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WaterLoss2022

19-22 June 2022

Praha • Prague

LEAK365: Full Scale Smart Water Leakage Management

Thorkil Bartholdy Neergaard



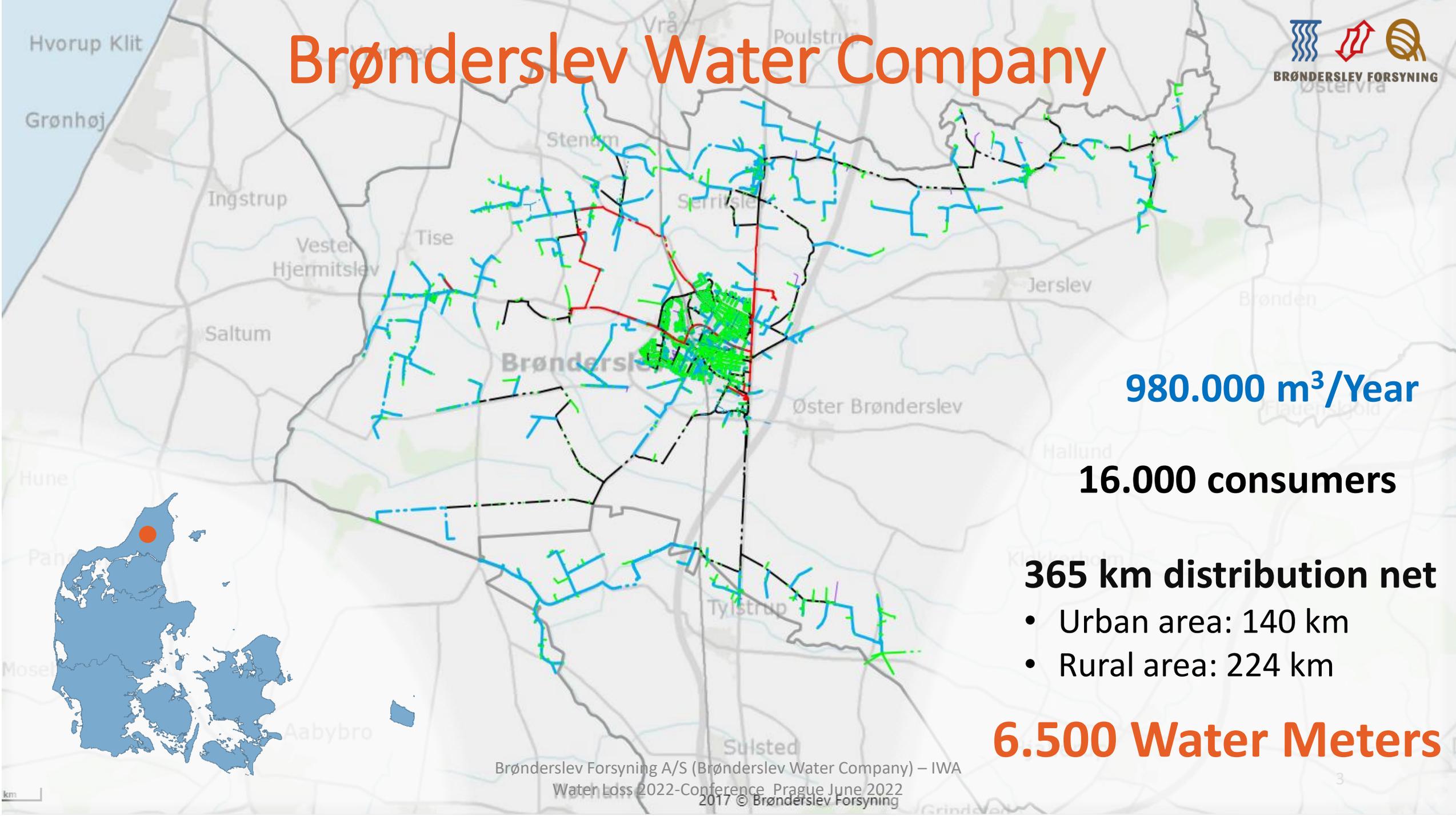
Smart Network Management

Datadriven Added Value

