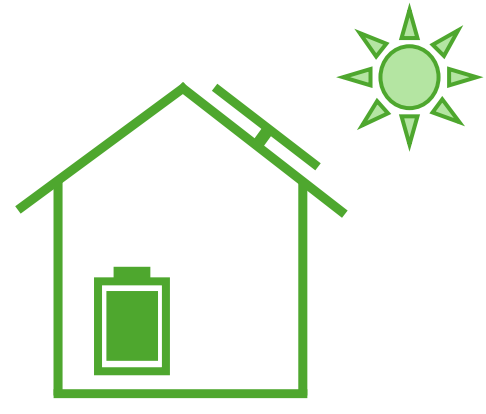


Dynamic Network Prices for Hosting Capacity Management

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Background

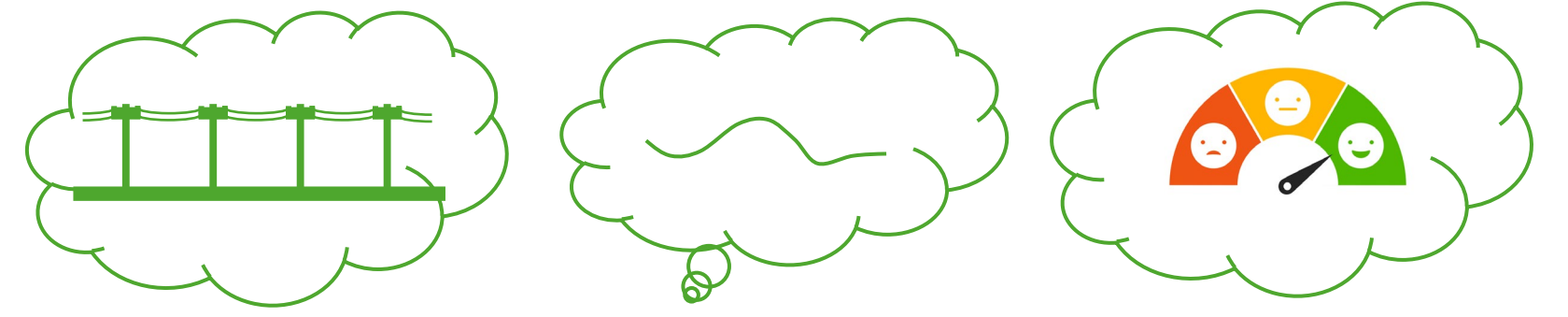


Increasing penetration of Distributed Energy Resources (DERs) brings challenges to LV distribution networks. How to effectively manage hosting capacity becomes a concern.



Existing solutions being explored rely on assumed prosumer behavioural patterns, overlook their desire to retain control over their devices.

Current fixed/tou tariffs are based on spatial and temporal averages, having limited impact on network conditions.



Can we leverage network price signals to manage network hosting capacity?

Can we take into account prosumers' prerogative in the design of dynamic tariffs that also considers network constraints?

Methodologies

Upper Level: DSO

Objective:
Revenue collection for investment cost recovery

- Roles:**
- Setting dynamic network prices
 - Ensuring revenue adequacy
 - Maintaining safe and reliable network operations

- Constraints:**
- Annual repayment requirement for cost recovery
 - Active and reactive power balance
 - Bus voltages, line thermal limits



