Task 3 — Load Profiles and an Industrial Proxy

> **Question:**
> Develop a detailed analysis of the Polish electricity load profile by identifying distinct patterns and how they have changed throughout time. Visualize the typical weekday and weekend load profile. Moreover, given the aggregate hourly load data, isolate the power load profile of the Polish industrial sector.

What was done (short)

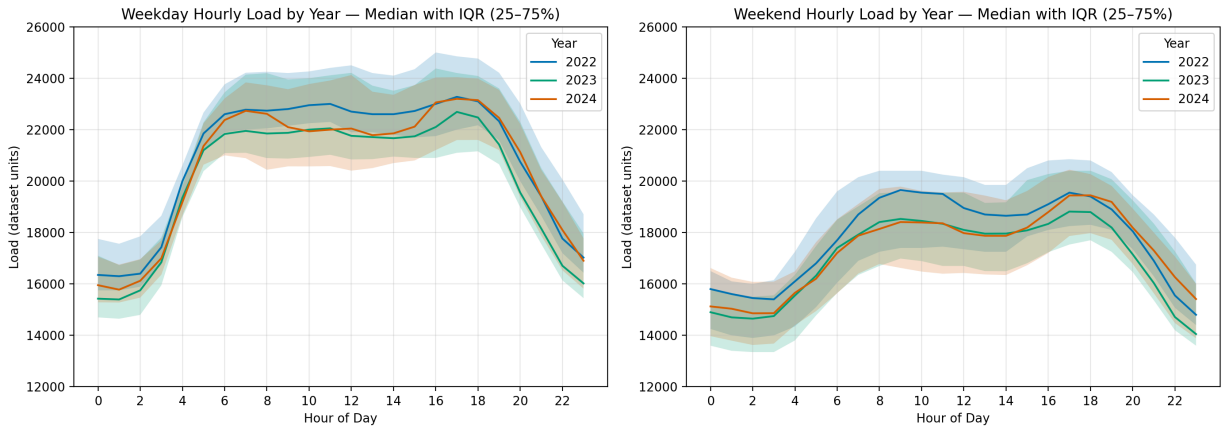
- The hourly load series from `clean_data.csv` is split into **weekdays** and **weekends**.
- Typical profiles are shown with medians and IQR (25–75%).
- **Load velocity** is computed as the hour-to-hour change and plotted for weekdays and weekends.
- An **industrial proxy** is built as weekday load **above** a weekend baseline at the same month and hour.

Industrial method (concise math).
Weekend baseline by month and hour:
$B_{m,h}=\operatorname{median}\{\text{Load}_t:\ t\ \text{is weekend},\ \text{month}(t)=m,\ \text{hour}(t)=h\}.$

Weekday “excess” at time t (month m, hour h):
$E_t=\text{Load}_t - B_{m,h}$

Plots

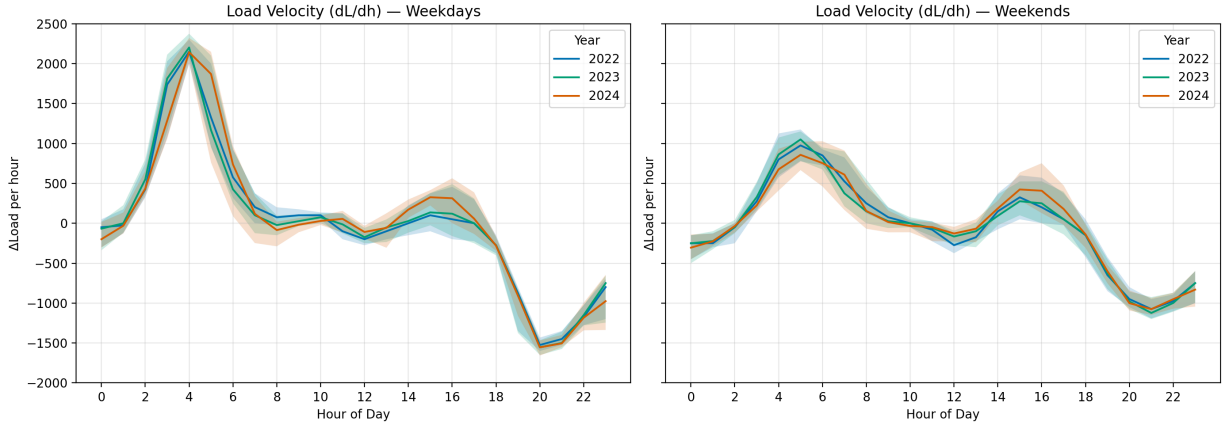
Weekday vs Weekend profiles by year



What it shows.

Weekdays sit **above** weekends and have a stronger **morning ramp** and **evening plateau**. Weekends are **lower** and **flatter**. The shaded IQR shows that profiles shift across years very little.

Load velocity (Δ per hour) — weekdays vs weekends



How it is computed.

Velocity is the hour-to-hour change: $\Delta L*t = L*t - L*{t-1}.$

For each hour of day, the medians (and IQR) of $\Delta L*t$ are taken by **year** and **weekday/weekend**.

What it shows.

- **Weekdays:** a sharp positive spike around **05–06** (morning ramp), near-zero around **midday**, and a large **negative** spike around **19–20** (evening drop).
- **Weekends:** the same pattern but **smaller** ramps.
- Year lines show that ramp **sizes** shift across **2022–2024**.

