MATERIALS & ENERGY
ICOME2024
Bangkok Thailand
30 Oct - 1 Nov 2024

UNIVERSITÉ DE LORRAINE

KMUTNB INVENTION TO INNOVATION

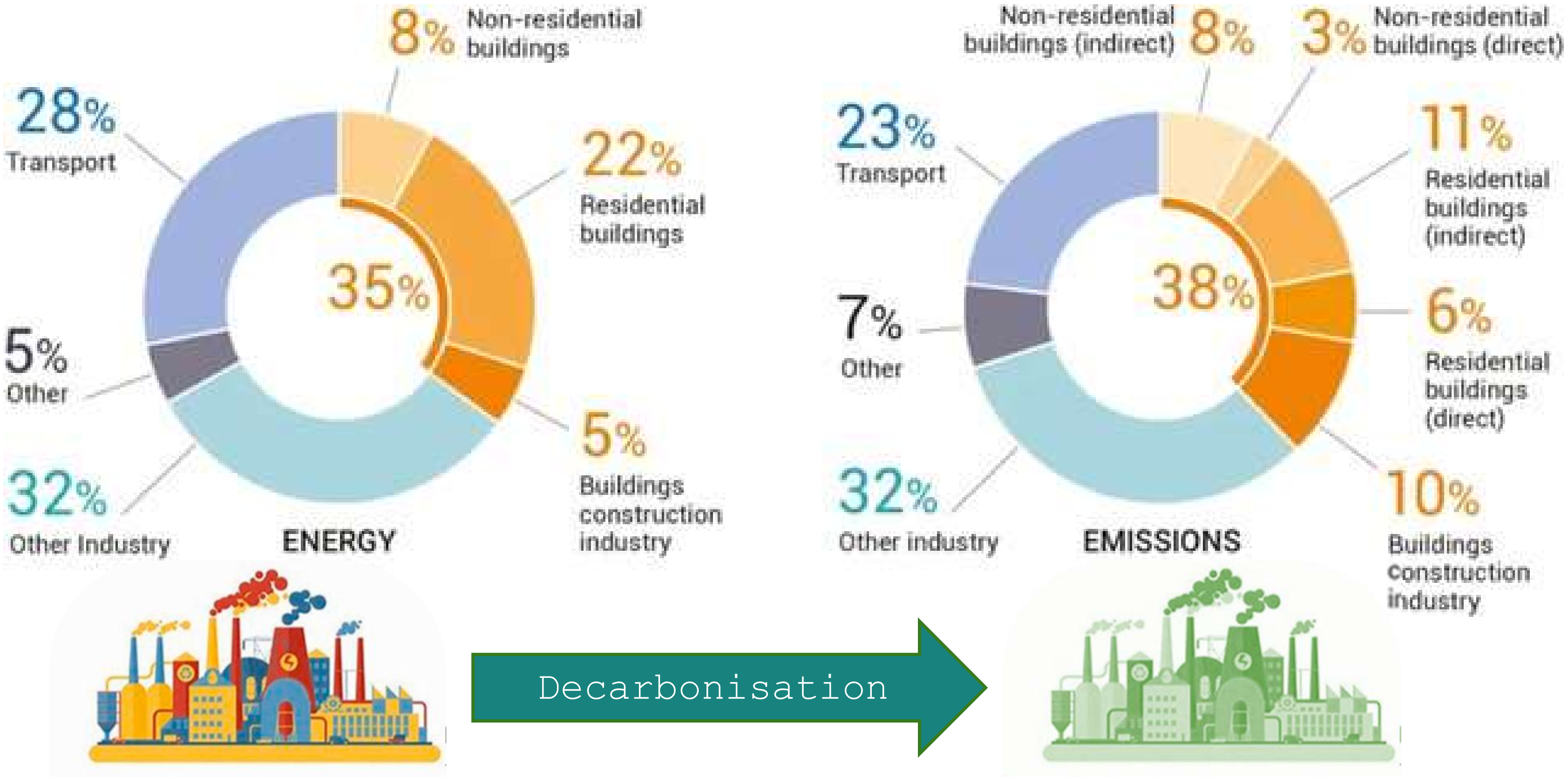
Sustainable Industry Through Green Hydrogen Multi-sector Application: KoNSTanZE project

