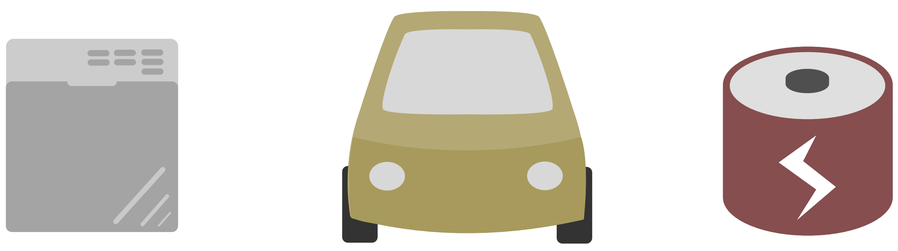
# Optimal Control of Distributed Demand Response and Storage

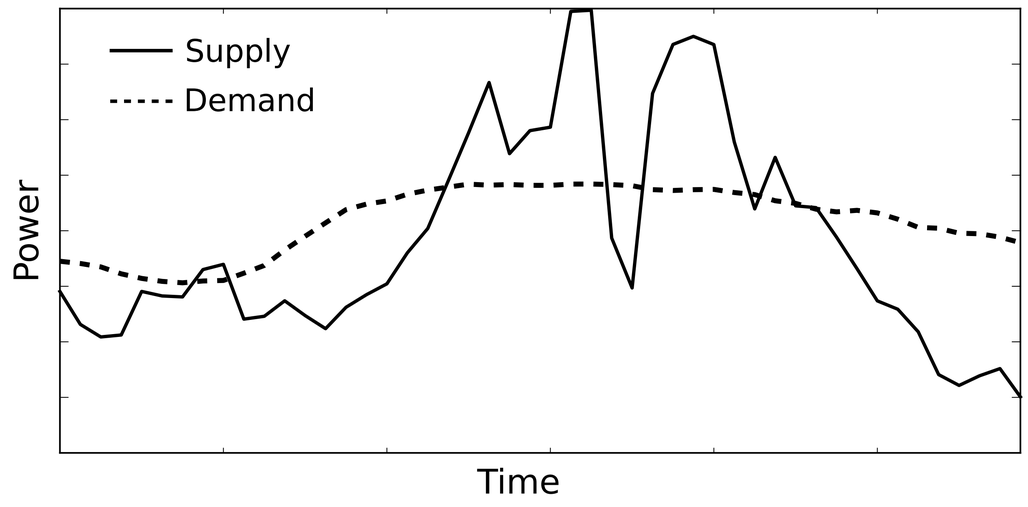
**Paul Scott** paul.scott@anu.edu.au, Supervisor: **Sylvie Thiebaux** sylvie.thiebaux@anu.edu.au

Renewables generate power when it is available, not necessarily when we need it. With the right control strategy we can use demand response and storage to ensure that supply and demand remain balanced.

Battery technology is getting cheaper every year and new smart appliances and home automation systems are coming onto the market. These technologies are for the first time giving consumers the ability to control how and when they consume electricity.

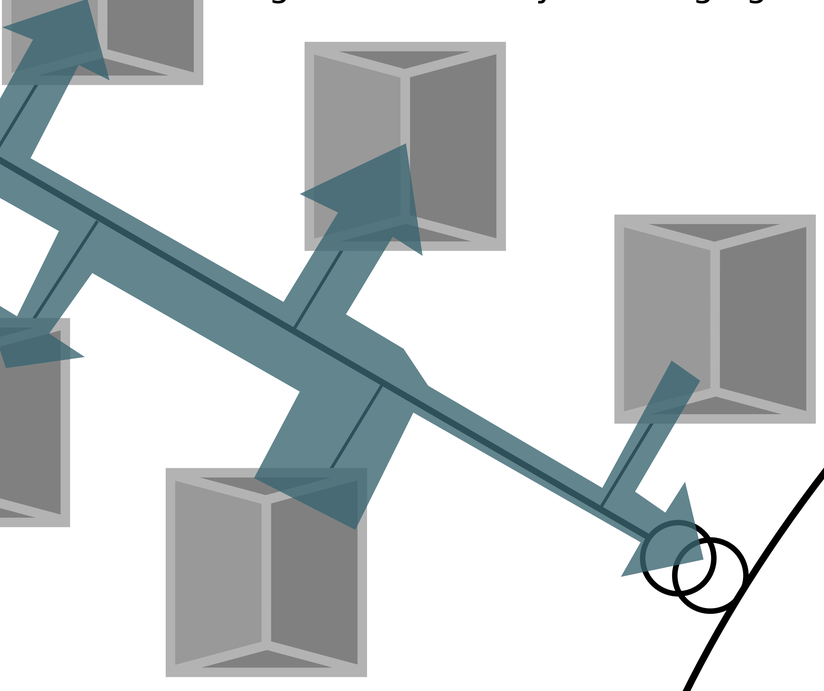


An unsolved problem is how to coordinate the demand response activities of numerous households in order to most efficiently operate the network. What may be locally optimal for one participant could be detrimental for the rest of the network, so we need to establish a way for all participants to cooperate.




By using real-time locational marginal prices we can ensure that the network remains in a safe operating state while providing the lowest cost power overall. We use a distributed algorithm to ensure that we preserve the privacy of customers and that our solution will scale to very large systems.

