Occupant-Centric Direct Load Control for peak demand reduction

Zeinab Khorasani Zadeh

Ph.D. student in building engineering, Concordia University

Supervisors:

Dr. Mohamed Ouf

Dr. Burak Gunay

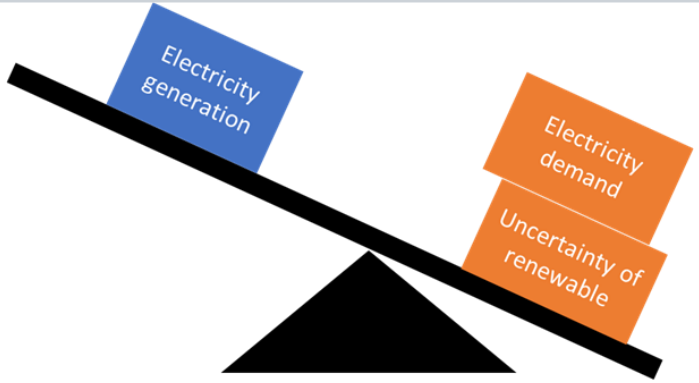
Peak Demand In Residential Houses

Peak load (Maximum electricity load) strains existing electricity infrastructure.

The increasing integration of renewable energy introduces uncertainties in the power sector.

Utility Challenge: Electrical utilities must match electricity generation and demand, especially during peak load times

In Feb 2023, demand in the province of Quebec peaked at 42,700 megawatts at 5 PM (-29 C in Montreal), surpassing last year's record of around 40,500 MW.



