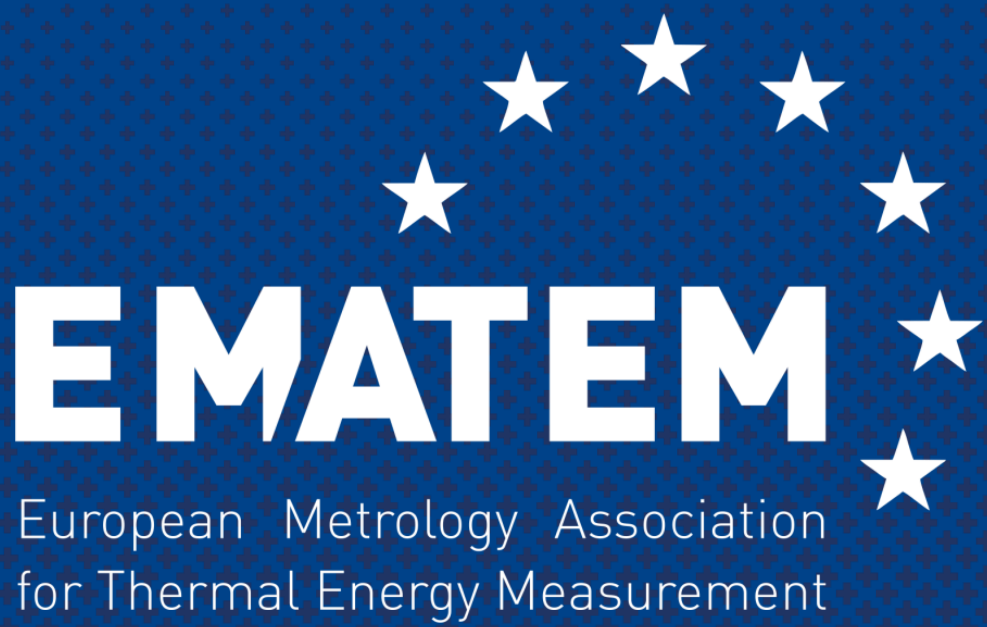


TOGETHER
we care about
METERING



Leckagenerkennung im Metering

Ein globaler Game Changer
für Wasserverluste, Energieeffizienz
und Netztransparenz



In Germany, water travels an average of 15 to 20 km through pipes before it comes out of your tap.

Average distance from the waterworks to the house connection:
approx. 10–15 km

Average distance from the well/source to the waterworks:
approx. 5 km

WOW,
THAT'S
AMAZING!



AI

JUMO

ILI – Infrastructure Leakage Index

Germany

5%

Italy

42%

USA

20%

Turkiye

43%

Norway

31%

China

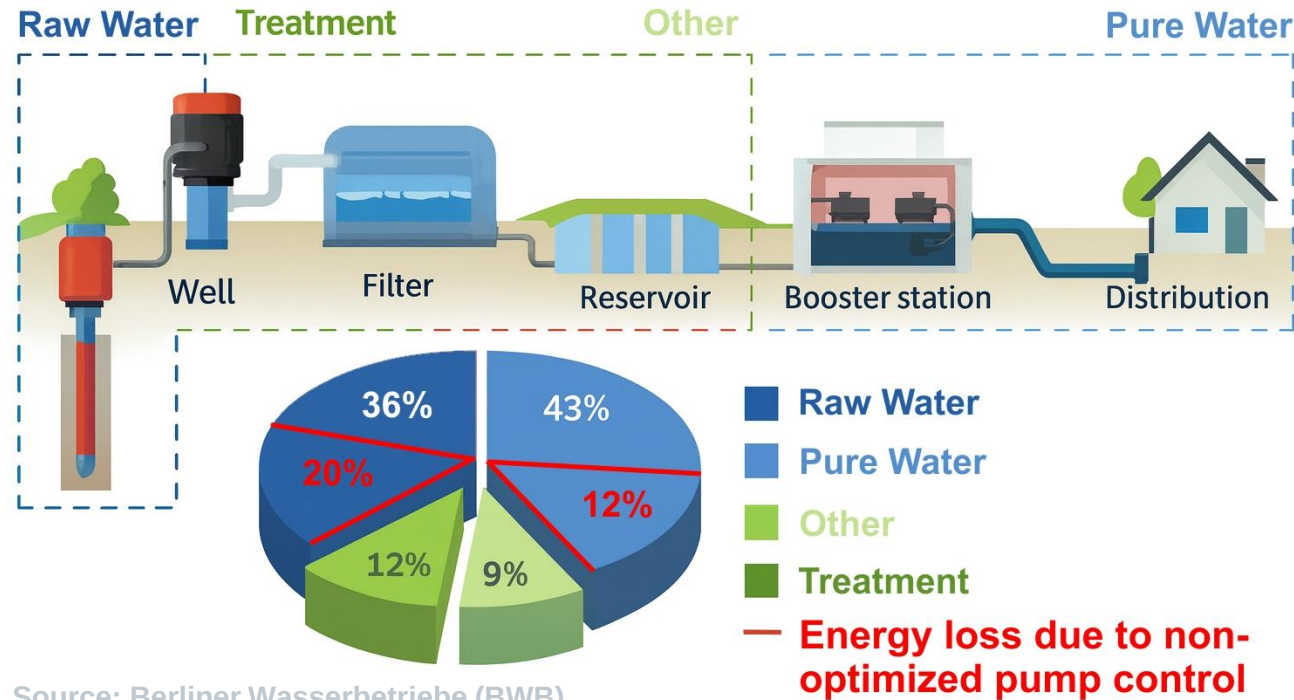
20%



The Infrastructure Leakage Index (ILI) is a parameter that shows the actual water losses of a supply network per country.

There are significant differences depending on the country.

High energy consumption of pumps in drinking water networks



Source: Berliner Wasserbetriebe (BWB)

In Germany, the total energy requirement for water supply is around 8.35 TWh.

This corresponds to an average of approximately 0.5 kWh of electricity **per cubic meter** of drinking water extracted.

The majority of the energy - approximately **80%** - is consumed by **pumps**.

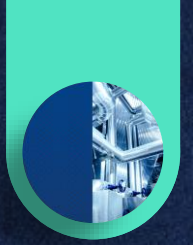
On average, 15% of municipal electricity consumption is attributable to water extraction and distribution.



Latest projects (2020–2025) show that there is **considerable potential for savings** in the operation of drinking water pumps. Across the country, utilities are increasingly focusing their attention on **optimizing pumps and pressure**—from high-tech municipal utilities to small special-purpose associations.

Demand-based pressure control, variable-speed pumps, more efficient units, and smart control technology typically enable **savings of 15–30%** in pump energy, and in some cases even more.

