

# Community Solar Adoption

*Utilizing statewide data to identify buildings and organizations to participate in the Indiana Energy Independence Fund program*

**DSCI-D592 Data Science in Practice**

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# Sponsor



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Indiana Energy Independence Fund



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# Why Community Solar?

## Why do we need it?

- The effects of climate change are being felt now and predicted to continue to worsen over time.
- Electrical demand projections are increasing due to factors like Electric vehicles, and data center growth due to AI use among other factors<sup>1</sup>.
- Electricity costs rise over time and are currently outpacing the already high levels of inflation<sup>2</sup>.



# Why Community Solar?

## How does it help?

- Focuses on adding energy to the grid through solar generation.
- Shares the energy cost savings with those struggling to keep up with the cost of electricity.
- Non-profit Organizations can access Federal funding through direct pay programs rather than tax incentives.
- Electrical production is closer to the point of use, reducing grid distribution costs.
- Combined with energy storage, adds resiliency to the community.
- Funding targeted to those communities at economic risk due to fossil fuel dependence.



# Objective

**The Community Solar** adoption project is looking to identify potential locations for community solar projects in the state of Indiana which would represent a partnership with an anchor tenant (an organization to host the solar system) to share solar energy with the nearby communities. The team looked at non-profit organizations or public facilities that are located in economically challenged areas of the community which would qualify for tax benefits under the justice 40 initiative of the US Government.

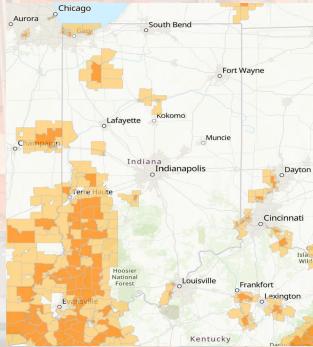


# Data Mining

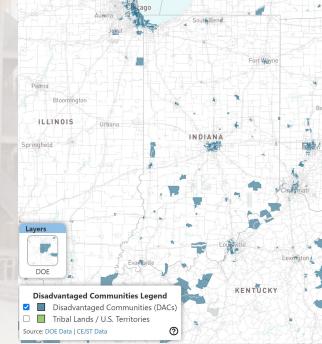
Data Harvest Locations



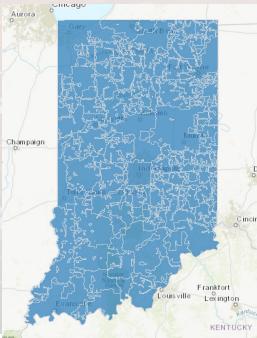
Energy Communities



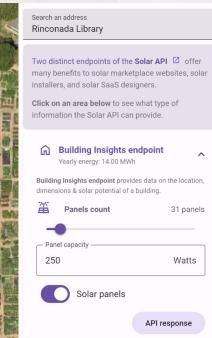
Disadvantaged Communities



Electric Service Territories



Google Solar API



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# Data Wrangling

## Criteria

- Non-profit Organization (NPO)
- Near a disadvantaged community (DAC)
- Location receives adequate sunlight

## Preferred Attributes

- Serviced by municipally owned electric company
- Within a Fossil Fuel or Coal Energy Community (EC)
- Larger usable roof space for solar array



# Data Wrangling

## Data Sources

- [Indiana GIS Data Harvest](#) (Nonprofit Organization Information)
- [Indiana Map](#) (Electric Utility Territories and Information)
- [US Department of Energy](#) (Energy Communities)
- [US Department of Energy](#) (Disadvantaged Communities)
- [Google Solar API](#) (Solar Potential Information)
- [Google Place API](#) (Estimation of location names and address)



# Data Wrangling

## Tools

- Python- Created Jupyter Notebook to detail dataset build process.
  - GeoPandas- Working with public GIS datasets.
  - Requests- Gather data from APIs.
  - Google maps- Adding solar data and place information.
  - Folium- Interactive mapping with satellite images for locations.
- Javascript- For displaying location features and solar maps.
- C# - Building the the web application.



# Data Wrangling

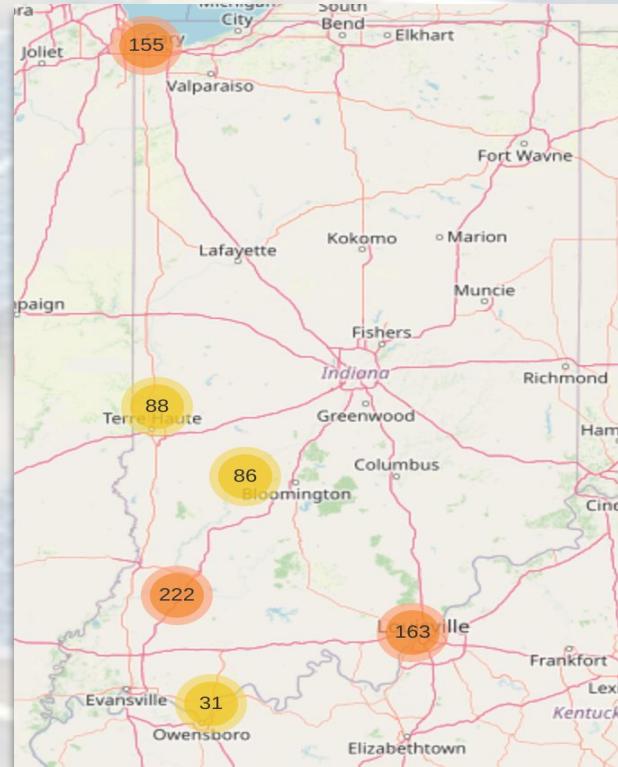
## Methodology

- Filtered to NPOs in Indiana Data Harvest dataset
- Further filtered to NPOs that were within a DAC, EC, and municipal electric utility territory
- Used Google Solar API to map Solar Potential to NPO addresses
- Used Google Place API to map NPO addresses to NPO names



