

# DataWatt - DESIGN PROJECT - SIE 2025

## Analyse comparative des consommations électriques

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### Research Question

How can consumption by private individuals, professionals and municipal actors be assessed using appropriate indicators and how to efficiently communicate them ?

### Goals

The first goal is to select a relevant amount of indicators for the private individuals, professionals and municipal actors, to understand their load curves.

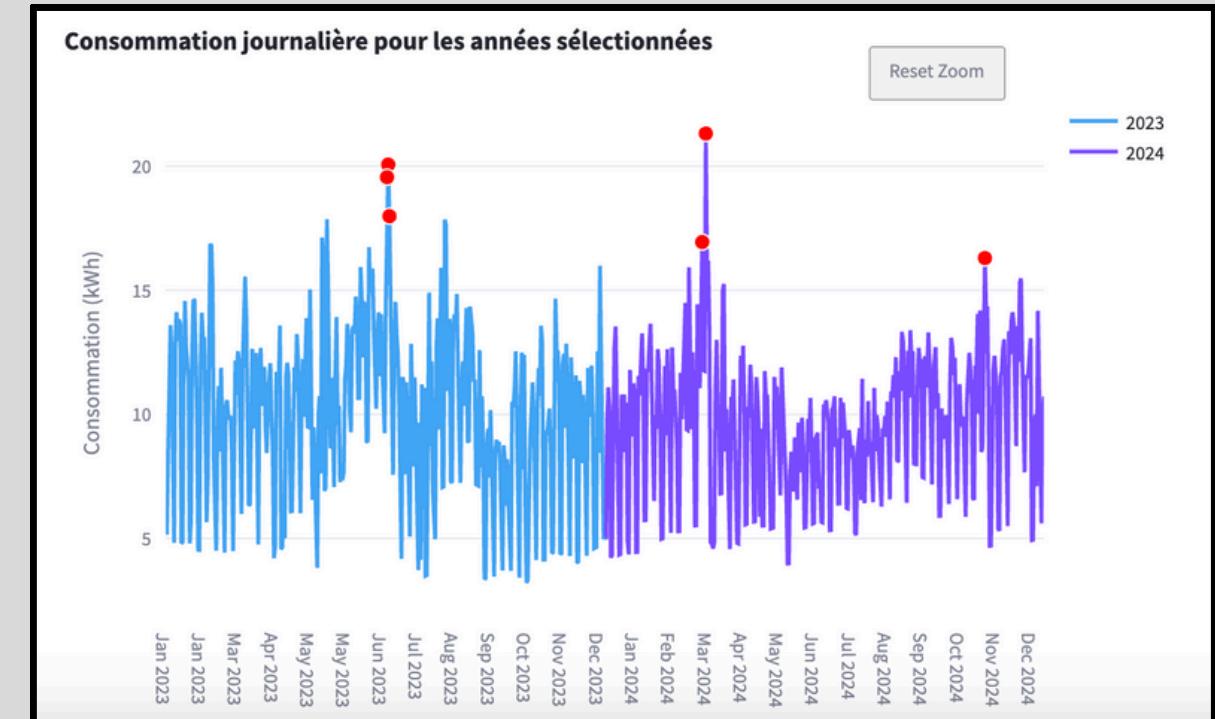
The second goal is to develop a web app, that shall be coded using Python, as a tool for users. The web app shall be interactive and the indicators must be configurable to meet the specific requirements of private individuals, professionals and municipal actors. On this poster, results for a typical private user are shown.

### Literature review

Recent studies have highlighted a range of indicators to analyze electricity consumption patterns and promote energy efficiency. Time-based analyses are widely used to visualize regularities and anomalies via time-series plots or heatmaps. Cost metrics based on time-of-use tariffs help users assess potential savings through load shifting, using National energy standards like Minergie and SuisseEnergie as benchmarks. Machine Learning Techniques for clustering are used to identify typical usage profiles and enable more personalized energy-saving recommendations.

