Feasibility Analysis of Retrofitting Central Illinois Regional Airport with a Solar Photovoltaic Power Plant

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Research Question

- What percent of Central Illinois Regional Airport's annual electrical energy consumption could be offset by the installation of commercial-scale solar photovoltaic (PV) on unused airport property?

Introduction

- With the growing political push towards clean energy, we look at ways to harness energy in a sustainable way. To address this issue, we aim to create a construction bid where solar photovoltaic is implemented on unused land at Central Illinois Regional Airport. Many Municipal airports, often as a consequence of the public bidding domain where the lowest and most responsible bidder is awarded the project, and FAA regulations for spacing, properties are left with an abundance of unused land that could be utilized for energy expense maximization. This research aims to be an economic and environmentally driven framework for institutions should they be interested in proposing a photovoltaic retrofit of their own.

Methodology

- Our goal is to utilize the scientific process to comprehensively address our research questions. We used energy consumption data provided from CIRA, Bloomington Normal Airport Authority, StraightUp Solar, GRNE Solar, and Corn Belt Energy to make decisions on the setup and layout of the system. The two programs that we used are Helioscope (a solar PV layout and analysis program) and System Advisory Model (a wholistic energy foundation and costing software). Lastly, we took the information from Helioscope and SAM to finalize the layout and plan for a future construction project.

Background-Central Illinois Regional Airport

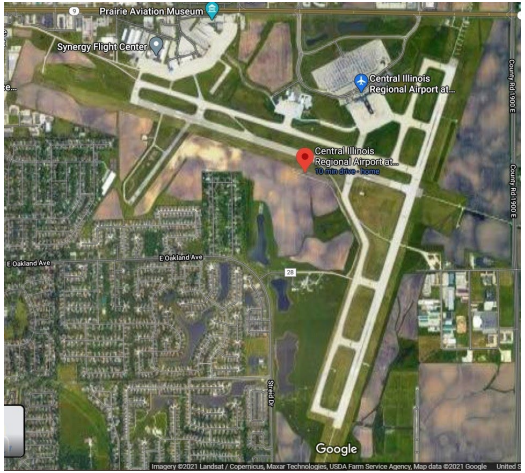


Figure 1. Aerial photograph of Central Illinois Regional Airport

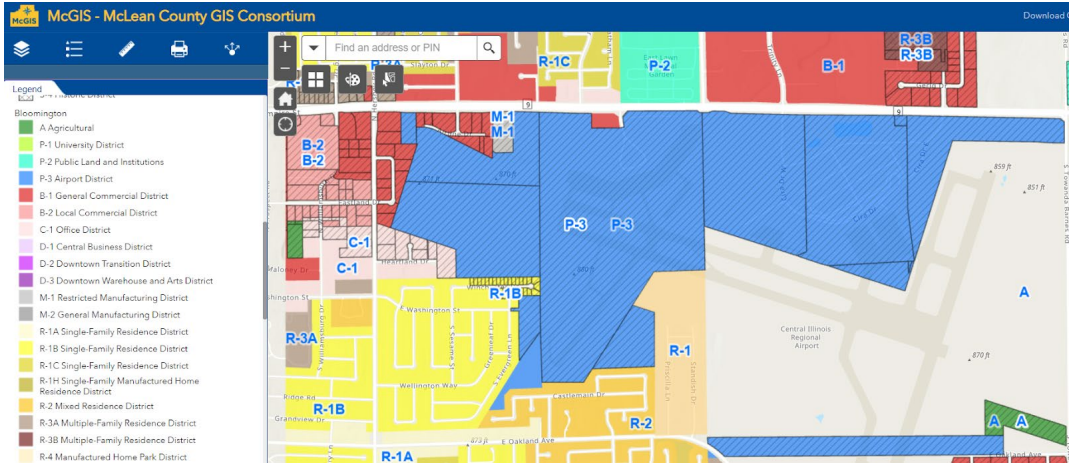


Figure 2. Zoning map of the northern sector of Central Illinois Regional Airport provided by Mclean County GIS

CIRA Solar Resource

Bloomington, Illinois, United States - Solar energy and surface meteorology

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Insolation, kWh/m²/day	1.77	2.50	3.47	4.43	5.30	5.93	5.97	5.23	4.34	3.08	1.86	1.47
Clearness, 0 - 1	0.43	0.45	0.46	0.46	0.48	0.51	0.53	0.52	0.52	0.49	0.41	0.39
Temperature, °C	-3.57	-0.82	4.58	11.57	18.00	22.84	24.90	23.72	19.56	13.60	6.10	-1.24
Wind speed, m/s	6.48	6.24	6.68	6.61	5.75	5.19	4.62	4.45	4.86	5.53	6.06	6.19
Precipitation, mm	45	43	76	98	102	99	109	87	87	71	72	64
Wet days, d	9.8	8.7	11.8	11.8	10.6	9.4	9.1	8.7	8.8	8.4	9.9	11.1