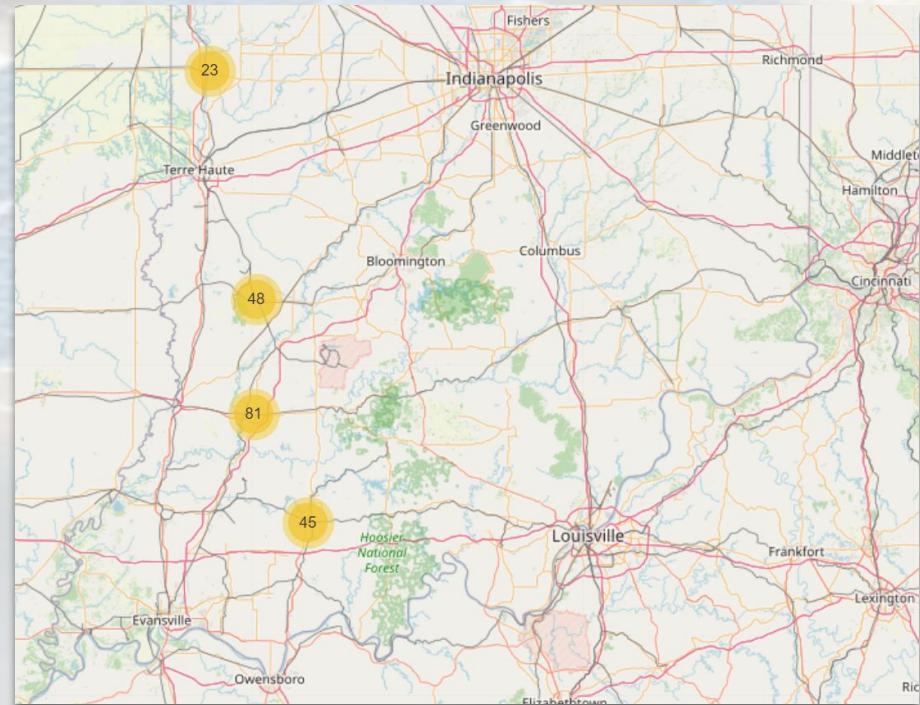
# Output Datasets: Overall Map

All Locations in a DAC and Coal EC  
in the state of Indiana. Total of 745  
Locations.



# Output Datasets: DAC and Coal EC Municipal Utilities Locations

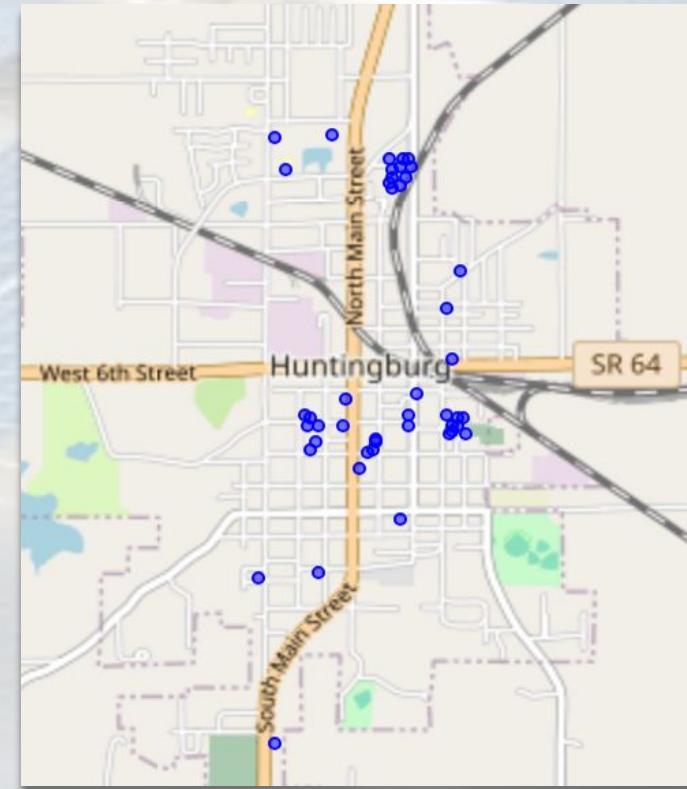
Municipal locations in a DAC and  
Coal EC- 197 Locations clustered in 4  
communities



# Output Datasets: Municipal Utilities

Municipal locations in a DAC and  
Coal EC- 197 Locations clustered in 4  
communities

