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Project/Description:

Our project is to uncover the drivers for solar power uptake in 49 different US States, exploring whether socioeconomic status or local weather conditions are biggest drivers for people to adopt solar panel coverage.

Hypothesis:

- Sunnier regions have more solar panels per person
- Wealthier regions have more solar panels per person
- Regions with higher electricity prices have more solar panels per person
- Regions with better government incentives have more solar panels per person
- Regions with higher educated households are more likely to have solar panels

Questions:

1. Does geographic location contribute to solar panel adoption?
2. Do government incentives actually incentivize solar panel adoption?
3. Does income level contribute to solar panel adoption?
4. Does education level contribute to solar panel adoption?
5. Do higher electricity prices contribute to solar panel adoption?

Dataset from Stanford's DeepSolar Project:

1. https://www.kaggle.com/tunguz/deep-solar-dataset/home
2. Openweather API
3. gmaps API

Tasks:

1. Organize Stanford dataset into workable dataframe.
2. Breakout location data and obtain weather conditions by county from OPENWEATHER API.
3. Establish consumer/demographic profiles as they relate to solar panel usage.
4. Visualize solar panel density and both weather and/or economic data on gmaps.
5. Run statistical testing on each variable.

Major Findings:

Does geographic location contribute to solar panel adoption?

Yes, in most parts of the country higher solar radiation correlated with solar panel uptake.
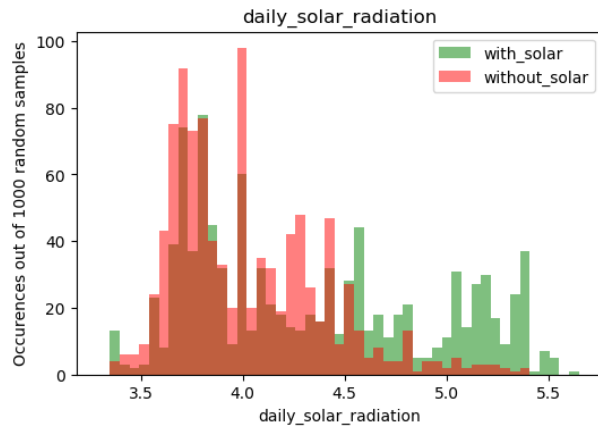
Mean daily_solar_radiation with solar is 4.33

