# JCCC SPACES

## Solar Power Appointed Consumer Electronic Stations

Taylor L. Hall Zero1.Advantage@gmail.com

## An Introduction

Walk through any hall, lobby, or willing space outside and there will be no shortage of students with a laptop or cell phone. It is the inevitability of our age. We find ourselves reliant on these devices and they greatly improve our lives; in this circumstance our ability to educate and learn. With that, we have to charge the batteries of these devices more frequently. I use my laptop a significant amount on campus and subsequently need to charge it on site. The costs of utilities are unforgiving, and continuing to increase; Johnson County Community College (JCCC) is victim to the same high costs as any other residence, business or organization. Solar Powered Appointed Consumer Electronic Stations (SPACES) provide the opportunity to cut costs of electricity, by providing solar energy for students to charge their mobile devices.

## SPACES Unit

Solar power is a source of energy that everyone knows about, but is rarely implemented. It is true that the cost to fully implement solar power/energy is comparatively high, as opposed to just "tapping in" to the common power grid. A good quote to recall while reading this proposal, as Benjamin Franklin simply stated, "A penny saved, is a penny earned". We do not need to spend hundreds of thousands of dollars in order to fully employ solar power on campus.

Imagine a beautiful spring early afternoon, the sun high in the sky in an open courtyard of JCCC. A table with solar panels elevated by a post looms over the students gathered around it. The SPACES units enable students to socialize, study, and charge their electronic devices; free from the costs of the outlets scattered throughout the halls of the college. A SPACES unit entails a commercial outdoor picnic table and module next to it. This module holds solar charged batteries, a power inverter, other miscellaneous electronics inside the unit, and most importantly solar panels elevated at a safe height above the table.

From the start we are confronted with vast choices, but perhaps a table made up from recycled materials since we are themed with sustainability. Resinwood has caught on with a few manufacturers, made up entirely of recycled plastics; the overall product remains aesthetically sound. Here is a display of a picnic table built with Resinwood, displayed on the website Parknpool.com.

(Parknpool.com)

Placed beside the table would be the focus of our project. A tower approximately twelve inches deep and eighteen inches wide at the base, as the structure rises from the ground at waist height. Positioned to the right would hold educational material for any passerby. Included information could range from information on the SPACES, to a list of sustainable ideas that readers could implement around their home. The remaining structure along the left side would continue up to head height encapsulating a post that would continue skyward to a safe height of approximately 12 feet. At which point two solar panels would hang over and send power down to the SPACES unit and educational environment below. Inside the SPACES would hold a power inverter, a charge controller, and pack of commercial batteries to retain temporary electricity. The free energy would then flow out of the unit and through the wiring safely diverted through one of the resin boards, then up to an exterior grade power strip where students would charge their laptops while doing any necessary research.

## Research

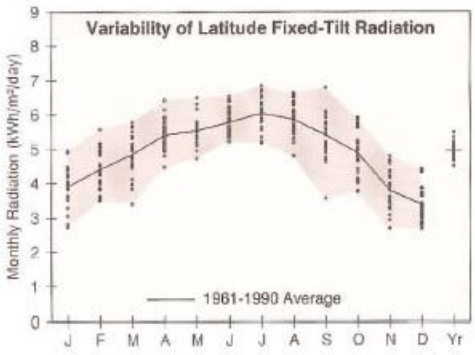
One thing to consider is the sun-hours in a day, which is a variable due to time of day and season. NREL is the National Renewable Energy Laboratory, and supply a large quantity of information regarding solar energy. Below is a chart of solar readings regarding sun-hours taken in Topeka, Kansas (nearest city by longitude and latitude).

