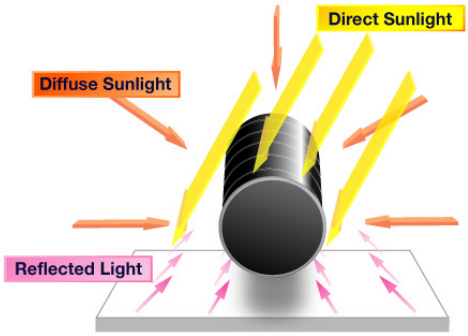
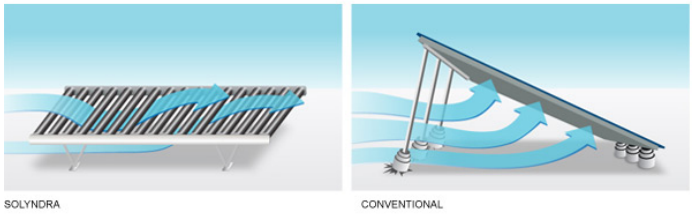
Analysis 1: Solyndra Solar Panels

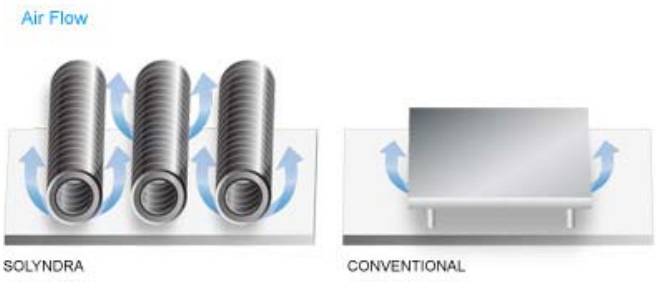
About Solyndra



Solyndra Solar Panels are the new look of solar energy. These panels consist of a frame with multiple cylindrical PV tubes running along it. This unique shape when matched with a reflective roof surface allows the panels to absorb sunlight from a 360˚ surface converting direct, diffuse, and reflected sunlight into energy. This also allows the panels to be equally efficient without mounting them at an angle. In addition the shape allows wind to flow through the panels allowing them to be installed without roof penetration, attachments, or ballasts, making installation quicker, easier, and cheaper than conventional models. This also makes the panels easily removable for roof maintenance.



The panel spacing between PV tubes allows natural airflow allowing the panel to operate at a lower temperature which allows the module to create higher energy production. The panel shape and weight also allows wind up to 130mph. The windiest city in this location requires buildings to be designed to withstand 120mph wind; therefore this system is more than qualified for local wind design.



Installation Location

After analyzing the location of the hotel I have come to a conclusion of where the Solyndra Panels will be applied. I have decided to only cover the back half of both new and existing roofs for a few good reasons. The first reason is that the back of each building faces south, and in south Jersey this is where the roof will see the most sunlight. The second main reason is that the solar panels aren't aesthetically appealing therefore placing them on the roof portions most visible to the public was deemed unacceptable by the building owner. As for placing solar panels on the new pool enclosure, it did not seem efficient since the existing and new building shade the pool structure through most of the day, except when sunlight is directly overhead.

Panel & Roofing Selection

Currently Solyndra's highest producing panel is their SL-001-191 model with a maximum power rating of 191 Wp at standard test conditions (irradiance of 1000 W/m^2, air mass 1.5, and cell temperature of 25˚C. Full specifications for the Solar panels are in Appendix B figure 1 at the back of this assignment.

Since the panels are more efficient on a reflective roof surface it was important to choose a new roof with high reflectivity. I have chosen the EverGuard Freedom TPO HW self adhered membrane in white for the reflective surface. The roofs are at a 6/12 slope which makes it hard to apply a liquid membrane, which is why I selected the self adhered membrane. This membrane has a reflectivity of 0.76 and an emissivity of 0.9.

Sizing the System

These panels are 1.82m x 1.08m x 0.05m in size and with both rear roof areas totaling approximately 11760 ft^2 we can install about 250 panels to each roof (calculations below). There is more roof area available than the area of 250 panels, but we need to keep room for roof obstacles and panel spacing.

Roof Area = $5880ft^2 * 2 = 11760ft^2$

Panel size = $(1.82m)*(1.08m)*(3.28ft/m)^2 = 21.2ft^2$

# of Panels (No Spacing)= $11760ft^2/21.2ft^2 = 554.7$ Panels

# of Panels (W/ Spacing)= approximately 500 Panels (250/roof)

System Power = 191Wp * 500 Panels = 95.5kW Power

Schedule Analysis

The labor rate for this Solyndra Solar Panel system is 10 panels/hr, using a crew of 3 men. The labor rate at which they install the panels may seem higher than usual PV panel installation because Solyndra panels have a much simpler installation process. With a total of 500 panels being installed at a rate of 10 panels/ hr, we can see that it will take 50 hours for the 3 man crew to finish. With an average work day consisting of 8 hrs, we can see that it will take 6.25 days to complete the system installation.

