



SOLAR CARPORTS

ASSESSMENT OF OPEN PARKING LOTS TO LOCATE POTENTIAL SOLAR CARPORT INSTALLATIONS AT THE UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

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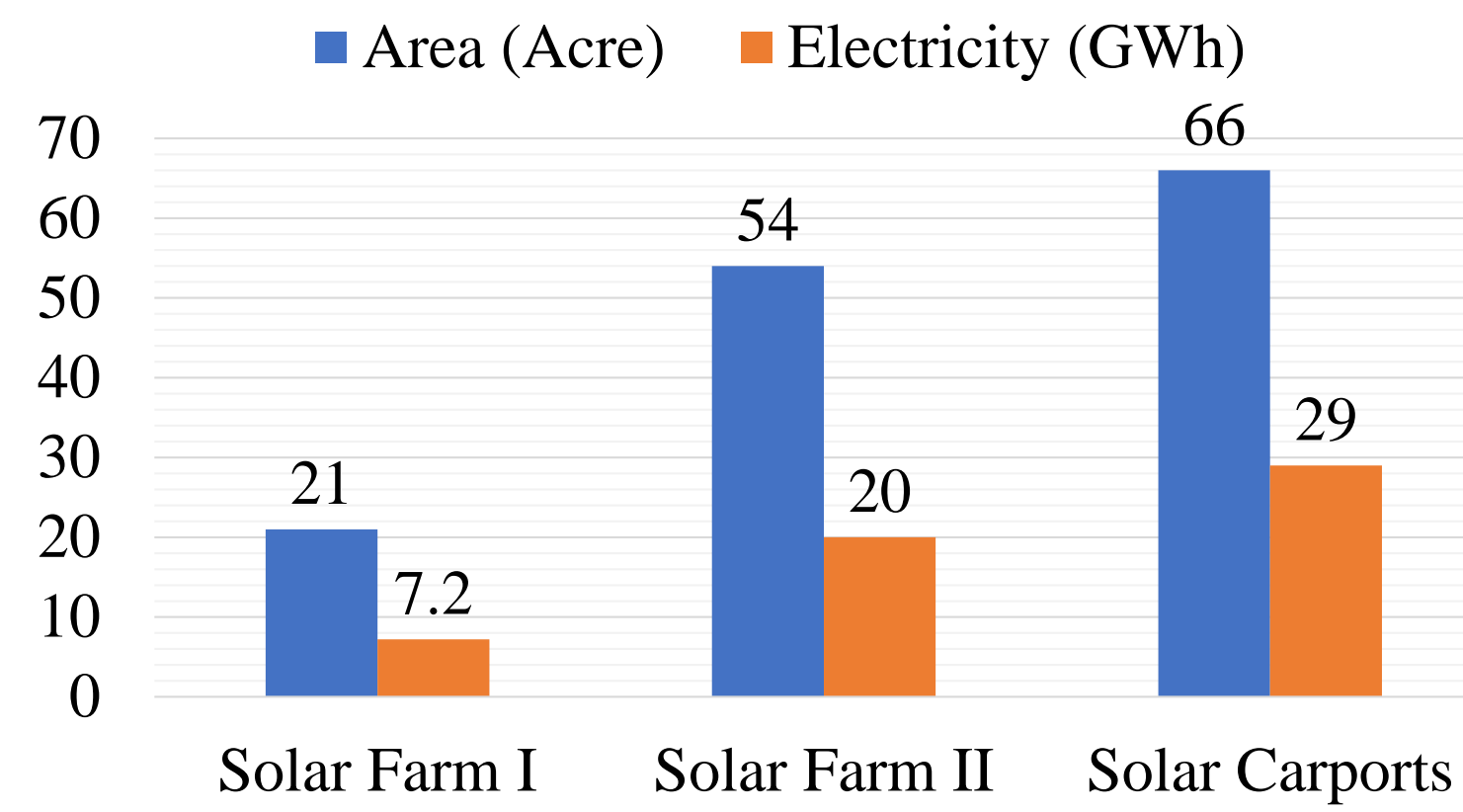
Advisor: Dr. Dustin Allred |

