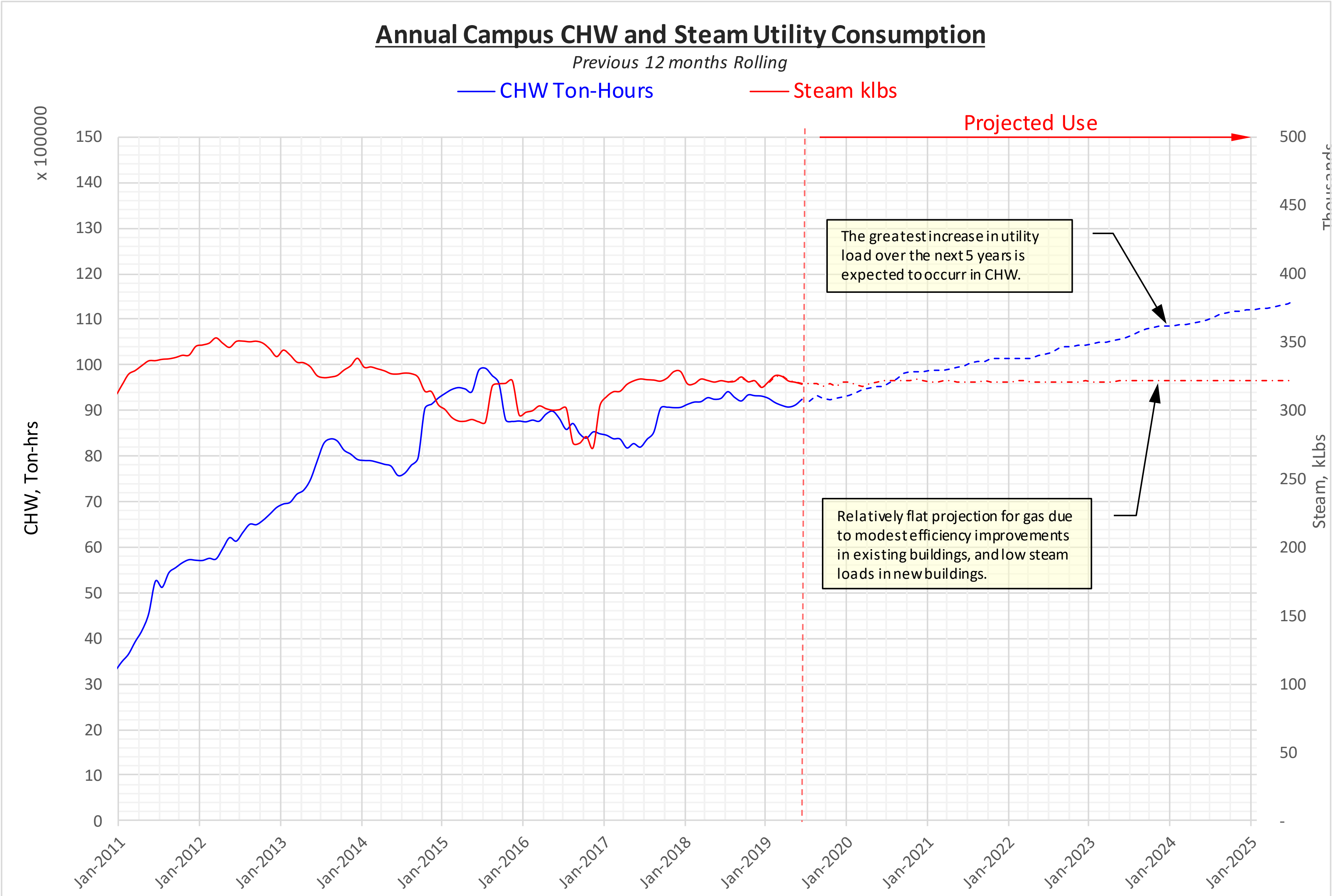
Graph 3 below shows historical Core Eugene Campus electric use trends with projections through 2024.

Graph 4 shows historical Core Eugene Campus steam and CHW energy use trends with projections through 2024. CHW use is projected to be the area of greatest utility use growth over the next 5 years and represents the most significant capacity issue facing UO Utilities & Energy

***Graph 3***


Annual Campus Electric Consumption
Previous 12 months Rolling
Total Annual (previous 12 month rolling), MWh
Annual Projection Total including CHW Efficiency Measures MWh
Campus Annual Use (12-Mo. Rolling) MWh, not including Central Plant usage.
Projected Use
x 100000
Electric, MWh
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
Jan-2025

***Graph 4***


Annual Campus CHW and Steam Utility Consumption
Previous 12 months Rolling
CHW Ton-Hours
Steam klbs
Projected Use
The greatest increase in utility load over the next 5 years is expected to occurr in CHW.
Relatively flat projection for gas due to modest efficiency improvements in existing buildings, and low steam loads in new buildings.
CHW, Ton-hrs
x 100000
Steam, kLbs
Thousands
Jan-2011
Jan-2012
Jan-2013
Jan-2014
Jan-2015
Jan-2016
Jan-2017
Jan-2018
Jan-2019
Jan-2020
Jan-2021
Jan-2022
Jan-2023
Jan-2024
Jan-2025

# 5 Utility Planning

## 5.1 Utility Overview

Most of the cost associated with UO utility use occurs within electric, chilled water and steam utilities that are distributed throughout the Campus from the Central Power Station. While electric, chilled water (CHW) and steam plant infrastructure has been upgraded within the last decade, continued campus growth with an emphasis on energy intensive science and research, has contributed to load growth that will soon exceed the capacity of the CHW plant and distribution system.

## 5.2 Utility Capacity and Load Projections

Increased utility loads associated with new facilities are progressively reducing reserve capacity needed for safe, reliable and efficient operation of the utility systems.

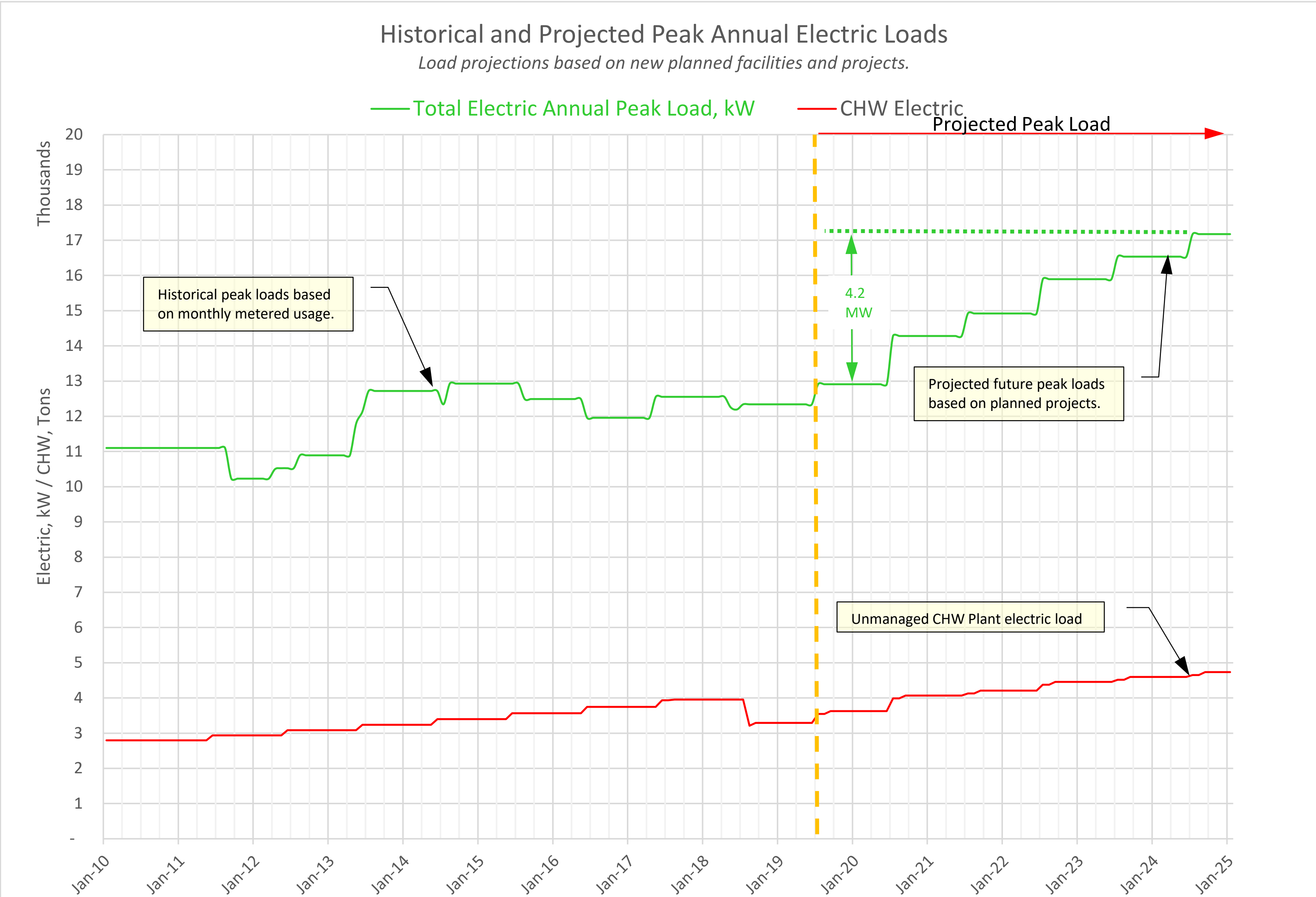
Utility load and cost projections are shown on the following pages.

Rates used to generate these projections are shown in the table below.

