Carbon-Aware EV Charging

Yuanyuan Shi

Assistant Professor

University of California, San Diego

My Research: Learning and Control for Power Systems

Applications

- Voltage/frequency control

- Smart buildings

- Electric Vehicles

- Energy market

❖ Carbon-aware EV charging

❖ Stability-constrained Reinforcement Learning for inverter-based voltage and frequency control

❖ Operator learning for PDE and building control
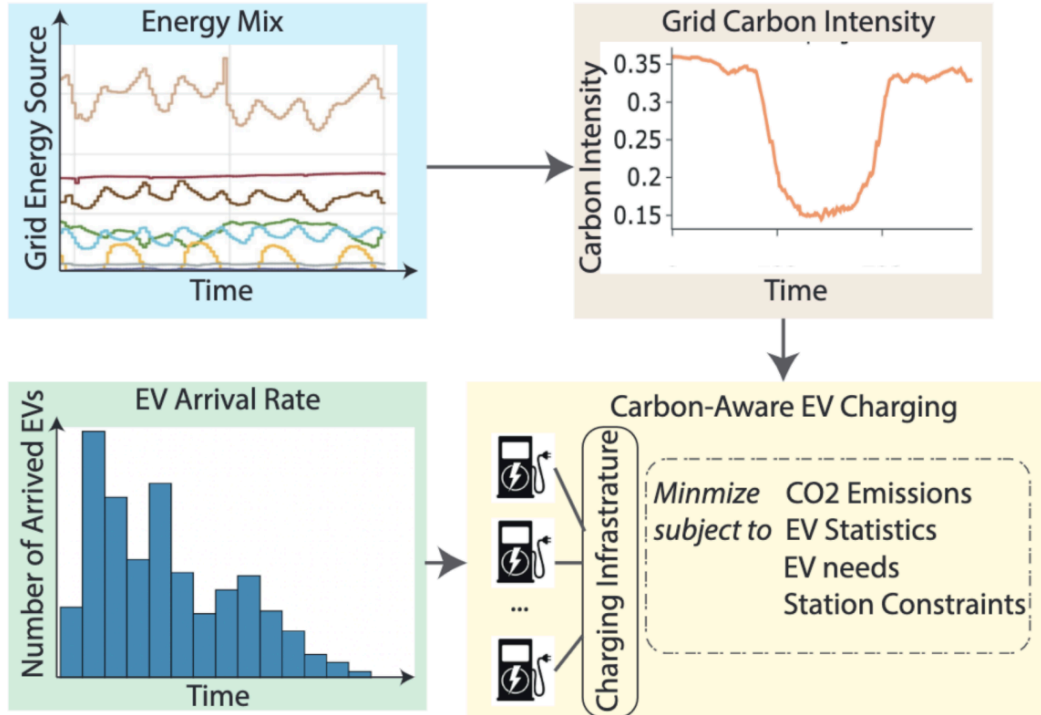
❖ Learning strategic DER behaviors and interactions

Energy Systems
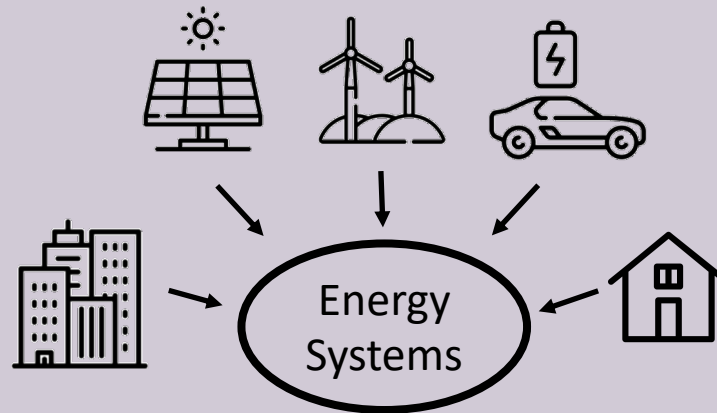
Methods

- **Machine learning**

- **Nonlinear control**

- **PDE control**

- **Optimization**

https://yyshi.eng.ucsd.edu/research

Carbon-Aware EV Charging

- EV can only be **"carbon-zero"** if it's charged by clean energy
- But carbon intensity (renewable ratio) and EV charging demand do not always align!
- From time-of-use charging price optimization → carbon-aware EV charging, can reduce > 20% carbon emission
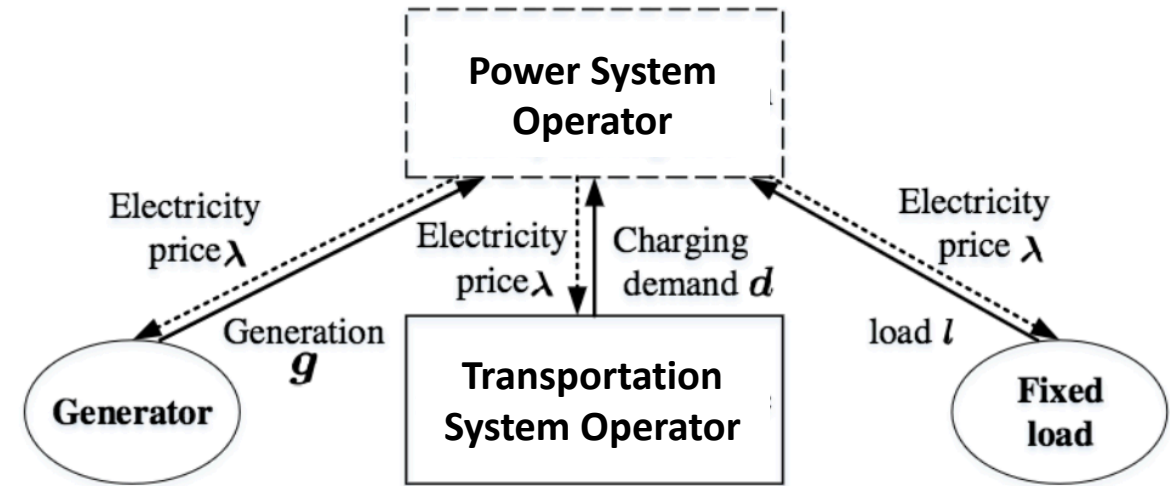
- Multi-station EV charging couples the operation of power and traffic networks
- We propose a Charging Demand Function approach that can solve the bilevel program with optimality guarantee

Thank you!

yyshi@eng.ucsd.edu

References:

[1] Kai-wen Cheng, Yuxin Bian, Yuanyuan Shi, and Yize Chen, "Carbon-Aware EV Charging," *IEEE International Conference on Communications, Control, and Computing Technologies for Smart Grids (SmartGridComm),* 2022.

[2] Yufan Zhang, Sujit Dey, and Yuanyuan Shi, "Optimal Vehicle Charging in Bilevel Power-Traffic Networks via Charging Demand Function," Arxiv preprint.