Eastern Washington University

CHENEY, WASHINGTON
JUNE 2012

ENERGY EFFICIENCY & SUSTAIABILITY REPORT

Report Contents

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Executive Summary

In keeping with Eastern Washington University's new strategic theme, "Inspiring the Future", the Facilities team aims to motivate future students, staff and faculty through the University's ongoing leadership in energy efficiency and sustainability.

Continuing a long legacy of sensible investments in infrastructure and operational efficiency, Eastern Washington University's Facilities team has partnered with energy efficiency design/build firm McKinstry to develop a comprehensive campus-wide Energy Efficiency and Sustainability Plan, carefully identifying opportunities to reduce energy consumption and carbon emissions while improving campus operations.

This plan charts a course towards helping the University achieve its vision for a carbon neutral campus.

The Plan:

1. Establishes quantifiable methods to reduce greenhouse gas emissions
2. Develops ways to incorporate energy efficiency and sustainability into every aspect of the institution
3. Supports the University's 2007 adoption of the American College and University Presidents' Climate Commitment (ACUPCC)
4. Accumulates audit findings of 16 buildings, identifying opportunities for energy and operational savings
5. Assesses campus infrastructure for additional water and energy savings
6. Paves the way for actions to reach goals

Much has already been accomplished. This document describes past successes as well as current initiatives and best practices. It also details opportunities for improvements to facilities and operations that can enhance the campus master plan.

To implement the recommendations, the University has a range of financing options to consider:

- Projects could be financed all at once, through a construction bond, paying for these investments with savings in energy and operations.
- Projects could be implemented in a phased approach over many years, as similar projects have been since 2001. Table 1 below shows how this approach might be applied.

Whichever options the University pursues in coming years, implementation of the plan and completed projects will yield quantifiable reductions in carbon emissions and improvements in energy efficiency, while continuing stakeholder involvement will aid the University's progress towards a sustainable, carbon-neutral campus that instills environmental responsibility as a core value among students, faculty and administrators, and that serves as a model for campuses nationwide.

Executive Summary

TABLE 1 - EXAMPLE: HOW PHASING PROJECTS COULD SPREAD COSTS

Biennium in which phases of work will be funded.	Phase of Work	Buildings included in phase of work	Range in Costs
	Phase 5	PEA, PAV, JTF	$4,021,953 - $4,915,720
	Phase 6	MUS, RTV	$4,113,055 - $5,027,067
	Phase 7	COM, THR	$3,783,507 - $4,624287
	Phase 7	JFK, MAR, SUT, WIL	$3,897,185 - $4,763,226
	Phase 8	ART, ECC, PUB	$1,422,608 - $1,738,743
	Phase 8	PUB	$3,997,923 - $4,886,349
	Phase 9	ROZ-Heating	$2,848,649 - $3,481,681
	Phase 9	ROZ-Heating	$2,900,205 - $3,544,695
	Phase 10	ROZ-Cooling	$2,208,995 - $2,669,882
	Phase 11	ROZ-Cooling	$3,273,672 - $4,001,160
	Phase 12	Solar, Wind, Bldg Water Use.	$3,025,713 - $3,698,094
	Phase 13	Campus Landscape Initiatives	$4,884,350 - $5,969,700
	Phase 14	Campus Landscape Initiatives	$4,884,350 - $5,969,700

Costs are in 2010 dollars, giving Rough Order of Magnitude (ROM) ranges for each phase. Details can be found in the project section of this document.

The Campus Energy Efficiency and Sustainability Study focuses on eight key areas:

1. Campus Energy Efficiency Projects & Greenhouse Gas (GHG) Emissions:
   Eastern Washington University has been proactive in boosting energy efficiency and reducing greenhouse gas emissions. This section highlights activities to date and gives an overview of campus emissions.

2. Reducing Scope 1 & 2 Emissions:
   As part of the study, Eastern Washington University directed McKinstry to audit 16 key facilities on campus in an effort to drive energy efficiency and reduce emissions. This section highlights the findings of this analysis, summarized in specific improvements recommended by McKinstry for each building.

3. Reducing Scope 3 Emissions:
   This section focuses on reducing Scope 3 Emissions; emissions directly or indirectly related to transportation and waste stream management for the campus community.

4. Efficient and Sustainable Campus Systems:
   In addition to buildings, we recognize that the physical campus environment has a big impact on our overall sustainability impact. This is the most visible element. In this section, we explore improvements to the physical campus environment.

Executive Summary

5. Renewable Energy and Offsets:
   We explore renewable energy options in this section, with a focus on solar and wind. We also look at the option of using different fuel sources for campus heating.

6. Energy Efficiency and Sustainability in Campus Culture:
   This section focuses on Eastern Washington University's commitment to communication and stakeholder involvement as we continue to define a path to carbon neutrality.

7. Sustainability in Curriculum:
   Eastern Washington University is committed to incorporating sustainability across the curriculum. The University is working with faculty to achieve desired student learning.

8. Funding Energy Efficiency and Sustainability Projects:
   As Eastern Washington University moves forward with implementation of various energy efficiency and sustainability strategies, a key component of the University's ability to affect these changes would be funding strategies to accomplish this important work. Because this work involves addressing infrastructure, deferring maintenance and upgrading existing systems, various approaches can move the organization toward its goals. However, continuing the Facilities team's plan requires the University's continued diligence in maintaining infrastructure, as well as ongoing commitment by the administration to meet ACUPCC carbon emission reduction guidelines.

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Campus Energy Efficiency Projects & GHG Emissions

1. *Energy Efficiency Projects To Date*
2. *2007 GHG Emissions Inventory*
    - a. *Data Collection*
    - b. *Benchmark Values*
    - c. *Emission Reduction Goals*
    - d. *Tracking Reductions*

Energy Efficiency Projects & GHG Emissions

Executive Report

1. Energy Efficiency Projects to Date

SUSTAINABILITY PROGRAMS

- In April 2011, Eastern Washington University's Recycling Department celebrated Earth Day by calling attention to present campus sustainability practices and accomplishments.
- The Recycling Department actively educates the University community on sustainability practices, promoting programs such as self-service recycling, energy conservation, and sustainable foods (working with the Sustainable Food Project student group).
- In June 2011, we began a compost collection pilot program in Dining Services, diverting food waste to the Barr-Tech Composting facility and reducing our conventional waste stream in the process. In addition, the dining operation is actively moving toward biodegradable, compostable take-out containers.
- Custodial Operations continues to integrate greener cleaning products.
- Installation of the artificial red turf on Roos Field has significantly reduced our irrigation needs.
- The University chips tree-pruning waste to create a springy, well-drained surface on the cross-country running trail, reducing the waste stream in the process.
- Planting beds are top-dressed with composted grass clippings and mulched with pruning waste chips, which reduces the waste stream, conserves irrigation water and cuts the need to buy mulch.

Campus Lighting Upgrades

- In the late 90s Eastern Washington University implemented a campus wide Lighting System Retrofit. This project consisted of retrofitting energy inefficient T12 fluorescent lamps and standard magnetic ballast fluorescent fixtures with energy efficient T8 lamps and electronic ballast, and replacing incandescent bulbs with compact fluorescents. Most buildings on campus had their lighting retrofitted.

Eastern Washington University has been proactive in improving construction standards and specifications for energy efficient equipment and systems. These facility improvements save roughly $365,540 in energy costs and $281,461 in operational costs each year.

Currently, five major sustainable building projects have either been completed, are underway or are in various stages of planning. Projects feature high-level leadership in Energy Efficiency and Design (LEED) certification either approved, pending or projected:

- Hargreaves is complete and certified LEED Gold
- Patterson Hall is in progress and anticipating LEED Gold
- Martin/Williamson pre-design report indicates potential for LEED Gold
- University Recreation Center is complete and certified LEED Gold
- University Science Center, Science I, is pre-design complete with LEED Gold as minimum

McKinstry and Eastern Washington University have created this Energy Efficiency and Sustainability Plan to accomplish even more. As part of this, McKinstry completed facility audits on 16 campus buildings to identify additional opportunities for Eastern Washington University to save energy, cut emissions and reduce costs. This report details projects that will reduce emissions by a combined estimate of 6,650 MT CO_2e. These FIMs are detailed in Sections 2, 4, and 5 of this report.

Energy Efficiency Projects & GHG Emissions

This report outlines ways to carry these efforts forward, building a foundation for further improvements in Eastern Washington University efficiency and emissions reduction.

MCKINSTRY'S ENERGY SAVINGS PERFORMANCE CONTRACT

Beginning with Eastern Washington University's 2001 hiring of McKinstry as Energy Services Company (ESCO), numerous energy efficiency projects have been completed, in four major phases:

PHASE ONE: 2002-2004

- Complete HVAC upgrades at Kingston and Isle Halls
- Controls upgrades at Martin, Tawanka, and Huston Halls
- Installation of variable frequency drives at buildings including Science Hall, JFK Library, Sutton Hall, and the Art Building
- Installation of a new Computer Room Air Conditioning Unit in Huston Hall
- Rozell Central Chilled Water Plant improvements including installation of a 200-ton plate-and-frame heat exchanger; replacement of a 750-ton cooling tower with a new 1,000 open-circuit, induced-draft cooling tower, installation of Delta Digital Controls.
- Replacement of roll filters with filter banks in several air handing systems across campus

PHASE TWO: 2005-2006

- Aquatics Building: Structural analysis showed that a high humidity and chlorine environment had caused excessive damage to the structural integrity to roof trusses. McKinstry replaced the existing HVAC system with an energy efficient dehumidification system, installed a more efficient pool pump, improved lighting throughout the building, repaired and painted the natatorium roof and associated trusses, installed a new pool liner, and refitted the steam station with new steam valves.

PHASE THREE: 2007-2009

- Physical Education Activities Buildings: HVAC controls and lighting system upgrades in the Physical Education Activities Buildings, Jim Thorpe Fieldhouse and the Pavilion (Reese Court). McKinstry replaced eight air handling units, plus controls and installed ductwork throughout the gymnasiums.
- Physical Education Classroom Building: HVAC and lighting system upgraded, with construction staged to keep half of the building occupied and running during construction. McKinstry installed a new variable air volume air handling unit with fan wall technology in the basement and installed new ductwork, VAV terminal units and piping distribution systems, digital controls, and energy efficient lighting fixtures throughout the building.

PHASE FOUR: 2011-2012

- Rozell Central Steam Plant: Began replacement of the boiler feed water pumps to improve pump efficiency, reliability and redundancy.
- Tawanka Hall: Began replacement of all electrical ovens with gas ovens, and the complete replacement of all walk-in and reach-in coolers and freezers. This project improves the overall energy efficiency and redundancy of the refrigeration and food storage systems.

Energy Efficiency Projects & GHG Emissions

Detailed Report

1. Energy Efficiency Projects To Date

Eastern Washington University has been one of the more progressive higher education institutions when it comes to energy efficient and sustainability design of new buildings on the Cheney Campus as well as aggressively pursuing energy conservation projects in their facilities. The design and construction standards that the university employs are centered on having the most energy efficient systems possible installed for the amount of money spent.

CAMPUS WIDE LIGHTING SYSTEM RETROFIT

In the late 90's the university implemented a campus wide lighting system retrofit. This project consisted of retrofitting fluorescent fixtures that had T12 lamps and standard magnetic ballast with T8 lamps and electronic ballast, retrofitting energy efficient incandescent bulbs with compact fluorescent screw-ins. For the most part a majority of the buildings on campus were done at this time. There were a few however that still had T12 lamps and magnetic ballast, and energy inefficient HID lighting. Many of these remaining buildings and facilities would be addressed later.

ENERGY SAVINGS PERFORMANCE CONTRACT

In 2001, the university sent out a Request for Qualifications for Energy Services Companies (ESCO) for performance contracting services. Many ESCOs responded but only a few were shortlisted for interviews. McKinstry was awarded the Performance Contract. The last part of 2001 and most of 2002 were spent performing the energy audit and formalizing the contact. In late 2002 and all of 2003, the Phase 1 group of projects consisted of complete HVAC upgrades at Kingston and Isle Halls, controls upgrades at Martin, Tawanka, and Hustan Halls, installation of variable frequency drives at several buildings on campus (Science Hall, JFK Library, Sutton Hall, and the Art Building to name a few), Computer Room Air Conditioning Unit in Hustan Hall's computer room, installation of a 200 Ton Plate and Frame Heat Exchanger in the Rozell Central Chilled Water Plant, and replacing a 750 Ton cooling tower with a new open circuit, induced draft cooling tower at Rozell. The central chilled water plant at Rozell also had the existing Staeffa Digital Controls replaced with Delta Digital Controls. Several air handing systems across campus had their roll filters replaced with filter banks as well. The first phase of work at EWU was successfully wrapped up in 2004.

In 2005, EWU and McKinstry entered into a second phase of work for several energy retrofits in the Aquatics Building. The retrofits performed in this building were quite extensive. The existing false ceiling in the Natatorium, spectator section, and lobby areas were rotting out and starting to fall. This was due to the high humidity levels in the natatorium and the inability of the existing HVAC system to control the humidity in the natatorium. An independent structural analysis was done on the roof trusses. It had been found that over time the content of chlorine in the air had done significant damage to the trusses. McKinstry replaced the existing HVAC system with an energy efficient Dehumidification system, new energy efficient pool pump, new lighting system throughout the building, the natatorium roof was repaired and a special primer and paint for Natatoriums was applied. A new pool liner was installed, and the steam station and steam valves were rebuilt or retrofitted with new steam valves. The project was implemented over the summer of 2006 and was back up and operating in time for the fall quarter. This project was one of the more notable projects McKinstry had done on EWU's campus.

In 2007, EWU and McKinstry embarked on a third phase of work that involved the upgrade of the HVAC and Lighting systems throughout the athletic facilities. This third phase of work was broken up into 2 separate phases of work. The first phase of work included work to be done throughout the Physical Education Activities Buildings, Jim Thorpe Fieldhouse, and the Pavilion (Reese Court). The second phase of work would eventually include the Physical Education Classroom (PEC) building. The work that was done in the first part of the third phase of work included McKinstry replacing (8) air handling units and ductwork throughout the Physical Education Activities (PEA) buildings and their respective pneumatic controls, with New air handling units, ductwork distribution systems, and digital controls. McKinstry also implemented lighting retrofits throughout the PEA buildings, as well as the Pavilion and Jim Thorpe Fieldhouse.

In 2008 and 2009, McKinstry started the 2nd half of the third phase of work. This included the entire HVAC and lighting system upgrade at the Physical Education Classroom (PEC) Building. The work was staged in a way that allowed one half of the building to be worked on while the other half of the building was occupied and running. A new variable air volume air handling unit using fan wall technology was installed in the basement of the building while all new ductwork and piping distribution systems were installed throughout both floors of the building. New variable air volume boxes with reheat coils were installed as well as new hot water baseboard fin tubes on both floors of the building. New digital controls were installed as well as all of the casework on the second floor. All new energy efficient lighting fixtures were installed throughout the project.

In 2011 McKinstry developed fourth phase projects to replace the boiler feed water pumps in Rozell's central steam plant as well as replacing all of the refrigeration and food storage systems and the electrical ovens in Tawanka Hall. These projects are under contract and slated to be implemented in late 2011 and the first half of 2012. The boiler feed water project will give the university an energy efficient means of pumping feed water while offering a level of redundancy they have not had before. The Tawanka Hall project will have all of the walk-in coolers and freezer getting replaced with more energy efficient refrigeration equipment and compartment walls. The same will be done with the reach-in coolers and freezers. The electric ovens will be replaced with gas fired ovens.

A lot of great energy efficiency projects have been implemented over the last 10 plus years, but there are many more energy efficiency projects to do on campus. McKinstry and EWU have developed a very close working relationship over the last 10 years and have developed an energy efficiency master plan with their sights set on implementing more of this work in the future. The body of the work is presented in this report represents the fruit of their labor. It is our hope that this acts as a compass for accomplishing this work.

Energy Efficiency Projects & GHG Emissions

Executive Report

2. 2007 Greenhouse Gas Inventory (GHG) Results

A. DATA COLLECTION

A team of Eastern Washington University faculty and staff compiled the 2007 Campus Greenhouse Gas Inventory, reporting their findings to the ACUPCC. That inventory serves as the baseline for this report.

To ensure consistency and transparency, the greenhouse gas analysis follows the World Resources Institute Greenhouse Gas Inventory Protocol; the accepted standard for emissions reporting, which groups emissions into three categories, or "Scopes":

- Scope 1: Direct Emissions – exhaust from campus buildings and vehicles, and fugitive emissions from refrigerants.
- Scope 2: Indirect Emissions – from purchased electricity, purchased steam or chilled water, for example.
- Scope 3: Tertiary Emissions - business air travel, commuting by students, staff and faculty, solid waste disposal and water consumption.

Eastern Washington University uses the Clean Air Cool Planet Campus Carbon Calculator, a campus-specific inventory program that allows annual data updates, so as Eastern Washington University uses the calculator over time it will show trends and identify opportunities to address emissions. Eastern Washington University's full 2007 GHG inventory report can be viewed on the ACUPCC website:

http://www.presidentsclimatecommitment.org

Energy Efficiency Projects & GHG Emissions

B. TABLE 2 – 2007 BENCHMARK VALUES

2007 GREENHOUSE GAS INVENTORY	METRIC TONS OF CARBON DIOXIDE EMISSIONS	% OF NET EMISSIONS
CO-GEN ELECTRICITY	0.0	0%
CO-GEN STEAM	0.0	0%
OTHER ON-CAMPUS STATIONARY	15,836.7	32%
DIRECT TRANSPORTATION	471.2	1%
REFRIGERANTS & CHEMICALS	111.0	0%
AGRICULTURE	38.6	0%
PURCHASED ELECTRICITY	16,858.0	34%
PURCHASED STEAM / CHILLED WATER	0.0	0%
FACULTY / STAFF COMMUTING	2,784.9	6%
STUDENT COMMUTING	9,502.9	19%
DIRECTLY FINANCED AIR TRAVEL	2,044.8	4%
OTHER DIRECTLY FINANCED TRAVEL	279.8	1%
STUDY ABROAD AIR TRAVEL	0.0	0%
SOLID WASTE	-25.5	0%
WASTEWATER	2.2	0%
PAPER	535.4	1%
SCOPE 2 TRANSMISSION & DISTRIBUTION LOSSES	1,667.3	3%
SCOPE 1	16,457.5	33%
SCOPE 2	16,858.0	34%
SCOPE 3	16,791.8	34%
ALL SCOPES	50,107.3	100%
ALL OFFSETS	-12.7	
TOTAL EMISSIONS	**50,094.6**	

Energy Efficiency Projects & GHG Emissions

EASTERN 2007 EMISSIONS

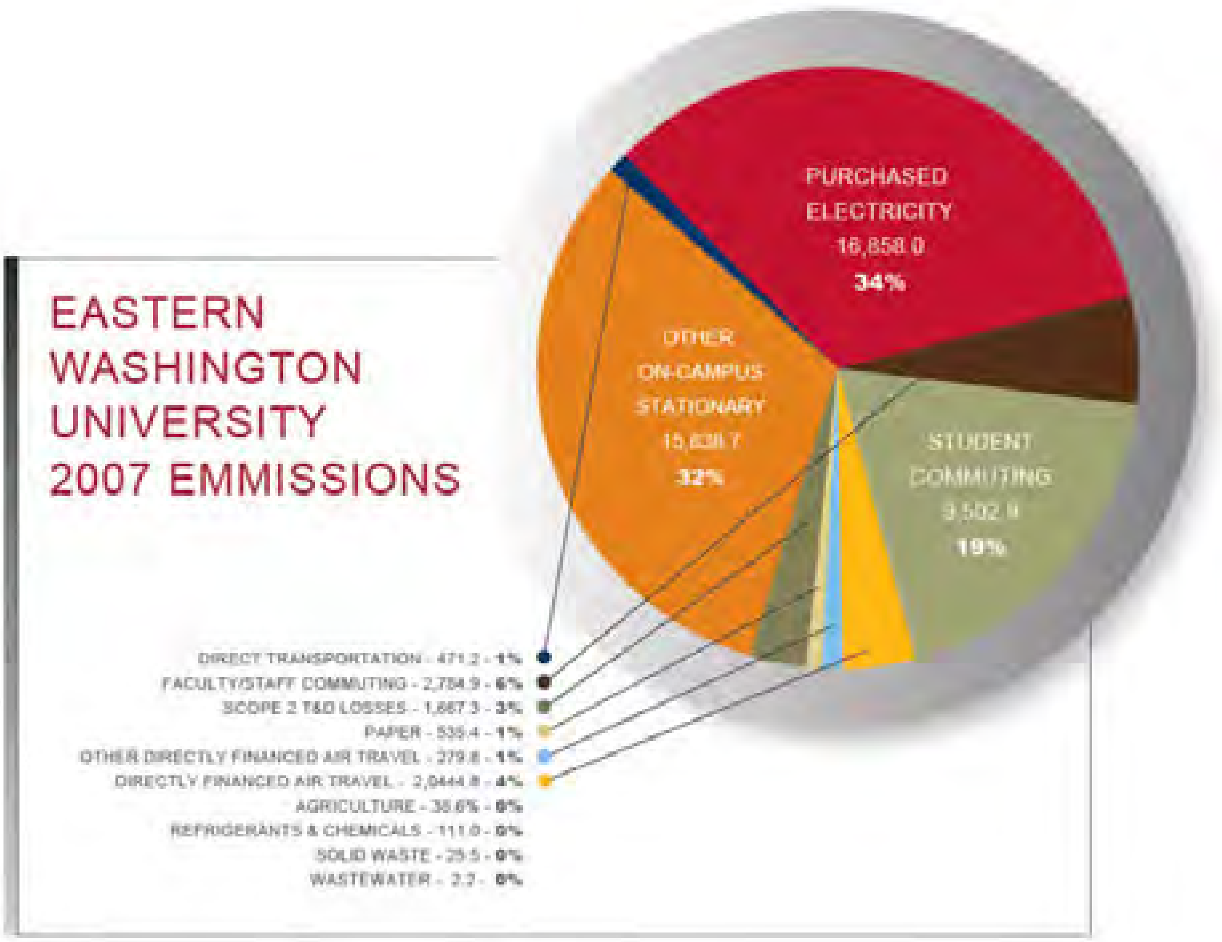
C. EMISSIONS REDUCTION GOALS

Eastern Washington University's climate action planning process began with a campus charrette in May 2010. To better define goals, campus leaders will continue to assemble stakeholders, further identifying core sustainability and emissions reduction focuses, setting interim benchmarks for reporting to ACUPCC.

D. TRACKING REDUCTIONS

As a signatory to the American College and University Presidents' Climate Commitment, Eastern Washington University must track and report its progress in cutting GHG emissions. Having defined the interim goals for emission reductions, the University will apply key strategies and tactics to achieve those goals on their path to a carbon neutral campus.

GRAPH 1



2

Reducing Scope 1 & 2 Emissions

Energy Efficiency Facility Improvement Measures

1. Summary of DES Evaluation
- *a. Wedge Graph of Carbon Emissions*
- *b. Discussion of Goals – Perspective on Prioritizing Project Implementation*

2. Building Energy Audit Report
- *a. Buildings Surveyed*
- *b. Summary of Findings by Building*
- *c. Emissions Savings by Building*

3. Analysis Findings
- *a. Carbon Reduction Potential*
- *b. Emissions Impact*

Reducing Scope 1 & 2 Emissions

Executive Report

1. Summary of DES Evaluation

Eastern Washington University chose 16 buildings on their campus for McKinstry to perform an energy audit on. This was started during the summer of 2009 and completed in the fall of the same year. The buildings that were surveyed are listed below.

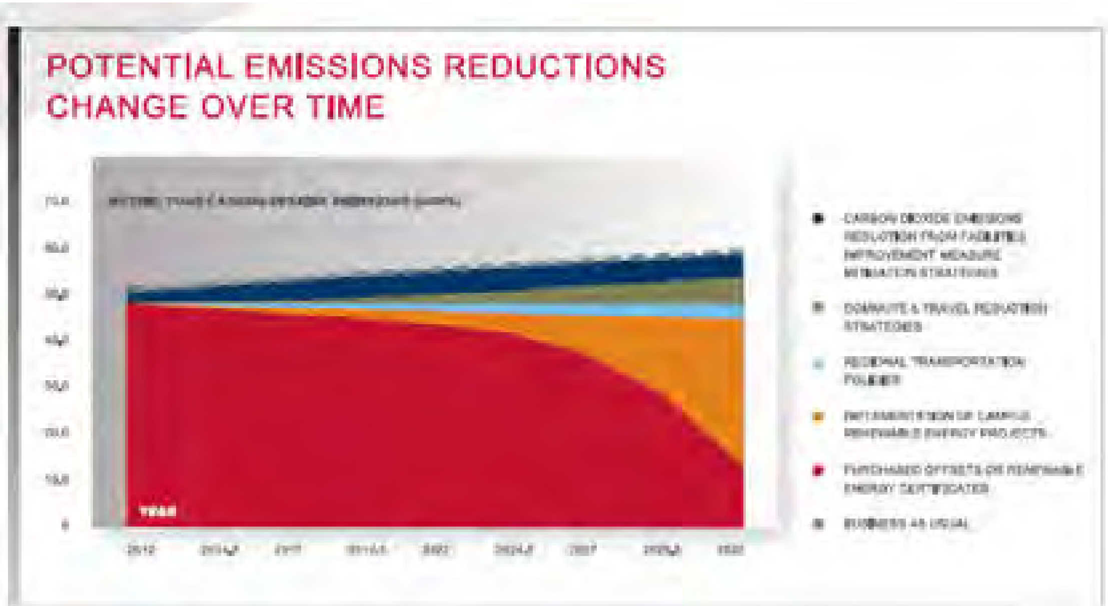
a. Art Building – 35,493 square feet
b. Communication Building – 19,289 square feet
c. John F. Kennedy Library – 165,169 square feet
d. Martin Hall – 57,792 square feet
e. Music Building – 47,618 square feet
f. Radio / TV Building – 15,983 square feet
g. Science Building – 148,149 square feet
h. Theater / Drama Building – 36,130 square feet
i. Williamson Hall – 31,599 square feet
j. Eastern's Children Center – 14,865 square feet
k. Rozell Central Heating and Cooling Plant – 56,561 square feet
l. Sutton Hall – 31,984 square feet
m. Jim Thorpe Fieldhouse – 51,316 square feet
n. Pavilion – 119,658 square feet
o. Physical Education Activities Building – 93,856 square feet
p. Pence Union Building – 141,025 square feet

All of the above buildings are served high pressure steam for building heat, domestic hot water, and in some cases humidifiers and other process loads from the Rozell central steam plant. All of the above buildings with the exception of the PEA Body Shop AHUs utilize the chilled water from Rozell. The following are building by building descriptions of the respective building's existing ventilation system and its current condition.

McKinstry developed many Facility Improvement Measures (FIMs) for each of the buildings listed above. The range of their respective costs, energy savings, operational cost savings, and potential utility rebate incentive are included in the attached Table 4.2. With the collaboration of EWU's maintenance staff many of the FIMs were developed.

Reducing Scope 1 & 2 Emissions

A. WEDGE GRAPH OF CARBON EMISSIONS



The wedge graph shown above details one potential course for reducing campus emissions. This initial representation assumes an annual 3% emissions increase to account for University growth and the impact that the following strategy implementation could produce. The scenario includes a 5 year implementation schedule of all facility improvement measures (FIMs) identified in McKinstry's facility study; a 1% annual reduction of transportation (based on Scope 3 campus policies and programs); and a 0.75% annual emissions decrease from regional transportation policies stemming from efficiency standards and expanded transit options. The graph also illustrates the potential impact of a heavy future investment in renewable energy as the technology becomes more affordable. The mitigation reduction levels shown in this graph will be updated to accurately reflect Eastern Washington University's goals and approach to carbon mitigation as they are quantified. The red wedge represents the remaining balance in carbon offsets in any given year that Eastern Washington University would need to pursue to mitigate emissions to claim carbon neutrality.

Note: this graph will evolve to reflect the impact of programs, measures and goals defined by campus stakeholders.

B. DISCUSSION OF GOALS - PERSPECTIVE ON PRIORITIZING PROJECT IMPLEMENTATION

Before beginning any capital facility improvement at Eastern Washington University, each building or improvement will be evaluated for cost, impact, need and available funding. The facilities team and stakeholder group can prioritize projects with consideration to their impact on campus carbon neutrality goals. The stakeholder team will report to the university president and executive staff, to ensure that all sustainability and emissions reduction strategies are in alignment with University goals.

Reducing Scope 1 & 2 Emissions

Detailed Report

1. Summary of the DES Evaluation

Eastern Washington University chose (16) buildings on their campus for McKinstry to perform an energy audit on. This was started during the summer of 2009 and completed in the fall of the same year. The buildings that were surveyed are listed below.

a. Art Building – 35,493 square feet
b. Communication Building – 19,289 square feet
c. John F. Kennedy Library – 165,169 square feet
d. Martin Hall – 57,792 square feet
e. Music Building – 47,618 square feet
f. Radio / TV Building – 15,983 square feet
g. Science Building – 148,149 square feet
h. Theater / Drama Building – 36,130 square feet
i. Williamson Hall – 31,599 square feet
j. Eastern's Children Center – 14,865 square feet
k. Rozell Central Heating and Cooling Plant – 56,561 square feet
l. Sutton Hall – 31,984 square feet
m. Jim Thorpe Fieldhouse – 51,316 square feet
n. Pavilion – 119,658 square feet
o. Physical Education Activities Building – 93,856 square feet
p. Pence Union Building – 141,025 square feet

All of the above buildings are served high pressure steam for building heat, domestic hot water, and in some cases humidifiers and other process loads from the Rozell central steam plant. All of the above buildings with the exception of the PEA Body Shop AHUs utilize the chilled water from Rozell. The following are building by building descriptions of the respective building's existing ventilation system and its current condition.

McKinstry developed many Facility Improvement Measures (FIMs) for each of the buildings listed above. The range of their respective costs, energy savings, operational cost savings, and potential utility rebate incentive are included in the attached Table 4.2. With the collaboration of EWU's maintenance staff many of the FIMs were developed.

Reducing Scope 1 & 2 Emissions

Executive Report

2. Building Energy Audit Report

McKinstry audited the existing buildings listed below, assessing and documenting how the existing Heating, Ventilating and Air Conditioning (HVAC) systems were operated and controlled. This included notating their existing condition and state by performing site surveys with Eastern Washington University's maintenance personnel, and wherever possible running trends with the existing controls system. By doing this, McKinstry was able to establish a baseline on the equipment performance. Once the baseline is known, the potential energy savings can be quantified and associated with the recommended facility improvement measures.

A. BUILDINGS SURVEYED

At the University's behest, McKinstry performed energy audits for the following buildings:

1. Art Building – 35,493 square feet
2. Communication Building – 19,289 square feet
3. John F. Kennedy Library – 165,169 square feet
4. Martin Hall – 57,792 square feet
5. Music Building – 47,618 square feet
6. Radio / TV Building – 15,983 square feet
7. Science Building – 148,149 square feet
8. Theater / Drama Building – 36,130 square feet
9. Williamson Hall – 31,599 square feet
10. Eastern's Children Center – 14,865 square feet
11. Rozell Central Heating and Cooling Plant – 56,561 square feet
12. Sutton Hall – 31,984 square feet
13. Jim Thorpe Fieldhouse – 51,316 square feet
14. Pavilion – 119,658 square feet
15. Physical Education Activities Building – 93,856 square feet
16. Pence Union Building – 141,025 square feet

Note: The Rozell steam plant furnishes all the above buildings with high pressure steam for heat, hot water and other needs. The plant also supplies chilled water to all building air handling units, except in the Physical Education Activities Building Body Shop.

Reducing Scope 1 & 2 Emissions

Detailed Report

Energy Audit Building List

#	Name	Use	Year Built	GSF
	Buildings			
1	Art Building	Academic	1972	35,493
2	Communications Building	Academic	1970	19,289
3	John F. Kennedy Library	Academic	1998	165,159
4	Martin Hall	Academic	1982	57,792
5	Music Building	Academic	1970	47,618
6	Radio /TV Building	Academic	1972	15,983
7	Science Building	Academic	1994	148,149
8	Theatre Drama Building	Academic	1971	36,130
9	Williamson Hall	Academic	1977	31,599
10	Eastern's Children Center	Administrative	2001	14,865
11	Rozell - Central Heating and Cooling Plant	Administrative	2002	56,561
12	Sutton Hall	Administrative	1996	31,984
13	Jim Thorpe Fieldhouse	Athletic	1978	51,316
14	Pavilion (Reese Court)	Athletic	1975	119,658
15	Physical Education Activities (PEA)	Athletic	1972	93,856
16	Pence Union Building (PUB)	Auxiliary	1995	141,025
Subtotal		**-**		**1,066,477**

Reducing Scope 1 & 2 Emissions

Executive Report

B. SUMMARY OF FINDINGS BY BUILDING

McKinstry believes that air handling systems and their controls present the best opportunity for energy savings in these buildings. Each buildings' air handling system and its current condition are summarized below.

ART BUILDING

The building is served by three air handler units. AHU-1 and AHU-2 serve the second floor and the middle of the first floor through a variable volume, dual duct system with 100% OSA. AHU-2 has a dedicated exhaust fan system. The two units share a glycol run-around loop to recover energy from the tempered exhaust air, transferring heat to the incoming air. The air is then heated by a face-and-bypass steam pre-heat coil or cooled by a chilled water coil. The air leaving either coil is 55 degrees before going to the hot duct or cold duct. The hot duct has two low-pressure steam coils (5 pounds per square inch) that heat the air depending on what the duct reset temperature specifies. The final tempering of the air is accomplished at the zone level by dual duct Variable Air Volume (VAV) mixing boxes. This air handling unit and its respective boxes are controlled with Staeffa digital controls.

AHU-3 serves the Lithographic Studio. It is a constant volume air handling unit, ventilating and tempering 100% outdoor air. This unit tempers the outdoor air with an air-to-air heat recovery unit with a rated efficiency of 85%. The air is then heated to 55 degrees by a face-and-bypass steam preheat coil. This unit serves three duct coils each, with a hot water coil and a chilled water coil. The final tempering of the air is performed by the duct coils. The AHU and its coils are controlled with Staeffa digital controls.

AHU-4 serves the Woodshop and Studio. It is a constant volume air handling unit, ventilating and tempering 100% outdoor air. This unit initially tempers the outdoor air with an air-to-air heat recovery unit in the air handler with a rated efficiency of 85%. The air is then heated to 55 degrees by a face-and-bypass steam preheat coil. This unit serves three duct coils each, with a hot water coil and a chilled water coil. The final tempering of the air is performed by the duct coils. AHU-4 and each duct coil are controlled with Staeffa digital controls.

Due to the use of paint and other volatiles, this building has a large number of constantly-running exhaust fans, even in spaces where there are no people working and no exhibits that require fresh air.

B. SUMMARY OF FINDINGS BY BUILDING

ART BUILDING

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT

The Fine Arts Complex of the Eastern Washington University is comprised of five buildings: Art, Music, Theater, Radio and TV, and Communications on the south side of the EWU campus in Cheney Washington. McKinstry installed some variable frequency drives on the main air handling unit serving the Art Building as well as its dedicated main building exhaust fan. A preliminary energy audit was conducted on August 4, 2010 by McKinstry.

The Art Building (ART) was completed in 1972, and is the center of the Fine Arts Complex. It is a two story 35,000 square foot building. The exterior walls have red face brick over concrete masonry block walls. The Art Building houses a Digital Lab, a ceramics and sculpture studio, photography dark room, as well as studios for painting, drawing, and printmaking. In addition there are classrooms, exhibition area, and faculty offices and a lecture hall. The window areas are relatively small in square footage. The roof is comprised of a built up membrane roof. The occupancy rate is approximately 180 faculty/staff members and students, Mondays through Fridays throughout the school year. Operating hours are 7:00 AM to 8:30 PM through the school year. The summer has a reduced amount of hours and a much lower occupancy rate.

PREVIOUS ENERGY RETROFITS

No previous mechanical retrofit work was completed by McKinstry; however there was a lighting retrofit and HVAC upgrade in 97.

HEATING SYSTEM

Heating is provided to the Art Building by the Rozell Central Steam Plant. High pressure steam enters the building through the utility distribution tunnel and comes into the steam station at 110 psi. The steam is then reduced to 50 psi (medium pressure) which is used for the domestic hot water heater. The steam is reduced even further to 15 psi. The 15 psi steam is used in the steam pre-heat coils in the air handling units (AHU-1, 3, and 4) serving this building. The 15 psi steam is used to heat water that is used in duct heating coils 1 through 6. The hot water is heated through steam/water converters. The hot water serves the fin-tube convection heaters as well.

COOLING SYSTEM

Chilled water from the central plant is used in the cooling coils of the AHU's serving the Art Building.

AIR DISTRIBUTION SYSTEM

The building is served by (3) Air Handler Units. AHU 1 and AHU 2 serves the 2nd floor and the middle of the 1st floor. It is a variable volume, dual duct system with 100 % OSA. The unit has a dedicated exhaust fan system, AHU-2. AHU-1 has glycol run-around loop with AHU-2. This heat recovery coil recovers energy from the tempered air getting exhausted and transfers the heat to the outdoor air getting introduced to AHU-1. The air is then heated by a face and bypass steam pre-heat coil or cooled by a chilled water coil. The air leaving either coil is 55 degrees before going to the hot duct or cold duct. The hot duct has (2) low pressure steam coils (5 psig) that heat the air to the desired temperature depending on what the duct reset temperature is calling for. The final tempering of the air is accomplished at the zone level by dual duct VAV mixing boxes. This air handling unit and its respective boxes are controlled with Staeffa digital controls.

AHU-3 serves the Lithographic Studio. It is a constant volume air handling unit ventilating and tempering 100% outdoor air. This unit tempers the outdoor air with an air to air heat recovery unit in the air handler with a rated efficiency of 85%. The air is then heated to 55 degrees by a face and bypass steam preheat coil. This unit serves (3) duct coils each with a hot water coil and a chilled water coil. The final tempering of the air is performed by the duct coils. Each duct coil served by AHU 3 and the air handler itself are controlled with Staeffa digital controls.

AHU-4 serves the Woodshop and Studio. It is a constant volume air handling unit ventilating and tempering 100% outdoor air. This unit initially tempers the outdoor air with an air to air heat recovery unit in the air handler with a rated efficiency of 85%. The air is then heated to 55 degrees by a face and bypass steam preheat coil. This unit serves (3) duct coils each with a hot water coil and a chilled water coil. The final tempering of the air is performed by the duct coils. Each duct coil served by AHU 3 and the air handler itself are controlled with Staeffa digital controls.

Due to the use of paint, and other volatiles, this building has a large number of exhaust fans. It is believed that the exhaust fans running 24/7 is what is causing such an issue with the air balancing between the supply and exhaust. While on site and performing this survey, it was noted that all exhaust fans were running even in spaces where there weren't any people working or had exhibits that require the exhaust fans to be on.

SEQUENCE OF OPERATIONS:

1. The AHUs are running 6:00 am to 8:00 pm, Monday through Friday, Night setback is 55°F. Upon request the unit will run on weekends and when the outdoor air temperature is 20°F and below the air handlers will run 24/7.
2. Most of the exhaust fans are running 24/7 365 days a year.
3. There is no Cold Duct / Hot Duct Reset control strategies in place. This would be difficult to do on AHU-1 with the steam coils serving the hot duct.

AREAS OF INTEREST

1. AHU 1 is the Supply Fan and AHU2 is the Exhaust Fan. The face and bypass damper does not close tight.
2. A number of EF fans were not working: EF 8,9,11, 14, 16, 17 and 18. SF1 -possibly no belt.
3. An air balance of the entire system must be done in order to ensure that the system is working as intended. The Kiln exhaust fans should only operate when the Kiln's are in operation.
4. Additional Energy Saving control strategies could be employed.

Reducing Scope 1 & 2 Emissions

TABLE 1 AIR HANDLER UNITS

Name	AHU 1 (1)	AHU 2 (1)	AHU 3	AHU 4
Location	Rm 204	Rm 204	Roof	roof
Area Served	Supply Fan	2nd floor & middle of 1st floor	Lithography	Wood shop/Studio
Name Plate Data				
Make	Haakon	Haakon	Haakon	Haakon
Model number	AirPak			
Serial number				
Design Load (CFM)	36,0685 @6.5”wc			
Controls				
Type				
Supply Fan Data			8950 4.5” wc	8550 @4.5”wc
Make	Haakon		Pent Pak	Haakon
Model number	AirPak			Haakon
Serial number	97-5293-01		97-5293-03	97-5293-04
Voltage	230/460		230/460	230/460
Amperage	180/90		35.6/17.8	35.6/17.8
HP	75		15	15
Efficiency	94.1%			
Power Factor	82.5%			91.8
Frame Number	365T			
Motor Type (TEFC)	ODP		254T	254T
Actual Kw	56.7 @ 60 Hz (2)		7.72	7.5
Actual Volts	480		473	472
Actual Amps	75.8		13	13.1
Exhaust Fan Data				
Make		Haakon	Pent Pak	Haakon
Model number		AirPak		Haakon
Serial number		97-5293-02	97-5293-03	97-5293-04
Voltage		230/460	230/460	230/460
Amperage		63/31.5	35.6/17.8	35.6/17.8
HP		25	15	15
Efficiency		.917		
Power Factor		.81		91.8
Frame Number		284T		
Motor Type(TEFC)		ODP	254T	254T
Actual Kw		2.6 @ 30.8 Hz (2)	7.72	7.5
Actual Volts			473	472
Actual Amps			13	13.1
Type of system	VVDD 100%OSA	VVDD 100% OSA		
Steam Heat Data				
Pressure	Low			
Coil Type	Face & Bypass		Face & Bypass	Face & Bypass
Control Valve Set up	Single 2-way			

(1) AHU1 is the Supply Fan and AHU2 is the Exhaust Fan
(2) Entering side of VFD

Table 2 Pumps

Name	**P1 HW**	**P2 HW**	**P3 CHW**	**P4 CHW**	**P5 HRP**
Location	RM 204	RM 204	RM 204	RM 204	RM 204
Area Served	Reheat loop	Reheat loop			
Name Plate Data					
Make	B & G 80	B & G 80	B & G 80	B & G 80	B & G 80
Model number	1.5x7B6.500 BF	1.5x7B6.500 BF	3x7B6.625 BF	2.5 x 7 7.000BF	2.5 x 9.5
Serial number	2063746	2063747	2063458	2063441	2063472
Type	Century Inline	Century Inline	Century Inline	Century Inline	Century Inline
GPM/FT Head	40/48’	40/48’	112/32’	88/48’	157/70’
Voltage	200-230/460	200-230/460	200-230/460	200-230/460	200-208-230/460
Amperage	3.5-3.8/18	3.5-3.8 NL /18	9.1-8.8/4.4	6.2-6.4/3.2	2.2-21.5-21/10.5
HP	1	1	3	2	7.5
Efficiency	NL	NL	NL	NL	NL
Power Factor	NL	NL	NL	NL	NL
Frame Number	L143JM	L143JM	Y182JM	N145JM	S213JM
Actual Kw	.73	.8	1.05	1.31	4.8
Actual Volts	472	472	473	471	476
Actual Amps	1.78	1.85	3.24	2.88	8.5

Name	**EF 1**	**EF 2**	**EF 3**	**EF 4**	**EF 5**
Location					
Area Served	Flammable SR	Rm 202 Photo	Rm 202 Photo	Rm 111 G Kiln	Rm 111 H
Name Plate Data					
Make					
Model number					
Serial number					
Type					
Voltage					
Amperage					
HP					
Efficiency					
Power Factor					
Frame Number					
Actual Kw	2.4	.44	1.1	.33	.55
Actual Volts	123	476	477	122	475
Actual Amps	6.27	1.3	1.7	6	1.24
Motor Phase	1	3	3	1	3

Reducing Scope 1 & 2 Emissions

Name	**EF 6**	**EF 6**	**EF 6**	**EF 9**	**EF 10**
Location					
Area Served	Rm 209	Rms 208/209	Rm 111G (Kiln-Gas)	Rm 411 G (Kiln-Electric)	Rm 111 B/C (Welding)
Name Plate Data					
Make					
Model number					
Serial number					
Type					
Voltage					
Amperage					
HP					
Efficiency					
Power Factor					
Frame Number					
Actual Kw	2.2	.24			.9
Actual Volts	123	121			481
Actual Amps	4.26	4.3			1.4
Motor Phase			3	3	3

Name	**EF 11 (1)**	**EF 12**	**EF 13**	**EF 14 (2)**	**EF 15**
Location					
Area Served	Rm 111I (Kiln-Gas)	Rm 120-121 (RR)	Rm 207/208	Rm 206	Rm 114 D (Kiln Electric)
Name Plate Data					
Make					
Model number					
Serial number					
Type					
Voltage					
Amperage					
HP					
Efficiency					
Power Factor					
Frame Number					
Actual Kw		.37	.31		.52
Actual Volts		123	123	121	476
Actual Amps		5.3	6.8		1.47
Motor Phase	3	1	1	1	3

Note:

(1) EF 11 not running, no belt
(2) EF 14 not funning

Reducing Scope 1 & 2 Emissions

Name	**EF 16 (1)**	**EF 17 (1)**	**EF 18 (1)**	**SF 1 (2)**	**SF 2**
Location					
Area Served				RM 111G	
Name Plate Data					
Make					
Model number					
Serial number					
Type					
Voltage					
Amperage					
HP					
Efficiency					
Power Factor					
Frame Number					
Actual Kw				.17	.6
Actual Volts			122	476	481
Actual Amps			.2	1.1	1
Motor Phase				3	3

Note:
(1) Not running
(2) SF 1 possibly no belt

Name	**SF 3 (1)**	**SF 4**			
Location					
Area Served		114 D			
Name Plate Data					
Make					
Model number					
Serial number					
Type					
Voltage					
Amperage					
HP					
Efficiency					
Power Factor					
Frame Number					
Actual Kw		.1			
Actual Volts		477			
Actual Amps		.6			
Motor Phase					

Note:
(1) SF3 may not exist. No Starter.

Reducing Scope 1 & 2 Emissions

Executive Report

COMMUNICATION BUILDING

A single air handler, AHU-3, serves this entire building. The AHU is a constant volume, dual-duct system that serves 76 mixing boxes in the crawl space below the first floor and above the false ceilings on the first and second floors.

The air handler and its mixing boxes are pneumatically controlled. There is a Staeffa Control System interface with the pneumatic controls, however it appears that the dampers are not sealing completely, and the system is very limited in its energy management capabilities.

The chilled water coil has a 3-way valve which has been converted into a 2-way valve. There were several small exhaust fans for the toilets.

The overall condition of this system is poor. Constriction of outdoor ductwork shows that the air intake must be enlarged. The system has outlived its useful service life and should have the major components such as the air handler and the mixing boxes replaced.

Detailed Report

COMMUNICATION BUILDING

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT AUGUST 4 2010

The Fine Arts Complex of the Eastern Washington University is comprised of five buildings on the south side of the EWU campus in Cheney Washington. McKinstry has not previously completed retrofits of these buildings. A preliminary energy audit was conducted on the Communications Building, Art Building, Music Building, Radio & TV building, and Theater Building on August 4, 2010 by McKinstry. Due to the complexity of the buildings and their respective HVAC systems this survey took several days.

The Communications Building, completed in 1966, is a two story 19,000 sf cement masonry block building, with red face brick. Half of the building has a basement. The building consists of classrooms and faculty offices and is in operation from 8:00 AM to 8:00 PM during the academic year (September through May) and from 8:00 to 5:00 PM during the summer (June through August). The occupancy ratio is 50 faculty/staff and 500 students.

PREVIOUS ENERGY RETROFITS

No previous retrofit work was completed by McKinstry in this facility. There was a lighting retrofit done campus wide in the 2000 to 2001 time frame. The hallways in the Communications Building seem to be inadequate and under lit.

HEATING SYSTEM

The facility is heated by steam from the Central Plant at Rozell Hall. The steam from the plant enters the building at 110 psi and is reduced to medium pressure at 46 psi and then to low pressure at 12 psi through pressure regulation stations. The low pressure steam is used in the air handling unit steam coil via 1/3-2/3 steam control valves. There is currently no steam to water converter. The condensate return system employs a single pump Condensate pump.

COOLING SYSTEM

Chilled water from the central Plant at Rozell Hall is used in the Air Handler to provide cooling. The AHU has a tertiary chilled water booster pump for circulating the chilled water through the AHU's chilled water coil.