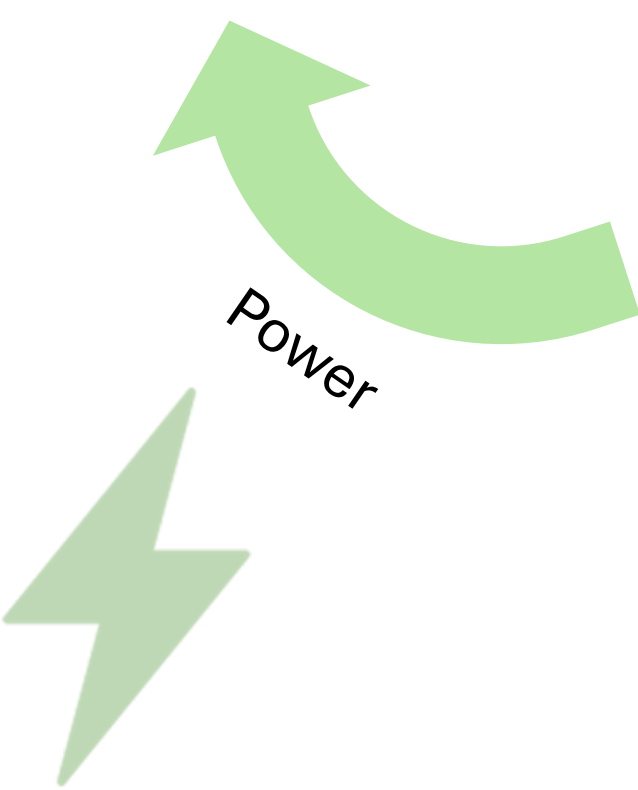
Prices

Objective:
Electricity expenditure minimisation

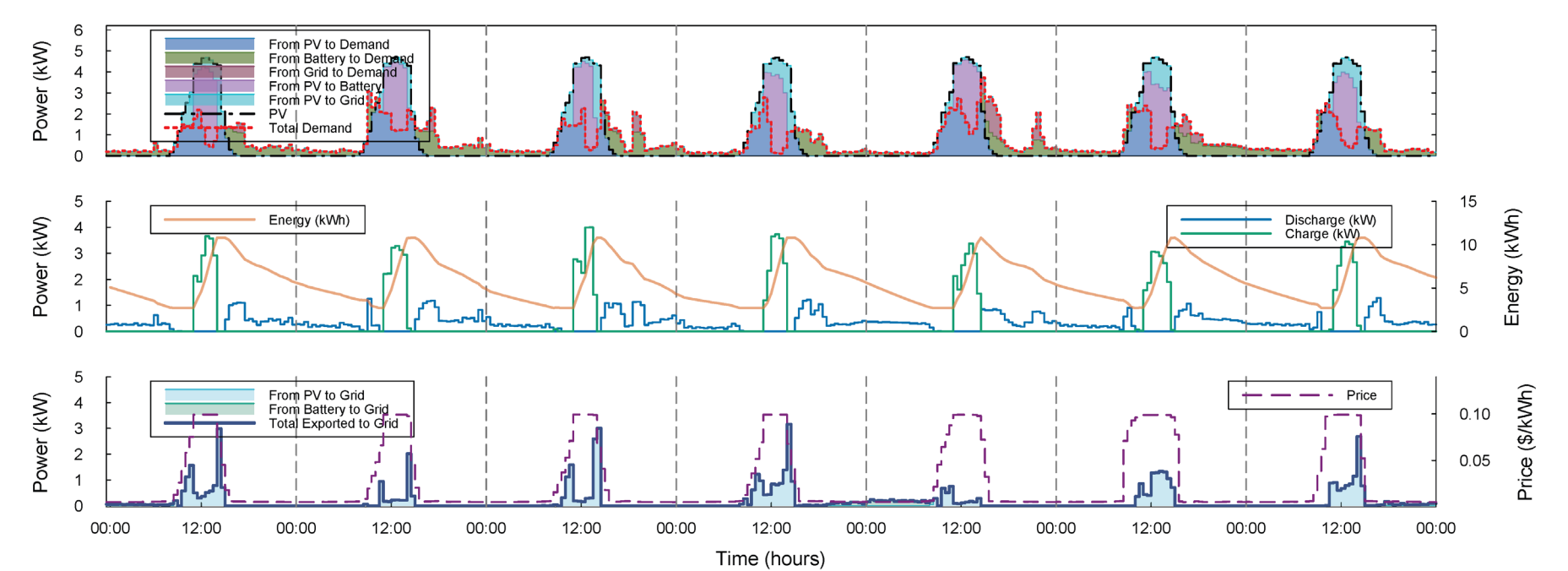
Roles:
Operating PVs and BES systems according to the received price signals