IZES
Institut für ZukunftsEnergie- und Stoffstromsysteme

BOSCH

Contexte / Objectives

Current Distribution of Energy Consumption & CO2 Emissions by Sector (2019)



Contexte / Objectives

Decarbonising Industry

Renawable Energies

Green Hydrogen

Gefördert durch:

Bundesministerium für Wirtschaft und Klimaschutz

aufgrund eines Beschlusses des Deutschen Bundestages

ptJ Projektträger Jülich Forschungszentrum Jülich

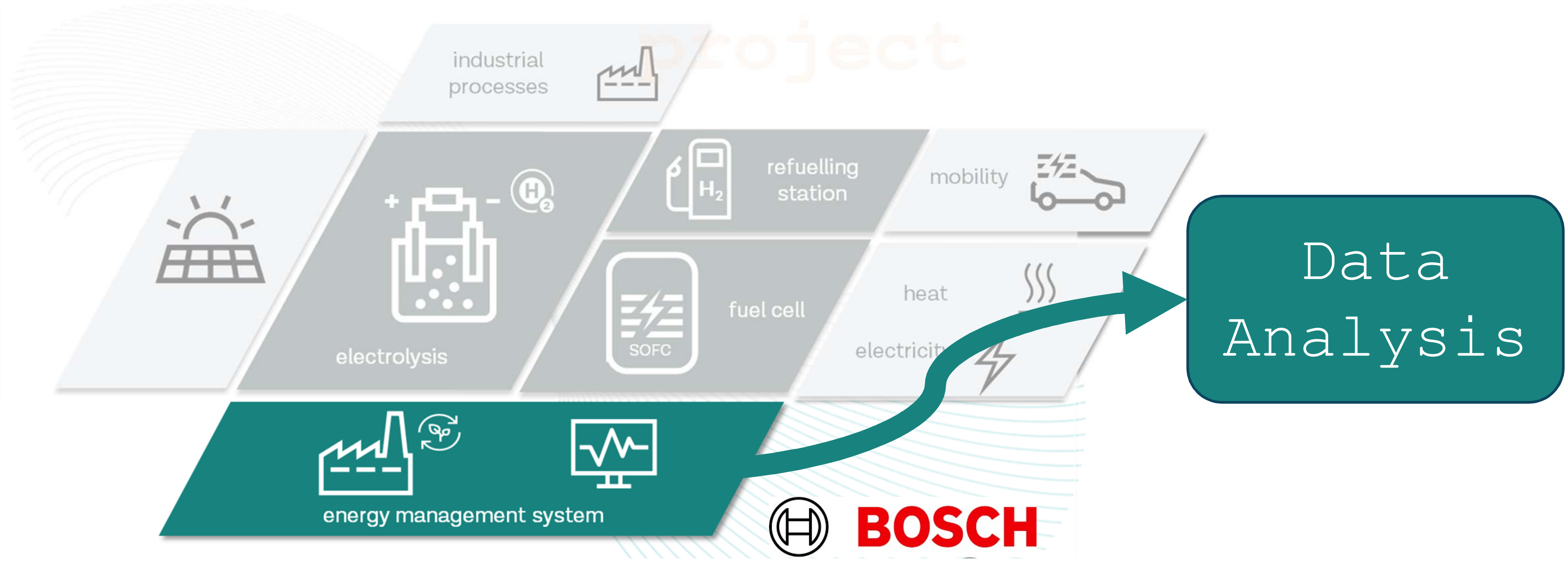
IZES Institut für ZukunftsEnergie- und Stoffstromsysteme

