PERFORMANCE ANALYSIS OF EV CHARGERS

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Knowing the Data

Chargers

There are 80 chargers: 42 Slow, 28 Semi-fast and 10 Ultra-fast; 43 of them are located in Supermarkets, 19 in Shopping Malls, and the remaining 18 in other public locations.

Charging Sessions

The charging sessions take place from January, 1st 2022 through March, 31st 2023, for 454 days. The median session lasts for 47 minutes and 11 seconds, uses 15kWh and nets 1.02€ in revenue.

DURATION (sec)

Duration of the charging session, measured in seconds.
Ranges from 0s to 6451s and has a median of 2831s. There is a demarked right skew.

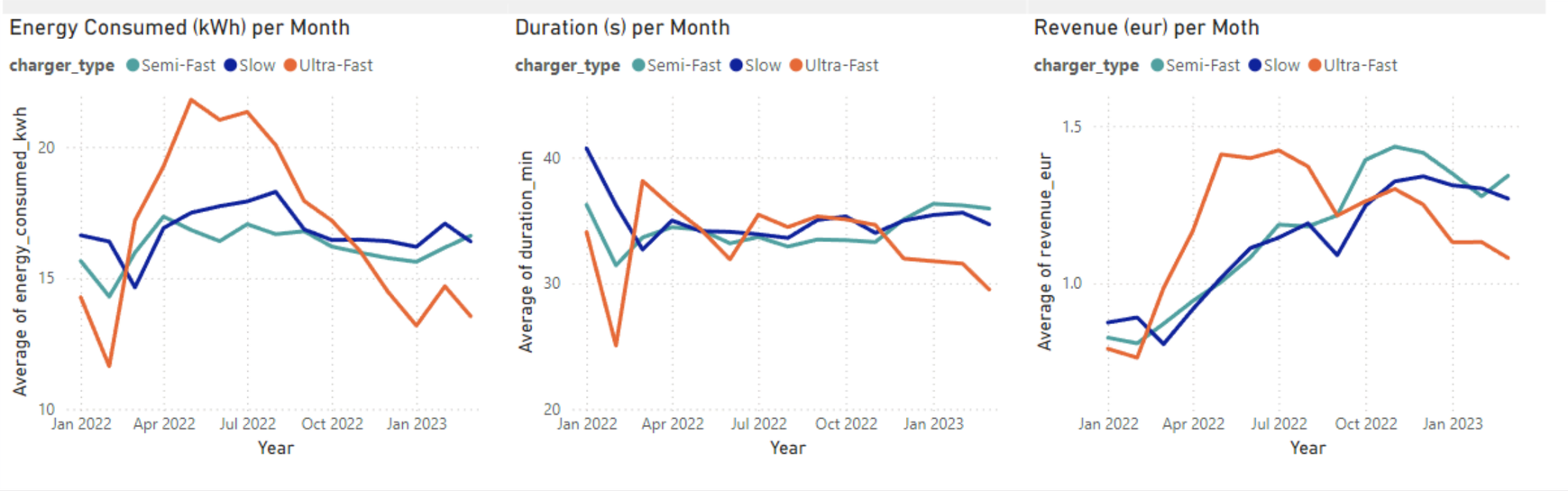
ENERGY CONSUMED (kWh)

Energy consumed on that session, measured in kWh.
Ranges from 0 to 58.1kWh, with a median of 14.9kWh. The right skew is very pronounced.

REVENUE (eur)

Revenue of the session, measured in Eur.
Ranges from 0€ to 4.11€, with a median of 1.02€. Again, there is a pronounced right skew.