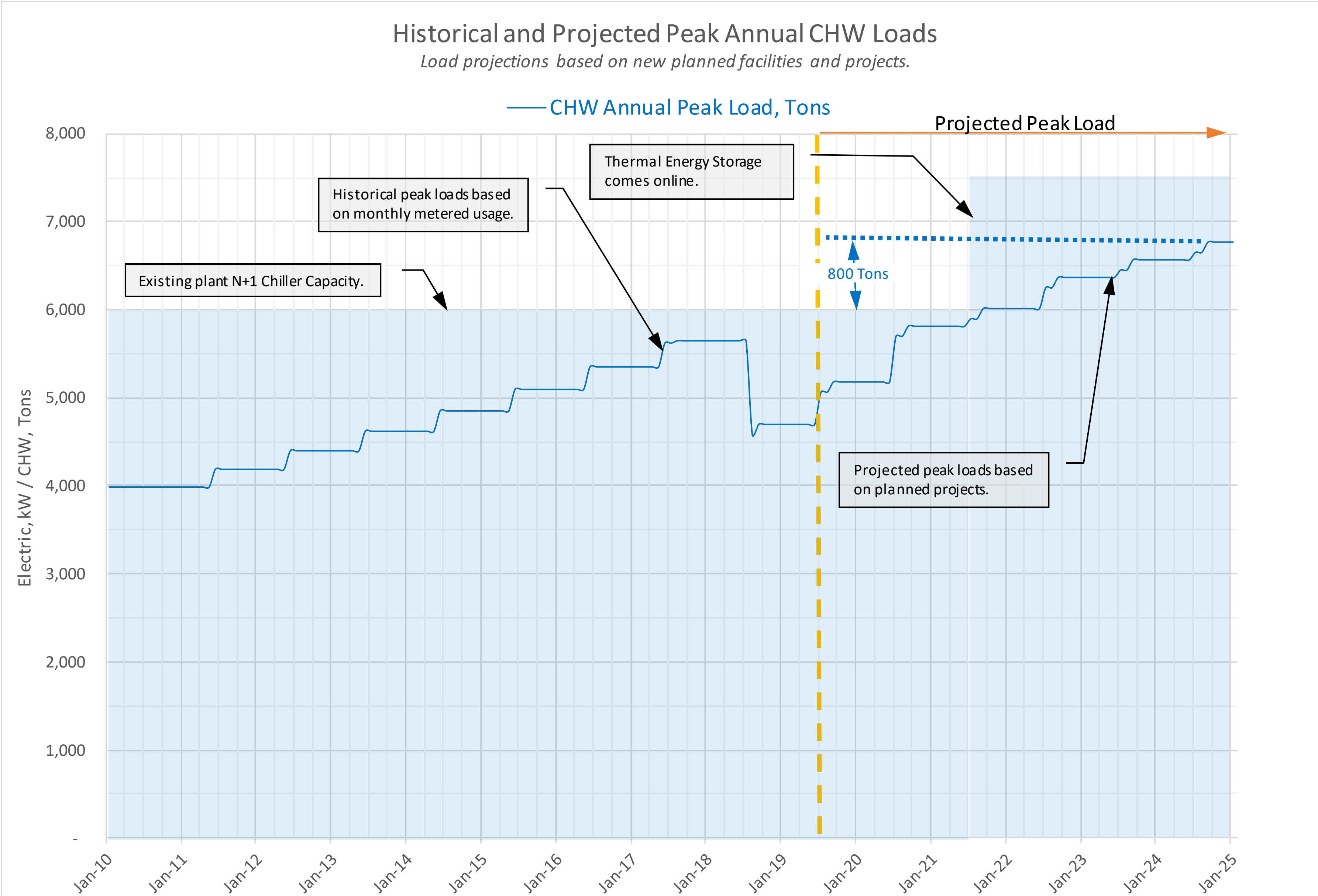
***Table 3***

| **Annual Utility Use Projection and Escalation Rates** | | | |
|---|---|---|---|
| *2019-2024* | | | |
| | **Utility** | **Rate** | **Notes** |
| **Peak Load Change** | Total Electric | 6.03% | Based on new peak load estimates for facilities added over the projection period. |
| | Campus Electric | 5.66% | |
| | Chilled Water | 6.90% | |
| | Steam | 2.12% | |
| | Water/Sewer | 3.00% | Analysts estimate |
| **Consumption Change** | Total Electric | 6.03% | Consumption is assumed to increase in proportion to new facility peak load |
| | Campus Electric | 5.66% | |
| | Chilled Water | 6.90% | |
| | Natural Gas | 2.12% | |
| | Water/Sewer | 3.00% | |
| **Efficiency Efforts** | Total Electric | -2.00% | Estimated consumption reduction rates due to energy projects and efficiency efforts. |
| | Campus Electric | -2.00% | |
| | Chilled Water | -2.00% | |
| | Natural Gas | -2.00% | |
| | Water/Sewer | -1.00% | |
| **Net Use** | Total Electric | 3.91% | Product of rates above |
| | Campus Electric | 3.54% | |
| | Chilled Water | 4.76% | |
| | Natural Gas | 0.08% | |
| | Water/Sewer | 1.97% | |
| **Utility Rate Escalation** | Electric | 4.00% | Anticipate increasing escalation over short term compared to recent past. |
| | Natural Gas | 2.00% | Based on gas market futures trends. |
| | Water/Sewer | 4.00% | Based on water/sewer utility industry trends. |
| **Net Cost** | Electric | 8.06% | End result rates |
| | Natural Gas | 2.08% | |
| | Water/Sewer | 4.08% | |

***Graph 5***

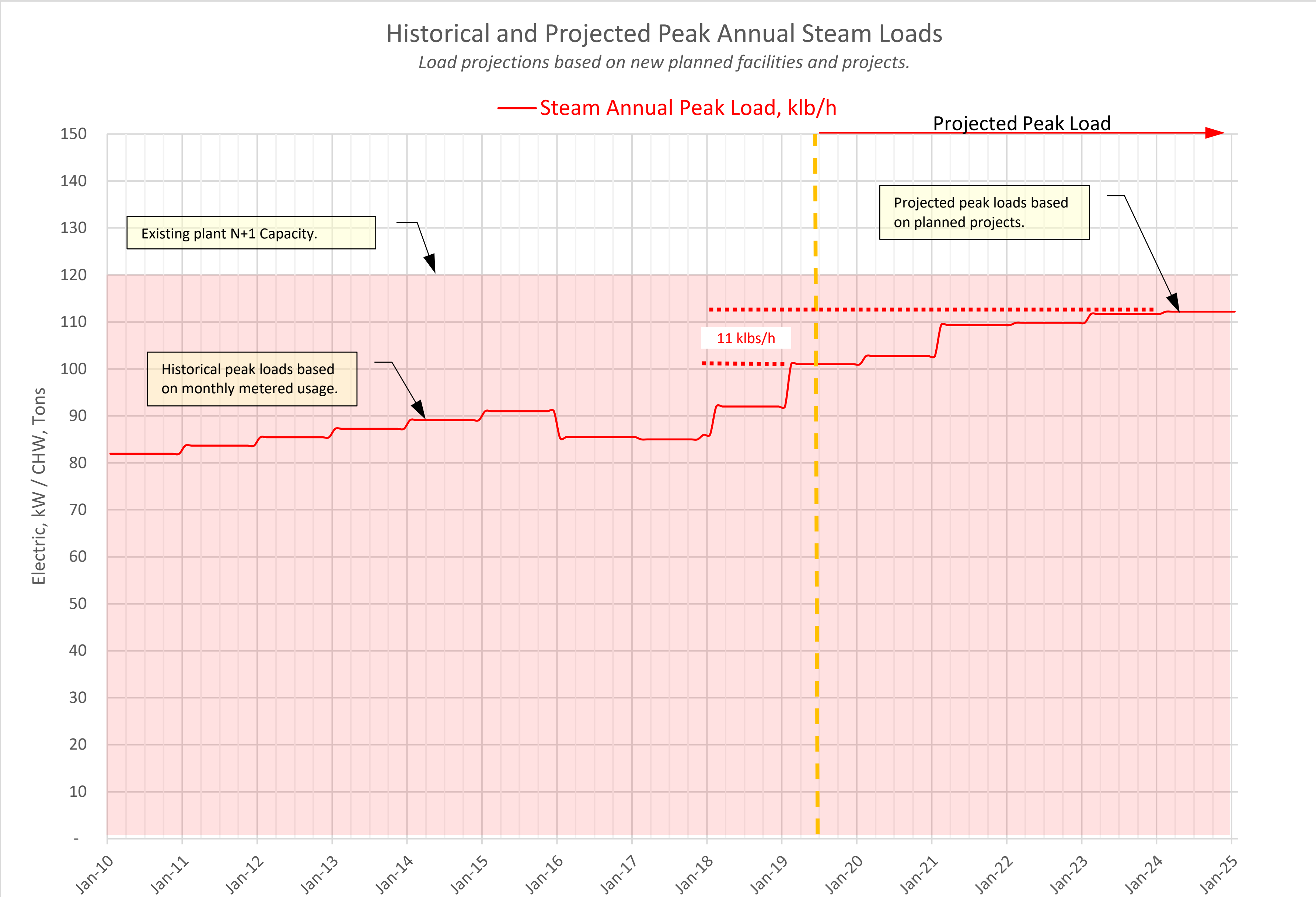

Historical and Projected Peak Annual Electric Loads
Load projections based on new planned facilities and projects.
Total Electric Annual Peak Load, kW
CHW Electric
Projected Peak Load
Thousands
Electric, kW / CHW, Tons
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
-
Historical peak loads based on monthly metered usage.
4.2 MW
Projected future peak loads based on planned projects.
Unmanaged CHW Plant electric load
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25

***Graph 6***



Historical and Projected Peak Annual CHW Loads
Load projections based on new planned facilities and projects.
CHW Annual Peak Load, Tons
Projected Peak Load
Thermal Energy Storage comes online.
Historical peak loads based on monthly metered usage.
Existing plant N+1 Chiller Capacity.
800 Tons
Projected peak loads based on planned projects.
Electric, kW / CHW, Tons
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
-
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25

***Graph 7***


Historical and Projected Peak Annual Steam Loads
Load projections based on new planned facilities and projects.
Steam Annual Peak Load, klb/h
Projected Peak Load
Existing plant N+1 Capacity.
Projected peak loads based on planned projects.
Historical peak loads based on monthly metered usage.
11 klbs/h
Electric, kW / CHW, Tons
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
-
Jan-10
Jan-11
Jan-12
Jan-13
Jan-14
Jan-15
Jan-16
Jan-17
Jan-18
Jan-19
Jan-20
Jan-21
Jan-22
Jan-23
Jan-24
Jan-25

## 5.3 Managing Utility Load Growth

The Chilled Water system is currently the most constrained Campus utility. As new campus facilities come into service over the next couple of-years, the additional Chilled Water (CHW) system loads are projected to push total peak loads above currently available capacity (see Graph7 above).

