

# Project D

## Framework for Demand-Supply Matching and Ancillary Service Provision Through Distributed Energy Resources

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### Market-Based Supply-Demand Matching Mechanisms

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#### Market-Based Supply-Demand Matching

This research addresses the question of how to coordinate through market mechanisms, game theory, agent based systems, and other methods the operation of electrical grids in the built environment.

Market-based supply-demand matching plays a vital role in operating the electrical grid. The necessity of exactly balancing electrical supply and demand at all times greatly complicates the matching of offers and restricts the market in its workings.

#### Mechanism Design

In mechanism design, a desired objective is identified within some strategic setting; for example a market. A set of incentives, or mechanism, is then designed such that autonomous participants in the setting together reach the desired objective.

In electrical grids, the objective is to balance supply and demand. There are, however, more requirements for a suitable market mechanism:

- The market should be transparent.
- The market should allow for ahead planning.
- The market should be fair.

#### Congestion Management

Congestion in the electrical grid occurs during so called 'peak hours' when demand rises sharply. However, in the future, there may be more sources of congestion in the grid. When a critical amount of wind turbines is deployed, a moment of strong wind may cause a sharp rise in supply. Moreover, the deployment of distributed energy resources in the low-voltage grid may cause local congestion.

Congestion management attempts to preempt these situations and avoid them. One approach is to include congestion management in the market mechanism.

#### Fairness

Since electricity is a vital part of almost every person's life, let alone important public services, a certain measure of fairness may be required of the electricity market. A fair market may require that:

- Similar users are treated similarly.
- A minimum amount of electricity is guaranteed to be available to every user.
- The market power of users is limited.
- Trading does not require use of super computers.

Such notions of fairness may be incorporated in the market mechanism.

### Possible Collaboration within Project D:

WP3.3: Market-Based Supply-Demand Matching Mechanisms

WP3.4: Ancillary Services Provision Through Distributed Energy Resources

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#### Local Network Markets

To simplify the electricity grid and alleviate burden on DSO's, it could be beneficial to incorporate local markets that balance supply and demand as much as possible within the local market itself. These local markets would include distributed energy resources and ancillary services employed to locally balance the market.

In this line of research, *Mana Farrokhsresht* would be interested in simulation tools and coordination strategies for distribution system stakeholders, while *Brinn Hekkelman* would be interested in mechanism design & strategies and decentralized coordination frameworks.