University of Colorado **Denver**

Presidential Initiative

ON URBAN AND PLACE-BASED RESEARCH

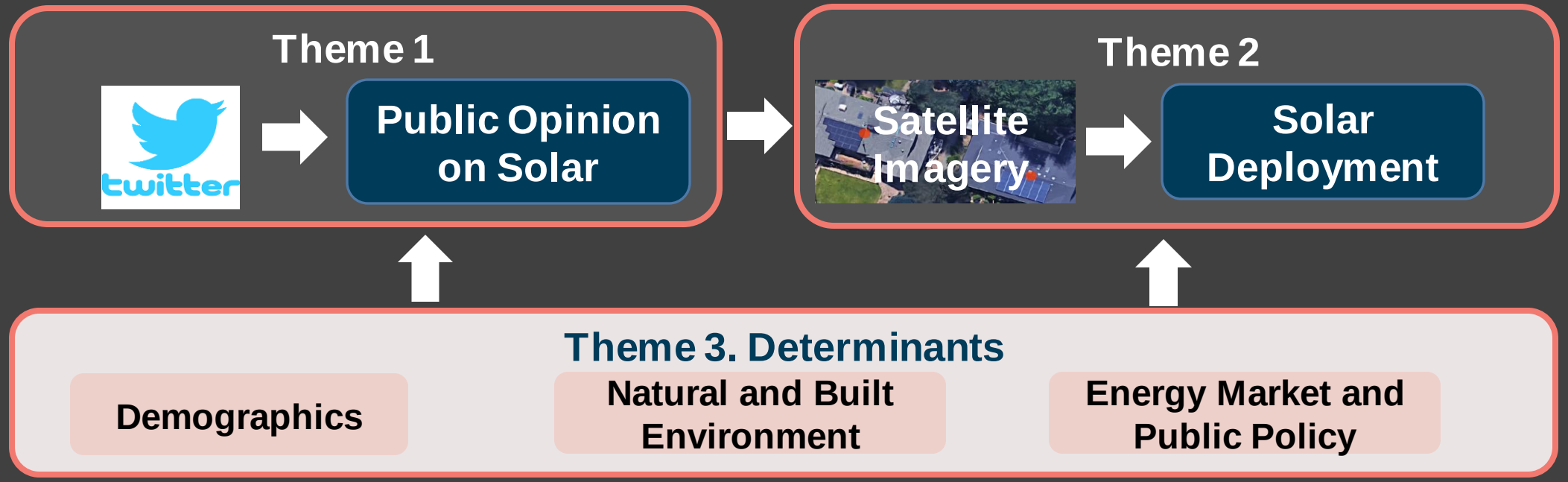
2021 Fall Research Showcase

Integrated Solar Energy for Sustainable, Resilient, and Equitable Communities

SERENA KIM, SCHOLAR IN RESIDENCE, SCHOOL OF PUBLIC AFFAIRS

Project Purpose and Objectives

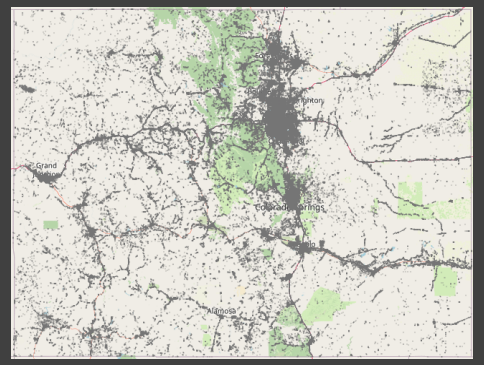
1. How does rooftop solar deployment vary across neighborhoods?
2. What are the determinants of rooftop solar deployment?

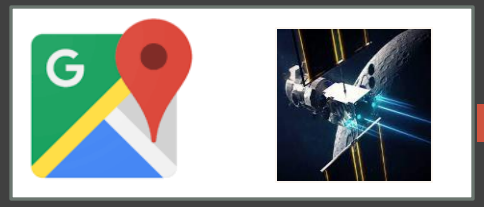


Methods and Activities

200K Census Blocks in CO

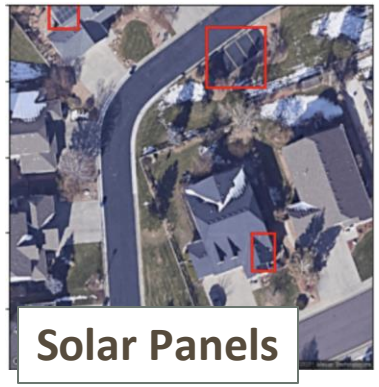
150K Census Blocks in CO





Neural Network (Faster R-CNN)