AIR DISTRIBUTION SYSTEM

There is one Air Handler, AH-3, which serves the entire building. The AHU is a constant volume, dual duct system that serves (76) mixing boxes located in the crawl space below the first floor and above the first floor's false ceiling. There are a few mixing boxes located above the 2nd floor's false ceiling. The air handler's outdoor air opening is too small and will need to be made larger. This is evident by the outdoor air ductwork constricting.

The air handler and its mixing boxes are pneumatically controlled. There is a Staefa Control System interface with the pneumatic controls, however it appears that the dampers are not sealing completely, and the system is very limited in its energy management capabilities. The chilled water coil has a 3-way valve which has been converted into a 2-way valve. There were several small exhaust fans for the toilets.

The overall condition of this system is not very good. The system has outlived its useful service life and should have the major components such as the air handler and the mixing boxes replaced.

SEQUENCE OF OPERATIONS

The air handler operates Monday through Friday, 6:00 am to 8:00 pm. The air handler will operate on weekends on request. When the outdoor air temperature is below 20°F, the air handler will run 24/7. It is believed that the AHU sometimes operates continuously during the cooling season. This is due to the operating schedules not being re-implemented. The air handler has a night setback temperature of 55°F.

The air handler doesn't have a morning warm-up / cool-down sequence or a morning purge sequence. When the unit starts up in the morning the dampers go to their minimum position.

There is no Cold Duct/Hot Duct Reset control strategy or economizer control strategy in place. Over all the controls capability for energy management is very limited.

FURTHER INVESTIGATIONS

Jim Butler, the EWU Plumbing supervisor noted that the steam station and the steam traps were in poor condition. They components of the steam station such as the gate valves and steam traps need to get replaced.

The condensate receiver next to the steam station has had and currently does have a leak which results in the condensate running out onto the floor in the mechanical room.

TABLE 1 AIR HANDLER UNITS

Name	**AH 3**
Location	Communications
Area Served	Communication
Name Plate Data	
Make	Trane
Model number	H-31
Serial number	K160757
Controls	
Type	Pneumatic/Steafa
Supply Fan Data	
Make	Marathon
Model number	
Serial number	

Voltage	208
Amperage	110
HP	40
Efficiency	NL
Power Factor	NL
Frame Number	324T
Motor Type (TEFC)	TDR-BE-ODP
Actual Kw	20.5
Actual Volts	204.5
Actual Amps	70.7
Return Fan Data	
Make	US Motor (uniclose)
Model number	
Serial number	
Voltage	208
Amperage	23
HP	7.5
Efficiency	NL
Power Factor	NL
Frame Number	213T
Motor Type(TEFC)	ODP
Actual Kw	5.4
Actual Volts	204.5
Actual Amps	20.8
Type of system	
Exhaust Fan	NA
Steam Heat Data	

Reducing Scope 1 & 2 Emissions

Pressure	LOW
Coil Type	Serpentine
Control Valve Set up	1/3-2/3

TABLE 2 PUMPS

Name	**CHW1**
Location	Communication
Area Served	Communications
Name Plate Data	
Make	Pacific
Model number	
Serial number	
Type	Base mtd end suction
GPM/FT Head	67/21’
Voltage	208
Amperage	26
HP	¾
Efficiency	NL
Power Factor	NL
Frame Number	J56
Actual Kw	0.59
Actual Volts	203.5
Actual Amps	2.21

Reducing Scope 1 & 2 Emissions

Executive Report

CHILDREN'S CENTER

A single VAV (Variable Air Volume) Pace custom air handler serves the entire building. The unit has a dedicated supply and return fan. An econo-disc is intended to adjust air volume, but it is out of order, so the system runs at constant volume.

The air handler serves 18 VAV boxes, with digital thermostats adjusting air volume for each zone. Each VAV box has a hot water reheat coil. The HVAC systems serving the Children's Center are controlled and monitored by obsolete Staeffa Digital Controls.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN CHILDREN'S CENTER (ECC)

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT AUGUST 4, 2010

OVERVIEW

The Eastern Children's Center (ECC) of the Eastern Washington University is on the south side of the EWU campus in Cheney Washington on the corner of Washington and Seventh Street. McKinstry has not previously completed any retrofits at this building. A preliminary energy audit was conducted on August 4, 2010 by McKinstry.

The ECC is a single story structure, 14,000 square foot red brick façade/stucco building which was completed in 2002 following the Phase 2 Campus Expansion. The Mechanical Room is in the attic and there is no basement. It currently provides full time, part time and after-school child care for 194 children from ages 6 weeks to 10 years old. The operating hours are 7:00 AM to 6 PM Monday through Friday all year. The security of the children is very important and access to the building is limited.

PREVIOUS ENERGY RETROFITS

The building was built in 2 phases with the first phase starting in 1999. The other phase started in 2000. Construction was completed in 2002/2003 time frame.

HEATING SYSTEM

The facility uses low pressure steam from the central Steam plant for the heating. The steam enters the building at 110 psi and is reduced to 33 psi and then to 12 psi through the steam steam station, which has 2 pressure reducing valves. The low pressure steam is used for AHU's preheat coil and for the steam/water converter for the reheat valves in the VAV boxes. A single pump in the condensate receiver is use for pumping the condensate back through the utility tunnels back to the central steam plant in Rozell. Heating hot water is circulated through-out the building by (2) redundant hot water pumps, HWHP 1 and HWHP 2 are

COOLING SYSTEM

Chilled water from the central chilled water plant is used in the cooling coil of the AHU. There are two fully redundant pumps that circulate the chilled water through the coil, CWP 1 and CWP2.

AIR DISTRIBUTION SYSTEM

There is one variable air volume air handling unit that serves the entire building. The air handler is a Pace custom air handler. The unit has a dedicated supply and return fan that utilize econo-disc for varying the volume of air. During our site survey McKinstry was informed that the econo-disc in the supply fan was not working as intended and thus the entire ventilation system has been operating in a constant volume mode of operation.

The air handler serves (18) VAV boxes that vary the volume of air according to what their respective zone is calling for as determined by its respective digital thermostat. Each VAV box has a hot water reheat coil. The HVAC systems serving the ECC are controlled and monitored by Staeffa Digital Controls, which are no longer supported.

Reducing Scope 1 & 2 Emissions

SEQUENCE OF OPERATIONS

1. The air handling unit operates from 4:00 am to 8:00 pm, Monday through Friday, operations on weekends are on request. When the outdoor air temperature is 20°F and below, the air handler runs continuously, 24/7. The night setback temperature is 55°F.
2. The air handler doesn't utilize morning warm-up / cool-down or morning purge.
3. The air handler doesn't utilize economizer control or supply air reset control strategies.
4. The heating hot water is not reset, and neither is the chilled water.

AREAS OF INTEREST

1. Econo-disk was disabled.
2. Complete change out of the existing Staeffa controls system with one of the approved vendors on campus. Implement the control strategies that are currently not employed.

Reducing Scope 1 & 2 Emissions

TABLE 1 AIR HANDLER UNITS

Name	AHU 1
Location	
Area Served	
Name Plate Data	
Make	Pace
Model number	PF-24 AF SWSI
Serial number	99-81625-01
Controls	
Type	STAEFA DDC
Supply Fan Data	
Make	Baldor
Model number	
Serial number	
Voltage	230/460
Amperage	40.6/20.3
HP	15
Efficiency	.91
Power Factor	.75
Frame Number	254T
Motor Type (TEFC)	
Actual Kw	8.6
Actual Volts	478
Actual Amps	15
	9200
Velocity	1877 rpm -11bhp
Return Fan Data	
Make	
Model number	PF-24 AF SWSI
Serial number	
Voltage	208-230/460
Amperage	13.7-13.2/6.6
HP	5
Efficiency	.875
Power Factor	.81
Frame Number	184T
Motor Type(TEFC)	
Actual Kw	2.4
Actual Volts	476
Actual Amps	4.8
Type of system	
Exhaust Fan	
	9200 @1.5 tsp
Velocity	1082 rpm–3.55bhp
Steam Heat Data	
Pressure	Low
Coil Type	Face & bypass
Control Valve Set up	na

Reducing Scope 1 & 2 Emissions

TABLE 2 PUMPS

Name	**HWH P1**	**HWHP 2**	**CWP 3**	**CWP 4**
Location	ECC			
Area Served	HEATING WATER	HEATING WATER	CHILLED WATER	CHILLED WATER
Name Plate Data				
Make	TACO	TACO	TACO	TACO
Model number	1911C1N14.4-1/00	1911C1N14.4-1/00	120-13.03-00	120-13.03-00
Serial number				
Type	Inline Circulator	Inline Circulator	Inline Circulator	Inline Circulator
GPM/FT Head				
Voltage	115/208-230	115/208-230	115	115
Amperage	5/2.4-2.5	5/2.4-2.5	3.6	1.76
HP	.25	.25	1/6	1/8
Efficiency	.55	.55	NL	NL
Power Factor	.57	.57	NL	NL
Frame Number	56C	56C	NL	NL
Actual Kw				
Actual Volts				
Actual Amps				
Velocity	1725 rpm	1725 rpm	1725 rpm	

Reducing Scope 1 & 2 Emissions

Executive Report

JIM THORPE FIELDHOUSE

The HVAC system consists of four AHUs. AHUs 1 and 2 serve the Fieldhouse; AHU-3 serves both racquetball courts; AHU-4 serves the hallway area between the Fieldhouse, Aquatics, and the Pavilion.

AHU 1, 2, and 3 each have return air capabilities, a pre-filter bank, and a steam pre-heat coil. AHUs 1 and 2 (referred to as H&V Units 1 & 2) supply tempered air through their respective rotating turret diffusers. The air from the Fieldhouse air handlers is unevenly distributed, causing problems with NCAA competitions when the high-velocity airflow actually interferes with game play, altering the trajectory of balls. The air handlers are pneumatically controlled. AHUs 1 and 2 each have just one control valve for their respective steam pre-heat coils. AHU-4 has a dedicated return fan.

Reducing Scope 1 & 2 Emissions

Detailed Report

JIM THORPE FIELD HOUSE

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT JULY 29, 2010

OVERVIEW

The Athletics Complex of the Eastern Washington University is comprised of several buildings on the west side of the EWU campus in Cheney Washington. McKinstry has previously completed retrofits of the HVAC, Controls, and Lighting systems in the Aquatics Building, most of the Physical Education Activities Buildings, Jim Thorpe Fieldhouse, The Pavilion (Reese Court), and the Physical Education Classroom (PEC) Building. A preliminary energy audit was conducted on the remaining systems not retrofitted in the PEA Building, Jim Thorpe Fieldhouse, and the Pavilion on July 29, 2010 by McKinstry.

JIM THORPE FIELD HOUSE

The Jim Thorpe Field House currently houses various indoor athletic activities such as various sports camps, ROTC, baseball team practices, golf, NCAA Tennis, and track and field all year long. The building is west of the PEA building complex, and can be accessed through the PEA building. It is a single story structure that has quite tall possibly 30 feet or higher. The facility, built in 1976, resembles an airplane hanger with neither basement nor windows. The conditioned floor space is 51,316 square feet. The walls from the exterior appear to be poured concrete and the roof is a built-up membrane roof.

PREVIOUS ENERGY RETROFITS

Previous retrofit work completed by McKinstry in this facility consisted of retrofitting (84) 1500W indirect HPS fixtures with energy efficient (6) lamp T5HO high Bay fixtures in 2007. Needless to say this single lighting retrofit resulted in a significant reduction in the electrical load.

HEATING SYSTEM

The heating system serving the Jim Thorpe Fieldhouse is provided by the Campus Central Steam Plant. The steam pressure coming into the building is 100 psi and is reduced to 15 psi steam at the steam station. The heating system serves (4) air handling units with steam pre-heat coils or a steam hot deck coil. Steam is also used for heating hot water via a converter, and then the hot water is used throughout the hallways between the Aquatics Building, the Pavilion, and the Fieldhouse. Low Pressure steam is also utilized by (3) steam unit heaters and (1) fan coil unit on the far south end of the field house. The steam traps for the main AHUs serving the Fieldhouse itself are not easily accessible. There is a reset schedule on the Hot water heating system. ATS controls the converter and hot water system. The horizontal condensate pipe has been reported to be in rough shape and thinning.

COOLING SYSTEM

There is only one air handling unit that has cooling capabilities. AHU 4 which serves the hallway area between the field house, Aquatics, and the Pavilion uses chilled water from the central chilled water plant in Rozell.

Reducing Scope 1 & 2 Emissions

AIR DISTRIBUTION SYSTEM

The HVAC system consists of four AHU's. AHU's 1 and 2 serve the Fieldhouse while AHU-3 serves the (2) Racquetball Courts, and then AHU-4 serves the Hallway area between the Fieldhouse, Aquatics, and the Pavilion.

AHU 1, 2, and 3 each have return air capabilities, pre-filter bank, and a steam pre-heat coil. AHUs 1 and 2 (referred to as H&V Units 1 & 2) supply their tempered air through their respective rotating turret diffusers. The air from these air handlers is not evenly distributed which causes problems with NCAA competitions when the high velocity of air interferes with the trajectory of the balls getting used in the particular competition taking place in the fieldhouse. The air handlers are pneumatically controlled. AHUs 1 and 2 each have just one control valve for their respective steam pre-heat coils.

AH-4 has a dedicated return fan.

SEQUENCE OF OPERATIONS

1. All (4) air handling units operate 24 hours a day seven days a week. Their energy management control capabilities are significantly limited to nonexistent.
2. No economizer controls or demand control ventilation control strategy.

AREAS OF INTERESTS

1. Replace all (4) air handling units with new air handling units and associated ductwork distribution systems for the fieldhouse area. Install all new digital controls on all (4) new AHUs and implement energy saving control strategies.
2. Replace all steam station valves and traps.

Reducing Scope 1 & 2 Emissions

Air Handling Units

Name	AHU 1	AHU 2	AHU 3	AHU 4 (listed as AH1)
Location	Thorpe Field House Roof	Thorpe Field House Roof	Thorpe Field House	Thorpe Field House
Area Served	Field House	Field House	Racquet ball court	Hallway btw Field house, aquatics and Pavilion
Name Plate Data				
Make	PACE	PACE	MCQUAY	MCQUAY
Model number	A-36 AF	A-36 AF	LHD 108CH	LML 108CH
Serial number	76-28103-01	76-28103-01	3 GA 00059	3 GA 00059
Supply Fan Data				
Make	Century	Century	WEG	Century
Model number	Not Labeled	Not Labeled	Not Labeled	Not Labeled
Serial number	Not Labeled	Not Labeled	Not Labeled	Not Labeled
Voltage	230/460	230/460	208-230/460	230/460
Amperage	25/12.5	25/12.5	3 -2.9/1.45	10/5
HP	10	10	1	3
Efficiency	Not Labeled	Not Labeled	85.5	0.81
Power Factor	Not Labeled	Not Labeled	.76	.69
Frame Number	5215T	5215T	E 143 15T	F182T
Motor Type (TEFC)	50	50	ENCL ODP	ENCL TE
Actual Kw	5.23	5.23	.45	1.77
Actual Volts	467.7	467.7	467.5	466.5
Actual Amps	8.7	8.7	1.23	4.13
Return Fan Data				
Make	NA	NA	NA	MCQUAY
Model number	NA	NA	NA	LML 108CI
Serial number	NA	NA	NA	3 FM 00041
Voltage	NA	NA	NA	230/460
Amperage	NA	NA	NA	5.2/2.6
HP	NA	NA	NA	1.5
Efficiency	NA	NA	NA	NA
Power Factor	NA	NA	NA	Not Labeled
Frame Number	NA	NA	NA	145T
Motor Type(TEFC)	NA	NA	NA	D
Actual Kw	NA	NA	NA	.83
Actual Volts	NA	NA	NA	471.3
Actual Amps	NA	NA	NA	2.24
Type of system	Constant Volume Variable Temperature	Constant Volume Variable Temperature	Constant Volume Variable Temperature	Constant Volume Multi-Zone
Exhaust Fan	NA	NA	NA	NA
Steam Heat Data				
Pressure	15 psi	15 psi	15 psi	15 psi
Coil Type	Serpentine coil	Serpentine coil	Serpentine coil	Serpentine coil
Control Valve Set up	1 Control Valve	1 Control Valve	1 Control Valve	1 Control Valve

Reducing Scope 1 & 2 Emissions

Table 1 Pumps

Name	**CHW1**	**HW Circ Pmp**
Location	Thorpe Field House	Thorpe Field House
Area Served	AHU 4 (AH-1)	Field House
Name Plate Data		
Make	TACO	TACO
Model number	Not Labeled	From Photo
Serial number	Not Labeled	From Photo
Type	In Line 1612/ 5.5/ C1N1 NO	Base Mounted end suction
GPM/FT Head	Not Labeled	From Photo
Voltage	230/460	From Photo
Amperage	2.2/1.1	From Photo
HP	½	From Photo
Efficiency	Not Labeled	From Photo
Power Factor	Not Labeled	From Photo
Frame Number	48	
Actual Kw		
Actual Volts		
Actual Amps		

Reducing Scope 1 & 2 Emissions

Executive Report

JOHN F. KENNEDY L IBRARY

There are 10 air handling units that serve this building. AHU 1 through AHU 7 are dual fan, dual duct VAV fan systems, each with a dedicated return fan. The hot duct supply fan, cold duct supply fan, and the corresponding return fan are all controlled with variable frequency drives. The VAV air handlers serve 193 dual-duct, VAV mixing boxes. These air handlers serve the general reading areas and offices throughout the library. The hot duct fan and the cold duct fan each have a heating hot water coil, while cold duct fans have chilled water coils. The hot duct fan receives 100% outdoor air while the cold duct fan mixes the outdoor air with the return air.

AHUs 8 and 9 serve the archive areas. Both of these air handlers are constant-volume, variable-temperature units that maintain humidity in their respective areas they serve. They have a direct expansion coil for cooling and dehumidification purposes. They also have heating hot water coils and humidifiers.
AHU-10 is a constant-volume, variable-temperature air handler serving the Auditorium. The air handler has a dedicated return fan, a hot water heating coil and a chilled water coil. It has the same operating hours as the other AHUs serving the library building, even though the auditorium sees intermittent use.

All of the HVAC systems are currently controlled by dated Staeffa digital controls, which are a growing maintenance burden due to the difficulty of finding replacement parts.

Reducing Scope 1 & 2 Emissions

Detailed Report

JOHN F. KENNEDY LIBRARY

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT - AUGUST 10, 2010

OVERVIEW

The John F. Kennedy Library of the Eastern Washington University is in the center of the EWU campus in Cheney Washington. McKinstry has previously completed minor retrofits in this facility. A preliminary energy audit was conducted on August 10, 2010 by McKinstry.

BUILDING NAME

The John F. Kennedy Library is a 153,000 square foot facility, originally completed in 1968 and was expanded and remodeled in 1998. It is widely viewed as one of the nicest facilities on the EWU campus. The exterior walls are comprised of red face brick and large areas of energy efficient Low E glazing. The exterior walls help give the building it's character. This building operates year round, but has reduced hours during the Summer and between session periods. There are 43 employees, and can serve up to 300 to 400 students/visitors daily. Normal operating hours are as follows: Monday-Thursday: 7:30am to 8pm, Friday: 7:30am to 6pm Saturday: Closed, and Sunday: 1pm to 8pm.

PREVIOUS ENERGY RETROFITS

McKinstry replaced all of the econo-disc in each of the Dual Fan Dual Duct VAV systems with VFDs in the JFK Library Building in 2003.

HEATING SYSTEM

High pressure steam comes into the building at 110 psi and then gets reduced to 50 psi and then again down to 15 psi. This is done at the steam reducing station. The medium pressure steam is utilized at the instantaneous DHW heater.

COOLING SYSTEM

Cooling is provided by the campus chilled water system. Chilled water is circulated from the Rozell building to the campus distribution loop. Chilled water is pumped at AHUs 1 through 7 and AHU-10 via small coil pumps. AHUs 8 and 9 use direct expansion coils for dehumidification purposes.

AIR DISTRIBUTION SYSTEM

There are 10 Air Handlers. AHU 1 through AHU 7 are Dual Fan, Dual Duct VAV fan systems. Each of these AHUs has a dedicated return fan. The Hot Duct supply fan, cold duct supply fan, and the corresponding return fan are all controlled with variable frequency drives. The VAV air handlers serve (193) dual duct variable air volume mixing boxes. These air handlers serve the general reading areas and offices throughout the library. The hot duct fan and the cold duct fan each have a heating hot water coil. The cold duct fan has a chilled water coil. The hot duct fan receives 100% outdoor air while the cold duct fan mixes the outdoor air with the return air.

AHU-8 and AHU-9 serve the archive areas. Both of the air handlers are a constant volume, variable temperature air handler. These units maintain the humidity in their respective areas they serve. They have a direct expansion coil for cooling and dehumidification purposes, heating hot water coil and humidifiers.

AHU-10 is a constant volume, variable temperature air handler that serves the auditorium. The air handler has a dedicated return fan. The AHU has a hot water heating coil and a chilled water coil. It has the same operating hours as the other AHUs serving the library building, even though the auditorium sees intermittent use.

All of the HVAC systems are currently controlled by the existing Staeffa Digital Control system. The Staeffa controls are becoming an ever increasing maintenance burden. It is becoming increasingly difficult to find and acquire replacement parts.

SEQUENCE OF OPERATIONS

The air handlers 1 through 7 and 10 run from 5:30 am till 10 pm Monday through Sunday year round. The Dual Fan Dual Duct VAV systems reset their respective hot ducts and cold ducts. EWU uses the economizer control strategy as well.

1. Implement a morning Warm-up / Cool-down and morning purge control strategy.
2. Implement a Demand Control Ventilation Control strategy in areas served by AHUs 1 through 7 and #10.
3. Event Scheduling on AHU#10.

AREAS OF INTEREST

1. There are very limited switching capabilities of the lighting. The light switches are in four quadrants.
2. There are a significant amount of HID fixtures at the north and south end of the building.
3. Retrofit the existing Staeffa Controls System with one of the approved controls contractors on campus.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

EWU - JFK Library
Date : 8/10/10 MK

	Data	AHU - 1	AHU - 2	AHU - 3
1	Area Served	Library Area	Library Area	Library Area
2	System Type	Dual Fan, DD, VAV	Dual Fan, DD, VAV	Dual Fan, DD, VAV
3	Manufacturer	Pace	Pace	Pace
4	Cold Deck Model Number	PF-33 AF SWSI	PF 30 AF SWSI	PF 30 AF SWSI
5	Cold Deck Serial Number	95-77261-01	95-77261-02	95-77261-03
6	Cold Deck CFM	22,345.00	16950	25825
7	TSP in W.C.	6.50	6	6.5
8	rpm		1694	1462
9	Bph		24.02	39.6
10	Hot Dec Model Number	PF-27 AS SWSI	PF 24AF SWSI	PF 30 AF SWSI
11	Hot Deck Serial Number	95-77261-01	95-77261-02	95-77261-03
12	Hot Deck CFM	14,120.00	11005	16800
13	TSP in W.C.	6.00	6	6
14	rpm		2117	1689
15	Bph		15.98	23.79
16	**Motor Name Plate Data (Cold Deck)**			
17	Manufacturer	Super -E	Super -E	Super -E
18	Voltage	230/460		
19	Amperage	95/47.5	72/30	118/59
20	HP	40.00	30	50
21	Motor Efficiency	63.60	92.4	93.1
22	Power Factor	NA	NA	NA
23	Frame	324T	286T	326T
24	Motor Type	ODP	DP	DP
25	Actual kW Measured	8.75	0.25	1
26	Actual Voltage Measured	?	484,487,487	484,487,487
27	Actual Amperage Measured	11.60	4.7, 4.9, 5	13.2,13.3,15.1
28	**Motor Name Plate Data (Return Fan)**			
29	Manufacturer	Reliance	Reliance	Reliance
30	Voltage	230/460		
31	Amperage	61./30.5	49/24.5	73/36.5
32	HP	25.00	20	30
33	Motor Efficiency	93.50	93	92.4
34	Power Factor	84.00	83.5	84
35	Frame	284T	256T	286T
36	Motor Type	ENCL (TEFC) P	P	P
37	Actual kW Measured	1.40	0.1	OFF .02
38	Actual Voltage Measured	478.00	484,488,488	484,488,488
39	Actual Amperage Measured	1.90	1.3, 1.8 , 2.1	OFF
40	**Motor Name Plate Data (Return Fan)**			
41	Return Fan Model Number	PF-27 AS SWSI	PF 30 AF SWSI	PF 36 AF SWSI
42	Return Fan Serial Number	95-77261-01	95-77261-02	95-77261-03
43	Return Fan CFM	22,345.00	16950	25825
44	TSP in W.C.	4.00	4	4
45	rpm		1513	1281
46	Bph		16.77	25.75

Table 2 Air Handler Units—Continued

EWU - JFK Library
Date : 8/10/10

	Data	AHU - 4	AHU - 5	AHU - 6	AHU - 7
1	Area Served	Library Area	Library Area	Library Area	Library Area
2	System Type	Dual Fan, DD, VAV	Dual Fan, DD, VAV	Dual Fan, DD, VAV	Dual Fan, DD, VAV
3	Manufacturer	Pace	Pace	Pace	Pace
4	Cold Deck Model Number	PF-30 AF SWSI	PF-30 AF SWSI	PF 30AF SWSI	PF 30AF SWSI
5	Cold Deck Serial Number	95-77261-04	95-77261-05	95-77261-06	95-77261-06
6	Cold Deck CFM	20440	16150	19660	19660
7	TSP in W.C.	6	6.5 @15.75	6.5	6.5
8	rpm			1844	1844
9	Bph	30.17	15.33	30.75	30.75
10	Hot Dec Model Number	PF-24 AS SWSI	PF-24 AS SWSI	PF 27 AF SWSI	PF 30AF SWSI
11	Hot Deck Serial Number	95-77261-04	95-77261-04	95-77261-06	95-77261-06
12	Hot Deck CFM	11580	10625	12690	19660
13	TSP in W.C.	6 .00	6 .00	6	6.5
14	rpm			1831	1844
15	Bph	17	15.33	17.86	30.75
16	**Motor Name Plate Data (Cold Deck)**				
17	Manufacturer	Super -E	Super -E	Super -E	Super -E
18	Voltage		230/460		
19	Amperage	96/48	74/37	95/47.5	74/37
20	HP	40	30	40	30
21	Motor Efficiency	94.5	93.6	93.6	93.6
22	Power Factor	NA	sf 1.15	NA	NA
23	Frame	324T	286T	324T	286T
24	Motor Type	DP	DP	DP	DP
25	Actual kW Measured	1.0 @ 38.2	1 @ 36.8	1.62 @ 43.6	.62 @ 4
26	Actual Voltage Measured	479/483/479	486	484/488/488	484/487/485
27	Actual Amperage Measured		6.5	13.1/11.7/12.2	8.5/11.2/8.8
28	**Motor Name Plate Data (Return Fan)**				
29	Manufacturer	Reliance	Reliance	Reliance	Reliance
30	Voltage				
31	Amperage	49/24.5	49/24.5	49/24.5	61/30.5
32	HP	20	20	20	25
33	Motor Efficiency	93	93	93	93.6
34	Power Factor	83.5	83.5 sf 1.15	83.5	84
35	Frame	256T	256T	256T	284T
36	Motor Type	P	P	P	P
37	Actual kW Measured	.02 @ 0	.03 @ 0.0	.8 @27	0 @ 0
38	Actual Voltage Measured	483 AVER.	483		482/486/484
39	Actual Amperage Measured	0.03	0.17	2.4/1.8/1.5	
40	**Motor Name Plate Data (Return Fan)**				
41	Return Fan Model Number	PF-30 AF SWSI	PF-30 AF SWSI	PF 30 AF SWSI	PF 30 AF SWSI
42	Return Fan Serial Number	95-77261-04	95-77261-05	95-77261-06	95-77261-07
43	Return Fan CFM	20440 @ 30.17	16250	17190	18250
44	TSP in W.C.	4	4	4	4
45	rpm		1775	1557	1573
46	Bph	21.94		18.09	18.57

Table 3 Air Handler Units—Continued

EWU - JFK Library
Date : 8/10/10

	Data	AHU - 8	AHU - 9	AHU - 10
1	Area Served	Archives Room	Archives Room	Auditorium
2	System Type	CV Variable Temp	CV Variable Temp	CV Variable Temp
3	Manufacturer	Pace	Pace	Pace
4	Cold Deck Model Number	SCF-124A MI	97A 113A MI	PF 18 AF SWSI
5	Cold Deck Serial Number	95-77261-08	95-77261-9	95-76844-01
6	Cold Deck CFM	2000	1000	4500
7	TSP in W.C.	1.5	1.5	1.75
8	rpm	1439	2176	1777
9	Bph	1.25	0.62	2.12
10	Hot Dec Model Number			
11	Hot Deck Serial Number			
12	Hot Deck CFM			
13	TSP in W.C.			
14	rpm			
15	Bph			
16	**Motor Name Plate Data (Cold Deck)**			
17	Manufacturer	Magnetek E Plus	Baldor	Magnetek E Plus
18	Voltage	230/460	208-230/460	230/460
19	Amperage	7.8/3.9	5.9-5.6/2.8	7.8/3.9
20	HP	3	2	3
21	Motor Efficiency	86.5	84.9	86.5
22	Power Factor	NA	?	NA
23	Frame	5182T	145T	5182T
24	Motor Type	Class B	Class B	SCE
25	Actual kW Measured	0.9	0.82	1 (CV)
26	Actual Voltage Measured	484/487/485	484/488/487	478/482/484
27	Actual Amperage Measured	2.4/2.5/2.8	1.8/1.8/2.1	3.4/3.2/3.2
28	**Motor Name Plate Data (Return Fan)**			
29	Manufacturer			
30	Voltage			
31	Amperage			
32	HP			
33	Motor Efficiency			
34	Power Factor			
35	Frame			
36	Motor Type			
37	Actual kW Measured			
38	Actual Voltage Measured			
39	Actual Amperage Measured			
40	**Motor Name Plate Data (Return Fan)**			
41	Return Fan Model Number			PF 18 AF SWSI
42	Return Fan Serial Number			95-76844-01
43	Return Fan CFM			4500
44	TSP in W.C.			1
45	rpm			1612
46	Bph			1.44

Reducing Scope 1 & 2 Emissions

Table 4 Pump Units

EWU - JFK Library

Data	Pump - 1	Pump - 2	Pump - 3
Area/System/Equipment Served	Hot Water	Hot Water	Chilled water AHU1
Pump Type	Floor mtd Centrifugal	Floor mtd Centrifugal	
Manufacturer	TACO	TACO	TACO
Model Number			VI2506
Serial Number			
GPM			130
Ft of Head			30
Motor Name Plate Data			
Manufacturer	Super E	Super E	BALDOR
Model Number	EM2589T	EM25898T	
Serial Number		35110	
Voltage	230/460	230/460	230/460
Amperage	95/47.5	95/47.5	4.2/2.1
HP	40	40	1.5
Motor Efficiency	93.5	93.5	87.5
Power Factor			
Frame			145JM
Motor Type			TEFC
Actual kW Measured	17.1		1.1
Actual Voltage Measured	479		477
Actual Amperage Measured	23.1		1.7

Table 5 Pump Units—Continued

Data	Pump - 4	Pump - 5	Pump -8	Pump - 7
Area/System/Equipment Served	AHU -2	AHU-3	AHU- 6	AHU -5
Pump Type	In Line	In Line	In Line	In Line
Manufacturer	TACO	TACO	TACO	TACO
Model Number	VI25006b2h	VI3006b2hsab (?)	VI 2508	
Serial Number				
GPM	110	220	140	135
Ft of Head	25	25	25	25
Motor Name Plate Data				
Manufacturer	BALDOR Super E	BALDOR Super E	BALDOR Super E	BALDOR Super E
Model Number				
Serial Number				
Voltage	230/460	230/460	230/460	230/460
Amperage	4.2/2.1	9/4.5	4.2/2.1	4.2/2.1
HP	1.5	3	1.5	1.5
Motor Efficiency	87.5	89.5	87.5	87.5
Power Factor				
Frame	145JM	182JM	1457M	1457M
Motor Type	Class F	TE	CLASS F	CLASS F
Actual kW Measured	0.54	1.5	0.6	0.6
Actual Voltage Measured	484	484	484	481
Actual Amperage Measured	1.8	3.8	1.8	1.8

Class F motor

Table 6 Pump Units—Continued

EWU - JFK Library

Data	**Pump - 6**	**Pump - 9**	**Pump - 10**
Area/System/Equipment Served	AHU-4	AHU-7	AHU-10
Pump Type	In Line	In Line	In Line
Manufacturer	TACO	TACO	TACO
Model Number		VI 2508	
Serial Number			
GPM	125	139	
Ft of Head	25	25	
Motor Name Plate Data			
Manufacturer	BALDOR Super E	BALDOR Super E	EVERSON (?)
Model Number			
Serial Number			
Voltage	230/460	230/460	230/460
Amperage	4.2/2.1	4.2/2.1	3/1.5
HP	1.5	1.5	0.45
Motor Efficiency	87.5	87.5	
Power Factor			
Frame	1457M	1457M	
Motor Type	CLASS F	CLASS F	
Actual kW Measured	0.6	0.6	0.5
Actual Voltage Measured	484	484	484
Actual Amperage Measured	1.8	1.8	1.5

Reducing Scope 1 & 2 Emissions

Executive Report

MARTIN HALL

Approximately 80% of the conditioned square footage in Martin Hall is served by the dual-fan, dual-duct VAV air handling system. The cold duct supply fan is located on the first floor of Martin Hall while the hot duct fan is located directly above the cold duct fan on the second floor. Both air handlers bring in outdoor air and mix it with return air from the plenum. There is one return air fan that serves both supply fans. The cold duct fan has a chilled water coil but no pre-heat coil. The hot duct fan has a steam heating coil that heats the mixed air to the desired set point of the hot duct. This air handling system serves VAV mixing boxes throughout the areas served by this air handling system. The cold duct fan is labeled AHU-1 and the hot duct fan is labeled AHU-2.

The lab area on the 2nd floor is served by AHU-3, which ventilates and tempers 100% outdoor air. The AHU has an air-to-air heat exchanger that tempers the outdoor air with the exhaust air, the air is then heated with a steam coil, and cooled with a direct expansion coil. The corresponding condensing unit is on the roof by AHU-4's penthouse mechanical room.

The Auditorium is served by AHU-4, a constant volume, variable temperature air handing unit with return air capabilities but no return fan. This air handler has a chilled water coil and a steam heating coil. There have been ongoing comfort complaints. The zones at the end of the duct run appear to be starved for air.

Reducing Scope 1 & 2 Emissions

Detailed Report

MARTIN HALL

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT AUGUST 18, 2010.

OVERVIEW

Martin Hall is located in the center of Eastern Washington University campus in Cheney, Washington. McKinstry has not previously completed any retrofits. A preliminary energy audit was conducted on August 18, 2010 by McKinstry.

MARTIN HALL

Martin Hall is a two-story, 57,000 square foot masonry brick structure which was completed in 1937. It houses the departments of Education and Counseling, as well as Educational and Developmental Psychology and has classrooms and faculty offices. The operation hours are from 7:00 am until 7:00 pm, Monday through Friday during the academic year and reduced operating hours during the summer. The occupancy is 31 faculty/staff to 750 students.

PREVIOUS ENERGY RETROFITS

In 2003, McKinstry implemented some energy efficiency retrofits. Variable frequency drives and digital controls were installed on the HVAC equipment serving Martin Hall. Energy saving control strategies were implemented.

HEATING SYSTEM

Heating is provided to Martin Hall by the Rozell Central Steam Plant. High pressure steam enters the building through the utility distribution tunnel and comes into the steam station at 110 psi. The steam is then reduced to 50 psi (medium pressure) which is used for the domestic hot water heater. The steam is reduced even further to 15 psi. The 15 psi steam is used in the steam pre-heat coils in the air handling units (AHU-1/2, 3 and 4) serving this building. The hot water is heated through a steam/water converter. The hot water serves the fin-tube convection heaters as well. There are (2) hot water pumps that circulate water throughout Martin Hall.

COOLING SYSTEM

Chilled water from the central plant is used in the cooling coils of the cold duct supply fan. There is a single chilled water pump that circulates chilled water to AHU-1 and AHU-4.

AIR DISTRIBUTION SYSTEM

Approximately 80% of the conditioned square footage in Martin Hall is served by the dual fan, dual duct variable air volume air handling system. The cold duct supply fan is located on the first floor of Martin Hall while the hot duct fan is located directly above the cold duct fan on the 2nd floor. Both air handlers bring in outdoor air and mix it with return air from the plenum. There is one return air fan that serves both supply fans. The cold duct fan has a chilled water coil but no pre-heat coil. The hot duct fan has a steam heating coil that heats the mixed air to the desired set point of the hot duct. This air handling system serves variable air volume mixing boxes throughout the areas served by this air handling system. The cold duct fan is labeled

AHU-1 and the hot duct fan is labeled AHU-2.

The lab area on the 2nd floor is served by AHU-3. AHU-3 ventilates and tempers 100% outdoor air. The AHU has an air to air heat exchanger that tempers the outdoor air with the exhaust air, the air is then heated with a steam coil, and cooled with a direct expansion coil. The corresponding condensing unit is on the roof by AHU-4's penthouse mechanical room.

The auditorium is served by AHU-4. AHU-4 is a constant volume, variable temperature air handling unit with return air capabilities but no return fan. This air handler has a chilled water coil and a steam heating coil.

SEQUENCE OF OPERATIONS

1. The air handlers are on a start/stop schedule from Monday through Friday.
2. The Cold Duct and Hot Duct are reset.
3. AHUs 3 and 4 are on a similar start/stop schedule.

AREAS OF INTEREST

1. RCx of the existing controls systems.
2. Evaluation of the existing energy saving control strategies.

Reducing Scope 1 & 2 Emissions

TABLE 1 – AIR HANDLER UNITS

EWU - Martin Hall

Data	AHU - 1 / 2	AHU - 3	AHU - 4
Area Served	80% of Martin Hall	Lab on 2nd floor	Auditorium
System Type	Dual Fan DD VAV	CV VT	CVVT w/ RF
Manufacturer	Pace	Carrier	Pace
Cold Deck Model Number	P-49AF-SI	39BA050815	PF-22AF-SWSI
Cold Deck Serial Number	81-40670-01	P14092358	95-76845-02
Cold Deck CFM			7200
TSP in. W.C.			2.5
Hot Deck Model Number	PF-27AF-SI		
Hot Deck Serial Number	81-40670-02		
Hot Deck CFM			
TSP in. W.C.			
Motor Name Plate Data (Cold Deck)			
Manufacturer	Reliance	Baldor	Magnetek
Voltage	230/460	230/460	208V
Amperage	120/60	3.2 / 1.6	28 Amps
HP	50	1	10
Motor Efficiency	94.1	n/a	89.50%
Power Factor	83.5	n/a	85.50%
Frame	326T	143T	S215T
Motor Type	ODP	TEFC	ODP
Actual kW Measured	39.3	1.07	5.8
Actual Voltage Measured	482	484.3	206.1
Actual Amperage Measured	50	1.56	21.3
Motor Name Plate Data (Hot Deck)	AHU-2		
Manufacturer	Reliance		
Voltage	230/460		
Amperage	50/25		
HP	20		
Motor Efficiency	91.7		
Power Factor	82%		
Frame	256T		
Motor Type	ODP		
Actual kW Measured	2.09		
Actual Voltage Measured	484		
Actual Amperage Measured	3.3		
Motor Name Plate Data (Return Fan)	RF-1 / EF-1	EF-4	Pace
Return Fan Model Number	6MH-1016	Inaccessable	PF-30AF-SWSI
Return Fan Serial Number	81-102-018		95-76845-01
Return Fan CFM			7200
TSP in. W.C.			1.1
Manufacturer	Reliance		Magnetek
Voltage	230/460		200
Amperage	59.4/29.7		9
HP	25		3
Motor Efficiency	91.6		85.50%
Power Factor	84.5		86.50%
Frame	284T		S182T
Motor Type	TEFC		ODP
Actual kW Measured	2.6	0.85	2
Actual Voltage Measured	484	480	206.1
Actual Amperage Measured	12	2.39	7.1 amps

Reducing Scope 1 & 2 Emissions

TABLE 2 – PUMPS

EWU - Martin Hall

Data	Pump - 1	Pump - 2	Pump - 3
Area/System/Equipment Served	HW - Base board	HW - Base board	CHW - Cold Deck
Pump Type	In-line Centrifugal	In-line Centrifugal	Basement
Manufacturer	Taco	Taco	Taco
Model Number			BB 3008
Serial Number			
GPM			224
Ft of Head			42
Motor Name Plate Data			
Manufacturer	GE	GE	Gould
Model Number	5K458G1133H	5K458G1133H	
Serial Number			
Voltage	230/460	230/460	230/460
Amperage	5.6 / 2.8	5.6 / 2.8	12.4/6.2
HP	1.5	1.5	5
Motor Efficiency			87
Power Factor			87.4
Frame	56	56	5184T
Motor Type	ODP	ODP	ODP
Actual kW Measured	0.93	0.93	3.7
Actual Voltage Measured	4.33	4.33	487
Actual Amperage Measured	1.98	1.98	4.9

Reducing Scope 1 & 2 Emissions

Executive Report

MUSIC BUILDING

The building has two air handling units, AH-1 and AH-2. AH-1 serves the entire Music building while AH-2 serves the recital hall.

AH-1 is a constant volume, dual duct system. The supply fan is located in sub-grade mechanical room off of the first floor while its corresponding return fan is located in a penthouse mechanical room. This system serves constant-volume mixing boxes located throughout the Music Building. This ventilation system is controlled with old pneumatic controls that are very limited in their energy saving control capabilities. This system has outlived its useful service life.

HVAC Shop Supervisor Robert "Gum" Carlson says that the zones at the end of the duct runs cannot deliver the proper airflow. An analysis by Eastern Washington University engineering staff showed that the AHU system was undersized.

AHU-2 serves the recital hall and is a constant-volume, multi-zone unit with four zones and a dedicated return fan. The controls on this air handling unit are of an unusual pneumatic design and need further investigation. The AHU itself is very loud, drawing complaints from occupants. There is significant attenuation according to the drawings already in place so this investigation will be critical to the successful retrofit of this system.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/**MUSIC BUILDING**

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT **AUGUST 4, 2010**

OVERVIEW

The Fine Arts Complex of the Eastern Washington University is comprised of five buildings: Art, Music, Theater, Radio and TV, and Communications on the south side of the EWU campus in Cheney Washington. McKinstry has not previously completed retrofits of this complex. A preliminary energy audit was conducted on August 4, 2010 by McKinstry.

MUSIC BUILDING

The Music Building (MUS) is part of the Fine Arts Complex which was completed in 1970. It is a two story 47,000 square foot concrete masonry block building with red face brick. The roof appears to be built up felt and tar. The building has faculty offices, 32 practice rooms, several music laboratories, music classrooms, two large rehearsal rooms (vocal and instrumental) and a 250-seat capacity recital hall. Windows are double pane. The occupancy ratio is 10 faculty/staff members and 200 students. Operating hours for the classroom area are 7:00AM to 7:00PM year round.

PREVIOUS ENERGY RETROFITS

No previous mechanical retrofit work was completed by McKinstry in this facility. A previous lighting retrofit was done in the 1990's.

HEATING SYSTEM

The heating system serving the Music building is provided by the campus central steam plant. The steam pressure coming into the building is 110 psi and is reduced to 35 psi steam at the steam station and then further reduced to 14 psi at the pressure regulating stations. The medium pressure steam is used to heat the domestic hot water, while the low pressure steam is used for building heat and the humidifiers. The air handlers have low pressure steam pre-heat coils.

COOLING SYSTEM

Chilled water from the central plant is used in the cooling coils of both AHUs.

AIR DISTRIBUTION SYSTEM

The building has two air handlers, AH1 and AH2. Air Handler 1 serves the entire Music building while AH-2 serves the recital hall. AH-1 is a constant volume, dual duct system. The supply fan is located in sub-grade mechanical room off of the first floor while its corresponding return fan is located in a penthouse mechanical room. This system serves constant volume mixing boxes located throughout the Music Building. This ventilation system is controlled with old pneumatic controls that are very limited in their energy saving control capabilities. This system has outlived its useful service life.

The HVAC Shop Supervisor, Robert "Gum Carlson, offered that the areas at the end of the duct runs were not satisfied. He referenced an analysis done by the internal engineering folks at EWU, who showed that the AHU system was undersized.

Reducing Scope 1 & 2 Emissions

AH 2 serves the recital hall and is a constant volume multi-zone unit with (4) zones and a dedicated return fan. The controls on this air handling unit are pneumatic. The control set up has unusual set up and needs to be further investigated. One of the major complaints of this air handling system is that it has been very loud. There is significant attenuation according to the drawings already in place so this investigation will be critical to the successful retrofit of this system.

SEQUENCE OF OPERATIONS

- AH-1 operates 24/7 year round due to having to maintain relative humidity setpoints.
- No Cold / Hot Duct Resets.
- No economizer control strategies.
- AH-2 runs intermittently due to noise. There is significant sound attenuation in the ductwork distribution system as well as at the air handler itself.

FURTHER INVESTIGATION

- AH-1 air handler and corresponding mixing boxes replacement
- AH-2 air handler replacement
- Recital Hall Air Handler Noise
- AH-1 possibly could be undersized.
- The Mechanical Room has a variety of incandescent light bulbs, 150 W, 200 W and 300 W. Potentially easy savings if the lights were retrofitted.
- AHU 2 control valve has an unusual set up.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

Name	AHU 1	AHU 2
Location	MUSIC	MUSIC
Area Served	All but Recital Hall	Recital Hall
Name Plate Data		
Make	Trane Climate Changer	Trane Climate Changer
Model number	H-63 DD	31
Serial number	K149732	U93303
Controls		
Type	Pneumatic w/ Staefa Interface	Pneumatic
Supply Fan Data		
Make	Century	Century
Model number		
Serial number		
Voltage	230/460	230/460
Amperage	140/70	40/20
HP	60	15
Efficiency	NL	NL
Power Factor	NL	NL
Frame Number	364T	254T
Motor Type (TEFC)	ODP	ODP
Actual Kw	35.7	10.7
Actual Volts	484.4	482
Actual Amps	51.5	17
Return Fan Data		
Make		American Air Filter
Model number		H22LPHVFYA
Serial number		479-968-02
Voltage	230/460	230/460
Amperage	24/12	13.6/6.8
HP	10	5
Efficiency	89.5	NL
Power Factor	85.5	NL
Frame Number	D215T	184T
Motor Type(TEFC)	ODP	ODP
Actual Kw	4.85	2.7
Actual Volts	486	483
Actual Amps	8	5.6
Type of system		CVMZ
Exhaust Fan	EF2	
Steam Heat Data		
Pressure	Low	Low
Coil Type	Serpentine	Serpentine
Control Valve Set up	1/3-2/3	1/3-2/3

Table 2 Pumps

Name	CHW1	CHW2
Location	Music	Music
Area Served	AH1	AHU2
Name Plate Data		
Make	Century motor	Pacific w/ Marathon motor
Model number		
Serial number		
Type	ODP	TEFC
GPM/FT Head	130/37	72/37
Voltage	230/460	230/460
Amperage	10/5	2/4/1.2
HP	3	1.5
Efficiency	NL	NL
Power Factor	NL	NL
Frame Number	S182T	145T
Actual Kw	1.9	
Actual Volts	484	
Actual Amps	4.5	

Table 3 Fans

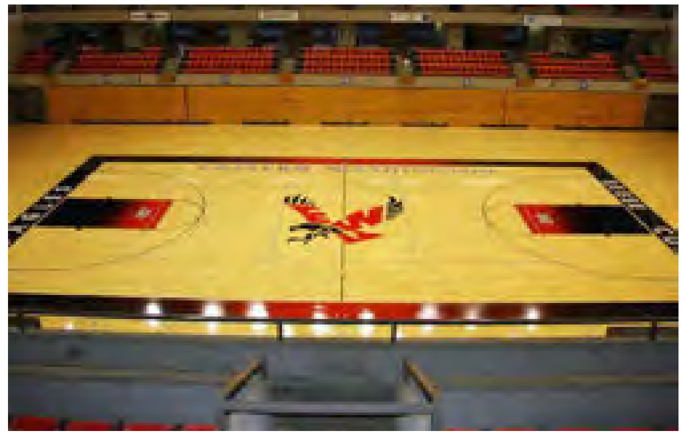
Name	EF 1	EF 2
Location		Mechanical Room
Area Served		AH1
Name Plate Data		
Make		Magnetek
Model number		
Serial number		
Type		
Voltage		230
Amperage		3.6/1.7
HP		1
Efficiency		77.8
Power Factor		74
Frame Number		
Actual Kw		.5
Actual Volts		487
Actual Amps		1.6

Reducing Scope 1 & 2 Emissions

Executive Report

PAVILION

The HVAC system consists of four constant volume variable temperature air handler units and one constant-volume, multi-zone unit. AHU 1 and 2 serve areas on the first floor beneath the Coliseum: meeting rooms, conference rooms, locker rooms, bathrooms, and the training room. AHU-3 serves the equipment issue room. AHU 4 and 5 serve the Coliseum court and seating areas. All five of these units have pneumatic controls.



