



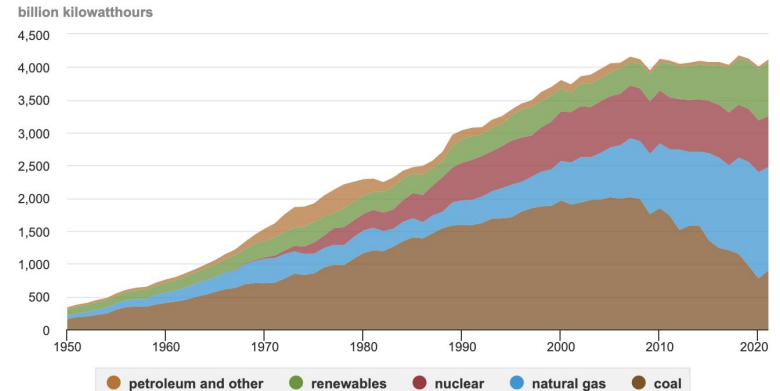
# Here Comes the Sun: Solar Siting for Williams' Electricity Production

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# State of the World

- Joe Biden: goal of 100% carbon-free grid by 2035 (Dec. 2021)
- Massachusetts: net-zero emissions by 2050

U.S. electricity generation by major energy source, 1950-2021



# Why solar siting at Williams?

- Integral Group ('19-'20): pathways to **2050 carbon neutrality**
- Strategic Plan ('21): "100% renewable purchased" + **increased generation** as a goal
- Opportunities on College-owned land?



# Solar So Far

- Environmental Center (CES+Zilkha) (58.39 DC kW)
- Horn Hall (50.15 DC kW)
- South Science Building (52.08 DC kW)
- Sawyer Library (81.60 DC kW)
- Farmington Solar Project (76 MW)
- The Log (13.92 DC kW)! and more...





# 1. What makes a good site?

Our research for (1) ground-mount, (2) roof-mount, and (3) carport systems

# 1. Human Interest Considerations

- Stockbridge-Munsee Site of Importance
- Current use!
  - Local agricultural economy
  - Recreation
  - CO<sub>2</sub> sequestration



## 2a. Technical

	(+)	(-)	<b>Data Collection</b>
<b>Topography</b>	Flat, gradual	Unsuitable ecosystem (floodplain, forest, wetland)	Site visit and previous student report
<b>Shading</b>	No tree or building shading	Complete shade	GoogleEarth and site visit
<b>Orientation</b>	South	North	GoogleEarth and site visit

## 2b. Technical

	(+)	(-)	Data Collection
<b>Roof slope</b>	Flat, gradual	Unusual features	Site visit
<b>Roof material</b>	Standing-seam metal	Slate	GoogleEarth and site visit
<b>Orientation</b>	South	North	GoogleEarth and site visit
<b>Shading</b>	No tree or building shading	Shaded	GoogleEarth and site visit

## 2b. Technical: A bad example

(-) Slate roof

(-) North-facing  
roof



(-) Steep, complex  
roof

(+) Minimal shading  
from trees, buildings

Weston Hall (Admissions)

## 2c. Technical

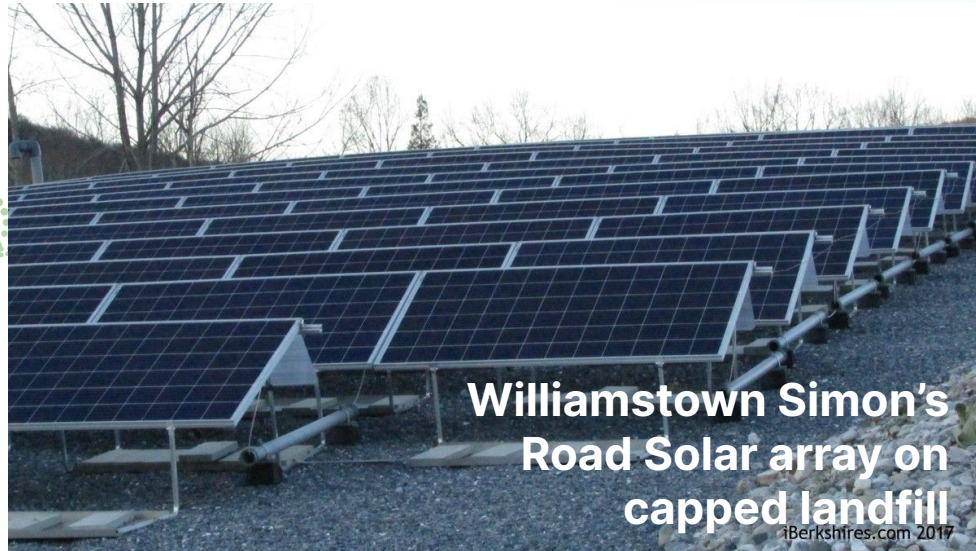
	(+)	(-)	Data Collection
Shading	No tree or building shading	Complete shade	GoogleEarth and site visit





# 3. Size: Bigger is better!

- Carbon avoided
- Economies of scale, generally — system cost





## 4. Future Considerations

- Roof age and load → structural engineer
- Grid connection → discuss with local utilities
- Ownership structure (PPA) → post-system design



# 5. Cobenefits

- Carports → covers cars in rain/snow, charging stations
- Roof-mounted → visibility
- Ground-mounted → agrivoltaics potential (if Williams acquired new undeveloped land)