Mean daily_solar_radiation without solar is 4.02

p-value = 4.0938392889945715e-43

Drivers of Solar Panel Adoption in the USA

Local Climate Vs Targets

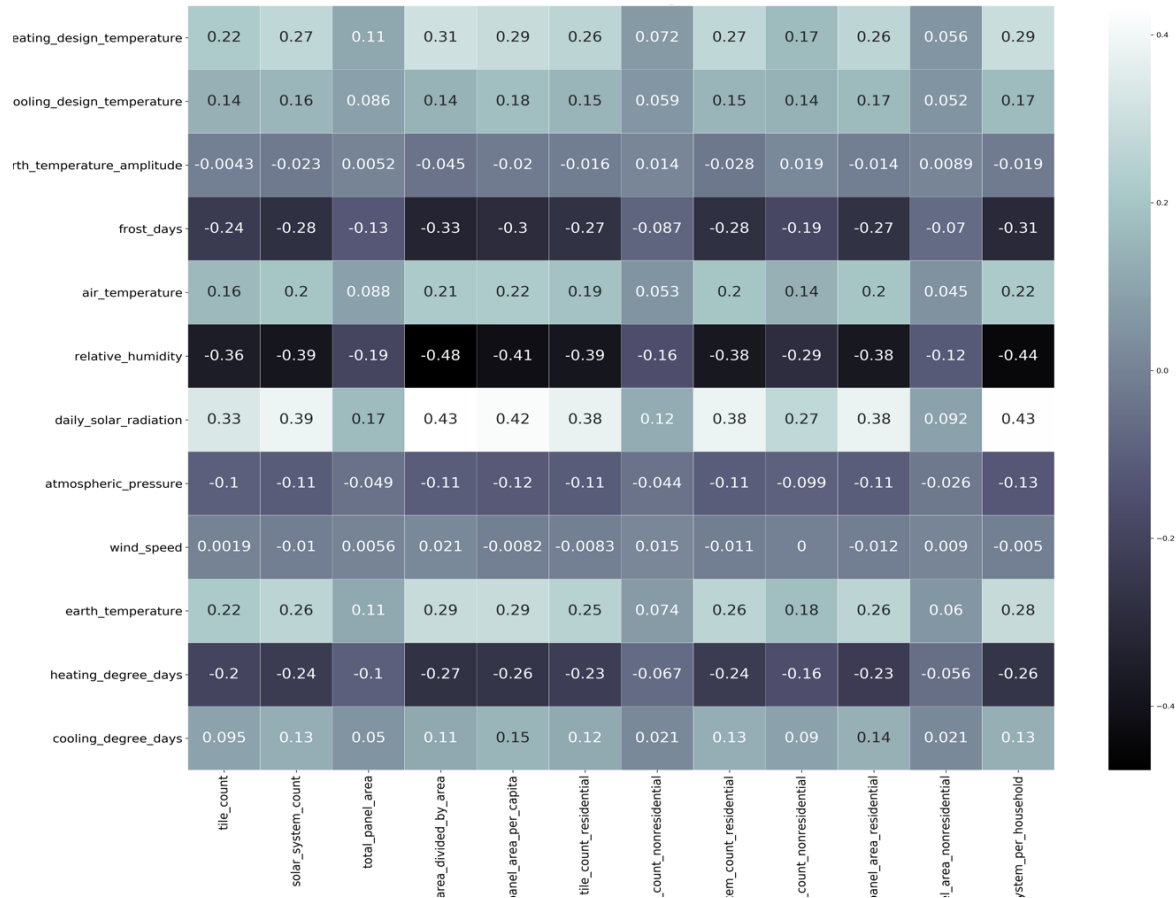|	tile_count	solar_system_count	total_panel_area	area_divided_by_area	panel_area_per_capita	tile_count_residential	count_nonresidential	em_count_residential	count_nonresidential	panel_area_residential	area_nonresidential	ystem_per_household
heating_design_temperature	0.22	0.27	0.11	0.31	0.29	0.26	0.072	0.27	0.17	0.26	0.056	0.29
cooling_design_temperature	0.14	0.16	0.086	0.14	0.18	0.15	0.059	0.15	0.14	0.17	0.052	0.17
earth_temperature_amplitude	-0.0043	-0.023	0.0052	-0.045	-0.02	-0.016	0.014	-0.028	0.019	-0.014	0.0089	-0.019
frost_days	-0.24	-0.28	-0.13	-0.33	-0.3	-0.27	-0.087	-0.28	-0.19	-0.27	-0.07	-0.31
air_temperature	0.16	0.2	0.088	0.21	0.22	0.19	0.053	0.2	0.14	0.2	0.045	0.22
relative_humidity	-0.36	-0.39	-0.19	-0.48	-0.41	-0.39	-0.16	-0.38	-0.29	-0.38	-0.12	-0.44
daily_solar_radiation	0.33	0.39	0.17	0.43	0.42	0.38	0.12	0.38	0.27	0.38	0.092	0.43
atmospheric_pressure	-0.1	-0.11	-0.049	-0.11	-0.12	-0.11	-0.044	-0.11	-0.099	-0.11	-0.026	-0.13
wind_speed	0.0019	-0.01	0.0056	0.021	-0.0082	-0.0083	0.015	-0.011	0	-0.012	0.009	-0.005
earth_temperature	0.22	0.26	0.11	0.29	0.29	0.25	0.074	0.26	0.18	0.26	0.06	0.28
heating_degree_days	-0.2	-0.24	-0.1	-0.27	-0.26	-0.23	-0.067	-0.24	-0.16	-0.23	-0.056	-0.26
cooling_degree_days	0.095	0.13	0.05	0.11	0.15	0.12	0.021	0.13	0.09	0.14	0.021	0.13

Drivers of Solar Panel Adoption in the USA

Do government incentives actually incentivize solar panel adoption?

Yes, government incentives do actually incentivize solar panel adoption, especially in the southwestern states plus Louisiana.