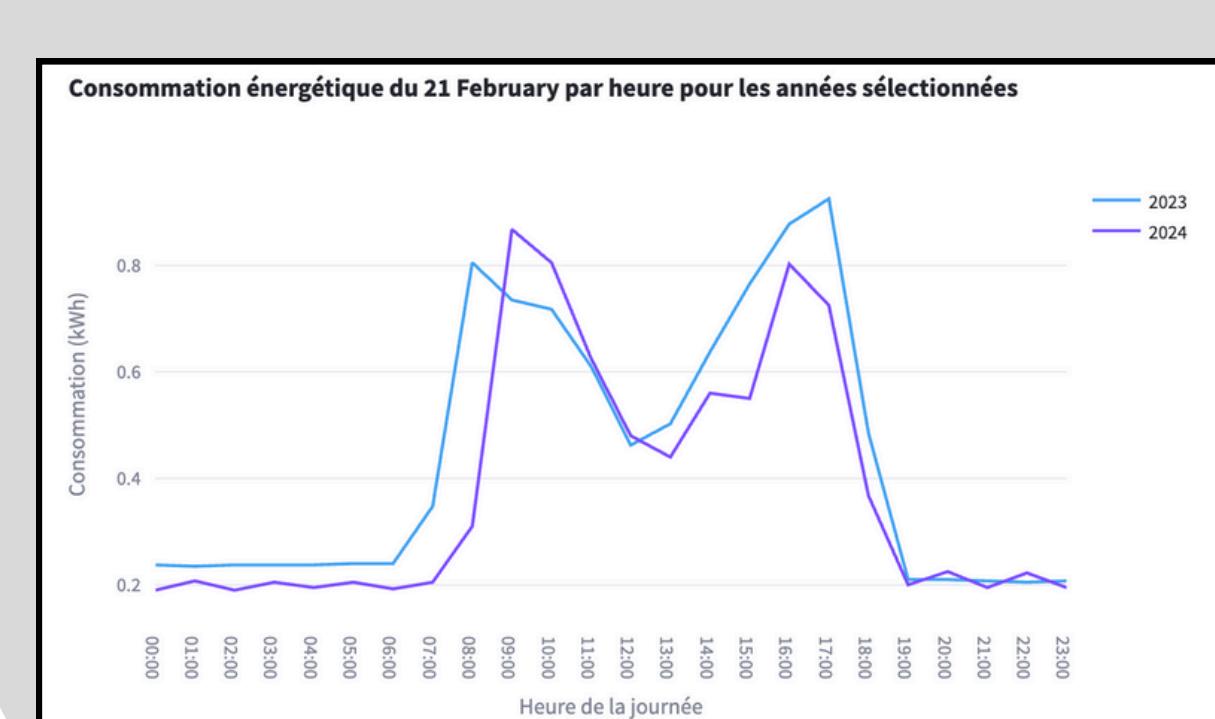
## UPLOAD, VISUALIZE AND ECONOMIZE !