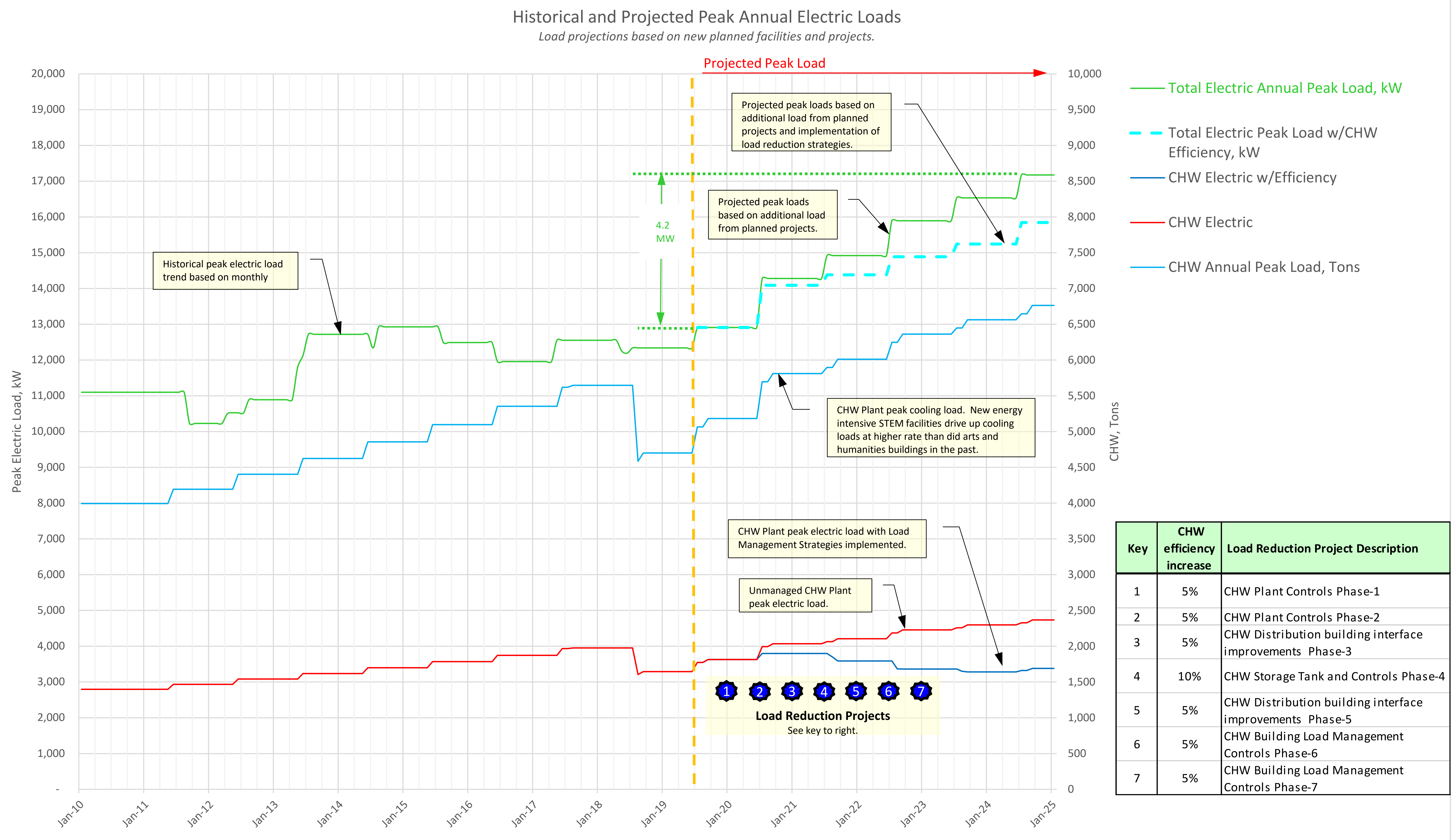
There are several strategies for dealing with the additional loads and capacity needed to meet them.

1. **Unmanaged curtailment.** This is the do nothing approach which results in loss of service at the most constrained parts of the system during peak load events. Disruption of critical business functions could occur.
2. **Managed curtailment**. This required installation and configuration of instrumentation and controls as well as interdepartmental coordination. During peak load events, loads would be curtailed on a predetermined prioritized basis. Disruption of critical business functions would be managed. First-cost associated with this option are generally assumed to be moderate and it would take a time to implement the necessary changes.
3. **Reduce Distribution Losses**. Currently system capacity is lost in the distribution system due to various inefficiencies. These could be reduced through installation of instrumentation and controls (same as above) with additional attention to building CHW components and controls. Recovered capacity at critical locations could be significant. Implementation of this option would further reduce disruption of critical business functions compared to Managed Curtailment. Cost and time to implement would also be somewhat greater than Managed Curtailment.
4. **Optimize CHW Plant Controls.** Operation of the CHW Plant equipment has room for optimization which could marginally improve peak capacity. The more significant benefit would be reduction of operation and maintenance costs due to significantly improved efficiency.
5. **Add CHW Thermal Storage.** The addition of a large thermal storage tank could add a significant amount of peak load capacity by making CHW efficiently generated during cooler night hours available for use during afternoon peak cooling hours. Additional cooling tower and waterside heat exchanger capacity would also be needed. It is estimated this option, coupled with options 3 and 4 would obviate the need for curtailment through FY25 and beyond. This option would also result in a significant reduction of operation and maintenance costs due to reduced equipment loads and increased operational efficiencies. Both time and capital required for implementation of this option are significant. This option has been approved and project planning and engineering is in early stages as of Nov. 1, 2019.
6. **Add CHW Plant Capacity.** Installation of an additional chiller with cooling towers at the central CHW Plant is the most capital intensive option for increasing peak cooling capacity and would also require coupling with options 3 and 4 to provide sufficient distribution capacity.

Implementation of Options 2, 3, 4 and 5 appear to be the most efficient and cost effective means of maintaining CHW service for business critical operations at the University over the near term future.

The Energy Management Program will continue to provide analysis and support for identifying, understanding and efficiently resolving utility load related issues.

***Graph 8***

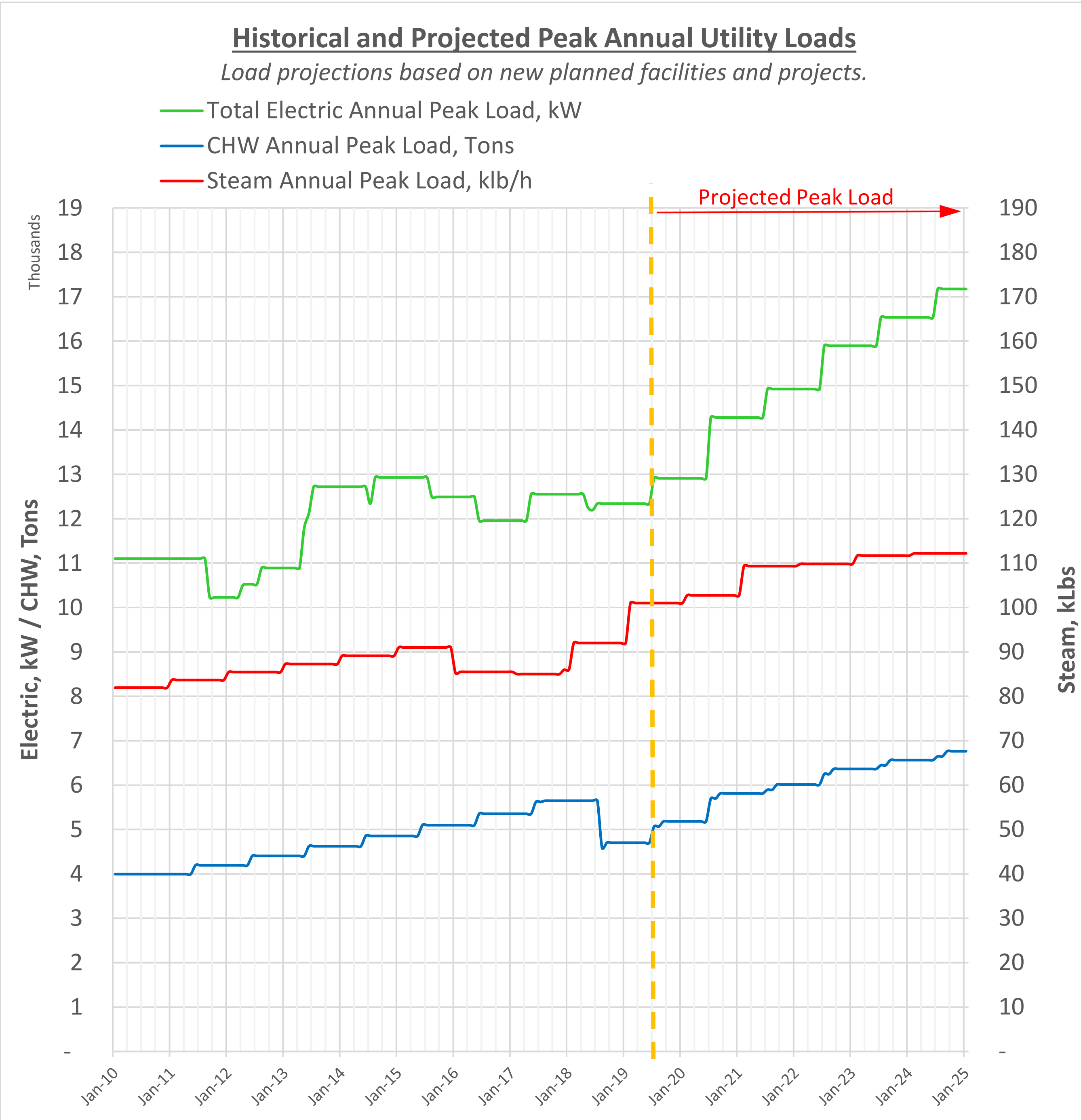



| Key | CHW efficiency increase | Load Reduction Project Description |
|---|---|---|
| 1 | 5% | CHW Plant Controls Phase-1 |
| 2 | 5% | CHW Plant Controls Phase-2 |
| 3 | 5% | CHW Distribution building interface improvements Phase-3 |
| 4 | 10% | CHW Storage Tank and Controls Phase-4 |
| 5 | 5% | CHW Distribution building interface improvements Phase-5 |
| 6 | 5% | CHW Building Load Management Controls Phase-6 |
| 7 | 5% | CHW Building Load Management Controls Phase-7 |

## 5.4 Utility Master Planning

As utility systems continue to age, major investment in renovation of these systems will be needed. With the need for reinvestment comes the opportunity to transition existing obsolete systems to more sustainable technologies that provide better long term financial performance. Utility Master Planning is needed to map out the costs, benefits and feasibility of various options. The results of this planning effort will play a large part in determining future energy and operating costs of the Campus utility systems.

***Graph 9***



## 5.5 Utility Rates

Campus utility rates are charged equally to all customers per unit of electric, steam and Chilled Water energy consumed.

### Energy Charge

In recent years UO utility rates for electric CHW and steam use have been based on operational and debt service costs for each utility and apportioned to administrative units according to energy consumed.

Historic and current campus utility rates are shown in the table below.

***Table 4***

**UO Campus Utility Rates - FY11-20**

*Historical and current*

| | Utility Rate | FY11 | FY12 | FY13 | FY14 | FY15 | FY16 | FY17 | FY18 | FY19 | FY20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| General | Electric, $/kWh | $ 0.0590 | $ 0.0738 | $ 0.0778 | $ 0.0836 | $ 0.0911 | $ 0.0991 | $ 0.0991 | $ 0.0980 | $ 0.0914 | $ 0.0937 |
| | Steam, $/kLb | $ 19.9291 | $ 24.9114 | $ 26.2000 | $ 28.1650 | $ 30.7000 | $ 30.7000 | $ 30.7000 | $ 31.3100 | $ 30.3700 | $ 28.6506 |
| | CHW, $/Ton-hr. | $ 0.1968 | $ 0.2460 | $ 0.2590 | $ 0.2784 | $ 0.3035 | $ 0.3035 | $ 0.3187 | $ 0.3186 | $ 0.3823 | $ 0.4557 |

### Savings Rates for Energy Efficiency Improvements

Because there are significant fixed operating costs in the utility energy rates, a separate set of marginal cost rates for savings is used for computing the value of energy use reductions due to efficiency projects.

Rates for computing the value of energy use reductions are shown in the table below.

