

Engineering 308 Semester Project: CCAT Net Zero Energy (NZE) Planning Project Fall 2014

Project Overview:

The Campus Center for Appropriate Technology (CCAT) at Humboldt State University has partnered with the fall 2014 Engineering 308 class, in order to have a plan provided with the goal for CCAT to reach Net Zero Energy (NZE) by the end of 2015. This plan provides support, recommendations, and advice for obtaining NZE. The vision is to lead CCAT to use energy in a way that does not create negative environmental, cultural, and social impacts. The mission is to plan a NZE CCAT that suits their own mission of demonstrating how easy it is to live lightly on the Earth. Throughout the course of this project, the students in Engineering 308 were performing the following tasks that would culminate on one goal of NZE:

- 1). Provide research in NZE buildings,
- 2). Provide a template for future projects,
- 3). Complete an inventory of the energy use at CCAT,
- 4). Complete an energy audit of CCAT,
- 5). Analyze the impacts of the energy use at CCAT, and
- 6). Create a plan for CCAT to reach net zero energy by the end of 2015

A net-zero building produces the same amount of energy it consumes (Appropedia, CCAT NZE study). An edifice of this type consumes no extra energy from the grid, meaning all energy consumed in the structure is created through renewables on site (Appropedia, CCAT NZE study).

Reaching net-zero can be difficult and requires changes to the way the building consumes energy. An in-depth home energy audit should be performed to identify the appliances and the energy usage in the home. This audit should also include finding ways to cut back on energy consumption and implementing useful tools in the house to help the occupants keep track of energy consumption.

Net zero energy construction and design is an efficiency oriented technique that focuses on conserving resources, conserving energy, and balancing those concepts while utilizing the highest performing appliances and systems available.

According to Marzsal et al., "The Zero Energy Building (ZEB) concept is no longer perceived as a concept of a remote future, but as a realistic solution for the mitigation of CO₂ emissions and/or the reduction of energy use in the building sector." (Appropedia, CCAT NZE study) We will be analyzing CCAT's energy use and giving the residents suggestions on how they can reduce it.

CCAT has taken the first steps towards becoming a net-zero energy by building by adopting the use of efficient appliances and a lifestyle of energy awareness and reduction. In order to achieve net-zero status the residents and club has a few areas where they can improve. The class has

provided recommendations for reaching net zero that will be low and high cost and recommendations for modifying behavior. This is one of the hardest parts for CCAT to adopt because it requires breaking habits and relearning new ones and its savings are smaller compared to larger purchases and installations.

To summarize our recommendations, we feel that CCAT directors need to play a more active role within their home and consolidate their many activities towards a long-lasting goal of becoming net-zero. Some other recommendations include: switching from the gas stove to an electric stove, installing LED lighting, and switching to a heat pump that used half the energy of a regular pump that is currently installed.

Products:

Research->http://www.appropedia.org/CCAT_NZE_study<

Inventory- See *Excel Spreadsheet*

Audit-See *Excel Spreadsheet*

Sources:

1). <http://www.sciencedirect.com.ezproxy.humboldt.edu/science/article/pii/S0378778810004639>

2). ""Net Zero Energy Project." by Ty Newell and Ben Newell. ASHRAE Journal, 52.9 (2010): 88-89."

3). <http://www.sciencedirect.com.ezproxy.humboldt.edu/science/article/pii/S0378778810004639>

CCAT NZE study. (n.d.). Retrieved December 18, 2014, from http://www.appropedia.org/CCAT_NZE_study

LOW END SOLUTIONS

Lighting Technology

-LED Lighting

Installing LED Lighting is essential for going net-zero. Led lighting is not only less harmful to the environment but also has a better efficiency than any other bulb. They lack mercury which is not something that CFLs do not. Most of the time they are made to be shatter proof so they don't break into a million harmful little pieces when they hit the floor. It is without hesitation that we recommend the LED light bulb to replace all current CFLs. The best part is that there will be no change in their light quality. The performance of LEDs is just as good if not better than any standard light bulb. For the low end we found a less costly LED replacement. The TCP LED 60w has a slightly smaller energy rating at 9.8 watts but it is sold in packs of 6, at 6 dollars a bulb for a total of \$36.00. Comparatively the price difference between the low end and high end will save almost 30 dollars with similar results.



TCP LED Light bulbs

- 5 Bedroom 1
- 5 Bedroom 2
- 6 Bedroom 3
- 2 Restroom
- 7 Living Room
- 9 Kitchen
- 1 Pantry
- 4 Hallway
- 1 Dining Room

http://www.amazon.com/TCP-LA1027KND6-LED-A19-Equivalent/dp/B00KDZGBM8/ref=sr_1_1?ie=UTF8&qid=1418527640&sr=8-1&keywords=led+light+bulbs

- Motion Sensor Light Switches

Light switches with motion sensors and would be great for the hallway, kitchen, pantry, mudroom and bathrooms. They can be relatively cheap or cost a fortune depending on what features you are looking for. Besides the initial cost the most costly part of these devices would be the installations. Without the right training one could accidently electrocute themselves so this is *not* a DIY project.

