Design Project – SIE 2024

Comparative analysis of electrical consumptions

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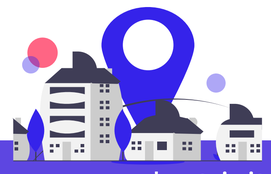
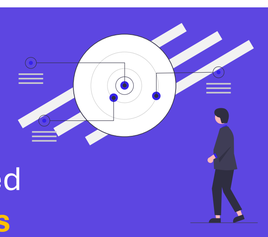
INTRODUCTION



Growing **environmental awareness** and the necessity to ensure electricity supply compel the electric distribution manager, SIE SA, to process consumer data in a way that enables consumers **to compare and monitor their electrical consumption** against similar types of consumers (Art. 13c63 OApEl). This study specifically focuses on **public entities in the West-Lausanne** municipalities of Renens, Ecublens, Crissier, and Chavannes-près-Renens, each with an **annual consumption exceeding 20,000 kWh**.

OBJECTIVES



- Define **methodology to compare and assess** electricity consumers
- **Characterize electrical loads**
- Identify big consumers for which action should be prioritized
- Quantify potential **energy consumption and costs savings**
- **Incite clients to reduce** their electrical consumption

DATA

Data processing

The loads are normalized and sorted into distinct infrastructure typologies to be compared

Time frame :

2022 – 2023

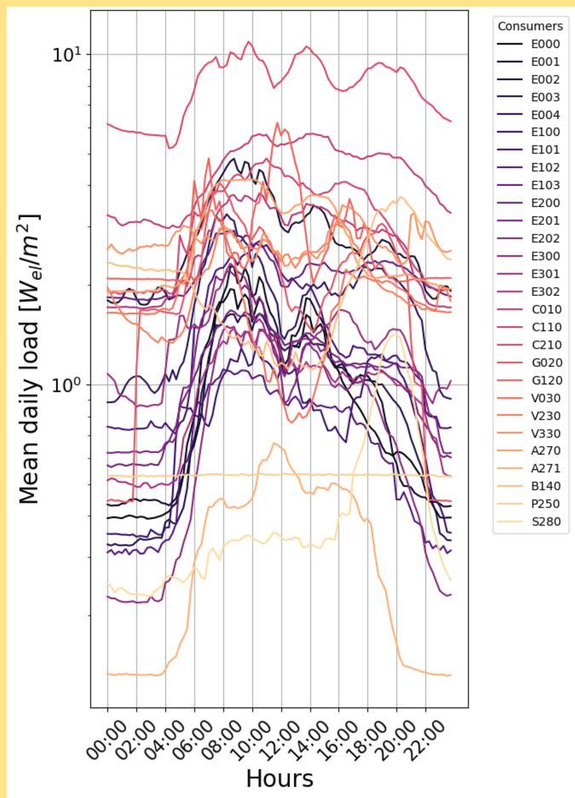
Data type

- Electric load time series
- Clients' adresses
- Electric tarifs
- Building useful areas

Assessed typologies

- Schools
- Public works
- Administrative buildings
- Socio-cultural centers
- Sports infrastructures
- Day-cares
- Bars
- Parking lot