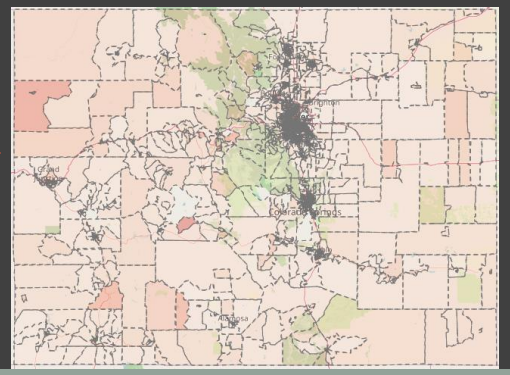
650K Images



Solar Panels

Roofs

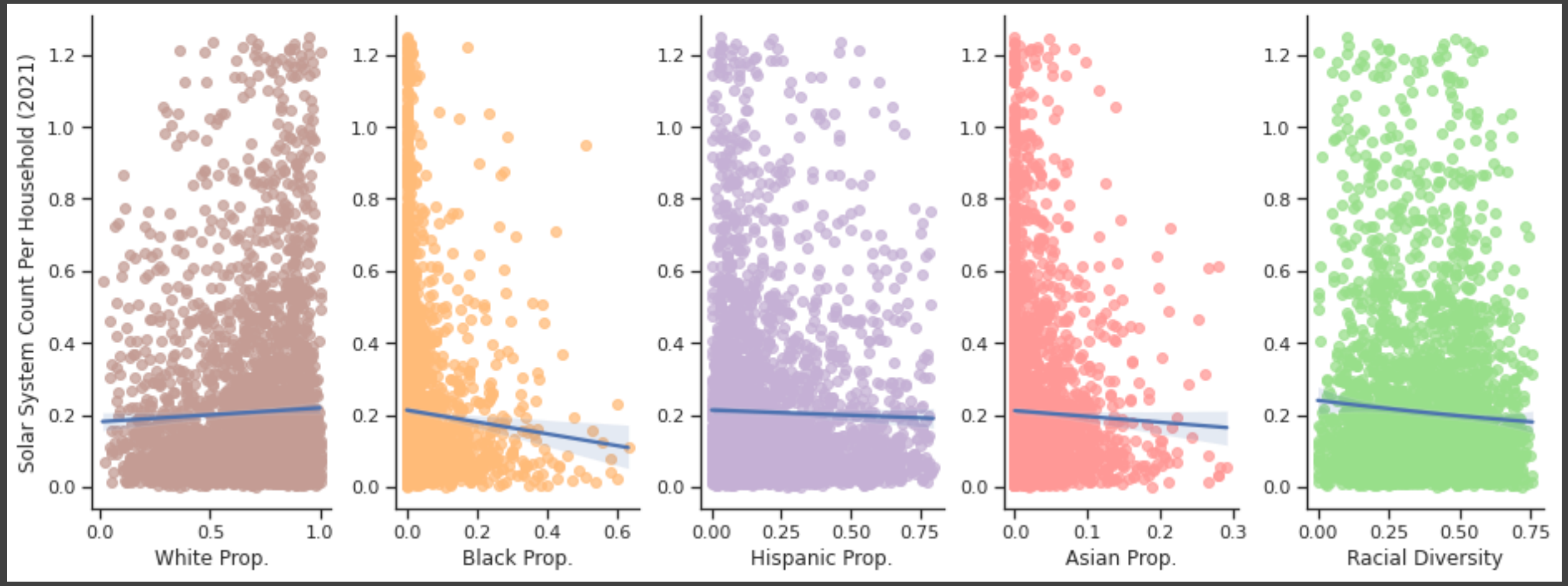
3.5K Block Groups



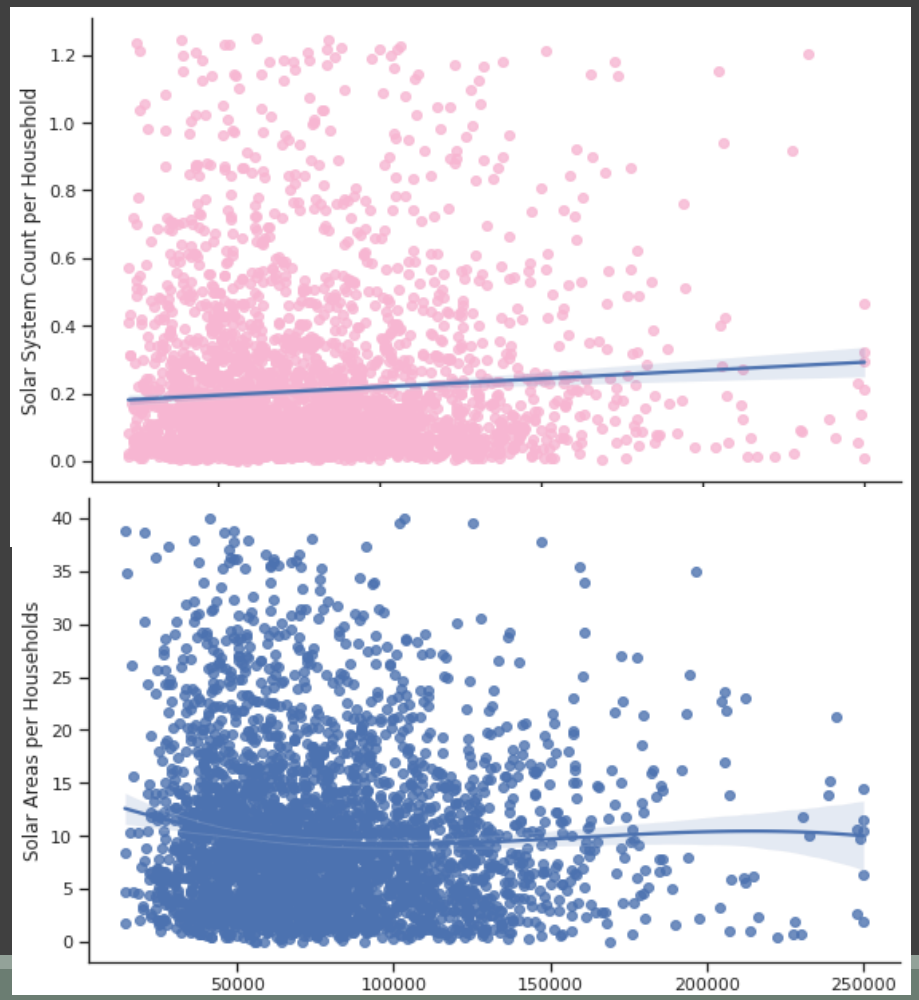
- **Census Block-Group Level:**
  - ✓ Demographics (US Census)
  - ✓ Housing Characteristics (US Census)
  - ✓ Electricity Price & Service Provider (NREL)
  - ✓ Solar Irradiance (NREL)
- **Census Tract Level:**
  - ✓ Natural Hazard Risk Index (FEMA)
  - ✓ Urban-Rural Classification (USDA)
  - ✓ Tree Canopy Cover (USFS)
  - ✓ Transmission Lines (HIFLD)
- **City/County Level:**
  - ✓ Permitting and Inspection Rules (NREL)

