Smart Electric Vehicle Charging Station Scheduling with Vehicle-to-Grid Technology

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Citizen-Centric Artificial Intelligence Systems

Problem Statement and Research Objective

Problem

The growing adoption of electric vehicles (EVs) increases the demand for charging infrastructure, especially during peak hours.
Ensuring **fair** energy allocation at EV charging stations is a complex challenge due to the need to:

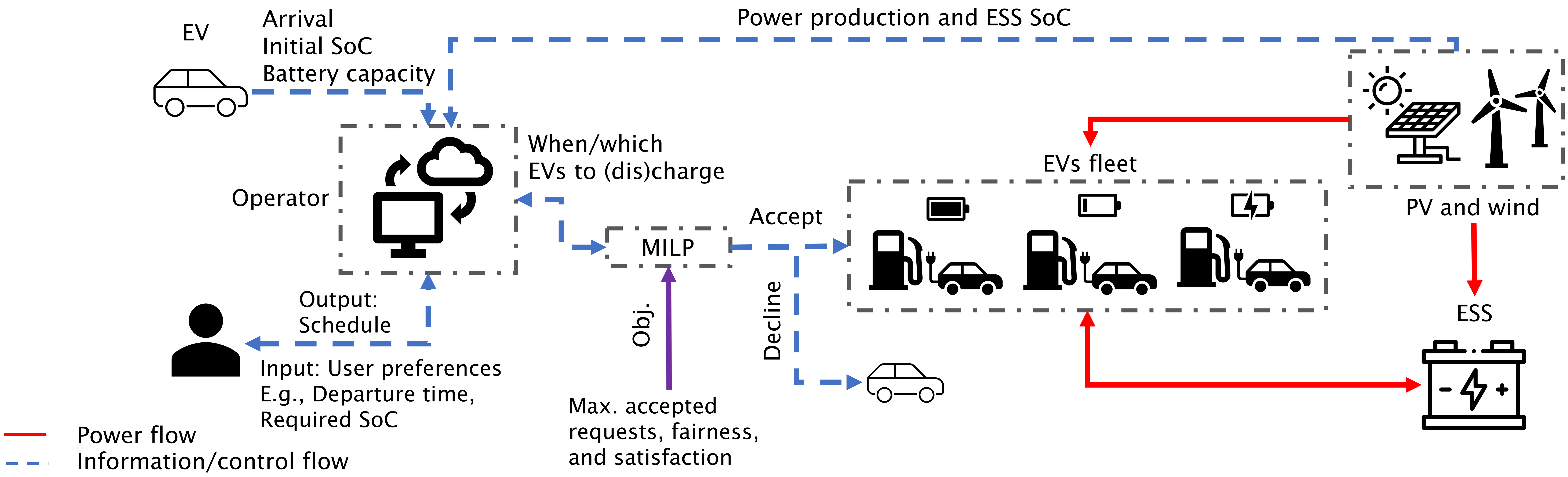
- Preserve **user comfort**,
- Prevent **battery degradation**,
- Manage **demand peaks**,
- Minimize **environmental impact**.

Existing systems often overlook **fairness**, **user incentives**, and the potential of EVs to act as **distributed** energy storage.