European Water Resilience Strategy



It is a strategy for securing water resources in the long term

- Adaptation to climate risks such as drought and extreme weather events
- Stronger commitments for municipalities, industry, and agriculture
- Promotion of modern measurement and monitoring technologies (e.g., leakage monitoring)
- National implementation and prevention strategies should be largely in place by 2027



Goal: A resilient, sustainable European water system by 2050

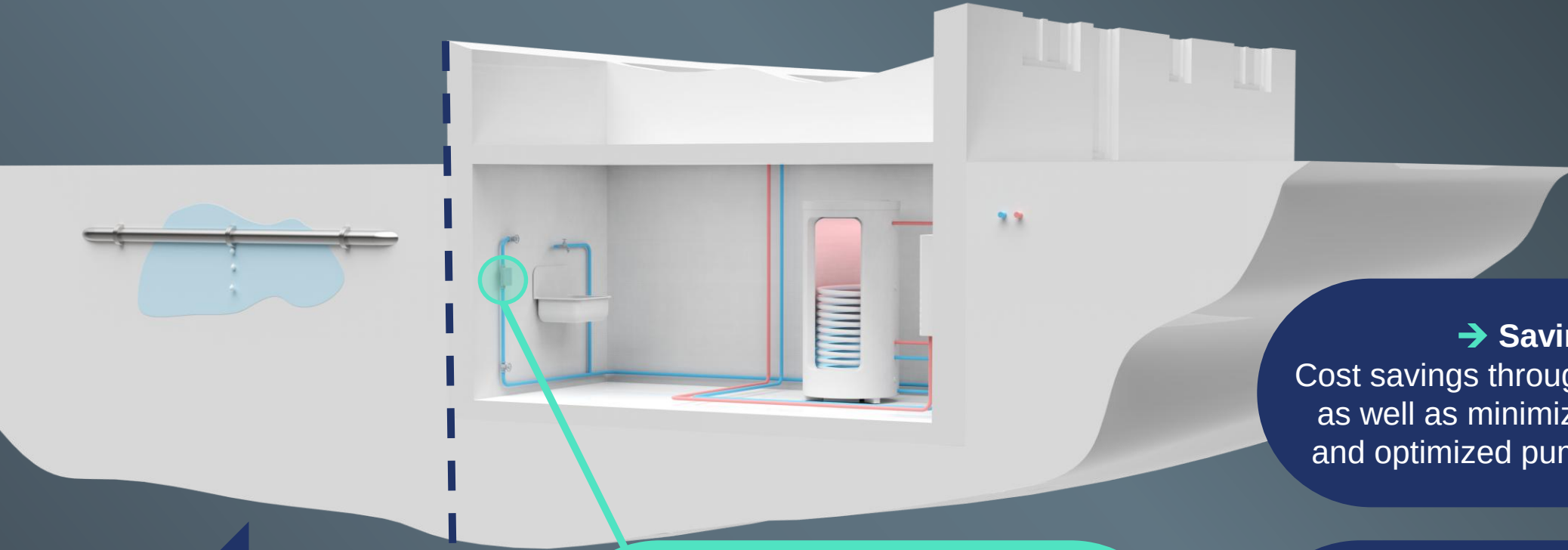
But it is not just an issue in the EU, but worldwide.



European
Commission

Application: Pressure cell for water meters

Pressure measurement redefined: A globally challenge, our solution



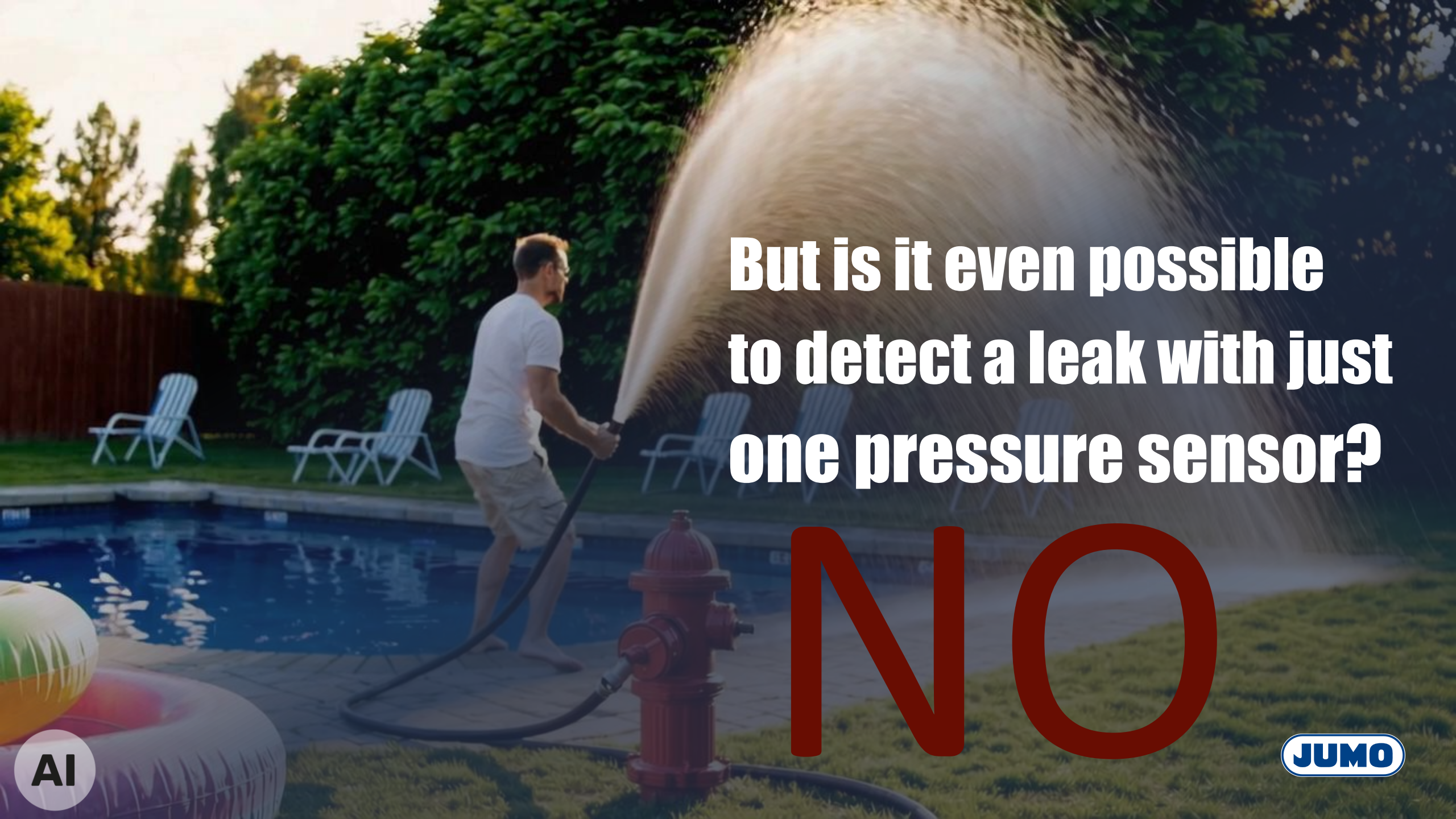
→ **Saving costs**
Cost savings through leakage detection as well as minimization of water loss and optimized pump pressure control

→ **Customer satisfaction**
Quick troubleshooting during startup and cost savings through energy reduction

Leak detection
towards the grid

**Water Meter with
Pressure Sensor**
Last and logical node
in the entire grid



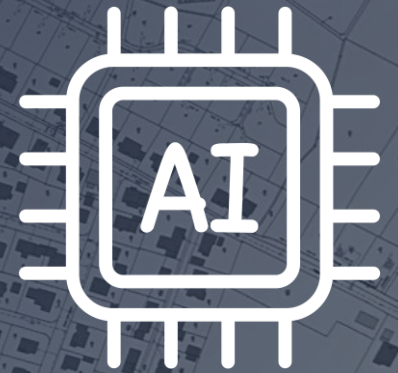
A man in a white t-shirt and khaki shorts is standing on a paved pool deck, holding a black hose connected to a red fire hydrant. He is spraying a large, powerful jet of water into a swimming pool. The pool is surrounded by a wooden fence and greenery. Several lounge chairs are visible in the background. The scene is set during the day with bright sunlight.