The best time for this system to be implemented would be directly after the roof is completed. Also, because the tasks that must be done after roof installation are not directly related to the completion of the roof, the schedule will not change due to solar panel installation. However, a labor cost will be added for the 6.25 days it will take to install the system.

Cost Analysis

To determine the cost we must look at a few different factors. First we must determine the product cost, which Solyndra panels include the panel and the mounting equipment together. This value was obtained from a Solyndra representative to be $5.42/W including installation. In addition we need to purchase a 100kw commercial inverter to cover the load and a monitoring system to ensure the system is functioning at its expected output. We also need to include the cost for permits to install the system.

Although solar panels seem incredibly expensive to install and may appear to have ridiculous pay back periods, there are state and federal tax incentives and rebates that makes these systems more affordable.

Federal – Federal tax cuts offer a business energy Investment Tax Credit(ITC) on a variety of alternative energy systems. The credit is available until December 31, 2016 for energy systems like solar, wind, and geothermal. This credit will pay for 30% of the entire systems expenditures and has no maximum limit.

State – In the state of New Jersey, solar panel implementation is eligible for a sales tax incentive which eliminates the 7% state tax. This incentive is available for all solar energy equipment and is available to all New Jersey taxpayers. This incentive doesn't apply to buildings which actually need an alternative source to run. Luckily this specific system is designed to produce energy to reduce the buildings total energy load; therefore it is eligible.

Renewable Energy Incentive Program (REIP) – For commercial buildings in New Jersey, a $1.00/W rebate is available to those who install up 50 kW systems. Unfortunately this current system is 95.5 kW which makes it ineligible for this rebate.

Description	Cost
Solyndra Solar Panels (500)	$517,610
Labor Combiner Boxes Wiring	
Monitoring System	$6,500
100 kW Inverter (w/ 10 yr warranty)	$51,215
Permitting	$5,000
7% NJ State Tax	$40,623
Total System Cost	**$620,948**
System Cost per Watt	**$6.50**
Incentives	**Savings**
Federal Investment Tax Credit (30%)	$186,284
NJ Solar System Tax Exemption	$40,623
New Total System Cost	**$394,041**
New System Cost per Watt	**$4.13**

Energy Efficiency Analysis: Electrical Breadth

In order to determine payback rate, annual savings, and annual energy produced I used the PV Watts calculator from pvwatts.org. This program takes into account the specific locations solar radiation (kWh/m^2/day), electricity cost ($/kWh), array tilt, and array azimuth.

In addition to determining the energy savings presently, it is also useful to determine future annual savings due to the future proposed carbon tax. In the future there will most likely be an additional $0.1027 – $0.1137 /kWh increase in electrical cost (Referenced in Lindsay Hagemann's Thesis Report 2009). This tax is to help reduce the amount of carbon dioxide and greenhouse gas emissions in the US. We can also determine how many pounds of CO_2 we will save to see the reduction in environmental pollution from the solar panel system implementation. Approximately 1.43 lbs of CO_2 is produced by 1 kWh of energy in New Jersey.

Below is a summary of the results from the PV Watts calculator. This table shows savings with and without carbon tax. A solar radiation map is located in Appendix B Figure 2 and the full PV Watts results are located in Appendix B Figure 3 at the back of this assignment.

Location	Atlantic City, NJ
Array Tilt (6/12 slope)	26.6°
Array Azimuth (SE)	45°
Avg. Solar Radiation	4.67
Electricity Cost	13 ¢/kWh
DC Power Rating	95.5 kW
AC Power Rating	73.5 kW
Annual AC Energy Produced (kWh)	**118,886 kWh**
Annual Energy Savings ($)	**$15,455.18**
Savings (lbs of CO_2/yr)	**170,007**

With Future Carbon Tax	
Electricity Cost	24 ¢/kWh
Annual AC Energy Produced (kWh)	**118,886 kWh**
Annual Energy Savings ($)	**$28,532.64**
Savings (lbs of CO_2/yr)	**170,007**

Currently the existing building uses an average of 20,000 kWh/ month, and with the addition being approximately the same size as the existing plus a pool enclosure we can expect the new average to be about 45,000 kWh/ month. With that being said we can determine the percentage of building energy that will be supplied by the solar panels.

$$\frac{118{,}886\ kWh}{45{,}000\ kWh * 12} = 22\%$$

Payback

The payback period is one of the main concerns from an owner's perspective. If the owner plans on owning the building for longer than the payback period, then they will most likely benefit from the implementation of the solar system. However, if the owner doesn't plan on keeping the building for that length of time they will most likely be losing money in investing in this system, unless they get compensation for the system from the individual purchasing the building. Below are the calculations to determine payback period, with and without a carbon tax.

No Carbon Tax – $394,041/$15,455.18 = 25.5 years

With Carbon Tax - $394,041/$28,532.64 = 13.8 years

As you can probably tell this is a very long payback period, but with the implementation of a carbon tax, increased fuel cost, and environmental requirements that will be seen in the future the payback period may be less as these changes are made. One thing is for sure you will not see an increased payback period over time.