Client: University of Illinois Facilities and Services

INTRODUCTION

- The objective of the report is to document open parking lot areas at the campus of the University of Illinois at Urbana-Champaign for potential installation of solar carports.
- The areas assessed will collectively act as a Solar Farm and contribute to clean energy generation on campus in addition to the functioning Solar Farm I and the under-construction Solar Farm II.
- The development of infrastructure to harness solar energy is in tune with the goals of the Illinois Climate Action Plan (iCAP) of 2015 and the intent of the university to become carbon neutral by the year 2050.
- The areas assessed have a potential to generate electricity ranging from 28.94 GWh to 46.3 GWh on an annual basis, depending on the efficiency of the solar panels.

Output Potential of Solar Carports at the University of Illinois at Urbana-Champaign



WIKI

Benefits of Solar Carports

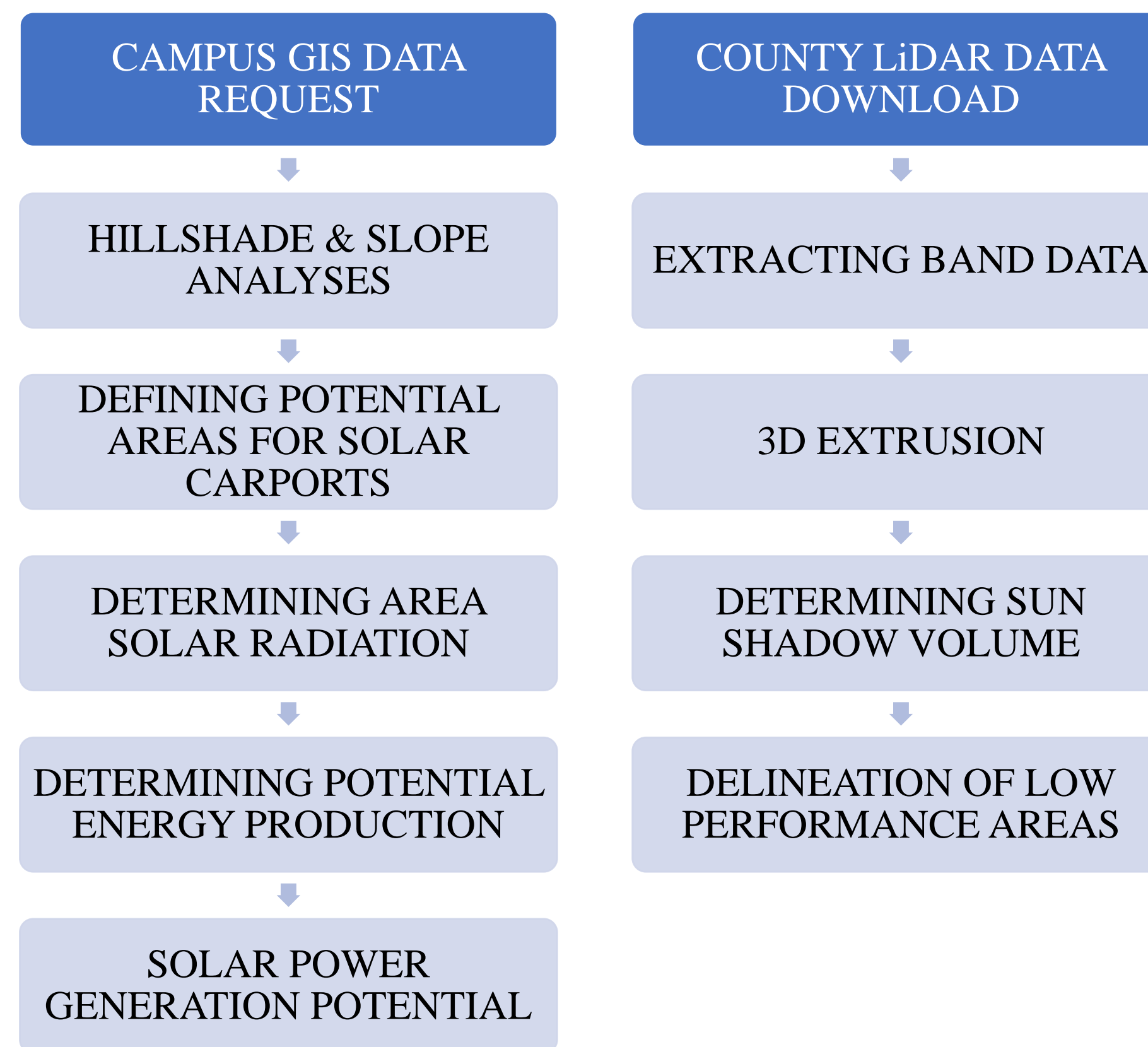


METHODOLOGY

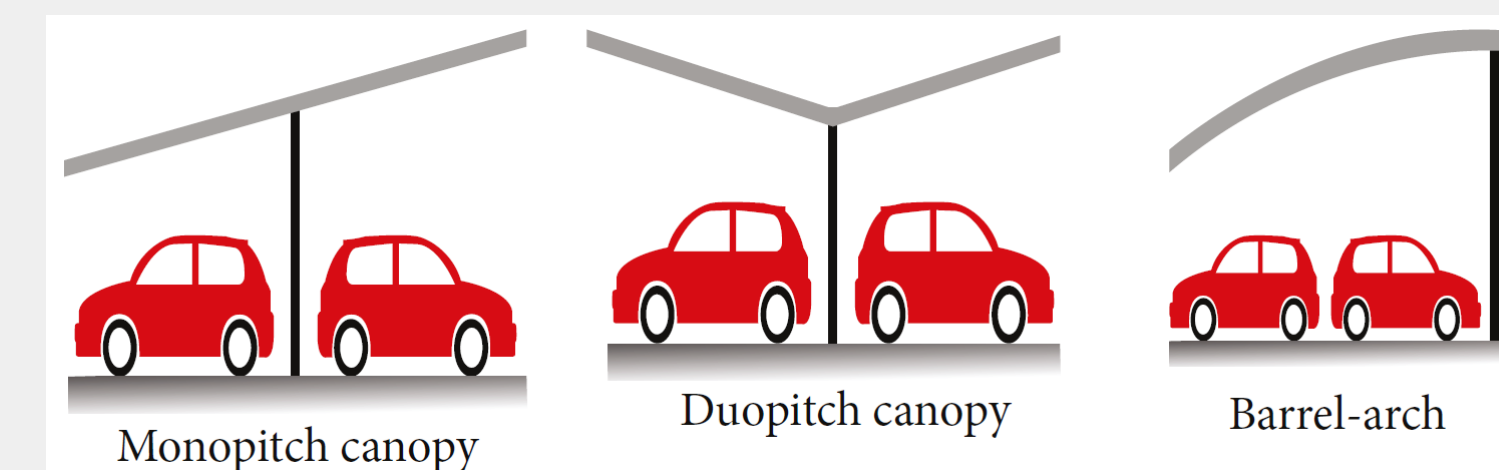
The exercise to document the areas required the following.

- Identification of the open parking lots on campus.
- Delineation of areas for solar carports installation.
- Assessment of the identified areas for annual solar radiation and shadow volumes.
- Tabulation and identification of the areas for their potential energy generation capabilities.
- Calculation of potential solar power generation.
- Production of maps to inform of conditions of annual solar radiation and shadow volumes for the areas considered.