Using lights only when necessary is a big part of the plan. Changing behavior can be somewhat difficult so this can alleviate some of the pain of saving money while saving energy. Motion Sensors will not save so much on efficiency but more on the amount of usage you see per day. With lighting equivocating to a good portion of their energy bill it can make quite a difference. For our low end suggestion we have the standard Leviton Passive Infrared Wall Switch Occupancy Sensor. It is very similar to the ones you see in office buildings, hospitals, and schools. They can detect ambient light and have an automatic response of turning on only when

there is not ample light already. This is a cheap and effective addition to the LED lighting, 1 unit cost \$16.17.

Leviton Passive Infrared Wall Switch Occupancy Sensor



- Kitchen
- Hall Way
- Bathroom
- Pantry
- Mudroom

http://www.amazon.com/Leviton-PR150-1LW-Infrared-Occupancy-Residential/dp/B0007N72PG/ref=sr_1_29?s=hi&ie=UTF8&qid=1418364512&sr=1-29&keywords=motion+sensor+indoor+lighting

-Timer

In order to reach net zero, CCAT must reduce the amount of electricity used as well as the duration. Digital timers facilitate the process of using the proper amount of electricity versus using an excessive amount. One product that we suggest for a low end budget is Home Depot's 24-Hour Plug-In Big Button Timer (model #15076) priced at \$6.97 per piece. This digital timer will allow residents from CCAT to set up automated daily cycles that may be programmed in a 24 hour cycle. It is LED & CFL compatible and is very easy to set up in comparison to more complex models.

In setting up the timer, the consumers will be able to use a system where they program the timer to turn on or off after a certain amount of time or at a certain time of the day. This timer is for indoor use only and can facilitate reducing the amount of light used in the living room or kitchen area where much of the energy is used. It is also very fitting for all of the resident's bedrooms where a timed system can prevent the overuse of lights at night when there is the possibility of accidentally falling asleep before turning everything off.

One suggestion may be to have a timed system where all appliances shut down completely when it is ensured that no one will be using them.



24-Hour Plug-In Big Button Timer

- living room

http://www.homedepot.com/p/GE-24-Hour-Plug-In-Big-Button-Timer-15076/100685878?MERCH=REC_-PIPHorizontal1_rr_-100685881_-100685878_-N

-Smart Home Technology

Although a smart home, where all of the electrical devices and applications can be accessed and monitored in one overarching system, may initially sound costly, the amount of money saved from reducing the amount of energy used can easily pay it off. There are several smart home apps that are affordable and can be used to control electrical applications from wireless devices such as a cellphone, computer, or tablet. This is a convenient way for residents to keep track of their energy consumption on a daily and/or monthly basis. Users may access their power settings for their lights in order to dim them and vastly reduce their energy use or turn them off completely. They may also access other common household appliances such as devices that need to be turned off after a certain period of time such as a crockpot that sits for an extended amount of time.

An example of such an app is Conductor for Mi Lightstyle which offers the features listed above. The price of the products is \$24.99 and unlike a smart home technology system from a provider such as Vivint Home, this app does not charge on a monthly basis. This will work great with a low-end budget and provide all of the vital features that help cut back on energy use such as controlling the lighting and other common household appliances.

Conductor for Mi Light Style



- CCAT residents' android cell phones (3)

<http://appgenius.co/it/android/conductor-for-mi-lightstyle/188484/>

Total cost of low end solutions

TCP LED Light Bulb (6pack) = \$36.00 = 40 bulbs/6 = approx. 7 = \$252.00 total

Leviton Passive Infrared Wall Switch Occupancy Sensor = \$16.17 = 5 needed = \$80.85 total

24 Hour Plug-in Big Button Timer = \$6.97

Conductor for Mi Lightstyle = \$24.99 x 3 = \$74.97

Total Low End Solutions = \$414.79

Water and Space Heating Technology

It would be advantageous to purchase new forms of water and space heating that utilize highly efficient heat pump technology. Without going in to too much detail, the heat pump takes cold air from the outside and turns it into warm air by condensing it. It uses a lot less energy than the conventional way of heating air or water. The following are some suggestions from Mike Winkler.

- **General Electric Water Heater (GeoSpring \$1199 +tax):**

CCAT has something similar already to this product installed at the moment. If you want to upgrade to a newer model this is the cheapest one. Drawback: will have to go pick it up in Sacramento because they don't currently deliver to this zip code, self-installation necessary.