Mean daily normalized loads

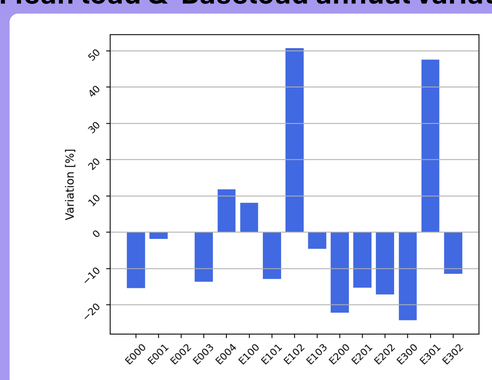


METHODS

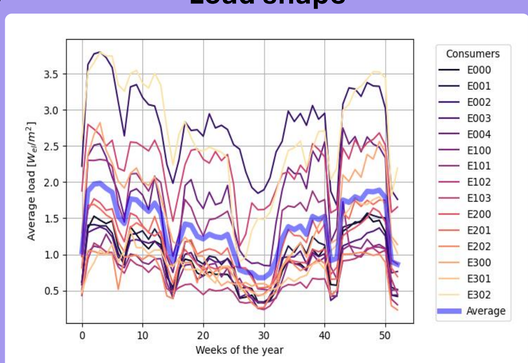
Metrics

Statistical analysis to characterize loads and identify energy consumption reduction potential

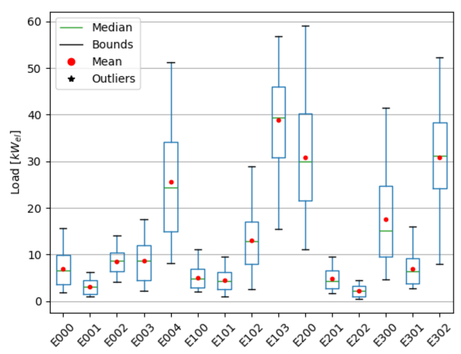
Mean load & Baseload annual variations



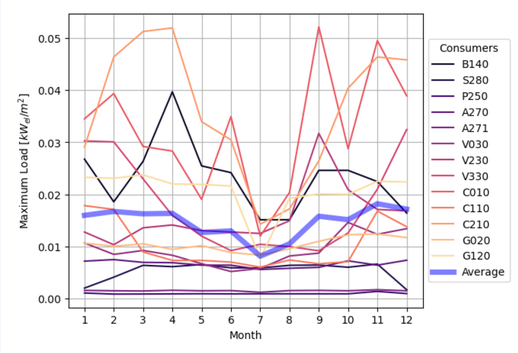
Load shape



Annual mean load or baseload



Monthly peaks

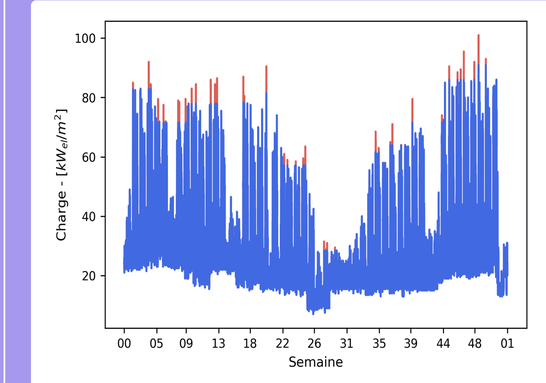


Savings

A peak-shaving method is used to propose savings:

The maximum load is reduced to a variable factor : 0 to 20%, inducing reductions in maximum power and energy consumption. This method targets the reduction of network stress by lowering maximum loads.

Peak shaving



** The figures presented illustrate the processing methods used but do not numerically represent the results.*

RESULTS

Benchmark

Score bins

Distance to best and worst of class is used to normalize the scores of each metric and define scores from 1 to 5.

$$score_i = 100 \cdot \frac{metrique_i - metrique_{min}}{metrique_{max} - metrique_{min}}$$

School benchmark (largest cohort)