Quantitative and Qualitative Analyses Workflow

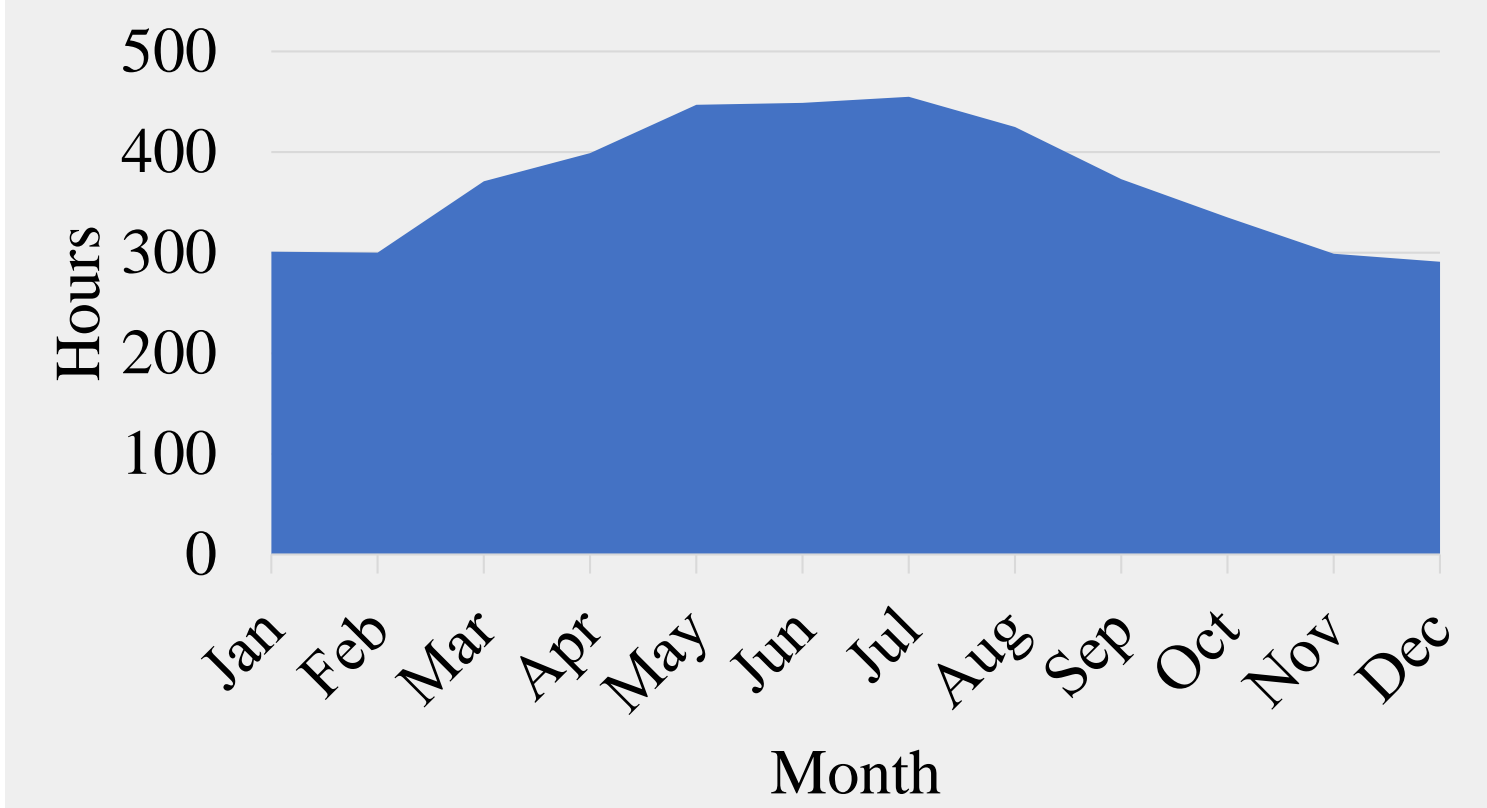


Roof Structure of Carports