GeoSpring

Hybrid Water Heater

<https://www.gewaterheater.com/GEStore/Appliances/BuyOnline/Specifications?sku=GEH50DEEDSR>

- **Extra wiring is more expensive:**

To turn the boiler all the way to electric or a Heating Pump Boiler you would have to change the current wiring at CCAT to make this possible and according to Michael Winkler this would be expensive. You would need to hire a specialist to come check out the place to give us an estimate.

- **Daikin Heat Pump Heating system (\$3,910):**

This heating system can be configured to stay at a constant desired temperature. It senses when there has been no motion for 20 minutes and will turn off, which is a nice energy saving option,

however it will not compromise comfort because it can sense when someone re-enters the room and adjusts back to the user's settings.

http://ecomfort.com/mxs-series-26000-btu-tri-zone-ductless-heat-pump-system-wall-mounted-172-seer-93-hspf-95811.html?utm_source=adwordsfroogle&utm_medium=product_search&utm_campaign=adwordsfroogle&utm_content=95811&var1=ecomfortusa&var2=adwordsfroogle&var3=93396&gclid=CI-WkOemzMICFaZDMgodg1oAXQ

- Heat Pump Dryer by Whirlpool (\$1,799.00):

This uses half of the energy that a conventional dryer uses, with the similar technology to the Daikin heat pump

[http://www.whirlpool.com/laundry-1/laundry-2/dryers-3/-\[WED99HEDW\]-1022543/WED99HEDW/](http://www.whirlpool.com/laundry-1/laundry-2/dryers-3/-[WED99HEDW]-1022543/WED99HEDW/)

Total estimated heating solution cost: \$6,908

Interview with Michael Winkler (Redwood Coast Energy Authority): His recommendations for CCAT over the phone Sunday, December 14th 2014

HIGH END SOLUTIONS

Lighting Technology

-LED Lighting.

The G7 Power Incline LED 10W could work, to replace all the lighting throughout the house. Compared to an 18 watt CFL, it will save about 8 watts throughout the upstairs per light fixture. This particular LED light also comes with a 5 year warranty. It cost \$10.95 per bulb. It's stylish and has been rated through multiple other customers as being an even lighting experience with great overall performance.



G7 Power Incline LED 10W

- 5 Bedroom 1
- 5 Bedroom 2
- 6 Bedroom 3
- 2 Restroom
- 7 Living Room
- 9 Kitchen
- 1 Pantry
- 4 Hallway
- 1 Dining Room

http://www.amazon.com/G7-Power-Incline-Standard-Dimmable/dp/B00KQPMF84/ref=sr_1_5?s=hi&ie=UTF8&qid=1418363395&sr=1-5

- Motion Sensor Light Switches

A good product is the Heath Motion Activated Wall Switch. The Heath model has the ability to

choose to leave the lights on or use the motion sensor at all times. This isn't a necessity but it would mean additions to the bedrooms would be possible too. Users would have the option of having the switch off when they don't want to use the lights at all. This would mean adding 3 more on in addition to the ones that would have placed with the cheaper option for a total of 7 switches changed out. This unit costs \$21.99 but may be worth it for the comfort of the residents.



Heath Motion Activated Wall Switch

- All 3 Bedrooms
- Bathroom
- Kitchen
- Hallway
- Pantry
- Mudroom

http://www.amazon.com/Heath-Zenith-SL-6115-WH-Motion-Activated-Switch/dp/B004J0O5W6/ref=zg_bs_6291361011_8

- Solar Tubes

Solar tubes are a great way to cut down on cost by using an embedded energy free technology. Other than the actual materials of the aluminum or plastic there really isn't too much to these free light sources. They can provide enough light on a sunny day that can brighten a room through no energy use. These could save quite a bit, even used on cloudy days. There's still natural light that one may use when it's cloudy and, in combination with, photo sensors this could save watts like nothing else. There are variations of these technologies that can cost close to nothing but for our purposes we will stick with something other than the widely known variation of the water bottle solar tube which can cost someone little to no money to create. It is still an amazing money saver but we feel that for CCAT we should stick to something that would be close to 100% reliable.

The ODL Tubular Skylight, it isn't the absolute cheapest but it is big and could have a major effect. This particular solar tube can be adjusted for any roof angle and will provide a space with over 10 inches of free solar tube lighting. This unit cost \$210.58 and comes with most of the installation materials other than the actual power tools. One could do this one on their own, especially since it's being installed into the CCAT house it could save quite a bit of money to do it themselves. The ODL is rated to light a room sized at 150 square feet. It's also made with weather resistant materials.

ODL Tubular Skylight



- Kitchen
- Pantry
- Mudroom

(<http://www.amazon.com/ODL-EZ10SCANH-Tubular-Skylight-Flashing/dp/B000ETQ11O>)

-Photo sensors

Photo sensors will be a great way to regulate use of lighting and decrease the amount of excess light use when not appropriate. Photo sensors can be installed both indoors and outdoors. These sensors would be great for outdoor sheds, backyard door lighting, living room and hallways. These fixtures have light meters and sensors to control the lighting and minimize energy use. Both low and high end cost sensors lack the use of power because they are linked to the actual light switch. Therefore, power is not directly drawn. These are non-input devices which are never turned on but used 24 hours a day.