Community 1: Huntingburg

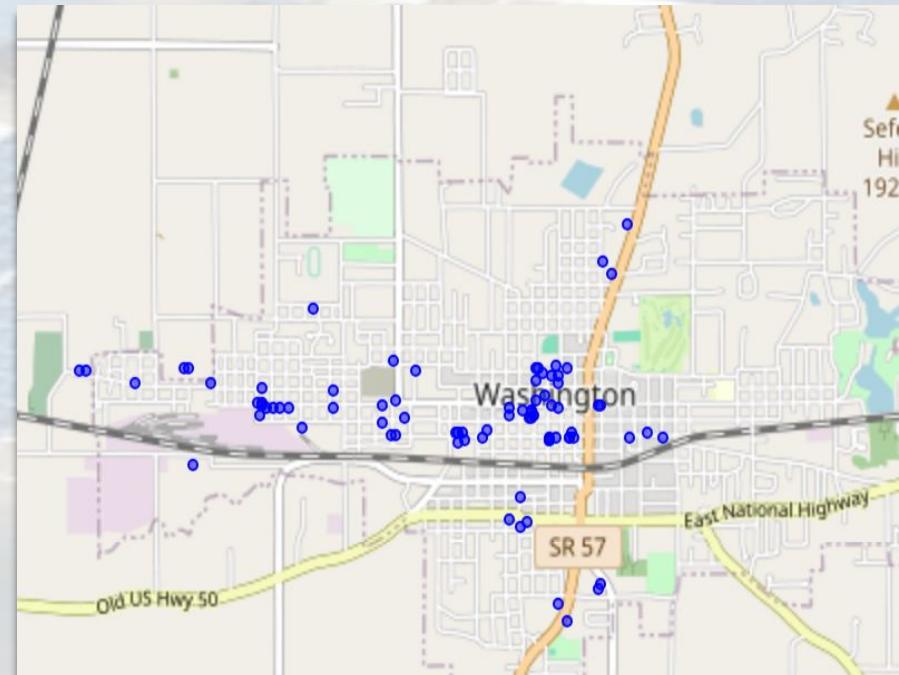


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# Output Datasets: Municipal Utilities

Municipal locations in a DAC and  
Coal EC- 197 Locations clustered in 4  
communities

Community 2: Washington



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# Output Datasets: Municipal Utilities

Municipal locations in a DAC and  
Coal EC- 197 Locations clustered in 4  
communities

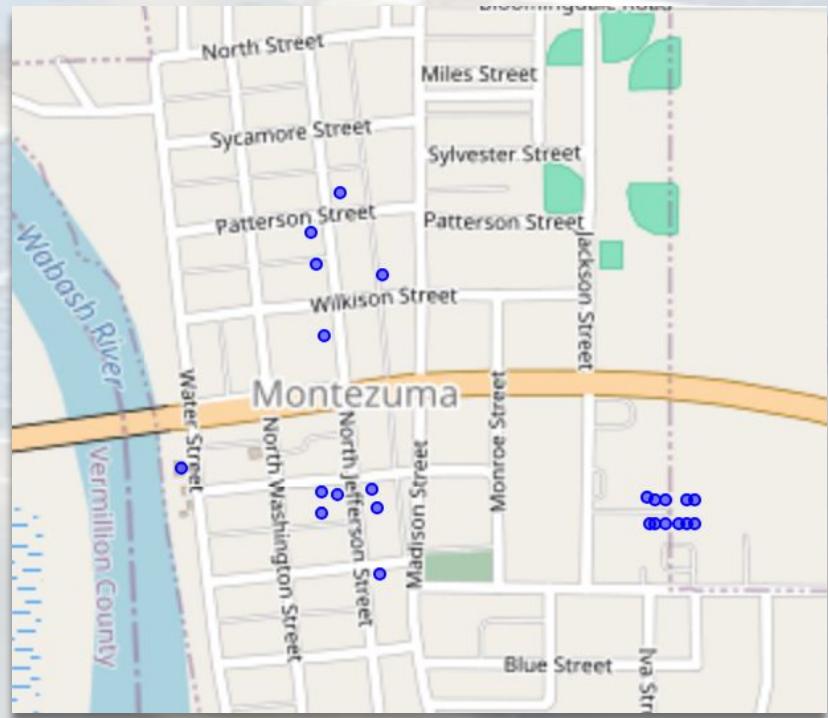
Community 3: Linton



# Output Datasets: Municipal Utilities

Municipal locations in a DAC and  
Coal EC- 197 Locations clustered in 4  
communities

Community 4: Montezuma



# Municipal Organization #1

Location Name: **Glenburn Home**

Location Type: **Nursing Home**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: **17.15**

Utility Name: **LINTON MUNICIPAL UTILITIES**

Energy Communities: **Coal, FFE**

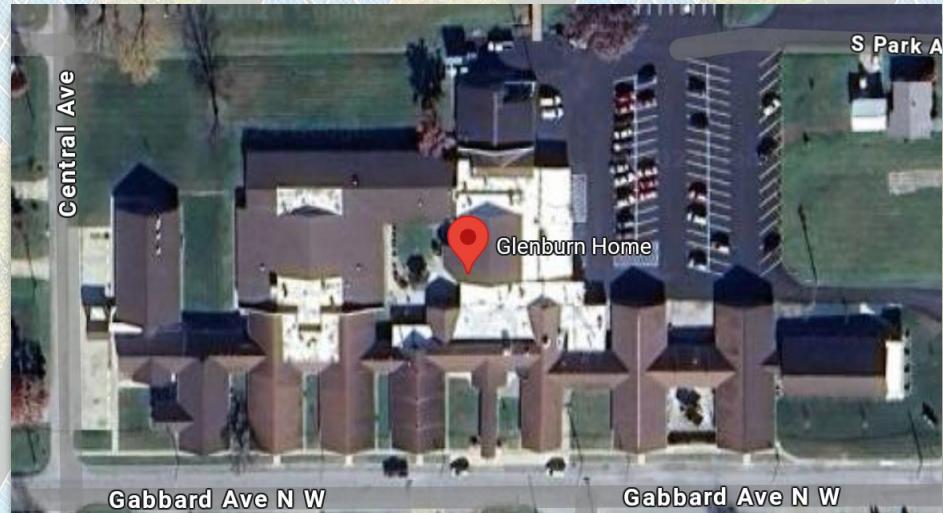
## Solar Data:

Max Array Area (M<sup>2</sup>): **6316.411**

Whole Roof Sunshine Ave: **1281.27**

Solar Data Date: **9/20/2020**

Image Quality: **Medium**



# Municipal Organization #2

Location Name: **Central Christian Church**

Location Type: **Church**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: **15.83**