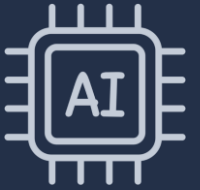
**But is it even possible
to detect a leak with just
one pressure sensor?**

NO

The solution for this is ...

Leakage detection
with a **pressure sensor**
network and **artificial**
intelligence





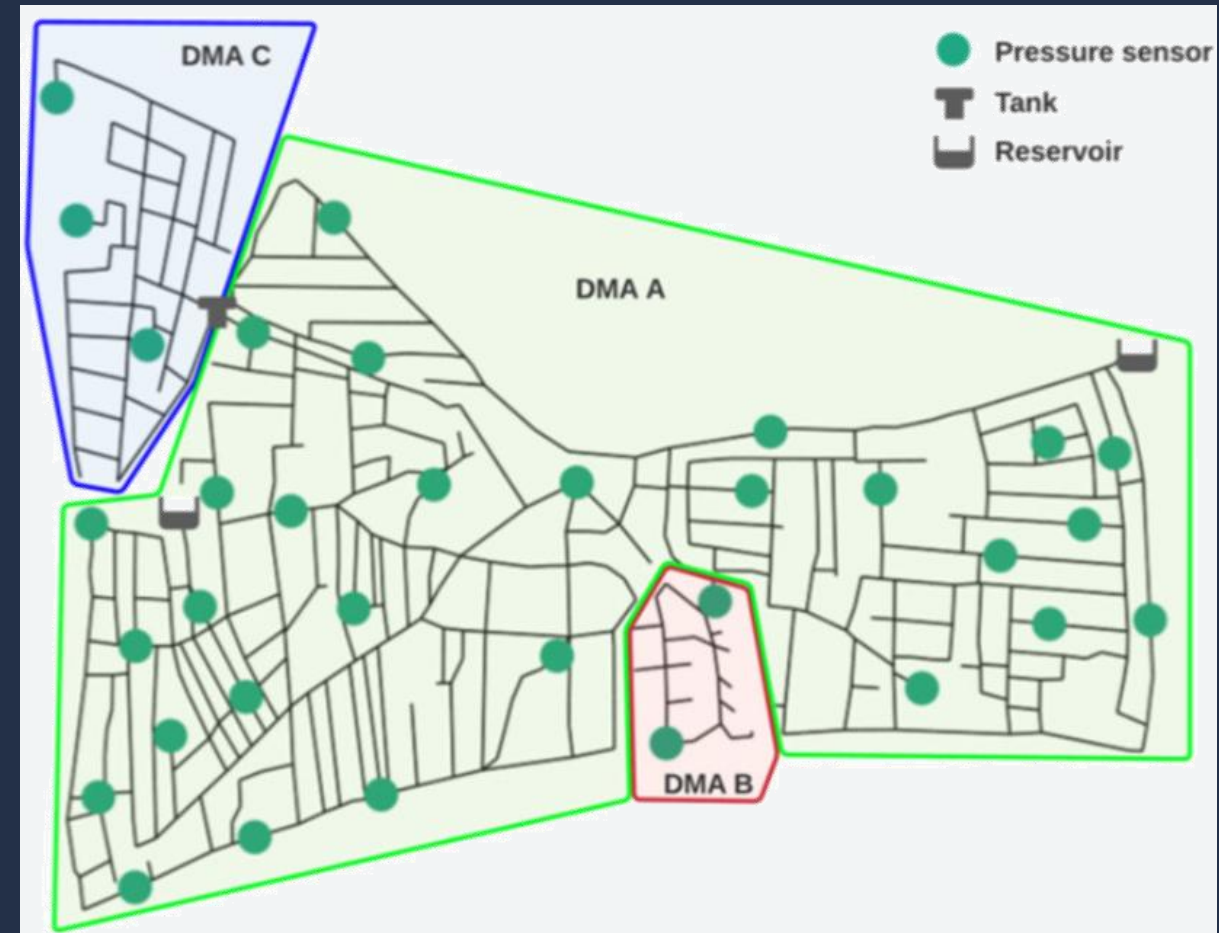
The challenge

- ① Find leakage in water pipe network
- ① Battle of the Leakage Detection and Isolation Methods (BattleDIM 2020*)
- ① Water distribution network created based on a real network of a city in Cyprus
- ① Mixture of residential, commercial and industrial demands

* [https://doi.org/10.1061/\(ASCE\)WR.1943-5452.0001601](https://doi.org/10.1061/(ASCE)WR.1943-5452.0001601)

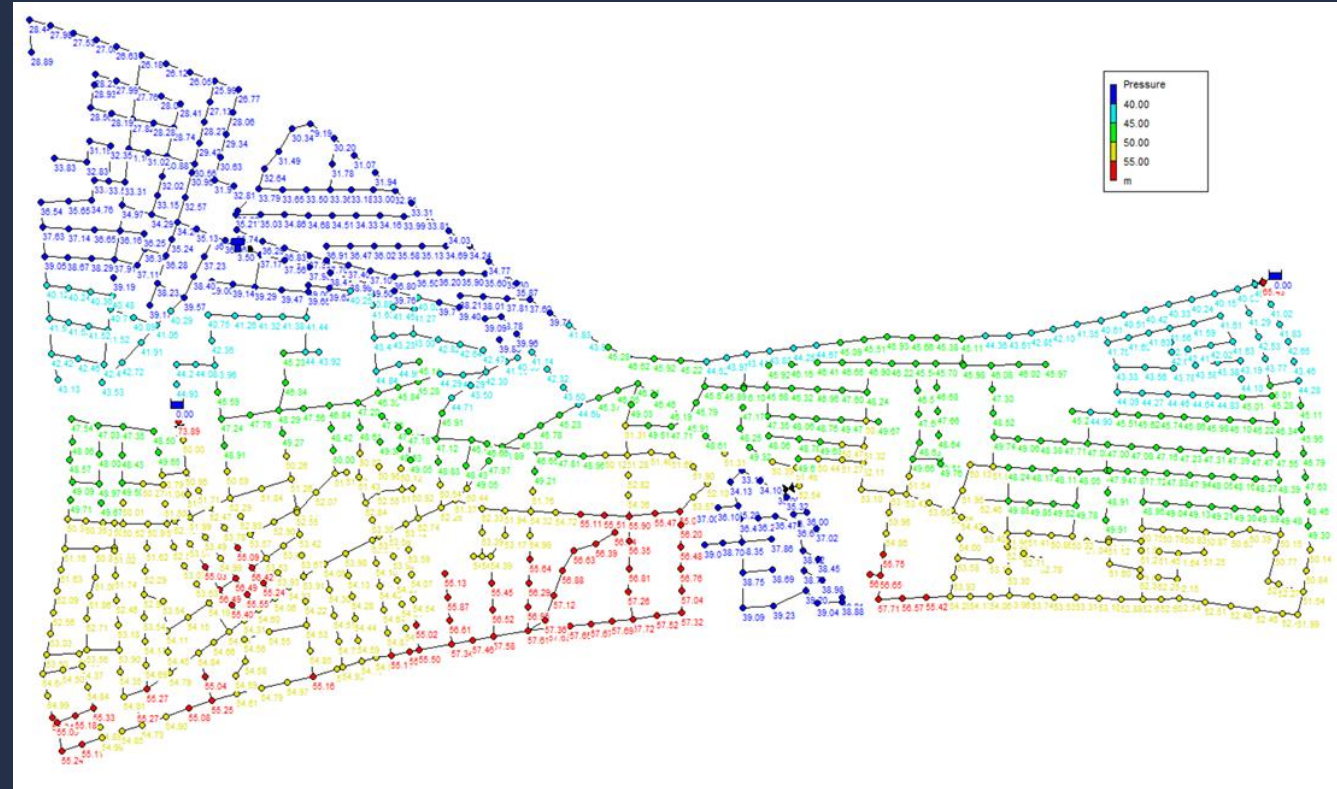
L-Town

- ✓ The Numbers:
 - ✓ ~ 10000 people
 - ✓ 900 pipes, 1 Pump, 3 Pressure reducing valves, 42 km pipe length
- ✓ Residential and commercial patterns extracted from real data
- ✓ Industrial patterns based on Automated Meter Reading data
- ✓ No special days