BOSCH

KoNSTanZE project

Contexte / Objectives

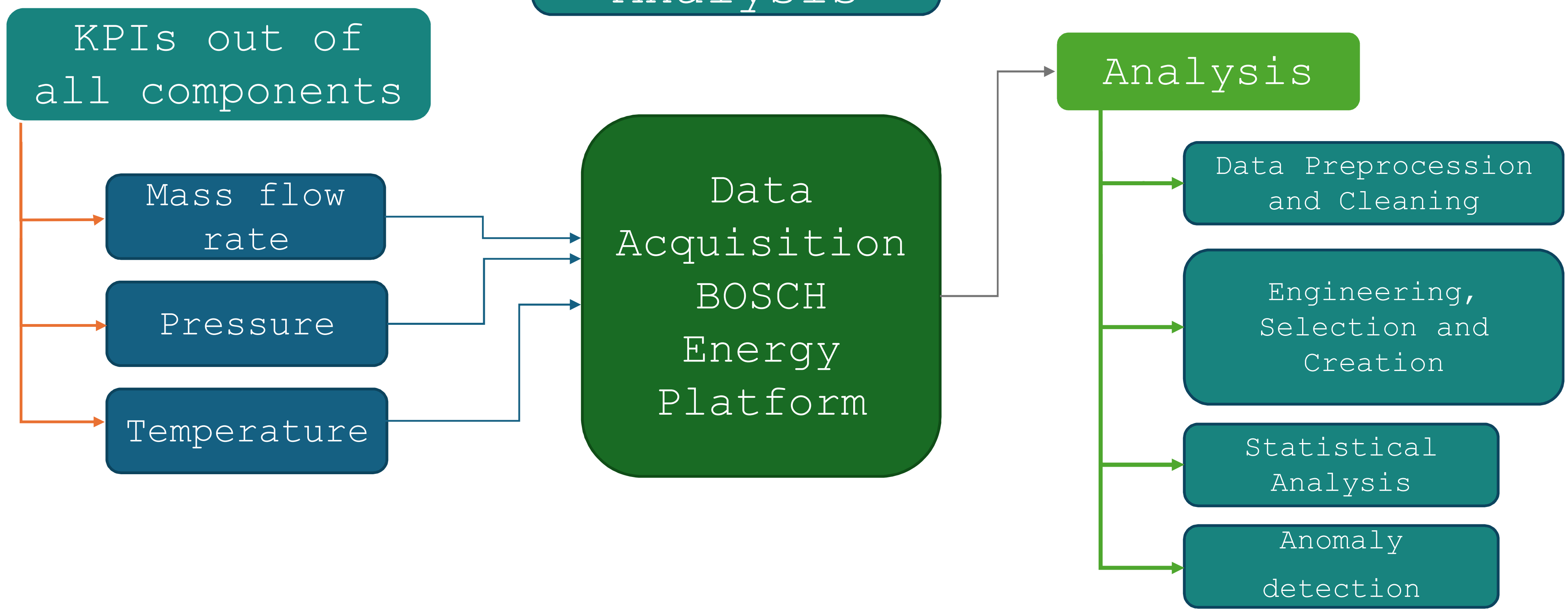
KoNSTanZE



Schematic KoNSTanZE test field

Methodology

Data Analysis



Methodology

MATLAB

Analysis

- Data Pre-procession and Cleaning
- Engineering, Selection and
- Statistical Analysis
- Anomaly detection

$$Z - score = (X - \mu)/\sigma$$

$$\Delta \dot{m} = \dot{m}(t) - \dot{m}(t-1)$$

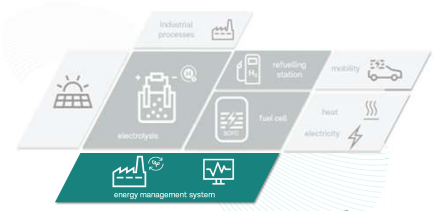
$$\sigma = \sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(X_i - \mu)^2} \quad ; \quad \mu = \frac{1}{N}\sum_{i=1}^{N} X_i$$

$$ACF(h) = \frac{\sum_{t=1}^{N-h}(X_t - \mu)(X_{t+h} - \mu)}{\sum_{t=1}^{N}(X_t - \mu)^2}$$

$$Anomaly\ Score = Distance\ from\ \mu\ in\ terms\ of\ \sigma\ (Z - score)$$

Results

MATLAB



Raw Pressure Data for Mid-Pressure Tanks (MD1, MD2)