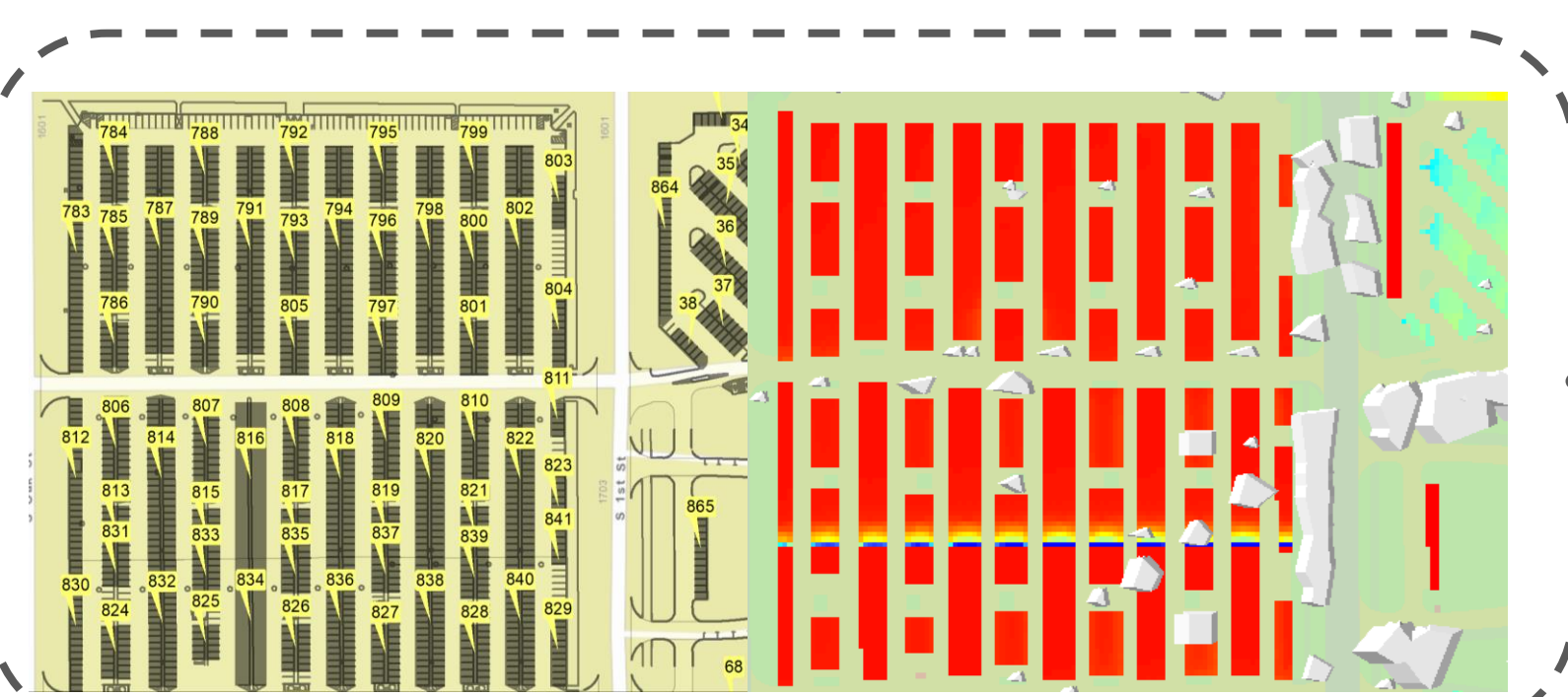
Monopitch canopy tilted 10° towards South/West preferred

Daylight Hours in Urbana-Champaign (2018)