Utility Name: **HUNTINGBURG MUNICIPAL  
ELECTRIC UTILITY**

Energy Communities: **Coal, FFE**

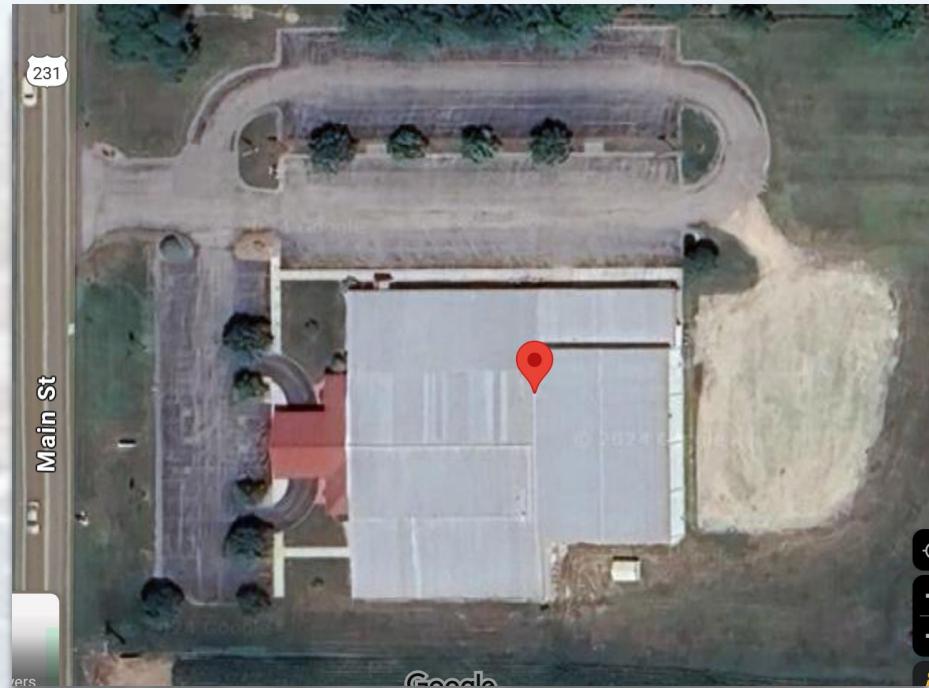
## Solar Data:

Max Array Area (M<sup>2</sup>): **2036.179**

Whole Roof Sunshine Ave: **1367.73**

Solar Data Date: **5/12/2022**

Image Quality: **Medium**



# Municipal Organization #3

Location Name: Huntingburg Event & Community Center

Location Type: Non-profit community event center

Dept. of Energy DAC Tract: Yes

10K DAC Score: 15.83

Utility Name: HUNTINGBURG MUNICIPAL ELECTRIC UTILITY

Energy Communities: Coal, FFE

## Solar Data:

Max Array Area (M<sup>2</sup>): 2009.99

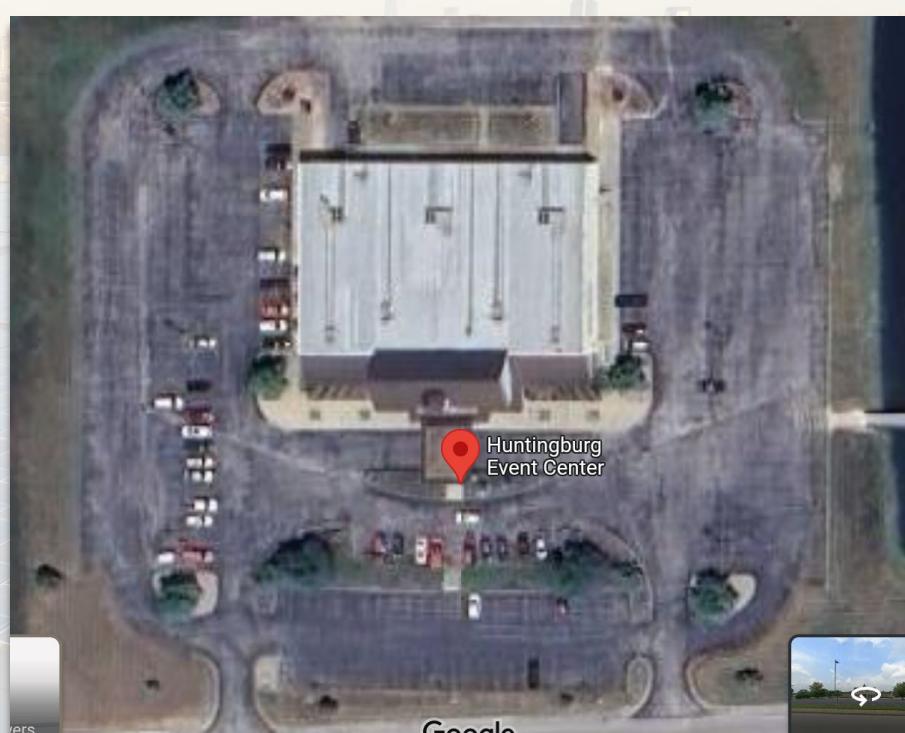
Whole Roof Sunshine Ave: 1320.36

Solar Data Date: 5/12/2022

Image Quality: Medium

Org Website:

<https://www.huntingburgeventcenter.org/>



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# Municipal Organization #4

Location Name: **Office of Hispanic Ministry,  
Diocese of Evansville (St. Mary Catholic  
Church)**

Location Type: **Catholic Church Ministry Office**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: **15.828**

