SIMULATION OF SOLAR PANEL ADOPTION USING AGENT-BASED MODEL: A CASE STUDY OF CALIFORNIA

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Overview
As stated by National Aeronautics and Space Administration (NASA), California is one of the states with the highest solar irradiance in the United States. Government supportive renewable energy programs and compatible climate increase popularity of solar energy use in California. According to the Federal Energy Regulatory Commission report, in California, there is 50% electricity supply coming from renewable energy, 40% of which is solar power, indicating a huge potential to promote solar panels. Set to take effect in 2020, California Energy Commission (CEC) gave final approval to mandate solar panels to be installed in all new homes up to three-stories-high with the goal of building homes that are more reliable and efficient while facing recent extreme weather events. In order to understand the decision making process on solar panel adoption, and forecast the level and rate of solar panel adoption, we develop an agent-based model to simulate people's behavior, including how they act, react, and interact, given heterogeneous situations. This way we could explore possible outcomes emerged in the complex adaptive system. The model focuses on home owners, using preference, salience level, and basic demographic data as inputs. Cost benefit analysis, decision theory, and expected utility are utilized in modeling agents behavior. Different policies and strategies are used as policy levers in simulations and sensitivity analysis.

The paper is organised as follows: After the introduction the second section gives a brief overview of the literature on renewable energy and consumer choice. The third section describes the agent-based model, including agents, attributes, state variables, and behavior rules. In section four we conduct simulations and sensitivity analysis, to explain and predict solar panel adoption, analyze key policy levels and interpret results. In the final section policy implications are derived.

Methods
Agent-based model, cost benefit analysis, expected utility, decision theory.

Results
First, expected utility calculation is used in performing cost benefit analysis, from which residents agents adjust their preference and salience level towards solar panel adoption.

Second, the simulation results indicates residents willingness to adopt solar panel is affected by the interaction between agents, as agents exchange preferences weighted by other attributes.

Third, we found policy levers also affect the level and rate of solar panel adoption, given various demographic patterns.

Conclusions
Residents willingness to instal solar panel depends on electricity usage, cost, and the interaction with others. Other influential factors on solar panel adoption includes demographic patterns, policy support, among others. This simulation tool helps researchers and stakeholders understand decision making process, and make policy recommendations on promoting solar panel adoption to achieve California’s ambitious carbon-neutral energy goal within the next few decades.

References


2018 Fact Sheet. SEIA. Retrieved from https://www.seia.org/resource-types/fact-sheet

