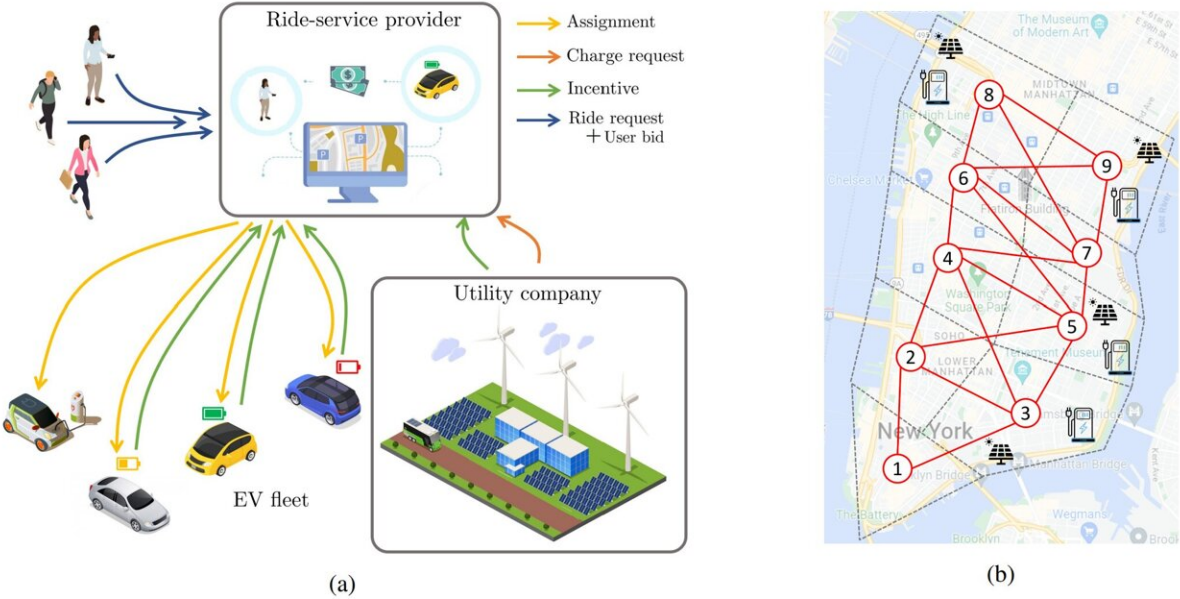


New research into decarbonization of transportation sector through EV ride-shares

May 25 2023, by Josh Rhoten



(a) Description of the interaction between utility company, ride-service provider, and drivers. The ride-service provider receives ride requests from customers and charge requests from a utility company. The bargaining procedure involves a vehicle-request assignment problem that takes into consideration incentives coming from both parties and bids from customers, to assign available EVs to requests. (b) Case study: Lower Manhattan, New York City, NY, partitioned into 9 regions (links between regions correspond to a reachable site within a 10 minute drive). PV generation is present in 4 regions. This image has been designed using assets from Freepik.com. Credit: *arXiv* (2023). DOI: 10.48550/arxiv.2305.02419

If you are standing on a corner waiting for a ride-share car, would you be willing to wait longer if you knew your driver was piloting an electric vehicle? What if it was powered by 100% green energy? How much longer would you be willing to wait? Would you pay more for the privilege if the app told you about the option?

A paper recently submitted to *Scientific Reports* (and available on the *arXiv* preprint server) from researchers in the Department of Electrical, Computer and Energy Engineering at CU Boulder explores those questions as part of a larger push globally to decarbonize [transportation services](#).

First author and Postdoctoral Researcher Elisabetta Perotti said the paper considers a scenario in which a 100%-electrified fleet of vehicles must attend to both ride requests submitted by customers and charging requests sent by a utility company during a period of high renewable energy generation.

"For example, a ride-hailing company like Lyft receives both types of these requests and then has to solve an optimization problem to decide how to best allocate the electric vehicles that are available in order to minimize operating costs," said Perotti. "In this paper we propose incentives to promote the charging of electric vehicles during hours of high renewable generation and balance that against quality of service and the public's willingness to use the system."

Better synchronization with a schedule that prioritizes [renewable energy sources](#) would also avoid [negative impacts](#) on the grid that could come from an uncontrolled charging schedule for the fleet, Perotti added.

Perotti is working in this area through a Schmidt Science Fellowship. The elite program connects postdoctoral research to a discipline in engineering, [natural sciences](#), mathematics or computing that differs

from the individual's existing area of expertise and planned area of future research. Perotti already had a strong background in [theoretical physics](#) and mathematics from her Ph.D. at Uppsala University in Sweden and said she is using the fellowship to pivot to a focus on concrete problems in renewable energy.

"I knew that many researchers at CU Boulder have and are working on ambitious plans to tackle climate change and that the university has become an example for the whole U.S. leading the way towards the energy transition," she said. "It quickly became clear that (Emiliano Dall'Anese's lab) would be a good fit for me as it allows me to combine my passion for math with the concrete objective of addressing environmental and [climate change](#) concerns."

The paper outlines a mechanism inspired by [game theory](#) in which the power utility company proposes incentives and then the ride-sharing platform assigns vehicles to both ride and charge requests. To test their work, the team used sample data recorded by the Taxi and Limousine Commission in New York city and renewable energy information from the New York Independent System Operator.

The results show that it is indeed possible to shift the charging of electric vehicles to overlap with periods of high renewable generation and to adapt to intermittent power generation while still minimizing the impact on the quality of service for the ride-sharing platforms.

Developing the main algorithm for this work was not easy, according to Perotti, who worked with researchers at the Catholic University of Louvain in Belgium and the Polytechnic Institute of Paris on the project.

"The ride-service provider and the utility company have different objectives, so it is challenging to formulate an [optimization problem](#) that aims at reducing both their operational costs," she said. "That gets even

more convoluted when including financial incentives and our bargaining mechanism into the 'game' so there is a lot to consider and manage with the algorithm."

Perotti added that the paper also shows that some form of ridesharing is necessary in the future to fully benefit from an active fleet of [electric vehicles](#) powered by renewable energy like wind and solar.

Perotti said she has enjoyed working with Associate Professor Emiliano Dall'Anese and having the chance to gain exposure, skills and knowledge with optimization and control theory in his group.

"Even though my Ph.D. research was theory-based I learnt how to jointly operate an extensive toolbox of mathematics, physics, computer science and problem-solving techniques," she said. "Those interdisciplinary skills are proving useful in this research area and will be useful for years to come as I apply them to my pivot research that tackles pressing global challenges."

More information: Elisabetta Perotti et al, Towards the Decarbonization of the Mobility Sector: Promoting Renewable-Based Charging in Green Ride-Sharing, *arXiv* (2023). [DOI: 10.48550/arxiv.2305.02419](#)

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