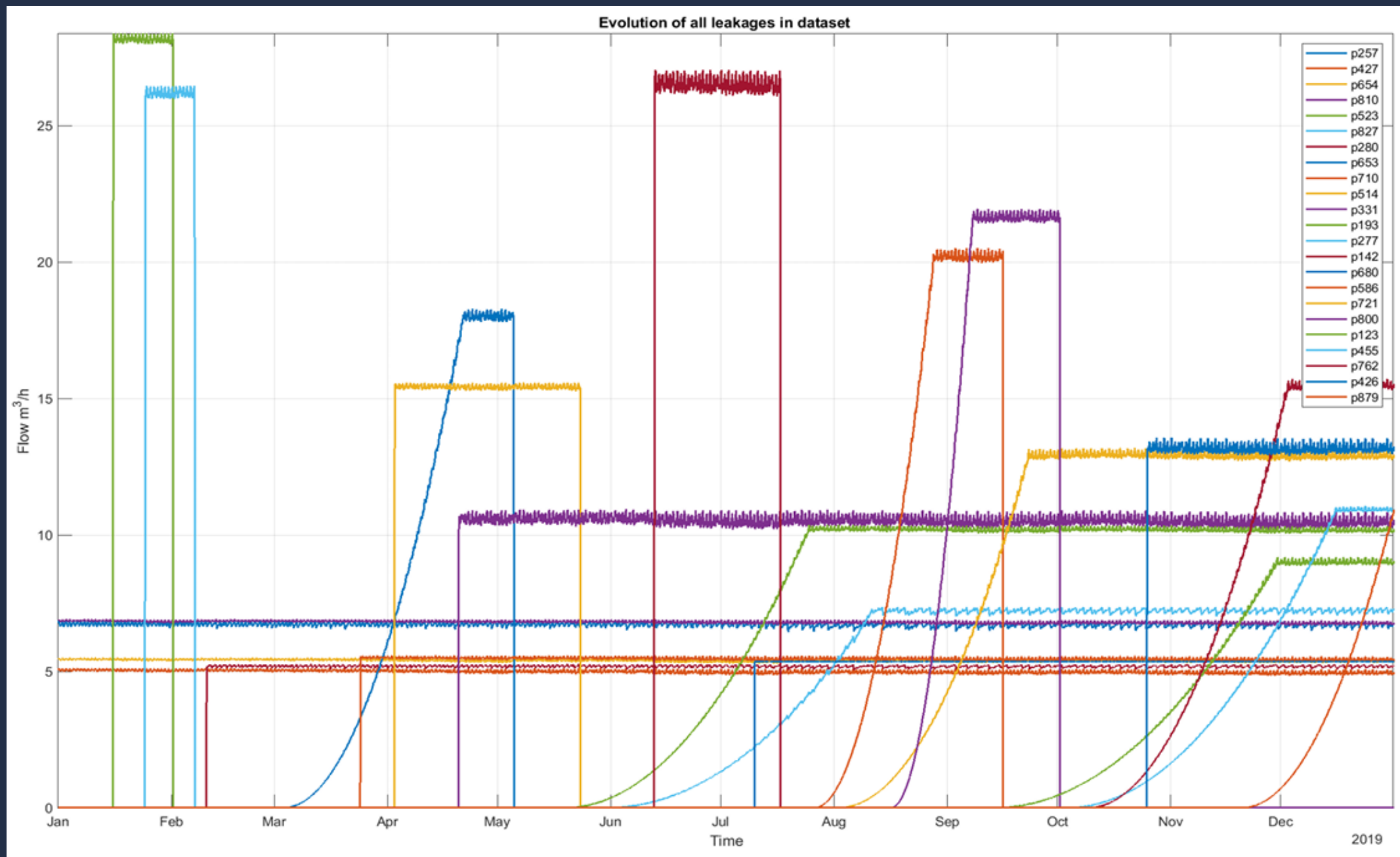
Network behaviour

- ✓ Normal pressure: 2.6 – 6 bar
- ✓ Base demands: randomised uniformly between $\pm 10\%$ of real value
- ✓ Pipe parameters: Randomised uniformly $\pm 10\%$ of real value



Leakage types

- ✓ Average system inflow $\sim 180 \text{ m}^3/\text{h}$
 - ✓ Background leakage: Small leaks with size of 1-5 % of inflow ($< 9 \text{ m}^3/\text{h}$)
 - ✓ Medium pipe bursts: 5-10 % of average inflow
 - ✓ Large pipe bursts: Above 10 % of average inflow
-
- ✓ Assumption for data set: Large and some medium leakages (above $15 \text{ m}^3/\text{h}$) are fixed by water utility after max. 2 months.