UMass Amherst carport



William's Library Shelving Facility

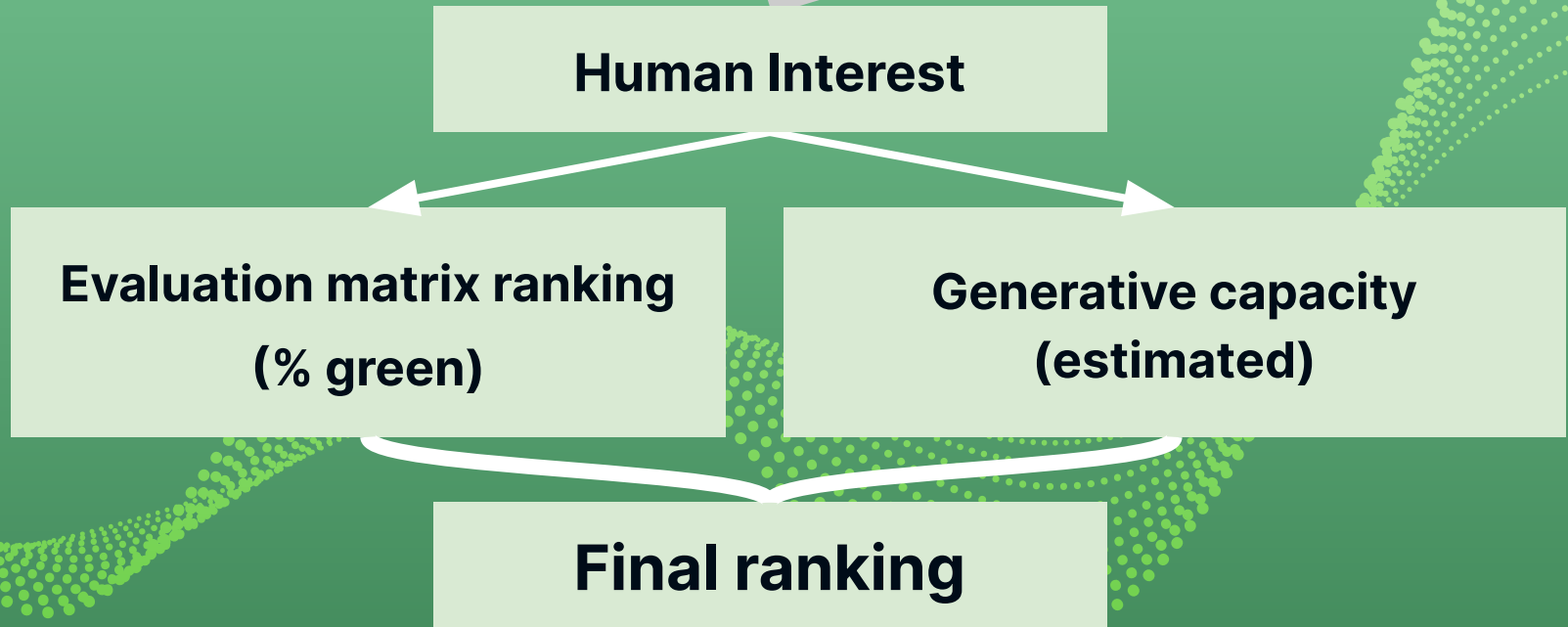


Williams' Simon Road Solar LLC



# 2. Combining the Considerations

Any red =  
elimination



# 3. Where could solar be?

Applying our findings to Williams-owned properties

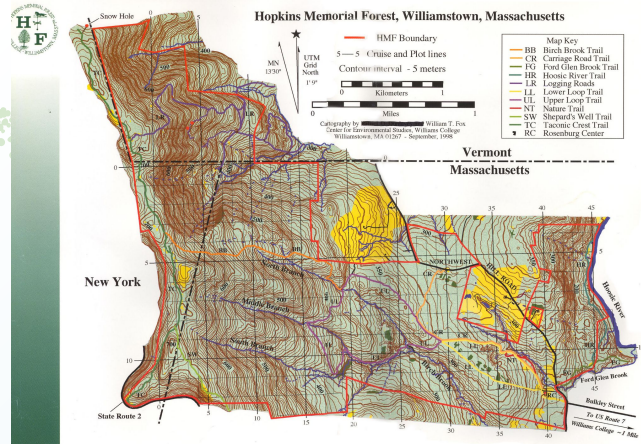
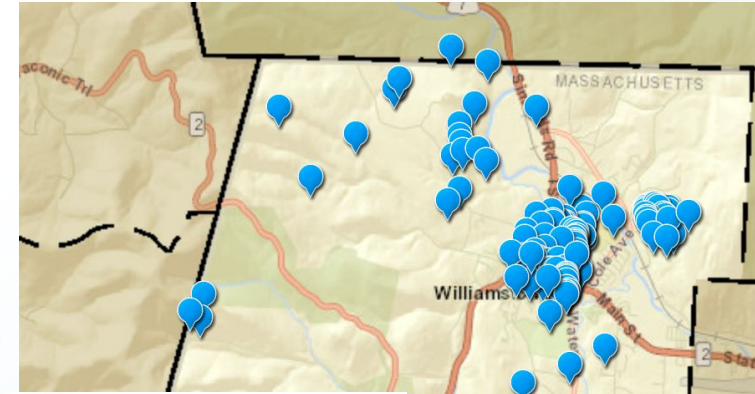


# How many acres of land does Williams own?

Williams-owned properties on the town assessor map

- Facilities property list has 231 buildings — does not include open land
- College should be more transparent about how much they own — can't answer the question