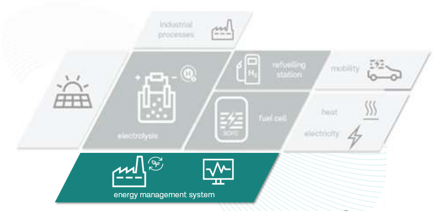
Upper Limit (500 bar)

Raw Data

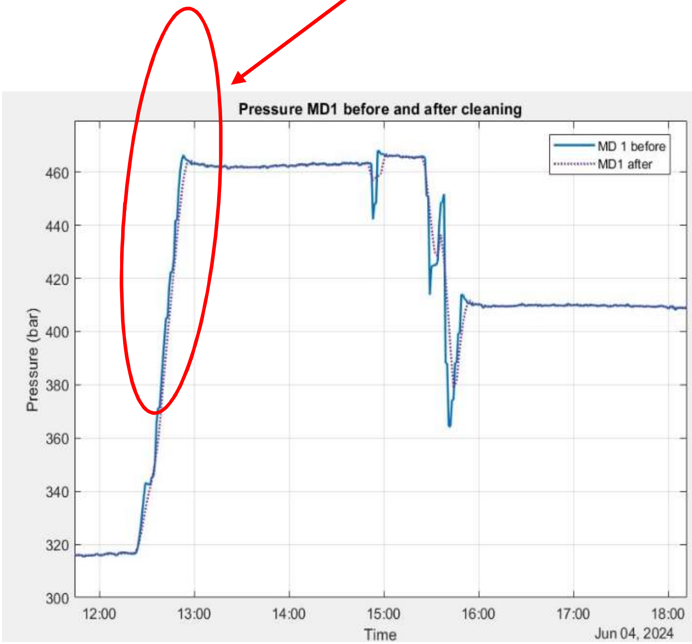
Lower Limit (50 bar)

Results

MATLAB



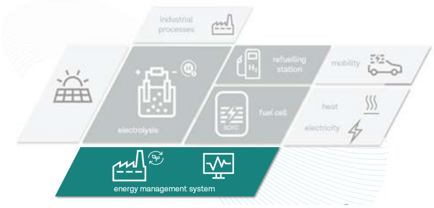
Separation of Data and Identifying Filling Process and its Efficiency