### VISUALIZE YOUR CONSUMPTIONS !



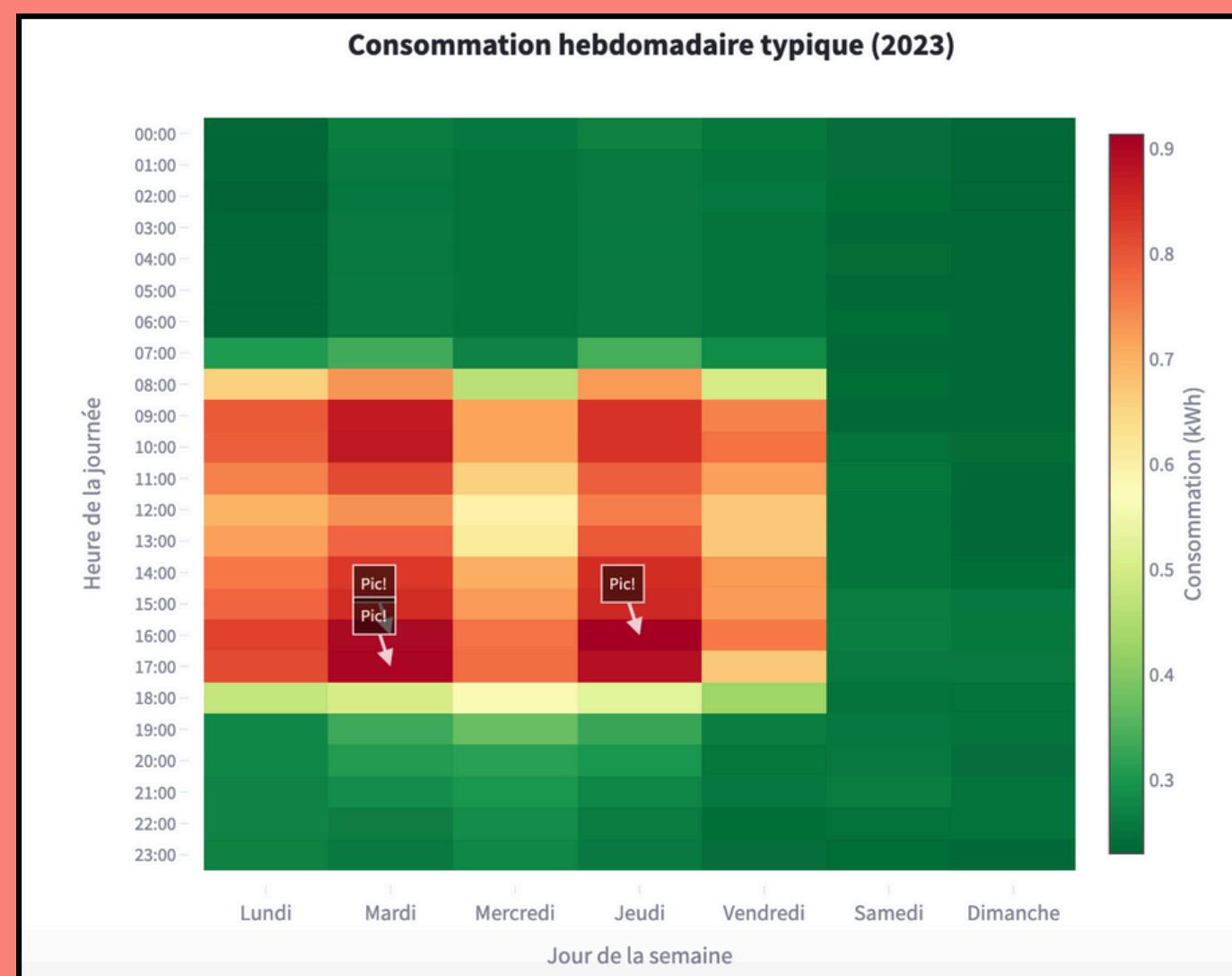
**Yearly view:** Exposing long-term trends and automatically flagging the three highest consumption days [1] [2].

**Weekly view:** Makes it easy to spot systematic business days and weekend contrasts.



**Daily view:** Hourly or quarter-hourly curve for a chosen date.

### GET A HEATMAP PATTERN OF YOUR CONSUMPTION !



A **weekly pattern heatmap** aggregating consumption by hourly time range of the week and time of day, showing typical behavior over a week [3] [4].

On this heatmap, it's typically a building with professional activities, with notable consumption only between 08h00 to 17h00 during business days.

### OBTAINT YOUR ASSOCIATED COSTS !

Converts your kWh into CHF costs with an editable tariff (default is the average SIE SA tariff), delivering price so the tool works for any utility area [5]. For this profile :