HMF extends into VT and NY



# Example Top Sites - On-campus

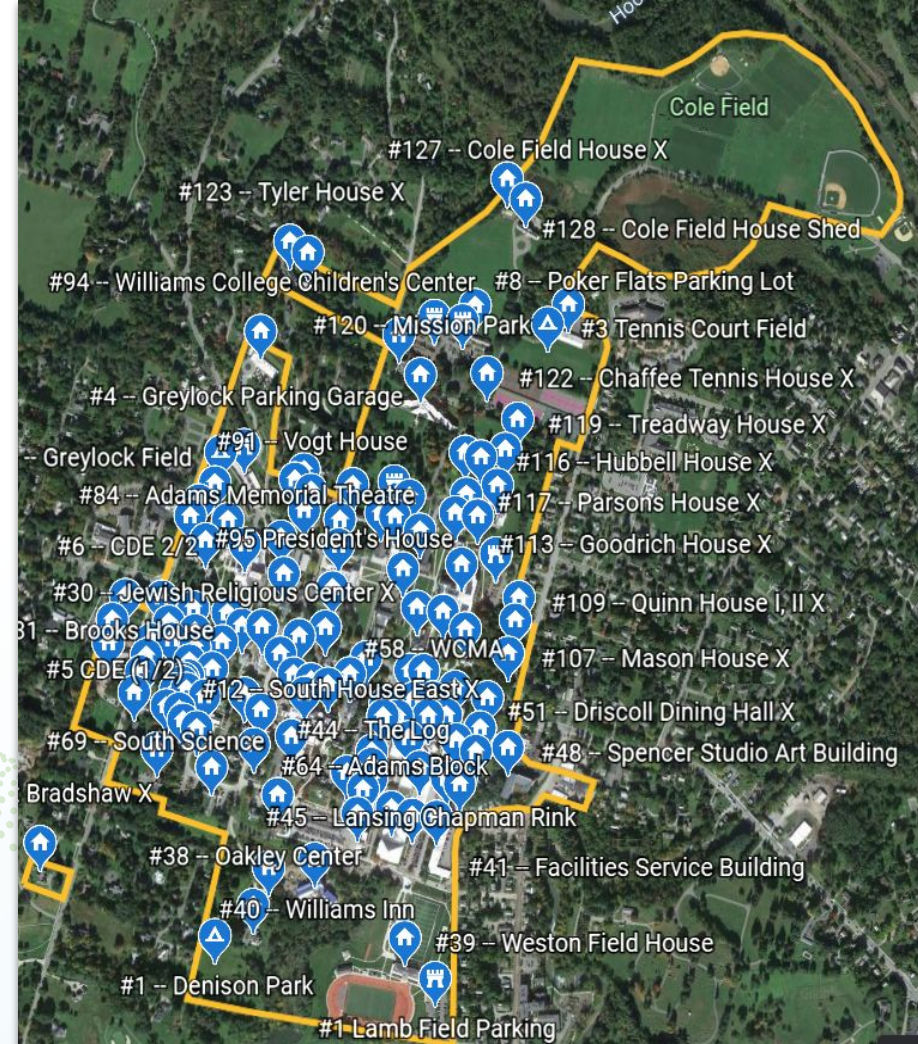
- Directly powers Williams College
- Visible
- Relatively inexpensive connection
- Smaller sites (rooftop)
- Some previous penetration





# On Campus - All

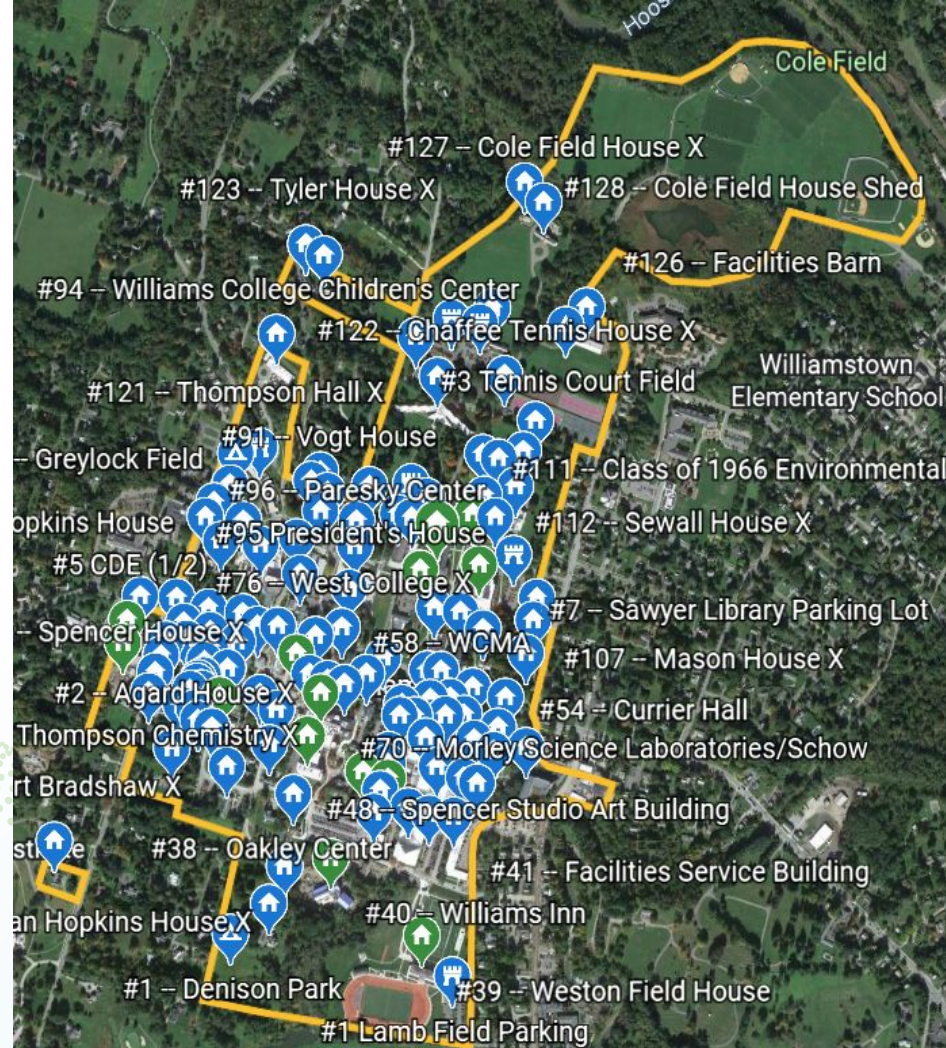
- 130 buildings
- 7 parking lots
- 3 open fields





