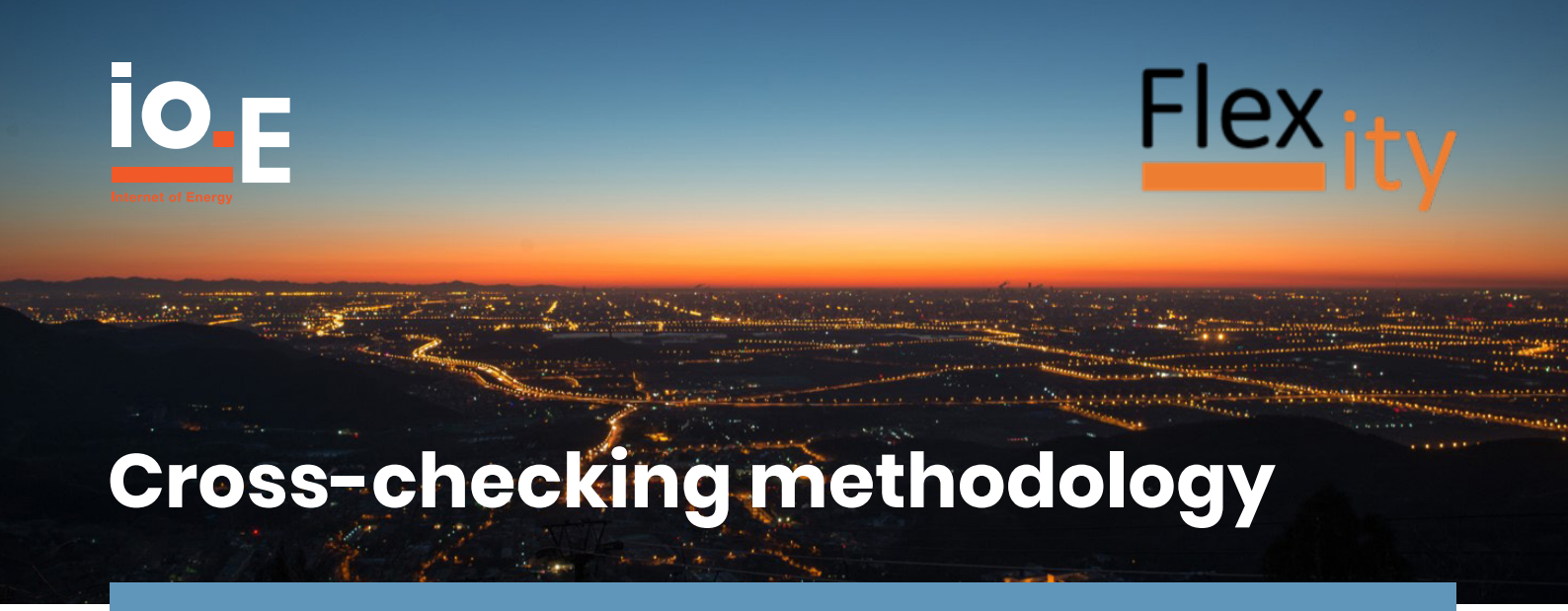


Cross-checking methodology

What is Flexity: Flexity is one of the leading Use Cases within the IO.Energy Ecosystem. Flexity investigates which household assets (EVs, boilers…) can be technically operated and which value can be offered to the end-consumer in return. Moreover, Flexity investigates how the digital meter can be used to facilitate the settlement of new services on residential level.

Objective of this note: this note summarises Flexity key findings with respect to its cross-checking methodology, which was set up to investigate if commercial metering data (from Voltalis, Jedlix, tiko) could be validated using the digital meter's P1 port.

Two research questions at the basis of the exercise

The objective of this exercise was to come up with some first ideas and lines of thinking for a technology agnostic methodology that allows to validate commercial submetering from third parties (Voltalis, Jedlix, tiko) by means of the digital meter's P1 port. The following two research questions are at the foundation of the exercise:

1. **Can we visually identify an activation of a sub-metered asset when looking at P1 data at Access-Point ("AP")?**
2. **Can we have an insight on the probability that the commercial submetering data is authentic when considering only trusted P1 data?"**

Research question 1: visual identification of an activation

The first research question brought about the following findings:

1. Changes in activity on the asset can predominantly be traced back on access-point, however an ad-hoc visual technique undoubtedly has its limitations. Figure 1 below shows a charging session of an EV that has a distinctive impact when looking at the data on access-point (in blue).

