

Zero Net Energy – Spring 2018

Energy Audit of the McLaughlin Wildlife Reserve

Background

McLaughlin Reserve exists in a location that was previously owned and operated by Homestake Mining. Though most of the mining facility has been broken down, a warehouse and field station still exists on site. Since 1993, UC Davis has occupied the land and used it as a research station. Now that the mining operation is in shutdown/maintenance mode the warehouse is used very sporadically for industrial purposes and the and UC Davis uses the warehouse to maintain the facility and machinery onsite. Additionally, about a quarter of the warehouse is used as an office, both by the mining company and by UC Davis. The field station is used primarily in the spring and summer to house researchers.



Above you see a figure that shows monthly energy usage for the site over the last two years. The McLaughlin Reserve currently spends around 33,000USD on energy every year. The site is composed of a 6,700 sq ft field station as well as a 25,300 sq ft warehouse. Though the space has relatively a small energy intensity (4.63kWh/sq ft), the amount of energy used compared to the amount of work done is intense.

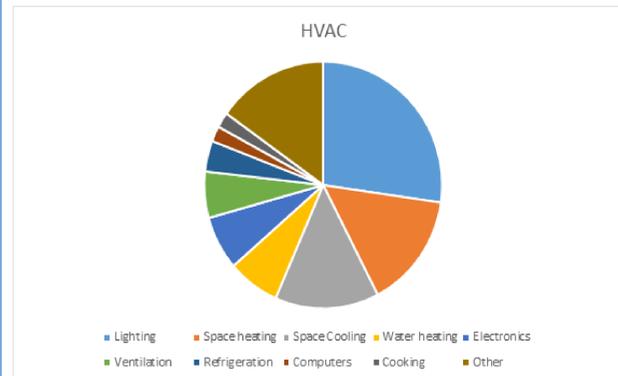
We conducted an energy audit of the facility taking an inventory of all energy consuming equipment along with incorporating behavioral and occupancy data learned from facility staff

Contact Info

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Research

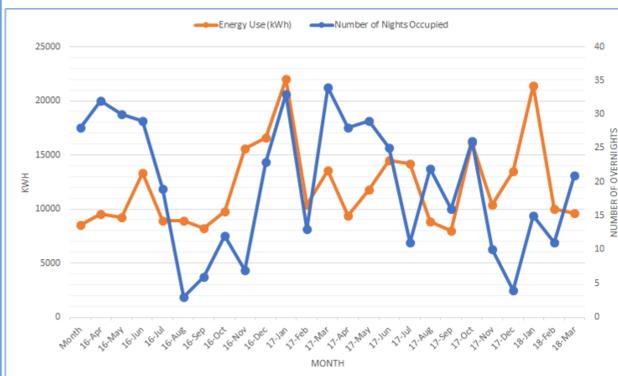
From our literature research from Energy Future: Think Efficiency (APS) 2008, buildings cover 39% of the the U.S energy expenditure, industry covers 33% and transportation covers 28%



According to the Energy Data Book of 2007, from the U.S. Department of Energy, the typical breakdown for commercial buildings in the US, over 50% of the energy(56%), comes from lighting and HVAC.

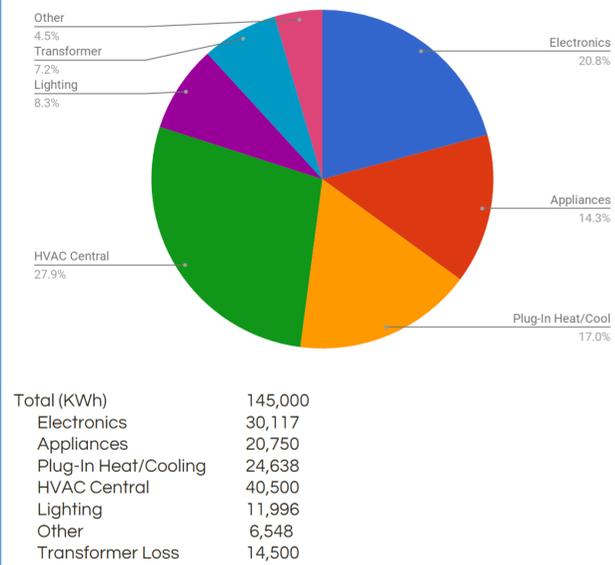
Approach

After our site visits we created a spreadsheet that lists all energy consuming equipment onsite, estimates usage for each line item, and then calculates total energy use per year. We also looked at the scheduling database to look at energy use versus on-site occupancy.



The figure above shows the correlation between the monthly energy expended on site and the number of nights the field station was occupied by visitors in a given month.

Results



We found that HVAC accounts for about 30% annual consumption, electronics accounts for 20% and Plug-in Heat/Cool accounts for 17% of total annual energy use.

Recommendations

By our estimation 47% of energy used on site is for heating and cooling. For this reason we recommend installing a higher efficiency HVAC system and installing remote monitoring thermostats. Currently, McLaughlin reserve is spending around \$9,000 on HVAC every year. Installing Higher efficiency HVAC system can potentially save \$4000/year.

HVAC Replacement Cost Analysis

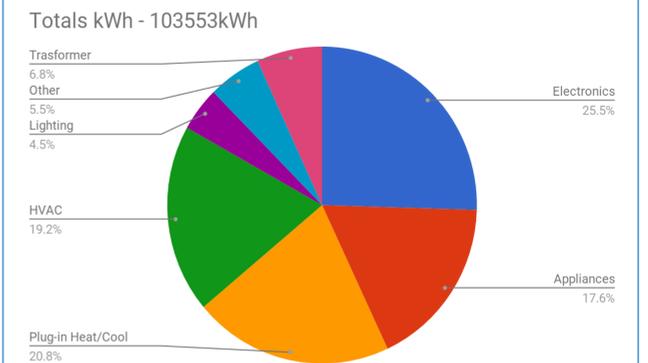
Installation Cost = Total Cost of Equipment + Labor
\$20,900

Annual Cost to Operation: \$4710
Annual Savings: \$4140

ROI: 6 years



From the lighting group, we expect lighting to decrease from 12,000kwh- 5300kwh per year. With our proposed system, we could have a system that requires around 22700kwh per year instead of 41k-58k. That can decrease HVAC consumption substantially. The following chart represents the new energy breakdown that can potentially happen:



Incorporating both reductions in lighting use and HVAC consumption we estimate McLaughlin could save ~ 40,000kWh/year

Solar Estimate

We looked at options for a cash payment system compared to a monthly PPA . For the cash system we estimate \$3.5/W and sized a system that would produce around 100,000kWh per year. With a total initial investment of \$250,000 we expect an ROI of 10.5 years and an estimated savings of 350,000 after 20 years.

To estimate a power purchase agreement scenario. We used a current UC Davis PPA rate at \$0.9/kWh with rate increase 1.06%. The estimate monthly saving will be up to \$146,819 after 10 years.



References

- ENERGY FUTURE: Think Efficiency (APS) 2008
- Energy Data Book (2007): EERE, U.S. Department of Energy
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- <http://smashpost.info/good-garage-space-heater/good-garage-space-heater-best-garage-electric-space-heater/>
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