# Already has Solar

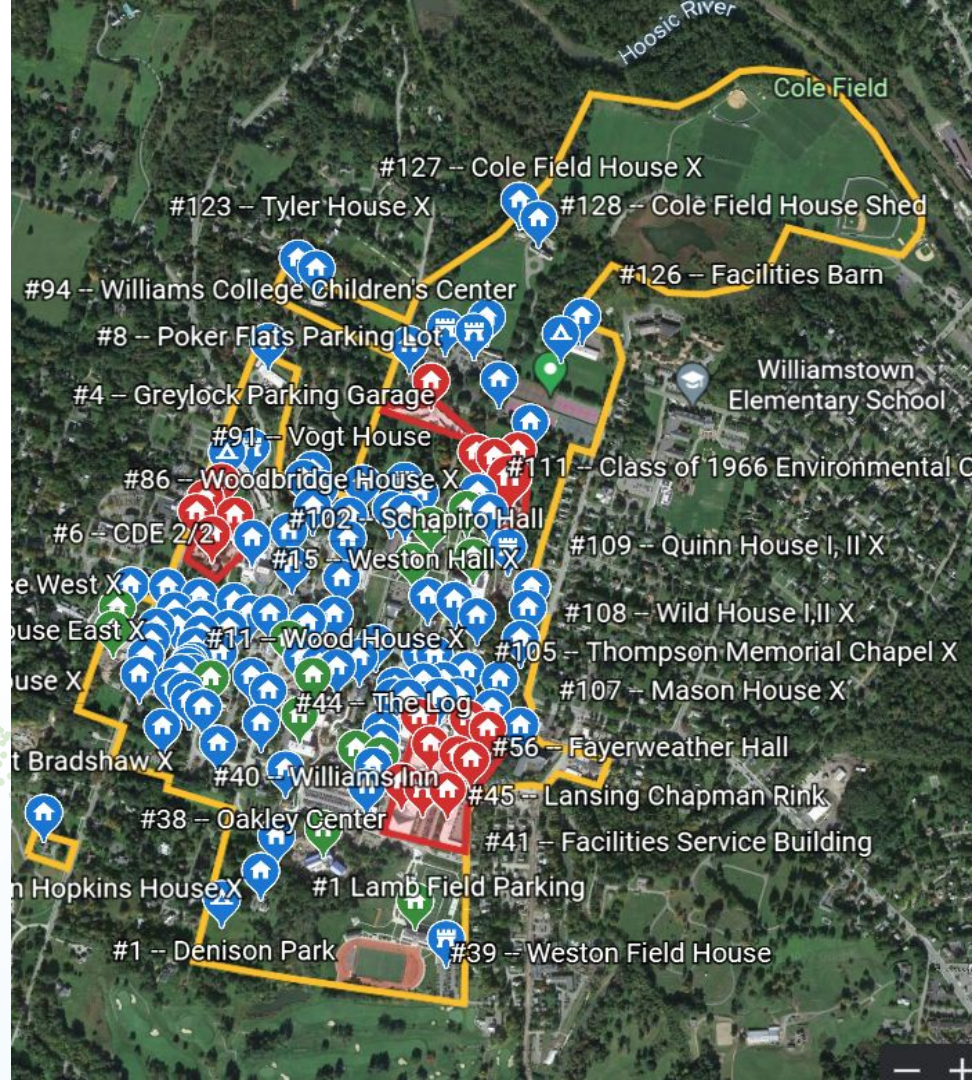
- 14 buildings
- Installed, in process, and upcoming
- Labeled green





# Zones of Uncertainty

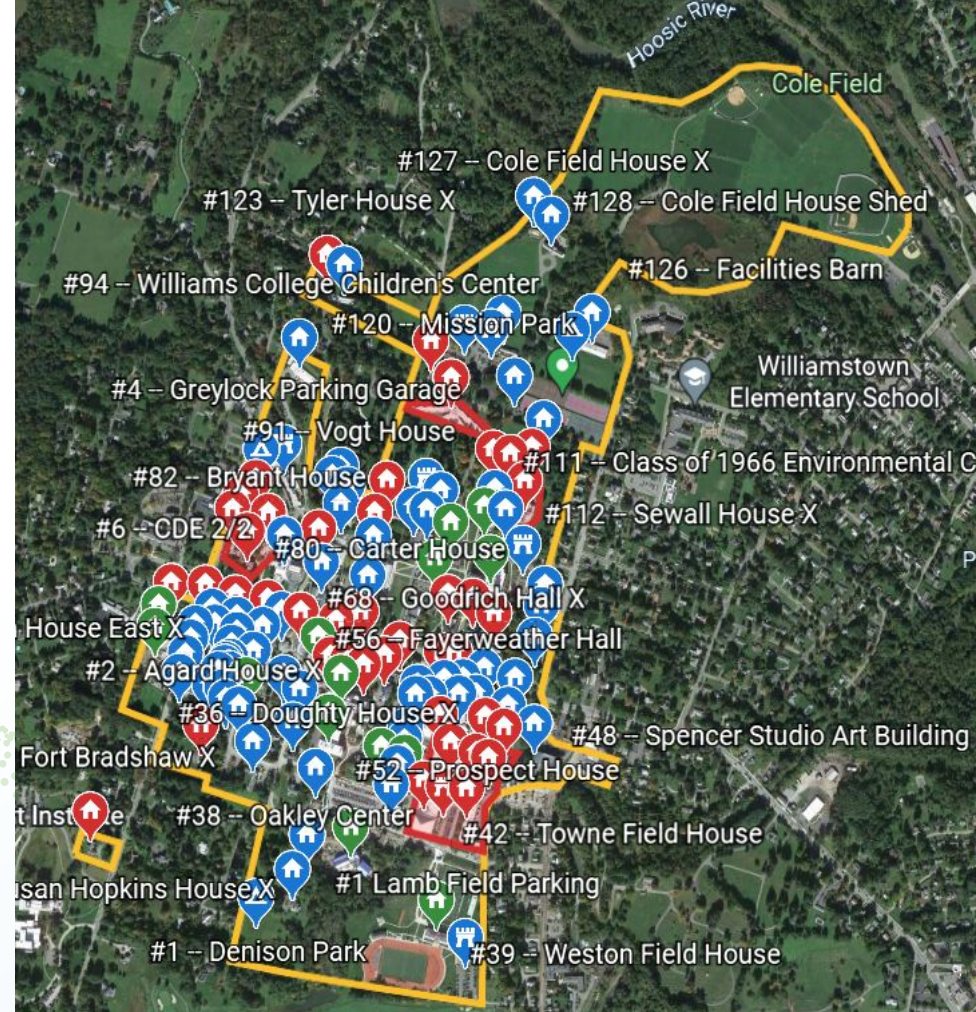
- 4 zones
- 18 buildings
- 1 parking lot
- Do not have 25+ clarity on plans
- Red zones
- Labeled red