Mean incentive_count_nonresidential with solar is 38.86

Mean incentive_count_nonresidential without solar is 28.88
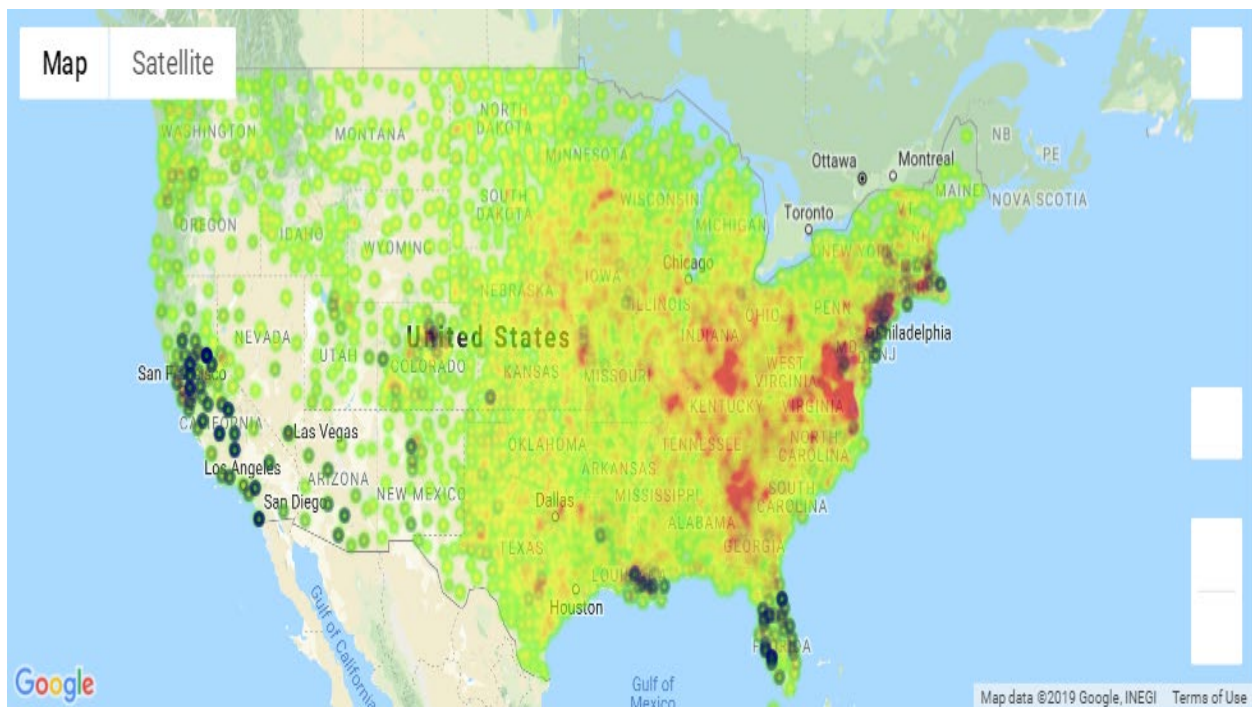
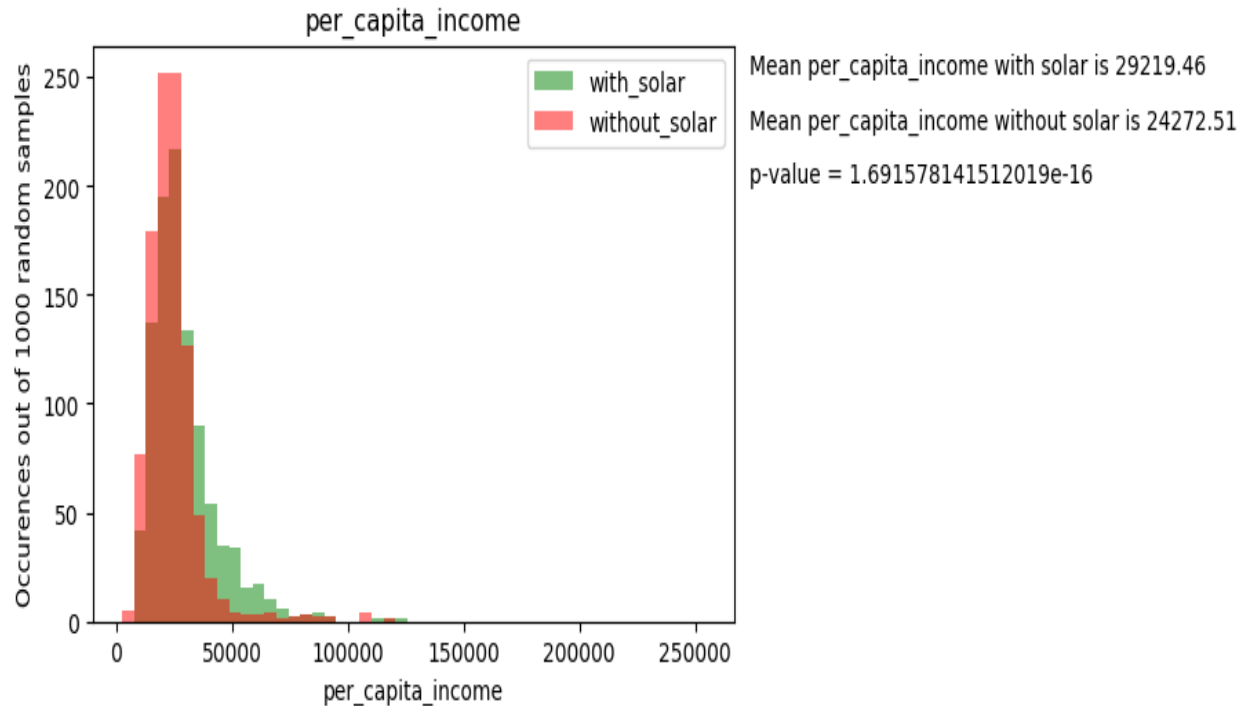p-value = 2.4322297633149476e-39