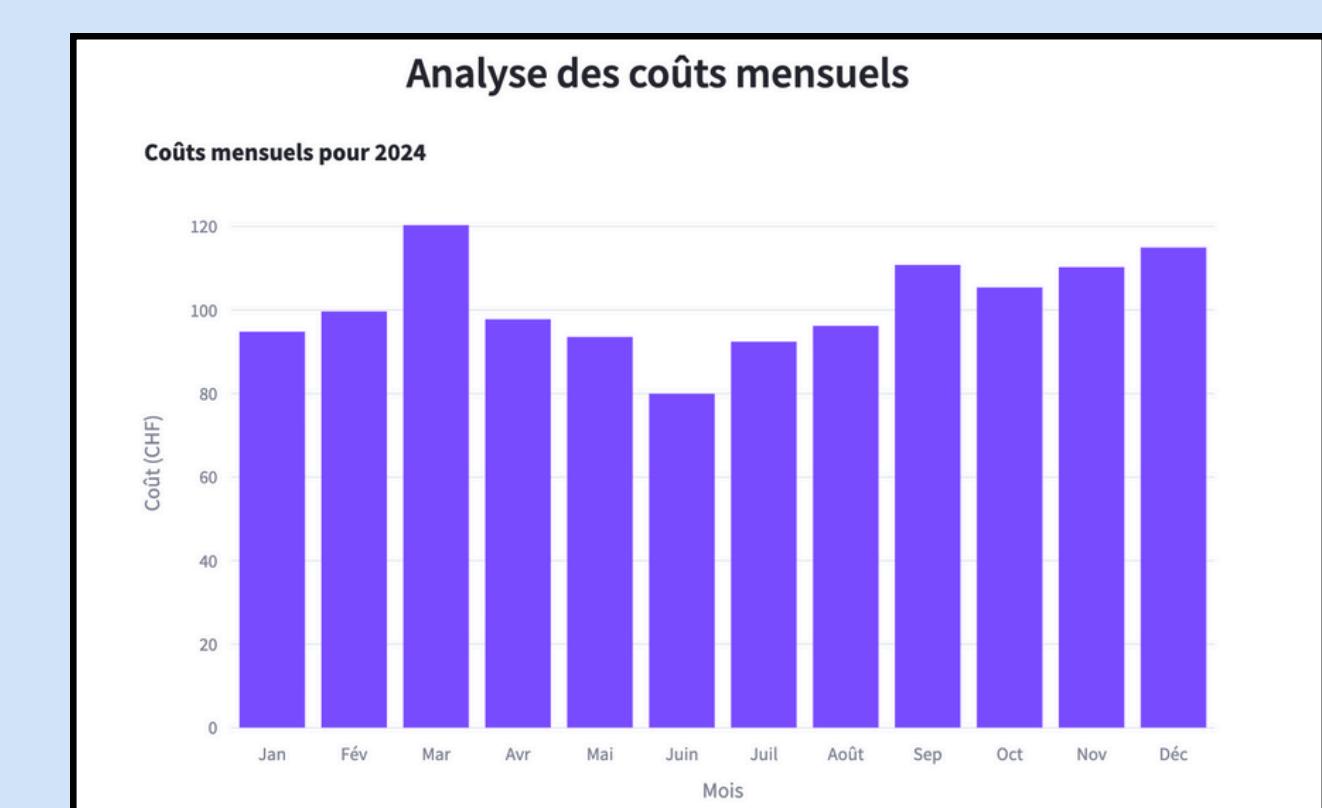
**Mean daily consumption of 9.5 kWh in 2024**

**Consumption of 3'475 kWh in 2024**

**Daily costs of CHF 3.32**

**Annual costs of CHF 1'216**

**Single-rate tariff CHF 0.35.- per kWh**

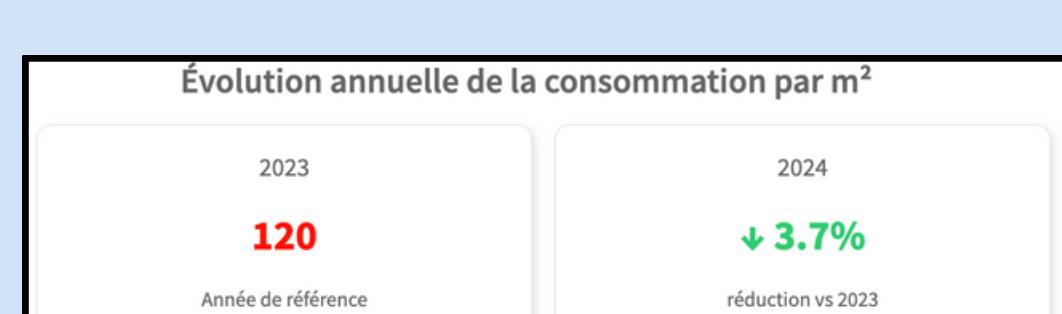


### GET ADVANCED METRICS !

Get access advanced metrics for a better understand of the structure of your consumption such as day-night and weekday-ratios.