Using photo sensors is a big contribution factor to using lights only when necessary. They range in prices depending on the level of features desired. Photo Sensors can give a sense of when lights are needed and train the residence to become more aware of their natural light. This can be seen in a slight decrease of their energy bill eliminating the excess and human error of using lighting when not appropriate.

Watt Stopper LMLS-400 Switching and Dimming Closed Loop Digital Photosensor; 24 Volt DC



- Living Room
- Dining Room
- Kitchen
- Mudroom
- Hallway

(<http://www.enviroasis.com/SENS-WS-LS-301/?gclid=COiV-b-9xsICFceVfgodYl4ACw>)

-Dimmers

Dimmers are used to control the intensity of light in a room. They provide a soft environment with the desired brightness. Depending on the necessity of the user, dimmers can save a great percentage in energy consumption. Places where sometimes there is no need to use too bright lighting such as living room or bedroom can save great amounts of energy while adjusting the intensity of light depending on the user's need. Dimmers have the potential of saving 20% of the energy used for lighting; reducing the intensity of light by 25% saves 20% of energy consumption. This means more dimming is equivalent to more saving.

In places where the presence of people is constant it is better to use a dimmer instead of a motion sensor. If a person is sitting on a couch, without making any movement, the sensor may

understand that there is nobody in the place and turn the lights off. A dimmer would be adjustable for the user needs and it would save energy when possible.



Leviton 6674-P0W SureSlide Universal 150-Watt LED and CFL/600-Watt Incandescent Dimmer

- 3 - Bedrooms
- 1 - Living room
- 1 - Dining room
- 1 - Pantry
- 1 - Hallway

http://www.amazon.com/Leviton-6674-P0W-SureSlide-Universal-Incandescent/dp/B0076HPM8A/ref=sr_1_6?ie=UTF8&qid=1418609540&sr=8-6&keywords=dimmer

-Digital Timers

In order to reach net zero, CCAT must reduce the amount of electricity used as well as the duration. Digital timers facilitate the process of using the proper amount of electricity versus using an excessive amount. When making the switch to net zero the best possible timer will facilitate this process. There are several models with varying prices; usually, the more expensive digital timers will have more features that enable consumers to reduce their energy consumption. With this device, lights can be programmed to turn off as well as other common household appliances that consume significant amounts of energy. Many retailers offer a variety of models; one suggestion is Home Depot’s 15 Amp Astronomic Digital In-Wall Timer (model #ST01K) priced at \$53.24 per piece. This digital timer has the ability to be programmed in a 24 hour cycle or a 7 day cycle with up to twenty “on/off events” where cycles may be interrupted accordingly to the energy use. This digital timer has features that are more specific to the cycles of consumption and can be very useful for members of CCAT considering a student’s energy consumption patterns will vary week to week. This particular model is a self-adjusting wall switch timer that only needs to be installed once and whose settings can be modified accordingly. This timer may be used to control the lights in the entire residence including the living room and kitchen where much of the energy is consumed.

15 Amp Astronomic Digital In-Wall Timer



- living room

<http://www.homedepot.com/p/Intermatic-15-Amp-Astronomic-Digital-In-Wall-Timer-White-ST01K/205478792>

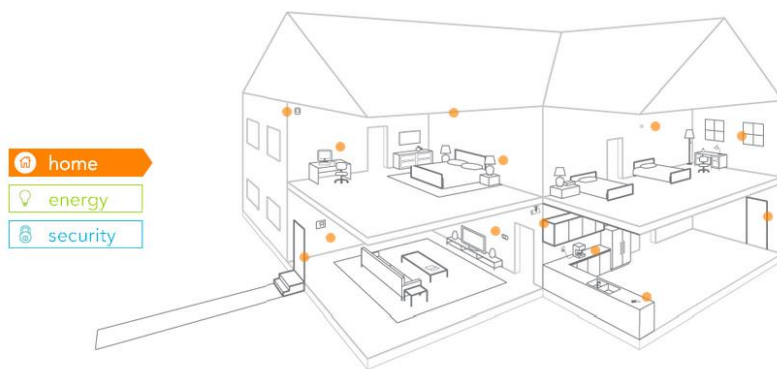
-Vivint Home

Smart home technology is a vital component when striving to make the transition to being net zero. CCAT residents will be able to control the usage of lighting more efficiently than just a timed lighting system, as well as have accurate figures that reflect their actual energy consumption levels. Smart home technology is an essential all-in-one system that allows consumers to monitor all of the devices in their home including lights, the thermostat, and all other appliances that are powered by electricity.

