Mapping Rooftop Photovoltaic Panels & Assessing the Suitability of Building Rooftops for Photovoltaic Installation in Worcester, MA

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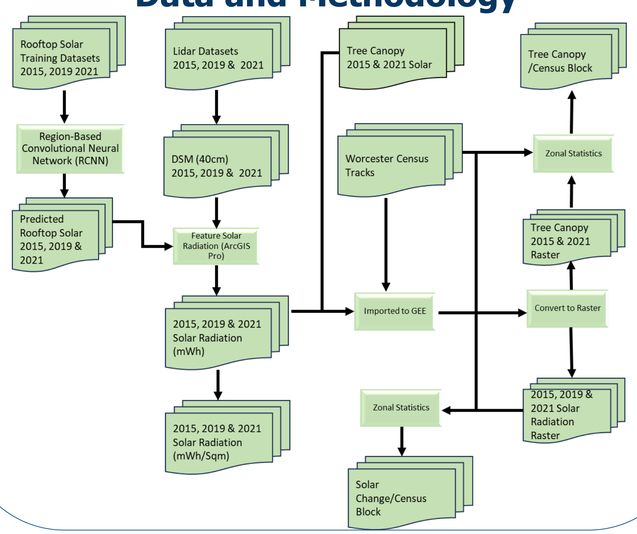
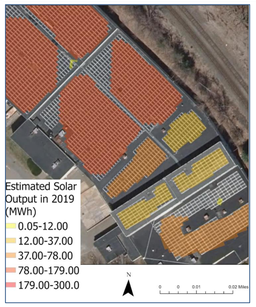
Introduction

Governments worldwide are reshaping energy policies to combat climate change, transitioning from conventional to renewable energy sources. This has increased global reliance on renewables between 8-10% which aligns with environmental goals and presents socio-economic benefits (Shivanshu (2020)). Solar energy, notably rooftop installations, plays a pivotal role, with urban areas increasingly adopting them. However, their efficacy depends on factors like building suitability, often overlooked in assessments. Our project, focused on Worcester, Massachusetts, utilized high-resolution datasets and adapted methodologies to identify, evaluate, and analyze rooftop solar panels. The project mapped rooftop solar panels in Worcester, developed an MCE model, and assessed solar potential and impacts. Our Research questions explored electricity capacity, rate of change, spatial distribution patterns, and tree canopy cover changes. The project provided insights into solar adoption patterns, suitability, and potential environmental impacts.

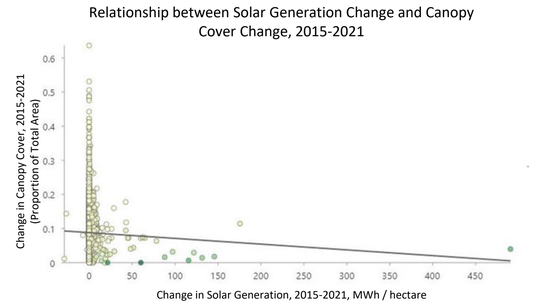
Data and Methodology



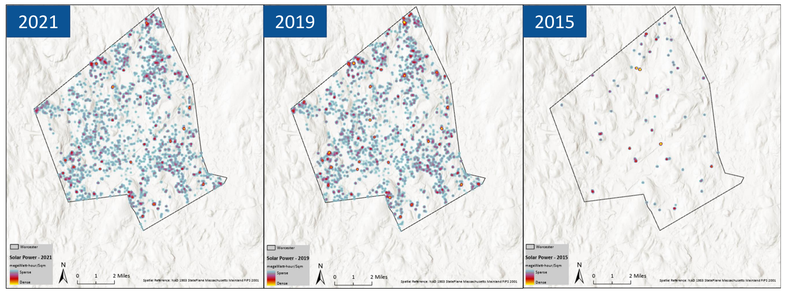
Results



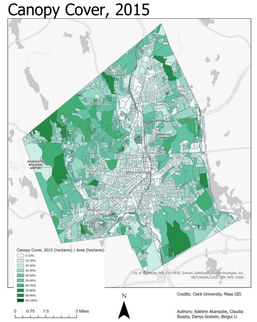
Predicted 2019 Solar Output (MHh)



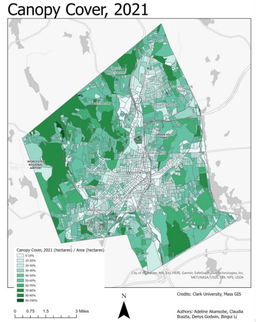
Solar Power (MWh/Sqm)



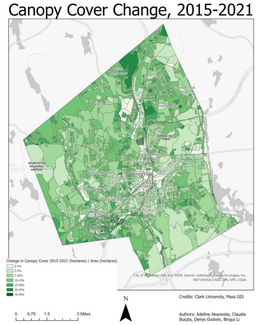
Canopy Cover, 2015



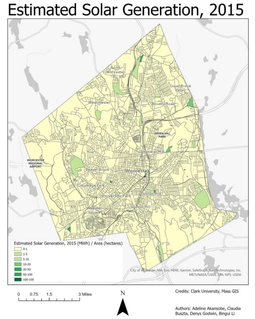
Canopy Cover, 2021



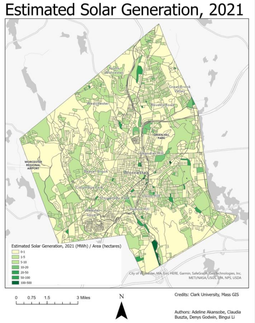
Canopy Cover Change, 2015-2021



Estimated Solar Generation, 2015



Estimated Solar Generation, 2021



Year	Identified Rooftop Solar Patches	Solar Panel Area (m^2)	Estimated Power Output (MWh)	Total Available Solar Energy (MWh)
2015	128	25,977	2,100	15,262
2019	2,944	213,378	16,265	118,206
2021	2,870	232,649	17,881	129,950

Year	Tree Canopy Area (Hectares)
2021	4,002.01
2015	3,430.90

Discussions

There was a rapid increase in solar panel installations from 2015-2021 with an increase in total area of solar panels and power output estimates increased for each consecutive year. Number of solar panels decreased from 2019 to 2021.

Rate of increases from 2015 to 2019 was higher than 2019 to 2021, thus installation reduced but increase in output likely to be solar upgrades.

Tree canopy decreased by 22,775 hectares from 2015 to 2021. This number, while much larger proportionately than the area of increase in solar panels, also includes trees removed for urban development.

Conclusions

Over the last six years in Worcester, solar panel installations have surged, contributing to increased total area and power output estimates. Despite a decrease in the number of solar panels from 2019 to 2021, likely due to data inaccuracies, the growth rate has slowed, possibly influenced by the higher initial count in 2019. Concurrently, tree canopy cover decreased significantly by 22,775 hectares from 2015 to 2021, reflecting a complex interplay of natural changes and urban development.

The results of the regression analysis between the change in tree canopy (2015-2021) and the change in solar generation per census block indicate a negative correlation.

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