1. Todd Dunfield gave an overview of the University’s bike sharing and bike recycling program. Bikes used in the program are generally those that students have donated upon graduation. Currently, there are about 5-7 bikes available in the program that are rented out per semester to students and faculty. Since transportation makes up a large chunk of the University’s greenhouse gas emissions, Dunfield hopes to expand the scope of the bike sharing program over the next 18-24 months. Such an initiative would include an expansion of bike lockers on campus and the number of bikes available for rent, as well as research among students and faculty to determine just how many people are using bikes around campus, and, if they are not, what is preventing them from doing so. To help expedite this process, Dunfield has assumed the role of head of the Transportation Sub-committee of the ACSS.

2. Kristen Kupda, a mechanical engineer and member of MW Consulting Engineers, gave a presentation on the viability of certain alternative energy resources to Gonzaga. According to Kupda, in addition to the reduction of greenhouse gas emissions, the goals of implementing renewable energy resources should be to save money and to attract students and other community members to the institution. Kupda covered resources such as solar power, wind power, biomass energy and geothermal heating and cooling. Essentially, the feasibility of all these resources was generally limited as concerns Gonzaga; they all require significant upfront investment which takes close to 100 years to make up in energy savings, and the amount of campus-wide energy accounted for by these resources is generally very minimal. The one resource that may be worthwhile is heating and cooling provided by heat pumps that use water from Spokane’s aquifer to heat and cool buildings and return the water to the aquifer after use. Heat pumps are estimated to be 300-350% efficient, compared with traditional boilers that Gonzaga currently uses which are only about 90% efficient; also, heat pumps are estimated to cost about $100,000 less per year compared to boilers. One potential drawback to heat pumps is the possibility of contamination of groundwater when the water in the pumps is returned to the aquifer after use. Kupda concluded by discussing some basic classroom design features that can also help to cut energy costs. Things like better insulation, skylights, ceiling fans, and concrete floors, which can help cool a building in hot weather, are all simple steps the University could take in new building design or retrofitting projects that would help reduce campus energy consumption. Kupda also made the point that, although some renewable energy projects may not be the most cost effective, they
may be worth pursuing anyway if they are in line with the mission of the school; their benefits can be seen in other ways such as increased enrollment, positive publicity, etc.

The next CAP meeting will be held Thursday, April 7 in College Hall 402. The next Steering Committee meeting will be held Thursday, March 17 in College Hall 402. Both meetings will take place at 12:10pm.
• Colleges & Universities that exert leadership in addressing climate change will stabilizing & reduce their long term energy costs, attract excellent students and faculty, attract new sources of funding and increase alumni support.

• Operational Cost Savings

• Reduce Infrastructure

“Building consume more energy than any other sector; Buildings are the largest contributor to climate change”
– Architecture 2030
Presidents Commitment for Climate Change:

- Reduce Greenhouse Gases by 80% by 2050
- Develop an Institutional Plan for Carbon Neutrality
- Incorporate into Curriculum

Renewable Power is a Key Component to Carbon Neutrality
RENEWABLE RESOURCES

SOLAR POWER
SOLAR HOT WATER
WIND POWER
EARTH
BIOMASS/BIOFUELS
CLASSROOM OF THE FUTURE
SOLAR POWER
* 20% DIFFERENCE IN SOLAR POTENTIAL BETWEEN EASTERN & WESTERN WASHINGTON
SOLAR POWER

HOW SOLAR POWER WORKS

Photovoltaic system components

GRID TIED PV SYSTEM
Generally for On-Site Electricity Use

Flat Roofs Typical Installation

Building Integrated PV Systems (BIPV)

Example
• Hogue Hall
• 28 kw PV Array
• Service 96,000 Sqft Building
• Array is 1512 Sqft and Sits on a Roof of 43,000 Sqft
• Provides 2.5% Electricity for the Building

Renewable Power is a Key Component to Carbon Neutrality
PV Systems Serves “Other” Purpose in Building Design in Addition to Energy Production
**SOLAR POWER**
**RECENT PHOTO-VOLTAIC PROJECTS**

**SPOKANE CONVENTION CENTER PARKING LOT LIGHTING**
- 2010 Install
- $150,000 Cost Premium
- 0.5 kw PV
- 3.75 Avoided kw
- 13,687 kwh/Year Savings
- $1406 /Year Savings at 9.4 cents/kwh
- Save on Relamping: 1 Time for 13.7 Years vs. 2.7 Years