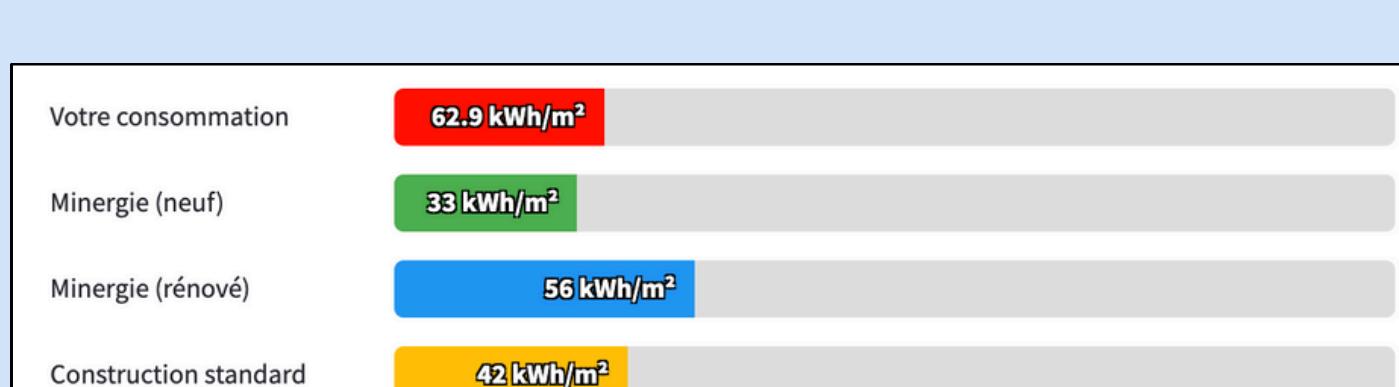
To get more personalized indicators and recommendations, fill a form is needed (information are not saved).

### COMPARE YOURSELF WITH STANDARDS !



Tracks consumption per m<sup>2</sup> over time, letting you monitor how your energy-use density evolves and spot efficiency gains or losses.

Benchmarks against Minergie targets [6], showing whether your kWh/m<sup>2</sup> falls above or below Swiss efficiency standards.