# Slate roof

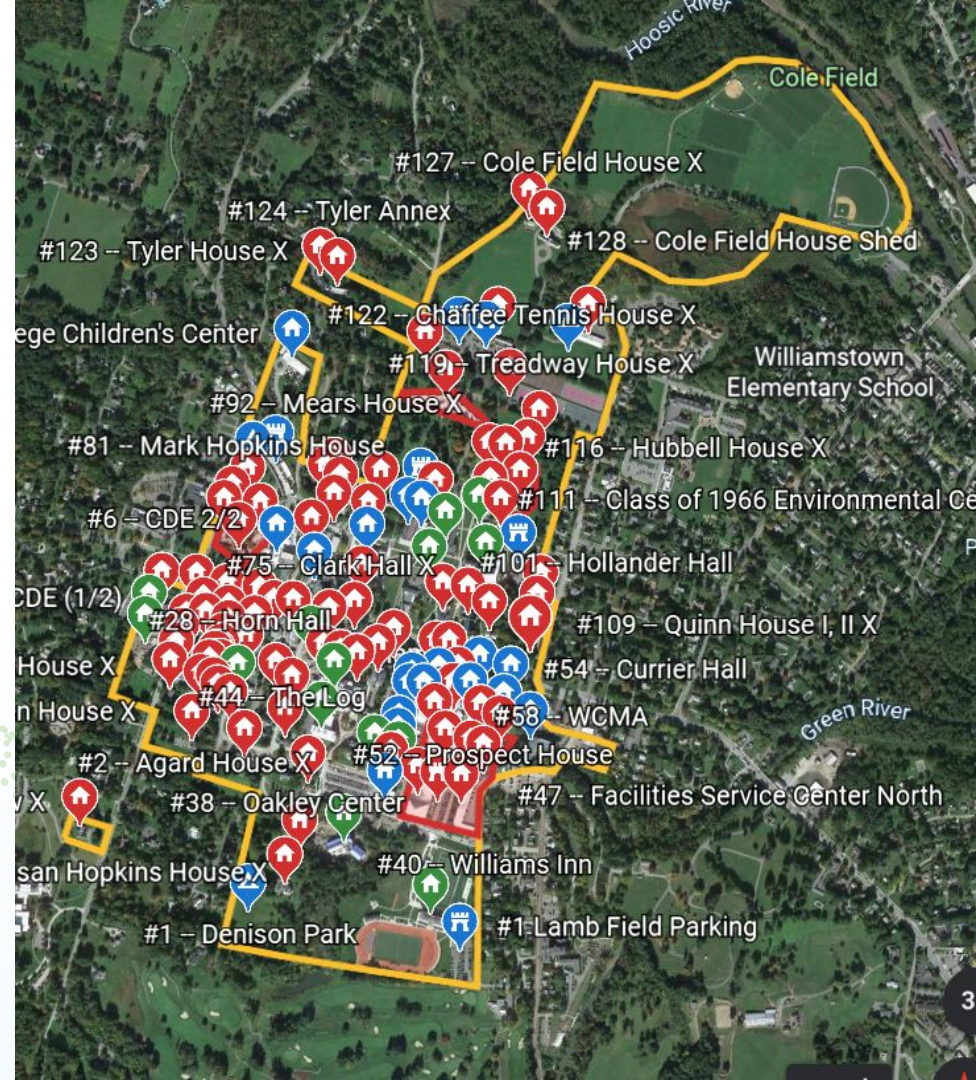
- 24 additional buildings
- Not suitable for solar
- Mostly old, mostly small





# Other Factors

- 57 additional buildings
- Too small (< 50kW)
- Southern tree shading
- Oddly shaped roof
- Slated for demo