***Table 5***

**FY19-23 Energy Rates for Project Efficiency Calculations**

*Use the following Energy Rates in Payback and ROI performance calculations of energy related projects at the University of Oregon.*

Please contact the UO Energy Management Office at ext. 62223 regarding use of these rates.

| Utility | Rate FY19 | FY20 | FY21 | FY22 | FY23 | Unit | Notes |
|---|---|---|---|---|---|---|---|
| Electricity | | | | | | | |
| *CPS* | $ 0.04015 | $ 0.04135 | $ 0.04260 | $ 0.04387 | $ 0.04519 | kWh | EWEB kWh rate to plant (HV bill). |
| *EWEB direct* | Varies* | | | | | kWh | * Depends on specific rate from EWEB to customer. |
| Steam | $ 5.2013 | $ 5.3573 | $ 5.5180 | $ 5.6836 | $ 5.8541 | klb | Steam cost /klb |
| Chilled Water | $ 0.0656 | $ 0.0676 | $ 0.0696 | $ 0.0717 | $ 0.0738 | ton-hr | (elec cost + water cost) /ton-hr |
| Potable Water | $ 2.829 | $ 2.914 | $ 3.001 | $ 3.091 | $ 3.184 | kgal | kgal rate published on EWEB website. Basic rate, doesn't vary with service type |
| Sewer | $ 5.902 | $ 6.079 | $ 6.261 | $ 6.449 | $ 6.643 | kgal | kgal rate published by City (low strength commercial service rate) |
| Natural Gas | Varies* | | | | | therm | * Depends on specific rate from NW Natural to customer |

## Cost of Increased Utility Loads

Increased utility loads associated with new facilities are progressively reducing reserve capacity needed to maintain reliable service. In order to maintain redundancy, additional plant and distribution capacity must be installed to offset these additional utility loads.

The tables below show development of capital cost of increasing capacity needed to meet additional loads since central plant improvements in the 2010 to 2012 timeframe.

***Table 6***

| Incremental Utility Capacity Costs | | | | | |
|---|---|---|---|---|---|
| **Description** | **Elec Cost/kW** | **CHW Cost/Ton** | **Steam Cost/klb/h** | **Notes** | |
| Plant | $2,675 | $2,433 | $60,833 | Cost per unit for added plant capacity. | |
| Distribution | $529 | $611 | $146,903 | Cost per unit for added distribuion capacity. | |
| **Combined** | **$3,204** | **$3,044** | **$207,737** | Total cost per unit for added capacity. | |
| | | | | | |
| **Increased Utility Loads** | | | | | |
| **Utility** | **Elec, kW** | **CHW, Tons** | **Steam, klbs/h** | | |
| **2010 thru 2023** | **6,280** | **6,534** | **21.4** | Diversified load increase since plant upgrade. | |
| **2019 thru 2023** | **4,841** | **2,762** | **11.2** | Diversified load increase 2019 thru 2023. | |
| | | | | | |
| **Incremental Cost of Increased Load (since plant construction)** | | | | | |
| **Utility** | **Elec** | **CHW** | **Steam** | **Total Incremental Capacity Cost** | |
| **Plant** | **$16,800,000** | **$15,900,000** | **$1,300,000** | **$34,000,000** | Cost of added plant capacity. |
| **Distribution** | **$4,000,000** | **$4,000,000** | **$4,000,000** | **$12,000,000** | Cost of added distribuion capacity. |
| **Total** | **$20,800,000** | **$19,900,000** | **$5,300,000** | **$46,000,000** | Total cost of added capacity. |

### Capacity Charge

Capacity Charges based on annual peak demand are recommended as a means of fairly distributing cost for additional plant capacity needed to meet increased peak loads of new facilities. See example of capacity rates in table below. In the example below, the cost associated with providing additional capacity needed to meet expected increased loads are paid for over a 20-year term with an annual interest rate of 4.5%.

***Table 7***

| **Monthly Incremental Utility Capacity Costs**<br>*based on rolling annual peak demand* | | | |
|---|---|---|---|
| | | | |
| *Rates based on:* | | | |
| *Term, years* | *20* | | |
| *Annual interest rate* | *4.5%* | | |
| | | | |
| **Description** | **Electric Capacity Rate/kW** | **CHW Capacity Rate/Ton** | **Steam Capacity Rate/klb/h** |
| Plant Component | $33.46 | $15.22 | $381 |
| Distribution Component | $3.31 | $3.82 | $919 |
| **Capacity Rate, Total** | **$37** | **$19** | **$1,299** |
| | | | |
| Typ. Monthly Charges | $181,687 | $102,272 | $23,540 |
| Monthly Total Charges | $307,499 | | |
| Annual Total Charges | $3,689,989 | | |

# 6 Recent Program Achievements

### Strategic Planning

- Increased water/sewer cost management efforts. (ZIRC)
- Continuing support for Campus Utilities feasibility study and long range Utilities Master Plan.
- Developed long range utility use and cost projections.

### Regulatory /Compliance

- Continued support of compliance with federal, state and local regulatory agencies (EIA, DEQ, LRAPA).
- Investigated and analyzed applicable legislative and regulatory developments (legislative developments, energy and carbon market impacts).
- Provided projections of future utility use required by utilities. (EWEB)

### Community Engagement

- Increased coordination between campus units.
- Engaged with campus partners and customers to provide valuable analytical products and services. (SRC, ZIRC)

### Finances

- Managed ERF allocation. Analyzed financial performance of projects.
- Pursued utility efficiency incentive offers. Ongoing management and support for utility incentive application and payment. Chiller Plant, Lillis, SRC
- Support of annual utilities budget development.

### Accounting

- Support for accounting chargebacks and utility bill payment.
- Collaborate with FASS to improve utility accounting processes.

### Procurement

- Ongoing investigation and pursuit of utility cost reduction strategies.
- Ongoing monitoring of energy market dynamics.

### Metering, Monitoring and Verification

- Improve campus-wide coverage and accuracy of utility sub-metering.
- Initiated, defined and implemented (in progress) Utility Metering Program to address meter installation, maintenance and replacement.
- Investigation of automated acquisition of comprehensive hourly utility water and electric meter data. (EWEB)
- Developed procedures for automatic ingestion of main gas meter hourly data.

### Data Processing and Management

- Coordinated development of utility meter and energy management data architecture
- Collaboration with FASS-IT on development of Utility Data Warehouse functionality.
- Development of virtual utility meters, meter validation and improved support for internal and external billing data functionality.

### Energy Performance Evaluation and Benchmarking

- Research and development or facility energy dashboard architecture.

- Continue ongoing effort to benchmark facility energy performance.

### Energy Opportunity Assessment:

- Provide analysis as needed.
- Create inventory of efficiency opportunities.

### Project Development, Planning and Implementation:

- Continue planning for increased internal efficiency project implementation capability.
- Develop additional FY20 and FY21 energy project candidates

**FY19/FY20 Projects:**

**Tune-ups**

- Lillis HVAC Optimization.  (in progress)
- SRC HVAC Optimization.  (in progress)

**RCX Projects**

- CPS Chiller Plant/Controls Optimization (in planning).
- CPS Chilled Water Distribution Building Interface Instrumentation and controls (in planning).

**ECMs**

- Chilled Water Thermal Storage (in planning).
- Investigated lighting Upgrades at Esslinger.
- ZIRC RO Water Supply?

### 10 - Efficiency Standards

- Contributed to update of Division 33 Utility Standards/Specifications.

# 7 Program Action Goals for FY20-21

## 7.1 Administration

### 7.1.1 Strategic Planning

- Increase water/sewer cost management efforts in anticipation of continued rate increases.
- Promote Campus Utilities feasibility study and long range Utilities Master Plan that minimizes cost risk exposure.

### 7.1.2 Regulatory /Compliance

- Support compliance with federal, state and local regulatory agencies (EIA, DEQ, LRAPA).
- Investigate and analyze applicable legislative and regulatory developments.
- Provide projections of future utility use where required by utilities.

### 7.1.3 Community Engagement

- Increase coordination between campus units.
- Continue collaboration with academic units where mutually beneficial.
- Engage with campus partners and customers to provide valuable analytical products and services. (SRC, ZIRC)
- Develop platform and methods for sharing utility metrics, KPI and dashboards with UO Campus and larger community.

## 7.2 Accounting and Finance

### 7.2.1 Finances

- Increase use of Energy Revolving Fund to finance energy projects that meet required financial performance criteria.
- Pursue utility efficiency incentives. Ongoing management and support for utility incentive application and payment.
- Support development of annual utilities budget.

### 7.2.2 Accounting

- Improve support for utility accounting, chargebacks and utility bill payment.
- Collaborate with FASS to improve overall utility accounting processes.
- Develop utility capacity charge model rates to allocate funding for increased utility plant and distribution capacity.

### 7.2.3 Procurement

- Monitor applicable utility rates and markets.
- Investigate and pursue utility cost reduction strategies.

## 7.3 Metering and Data

### 7.3.1 Metering, Monitoring and Verification

- Improve campus-wide coverage and accuracy of utility metering.
- Develop and implement Utility Metering Program to address need for consistent utility meter installation, commissioning, calibration, maintenance and replacement.
- Pursue comprehensive hourly data acquisition on utility water meters. Investigate further automation of sub-meter reading, implement where feasible.

### 7.3.2 Data Processing and Management

- Continue collaboration with FASS-IT on development and deployment of Utilities Data Warehouse functionality.
- Implement virtual utility meters, meter validation and improved support for internal and external billing data functionality of the Utility Data Warehouse.

### 7.3.3 Energy Performance Evaluation and Benchmarking

- Continue ongoing effort to benchmark facility energy performance.
- Continue development and implementation of energy dashboard architecture for both overall utilities and individual buildings.

## 7.4 Efficiency Projects

### 7.4.1 Energy Opportunity Assessment:

- Provide opportunity analysis as needed.
- Create/expand inventory of efficiency opportunities.

### 7.4.2 Project Development, Planning and Implementation:

- Support increased internal implementation capability for efficiency improvements.
- Develop additional FY20-21 energy project candidates.
- Provide economic analysis of utility infrastructure upgrades.

**FY20-21 Energy Projects:**

**Tune-ups**

- Lillis HVAC Optimization. (Complete by Mar. 1, 2020
- SRC HVAC Optimization. (Complete by Mar. 1, 2020)
- ZIRC HVAC Optimization. (under investigation)

**RCX Projects**

- Lab Building Energy Projects (TBD)
- CPS Boiler Blowdown Optimization
- CPS Chiller Plant/Controls Optimization (in planning)
- Building CHW Connection Instrumentation and Control (in planning)

**ECMs**

- Chilled Water Thermal Storage (in planning).
- Lighting Upgrades at Esslinger. (under investigation)
- ZIRC RO Water Supply.