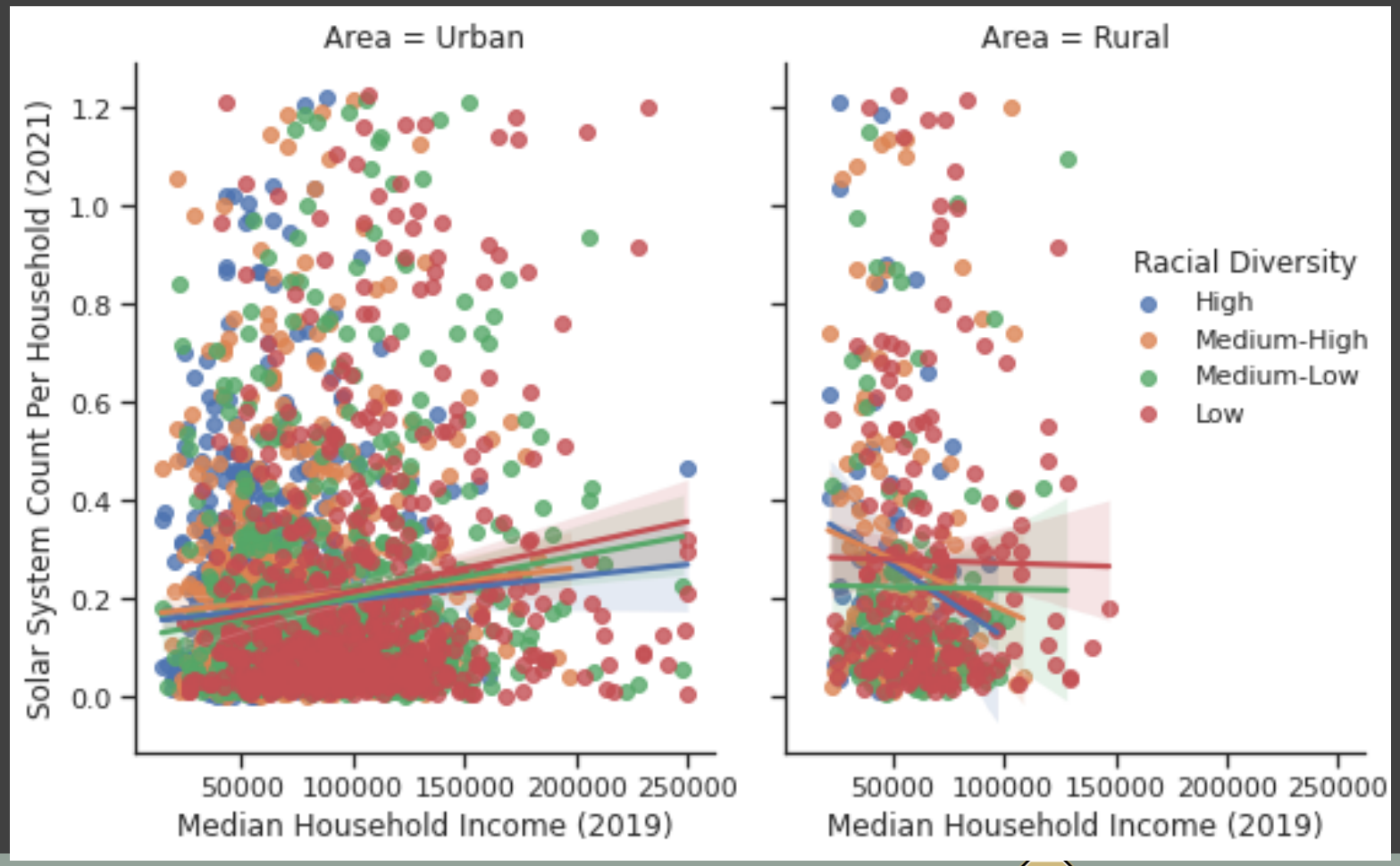
Analytics

Racial/Ethnic Diversity and Solar Deployment

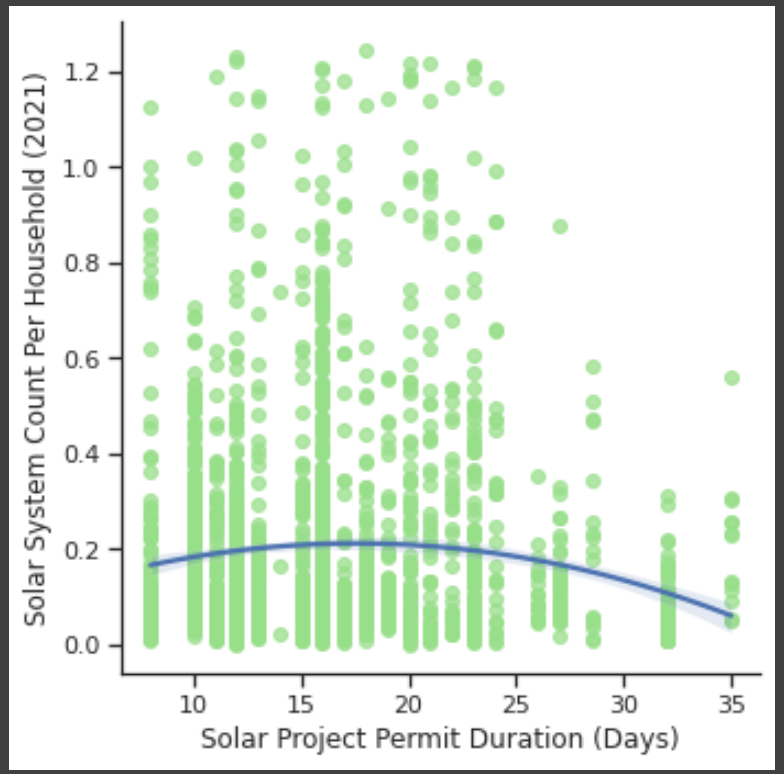


