IBIL

Fleet electrification:
minimizing uncertainty & TCO

EVS35 OSL2022

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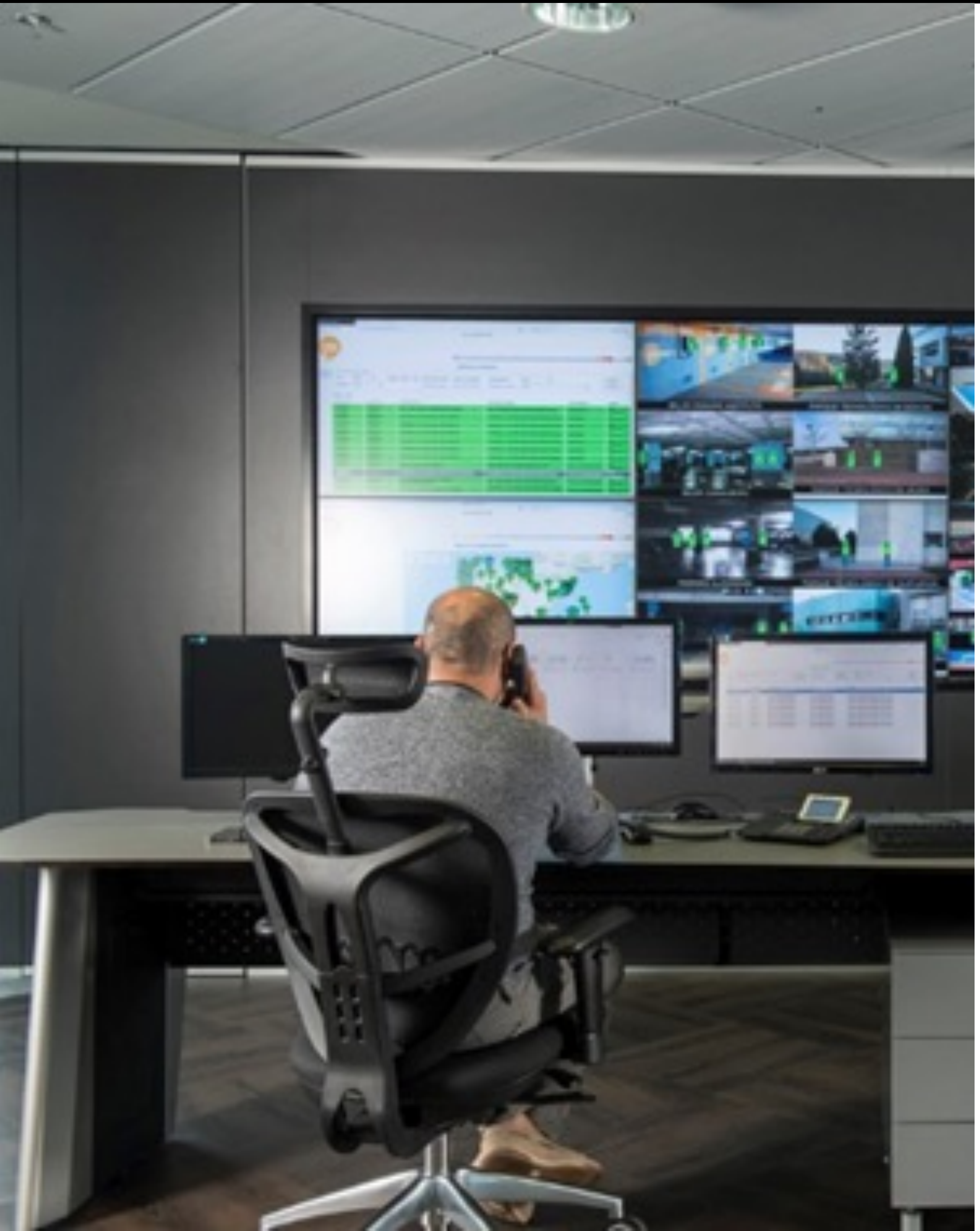
IBIL at a glance



OPERATION

Operation & Maintenance

EXECUTION

Project execution

PROJECT

Detailed project

CONSULTING

Charging concept

Audit and analysis of facilites

Analysis of requirements

Fleet electrification: How much should I spend on infrastructure, what will be the electricity bill?