CEO Mr. Thorkil Bartholdy Neergaard

IWA Conference, Water Loss 2022, Prague, June 2022

Brønderslev Water Company



980.000 m³/Year

16.000 consumers

365 km distribution net

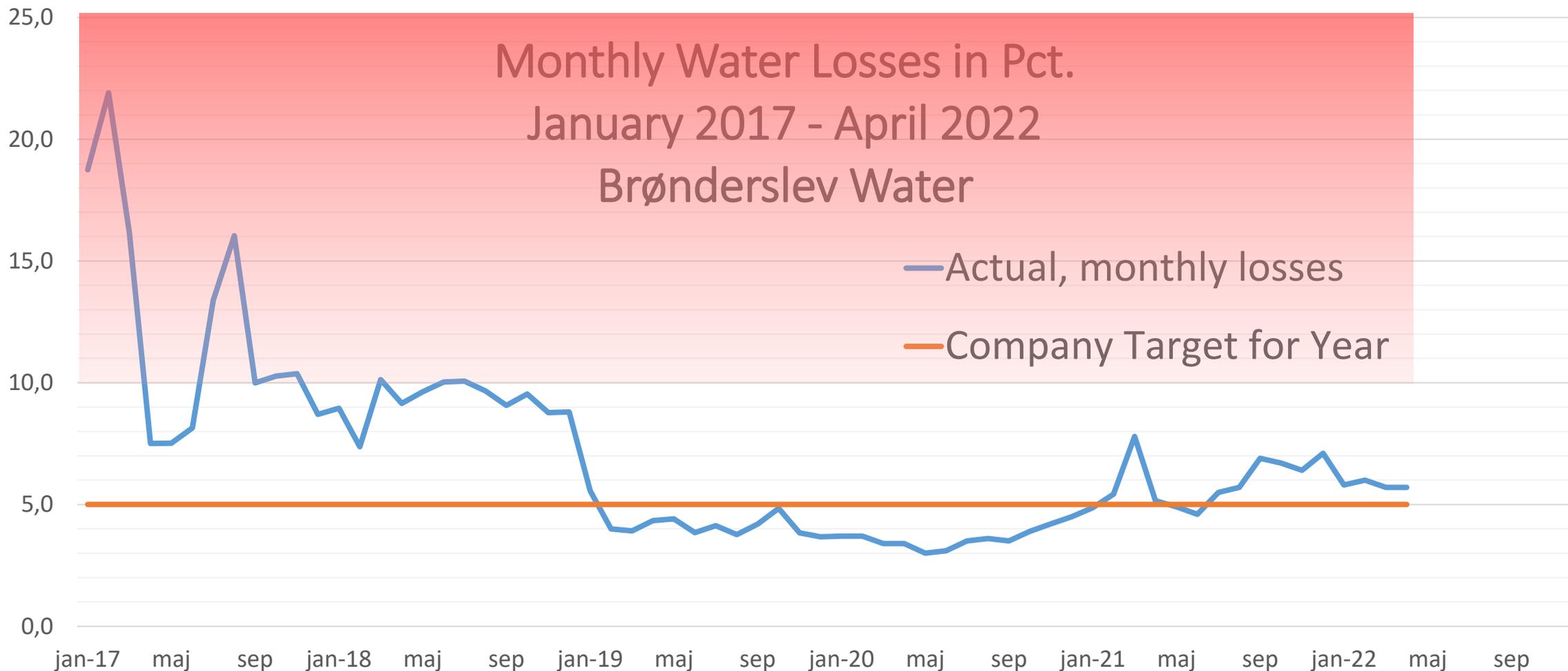
- Urban area: 140 km
- Rural area: 224 km