Government Incentives Vs Targets

Drivers of Solar Panel Adoption in the USA

Does income level contribute to solar panel adoption?

Yes, wealthier people were shown to be more likely to have solar panels on their homes or businesses.

Mean per_capita_income with solar is 29219.46

Mean per_capita_income without solar is 24272.51

p-value = 1.691578141512019e-16

Drivers of Solar Panel Adoption in the USA

Does education level contribute to solar panel adoption?

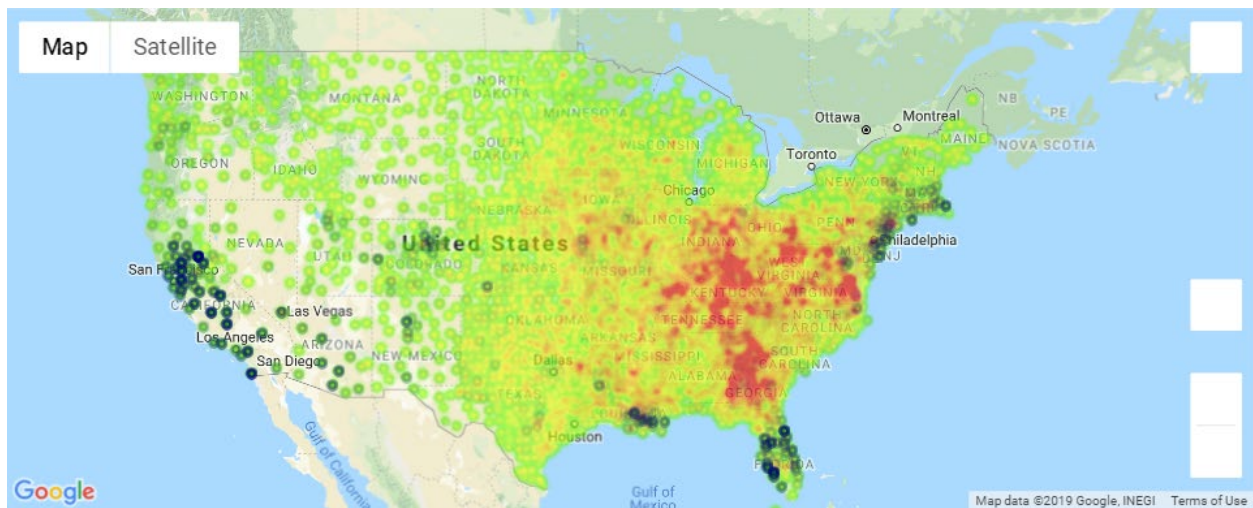Yes, people with only a high school education or lower were correlated with lower solar panel uptake.
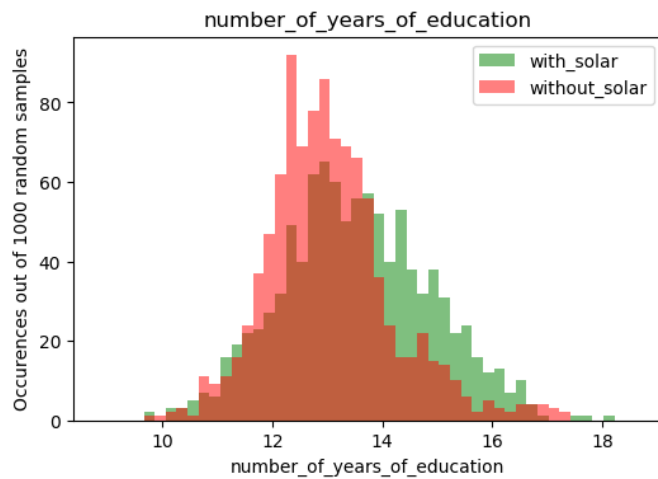
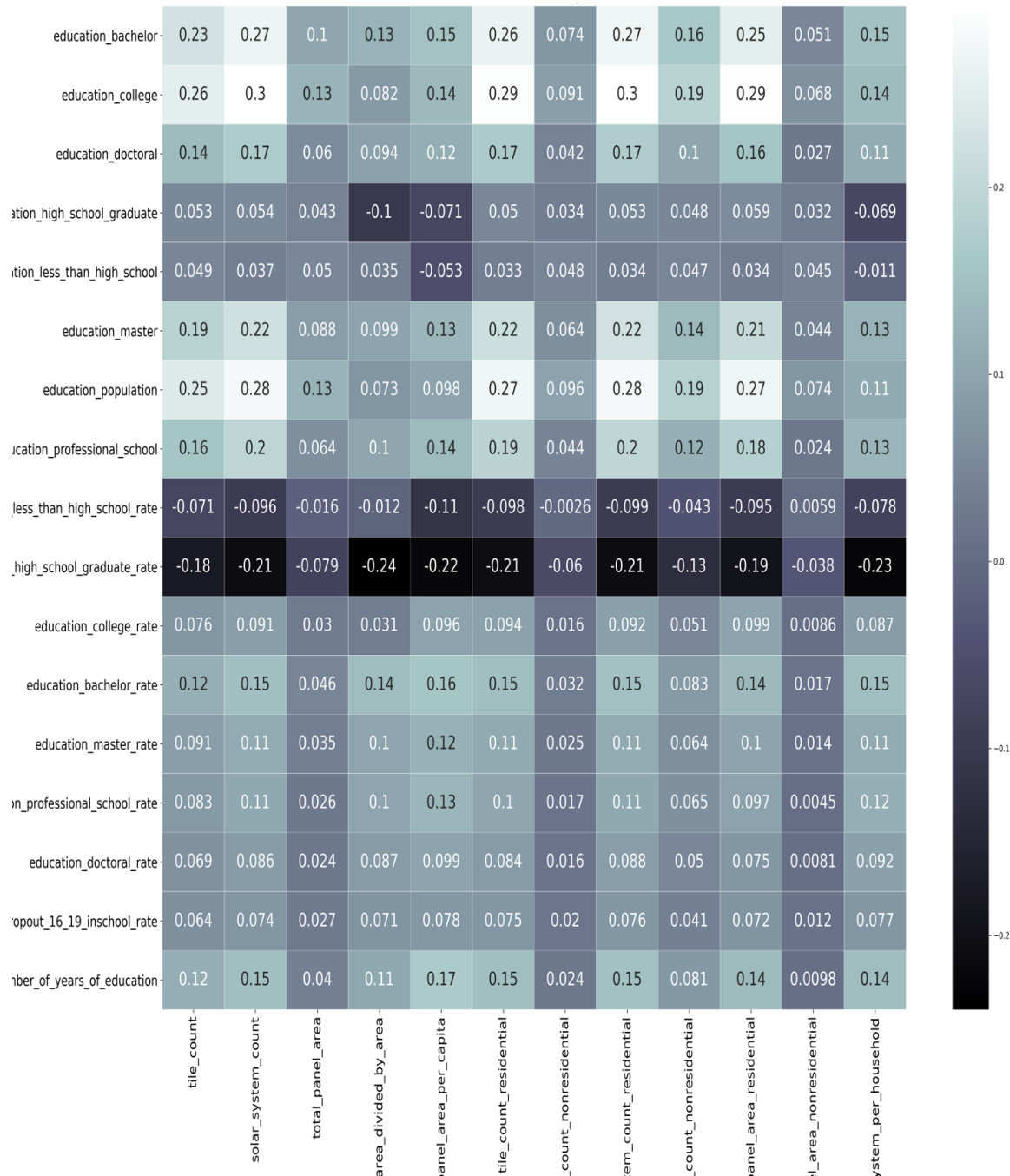Mean number_of_years_of_education with solar is 13.53