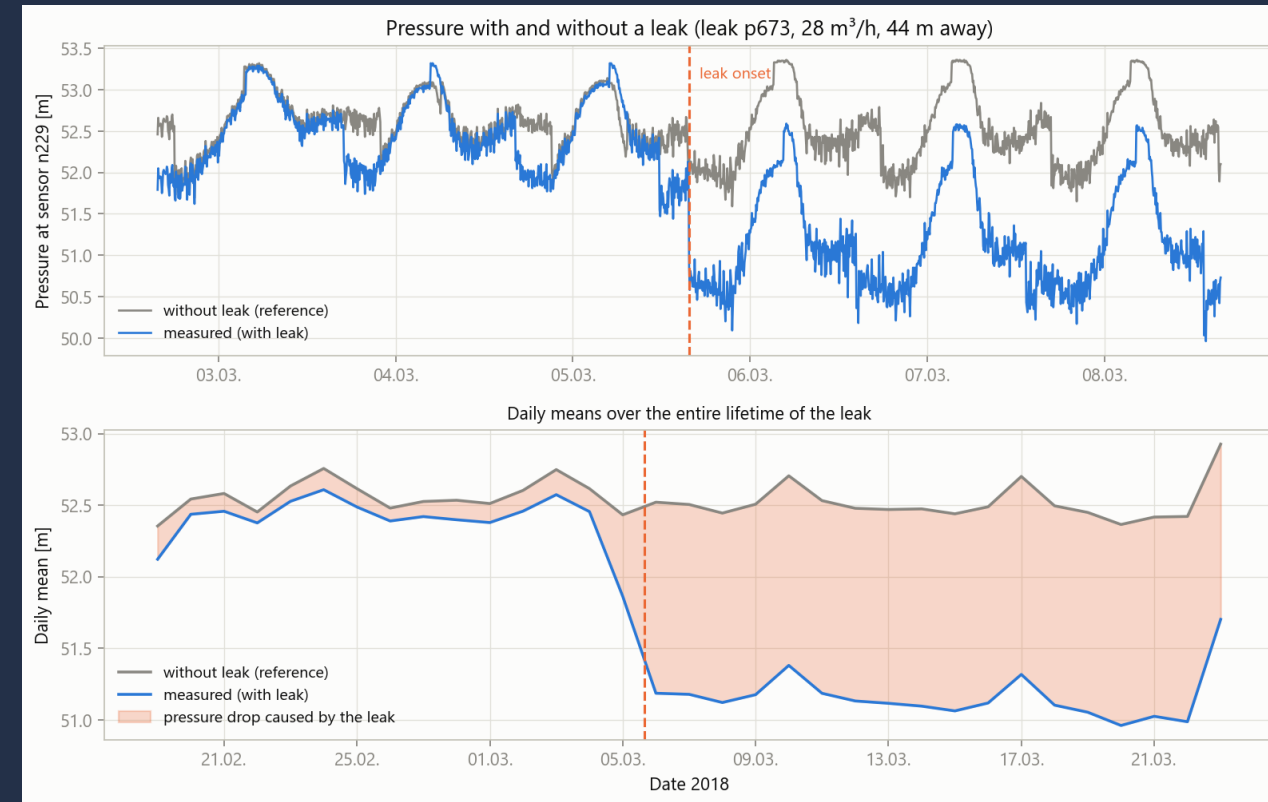


JUMO Model

- ④ Data set contains one tank water level sensor, 3 flow sensors, 33 pressure sensors, unknown number of AMRs
- ④ We restrict our model to pressure readings
- ④ Model captures normal behaviour, i.e. pressure drops from consumption, seasonal variations, ...
- ④ It is designed to run on embedded hardware

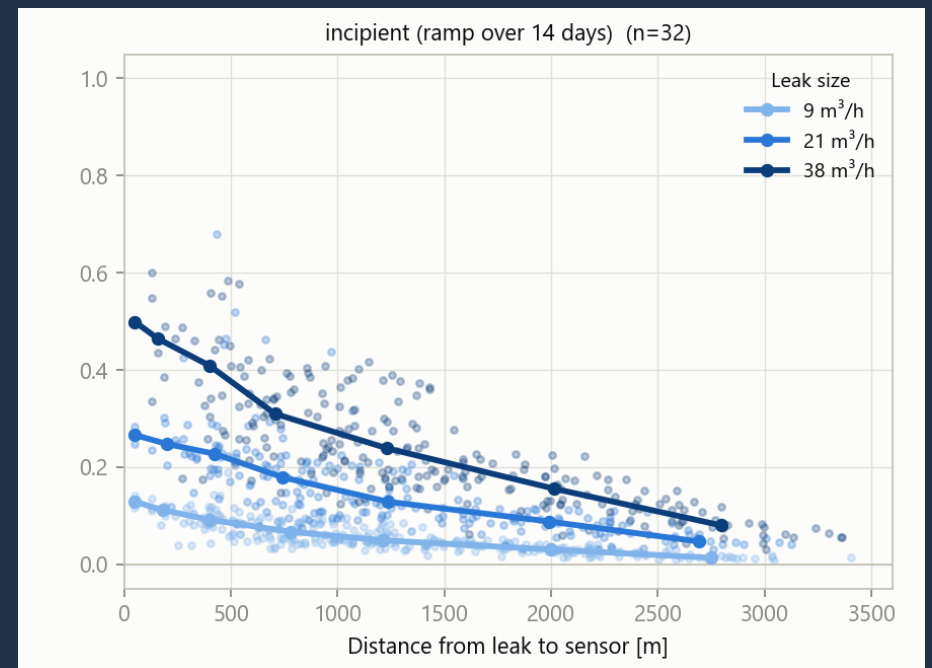
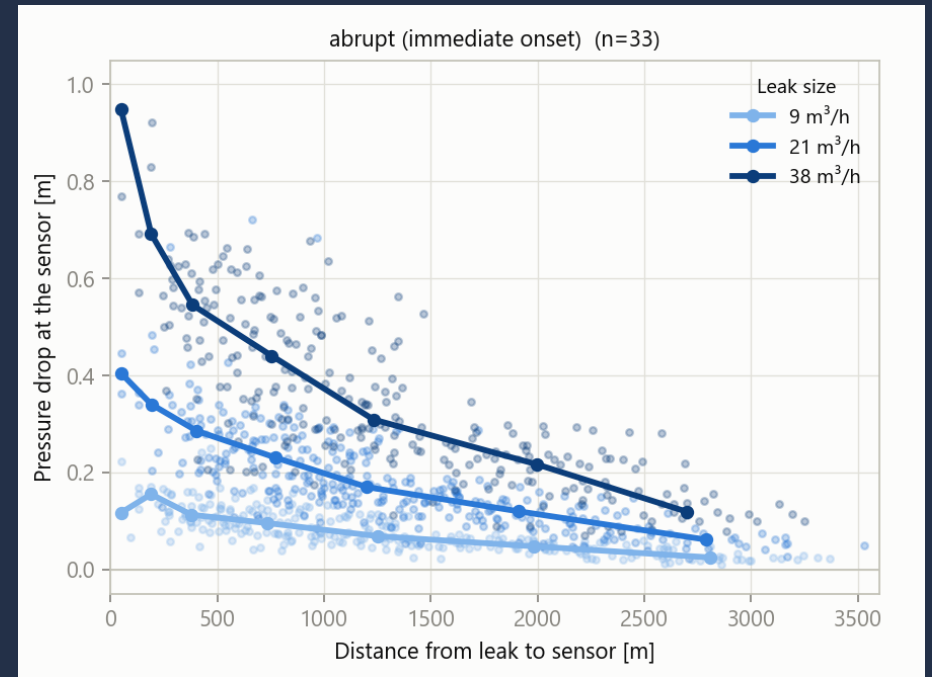
How detection works

- ✓ Model is purely data-driven
- ✓ No hydraulic model needed
- ✓ For localisation the water pipe network graph has to be known
- ✓ Training, re-training and check for model integrity is completely automated