6.500 Water Meters

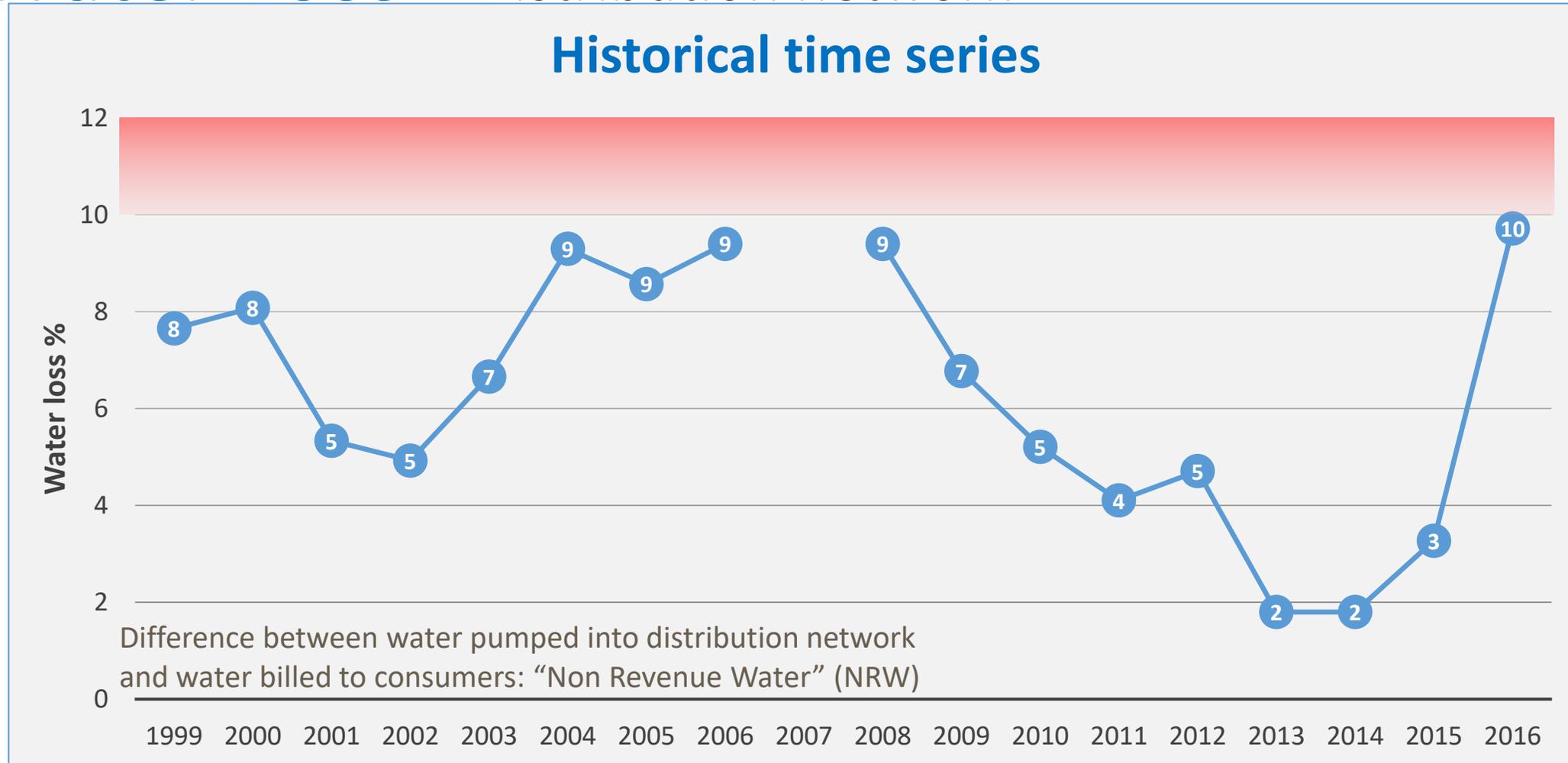
Brønderslev Forsyning A/S (Brønderslev Water Company) – IWA

