Proceedings of the 6th International Conference on Statistics: Theory and Applications (ICSTA'24)
Barcelona, Spain – August 19 - 21, 2024
Paper No. 159
DOI: 10.11159/icsta24.159

Impact of Heating System Conversion on Peak Electricity Demand

Sanogo Sy K. John Asaph[1], Beaulieu Vincent[2], Ste-Marie Isabelle[2], Zhou Yaming[2], Ouhourane Mohamed[2]
[1]Hydro-Québec
75 boulevard René-Lévesque Ouest, Montréal, Canda
sanogo.sykeprissiejohnasaph@hydroquebec.com
[2]Hydro-Québec
75 boulevard René-Lévesque Ouest, Montréal, Canda
beaulieu.vincent@hydroquebec.com
ste-marie.isabelle.2@hydroquebec.com
zhou.yaming@hydroquebec.com
Ouhourane.Mohamed@hydroquebec.com

Extended Abstract

The study objective is to estimate the impact of converting space heating systems from fossil fuels to electricity on winter peak electrical demand. We analyzed the hourly electricity consumption data of over 4 million installations over a period spanning from December 1, 2022, to March 31, 2023, aggregated to obtain daily consumption data. Using georeferencing, daily temperature data was acquired to calculate Heating Degree Days, a proxy for space heating requirements. Outliers were removed following Tukey's rule. Using residential survey data to identify installations using oil and gas for space heating, the Kolmogorov-Smirnov test and Q-Q plot confirmed a log-normal distribution, and the 5% confidence interval was established. Energy consumption profiles were modeled using piecewise linear regression analysis. The K-Nearest Neighbors (KNN) algorithm identified eight clusters based on energy profiles with a focus on the horizontal cluster showing no sensitivity to temperature. This cluster represents installations with fossil fuel space heating systems. The methodology was replicated for the previous three winter periods to retain the installations with fossil fuel space heating systems over the entire period. Impacts were estimated using regression analysis, with peak hour consumption assessed before and after conversion. The conversion's diversified impact at peak demand hour is estimated at 5.21 kWh per installation. The findings stress the importance of sound utility planning and implementing strategic measures to ensure winter peak demand hours can reliably be met as the Province of Quebec moves towards meeting its greenhouse gas emission targets.

References

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