Fleet operators make purchasing decisions based on TCO

- "**Traditional**" **TCO components** are easy for them to estimate:
  - Vehicle cost
  - Financial costs
  - Vehicle maintenance costs

- Electrification brings some **new components** into this **TCO** estimation
  - Charging Infrastructure cost
    - *Charging stations*
    - *Grid Connection*
  - Electricity costs

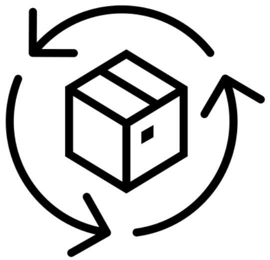
But how does this affect fleet operations?

The operational constraints for fleets can be quite different depending on the use case

	Predefined route	Charging timetable	Preconditioning power requirements	Dispersion in battery sizes	Dispersion in supported kW vs. SoC
Ride hailing service	No	24/7	Low	High	High
Parcel delivery vans	No	Night time only	Low	Low	Low
Transit buses	Yes	Mostly night-time	Medium	Low	Low

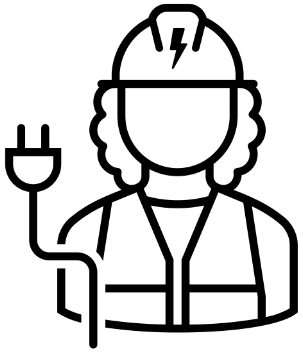
Define optimal charging infrastructure, understand costs… Without affecting operations. How?

A standardized **methodology** is **needed** to determine **technical feasibility of the electrification project and its TCO**



1. Operational feasibility

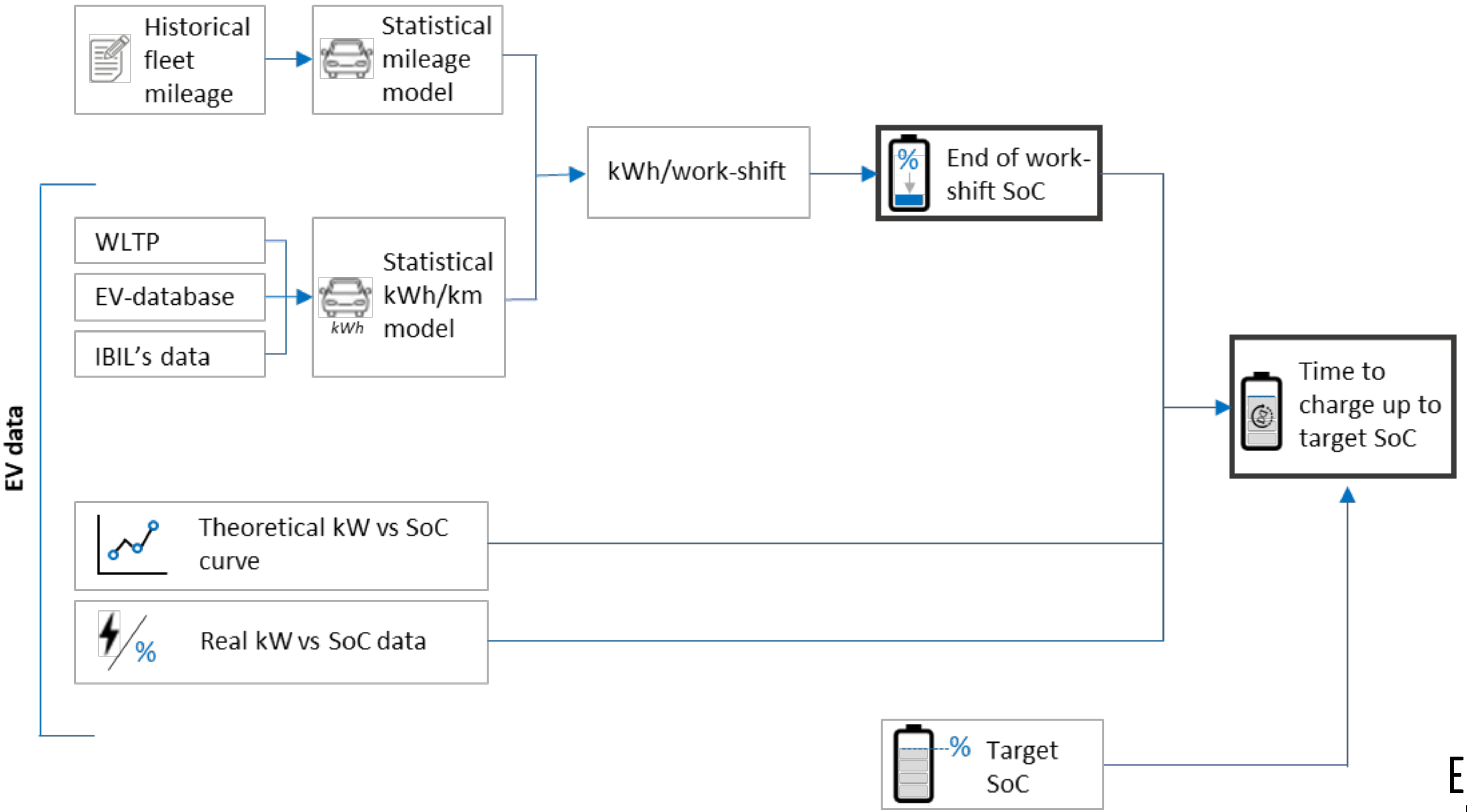
How likely are the fleet and the charging infrastructure to keep up with the business needs?