Water Loss 2022-Conference, Prague June 2022
2017 © Brønderslev Forsyning

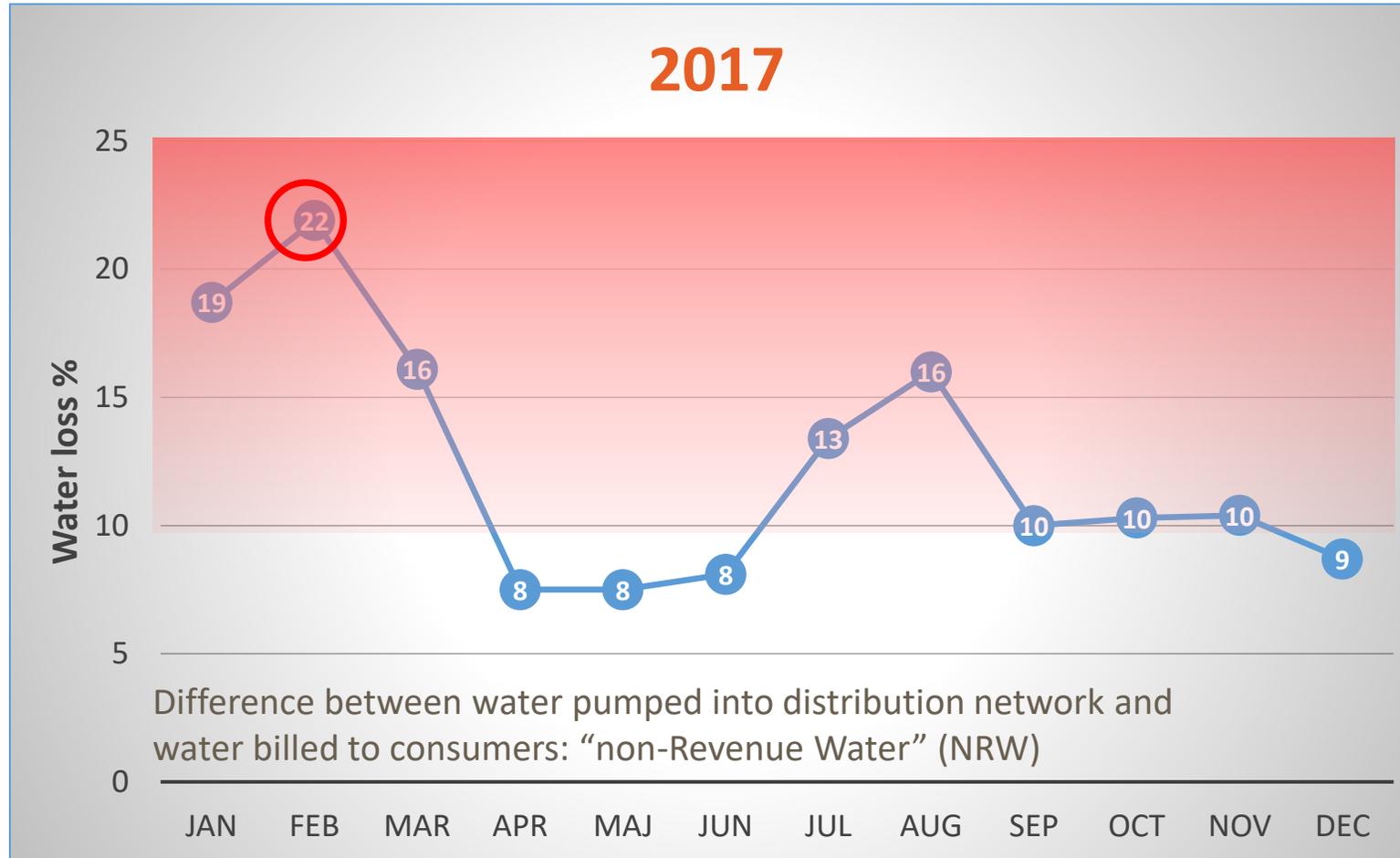
Monthly Water Losses in Pct. January 2017 - April 2022 Brønderslev Water



