Study Committee C5

ELECTRICITY MARKETS & REGULATION

Paper 11157_2022

Evaluation of critical peak pricing impact on Hydro-Quebec residential customers load profile for distribution network planning

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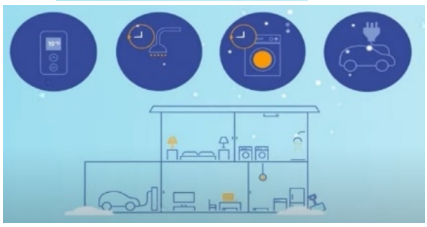
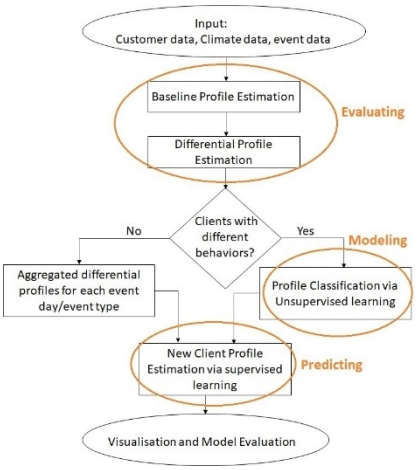
Motivation

- Intermittent renewable energy sources and end-use electrification such as transportation and heating introduce a significant challenge for the reliability of the power grid. Hydro-Québec put in place different demand-side management mechanism such as dynamic tariffication (DT) to shift electricity consumption outside peak period.
- In winter 2019-2020, Hydro-Quebec launched two types of DT rates, called Winter Credit Option and Flex D Rate available to a limited number of residential customers.
- We propose an algorithm to evaluate the impact of the DT on individual customers consumption pattern for distribution network planning.





Method/Approach

- Baseline Estimation
  - Arithmetic methods
  - Control group methods
  - Machine learning methods
  - Linear regression methods:

$$pl(d,h) = C1(h) + C2(h) * temperature\ (d,h)$$

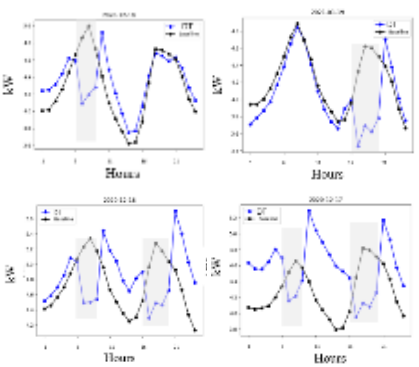
h: Hour,
d: Admissible day,
pl(d,h): Expected load for day d and hour h
The coefficients are calculated using a linear regression on data from all eligible days from December 2020 to March 2021.
Eligible days: Weakdays, No-event days

- Differential profile Estimation
- Clustering: unsupervised learning
- Predicting : Supervised Learning

Future works

Experimental setup & test results

- Several thousands of consumption patterns for Flex D tarif.
- Peak events in the morning (am), at the end of the day (pm), or both (am-pm).
- Estimated Baseline profile versus DT profile for each event day:



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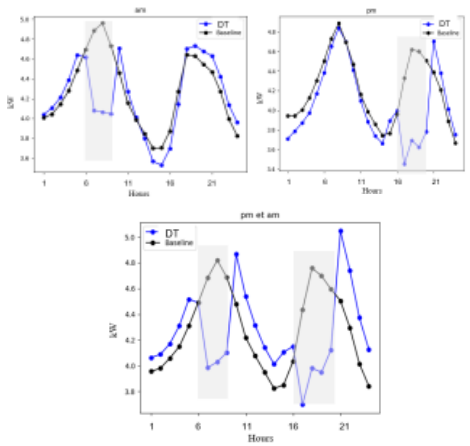
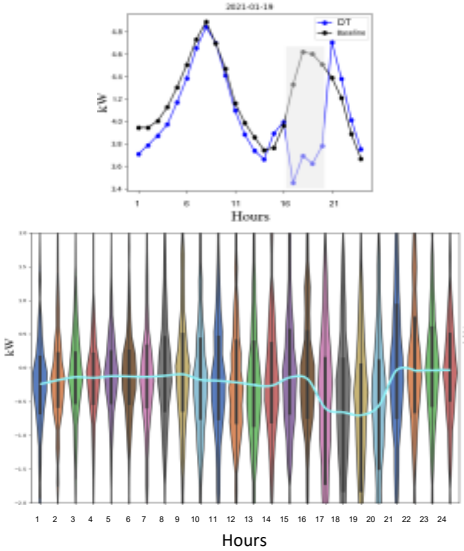
(continued)

Experimental setup & test results

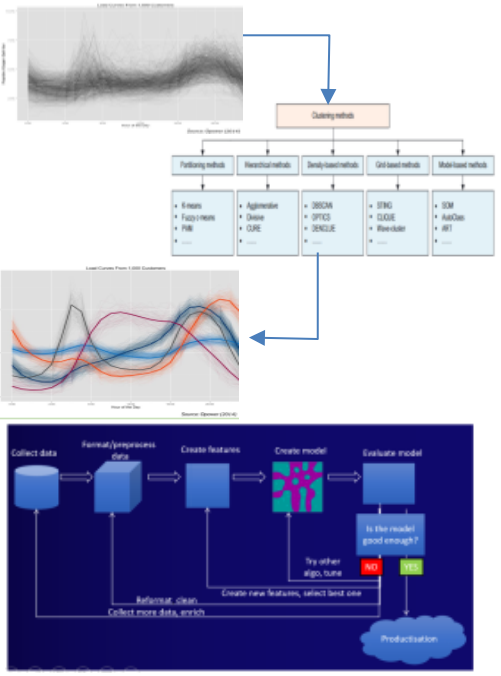
- Estimated Baseline profile versus DT profile for each type of event:



- Estimation of the aggregated differential profile presented in violon plot



Discussion on the future works



Conclusion

- Dynamic tariffication programs provided by Hydro-Québec:
  - Winter Credit
  - Flex D
- Proposed algorithm to evaluate the effect of the Flex D program on the customers consumption pattern.
  - Flex D
  - Baseline Profile Estimation
  - Differential Profile Estimation
- Future Works:
  - Analysing other Baseline methods
  - Applying the Supervised and Unsupervised Learning for modeling and prediction