2. Infrastructure feasibility

How should we build the charging infrastructure and how much will this cost?

Operational feasibility: How likely are the fleet and the charging infrastructure to keep up with the business needs?

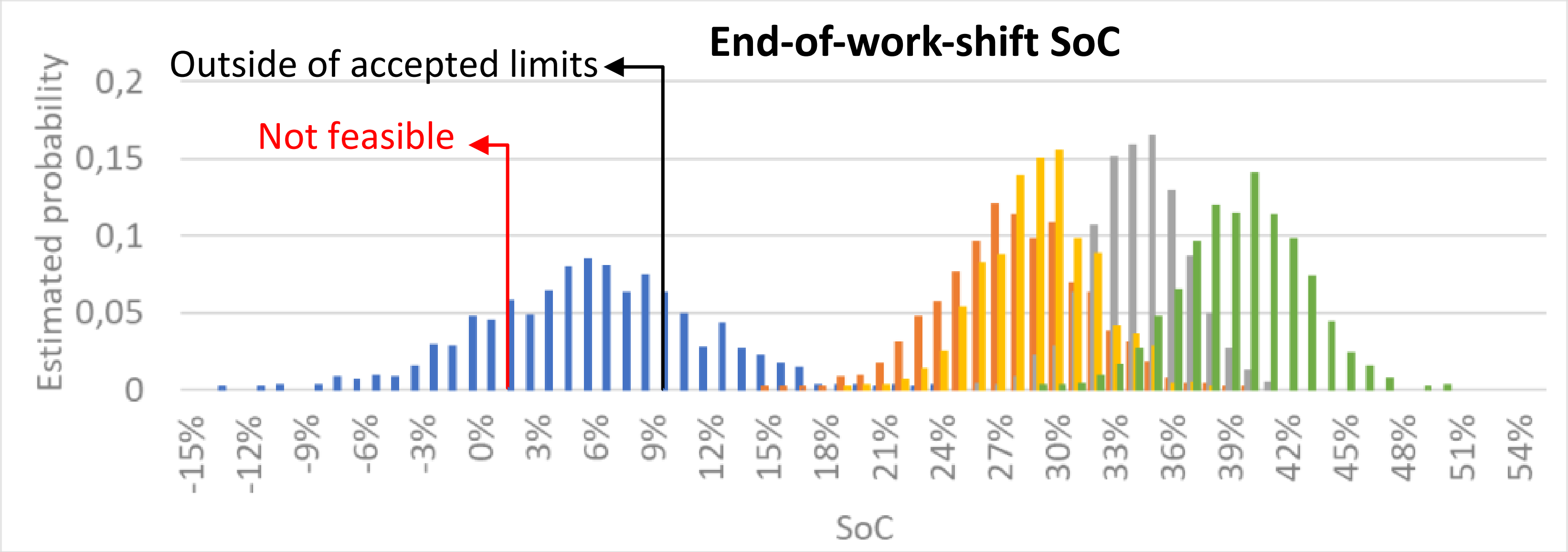


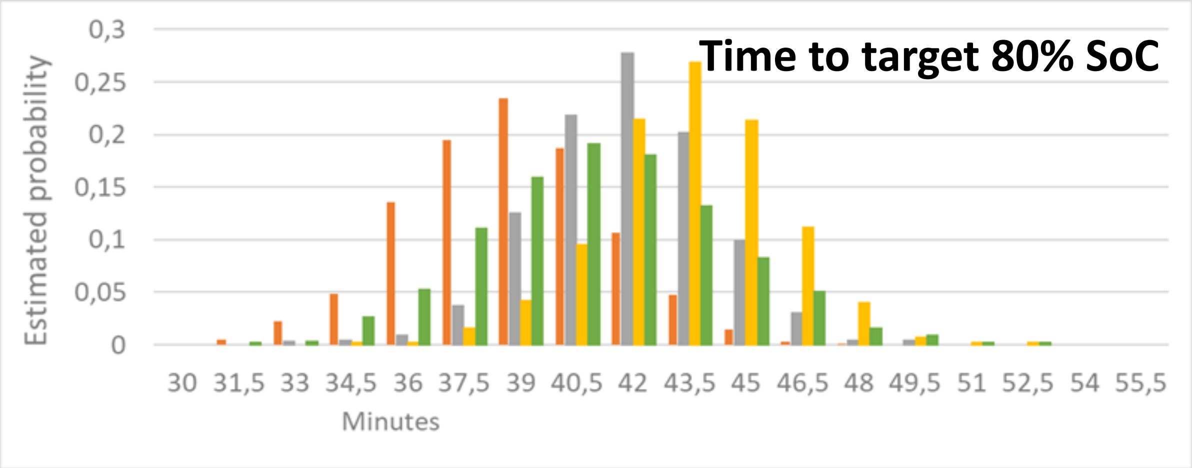
Operational feasibility example: Analysis of a ride hailing fleet (Monte Carlo)

Constraints: 5 EV models. 50 kW chargers. 60’ to charge to 80% SoC. Avoid discharging below 10% SoC