Water Loss – Distribution network



Water Loss – Distribution net

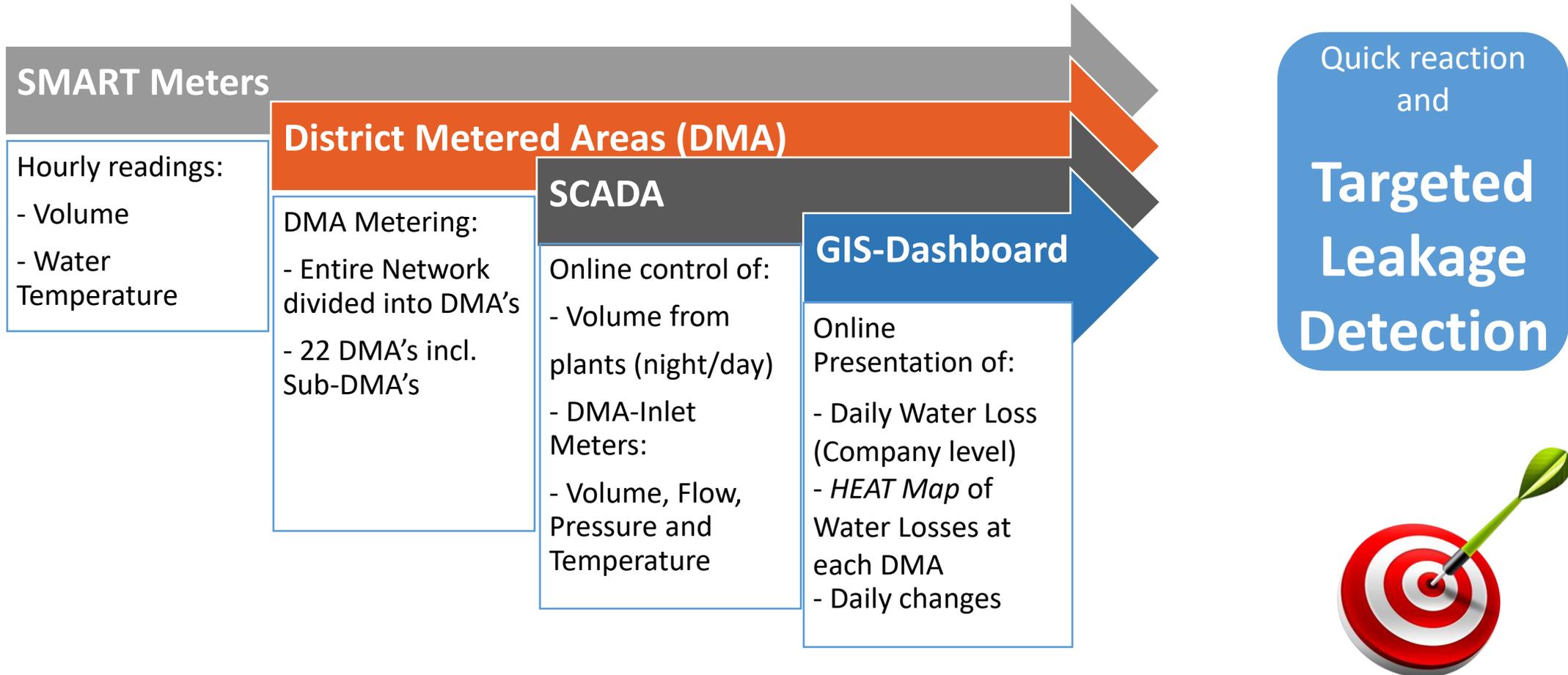


Penalty paid to the National Authority, almost 1 Euro per m³ lost

LEAK365: Smart Leakage Management based on Digitized Data

- | | |
|---------------------------------------|--------------------------|
| 1. Smart Meters at every consumer | Done (2015) |
| 2. Hourly Readings from Fixed Network | 95-98 %, Done |
| 3. Sectioning of Distribution Network | Done, 2016 - 2022 |
| 4. 24/7/365 GIS-Monitoring of NRW | Done, since 2021 |
| 5. Staff Competence and Awareness | Ongoing... |