- Constraints:**
- Power exchange with the grid
 - PV system power
 - Battery charging, discharging power and energy

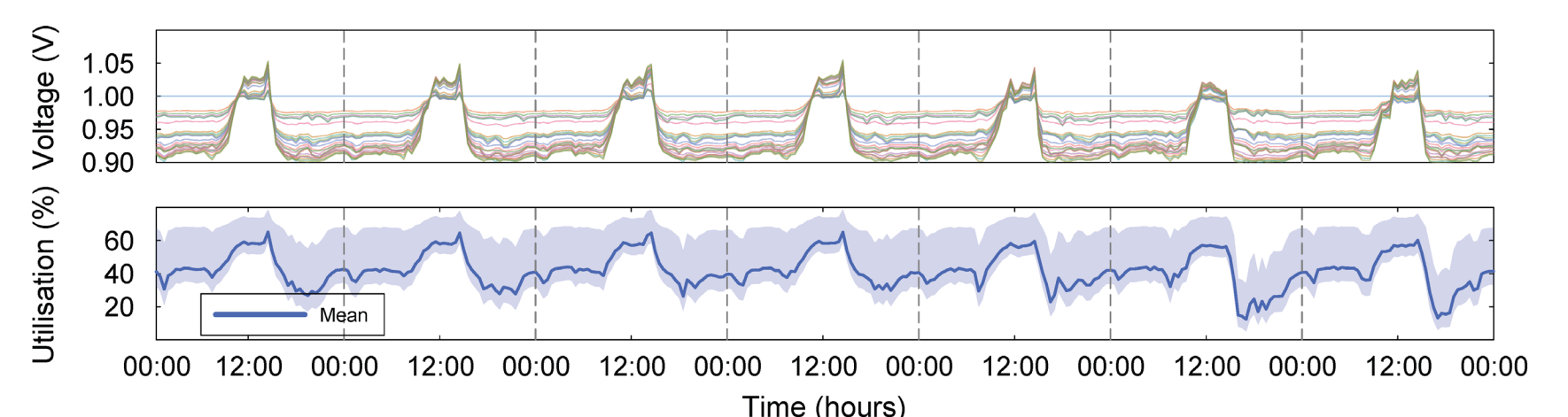
Lower Level: Prosumers



Results



- Time-series operation of a prosumer over the one-week simulation. From top to bottom are the illustration of demand composition, battery operation, power export with prices.
- Coordinated use of PV, battery, and grid to balance supply and demand. PV dominates at midday to supply load and charge the battery, while battery discharge and grid imports meet demand when solar is unavailable.
- The dynamic export tariffs influence prosumer exports, with high midday prices encouraging battery storage and low prices incentivising PV and battery export, benefiting both prosumers and the network.



- Bus voltages and line utilisation remains within safe operation limits, confirming reliable and uncongested network operation under the optimisation framework.

Takeaways

- ❖ A bilevel optimisation framework for designing dynamic network tariffs linking network prices with local operating conditions with prosumer decision making explicitly modelled;
- ❖ Separate the roles of DSO and prosumers, ensuring equilibrium consistency and preserve customer prerogative;
- ❖ Support coordinated DER operation and efficient utilisation of network capacity;
- ❖ Effective economic incentives for prosumer participation. Incentivise customers to shift consumption to periods when there is no network issue, as opposed to when energy is cheaper.



- Prosumer expenditure and net energy traded with or without BES system installation.
- By reducing reliance on imports and enabling controlled exports, BES-equipped houses not only help flatten net demand on the network but also lower their own bills.

References:

- [1] Department of Climate Change, Energy, the Environment and Water, "National Consumer Energy Resources Roadmap," 2024
 [2] Enea Consulting, "Project Edith Overview Report," 2022. [Online]. Available: <https://www.ausgrid.com.au/-/media/Documents/Reports-and-Research/Project-Edith/Project-Edith-2022.pdf>