Utility Name: **HUNTINGBURG MUNICIPAL  
ELECTRIC UTILITY**

Energy Communities: **Coal, FFE**

## Solar Data:

Max Array Area (M<sup>2</sup>): **1572.96**

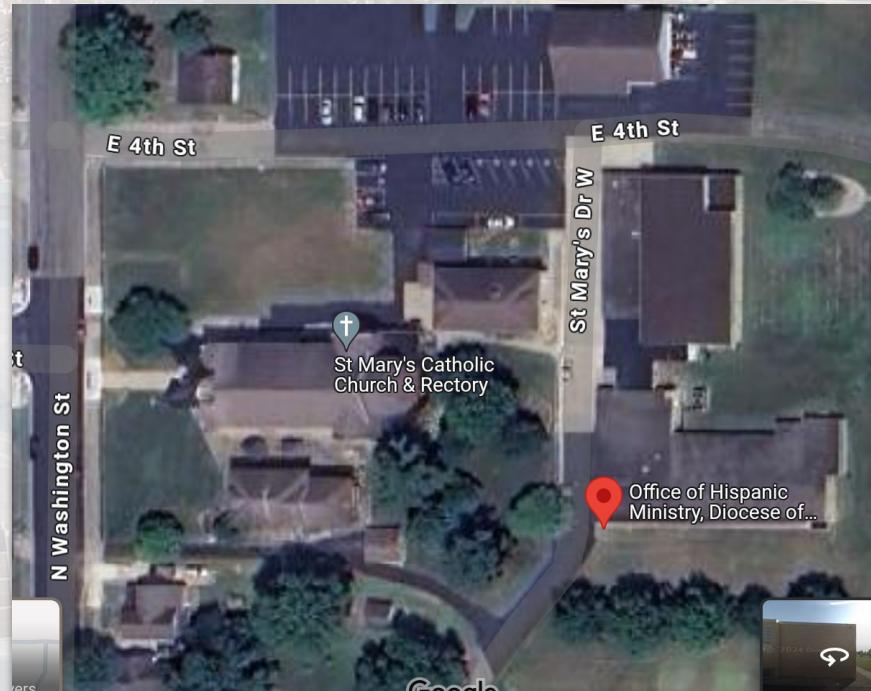
Whole Roof Sunshine Ave: **1329.09**

Solar Data Date: **10/22/2023**

Image Quality: **Medium**

Org Website:

<https://www.evdio.org/ministerio-hispano-hispanic-ministry.html>



# Municipal Organization #5

Location Name: **Daviess County Family YMCA**

Location Type: **YMCA**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: **18.70**

Utility Name: **WASHINGTON LIGHT AND POWER  
(Municipal)**

Energy Communities: **Coal, FFE**

## Solar Data:

Max Array Area (M<sup>2</sup>): 1571.33

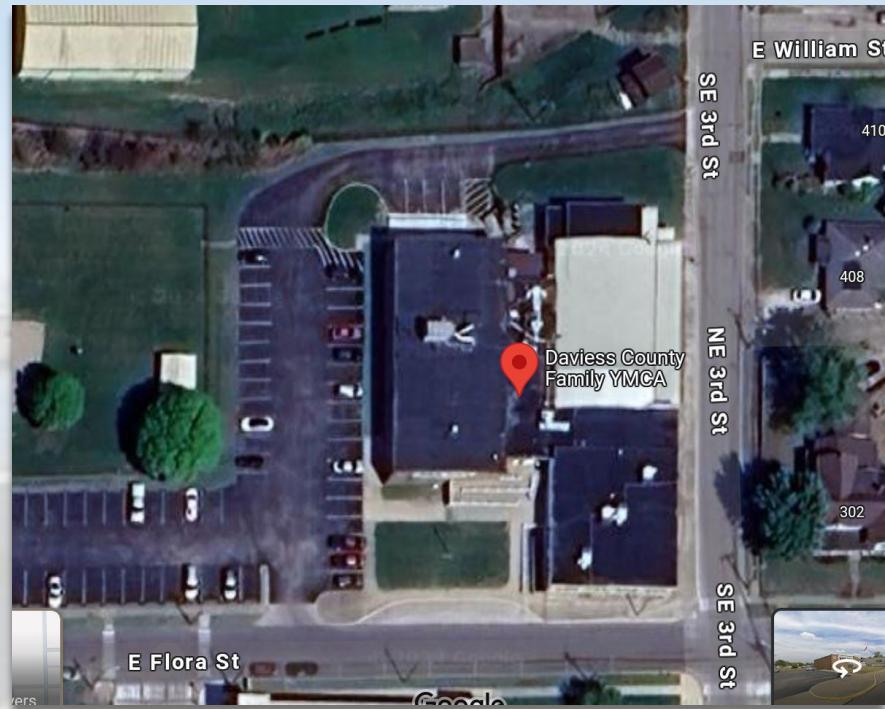
Whole Roof Sunshine Ave: 1316.27

Solar Data Date: 9/5/2020

Image Quality: Medium

Org Website:

<https://www.dcymca.org/>

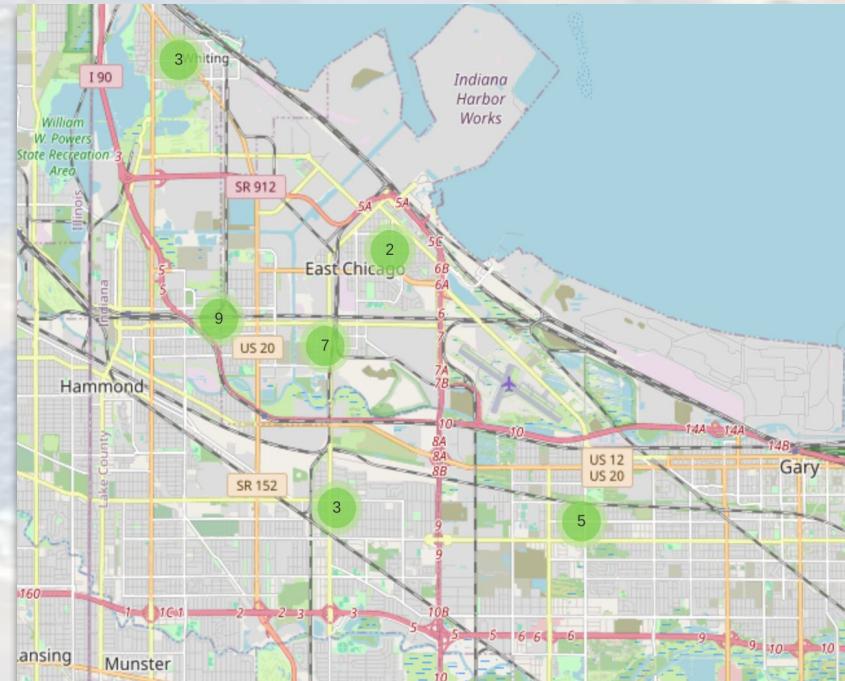


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# Output Datasets: Large Array Area

