Rooftop Solar Potential of Southwestern University: LiDAR application to Solar Mapping

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Introduction

Southwestern University is one of the highest rated campuses for sustainability according the College Sustainability Report by the Sustainable Endowments Institute. Thanks to student efforts over 90% of the Universities energy comes from wind power and the school has reduced building energy consumption through energy management systems, building metering, and light sensors. Photovoltaics could potentially further offset Southwestern's energy usage. Previous studies on campus have studied the effectiveness of single Photovoltaic cells, but not for the entire campus. Widespread use of photovoltaics across campus could potentially provide a significant source of on site energy. This study uses LiDAR and GIS to estimate the solar potential of the Southwestern Campus rooftops and aid in development plans for continued sustainability.

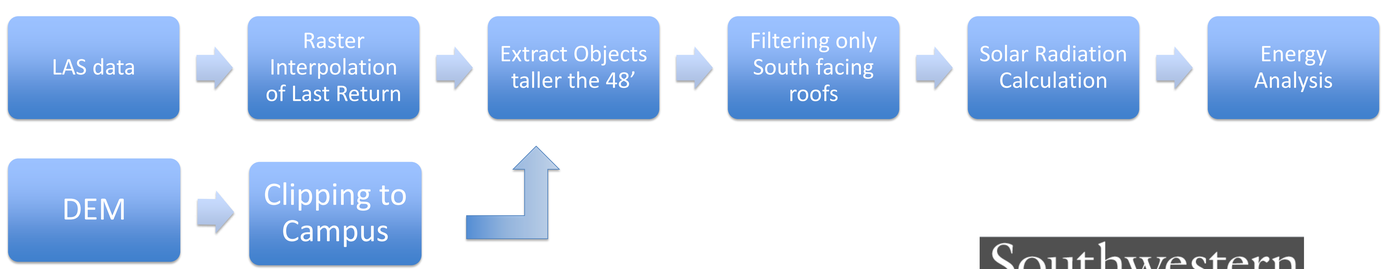
Study Area

The study analyzed the Southwestern University campus in Georgetown, Texas. The The original data was from a light detection and ranging (LiDAR) point file as well as a USGS digital elevation model (DEM) of central Texas. The data covered Southwestern University buildings, dormitories, and fields.

Creating a Digital Roof Model (DRM)

LiDAR data was processed for the last return values, and with unfiltered data a raster interpolation was used to create a DEM. This model was then filtered for objects that were 48 feet above the USGS bare earth DEM. This extracted the roofs of buildings 4 stories or taller on the campus, creating a digital roof model (DRM). The DRM was then filtered to only include south facing roofs.

Work Flow



Solar Siting

Suitable locations for solar collector have particular characteristics and requirements. Locations in the DRM were filtered to provide areas that met suitable site requirements. These characteristics were:

- Elevation – Locations were on top of buildings that were tall enough not to have tree growth blocking the sun. This was four stories or 48 feet.
- Aspect – The aspect of the roof should be south facing because Georgetown is located in the northern hemisphere.

Filters could have been put in place for high radiation and slope, but all south facing roofs 4 stories had high solar irradiance.

Solar Calculations

Solar radiation tools from ESRI ArcGIS Spatial Analyst Toolset were used to calculate the annual radiation. This raw number was then converted into electrical output by assuming 15% efficient photovoltaic panels and an 80% DC to AC conversion.

$$PV\ (KWh) = Total\ Radiation\ (KWh) \times .15\ \times\ .80$$

Results

The following table has the results from the solar calculations. 8,109 square meter of roofspace met the characteristics for solar collectors. This area has high annual radiation, which can produce almost 60 thousand KWh of electricity with Solar PV.

Total Roofspace	Total Solar Radiation	PV Electricty
m^2	*MW*	*KWh*
8,103	1,421,196	59,690

Conclusions

Southwestern has an untapped potential for solar energy. This analysis shows that through the installation of Solar PV on the highest potential locations, the University can offset the annual use of 100 average US households electricity use.

Southwestern

Acknowledgements

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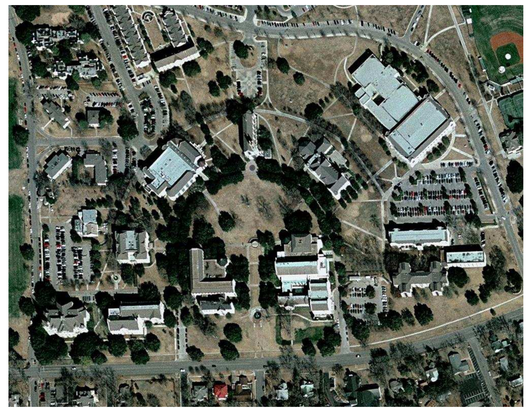
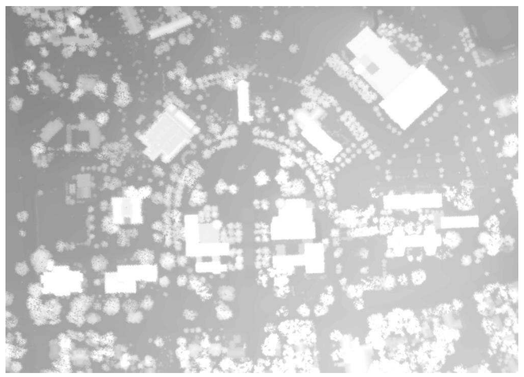


Southwestern University Campus



Last Return LiDAR DEM

Filter Mask

Solar Radiation Map