**Topeka, KS**

**WBAN NO. 13996**

LATITUDE: 39.07° N
LONGITUDE: 95.63° W
ELEVATION: 270 meters
MEAN PRESSURE: 985 millibars

STATION TYPE: Secondary

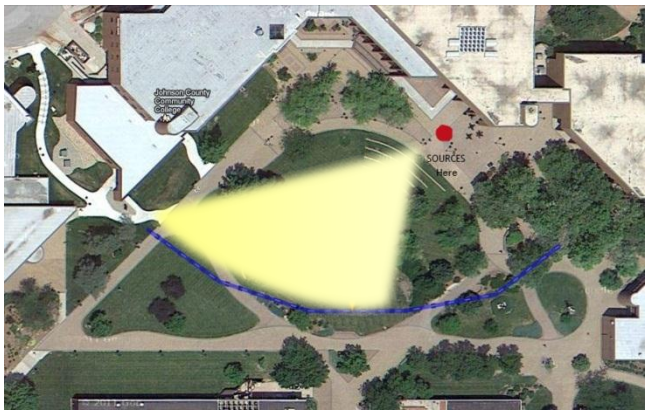



Solar Radiation for Flat-Plate Collectors Facing South at a Fixed Tilt (kWh/m²/day), Uncertainty ±9%

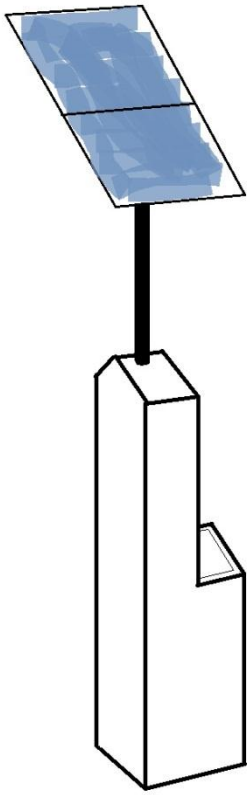
| Tilt (°) | | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | Year |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Average | 2.3 | 3.0 | 4.0 | 5.1 | 5.9 | 6.5 | 6.6 | 5.8 | 4.6 | 3.5 | 2.4 | 1.9 | 4.3 |
| | Min/Max | 1.8/2.6 | 2.6/3.6 | 3.0/4.6 | 4.3/6.0 | 5.1/6.8 | 5.8/7.3 | 5.7/7.5 | 4.8/6.4 | 3.3/5.6 | 2.9/4.1 | 1.9/2.8 | 1.7/2.3 | 4.1/4.7 |
| Latitude -15 | Average | 3.4 | 4.0 | 4.7 | 5.5 | 5.9 | 6.3 | 6.5 | 6.1 | 5.3 | 4.6 | 3.4 | 2.9 | 4.9 |
| | Min/Max | 2.5/4.2 | 3.3/5.0 | 3.4/5.6 | 4.6/6.5 | 5.1/6.9 | 5.7/7.2 | 5.6/7.4 | 5.0/6.9 | 3.6/6.6 | 3.6/5.4 | 2.5/4.2 | 2.4/3.8 | 4.5/5.4 |
| Latitude | Average | 3.9 | 4.4 | 4.9 | 5.4 | 5.5 | 5.8 | 6.0 | 5.9 | 5.4 | 4.9 | 3.8 | 3.4 | 4.9 |
| | Min/Max | 2.7/4.9 | 3.5/5.6 | 3.4/5.8 | 4.5/6.4 | 4.7/6.5 | 5.2/6.5 | 5.2/6.8 | 4.8/6.6 | 3.6/6.8 | 3.8/5.9 | 2.7/4.8 | 2.7/4.4 | 4.5/5.5 |
| Latitude +15 | Average | 4.2 | 4.5 | 4.7 | 5.0 | 4.9 | 5.0 | 5.3 | 5.3 | 5.2 | 4.9 | 4.0 | 3.6 | 4.7 |
| | Min/Max | 2.9/5.3 | 3.5/5.8 | 3.3/5.7 | 4.1/5.9 | 4.2/5.8 | 4.6/5.6 | 4.5/6.0 | 4.3/6.0 | 3.4/6.6 | 3.7/6.0 | 2.8/5.1 | 2.8/4.8 | 4.3/5.3 |
| 90 | Average | 3.9 | 3.9 | 3.5 | 3.1 | 2.6 | 2.5 | 2.6 | 3.1 | 3.6 | 4.0 | 3.5 | 3.4 | 3.3 |
| | Min/Max | 2.6/4.9 | 2.9/5.0 | 2.4/4.2 | 2.6/3.6 | 2.4/3.0 | 2.3/2.6 | 2.3/2.9 | 2.6/3.4 | 2.3/4.5 | 2.9/4.9 | 2.4/4.6 | 2.5/4.6 | 2.9/3.7 |

(NREL Renewable Resource Data Center Website)

The average sun-hours in a year for this area are just under 5 hours each day, and the peak hours being in the afternoon. If the first SPACES unit is placed in the courtyard south east of the student center, it would be ideally placed because of the skyline allowing sunlight and taking advantage of the peak hours in the afternoon.