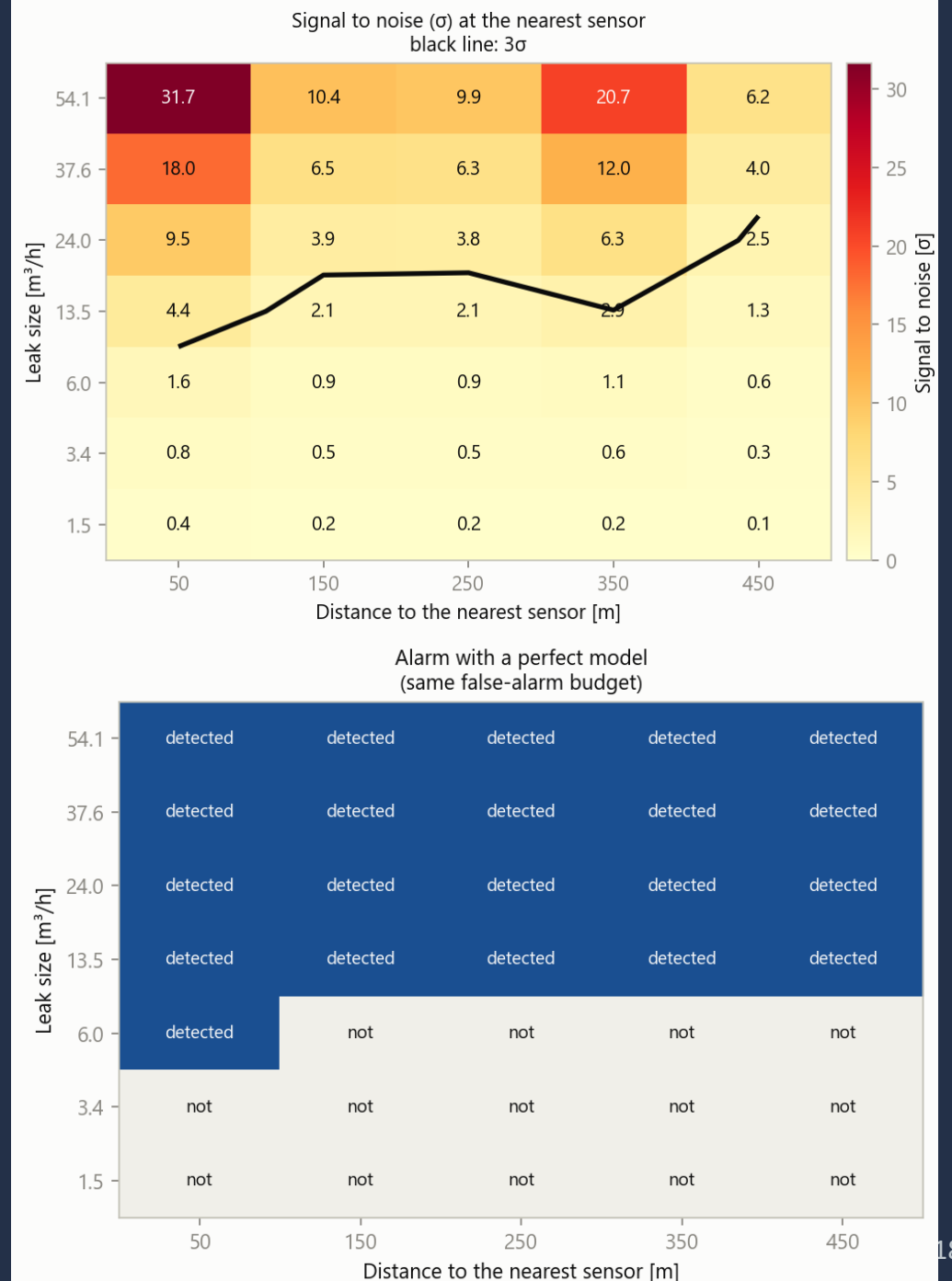
Distance ↔ Leakage size

- ✓ 90 % of cases lie in between 294 m and 2325 m
- ✓ Pressure drop depends on leakage size
- ✓ Pressure also drops over distance
- ✓ That's a problem for the model in localising the leakage

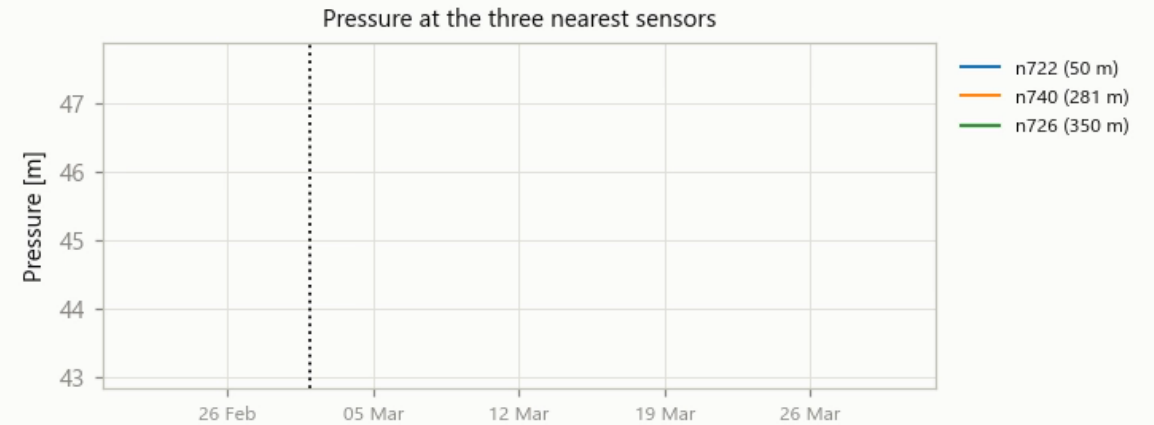
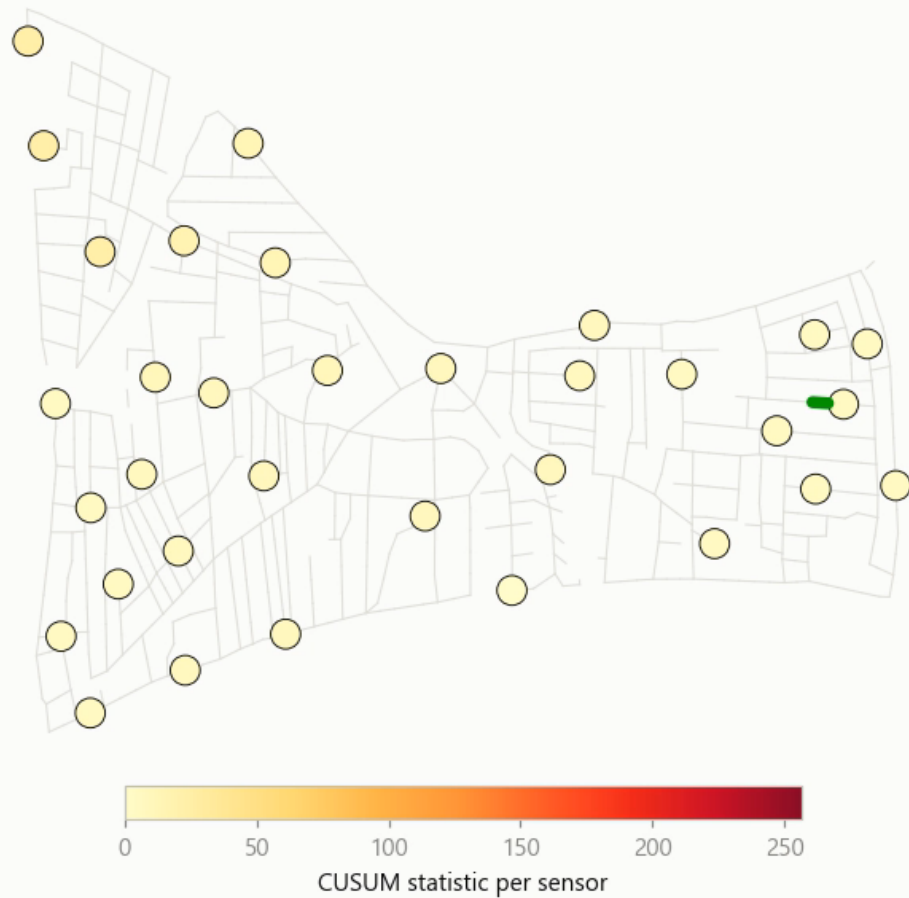


Detectability

- ✓ There is a trade-off between sensor density and detectability of leaks
- ✓ More sensors makes it possible to detect smaller leaks to a certain extent
- ✓ More sensors help in localisation



