Saving Olivet Money *With* Creation Care

Nicholas Boros

Scholar Week

April 16, 2018
“God allows us the low points of life in order to teach us lessons that we could learn in no other way.” – C.S. Lewis
Motivation

The current decisiveness in politics and society, convince us that most things are binary:

Pro-Life or Pro-Choice
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Pro-Creation Care or Pro-Financially Responsible
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Pro-Creation Care or Pro-Financially Responsible
1. Very big ways of saving money at Olivet with creation care.
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2. Small ways of saving money at Olivet with creation care.
1. Very big ways of saving money at Olivet with creation care.
2. Small ways of saving money at Olivet with creation care.
3. Low hanging fruit: Creation care that has a very small cost, yet a big impact.
1. Solar Panels

Google Project Sunroof:
- Type in address
- How many solar panels are best?
- Where to place them?
- How many hours of sunlight per year?
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- Type in address
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Burke Administration Building:

Comparison with residential homes.
1. Solar Car Ports

Figure: Michigan State University solar carport project completed on December 20, 2017.
1. Solar Carports: Proposal

What if we also did solar carports here at ONU?

*Google Project Sunroof* can be used to

- count the number of viable parking spots on campus
- estimate the number of hours of sunlight per year
1. Solar Carports: Sanity Check

Solar panels in Illinois? Maybe in Texas... by they can’t make sense here.

Figure: From Wikipedia.
1. Solar Carports: Calculation

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of Parking Spots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burke parking lot</td>
<td>205</td>
</tr>
<tr>
<td>Admissions and Shine parking lot</td>
<td>87</td>
</tr>
<tr>
<td>Chapel parking lot</td>
<td>598</td>
</tr>
<tr>
<td>Weber and Warming House parking lots</td>
<td>370</td>
</tr>
<tr>
<td>Baseball Diamond parking lot</td>
<td>315</td>
</tr>
<tr>
<td>Miller parking lot</td>
<td>22</td>
</tr>
<tr>
<td>LaVasseur Square parking lot</td>
<td>111</td>
</tr>
<tr>
<td><strong>Total on main campus</strong></td>
<td><strong>1,688</strong></td>
</tr>
</tbody>
</table>

Parking spots are 9 ft $\times$ 18 ft, totaling to about 273,456 ft$^2$. 
1. Solar Carports: Calculation

Canadian Solar panels:

- Measure about 17.62 ft$^2$, so we would need about 15,519 solar panels.
- Can generate 0.325 kW each.
- Cost about $310.00 each.

Solar array would be able to output

\[(15,519)(0.325\text{kW}) = 5043.7\text{kW}.\]
1. Solar Carports: Calculation

Not optimal south angle: Output = 5043.7kW − 10% = 4539.33kW

Figure: Michigan State University solar carport project completed on December 20, 2017.
Solar array can generate approximately

\[
(0.8)(1400 \text{ hrs sunlight/yr})(4539.3\text{kW}) = 5,084,016\text{kWh/yr}.
\]

* Solar array in Ireland had 20% loss from “array capture losses, system losses, cell 385 temperature losses, soiling and degradation”
1. Solar Carports: Calculation

Cost of solar panels
\[= (0.75)(15,519 \text{ solar panels})($310.00) = $3,608,167\]

Cost of carports
\[= (0.75)(1688 \text{ pk. spt.})(1300 \text{ carport/pk. spt.}) = $1,645,800\]

Connect to grid (including inverters)
\[= (5,084,016 \text{ kWh/yr}) \left( \frac{2.5 \text{ million}}{15,000,000 \text{ kWh/yr}} \right) = $847,336\]

Cost of setting up carports = $847,336

Total cost = $6,948,639
1. Solar Carports: Calculation

Break even analysis?

Solar carport array generates = 5,084,016 kWh/yr.

We could save = $508,402/yr (assuming that we pay $0.10/kWh)

Break even time = \frac{$6,948,639}{$508,402} = 13.7 \text{ years.}

After break even point, we would be saving $508,402/yr.
What if instead, or in addition to, we installed solar panels on the roofs of campus buildings here at ONU?