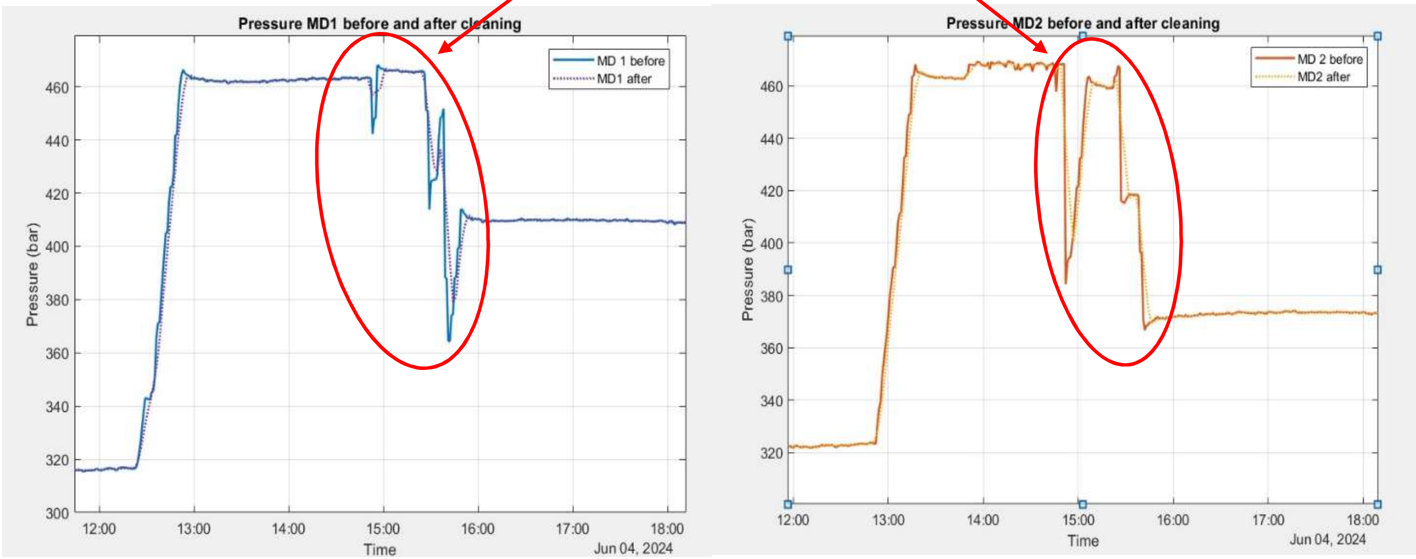


Results

Emptying Process and its Safety

MATLAB



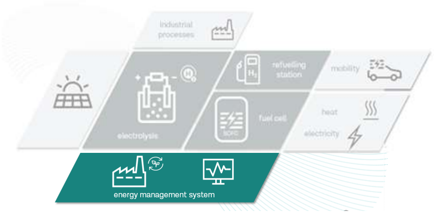


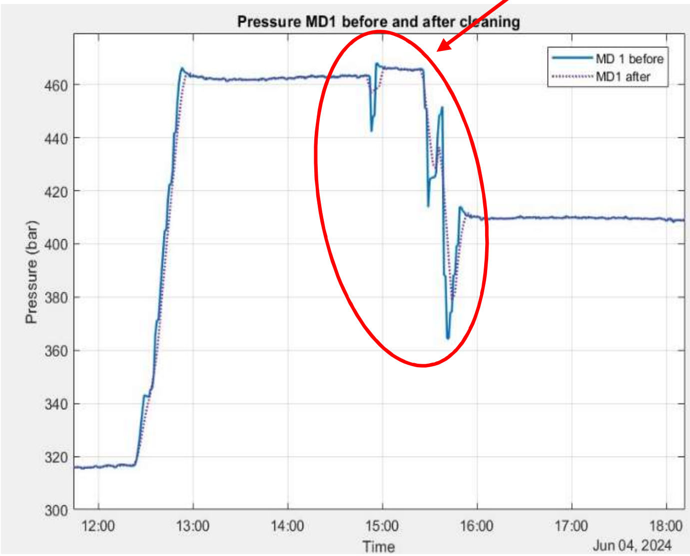
The pressure in MD1 highlights a drop after a stabilization periods and this suggest that a emptying process was engaged, notably for a vehicle filling proces