Performance Analysis of EVC Network Over Time



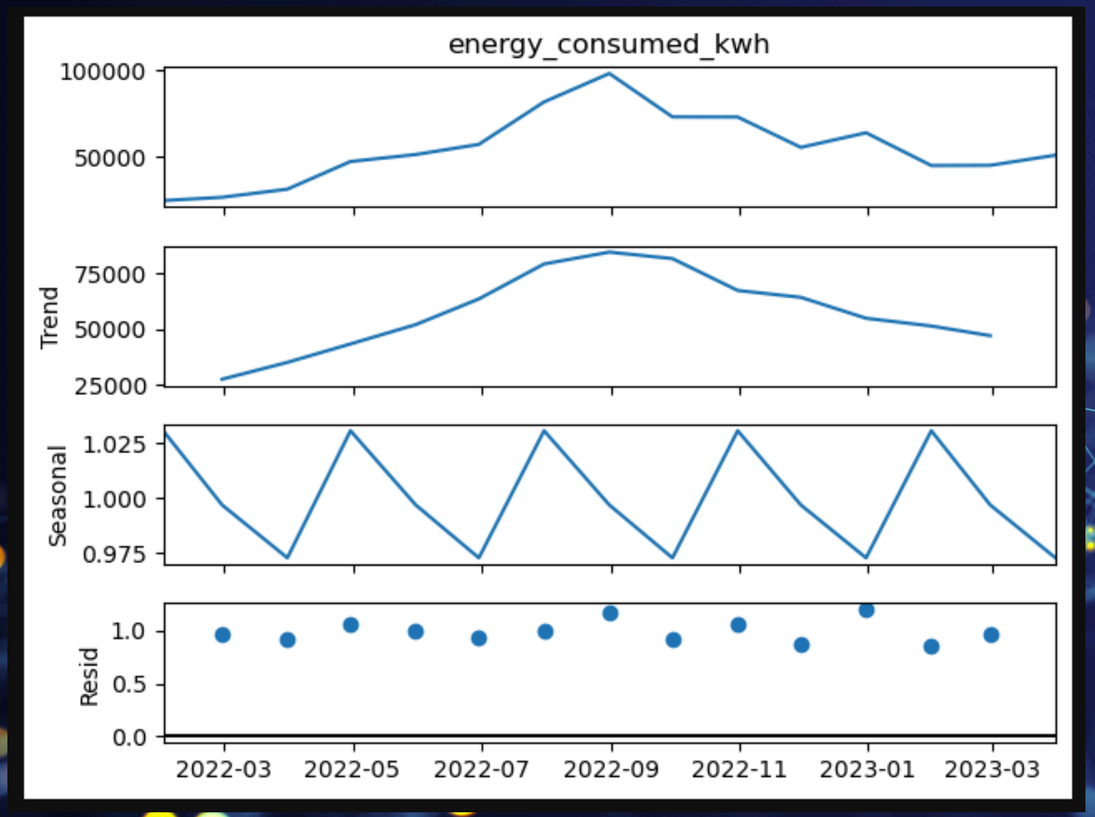
In February 2022, there is a considerable dip in average Energy Consumed (EC) and average Duration (DUR). This is particularly noticeable in Semi- and Ultra-Fast chargers. After removing the charging sessions with EC=0, this dip is significantly smoothed out. It's possible that there is either a technical fault in the charger itself, or a wrong reading.

In March 2022, the Slow chargers have a significant drop in all metrics (EC, DUR & REV). The chargers with worst performance during this month are among the worst performing overall, so it is unlikely for a single charger point to have much of an impact.

March 2022 starts a general upward trend in EC and REV.
EC is at 15.95 kWh this month but rapidly grows in the next months, peaking first in May at 17.94 kWh, falling to 17.66 kWh in June and again peaking in July at 18.24 kWh. REV sees an average charge of 88 cents in March quickly grow to 1.22€ in August and after a dip in September to 1.16€, it goes back up for a new peak of 1.36€ in November.
This growth seems to be leveraged by the Ultra-Fast chargers, that mirror the EC peaks and valleys of the average, and the first peak in REV. Ultra-fast chargers however have a very slight second peak, being surpassed in REV by both Semi-Fast and Slow chargers by November 2022. This rise of revenue while the energy consumed falls may be attributed to a rise in tariffs.

This trend seems to have no impact on the Duration of the charge, positive or negative, outside of the EC dip in June.