Objective

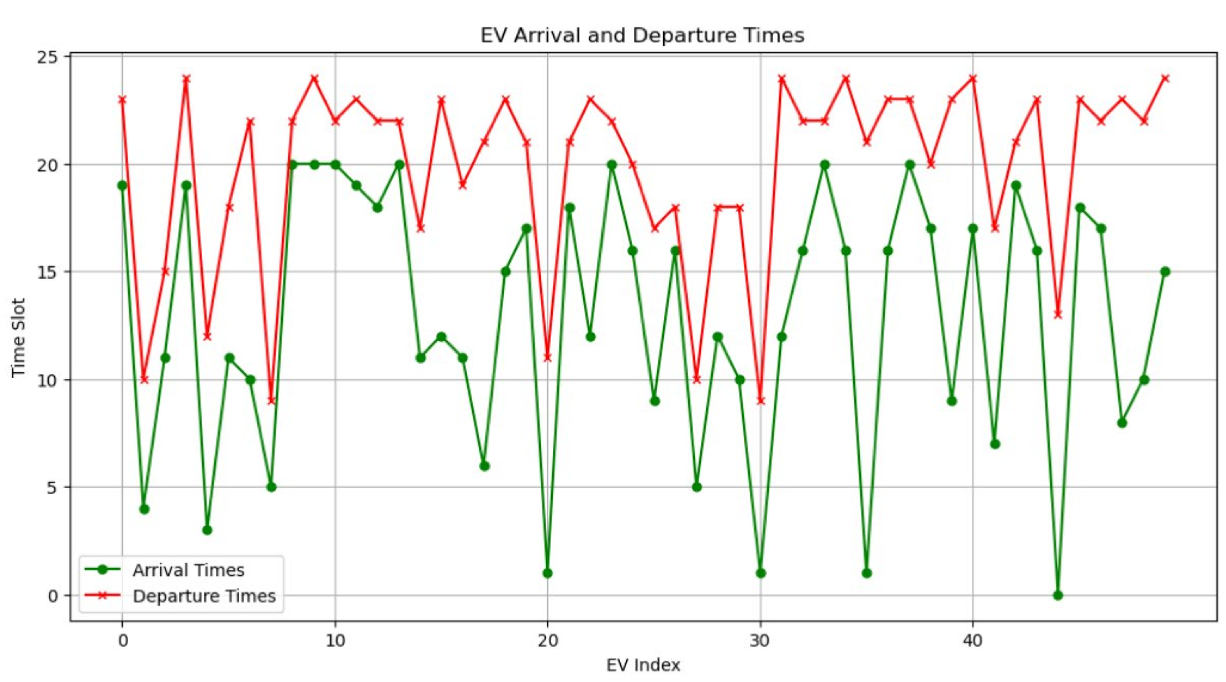
1. **Enable EVs to Act as Batteries**: Leverage EVs for peak shaving to reduce stress on the grid during high-demand periods.
2. **Enhance Grid Stability through V2G**: Use vehicle-to-grid (V2G) technology to allow EVs to discharge energy back to the grid when needed.
3. **Ensure Fair Resource Allocation**: Design a fair scheduling framework that maintains user trust and satisfaction while distributing energy resources efficiently.
4. **Integrate Renewable Energy Sources**: Incorporate photovoltaic systems with EV stations to increase clean energy usage and reduce environmental impact.