Top Quarter in  
Array Area in a  
DAC and Coal EC.  
**155 Locations.**

*Northwest  
Region*



**Overview**

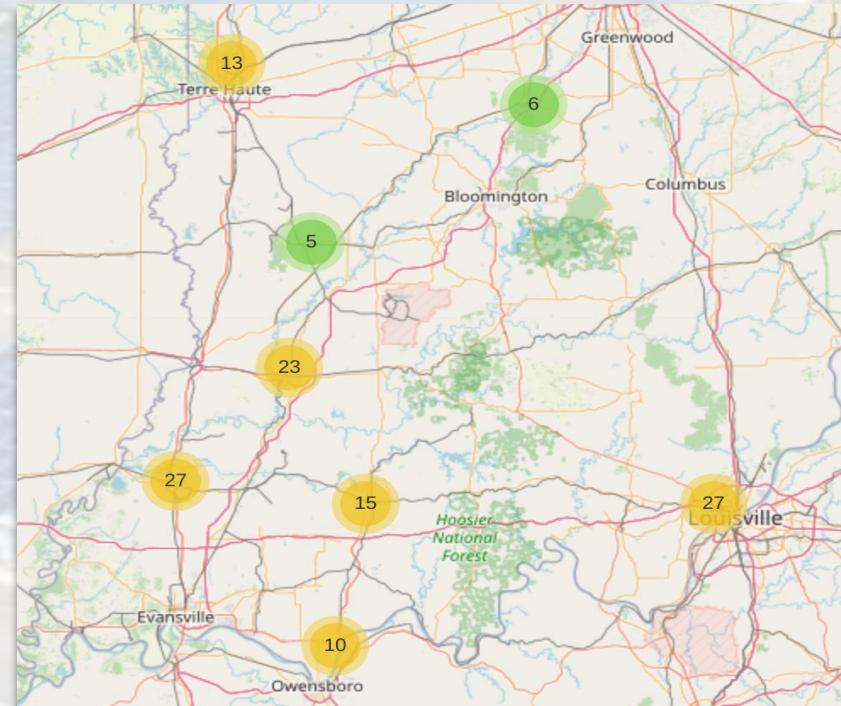


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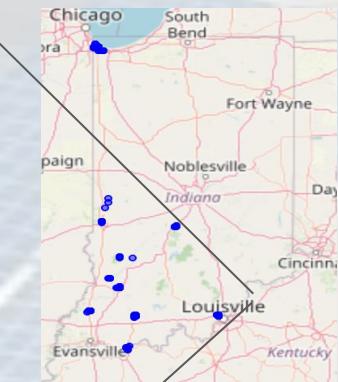
# Output Datasets: Large Array Area

Top Quarter in  
Array Area in a  
DAC and Coal EC.  
**155 Locations.**

*Southwest  
Region*



**Overview**



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# Large Array Area Organization #1

Location Name: **Baptist Health Floyd**

Location Type: **Hospital**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: 16.97

Utility Name: **DUKE ENERGY (IOU)**

Energy Communities: **Coal, FFE**

## **Solar Data:**

Max Array Area ( $M^2$ ): 14,236.89

Whole Roof Sunshine Ave: 1,239.57

Solar Data Date: 9/16/2019

Image Quality: High

Org Website:

<https://www.baptisthealth.com>



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# Large Array Area Organization #2

Location Name: **Bishop Noll Institute**

Location Type: **Catholic High School**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: **19.40**

Utility Name: **NORTHERN INDIANA PUBLIC  
SERVICE COMPANY (IOU)**

Energy Communities: **Coal**

## **Solar Data:**

Max Array Area (M<sup>2</sup>): 10018.85

Whole Roof Sunshine Ave: 1266.36

Solar Data Date: 10/27/2021

Image Quality: High



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# Large Array Area Organization #3

Location Name: IU Health Morgan

Location Type: Hospital

Dept. of Energy DAC Tract: Yes

10K DAC Score: 16.30

Utility Name: DUKE ENERGY (IOU)

Energy Communities: Coal

## Solar Data:

Max Array Area (M<sup>2</sup>): 7162.64

Whole Roof Sunshine Ave: 1280.82

Solar Data Date: 10/20/2022

Image Quality: Medium

Org Website:

<https://iuhealth.org/find-locations/iu-health-morgan>



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# Large Array Area Organization #4

Location Name: **City Baptist High School**

Location Type: **High School**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: **19.41**

Utility Name: **NORTHERN INDIANA PUBLIC  
SERVICE COMPANY (IOU)**

Energy Communities: **Coal**

## **Solar Data:**

Max Array Area (M<sup>2</sup>): 6444.08

Whole Roof Sunshine Ave: 1273.67

Solar Data Date: 10/15/2022

Image Quality: High

Org Website:

<https://www.cbshammond.com/>



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# Large Array Area Organization #5