Vivint Home is a smart home technology provider that strives to provide affordable solutions to managing energy consumption. Rates start as low as \$53.99/month over a 48 or 60 month agreement and a \$99 activation fee. This package includes a touchscreen panel that connects all devices in the residence including high energy consuming devices and the thermostat which is included. There is also a small appliance control which enables users to turn on or off any devices that plug into electrical outlets such as musical instruments, personal fans, etc. This will be particularly useful for devices in CCAT that need to be turned on for long periods of time but do not have a set time as to when they need to be turned off; examples of this include many of the appliances in the kitchen such as the crockpot or the dehydrator.

Vivint Home

- living room



http://www.vivint.com/?mkwid=s05kvUjEG|pcrid|47795324637|pkw|vivint|pmt|p|pdv|c&mm_campaign=B10747813A0932B7D30A8870728337C0&utm_source=google&utm_medium=cpc&utm_term=vivint&utm_campaign=National+%28Brand%29+-+EC&c_ps=s.google_k.vivint_m.p_n.g_po.1t1_ex_d.c&adid=47795324637&exid=117159&keyword=vivint&gclid=CPrs64SXx8ICFZFefgodXYsA-A

Stove-Oven-Range Light Bulb:

LED stove oven-range light bulb.

Stove-Oven-Range Light Bulb: Cost \$15.23



[Untitled photograph of a Stove-Oven-Range light bulb]. Retrieved December 14, 2014, from: <http://www.ebay.com/itm/LED-Replacement-for-Stove-Oven-Range-Light-Bulb-WB08X10028-ZV30SF1SS-/290675271667>

Cost :

G7 Power Incline LED 10W = \$10.95 per bulb x 40 bulbs total = \$438.00 Total

Heath Motion Activated Wall Switch = \$21.99 = 8 needed = \$175.92 Total
ODL Tubular Skylight = \$210.58 = 1 Kitchen, 1 Pantry, 1 Mudroom = \$631.74 total
Watt Stopper LMLS-400 = \$ 161.37 = 5 sensors = approx. \$806.85 total
Dimmers = \$ 17.97 per unit * 7 units = \$ 125.79
Vivint Home (48 months) + installation = \$53.99(48) + \$99 = \$2,690.52
Stove-Oven-Range Light Bulb: Cost \$15.23
Total High End Solutions =\$4884.05

-Solar Possibilities

With an assumed average monthly energy demand of 500 kWhs, CCAT will need 9 additional 300W solar PV panels to achieve net-zero. When better, month-specific data is available; this spreadsheet will be able to produce more accurate estimations of the number of needed panels. Constraints of rooftop space are also worth mentioning. Assuming two square meters per panel, CCAT will need 18 square meters *additional* roof space. Judging from the Google satellite image, CCAT doesn't have this available. At the current estimated energy demand levels, CCAT will have to give up some landscaping space or come up with a creative solution, perhaps getting the panels mounted on a nearby building instead.

The current values are expected to change when better data is available. This could very well solve the space constraint problem, so there's not much reason to worry about it until we have monthly estimates available.

Cooking Technology

Options include; changing the gas oven for an electric oven and adding some more solar panels to connect to the new oven or to improve the actual oven that they have.

-Solutions

One solution is to exchange the gas oven for an electric oven. The electric oven costs more; another recommendation is to add a solar panel to the roof in order to generate energy for the oven.

- Technologies and Behaviors

Investing in new more efficient electric appliances and appliances that use what the house produces

-Refrigerator

the Liebherr CS 2060, CS 2061, CS 2062

Cost: \$5,200

- Induction stove

Highest overall rated stove

Cost: \$2,000

Induction stove (\$1,104): heats using magnetism to heat cookware, remains cool to the touch when on. It cooks things much faster as well which saves time and amount of energy it takes to cook things.

http://www.searsoutlet.com/d/product_details.jsp?pid=105835&mode=buyUsedOnly&sid=IDx20110411x000008&ci_src=17588969&ci_sku=21596238

-Induction Cooktop Hotplate:

7” portable induction cooktop burner. 7 levels of power to deliver efficient heating.

Induction Cooktop Hotplate: Cost \$44.99



[Untitled photograph of a induction cooktop hotplate]. Retrieved December 14, 2014, from: http://www.bestbuy.com/site/elite-platinum-7-portable-induction-cooktop-burner-black/1857621.p?id=1219066207760&skuId=1857621&ref=06&loc=01&ci_src=14110944&ci_sku=1857621&extensionType=pla:g&s_kwid=PTC!pla!!65997392903!g!!46569441399&kpid=1857621&k_clickid=63b8db43-aa3e-bfe9-1a62-00003cd634f8&kpid=1857621&lsft=ref:212,loc:1&ksid=63b8db43-aa3e-bfe9-1a62-00003cd634f8&ksprof_id=13&ksaffcode=806&ksdevice=c

Sunfocus® 3 in 1 Solar Electric Oven:

Temperatures range up to 375 F. 3 in 1 design: solar oven, electric oven, and slow cooker.