# Remaining Sites

- 17 buildings
- Many close to 50 kW threshold
- Top 6 by size and suitability



STUDENT MOCKUP



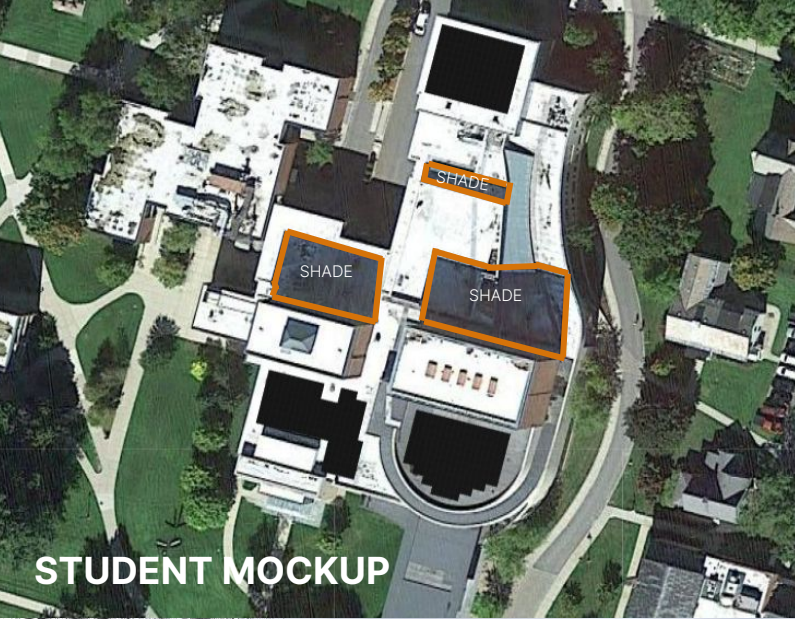
# Chandler Athletic (34 Spring Street)

- 133.2 kW, 72.6 tons of CO<sub>2</sub> avoided annually
- 8.3 homes' yearly energy
- Flat roof
- Close to S orientation
- No shading



# Adams Memorial Theatre (1000 Main Street)

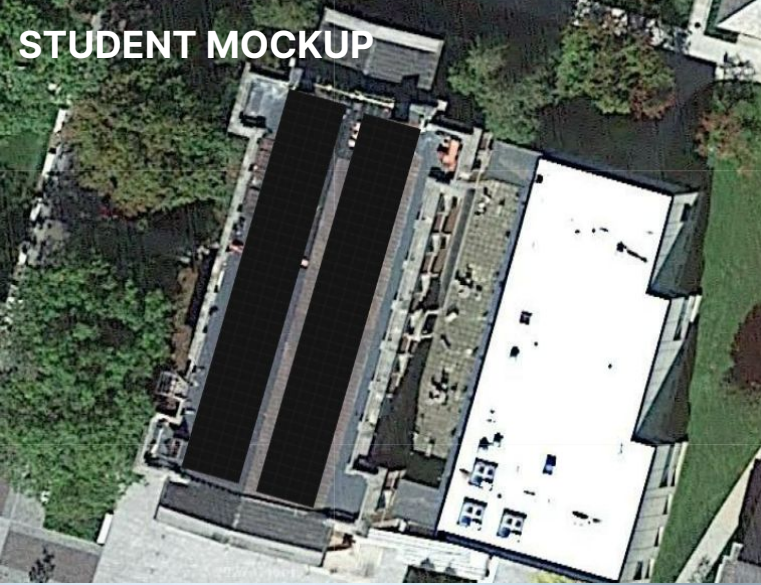
- 156.9 kW; 85.5 tons of CO<sub>2</sub> avoided annually
- 9.8 homes' yearly energy
- Flat roof
- Close to S orientation
- No shading (parts)
- Many-sectioned roof



STUDENT MOCKUP

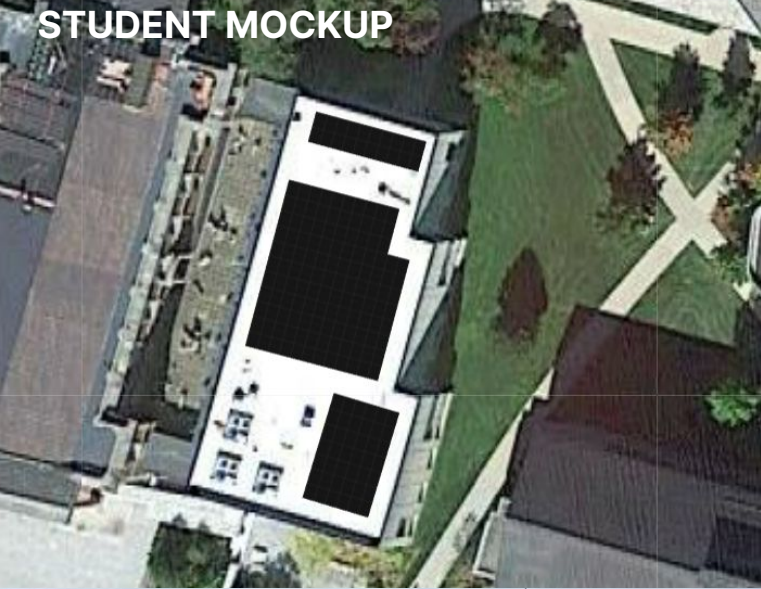






## Chapin Hall

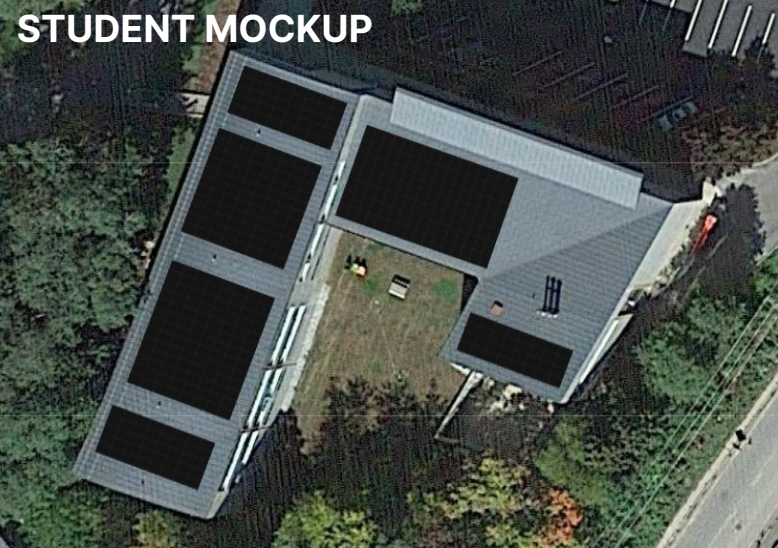
- 106.6 kW; 58.1 tons of CO<sub>2</sub> avoided annually
- 6.6 homes' yearly energy
- E/W roof
- Slightly pitched
- No shading
- Standing seam metal
- Could be done alongside Bernhard