LEAK365: Core Elements in Strategy

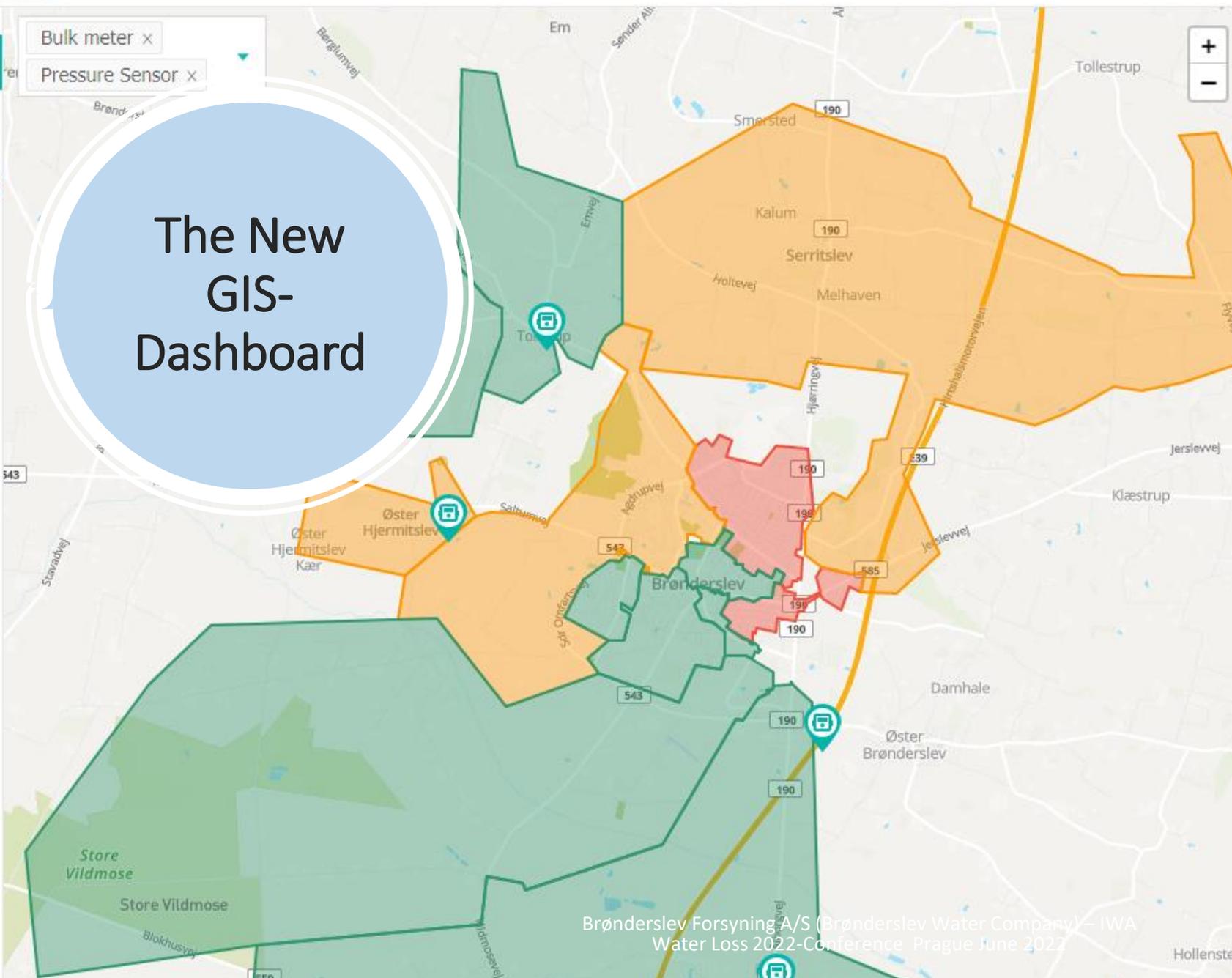


In addition: A competent and dedicated staff!

- Bulk meter x
- Pressure Sensor x

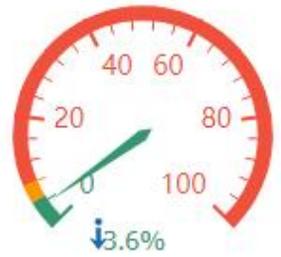
The New GIS-Dashboard

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- 
- 
- 
- 



Daily NRW

2021-12-06



NRW volume	69.1 m³
Delivery volume	1931.0 m³
Consumption volume	1861.8 m³

Top 5 Highest NRW

Top 5 Highest Increase of NRW

16 - Knu...	1.8%	×2.8	4.7%
10 - Tom...	0.3%	×1.6	0.6%
09 - Tols...	2.5%	×1.4	2.9%
02 - Agd...	4.4%	×1.3	5.6%
13 - Vild...	2.3%	×1.2	2.8%

Dashboard

DMA

28 Event

Data ▼

Asset ▼

Report

Q DMA name search

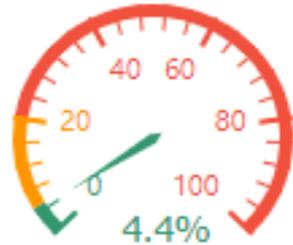
Daily NRW ▼

↓ NRW (%)

