# Optimal charging station placement in a free-floating electric car sharing system

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## Abstract

In recent years, free-floating car sharing systems have become a popular mode of transportation within urban areas, as they allow their customers similar flexibility to owning a car without the associated costs. Using electric vehicles allows the operator to operate in an environmentally-friendly way, while also improving efficiency.

These vehicles must, however, be regularly recharged to ensure that they do not run out of battery. Thus, a network of charging stations must be built within the system's area of operation, where cars can be recharged when they are not in use. Since building and maintaining these stations is costly, placing them effectively is paramount to the economic viability of any free-floating electric car sharing system.

We present integer linear programming formulations for solving the problem of finding optimal locations and sizes for charging stations within such a system. Given a limited budget, we want to place them in such a way as to maximize the amount of customer demand that can then be satisfied. We assume that customers are willing to walk a short distance to get to an available car at the start of their trip. They may end their trip anywhere within the system's operational area, but are incentivized by lower rental fees to return cars with low battery to a charging station close to their actual destination.

We analyze the performance of our algorithms on a set of benchmark instances that is based on both artificial and real-world data.

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