Google Project Sunroof can be used to
- count the annual hours of sunlight for each building
- estimate the size (in square feet) of the solar panels for each roof
1. Solar Panels on Roofs: Proposal

Differences from solar carports:
1. Facing south at optimal fixed angle on roof (no 10% loss)
2. Lower mounting and labor costs vs. carports
3. No possible aesthetic concerns

Figure: From Energy Sage
Cost of solar panels
\[ = (0.75)(22,408 \text{ solar panels})(\$310.00) = \$5,041,800 \]

Cost of mounting
\[ = (22,408 \text{ panels})(\$100/\text{panel}) = \$2,240,800 \]

Connect to grid (including inverters)
\[ = (8,195,852 \text{ kWh/yr}) \left( \frac{\$2.5 \text{ million}}{15,000,000 \text{ kWh/yr}} \right) = \$1,365,975 \]

Cost of setting up mounting
\[ = \frac{1}{3} \cdot \$1,365,975 = \$455,325 \]

Total cost
\[ = \$9,103,900 \]
1. Solar Panels on Roofs: Calculation

Break even analysis?

Solar roof array generates = 8,195,852 kWh/yr.

We could save = $819,585/yr (assuming that we pay $0.10/kWh)

Break even time = \frac{\$9,103,900}{\$819,585} = 11.1 \text{ years.}

After break even point, we would be saving $819,585/yr.
1. Solar Panels: Carport vs. Rooftop

<table>
<thead>
<tr>
<th></th>
<th>Carport</th>
<th>Rooftop</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upfront Cost</td>
<td>$6,948,639</td>
<td>$9,103,900</td>
<td>$16,052,539</td>
</tr>
<tr>
<td>Break Even</td>
<td>13.7 yrs</td>
<td>11.1 yrs</td>
<td>≈ 12 yrs</td>
</tr>
<tr>
<td>Savings after B.E.</td>
<td>$508,402/yr</td>
<td>$819,585/yr</td>
<td>$1,327,987/yr</td>
</tr>
</tbody>
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Wait... Inverters are warrantied for 12 yrs, with extendable warranties for 20 or 25 yrs. Replacement cost?

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</tr>
<tr>
<td>Savings after B.E.</td>
<td>$397,958/yr</td>
<td>$705,809/yr</td>
<td>$1,103,767/yr</td>
</tr>
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Sanity Check: Break even in El Paso will be between 7 and 9 years instead, because of 50% more sunlight per year.

Loss in efficiency from panels? 2% first year and 0.5% each subsequent year.
2. Lighting: Saving money in smaller ways

Signs aren’t often as effective as we would like.

Figure: Signs for English and Modern Languages Made by Sara Curtis
What if we installed automatic motion sensor switches in the classrooms, conference rooms, etc.?

How much money could we save per year?
2. Lighting: Burke 001 Calculation

- Fall/Spring: Approx. 49 hrs/wk when building is open and no classes in the room.
- Summer: Approx 49 hrs/wk when building is open and no classes in the room.
- $45 \times$ Phillips T8 fluorescents that draw 32 W = 0.032kW each.

We would use approximately:

$$(45 \text{ bulbs})(0.032 \text{ kW/bulb})(49 \text{ hrs/wk})(40 \text{ wks/sem}) = 2822.4 \text{ kWh/cal yr}$$

- Cost for Lighting
  $= (\$0.10/\text{kWh})(2822.4 \text{ kWh/cal yr}) = \$282.24/\text{cal yr}$
- Cost of auto on/off switch $\approx \$100$
- Cost of 45 LED replacement bulbs $= \$450$
2. Lighting: Burke Basement Conf. Room Calculation

- Fall/Spring: Approx. 35 hrs/wk when lights are on and room is not being used.
- \(18 \times \) Phillips T8 fluorescents that draw 32 W = 0.032kW each.