# Bernhard Music Center (54 Chapin Hall Drive)

- 69.6 kW; 37.9 tons of CO<sub>2</sub> avoided annually
- 4.3 homes' yearly energy
- Flat roof
- Close to S orientation
- No shading
- Some RTUs





## Spencer Studio Art (Driscoll Hall Dr)

- 153.9 kW, 83.8 tons of CO<sub>2</sub> avoided annually
- 9.6 homes' yearly energy
- Flat and barrel roof
- S, E, & W orientation
- No shading
- Fake standing seam metal



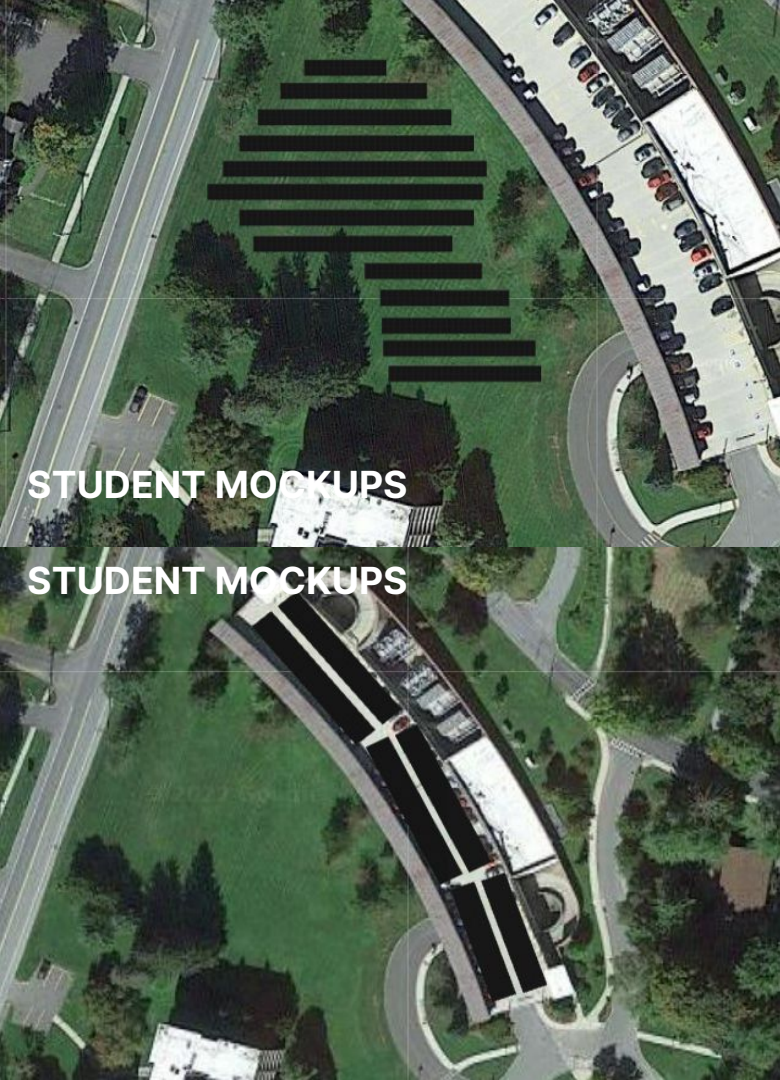
# Children's Center (44 Whitman Street)

- 98.8 kW; 53.8 tons of CO<sub>2</sub> avoided annually
- 6.1 homes yearly energy
- Flat roof
- Close to S orientation
- Minimal shading
- Need connection information

# Honorable Mentions

- Carrier/Berkshire Quad (Four Buildings)
- Simon Squash
- Danforth Block
- Chandler Commercial/Adams Block
- B&L Building
- Faculty House
- Paresky Center