AHU-1 is a heat-only unit that has return air capabilities, a dedicated return fan, a pre-filter and a serpentine steam pre-heat coil.

AHU-2 has a pre-filter, a dedicated return fan, a steam pre-heat coil and a chilled water coil for the hot deck and cold deck.

It serves two separate zones. AHU-3 is a four-pipe vertical fan coil unit serving the athletic equipment room.

AHU-4 and AHU-5 are both built-up air handing units. They each have a dedicated return air system and return fan. The axial-vane supply and return fans have sound attenuators that create a significant pressure drop. All of the systems are controlled pneumatically and are limited in the energy saving capabilities. The equipment and systems have outlived their useful service lives.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/THE PAVILION

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT JULY 29, 2010

OVERVIEW

The Athletics Complex of the Eastern Washington University is comprised of several buildings on the west side of the EWU campus in Cheney Washington. McKinstry has previously completed retrofits of the HVAC, Controls, and Lighting systems in the Aquatics Building, most of the Physical Education Activities Buildings, Jim Thorpe Fieldhouse, The Pavilion (Reese Court), and the Physical Education Classroom (PEC) Building. A preliminary energy audit was conducted on the remaining systems not retrofitted in the PEA Building, Jim Thorpe Fieldhouse, and the Pavilion on July 29, 2010 by McKinstry.

THE PAVILION

The Special Events Pavilion (Reese Court), completed in 1975, is a multiuse facility which seats 5000. It is primarily the University's basketball court, but also houses concerts, dances, and graduations ceremonies year round. In addition it has training rooms and locker rooms for volleyball, wrestling, and football teams as well as business offices. The building is a two story 119,000 sf structure where the center court (107 X 171 feet) is below grade, and seating is at grade level and mezzanine level. Most of the equipment, training and locker rooms are located on the lower level. The walls from the exterior appear to be poured concrete and the roof is a built-up membrane roof. The windows are tinted low-E thermo pane windows.

PREVIOUS ENERGY RETROFITS

Previous retrofit work completed by McKinstry in this facility consisted of a lighting retrofit in 2007.

HEATING SYSTEM

The heating system serving the Pavilion is provided by the Campus Central Steam Plant. The steam pressure coming into the building is 100 psi and is reduced twice. The steam goes through a reducing station where it is first reduced to 25 psi and then again to 15 psi steam. The 25 psi steam is used for the domestic water system

The heating system serves five air handling units with steam pre-heat coils. Steam is also used for heating hot water via a converter. The heating hot water is used for unit heaters, fan coil units and baseboard heaters. There is a reset schedule on the hot water heating system.

Medium pressure steam is used for domestic hot water (DHW).

Kerry Pease's office is heated by the unit heaters. The Eastside and the Westside offices are each served by (4) 4-pipe return air only fan coil units.

COOLING SYSTEM

The cooling system uses chilled water from the central chilled water plant in Rozell. Chilled water is used in all but one of the air handling units.

Reducing Scope 1 & 2 Emissions

AIR DISTRIBUTION SYSTEM

The HVAC system consists of four (4) constant volume variable temperature air handler units and (1) constant volume multi-zone unit. AHU 1 and 2 serves the areas on the first floor underneath the seating areas in the coliseum. The spaces served by these units consist of meeting rooms, conference rooms, locker rooms, bathrooms, and the training room. AHU-3 serves the equipment issue room. AHU-4 and AHU 5 serves the coliseum court, and seating areas. All (5) of these units are controlled with pneumatic controls.

AHU-1 is a heating only air handing unit that has return air capabilities and a dedicated return fan. This air handling unit has a pre-filter, and a serpentine steam pre-heat coil.

AHU-2 has a pre-filter, and a dedicated return fan. The air handling unit has a steam pre-heat coil and a chilled water coil for the hot deck and cold deck. The multi-zone unit serves 2 separate zones.

AHU-3 is could be classified as a 4-pipe vertical fan coil unit. This unit serves the athletic equipment room.

AHU-4 and AHU-5 are both built up air handing units. They each have a dedicated return air system and return fan. Their respective fans are axial vane fans on the supply and return fans. Due to the type of fan that is installed there is sound attenuators on the supply and discharge side of each fan, which adds a significant pressure drop.

SEQUENCE OF OPERATIONS

1. The AHUs run 24/7.
2. There are no reset schedules or other basic control strategies.
3. There is no HW reset schedule.

AREAS OF INTEREST

1. The Training areas and offices have problems with ventilation. Training Room appears to have no ventilation, although there was ductwork in the hung ceiling. It could not be determined at the time of the audit where these ducts ran. Which air handler serves the locker rooms also needs to be determined.
2. AHU 1 has an OA intake source off of a parking lot.
3. The East side and West side offices are served by return air only fan coil units, which could be replaced by air handling units on the roof.
4. AHU 4 & 5 supply and return fans are dual rated. The Supply Fan is listed with a 30 HP and a 37 HP motor. The Return fan is listed as a 15 HP and a 20.4 HP motor. There might be some redundancy in motor capacity.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

Name	AH 1	AH 2	AH3	AH4	AH5
Location	Pavilion	Pavilion	Pavilion	Pavilion	Pavilion
Area Served	Mezzanine and seating	Mezzanine and seating	Equipment Issue Room	Coliseum Court Area	Coliseum Court Area
Name Plate Data					
Make		McQuay	McQuay	Joy	Joy
Model number		MMM-214-CM		54-26.5-1150	54-26.5-1150
Serial number		955385		SF32112-1	SF32112-1
Controls					
Type	Shaw Pneumatic	Shaw Pneumatic			
Supply Fan Data					
Make	Not Labeled	Magnetek		Reliance	Reliance
Model number	Not Labeled	Not Labeled			
Serial number	Not Labeled	Not Labeled			
Voltage	230/460	230/460	230/460	230/460	230/460
Amperage	20/10	26/13	5/2.5	96/48	96/48
HP	7.5	10	1.5	37.5	37.5
Efficiency	Not Labeled	88.5			
Power Factor	Not Labeled	82			
Frame Number	D213T	215T	145T		
Motor Type (TEFC)		SC	SC		
Actual Kw	2.55	3.5	.58	22.9	22.9
Actual Volts	4.81	479	478	479.9	479.9
Actual Amps	5.6	7.1	1.95	33.9	33.9
Return Fan Data					
Make	Century	NA	NA	Reliance	Reliance
Model number		NA	NA		
Serial number	613	NA	NA		
Voltage	230/460	230/460	NA	230/460	230/460
Amperage	6/3	9.6/4.8	NA	60/30	60/30
HP	2.0	3	NA	20.4	20.4
Efficiency	NA	NA	NA		
Power Factor	NA	NA	NA		
Frame Number	N145	S182T	NA	286	286
Motor Type(TEFC)	NA	ODD	NA		
Actual Kw	1.33	2.3	NA	8.8	8.8
Actual Volts	481.2	479	NA	480.5	480.5
Actual Amps	2.4	4.2	NA	16.8	16.8
Type of system	Constant Volume Variable Temperature	Constant Volume Multiple Zone (2 zones)	Constant Volume Variable Temperature	Constant Volume Variable Temperature	Constant Volume Variable Temperature
Exhaust Fan	EF1	NA			
Steam Heat Data					
Pressure	15 psi	15 psi	15 psi	15 psi	15 psi
Coil Type	Serpentine coil	Serpentine coil	Serpentine coil	Serpentine coil	Serpentine coil
Control Valve Set up	1/3-2/3	1/3-2/3			

Reducing Scope 1 & 2 Emissions

Table 2 Pumps

Name	**CHW PMP1**	**HW Circ Pmp**
Location	AH1 Mech Room	
Area Served	AHU 1 (AH-1)	
Name Plate Data		
Make	PACO	PACO
Model number	Not Labeled	
Serial number	Not Labeled	
Type	Centrifugal Splitcase	
GPM/FT Head	630 GPM/87’	110 GMP/60’
Voltage	230/460	230/460
Amperage	46.8/23.4	14/7
HP	20	5
Efficiency	93%	82.5%
Power Factor	86.5	81
Frame Number	256T	184 JM
Motor Make	Magnetek	
Motor Type	TE	
Actual Kw		
Actual Volts		
Actual Amps		

Table 3 Fans

Name	**EF 1**
Location	
Area Served	AHU 1 (AH-1)
Name Plate Data	
Make	Reliance
Model number	Not Labeled
Serial number	Not Labeled
Type	
Voltage	230/460
Amperage	2.2/1.1
HP	3/4
Efficiency	82.5%
Power Factor	84
Frame Number	FM 56
Actual Kw	
Actual Volts	
Actual Amps	

Reducing Scope 1 & 2 Emissions

Executive Report

PENCE UNION BUILDING (PUB)

The older section of the PUB is served by the four original air handling units. AHUs 1, 2, and 3 are constant volume dual duct air handling units that serve constant-volume mixing boxes. These air handlers serve the main auditorium as well as all meeting rooms, offices and classrooms in the 1970 section of the PUB. AHU-4 is a constant-volume, multi-zone unit that serves the kitchen area in the older section of the PUB. The multi-zone unit has a steam pre-heat coil that tempers the mixed air to the required temperature in the hot deck while the chilled water coil maintains a discharge air temperature of 55 degrees. The multi-zone unit has return air capabilities but does not have a dedicated return fan. AHU 1, 2 and 3 each have a steam pre-heat coil, and a chilled water coil. They each have a dedicated return fan. They are pneumatically controlled but have a Staeffa controls system interface which allows for supervisory control.

The new section of the PUB is served by AC-1 and AC-2. They are VAV air handling units with a dedicated return fan. The fan motors are controlled with variable frequency drives. Each air handler has a hot water heating coil and a chilled water coil. They serve VAV boxes with hot water reheat coils. These systems are controlled and monitored with old Staeffa controls systems which are no longer supported. These air handlers serve the entire new section of the PUB, including the kitchen in the building's 1995 section.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/PENCE UNION BUILDING

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT

OVERVIEW

The Pence Union Building (PUB) serves as the community center for Eastern Washington University and is located in the center of the EWU campus in Cheney Washington. A preliminary energy audit was conducted on the PUB in August of 2010 by McKinstry.

PENCE UNION BUILDING (PUB)

The Pence Union Building (PUB) was built in 1970 with a major addition added in 1995. This is a large brick 141,000 square foot facility that houses student centered facilities and services. EWU's Dining Services also have (2) restaurants they operate. The building also contains the campus bookstore, a bus stop for Spokane transit, computer labs, student lounges and meeting rooms. The building is operated all year long and the building is open during the academic year from 6am to midnight during the weekdays, and 7am to midnight on the weekends.

PREVIOUS ENERGY RETROFITS

Previous energy retrofit work completed previously was the lighting system retrofit.

HEATING SYSTEM

The heating system serving the PUB is provided by the Campus Central Steam Plant. The steam pressure coming into the building is 100 psi and is reduced twice. The steam from the central plant comes into the PUB in two different locations. High Pressure steam comes into the 1970 lower level mechanical room and also in the 1995 lower level mechanical room. In each case the high pressure steam goes through a reducing station where it is first reduced to 25 psi and then again to 15 psi steam. The 25 psi steam is used for the domestic water system

The heating system serves (6) air handling units, (4) of the (6) air handlers have steam pre-heat coils. Steam is also used for heating hot water via a converter. The heating hot water is used for unit heaters, fan coil units and baseboard heaters. There is a reset schedule on the hot water heating system.

Medium pressure steam is used for domestic hot water (DHW).

COOLING SYSTEM

The cooling system uses chilled water from the central chilled water plant in Rozell. Chilled water is used in all of the air handling units.

AIR DISTRIBUTION SYSTEM

The older section of the PUB is served by the (4) original air handling units. AHU's 1, 2, and 3 are constant volume dual duct air handling units that serve constant volume mixing boxes. These air handlers serve the main auditorium, and all of the meeting rooms, offices, and classrooms throughout the 1970 Section of the PUB. AHU-4 is a constant volume, multi-zone unit that serves the kitchen area in the older section of the PUB. The multi-zone unit has a steam pre-heat coil that tempers the mixed air to the required temperature in the hot deck while the chilled water coil maintains a discharge air temperature of 55 degrees. The multi-zone unit has return air capabilities but does not have a dedicated return fan. AHU-1, 2, and 3 each have a steam pre-heat coil, and a chilled water coil. They each have a dedicated return fan. They are pneumatically controlled but have a Staeffa Controls System interface which allows for supervisory control.

The new section of the PUB is served by AC-1 and AC-2. They are variable air volume air handling units with a dedicated return fan. The fan motors are controlled with variable frequency drives. Each air handler has a hot water heating coil and a chilled water coil. They serve variable air volume boxes with hot water reheat coils. These systems are controlled and monitored with old Staeffa controls systems which are no longer supported. The entire new section of the PUB is served by these air handlers including the kitchen in the 1995 section of the PUB.

SEQUENCE OF OPERATIONS

1. The AHUs operate Monday through Sunday even when the spaces they serve are unoccupied. 3 am till 10 pm
2. No Morning Warm-up / Morning Cool-down / No Morning Purge.
3. No Economizer Control
4. No Hot Water Reset
5. No HD/CD Resets on the old AHUs and the Supply Air Reset on the AC-1 and 2 Supply Fans.

AREAS OF INTEREST

1. Replace and upgrade all of the older building’s ventilation systems and their controls. This includes replacing pumps and certain components of the steam station in the 1970 building’s mechanical room.
2. Replace the Staeffa controls systems on the ventilation systems serving the newer section of the PUB.
3. Electrical service upgrade in the older section of the PUB.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

Date: 10/11/2010

Job number | Building: **P 11561 PUB** **Name:**_DDM

Air Handling Unit Tag	**AHU 2**	**AHU 3**	**AHU 4**
Area Served			
System Type			
Manufacturer	ALADDIN	ALADDIN	ALADDIN
Cold Deck Model Number	MCM 1-36	MCH 1-33	MC 2-18
Cold Deck Serial Number	55946-2	55947	55948
Cold Deck CFM	NL	NL	9,880
TSP in. W.C.	NL	NL	2.54"
Hot Deck Model Number	NA	NA	NA
Hot Deck Serial Number	NA	NA	NA
Hot Deck CFM	NA	NA	NA
TSP in. W.C.	NA	NA	NA
~~Motor Name Plate Data (Cold Deck~~)	SUPPLY	SUPPLY	SUPPLY
Manufacturer	LINCOLN	WEG	LINCOLN
Voltage	208 / 416	208-230 / 460	208 / 416
Amperage	132 / 66	121 / 60.5	29 / 14.5
HP	50	40	10
Motor Efficiency	NL	0.941	NL
Power Factor	NL	0.83	NL
Frame	365 U	324 T	215 T
Motor Type	ODP	TEFC	TEFC
Actual kW Measured	31.8	19	5
Actual Voltage Measured	207	207	212
Actual Amperage Measured	105	71	19.6
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)	RETURN	RETURN	
Return Fan Model Number	M 1-36	M 1-33	
Return Fan Serial Number	56182	56183	
Return Fan CFM	24830	21090	
TSP in. W.C.	8.15 "	1.0 "	
Manufacturer	WEG	WESTINGHOUSE	
Voltage	208-230 /460	200	
Amperage	25.5 / 12.8	30	
HP	10	10	
Motor Efficiency	0.902	NL	
Power Factor	0.82	NL	
Frame	215 T	215 T	
Motor Type	TEFC	TEFC	
Actual kW Measured	4.8	5.4	
Actual Voltage Measured	212	209	
Actual Amperage Measured	16	22	

Reducing Scope 1 & 2 Emissions

Table 2 Air Handler Units

		Date: 10/11/2010
Job number | Building:	**P 11561 PUB**	**Name:** _DDM

Air Handling Unit Tag	**AH-5 * no photo**	**AH-6 * no photo**	**AH-1**
Area Served			
System Type			
Manufacturer	PACE	PACE	PACE
Cold Deck Model Number	PF 33 AF SWSI	PF 44 AF SWSI	MCH 1-36
Cold Deck Serial Number	94 - 75138-02	95 - 75138-03	55946-1
Cold Deck CFM	416,000	20,400	NL
TSP in. W.C.	3.5 "	3.5 "	NL
Hot Deck Model Number	NA	NA	NA
Hot Deck Serial Number	NA	NA	NA
Hot Deck CFM	NA	NA	NA
TSP in. W.C.	NA	NA	NA
~~Motor Name Plate Data (Cold Deck)~~	SUPPLY	SUPPLY	SUPPLY
Manufacturer	BALDOR	BALDOR	LINCOLN
Voltage	230 / 460	231 / 460	208/ 416
Amperage	110 / 59	48 / 24	132 / 66
HP	50	20	50
Motor Efficiency	0.93	0.93	NL
Power Factor	NL	NL	NL
Frame	326 T	256 T	365 U
Motor Type	ODP	ODP	ODP
Actual kW Measured	35 (AH5 VFD installed 1/4/06 is blank)	10.6 (58.7 hz)	34
Actual Voltage Measured	479	478	209
Actual Amperage Measured	45	133	110
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
~~Motor Name Plate Data (Return Fan)~~	RETURN	RETURN	RETURN
Return Fan Model Number	PF 54 AFSWSI	PF 40 AFSWSI	M 1-36
Return Fan Serial Number	94-75138-1	SAME AS SUPPLY	56182
Return Fan CFM	38,500	19000	24,380
TSP in. W.C.	1.5 "	1.25"	8.15"
Manufacturer	BALDOR	BALDOR	WESTINGHOUSE
Voltage	230 / 460	231 / 460	200
Amperage	61 / 30.5	25 / 12.5	30
HP	35	10	10
Motor Efficiency	0.924	0.917	NL
Power Factor	NL	NL	NL
Frame	284 T	215 T	215 T
Motor Type	ODP	ODP	TEFC
Actual kW Measured	6.2 (33.7 HZ)	3.5 (46.5 HZ0	6.1
Actual Voltage Measured	479	478	211
Actual Amperage Measured	8	4.7	23.2

Reducing Scope 1 & 2 Emissions

Table 1 Pumps

Date: 10/11-10/12/2010

Job number | Building: **P 11561 PUB** **Name:** DDM

Pump Data	**CW PUMP 1**	**CW PUMP 2**	**CW PUMP 3**
Area/System/Equipment Served			
Pump Type	Base Mounted End Suction	Base Mounted End Suction	Base Mounted End Suction
Manufacturer	B & G	B & G	B & G
Model Number	Q 44161 / 2.5 A / 6.5 BF	Q 44161 / 2.5 A / 6.5 BF	Q 44161 / 2.5 A / 6.5 BF
Serial Number			
GPM	120	120	120
Ft of Head	40'	40'	40'
Motor Name Plate Data			
Manufacturer	Lincoln	Lincoln	Lincoln
Model Number			
Serial Number			
Voltage	208 / 416	208 / 416	208 / 416
Amperage	6.4 / 3.2	6.4 / 3.2	6.4 / 3.2
HP	2.00	2.00	2.00
Motor Efficiency	NL	NL	NL
Power Factor	NL	NL	NL
Frame	145 T	145 T	145 T
Motor Type	TEFC	TEFC	TEFC
Actual kW Measured	0.9	1.36	1.44
Actual Voltage Measured	211	212	212
Actual Amperage Measured	4.8	5.4	5.6

Pump Data	**CW PUMP 4**	**CW PUMP 5* (no photo)**	**NOT LABELED (Conference Rm)**
Area/System/Equipment Served		CHILLED WATER (AH5)	Hot Water
Pump Type	BMES	BMES	BMES
Manufacturer	B & G	ARMSTRONG	ARMSTRONG
Model Number	Q 44162 / 1.5 AB (?) / 6 -1/8 BF	TAG COVERED BY INSULATION BLANKET	4030 3 x 2 x 13
Serial Number		TAG COVERED BY INSULATION BLANKET	C310 96
GPM	57	TAG COVERED BY INSULATION BLANKET	225
Ft of Head	37	TAG COVERED BY INSULATION BLANKET	115
Motor Name Plate Data			
Manufacturer	Lincoln	BALDOR	BALDOR
Model Number			
Serial Number			
Voltage	208 / 416	230 / 460	230 / 460
Amperage	5.5 / 2.75	18.6 / 9.3	36 / 18
HP	1	7.5	15
Motor Efficiency	NL	0.91	0.924
Power Factor	NL	NL	NL
Frame	145 T	213 T	254 T
Motor Type	TEFC	ODP	ODP
Actual kW Measured	1.14	5.2	9.5
Actual Voltage Measured	212	478	475
Actual Amperage Measured	4.7	8	14.3

Table 2 Pumps

Date: 10/11-10/12/2010

Job number | Building: **P 11561 PUB** **Name:** DDM

Pump Data	CW PUMP 6 * No photo	CW PUMP 7* No photo	CW PUMP 8* No photo
Area/System/Equipment Served	CHILLED WATER AH6	AH5 HTG CIRC PUMP	AH6 HTG CIRC PUMP
Pump Type	BMES	IN LINE (HORIZONTAL)	IN LINE (HORIZONTAL)
Manufacturer	ARMSTRONG	ARMSTRONG	ARMSTRONG
Model Number	TAG COVERED BY INSULATION BLANKET	TAG IS MISSING	H-64 - 3-BF
Serial Number	TAG COVERED BY INSULATION BLANKET	TAG IS MISSING	0915 BF
GPM	TAG COVERED BY INSULATION BLANKET	TAG COVERED BY INSULATION BLANKET	TAG COVERED BY INSULATION BLANKET
Ft of Head	TAG COVERED BY INSULATION BLANKET	TAG COVERED BY INSULATION BLANKET	TAG COVERED BY INSULATION BLANKET
Motor Name Plate Data			
Manufacturer	US ELECTRIC	MARATHON	MARATHON
Model Number	C 537A		
Serial Number			
Voltage	208-230 / 460	208-230 / 460	208-230 / 460
Amperage	15.9-14.9 / 7.45	9.2- 8.6 / 4.3	2.7-2.8 / 1.4
HP	5	3	0.75
Motor Efficiency	0.815	NL	NL
Power Factor	NL	NL	NL
Frame	184 JM	56C - 95	56 C
Motor Type	ODP	ODP	ODP
Actual kW Measured	3	1.4	0.7
Actual Voltage Measured	478	479	478
Actual Amperage Measured	5.6	2,7	1 26

Data			
Area/System/Equipment Served			
Pump Type			
Manufacturer			
Model Number			
Serial Number			
GPM			
Ft of Head			
Motor Name Plate Data			
Manufacturer			
Model Number			
Serial Number			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			

Table 1 Fans

Date: 10/12/2010

Job number | Building: **P 11561 PUB** **Name:** DDM

Unit Tag	**PUB EX FAN 17**	**PUB EX FAN 18**	**PUB EX FAN 15**
Area Served	KITCHEN	KITCHEN	
System Type	HOOD CONSTANT VOLUME		
Manufacturer	GREENHECK	GREENHECK	GREENHECK
Cold Deck Model Number	CUBE-300HP - 50 - G	CUBE-360HP - 75 - G	DATA NOT COLLECTED
Cold Deck Serial Number	98 H 17949	94 LO2 726	DATA NOT COLLECTED
Cold Deck CFM			DATA NOT COLLECTED
TSP in. W.C.			DATA NOT COLLECTED
Hot Deck Model Number			DATA NOT COLLECTED
Hot Deck Serial Number			DATA NOT COLLECTED
Hot Deck CFM			DATA NOT COLLECTED
TSP in. W.C.			DATA NOT COLLECTED
Motor Name Plate Data (Cold Deck)			
Manufacturer	MAGNETEK	MAGNETEK	DATA NOT COLLECTED
Voltage	208-230 / 1460	208-230 / 1460	DATA NOT COLLECTED
Amperage	14.8 - 1417	74 - 21.6 / 10.8	DATA NOT COLLECTED
HP	5	7.5	DATA NOT COLLECTED
Motor Efficiency	0.875	0.84	DATA NOT COLLECTED
Power Factor	0.765	0.766	DATA NOT COLLECTED
Frame	5184 T	213 T	DATA NOT COLLECTED
Motor Type	ODP	ODP	DATA NOT COLLECTED
Actual kW Measured	3	4.5	1
Actual Voltage Measured	481	481	479
Actual Amperage Measured	5.2	9.2	2
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)			
Return Fan Model Number			
Return Fan Serial Number			
Return Fan CFM			
TSP in. W.C.			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			

Reducing Scope 1 & 2 Emissions

Table 2 Fans

Date: 10/12/2010
Job number | Building: **P 11561 PUB** **Name:** DDM

Unit Tag	PUB EX FAN 16	PUB EX FAN 8	PUB EX FAN 9
Area Served			
System Type			
Manufacturer	GREENHECK	PORTER 270G	PORTER 182 F
Cold Deck Model Number	DATA NOT COLLECTED		
Cold Deck Serial Number	DATA NOT COLLECTED		
Cold Deck CFM	DATA NOT COLLECTED		
TSP in. W.C.	DATA NOT COLLECTED		
Hot Deck Model Number	DATA NOT COLLECTED		
Hot Deck Serial Number	DATA NOT COLLECTED		
Hot Deck CFM	DATA NOT COLLECTED		
TSP in. W.C.	DATA NOT COLLECTED		
Motor Name Plate Data (Cold Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured	0.7		
Actual Voltage Measured	479		
Actual Amperage Measured	1.2		
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)			
Return Fan Model Number			
Return Fan Serial Number			
Return Fan CFM		5870	2625
TSP in. W.C.		1"	1.125"
Manufacturer		MARATHON	MARATHON
Voltage		230/ 460	208
Amperage		3-Jun	6.6
HP		2	2
Motor Efficiency		0.856	NL
Power Factor		NL	NL
Frame		145 T	145 T
Motor Type		ODP	ODP
Actual kW Measured		1	1.2
Actual Voltage Measured		210	212
Actual Amperage Measured		4.1	5

Table 3 Fans

Date: 10/10/2010
Job number | Building: **P 11561 PUB** **Name:** DDM

Unit Tag	**PUB EX FAN 2 * Possible motor failure**		
Area Served	OLD MECH ROOM		
System Type			
Manufacturer	LINCOLN		
Cold Deck Model Number			
Cold Deck Serial Number			
Cold Deck CFM			
TSP in. W.C.			
Hot Deck Model Number			
Hot Deck Serial Number			
Hot Deck CFM			
TSP in. W.C.			
Motor Name Plate Data (Cold Deck)			
Manufacturer	LINCOLN		
Voltage	208 / 416		
Amperage	4.2 / 2.1		
HP	1		
Motor Efficiency			
Power Factor			
Frame	143 T		
Motor Type	3 PH (1740 RPM)		
Actual kW Measured	MOTOR OFF AT DISCONNECT. UNKNOWN REASON.		
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)			
Return Fan Model Number			
Return Fan Serial Number			
Return Fan CFM			
TSP in. W.C.			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			

Reducing Scope 1 & 2 Emissions

Executive Report

PHYSICAL EDUCATION ACTIVITIES BUILDING (PEA)

AHU 9 and 10 hang from the gymnasium ceiling, serving the body shop. Both are constant-volume, variable-temperature air handler units with pre-filters and serpentine, low-pressure steam pre-heat coils, and both have return-air capabilities. The units are loud and because they are manually switched on and off, staff keeps them switched off most of the time when the space is occupied. Because the starter/disconnects for each of these units is 12 feet or more above the gymnasium floor, a ladder is needed to switch on these units. Meanwhile, pneumatic controls limit the energy-saving control strategies of these units.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/PHYSICAL EDUCATION ACTIVITIES - THE BODY SHOP (GYM 270)

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT JULY 29, 2010

OVERVIEW

The Athletics Complex of the Eastern Washington University is comprised of several buildings on the west side of the EWU campus in Cheney Washington. McKinstry has previously completed energy retrofits of the HVAC, Controls, and Lighting systems in the Aquatics Building, most of the Physical Education Activities Buildings, Jim Thorpe Fieldhouse, The Pavilion (Reese Court), and the Physical Education Classroom (PEC) Building. A preliminary energy audit was conducted on the remaining systems not retrofitted in the PEA Building, Jim Thorpe Fieldhouse, and the Pavilion on July 29, 2010 by McKinstry.

THE BODY SHOP

The former Body Shop, recently renamed Gym 270, is located in the Physical Education Activities Building. Gym 270 is a multi-purpose room featuring an open floor which can be used for volleyball and badminton courts, and small to medium sized activity. The room is used all year round when classes are in session, starting at 7:00 AM. The occupancy is from 7 am to 9 pm, Monday through Friday, and from 7 am till 7 pm on Saturdays and Sundays. This is a two story structure with 1 foot poured concrete walls and a built up membrane roof. There are no windows in the facility.

PREVIOUS ENERGY RETROFITS

No previous retrofit work completed by McKinstry in this facility.

LIGHTING SYSTEM

The lighting system in the body shop consists of 1000 Watt high pressure sodium fixtures. The lighting in the Dance Studio, hallways on either side of the inside entrance to the field house, and the Raquetball Courts are energy inefficient and should be considered for retrofits.

HEATING SYSTEM

The heating system serving the Gym 270 is provided by the Campus Central Steam Plant. The steam pressure coming into the building is 100 psi and is reduced twice, first to 25-50 psi at the steam station, and then again down to 10 to 15 psi. Medium pressure steam is also used for domestic hot water (DHW).

The heating system serves two air handling units with steam pre-heat coils. Steam is also used for heating hot water via a converter, and then the hot water is used for unit heaters, fan coil units and baseboard heaters. There is also a laundry with four steam dryers. There is a reset schedule on the hot water heating system (180 ° F to 12O ° F). ATS controls the converter and hot water system. Three pumps are associated with the hot water system, with one being located in the PEA building while the other 2 are in the Jim Thorpe Field house. The pumps are lead/lagged in the Field House.

COOLING SYSTEM

The AHUs in the body shop do not have cooling capabilities. They do not have economizer capabilities.

Reducing Scope 1 & 2 Emissions

AIR DISTRIBUTION SYSTEM

The HVAC systems serving the body shop consists of two (2) constant volume variable temperature air handler units. Each unit is hung from the ceiling in the gymnasium, and has a pre-filters, and a serpentine low pressure steam pre-heat coil. These units have return air capabilities. The units are turned on and off manually, and one of the issues with these units is that they are loud which is why they are turned off a majority of the time when the space is occupied. The nomenclature/designation for these units is AHU 9 and 10. These air handlers are pneumatically controlled, and the starter/disconnects for each of these units is 12 or more feet off the gymnasium floor so it takes someone with a ladder to turn these units on. The pneumatic controls limit their energy saving control strategies.

This FIM will require and adjusted baseline like it was done for the air handling units in Gymnasiums 264 and 265.

SEQUENCE OF OPERATIONS

1. If the units were not so loud they would run 24/7.
2. No energy saving control strategies of any sort are employed.

AREAS OF FURTHER INVESTIGATION

1. The laundry dryers are run off steam, check to see if savings would result from replacing with gas fired dryers.
2. According to Jim Butler, EWU Plumbing supervisor, the condensate return piping coming from AHU's 9 and 10 is getting thin and will require replacement in the not to distant future.
3. Replace AHU's 9 & 10 with a similar retrofit that was performed in Gyms 264 and 265.
4. Perform the lighting retrofit in the Gym 270, the Dance Studio, hallways on either side of the fieldhouse, and the racquetball courts.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

Name	AH 9	AH 10
Location		
Area Served		
Name Plate Data		
Make		
Model number		
Serial number		
Controls		
Type	Pneumatic	
Supply Fan Data		
Make		
Model number		
Serial number		
Voltage		
Amperage		
HP		
Efficiency		
Power Factor		
Frame Number		
Motor Type (TEFC)		
Actual Kw		
Actual Volts		
Actual Amps		
Return Fan Data		
Make		
Model number		
Serial number		
Voltage		
Amperage		
HP		
Efficiency		
Power Factor		
Frame Number		
Motor Type(TEFC)		
Actual Kw		
Actual Volts		
Actual Amps		
Type of system		
Exhaust Fan	NA	NA
Steam Heat Data		
Pressure	15 psi	15 psi
Coil Type	Serpentine coil	Serpentine coil
Control Valve Set up	1/3-2/3	1/3-2/3

Reducing Scope 1 & 2 Emissions

Executive Report

RADIO/TV BUILDING

The air handler serving this building is a constant-volume, dual-duct air handler that serves 41 constant-volume mixing boxes. The air handler has a dedicated return fan plus a pre-filter, low-pressure, serpentine steam coil and a chilled water coil. This unit and its corresponding mixing boxes are controlled with pneumatic controls and a dated Staeffa Digital controls interface. This unit outlived its useful service life and has limited control capabilities.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/RADIO-TV BUILDING

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT - AUGUST 4, 2010

OVERVIEW

The Fine Arts Complex of the Eastern Washington University is comprised of five buildings: Art, Music, Theater, Radio-TV, and Communications on the south side of the EWU campus in Cheney Washington. McKinstry has not previously completed retrofits of this complex. A preliminary energy audit was conducted on August 4, 2010 by McKinstry.

RADIO/TV BUILDING (RTV)

The Radio-TV Building (RTV) is part of the Fine Arts Complex which was completed in 1972. It is a two story 16,000 square foot concrete masonry block building with red face brick. The facility consists of classrooms and laboratories, offices, a campus radio station KEWU, a TV studio, and 2 screening rooms seating 50 and 30 people. The windows are double pane. The occupancy ratio is 20 to 30 faculty/staff members and 200 students. Operating hours for the classroom area are 8:00AM to 9:00 pm during the academic year. The radio station operates 6:00 AM to Midnight daily.

PREVIOUS ENERGY RETROFITS

No previous mechanical retrofit work was completed by McKinstry in this facility, however the lighting systems had been retrofitted to energy efficient lighting in the 2000 – 2001 time frame.

HEATING SYSTEM

The heating system serving the RTV building is provided by the campus central steam plant. The steam pressure coming into the building is 100 psi and is reduced twice. The high pressure steam is first reduced to 22 psi steam and then further reduced to 15 psi. The medium pressure steam is utilized for the domestic hot water system while the low pressure steam is used for heating at the air handling unit. The components at the steam station such as the valves and steam traps are in need of getting replaced. Jim Butler, the Pipefitter and Plumbing Supervisor for EWU, noted that the steam station and condensate system was in poor condition and certain components should be consid3red for replacement.

The Condensate return system has one receiver with a single condensate return pump. The steam traps were not easily accessible.

There is no heating hot water converter, but the building has two domestic hot water heaters, one is electric and the other is steam.

COOLING SYSTEM

Chilled water from the central plant is used in the cooling coil of the AHU.

AIR DISTRIBUTION SYSTEM

The air handler serving this building is a constant volume, dual duct air handler that serves (41) constant volume mixing boxes. The air handler has a dedicated return fan, has a pre-filter, low pressure steam coil of the serpentine type, and a chilled water coil. This unit and its corresponding mixing boxes are controlled with pneumatic controls and have a Staeffa Digital controls interface. The controls are very limited in their energy management capabilities.

Reducing Scope 1 & 2 Emissions

SEQUENCE OF OPERATIONS

1. The Air Handling Unit operates 24/7.
2. There is no CD / HD Reset
3. There is no Start/Stop with Night Setback.
4. No Morning Warm-up/ Morning Cool-down, Morning Purge
5. There is no Economizer Control Strategies.

AREAS OF INTEREST

1. There are two compressors are in the building: Devilbliss ™ serves the controls, and the other is for theater operations.
2. The AHU serves both the building & radio station. Radio station currently does not operate 24/7 but if the operation changes, it may be better to have a dedicated AHU for station, rather than heat/cool the whole building.
3. Install a 4-Pipe Fan Coil Unit for the Radio Station. Demo the CV Dual Duct air handling unit and the constant volume mixing boxes to a Dual Fan, Dual Duct VAV Air Handling Unit and VAV Mixing Boxes and install digital controls.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

Name	AH 1 (HOA switch tagged AHR-1 RFR-1
Location	RTV
Area Served	RTV
Name Plate Data	
Make	ALADDIN
Model number	MCH size 1-36
Serial number	58617
Controls	
Type	
Supply Fan Data	
Make	WEG
Model number	
Serial number	
Voltage	208-230/460
Amperage	132-120/60.2
HP	50
Efficiency	.93
Power Factor	.83
Frame Number	326T
Motor Type (TEFC)	NL
Actual Kw	24.7
Actual Volts	204/5V
Actual Amps	86.6
Return Fan Data	
Make	ALADDIN (m)
Model number	1-26 (S)
Serial number	
Voltage	200
Amperage	45
HP	15
Efficiency	]NL
Power Factor	NL
Frame Number	254T
Motor Type(TEFC)	X
Actual Kw	7
Actual Volts	206.5
Actual Amps	29.8
Type of system	
Exhaust Fan	
Steam Heat Data	
Pressure	LOW
Coil Type	Serpentine
Control Valve Set up	2-way

Reducing Scope 1 & 2 Emissions

Table 2 Pumps

Name	**CHW1**	**CHW Circ Pump**
Location		RTV
Area Served		RTV
Name Plate Data		
Make		Federal
Model number		
Serial number		
Type		Base mtd end suction
GPM/FT Head		165/55’
Voltage		200
Amperage		15.7
HP		5
Efficiency		NL
Power Factor		NL
Frame Number		184T
Actual Kw		2.7
Actual Volts		207.2
Actual Amps		10.2

Reducing Scope 1 & 2 Emissions

Executive Report

ROZELL BUILDING

The Rozell building contains the central heating and cooling generating equipment for the entire campus.

HEATING PLANT

There are five high-pressure steam boilers located in the central steam plant at Eastern Washington University. All are capable of firing off of natural gas and No. 2 fuel-oil. Boiler #1 is rated at 56,000 lbs/hr, Boiler #2 at 25,000 lbs/hr, Boiler #3 at 25,000 lbs/hr, Boiler #4 at 47,000 lbs/hr, and Boiler #5 at 89,000 lbs/hr. With the exception of boiler #5, which was installed and fired in 2003, all of the boilers are more than fifty years old—and some are more than sixty years old. Boiler #3 broke down three years ago and it remains out of service to this day. Boilers #1, #3, and #5 have boiler feedwater economizers installed in their exhaust stack; Boilers #2 and #4 do not. Typically during the cooling season, only Boiler #2 operates. Boilers #1 and #4 operate during the shoulder seasons and Boiler #5 operates during the peak months of the heating season. Boiler #5 is the only boiler with a low-nitrogen-oxide burner; the other boilers' burners should be upgraded to low-NOx burners as well.

Condensate from the campus is pumped into a large tank in the lower level of the Rozell Building's boiler room. If required, make-up water is introduced into the system with the campus condensate. From this tank the water is then pumped to the De-aerator (DA) tank which is located in the boiler room. From the DA tank the water is then pumped into the respective boilers based on their need, using the dedicated floor-mounted feedwater pumps. These pumps are capable of pumping the water into the boilers directly, as in the case of Boiler #2 or Boiler #4 or into the economizers on Boilers #1 and #5. The boiler feedwater being pumped into the stack economizers must be under an elevated pressure in order to ensure it does not flash off to steam in the heat exchanger in the exhaust stack. After taking the heat out of the exhaust stack gases, the feedwater is then introduced into the boiler.

The facility has three 50-horsepower boiler feedwater pumps, all taken from another system. These well-used pumps have had several seal and impeller failures, sometimes simultaneously, placing the entire feedwater load on the steam turbine pump—which can only operate when the minimum load is 20,000 lb/hr or greater, thus risking complete steam plant shut down.
The methodology in which chemicals are introduced into the steam system should be analyzed as well, as this may produce significant savings in both energy and chemicals.

COOLING PLANT

The University's cooling system is comprised of three 1,000-ton, water-cooled Carrier centrifugal chillers and two 500-ton water-cooled Carrier Centrifugal chillers, producing a total cooling capacity of 4,000 tons. Each chiller has a dedicated primary chilled water pump and condenser water pump, as well as a dedicated cooling tower. All of the towers are induced-draft, open-circuit Marley cooling towers. The three 1,000-ton towers are sized to deliver 85 degree water to the chillers, while the 500-ton towers were originally sized to deliver the water at 85 degrees as well. Due to age, the 500-ton towers can deliver only 88-90 degree water during the peak of the cooling season.

The chilled water distribution system is a primary/secondary, variable-volume pumping system with tertiary pumps at the building or load source. There are three secondary system pumps that serve the campus loop. They are brought online/ offline based on being able to maintain 14 inches Water Column (WC) between the supply and return lines. Only one of the secondary pumps is controlled with a variable-frequency drive, while the other two have two-speed motors. For some reason, the tertiary pumps in the buildings or at the coils are only turned on when the outdoor air temperature reaches 85 to 90 degrees. Peak-season cooling is between 2,300 and 2,400 tons.

There are two plate-and-frame heat exchangers for free cooling. The older unit is approximately fourteen years old and has 300 tons of cooling capacity. The newer unit, installed by McKinstry in 2003, has a cooling capacity of 200 tons. Each unit has a one-degree approach.

AIR DISTRIBUTION SYSTEM

Rozell's office area is served by a variable-volume air handler with VAV boxes and hot water reheat coils. The unit is mounted on the roof of next to the cooling towers. Other constant-volume variable-temperature air handling units serve the boiler room and the refrigeration mechanical room.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/ROZELL CENTRAL PLANT BUILDING

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT – AUGUST 2010

OVERVIEW

The Rozell Central Heating and Cooling Plant building is a support services facility of Eastern Washington University and is located on the northern side of the EWU campus in Cheney Washington. A preliminary energy audit was conducted on all of the systems in Rozell.

ROZELL CENTRAL PLANT BUILDING

The Rozell Central Plant Building is a two-story brick building which was built in 1970. The latest upgrades and renovations were completed in the 2002 – 2003 time frame. This is a 56,000 square foot facility which houses the Campus's Central Steam Plant and the central chilled water plant. It also houses the university's Construction and Planning Department, as well as the Director of Maintenance and the energy management office and Facilities Information Technology offices. Facilities I.T. is responsible for architecting and administering the support systems and server farm for all of Facilities and Planning. The Central Heating and Cooling Plants provide high pressure steam and chilled water to the Utility Tunnel System that basically brings the steam and chilled water to most buildings on the EWU campus. Condensate return is also brought back from the buildings on campus through the utility tunnel system.

PREVIOUS ENERGY RETROFITS

McKinstry has previously completed retrofits of the Rozell Central Plant building in 2003. At that time McKinstry installed a new 1,000 Ton Open Circuit, Induced Draft Marley Cooling Tower and its associated condenser water pump. McKinstry installed a 200 Ton Plate and Frame heat exchanger, and associated pumps, as well as automating the chilled water plant with Delta Digital Controls. McKinstry also installed a small cooling only fan coil for the UPS systems in the lower level mechanical room. Prior to that, a lighting retrofit was done throughout the building that saw all of the T12 fluorescent lamps and standard ballasts getting retrofitted with T8 Lamps and electronic ballast. The only area of Rozell that still has an opportunity to save energy on lighting is in the Boiler room itself, with the high bay lighting fixtures.

HEATING SYSTEM

There are (5) five high pressure steam boilers located in the central steam plant at EWU. All are capable of firing off of natural gas and No. 2 fuel-oil. Boiler #1 is rated at 56,000 lbs/hr, Boiler #2 at 25,000 lbs/hr, Boiler #3 at 25,000 lbs/hr, Boiler #4 at 47,000 lbs/hr, and Boiler #5 at 89,000. With the exception of boiler #5 which was installed and fired in 2003, all of the boilers range in age from 50 plus years old to 60 plus years old. Three years ago, Boiler #3 had significant issues which caused it to shut down and to this day it has not been brought back on line. Boilers #1, #3, and #5 have boiler feedwater economizers installed in their exhaust stack; boilers #2 and #4 do not. Typically during the cooling season, only boiler #2 operates. Boilers #1 and #4 operate during the shoulder seasons and boiler #5 operates during the peak months of the heating season. Boiler #5 is the only boiler with a Low NOx Burner. The other 4 boilers would be excellent candidates to have their burners swapped out with Low NOx Burners.

Reducing Scope 1 & 2 Emissions

Condensate from around the campus is pumped into a large tank in the lower level of the Rozell Building's boiler room. If required, make up water is introduced into the system with the campus condensate. From this tank the water is then pumped up to the Deaerator tank which is located in the boiler room. From the DA tank the water is then pumped into the respective boilers based on their need using the dedicated floor mounted boiler feedwater pumps. These pumps are capable of pumping the water into the boilers directly, as in the case of Boiler #2 or Boiler #4 or into the economizers on Boilers #1 and #5. The boiler feedwater being pumped into the stack economizers must be under an elevated pressure in order to ensure is doesn't flash off to steam in the heat exchanger in the exhaust stack. After taking the heat out of the exhaust stack gases, the feedwater is then introduced into the boiler.

Currently Eastern Washington University has (3) three 50 HP boiler feedwater pumps, these pumps were taken from another system to be used for the feedwater system. As a result of making use of these (3) three used pumps, there have been several seal and impeller failures which has resulted in simultaneous outages in all (3) three pumps. This has placed the entire feedwater load on the steam turbine pump, a pump that can only operate when the minimum load is 20,000 lb/hr or greater, thus placing the steam plant at risk of being completely shut down.

The way chemical is introduced into the steam system should be analyzed. It has been McKinstry's experience that this usually leads to significant savings from an energy perspective as well as a capital dollars expenditure on less chemicals.

COOLING SYSTEM

The university's cooling system is comprised of (3) 1,000 ton water cooled Carrier centrifugal chillers, and (2) 500 ton water cooled Carrier Centrifugal chillers. In all there is a cooling capacity of 4,000 tons. Each chiller has a dedicated primary chilled water pump and condenser water pump, as well as a dedicated cooling tower. All of the towers are induced draft, open circuit Marley cooling towers. The three 1,000 ton towers are sized to deliver 85 degree water to the chillers, while the (2) 500 ton towers were originally sized to deliver the water at 85 degrees as well. The age of the (2) 500 ton towers and their ability to reject heat to the atmosphere has deteriorated through the years and are only able to deliver 88 to 90 degree water during the peak of the cooling season.

The chilled water distribution system is a primary / secondary variable volume pumping system with tertiary pumps out at the building or load source. There are three secondary system pumps that serve the campus loop. They are brought on / off line based on being able to maintain 14 in. WC between the supply and return lines. Only one of the secondary pumps is controlled with a VFD, while the other 2 are 2-speed motors. For some reason, the tertiary pumps in the buildings or at the coils are only turned on when the outdoor air temperature reaches 85 to 90 degrees.

According to the Plant Supervisor, Kevin Beckwith, told McKinstry that the largest cooling load that the plant personnel see during the peak of the cooling season is approximately between 2,300 tons and 2,400 tons.

There are 2 plate and frame heat exchangers for free cooling. The older of the 2 is approximately 14 years old and has 300 tons of cooling capacity while the newer of the 2 that McKinstry installed in 2003, has a cooling capacity of 200 tons. Each plate and frame heat exchanger has a 1 degree approach.

AIR DISTRIBUTION SYSTEM

The ventilation system serving the office area of Rozell is comprised of a variable volume air handling unit with VAV boxes with hot water reheat coils. This unit is mounted on the roof of the Rozell Building next to the cooling towers.

Reducing Scope 1 & 2 Emissions

SEQUENCE OF OPERATIONS

1. The VAV AHU operates 24/7, and is controlled with Staeffa Digital controls. No night setback or start/stop controls.
2. There is no morning purge, morning warm-up / morning cool-down.
3. It is not known if the air handler has economizer controls or not.

AREAS OF INTEREST

1. Boiler Feed Water Pump Retrofits.
2. Retrofit #3 Boiler that is sized to deliver 40,000 lbs/hr of high pressure steam.
3. Install Boiler Feed Water Economizers on #2 and #4 Boilers.
4. Install Low NOx Burners on Boilers #1, #2, and #4.
5. Retrofit the high bay lighting fixtures in the boiler room with T5HO fixtures.
6. Install VFDs on the chiller compressors, and on the (3) 1,000 ton cooling towers.
7. Install (2) new Cooling Towers with VFDs, sized to deliver 75 degree water during peak loads.
8. Swap out the (2) 2-speed motors with inverter duty ready motors and pumps and control them with VFDs and map them into the Delta Digital Control system.
9. Examine the feasibility of adding another 1,000 Ton Water-Cooled Chiller and corresponding cooling tower with associated pumps.