Research Framework

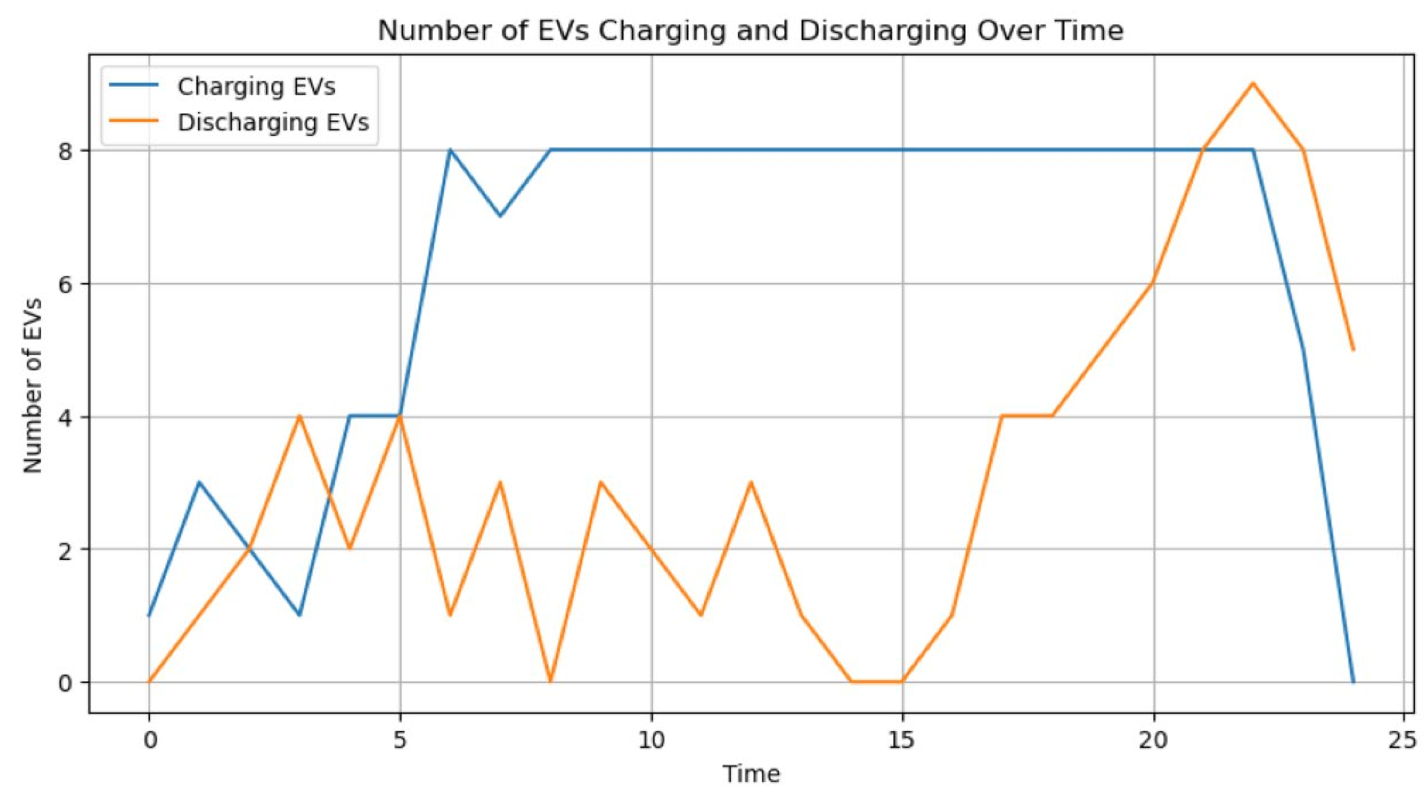


Results

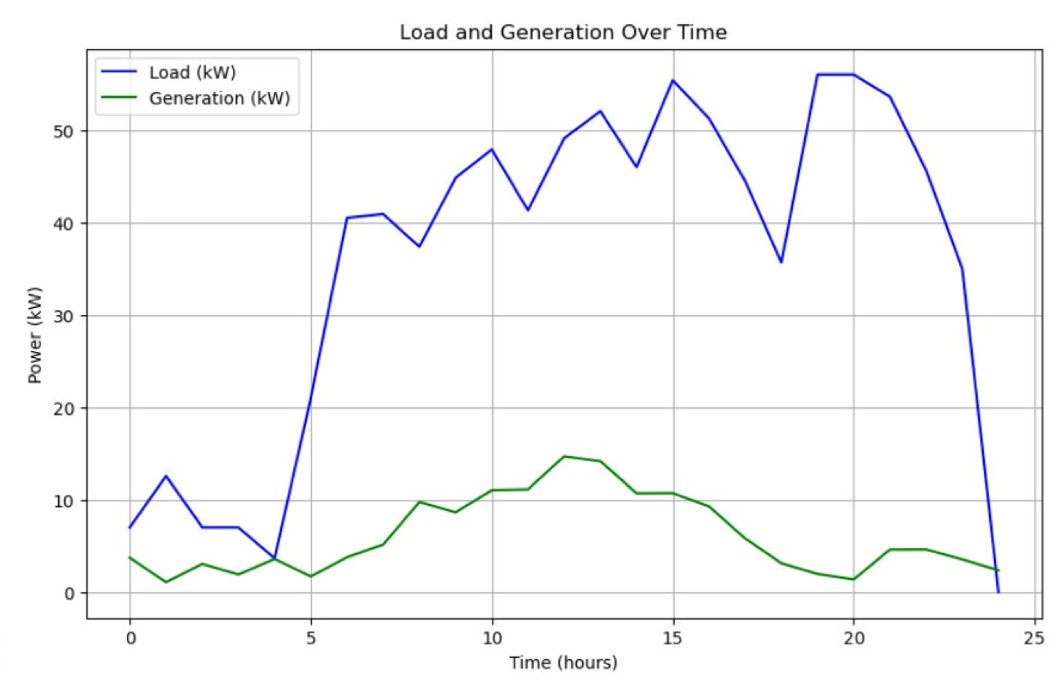
EVs arrival and departure



(Dis)Charging schedule



Load and generation



Conclusion and Future Perspective

1st step: Current stage

A smart offline scheduling framework was developed using MILP to manage the (dis)charging process. Considering:

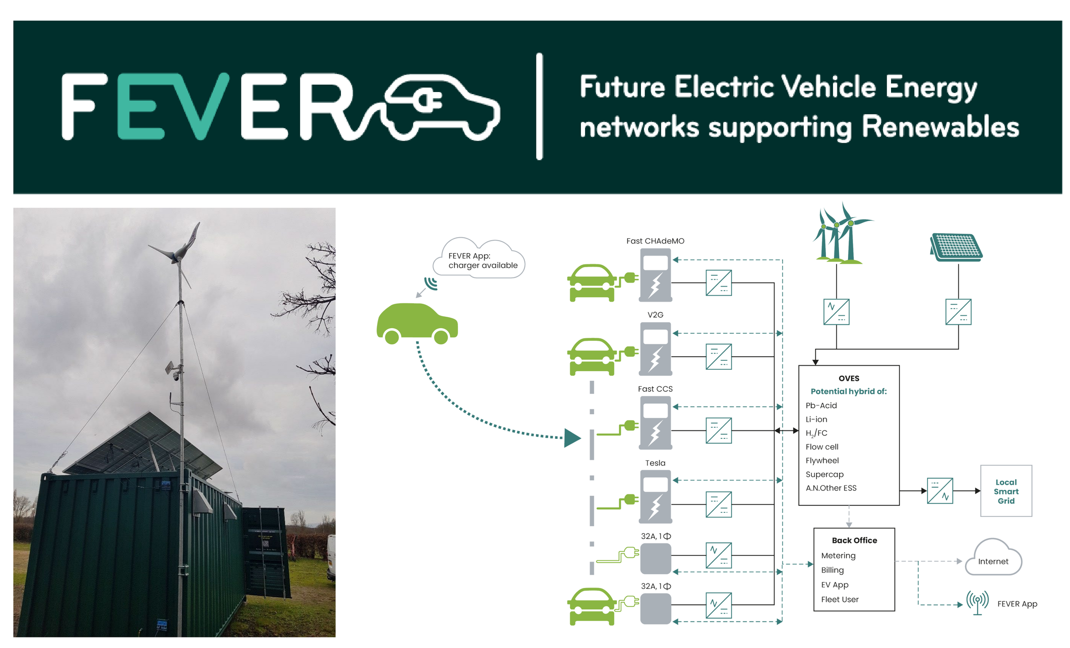
- User preferences and comfort,
- Fairness,
- System constraints,
- Partial charge fulfilment,
- V2G incentives.

2nd step

Enhancing Scheduling Robustness by:

- Using a **dynamic** scheduling framework,
- Leveraging deep learning for renewable energy power **forecasting.**

3rd step: Integration with green technologies



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