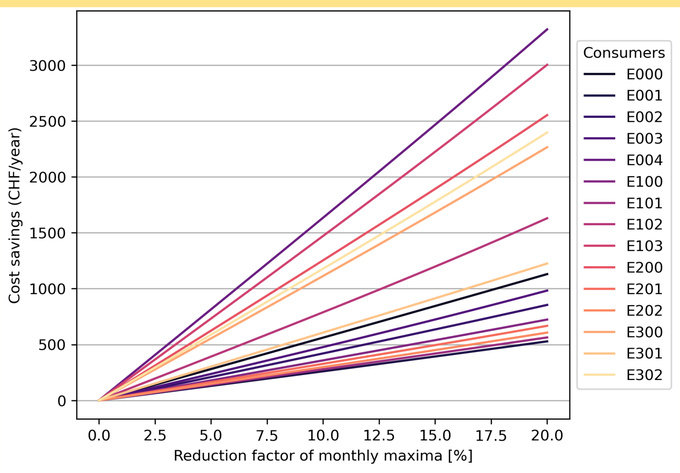
Score [percentile]	Baseload trend [%/year]	Mean monthly peak [W/m^2]	Annual mean load [kW]	Annual mean energy intensity [W/m^2]	Mean load trend [%/year]	Baseload ratio [% of max]
5]80,100]	≤ 51	≤ 9.2	≤ 39	$\leq 2,8$	≤ 25.2	≤ 49
4]60,80]	≤ 36	≤ 7.8	≤ 31	≤ 2.4	≤ 16.8	≤ 41
3]40,60]	≤ 21	≤ 6.6	≤ 24	≤ 1.9	≤ 8.3	≤ 33
2]20,40]	≤ 6	≤ 5.3	≤ 17	≤ 1.5	≤ -0.2	≤ 26
1 [0,20]	≤ -9	≤ 4	≤ 10	≤ 1.1	≤ -8.7	≤ 18
0 (min)	-24	2.7	2	0.7	-17.1	11

Other consumers benchmark

Score [percentile]	Baseload trend [%/year]	Mean monthly peak [W/m^2]	Annual mean load [kW]	Annual mean energy intensity [W/m^2]	Mean load trend [%/year]	Baseload ratio [% of max]
5]80,100]	≤ 126	≤ 36	≤ 12	≤ 3.9	≤ 68	≤ 66
4]60,80]	≤ 87	≤ 29	≤ 10	≤ 3.3	≤ 43	≤ 55
3]40,60]	≤ 49	≤ 22	≤ 8	≤ 2.6	≤ 19	≤ 44
2]20,40]	≤ 10	≤ 15	≤ 6	≤ 2.0	≤ -6	≤ 33
1 [0,20]	≤ -28	≤ 8	≤ 4	≤ 1.4	≤ -31	≤ 22
0 (min)	-67	0.9	2	0.7	-56	11

Cost savings

Cost savings by peak-shaving



Cost savings are composed of peak power reduction and energy consumption reduction

Energy savings

446.5 kWh/year
in average for schools

216.1 kWh/year
in average for others

Such savings are obtained with a 20% peak-shaving process.

Self-assessment

What is my grade ?

Grading weighting factors

Metrics	Baseload trend	Mean monthly peak	Annual mean load	Annual mean energy intensity	Mean load trend	Baseload ratio
Coefficient λ_i	1/11	2/11	3/11	3/11	1/11	1 /11

1. Based on the benchmark tables, determine your **score for each metric**.
2. **Grade** $\sum_{i=0}^{n} \lambda_i \cdot score_i$
3. If **Grade** ≥ 3, conducting an **audit is advised** on the critical metrics with scores ≥ 3.

CONCLUSION

Key findings

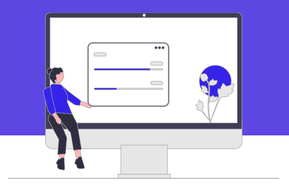
Selection of statistical methods to analyze and evaluate electrical load patterns, a commonly available data type, effectively allowed the establishment of a **benchmark**, the **identification of anomalies**, and **proposal of an energy and cost saving strategy**. This constitutes a **reproductible** framework for electric distribution managers to process the data of their consumers.

Limitations

- The **electrical load data lacks context** for it to be sensibly analyzed. The refinement of analyses thus depends on the cooperation of building managers to provide contextual information.
- Limited significance of the benchmark due to **limited number of consumers**.

Automatization

The statistical analyses of loads can be mechanized into an **accessible software to self-monitor load-curves** by building or electric network managers, Thus facilitating scoring and increasing.



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