# 8 Appendix

- ❖ University of Oregon Campus Energy Management, July 2017
- ❖ University of Oregon Enterprise Energy Management
- ❖ Energy Revolving Fund Business Rules
- ❖ Campus Energy Measurement and Verification
- ❖ SEMP Discussion Notes

# UNIVERSITY OF OREGON
# CAMPUS ENERGY MANAGEMENT
## JULY 2017

Energy management at a large public institution of higher education is complex. It requires a clear understanding of key roles and responsibilities and frequent communication between the units charged with these responsibilities. Campus Planning and Facilities Management has identified 11 functions that constitute a decision-making framework to manage energy for the University of Oregon. These 11 functions are listed below. Roles and responsibilities for each are described in this document.

| Function | Lead Department | Contact | Stakeholders |
|---|---|---|---|
| Procurement | Utilities and Energy | Tony Hardenbrook | Design and Construction<br>Finance and Administration Shared Services – Purchasing |
| Production | Utilities and Energy | Tony Hardenbrook | Campus Planning<br>Design and Construction<br>Environmental Health and Safety |
| Distribution | Utilities and Energy | Tony Hardenbrook | Campus Planning<br>Design and Construction |
| Utility Level Metering | Utilities and Energy | Tony Hardenbrook | Design and Construction<br>Facilities Services - Building Automation<br>Finance and Administration Shared Services – Information Technology |
| Data Collection, Reporting, and Benchmarking | Utilities and Energy | Tony Hardenbrook | Design and Construction<br>Facilities Services - Building Automation<br>Sustainability<br>Environmental Health and Safety<br>Finance and Administration Shared Services – Information Technology |
| Future Energy Projections | Utilities and Energy | Tony Hardenbrook | Campus Planning<br>Design and Construction<br>Finance and Administration Shared Services |

| Function | Lead Department | Contact | Stakeholders |
|---|---|---|---|
| Building Level Energy Performance | Facilities Services: Building Automation | David Ward | Design and Construction<br>Sustainability<br>Utilities and Energy<br>Finance and Administration Shared Services - IT |
| Utility Billing and Invoicing | Finance and Administration Shared Services:<br>Finance<br>Purchasing | Jon Marchetta | Finance and Administration Shared Services<br>Utilities and Energy<br>Auxiliaries |
| Design, Construction, and Commissioning | Design and Construction | Jeff Madsen | Campus Planning<br>Facilities Services<br>Sustainability<br>Utilities and Energy<br>Student Life<br>Athletics<br>Environmental Health and Safety |
| Pollution Reporting | Environmental Health and Safety | Steve Stuckmeyer | Sustainability<br>Utilities and Energy<br>Design and Construction |
| Academic Partnerships | Office of Sustainability | Steve Mital | Campus Planning<br>Design and Construction<br>Facilities Services<br>Utilities and Energy<br>Energy Studies in Buildings Laboratory<br>Environmental Health and Safety |

## Procurement

**Lead Department:** Utilities and Energy

**Lead Contact:** Tony Hardenbrook

**Stakeholders:** Design and Construction, FASS-Purchasing

**Purpose:**

Utilities and Energy staff work with a variety of providers (IGI/NWN) and the local utility (EWEB) to purchase energy and related services, as well as evaluate contracts with these parties to optimize value.

**Key Tasks:**

Utilities and Energy staff cooperates with Purchasing and Finance and Administration Shared Services (FASS) to procure energy and related services from several sources including natural gas hedging from Northwest Natural (NW Natural) and IGI Distributors Incorporated (IGI), maintaining an inventory of diesel fuel for the Central Power Station (CPS) emergency generators, and a variety of utility services from the Eugene Water and Electric Board (EWEB).

- University of Oregon (UO) buys power from EWEB for distribution on campus
- UO purchases Natural Gas for operations related to the steam plant and cogeneration system
- The billing and authorization process is handled with assistance from FASS
- CPS staff are responsible for reviewing and verifying invoices and billing

Utilities and Energy staff will assist Design and Construction to arrange for direct power from EWEB during a new construction project or renovation as needed.

Utilities and Energy Department is only responsible for electrical power that is distributed by the UO micro-grid. Natural gas and electrical power not related to utility operations and distribution is acquired by individual UO departments.

**Regular Deadlines:**

IGI natural gas monthly nomination: due by 21st of each month

Procurement, sale, and distribution contract evaluation/negotiation: as required

EWEB electrical power nominations using PowerSS web application: 48 hours prior to producing electrical power with the cogeneration system.

EWEB invoice review and payment: by 3rd business day of every month.

**Data Needs:**

Utilities and Energy staff maintains and analyzes billing and consumption data for the purpose of ensuring system optimization, billing accuracy, budget projection, and benchmarking.

**Stakeholder Expectations:**

Expectations of Lead:

Utilities and Energy department expects all invoices to be paid by FASS-Purchasing on time using appropriate account indexes.

Utilities and Energy depends on FASS-Purchasing for budget and financial data for energy contracts and planning.

Expectations of Stakeholders:

CPS operations depend on consistent and reliable delivery of energy and related services from providers and the local utility to provide utility service to campus.

FASS-Purchasing relies on Utilities staff review of invoices for electricity and natural gas to determine accuracy of billing.

## Production

**Lead Department:** Utilities and Energy

**Lead Contact:** Tony Hardenbrook

**Stakeholders:** Campus Planning, Design and Construction, Environmental Health and Safety

**Purpose:**

CPS produces and provides electricity, steam, chilled water, and compressed air to campus buildings; equipment includes natural gas boilers, chillers, air compressors, diesel generators for emergency power, and the cogeneration plant.

**Key Tasks:**

Several utilities are produced at CPS requiring inputs from EWEB, NW Natural, and IGI Distributors Incorporated:

- Steam is produced using natural gas/diesel fired boilers or in the cogeneration system where exhaust heat from a combustion turbine generator (CTG) is repurposed in a heat recovery steam generator (HRSG).
- Electricity is produced with the CTG and a steam turbine generator (STG), as well as emergency diesel generators that are used as a backup power source.
- Chilled water is produced using centrifugal chillers.
- Water is acquired from EWEB and processed through a reverse osmosis system for use in steam production and chilled water system makeup water.
- CPS also produces compressed air and untreated steam for use in the science and health buildings.

The Utilities and Energy department works with Design and Construction and Campus Planning to analyze growth projections and ensure that CPS can meet utility system demands, both current and in the future.

**Regular Deadlines:**

Daily Production reports for utility system consumption/usage and production data.

Daily Water chemistry reports.

**Data Needs:**

CPS operators and staff maintain production operations using multiple digital control systems including WonderWare, Siemens Insight, Carrier I-VU, and PME (Ion), EATON, as well as Allen Bradley based PLC's and custom master plant controls. These systems also provide energy-related data that is used to optimize operations and service to campus.

**Stakeholder Expectations:**

<u>Expectations of Lead</u>:

Utilities and Energy department requires information about new construction projects and buildings from Design and Construction to compensate for increased utility demands.

Expectations of Stakeholders:

Customers expect consistent and reliable utility service from CPS as well as support and backup power service in the event of an outage or emergency.
Utility service and production data.

# Distribution

**Lead Department:** Utilities and Energy

**Lead Contact:** Tony Hardenbrook

**Stakeholders:** Campus Planning, Design and Construction

**Purpose:**

Provide post-production distribution of utility systems to campus utilizing piping and electrical feeders through the campus tunnel system. The distribution of several utilities requires integrated control systems for each utility in order to safely provide the utilities to campus.

**Key Tasks:**

CPS operates and maintains the production equipment in the plant as well as the piping and wiring in the underground utility tunnels.

The Utility staff works with the BAS group and Facilities to maintain utility distribution systems and deliver utilities to the campus buildings.

Building energy systems are controlled via Siemens Insight and other programs.

CPS provides 12,500V electricity, 60lb steam, 90psig chilled water, 100psi compressed air, 100psi untreated steam, and condensate return systems that are used directly or are reduced for use in buildings on campus.

**Regular Deadlines:**

Not applicable, provide continuous supply.

**Data Needs:**

CPS operators and staff maintain production operations via digital control systems such as WonderWare, Siemens Insight, Carrier I-VU, and PME (Ion). These systems also provide energy-related data used to optimize operations and service to campus.

Steam, chilled water and other main utility meters provide data via the Siemens Insight system. Electrical power metering and data is provided via the PME system.

Distribution metering data is required for billing, consumption data, building energy performance analysis and is the basis for bench marking energy performance of the campus buildings.

**Stakeholder Expectations:**

Expectations of Lead:

Utilities and Energy cooperates with the BAS group to ensure proper system operation within buildings.

Expectations of Stakeholders:

Customers expect consistent and reliable utility service from CPS as well as support and backup power service in the event of an outage or emergency.

Comply with Campus Planning principles and Design and Construction standards when making physical changes

## Utility Level Metering

**Lead Department:** Utilities and Energy

**Lead Contact:** Tony Hardenbrook

**Stakeholders:** Design and Construction, Facilities Services-Building Automation, FASS-IT

**Purpose:**

Utilities and Energy staff maintains a system of utility grade meters on buildings and systems on campus. Data from these meters is used for billing, consumption reports, and benchmarking.

**Key Tasks:**

Utilities and Energy staff work with contractors to maintain and calibrate utility meters on campus. Meters are read both manually and from various systems which requires the cooperation of FASS-IT and the BAS group to maintain data quality, meter and control loop functionality, and electronic system setup. Meters are integrated into Siemens Insight, Ion PME, I-VU, and WonderWare.

The Utilities and Energy staff works with Design and Construction to acquire the proper meters and instrumentation needed for utility metering and assists with meter setup in new construction projects and renovations.

The Utilities and Energy staff determine the proper specification for metering and to which system the utility level meters will be associated.

*Note: the campus domestic water system is currently under review in order to determine which party is responsible for ownership and calibration of domestic water meters.

**Regular Deadlines:**

Auxiliary energy consumption data submission for billing purposes: due 5$^{th}$ of the month

Meter calibration: as required

**Data Needs:**

Metering data is used for billing, energy analysis and benchmarking building energy performance.

Data is used for external reports for tax purposes.

Metering data is required by Utilities and Energy and SRS/EHS for air permit compliance.

**Stakeholder Expectations:**

<u>Expectations of Lead</u>:

Utilities and Energy depends on support from FASS-IT and the BAS group to access and maintain meter data from digital systems such as PME and Siemens Insight.

Utilities and Energy expect data systems controlled by BAS group to be properly maintained and data integrity to be maintained for utility metered information.

Expectations of Stakeholders:

CPS customers expect their meters to be functioning properly and the data to be collected on time in order ensure accurate billing and consumption reports.

Building level metering data accuracy.

Electronic data quality and accuracy.

## Data Collection, Reporting, and Benchmarking

**Lead Department:** Utilities and Energy

**Lead Contact:** Tony Hardenbrook

**Stakeholders:** Design and Construction, Facilities Services-Building Automation, Sustainability, Environmental Health and Safety, FASS-IT

**Purpose:**

Energy data related to CPS, utility level usage, and building systems is collected and analyzed for the purpose of billing, budget planning, consumption reporting, and building performance benchmarking in order to ensure system optimization and to identify potential energy savings.

**Key Tasks:**

Utilities and Energy staff are responsible for collecting and analyzing data related to utility level efficiency, performance, energy consumption and demand, weather and air temperature, integrated systems, and billing. Employees read a collection of utility level meters on a daily or monthly basis either manually or via one of several automated systems including Siemens Insight, Wood Harbinger I-VU, WonderWare, Ion Power Monitor Expert, and Eaton Electric. Working together with the Building Automation Systems group, Sustainability, and Design and Construction, energy data is collected, organized, and validated through FASS-IT for the purpose of reporting. Billing data is also collected through cooperation with FASS.