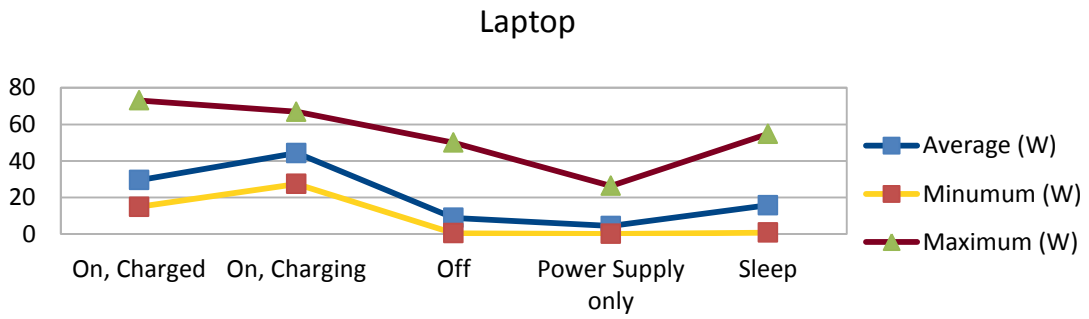

(Satellite image from Maps.Google.com)

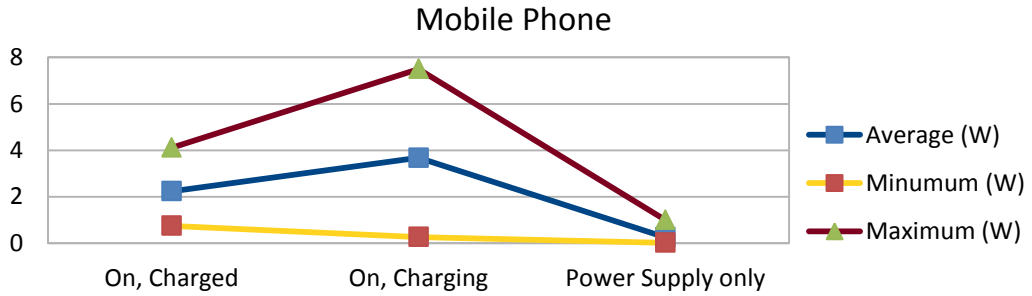


## Benefit to Campus

Whether a student is waiting on their next class, or studying on campus due to available study resources; laptop usage on campus is a necessity. To determine the impact on power usage, I referenced to Lawrence Berkley National Laboratory's data on power usage.

| Product/Mode | Average (W) | Minumum (W) | Maximum (W) |
|---|---|---|---|
| **Mobile Phone** | | | |
| On, Charged | 2.24 | 0.75 | 4.11 |
| On, Charging | 3.68 | 0.27 | 7.5 |
| Power Supply only | 0.26 | 0.02 | 1 |
| **Laptop** | | | |
| On, Charged | 29.48 | 14.95 | 73.1 |
| On, Charging | 44.28 | 27.38 | 66.9 |
| Off | 8.9 | 0.47 | 50 |
| Power Supply only | 4.42 | 0.15 | 26.4 |
| Sleep | 15.77 | 0.82 | 54.8 |



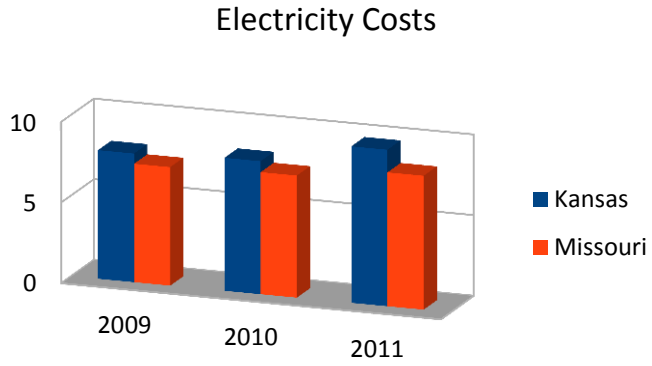
If a SPACES unit table is filled with six individuals, each charging and using their laptops, as well as mobile phones, the maximum total Wattage draw would amount to 446.4 Watts, according to the Lawrence Berkley chart. The next step entails the formula for determining the cost of power used by the devices:

$$\frac{\text{Watts} \times \text{Hours used}}{1000} \times \text{Cost of electricity per kWh} = \text{Total Cost}$$