Sunfocus® 3 in 1 Solar Electric Oven: Cost \$499



[Untitled photograph of a 3 in 1 solar electric oven]. Retrieved December 14, 2014, from: <http://www.amazon.com/Sun-BD-Corp-SFSEO1-Sunfocus%C2%AE/dp/B00AXP92EW>

Total Cost:

Approximately \$8243.99

Miscellaneous Technologies

- Solar Powered Ceiling Fan

A solar panel is wired directly to the fan so that the more sun the solar panel gets the faster the fan spins.



[Untitled photograph of a Solar powered ceiling fan]. Retrieved December 14, 2014, from: <http://www.gogreensolar.com/products/solectric-eco-breeze-solar-powered-ceiling-fan>

-Generator Solar Laptop Charger

Voltaic generator solar laptop charger, includes V72 battery and 17.6 Watt solar panel. Efficiently powers laptops, cell phones, cameras, tablets, and most other handheld electronics.



[Untitled photograph of a Generator solar laptop charger]. Retrieved December 14, 2014, from: <http://www.voltaisystems.com/generator>

-ALLPOWERS (Used for laptop, camera, etc)

18V 14W Solar Laptop Panel Charger.



[Untitled photograph of a solar laptop charger]. Retrieved December 14, 2014, from: http://www.amazon.com/Christmas-ALLPOWERS-Technology-Blackberry-Bluetooth/dp/B00G6C5NR6/ref=sr_1_5/186-5404476-2124827?ie=UTF8&qid=1418416330&sr=8-5&keywords=solar+charger+for+laptop

-32" Samsung Smart TV

LED H6350 Series Smart TV-32''



[Untitled photograph of a 32" Samsung smart TV]. Retrieved December 14, 2014, from: <http://www.samsung.com/us/video/tvs/UN32H6350AFXZA>

-Eton Rukus Solar Portable Bluetooth Sound System

Built-in solar panel charges the sound system throughout the day for use. It delivers 14 Watts of powerful stereo sound.



[Untitled photograph of a Eton Rukus Solar portable bluetooth sound system]. Retrieved December 14, 2014, from: http://www.frys.com/product/7583336?source=google&gclid=CMfLq9yUx8ICFYU_aQodAxcAVw

-Timex Solar-Powered Alarm Clock

Built-in solar cell powers the clock from sunlight and the battery takes over in the absence of light



[Untitled photograph of a Timex solar-powered alarm clock]. Retrieved December 14, 2014, from: <http://www.walmart.com/ip/23143653?www=true&productRedirect=true>

-Bonjour Maximus 8-Cup French Press:

Use for coffee or tea. Eliminates the energy used from a coffee machine.



[Untitled photograph of a Bonjour Maximus 8-cup French Press]. Retrieved December 14, 2014, from:http://www.williams-sonoma.com/products/8260424/?catalogId=68&sku=8260424&cm ven=Google PLA&cm cat=Shopping&cm pla=default&cm ite=default&gclid=CjziusL_xslCFcyMgodUIAfg&kwid=products-plaid

-French Press (\$49.00): The current way of making coffee uses a lot of energy at CCAT. In order to save this energy you could boil water on the induction stove and use a large French press. The link below has a 51 oz model.

<http://www.amazon.com/Bodum-Chambord-French-Coffee-Chrome/dp/B00005LM0T>

Cost:

- Solar Powered Ceiling Fan: Cost \$299
- Generator Solar Laptop Charger: Cost \$399
- ALLPOWERS (Used for laptop, camera, etc): Cost \$65.99
- 32" Samsung Smart TV: Cost \$599.99
- Eton Rukus Solar Portable Bluetooth Sound System: Cost \$149.99
- Timex Solar-Powered Alarm Clock: Cost \$17.99
- Bonjour Maximus 8-Cup French Press: Cost \$49.95

Total cost of Miscellaneous Technologies: \$1581.91 plus tax.

Behavior Modifications:

CCAT has taken the first steps towards becoming net-zero energy by adopting the use of efficient appliances and a lifestyle of energy awareness and reduction. This is one of the hardest parts for CCAT to adopt because it requires breaking habits and relearning new ones and its savings are smaller compared to larger purchases and installations.

To summarize, we feel that CCAT directors need to play a more active role within their home and consolidate their many activities towards a long-lasting goal of becoming net-zero.

-The directors need is a monthly time to review the energy bill

One method that would also work is to install an electronic meter in a place where energy consumption can be regularly monitored (more information available; <http://www.theenergydetective.com/>).