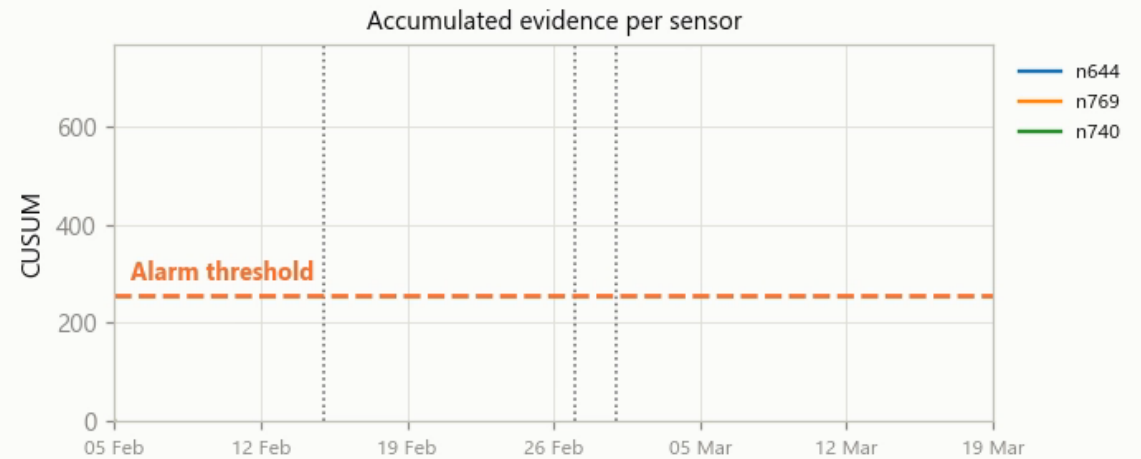
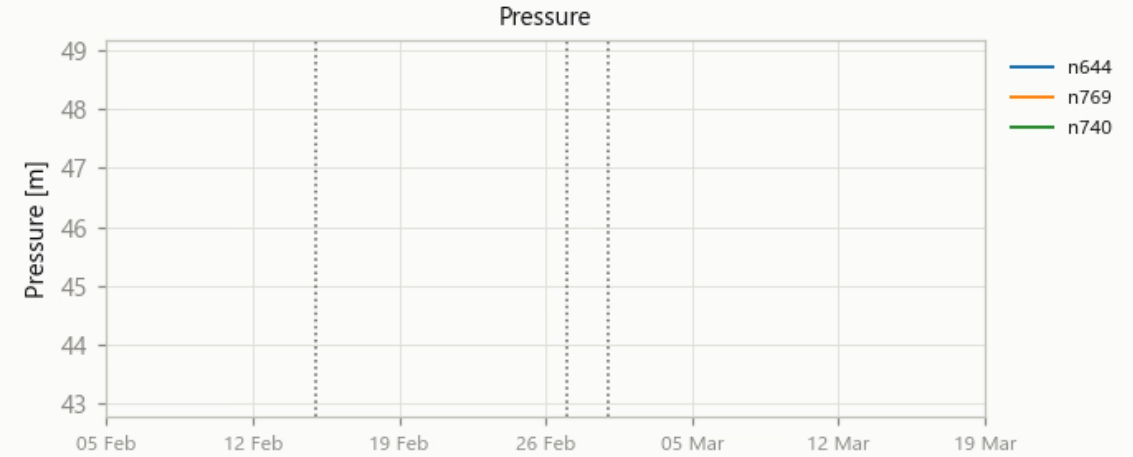
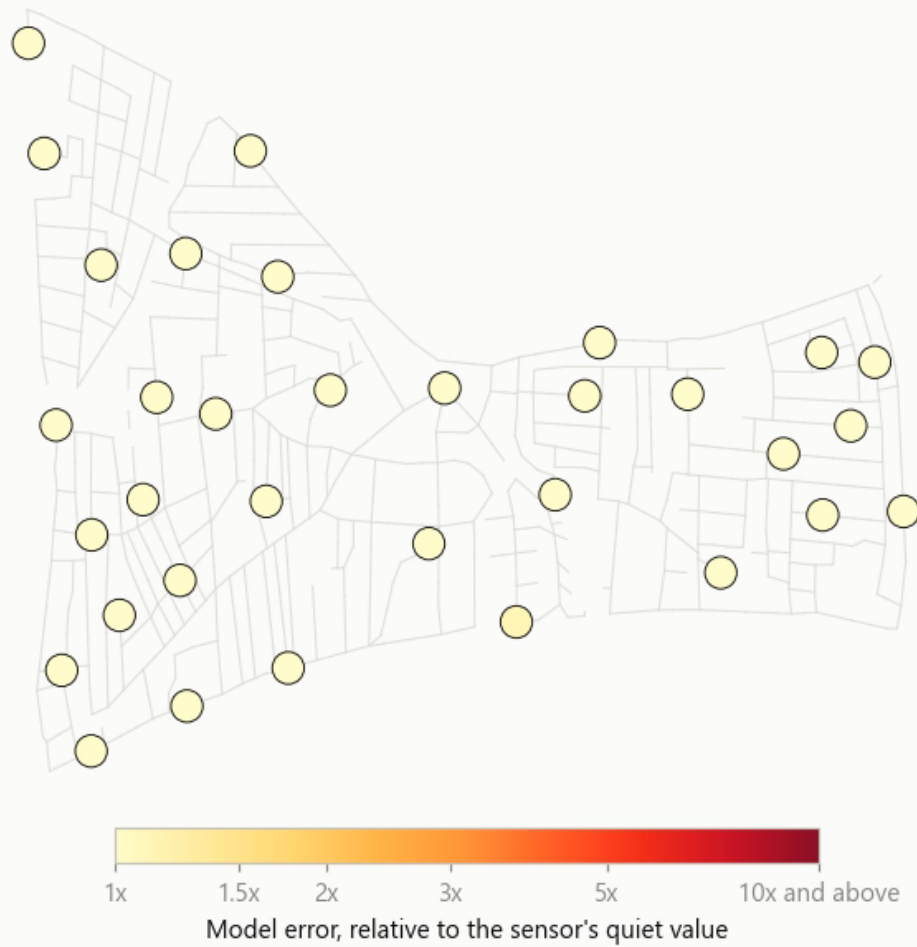
Detecting a leak over time ($38 \text{ m}^3/\text{h}$, 50 m from the nearest sensor)



Normal operation

10.0 days before leak onset

Three leaks, staggered in time (green rings: actual leaks)



05 Feb • 0 leaks active

Goals

- ① Evaluation of successful leakage detection is based on economical approach:
 - ① Water saved from successful detection 
 - ① Costs of sending a repair crew to search for a leakage 

Metric	Limit/Costs
Max detection distance	300 m
Cost of water per m ³	0.80 €
Maximum repair crew cost	500 €

The result (comparison BattleDIM and JUMO)

Team Name	Recall	False Positives	Economic score
PERFECT-SCORE	100%	0	€523,154
Tongji-Team (Hybrid)	56.52%	3	€264,873
Under Pressure (Hybrid)	65.22%	4	€260,562
AE (max 4 anomalies)	65.22%	62	JUMO €239,852
IRI (Hybrid)	43.47%	1	€210,772
AE (rolling max 3)	52.17%	59	JUMO €210,245
Leakbusters (Model-Based)	47.83%	7	€195,490
Tsinghua	47.83%	5	€167,981
UNIFE	43.47%	4	€127,626