Mean number_of_years_of_education without solar is 13.04

p-value = 7.826261941164735e-18

Drivers of Solar Panel Adoption in the USA

## Education Levels Vs Targets

	tile_count	solar_system_count	total_panel_area	area_divided_by_area	panel_area_per_capita	tile_count_residential	count_nonresidential	em_count_residential	count_nonresidential	anel_area_residential	l_area_nonresidential	ystem_per_household
education_bachelor	0.23	0.27	0.1	0.13	0.15	0.26	0.074	0.27	0.16	0.25	0.051	0.15
education_college	0.26	0.3	0.13	0.082	0.14	0.29	0.091	0.3	0.19	0.29	0.068	0.14
education_doctoral	0.14	0.17	0.06	0.094	0.12	0.17	0.042	0.17	0.1	0.16	0.027	0.11
ation_high_school_graduate	0.053	0.054	0.043	-0.1	-0.071	0.05	0.034	0.053	0.048	0.059	0.032	-0.069
tion_less_than_high_school	0.049	0.037	0.05	0.035	-0.053	0.033	0.048	0.034	0.047	0.034	0.045	-0.011
education_master	0.19	0.22	0.088	0.099	0.13	0.22	0.064	0.22	0.14	0.21	0.044	0.13
education_population	0.25	0.28	0.13	0.073	0.098	0.27	0.096	0.28	0.19	0.27	0.074	0.11
ucation_professional_school	0.16	0.2	0.064	0.1	0.14	0.19	0.044	0.2	0.12	0.18	0.024	0.13
less_than_high_school_rate	-0.071	-0.096	-0.016	-0.012	-0.11	-0.098	-0.0026	-0.099	-0.043	-0.095	0.0059	-0.078
high_school_graduate_rate	-0.18	-0.21	-0.079	-0.24	-0.22	-0.21	-0.06	-0.21	-0.13	-0.19	-0.038	-0.23
education_college_rate	0.076	0.091	0.03	0.031	0.096	0.094	0.016	0.092	0.051	0.099	0.0086	0.087
education_bachelor_rate	0.12	0.15	0.046	0.14	0.16	0.15	0.032	0.15	0.083	0.14	0.017	0.15
education_master_rate	0.091	0.11	0.035	0.1	0.12	0.11	0.025	0.11	0.064	0.1	0.014	0.11
n_professional_school_rate	0.083	0.11	0.026	0.1	0.13	0.1	0.017	0.11	0.065	0.097	0.0045	0.12
education_doctoral_rate	0.069	0.086	0.024	0.087	0.099	0.084	0.016	0.088	0.05	0.075	0.0081	0.092
opout_16_19_inschool_rate	0.064	0.074	0.027	0.071	0.078	0.075	0.02	0.076	0.041	0.072	0.012	0.077
mber_of_years_of_education	0.12	0.15	0.04	0.11	0.17	0.15	0.024	0.15	0.081	0.14	0.0098	0.14