-To be energy savers the directors need to be energy conscious

They need to know which appliances use the most and how they can limit phantom watts, and excessive use. According to several studies, having an **energy monitor** is a simple step shown to reduce energy by 10-15%.

-Initial Assessment

A few members had the chance to go to a home energy workshop at Redwood Coast Energy Authority and CCAT might consider their services (Blower Door Test, Duct Blaster, Combustion Gas Analysis) \$300-400.

-Following an Assessment

Residences may make specific updates in their home based on a point system and receive rebates up to \$6,500; see EnergyUpgradeCA.org for more info. This assessment would find building and duct leak points and other inefficiencies in the building.

-Weatherization

Updates to your home can create savings around 5-30 % (<http://energy.gov/public-services/homes/home-weatherization>). There are some simple ones which you could do for less than a hundred dollars to improve building insulation and heating efficiency: additional insulation in attic (including cavity carrying wires into home) as well as foam weatherization strips, caulking, and *Great Stuff* for sealing doors, windows (especially double doors downstairs), and any openings to outside (vents, etc.). Window curtains are another option to improving drafty windows and improving R-Value. The “cooler” in kitchen is letting lots of outside air into the home and the directors should consider reevaluating this project and others which compromise the building envelope. Additional products recommended are motion sensors and timers on appliances that are used around the same time, often. (For example: televisions, computers, cell phone chargers.)

-How you spend your time at CCAT.

Delegating electronic “quiet hours” say 12-5am where electronics must be off. Use of Christmas lights and only one bulb per fixture instead of three for saving electricity and it would be best to keep on following these habits. We feel that shower timers are another way of being accountable for hot water usage and that directors are using equal amount.

-Use During Workshops

Try scheduling more of them for daytime hours when less electrical lighting is needed we also feel this might draw more attention and use to CCAT when students are on campus.

-Consolidating projects and appliances past and present at CCAT.

It will not be possible to become net zero with older or inefficient products. Downstairs, it seemed there were many duplicate, outdated, or unused products (computers, radios, lamps, hot plate, chargers, etc.) All the broken appliances and projects that are not being used, could be recycled, upcycled, or fixed in order to be more aware of how much electricity is being used.

-Downstairs Closets

An entire downstairs closet has been devoted to gardening equipment, pots, and accessories; the problem is that moving things indoor/outdoor brings pests and dirt with them, which requires more energy to move back and forth and to clean. The maintenance closet was a “fire hazard” to walk through because stuff was everywhere.

Ways to resolve this involves:

- 1) free the garden closet and organize the maintenance closet
- 2) inventory what is being used and what can be recycled/ scrapped
- 3) enjoy the extra space and money for energy saving fun!

-Space Lighting

CCAT has several of lights per room, every bedroom has 4 lights, the hallway has 4 lights, and the living room and kitchen has 6. Reduce the amount of light bulbs per room and use a single and stronger light will reduce the energy consumption considerably. One LED light equivalent to a 60W incandescent bulb is enough to illuminate a single bedroom. As the residents said they only turn the lights of the bedrooms a few minutes before sleeping, a stronger light wouldn't be necessary. Hallways don't need much lightening, as the only purpose to turn its lights on is to be able to watch where you are going. A single light for the hallway would also be sufficient. As the residents spend too much time in the living room, and most likely studding, more than one light could be appropriate. The kitchen should also have only one light, as there is already a light for the stove, where more caution is necessary.

-Sources

- 1)"Behavior and Energy" K. Carrie Armel. Precourt Institute for Energy Efficiency. Stanford School of Medicine.
- 2)"The Effects of Household Characteristics and Energy Use Consciousness on the Effectiveness of Real Time Energy Use Feedback" . Daisy Allen and Kathryn Janda, Oberlin College. 2006.
- 3)<http://energy.gov/public-services/homes/home-weatherization>
- 4)<http://www.theenergydetective.com/>

5)<http://www.homedepot.com/p/Lutron-Maestro-2-Amp-Single-Pole-Occupancy-Sensing-Switch-White-MS-OPS2H-WH/203202128?N=5yc1vZc32r>)

Summary of changes in Excel sheet:

UPSTAIRS - Low Solutions

- Bedroom 1 ceiling lights reduced 3 to 2 bulbs
- Bedroom 1 cellphone charger use hours reduced 8 to 6 hours
- Bedroom 2 ceiling lights reduced 4 to 2 bulbs
- Bedroom 2 television use hours reduced 3 to 2.5 hours
- Light wattage reduced to 9.8 in bedroom 1, 2, 3, restroom, living room, kitchen, pantry, hall, dining room
- Bedroom 3 laptop charger reduced hours used 4 to 3.5 hours
- Bedroom 3 ceiling lights reduced 4 to 3 bulbs
- Living room subwoofer changed to 50 watts
- Living room stereo, subwoofer, and printer on a power strip to negate phantom loads
- Living room stereo and subwoofer used 2.5 hours rather than 3 and 6 days a week rather than 7
- Kitchen lights reduced from 4 to 6 bulbs
- Pantry light 2 to 1 bulbs
- Hall light 4 to 1 bulbs
- Dining room music speaker reduced 3 to 2.5 hours
- Stove reduced from 1 hour to 50 minutes