Now we only need to determine the costs of electricity. The cost of electricity has greatly risen in the last three years in both Kansas and Missouri. At this rate, if the cost of electricity continues to rise, we will need to create an alternative method to power these small devices. The following data is an accumulation of three different sources on electricity costs in the last three years:

Electricity Costs in the last three years

| | cents per kWh | |
|---|---|---|
| | Kansas | Missouri |
| 2009 | 7.98 | 7.35 |
| 2010 | 8.25 | 7.57 |
| 2011 | 9.7 | 8.3 |

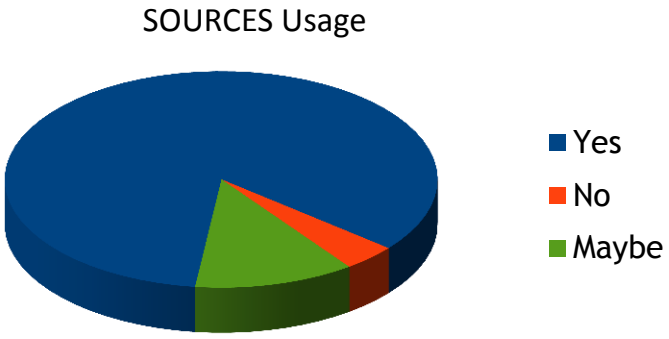



Now we can put the formula together with all of our data.

$$\frac{446.4\ \text{W} \times 4.9\ \text{(Peak hours)}}{1000} \times \$0.097\ \text{(Cost of electricity in 2011)} =$$

The equation results in $0.21 each day, which doesn't seem like much initially. Considering that equation is using last year's electricity prices, and though this year's prices are unavailable, it appears that the prices have yet again increased. That amounts to over seventy-five dollars a year for just one table of students. Take in to account the thousands of JCCC students, a few SPACES units placed around campus could positively impact the utility budget.

In a short survey performed on campus, to find out if students would implement my idea into their routine. I asked, "What is the likelihood of you using a solar powered station to charge your mobile device as opposed to anywhere else on campus?" Twenty one out of twenty five randomly selected JCCC students said yes, definitely, or "heck yeah." One student said no, they felt it wouldn't be convenient to walk across campus just to charge their device for a short time, and three students were neutral on the concept.




One foreign exchange student who I happened upon was thrilled at the concept of a SPACES unit when I briefly explained it. She told me that the same technology is implemented for the "small things" in her home country of Austria.

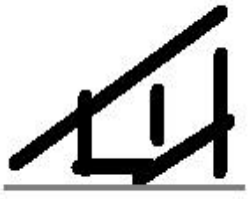
## Cost of a Unit

And now we need only to determine the rough estimate for one of these environmentally friendly units. In any project there is always room for the unforeseen, but there are not many components that comprise a SPACES unit.

| Item | Quantity | Cost | Description |
|---|---|---|---|
| **ResinWood Picnic Table** | | $830.95 | Picnic Table |
| **Sunforce 130 Watt** | 2 x | $699.99 | Solar Panels |
| 4 x 8 - 1/4" Sheet steel | | $146 | Body of Unit |
| 12V 1000 Watt Inverter | | $959.00 | Inverter |
| 12, 24, 48V Controller | | $145 | Charge Controller |
| 200aH 6V DC Battery | 2x | $250.00 | Batteries |
| Wiring, Paint, etc. | | $100 | |
| | | | |
| Est. Total | | $4,080 | |

## Conclusion

A SPACES unit contributes in more ways than one. It helps Johnson County Community College regarding the budget spent on electricity. Every student who chose to charge with solar energy would be positively contributing to the environment by reducing the amount of pollution produced by power plants. The educational material supplied at each unit broadens student awareness of sustainability. Most importantly we must remember: big things start small.

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