Drivers of Solar Panel Adoption in the USA

Do higher electricity prices contribute to solar panel adoption?
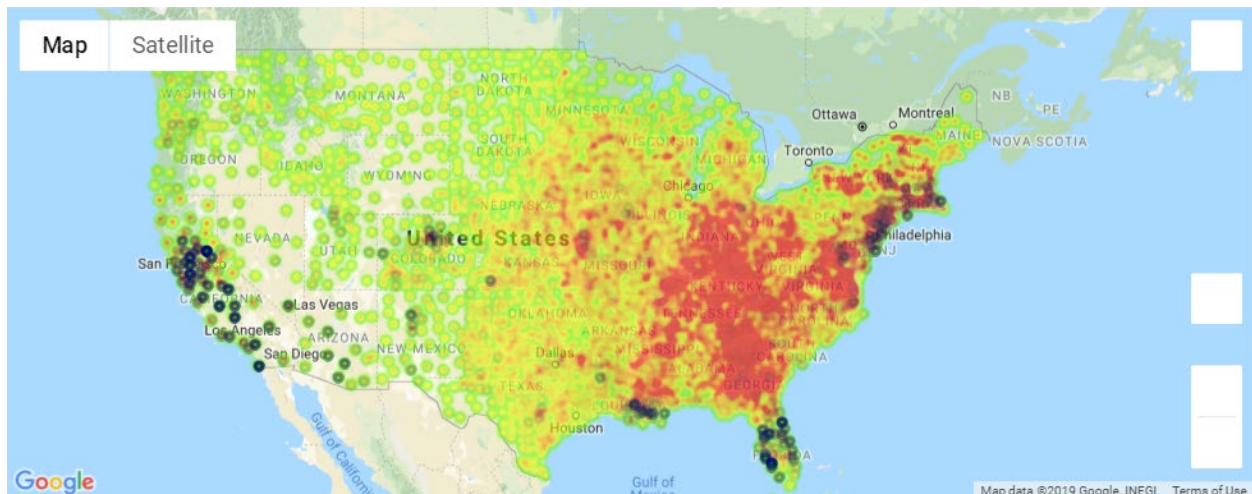
Yes, we found a higher correlation between electricity price – residential and solar panel uptake per household that determines electricity prices do contribute to the decision to use solar panels.