Location Name: **Lincoln Hills**

Location Type: **Senior Living Center**

Dept. of Energy DAC Tract: **Yes**

10K DAC Score: **16.87**

Utility Name: **DUKE ENERGY (IOU)**

Energy Communities: **Coal**

## Solar Data:

Max Array Area (M<sup>2</sup>): 3982.33

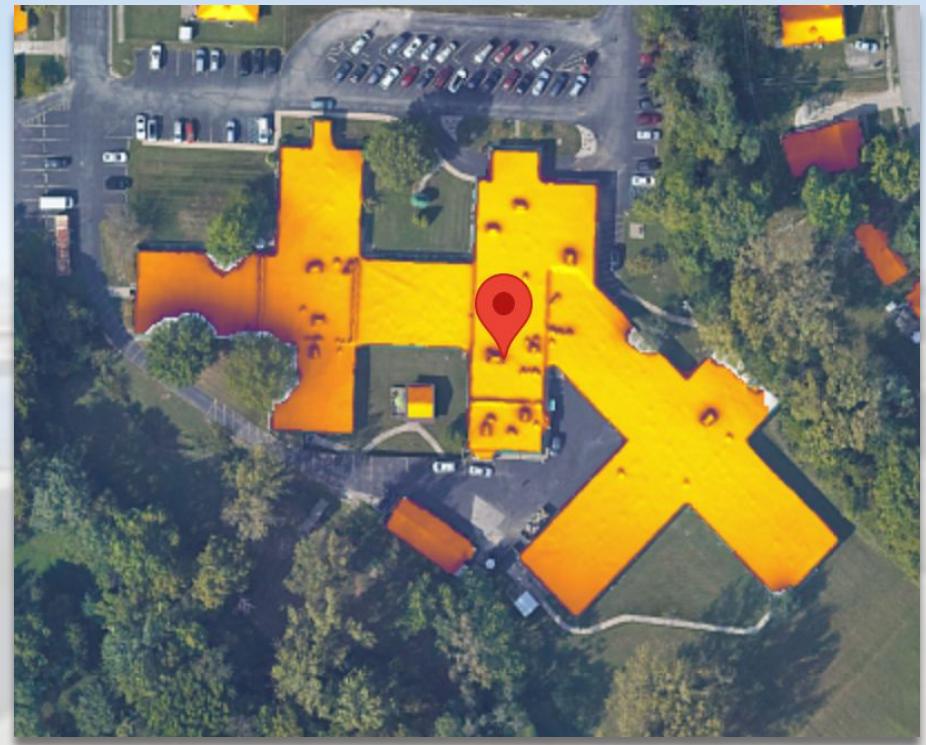
Whole Roof Sunshine Ave: 1280.77

Solar Data Date: 10/17/2020

Image Quality: High

Org Website:

<https://cardon.us/communities/linden-hills-health-center/>



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# Solar Insights Web Application

## Introduction to the Interactive Solar Insights Project

### **Purpose:**

Integration of Google Solar API using C# CSHTML, JavaScript for enhanced web application.

**Locations:** Filtered locations as input to Google Solar APIs for estimation and building insights



# Understanding Google Solar API

## Features and Capabilities of Google Solar API

- **Description of the API:** Provides detailed solar data for buildings including sun exposure and shaded areas.
- **API utility:** Helps decide optimal placement for solar modules based on yearly, monthly, or hourly sunlight data.
- **Challenges:** Complexity in handling GeoTIFF files, which require processing for application use.



# Application Functionality and User Interface

## Functionality and UI of the Solar API Application

- **Core functionalities:** Display of interactive maps, solar exposure calculation.
- **User interface components:** Map container, selection controls, address input.
- Demonstration of adding and interacting with solar data layers on the map.



# Challenges and Solutions

## Challenges in Project Implementation and Solutions

- **Major challenges:** Processing complex GeoTIFF files, managing data layers, and ensuring accurate coordinates.
- **Solutions implemented:** Using specific libraries for image handling, detailed documentation exploration, and custom script adjustments for API interactions.



# Technical Setup and Integration

## **Setting Up and Integrating Google Solar API**

- **Key technologies:** CSHTML, JavaScript.
- **Libraries and frameworks utilized:** Proj4JS for coordinates, GeoTIFF.js for image processing.
- Steps for setting up the API and integrating it with web applications.



# Solar Insights Web Appl. Screen-1

LUDDY SCHOOL OF  
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AND ENGINEERING  
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Data Science In Practice  
Community Solar Power Estimator