Houses export power back to the network from excess rooftop solar generation or by discharging batteries.



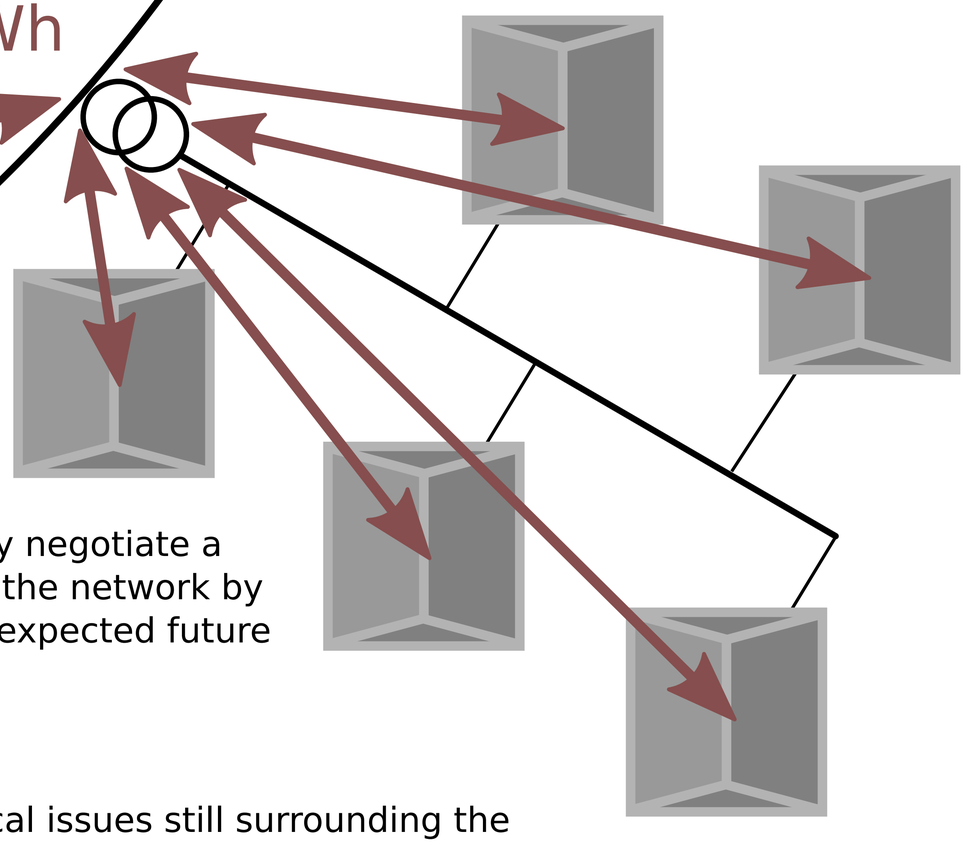
Distributed solar and wind sell power into the network.

Can operate as a stand alone microgrid when disconnected from the rest of the netwok.

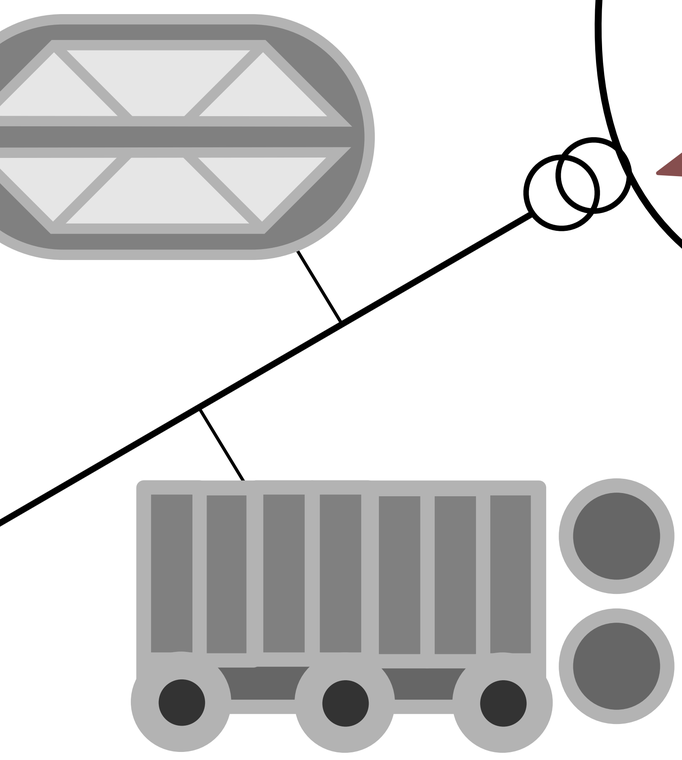
Prices vary between network nodes to account for network losses and to prevent the overloading of lines and equipment.

20c/kWh

30c/kWh



Participants iteratively negotiate a price at each node in the network by communicating their expected future consumption profiles.



Industry adjusts power consumption in response to network real-time price signals.

We are tackling a range of practical issues still surrounding the use of distributed algorithms for control of demand response and storage. These include handling non-convex power flow equations, loads which are discrete in nature, uncertainty and game theoretic aspects.

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