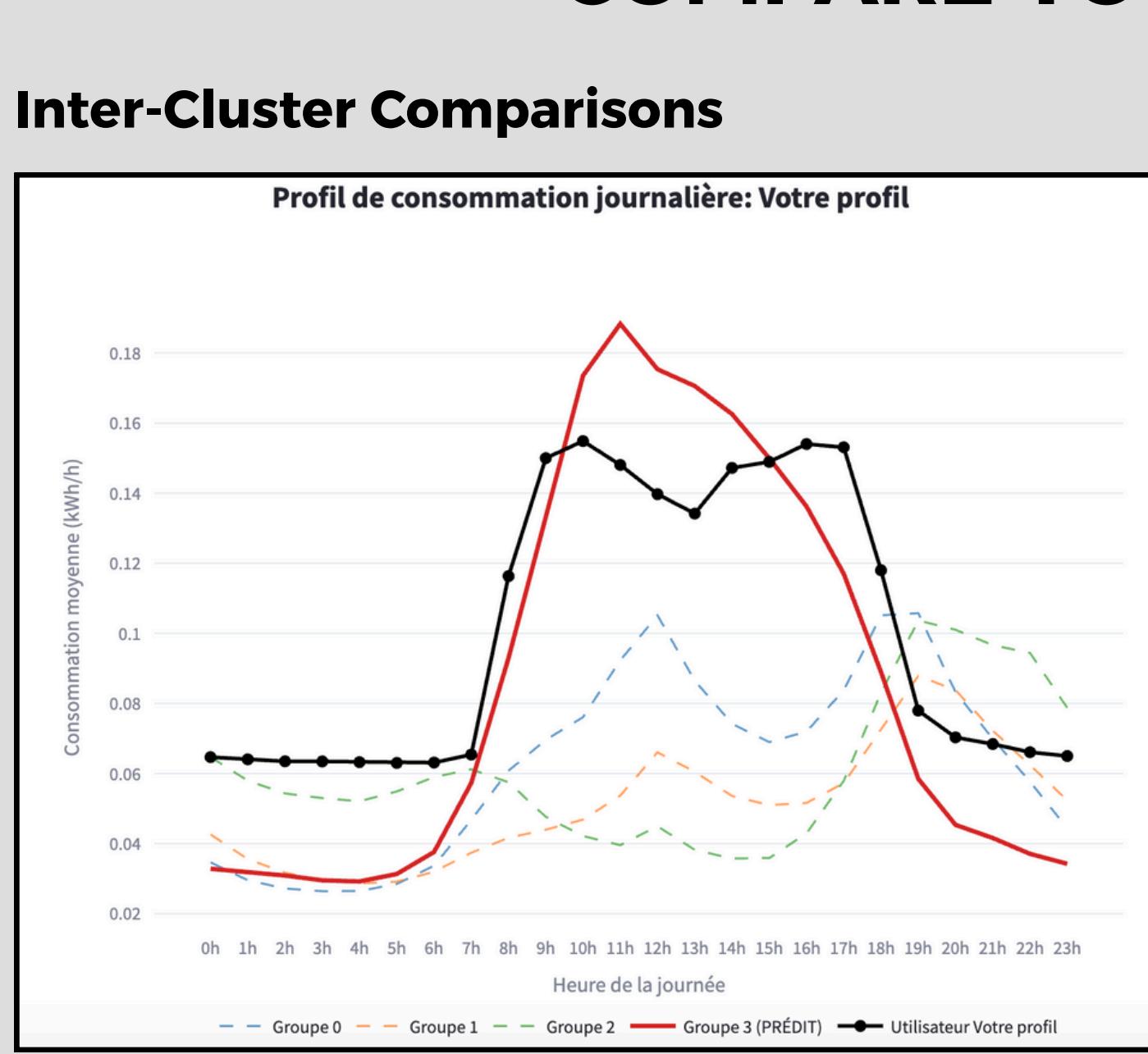


**⚠ Note:** the analysis treats total household electricity as a single load; individual end-uses (heating, solar panels, etc.) are not automatically disaggregated.

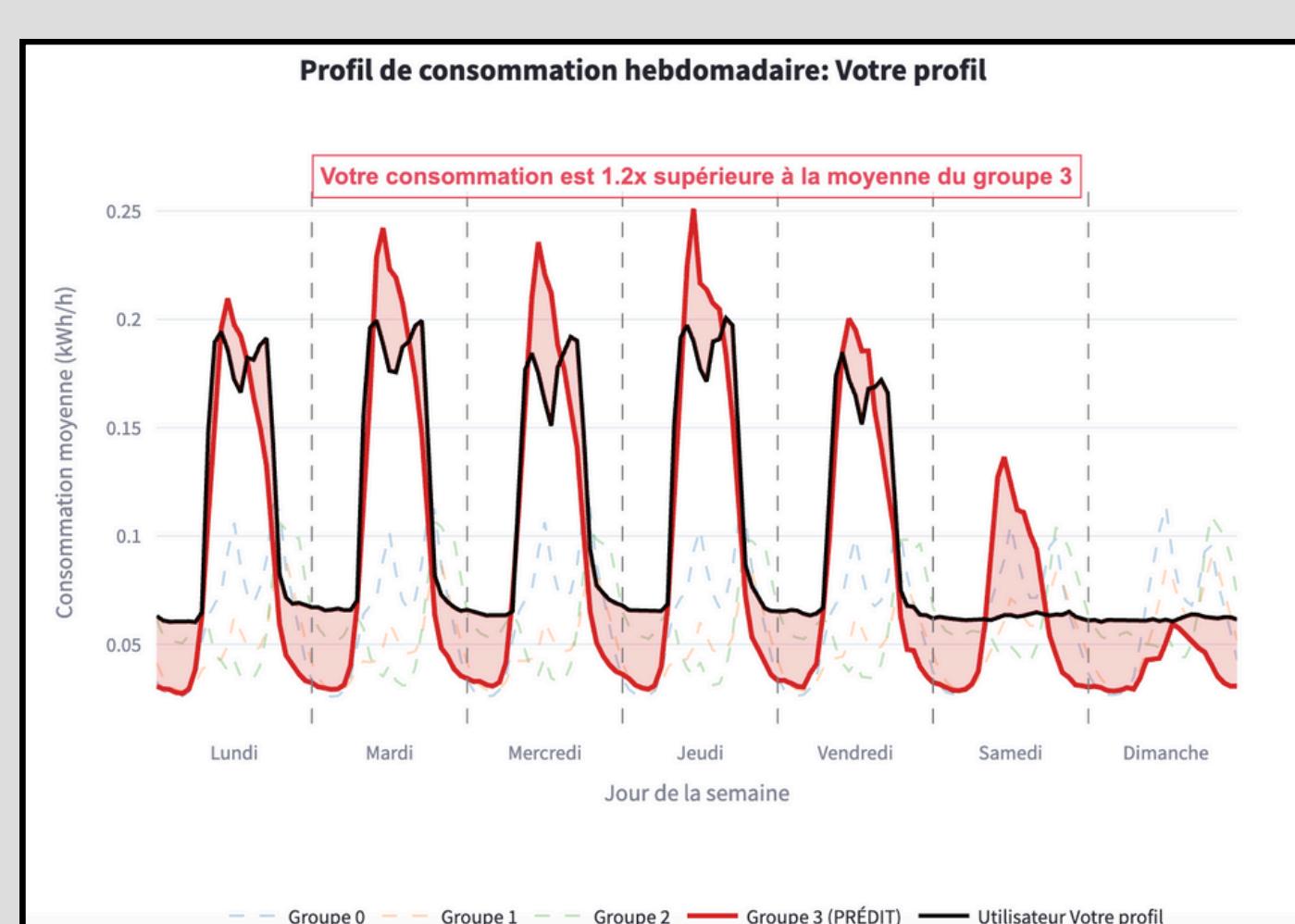
### GET RECOMMENDATIONS !