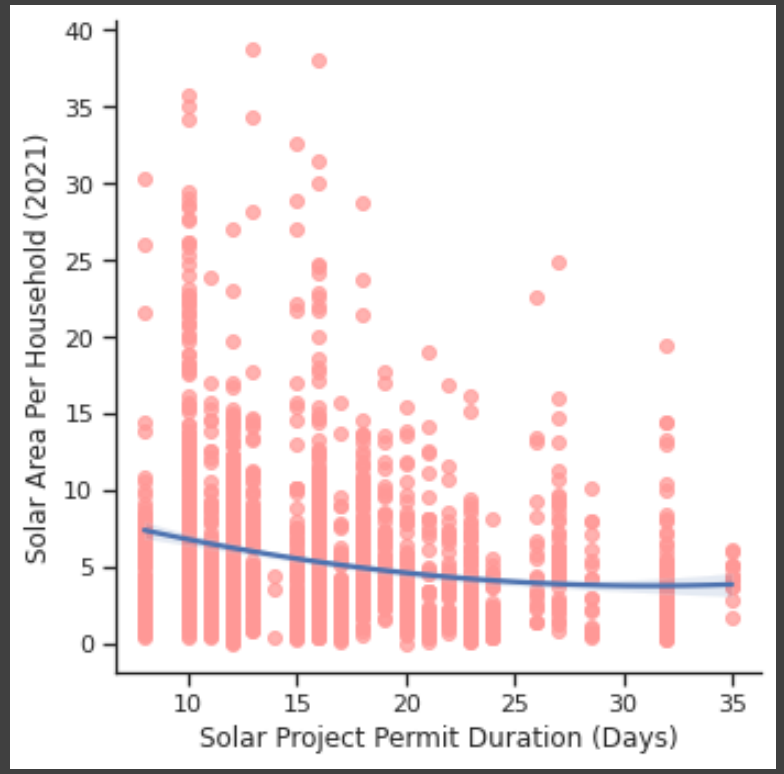
Solar Income Gap is More Pronounced in Urban Areas and in Racially/Ethnically Homogenous Communities

