Leveraging government mobility data to design a charging station network in Santiago, Chile

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The Chilean government is promoting electromobility, particularly in big cities, as the Metropolitan area of Santiago. To facilitate the adoption of electric vehicles, it is crucial to establish a network of charging stations that can cater to the needs of drivers. To enable drivers to charge their electric vehicles near their homes or at their trip destinations, the analysis of the government's mobility data provides the information necessary to create an origin-destination matrix of the journeys made by car by the citizens. This matrix helps identify the key municipalities that serve as origin and destination points for most journeys made by car. By identifying these key areas, it becomes possible to strategically plan the placement of charging stations in locations such as workplaces, shopping malls, theaters, and restaurants that are frequented by people.

Designing a charging station network can be performed thanks to covering location problems. A facility, a charging station, is said to cover a demand node if it is located within a pre-defined distance threshold of the node. This threshold is commonly known as the coverage radius and plays a crucial role in determining the problem's solution. Therefore, choosing an appropriate coverage radius is an essential step in solving the covering location problem: a very large radius of action means that vehicles would have to drive a longer distance to a charging point, while a very small radius means that many charging facilities would have to be set up to meet the demand, so different alternatives are tested and the results are compared. In the Set Covering Location Problem (SCLP), the objective is to locate the minimum number of facilities within a set of feasible locations required to cover all of the demand nodes. To give the model as much freedom as possible, a set of regularly spaced points in Santiago is considered as a set of feasible locations. An underlying assumption of the SCLP is that all of the demand nodes must be covered. However, charging stations are expensive and a budget does exist. The objective is to locate a predetermined number of charging stations in such a way as to maximize the demand that is covered. The maximal covering location problem (MCLP) is typically applied when there are limited resources or budgets to cover all demand nodes.

Our contribution is twofold. Firstly, we have analyzed the government's mobility data to identify the potential demand for charging stations in each area. This analysis has helped us to understand the travel patterns of citizens and to determine the importance of each municipality as a point of origin and destination. Secondly, we have used this information to develop a maximum coverage model that optimizes the location of charging stations while satisfying global budget constraints.

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