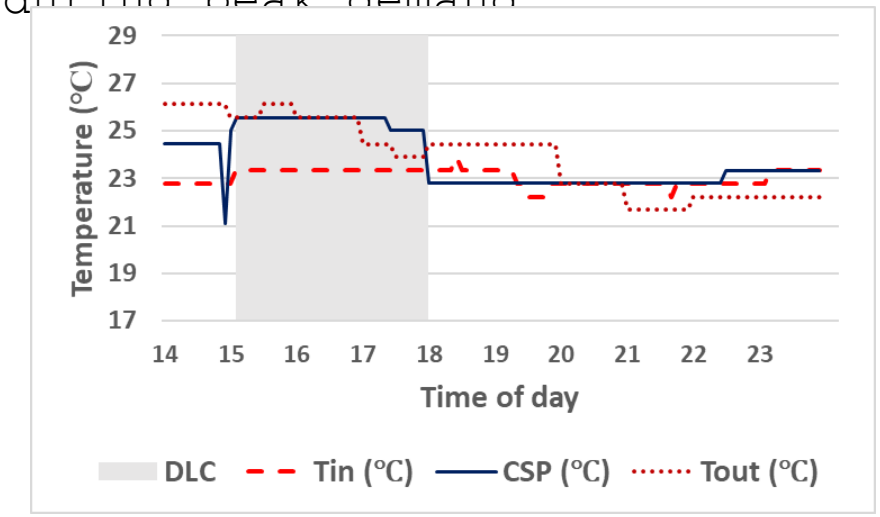
Utilities challenge during peak time

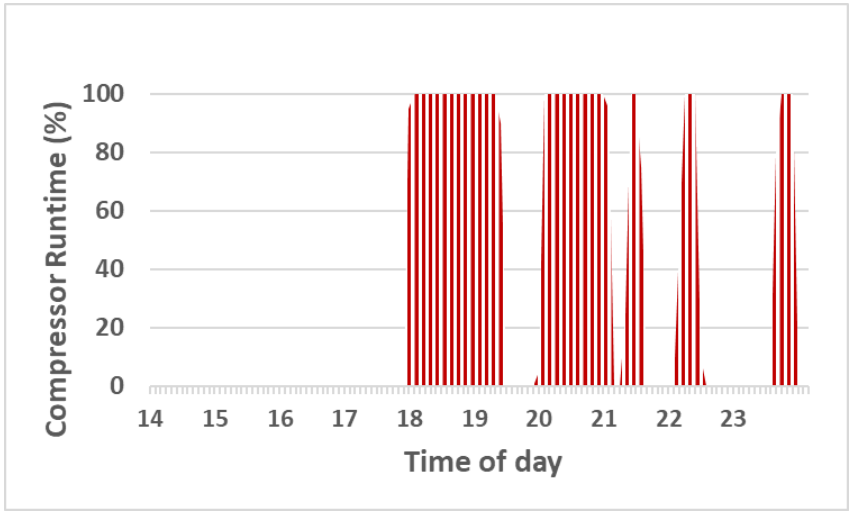
Demand Side Energy Management

Potential Solution:

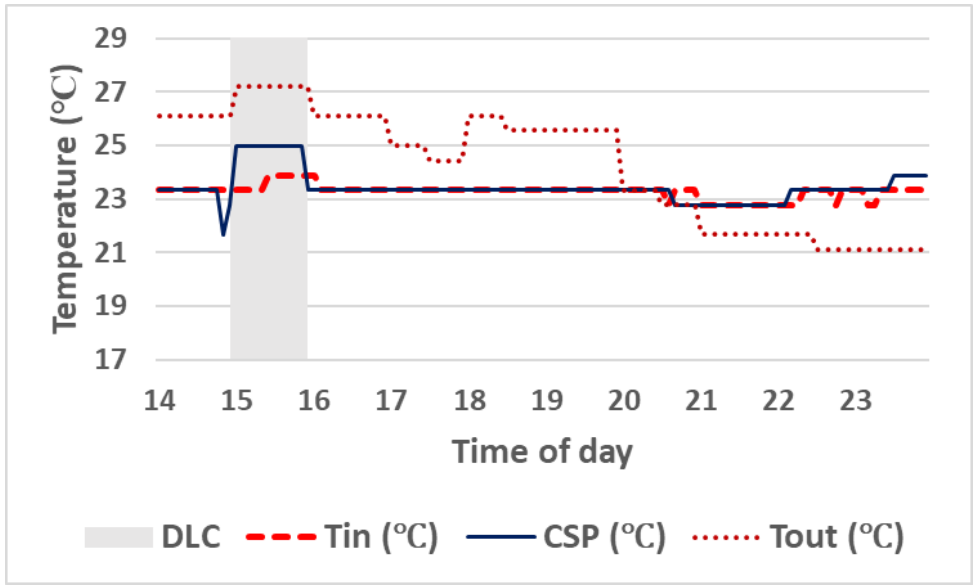
- Increase capacity (financial inefficiency)
- Opt for high-cost electricity imports (environmentally unfavorable)
- Demand Side Management (DSM)

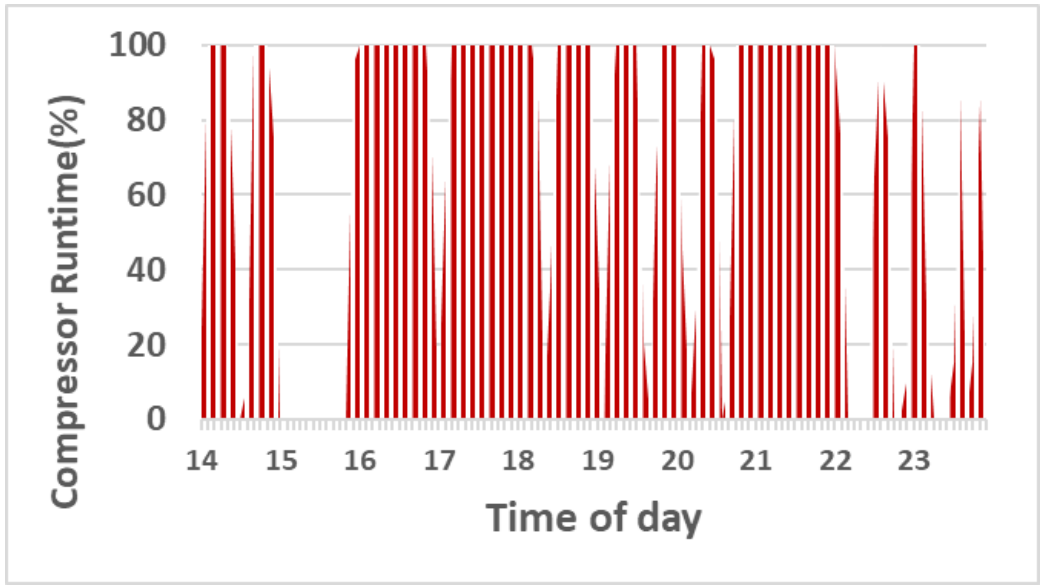
Direct Load Control (DLC): type of DSM in which utilities directly adjust the participating customers' smart thermostats to manage their electricity usage during peak demand