Reducing Scope 1 & 2 Emissions

Table 1- Air Handler Units

		Date:	10/13/10 to 10/14/10
Job number | Building:	**P 11561 Rozell**	**Name:**	DDM

Air Handling Unit Tag	**Air Handler**	**AHU -1**	**AHU-2**
Area Served	Chiller room	Pump Room	Pump Room
System Type		Fan coil	Same as AHU 1
Manufacturer	Carrier	MagicAire	MagicAire
Cold Deck Model Number	39TH13MBN	60-BVW-B	60-BVW-B
Cold Deck Serial Number	5196F46022	W040 189398	W040189399
Cold Deck CFM	NL	NL	NL
TSP in. W.C.	NL	NL	NL
Hot Deck Model Number			
Hot Deck Serial Number			
Hot Deck CFM			
TSP in. W.C.			
Motor Name Plate Data (Cold Deck)			
Manufacturer	Magnetck	GE	Magnetck
Voltage	230/460	208-230/460	230/460
Amperage	8.2/4.1	5.5-5.6/2.8	8.2/4.1
HP	3	1.5	3
Motor Efficiency	0.875	NL	0.875
Power Factor	0.78	NL	0.78
Frame	182T	56 H	182T
Motor Type	TEFC	ODP	TEFC
Actual kW Measured	3	1.3	1.3
Actual Voltage Measured	485	485	485
Actual Amperage Measured	4.5	2.3	2.2
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)	EF-31-1		
Return Fan Model Number	not accessible		
Return Fan Serial Number	not accessible		
Return Fan CFM	not accessible		
TSP in. W.C.	not accessible		
Manufacturer	not accessible		
Voltage	36% OPF		
Amperage	not accessible		
HP	ODP		
Motor Efficiency	1.2		
Power Factor	486		
Frame	3.7		
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			

Reducing Scope 1 & 2 Emissions

Table 2- Air Handler Units Cont.

Date: 10/12/2010
Job number | Building: **P 11561 Rozell** **Name:** DDM

Air Handling Unit Tag	**AH-1 (Roof)**	**AHU -27- 1**	**NL (Boiler Room)**
Area Served	Offices	Boiler Room	Pump Room
System Type	VAV	NL	NL
Manufacturer	HAAKON	NL	NL
Cold Deck Model Number	Size 321 Type APF	NL	NL
Cold Deck Serial Number	00-156397-2-1	NL	NL
Cold Deck CFM	NL	NL	NL
TSP in. W.C.	NL	NL	NL
Hot Deck Model Number	NL	NA	NA
Hot Deck Serial Number	NL	NA	NA
Hot Deck CFM	NL	NA	NA
TSP in. W.C.	NL	NA	NA
Motor Name Plate Data (Cold Deck)			
Manufacturer	BALDOR	Magnetck	Magnetck
Voltage	230/460	460	460
Amperage	47/235	7.1 / 4.8	7.1 / 4.8
HP	20	5.5 (1750) / 2.2 (1160)	5.5 (1750) / 2.2 (1160)
Motor Efficiency	0.93	.86 (1750) / .75 (1160)	.86 (1750) / .75 (1160)
Power Factor	0.86	.82 (1750) / .62 (1160)	.82 (1750) / .62 (1160)
Frame	256T	5215T	5215T
Motor Type	ODP	ODP	ODP
Actual kW Measured	14,8	0.63	0.8
Actual Voltage Measured	488	484	489
Actual Amperage Measured	18.8	3,6 (High Speed)	3.8 (High Speed)
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)	Twin City Fan & Blower		
Return Fan Model Number	Size 321 Type APF		
Return Fan Serial Number	00-156397-1-1		
Return Fan CFM	NL		
TSP in. W.C.	NL		
Manufacturer	BALDOR		
Voltage	230 / 460		
Amperage	12.8/6.4		
HP	5		
Motor Efficiency	0.895		
Power Factor	0.81		
Frame	184T		
Motor Type	ODP		
Actual kW Measured	2.9		
Actual Voltage Measured	483		
Actual Amperage Measured	5.1		

Reducing Scope 1 & 2 Emissions

Table 3- Pumps

Date: 10/13-10/15/2010
Job number | Building: **P 11561 Rozell** **Name:** DDM

Pump Data	**P-3**	**P-1**	**P-2**
Area/System/Equipment Served	CHW pump for AHU 1 (roof)	Heating Water	Same as P1
Pump Type	Horizontal inline	Horizontal inline	Horizontal inline
Manufacturer	Armstrong	Armstrong	Armstrong
Model Number	NL	NL	NL
Serial Number	NL	NL	NL
GPM	inaccessible	inaccessible	inaccessible
Ft of Head			
Motor Name Plate Data			
Manufacturer	NL	NL	
Model Number	NL	NL	
Serial Number	NL	NL	
Voltage	115/208-230	208-230/460	
Amperage	5.8/2.8-2.9	3.5-3.6/1.8	
HP	2-Jan	1	
Motor Efficiency	NL	NL	
Power Factor	NL	NL	
Frame	56	56L	
Motor Type	ODP	ODP	
Actual kW Measured	0.45	1.0 KW	.6 KW
Actual Voltage Measured	121	484	485
Actual Amperage Measured	4.6	1.8	1.6

Pump Data	**CWP-1**		
Area/System/Equipment Served	AHU- 1 & 2 Chilled Water		
Pump Type	Horizontal Inline		
Manufacturer	B & G		
Model Number	60 1.5 x 5.25		
Serial Number	510884 B40		
GPM	27		
Ft of Head	13'		
Motor Name Plate Data			
Manufacturer	B & G		
Model Number			
Serial Number			
Voltage	115/208-230		
Amperage	2.8/1.5-1.4		
HP	44		
Motor Efficiency	NL		
Power Factor	NL		
Frame	56Z		
Motor Type	ODP		
Actual kW Measured	0.25		
Actual Voltage Measured	121		
Actual Amperage Measured	2		

Reducing Scope 1 & 2 Emissions

Table 4- Pumps Cont.

Date: 10/14/2010

Job number | Building: **P 11561 Rozell** **Name:** DDM

Pump Data	**HWP-1**	**HWP-2**	**HWP-3 (Seal at input shaft leaks)**
Area/System/Equipment Served			
Pump Type	BMES	BMES	BMES
Manufacturer	Worthington	Worthington	Worthington
Model Number	2CNE 82 CN-8A	2CNE 82 CN-8A	11-28951-133201
Serial Number	1533984	1541544	B2F32164
GPM	NL	NL	NL
Ft of Head	NL	NL	NL
Motor Name Plate Data			
Manufacturer	Siemens	WEG	Reliance
Model Number			
Serial Number			
Voltage	230 / 460	208-230 / 460	230 / 460
Amperage	18 / 9	13 / 6.48	21 / 10.5
HP	7-Jan	5	7.5
Motor Efficiency	0.902	0.875	NL
Power Factor	NL	0.82	NL
Frame	213T	184T	213T
Motor Type	TEFC	TEFC	ODP
Actual kW Measured	4	3.9	5.3
Actual Voltage Measured	487	487	487
Actual Amperage Measured	6.2	5.9	8.7

Data	**Cooling Tower Booster**		
Area/System/Equipment Served			
Pump Type	Vertical Incline		
Manufacturer	Armstrong		
Model Number	4380 3 x 3 x 13	`	
Serial Number	596918		
GPM	190		
Ft of Head	57'		
Motor Name Plate Data			
Manufacturer	Baldor		
Model Number			
Serial Number			
Voltage	230 / 460		
Amperage	16 / 8		
HP	5		
Motor Efficiency	0.895		
Power Factor	0.64		
Frame	2155P		
Motor Type	ODP		
Actual kW Measured	Not Running, No Demand		
Actual Voltage Measured	Not Running, No Demand		
Actual Amperage Measured	Not Running, No Demand		

Reducing Scope 1 & 2 Emissions

Table 5- Pumps Cont.

Date: 10/15/2010

Job number | Building: **P 11561 Rozell** **Name:** DDM

Pump Data	**BFWP-1**	**BFWP-2**	**BFWP-3**
Area/System/Equipment Served			
Pump Type	Split Case	Split Case	
Manufacturer	Mueller Pump	Weinman	
Model Number	2JD	2JD - 2-WCT	
Serial Number	18654	T742 730	
GPM	NL	200	
Ft of Head	NL	475	
Motor Name Plate Data			
Manufacturer	Reliance	Baldor (on VFD)	Seimens - Allis
Model Number			
Serial Number	3450 RPM	3450 RPM	3520 RPM
Voltage	480	230 / 460	230 / 460
Amperage	57.4	108 / 54	121 / 60.5
HP	50	50	50
Motor Efficiency	NL	0.941	0.875
Power Factor	NL	0.92	NL
Frame	324 TS	324TS	324 TS
Motor Type	ODP	TECF	ODP
Actual kW Measured	lock out tag for repairs	too large of a load for this pump	36
Actual Voltage Measured			485
Actual Amperage Measured			48

Data			
Area/System/Equipment Served			
Pump Type			
Manufacturer			
Model Number			
Serial Number			
GPM			
Ft of Head			
Motor Name Plate Data			
Manufacturer			
Model Number			
Serial Number			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			

Reducing Scope 1 & 2 Emissions

Table 6- Pumps Cont.

Date: 10/14/2010
Job number | Building: **P 11561 Rozell** **Name:** DDM

Pump Data	**CWP-1**	**CWP-2**	**CWP-3**
Area/System/Equipment Served	Campus loop	Campus loop	Campus loop
Pump Type			
Manufacturer	B & G	Paco	Paco
Model Number	Tag Missing	6AM -KPS	6AM -KPS
Serial Number	Tag Missing	2AF 32165 A	2AF 32165 B
GPM	Tag Missing	1100 / 700	1100 / 700
Ft of Head	Tag Missing	42 / 18	42 / 18
Motor Name Plate Data			
Manufacturer	Lincoln	General Electric	General Electric
Model Number			
Serial Number			
Voltage	230 / 460	480	480
Amperage	154 / 77 (Idle amps 43/ 21.5)	23 / 16 (2 speed)	23 / 16 (2 speed)
HP	60	20 / 13.5	20 / 13.5
Motor Efficiency	0.917	NL	NL
Power Factor	NL	NL	NL
Frame	364 TS	286 T	286 T
Motor Type	ODP	ODP	ODP
Actual kW Measured	48.5	9.6	not enabled
Actual Voltage Measured	475	481	No M-O-A
Actual Amperage Measured	63.1	11.8 (low speed?)	

Pump Data	**CWPE-1**	**CWPE-2**	**CWPE-3**
Area/System/Equipment Served	Evap Pump 1	Evap Pump 2	
Pump Type	BMES	BMES	
Manufacturer	B & G	B & G	B & G
Model Number	5 BC 8.375 BF	5 BC 8.375 BF	Vscs 8 x 10 x 10.5 9.875 BF RHR
Serial Number	2021930	2021930	2002 129
GPM	1000	1000	2000
Ft of Head	46'	46'	60'
Motor Name Plate Data			
Manufacturer	Marthon	Marthon	Marthon
Model Number			3VF 324TTOP40260CL
Serial Number			
Voltage	230 / 460	230 / 460	230 / 460
Amperage	38.4/19.2	38.4/19.2	97 / 48.5
HP	15	15	48
Motor Efficiency	0.91	0.91	0.93
Power Factor	0.802	0.802	0.835
Frame	254T	254T	324 T
Motor Type	ODP	ODP	ODP
Actual kW Measured	10.7	Off at Disconnect	Not enabled. No MOA
Actual Voltage Measured	479		Pump/Motor spinning due to water through the
Actual Amperage Measured	16.6		impeller . Same as CWPE 4 & 5

Reducing Scope 1 & 2 Emissions

Table 7- Pumps Cont.

Date: 10/14/2010

Job number | Building: **P 11561 Rozell** **Name:** DDM

Pump Data	**CWPE-4 / CWPE-5**	**CDP-1 / CDP-2**	**CDP-3**
Area/System/Equipment Served	Evap Pump 4 & 5		
Pump Type		BMES	VSC
Manufacturer	B & G	B & G	B & G
Model Number	VSLS 8 x 10 x 10.5 9.875 BF RHR	1510 6 E 10.0 BF	NL
Serial Number	2002 128 / 2002 130	NL / 2022049	NL
GPM	2000	NL / 1500	NL
Ft of Head	60'	NL / 80'	NL
Motor Name Plate Data			
Manufacturer	Marthon	US ELECTRIC	US ELECTRIC
Model Number	3VF 324TTOP40260CL	R357 B	R322
Serial Number			
Voltage	230 / 460	230 / 460	460 / 230
Amperage	97 / 48.5	94 / 47	112 / 225
HP	48	40	100
Motor Efficiency	0.93	0.945	0.945
Power Factor	0.835	0.87	0.874
Frame	324 T	324 T	404 TS
Motor Type	ODP	ODP	ODP
Actual kW Measured	Not enabled. No MOA	22.4 / No MOA	54.6
Actual Voltage Measured	Pump/Motor spinning due to water through the	0.473 / Not Enabled	476
Actual Amperage Measured	impeller . Same as CWPE 4 & 5	28.7 / Not Enabled	81.3

Pump Data	**CDP-4 & 5**		
Area/System/Equipment Served			
Pump Type	VSC		
Manufacturer	B & G		
Model Number	VSC 10 X 10 X 13 11.5 BF		
Serial Number	1997184 / 1997183		
GPM	3000		
Ft of Head	95		
Motor Name Plate Data			
Manufacturer	Marathon		
Model Number	30 404TSTDS4026BTW		
Serial Number			
Voltage	230 / 460		
Amperage	232 / 116		
HP	100		
Motor Efficiency	0.941		
Power Factor	0.845		
Frame	404TS		
Motor Type	ODP		
Actual kW Measured	66 / 62		
Actual Voltage Measured	476 / 481		
Actual Amperage Measured	102 / 91.6		

Table 8- Chillers

Date: 10/14/2010

Job number | Building: **P 11561 Rozell** **Name:** DDM

Chiller Data	CHILLER 1	CHILLER 2	CHILLER 3
Area/System/Equipment Served			
Chiller Compressor Type	Centrifugal	Centrifugal	Centrifugal
Manufacturer	Carrier	Carrier	Carrier
Model Number	19 XL 50534 93CP	19XL 50534 93 CP	19 EX 3133-736DK621 S
Serial Number	4996 J 55005	4996 J 55006	4996 J 54998
Tonnage			
Motor Name Plate Data			
Manufacturer			
Model Number			
Serial Number			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured	286 KW	NOT RUNNING	NOT RUNNING
Actual Voltage Measured	477 V		
Actual Amperage Measured	406		

Chiller Data	CHILLER 4	CHILLER 5	
Area/System/Equipment Served			
Chiller Compressor Type	Same as 3	Same as 3	
Manufacturer			
Model Number			
Serial Number	4996 J 54 999	4996 J 55 000	
Tonnage			
Motor Name Plate Data			
Manufacturer			
Model Number			
Serial Number			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured	NOT RUNNING	NOT RUNNING	
Actual Voltage Measured			
Actual Amperage Measured			

Table 9- Fan

Date: 10/15/2010

Job number | Building: **P 11561 Rozell** **Name:** DDM

Unit Tag	**#1 FD Fan**	**#2 FD Fan**	**#3 RD Fan**
Area Served	Boiler #1	Boiler #2	Boiler #3
System Type	Variable Volumn/ Comb Air	Variable Volumn/ Comb Air	Variable Volumn/ Comb Air
Manufacturer	Clavage Fan	Clavage Fan	NL
Cold Deck Model Number	Size 66 Type AFP	Size 1-3/8th Type Uni-Comb	NL
Cold Deck Serial Number	7087 CE-1	2559	NL
Cold Deck CFM	NL	NL	NL
TSP in. W.C.	NA	NL	NL
Hot Deck Model Number	NA	NA	NA
Hot Deck Serial Number	NA	NA	NA
Hot Deck CFM	NA	NA	NA
TSP in. W.C.	NA	NA	NA
Motor Name Plate Data (Cold Deck)			
Manufacturer	Reliance (w/ VFD)	NL (w/ VFD)	Magnetek
Voltage	230 / 460	230 / 460	208-230 / 460
Amperage	95.4 / 47.7	36 / 18	108-98 / 49
HP	40	15	40
Motor Efficiency	0.936	NL	0.936
Power Factor	0.833	NL	0.83
Frame	324 T	NL	E324 T
Motor Type	TEFC	NL	ODP
Actual kW Measured	1.8 (@23.7 Hz)	ODP	Log out for Maintenance
Actual Voltage Measured	484	Not Running due to Load	
Actual Amperage Measured	2.7		
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)			
Return Fan Model Number			
Return Fan Serial Number			
Return Fan CFM			
TSP in. W.C.			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			

Table 10- Fan Cont.

Date: 10/15/2010

Job number | Building: **P 11561 Rozell** **Name:** DDM

Unit Tag	**#4 FD Fan**	**#5 FD Fan**	
Area Served	Boiler #4	Boiler #5	
System Type	Variable Volume/ Comb Air	Variable Volume/ Comb Air	
Manufacturer	Clavage Fan	Buffalo Forge	
Cold Deck Model Number	Size 60 Type AFP	980 L-25, S, 8, CW, 180 ° F	
Cold Deck Serial Number	1145 - AT	101883-001	
Cold Deck CFM	NL	NL	
TSP in. W.C.	NA	NL	
Hot Deck Model Number	NA	NA	
Hot Deck Serial Number	NA	NA	
Hot Deck CFM	NA	NA	
TSP in. W.C.	NA	NA	
Motor Name Plate Data (Cold Deck)			
Manufacturer	Reliance	GE	
Voltage	230 / 460	460	
Amperage	71 / 35.5	223	
HP	30	200	
Motor Efficiency	0.924	0.954	
Power Factor	0.851	0.875	
Frame	286 T	447 T	
Motor Type	ODP	TEFC	
Actual kW Measured	Not Running due to Load	Not Running due to Load	
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Hot Deck)			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
Motor Name Plate Data (Return Fan)			
Return Fan Model Number			
Return Fan Serial Number			
Return Fan CFM			
TSP in. W.C.			
Manufacturer			
Voltage			
Amperage			
HP			
Motor Efficiency			
Power Factor			
Frame			
Motor Type			
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			

Reducing Scope 1 & 2 Emissions

Table 11- Boilers

Date: 10/15/2010
Job number | Building: **P 11561 Rozell** **Name:** DDM

Unit Tag	**Boiler 1**	**Boiler 2**	**Boiler 3**
Area Served			
System Type	Gas & Oil Burner	Gas & Oil Burner	Gas & Oil Burner
Manufacturer	Babcock & Wilcox	E. Keeler Co	Union Iron Works
Serial Number	?	13694	23439
Capacity MBH or lbs/hr	56,000	25,000	25,000
GPM			
Design PSI	250	200	250
Steam Temp	406 ° F	407 ° F	408 ° F
Boiler Heating Surface (sqft)	4,410	2160	3064
Year Built	1974	1960	1966
Unit Tag	**Boiler 4**	**Boiler 5**	
Area Served			
System Type	Gas & Oil Burner	Gas & Oil Burner	
Manufacturer	Babcock & Wilcox	Nebraska	
Serial Number		D4412	
Capacity MBH	47,000	89,000	
GPM			
Design PSI	250		
Steam Temp	406 ° F	407 ° F	
Boiler Heating Surface (sqft)	4410	7890	
Year Built	1969	2001	

Table 12- Heat Exchange

Date: 10/10/2010
Job number | Building: **P 11561 Rozell** **Name:** DDM

Unit Tag	**Heat Exchanger 1 (HX 1)**	**Heat Exchanger 2 (HX 2)**	
Area Served			
System Type	Plate & Frame Type	Plate & Frame Type	
Manufacturer	B & G	B & G	
Serial Number	89R86401-01	912716-2	
P/N	5-618-11-337-001	5-423-23-266-002 / %BY542300005500	
M/N	GPX 1152-337	NL	
Year Built	1996	2003 (Installed by Ramsey)	
Unit Tag			
Area Served			
System Type			
Manufacturer			
Serial Number			
Capacity MBH			
GPM			
Design PSI			
Steam Temp			
Boiler Heating Surface (sqft)			
Year Built			

Table 13- Cooling Towers

Date: 10/15/2010
Job number | Building: P 11561 Rozell
Name: DDM

Unit Tag	Cooling Tower 1	Cooling Tower 2	Cooling Tower 3
Area Served			
System Type	Cooling Tower w/ 2 speed Fan	Cooling Tower w/ 2 speed Fan	Medium Size w/ 2 speed Fan
Manufacturer	Marley NC Tower	Marley NC Tower	Marley NC Tower
Serial Number	3-1328-69 A / 3-8612 - 69 A	3-1328-69 A / 3-8612 - 69 A	NC 8311 CICM or NC 8311 GICM / NC 233570-Ai
P/N			
M/N	SLM-324UC-FMA EM 1 9-321284-01	SLM-324UC-FMA EM 1 9-321284-01	
?	JS	JS	
Year Built			
Fan Data			
Manufacturer	?	?	US Electric Two Speed
Voltage	460	460	460
Amperage	25 / 7.5	25 / 7.5	63 / 23.5
HP	20 / 5	20 / 5	50 / 12.5
Motor Efficiency			NL
Power Factor			NL
Frame	None	None	364 T
Motor Type	TEFC	TEFC	TEFC
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
RPM	1740 / 860	1740 / 860	1785 / 895

Table 14 Cooling Towers Cont.

Date: 10/15/2010
Job number | Building: P 11561 Rozell
Name: DDM

Unit Tag	Cooling Tower 4	Cooling Tower 5	
Area Served			
System Type			
Manufacturer			
Serial Number	NC 9141GS	NC 9141GS	
P/N	09743-001-96	097943-002-96	
M/N			
Year Built			
Fan Data			
Manufacturer	Seimens (2 Speed)	Seimens (2 Speed)	
Voltage	460	460	
Amperage	74 / 25	74 / 25	
HP	60 / 15	60 / 15	
Motor Efficiency	NL	NL	
Power Factor	NL	NL	
Frame	366	366	
Motor Type	TEFC	TEFC	
Actual kW Measured			
Actual Voltage Measured			
Actual Amperage Measured			
RPM		1780 / 885	

Reducing Scope 1 & 2 Emissions

Executive Report

SCIENCE HALL

It is McKinstry's opinion that the re-model and retrofit of Science Hall's HVAC systems could potentially provide the most significant energy savings of any project on campus. This building is due to be remodeled after the new Science 1 and Science 2 Buildings have been built.

Three large, constant-volume, terminal-reheat air handing units introduce 100% outdoor air to the building. Each unit has a run-around heat recovery coil, a face/bypass low pressure steam coil, a chilled water coil and humidifiers. They serve a wide variety of areas such as classrooms, laboratories, offices, and administrative areas. This building has a general exhaust system and fume hood exhaust systems. The balance between the three systems is controlled by the Staeffa digital control and pneumatic controls.
Two of the three AHUs are remotely located in below grade mechanical rooms. Due to how the outdoor air is introduced to these AHUs, the pre-heat coils have frozen up before on more than one occasion. It is McKinstry's recommendation that the outdoor air intakes be addressed.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/SCIENCE BUILDING

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT – AUGUST 2010

OVERVIEW

The Science Building is the largest academic facility on the Eastern Washington University and is located right on Washington St. in the center of the EWU campus in Cheney Washington. A preliminary energy audit was conducted on the building in August of 2010 by McKinstry.

SCIENCE BUILDING

The Science Building is two-story concrete masonry building which was built in 1962 with renovations made in 1994. This is a 148,000 square foot facility which houses most of the science departments on campus and includes laboratories, classrooms and faculty offices. It is in the shape of square with an open courtyard in the center. The science departments in this building are chemistry, biology, geology, physics and natural and environmental science. The facility has a greenhouse, planetarium and a, Vivarium.

PREVIOUS ENERGY RETROFITS

In 2003, McKinstry installed replaced vari-cones on many of the air handlers and installed variable frequency drives. Prior to 2003, a lighting retrofit was done in the 2000 – 2001 time frame.

HEATING SYSTEM

The heating system serving the theater is provided by the Campus Central Steam Plant. The steam pressure coming into the building is 110 psi and is reduced twice in the existing steam station. First the steam pressure is reduced to 30 psi steam at the steam station and then further reduced to 12 psi. The medium pressure steam is used for heating the domestic water, while the low pressure steam is used for the low pressure steam pre-heat coil in the multi-zone air handling unit, and is used for heating hot water through a steam / water converter for the reheat coils located throughout the building.

COOLING SYSTEM

The cooling system uses chilled water from the central chilled water plant in Rozell.

AIR DISTRIBUTION SYSTEM

The ventilation systems in the Science Building are comprised of (3) large constant volume terminal reheat air handing units that introduce 100% outdoor air to the building. Each unit has a run around heat recovery coil, a face/bypass low pressure steam coil, a chilled water coil and humidifiers. They serve a wide variety of areas such as classrooms, laboratories, offices, and administrative areas. This building has a general exhaust systems and fume hood exhaust systems. The balance between the three systems is controlled by the Staeffa digital control/ and pneumatic controls.

There are issues with the pre-heat coils freezing up that need to be addressed. 2 of the supply air handlers are in their respective underground mechanical rooms that are only connected to the science building through the utility tunnels. The outdoor air vents have a lot of tree dirt and snow that accumulates at the bottom of the outdoor air intakes into the air handlers. This blockage deprives the coils to work appropriately and thus causes some freezing problems.

Reducing Scope 1 & 2 Emissions

SEQUENCE OF OPERATIONS

1. The ventilation systems in the Science Building are comprised of (3) large constant volume terminal reheat air handing units that introduce 100% outdoor air to the building. Each unit has a run around heat recovery coil, a face/bypass low pressure steam coil, a chilled water coil and humidifiers. They serve a wide variety of areas such as classrooms, laboratories, and offices.

AREAS OF INTEREST

1. This building presents the university with its largest source of potential energy savings. This building consumes more energy than any other building on campus. The potential retrofits that McKinstry would recommend is momentarily limited due to the eventual plans for EWU to build Science 1 and Science 2 in the next 4 to 6 years.
2. Create a different design for the outdoor air intake for the (2) AHUs located in their respective underground mechanical rooms.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

Name	**AHU 1**	**AHU 2**	**AHU 3**	**AHU 4 (listed as AH1)**
Location				
Area Served				
Name Plate Data				
Make				
Model number				
Serial number				
Controls				
Type				
Supply Fan Data				
Make				
Model number				
Serial number				
Voltage				
Amperage				
HP				
Efficiency				
Power Factor				
Frame Number				
Motor Type (TEFC)				
Actual Kw				
Actual Volts				
Actual Amps				
Return Fan Data				
Make				
Model number				
Serial number				
Voltage				
Amperage				
HP				
Efficiency				
Power Factor				
Frame Number				
Motor Type(TEFC)				
Actual Kw				
Actual Volts				
Actual Amps				
Type of system				
Exhaust Fan				
Steam Heat Data				
Pressure				
Coil Type				
Control Valve Set up				

Reducing Scope 1 & 2 Emissions

Table 2 Pumps

Name	CHW1	HW Circ Pmp
Location		
Area Served		
Name Plate Data		
Make		
Model number		
Serial number		
Type		
GPM/FT Head		
Voltage		
Amperage		
HP		
Efficiency		
Power Factor		
Frame Number		
Actual Kw		
Actual Volts		
Actual Amps		

Name	EF x
Location	
Area Served	
Name Plate Data	
Make	
Model number	
Serial number	
Type	
Voltage	
Amperage	
HP	
Efficiency	
Power Factor	
Frame Number	
Actual Kw	
Actual Volts	
Actual Amps	

Reducing Scope 1 & 2 Emissions

Executive Report

SUTTON HALL

A central VAV air handling unit located in the basement mechanical room serves VAV boxes. The air handler has a dedicated steam pre-heat coil, a chilled water coil, pre-filters, final filters and a dedicated return fan.

In 2003, VFDs were installed and integrated into the digital control system. Together with the digital controls system, these VFDs now control air volume. McKinstry will evaluate whether or not this air handler is properly sized. The building's HVAC systems are controlled with Staeffa digital controls.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/SUTTON HALL

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT AUGUST 18, 2010.

OVERVIEW

Sutton Hall of Eastern Washington University is one of the six historic buildings in the EWU Historic District of the EWU campus in Cheney Washington. The EWU Historic District, as it is commonly known, was the first university historic district in the state to receive National Register designation. A preliminary energy audit was conducted on August 18, 2010 by McKinstry.

SUTTON HALL

Sutton Hall is a 32,000 square foot three-story red and brown brick structure with concrete foundation and flat roof which was completed in 1923. It was originally the first men's dormitory on the campus. Its foot print is that of a wide letter "H", 133 feet long across the east facade with two 111 foot wings. Around 1978 it ceased operation as a dormitory and it was completely remodeled in 2001 as an administrative building.

The new HVAC system was designed for a wide open floor plan to accommodate a cubicle office environment. Over the past 10 years however, there have been many walls and partitions that have been constructed for office space, which went against the intent of the original HVAC design. The Building Maintenance department on campus has received many comfort complaints from the occupants complaining of their respective zones being to warm or to cold. There are some that the main AHU serving this building is undersized.

PREVIOUS ENERGY RETROFITS

In 2003, McKinstry replaced the Vari-cones on the supply and return fans and replaced them with variable frequency drives and connected them to the existing Staeffa Digital Controls system.

HEATING SYSTEM

Heating in this building is provided by the Rozell Central steam plant. Steam is introduced to the building at 110 psi and then reduced to 35 psi and then further to 15 psi. The 35 psi steam is utilized in the domestic hot water system while the low pressure steam is used in the pre-heat coil in the main air handling unit and a skid mounted steam/water converter, where the heated water gets circulated to the baseboard fin tube radiators located around the perimeter of the building on all floors.

COOLING SYSTEM

Cooling is provided to Sutton Hall from the central chilled water plant. The chilled water is used by the main air handling unit's chilled water coil.

AIR DISTRIBUTION SYSTEM

The ventilation system in Sutton Hall is comprised of a central variable air volume air handling unit located in the basement mechanical room that serves variable air volume boxes. The air handler has a dedicated st5eam pre-heat coil and a chilled water coil, pre-filters, and final filters, and a dedicated return fan. In 2003, variable frequency drives were installed and mapped into the digital control system, The VFDs, in conjunction with the

Reducing Scope 1 & 2 Emissions

digital controls system, now control the volume of air. McKinstry will evaluate whether or not this air handler is properly sized. The building's HVAC systems are controlled with Staeffa Digital Controls.

SEQUENCE OF OPERATIONS

1. Due to the design of the ventilation system the air handler struggles with the start up loads in the morning which translates to longer operating hours.
2. This air handler struggles with economizer operation.
3. No supply air reset strategy.
4. No Hot water reset strategy in place.

AREAS OF INTEREST

1. Verify that the sizing of the existing air handler is adequate.
2. Re-zone the VAV boxes. Control the VAV Boxes in unison with the base board heating systems.
3. Swap out all controls to one of the approved vendors on campus.
4. Implement energy saving control strategies.
5. Balance the ventilation systems.
6. Commission the controls.

Reducing Scope 1 & 2 Emissions

Table 1 Air Handler Units

EWU -

Data	AHU - 1
Area Served	Entire Building
System Type	VAV AHU W/ VAVRH
Manufacturer	Pace
Cold Deck Model Number	P-36AF-SWSI
Cold Deck Serial Number	94-75838-01
Cold Deck CFM	26,000
TSP in. W.C.	4.5
Hot Deck Model Number	
Hot Deck Serial Number	
Hot Deck CFM	
TSP in. W.C.	
Motor Name Plate Data (Cold Deck)	
Manufacturer	Reliance
Voltage	230/460
Amperage	96/48
HP	40
Motor Efficiency	93
Power Factor	83.5
Frame	324T
Motor Type	ODP
Actual kW Measured	18.1
Actual Voltage Measured	469
Actual Amperage Measured	24.2
Motor Name Plate Data (Hot Deck)	
Manufacturer	
Voltage	
Amperage	
HP	
Motor Efficiency	
Power Factor	
Frame	
Motor Type	
Actual kW Measured	
Actual Voltage Measured	
Actual Amperage Measured	
Motor Name Plate Data (Return Fan)	RF-1
Return Fan Model Number	PF-36AF-SWSI
Return Fan Serial Number	94-75838-02
Return Fan CFM	21,000
TSP in. W.C.	2.0
Manufacturer	Reliance
Voltage	230/460
Amperage	38/19
HP	15
Motor Efficiency	92.40%
Power Factor	82%
Frame	254T
Motor Type	ODP
Actual kW Measured	7.6
Actual Voltage Measured	469
Actual Amperage Measured	10.6

Table 2 Pumps

EWU -

Data	Pump - 1	Pump - 2	Pump - 3
Area/System/Equipment Served	CHW - AHU-1 CC	HW - Reheats/Baseboard	HW - Reheats/Baseboard
Pump Type	Centrifugal	Centrifugal	Centrifugal
Manufacturer	Bell & Gossett	Bell & Gossett	Bell & Gossett
Model Number			
Serial Number			
GPM	200	270	270
Ft of Head	50	65	65
Motor Name Plate Data			
Manufacturer	US Electric Motor	Magnetek	Magnetek
Model Number			
Serial Number			
Voltage	230/460	230/460	230/460
Amperage	13.4 / 6.7	19.2 / 9.6	19.2 / 9.6
HP	5	7.5	7.5
Motor Efficiency	89.50%	88.50%	88.50%
Power Factor		82.50%	82.50%
Frame	184T	S213T	S213T
Motor Type	ODP	ODP	ODP
Actual kW Measured	3.8	4.9	4.9
Actual Voltage Measured	469	460	460
Actual Amperage Measured	4.88	6.3	6.3

Table 3 Chillers

EWU -

Data	Pump - 1	Pump - 2	Pump - 3	Pump - 4	Pump - 5	Pump - 6	Pump - 7	Pump - 8	Pump - 9	Pump - 10
Area/System/Equipment Served										
Chiller Compressor Type										
Manufacturer										
Model Number										
Serial Number										
Tonnage										
Motor Name Plate Data										
Manufacturer										
Model Number										
Serial Number										
Voltage										
Amperage										
HP										
Motor Efficiency										
Power Factor										
Frame										
Motor Type										
Actual kW Measured										
Actual Voltage Measured										
Actual Amperage Measured										

Reducing Scope 1 & 2 Emissions

Executive Report

THEATER HALL

The HVAC system consists of two air handling units AHU-1 (labeled AH-D-1) serves four zones in the Auditorium. It has a steam pre-heat coil and a chilled water coil for cooling (listed at 21,000 CFM@ 3” SP with 1130 rpm). AHU-2 serves the building beyond the Auditorium. It is a constant-volume, terminal-reheat air handling unit with a dedicated return fan. It does not have a pre-heat coil, relying almost exclusively on return air mixing with outdoor air. Final air tempering is performed at the zonal level by the terminal boxes. Both air handlers rely on the building’s original pneumatic controls. This equipment has outlived its rated useful service life and should be considered to be replaced with energy efficient HVAC systems. These AHUs are limited in their energy saving capabilities.

Note: excessive sound attenuation throughout both ventilation systems presents a great opportunity to decrease pressure drop.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/THEATER-DRAMA BUILDING

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT AUGUST 4, 2010

OVERVIEW

The Fine Arts Complex of the Eastern Washington University is comprised of several buildings: Art, Music, Theater, Radio and TV, and Communications on the south side of the EWU campus in Cheney Washington. McKinstry has not previously completed retrofits of this complex. A preliminary energy audit was conducted on August 4, 2010 by McKinstry.

THE THEATER BUILDING

The Theater building is part of the Fine Arts Complex which was completed in 1971. The facility consists of classrooms, offices and a performance theater. This is a three story 36,000 sf concrete masonry block building with red face brick. Windows are double pane. The occupancy ratio is 50 faculty/staff members and 400 students. Operating hours are 8:30AM to 8:00 pm though out the year. The occupancy tapers off in the summer pretty drastically as well as weekends. Performances are held periodically throughout the year in the evenings.

PREVIOUS ENERGY RETROFITS

No previous mechanical retrofit work was completed by McKinstry in this facility. A lighting retrofit was done in the 2000 to 2001 time frame.

HEATING SYSTEM

The heating system serving the theater is provided by the Campus Central Steam Plant. The steam pressure coming into the building is 110 psi and is reduced twice in the existing steam station. First the steam pressure is reduced to 22 psi steam at the steam station and then further reduced to 12 psi. The medium pressure steam is used for heating the domestic water, while the low pressure steam is used for the low pressure steam pre-heat coil in the multi-zone air handling unit, and is used for heating hot water through a steam / water converter for the reheat coils located throughout the building.

COOLING SYSTEM

Cooling in this building is provided by the central chilled water plant in Rozell.

AIR DISTRIBUTION SYSTEM

The HVAC system consists of two air handler units. AH1 (Labeled AH-D-1) is a Multi-zone unit which serves 4 zones. This unit has a steam pre-heat coil and a chilled water coil for cooling (AH1 is listed at 21,000 CFM@ 3" SP with 1130 rpm). This unit serves the auditorium.

AH 2 is a constant volume, terminal reheat air handling unit with a dedicated return fan. This air handler does not have a pre-heat coil and relies almost exclusively on the return air mixing with the outdoor air. Final tempering of the air is performed at the zonal level by the terminal boxes. This air handler serves the rest of the building outside of the auditorium. Both air handlers are controlled old pneumatic controls.

One item to note was the excessive sound attenuation throughout both ventilation systems. This could present a great opportunity to decrease the pressure drop across both ventilation systems if addressed properly.

SEQUENCE OF OPERATIONS

1. Both AHUs operate 24/7.
2. Very limited in energy management capabilities.

AREAS OF FURTHER INVESTIGATION

1. Convert both ventilation systems to VAV systems. Examine feasibility of using fan walls to control the noise levels throughout the building. Install new VAV boxes with factory mounted digital controls. Install a heating hot water coil in AHU#2.
2. Lighting system retrofit in the stage area of the auditorium.
3. The steam station needs to have certain components replaced.

Reducing Scope 1 & 2 Emissions

TABLE 1 AIR HANDLER UNITS

Name	AH 1	AH 2
Location	Theater	Theater
Area Served		
Name Plate Data		
Make	Aladdin	Aladdin
Model number	MC Size 1-33	
Serial number	58619	
Controls		
Type	Pneumatic	
Supply Fan Data		
Make	Century Motor	Century
Model number		
Serial number		
Voltage	200-208	200-208
Amperage	56	56-56
HP	20	20/3ph
Efficiency	NL	
Power Factor	NL	
Frame Number	256T	256T
Motor Type (TEFC)	SC	ODP
Actual Kw	12.3	11.5
Actual Volts	205.4	205.8
Actual Amps	42.2	39.5
Return Fan Data		
Make	Woods	Magnetec
Model number		
Serial number		
Voltage	208	208-230/460
Amperage	25.5	22-21/10.5
HP	10	7.5/3ph
Efficiency	NL	82.9
Power Factor	NL	80.7
Frame Number	4084F	5213T
Motor Type(TEFC)		ODP
Actual Kw	2.1	2.9
Actual Volts	206.3	206.3
Actual Amps	8.3	11
Type of system		
Exhaust Fan	NA	NA
Steam Heat Data		
Pressure	15 psi	15 psi
Coil Type	Serpentine coil	Serpentine coil
Control Valve Set up	1/3-2/3	1/3-2/3

Reducing Scope 1 & 2 Emissions

TABLE 2 PUMPS

Name	**CHW1 CLG 1**	**CHW1 CLG 2**	**HWH P1**
Location	AH2	AH1	
Area Served			
Name Plate Data			
Make	Federal	Federal	Federal
Model number			81-184 TDR-BZ
Serial number			
Type	Base mtd, end suction	Base mtd, end suction	ODP
GPM/FT Head	77/92'	77/92'	62/63'
Voltage	208	208	208-220/440
Amperage	15.1	15.1	6.4/3.2
HP	5	5	2/ 3ph
Efficiency	NL	NL	
Power Factor	NL	NL	
Frame Number	184T	184T	184 CZ
Actual Kw	4.1	4.3	1.7
Actual Volts	205.1	205.5	206.8
Actual Amps	14.8	14.5	5.6

TABLE 3 HEAT EXCHANGER

Name	**HZ 1**
Location	
Area Served	
Name Plate Data	
Make	B & G (1970)
Model number	SU-84-2
Serial number	125674

Reducing Scope 1 & 2 Emissions

Executive Report

WILLIAMSON HALL

A built-up, constant-volume, terminal-reheat air handler is located in a penthouse mechanical room. This unit has a pre-filter, low-pressure steam pre-heat coil, a chilled water coil and a dedicated return fan. The air handling system and the terminal boxes are controlled pneumatically. This air handler has outlived its useful service life and is limited in its energy saving capabilities. This AHU runs 24/7.

Reducing Scope 1 & 2 Emissions

Detailed Report

EASTERN WASHINGTON UNIVERSITY/WILLIAMSON HALL

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT AUGUST 18, 2010.

OVERVIEW

Williamson Hall is located in the center of the Eastern Washington University campus in Cheney Washington. It is physically connected to Martin Hall. A preliminary energy audit was conducted on August 18, 2010 by McKinstry.

WILLIAMSONHALL

Williamson Hall is a three-story, 31,000 square foot Masonry/Brown Brick structure which was completed in 1967 as an addition to Martin Hall. The glazing in this building is comprised of single pane glass. It was renovated in 1977. It houses the departments of education and children's studies and holds classrooms and faculty offices. The operation hours are 7:00 am to 6:00 pm during the academic year and reduced hours of operation during the summer. The occupancy is 75 faculty/staff to 300students.

PREVIOUS ENERGY RETROFITS

There was no previous retrofit work completed by McKinstry in this facility, although a lighting retrofit was done in the late 90's.

HEATING SYSTEM

The heating system serving the theater is provided by the Campus Central Steam Plant. The steam pressure coming into the building is 110 psi and is reduced twice in the existing steam station. First the steam pressure is reduced to 22 psi steam at the steam station and then further reduced to 12 psi. The medium pressure steam is used for heating the domestic water, while the low pressure steam is used for the low pressure steam pre-heat coil in the multi-zone air handling unit, and is used for heating hot water through a steam / water converter for the reheat coils located through-out the building.

COOLING SYSTEM

Cooling in this building is provided by the central chilled water plant in Rozell. The air handler serving this building originally had a dedicated condensing unit. During the 1977 renovation, this unit had the direct expansion coil removed and the new chilled water coil installed.

AIR DISTRIBUTION SYSTEM

The ventilation system serving Williamson Hall consists of a built-up constant volume, terminal reheat air handing unit that is located in a penthouse mechanical room. This unit has a pre-filter, low pressure steam pre-heat coil, and a chilled water coil. The air handler has a dedicated return fan. The air handling system and the terminal boxes are controlled pneumatically.

Reducing Scope 1 & 2 Emissions

SEQUENCE OF OPERATIONS

1. The air handler operates 24/7
2. No economizer control
3. No Supply air reset
4. No HW Reset

AREAS OF INTEREST

1. Convert the constant volume air handler to a variable air volume air handling unit. Replace the existing built up air handling unit with a new custom air handling unit with fan wall technology. Retrofit all constant volume boxes with VAV boxes with hot water reheat. Reheats will have controls factory mounted.
2. Renewal of auxiliary systems.
3. Window retrofit.

Table 1 Air Handler Units

EWU - Williamson Hall

Data	AHU - 1
Area Served	Entire Building
System Type	CVTR w/RF
Manufacturer	Barry Blower Co.
Cold Deck Model Number	490-SWSI
Cold Deck Serial Number	674901
Cold Deck CFM	
TSP in. W.C.	
Hot Deck Model Number	
Hot Deck Serial Number	
Hot Deck CFM	
TSP in. W.C.	
Motor Name Plate Data (Cold Deck)	
Manufacturer	Leeson
Voltage	208/230
Amperage	137 - 125/62.5
HP	50
Motor Efficiency	93
Power Factor	80.5
Frame	365T
Motor Type	ODP
Actual kW Measured	24.3
Actual Voltage Measured	207
Actual Amperage Measured	87
Motor Name Plate Data (Hot Deck)	
Manufacturer	
Voltage	
Amperage	
HP	
Motor Efficiency	
Power Factor	
Frame	
Motor Type	
Actual kW Measured	
Actual Voltage Measured	
Actual Amperage Measured	
Motor Name Plate Data (Return Fan)	RF-1
Return Fan Model Number	
Return Fan Serial Number	
Return Fan CFM	
TSP in. W.C.	
Manufacturer	Leeson
Voltage	230/460
Amperage	29 - 27/13.5
HP	10
Motor Efficiency	90.20%
Power Factor	77%
Frame	256T
Motor Type	ODP
Actual kW Measured	6.2
Actual Voltage Measured	208V
Actual Amperage Measured	21.4

Reducing Scope 1 & 2 Emissions

Table 2 Pumps

EWU - Williamson Hall

Data	Pump - 1	Pump - 2	Pump - 3
Area/System/Equipment Served	Reheat System	Baseboard System	Chilled Water Pump
Pump Type	Centrifugal	Centrifugal	Centrifugal
Manufacturer		Pacific	
Model Number			
Serial Number			
GPM			
Ft of Head			
Motor Name Plate Data			
Manufacturer		Century	
Model Number			
Serial Number			
Voltage	208/230	208/230	
Amperage	9.7 - 8.2 / 4.1	6.2 - 5.8 / 2.9	
HP	3	2	
Motor Efficiency			
Power Factor			
Frame			
Motor Type	TEFC		
Actual kW Measured	1.67	1.41	
Actual Voltage Measured	210	210	
Actual Amperage Measured	6	4.8	

Table 3- Chillers

EWU - JFK Library

Data	Pump - 1	Pump - 2	Pump - 3	Pump - 4	Pump - 5	Pump - 6	Pump - 7	Pump - 8	Pump - 9	Pump - 10
Area/System/Equipment Served										
Chiller Compressor Type										
Manufacturer										
Model Number										
Serial Number										
Tonnage										
Motor Name Plate Data										
Manufacturer										
Model Number										
Serial Number										
Voltage										
Amperage										
HP										
Motor Efficiency										
Power Factor										
Frame										
Motor Type										
Actual kW Measured										
Actual Voltage Measured										
Actual Amperage Measured										

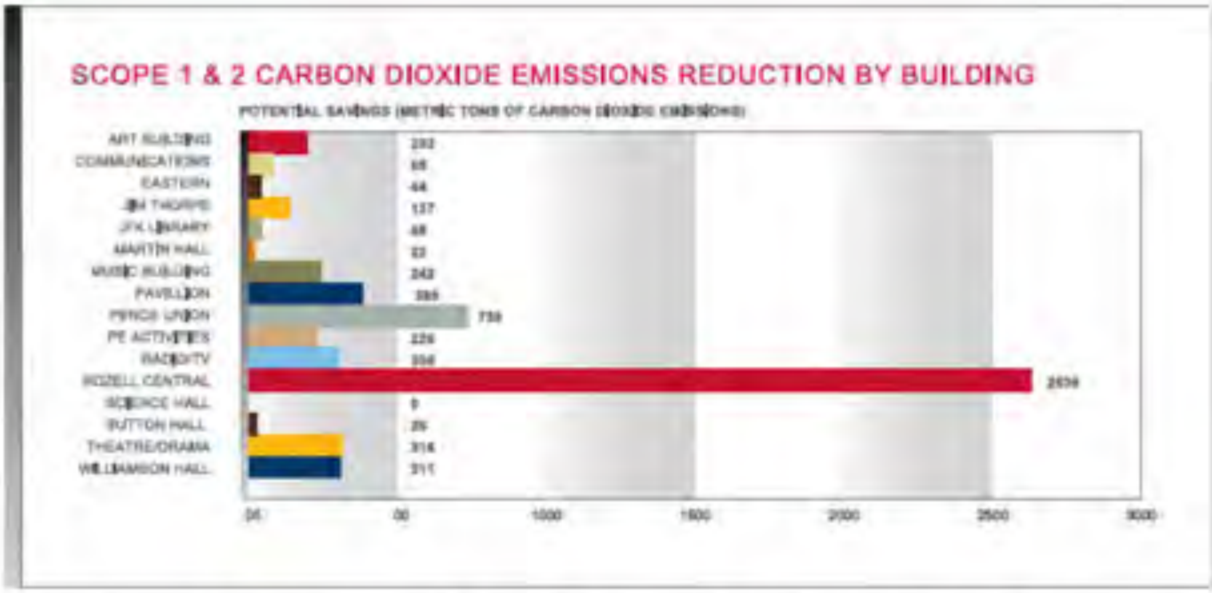
Reducing Scope 1 & 2 Emissions

Executive Report

C. EMISSIONS SAVINGS BY BUILDING

This graph shows potential carbon savings for each building that was audited from implementing the recommended facility improvement measures identified on Table 2.