DOWNSTAIRS - Low Solutions

- Lights reduced to 7.5 watts

OUTSIDE - Low Solutions

- Power drill, circular saw, belt sander reduced from 3 to 1 hours used
- Shopvac reduced from 3.5 days to 2 days
- Lights on house exterior reduce to 7.5 watts

UPSTAIRS - High Solutions

- Bedroom 1 ceiling lights reduced 10 to 7.5 watts
- Bedroom 1 lamp reduced 19 to 7.5 watts
- Bedroom 1 lamp reduced 42.5 to 10 to 7.5 watts
- Bedroom 1 cell phone charger reduced to 0 watts
- Bedroom 1 laptop charger reduced to 0 watts
- Bedroom 1 hours of light reduced from 0.33 to 0.25 hours
- Bedroom 1 cell phone charger reduced from 8 hours to 2 hours use
- Bedroom 2 ceiling lights reduced 17 to 10 to 7.5 watts
- Bedroom 2 lamp reduced 12.1 to 10 to 7.5 watts
- Bedroom 2 laptop charger reduced to 0 watts
- Bedroom 2 cell phone charger reduced to 0 watts
- Bedroom 2 television reduced from 105 to 88 watts
- Bedroom 2 printer reduced from 14 to 0 watts
- Bedroom 2 alarm clock reduced to 0 watts
- Bedroom 2 ceiling lights reduced 0.75 to 0.5 hours
- Bedroom 2 lamp reduced 0.54 to 0.25 hours
- Bedroom 2 cell phone charger reduced to 2 hours used
- Bedroom 2 computer speakers reduced from 1 to 0.25 hours used
- Bedroom 2 television reduced from 3 hours to 0.5 hours
- Bedroom 3 desk Lamp 13 to 10 to 7.5 watts and 1.5 to 1 hours
- Bedroom 3 Closet Light 17 to 10 to 7.5 watts and 0.29 to 0.1 hours
- Bedroom 3 Fan 14 to 0 watts and 1.5 to 1 hours
- Bedroom 3 Laptop Charger 68.5 to 0 watts
- Bedroom 3 Radio 5 to 0 watts
- Bedroom 3 Ceiling Lights 17 to 10 to 7.5 watts and 1.8 to 1.6 hours
- Bedroom 3 Camera Charger 4.3 to 0 watts
- Bedroom 3 Phone Charger 5 to 0 watts
- Bedroom 3 iPod Charger 1 to 0 watts 8 to 4 hours
- Bedroom 3 Alarm Clock 2 to 0 watts
- Living room ceiling lights 17 to 10 to 7.5 watts and 5 to 4 hours
- Living room fan 6 to 0 watts and 4 to 3 hours
- Living room lights 17 to 10 to 7.5 watts
- Kitchen Ceiling Lights 17 to 10 to 7.5 watts and 4 to 3 hours
- Kitchen Toaster Oven 930 to 0 watts
- Kitchen Stove Fan 190 to 0 watts and 2 to 1 hours
- Kitchen Stove Light 23 to 10 to 7.5 watts and 2 to 1 hours
- Kitchen Coffee Pot 675 to 0 watts
- Kitchen Pantry Light 17 to 10 to 7.5 watts
- Kitchen Crockpot 292 to 0 watts
- Pantry lightbulb 18 to 10 to 7.5 watts
- Hall ceiling lights 17 to 10 to 7.5
- Dining room ceiling light 20.5 to 10 to 7.5 watts and 1.5 to 1 hour

- Dining room landline phone 0.75 to 0 watts and not used
- Stove 14000 to 0 BTU/hour

DOWNSTAIRS - High Solutions

- Meeting room LED lights at 7.5 watts used for 2 hours
- Meeting room String lights reduced to 0 hours used
- Meeting room LED desk lamp at 7.5 watts
- Restroom LED lights at 7.5 watts for 1 hour
- Restroom compost vent used for 0.25 hours
- Mechanical room LEDs at 7.5 watts
- Mechanical room washing machine used for 0.33 hours
- Mechanical room clothes dry rack, air dry clothes as much as possible
- Office LEDs at 7.5 watts
- Office induction cook top at 800 watts
- Office lamp LED at 7.5 watts
- Composting Room LED at 7.5 watts

OUTSIDE - High Solutions

- Toolshed Eton rukus sound system at 160 watts
- Toolshed Clip-on Solar Cell Fan at 0 watts
- House exterior all lights are LEDs at 7.5 watts