Get personalized recommendations and implementation pathways aimed at reducing energy consumption and achieving cost efficiency through adaptive measures.

### Inter-Cluster Comparisons



**Daily profile**



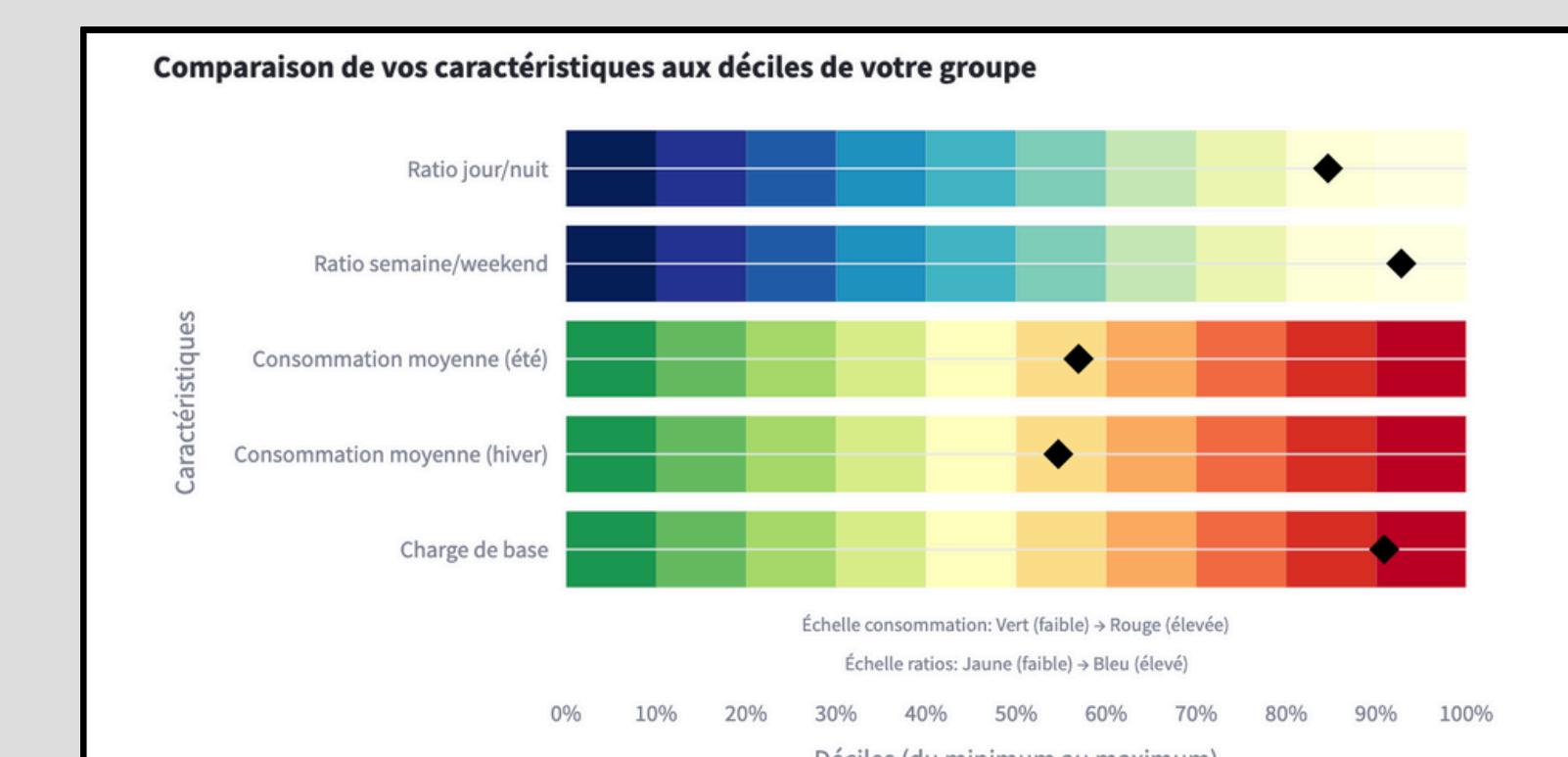
**Weekly profile**

Your load curve is compared to about 1'000 reference households; an **unsupervised K-Means** model slots you into one of four characteristic clusters [7] [8].

K-Means is tailored and trained with features that take up the displayed indicators for each user in the web app, for inter-cluster and intra-clusters comparisons.

- Cluster 0 : **Building with high consumption**
- Cluster 1 : **Regular Household**
- Cluster 2 : **Household with low daytime consumption or with solar panel**
- Cluster 3 : **Building with professionals activities**

### Intra-Cluster Comparisons



This shows how far your consumption sits from the detected cluster center; the greater the gap, the more your habits diverge from users of the same group.

### Limits

The web app facilitates the visualization of consumption anomalies and provides insights into usage patterns; however, it doesn't disaggregate the consumption curve. As a result, users are required to interpret the displayed information in relation to their specific context and operational conditions.

### Conclusions

Context-specific indicators, integrated into an interactive web app, enable effective assessment of electricity consumption across private, professional and municipal users, thereby enhancing user comprehension and supporting energy efficiency objectives

### References

[1] N. Ahmed and K. Mueller. (2019) EnergyScout: A consumer oriented dashboard for smart meter data analytics. [Online]. Available: <https://arxiv.org/abs/1911.09284.pdf>

[2] D. Expertise. (2023) Minergie - présentation du standard de construction. [Online]. Available: <https://www.d-expertise.ch/2023/03/30/minergie-présentation-du-standard-de-construction/>

[3] C. R. U. T. E. E. J. D. Rhodes, W. J. Cole and M. E. Webber. (2014) "clustering analysis of residential electricity demand profiles," *applied energy*, vol. 135, pp. 461–471. [Online]. Available: <https://doi.org/10.1016/j.apenergy.2014.08.111>

[4] Perlas.ch. (2024) Perlas - personalised residential load curve analysis - energieeffizienzportal. [Online]. Available: <https://perlas.ch/>

[5] D. Kubitschka. (2018) How a heat map can lower your energy bill - energieengineering Blog. [Online]. Available: <https://kw-engineering.com/energy-savings-calendar-heat-map/>

[6] SIE SA. Tarifs et listes de prix. [Online]. Available: <https://www.sie.ch/électricité/tarif-et-liste-de-prix-267>

[7] D. Expertise. (2023) Minergie - présentation du standard de construction. [Online]. Available: <https://www.d-expertise.ch/2023/03/30/minergie-présentation-du-standard-de-construction/>

[8] K. Yu, J. Cao, X. Chen, Z. Yang, and L. Gan. "Residential load forecasting based on electricity consumption pattern clustering." *Frontiers in Energy Research*, vol. 10, Jan. 2023. [Online]. Available: <https://www.frontiersin.org/journals/energy-research/articles/10.3389/fenrg.2022.1113733/full>

## NOW IT'S YOUR TIME TO TEST IT !

### DISCOVER

### THE WEB APP !



<https://datawatt-design-project.streamlit.app>

### DISCOVER

### DEMO VIDEO !



<https://www.youtube.com/watch?v=p9kK-sl7As>