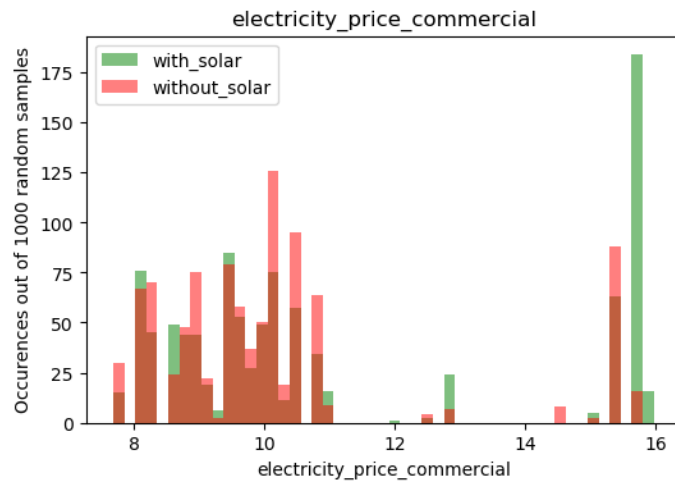
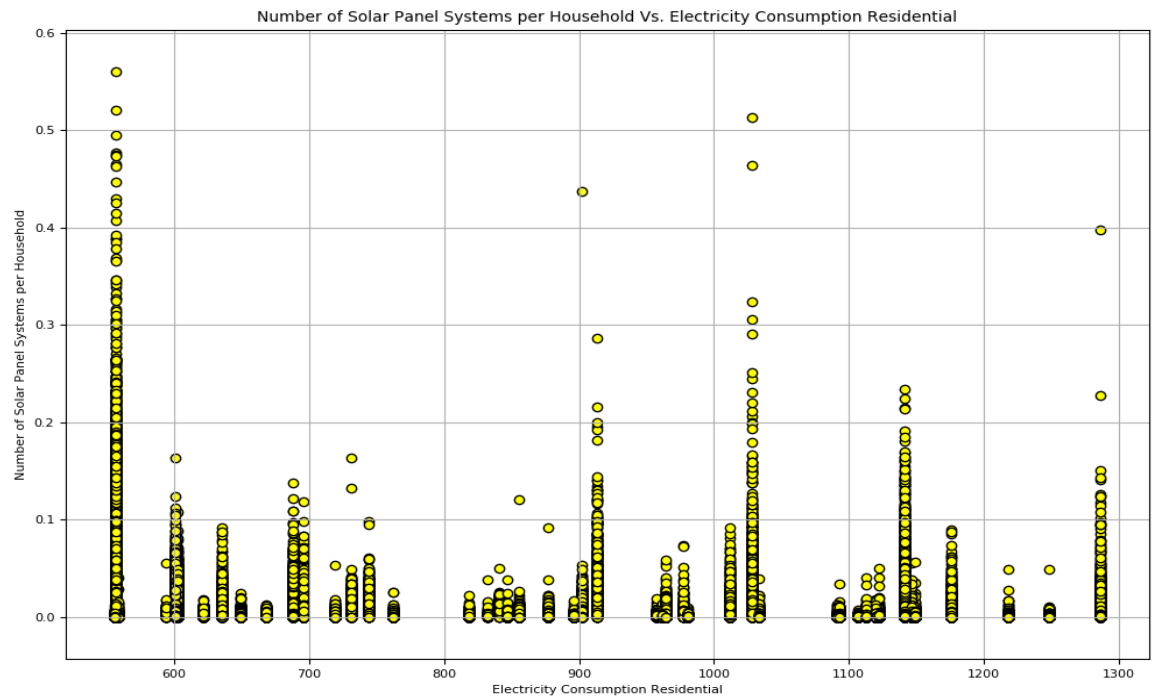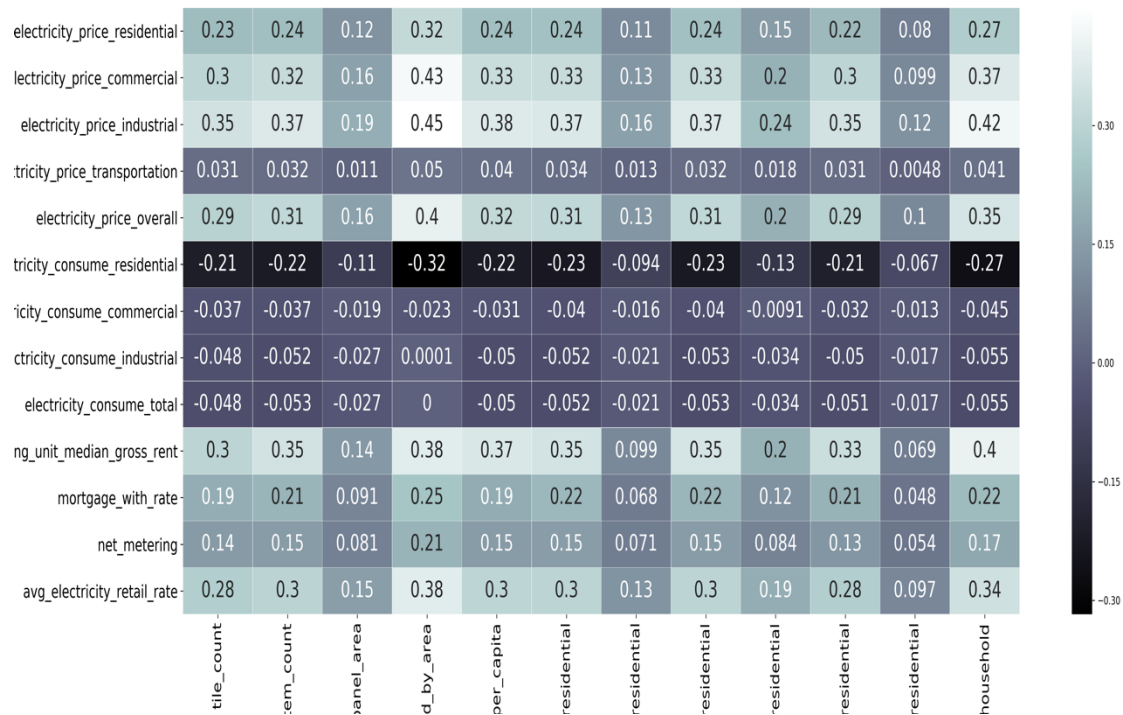Mean electricity_price_commercial with solar is 11.15
Mean electricity_price_commercial without solar is 10.19
p-value = 9.728933522822267e-18