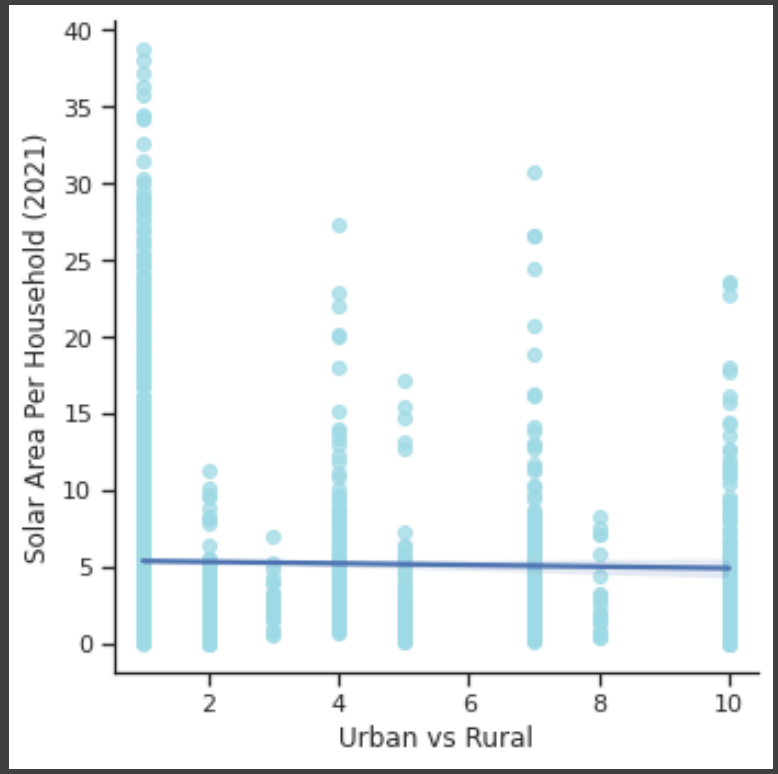




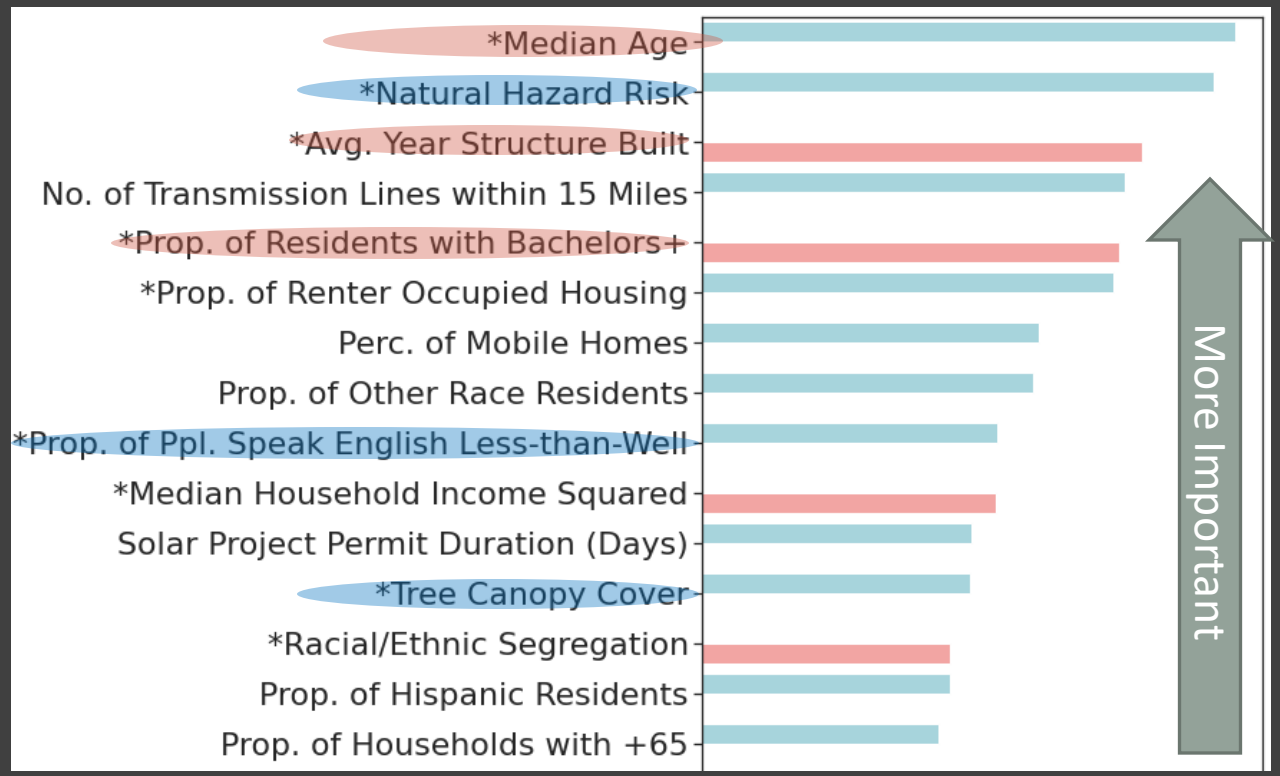
City/County Solar Permitting/Inspection Rules