GRAPH 3



Based on electric, campus stationary combustion and refrigerants [Scope 1 and 2 without agriculture or transportation] data from the 2007 GHG Inventory prepared by Eastern Washington University.

Reducing Scope 1 & 2 Emissions

Executive Report

3. ANALYSIS FINDINGS

A. TABLE 2: CARBON REDUCTION POTENTIAL

Implementation of measures in the accompanying table for Facility Scope 1 & 2 would cut campus emissions by an estimated 3,722 metric tons—a significant reduction from the 32,806 metric tons of emissions from facility operations, which accounts for 65% of all campus emissions.

Facility Improvement Measure (FIM) Summary - Rough Order of Magnitude (ROM)

Project	Eastern Washington University
Scenario	Building Measures
Date	November 17, 2011

LEGEND:
1 - High Priority
2 - Medium Priority
3 - Neutral Priority

			Budget *		Annual Utility Savings				Estimated Net Customer Cost (with Incentives)		Estimated Modified Payback				
FIM Name	FIM Description	Building	Min	Max	Min	Max	Annual Operational Savings **	Potential Incentives ***	Min	Max	Min	Max	Carbon Savings (Metric Tonnes)	EWU Value Proposition	Ranking
4.01-ART: Controls Upgrade	McKinstry proposes to remove and replace all of the Staeffa controls and replace them with one of the approved controls contractors for the EWU campus. Wiring, conduit, Belimo valves and actuators will be re-used where appropriate. McKinstry proposes to commission the controls system as well in order to augment the existing controls strategies with additional energy saving control strategies. McKinstry will also diagnose the balancing issues within the building McKinstry proposes to remove and replace all of the Staeffa controls and replace them with one of the approved controls contractors for the EWU campus. Wiring, conduit, Belimo valves and actuators will be re-used where appropriate. McKinstry proposes to commission the controls system as well in order to augment the existing controls strategies with additional energy saving control strategies. McKinstry will also diagnose the balancing issues within the building.	Art Building	$235,625	$287,987	$30,203	$33,382	$9,228	$42,744	$192,881	$245,243	4.5	6.2	203	1. One of the remaining buildings on campus with the old Staeffa Digital Controls Systems that is no longer supported and becoming more difficult and expensive to obtain replacement parts. 2. Address the balancing issues that have plagued this building for a long time and thus caused excessive energy use. 3. Occupant comfort.	1
3.01-COM: CV Dual Duct Conversion to Dual Fan Dual Duct VAV	McKinstry proposes to remove and replace the existing supply fan and mixing boxes and associated controls and replace them with an energy efficient dual fan, dual duct variable air volume air handler and (76) new variable air volume mixing boxes and a new digital controls system. The outdoor air opening is currently too small and is causing the outdoor air duct to cave in.	Communications Building	$906,667	$1,108,149	$12,457	$13,768	$11,685	$9,654	$897,013	$1,098,495	35.2	45.5	85	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with a new energy efficient HVAC equipment and systems. New Dual Duct VAV Boxes with Digital Controls. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The existing concealed spline ceiling will be removed and disposed of and a new lighting system and ceiling will be installed in its place. 4. New lighting controls will also be installed 5. Occupant Comfort	1
4.01-ECC: Controls Upgrade	McKinstry proposes to remove and replace all of the Staeffa controls and replace them with one of the approved controls contractors for the EWU campus. Wiring, conduit, and Belimo valves and actuators will be re-used where appropriate. The controls system will be retro-commissioned and the existing controls strategies will be augmented with newer energy saving control strategies. The vari-cones will be removed and replaced on the supply and return fans with new ABB Variable Frequency Drives. Currently the AHU is operating in a constant volume mode of operation due to the broken vari-cones. McKinstry proposes to remove and replace the vari-cones that are no longer working properly on the supply and return fans with new ABB Variable Frequency Drives. The AHU is currently operating in a constant volume mode of operation due to the broken vari-cones. The Staeffa controls will be removed and replaced with one of the approved controls contractors for the EWU campus. Wiring, conduit, Belimo valves and actuators will be re-used where appropriate. McKinstry proposes to retro-commission the controls system as well as augment the existing controls strategies with newer energy saving control strategies.	Eastern Children's Center	$92,702	$113,302	$6,398	$7,072	$3,784	$1,355	$91,347	$111,947	8.4	11.0	44	1. One of the remaining buildings on campus with the old Staeffa Digital Controls Systems that is no longer supported and becoming more difficult and expensive to obtain replacement parts. 2. The new VFDs will allow the AHU to operate as it was initially intended, in a variable volume mode of operation. 3. Additional Energy saving control strategies will be implemented, such as HW reset, morning purge, economizer control, supply air reset, and morning warm-up/cool-down. 4. Occupant Comfort.	1
3.01-JTF: HV's 1 & 2 and Controls Retrofit	McKinstry proposes replacing the existing HV's 1 & 2 with 2 new AHUs with associated new ductwork and controls. The existing H&V Units operate 24/7, 365 days a year and do not have a ductwork distribution system. They currently use a torret diffuser that distributes the air and the air coming out the diffuser can affect the trajectory of the balls in some of the sporting that take place in the field house. Overall the air is inefficiently distributed. This FIM calls for installing ductwork to distribute the air more evenly. The issue with the relief air dampers will get addressed.	Jim Thorpe Fieldhouse	$575,692	$703,624	$13,919	$15,384	$10,228	$929	$574,763	$702,695	22.4	29.1	103	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The new ductwork distribution systems in the fieldhouse will allow the tempered air to get ventilated more evenly and efficiently and will not interfere with the trajectory of balls during any competition 4. Occupant Comfort.	1
3.02-JTF: AH's 1 & 2 and Controls Retrofit	McKinstry proposes replacing the existing AH's 1 & 2 with 2 new AHUs with associated new piping and controls. The existing AHUs operate 24/7, 365 days a year.	Jim Thorpe Fieldhouse	$135,451	$165,551	$4,427	$4,893	$6,445	$105	$135,346	$165,446	11.9	15.2	34	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. Occupant Comfort.	1
4.01-JFK: Controls Upgrade	McKinstry proposes to remove and replace all of the Staeffa controls and replace them with one of the approved controls contractors for the EWU campus. Wiring, conduit, Belimo valves and actuators will be re-used where appropriate. The controls system will be retro-commissioned and the existing control strategies will be augmented with newer energy saving control strategies.	John F Kennedy Library	$503,575	$615,481	$5,131	$5,671	$10,728	$0	$503,575	$615,481	30.7	38.8	41	1. One of the reminaing buildings on campus with the old Staeffa Digital Controls Systems that is no longer supported and becoming more difficult and expensive to obtain replacement parts. 2. Implement Demand Control Ventilation strategies on all AHUs serving the library, and auditorium. 3. Additional Energy saving control strategies will be implemented, such as HW reset and morning purge. 4. Occupant Comfort	1
9.01-JFK: Lighting Upgrades	McKinstry proposes to replace these maintenance intensive fixtures with 19W LED retrofits with a rated lamp life of 50,000 hrs. To further increase savings these fixtures would be turned off during daylight hours as ambient light allows	John F Kennedy Library	$24,432	$29,862	$1,322	$1,461	$1,026	$2,487	$21,945	$27,375	8.8	11.7	7	1. Replace energy inefficient HID lighting with energy efficient LED Lighting. 2. Daylight controls will be installed to shut them down during daylight hours.	1
26.01-MAR: Retro-commissiong	McKinstry proposes to retro-commission the existing Dual Fan, Dual Duct VAV system and ensure that the AHU is operating as intended.	Martin Hall	$39,573	$48,367	$3,471	$3,837	$5,504	$6,292	$33,281	$42,075	3.6	4.7	22	1. Retro-commissioning will ensure that the HVAC systems are operating as energy efficiently as possible.	1
3.01-MUS: CV Dual Duct Conversion to Dual Fan Dual Duct VAV	McKinstry proposes to remove and replace the existing constant volume dual duct HVAC system and its corresponding (73) mixing boxes and associated controls with an energy efficient dual fan, dual duct variable air volume air handler as well as (73) new variable air volume mixing boxes with a new digital controls system. This FIM includes replacing the existing concealed spline ceiling and the existing lighting system, with a new T-Bar grid and acoustic ceiling tiles and energy efficient lighting systems.	Music Building	$1,003,402	$1,226,380	$23,931	$26,450	$8,380	$29,034	$974,368	$1,197,346	28.0	37.1	167	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New Dual Duct VAV Boxes with Digital Controls. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The existing concealed spline ceiling will be removed and disposed of and a new lighting system and ceiling will be installed in its place. 4. New lighting controls will also be installed 5. Occupant Comfort	1
3.02-MUS: Multizone Conversion to VAV AHU with VAV Reheat	McKinstry proposes to remove and replace the existing constant volume multi-zone air handling unit that serves the Recital Hall portion of the Music Building, and its corresponding return fan located in the adjacent mechanical room, and their associated controls. The multi-zone unit serves (5) separate zones. McKinstry proposes to install an energy efficient Variable air volume air handler, and (5) variable air volume boxes with hot water reheat coils with a new digital controls system. Demand control ventilation control strategy will be employed on this air handling system. McKinstry will address the noise issues with this air handling unit.	Music Building	$476,733	$582,673	$11,488	$12,698	$8,380	$18,180	$458,553	$564,493	21.8	28.4	75	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New VAV Boxes with digital controls will be installed. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The noise issues attributed with this AHU will be addressed. 4. All Mechanical / Electrical work will be performed in the existing mechanical rooms minimizing the impacts to the rest of the building. 5. Occupant Comfort.	1

3.01-PAV: AHU Retrofit	McKinstry proposes to replace the (3) of the existing AHU's with (4) AHU's. The single multi-zone unit will be broken up into two separate zones served by two separate AHUs. The existing ductwork will be modified slightly in the mechanical rooms in order to accommodate the new units. New digital controls will be installed on all (4) new units.	Pavilion (Reese Court)	$459,128	$561,156	$18,372	$20,306	$6,054	$22,920	$436,208	$538,236	16.5	22.0	128	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. All Mechanical / Electrical work will be performed in the existing mechanical rooms minimizing the impacts to the rest of the building. 4. Occupant Comfort.	1
3.02-PAV: Upgrade to AHU 4 and 5	McKinstry proposes to replace the supply and return axial vane fans for AH-4 and AH-5. This will entail removing the sound attenuators on either side of the fans and installing straight ductwork. The new fan wall's volume will be controlled with VFDs and each air handler will have new digital controls installed.	Pavilion (Reese Court)	$464,740	$568,016	$32,546	$35,972	$6,054	$57,435	$407,305	$510,581	9.7	13.2	204	1. Replacing the Axial Vane Supply and Return Fans with a supply and return fan arrays will ensure that the AHUs never have a catastrophic failure. 2. The sound attenuators will be removed and thus the pressure drops decreased and therefore greater energy savings will be realized. 3. The digital controls will allow remote control and alarming capabilities. Energy saving control capabilities will be installed. 4. Occupant Comfort.	1
9.01-PAV: Lighting Retrofit	The purpose of this FIM is to increase the switching flexibility of the existing control system (four light levels currently available) by replacing the (48) 1000W MH fixtures with energy efficient instant on T5 HO fixtures assemblies, this will allow dual light levels at each location. The existing 1500W quartz fixtures would be replaced with a similar T5 HO assembly with the control remaining the same. The 1000W MH Flood fixtures would be replaced with new 1500W MH Floods, controls would remain the same and vertical footcandles would be increases to the NCAA recommended 90.	Pavilion (Reese Court)	$140,136	$171,278	$10,003	$11,056	$277	$18,000	$122,136	$153,278	10.8	14.9	55	1. New energy efficient lighting with multi-level controls will allow for greater lighting level capabilities.	1
11.00-PUB: Electrical Upgrade	McKinstry proposes to upgrade the existing electrical distribution system with a new main switchboard, motor control center and branch circuit panels to replace the existing ITE equipment. All existing feeders and branch circuit wiring will be re-used.	Pence Union Building	$344,626	$421,210	$0	$0	$0	$0	$344,626	$421,210	0.0	0.0	0	1. The existing electrical service is insufficient and would need to be addressed upon any future remodel of the Pence Union Building.	1
3.01-PUB: HVAC Upgrade	McKinstry proposes to remove and replace the existing constant volume dual duct air handler in the lower level mechanical room. The nomenclature for this unit is AH-1. It serves the existing multi-purpose room. McKinstry proposes to replace this system and its respective controls with a dual fan, dual duct variable air volume air handling system. All of the existing pneumatic controls will be retrofitted with new digital controls. McKinstry proposes to remove and replace all of the existing (28) constant volume mixing boxes served by this AHU with VAV mixing boxes with digital controls. McKinstry proposes to remove and replace the existing constant volume dual duct air handler in the lower level mechanical room. The nomenclature for this unit is AH-1. It serves the existing multi-purpose room. McKinstry proposes to replace this system and its respective controls with a dual fan, dual duct variable air volume air handling system. All of the existing pneumatic controls will be retrofitted with new digital controls. McKinstry proposes to remove and replace all of the existing (28) constant volume mixing boxes served by this AHU with VAV mixing boxes with digital controls.	Pence Union Building	$612,889	$749,087	$26,971	$29,810	$4,344	$7,950	$604,939	$741,137	17.7	23.7	193	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New Dual Duct VAV Boxes with digital controls. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The existing concealed spline ceiling will be removed and disposed of and a new lighting system and ceiling will be installed in its place. 4. New lighting controls will also be installed 5. Occupant Comfort. 6. Energy Efficient remodel and revitalization of a high profile building on the EWU Campus.	1
3.02-PUB: HVAC Upgrade	McKinstry proposes to remove and replace the existing constant volume dual duct air handler in the upper level mechanical room. The nomenclature for this unit is AH-2. It serves the meeting rooms and classrooms on the 2nd and 3rd floors of the PUB. McKinstry proposes to replace this system and its respective controls with a dual fan, dual duct variable air volume air handling system. All of the existing pneumatic controls will be retrofitted with new digital controls. McKinstry proposes to remove and replace (34) of the existing constant volume mixing boxes served by this AHU with (34) new VAV mixing boxes with digital controls.	Pence Union Building	$645,983	$789,535	$27,749	$30,670	$4,344	$7,245	$638,738	$782,290	18.2	24.4	200	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New Dual Duct VAV Boxes with digital controls. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The existing concealed spline ceiling will be removed and disposed of and a new lighting system and ceiling will be installed in its place. 4. New lighting controls will also be installed 5. Occupant Comfort. 6. Energy Efficient remodel and revitalization of a high profile building on the EWU Campus.	1
3.03-PUB: HVAC Upgrade	McKinstry proposes to remove and replace the existing constant volume dual duct air handler in the upper level mechanical room. The nomenclature for this unit is AH-3. It serves the meeting rooms and classrooms on the 2nd and 3rd floors of the PUB. McKinstry proposes to replace this system and its respective controls with a dual fan, dual duct variable air volume air handling system. All of the existing pneumatic controls will be retrofitted with new digital controls. McKinstry proposes to remove and replace the existing (26) constant volume mixing boxes served by this AHU with VAV mixing boxes with digital controls.	Pence Union Building	$617,569	$754,807	$23,070	$25,498	$4,344	$7,710	$609,859	$747,097	20.4	27.3	166	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New Dual Duct VAV Boxes with digital controls. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The existing concealed spline ceiling will be removed and disposed of and a new lighting system and ceiling will be installed in its place. 4. New lighting controls will also be installed 5. Occupant Comfort. 6. Energy Efficient remodel and revitalization of a high profile building on the EWU Campus.	1
3.04-PUB: HVAC Upgrade	McKinstry proposes to remove and replace the existing Multi-zone Unit in the lower level mechanical room. The unit serves the kitchen in the older section of the PUB and its adjacent areas. The nomenclature for this unit is AH-4. McKinstry proposes to replace this system and its respective controls with a variable air volume air handling unit. VAV Boxes with hot water reheat coils will be installed into each zone. All of the existing pneumatic controls will be retrofitted with new digital controls.	Pence Union Building	$281,938	$344,590	$4,409	$4,873	$4,344	$4,875	$277,063	$339,715	30.1	38.8	31	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New VAV Boxes with digital controls. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The existing concealed spline ceiling will be removed and disposed of and a new lighting system and ceiling will be installed in its place. 4. New lighting controls will also be installed 5. Occupant Comfort. 6. Energy Efficient remodel and revitalization of a high profile building on the EWU Campus.	1
4.01-PUB: Controls Upgrade	McKinstry proposes to remove and replace all of the Staeffa controls and replace them with one of the approved controls contractors for the EWU campus. Wiring, conduit, Belimo valves and actuators will be re-used where appropriate. McKinstry proposes to commission the controls system as well in order to augment the existing controls strategies with newer energy saving control strategies.	Pence Union Building	$180,073	$220,089	$25,962	$28,695	$5,000	$56,415	$123,658	$163,674	3.7	5.3	149	1. One of the remaining buildings on campus with the old Staeffa Digital Controls Systems that is no longer supported and becoming more difficult and expensive to obtain replacement parts. 2. Additional Energy saving control strategies will be implemented, such as HW reset and morning purge. 3. Occupant Comfort	1

3.01-PEA: AHU Retrofit	McKinstry proposes to remove and replace the (2) CVVT AHUs that are hung from the ceiling with (2) Haakon Custom Units mounted on the roof. Each unit will have new ductwork distribution systems installed.	Physical Education Activities	$336,717	$411,543	$23,237	$25,683	$4,876	$536	$336,181	$411,007	11.0	14.6	168	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The new ductwork distribution systems in the fieldhouse will allow the tempered air to get ventilated more evenly and efficiently and will not interfere with the trajectory of balls during any competition 4. Occupant Comfort.	1
9.01-PEA: Lighting Retrofit	McKinstry proposes the work in the following areas: Dance Studio - McKinstry proposes to upgrade existing ceiling to a Second Look accessible system, install linier T5 direct/indirect fixtures with dimming capabilities and install a new dimming system with multiple scene capability. Body Shop - The purpose of this FIM is to replace the existing energy inefficient lighting with (28) five lamp T5HO fixtures. A low voltage occupancy sensor system to minimize unoccupied burn hours is also included in this FIM. Racquetball Court A, B, C - The purpose of this FIM is to replace the existing energy inefficient lighting one for one with new (6) lamp T8 Racquetball Court rated fixtures. Existing three level switching will be retained and ceiling modifications will be minimal. Ramps to Fieldhouse - The purpose of this FIM is to replace the existing energy inefficient lighting with (2) lamp T8 enclosed fixtures to match existing corridors.	Physical Education Activities	$122,554	$149,788	$10,507	$11,613	$545	$15,740	$106,814	$134,048	8.8	12.1	58	1. Significant energy savings. 2. Enhanced use of the Dance Studio. 3. Removal of energy inefficient HID Lighting and replaced with T5 HO Lamps and T8 Lamps. 4. Increased lumen output.	1
3.01-RTV: CV Dual Duct Conversion to Dual Fan Dual Duct VAV	McKinstry proposes to remove and replace the existing supply fan and mixing boxes and associated controls and replace them with an energy efficient dual fan, dual duct variable air volume air handler with new variable air volume mixing boxes and a new digital controls system.	Radio/TV Building	$804,896	$983,762	$45,310	$50,079	$7,891	$8,549	$796,347	$975,213	13.7	18.3	306	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New Dual Duct VAV Boxes with Digital Controls. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The existing concealed spline ceiling will be removed and disposed of and a new lighting system and ceiling will be installed in its place. 4. New lighting controls will also be installed 5. Occupant Comfort	1
1.01-ROZ: Low Nox Burners	McKinstry proposes to install new dual fuel Low NOx burners. The primary fuel source will be natural gas while the back up fuel source will be #2 fuel oil.	Rozell Central Plant	$1,611,225	$1,969,275	$65,436	$72,324	$0	$0	$1,611,225	$1,969,275	22.3	30.1	562	1. Decrease of pollutants and efficient combustion of fossil fuel.	3
2.01-ROZ: CHW Pump Upgrades and Reconfiguration	McKinstry proposes to furnish and install new inverter duty ready motors for the (2) secondary chilled water pumps and install the necessary control points and VFDs. The secondary chilled water pumps will be brought on line as the load in the buildings dictate. The lead pump will ramp up to 100% before the next secondary pump is brought on-line.	Rozell Central Plant	$74,018	$90,466	$9,105	$10,063	$0	$1,133	$72,885	$89,333	7.2	9.8	50	1. Maximize the cooling efficiency of the chilled water loop pumping system.	1
9.01-ROZ: Lighting Upgrades	The purpose of this FIM is to replace the existing energy inefficient lighting with (27) four lamp T5HO fixtures. The existing (9) fixtures currently connected to the EM Panel will remain as night lights and extra switching will be added for convenience at various egress locations for control of the remaining (18) fixtures. The purpose of this FIM is to replace the existing energy inefficient lighting with (27) four lamp T5HO fixtures. The existing (9) fixtures currently connected to the EM Panel will remain as night lights and extra switching will be added for convenience at various egress locations for control of the remaining (18) fixtures.	Rozell Central Plant	$18,496	$22,606	$3,123	$3,452	$0	$4,680	$13,816	$17,926	4.0	5.7	17	1. Significant energy savings. 2. Removal of energy inefficient HID Lighting and replaced with T5 HO Lamps and T8 Lamps.	1
4.01-SCI: Controls Upgrade	McKinstry proposes to remove and replace all of the Staeffa controls and replace them with one of the approved controls contractors for the EWU campus. Wiring, conduit, Belimo valves and actuators will be re-used where appropriate. McKinstry proposes to commission the controls system as well in order to augment the existing controls strategies with newer energy saving control strategies.	Science Hall	$708,230	$865,614	$0	$0	$13,972	$0	$708,230	$865,614	50.7	62.0	0	1. One of the remaining buildings on campus with the old Staeffa Digital Controls Systems that is no longer supported and becoming more difficult and expensive to obtain replacement parts. 2. Additional Energy saving control strategies will be implemented, such as HW reset and morning purge. 3. Occupant Comfort	3
4.01-SUT: Controls Upgrade	McKinstry proposes to remove and replace all of the Staeffa controls and replace them with one of the approved controls contractors for the EWU campus. Wiring, conduit, Belimo valves and actuators will be re-used where appropriate. McKinstry proposes to retro-commission the controls system as well as augment the existing controls strategies with newer energy saving control strategies.	Sutton Hall	$284,119	$347,257	$4,036	$4,461	$3,713	$3,947	$280,172	$343,310	34.3	44.3	26	1. One of the remaining buildings on campus with the old Staeffa Digital Controls Systems that is no longer supported and becoming more difficult and expensive to obtain replacement parts. 2. Additional Energy saving control strategies will be implemented, such as HW reset and morning purge. 3. Occupant Comfort	1
11.00-THR: Electrical Upgrades	McKinstry proposes to upgrade the existing electrical distribution system with a new main switchboard and branch circuit panels to replace the existing ITE equipment. All existing feeders and branch circuit wiring will be re-used.	Theater/Drama Building	$95,670	$116,930	$0	$0	$0	$0	$95,670	$116,930	0.0	0.0	0	1. The existing electrical service is insufficient and would need to be addressed upon any future remodel of the Theater / Drama Building.	1
3.01-THR:Terminal Re-Heat Conversion to VAV AHU with VAV Reheat	McKinstry proposes to remove and replace the existing constant volume terminal reheat HVAC system and its corresponding terminal units and associated controls with an energy efficient variable air volume air handler with new variable air volume terminal boxes and new digital controls system.	Theater/Drama Building	$632,759	$773,372	$21,269	$23,508	$4,923	$29,124	$603,635	$744,248	21.2	28.4	144	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New VAV Boxes with digital controls will be installed. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. All Mechanical / Electrical work will be performed in the existing mechanical rooms minimizing the impacts to the rest of the building. 4. Occupant Comfort.	1
3.02-THR: Multizone Conversion to VAV AHU with VAV Reheat	McKinstry proposes to remove and replace the existing constant volume multi-zone air handling unit that serves the Theater, and its corresponding return fan with an energy efficient Variable air volume air handler with (4) variable air volume boxes with hot water reheat with new digital controls system. Demand control ventilation control strategy will be employed on this air handling system.	Theater/Drama Building	$466,853	$570,598	$26,532	$29,325	$4,923	$42,098	$424,755	$528,500	12.4	16.8	172	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New VAV Boxes with digital controls will be installed. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. All Mechanical / Electrical work will be performed in the existing mechanical rooms minimizing the impacts to the rest of the building. 4. Occupant Comfort.	1
11.01-WIL: Electrical Upgrade	McKinstry proposes to upgrade the existing electrical distribution system with a new main switchboard and branch circuit panels to replace the existing Federal Pacific equipment. All existing feeders and branch circuit wiring will be re-used	Williamson Hall	$96,393	$117,813	$0	$0	$0	$0	$96,393	$117,813	0.0	0.0	0	1. The existing electrical service is insufficient and would need to be addressed upon any future remodel of the Williamson Hall.	1
3.01-WIL: HVAC Upgrade	McKinstry proposes to remove and replace the existing constant volume terminal reheat HVAC system and its corresponding terminal units and associated controls with an energy efficient variable air volume air handler with (49) new variable air volume terminal boxes and new digital controls system.	Williamson Hall	$848,652	$1,037,242	$41,177	$45,511	$9,340	$60,216	$788,436	$977,026	14.4	19.3	274	1. Replacing energy inefficient HVAC equipment that has surpassed its useful service life with energy efficient HVAC equipment and systems. New VAV Boxes with digital controls will be installed. 2. Replacing old pneumatic controls with new digital controls and implementing energy saving control strategies. The new digital controls system will have remote alarming and monitoring capabilities. 3. The noise issues attributed with this AHU will be addressed. 4. All Mechanical / Electrical work will be performed in the existing mechanical rooms minimizing the impacts to the rest of the building. 5. Occupant Comfort.	1
7.01-WIL: Window Retrofit	McKinstry proposes to remove and dispose of the existing windows and replace with energy efficient windows throughout Williamson Hall. The windows and their frames that get installed will be in accordance with EWU's specification	Williamson Hall	$368,358	$450,216	$5,428	$5,999	$0	$7,392	$360,966	$442,824	60.2	81.6	37	1. New energy efficient, Low E windows will change the outward appearance of the building while saving energy.	2
			$14,209,874	**$17,367,624**	**$536,988**	**$593,514**	**$160,332**	**$466,745**	**$13,743,129**	**$16,900,879**	**18.2**	**24.2**	**36.9**		

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*** Incentives are contingent on final approval and are not guaranteed. Funds are shown for reference only.

Facility Improvement Measure (FIM) Summary - Rough Order of Magnitude (ROM)

LEGEND:
1 - High Priority
2 - Medium Priority
3 - Neutral Priority

Project	Eastern Washington University
Scenario	Central Plant + Water + Irrigation
Date	November 17, 2011

			Budget *		Annual Utility Savings				Estimated Net Customer Cost (with Incentives)		Estimated Modified Payback				
FIM Name	FIM Description	Building	Min	Max	Min	Max	Annual Operational Savings **	Potential Incentives ***	Min	Max	Min	Max	Carbon Savings (Metric Tonnes)	EWU Value Proposition	Ranking
18.01-EWU: Campus Wide Water Re-Commissioning	McKinstry proposes to replace all internal plumbing components and recommission all toilets, sinks, urinals, and shower heads in all buildings across campus. New internal components will have variable flow technology.	Campus	$568,175	$694,437	$41,582	$45,959	$19,170	$0	$568,175	$694,437	8.7	11.4	206	1. Just under 18,000,000 gallons of water saved annually. 2. Reduction of maintenance costs and plumbing fixture upgrades. 3. Increased consistency and performance of the system.	1
18.02-EWU: Campus Wide Irrigation Upgrades	McKinstry proposed to replace all manual irrigation controllers with WeatherTrak controllers and install rain sensors.	Campus	$241,909	$295,667	$3,189	$3,524	$0	$0	$241,909	$295,667	68.6	92.7	18	1. Only deliver the water required for adequate irrigation across the EWU campus. 2. 13,832,200 gallons of water saved through a reduction in irrigation systems operation.	2
1.00-ROZ: Boiler Feed Water Economizers	Boilers #2 and #4 do not have the economizers and thus use more energy when the feed water is pumped into each of the boilers. McKinstry proposes to install boiler feed water economizers into the boiler's exhaust stack.	Rozell Central Plant	$173,773	$212,389	$70,381	$77,790	$0	$0	$173,773	$212,389	2 2	3 0	604	1. Significant energy savings. 2. Feed water system can now operate at the same pressure.	1
1.01-ROZ: Low Nox Burners	McKinstry proposes to install new dual fuel Low NOx burners. The primary fuel source will be natural gas while the back up fuel source will be #2 fuel oil.	Rozell Central Plant	$1,611,225	$1,969,275	$65,436	$72,324	$0	$0	$1,611,225	$1,969,275	22.3	30.1	562	1. Decrease of pollutants and efficient combustion of fossil fuel.	3
1.02-ROZ: Replace Boiler #3	McKinstry proposes to remove and dispose of the existing 25,000 lb/hr high pressure steam Boiler #3 and replace it with a new energy efficient 40,000 lb/hr high pressure steam boiler. The new boiler will be equipped with a new Low NOx Dual Fuel Burner.	Rozell Central Plant	$1,390,314	$1,699,272	$105,980	$117,136	$0	$0	$1,390,314	$1,699,272	11.9	16.0	910	1. Installation of a 40,000 lb/hr boiler that replaces the 25,000 lb/hr boiler that hasn't worked for three years. 2. Replacing a boiler that is over 40 years old with a larger more energy efficient boiler with a Low NOx Burner, and a boiler feed water economizer.	1
2.00-ROZ: VFD Upgrades	McKinstry proposes to furnish and install Variable Frequency Drives on the chillers compressor motors, remove the existing 2-speed motors in the cooling towers, and install inverter duty ready motors and the VFDs the cooling tower fan motors. The drives and their respective points will be mapped into the existing controls system.	Rozell Central Plant	$824,706	$1,007,974	$38,424	$42,469	$0	$59,850	$764,856	$948,124	18.0	24.7	211	1. Making the existing chillers and towers energy efficient. 2. Maximize the cooling efficiency of the entire cooling plant.	1
2.01-ROZ: CHW Pump Upgrades and Reconfiguration	McKinstry proposes to furnish and install new inverter duty ready motors for the (2) secondary chilled water pumps and install the necessary control points and VFDs. The secondary chilled water pumps will be brought on line as the load in the buildings dictate. The lead pump will ramp up to 100% before the next secondary pump is brought on-line.	Rozell Central Plant	$74,018	$90,466	$9,105	$10,063	$0	$1,133	$72,885	$89,333	7 2	9 8	50	1. Maximize the cooling efficiency of the chilled water loop pumping system.	1
2.02-ROZ: Install New Chiller and Tower	McKinstry proposes to furnish and install new primary chilled water pumps that are dedicated to their respective chiller. The primary pumps will be piped in parallel. This will allow the horse powers on these pumps to be significantly decreased. McKinstry also proposes to furnish and install new inverter duty ready motors for the (2) secondary chilled water pumps and install the necessary control points and VFDs. The secondary chilled water pumps will be brought on line as the load in the buildings dictate. The lead pump will ramp up to 100% before the next secondary pump is brought on-line.	Rozell Central Plant	$1,818,709	$2,222,867	$39,891	$44,090	$0	$46,913	$1,771,796	$2,175,954	40.2	54.5	219	1. This will give EWU a level of redundancy in the future that they may not have today as buildings and facilities are connected to the campus chilled water loop.	3
2.04-ROZ: Install 2 new energy efficient cooling towers	McKinstry proposes to install new energy efficient, open circuit, induced draft cooling towers with VFDs on their fan motors. The new cooling towers will be sized for supplying 75 degree water to the chillers during peak load conditions.	Rozell Central Plant	$328,496	$401,495	$11,479	$12,688	$0	$5,977	$322,519	$395,518	25.4	34.5	63	1. This will allow the (2) 500 Ton water cooled chillers to operate efficiently by receiving condenser water at 75 degrees, instead of the 88 degree water they have been receiving. 2. The new energy efficient cooling towers will prolong the life of their corresponding chillers.	1
			$7,031,325	**$8,593,841**	**$385,468**	**$426,043**	**$19,170**	**$113,873**	**$6,917,452**	**$8,479,968**	**15.5**	**21.0**	**#REF!**		

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Facility Improvement Measure (FIM) Summary - Rough Order of Magnitude (ROM)

LEGEND:
1 - High Priority
2 - Medium Priority
3 - Neutral Priority

Project	Eastern Washington University
Scenario	Solar + Wind
Date	November 17, 2011

			Budget *		Annual Utility Savings				Estimated Net Customer Cost (with Incentives)		Estimated Modified Payback				
FIM Name	FIM Description	Building	Min	Max	Min	Max	Annual Operational Savings **	Potential Incentives ***	Min	Max	Min	Max	Carbon Savings (Metric Tonnes)	EWU Value Proposition	Ranking
24.02-EWU: Solar Equipment Installation	McKinstry proposes to install a Photo-voltaic solar panel arrays on the roof of the Computer and Engineering Building, photo-voltaic awnings on the western and southern façade, and a ground mounted photo-voltaic solar array.	Campus	$294,676	$360,160	$3,746	$4,140	$0	$54,224	$240,452	$305,936	58.1	81.7	21	1. Demonstrable renewable energy project on campus. 2. Reduction in electrical energy consumption in CEB.	3
24.03-EWU: Wind Turbine Installation	McKinstry proposes to install (2) 50 kW Wind Turbines by the Water Tower and tie into the inverter box into the Pavilion's electrical power system.	Campus	$818,100	$999,900	$12,244	$13,533	$0	$177,241	$640,859	$822,659	47.4	67.2	67	1. Demonstrable renewable energy project on campus. 2. Reduction in electrical energy consumption in the Pavilion.	3
			$1,112,776	**$1,360,060**	**$15,990**	**$17,673**	**$0**	**$231,465**	**$881,311**	**$1,128,595**	**49.9**	**70.6**	**#REF!**		

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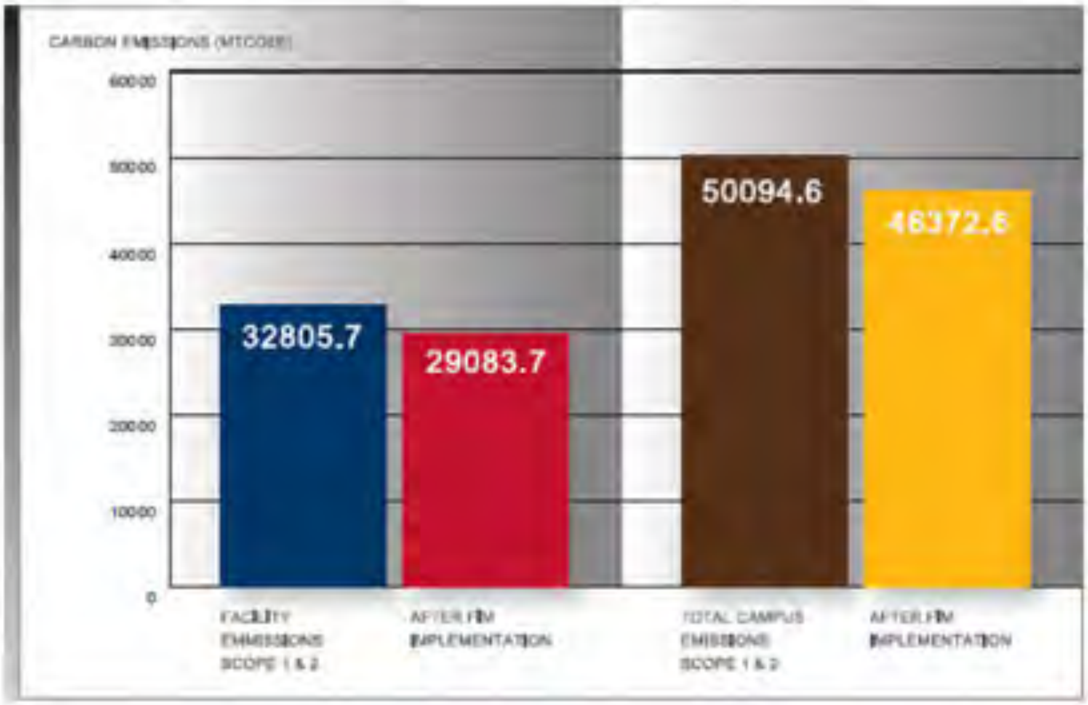
Reducing Scope 1 & 2 Emissions

Executive Report

B. IMPACT OF FIM IMPLEMENTATION ON CAMPUS EMISSIONS

GRAPH 4



3

Reducing Scope 3 Emissions

1. Transportation

a. Current Commute Options

b. Strategies to Decrease Commuter Emissions

c. Air Travel Emissions

2. Waste Stream Management

a. Waste Disposal & Recycling

Reducing Scope 3 Emissions

Executive Report

1. Transportation

Scope 3 transportation emissions are a major issue, making up 33% of Eastern Washington University's carbon footprint. Of these emissions, 73% are from student, faculty and staff commuting, with the remainder due largely to faculty and staff travel. However, because travel and commuting are usually behavioral choices beyond the University's direct control, reducing these emissions poses special challenges. Still, Eastern Washington University is working to develop effective alternatives, reducing transportation emissions while increasing connectivity with the surrounding Cheney community.

A. CURRENT COMMUTING OPTIONS

Eastern Washington University's Commute Trip Reduction program offers passes that make bus travel essentially free to all students, faculty and staff; they simply swipe their University ID cards in onboard readers for free bus rides. The reader data then helps the University track transit ridership. The program also offers gift incentives for faculty and staff to reduce single-occupancy vehicle commuting.

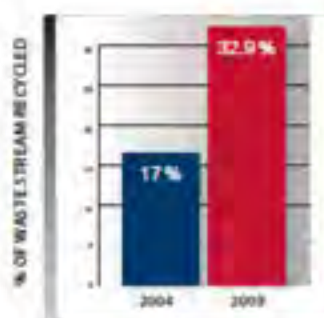
B. STRATEGIES TO DECREASE COMMUTER EMISSIONS

Further strategies to track and reduce commute emissions will evolve as the stakeholder committee studies and develops commuting alternatives. Best practices that may be discussed include disincentives for single occupancy vehicles, further incentives for alternative transportation as well as for living closer to the University; limiting parking and increasing parking fees, creating commuter buses and promoting carpooling. Meanwhile, more accurate tracking of this progress is needed as well. Possibilities include the addition of automated tracking of miles for reimbursed trips or trip requests. The implementation of additional tracking should be centralized and maintained by a designated person involved with the greenhouse gas emissions reporting process.

C. AIR TRAVEL EMISSIONS

Because air travel is highly polluting, a key task for the stakeholder committee will be to balance emissions reduction with faculty needs to attend meetings and conferences, and student needs to travel for athletics and study abroad. Possible strategies may include encouraging local destinations, emphasizing nonstop flights, purchasing offsets for student trips, taking better advantage of improvements in videoconferencing, and more closely tracking travel emissions.

2. Waste Stream Management



Eastern Washington University has made it a priority to reduce campus waste through more recycling, better disposal in-place, and better educating the campus about best practices. Progress to date is encouraging; recycling increased from roughly 17% of the waste stream in 2004 to 32.9% in 2009, saving $86,522 in waste disposal costs and reducing Scope 3 emissions. Public education has proven especially critical to the success of these programs.

Reducing Scope 3 Emissions

A. WASTE DISPOSAL & RECYCLING

The current recycling program owes its growing success to ongoing programs such as Deskside Recycling; Recyclemania; composting; wood recycling and Move Out/Pitch In, as well as through events such as Earth Day, the Homecoming Parade and EPA Game Day Challenge. As a participant in the Washington State Recycling Conference, Eastern Washington University continues to learn ways to improve recycling, helping its administrators and stakeholders to further develop waste reduction and recycling programs.

4

Efficient & Sustainable Campus Systems

Efficient & Sustainable Campus Systems

Executive Report

1. Exterior Environments

Another key component of looking at a campus wide analysis includes the external environment and the overall combined affect these elements have on efficiency and sustainability measures. The following points out related infrastructural decisions that the University can incorporate into their master planning and philosophy for creating a green campus.

A. MICROCLIMATE ANALYSIS

Many Eastern Washington University buildings and parking lots absorb and retain more solar heat than the surrounding landscape, creating an "urban heat island" effect, raising emissions and costs for cooling buildings on campus and throughout the Cheney area. This could be easily mitigated with more trees, especially in parking areas. We recommend adopting a campus tree shade standard of 30% coverage or more—and 50% or more within parking lots, by planting one tree per five parking spaces.

BENEFITS:

- Reduced energy use: Trees and vegetation that shade buildings decrease demand for air conditioning.
- Lower greenhouse gas emissions: By reducing energy demand, trees and vegetation decrease the production of associated air pollution and greenhouse gas emissions. They also sequester carbon dioxide.
- Enhanced stormwater management and water quality: Vegetation reduces runoff and erosion, and improves water quality by absorbing and filtering rainwater. (http://www.na.fs.fed.us/urban/inforesources/ucftoolkit/pdf/StatisticsSheet.pdf)
- Better air quality: Trees remove air pollutants and produce oxygen.
- Reduced pavement maintenance: Shade can slow deterioration of street pavement, cutting maintenance needs. (Source: http://www.epa.gov/hiri/mitigation/trees.htm)

RECOMMENDATIONS:

- Plant existing parking lots with trees for shade and stormwater mitigation. Especially the unshaded parking lots west of Washington Street, where 363 trees could eventually shade about 60% of the parking area.
- Remove paving to accommodate new or enhanced tree planters, remove existing crushed rock and compact sub grade to accommodate run off, install curbing to protect trees and irrigation systems.
- New parking lots should incorporate trees and irrigation protected by curbing (while keeping water savings in mind).
- Install shade structures with integrated solar panels to both cool the lots and provide electricity production for electric vehicle charging stations. http://solarelectricvehiclechargingstation.com
- http://www.alpha.com/Power/Solar-Shade-Parking-Structures
- http://www.urbanforestrysouth.org/resources/library/where-are-all-the-cool-parking-lots/file_name
- http://www.epa.gov/hiri/mitigation/trees.htm

Efficient & Sustainable Campus Systems

Detailed Report

MICRO CLIMATE ANALYSIS | PARKING LOT TREE SHADING - EWU

Many buildings and parking lots are exposed to direct solar radiation resulting in the urban heat island effect. Urban Heat Island Effect -means the occurrence of higher air and surface temperatures occurring in medium and large sized urban centers due to the retention and emittance of mainly solar heat from roads, buildings and other structures, than in surrounding rural areas. The heat stored in pavements and buildings has the effect of maintaining higher temperatures in urban centers than in surrounding rural areas. Rural areas cool faster after sunset and at night than urban areas because of this stored heat. The warming that results from urban heat islands over small areas such as cities is an example of local climate change.

Many campus parking lots are inadequately shaded. This directly results in increasing the heat island effect for Cheney and locally increasing cooling costs for buildings. Retrofit existing high priority, non-shaded parking lots to have at least 25% tree shade coverage. Plan for all new parking lots to have 30% coverage or more. EWU should consider including at least 50% tree coverage within parking lots through the installation of one tree per 5 parking spaces.
One example is that trees reduce runoff and erosion from storms by approximately 7%.
(http://www.na.fs.fed.us/urban/inforesources/ucftoolkit/pdf/StatisticsSheet.pdf)

Other benefits of trees on parking lots include:

- Reduced energy use: Trees and vegetation that directly shade buildings decrease demand for air conditioning.
- Improved air quality and lower greenhouse gas emissions: By reducing energy demand, trees and vegetation decrease the production of associated air pollution and greenhouse gas emissions. They also remove air pollutants and store and sequester carbon dioxide.
- Enhanced stormwater management and water quality: Vegetation reduces runoff and improves water quality by absorbing and filtering rainwater.
- Reduced pavement maintenance: Tree shade can slow deterioration of street pavement, decreasing the amount of maintenance needed.
  (From: http://www.epa.gov/hiri/mitigation/trees.htm)

RECOMMENDATION OR PROPOSED CONDITION:

Existing Development: Consider modifications to existing parking lots to incorporate trees for shading and mitigation of stormwater.

Parking area west of Washington Street: Assume 325sf per parking stall including drive aisle and space. Actual Tree Planting Space: 20' x 10'= 180sf.

A specific project would be to retrofit the large parking lots west of Washington with trees.

Square footage of unshaded parking lots west of Washington:
West Campus: 590,900sf / 325sf = 1,818 spaces (approximately)
20% of spaces converted to landscaping with one tree
20% x 1,818 spaces = 363 new trees
363 trees x 706sf (Large Tree: 30' diameter) = 349,206sf of shade in the parking lot when the trees are nearly full grown. This planting would result in shading approximately 59% of the parking lot.

Efficient & Sustainable Campus Systems

FUTURE DEVELOPMENT: CONSIDER REQUIRING NEW PARKING LOTS TO:

A. Incorporate trees for shading in parking lot designs.
B. Installation of shade structures with integrated solar panels could reduce the solar heat gain in the parking lots as well as provide electricity production for electric vehicle charging stations. http://solarelectricvehiclechargingstation.com/, http://www.alpha.com/Power/Solar-Shade-Parking-Structures/

Installation of carports with solar charging stations would not reduce the amount of storm water runoff to the extent of trees.

Savings: Reduced energy costs and consumption, reduced greenhouse gas emissions, comfort and health benefits, storm water quality improvement, reduced heat island effect.

A. Total Benefits per Tree: $18.57 per tree
   (Energy Savings, CO2, Air Quality, Storm water) Note: Does not include increase in property values or aesthetics. This adds an additional $51.59 per tree for a total benefit of $70.16 per tree.
   Total Annual Maintenance Costs per Tree: $32.24
   Note: This includes all related tree maintenance costs, planting, pruning, remove/dispose, waste, infrastructure and liability, administrative costs. (Total cost of tree maintenance costs tree in Fort Collins / number of trees; $997,638/30,943 trees)
   Information on EWU tree maintenance cost was not available.

   Calculations adapted from *Municipal Forest Benefits and Costs in Five US Cities, Greg McPherson, James R. Simpson, Paula J. Peper, Scott E. Maco, and Qingfu Xiao, Journal of Forestry, December 2005, page 411. Calculations based on study of Fort Collins, CO.*

   Potential Annual Energy Savings: $3.62 per tree or $1,314.00 per year.

Table 2. Annual benefits and costs for each city

Total benefits	Ft. Collins	Cheyenne	Bismarck	Berkeley	Glendale
Energy	112,025	186,967	81,318	553,061	116,735
CO_2	40,454	29,134	27,268	49,580	12,059
Air Quality	18,477	11,907	3,785	−20,658	52,378
Stormwater	403,597	55,297	196,227	215,648	37,298
Property increase	1,596,247	402,723	567,536	2,449,884	467,215
Total benefits	2,170,799	686,029	879,098	3,247,545	665,856
Total costs					
Planting	111,652	15,913	5,880	85,000	21,100
Pruning	405,344	88,677	94,898	770,000	88,412
Remove/dispose	130,487	23,337	50,061	70,000	12,716
Irrigation/green waste	94,384	97,840	38,241	195,000	65,813
Infrastructure and liability	72,200	0	21,459	1,062,000	3,000
Admin/inspect/other	183,561	76,130	106,118	180,000	85,661
Total costs	997,638	327,897	316,640	2,372,000	276,430
Net benefits	1,173,161	358,131	662,454	875,545	389,426
BCRs	2.18	2.09	3.09	1.37	2.41

FIGURE 1: FROM MUNICIPAL FOREST BENEFITS AND COSTS IN FIVE US CITIES

Additional information on parking lot shading is available at:
http://www.urbanforestrysouth.org/resources/library/where-are-all-the-cool-parking-lots/file_name
http://www.epa.gov/hiri/mitigation/trees.htm

Efficient & Sustainable Campus Systems

SCOPE OF WORK INCLUDES:

A. Demolition
   1. Remove paving as necessary to accommodate tree planter areas, trenching for irrigation and misc. demolition for installation of associated irrigation infrastructure.
   2. Remove crushed rock and compacted subgrade in tree planting areas.

B. Hardscape
   1. Replace asphalt or other hardscape removed to accommodate tree plantings and irrigation installation.
   2. Install 6" curbing around tree planter areas to protect trees from vehicle damage.

C. Landscape
   1. Install 6.5 cuyds of topsoil in tree planting area.
   2. Install trees and planting areas in parking lots as directed.

D. Irrigation: Reconfigure irrigation as necessary to accommodate new tree plantings. Extend drip irrigation to each tree location in parking lot.