Drivers of Solar Panel Adoption in the USA

Costs Vs Targets

	tile_count	em_count	anel_area	d_by_area	per_capita	residential	residential	residential	residential	residential	residential	household
electricity_price_residential	0.23	0.24	0.12	0.32	0.24	0.24	0.11	0.24	0.15	0.22	0.08	0.27
electricity_price_commercial	0.3	0.32	0.16	0.43	0.33	0.33	0.13	0.33	0.2	0.3	0.099	0.37
electricity_price_industrial	0.35	0.37	0.19	0.45	0.38	0.37	0.16	0.37	0.24	0.35	0.12	0.42
electricity_price_transportation	0.031	0.032	0.011	0.05	0.04	0.034	0.013	0.032	0.018	0.031	0.0048	0.041
electricity_price_overall	0.29	0.31	0.16	0.4	0.32	0.31	0.13	0.31	0.2	0.29	0.1	0.35
tricity_consume_residential	-0.21	-0.22	-0.11	-0.32	-0.22	-0.23	-0.094	-0.23	-0.13	-0.21	-0.067	-0.27
icity_consume_commercial	-0.037	-0.037	-0.019	-0.023	-0.031	-0.04	-0.016	-0.04	-0.0091	-0.032	-0.013	-0.045
ctricity_consume_industrial	-0.048	-0.052	-0.027	0.0001	-0.05	-0.052	-0.021	-0.053	-0.034	-0.05	-0.017	-0.055
electricity_consume_total	-0.048	-0.053	-0.027	0	-0.05	-0.052	-0.021	-0.053	-0.034	-0.051	-0.017	-0.055
ng_unit_median_gross_rent	0.3	0.35	0.14	0.38	0.37	0.35	0.099	0.35	0.2	0.33	0.069	0.4
mortgage_with_rate	0.19	0.21	0.091	0.25	0.19	0.22	0.068	0.22	0.12	0.21	0.048	0.22
net_metering	0.14	0.15	0.081	0.21	0.15	0.15	0.071	0.15	0.084	0.13	0.054	0.17
avg_electricity_retail_rate	0.28	0.3	0.15	0.38	0.3	0.3	0.13	0.3	0.19	0.28	0.097	0.34

Number of Solar Panel Systems per Household Vs. Electricity Consumption Residential

Conclusion:

- In general, our findings were consistent with our hypothesis. Most solar panel adoption was due to financial factors and government incentives. There are likely even more indicators, however we did not have time to further analyze

- We can infer that solar panel adoption is currently largely based on money factors