•After cleaning, the overall pressure trend remains very similar

Results

Emptying Process and its Safety



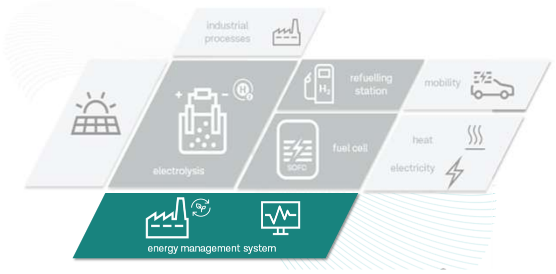


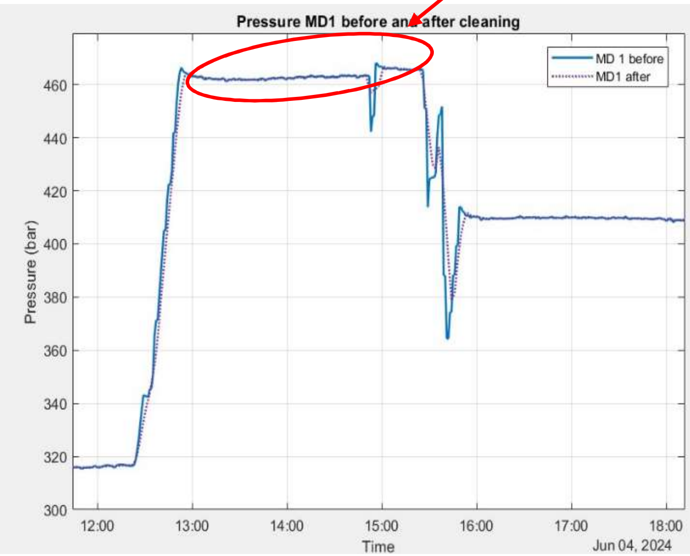
•The "after cleaning" data follows a similar pattern for MD2, showing that the cleaning did not significantly alter the overall pressure behavior in the vessel. However, minor differences can be seen around the stabilization points, especially around 14:00 and after 16:00

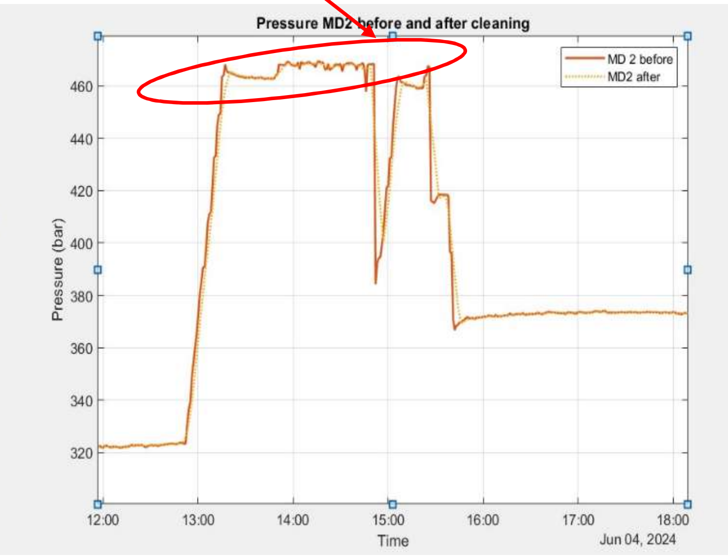
•The emptying process is concurrent to MD1 wichi is in lign with the operational mode of the station.

Results

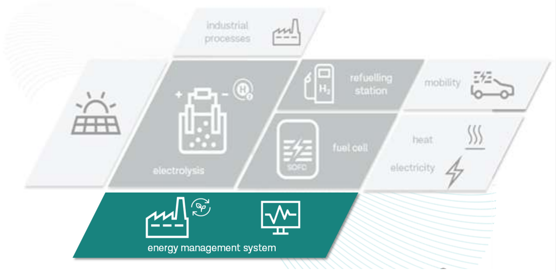
The cleaned data removes minor fluctuations, which are attributed to sensor noise

