

Improving Urban Sustainability Through Solar Panel Identification on Building Rooftops

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Introduction

Rooftops equipped with photovoltaic systems are considered sustainable roof typology because they promote the use of renewable energy sources, reduce carbon emissions, increase energy efficiency by reducing the strain on the national grid, and can increase property values.

According to a report by the National Renewable Energy Laboratory (NREL), as of 2019, homeowners with PV systems saved on average between \$44 and \$187 per month on their electricity bills, depending on the size of their PV system and their electricity usage. In Worcester, MA, the average cost for solar panel installation is between \$12,286 and \$15,016, considering the fact that homeowners can receive a 22% federal tax credit. Over a 25-year period, the average savings for Worcester homeowners range from \$67,527 to \$82,533. The average payback period for the installation of solar panels in Worcester is between 3.5 and 4.3 years.

Objectives

- Examine the current status of the sustainable roofscape by identifying solar installation on rooftops at a large-scale from satellite imagery.
- Uncover the pattern of sustainable rooftops across Worcester, MA and New York, NY.
- Track and monitor the current use of rooftops.

Train Data

Data Source

- Satellite imagery with resolution of 50 cm retrieved with the Mapbox static tiles API from 17 morphologically diverse and geographically distributed cities worldwide.
- Building footprints extracted from OpenStreetMap
- More than one million image chips

Test Data

- Satellite imagery of Worcester city from Google Satellite base map
- 12323 image chips

Implications of the Research

- Identifying rooftops with solar panels helps urban planners and policymakers to inform the success of urban solar energy projects and potential for expansion.
- For grid system operators and decision-makers, the detailed information on the locations and power capacity of solar panels can enable better planning of distribution line topologies to ensure electricity reliability with increased two-way flows of energy.
- This information can facilitate socioeconomic analyses of rooftop PV deployment and the development of predictive algorithms for anticipating future PV array locations.

Further Improvements

- Estimating the potential by identifying suitable roofs that are not yet utilized for PV system.
- Adding the capability of identifying solar farms.
- Calculating the estimated amount of electricity generated by solar panels in each area.
- Utilizing Meta AI's Segment Anything tool to detect and label rooftops with solar panels, which can then be used to fine-tune the model.

References

- Wu, Abraham & Biljecki, Filip. (2021). Roofpedia: Automatic mapping of green and solar roofs for an open roofscape registry and evaluation of urban sustainability. *Landscape and Urban Planning*.
- <https://www.solarreviews.com/solar-panels/worcester-massachusetts>