The Blue model cannot meet operational needs consistently

- It will need a different charging strategy

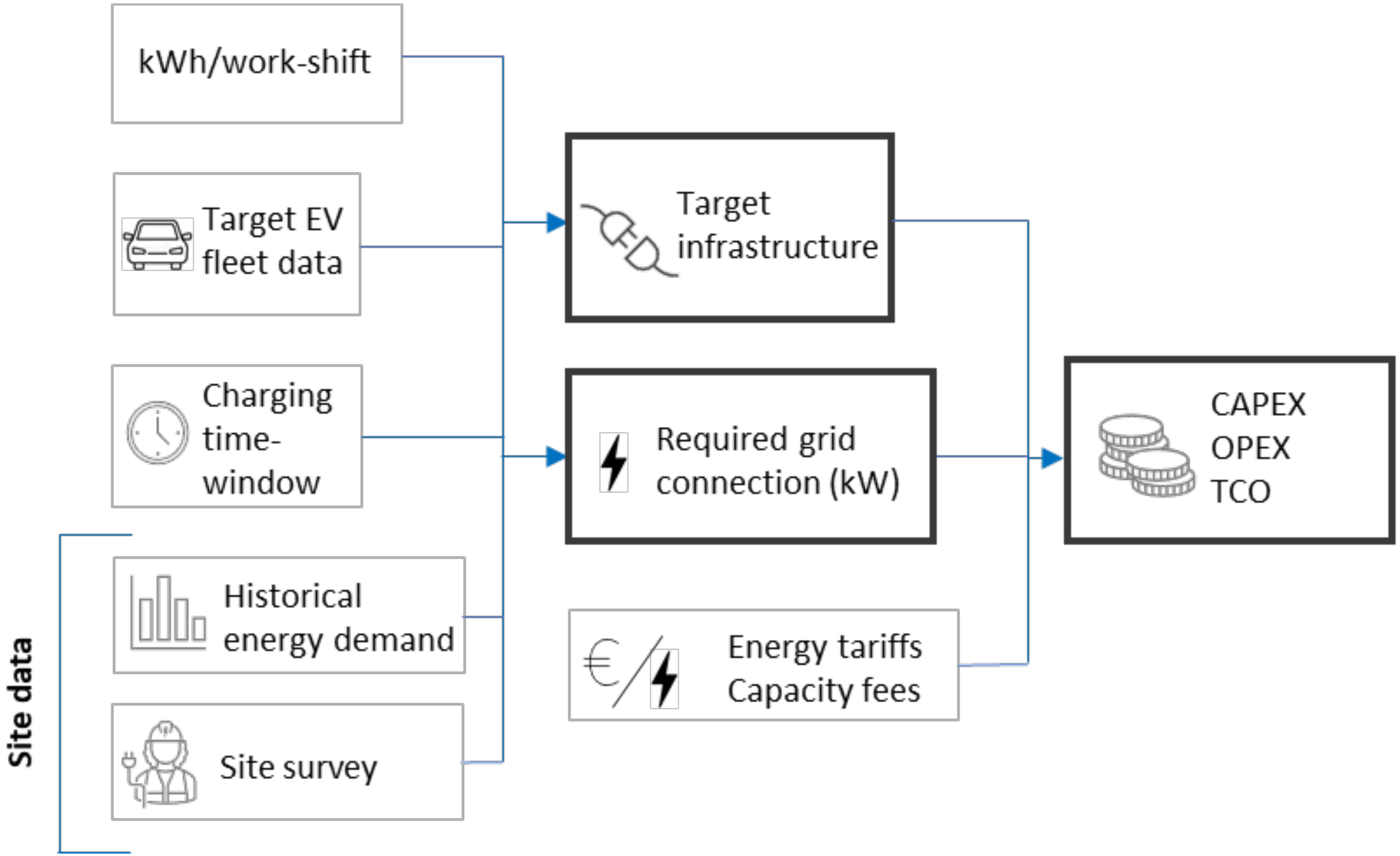




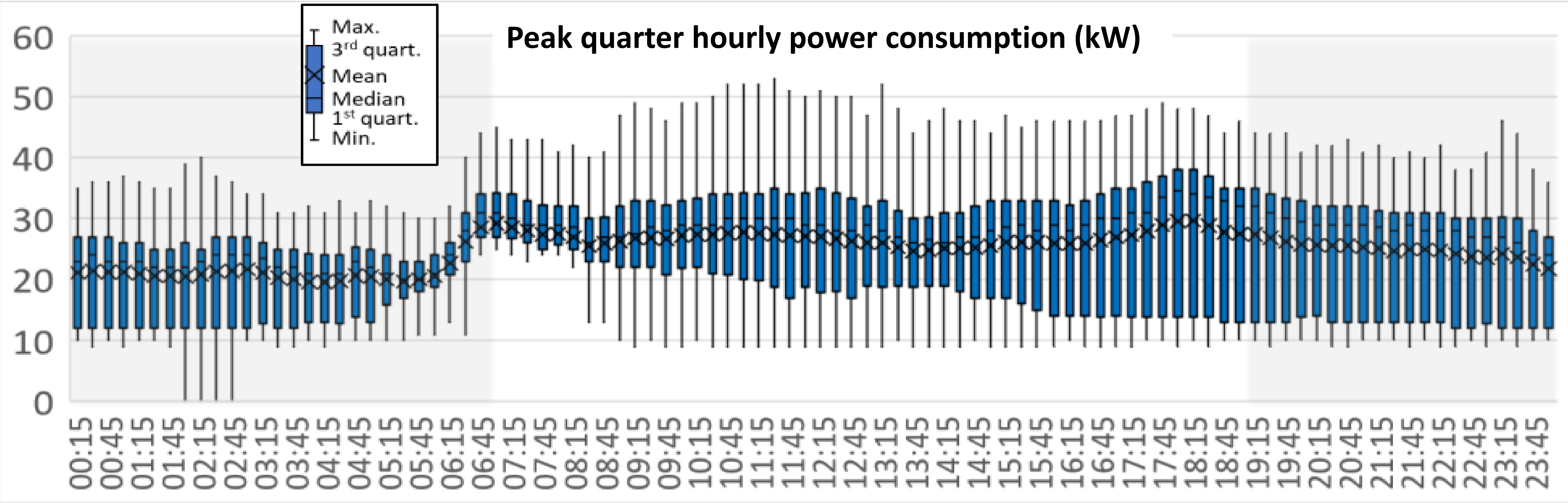
All models can be Charged up to the target SoC (80%) within the allowed 60’…

Blue model should go for 90% within 70’ or use faster chargers

Infrastructure feasibility: What is the TCO of the charging infrastructure project?



Infrastructure feasibility example: Parcel delivery fleet



Non-EV related consumption is very variable during the night→ A local EMS is needed for dynamic smart charging.

Base-load's peak consumption was <35 kW for roughly 80% of the nights, and these were just short peaks (mean consumption was lower, approx. 13kW)

90 kW at the grid connection point would allow charging 28 e-Vans (up to 7.4kW each) while also feeding all the other loads of the site

Infrastructure feasibility: Implementation with smart charging for a parcel delivery fleet

**Instantaneous current (A)
per phase on Site #1**

With an advanced EMS, just 90 kW were needed at the grid connection point for charging 28 e-Vans (7.4 kW each)

- The combination of single-phase and 3-phase loads makes phase-current monitoring necessary
- The local Energy Management System ensures that technical limits are not exceeded
- EMS ensures that contracted power limits are not exceeded

Buses: Preconditioning requirements set some additional constraints (both operational and infrastructure)

Winter: Worst case scenario due to the cold weather

Increased kWh/km consumption→ Lower SoC at the end of the work shift

Slower charging in cold weather

Higher energy demand for pre-heating the cabin