**CWU NEW RESIDENCE HALL PV – ELLensburg**
- 2010 Construction Starts
- $290,000 avg. Bid ($5,800kw)
- 50 kw PV Array
- 56,206 kwh/Year
- $3300/yr Savings at 5.9 cents/kwh

**COYOTE RIDGE CORRECTIONS CENTER – CONNELL**
- 2009 Install
- 76 kw
- $760,000 Installed Costs ($10,000/kwh)
- 105,525 kwh/Year
- $6720/Year Savings at 3.8 cents/kwh, $7.78/kw
- (a 76 kw System Would Support 0.4% of the GU Campus Electric Load)
• SOLAR PV EFFICIENCIES ARE IMPROVING:
  Double efficiency from efficiency in the last few years.

• PRICES ARE RAPIDLY DROPPING:
  $10,000/kW to as low as $5,800/kW

• TECHNOLOGY IS IMPROVING AND WILL GET BETTER

• RECOMMENDATIONS:
  – Make every new project PV ready. Leave space in electrical rooms for invertors, provide conduit up to the roof.
  – Preserve open roof space for future PV projects if they are not integrated into each project.
  – Design roof structures for wind/weight loads of PV system.
  – Pursue federal incentives.
  – Incorporate where it supports Gonzaga’s mission
SOLAR HOT WATER
SOLAR HOT WATER

CWU RESIDENCE HALL

- Collectors sized to provide 30–35% of the facilities annual hot water demand.

- 812 Sq. Ft. Panels

- $140,000, saves 1,431 therms gas/year or $1,560/yr at $1.10/therm.

- This system represents 0.12% of Gonzaga annual gas load.
WIND POWER
WIND POWER

STATE WIDE WIND POTENTIAL
SPOKANE COUNTY WIND POTENTIAL

Spokane < 10mph @ 50meters
Failing Grade
WIND POWER

CWU HOGUE HALL ENGINEERING TECHNOLOGY BUILDING

Case Study:
(3) –1kW wind turbines–parapet mounted
Ellensburg Wind: 13 mph

Purpose:
Support the Engineering Technology educational curriculum & increase student awareness.
EARTH
GEOEXCHANGE ENERGY

THREE TYPES:

1. Use of underground hot springs (not in Spokane!)
2. Extract heat from the earth—using the ground as a heat sink
3. Extract water from the aquifer for use in heating/cooling. Reinject after use

Extraction for heat requires a heat pump device which moves heat from one location to another much like the refrigerator in your house. Heat pumps can be used for heating, cooling or both.
GEOEXCHANGE ENERGY
HEAT PUMP FACTS

HEAT PUMP TECHNOLOGY:

• Can provide cooling and/or heating
• $111/kbtuh or $1,350/ton
• 300–350% efficient

TRADITIONAL TECHNOLOGY:

A. High Efficiency Boiler:
• Heating only device
• $23/kbtuh or $276/ton
• 90–92% efficient

B. Air Cooled Chiller:
• Cooling only device
• $77/kbtuh or $276/ton
• 300% efficient

80/50 Rule:
80% of heating (or more) can be met with equipment sized for 50% of peak capacity. Consider hybrid solutions especially in buildings where heating and cooling are mismatched.

Costs do not include well costs or ground loops costs. Ground loop costs which are the more expensive solution can cost $1,000 to $1,250/ton.
GEOEXCHANGE ENERGY
HEAT PUMP APPLICATIONS