RESULTS

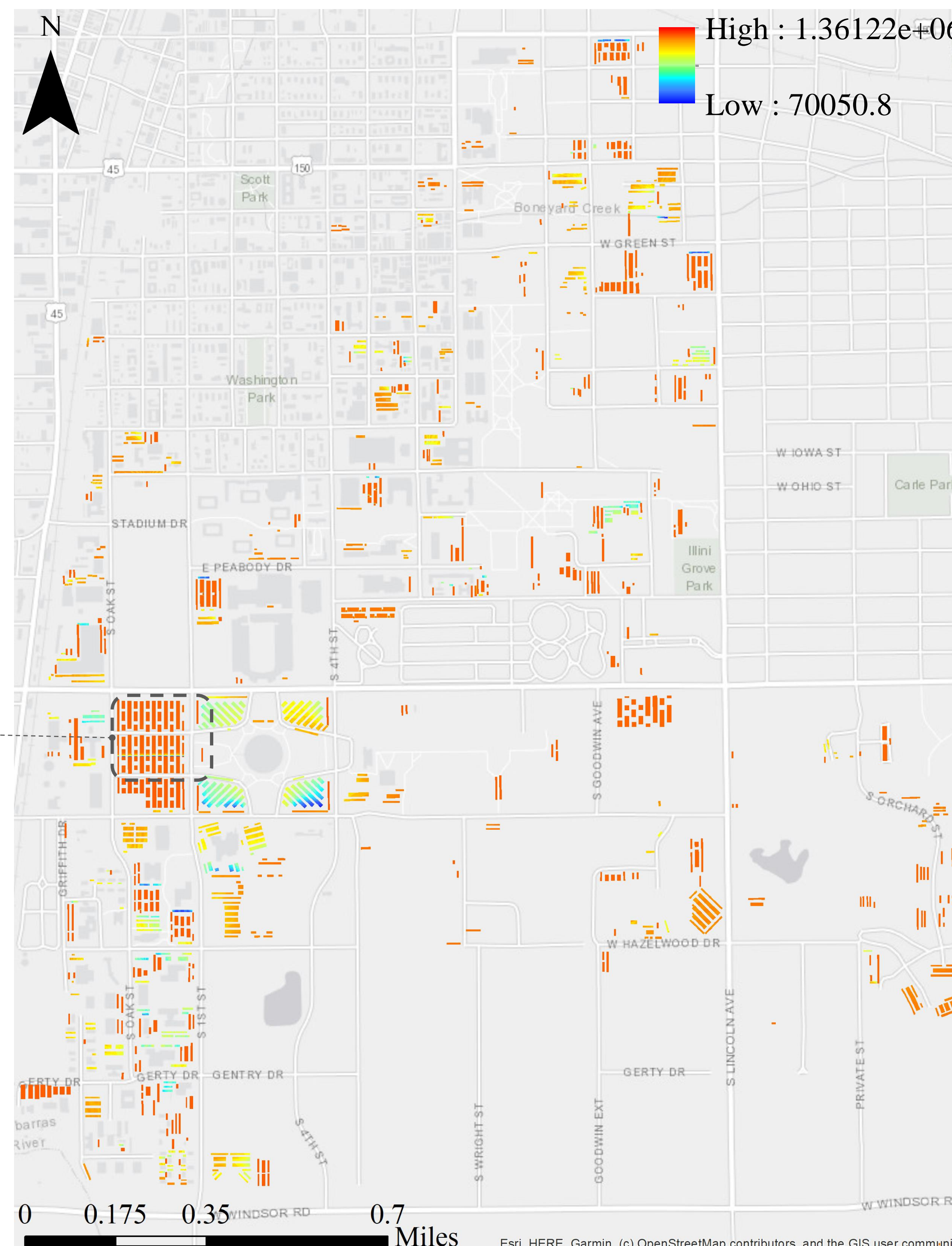
- The University of Illinois at Urbana-Champaign has 180.94 acres of open parking lot spaces. A total area of 65.75 acres of open parking lot spaces was identified for potential solar carport installation.
- 967 parking strips were identified during the analysis. Each parking strip is numbered and further identified by the parking lot it is located in using two tags generated by the university's Facilities and Services department – 'CampusRIGr' and 'UIUCTAG_NO'.
- The estimated potential energy from the parking strips assessed for year-round solar radiation stands at 257.25 GWh.
- Sun Shadow Volumes were generated to visualize the effect of shadows on the areas being considered for potential installation of solar carport structures.



Tagged Parking Strips (left) and assessed Shadow Volumes (right)