A number of reports are generated with varying periodicities. Included are energy, demand, and efficiency reports for Service Center customers (Auxiliary buildings on UO campus), commissioning reports for newer buildings, a monthly LRAPA (county air quality and pollution regulation) report, consumption profiles for Athletics, an annual EIA (federal energy information agency) report from CPS, and a variety of other documents related to natural gas, power, and water usage sent to NW Natural, IGI, and EWEB.

Additional reporting requirements can be requested through Utility and Energy Department.

Benchmarking is completed by comparing energy usage for provided utilities to either historical data for UO, peer institutions, or industry standards and requires the cooperation of the BAS group and FASS. These comparisons may be done for individual buildings (audits), the plant (efficiency comparisons), or the entire institution (greenhouse gas inventory and other sustainability measurements).

**Regular Deadlines:**

- Arena energy reports: mid-month
- LRAPA report (emissions): 10th of the month
- Campus utility usage and greenhouse gas emissions: end of fiscal year
- Budget planning: end of fiscal year
- EWEB projections: biannual or when requested
- Federal EIA report: Annual due by April
- UBIT tax reporting: end of fiscal year

**Data Needs:**

CPFM staff generates, maintains, analyzes, and delivers a variety of reports and other information to sources both internal and external. For these reports, data is organized and stored in spreadsheets, word documents, databases, and SQL reporting tools.

**Stakeholder Expectations:**

Expectations of Lead:

Utilities and Energy requires support from FASS-IT to maintain digital data collection systems such as PME, and cooperates with the BAS group to maintain utility data in Siemens Insight.

Expectations of Stakeholders:

CPS customers and other campus entities expect timely and accurate reports with consistent and reliable data.

## Future Energy Projections

**Lead Department:** Utilities and Energy

**Lead Contact:** Tony Hardenbrook

**Stakeholders:** Campus Planning, Design and Construction, FASS

**Purpose:**

The Utilities and Energy department is responsible for providing energy projection data to a number of parties for operational planning and budgetary purposes.

**Key Tasks:**

Employees assemble and analyze metering data from a number of sources and, in cooperation with Campus Design and Construction, provide information required by contract to EWEB for both 2-year and 10-year energy usage projections based on future construction, retrofit projects, and consumption profiles.

CPS uses projection data to calculate expected natural gas consumption and to nominate monthly natural gas purchases through a hedge with IGI and NW Natural. Additional nominations by Utilities staff include projecting power production via the cogeneration system in conjunction with PowerSS and EWEB. Utilities and Energy takes a market based approach towards the generation and sale of electrical power to EWEB with regard to the Mid-Columbia pricing index and cooperates with FASS to provide information related to budgetary planning.

Projection data is compared to current utility capacity and performance to determine capital additions to increase production and distribution capacity of the utility systems. Utilities staff, Design and Construction and consultant engineering support collaborate to meet any increased needs of the utilities.

**Regular Deadlines:**

EWEB projections: biannual

Natural gas nominations: mid-month

Contracts and hedge price negotiation: as required

**Data Needs:**

CPS staff maintains energy data in order to predict future needs including planning for campus growth and contract negotiation.

**Stakeholder Expectations:**

Expectations of Lead:

Utilities and Energy expects the Design and Construction department to provide accurate energy-related data associated with new construction projects as well as retrofits and renovation.

Utilities and Energy expects Design and Construction to collaborate with the development of capital plans and a commitment to the utility master plan to support the ability of utility systems to meet campus energy requirements.

Expectations of Stakeholders:

Utilities and Energy provide timely updates to campus energy projections to meet contractual commitments for EWEB requested usage projections.

Utilities and Energy will work with other departments to assess campus energy needs for planned future campus development. Utilities and Energy and Design and Construction will update the Utility Master Plan based on projected campus energy needs.

## Building Level Energy Performance

**Lead Department:** Facilities Services-Building Automation

**Lead Contact:** David Ward

**Stakeholders:** Design and Construction, Sustainability, Utilities and Energy, FASS-IT

**Purpose:** Ensure fully functioning and highly efficient facilities that provide a comfortable and productive environment across Campus.

**Key Tasks:**

The Building Automation Group coordinates with Facilities Services, Design and Construction, the UO Registrar's office, and the Utilities and Energy Department to gather data related to the performance of building automation systems.

The Building Automation System manager works with Facilities Services to ensure proper operation of HVAC and other building automation systems.

The Utilities and Energy department supports the Building Automation Group by supplying Chilled Water, Steam, Electricity, and compressed air for use in the building automation systems.

The Building Automation Group monitors alarms and indicators related to building systems and works with other units for response when appropriate.

FASS IT, Design and Construction, and the Utilities and Energy departments work with the Building Automation Systems group to assess energy usage data and develop actionable changes in operations and design to improve performance, including identifying energy projects for implementation.

**Regular Deadlines:** Daily import by InfoCenter (data storage for archiving purposes) from Insight. Daily export to Lucid (for Design & Construction use for recently completed renovation and new construction Projects). Daily trending in Insight (local to Insight and for the BAS Team).

**Data Needs:**

All utility head-in metering.

**Stakeholder Expectations:**

<u>Expectations of Lead:</u>

Data quality is maintained.

Consistent and reliable data export for analytics (for other stakeholders).

Periodic data export to UO Animal Care research Departments for monitoring and certifying their lab facilities (specific to this group).

Notifying EHS of building safety system concerns.

<u>Expectations of Stakeholders</u>:

Reliable and secure data storage.

Access to archived data for analytical and reporting purposes.

## Utility Billing and Invoicing

**Lead Department:** FASS

**Lead Contact:** Jon Marchetta

**Stakeholders:** FASS, Utilities and Energy, Auxiliaries

**Purpose:**

To bill, invoice, and pay utility bills received by Campus Planning and Facilities Management (CPFM) department and auxiliary customers.

**Key Tasks:**

FASS purchasing pays utility bills for the Innovation Center, president's residence, chancellor's residence, parking and transportation DMV-Former, UOPD East Station Main Offices. UOPD Offices/ Vehicle Maintenance (ODOT), Thompson University Center, Center for Medical Education and Research, 10th and Mill Building, PeaceHealth North Building, Millrace 4, 1715 Franklin, 1600 Millrace Dr, Research Finance and Administration, UO Gen Alder Building 200L, Baker Downtown Center, Oregon Institute of Marine Biology, Campus Planning and Facilities Management, Pine Mountain, Athletics (two bills), and Motor Pool.

<u>For CPFM</u>

- receive utility bill on or around the first of the month
- review bill if bill reaches or exceeds $5,000
- request adjustments if bill determined to be incorrect during review
- apply credits if credits are owed to UO
- pay bill via Banner after review and credit questions have been resolved

<u>For Utilities and Energy</u>:

- collect auxiliary consumption data: read physical meters across campus and read meters electronically in Power Monitoring Expert (PME) software.
- prepare customer invoices: receive spreadsheet from Utilities and Energy Department, review numbers
- send invoices to customers: email a screen print of the invoice to each campus customer
- recover costs: enter a Journal Voucher (JV) in banner for the utility billings total for each customer

**Regular Deadlines:**

<u>For CPFM</u>: Due dates vary by bill, but are generally two to three weeks after the bill was issued.

<u>For Utilities and Energy</u>: Deadlines are the fifth workday of the next month.

**Data Needs:**

For Stakeholders: In order to pay utility bills the following data are required: Total amount due, credits to be applied, revenues, billing index, account code, utility type, utility provider, invoice number.

For Utilities and Energy: In order to invoice campus customers for utility billings the following data is required: meter readings for meters distributed across campus buildings, current fiscal year utility billing rates, campus contacts email addresses, campus customer indexes, and special instructions such as split-billing percentages.

**Stakeholder Expectations:**

Expectations of Lead:

From Utilities and Energy: Meter readings are accurate.

Expectations of Stakeholders:

From FASS: Utility billing amounts are accurate and campus customers receive a line-by-line invoice explaining the charges each month. Bills will be paid before they are past-due in accurate amounts. Totals reaching or in excess of $5,000 will be reviewed by the FASS Assistant Director of Purchasing

## Design, Construction, and Commissioning

**Lead Department:** Design and Construction

**Lead Contact:** Jeff Madsen

**Stakeholders:** Campus Planning, Facilities Services, Sustainability, Utilities and Energy, Student Life, Athletics, Environmental Health and Safety

**Purpose:**

The design, construction and commissioning of buildings on the UO campus is a primary driver of how energy is consumed on the physical campus. Strategies to design and construct high efficiency buildings that exceed the building code as described in the Oregon Model of Sustainable Development enable the campus to consume less energy in the operation of its physical plant (Utility and Energy Systems, and Buildings).

**Key Tasks:**

Manage Design and Construction Standards to maintain up to date goals, guidelines, strategies, and performance criteria.

Direct process associated with construction and renovation of campus buildings, systems, etc. This process includes design, construction, energy modeling, commissioning, engineering, permitting, etc. Hire consultants and contractors to fulfill associated requirements.

Engage appropriate campus and utility entities as required to fulfill requirements. This may happen in direct association with a project or through engagement with the continued maintenance of the design and construction standards.

Follow up with Energy and Utilities as well as Facilities Services to confirm operation of the building is meeting design intent and confirm operation of building is being maintained as designed to meet energy efficiency goals of the University.

**Regular Deadlines:**

Various project deadlines associated with individual projects.

**Data Needs:**

Baseline utility usage data for buildings that are slated for construction. 1-year worth of data made available at the start of design would be optimal.

Annual energy use data for buildings after project has been completed.

**Stakeholder Expectations:**

<u>Expectations of Lead:</u>

Work in unison with Design and Construction to meet institutionally set energy goals.

Expectations of Stakeholders

Provide technical input for your area. (for any project these are the expectation for the stakeholders)

Work with our engineering team to establish performance criteria and goals within the Design and Construction Standards.

Availability for discussion of project related issues when they do not conform with the Design and Construction Standards.

Work within established campus planning principles – most importantly the Oregon Model for Sustainable Design, but also other principles that apply to physical campus development.

## Pollution Reporting

**Lead Department:**

- Environmental Health and Safety (EHS) for all compliance reporting.
- Sustainability Office for voluntary Greenhouse Gas emissions report.

**Lead Contact:**

- EHS - Steve Stuckmeyer
- Sustainability Office – Steve Mital

**Stakeholders:** Sustainability, Utilities and Energy, Design and Construction

**Purpose:**

The University of Oregon is required to operate and maintain all air contaminant discharge sources permitted by Lane Regional Air Protection Agency (LRAPA) in accordance with regulations promulgated by the Environmental Protection Agency (EPA) and the Oregon Department of Environmental Quality (DEQ). Environmental Health and Safety (EHS) monitors University units for compliance with the University's Air Contaminant Discharge Permit (ACDP), provides regulatory consultation, and service as liaison with regulators.

The University of Oregon also conducts a voluntary, comprehensive greenhouse gas emissions report on a bi-annual basis. This report is used to track progress against the University of Oregon's voluntary climate action plan.

**Key Tasks:**

Environmental Health and Safety (EHS) coordinates with partners on campus including the Utilities and Energy Department to gather and report data related to the consumption of natural gas, fuel oil and steam production on campus and for reporting emissions related information to Lane Regional Air Protection Agency (LRAPA). This information includes air quality content issues and GHG emissions.