EXCLUSIONS

A. Survey, Landscape Design, Engineering, Utilities and additional Hardscape.

Efficient & Sustainable Campus Systems

Executive Report

B. CREATE A WASHINGTON STREET PARKWAY

In accordance with the University's plans, we continue to recommend turning Washington and Betz Streets into a campus parkway, creating a better campus entry to the north, beautifying the present wide expanse of pavement, and establishing a strong visual edge to the urban area.

Because this involves improvement of a public road, Eastern Washington University should actively partner with Spokane County and the City of Cheney in project planning and execution, addressing issues such as vehicular traffic, pedestrian
crossings and nearby architectural elements.

For the roadway section, we propose a planted center median strip, one traffic lane in each direction, a bicycle lane in each direction, a large planting strip on either side, a multiple-use sidewalk on either side, and a row of trees outside of the walk on either side. The planted center median would end before intersections to allow for left turn lanes and stacking space. Within the campus, the boulevard would transition to the existing two-way street with parallel parking, bike lanes, planting strips, and sidewalks on both sides.

The improvements would include street trees planted along the length of the Parkway.

BENEFITS:

- Energy savings: Shade on streets and other hardscape elements cools the air by 5-15 degrees on warm days, reducing the urban heat island effect and cutting cooling costs for adjacent buildings by up to 35%.
- Safety: Street tree plantings often reduce traffic accidents and create a safer walking environment by narrowing the visual width of the street, slowing traffic.
- Pollution mitigation: Street trees absorb large amounts of air and water pollutants.
- Windbreaks: A double row of trees planted along Washington Street would slow wind through campus, reinforcing the windbreaks identified for the campus's western edge.
- Stormwater mitigation: Trees evaporate nearly a third of most precipitation, and can absorb almost as much in their roots and trunks, significantly reducing stormwater and its costs.
- Beauty: A tree-lined boulevard would be a tremendous aesthetic asset, especially for those entering campus from the north.

C. PAVER SIDEWALKS: REPLACE CONCRETE SIDEWALKS WITH PAVERS

BENEFITS:

- Improves infiltration
- Reduces stormwater
- Reduces snow removal costs

D. CONVERT SHRUB BED IRRIGATION

The existing shrub irrigation system is comprised of spray heads that waste water, add maintenance costs and increase chemical pollutants. The system must spray for long periods before any water reaches plant roots, which loses much water to evaporation and runoff. Also, because the widely damp soil surface encourages weeds, the present irrigation system raises the costs of labor, fuel and chemicals to control weed growth.

Efficient & Sustainable Campus Systems

RECOMMENDATION:

Replace spray heads with drip/bubbler heads within tree and shrub root zones, retaining the existing principal irrigation distribution network of automatic controllers, valves, mainlines and lateral lines. The drip/bubbler piping would attach to the existing lateral lines.

E. CAMPUS SUSTAINABLE LANDSCAPE PLAN

Eastern Washington University's 300 acres includes approximately 100 acres of developed, park-like campus and 200 acres of cultivated farmland. The current master plan does not sufficiently address ways to integrate sustainability and biodiversity into the University's daily working needs for this property.

A new Campus Sustainable Landscape and Open Space Plan will take into account the existing landscape and natural resources found on campus, laying out strategies to align development, maintenance and operations with the environment.

THESE STRATEGIES WOULD INCLUDE:

- On-site storm water management
- Chemical and fertilizer applications
- Fuel consumption
- Carbon emissions, and strategies for on-site carbon sequestration
- Equipment life cycle costs
- Labor cost management
- Water conservation and reuse

The University's master planning effort should incorporate these concepts and combine the thoughts of campus administrators, staff and stakeholders to guide the plan's completion over six to eight months, emphasizing a few key principles:

1. Landscape design and open space planning should express the academic vision of Eastern Washington University.
2. The campus landscape should support the daily life of Eastern Washington University.
3. Preserve and embrace the unique geography and geology of Eastern Washington University's location at the eastern edge of the Columbia Plateau and northern boundary of the Palouse.
4. Preserve the traditional character of the built and natural campus.
5. Strengthen the relationship between the Eastern Washington University and Cheney communities.
6. Recognize that regional influences and the character of the landscape define a sustainable strategy.
7. Mature campus trees, open grass areas and farm fields to the west constitute a majority of the campus open-space system.
8. Gateways, streetscapes, roads and walkways, and bike facilities are major campus landscape components for access and mobility.
9. Campus quadrangles are the basic building blocks for defining campus open space.
10. Campus courtyards are important open spaces and social hubs.
11. Campus lawns serve multiple roles including aesthetic, cultural and environmental.
12. Landscape design guidelines establish the framework for a sustainable campus open space strategy. Guidelines should consider incorporating:
    - Landscape preservation
    - Landscape restoration

Efficient & Sustainable Campus Systems

- Landscape enhancement
- Maintain campus neighborhoods while promoting a sense of community
- Build in an environmentally-responsible manner
- Sustain strong community relations
- Integrate campus-wide and neighborhood-specific sustainability strategies for:
    - Utility distribution
    - Storm water management
    - Energy efficiency goals/targets
    - Sustainable landscape strategies and planting materials
    - Paving materials
    - Exterior lighting plan
    - Transportation & parking plan
    - Potable water use plan

Efficient & Sustainable Campus Systems

Detailed Report

LANDSCAPE | STREET TREE PLANTING – WASHINGTON STREET - EWU

The streetscape along Washington Street is stark and auto centric. The street consists of two travel lanes and parking along the length of the street that includes both angle and parallel spaces. Washington Street also includes bike lanes on both sides. The sidewalks are adjacent to the curb and range in width from 5-6'. A project to improve the streetscape along Washington Street is identified on the EWU Wiki site under campus master plan.

CREATE CAMPUS PARKWAY

This proposed project would provide a much improved entry to campus from the north, and would create a strong visual edge to the urban area. This project involves improvement of a public road and would need to be approved and constructed by the City and County. EWU should act to encourage and partner with these entities and to develop a boulevard leading to the campus. The planning for the campus parkway will be a cooperative planning project with the City and the university. This cooperative planning will address issues of the campus, the city and the State Department of Transportation related to vehicular traffic, pedestrian crossings and architectural elements on and adjacent to Washington Street. Betz and Washington Streets are proposed to be developed as a boulevard. The proposed roadway section includes a center planted median strip, one traffic lane in each direction, a bicycle lane in each direction, a large planting strip on either side, a multiple-use sidewalk on either side and a row of trees outside of the walk on either side. The center planted median would end before intersections to allow for left turn lanes and stacking space. Inside the campus area, the boulevard section is proposed to transition to the existing two-way street with parallel parking, bike lanes, planting strips, and sidewalks on both sides. This transition is proposed to occur at the point where the new campus entry (see project 64) is proposed. (From List of Potential Projects, http://wiki.ewu.edu/campusmasterplan/Main_Page#Vision)

The improvement of Washington Street with a boulevard, street trees and paver sidewalks has multiple benefits. These include:

1. Street Trees
    a. Planting of street trees creates shade on streets and other hardscape elements resulting in a reduction of the urban heat island effect. Temperature differentials of 5-15 degrees are felt when walking under tree canopied streets. Studies have shown that a properly shaded neighborhood can reduce residential energy bills by 15-35%.
    b. Street tree plantings may actually reduce traffic accidents by creating vertical walls framing the street and leading to overall speed reductions.
    c. Street tree plantings create a safer walking environment.
    d. Pollution mitigation: Trees along streets have been shown to absorb 9 times more pollutants than more distant trees.
    e. Wind breaks – trees planted along Washington Street would form a double row of to modify the prevailing wind. These street trees would reinforce the windbreaks identified for the western edge of campus. The addition of trees, deciduous and evergreen, in a boulevard would add also significantly contribute to modification of the prevailing winds.
    f. Street trees and a boulevard on Washington Street would create a more aesthetically pleasing environment and significantly improve the first impressions of visitors entering campus from the north.
2. Drainage Infrastructure: Trees absorb the first 30% of most precipitation through their leaf system, allowing evaporation back into the atmosphere. Another percentage (up to 30%) of precipitation is absorbed back into the ground and taken in and held in onto by the root structure. This results in less storm water that will need to be managed.

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3. Paver sidewalks:
    a. Replacement of existing concrete walks with paver walks that are consistent with the campus character have been identified by staff to reduce snow remove maintenance and reduced storm drainage infrastructure requirements.
    b. Installation of pavers that all allow some portion of precipitation to infiltrate reduces the need for larger storm water facilities.
4. Proposal: Reconstruct Washington Street from the north campus boundary to 7th Street with street trees, planted boulevard with turn lanes, separated paver walkways and enhanced pedestrian crossings.

SCOPE OF WORK INCLUDES

1. Street Survey, Engineering, Utilities and Streetscape Design.
2. Demolition
    a. Remove and dispose of the existing sidewalk to be removed. Approximately 34,400 square feet.
    b. Coordinate with EWU, City of Cheney and State of Washington on demolition in the Washington Street Right of Way.
    c. Saw cut asphalt areas for boulevard installation, remove asphalt in boulevard, utility and irrigation access locations. Areas for turn lanes to be identified during design.
    d. Remove asphalt and curb as required for pedestrian crossing bulb outs.
    e. Remove landscape as identified in plans as required for relocation of walk away from curb to create landscape strip.
    f. Remove irrigation as identified on plans at future walk locations.
    g. Remove existing lighting.
3. Hardscape
    a. Construct new ten (10') foot wide paver walks on each side of Washington Street with street tree locations no greater than 35'. Approximately 57,400 square feet.
    b. Construct new boulevards with curbs. Repair asphalt as necessary.
    c. Restripe Washington Street as necessary to reflect changes in lane configurations for boulevard installation.
    d. Modify drainage as necessary to collect and treat stormwater.
4. Lighting and Electrical
    a. Replace existing lighting with more efficient light fixtures for pedestrian and street lighting. Consider solar light fixtures.
    b. Install pedestrian safety elements as indicated. Including pedestrian crossing lights, etc.
5. Landscape
    a. Street trees to be installed in soil volumes of no less than 1000cuft. Recommended dimensions 3' deep x 10' wide x 34' long. Continuous soil volumes of open soil, structural soil, tree grates or a combination of treatments for facilitating tree root growth.
    b. Trees to be planted 35' on center. Large canopy, long lived trees should be selected. Approximately, 140 trees total planted on both sides.
    c. Install irrigation for boulevards and street trees.
    d. Modify irrigation for adjacent landscape areas as required.
    e. Install new sod and landscaping adjacent to walk installation as indicated.

EXCLUSIONS

1. To be determined.

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LANDSCAPE | SHRUB BED IRRIGATION CONVERSION - EWU

GENERAL PURPOSE

The existing shrub irrigation system is comprised of spray heads to distribute water throughout the shrub bed. This system has proven to be inefficient in accomplishing its task of getting water to the plants root system. The entire shrub bed needs to be wetted down before water starts to percolate through the top soils into the sub grade and thus into the root system. More water is being supplied to the beds then necessary to keep the plant material in a thriving condition. Also, the propagation of weeds is stimulated by wetting the entire shrub bed which causes the increased transportation, manpower and chemicals to control weed growth. Converting the spray heads to a drip/bubbler head system reduces water use, manpower and chemicals including 'wear and tear' and fuel for vehicles.

RECOMMENDATION OR PROPOSED CONDITION:

Design a conversion system to keep the existing irrigation distribution system in place which would include automatic controllers, mainlines, control valves and lateral lines. The conversion would occur at the lateral lines to cut-in a new piping system to attach the drip/bubbler head to and locate each head within the root zone of each shrub/tree.

SCOPE OF WORK INCLUDES:

1. Demolition
    a. No anticipated demolition.
2. Hardscape
    a. Potential sleeving of piping under walks as necessary. Non anticipated.
3. Landscape
    a. Repair of landscape areas disturbed by conversion. Minimal impact anticipated.
4. Irrigation: Convert the existing irrigation distribution system in place that includes automatic controllers, mainlines, control valves and lateral lines to a bubbler system. The conversion would occur at the lateral lines to cut-in a new piping system to attach the drip/bubbler head to and locate each head within the root zone of each shrub/tree.

EXCLUSIONS

1. Final Design of system.

LANDSCAPE | CAMPUS SUSTAINABLE LANDSCAPE AND OPEN SPACE PLAN - EWU

GENERAL PURPOSE

Eastern Washington University is located on a '300-acre park-like campus' 17 miles from Spokane, WA. The 300 acres includes approximately 100 acres of the main developed campus and 200 acres in undeveloped property. The undeveloped property is currently in agricultural production. EWU campus has an existing aesthetically pleasing setting with well established landscapes of grass open spaces and towering shade trees with seasonal flowering beds of color. This beautiful setting has evolved over decades and many hands have influenced its development.

A new age is upon us which brings a new 'sustainable' point of view. We are proposing a landscape master plan that would take into account the existing landscape and the future 'sustainable' goals and image of the campus.

The current master plan does not sufficiently address the campus landscape in a holistic, comprehensive or sustainable way. The planning, design and management of a sustainable campus landscape requires the identification and analysis of goals for biodiversity and aesthetics with the daily working needs of EWU.

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The Campus Sustainable Landscape and Open Space Plan will take into account the existing landscape and natural resources found on campus and will propose improvements to the site. The plan will also lay out principles for future site/landscape development. The plan will provide strategies that will sustain the existing beauty of the campus and promote improvements in maintenance and operations. These strategies would include:

- On-site storm water management
- Landscape chemical and fertilizer applications
- Fuel consumption
- Carbon emissions and strategies for on-site carbon sequestration
- Equipment life cycle costs
- Labor cost management
- Water conservation and reuse, and promote carbon sequestration.

We propose to work from the entire campus site design in concert with campus administrators, staff and a 'sustainable' site committee to guide the master plan's direction and process until completion. We anticipate the time frame to be within a six to eight month window to complete said master plan.

In addition to the improved campus sustainability, the plan would include a framework for the aesthetic development of campus landscape, open space and circulation systems. Eastern has a long tradition of careful placement of buildings within the campus context. On occasion, existing buildings will need to be removed or replaced and provide an opportunity to create just the right relationship of a new building to its immediate surroundings. In this context, it is appropriate to think of buildings as backdrops to the exterior spaces that are, ultimately, the cohesive factor in experiencing Eastern's campus. Buildings may give form to the exterior space, they may frame an exterior space, or they may create circulation patterns for exterior space.

POTENTIAL SCOPE OF WORK:

EWU's Sustainable Landscape Master Plan should consider the incorporation of the following principles:

1. Landscape design and open space planning should express the academic vision of EWU.
2. The campus landscape should support the daily life of EWU.
3. Preserve and embrace the unique geography and geology of EWU's location at the eastern edge of the Columbia Plateau and northern boundary of the Palouse.
4. Preserve the traditional character of the built and natural campus.
5. Strengthen the relationship between the EWU and Cheney communities.
6. Recognition that regional influences and the character of the landscape define a sustainable strategy.
7. Mature campus trees, open grass areas and farm fields to the west constitute a majority of the campus open-space system.
8. Gateways, streetscapes, roads and walkways, and bike facilities are major campus landscape components for access and mobility.
9. Campus quadrangles are the basic building blocks for defining campus open space.
10. Campus courtyards are important open spaces and serve as social hubs.
11. Campus lawns serve multiple roles including aesthetic, cultural and environmental.
12. Landscape design guidelines establish the framework for a sustainable campus open space strategy. Guidelines should consider incorporating:
13. Landscape Preservation
14. Landscape Restoration
15. Landscape Enhancement Maintain campus neighborhoods while promoting a sense of community
16. Build in an environmentally-responsible manner
17. Sustain strong community relations
18. Landscape and open spaces should integrate campus-wide and neighborhood-specific sustainability strategies for:
    a. utility distribution
    b. storm water management
    c. energy efficiency goals/targets

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d. sustainable landscape strategies and planting materials
e. paving materials
f. exterior lighting plan
g. transportation & parking plan
h. potable water use plan

EXCLUSIONS

1. Project Specific Landscape Architecture, Engineering and Design.

Efficient & Sustainable Campus Systems

Executive Report

F. HARDSCAPE & ROOFTOPS

BUILDING FAÇADE SHADING

Many building facades absorb solar heat and contribute to the urban heat island effect, which poses challenges:

1. More energy consumption: Higher temperatures in summer increase energy demand for cooling and add pressure to the electricity grid during peak periods of demand. One study estimates that the heat island effect is responsible for 5–10% of peak electricity demand for cooling buildings in cities.
2. More air pollutants and greenhouse gases: Increasing energy demand generally results in greater emissions of air pollutants and greenhouse gas emissions from power plants. Higher air temperatures also promote the formation of ground-level ozone.
3. Compromised human health and comfort: Warmer days and nights, along with higher air pollution levels, can contribute to general discomfort and health issues.
4. Impaired water quality: Hot pavement and rooftop surfaces transfer their excess heat to stormwater, which then drains into storm sewers and raises water temperatures as it is released into streams, rivers, ponds and lakes, adding stress to aquatic ecosystems. (Source http://www.epa.gov/heatisland/about/index.htm)

Eastern Washington University buildings cover more than 1 million square feet. In the campus core east of Washington Street more than 30% of the ground is covered by buildings, roads, driveways or parking areas, which can significantly contribute to an urban heat island effect on campus and in the City of Cheney.

RECOMMENDATIONS:

1. Existing Development: Consider modifications to existing buildings, parking areas and streets that would increase reflectivity or shading. Possible strategies could include installing "green walls" and "green roofs" on buildings; tree plantings in parking lots and along streets; and tree cover on parking lots to reduce the hot air carried into campus from these areas. There are a number of buildings on campus that have unshaded building exposures on the south and west.
   a. West portion of campus: approximately 2,500LF of building façade that could equal approximately 60,000SF of exposed face at an average of two stories (24').
   b. East portion of campus: approximately 5,000LF of building façade that could equal approximately 120,000SF of exposed face at an average of two stories (24').

Planting trees to the south and west of these structures would shade their facades, save energy and add to general comfort on warm days.

Efficient & Sustainable Campus Systems

2. Future Development: Consider building and parking lot orientation in relation to sun angles in order to reduce cooling costs, diminish the heat island effect, and maximize natural lighting within buildings. Site deciduous trees to provide both summer shade and winter light. Use more reflective material on building rooftops and southwest facing facades to reduce summer cooling costs. Implement parking lot shading and street tree installation to provide shade. Shade unprotected west and southwest building facades with trees, "green walls" or other strategies.

SHADING HARDSCAPES, ROOFTOPS AND BUILDING FAÇADES SHOULD INCLUDE THE FOLLOWING STEPS:

TREE PLANTINGS FOR BUILDING FAÇADE SHADING:

A. Demolition
- Remove hardscape as necessary to accommodate planting of trees adjacent to existing buildings.

B. Hardscape
- Reconfigure walks and parking as necessary to accommodate planting of trees adjacent to existing buildings to provide shade on South and West facades.

C. Landscape
- Plant trees approximately 30' on center to provide additional shading on South and West sides of buildings.
- Modify existing landscape plantings as necessary to accommodate tree plantings.
- West portion of campus: approximately 2,500LF of building façade that would be shaded by approximately 80 new trees.
- East portion of campus: approximately 5,000LF of building façade that would be shaded by approximately 160 new trees.

D. Irrigation
- Reconfigure irrigation as necessary to accommodate new tree plantings.

GREEN WALLS FOR BUILDING FAÇADE SHADING:

A. Demolition
- Remove hardscape as necessary to accommodate placement of green screens adjacent to existing buildings.

B. Hardscape
- Reconfigure walks and parking as necessary to accommodate green screens adjacent to existing buildings to provide shade on south and west facades.
- Install 14' tall Greenscreen panels or approved equivalent adjacent to south and west facing walls, leaving unobstructed views from windows. Install per manufacturers specifications. (Source: http://www.greenscreen.com/home.html)

C. Landscape
- Plant climbing vines approximately 2' on center to climb on Greenscreens, providing additional shading on south and west sides of buildings.
- Modify existing landscape plantings as necessary to accommodate installation.
- West portion of campus: approximately 1,500LF of building façade that would be shaded by approximately 375 @ 4' x 14' panels with 750 climbing vines.
- East portion of campus: approximately 3,000LF of building façade that would be shaded by approximately 750 4'x14' panels with 1,500 climbing vines.

D. Irrigation
- Reconfigure irrigation as necessary to accommodate new vine plantings and panel locations.

Efficient & Sustainable Campus Systems

Detailed Report

HARDSCAPE AND ROOFTOPS| BUILDING FAÇADE SHADING - EWU

Many building facades are exposed to direct solar radiation resulting in the urban heat island effect. Urban Heat Island Effect -means the occurrence of higher air and surface temperatures occurring in medium and large sized urban centers due to the retention and emittance of mainly solar heat from roads, buildings and other structures, than in surrounding rural areas. The heat stored in pavements and buildings has the effect of maintaining higher temperatures in urban centers than in surrounding rural areas. Rural areas cool faster after sunset and at night than urban areas because of this stored heat. The warming that results from urban heat islands over small areas such as cities is an example of local climate change.

The higher temperatures in urban centers can cause the following adverse impacts:

1. Increased energy consumption: Higher temperatures in summer increase energy demand for cooling and add pressure to the electricity grid during peak periods of demand. One study estimates that the heat island effect is responsible for 5–10% of peak electricity demand for cooling buildings in cities.
2. Elevated emissions of air pollutants and greenhouse gases: Increasing energy demand generally results in greater emissions of air pollutants and greenhouse gas emissions from power plants. Higher air temperatures also promote the formation of ground-level ozone.
3. Compromised human health and comfort: Warmer days and nights, along with higher air pollution levels, can contribute to general discomfort, respiratory difficulties, heat cramps and exhaustion, non-fatal heat stroke, and heat-related mortality.
4. Impaired water quality: Hot pavement and rooftop surfaces transfer their excess heat to stormwater, which then drains into storm sewers and raises water temperatures as it is released into streams, rivers, ponds, and lakes. Rapid temperature changes can be stressful to aquatic ecosystems. (from http://www.epa.gov/heatisland/about/index.htm)

EWU has over 1 million square feet of buildings coverage. In the core of campus (east of Washington) over 30% of the campus is covered by buildings, roads, driveways or parking. These buildings and the associated parking areas can significantly contribute to an urban heat island effect on campus and in the city of Cheney.

RECOMMENDATION OR PROPOSED CONDITION:

1. Existing Development: Consider modifications to existing buildings, parking and streets that would increase reflectivity or shading. Possible strategies could include installing 'green walls' and 'green roofs' on buildings, tree plantings in parking lots and along streets, and tree cover on parking lots to reduce the hot air carried into campus from these areas. There are a number of buildings on campus that have unshaded building exposures on the South and West.
   a. West portion of campus: approximately 2,500LF of building façade that could equal approximately 60,000SF of exposed face at an average of two stories (24').
   b. East portion of campus: approximately 5,000LF of building façade that could equal approximately 120,000SF of exposed face at an average of two stories (24').

   These existing buildings could be evaluated for installation of trees on the South and West side adjacent to the building and in parking lots.

2. Future Development: Consider building and parking lot orientation in relation to sun angles in order to reduce cooling costs, heat island effect, and maximize natural lighting within buildings. Balance between shading and day lighting by using deciduous trees and position selection. Direct the use light colored or reflective material on building rooftops and southwest facing facades to reduce summer cooling costs. Implement parking lot shading and street tree installation to provide shade. Shade unprotected west and southwest building facades at least 50% with tree cover, 'green walls' or other strategies. Material selection should include the analysis and selection of construction materials with

higher solar reflectance. 'Solar reflectance, or albedo, is the percentage of solar energy reflected by a surface. Much of the sun's energy is found in the visible wavelengths; thus, solar reflectance is correlated with a material's color. Darker surfaces tend to have lower solar reflectance values than lighter surfaces. Researchers are studying and developing cool colored materials, though, that use specially engineered pigments that reflect well in the infrared wavelengths. These products can be dark in color but have a solar reflectance close to that of a white or light-colored material.' (from Reducing Urban Heat Islands: Compendium of Strategies, Urban Heat Island Basics; US EPA.)

Savings: Reduced energy costs and consumption, reduced greenhouse gas emissions, comfort and health benefits, stormwater quality improvement, reduced heat island effect.

SCOPE OF WORK INCLUDES:

ALTERNATIVE #1, TREE PLANTINGS FOR BUILDING FAÇADE SHADING:

A. Demolition
   1. Remove hardscape as necessary to accommodate planting of trees adjacent to existing buildings.
B. Hardscape
   1. Reconfigure walks and parking as necessary to accommodate planting of trees adjacent to existing buildings to provide shade on South and West facades.
C. Landscape
   1. Plant trees approximately 30' on center to provide additional shading on South and West sides of buildings.
   2. Modify existing landscape plantings as necessary to accommodate tree plantings.
   3. West portion of campus: approximately 2,500LF of building façade that would be shaded by approximately 80 new trees.
   4. East portion of campus: approximately 5,000LF of building façade that would be shaded by approximately 160 new trees.
D. Irrigation: Reconfigure irrigation as necessary to accommodate new tree plantings.

ALTERNATIVE #2, GREEN WALLS FOR BUILDING FAÇADE SHADING:

A. Demolition
   1. Remove hardscape as necessary to accommodate placement of green screens adjacent to existing buildings.
B. Hardscape
   1. Reconfigure walks and parking as necessary to accommodate green screens adjacent to existing buildings to provide shade on South and West facades.
   2. Install 14' tall Greenscreen panels or approved equal adjacent to south and west facing walls, leaving unobstructed views from windows. Install per manufacturers specifications. http://www.greenscreen.com/home.html
C. Landscape
   1. Plant climbing vines approximately 2' on center to climb on Greenscreens to provide additional shading on South and West sides of buildings.
   2. Modify existing landscape plantings as necessary to accommodate installation.
   3. West portion of campus: approximately 1,500LF of building façade that would be shaded by approximately 375 @ 4' x 14' panels with 750 climbing vines.
   4. East portion of campus: approximately 3,000LF of building façade that would be shaded by approximately 750 4'x14' panels with 1,500 climbing vines.
D. Irrigation: Reconfigure irrigation as necessary to accommodate new vine plantings and panel locations.

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EXCLUSIONS

A. Survey, Engineering, Utilities and Hardscape Design.
B. Hardscape and utility demolition, modifications, etc.
C. Preliminary, design development and final design of panels and installation at specific locations.
D. Final Cost Estimating and Bidding

Efficient & Sustainable Campus Systems

Executive Report

G. PEDESTRIAN

PEDESTRIAN AND WALKABILITY ANALYSIS

Current Condition: Traffic crossings are hazardous, public transportation and established bicycle routes are limited, and motor vehicle traffic volume is high due to the nature of campus location from urban hub. However, high-and-medium-traffic walks have notable lighting or accessibility issues.

RECOMMENDATIONS:

- Improve transportation and pedestrian linkages.
- Analyze areas of conflict, especially those along Washington Street identified in plan D-1.
- Improve safety of high or medium use crosswalks over major streets. Add street striping, signage, lighting, and ADA ramps.
- Improve transportation routes to include multiple stops around campus, especially at key locations such as the visitors center and other highly used areas.
- Consider a van pool and/or ride sharing program, specifying locations for pick-up and drop-off.
- In future development, prevent further conflict between high-traffic motor vehicle and pedestrian areas.
- Refine City of Cheney's bicycle routes plan. Consider adding more bike racks, showers for bike users, and a bike share program where students can borrow or rent bicycles for an allotted amount of time.
- Address areas where multiple problems occur within the same vicinity as noted on sheet D-1.
- In accordance with the University's developing accessibility plan, consider ADA problems and areas of low light levels along heavily used walks as noted on sheet D-1.
- Plan to address issues in areas of highest use or future development first.
- Offer incentives to use alternative transportation, especially for students and faculty who are traveling to and from Spokane, or over ten miles.
- Establish a fleet of campus owned electric cars to replace other campus vehicles.

Efficient & Sustainable Campus Systems

Detailed Report

VI. CAMPUS PEDESTRIAN AND WALKABILITY

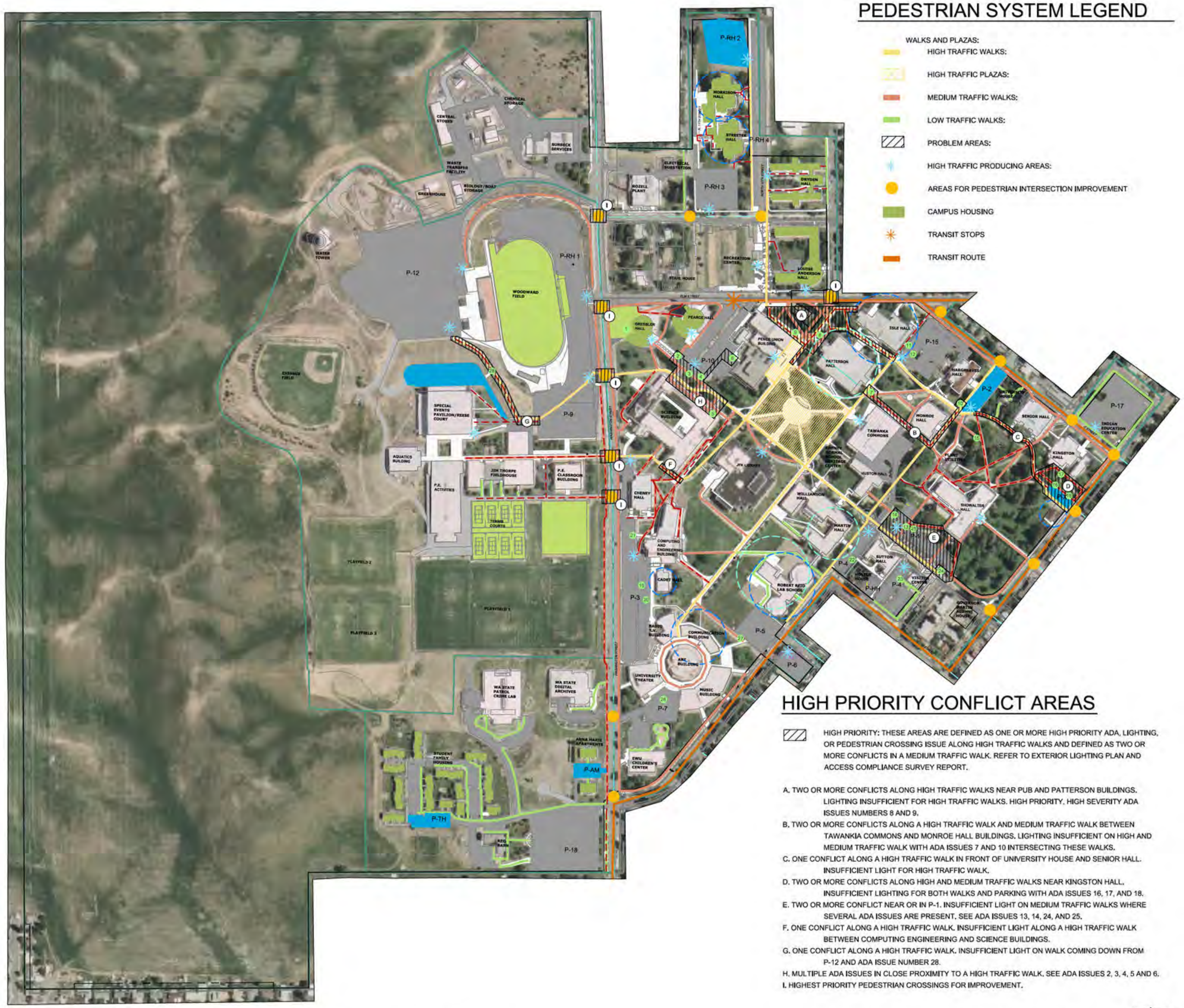
ROM PROJECT CP.1 – PEDESTRIAN AND WALKABILITY ANALYSIS

Current Condition: Currently many high traffic crossings are safety hazards; inadequate public transportation causing high traffic volumes; No established bicycle routes and high motor vehicle volumes; High and medium traffic walks have notable lighting or accessibility issues; No campus owned electric vehicles.

RECOMMENDATION OR PROPOSED CONDITION

Improve transportation and pedestrian linkages. Analyze areas of conflict, especially those along Washington Street identified in plan D-1. Crossings of high or medium use walks over major streets such as Washington, without adequate safety features need to be modified to reduce conflict. Improve crossings with street striping, signage, lighting, and ADA ramps. Improve transportation routes to include multiple stops around campus. Include stops at key locations such as visitors center highly used areas. Consider implementing a van pool and/or ride sharing program and select preferred locations for pick up and drop off. Consider a separate campus bus system as campus expands. Refine City of Cheney's bicycle routes plan. Plan carefully as to not cause conflict between high traffic motor vehicle and pedestrian areas. Consider the implementation more bike racks, showers for bike users, and a bike share program where students can borrow or rent bicycles for an allotted amount of time. Address areas where multiple problems occur within the same vicinity as noted on sheet D-1. Consider ADA problems and areas of low light levels along heavily used walks as noted on sheet D-1. Plan to address issues in areas of highest use or future development first. Offer incentives to use alternative transportation, especially for students and faculty who are traveling to and from Spokane or over 10 miles. Establish a fleet of campus owned electric cars to replace other campus vehicles.

Savings: Reduced motor vehicle use, increased pedestrian safety; reduced carbon emissions



PEDESTRIAN SYSTEM LEGEND

WALKS AND PLAZAS:
- HIGH TRAFFIC WALKS:
- HIGH TRAFFIC PLAZAS:
- MEDIUM TRAFFIC WALKS:
- LOW TRAFFIC WALKS:
- PROBLEM AREAS:
- HIGH TRAFFIC PRODUCING AREAS:
- AREAS FOR PEDESTRIAN INTERSECTION IMPROVEMENT
- CAMPUS HOUSING
- TRANSIT STOPS
- TRANSIT ROUTE

ADA ACCESS LEGEND

ADA ACCESS ZONES:

AREAS WITH TWO OR MORE SEVERITY 4, PRIORITY 1 LOCATIONS IN THE CENTRAL CAMPUS, AS OUTLINED IN THE ACCESS COMPLIANCE SURVEY REPORT.

D4 - 102	D7 - 103	F4 - 101
D5 - 109	D7 - 117	F4 - 102
D5 - 116	D7 - 118	F4 - 104
D5 - 118	E7 - 102	F6 - 101
D5 - 125	E7 - 104	F7 - 103
D5 - 127	E7 - 117	F7 - 118
D6 - 101	E8 - 119	D7 - 123
D6 - 116	E8 - 120	G5 - 101
D6 - 126	E8 - 123	G5 - 108
		D3 - 103

ADDITIONAL ADA ISSUES FOR CONSIDERATION INCLUDE ALL ISSUES OUTLINED IN THE ACCESS COMPLIANCE SURVEY REPORT, LOCATED IN THE CENTRAL CAMPUS PLAZA. THESE ARE NOT MARKED ON THE MAP, REFERENCE THE REPORT FOR MORE INFORMATION ON THE FOLLOWING NUMBERS.

D5 - 119	D6 - 130	E5 - 102
D6 - 127	D6 - 131	E6 - 119
D6 - 129	E5 - 101	E6 - 121

LIGHTING LEGEND

CAMPUS LIGHTING PER NAC EXTERIOR LIGHTING PLAN:

- HIGH PRIORITY AND LOW LIGHT LEVELS PATHS AS OUTLINED IN D2.
- HIGH PRIORITY AND LOW LIGHT LEVEL PARKING LOTS AS OUTLINED IN D2.

CORE PLAZA
CIRCULATION
ATHLETIC
PARKING
HISTORIC

HIGH PRIORITY CONFLICT AREAS

HIGH PRIORITY: THESE AREAS ARE DEFINED AS ONE OR MORE HIGH PRIORITY ADA, LIGHTING, OR PEDESTRIAN CROSSING ISSUE ALONG HIGH TRAFFIC WALKS AND DEFINED AS TWO OR MORE CONFLICTS IN A MEDIUM TRAFFIC WALK. REFER TO EXTERIOR LIGHTING PLAN AND ACCESS COMPLIANCE SURVEY REPORT.

A. TWO OR MORE CONFLICTS ALONG HIGH TRAFFIC WALKS NEAR PUB AND PATTERSON BUILDINGS. LIGHTING INSUFFICIENT FOR HIGH TRAFFIC WALKS. HIGH PRIORITY, HIGH SEVERITY ADA ISSUES NUMBERS 8 AND 9.

B. TWO OR MORE CONFLICTS ALONG A HIGH TRAFFIC WALK AND MEDIUM TRAFFIC WALK BETWEEN TAWANKIA COMMONS AND MONROE HALL BUILDINGS. LIGHTING INSUFFICIENT ON HIGH AND MEDIUM TRAFFIC WALK WITH ADA ISSUES 7 AND 10 INTERSECTING THESE WALKS.

C. ONE CONFLICT ALONG A HIGH TRAFFIC WALK IN FRONT OF UNIVERSITY HOUSE AND SENIOR HALL. INSUFFICIENT LIGHT FOR HIGH TRAFFIC WALK.

D. TWO OR MORE CONFLICTS ALONG HIGH AND MEDIUM TRAFFIC WALKS NEAR KINGSTON HALL. INSUFFICIENT LIGHTING FOR BOTH WALKS AND PARKING WITH ADA ISSUES 16, 17, AND 18.

E. TWO OR MORE CONFLICT NEAR OR IN P-1. INSUFFICIENT LIGHT ON MEDIUM TRAFFIC WALKS WHERE SEVERAL ADA ISSUES ARE PRESENT. SEE ADA ISSUES 13, 14, 24, AND 25.

F. ONE CONFLICT ALONG A HIGH TRAFFIC WALK. INSUFFICIENT LIGHT ALONG A HIGH TRAFFIC WALK BETWEEN COMPUTING ENGINEERING AND SCIENCE BUILDINGS.

G. ONE CONFLICT ALONG A HIGH TRAFFIC WALK. INSUFFICIENT LIGHT ON WALK COMING DOWN FROM P-12 AND ADA ISSUE NUMBER 28.

H. MULTIPLE ADA ISSUES IN CLOSE PROXIMITY TO A HIGH TRAFFIC WALK. SEE ADA ISSUES 2, 3, 4, 5 AND 6.

I. HIGHEST PRIORITY PEDESTRIAN CROSSINGS FOR IMPROVEMENT.

DEMOLITION AND CONSTRUCTION

NOTES: PER TEN YEAR CAPITAL PLAN OUTLAY.

- FUTURE DEMOLITION
- FUTURE CONSTRUCTION

ANALYSIS

NOTES

250' 125' 0 250' 500'

SCALE 1" = 250'-0"

1 CAMPUS PEDESTRIAN CIRCULATION ANALYSIS MAP

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REVISIONS

NO	DESCRIPTION	DATE	BY
1			
2			
3			
4			
5			
6			

PROJECT NAME
EWU ENERGY EFFICIENCY AND SUSTAINABILITY PLAN
PART 4: EFFICIENT AND SUSTAINABLE CAMPUS ENVIRONMENTS
D. PEDESTRIAN AREAS AND WALKABILITY

SHEET TITLE
CAMPUS PEDESTRIAN CIRCULATION ANALYSIS MAP

PROJECT NO.	10-018
DESIGNED BY	
DRAWN BY	JH
DATE	10-19-10
CHECKED BY	MT

SHEET NO.
D-1

Executive Report

2. Campus Water

A. STORMWATER

Agricultural Property Practices

Current Condition: The Eastern Washington University campus includes approximately 200 acres of cultivated farmland on the western campus boundary, no plans for which appear in the current campus master plan (May 2005). Construction of athletic fields has encroached on the area, creating steep cut slopes. The property drains towards the campus and adjacent neighborhoods, creating potential for sedimentation and drainage facility damage in seasonal rains or during construction.

RECOMMENDATIONS:

1. Manage future development of this property to include careful evaluation of grading and erosion control, as well as using topography and wind patterns to reduce heating and cooling costs.

2. Implement drainage-basin-level erosion control plans for permanent and temporary construction erosion control. Carefully select sites for future development and avoid development on steep slopes. Establish or leave native vegetation undisturbed when possible. Protect storm sewer inlets from sediment.

IMPERVIOUS SURFACES

Current Condition: The Eastern Washington University campus has more than 2.2 million square feet of building roofs and paved surfaces impervious to precipitation, creating approximately 11,654,000 gallons of storm water per year, which largely flows into storm drains and into the City of Cheney's sewage lagoons.

RECOMMENDATIONS:

1. For existing developed areas of campus consider modifications to existing impervious surface and roof drainage systems to reduce the amount of impervious surface:
    - Incorporate pavers as a campus standard for major walkways to reduce storm water runoff.
    - Consider green roof systems.
    - Modify existing building downspouts to discharge into planting areas, rain gardens or into storm water reuse facilities.
    - Use pervious pavements in parking lots and walkways.
    - Reduce street widths as appropriate.
    - Increase public transit, bicycle and pedestrian use to reduce requirements for parking lots.
2. Future development: reduce impervious surface areas and impacts of building roofs.
    - Require green roof systems and/or installation of solar PV systems on every new roof.
    - Require all roof runoff to be utilized on site or connected to a campus wide storm water reuse system.
    - Incorporate storm water forebays that could include infiltration basins, rain gardens or other treatment facilities prior to discharging roof runoff or storm water into water reuse facilities or storm drains.
    - Install pervious pavements in parking lots and walkways.
    - Reduce street widths as appropriate.
    - Increase public transit, bicycle and pedestrian use to reduce requirements for parking lots.
    - Consider extending the use of pavers to reduce labor costs associated with snow removal.

Efficient & Sustainable Campus Systems

STORMWATER COLLECTION AND RE-USE

Current Condition: Eastern Washington University has significant opportunities to reuse much of its annual 11.6 million gallons of stormwater and air conditioner condensate. These sources could reduce irrigation demand, preserving the aquifer to accommodate future campus growth. Retaining and reusing stormwater would also reduce flooding in utility tunnels, which currently require pumping.

RECOMMENDATIONS:

- Map drainage patterns, groundwater infiltration areas, flood zones and aquifer recharge zones, paying special attention to drainage from impervious surfaces.
- Establish a plan to store, treat and reuse this storm water along with groundwater and condensate—possibly in campus landscape irrigation, or in non-potable water uses such as building heating or toilets.
- When possible, infiltrate water naturally into the aquifer through rain gardens and infiltration swale systems.

Regularly inspect drain systems for blockages and pollution.

V.CAMPUS TOPOGRAPHY & RUNOFF

Ref. Sheets A.3; B.1; B.2

ROM PROJECT TR.1 – AGRICULTURAL PROPERTY PRACTICES

Current Condition: The EWU campus includes approximately 160 of undeveloped property on the western campus boundary that is in agricultural use. Farming practices periodically leave the property without vegetation and fugitive dust from the property is often blown onto campus.

The current campus master plan (May 2005) does not indicate plans for the western property. This area includes steep slopes and agricultural soils. Construction of athletic fields has encroached on the area and has resulted in steep cut slopes. The property has numerous existing drainages that have evidence of runoff toward developed portions of campus and adjacent neighborhoods. There is potential for sedimentation and damage of drainage facilities due to seasonal runoff or during construction.

RECOMMENDATION OR PROPOSED CONDITION:

1. Management and future development of this property (if desired) should include careful evaluation of grading and erosion control. The effects of topography on temperature and air flow should be considered and taken advantage of. Analysis of topography and natural wind patterns should occur in order to take full advantage of cooling effects or avoid higher heating costs.

2. Implement drainage basin level erosion control plans for permanent and temporary construction erosion control. Carefully select sites for future development and avoid development on steep slopes. Establish or leave native vegetation undisturbed when possible. Protect storm sewer inlets from sediment.

Savings: Money and Labor savings from protection of storm drainage facilities; reduced energy costs and consumption.

V. CAMPUS STORMWATER & DRAINAGE

Ref. Sheets B.1; B.2; C.1

ROM PROJECT SD.1 – STORMWATER REDUCTION

Current Condition: The EWU campus has over 1.1 million square feet of roof tops and another 1.2 million square feet of parking lots and driveways, with about half that have tree canopy for shade. These roofs and parking areas are exposed to direct solar radiation resulting in the heat island effect. In addition, the approximately 2.2 million square feet of building and pavement impervious surface directly results in storm water runoff that must be disposed of. The storm water from parking and driveways contains numerous contaminants including oils, heavy metals, fertilizers and sediment. Much of this runoff is discharged to storm drains without treatment. The storm drainage system apparently discharges to the city of Cheney sewage lagoons.

The amount of storm water generated over the course of the year is approximately of 11,654,000 gallons of storm water. (1,100,00sf x 1.42' precipitation per year = 1,558,333 cu. ft of stormwater or 11,654,649 gallons per year. A portion of this water will be absorbed in the turf areas adjacent to walkways and plazas. The stormwater that is not absorbed will ultimately be disposed of into the campus storm drain system without treatment.

Efficient & Sustainable Campus Systems

RECOMMENDATION OR PROPOSED CONDITION

1. For existing developed areas of campus consider modifications to existing impervious surface and roof drainage systems to reduce the amount of impervious surface with:
   - Incorporate pavers as a campus standard for major walkways to reduce storm water runoff.
   - Green roof systems
   - Modify existing building downspouts to discharge into planting areas, rain gardens or into storm water reuse facilities.
   - Pervious pavements in parking lots and walkways
     (Use of pavers as a campus standard contributes to the reduction in runoff.)
     - Open cell pavers with grass for overflow parking areas and emergency access.
     - Pervious or porous concrete
   - Reduced street widths, size streets appropriately for the amount of traffic.
   - Increase public transit, bicycle and pedestrian use to reduce requirements for parking lots.

2. For future development incorporate the following strategies to reduce the amount of impervious surface areas and impacts of building roofs. Reduction of impervious surface areas can contribute to the mitigation storm water and heat gain impacts of new building roofs and paving. Strategies include:
   - Requiring green roof systems and/or installation of solar PV systems on every new roof.
   - Require all roof runoff to be utilized on site or connected to a campus wide storm water reuse system.
   - Incorporate storm water forebays that could include infiltration basins, rain gardens or other treatment facilities prior to discharging roof runoff or storm water into water reuse facilities or storm drains.
   - Install pervious pavements in parking lots and walkways (Continue the use of pavers as a campus standard to reduce runoff.)
     - Open cell pavers with grass for overflow parking areas and emergency access.
     - Pervious or porous concrete
   - Reduced street widths, size street appropriately for the amount of traffic.
   - Increase public transit, bicycle and pedestrian use to reduce requirements for parking lots.
   - Consider extending the use of pavers to reduce labor costs associated with snow removal.

Savings: Reduced labor and energy costs and consumption, reduced greenhouse gas emissions, comfort and health benefits, stormwater quality improvement, reduced use of deicer and salts, reduced heat island effect.

ROM PROJECT SD.2 – STORMWATER COLLECTION AND RE-USE

Current Condition: With 1,558,333 cu.ft. of water (11.6 million gallons) of stormwater, there are significant opportunities to reuse storm water, ground water, and air conditioner condensate on campus. This reduces irrigation demand and helps preserve the aquifer, both of which are potential constraints on future campus growth. Additionally, currently groundwater is intruding into utility tunnels and basements and pumped to storm water drains.

RECOMMENDATION OR PROPOSED CONDITION:

Additional research and identification of groundwater infiltration areas needs to occur. Identify areas of flood zone, watersheds, stream corridors, hundred year floodplains, and aquifer recharge zones. Avoid construction in sensitive areas such as these and consider how to reuse water. Consider storm water that is a result of impervious areas for each drainage basin outline in Sheet A-3. Establish a plan to store, treat and reuse this storm water along with groundwater and condensate. Examples of reuse include campus landscape irrigation and reuse within buildings for necessities such as heating or non-potable water uses such as toilets.

Efficient & Sustainable Campus Systems

Plan to pre-treat or infiltrate water naturally when possible through rain gardens and infiltration swale systems. Allow natural recharge of aquifer. Additionally, the capturing of storm water reduces campus dependence on outside potable water resources. Plan and conduct a regular inspection of drainage outlets to ensure they are working properly and pollution is kept at a minimum.

Savings: Reduced irrigation costs, future growth ensured, potential reduction of heating costs.

