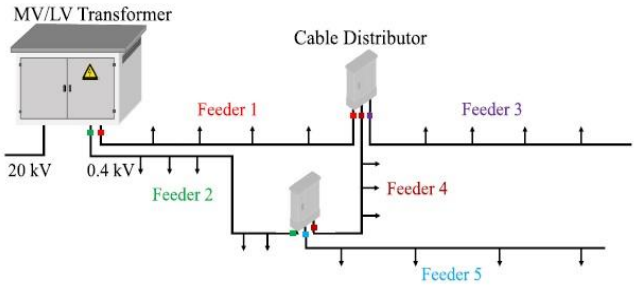

Fig. Schematic of a 400 V LV grid with a 20 kV/400 V transformer supplying multiple buildings through two cable distributors and five feeders

CREATING BETTER ESTIMATES FOR GREENER DISTRIBUTION GRIDS

Claudio Cañizares and Kankar Bhattacharya

Grid operators need to know how electricity is flowing in real time to prevent overloads, equipment damage and power outages. However, most low-voltage distribution grids that deliver electricity to houses and buildings weren't adequately designed to properly monitor and integrate solar panels, heat pumps, EV chargers, and other distributed energy resources.

Unless homes and businesses are equipped with smart meters, the state of the low-voltage distribution system at any given moment is unknown. In this case, the main information grid operators have is neighbourhood-level data from the transformers that connect higher-voltage transmission wires to the low-voltage feeders that serve end-users.

In collaboration with colleagues at Karlsruhe Institute of Technology (KIT) under a MITACS Globalink grant, Waterloo researchers Claudio Cañizares and Kankar Bhattacharya contributed to develop machine learning algorithms designed to provide a more detailed picture. The goal was to estimate how much of the power at each node within the distribution grid represents household electricity use, heating demand, and photovoltaic generation.

The team trained their algorithms with data from meters at a German distribution grid on how supply and demand fluctuate depending on weather conditions and the time of day, week and year. They then input real-time readings from distribution transformers and the location of solar panels, heat pumps, and EV charging stations of feeders at actual residential neighbourhoods in Karlsruhe, Germany, to demonstrate that the new method significantly outperformed traditional estimating techniques. The proposed approach gives grid operators a more accurate estimation of the conditions of the distribution systems they manage.

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***Partners**: MITACS, Karlsruhe Institute of Technology and the University of Waterloo*

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