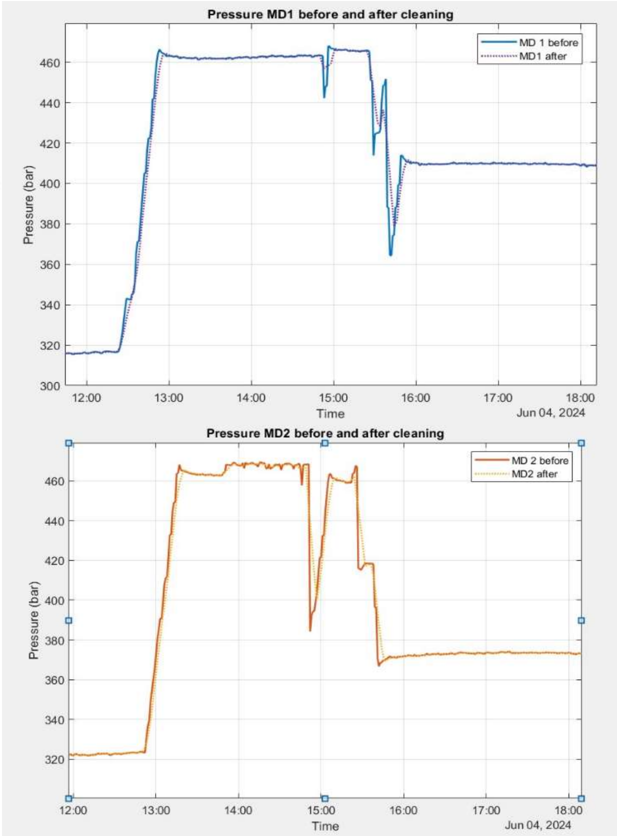






Results and discussion





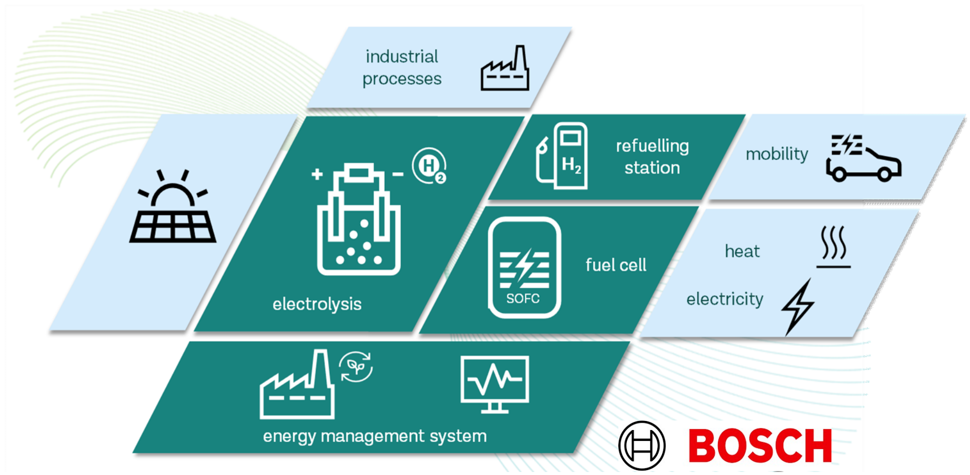
- The slight differences between the "before" and "after" traces indicate minor effects of the cleaning, but the overall pressure profiles remain consistent.

- The data suggest that the cleaning operation did not cause significant operational shifts in pressure regulation for either MD1 or MD2.

- The pressure dynamics, including the initial rise, stabilization, and the drop-off, likely reflect typical system behavior during hydrogen distribution, and the consistent patterns before and after cleaning suggest stability in the operation of these modules.

Conclusion

•The **KoNSTanZE project** uses the Bosch Energy Platform to collect data selected according to KPIs for hydrogen power plant operation.
•**Pre-processing methodologies** were implemented to clean and transform the dataset, removing noise and minor scatters from sensor data.
•By using **MATLAB** and employing **statistical tools, feature engineering**, and **data visualization**, the project effectively processed large datasets and identified anomalies like overpressure.
•The **real-time monitoring framework** ensures plant safety and performance, though it is more effective at diagnosing faults after they occur.
•**Current limitations** include incomplete early identification of
•issues such as leakage or sensor faults, requiring further
•enhancement in real-time anomaly detection



Perspectives

•Investigating other plant components (the refueling station).
•**Improving methods** for anomaly detection and **creating predictive models** based on cleaned data.
•**Development of a numerical twin** is planned to further optimize system performance and improve fault detection.

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Thank you for your attention

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