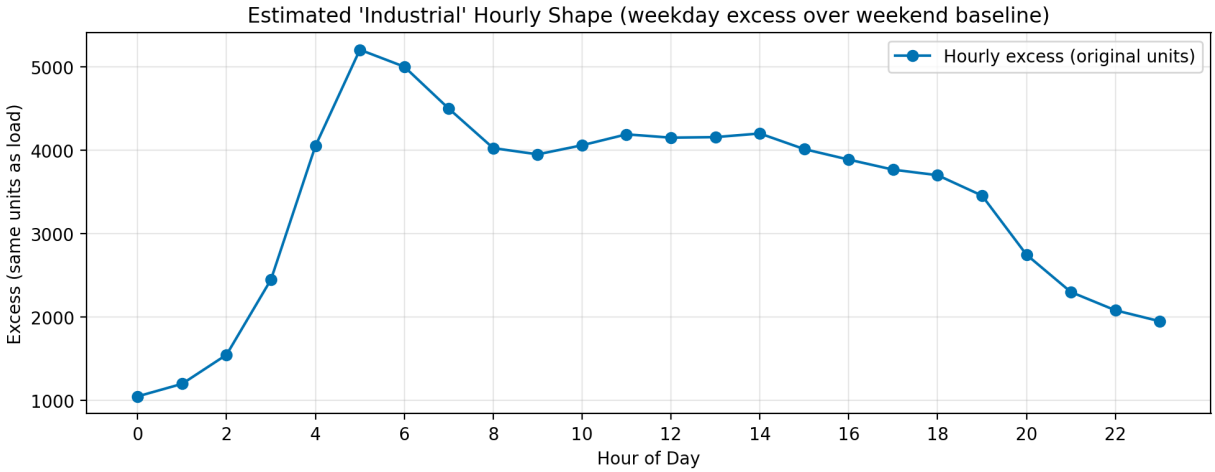
Why it helps.

Level plots show *how high* load is. Velocity shows *how fast* it moves.

This adds information on **ramping risk**, **flexibility needs**, and when the system is most

sensitive to shocks.

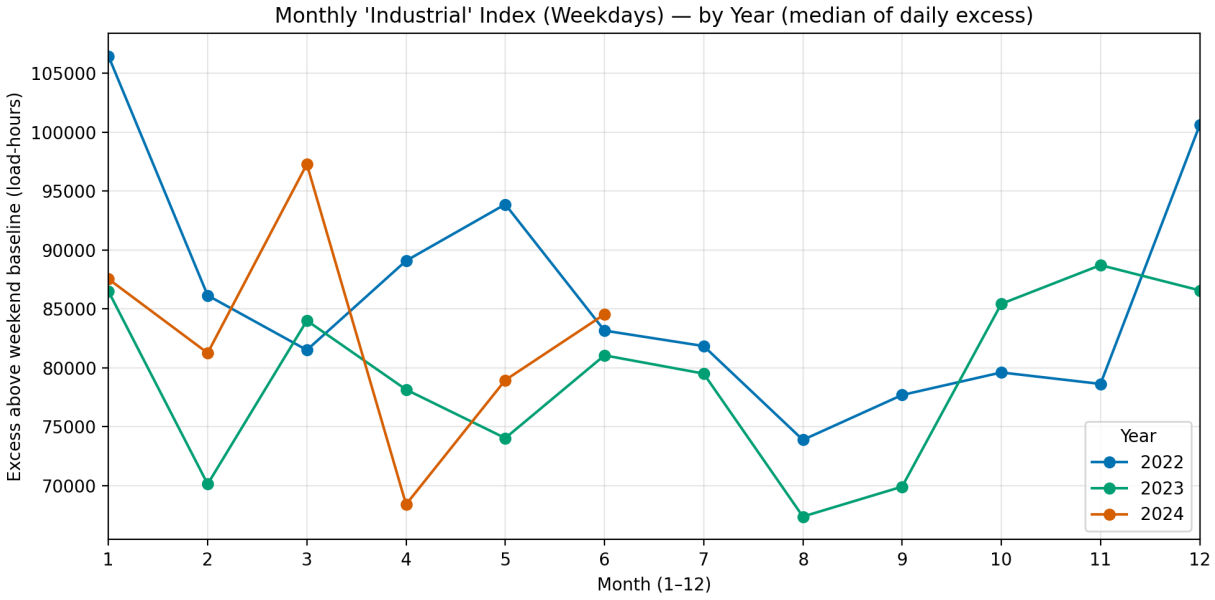
“Industrial” hourly shape (weekday excess over weekend baseline)



What it shows.
Excess load is near **zero at night** and concentrated in **working hours**.
This gives a simple, transparent **industrial profile** from aggregate data.

Limitations and a cleaner option.
This proxy is **crude**. It assumes weekends are “non-industrial” baselines.
A more precise approach would use **“hard holidays”** (e.g., **1 Jan**, **Christmas**, **Easter Sunday**, **Labour Day**).
On those days almost everything is closed, so what remains should be the **24/7 industrial** load plus a small set of other always-on uses.
That holiday baseline could replace (or calibrate) the weekend baseline.
This refinement was **not implemented due to time**.

Monthly “industrial” index by year (median of daily excess)



What it shows.
The index varies by **season** and **year**. It highlights months when industrial demand stands **well above** the weekend baseline.

Takeaways

- Weekdays are **higher and more peaked**; weekends are **lower and flatter**.
- **Velocity** reveals **when** ramps occur and how **large** they are (stronger on weekdays).
- The **industrial proxy** isolates working-hour excess; a **holiday-based** baseline would make it cleaner.

Files referenced (task folder)

- `task3/hourly_load_by_year_wd_we.png`
- `task3/load_velocity_wd_we.png`
- `task3/industrial_hourly_shape.png`
- `task3/industrial_index_monthly_by_year.png`
- (Tables: `weekday_daily_excess_matrix.csv`, `industrial_index_daily.csv`, `industrial_index_monthly_median.csv`)