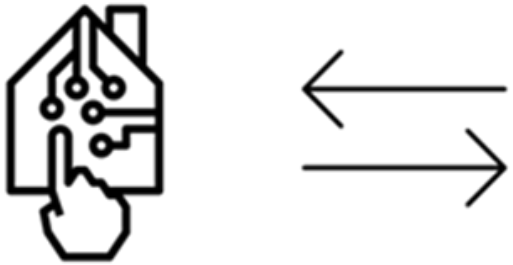




Utilities Challenge of DLC Override by Users



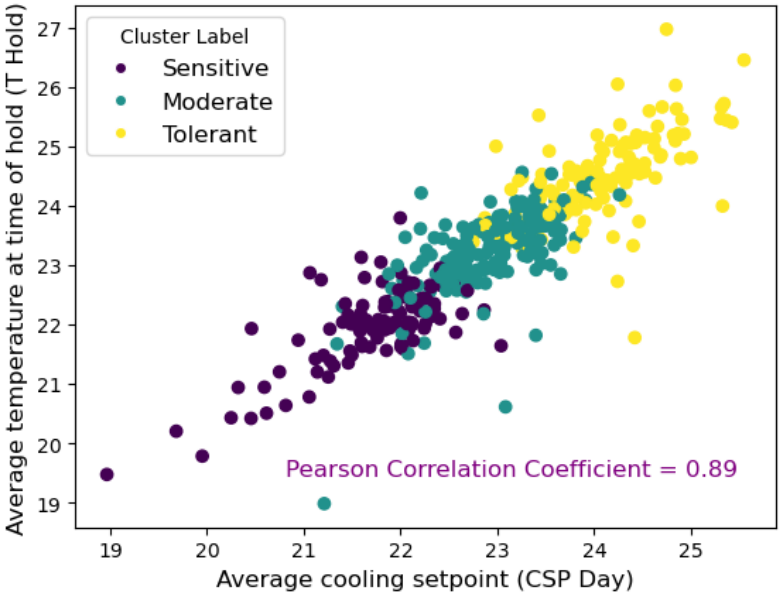




39%

Preference-based Clustering and User Behavior predictions

- Sensitive occupants: lower average cooling setpoints during summer and lower temperature settings when holding their smart thermostat.
- The developed prediction models enhance DLC effectiveness by tailoring personalized event characteristics, such as the cooling setpoint change magnitude, to match each cluster's unique preferences.



Variable	$T_{in\ day}$	$T_{in\ night}$	CSP_{day}	CSP_{night}	T_{hold}	N_{hold}	RC	N_{occ}	H_{age}	H_{area}
Cluster 1_Sensitive	21.74	21.55	22.38	21.66	21.98	10.9	72	1.4	31	2078
Cluster 2_Moderate	22.94	22.83	23.88	23.35	23.26	5.8	69	1.2	27	1984
Cluster 3_Tolerant	24.10	24.10	25.38	24.93	24.52	2.4	77	2.1	31	2358

Thank you