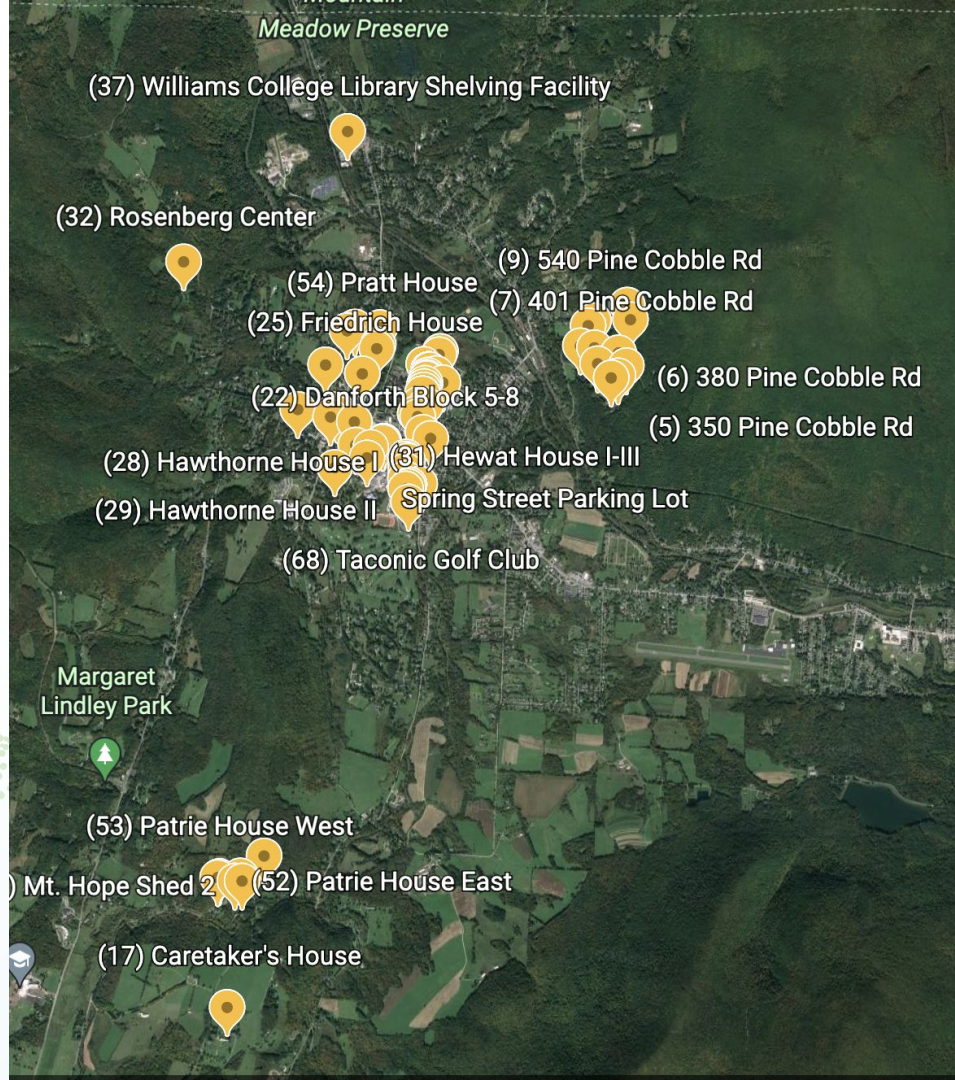


## “Gladden Field” and Parking Garage (near 44 North Street)

- 291.6 kW and 287.1 kW; 159.0 and 156.0 tons of CO<sub>2</sub> avoided annually
- 18.1 and 17.9 homes' yearly energy
- Ground mount and carport
- Close to Gladden
- Currently empty space

# Example Top Sites — Off-campus

- Indirectly contributes to emissions reductions
- Incorporates community
- Less visible
- Potential connection costs







# Grundy's Garage (Water St.)

- 164.3 kW; 89.5 tons of CO<sub>2</sub> avoided annually
- 10.2 homes' yearly energy
- Flat roof
- Minimal shading



# Spring Street Parking Lot (Carpport)

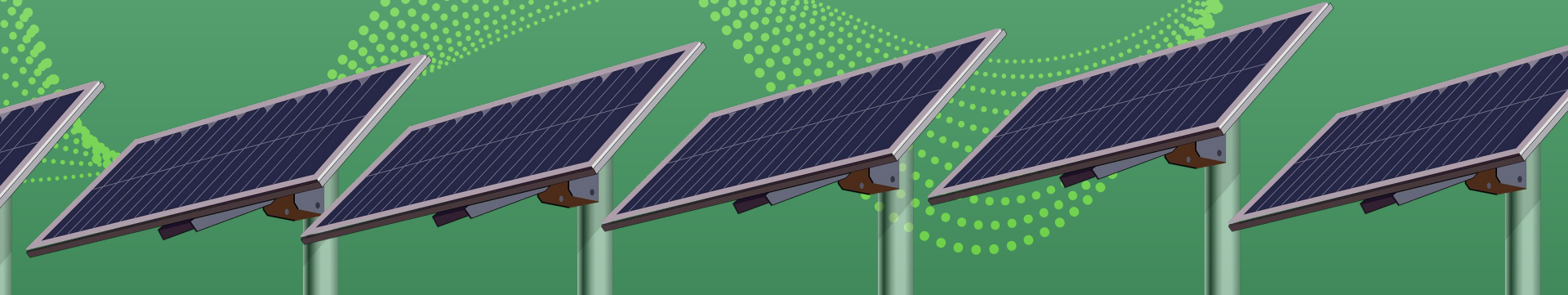
- 552.8 kW; 301.0 tons of CO<sub>2</sub> avoided annually
- 34.4 homes' yearly energy
- No shading
- Connection cost questions
- Provides cover for cars
- Potential for charging



TOTAL GENERATION  
POTENTIAL

=

2.015 MW



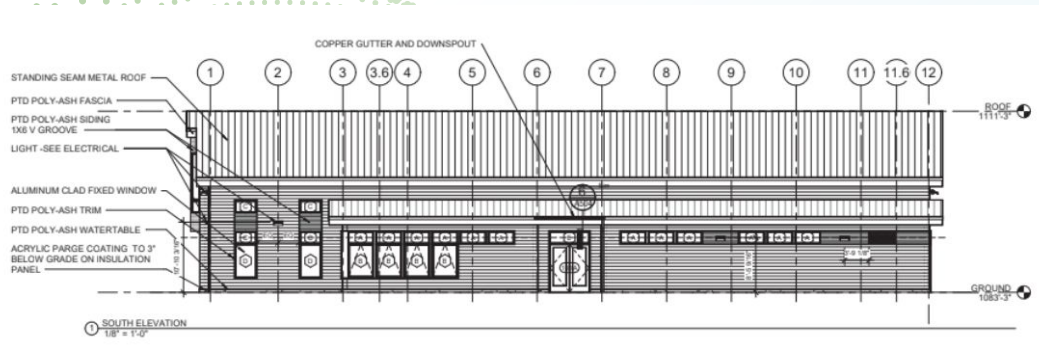
# 4. Recommendations for Williams

How the College should approach solar and renewables going forward



# All new buildings should have solar installed

- A significant investment in property should be accompanied with a significant investment in solar
- Barring shading, ability to connect to the grid, and building permanence



# Current use comes first

- Previously developed ideal for ground-mounted
- Consider wind for low impacts to land use





# Williams, please consider our sites <3

- Look at the sites we suggested
- Win (carbon elimination) — win (potentially cheaper because of changing incentive landscape)



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# Thank you!

Questions? Thoughts?