These data were obtained from the NASA Langley Research Center Atmospheric Science Data Center; New et al. 2002

Figure 3. Solar resource and climate analysis for Bloomington Illinois provided by GAISMA

Bloomington, Illinois, United States - Sun path diagram

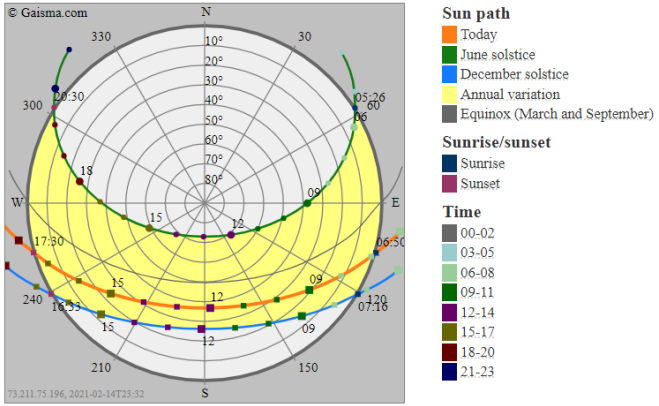
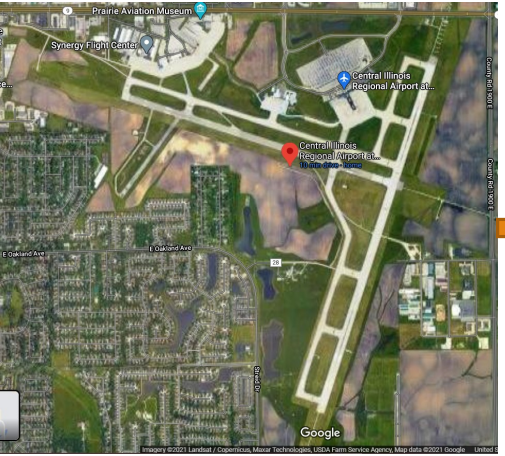
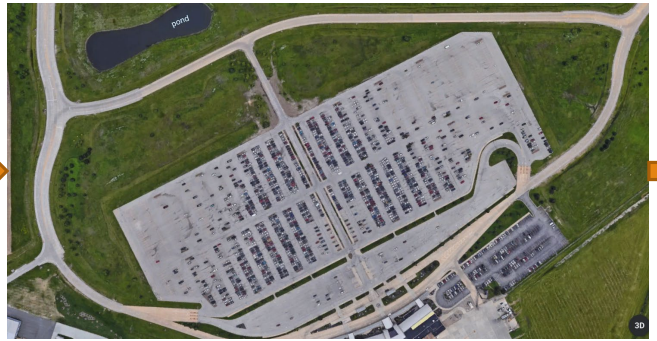


Figure 4. Sun path diagram at 40.5d Latitude, Bloomington Illinois, provided by GAISMA

Proposed Solar PV Powerplant Footprint





4110 kW Capacity

Figure 5. Final proposed PV power plant layout located on the north sector of CIRA's long term parking facility

CIRA Energy Use Trends

Central Illinois Regional Airport at Bloomington-Normal

- Customer to Corn Belt Energy Utility Co.
- 50 Metering locations ranging from 0.08-217 MWh annually
- Analyzed April 2019-April 2020 usage, over 600 inputs
- Margin of Error +/- 5%
- 6416.5 MWh/year of Energy used April 2019-April 2020

Construction Costing

- Installation cost quote from our two industry partners: $1.50/Watt and $1.50-$2.0/Watt
- 4110 kW system capacity
- $7,192,500 for installation at $1.75/Watt

Month	Solar Radiation (kWh/m^2/day)	AC Energy (kWh)	Value ($)
January	3.54	388,751	19,049
Febuary	4.4	417,239	20,445
March	5.3	544,755	26,693
April	5.27	508,766	24,930
May	5.59	538,613	26,392
June	5.87	528,941	25,918
July	6.17	572,430	28,049
August	6.08	552,475	27,071
September	5.99	548,582	26,881
October	4.85	489,757	23,998
November	3.95	395,940	19,401
December	2.99	316,989	15,532
Annual	**5**	**5,803,238**	**$284,359**

Table 1. PVWatts uses NREL International weather data to analyze projected energy outcomes

Results

- CIRA used 6500 MWh of electricity from APR’19-’20
- Goal to offset 65% of annual energy use or higher
- Our system has a nameplate capacity of 4110 kW

  -Producing over 5800 MWh annually

- Our proposed Power Plant can offset 85-90% of CIRA’s Energy Demand (0-5% Margin of Error)
- Aid in the states goals towards clean energy, while keeping the taxpayer in mind

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