250' 125' 0 250' 500'

SCALE: 1" = 250'-0"

1 CAMPUS IMPERVIOUS SURFACE ANALYSIS MAP

IMPERVIOUS SURFACE INVENTORY

CAMPUS ROOFTOP SURFACE:
- EAST OF WASHINGTON STREET: 826,300 SQ. FT.
- WEST OF WASHINGTON STREET: 346,200 SQ. FT.
- % OF EAST CAMPUS: 19%
- % OF WEST CAMPUS: 3%

CAMPUS PARKING AND DRIVE IMPERVIOUS SURFACES:
- EAST OF WASHINGTON STREET: 545,297 SQ. FT.
- WEST OF WASHINGTON STREET: 827,652 SQ. FT.
- % OF EAST CAMPUS: 12.61%
- % OF WEST CAMPUS: 7.43%

CAMPUS WALKWAY AND PLAZA IMPERVIOUS SURFACES:
- EAST OF WASHINGTON STREET: 596,036 SQ. FT.
- WEST OF WASHINGTON STREET: 181,991 SQ. FT.
- % OF EAST CAMPUS: 13.79%
- % OF WEST CAMPUS: 1.63%

CAMPUS COURTS AND IMPERVIOUS SPORTS SURFACES:
- EAST OF WASHINGTON STREET: 16,097 SQ. FT.
- WEST OF WASHINGTON STREET: 272,706 SQ. FT.
- % OF EAST CAMPUS: 0.37%
- % OF WEST CAMPUS: 2.45%

CAMPUS GRAVEL DRIVE AND WALKWAY SURFACES:
- EAST OF WASHINGTON STREET: 1,759 SQ. FT.
- WEST OF WASHINGTON STREET: 77,931 SQ. FT.
- % OF EAST CAMPUS: 0.04%
- % OF WEST CAMPUS: 0.7%

IMPERVIOUS SURFACE ANALYSIS

THE EWU CAMPUS HAS OVER 1.1 MILLION SQUARE FEET OF ROOF TOPS AND ANOTHER 1.1 MILLION SQUARE FEET OF PARKING LOTS AND DRIVEWAYS. APPROXIMATELY 500,000 SQUARE FEET OF PARKING LOTS AND DRIVEWAYS HAVE TREES THAT PROVIDE SHADE. THESE ROOFS AND PARKING AREAS ARE EXPOSED TO DIRECT SOLAR RADIATION RESULTING IN THE URBAN HEAT ISLAND EFFECT. THE HEAT STORED IN PAVEMENTS AND BUILDINGS HAS THE EFFECT OF MAINTAINING HIGHER TEMPERATURES IN URBAN CENTERS THAN IN SURROUNDING RURAL AREAS. RURAL AREAS COOL FASTER AFTER SUNSET AND AT NIGHT THAN URBAN AREAS BECAUSE OF THIS STORED HEAT. THE WARMING THAT RESULTS FROM URBAN HEAT ISLANDS OVER SMALL AREAS SUCH AS CITIES IS AN EXAMPLE OF LOCAL CLIMATE CHANGE. THE IMPACTS OF URBAN HEAT ISLAND WERE PREVIOUSLY DETAILED IN A-2.1.

IN ADDITION TO URBAN HEAT ISLAND EFFECT, THE 2.2 MILLION SQUARE FEET OF BUILDING AND PAVEMENT IMPERVIOUS SURFACE DIRECTLY RESULTS IN STORM WATER RUNOFF THAT MUST BE DISPOSED OF. THE STORM WATER FROM PARKING AND DRIVEWAYS CONTAINS NUMEROUS CONTAMINANTS INCLUDING OILS, HEAVY METALS, FERTILIZERS AND SEDIMENT. MUCH OF THIS RUNOFF IS DISCHARGED TO STORM DRAINS WITHOUT TREATMENT. THE STORM DRAINAGE SYSTEM APPARENTLY DISCHARGES TO THE CITY OF CHENEY SEWAGE LAGOONS.

THE AMOUNT OF STORM WATER GENERATED OVER THE COURSE OF THE YEAR IS IN EXCESS OF 11,654,000 GALLONS OF STORM WATER. (1,100,00SF X 1.42' PRECIPITATION PER YEAR = 1,558,333 CU. FT. OF STORMWATER OR 11,654,649 GALLONS PER YEAR. THIS VOLUME OF WATER IS GENERALLY DISPOSED OF INTO THE CAMPUS STORM DRAIN SYSTEM WITHOUT TREATMENT.

THE IMPLEMENTATION OF PAVERS AS A CAMPUS STANDARD FOR MAJOR WALKWAYS CONTRIBUTES TO REDUCTION OF STORM WATER RUNOFF.

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REVISIONS

NO	DESCRIPTION	DATE	BY
1			
2			
3			
4			
5			
6			

PROJECT NAME
EWU ENERGY EFFICIENCY AND SUSTAINABILITY PLAN
PART 4: EFFICIENT AND SUSTAINABLE CAMPUS ENVIRONMENTS
B. HARDSCAPES AND ROOFTOPS

SHEET TITLE
CAMPUS IMPERVIOUS SURFACE ANALYSIS MAP

PROJECT NO.	10-018
DESIGNED BY	
DRAWN BY	JH
DATE	10-19-10
CHECKED BY	MT

SHEET NO.
B-1

CAMPUS DRAINAGE INVENTORY

NOTES:

CAMPUS DRAINAGE ANALYSIS

NOTES:

KEY

NOTES:

1 CAMPUS DRAINAGE ANALYSIS MAP

250' 125' 0 250' 500'

SCALE 1" = 250'-0"

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SHEET TITLE
CAMPUS DRAINAGE ANALYSIS MAP

PROJECT NO.	10-018
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DRAWN BY	JH
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SHEET NO.
B-2

Efficient & Sustainable Campus Systems

Executive Report

B. BUILDING WATER

Many Eastern Washington University buildings present opportunities to improve toilets, urinals, and conserving water and standardizing plumbing components for maintenance savings. We also recommend updating flushometers and valves.

RECOMMENDATIONS:

- Recommission plumbing systems to provide variable flow technology and tuning to each fixture, improving performance while saving water.
- Upgrade existing flushometers with new, more durable internal components.
- Replace existing faucet aerators with pressure-independent components and modify faucets to fit a single aerator size, reducing maintenance costs.
- Use tamper-resistant components so only the staff can remove the devices.

GRAPH 7

Retrofitting plumbing systems could cut building water use by nearly half, with even greater savings in areas such as water heating

Efficient & Sustainable Campus Systems

Detailed Report

EASTERN WASHINGTON UNIVERSITY/CAMPUS WIDE WATER ANALYSIS

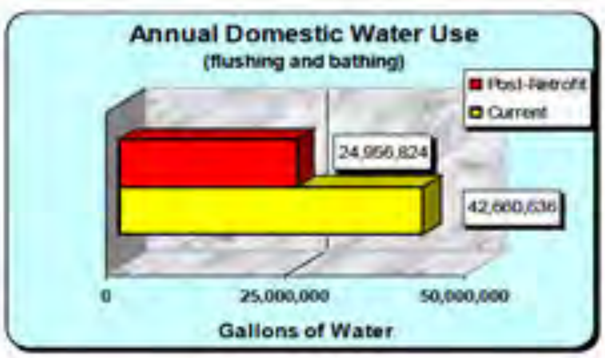
FIELD NOTES FROM PRELIMINARY ENERGY AUDIT OCTOBER 2010

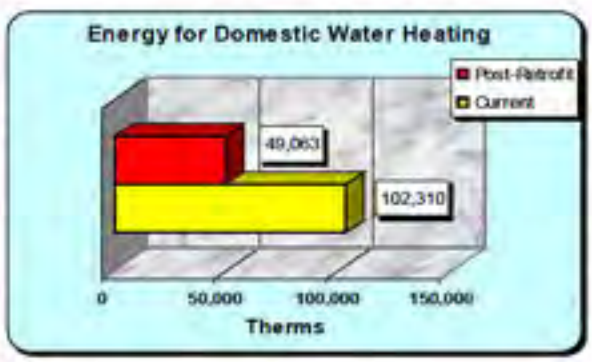
GENERAL PURPOSE

McKinstry proposes to bring an engineered solution to the reduction of water consumption by recommissioning the existing plumbing systems. Many of the existing bathroom toilets, urinals and sinks across the campus are consuming much more water than is required. Likewise, many of the existing bathroom toilet and urinal flushometers valves have exceeded their useful life and are becoming a maintenance item. Our recommendation is to provide "variable flow technology and tuning" to each fixture. This engineered solution will provide better performance while saving water.

The detailed proposal will emphasize increasing the operational performance of the systems with the minimum water required to create sustainable savings. Our Variable Flow Technology will tune each fixture to the right amount of water. The scope of work includes replacing existing flushometer internal components with new components featuring state-of-the-art thermal plastic elastomers (TPE), a material proven 10 times more affective in resisting the effects of chemicals in water. It also includes replacing existing sink faucet aerators with new components that are pressure independent. All faucets would be modified (using various adapters) to use one size device; no longer requiring the need to stock various aerators to fit different faucets. Additionally, the new devices would utilize tamper-resistant technology so only the facility staff can remove the devices. The following are proposed strategies to be implemented to improve the efficiency and performance of toilets, urinals, and sink faucets:

GENERATED (BASED ON CURRENT CHENEY WATER RATES):





SCOPE OF WORK INCLUDES:

- Replace all internal "wear" components on toilet and urinal flushometer valves with new components designed and tested to resist the rigors of substantial use, as well as the effects of chloramines and sediments in water.
- Where needed, replace the flushometer valve bodies on toilets and urinals with new valve bodies to provide consistency and common parts.
- Modify flushometers to meet the requirements of the individual fixtures to optimize the flush sequence and eliminate unnecessary consumption.
- Replace existing handles with new single piece, chemical resistant, ADA-compliant handles.
- Replace aerators in bathroom and general use sink faucets with new pressure independent aerator devices that provide a "spray" flow pattern.

Efficient & Sustainable Campus Systems

Executive Report

C. IRRIGATION

Based on industry-standard calculations, Eastern Washington University landscape irrigation consumes approximately 60,140,000 gallons of water each year, which presents major water conservation opportunities. At present, Eastern
Washington University uses no water-saving irrigation measures except timers to irrigate roughly during times of "estimated need", which can lead to over-watering.

RECOMMENDATION:

- Install an Internet-based, weather-tracking control system to adjust watering times to weather conditions. This provides a wireless, scalable management and reporting tool accessed from ordinary Web browsers. However, it first requires analysis of soil character and plant watering needs; after that information is entered, the system directs irrigation based on NOAA data for humidity, temperature and precipitation accurate to within one square kilometer.

Efficient & Sustainable Campus Systems

Detailed Report

EASTERN WASHINGTON UNIVERSITY/CAMPUS WIDE IRRIGATION

FIELD NOTES FROM PRELIMINARY ENERGY AUDIT OCTOBER 2010

Irrigation at Eastern Washington University is a major undertaking and represents a large portion of the water used on the campus. The campus does not employ any technology other than various forms of timers to schedule irrigation on an "estimated need" of what will keep things green. When systems like this are in place typically, over-irrigation occurs when schedules are manually calculated. These manual estimates of required minutes a sprinkler should run each day fail to comprehend true plant needs, soil moisture holding capacity and daily weather changes. When summer heat spikes require an increase to the amount of water applied, users make adjustments but then frequently forget to reset them when cooler weather or rain events occur.

Many of these other areas of irrigation cover significant amounts of space that require enough volume of irrigation water to cost justify an upgrade of their control system. This upgrade recommendation is to install an internet based weather tracking technology control system to deliver only the exact amount of water required. This control system will automatically adjust the "scheduled time" a zone should be provided irrigation based on daily weather changes. This is done first by analyzing the soil (slope, drainage, soil type, sun exposure, etc.) and landscape materials (turf, low maintenance shrubs, flowers, etc.) to determine the correct amount of water required for healthy plant life. To ensure you apply only the amount of water required, the control system will utilize satellite data to determine the evaporative rate (due to wind, sun, humidity) and the amount of rain provided by nature. Then only the amount of water needed is applied when and where it is need, and at the correct time of day.

This Central Irrigation Control system is network ready, and will provide a scalable management and reporting tool for EWU. The system is a wireless internet platform that is accessible from any web browser. Daily, the smart controllers receive weather data from multiple stations linked to NOAA that is accurate to one square kilometer.

Although the campus does not have water meters we were able to use standard irrigation precipitation rate formulas to back into an estimated irrigation volume.

THEORETICAL GALLONS PER MINUTE MODEL

A spreadsheet was developed to calculate gallons (output) based on runtime minutes (input). The input variables are: # of controllers, average # of wired zones per controller, % turf, % shrubs, water rate, # daily minutes per station, # days per week, and # of irrigation months. The runtime minutes for both turf and shrubs were given (ie: # days per week and minutes per day). Also, the # of irrigated months was provided (May 1 – Oct 1st = 5 months). The average number wired zones for the 36 controllers are 14.8 zones. The square footage of irrigated area was provided with a % turf and % shrubs value. The square footage of turf and shrubs was calculated and averaged to determine a turf/shrub ratio for the campus as a whole. The average for turf is 85% and the average for shrubs is 15%. The total square footage of irrigated area for each building was represented as 66 acres.

INPUTS ANALYSIS ASSUMPTIONS

36 # controllers
14.8 Average # of wired zones per controller
534 Total # of wired zones

STATIONS

85% Landscape % - Turf 429
15% Landscape % - Trees & Shrubs 105

Efficient & Sustainable Campus Systems

0% Landscape % - Native plants 0
100% 534
Unit Water Rates (future increases not included)
Kgal $0.68 Tier 1
Kgal Tier 2
Kgal Tier 3
Kgal Tier 4
Sewer rate
30 # *of Daily minutes p/station*
4 # of Days p/ week
5 # of Irrigation months

The estimated annual irrigation usage is 60,140,000 gal. This is based on these industry standard formulas.

SCOPE OF WORK INCLUDES:

Scope of work will include a full turnkey design, site assessment of each irrigated area, full installation of the new equipment, scheduling, programming and training of site staff for a complete and functional system. The wireless internet connection and 10 years of subscription service is included in this offering. New irrigation controllers will be located in areas adjacent to existing controllers and will not be screened (as existing controllers are not).

REMOVE EXISTING CONTROLLERS AND DISPOSE AS DESIRED BY CUSTOMER

1. Record program settings from old controller (Days, times, starts)
2. Conduct Ohm reading to identify any shorts prior to retrofit
3. Label field wires before removing
4. Shut off power to controller
5. Remove old controllers off of wall / out of pedestal
6. Cap electrical for units that will not be replaced with a new unit
7. Return each removed unit to property management office at each site at end of day

INSTALLATION AND WIRING

1. Physically install weather controllers selected for the project
2. Install / mount weather tracking device and data controller per manufacturers specifications
3. Connect and secure electrical including grounding to local code
4. Connect and secure 24v field wires
5. Where appropriate - install rain sensors in sensible places that will capture rain water effectively without overhead interference and with receivers mounted outside of any metal enclosures, connect rain sensor wires to RS port on controller.
6. Where appropriate – Connect flow sensor to flow monitoring port on controller
7. Run a valve test and troubleshoot wiring on any stations showing shorts or no-connects

PROGRAMMING WEATHER CONTROLLER DEVICE AND DATA GATHERING SYSTEM

1. Complete Program Worksheet
    a. Run each zone manually and walk site to complete program worksheet
    b. (provided with each controller). Program worksheet is a simple punch list that allows
    c. users to record zone by zone site data including;
    d. Plant type, soil, sprinkler, slope, sun exposure

2. Program Set Up
    a. Enter Set up information including
        i. Date, time, time-zone active stations
3. Program Days and Times
    a. Enter desired water day patterns, start times and water windows to meet site needs
4. Program Stations in Automated Mode
    a. Program Automated Mode by entering data from program worksheets,
    b. Plant, soil, sprinkler, slope, sun exposure (precipitation rate and root depth optional for maximum conservation)

NOTE: If new landscape is in place, then those stations/zones should be programmed into new data system

1. Provide a copy of the worksheet with each controller and one copy with the site manager/customer
2. Check Alerts
    a. Go to Alerts screen and verify that no alerts are present / troubleshoot as needed.
3. Preview
    a. Review each station in the Preview Screen for 'reasonable' program times and days.

Executive Report

3. Campus Infrastructure

A. BOILER PLANT (BIO-MASS/BIO-DIESEL)

A detailed description of the central heating and cooling plant equipment is in the page 17-18 Rozell Building description.

i. Boiler Plant Biomass/Biodiesel Fuel Switching

McKinstry evaluated the feasibility of switching to Bio-Mass/Bio-Diesel as a secondary fuel source for the existing boilers in the central plant, considering a number of factors in the process:

ii. Fuel Source Reliability – The reliability of the fuel source is high. Contracts for the fuel are usually a year in length. We evaluated two local Bio-Mass/Bio-Diesel fuel suppliers in eastern Washington. At the time of study, the price of Bio-Mass/Bio-Diesel fuel was lower than for #2 fuel oil but higher than for natural gas. The BTU content per gallon on average ranges between 125,000 to 130,000 BTUs per gallon for Bio-Diesel and 135,000 to 137,000 BTUs per gallon for Bio-Mass.

iii. To accommodate the new fuel we would remove and dispose of the old bunker oil tank and associated fuel lines, and we would either convert or replace the boiler burners to burn the new fuel.

B. UPGRADES TO THE EXISTING CENTRAL STEAM PLANT

Given Eastern Washington University's growth plans, McKinstry recommends further analysis to determine the University's future needs for steam plant capacity. As detailed in Table 2, we suggest several plant improvements:

i. Install boiler feedwater economizers on Boilers #2 and #4.
ii. Replace #3 Boiler with a new, more efficient boiler.
iii. Replace the burners on #1, #2 and #4 with low-nitrogen-oxide burners.

C. CENTRAL CHILLED WATER PLANT

The central chilled water plant has 4,000 tons of mechanical cooling capacity and another 500 tons of free cooling capacity through two plate-and-frame heat exchangers. According to plant personnel the peak load during the cooling season on the central chilled water plant is between 2,300 and 2,400 tons.

The chillers and their corresponding cooling towers vary in age. The three 1,000-ton chillers, two 500-ton chillers and their respective cooling towers were all installed in 1996. The third 1,000-ton cooling tower was installed in 2003, and the two 500-ton cooling towers were installed over 25 years ago. Both 500-ton cooling towers have outlived their useful service lives and are becoming inefficient.

D. UPGRADING THE EXISTING CENTRAL CHILLED WATER PLANT'S EFFICIENCY

As outlined in accompanying Table 3, there are several clear options to improve the chilled water plant's efficiency:

i. Install variable-frequency drives (VFDs) on the chiller compressors and cooling tower fans.

ii. Replace the two-speed chilled water pumps with two new pumps and VFDs on the system loop.
iii. Replace both 500-ton towers with energy-efficient, open-circuit, induced-draft, VFD-equipped cooling towers sized to deliver 75-degree water at peak conditions.

E. ADDING CHILLED WATER CAPACITY

After study, it appears that expanding the existing chilled water plant would be preferable to building a second one on campus. Although the University's plans to build Science 1 and Science 2 will increase chilled water needs, some of that new demand will be offset by efficiency improvements in other buildings as they remodeled, such as the Science Building, where much can be done to reduce the cooling load.
Further study is needed to accurately gauge future demand, but our initial recommendation is to enlarge the existing central plant, adding another 1,000-ton water-cooled centrifugal chiller, a 1,000-ton cooling tower and their associated pumps. These costs are presented in Table 3.

F. ADDING A THERMAL STORAGE TANK – Although the need for a thermal storage tank has been studied, more information is needed before recommendations can be made.

In time, a thermal storage tank may prove worthwhile, adding cooling capacity and improving the chilled water system's efficiency. Using the thermal storage tank as a primary source of cooling during the day, while shutting down or reducing use of chillers, is a very energy-efficient way to meet the University's cooling needs. In this scenario, the tank acts like a larger chilled water battery, charging during night when the cost to produce power is less. However, the utility rate that Eastern Washington University pays is not ratcheted as in other regions, which reduces the incentive to build such a system—making cost variables in site selection all the more important. For these reasons, further study would be wise.

Efficient & Sustainable Campus Systems

Detailed Report

Eastern Washington University/Campus Infrastructure

OVERVIEW

This section of the report is dedicated to Eastern Washington University's central heating and cooling plant. Most of the buildings and facilities on campus are served by the central heating and cooling plant. A preliminary energy audit was conducted on August 18, 2010 by McKinstry.

ROZELL CENTRAL PLANT

See write up in section 2 under Rozell Building.

PREVIOUS ENERGY RETROFITS

McKinstry retrofitted the existing boiler feedwater pumps with new vertical turbine feedwater pumps controlled with Variable Frequency Drives. The drive and pumps will be controlled through the ABB/Wonderware Control System.

BOILER PLANT BIOMASS/BIO-DIESEL FUEL SWITCHING

McKinstry evaluated the feasibility of switching to biomass/biodiesel as a secondary fuel source for the existing boilers in the central plant, considering a number of factors in the process:

- Fuel Source Reliability – The reliability of the fuel source is high. Contracts for the fuel are usually a year in length. We evaluated two local biomass/biodiesel fuel suppliers in eastern Washington. At the time of study, the price of biomass/biodiesel fuel was lower than for #2 fuel oil but higher than for natural gas. The BTU content per gallon on average ranges between 125,000 to 130,000 BTUs per gallon for biodiesel and 135,000 to 137,000 BTUs per gallon for biomass.

- To accommodate the new fuel we would remove and dispose of the old bunker oil tank and associated fuel lines, and we would either convert or replace the boiler burners to burn the new fuel.

We suggest further study, as bio-fuels could reduce both carbon emissions and fuel costs. However, the latter depends upon further discussion with bio-fuel suppliers, who insist on confidentiality agreements from McKinstry personnel before committing to prices. If EWU is interested, we will be more than happy to obtain firm fuel quotes.

UPGRADES TO THE EXISTING CENTRAL STEAM PLANT

Given EWU's growth plans, McKinstry recommends further analysis to determine the university's future needs for steam plant capacity. The Facility Improvement Measures detailed in Table 4.2 represent improvements to the plant as it stands today:

- Install boiler feedwater economizers on Boilers #2 and #4.

- Replace #3 Boiler with a new, more efficient boiler.

- Replace the burners on #1, #2 and #4 with Low-NOx burners.

CENTRAL CHILLED WATER PLANT

The central chilled water plant has 4,000 tons of mechanical cooling capacity and another 500 tons of free cooling capacity through two plate-and-frame heat exchangers. According to plant personnel the peak load during the cooling season on the central chilled water plant is between 2,300 and 2,400 tons.

The chillers and their corresponding cooling towers vary in age. The three 1,000-ton chillers, two 500-ton chillers and their respective cooling towers were all installed in 1996. The third 1,000-ton cooling tower was installed in 2003, and the two 500-ton cooling towers were installed over 25 years ago. Both 500-ton towers have outlived their useful service lives and are becoming increasingly energy inefficient. Their original design called for the towers to deliver 85 degree water back to their respective chillers. Currently in their existing condition they are only able to supply 88 degree water back to the chillers.

McKinstry believes there are many ways to improve the efficiency of the chilled water plant and to add capacity in the future:

UPGRADING THE EXISTING CENTRAL CHILLED WATER PLANT'S EFFICIENCY

As outlined in Table 4.2, EWU has several clear options that could make the chilled water plant more efficient:

- Install VFDs on the chiller compressors and cooling tower fans.
- Replace the two-speed chilled water pumps with two new pumps and VFDs on the system loop.
- Replace both 500-ton towers with energy-efficient, open-circuit, induced-draft , VFD-equipped cooling towers sized to deliver 75-degree water at peak conditions.

ADDING CHILLED WATER CAPACITY

After further study, McKinstry concludes that expanding the existing chilled water plant would be preferable to building a second and separate chilled water plant somewhere on the south side of the campus. Although the university's plans to build Science 1 and Science 2 will increase the overall chilled water load, some of that new demand will be offset by efficiency improvements in other buildings as they get remodeled and upgraded with energy efficient systems.

Further study is needed to accurately gauge future demand, but our initial recommendation is to enlarge the existing central plant, adding another 1,000-ton water-cooled centrifugal chiller, a 1,000-ton cooling tower and their associated pumps. These costs are presented in the Table 4.2 for this section.

ADDING A THERMAL STORAGE TANK

Although McKinstry studied the need for a thermal storage tank, we do not believe we yet have enough information to judge its practicality, so we recommend further analysis if EWU is interested. McKinstry has engineered and built this kind of system before at universities in the Pacific Northwest, and can certainly plan, engineer and build this if the university so chooses. However, costs vary depending on the site chosen and the site work required, as such, the cost estimate ranges have not yet been estimated.

In time, a thermal storage tank may prove worthwhile for EWU by adding cooling capacity and energy efficiency. Using the thermal storage tank as a primary source of cooling during the day, while shutting down or reducing use of chillers, is a very energy-efficient way to meet the university's cooling needs. However, the utility rate that EWU pays is not ratcheted as in other regions of the country, which reduces the incentive to build such a system—making cost variables in site selection all the more important. For these reasons, McKinstry recommends further study.

4. UNIVERSITY FLEET

Campus fleet-vehicle fuel use contributes little to Scope 1 emissions—1% or less in 2007—but fleet organizers are committed to reducing fuel usage wherever possible. The current Eastern Washington University fleet is comprised of 158 vehicles, supplemented with golf carts and gators to reduce use of larger vehicles.
The university does not currently have a formal plan for vehicle purchases but always prioritizes smaller, more fuel-efficient models, minimizing the use of large vehicles. This proactive management enables Eastern Washington University to maximize fuel and fleet budgets while minimizing emissions on campus.

Facility Improvement Measure (FIM) Summary - Rough Order of Magnitude (ROM)

Project	Eastern Washington University
Scenario	Central Plant + Water + Irrigation
Date	November 17, 2011

LEGEND:
1 - High Priority
2 - Medium Priority
3 - Neutral Priority

			Budget *		Annual Utility Savings				Estimated Net Customer Cost (with Incentives)		Estimated Modified Payback				
FIM Name	FIM Description	Building	Min	Max	Min	Max	Annual Operational Savings **	Potential Incentives ***	Min	Max	Min	Max	Carbon Savings (Metric Tonnes)	EWU Value Proposition	Ranking
18.01-EWU: Campus Wide Water Re-Commissioning	McKinstry proposes to replace all internal plumbing components and recommission all toilets, sinks, urinals, and shower heads in all buildings across campus. New internal components will have variable flow technology.	Campus	$568,175	$694,437	$41,582	$45,959	$19,170	$0	$568,175	$694,437	8.7	11.4	206	1. Just under 18,000,000 gallons of water saved annually. 2. Reduction of maintenance costs and plumbing fixture upgrades. 3. Increased consistency and performance of the system.	1
18.02-EWU: Campus Wide Irrigation Upgrades	McKinstry proposed to replace all manual irrigation controllers with WeatherTrak controllers and install rain sensors.	Campus	$241,909	$295,667	$3,189	$3,524	$0	$0	$241,909	$295,667	68.6	92.7	18	1. Only deliver the water required for adequate irrigation across the EWU campus. 2. 13,832,200 gallons of water saved through a reduction in irrigation systems operation.	2
1.00-ROZ: Boiler Feed Water Economizers	Boilers #2 and #4 do not have the economizers and thus use more energy when the feed water is pumped into each of the boilers. McKinstry proposes to install boiler feed water economizers into the boiler's exhaust stack.	Rozell Central Plant	$173,773	$212,389	$70,381	$77,790	$0	$0	$173,773	$212,389	2.2	3.0	604	1. Significant energy savings. 2. Feed water system can now operate at the same pressure.	1
1.01-ROZ: Low Nox Burners	McKinstry proposes to install new dual fuel Low NOx burners. The primary fuel source will be natural gas while the back up fuel source will be #2 fuel oil.	Rozell Central Plant	$1,611,225	$1,969,275	$65,436	$72,324	$0	$0	$1,611,225	$1,969,275	22.3	30.1	562	1. Decrease of pollutants and efficient combustion of fossil fuel.	3
1.02-ROZ: Replace Boiler #3	McKinstry proposes to remove and dispose of the existing 25,000 lb/hr high pressure steam Boiler #3 and replace it with a new energy efficient 40,000 lb/hr high pressure steam boiler. The new boiler will be equipped with a new Low NOx Dual Fuel Burner.	Rozell Central Plant	$1,390,314	$1,699,272	$105,980	$117,136	$0	$0	$1,390,314	$1,699,272	11.9	16.0	910	1. Installation of a 40,000 lb/hr boiler that replaces the 25,000 lb/hr boiler that hasn't worked for three years. 2. Replacing a boiler that is over 40 years old with a larger more energy efficient boiler with a Low NOx Burner, and a boiler feed water economizer.	1
2.00-ROZ: VFD Upgrades	McKinstry proposes to furnish and install Variable Frequency Drives on the chillers compressor motors, remove the existing 2-speed motors in the cooling towers, and install inverter duty ready motors and the VFDs the cooling tower fan motors. The drives and their respective points will be mapped into the existing controls system.	Rozell Central Plant	$824,706	$1,007,974	$38,424	$42,469	$0	$59,850	$764,856	$948,124	18.0	24.7	211	1. Making the existing chillers and towers energy efficient. 2. Maximize the cooling efficiency of the entire cooling plant.	1
2.01-ROZ: CHW Pump Upgrades and Reconfiguration	McKinstry proposes to furnish and install new inverter duty ready motors for the (2) secondary chilled water pumps and install the necessary control points and VFDs. The secondary chilled water pumps will be brought on line as the load in the buildings dictate. The lead pump will ramp up to 100% before the next secondary pump is brought on-line.	Rozell Central Plant	$74,018	$90,466	$9,105	$10,063	$0	$1,133	$72,885	$89,333	7.2	9.8	50	1. Maximize the cooling efficiency of the chilled water loop pumping system.	1
2.02-ROZ: Install New Chiller and Tower	McKinstry proposes to furnish and install new primary chilled water pumps that are dedicated to their respective chiller. The primary pumps will be piped in parallel. This will allow the horse powers on these pumps to be significantly decreased. McKinstry also proposes to furnish and install new inverter duty ready motors for the (2) secondary chilled water pumps and install the necessary control points and VFDs. The secondary chilled water pumps will be brought on line as the load in the buildings dictate. The lead pump will ramp up to 100% before the next secondary pump is brought on-line.	Rozell Central Plant	$1,818,709	$2,222,867	$39,891	$44,090	$0	$46,913	$1,771,796	$2,175,954	40.2	54.5	219	1. This will give EWU a level of redundancy in the future that they may not have today as buildings and facilities are connected to the campus chilled water loop.	3
2.04-ROZ: Install 2 new energy efficient cooling towers	McKinstry proposes to install new energy efficient, open circuit, induced draft cooling towers with VFDs on their fan motors. The new cooling towers will be sized for supplying 75 degree water to the chillers during peak load conditions.	Rozell Central Plant	$328,496	$401,495	$11,479	$12,688	$0	$5,977	$322,519	$395,518	25.4	34.5	63	1. This will allow the (2) 500 Ton water cooled chillers to operate efficiently by receiving condenser water at 75 degrees, instead of the 88 degree water they have been receiving. 2. The new energy efficient cooling towers will prolong the life of their corresponding chillers.	1
			$7,031,325	**$8,593,841**	**$385,468**	**$426,043**	**$19,170**	**$113,873**	**$6,917,452**	**$8,479,968**	**15.5**	**21.0**	**#REF!**		

* Since design cost, audit cost, etc. are distributed among the FIMs, the total project cost will not go up or down by exactly the amounts shown here if a FIM or FIMs are dropped.
** For non recurring operational savings, the values are averaged over the 1 year length of this analysis.
*** Incentives are contingent on final approval and are not guaranteed. Funds are shown for reference only.

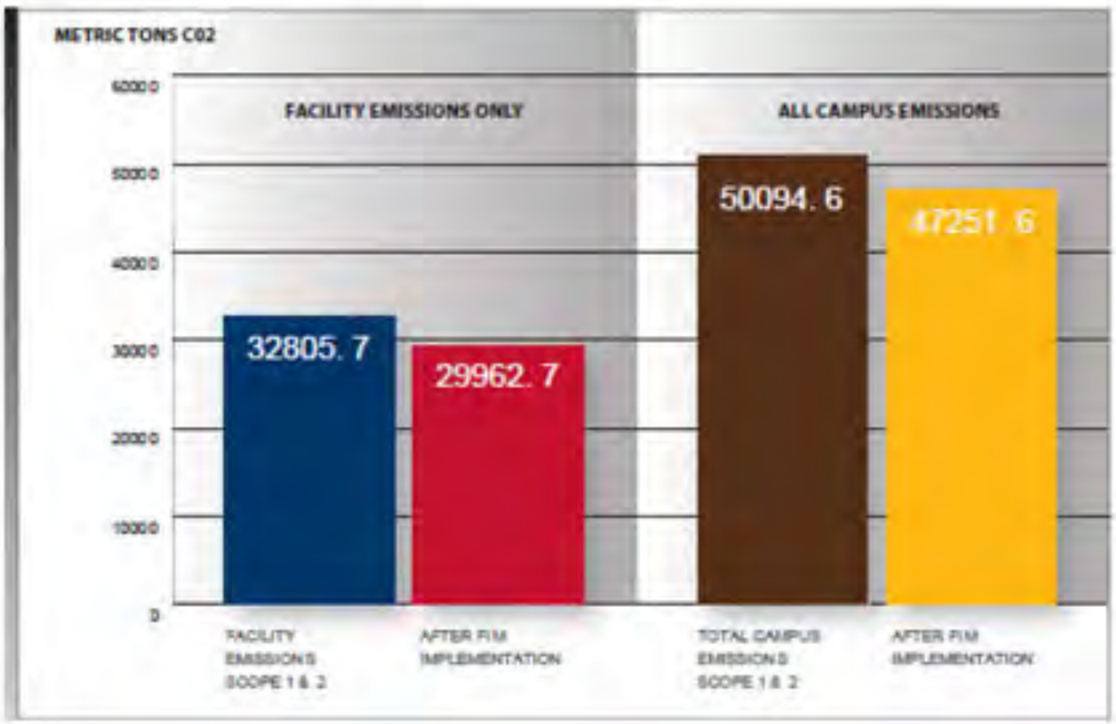
Efficient & Sustainable Campus Systems

Executive Report

B. EMISSIONS IMPACT

Implementation of the water and irrigation measures detailed in the following graph would cut campus carbon dioxide emissions by an annual estimated 2,843 metric tons.

GRAPH 8 - WATER AND IRRIGATION IMPROVEMENTS REDUCE CAMPUS CARBON EMISSIONS



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Renewable Energy & Offsets

1. *Alternative Options*
    a. *Solar*
    b. *Wind*
2. *Understanding Offsets*
    a. *Offsets*
    b. *Renewable Energy Certificates (RECs)*
3. *Analysis Findings*
    a. *Table: Facility Improvement Measures*
    b. *Emissions Impact*

Renewable Energy & Offsets

Executive Report

PART 5: RENEWABLE ENERGY & OFFSETS

1. Alternative Options

As the University exhausts efficiency opportunities, attention must turn to renewable energy sources, and there are a variety of opportunities to produce renewable energy on campus. The following measures will be considered for feasibility during the facility efficiency study described in Part 2.

A. SOLAR

Producing solar energy fits very well with the Energy Efficiency and Sustainability Plan, both managing the rising costs of purchased energy and reducing the quantity of Renewable Energy Certificates required by the plan. McKinstry studied the feasibility of campus solar energy production, and evaluated potential solar array locations.

BUILDING-MOUNTED ARRAYS: SCIENCE AND ENGINEERING BUILDING

- A standing-seam roof protrudes above the parapet roof, providing an ideal surface for attaching solar panels. Contingent on further study, the array could consist of 88 30-Watt, generic photovoltaic panels, totaling over 20 kilowatts.
- The building's broad, unshaded south façade lends itself to a solar array consisting of long awnings above the building's three rows of windows, which would both shade windows and generate electrical power.
- Another possibility is an array on the ground itself or on a low structure such as a parking lot cover. Very scalable, they can be either fixed in position or designed to pivot, tracking with the sun. However, more study is needed to find the right site.

Science and Engineering Building Roof

Ground Grid Array

Awning array, Science and Engineering Building South Façade

Renewable Energy & Offsets

Detailed Report

Eastern Washington University/Renewable Energy Solar Analysis

OVERVIEW

The scope of this effort was to determine where a solar array should be located on campus and to see if solar energy production could be accomplished at EWU. The location identified for the solar array sites were based on the following criteria:

- Educational value for students
- Uninterrupted exposure to the sun
- Building that had a southern exposure
- Building with architecture to support the Solar Array structures
    - Standing seem roof
    - Structure with the ability to attach an Awning Solar Array
- Building where the Solar Array would benefit academic programs as well
- Ground Grid application – multiple locations

One of the locations identified is the Science and Engineering building, the locations proposed are on the roof in the center of the structure and along the southern perimeter of the building.

The other Solar Array analyzed is a Ground Grid application. This application is mounted either on the ground or on a roof top or even on a parking lot cover. The unique quality of this application is its scalable feature which makes for a great demonstration application along any campus location or campus mall. An exact location for this application was not determined, at this time.

As the University exhausts efficiency opportunities, attention must be directed to renewable energy sources. Producing energy from a renewable solar resource strongly supports the Climate Action Plan (CAP) initiative by replacing purchased energy as well as reducing the quantity of Renewable Energy Credits (REC's) required to obtain the plans objectives. This will aid the University in better managing long term costs of electricity and REC's produced by renewable project, which will assist EWU in managing inflationary effects.

SITE INFORMATION

SOLAR ARRAY ROOF MOUNTED INSTALLATION SCIENCE AND ENGINEERING BUILDING

The Science and Engineering Buildings roof is an ideal candidate for this Solar Array solution. The building has an architecturally designed standing seam roof that protrudes above the existing parapet roof. This section of roof is constructed with a standing seam which is ideal for attaching the PV panels. In addition the roof has about an approximate 27 degree slope facing directly south without any obstruction to the sun. The slope of the roof is great enough to provide rain and snow run off. The actual PV panels would mount directly to the standing seam roof and depending on the structural engineering study the solar array may consist of 88 ~ 230w, generic PV modules, totaling over 20KW.

Renewable Energy & Offsets

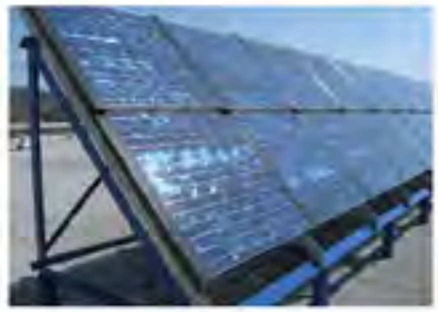
SOLAR ARRAY AWNING MOUNTED INSTALLATION SCIENCE AND ENGINEERING BUILDING

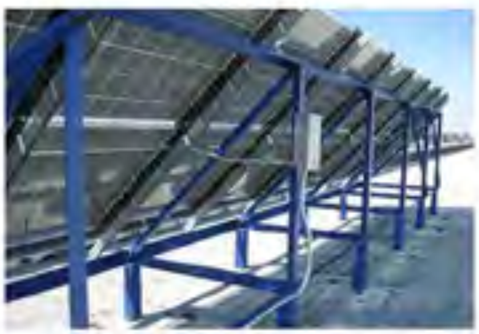
The Science and Engineering Building is an ideal candidate for the Awning Solar Array solution. The building which is constructed of brick has an unobstructed southern exposure with approximately 36 windows distributed across 3 rows. The PV Awning Solar Array serves two functions, first as an awning to block the sunlight and protect against the thermal gain and losses. Second the awning generates electrical power from the solar panels for the buildings consumption. The Solar Awning Array is architecturally designed and will be a compliment to the building that experiences severe thermal gains and losses.

SOLAR GROUND GRID INSTALLATION LOCATION TO BE DETERMINED

The Solar Ground Grid Array is a scalable multifaceted solar array that can be used in many different locations. This array is unique in that it can be designed to track with the suns path or it can also be designed to be in a fixed and mounted in one position. The Ground Grid Array can even be configured for confined space requirements if necessary. Based on the scalable features The Ground Grid Array is perfect for any demonstration site that has limited space but is a highly visible common area.

Renewable Energy & Offsets





AREAS OF FURTHER INVESTIGATION

- Electrical circuitry will need to be investigated to determine point of interconnect
- Utility interconnect will need further investigation
- Structural engineering analysis/study to determine the strength of the roof which will determine how many PV panels can be installed
- Location for the Ground Grid Solar Array- McKinstry did not determine the exact location of this array and will need EWU to provide guidance

Renewable Energy & Offsets

Executive Report

B. WIND

Wind Turbines are another option that would allow Eastern Washington University to generate electricity on-site. They come in a wide variety of sizes and are somewhat scalable, offering flexibility.

- Studies were performed on several possible wind turbine sites, with detailed testing at the best site: the ridge at the campus' western edge, by the water tower north of the baseball field.
- The consistent, westerly winds at the site average speeds of 5 meters per second with minimal turbulence, few obstructions and little seasonal change.
- We tested three sizes of wind turbines on site, with these results:
    - Skystream 3.7 Turbine: rated 2.4 kilowatts peak; expected to produce 239 kilowatt-hours per month, 2.91 megawatt-hours per year.
    - Xzeres 442 Turbine: rated 10 kilowatts peak; expected to produce 1026 kilowatt-hours per month, 1249 megawatt-hours per year.
    - Endurance E-3120 Turbine: rated 55 kilowatts peak; expected to produce 7888 kilowatt-hours per month, 95.91 megawatt-hours per year.

Renewable Energy & Offsets

Detailed Report

EASTERN WASHINGTON UNIVERSITY/RENEWABLE ENERGY WIND ANALYSIS

OVERVIEW

The scope of this effort was to determine if wind to energy production could be accomplished at EWU. The location identified for the wind turbine site was based on geography of the campus, prevailing winds, and industry knowledge. The location identified was the ridge at the campus's westerly most edge, just north of the baseball diamond. In order to determine the production levels a detailed wind study needed to be completed. The study included installation of wind monitoring equipment, data collection, data analysis, proposed wind turbine models, along with production level estimates.

As the University exhausts efficiency opportunities, attention must be directed to renewable energy sources. Producing energy from a renewable wind resource strongly supports the Climate Action Plan (CAP) initiative by replacing purchased energy as well as reducing the quantity of Renewable Energy Credits (REC's) required to obtain the plans objectives. This will aid the University in better managing long term costs of electricity and REC's produced by renewable project, which will assist EWU in managing inflationary effects.

The location studied determined that this is the prime site for a wind turbine generator. The specific site is adjacent to Roos Field, and serves this initiative well for many reasons. Being located on the westerly most edge of the campus allows for undisturbed wind. Secondly, this renewable energy source will be an unmistakable icon demonstrating EWU's leadership as a progressing carbon neutral campus, serving as a model for other campuses nationwide.

METHODOLGY

The objective of our wind resource study is to establish electric production estimates for a variety of commercially available wind turbines at the exact location of the installation site. This then allows for energy offset calculations, REC production estimates and long term planning in regards to Eastern's CAP. Priorities for the project were security of students and equipment, accuracy of data collected, and providing the analysis.

STEPS TAKEN TO MAKE RECOMMENDATION

1. Site selection
2. Equipment mounting
3. Data Collection
4. Comparison of data collected to wind map data of the overall g area to understand how Eastern's specific site resource compares
5. Comparison of data collected to a known data collection point. In this case Fairchild Air Force Base was selected by its proximity and similar exposure to wind currents. By comparing these two resources over the time period monitored, we can then apply formulas to accurately predict long term, seasonal results a Eastern's location.
6. Applying established wind resource data to specific commercially available wind turbine equipment of different capacities to predict energy outputs.

SITE INFORMATION

The proposed wind site is located on the Eastern Washington University (EWU) campus in Cheney, WA. The site for consideration is on the ridge located south of the water tank and west of Roos Field.

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Latitude 47.49354081334096 N

Longitude -117.59163737297058 E

A Davis 7911 wind speed and direction sensor was mounted on top of the water tank, approximately 130 feet above grade and 20 ft from the southwest edge of the tank.

To mitigate any concern that the airflow around the tank might create an increase in wind speed at the anemometer location, the anemometer was mounted on a mast 20 feet above the top of the tank and on the leading edge toward the predominant upwind direction.

GEOGRAPHY

The surrounding terrain is rolling hills relatively flat and open providing unobstructed wind resource with very little turbulence. It is farmland to the north and west, with university buildings and the City of Cheney, WA to the south and east. The buildings and trees of the community are located out of the predominant wind directions and have little effect on the site wind resource.

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WIND MAP DATA

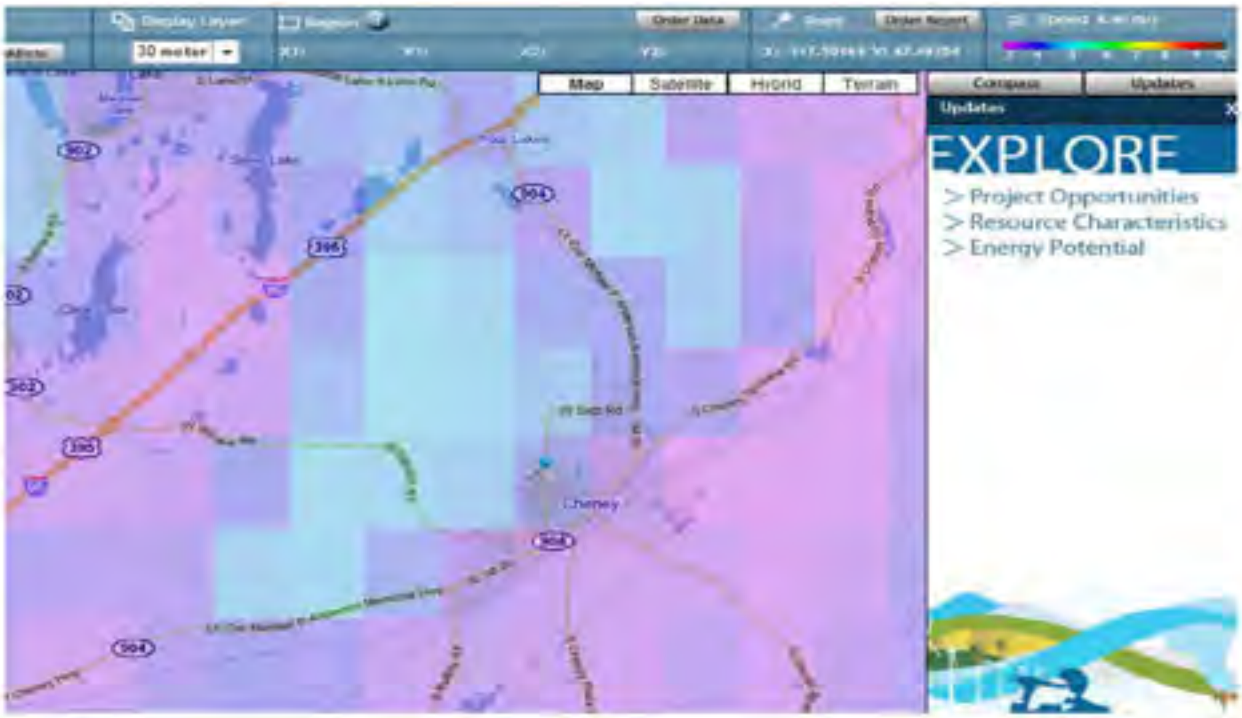
Wind map data is obtained to establish a more general region wide comparative basis. This data was obtained from the AWS Wind Explorer service. The service establishes wind speeds at 30 meter heights and 60 meter heights to establish a difference in wind speeds at these elevations (wind shear). This value is then

Renewable Energy & Offsets

used to establish performance estimates for turbines at differing hub heights.

Wind estimates of 4.4 m/s at 30 m height and 5.21 m/s at 60 m height were obtained from the AWS Wind Explorer service. The wind map shows an improvement in the wind resource immediately adjacent to the campus (the light blue area) with average wind speeds of about 5 m/s at 30 m height. Our measured value of 4.64 m/s indicates the location selected is the most ideal location on campus or in the community and leverages the greatest potential in the local area.

The ratio of wind speeds indicates a wind shear of 0.244 which is a typical value for this mixed terrain of buildings and farmland. The map value of 4.4 m/s compares well with the measured value of 4.64 m/s (corrected for height).