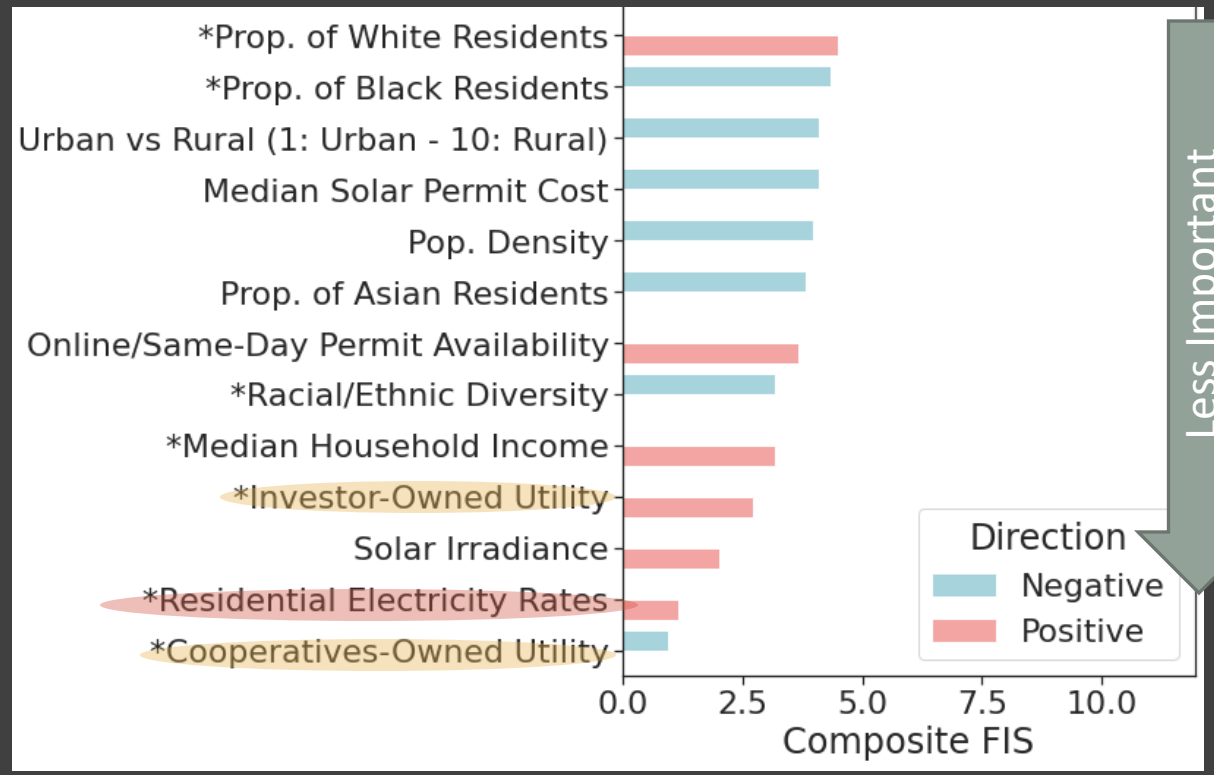






Determinants of Rooftop Solar Deployment





- The asterisks (*) indicate statistical significance in bivariate OLS.
- The composite Feature Importance Score (FIS) is the average of the standardized FIS calculated separately in four (4) models predicting solar system count and the size of rooftop solar areas per household using Random Forest and XGBoost Regressor.

Outcome

Theme 1

twitter → **Public Opinion on Solar**

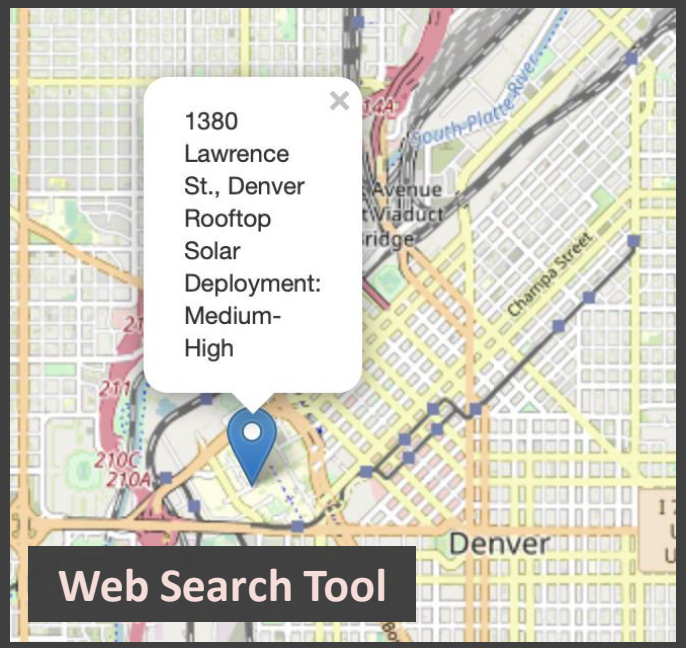
sustainability MDPI
Article

Public Sentiment toward Solar Energy—Opinion Mining of Twitter Using a Transformer-Based Language Model