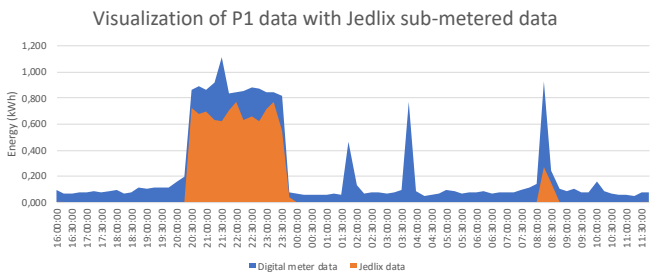


Fig. 1: the impact of an EV charging session (orange) on AP (blue)

2. A strong influence of other appliances increases the complexity of the exercise. Figure 2 below shows how heat-pump activity is easily recognized in the morning, but could be trickier to detect during the day (due to PV production) or in the evening when other activity in the house has a significant impact on access-point.

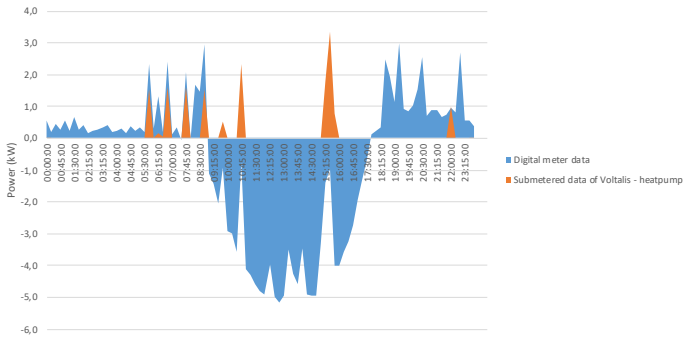


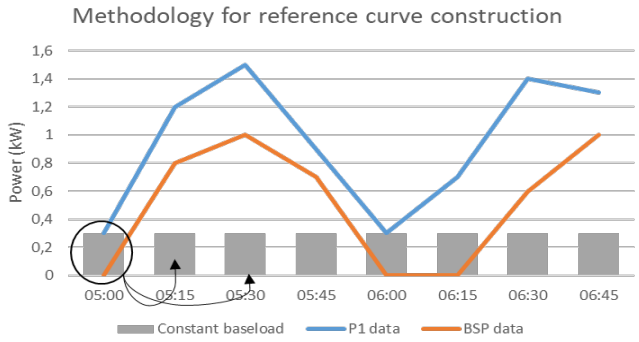
Fig. 2: the impact of a heat-pump (orange) on AP (blue)

Research question 2: probability that the commercial submetering data is authentic

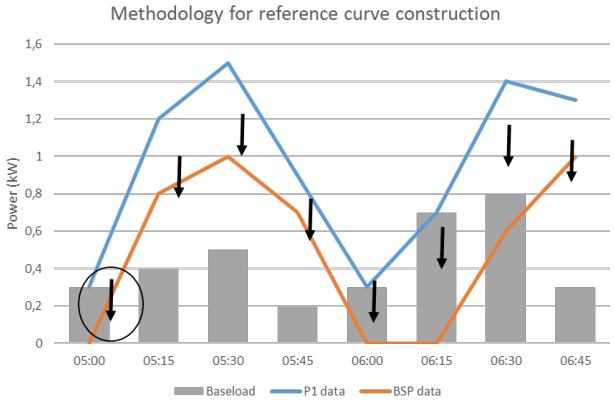
Methodology

The first findings displayed the necessity of taking into account the sheer impact of other appliances on access-point. Flexity developed a first elementary technique as described in the three steps below. This reconstruction technique consists of removing the consumption of other electric appliances within the data on access-point. In doing so, Flexity was able to recreate a curve that approximates the consumption pattern of the asset steered by the service provider. The % RMSE is used as a measure to quantify the difference between the estimated value (= reconstructed curve) and the observed value (BSP data).

1. **First we identified the baseload in the house:** The baseload is considered equal to the overall offtake of the household right before the asset is active