In summary: **More energy** needs to be charged into the bus battery, and there will be a little less time/power to do so (due to preconditioning right before the work-shift starts).

Preconditioning also introduces **technical challenges**:

- Integration with external IT systems (e.g. vehicle departure schedules etc.)
- Charging stations supporting preconditioning

Conclusions: The methodology offers a reliable way to properly assess the TCO

- Good quality, **real-life data** is the key for a robust TCO estimation
- **Statistical modelling** of the **fleet consumption** and charging patterns eases decision making:
  - By providing consistent estimates of operational benefits vs. investments (e.g. *Investing X k€ more on faster chargers reduces the probability of exceeding maximum charging time to less than 0.5%*)
  - By increasing confidence in the fleet purchasing decisions (e.g. *We are confident that all our EV models can provide the service as planned every day of the year*)
  - By easing the definition of acceptable operational parameters that can be included in SLA-s with charge service providers (e.g. *All cars should take less than 60' to charge up to 90% SoC in 99.9% of the charging sessions*)
  - By providing a clear estimate of the electrification project's TCO and its variability (e.g. *TCO will be X k€ ± Y k€*)
- Fleet operator friendly **digital tools** are needed both at the planning and operation stages to keep track of the electrification project and its performance and to make **economic and environmental benefits** visible.

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www.ibil.es
mzamalloa@ibil.es