LIMITATIONS

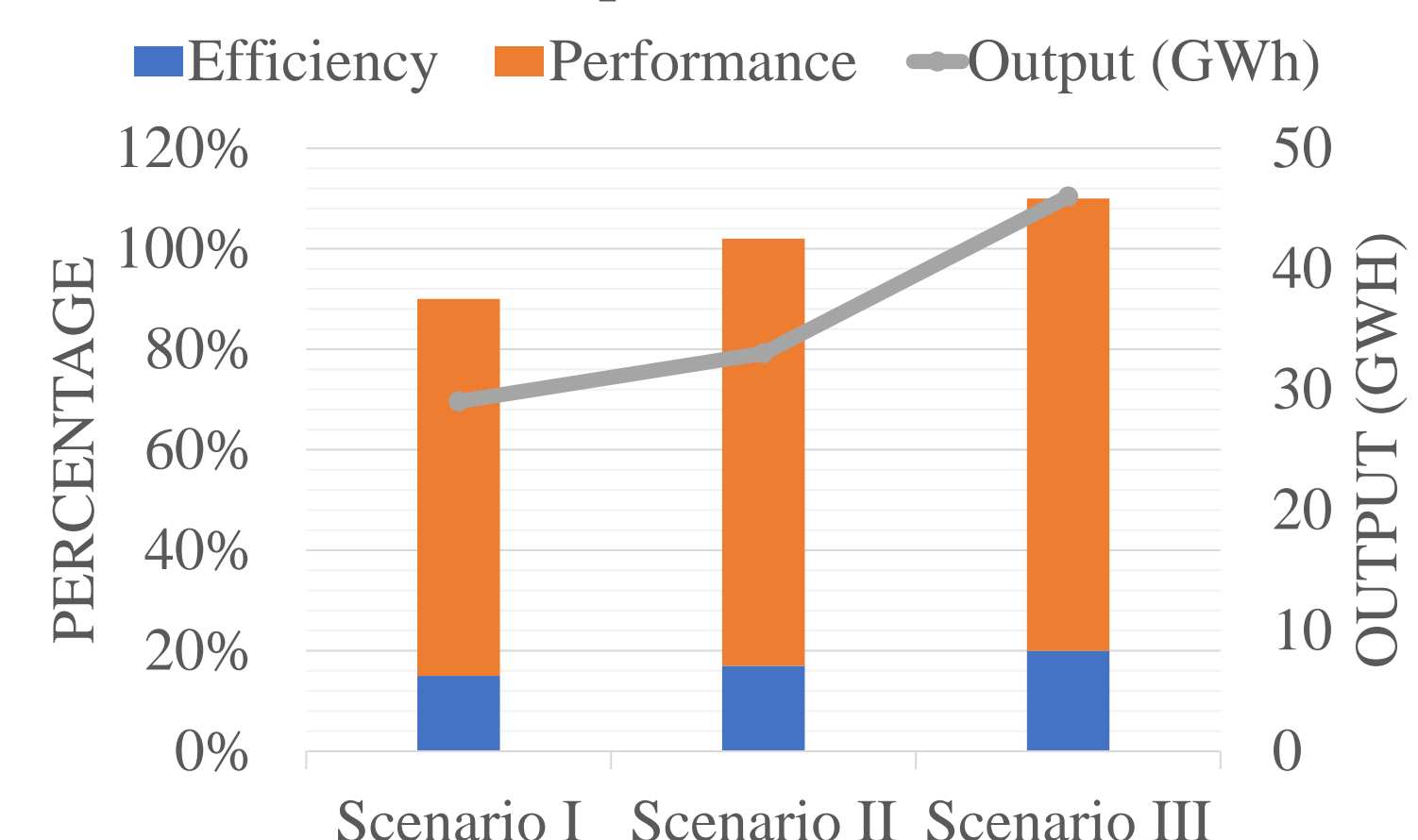
- Tree foliage accounted for by inspection of the satellite image does not give the accurate information of conditions on ground.
- The determination of shadow volumes is very limited and should be extended to be analyzed for various dates and for each parking strip.
- The effect of non-uniform solar radiation on solar photovoltaic panels might lead to their inefficiency.
- Economic considerations should be taken up on a case-by-case basis to determine the localized factors that would influence construction costs and return on investment.



CONCLUSION

- The report generated meets the objective of acting as a knowledge base for the University of Illinois' Facilities and Services department to assess particular open parking lots on campus for potential installation of solar carport structures.
- The university must give preference to developing comparatively large parking lot areas with the potential to house numerous solar carport structures on multiple parking strips and that have high annual solar radiation values.
- The university may explore the possibility of assessing entire open parking lots and not just the parking strips for housing solar photovoltaic panels.
- College campuses around the country may take inspiration from the potential carport installation at the university and replicate the same to make their campuses more sustainable and mitigate the emission of greenhouse gases.

Output Scenarios



ACKNOWLEDGEMENTS

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