EHS provides reports to the City of Eugene any discharges of effluent cooling water from the chilled water plant.

EHS coordinates with LRAPA for the air pollutant discharge permitting of the campus. The annual fees associated with the air permitting for the campus are paid by the Utilities and Energy department using funds from the Service Center.

EHS, Design and Construction, and the Utilities and Energy department must work closely together to ensure the configuration of the present steam, chilled water, and power production facilities is reflected in the air permitting and that the energy production systems stay within the limits of the approved air permit issued by LRAPA.

The voluntary greenhouse gas emissions report collects utility data for main campus, satellite campuses, and leased properties. The report also estimates greenhouse gas emissions from fleet, commute and business travel.

**Regular Deadlines:**

Monthly: Natural gas and oil fuel usage, hours of operation, and steam production per emission unit data submitted by Utilities to EHS.

Semi-annual: Emissions report submitted by EHS to LRAPA by July 30th of each year.

Annual: Emissions report submitted by EHS to LRAPA by January 30th for the previous calendar year.

Bi-annual: Comprehensive voluntary greenhouse gas emissions report that includes utilities, fleet, commute, and business travel.

**Data Needs:**

The Utilities and Energy department provides data required to EHS for Utilities emission unit operations, including fuel consumption, and any discharges related to chilled water system effluent losses to storm or waste water drains on campus.

The Utilities and Energy department provides Sustainability Office comprehensive electricity and natural gas consumption data for campus. FASS provides similar data for satellite campuses and leased properties.

**Stakeholder Expectations:**

Expectations of Lead:

Submit timely permit renewals.

Expectations of Stakeholders:

Maintain operations in compliance with provisions within the ACDP.

## Academic Partnerships

**Lead Department:** Office of Sustainability

**Lead Contact:** Steve Mital

**Stakeholders:** Campus Planning, Design and Construction, Facilities Services, Utilities and Energy, Energy Studies in Buildings Laboratory (ESBL), Environmental Health and Safety

**Purpose:**

Improving the student experience is one of three high level institutional priorities. Many academic departments have recognized the potential to develop projects in partnership with CPFM. These projects enhance students' learning experience and can contribute to CPFM's continuous improvement goals. The Sustainability Director will serve as the liaison between faculty and staff.

**Key Tasks:**

Identify current and appropriate challenges for students to investigate

Ensure faculty and students have appropriate access to data, tools, and people to complete their projects

Ensure that student projects support CPFM goals and needs

Ensure that the demands student projects place on CPFM staff time are appropriate.

**Regular Deadlines:**

Project requests can be initiated by faculty or staff.

Requests for data can be submitted at any time.

**Data Needs:**

Project proposals should include the following information:

- Value the project provides for CPFM and for students
- Project start-time and duration
- Anticipated needs to complete project including staff time, equipment, special access, and data
- Products expected from project

**Stakeholder Expectations:**

<u>Expectations for Lead</u>:

Review and respond to project requests in a timely fashion

Make certain that all key staff are aware of project requests and provide feedback as requested to determine if request is accepted

Inform AVP for CPFM of plans to support student projects on a quarterly basis

Expectations for Stakeholders:

To ensure energy-related student projects respond to real needs, are supported by CPFM leadership, and have the staff support and other resources needed to succeed it's important that all are forwarded to Sustainability director so that it can undergo coordinated review and decision process

Once a student project is accepted, key staff must provide requested data and access in a timely way.

**Background**

There are several Policies that impact the use of energy at the University of Oregon. These policies include the Campus Plan Policy 10: Oregon Model for Sustainable Development, the university Climate Action Plan, and the American College and University President's Climate Commitment. Despite the implementation of the policies mentioned, there is not a discernable Enterprise approach to managing energy on campus. An organizational standard needs to be developed within the VPFA portfolio as to how organizational functions are managed with regard to energy. This standard should take an Enterprise approach to the management of energy which integrates the task of managing energy into the overall management structure of the organization. This effort should include specific roles and responsibilities which will focus the efforts of the organization to meet the sustainability, environmental, and economic goals established by university leadership.

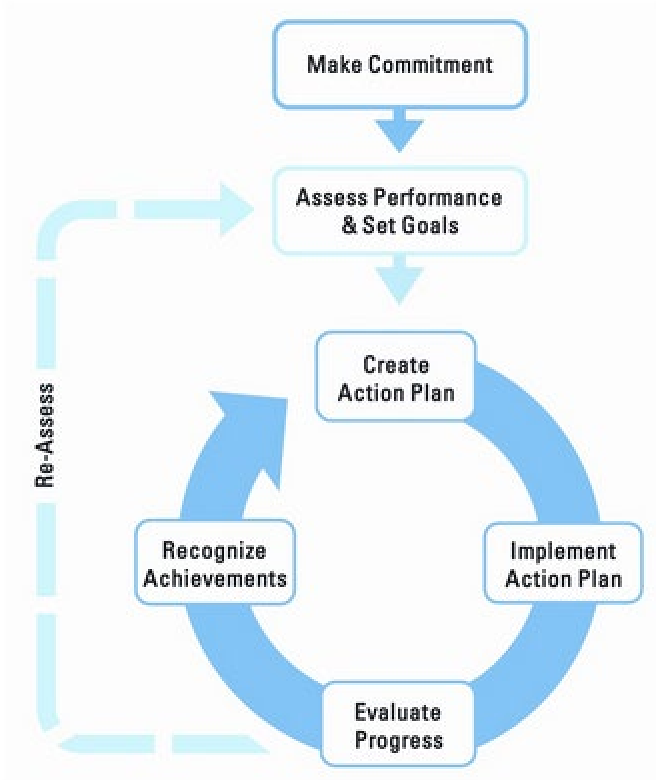
Proposed methods to achieve these goals are:

- Clarify roles and responsibilities between key units (Utilities, Design & Construction, Campus Planning, Sustainability, ESBL, Administration and Finance, and Risk Services)
- Establish platform to collect and share utility and energy usage data
- Identify and correct faults in metering and data collection
- Establish benchmarks of existing use
- Analyze utility data to identify conservation/efficiency opportunities
- Motivate and educate towards conservation
- Implement energy saving measures
- Establish reporting requirements for senior management to assess energy efforts.

**Strategic Energy Management Plan**

The Sustainability Director and the Director of Utilities have engaged the Community Service Center (CSC) faculty with assisting with the development of a Strategic Energy Management Plan (SEP). CSC is developing a draft proposal for the strategic energy plan. CSC draft proposal is to use the Environmental Protection Agency (EPA) Energy Star guidelines for Energy Management. In addition to creating a strategic energy management plan, the guidelines establish mechanisms for managing campus energy. The EPA has a robust, free system in place for use as a management guide, benchmarking campus building performance, and taking action on known data. This system is used by over 10,000 businesses, district energy providers, and universities.

The process is based on the below methodology:




**EPA Guidelines for Energy Management**

The first steps of the EPA guidance require the university to **Make a Commitment**. This step is needed in order to establish and implement the management structure that is currently absent and will be necessary to implement a strategic energy plan.

**Appoint an Energy Team Leader.** Sets goals, tracks progress, promotes the energy management program. Responsible to help the university achieve financial and environmental goals.

- Chairs an energy management team with participation from key units
- Coordinating the overall energy program
- Acting as the point of contact for senior management
- Increasing the visibility of energy management within the organization
- Drafting an Energy Policy
- Assessing the potential value of improved energy management
- Securing sufficient resources to implement strategic energy management
- Assuring accountability and commitment from core parts of the organization
- Identifying opportunities for improvement and ensuring implementation (including staff training)
- Measuring, tracking, evaluating, and communicating results

- Obtaining recognition for achievements

The Director of Sustainability is an appropriate designee to perform these functions.

**Establish an Energy Team.** This team executes energy related activities across the university. In addition to the Energy Team Leader who leads the team and dedicated energy staff, and should include a representative from each operational area that significantly affects energy use:

- Students
- Faculty
- Campus Operations Purchasing
- Campus Operations Facilities
- Building Management
- Enterprise Risk Services
- Campus Planning and Space Management
- Capital Design and Construction
- Sustainability
- Utilities
- Housing
- Athletics

**Institute Energy Policy.** The foundation of goals and integration across the university. This policy should formalize university leadership support and articulates the University's commitment to energy efficiency and environmental stewardship. The energy policies should:

- Have clear, measurable objectives that reflect the university's commitment, culture and priorities.
- Institute a clear decision-making process, define roles in the organization, and provide the authority for personnel to implement the energy management plan.
- Include provisions for evaluating and updating the policy to reflect changing needs and priorities.
- Provide a context for setting performance goals by linking energy goals to overall financial and environmental goals of the university.

With the assistance of the CSC, a well formed and articulate Strategic Energy Management Plan can be established using the EPA model. The result of the plan will lead to an Energy Action Plan that will address the goals of university leadership. The current organizational silos and fragmented efforts related to energy can be brought together in a coordinated process that will leverage talent, resources, and funding from across the university enterprise.

To: Mike Harwood, AVP Campus Planning and Facilities Management

From: Jon Marchetta, Director, Finance and Administration Shared Services

Date: 4.20.18

Subject: Energy Revolving Fund Business Rules

After consultation with a CPFM review team, the below is proposed as the framework for business rules governing the re-establishment of the Green Revolving Fund (referred to going forward, and proposed to be rebranded as the Energy Revolving Fund)

Proposal Review Team:

Jeff Madsen – Design and Construction
David Ward – Facilities Services
Jon Marchetta – Finance and Admin Shared Services
Tony Hardenbrook – Utilities and Energy
Steve Mital – Office of Sustainability

**Energy Revolving Fund Framework Proposal**

- The Utility Service Center will provide $50,000 per fiscal year into the Energy Revolving Fund (ERF) if the ERF fund balance is below $500,000 on July 1 of that year. If the Balance is over $500,000 on July 1, no contribution is provided that fiscal year.
- The Governing Body over the ERF will be the SEMP Energy Team, with the Energy Program Team Leader (Or delegate, most likely the Energy Manager) assigned the lead role over the ERF.
- ERF Annual recharge @ actual project ROI performance, based on approved payback criteria to be established by the Energy Team
- Projects using funding from the ERF must reduce overall energy costs. Projects with no fiscal ROI, or a non-monetary payback can submit a proposal for up to $10k of funding, subject to CPFM AVP approval.
- Projects must demonstrate a payback period of 5 years or less. Selection Criteria to be established by the Energy Team.
- Projects should have M&V plans. Projects that can only estimate the energy performance may still be considered subject to below approvals. Verification requirements similar to ESCO contracts. Specifics to be finalized by the energy team. Submittal packet still to be created.
- All projects will be submitted and initial review by Energy Program Team Leader (or delegate, most likely Energy Manager) for validity. The Initial review will include working with the submitting unit to ensure all required information is provided for review by the energy team.