Serena Y. Kim [1,2,*], Koushik Ganesan [3,†], Princess Dickens [4,†] and Soumya Panda [5]

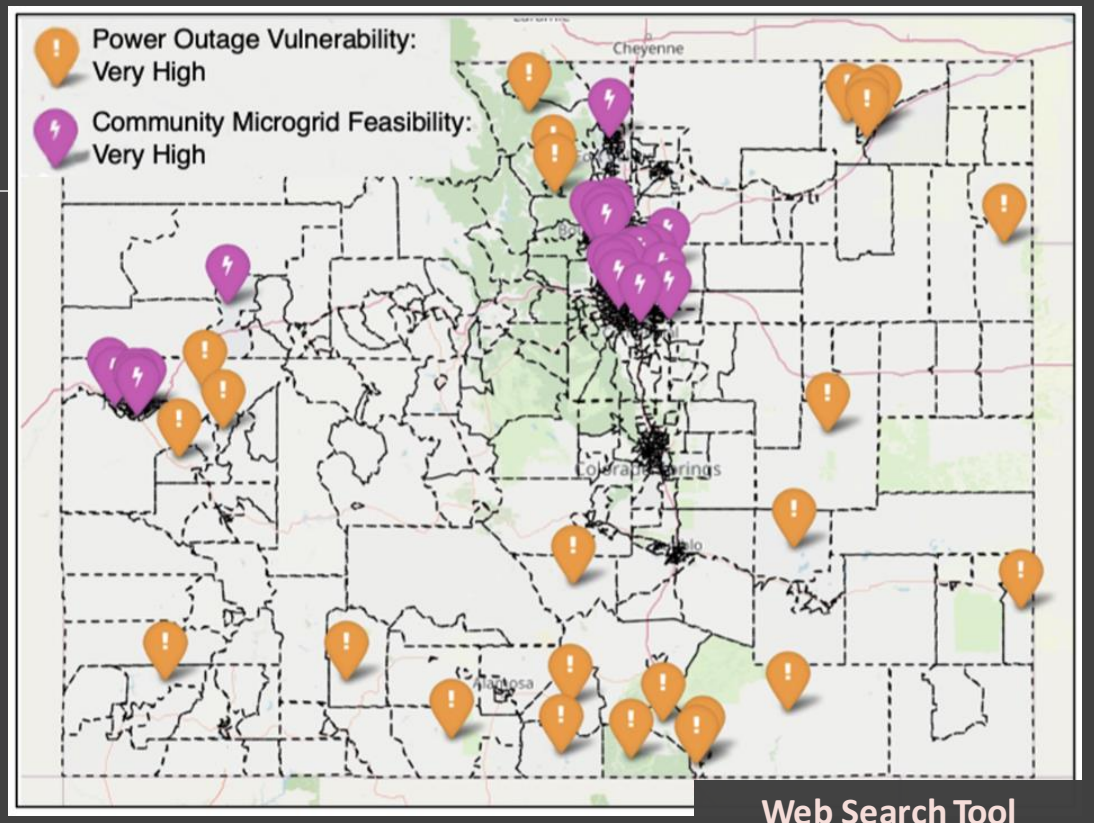
Theme 2

→ **Solar Deployment**



Web Search Tool

PostgreSQL · django · aws · HEROKU

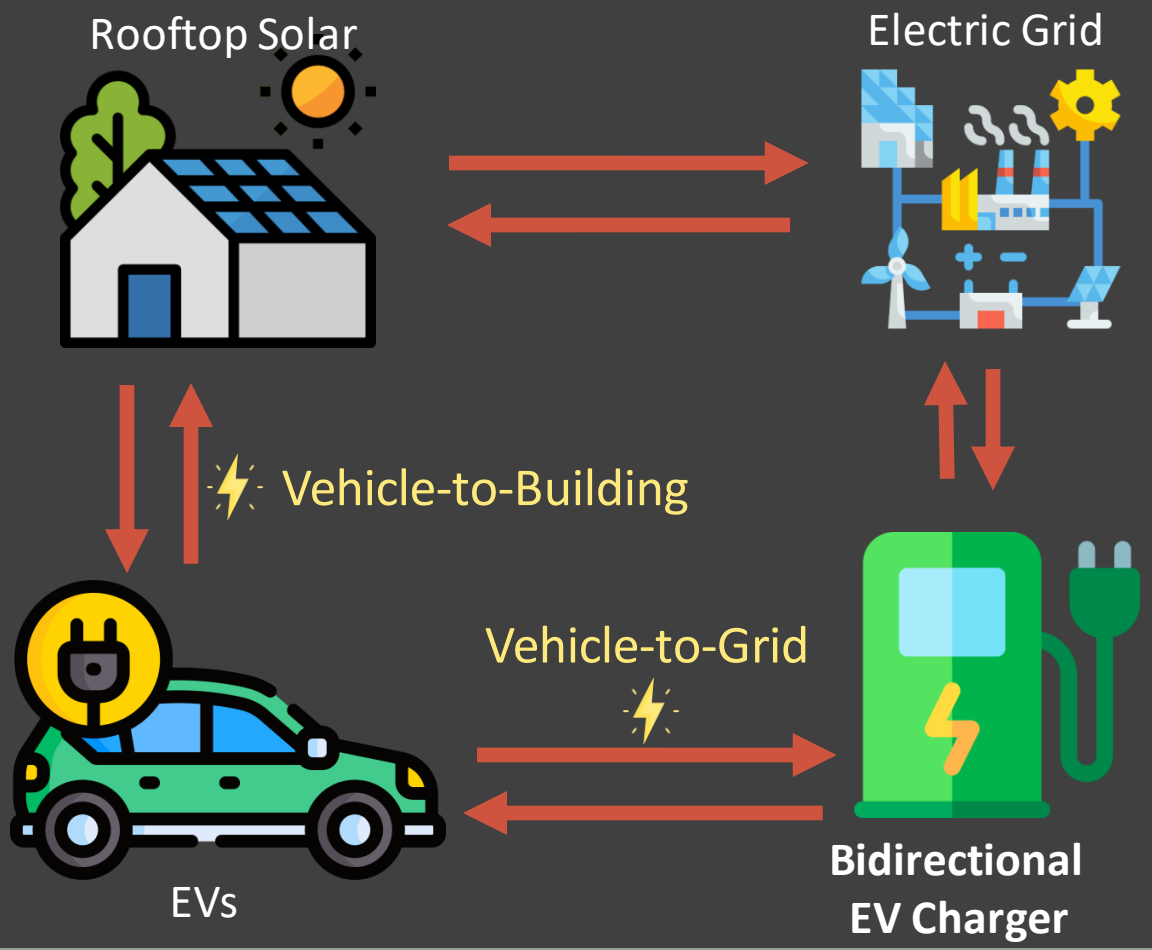


Web Search Tool

Theme 3. Determinants

Demographics | **Natural / Built Environment** | **Energy Market and Policy**

Future Research: Solar + Vehicle-to-Grid + Microgrids

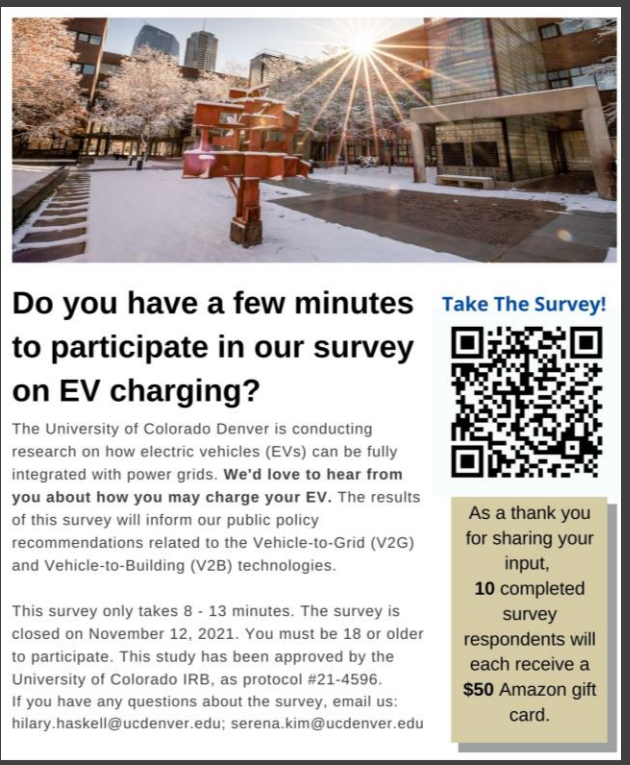


EVs as a Tool for Energy Efficiency and Resilience

COLORADO SMART CITIES ALLIANCE

FERMATA ENERGY

THE ALLIANCE CENTER



Do you have a few minutes to participate in our survey on EV charging?

The University of Colorado Denver is conducting research on how electric vehicles (EVs) can be fully integrated with power grids. **We'd love to hear from you about how you may charge your EV.** The results of this survey will inform our public policy recommendations related to the Vehicle-to-Grid (V2G) and Vehicle-to-Building (V2B) technologies.

This survey only takes 8 - 13 minutes. The survey is closed on November 12, 2021. You must be 18 or older to participate. This study has been approved by the University of Colorado IRB, as protocol #21-4596.
If you have any questions about the survey, email us: hilary.haskell@ucdenver.edu; serena.kim@ucdenver.edu

Take The Survey!

As a thank you for sharing your input, **10** completed survey respondents will each receive a **$50** Amazon gift card.

Willingness to Use V2G/V2B

Participants

- Serena Kim (School of Public Affairs; College of Engineering)
- Raven O'Rourke (Undergraduate Student, Computer Science)
- Koushik Ganesan (PhD Candidate, Physics, CU Boulder)
- Crystal Soderman (PhD Student, School of Public Affairs)
- Dan Connors (Associate Prof., Electrical Engineering)
- Will Swann (Assistant Prof., School of Public Affairs)