Time Series Analysis (Classical Decomposition - Additive) of the Energy Consumed

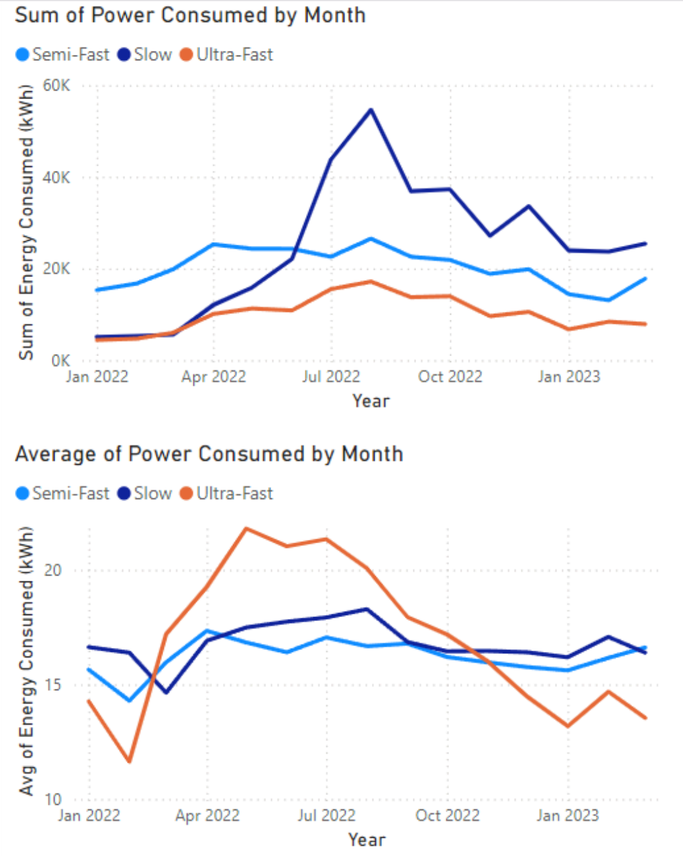


The data, grouped by month, show a clear positive trend in Energy Consumed, peaking in September 2022, followed by a noticeable decline.

Additionally, there is evident trimestral seasonality, peaking every February, May, August and November.

Due to the data covering only 15 months, it is not possible to determine any annual seasonality patterns.

Devising a New Charger Type Classification

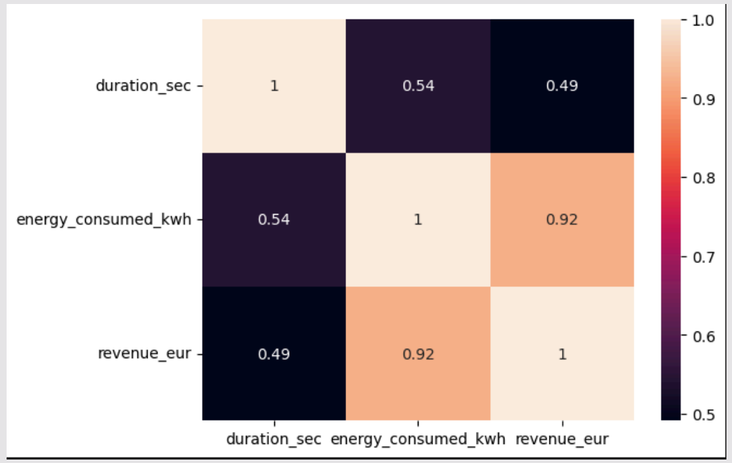


The current classification divides Charger Types into Slow, Semi-Fast, and Ultra-Fast categories. Ultra-Fast chargers, which should have a superior Power Output compared to Semi-Fast chargers, and significantly more than Slow chargers, show the lowest monthly total energy consumption, perhaps because there are only 10 Ultra-Fast chargers out of 80.

Although not expected, the average power consumption of Ultra-Fast chargers is also lower than both the other types for almost half of the tracked period. In contrast, Slow chargers are the top performers for the remaining time.

After training four different models on the data, K-Means provided the best fit, and was chosen as a more accurate classifier.

Correlation Matrix



	duration_sec	energy_consumed_kwh	revenue_eur
duration_sec	-		
energy_consumed_kwh	0.540684 *	-	
revenue_eur	0.491381 *	0.921477 *	-

* p < .05

The correlation matrix between the three main KPIs shows a positive correlation for everyone.

While the correlations Duration/Energy Consumed and Duration/Revenue have a positive but moderate correlation strength (as expected, considering different charger types), Energy Consumed/Revenue presents a significantly strong positive correlation.

Final Notes

- In slide 3, there's mention to a drop of average Energy Consumed by Slow chargers on February 2022., and that after cleaning the dataset of charging sessions with zero Energy consumed, that drop is smoothed. This is very evident when plotting the original dataset against the clean one (fig 1), with a difference in average of 2 kWh between them that month. This seems particularly significative when this cleaning seems to make almost no impact on any other month.
- In slide 5, in order to devise a new charger type classification, the data was used to train four separate Unsupervised Machine Learning models (K-Means, DBScan, Agglomerative Clustering, K-Nearest Neighbour), and the resulting labels evaluated using the Silhouette score. K-Means (with 3 clusters, 10 initiations and 300 iterations) had the best score of the four (0.55).

fig. 1 - Average Energy Consumed per Month, Original Dataset vs EC=0 Removed

Metrics and KPIs to follow

Tracking the hours the charger is available per day could provide further insights.

Given their strong correlation, Energy Consumed and Revenue can be condensed into a single KPI, **Energy Tarif**, measured in **kWh/cent**.

THANK YOU FOR THE OPPORTUNITY

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