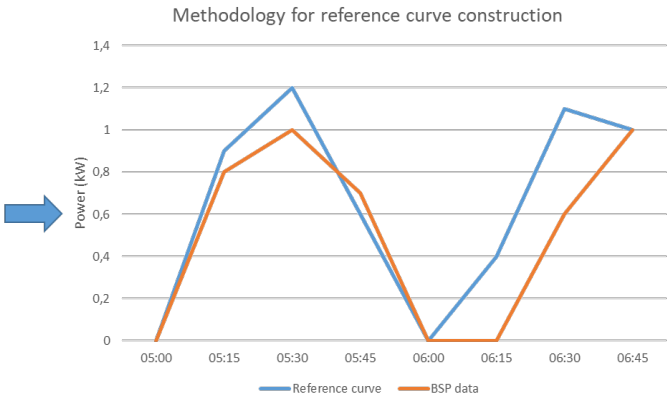


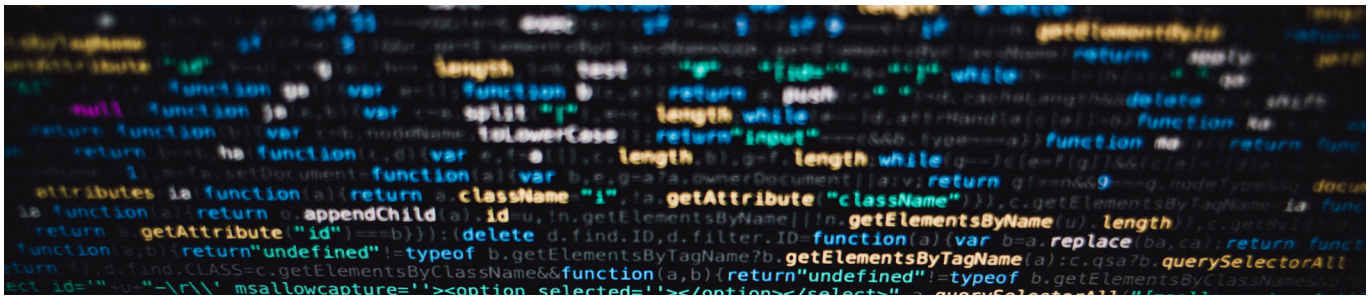
2. In a **second step,** we subtract this constant baseload from the raw P1 data. We thus **removed the "background noise"** of all the other appliances leaving us with a reconstructed P1 curve that theoretically should approximate/be close to the commercial sub-metered data.



3. In a final step, we **compare the commercial metering data with a reconstructed P1 curve**. In order to do so, we investigated a set of KPIs (RMSE and % RMSE) to confirm that both curves are similar.

- $\text{RMSE} = \sqrt{\frac{\sum \text{deviation (t)}^2}{N}}$
- $\%\ \text{RMSE} = \frac{\text{RMSE}}{\text{average } (P_{\text{reconstructed curve}})}$

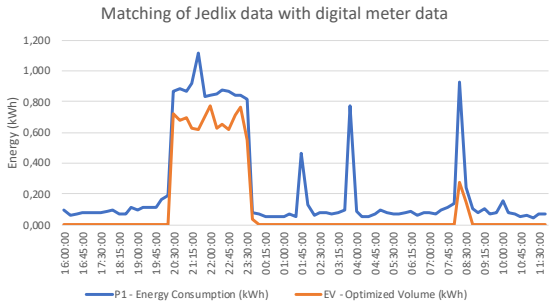




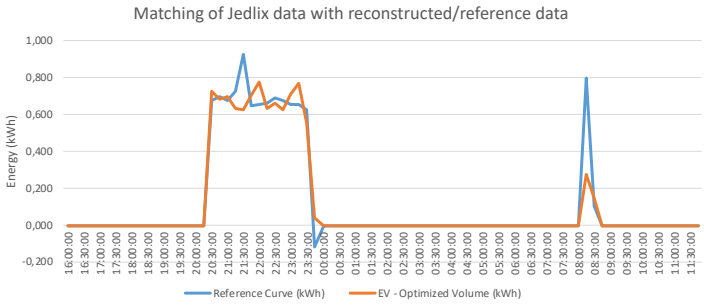
Results

Several datasets were analysed for two heat pumps and one EV. The example below shows the results for a typical charging session of an EV. When looking at the evolution of the %RMSE, the reconstructed curve evidently shows better results, indicating that subtracting the baseload based on the method explained in previous section could be a potential way forward. Similar results and conclusions were obtained for both heat pumps.

Flexity believes there is potential in using this estimation (based on trusted data on access-point) to validate commercial metering data for EVs, heat pumps and other residential assets on its authenticity. However, this methodology needs to be refined using a larger dataset that will equally help us to put in place a threshold (1%, 5%, etc.) for the %RMSE, which, at the time, was not feasible.



%RMSE = 0,63



%RMSE = 0,38

Conclusion and moving forward

The first result shows that a cross-checking mechanism using data on access-point could have the potential to provide a reasonable insight on the probability whether or not commercial submetering data is authentic. Let us not forget that the objective of this exercise was to provide some first reflections from a conceptual point of view to show how such a cross-checking methodology would look like. However, at this stage, it remains key to continue to investigate alternative avenues as well such as machine learning algorithms[1].

At the next stage of the research, Flexity recommends investigating to at least the following points:

- Investigate in depth to which extent a cross-check based on 15minute data could also provide reasonable insight on the probability that commercial sub-metering data (that might have a higher granularity up to 4") is correct or not?
- Investigate in depth how we should manage multiple flexible assets behind access-points such as solar production (that is highly volatile and is difficult to correct
- Investigate alternative methodologies such as machine learning and artificial intelligence

1. Flexity performed some first tests using a machine algorithm model. The model showed to be able to identify all heat-pump activations in a 2-day period. Therefore it remains worthwhile to further analyse the potential and effectiveness of these techniques

JEDLIX CGI ENGIE fluvius. Voltalis tiko