Dardeep Somel

Capstone 3 - Project Proposal

Project Scenario:
A solar energy company's marketing team has a set budget for a marketing campaign and needs to determine which city in the USA will offer the highest potential return on investment (ROI) based on the potential solar energy yield. They want to target a city where customers are likely to see significant benefits from installing solar panels, thus making the marketing campaign more effective.

Problem Statement

A Solar energy company's (Refer to as Solar Energy Co. moving forward) marketing team needs to determine which city in the US would provide the highest potential return on investment for a targeted marketing campaign. The campaign aims to promote solar panel installations in areas where consumers are most likely to benefit from solar energy.

Context

The Objective is to provide Solar Energy Co with a data-driven recommendation on which city to target for their marketing efforts. Targeting the right city will help the company focus its resources more efficiently, resulting in a higher conversion rate for solar panel installations, better customer satisfaction, and ultimately, increased revenue. Other factors to consider are;

- Solar Irradiance levels, which impact the potential energy yield from solar panels.
- Population and homeownership rates, which influence market size and receptivity.
- Energy costs, which affect the potential savings for consumers who switch to solar energy.

Criteria for Success

The success of the campaign will be measured by the ROI, which will be calculated based on the estimated number of solar installations generated by the campaign and the associated revenue, compared to the cost of the campaign in each city. Also, the effectiveness of the campaign will be evaluated by the conversion rate, defined as the percentage of the targeted homeowners who install solar panels following the campaign. These items will be handled by Solar Energy Co's internal marketing and CFO. For the Data Science team, the Criteria for Success would be the Payback Period; the average payback period for solar panel installations (measured in years) will be used as a secondary metric. Cities with shorter payback periods will be prioritized, as they offer quicker returns for consumers.

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Scope of Solution Space

The scope of the solution space defines the boundaries within which we will explore and evaluate potential solutions to the problem. It includes the methods, tools, data sources, and analysis techniques we will use to achieve the goal.The Scope of the solution space will require:

- Solar Irradiance Data. Collection of Daily/Weekly/Monthly solar irradiance data for the cities of interest from NASA's POWER API
- Demographic Data. Collection of the population (using top 200 populated cities in the US) and homeownership rates from the U.S. Census Bureau.
- Energy Cost Data. Collection of average residential electricity rates from the Energy Information Administration API
- Ensuring the data is clean and ready for EDA
- City Comparison. Analyzing and comparing cities based on solar irradiance levels, energy costs, population, and market potential
- Using Models such as Time Series to predict the future Solar Irradiance using historical data.
- Estimating the potential energy output of solar panels in each city, using the irradiance data and considering factors like panel efficiency.
- City Selection. Possibly developing a ranking system to prioritize cities based on the analyzed data
- Possible situations that could impact the potential success of the campaign
- Provide data-driven recommendations for the marketing campaign in a final report.
- Present a slide deck summarizing the key insights and proposed strategy.

Constraints within Solution Space

Constraints or challenges that may affect the solution are most likely due to data availability. Also using the historic data to predict future Solar Irradiance does not mean 100% accuracy and unexpected changes in solar incentives could impact the potential success of the campaign. Combining data from different sources may present challenges in terms of data compatibility and integration. Time constraints can limit the depth of the analysis and number of scenarios that can be explored.

Roof space varies across the nation, as different home sizes will impact available roof space. Average system size, with various solar panel options provided by the company there are different solar panel sizes.
Energy needs, The data that will be gathered from Energy Information Administration will include energy usage.

To help with the constraints above we may consider the following:

- A standard residential solar panel typically produces about 300 to 400 watts and is around 17.5 square feet (1.6 square meters) in size.
- The average U.S. household uses about 10,400 kWh of electricity per year. To offset this entirely with solar power, you would need a system that can generate about 8,000 to 10,000 kWh per year, depending on your location.
- To generate 10,000 kWh per year, you might need around a 7 to 10 kW system, which could require about 20 to 30 solar panels.
- For a 7 to 10 kW system, you would need approximately 350 to 525 square feet of roof space, assuming panels with an efficiency of 15-20%.

Stakeholders to provide key Insight

The marketing team is available for assistance. VP of operations, Head of Marketing and CEO will be the decision makers at the end of the day. They are technical when it comes to their product.

Key Data Sources

Solar Irradiance Levels: Cities will be evaluated based on their average daily and annual solar irradiance (measured in kW-hr/m²/day). Cities with higher irradiance levels will be prioritized as they indicate higher potential energy output from solar panels. NASA POWER API available to retrieve this data

Home Ownership Rates: The proportion of owner-occupied housing units (as a percentage of total housing units) will be analyzed. Cities with higher home ownership rates will be considered more favorable, as homeowners are more likely to invest in solar installations. U.S. Census data available via API. Population data is also available through U.S. Census, however our marketing team can provide you with the 201 top US populated cities if need be.

Energy Costs: The average residential electricity rates (measured in cents per kWh) will be assessed. Cities with higher electricity rates will be given higher priority, as potential savings from switching to solar will be greater. US. Energy Information Administration API available to retrieve this data.