  - Energy Program Team Leader (or delegate, most likely Energy Manager) will provide recommendations to fund/not fund the project to the Energy Team along with submittal packet.
  - Energy Team can directly approve the use of ERF funding up to $50K – approval by voting – majority vote. Results of team reviews sent to AVP. Larger than $50K projects, or recommended projects with a greater than 5 year payback require AVP approval.
- All submitted projects, with recommended funding and non-funding, reviewed by AVP after quarterly meeting. AVP can veto or override any individual Energy Team decisions.
- Annual report on fund status and project status to AVP, VP, and made available to the public (via CPFM website)

- CPFM AVP Approval required for
  - Payback periods of > 5years
  - Individual project funding over $50K
  - Projects with no energy cost savings or ROI
- FASS will
  - Maintain ERF account
  - Provide the Energy Team and AVP ERF accounting reports quarterly
- U&E will
  - Validate energy project annual cost avoidance for the first 5 years
  - Track project performance based on project M&V plan
  - Prepare annual public report on status of active projects (5 years or less) and projected paybacks – To be posted on website.

**Campus Energy Measurement and Verification** October 23, 2019

To: Mike Harwood, AVP Campus Planning and Facilities Management

From: Tony Hardenbrook, Director of Utilities and Energy

Subj: Campus Energy Measurement and Verification: Challenges and Recommendations

**Background**

The University of Oregon makes investments into a wide range of energy reduction and efficiency efforts. Historically, the actual energy reductions and savings associated with those efforts have been difficult to quantify. The initial estimates for energy cost reductions and usage reductions have generally not been able to be validated. There are physical and organizational challenges that contribute to the lack of adequate Measurement and Verification (M&V) of energy projects.

M&V is a *process*. This process relies on the ability to measure energy use and reliably determine the actual savings created by an energy management, conservation or efficiency project or program. This is done by comparing use before and after implementation of a project or program. Individual energy projects should include the following activities to ensure validation of performance *[1]*:

1) Baseline usage and estimate savings
2) Develop M&V plan for the project or program
3) Develop post-project reporting requirements
4) Perform annual M&V reporting

The campus does not have a formal enterprise level energy program that would properly support M&V functions. These functions include programed efforts to collect, store, disseminate, and analyze energy data that are needed to support M&V of campus energy projects.

The departments comprising CPFM have historically operated in silos without collective direction to establish conditions supporting M&V. Various energy control and monitoring systems have been installed across campus that operate independently and data cannot be easily shared. The organizational management and physical system architecture of the campus metering and energy data acquisition has been disparate.

The right tools for conducting analysis and the necessary staffing to conduct the front and back end analysis have not been present to address the M&V challenges today. Metering data quality has been a persistent problem at the Utility level. A lack of installed metering or an alternate means of measuring consumption within the campus buildings has been problematic in assessing the impact of energy projects.

A formal Enterprise Energy Program is needed that includes specific business rules and action plans to address the lack of the ability to determine energy usage and savings related to energy projects. This program should include defining clear M&V roles and responsibilities that provide mutual-support across CPFM departments. The actions needed to address M&V should also provide a means for analysis for determining future energy efficiency efforts.

Reference

*[1]* US Government: Office of Energy Efficiency and Renewable Energy- Federal Energy Management Program- *Measurement and Verification Activities Required in the Energy Savings Performance Contract Process*

The below issues and recommendations are intended to support the organizational challenges stated and energy program elements that will address M&V challenges for campus:

**1. Energy Data Warehousing**

The use of an SQL data warehouse bridges data from the disparate electronic systems on campus. The proper maintenance and operation of the data warehouse for energy analysis is the critical to the future of metering energy on campus and will lead to a successful ability to validate energy project performance estimates.

Past efforts to establish and maintain UO managed SQL databases that allow the warehousing of energy data have not been properly funded and supported, resulting in inadequate data quality and lack of utilization of this powerful tool. Addressing this issue will also strengthen the ability of CPFM to use data warehousing for other business purposes.

***Recommend*** CPFM commit resources to an SQL based process for storing and disseminating energy data usage which will include funds for FTE to manage the databases.

**2. Utility Meter Data Quality**

Multiple departments play a role in metering system energy and relaying that information to monitoring systems. Historical problems with ensuring the correct level effort and maintenance of the associated equipment and data must be corrected in order to ensure data quality of the installed metering. Proper supervision of work, a lack of clear demarcation of ownership of O&M responsibilities between departments, and a lack of technical skillsets within CPFM have led to the corruption of meter data quality.

Close supervision of UO and Siemens technical staff is needed to ensure meter commissioning, calibration of meters, and maintenance of associated panels and other equipment. Managers need to identify gaps in training and ability to ensure technicians have the requisite skills to perform work. The quality of utility level meter data must be considered a business critical function and made a priority for work management.

***Recommend*** *CPFM* consider options for reducing reliance on Siemens to maintain data quality of utility level metering. This may include moving responsibility for metering control loop from Siemens to other systems more easily maintained by CPFM staff.

***Recommend*** U&E and FASS-IT conduct feasibility test trials of alternate means of warehousing meter data that do not involve Siemens related hardware and software. Based on testing, U&E should provide recommendations on whether utility level metering data should be managed, maintained and warehoused using existing or alternative means. Looked at it, fiscally challenging.

***Recommend*** CPFM establish demarcations of departmental responsibility for metering and data maintenance. U&E will have responsibility for and direct the work related to utility level metering and data. Facilities Services will have responsibility for and direct the work related to building level metering and data. All contracts and agreements (Siemens or otherwise) adjusted to reflect the appropriate lines of responsibility. This will allow Siemens to perform work for U&E as well as work for FS. Work associated with utility level metering should be given high priority with sa`me day response time for troubleshooting problems.

### 3. Upgrade Obsolete or Stranded Metering

Some main utility meters are outdated and do not support integration to monitoring systems and cannot be networked. These meters are considered stranded and require manual readings to record energy use. Most Utility related data from EWEB and other off-campus energy providers is gathered through billing or requires staff to take manual readings.

***Recommend*** U&E continue to upgrade existing UO controlled utility level meters that are not compatible with exporting data to the UO network and the data warehouse.

***Recommend*** U&E coordination with BAS to identify and assimilate any building level metering that exists today that would be beneficial to recover data for analysis.

***Recommend*** developing strategies to acquire and warehouse data from EWEB, NW Natural and other sources that are not directly metered by UO.

### 4. Strategic Demand Side Metering

Resource constraints and benefits to energy reduction efforts should be major considerations for choosing the location of demand side metering installation. The installation and maintenance of demand side metering and the associated data maintenance costs will be the responsibility of individual projects and departments.

***Recommend*** the development of prioritized plans to install demand side metering that will support assessment of energy efficiency project performance.

### 5. Energy Project M&V Plans

***Recommend*** all future energy projects must include M&V monitoring plans for verifying proposed energy savings. This will ensure a clear stated method for verifying the performance of an energy project is known before the project is approved.

### 6. Establish Formal Analysis and Reporting Tools

The software platform currently in limited use for conducting energy analysis is Siemens Navigator. Siemens Navigator is a viable solution to meet the organizational energy analysis and reporting needs. However, the overall cost of using the Navigator platform is not well defined and the suitability of Navigator for various users across the organization needs to be discussed. A decision is needed to either make Navigator the program of record, or if CPFM needs to develop an RFP and assess which software platform would be best suited for energy analysis and reporting. Considerations should include but are not limited to: overall costs, independence in operating and working on the platform, and multi-business function performance. Adoption of one platform will reduce cost and ensure the maximum sharing of information across the enterprise. The U&E service center provides the funding for the current platform and associated contractor labor to support the use of Navigator.

***Recommend*** CPFM establish a software platform as the formal the monitoring, analysis and reporting tool for energy related functions on UO campus.

***Recommend*** the Energy Manager position be assigned the responsibility of leading future analysis of both Utility energy production and demand side energy performance. The Energy Manger should take a lead position in the use of the energy analysis platform that is adopted and work across the enterprise to develop analysis and reporting tools that support M&V. The work done by the Energy Manager will need to be integrated as a shared service within individual departments (BAS, D&C, U&E, etc.) which will minimize duplication of efforts and support the energy analysis needs of various departments including the validation of project energy performance.

**7. Staffing**

***Recommend*** hiring (1) OSNA and (1) Business Analyst to support the management of the data warehouse. These positions will interact with CPFM staff to bridge the data warehouse to different software platforms for business needs- such as Navigator, Wonder-Ware, AiM, etc. The Business Analyst will have oversight of data management of the warehouse and OSNA will provide technical assistance and data management assistance. These positions will also be leveraged for non-energy SQL business operations within the utility service center. Funding for the OSNA and Business Analyst has been identified through the U&E service center. The OSNA position will report to FASS-IT and the Business Analyst will report to U&E.

***Recommend*** hiring the position Energy Manager to support analysis of existing and potential energy related projects in support of the overall Enterprise Energy Program. Integration of duties and responsibilities of the Energy Manager within several CPFM departments will be critical to the success of this position in support M&V elements of the energy program. Functions related to demand side benchmarking should be incorporated into the responsibilities of this position in support of M&V and other elements of the energy program. The Energy Manager should assist projects with designing M&V plans for specific energy projects as well as any overall energy cost and usage goals put in place by the campus energy team. The Energy Manager should perform annual M&V reporting to account for the energy performance of projects. Funding for this position has been identified through the U&E service center. The Energy Manager will report to U&E.

SEMP DISCUSSION

- CPFM Energy Management Program- EPA model
- Energy Team- who? Need to designate Team Members
- Energy Team Leader
- Program Goals/
- Program Elements- Programmatic efforts that are needed to continue the energy program- foundation of the Energy Program. Should be a part of initial Goals.
    - M&V
    - Energy Data Management
    - Benchmarking
    - Energy Audits

- Refine goals in follow on years once there is more data and analysis.
- Specific Solutions should be part of Action Plans.

  Some Suggested
    - Create Energy Steward Shop within U&E to support Energy Program and CPFM Units
    - Establish a building energy benchmarking program
    - Establish a building energy audit program
    - Reduce energy cost by ____ %
    - Prioritize and Conduct Feasibility Studies for reducing energy cost and consumption
    - Improve Energy Data Management
        - Upgrade stranded metering
        - Improve meter data quality to >95%
        - Develop a prioritized demand-side metering plan
        - Update and maintain Data Warehouse functions
        - Establish Energy Data Reporting and Analysis software platform for Campus use
    - Establish Energy Project annual performance reports (M&V)
    - Onboard Staff to Support Energy Program
        - Hire Energy Manager
        - Hire Business Analyst to manager warehouse and coordinate analysis tools and product development
        - Hire OSNA to provide FTE support for IT functions and data warehouse functions
- Business Rules/Responsibilities
    - Designate Energy team
    - Designate Program Elements and responsibility
        - Example: Building Energy Audits- Energy Manager
    - Identify the Energy Steward Shop Support requirements
    - Data Warehousing business functions and responsibilities- Business Analyst/FASS IT
    - ERF Business Rules
    - Periodic Energy Team Reviews (semi-annual, annual)
    - Annual Reporting- Action Plans: Energy Manager to Energy Team

- Annual Goal Assessment/Updates: Energy Team to AVP
- Annual Action Plan updates: Energy Manager and team members propose action plans- Energy Team recommend Action Plans to AVP