Key Facts

Supply voltage
1.5 V to 3.6 V

Digital
pressure
sensor

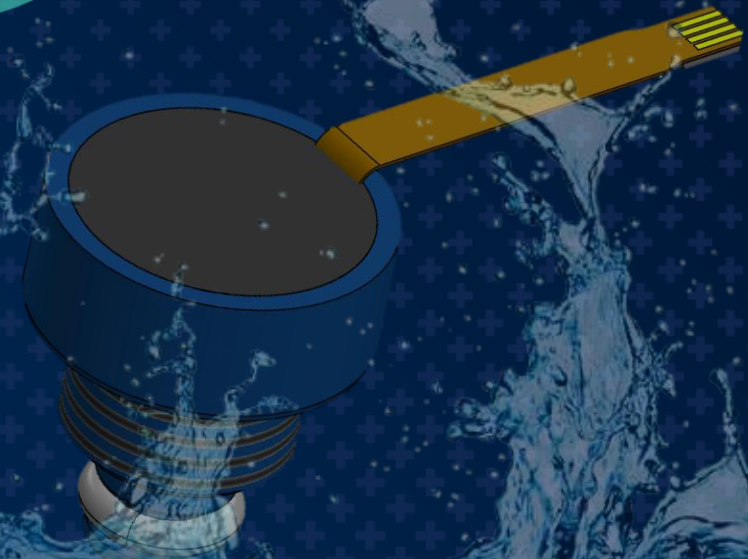
Fast
conversion
down to
0.37 ms

Operating
Range
0,3 to 16 bar

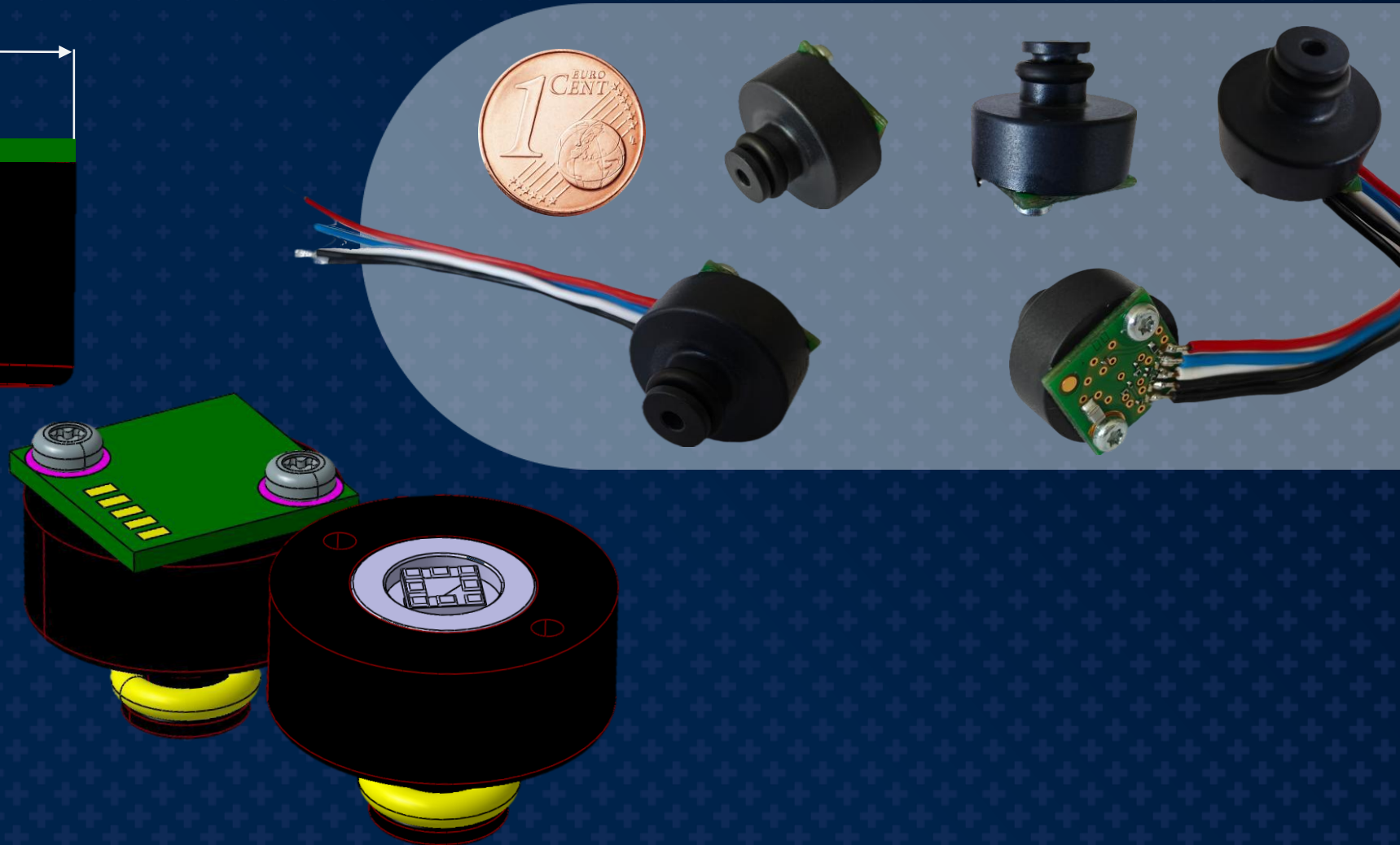
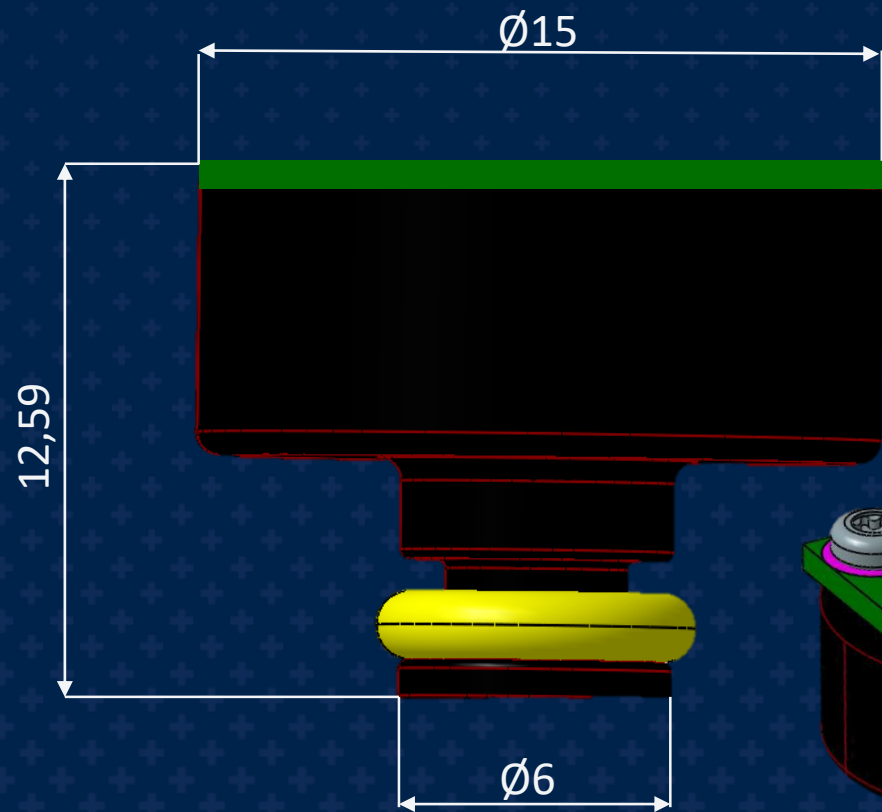
Low Energy
<0,34 μ A

SPI and I²C
interfaces

Excellent
long-term
stability



NEW Mini Water Pressure Sensor (now adapted to you)



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**We looking forward to your
questions!**

