Toronto Metropolitan University

Centre for Urban Energy
Faculty of Engineering
& Architectural Science

Research case study > Transmission and Distribution

Dynamic Reconfiguration and Feeder Power Management

Version 2 (July, 2026)

Context: Climate change and growing electrification are increasing grid load, requiring advanced solutions for power distribution systems. In Indian context, air-conditioning demand will coincide with nighttime electric vehicle charging, resulting in peak loading conditions on the distribution system. This becomes particularly challenging during the summer season, when the equipment is most derated due to high temperature. At the same time, during daytime hours, increasing solar penetration and reduced loading conditions may lead to lightly loaded feeders, increasing the risk of overvoltage conditions.

Problem: Transitioning to deep electrification will lead to increased electric loads and significantly challenge distribution utilities in feeder load management. Several times in the year, the network will operate in stressed operational circumstances. Algorithms for network management should work to mitigate overloads, whilst keeping switching costs to the least.

Solution: The project developed solutions in four parts:

(a) The first part was to develop a network reconfiguration algorithm that allowed for temporary overloads, prioritized certain type of switches and computed solutions in real-time, by leveraging underlying demand response resources, and energy storage units.

(b) The second step optimized demand response resources such that utility costs are the least. This yielded a demand response schedule that satisfied network reconfiguration requirement.

(c) The third step optimized energy storage units providing an energy exchange schedule that satisfied network reconfiguration requirement.

(d) Lastly, a load forecasting tool was developed to help with forecasting demand for the network reconfiguration algorithm.

The project assumes that network reconfiguration tool, considers demand from the load forecasting tool when executed, will create optimal network configuration, and also create schedule for demand response, and energy storage. The schedules will be issued to demand response and energy storage modules for implementation. This is how the four modules are tied.

Impact: The project tackles the challenges posed by the anticipated increase in electricity demands due to deep electrification in order to enhance feeder power management and operational efficiency. The project delivered four software modules for (a) network reconfiguration, (b) demand response scheduling, (c) energy storage scheduling, and (d) load forecasting.

CUE's Role: In collaboration with Tata Power Delhi Distribution Limited, CUE has developed methods and algorithms to develop dynamic reconfiguration and power management modules.

Partners: Tata Power Delhi Distribution Limited

Timeline: 2023 – 2026

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Key Stats:

4 Technical Reports
4 Software