EASTERN WASHINGTON UNIVERSITY
New Science Building
## CASE STUDY ENERGY SAVINGS POTENTIAL 750 TON HEATING PLANT

<table>
<thead>
<tr>
<th></th>
<th>STEAM</th>
<th>BOILERS</th>
<th>HEAT PUMP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AREA</strong></td>
<td>112,664 sqft</td>
<td>112,664 sqft</td>
<td>112,664 sqft</td>
</tr>
<tr>
<td><strong>ASSUMED HEAT LOAD</strong></td>
<td>125 kbtuh/sf/yr</td>
<td>125 kbtuh/sf/yr</td>
<td>125 kbtuh/sf/yr</td>
</tr>
<tr>
<td><strong>FUEL</strong></td>
<td>Gas</td>
<td>Gas</td>
<td>Electronic</td>
</tr>
<tr>
<td><strong>EFFICIENCY</strong></td>
<td>70%</td>
<td>90%</td>
<td>3.5 COP</td>
</tr>
<tr>
<td><strong>PEAK LOAD</strong></td>
<td>9,000 kbtuh</td>
<td>9,000 kbtuh</td>
<td>9,000 kbtuh</td>
</tr>
<tr>
<td><strong>ANNUAL CONSUMPTION</strong></td>
<td>14,083,000 kbtuh</td>
<td>14,083,000 kbtuh</td>
<td>14,083,000 kbtuh</td>
</tr>
<tr>
<td><strong>FULL LOAD HEATING HOURS</strong></td>
<td>1,565 Fl htg hrs</td>
<td>1,565 Fl htg hrs</td>
<td>1,565 Fl htg hrs</td>
</tr>
<tr>
<td><strong>PLANT LOAD</strong></td>
<td>20,118,571 kbtuh</td>
<td>15,647,778 kbtuh</td>
<td>4,023,714 kbtuh</td>
</tr>
<tr>
<td></td>
<td>201,186 therms</td>
<td>156,478 therms</td>
<td>40,237 therms</td>
</tr>
<tr>
<td></td>
<td>5,894,688 kwh</td>
<td>4,584,758 kwh</td>
<td>1,295,620 kwh</td>
</tr>
<tr>
<td><strong>PUMPING ENERGY</strong></td>
<td>0 kwh</td>
<td>0 kwh</td>
<td>398,236 kbtuh</td>
</tr>
<tr>
<td><strong>UTILITY RATE</strong></td>
<td>$0.86 per therm</td>
<td>$0.86 per therm</td>
<td>$0.86 per therm</td>
</tr>
<tr>
<td><strong>BUILDING HEATING COSTS</strong></td>
<td>$172,215 per year</td>
<td>$133,945 per year</td>
<td>$56,813 per year</td>
</tr>
<tr>
<td><strong>ENERGY COST SAVING OVER STEAM</strong></td>
<td>N/A</td>
<td>22%</td>
<td>67%</td>
</tr>
</tbody>
</table>
1. Until recently, economics of fuel costs did not favor electric heat sources.

2. Boilers more reliable than heat pumps and require less maintenance.

3. Some risk in underground conditions.
BIO MASS/BIO FUEL
BIO MASS/BIO FUEL

- Reduces petroleum dependence
- Requires steady & consistent stream of fuel generated from waste bio products or rapidly renewable materials. *Example: University of Idaho Steam Plant*
- May not reduce CO2 emissions
- Industry needs a drop-in bio fuel.
CLASSROOM OF FUTURE
LECTURE WING – PASSIVE ELEMENTS

- Outlet chimney for corridor night flush
- Skylights
- R-60 roof construction
- Perforated metal screen
- Gravity turbine ventilators for classroom night flush
- Clerestory outlet louver for planetarium night flush
- Intake louvers
- Radiant heat at louvers, typical
- P-32 wall exterior wall construction

Lecture Wing - Roof Plan
Lecture Wing - Floor Plan

Planning for the Future
ALTERNATE ENERGY SOLUTIONS
SYSTEM DIAGRAM- LECTURE ROOM

Direct/Indirect Sunlight

Diffused light through integrated louvers in skylight glazing

Corrected daylight factor at center of room with reflector-even distribution at desk zone

Daylighting more evenly distributed to edges of room by using angled ceilings to redirect daylighting from above
INTELLIGENT DAYLIGHTING SYSTEM
CORRIDOR NIGHT FLUSH CONCEPT

Outlet Damper Above (104 sf)

Inlet Louver (104 sf)

Interior Mass Walls, Typ. (8" Masonry)

Outlet Damper-Stack Effect

Cool Night Air Passes though Inlet Louvers and Cools Mass

Plan Perspective
CLASSROOM NIGHT FLUSH/DAYLIGHTING CONCEPT

Classroom Plan - Night Flush Diagram

Classroom Section - Night Flush/Daylighting Diagram
COMFORT

STRATEGIES UTILIZED TO EXPAND COMFORT RANGE

Concrete block- High mass construction to provide cool surfaces in cooling mode

Adjustable thermostats

Radiant heaters on cold surfaces such as windows to reduce radiant surface temperatures when in heating mode

Controlled fresh air to reduce occupant generated humidity

Occupant controlled ceiling fans for cooling