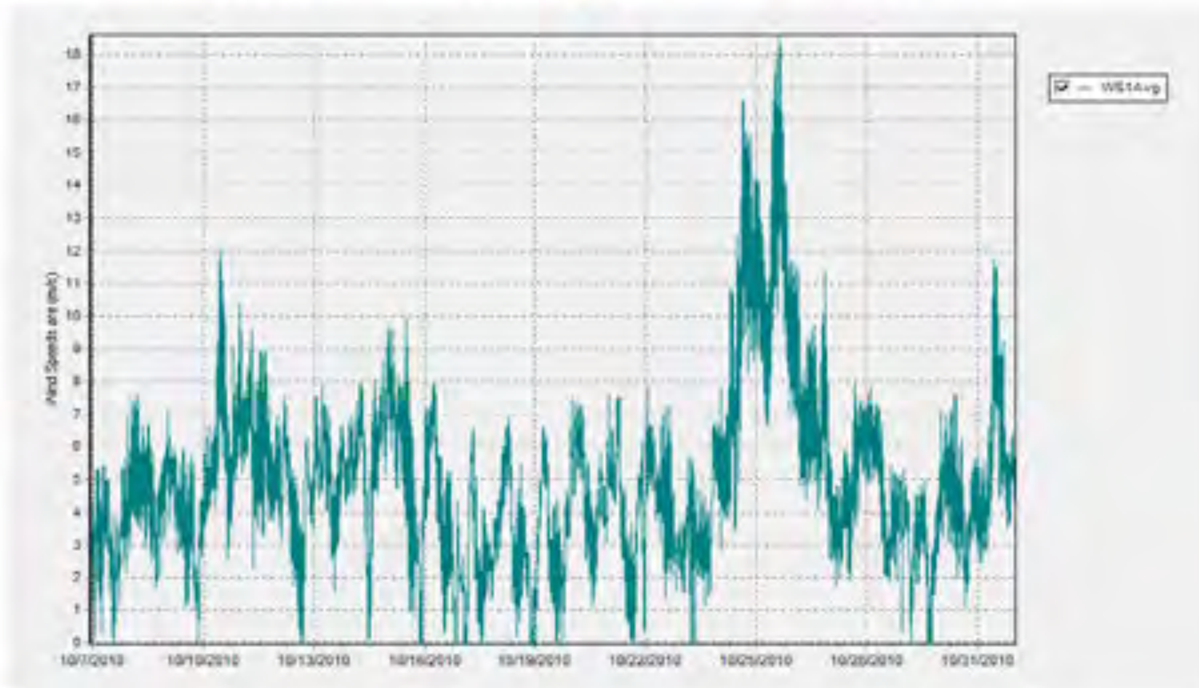
RAW DATA

Data was collected for 80 days from October 7 through December 26th.

The maximum instantaneous wind speed recorded was 28.4 m/s (64 mph) on Nov 16.

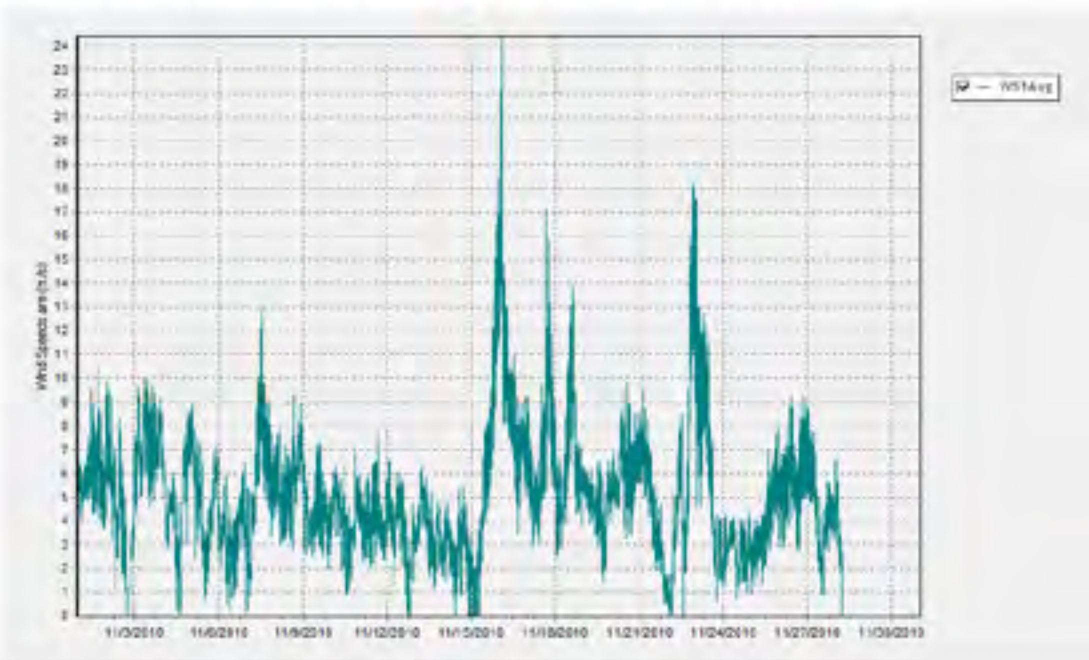
The following graphs are Wind Speed by Month indicating maximum and minimum wind speeds recorded by date in 10 second intervals.

Renewable Energy & Offsets

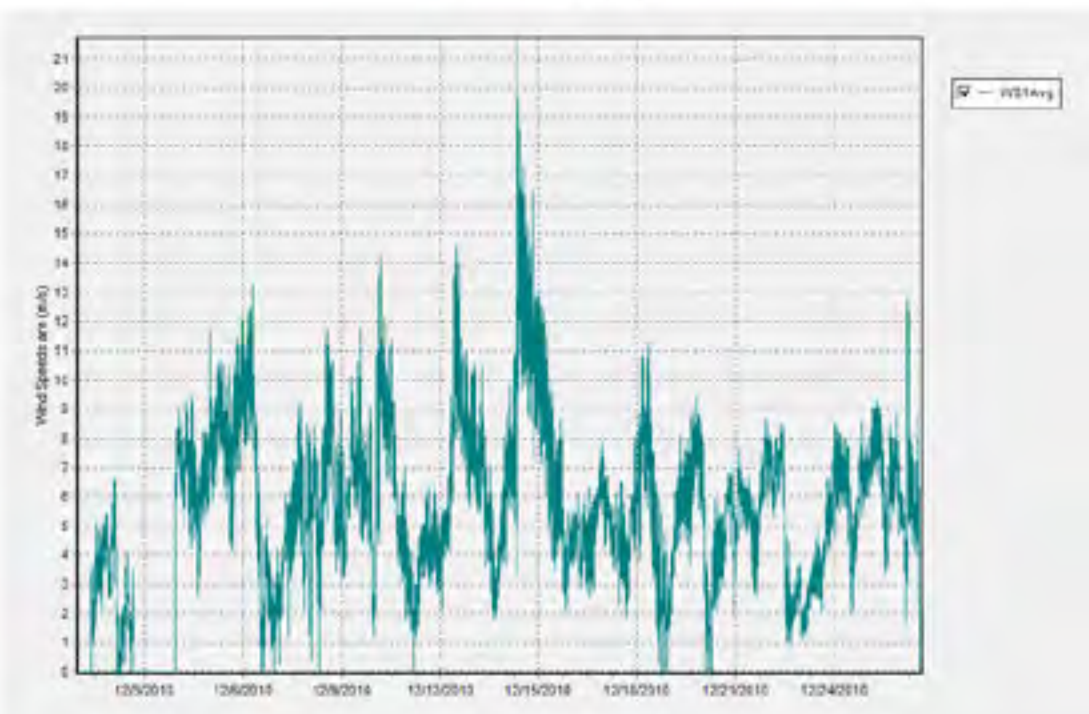


October, 2010

Renewable Energy & Offsets



November, 2010

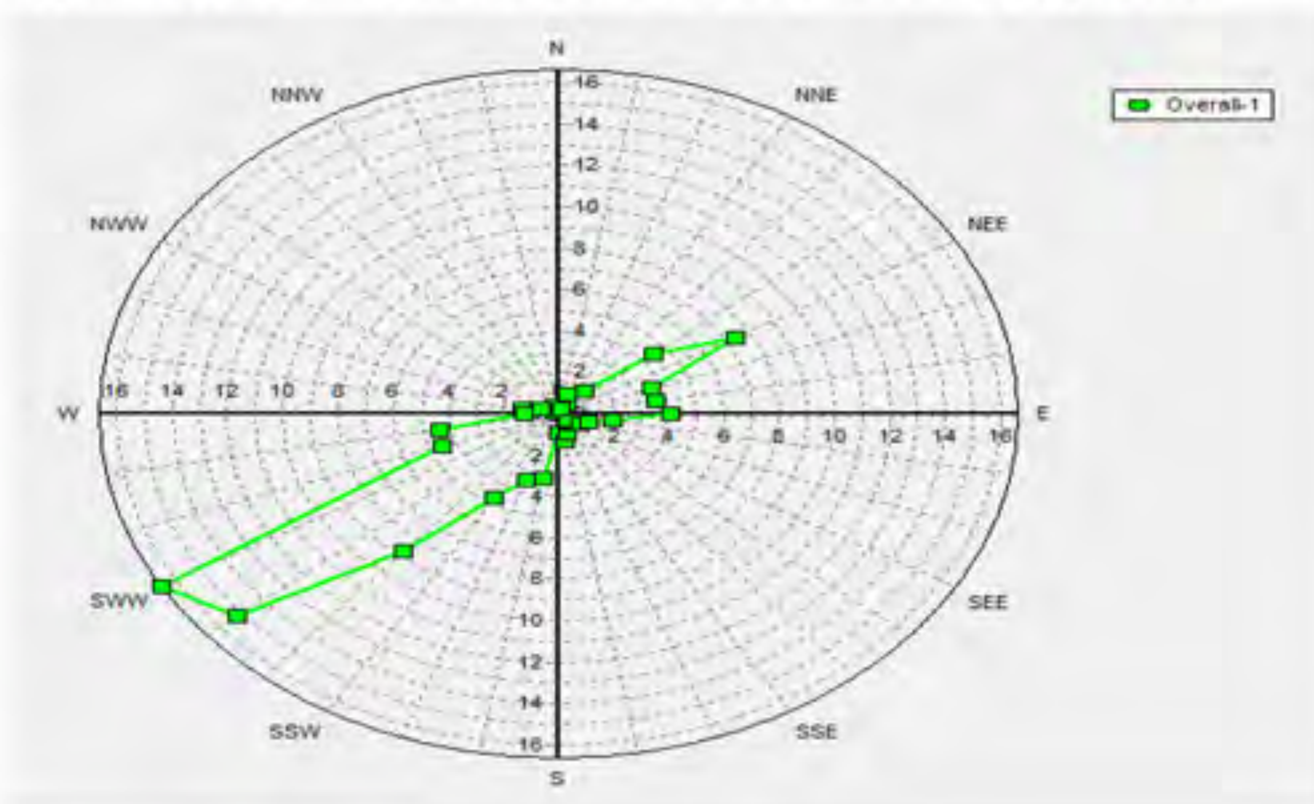


December, 2010

Renewable Energy & Offsets

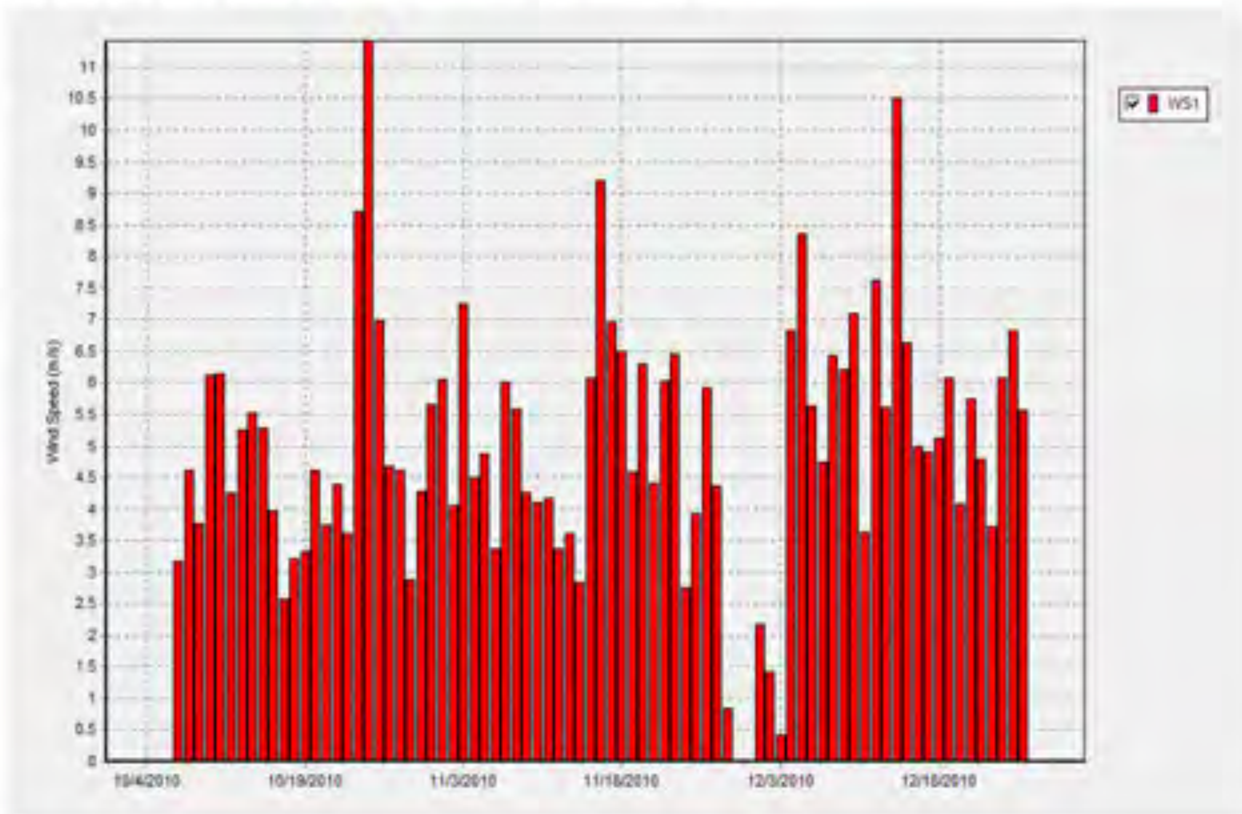
The chart displayed below is a wind power rose (a plot of wind direction weighted by wind speed cubed). This chart is useful in determining the final location of wind turbines by identifying the predominant wind direction on the monitored site.

The predominant wind direction is 220 degrees (SW), with also significant time at 60 degrees (NNE).



Renewable Energy & Offsets

The average wind speed by day is shown in the following graph:



Renewable Energy & Offsets

WIND STATISTIC TABLE

The average measured wind speed for the period was 5 m/s which compares reasonably well with the wind map value of 4.4 m/s. The wind speed standard deviation is low, resulting in very low turbulence intensity values (SD/mean), indicating that the wind flow is very consistent with minimal turbulence, and few obstructions up-wind. The root-mean-cube value can be used for wind turbine power estimation – it indicates the equivalent wind speed for a turbine with a cubic power function.

	October	November	December	Overall
Average WS	4.9	4.6	5.4	5
Minimum WS	0	0	0	0
Maximum WS	20.6	28.4	24.5	28.4
WS Standard Deviation	0.5	0.5	0.5	0.5
WS Root-mean-cube	6.1	6.1	6.7	6.3
Turbulence Intensity	9.4	10.4	9.6	9.8
Average Direction	161.6	188.9	157.2	169.2
Wind Power Direction	216.5	203.2	214.9	211.6

COMPARISON WITH OTHER LOCAL WEATHER STATIONS

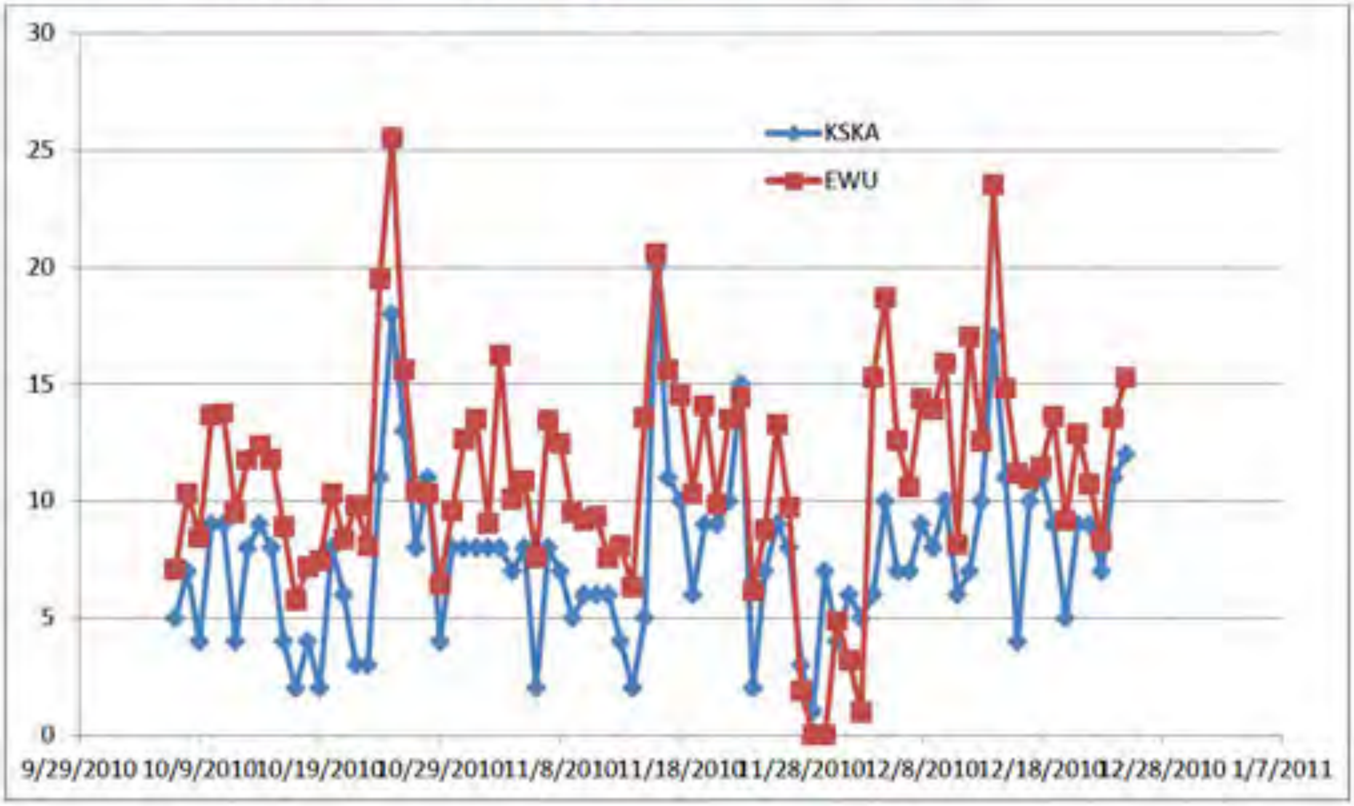
Day averages were downloaded from www.WeatherUnderground.com for Fairchild AFB (KSKA) for the same period as the monitoring. Fairchild AFB is about 8 miles NW of the EWU site.

The measured day averages, and Fairchild AFB day averages correlate very well; the correlation coefficient is 0.78.

The average ratio of EWU to KSKA data is 1.62. This difference can be explained as air weather stations sense wind speed at 10 m height, whereas the EWU data is measured at 40 m height.

This chart overlays wind speeds at the compared locations during the monitoring period.

Renewable Energy & Offsets

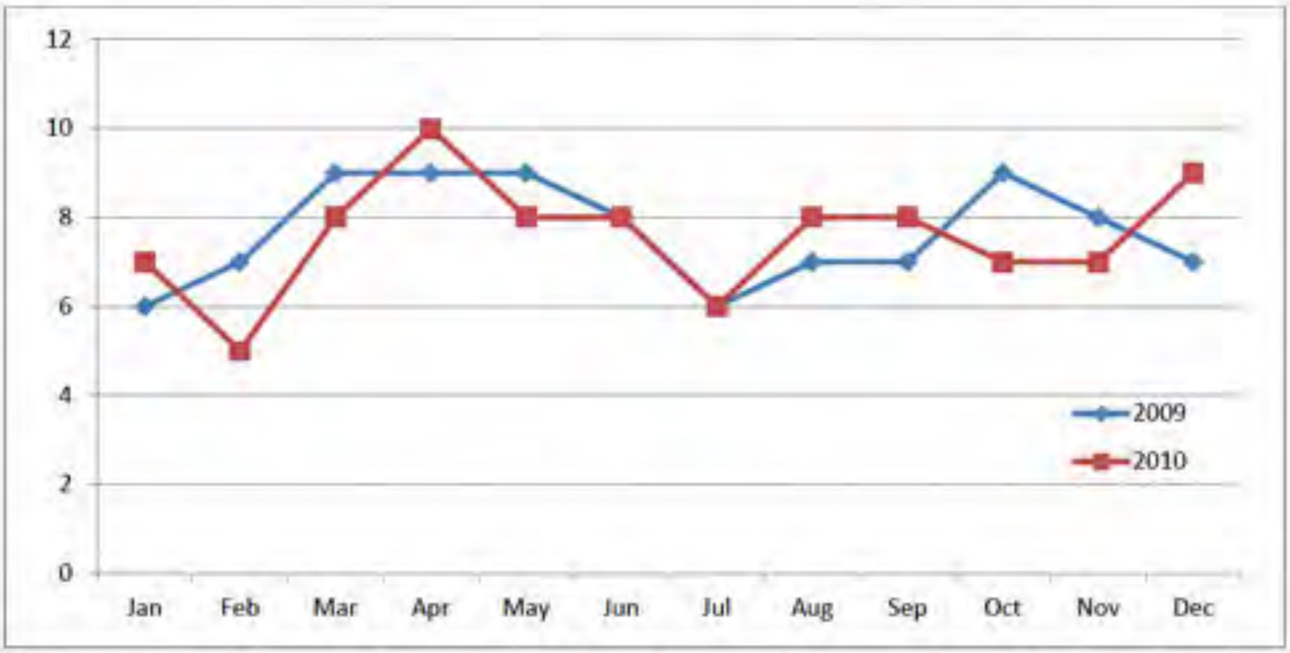


Considering the close correlation between the sites, and the absence of large geographical features that might cause seasonal wind regime changes, the annual performance of a wind turbine at EWU can be extrapolated using KSKA weather data.

	2009	2010
Jan	6	7
Feb	7	5
Mar	9	8
Apr	9	10
May	9	8
Jun	8	8
Jul	6	6
Aug	7	8
Sep	7	8
Oct	9	7

Nov	**8**	**7**
Dec	**7**	**9**
Average	**7.7**	**7.6**

Month Average Wind Speed (MPH) at KSKA - Fairchild AFB



Month Average Wind Speed (MPH) at KSKA - Fairchild AFB

There appears to be no major seasonal change – perhaps dips in February and July, but these are compensated for by higher wind speeds in March through May.

The three months of measured data at ESU should be representative of an average year's operation.

WIND TURBINE PRODUCTION

Production was estimated for the following turbines:

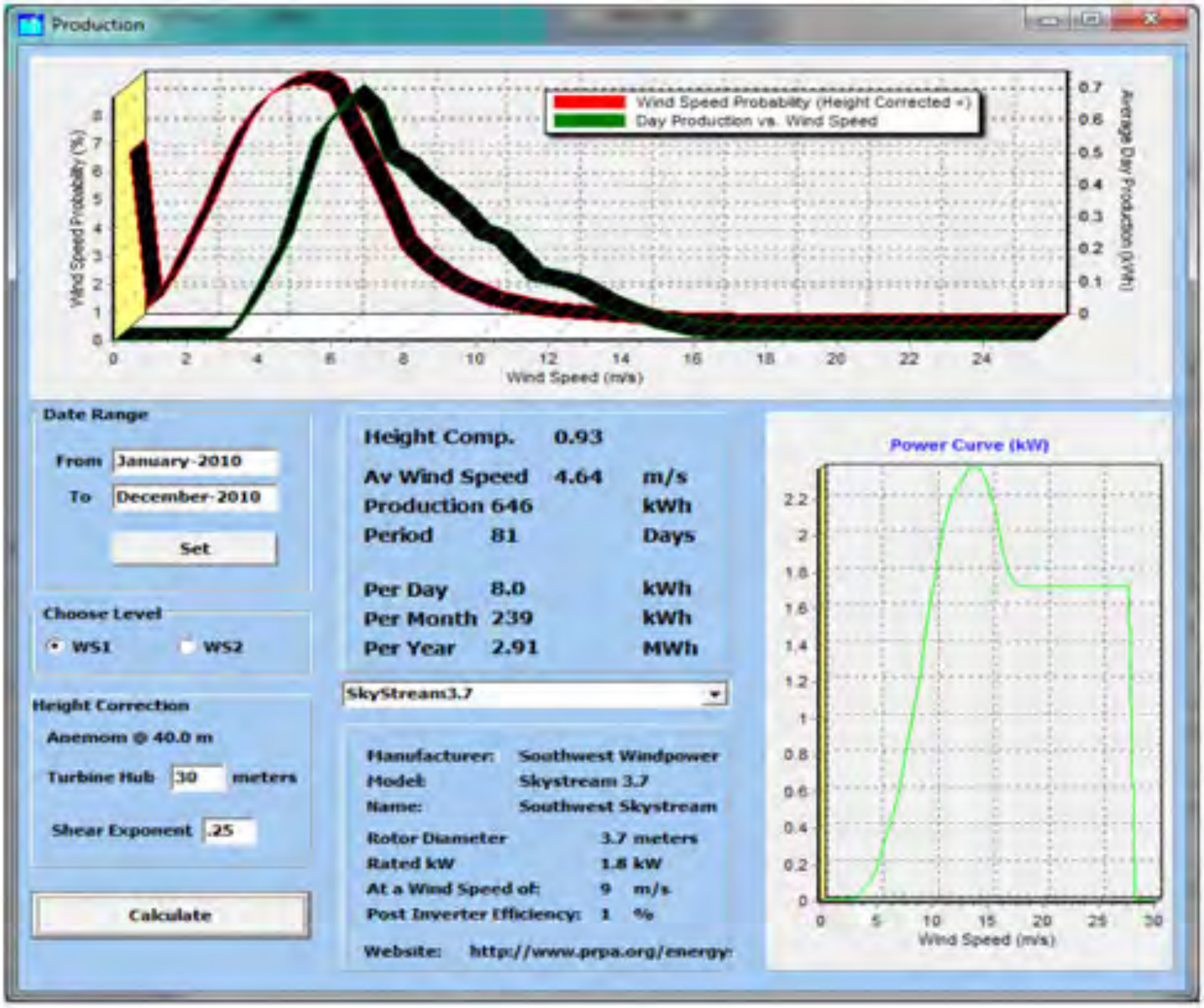
- SWWP Skystream
- Xzeres 442, and
- Endurance 3120

Production was estimated with turbine height at 100 ft (30 m) vs. the anemometer measurement height of 130 ft (40 m). A shear coefficient of 0.25 was used for the conversion. This resulted in a height compensation factor of 0.93, reducing the average wind speed from 5 to 4.64 m/s.

SWWP Skystream 3.7

Renewable Energy & Offsets

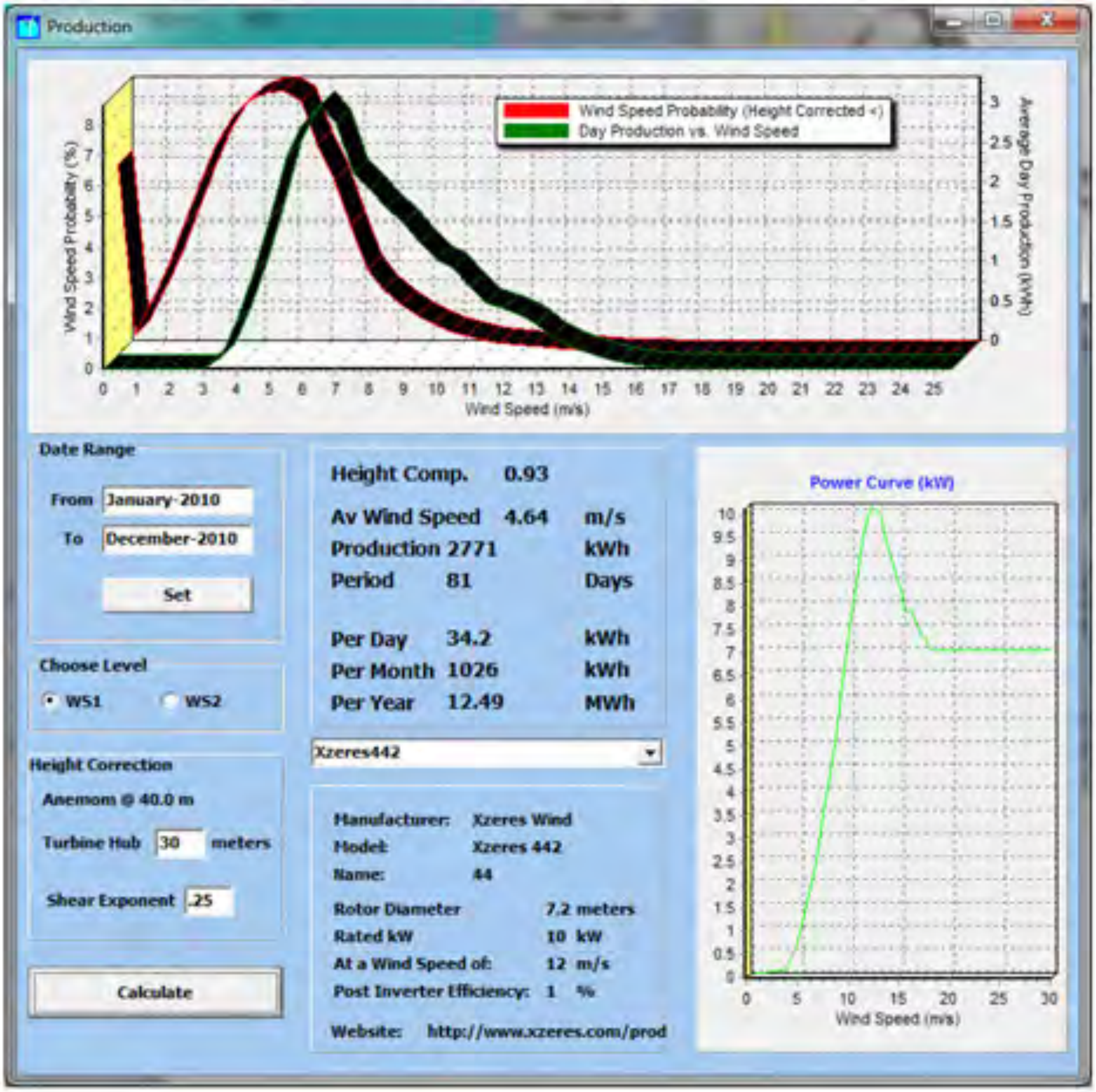
A Skystream 3.7 turbine is rated 2.4 kW peak and could be expected to produce 239 kWh/month, 2.91 MWh/year.



Xzeres 442

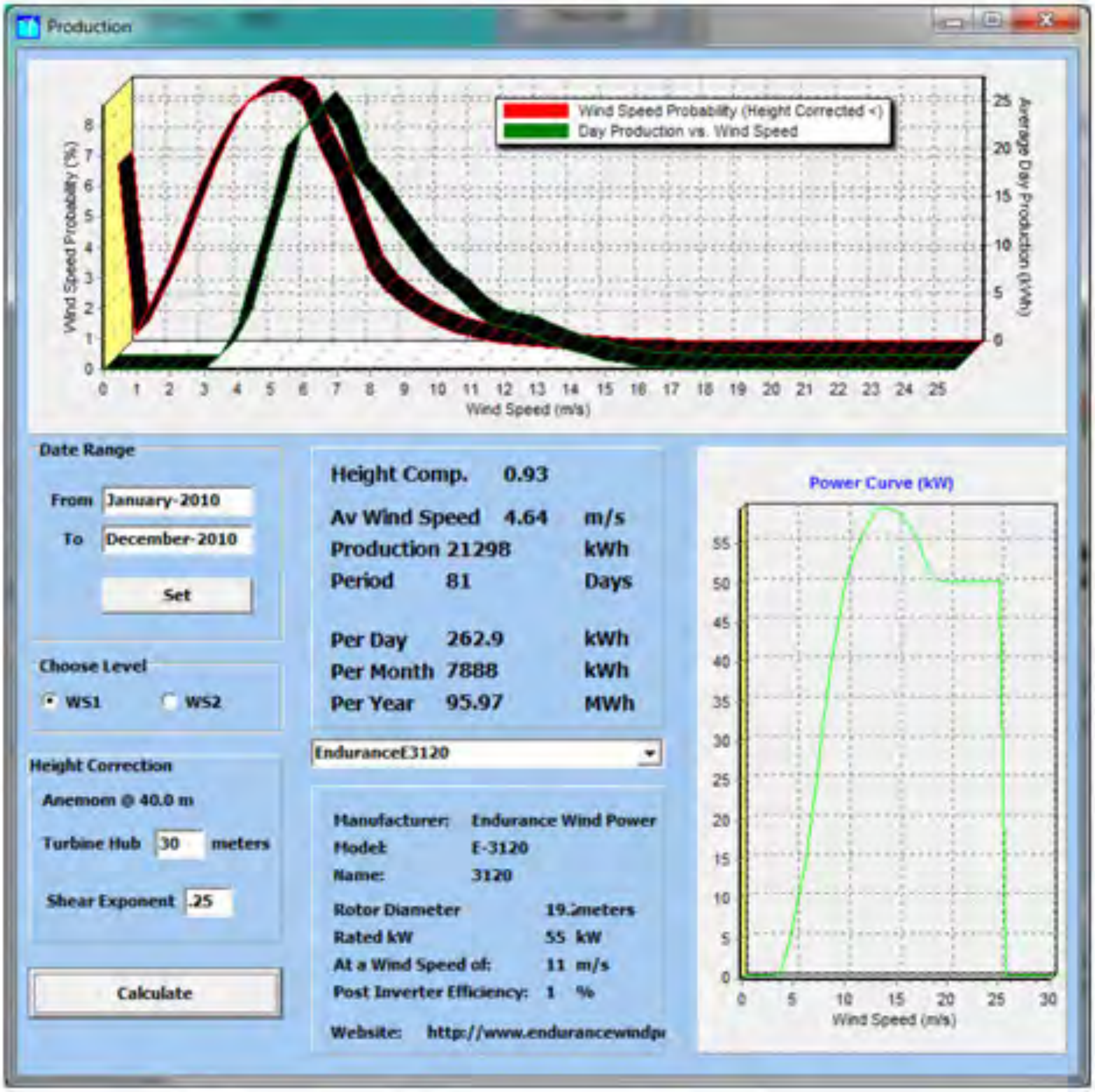
The Xzeres 442 turbine is rated 10 kW peak and could be expected to produce 1026 kWh/month, 1249 MWh/year.

Renewable Energy & Offsets



Renewable Energy & Offsets

The Endurance E-3120 turbine is rated 55 kW peak and could be expected to produce 7888 kWh/month, 95.91 MWh/year



Renewable Energy & Offsets

Executive Report

2. Understanding Offsets/Funding Opportunities

Although Eastern Washington University's top priority remains emissions reductions through campus initiatives, the university's expansion will inevitably exhaust efficiency opportunities on campus, so consideration of purchased offsets or Renewable Energy Certificates may become a focus of the emissions reduction strategy. As the offset market becomes more defined in the future, Eastern Washington University may have additional options to investigate as well.

A. OFFSETS

Purchasing certified third-party offsets would enable Eastern Washington University to report emissions mitigation through support of greenhouse gas emission reduction elsewhere. Should the University pursue purchased offsets, it should take care to focus on valid, high quality offsets. ACUPCC guidelines specify that offsets must be real, additional, transparent, measureable, permanent, verifiable, synchronous and registered; they must account for leakage; they must not be double-counted or retired.

B. RENEWABLE ENERGY CERTIFICATES (RECS)

Purchasing green power through RECs (or "green tags") would allow the University to mitigate some emissions associated with campus electricity use by supporting development of additional renewable energy generating capacity for the grid. RECs should be certified by an independent agency (i.e. Green-e) to guarantee their authenticity and accuracy. They are typically sold at a small premium over conventional electricity, but the volume purchased by Eastern Washington University may allow for better pricing opportunities.

Although the University emphasizes efficiency and conservation first, to cut emissions at the source, this strategy will continue to evolve. As the best opportunities to cut emissions with facilities improvements are realized, Eastern Washington University will need to consider options involving combinations of renewable energy, RECs and purchased offsets to account for the remaining emissions.

Renewable Energy & Offsets

Executive Report

3. Analysis Findings

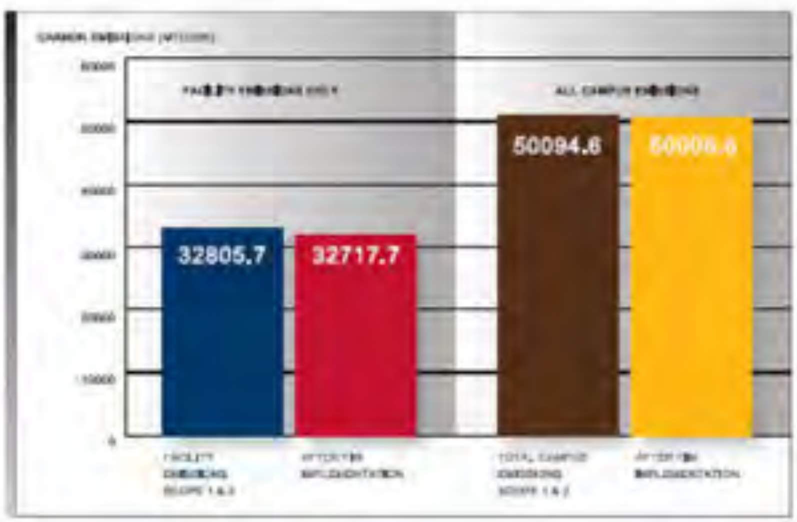
A. TABLE 5

**FACILITY IMPROVEMENT MEASURE (FIM) SUMMARY
ROUGH ORDER OF MAGNITUDE (ROM)**

FIM NAME	FIM DESCRIPTION	BUILDING	MIN	MAX	CARBON SAVINGS (METRIC TONS)	EASTERN WASHINGTON UNIVERSITY VALUE PROPOSITION
24.02-Eastern Washington University: Solar Equipment Installation	McKinstry recommends installing a Photo-voltaic solar panel arrays on the roof of the Computer and Engineering Building, photo-voltaic awnings on the western and southern façade, and a ground mounted photo-voltaic solar array.	Campus	58.1	81.7	21	1. Demonstrable renewable energy project on campus. 2. Reduction in electrical energy consumption in CEB.
24.03-Eastern Washington University: Wind Turbine Installation	McKinstry proposes to install (2) 50 kW Wind Turbines by the Water Tower and tie into the inverter box into the Pavilion's electrical power system.	Campus	41.4	67.2	67	1. Demonstrable renewable energy project on campus. 2. Reduction in electrical energy consumption in the Pavilion.
			49.9	70.6	88	

B. EMISSIONS IMPACT GRAPH 9

Implementation of these renewable energy projects would produce enough power each year to offset an estimated 88 metric tons of carbon dioxide emissions from purchased electricity.



6 Energy Efficiency & Sustainability in Campus Culture

Energy Efficiency & Sustainability in Campus Culture

Executive Report

1. Prioritizing Stakeholder Involvement

As part of developing the Campus Energy Efficiency & Sustainability Plan, Eastern Washington University held a kickoff design charrette on May 14, 2010. A key goal of this dynamic and interactive target-audience work session was to help the University community articulate ideas for a greener, more sustainable campus. The meeting also reviewed work completed to date on energy efficiency and sustainability, and the overarching tenets of the American College and University Presidents' Climate Commitment (ACUPCC), including the urgency of campus action and involvement.

An additional goal was to inform communication strategies for the University's Climate Action Plan, along with gathering suggestions for implementation.
The 39 attendees included Eastern Washington University faculty, staff and administration, representatives from the City of Cheney, and the planning team comprised of professionals from McKinstry, AHBL, Camp Creative and Mark Simonds Consulting.

The session was facilitated by Kim Pearman-Gillman from McKinstry, following introductory comments by President Dr. Rodolfo Arévalo and Vice President Mary Voves. The interactive workshop began with presentations by the planning team on the key principles of sustainability, the scope and parameters of the Energy Efficiency and Sustainability Plan, and the subsequent Climate Action Plan. This was followed by a breakout session comprised of eight stations related to the components of the plan:

- Building Energy-Efficient/High-Performance Buildings
- Energy Sources
- Renewable Energy
- Greenhouse Gases
- Waste Stream Efficiency
- Site and Landscape
- Community Engagement
- Academics

The stakeholder views gathered in this initial event provide a valuable foundation for continuing development of the Energy Efficiency & Sustainability Plan.

2. Culture at Eastern Washington University

Located in a rural Eastern Washington town, Eastern Washington University has a great opportunity to be a leader in sustainability initiatives among both students and the community. Although many students and faculty are interested in sustainability on campus, it is not yet a visible focus for the University. Signing the ACUPCC was a first step in emphasizing this priority for the school, with President Dr. Arévalo publicly committing to reducing emissions and prioritizing sustainability.

Even with campus interest, University leaders realize the challenges of institutional change. To build the necessary consensus, Eastern Washington University emphasizes stakeholder involvement. By bringing together students, committee members, faculty, staff and leadership, Eastern Washington University is developing new initiatives, ideas, facility upgrades and curriculum emphases to take the next step, truly integrating sustainability into the campus.

Energy Efficiency & Sustainability in Campus Culture

3. Institution Structure

When signing the ACUPCC, the University agreed to develop a stakeholder group to unite the campus behind the Climate Action Plan. Although a small group on campus completed the initial GHG Inventory and is driving the creation of the Energy Efficiency & Sustainability Plan, Eastern Washington University leaders stress that broad participation is critical for development of a successful plan, and is encouraging wider involvement with the climate action planning process.

During summer 2010, Eastern Washington University began building a campus climate committee. This stakeholder group is now increasingly responsible for setting goals and directing the University's pursuit of efficiency, carbon neutrality and sustainability on campus. Participants in this process will represent the entire campus: students, student groups, faculty, staff and campus leaders.
We recommend adding a designated sustainability coordinator, as many universities have. This position would be focused on proactive implementation of emissions reduction measures, coordination of projects, and campus engagement on the challenges of emissions reduction.

4. Communications Plan

In order to build momentum towards Eastern Washington University's goal to become an energy efficient and sustainable campus, the University developed a communications plan in 2010, some elements of which are already under way while others have yet to begin.
From the outset, the plan's key goal has been to build dialogue with a broad range of stakeholders:

- Students
- Faculty
- Administration
- City of Cheney
- Facilities and Planning Teams

WORK TO DATE:

TARGET AUDIENCE MEETINGS

In May 2010, Eastern Washington University launched stakeholder communications efforts with a campus charrette targeting the entire campus community: students, faculty, administration, facilities staff and the City of Cheney. We promoted the event with email blasts, flyers and invitations. The goal was to engage a broad range of Eastern Washington University community members to kick off the administration's focus on energy efficiency and sustainability—and to let leaders emerge who can help the University reach its goals.

BOARD OF TRUSTEE ENGAGEMENT

Eastern Washington University Associate Vice President for Facilities and Planning Shawn King and McKinstry's Director of Strategic Market Development Kim Pearman-Gillman have presented the Board with the overall scope of work to be accomplished in the Campus Energy Efficiency and Sustainability Plan. The findings of this study will be presented at a May 2012 board finance committee meeting.
American College and University Presidents Climate Commitment (ACUPCC)
We created the Eastern Washington University Climate Action Plan and posted it on the ACUPCC website, meeting University requirements: **http://www.presidentsclimatecommitment.org/**.

Energy Efficiency & Sustainability in Campus Culture

WORK TO DO:

American College and University Presidents Climate Commitment (ACUPCC)

As required by the ACUPCC, annually update the Eastern Washington University Climate Action Plan on the organization's website, showing progress to date. The plan addresses the next steps for Eastern Washington University to complete these upcoming obligations. As these milestones are reached, they will present excellent opportunities to publicize Eastern Washington University's success to the entire campus community. Among those opportunities would be articles to feature the University's successes as well as next steps for campus-wide sustainability.

Sustainability Committee

All elements and timing regarding this communication action plan have been prepared: announcing the committee formation, calling for volunteers, selecting the members and then announcing the group's composition.

Ongoing Sustainability Committee Communications

To complement intra-committee email communications, McKinstry suggests the University could consider a website to give both committee members and other stakeholders a current window into evolving Eastern Washington University progress on energy efficiency and sustainability. Regularly updated, it would be accessible campus-wide and even globally to showcase Eastern Washington University's leadership in this arena.

5. Campus Initiatives

Commitment to efficiency, sustainability and involvement has sparked several campus groups, projects and programs to make Eastern Washington University a healthier, cleaner and greener place:

Energy Efficiency and Conservation Projects

Efficiency improvements in campus infrastructure are a backbone for sustainable operations. Recent improvements and future goals are presented in more detail in sections 2 and 4 of this report.

Sustainable Building Guidelines

Policies specify that new campus buildings meet LEED Silver standards at a minimum, ensuring that as the campus grows or replaces old buildings, new high-performance buildings enhance the University's public sustainability presence.

Eastern Environmental Club

This club promotes environmental awareness on campus and in the community, engaging students in limiting humanity's impact on the planet.

Climate Committee

Eastern Washington University is currently forming a stakeholder climate committee to engage faculty, staff, students and campus leaders, defining and driving Eastern Washington University's approach to climate neutrality.

Student Orientation

Engaging students in the sustainability initiatives and goals for the campus starts during their initial orientation. Orientation includes awareness about campus sustainability initiatives with special attention to transportation options, waste and recycling, and how to get involved with projects.

Energy Efficiency & Sustainability in Campus Culture

6. Future Goals

With the recent formation of a Sustainability Committee, the campus community is moving ahead in promoting environmental sustainability and reducing the environmental impact of university operations. Students, faculty and staff comprise the committee, which is charged with advancing discussion and action among the various campus stakeholders.
The committee reports to the President.

COMMITTEE OBJECTIVES

1. Develop committee goals
2. Facilitate communication
3. Review campus community proposals and make recommendations
4. Educate the campus community about sustainability and energy efficiency

7. Key Performance Indicators

As EWU moves forward with developing additional sustainability and carbon reduction goals and initiatives, identifying quantifiable key performance indicators will be critical to track and report success. Many universities monitor changes in campus sustainability involvement through quantifiable metrics such as increasing number of campus wide programs, participation in activities, changes in funding, interest level from student surveys, emissions reduction reporting and monitoring of habitual changes such as transportation.

7

Sustainability In Curriculum

Sustainability in Curriculum

Executive Report

SUSTAINABILITY IN CURRICULUM

Eastern Washington University is now integrating sustainability into the student curriculum, creating a dynamic educational experience to prepare graduates for a more environmentally aware future, while attracting more students to the University.

A variety of courses already include a focus on sustainability elements, and the University is working to identify additional opportunities while also preserving teacher flexibility. By emphasizing faculty involvement in the planning process, University leaders are working to integrate strategies for educators to embrace.

8 Funding Energy Efficiency & Sustainability Projects

1. Funding Campus Sustainability

Funding Energy Efficiency & Sustainability Projects

Executive Report

1. Funding Campus Sustainability

Facility audits addressing Scope 1 and 2 emissions will identify potential rebates, incentives and grants that Eastern Washington University can pursue to assist in facility improvement costs. Some additional funding sources to investigate include green fees, funding from RCM programs, state and Federal grants, and local partnerships. The University continues to explore these and other opportunities to support energy efficiency and sustainability initiatives on campus:

Capital Project Savings—With capital improvements to campus facilities and more behavioral programs targeted at energy efficiency, Eastern Washington University will see significant savings on utility bills. At least some of these savings might fund further improvements on other buildings.

Green Fees—Green fees are a popular strategy at colleges. These fees are typically between $10 and $25 per semester/quarter. The funds support specific programs related to sustainability, emissions reduction, environmental restoration or funding a sustainability coordinator position.

State, Federal and Utility Grants—Grant programs offer institutions like Eastern Washington University funding to offset the upfront capital costs of projects that will save energy and emissions. These programs fluctuate and often have limited funds, so it is critical to have dedicated individuals tracking these opportunities.

The first step to creating a funding plan is to prioritize the Facility Improvement Measures and identify a phased approach to implementing the approved measures. Once this decision is made, it will be possible to identify project costs over the timeframe of the total project. With this information, along with the information from the above funding categories (energy savings, green fees, rebates/incentives/grants, etc.), Eastern Washington University will be able to determine their net financial position.

As mentioned above, a key component of the overall funding should consider financing against guaranteed energy and operational costs created as a result of implementing the measures. This approach has been used widely throughout higher education to help bridge the gap between total project costs and available capital funds.

Currently available financing programs reward sustainable projects with lower interest rates. However, because these programs and requirements change over time, it is not possible to accurately predict their availability at the time of project financing.