We would use approximately:

\[(18 \text{ bulbs})(0.032 \text{ kW/bulb})(35 \text{ hrs/wk})(30 \text{ wks/sem}) = 604.8 \text{ kWh/ac yr.}\]

- Cost for Lighting
  \[= (0.10/\text{kWh})(604.8 \text{ kWh/ac yr}) = 72.58/\text{ac yr}\]
- Cost of auto on/off switch \(\approx 100\)
- Cost of 18 LED replacement bulbs = 180
2. Lighting: My Burke Office Calculation

- Fall/Spring: Approx. 17 hrs/wk when I have class, meetings, etc.
- $9 \times$ Phillips T8 fluorescents that draw $32 \text{ W} = 0.032 \text{kW}$ each.

We would use approximately:

$$(9 \text{ bulbs})(0.032 \text{ kW/bulb})(17 \text{ hrs/wk})(15 \text{ wks/sem})(2+4/15 \text{ sem/ FA, SS, US})$$

$$= 165 \text{ kWh/acre yr}.$$ 

- Cost for Lighting
  $$= ($0.10/\text{kWh})(165 \text{ kWh/acre yr}) = $19.83/\text{acre yr}$$
- Cost of 9 LED replacement bulbs = $90
2. Lighting: Proposal

1. Install automatic motion sensor switches, or timer switches in classrooms, conference rooms, etc. Break Even within approximately 1 year.

2. Take the savings from the switch over approximately 2 years and replace all fluorescents with LEDs that cuts lighting cost, when in use, by 45%.
2. Lighting, Air Conditioners, TVs, Lab Equipment, Exercise Equipment, Etc.

Figure: Williams Hall

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2. Lighting, Air Conditioners, TVs, Lab Equipment, Exercise Equipment, Etc.

Figure: Wisner Hall
2. Lighting, Air Conditioners, TVs, Lab Equipment, Exercise Equipment, Etc.

Figure: TVs in Reed Hall on 24/7
2. Lighting, Air Conditioners, TVs, Lab Equipment, Exercise Equipment, Etc.

**Figure:** Air Conditioner Often on in Winter and Over Weekends/Breaks.

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2. Lighting, Air Conditioners, TVs, Lab Equipment, Exercise Equipment, Etc.

Figure: TV in Burke on 24/7
2. Lighting, Air Conditioners, TVs, Lab Equipment, Exercise Equipment, Etc.

Figure: TV in Burke on 24/7

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2. Lighting, Air Cond, Etc. Proposal

1. Install automatic motion sensor switches, or timer switches on all other Lighting, Air Conditioners, TVs, Lab Equipment, Exercise Equipment, Projectors etc.

2. For equipment that shouldn’t be turned off and on this way, or if it isn’t feasible, have Public Safety shut it down when closing building.
2. Office Computers

Proposal: Office Computers

- Screen: turn off after 5 minutes of inactivity.
- Computer: go to sleep after 30 minutes of inactivity.
- Cost: Less than 2 minutes of your time.
- Can we also do this for lab computers?
2. Office Computers: Screen/Computer Sleep

Figure: Type “Screen Saver” into Windows search and select “Turn Screen Saver Off/On” to bring this up. From here select “Change power settings”.

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2. Office Computers: Screen/Computer Sleep

Figure: Select “Choose when to turn off the display” on the left side.
2. Office Computers: Screen/Computer Sleep

Figure: Change display to “5 minutes” and computer to “30 minutes”
3. Other Ideas?

“Christians are supposed not merely to endure change, nor even to profit by it, but to cause it.” – Harry Emerson Fosdick
3. Other Ideas? Recycling

Figure: Effectiveness of Signs (Spring 2015)

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3. Other Ideas? Recycling

**Figure**: Effectiveness of Signs Above Recycle Bin (Spring 2018)
3. Other Ideas? Recycling Proposal

- Take some of the money we saved on cutting down in other wasteful areas to help improve our recycling.
- Recycle bins in every classroom, conference room, etc.
- Recycle bins on each floor.
- Better yet . . . next to each garbage can a clearly labeled recycle bin.
3. Other Ideas? Recycling Proposal

Figure: University of Tennessee

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“Christians are supposed not merely to endure change, nor even to profit by it, but to cause it.” – Harry Emerson Fosdick

- Think up your own ideas to *cause* changes, big or small, with Creation Care.
- Critique and/or improve these ideas presented here.
- Help put them into action.