**Address:** Boone County - INDIANAPOLIS / 5292 SNOWBELL LN

**Google Solar API Data**

Select Layer: Annual Flux

Month: July

Select Hour: 12 PM

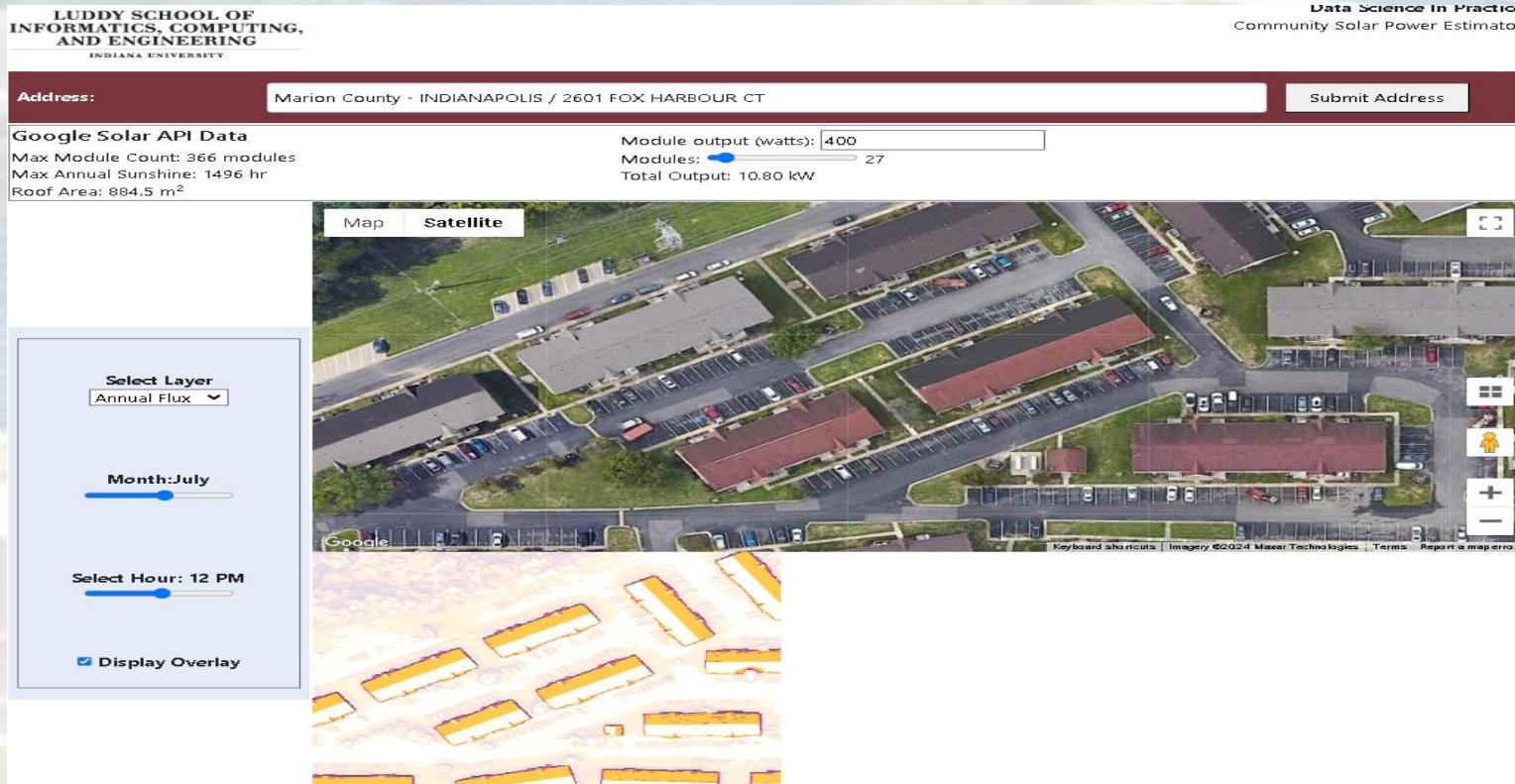
Display Overlay

Boone County - INDIANAPOLIS / 5292 SNOWBELL LN  
Marion County - INDIANAPOLIS / 2153 DR A J BROWN AVE  
Marion County - INDIANAPOLIS / 3155 E 10TH ST  
Marion County - INDIANAPOLIS / 8140 UNION CHAPEL RD  
Marion County - INDIANAPOLIS / 1902 N HARDING ST  
Marion County - INDIANAPOLIS / 963 N GIRLS SCHOOL RD  
Marion County - INDIANAPOLIS / 3243 N MERIDIAN ST  
Marion County - INDIANAPOLIS / 2601 FOX HARBOUR CT  
Marion County - INDIANAPOLIS / 348 W 11TH ST  
Marion County - INDIANAPOLIS / 3707 WOODVIEW TRCE  
Marion County - INDIANAPOLIS / 7401 S HARDING ST  
Marion County - LAWRENCE / 4712 N FRANKLIN RD  
Marion County - INDIANAPOLIS / 6067 DECATUR BLVD  
Marion County - INDIANAPOLIS / 2700 S TIBBS AVE  
Marion County - INDIANAPOLIS / 1002 W EDGEWOOD AVE  
Marion County - INDIANAPOLIS / 5360 ROCKVILLE RD  
Marion County - INDIANAPOLIS / 900 E STOP 11 RD  
Marion County - INDIANAPOLIS / 8615 SPRING MILL RD  
Marion County - INDIANAPOLIS / 1801 BROADWAY ST  
Marion County - LAWRENCE / 8155 OAKLANDON RD



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# Solar Insights Web Appl. Screen-2



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# Conclusion

## **Impact and Benefits:**

- Demonstrates the power of detailed solar data in determining optimal solar installation placement.
- It helps in understanding and visualizing the impact of solar exposure on buildings, enhancing energy efficiency plans.

## **GitHub URL**

<https://github.com/srisama/CommunitySolarProjectPoc>



# Next Steps

- Further analysis on the criteria for solar projects using solar data.
- Cleaning datasets to ensure location validity.
- Cleaning and verification of place names and details.
- Analyze the legal and political framework for Community Solar, weighing the relative merits of our data factors.
- Can we apply the project to other types of renewables?
- Can we apply the project to other states?
- Build a machine learning dataset to use with Google Solar API Data and other data features from the project to quickly assess locations.



# Resources

1. <https://www.utilitydive.com/news/electricity-load-growing-twice-as-fast-as-expected-Grid-Strategies-report/702366/>
2. <https://www.utilitydive.com/news/us-electricity-prices-rise-customer-eia-outlook/710113/>
3. Indiana Electric Utility Data:
  - o <https://www.indianamap.org/datasets/INMap::electric-service-territories-iurc/explore>
4. Google API Info:
  - o <https://developers.google.com/maps/documentation/solar/overview>
  - o <https://developers.google.com/maps/documentation/places/web-service/nearby-search>
5. Indiana Location Data:
  - o <https://data-harvest-ingov.hub.arcgis.com/>
6. Energy Communities Data:
  - o <https://arcgis.netl.doe.gov/portal/apps/experiencebuilder/experience/?id=a2ce47d4721a477a8701bd0e08495e1d>
7. Justice 40 Initiative:
  - o <https://www.energy.gov/sites/default/files/2022-07/Final%20DOE%20Justice40%20General%20Guidance%20072522.pdf>
  - o <https://energyjustice.egs.anl.gov/>