2022-04-28

16 - Knudsgade

[DMA Details](#)



NRW
12.3 m³

Delivery volume
280.0 m³



NRW increase
0.3

Consumption volume
267.7 m³

09 - Tolstrup



NRW
1.8 m³

Delivery volume
48.5 m³



NRW increase
2.2

Consumption volume
46.7 m³

08 - Kornumgaardsvej

[DMA Details](#)



NRW
4.1 m³

Delivery volume
121.0 m³



NRW increase
1.7

Consumption volume
116.9 m³

Drill Down
in Data

[Details](#)

 **Dashboard**

 **DMA**

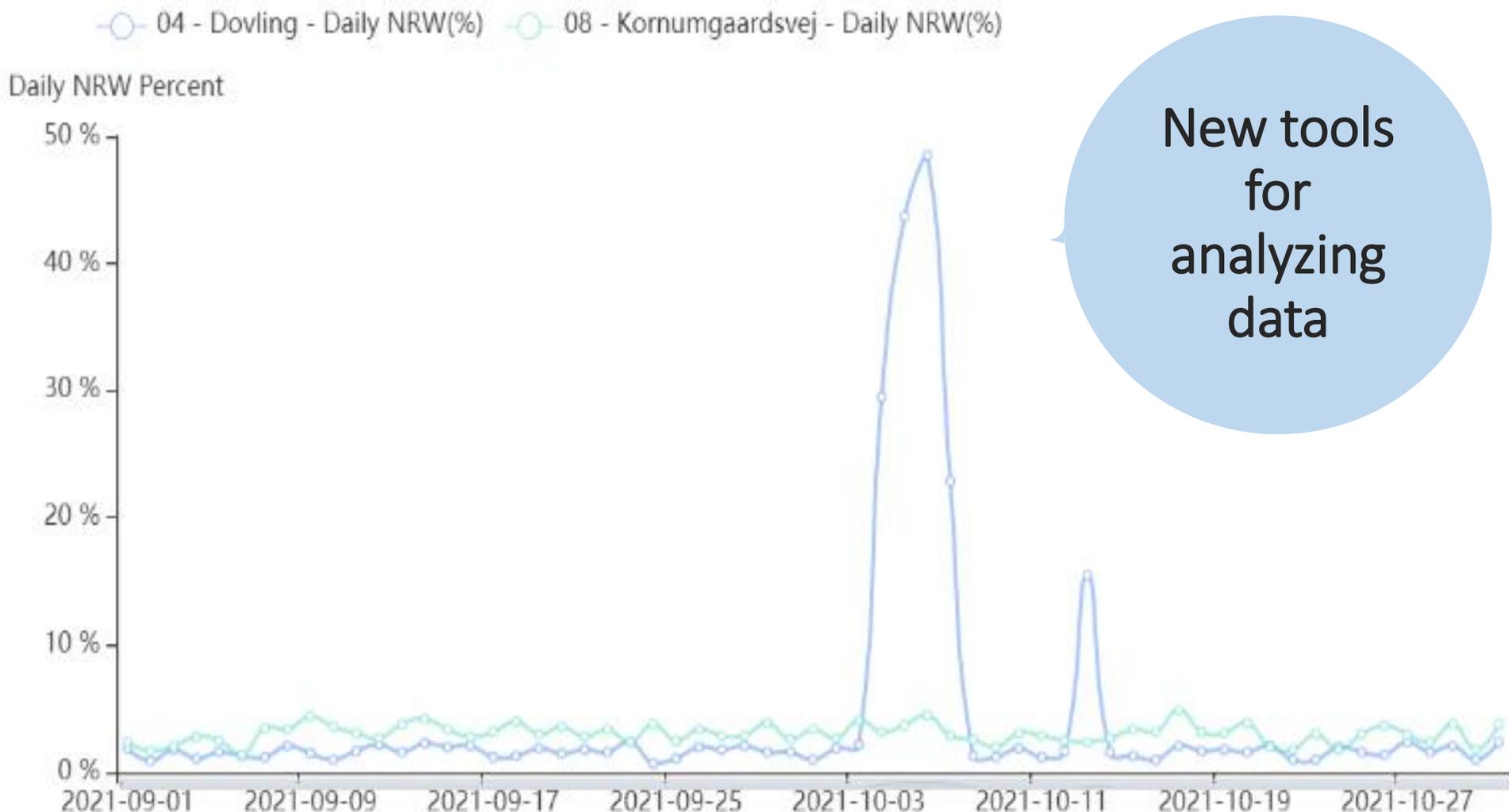
 **28** **Event**

 **Data** ▾

 **Asset** ▾

 **Report**

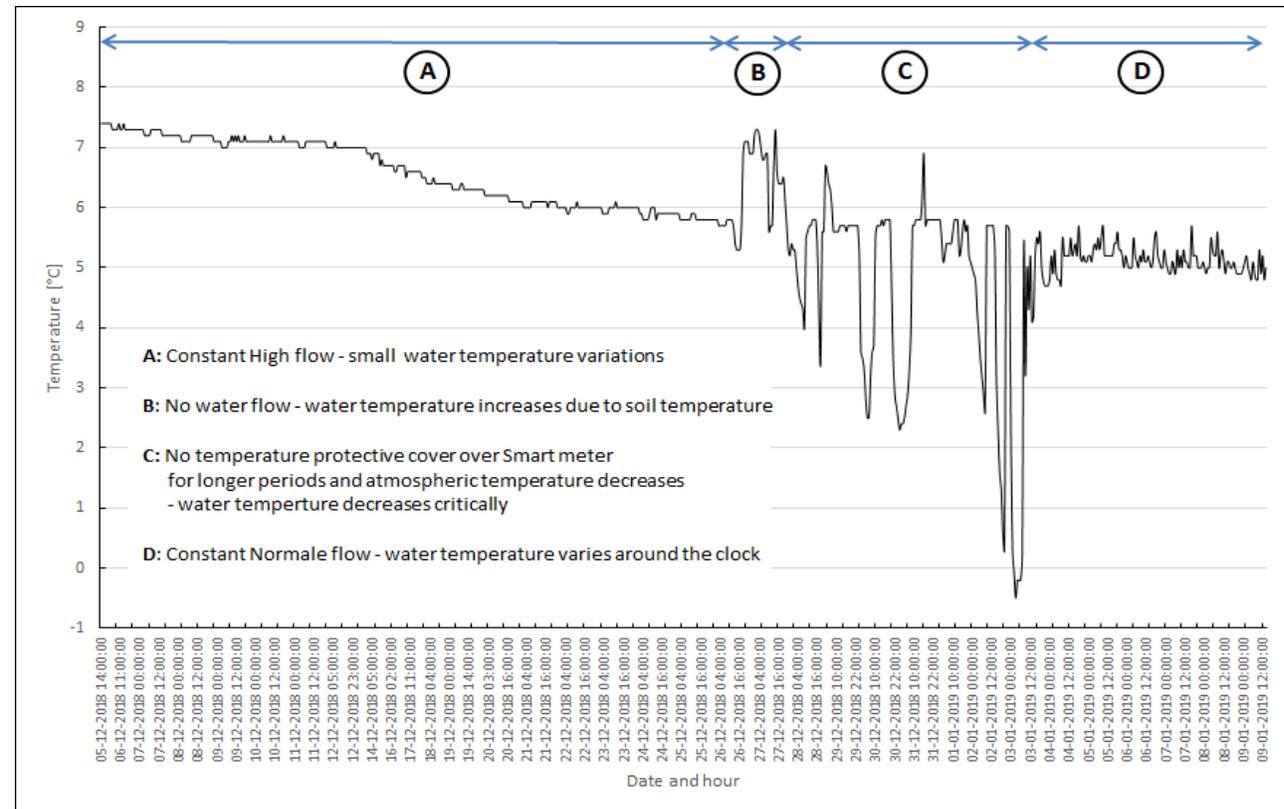
«



New tools
for
analyzing
data

Ideas for further improvements of LEAK365

- Use of data from night flow into DMA's and households
- Smart temperature: Predicting the exact location of a hidden leak by using AI working with water temperature data from meters and supply-pipes
- Incorporate data from regular water quality analysis (Bactiquant)
- Company synergy: Use data from sewage pumping stations



Example of temperature readouts from Smart Meter during different operational conditions.

Water loss – at customer

Leakage detection through self services



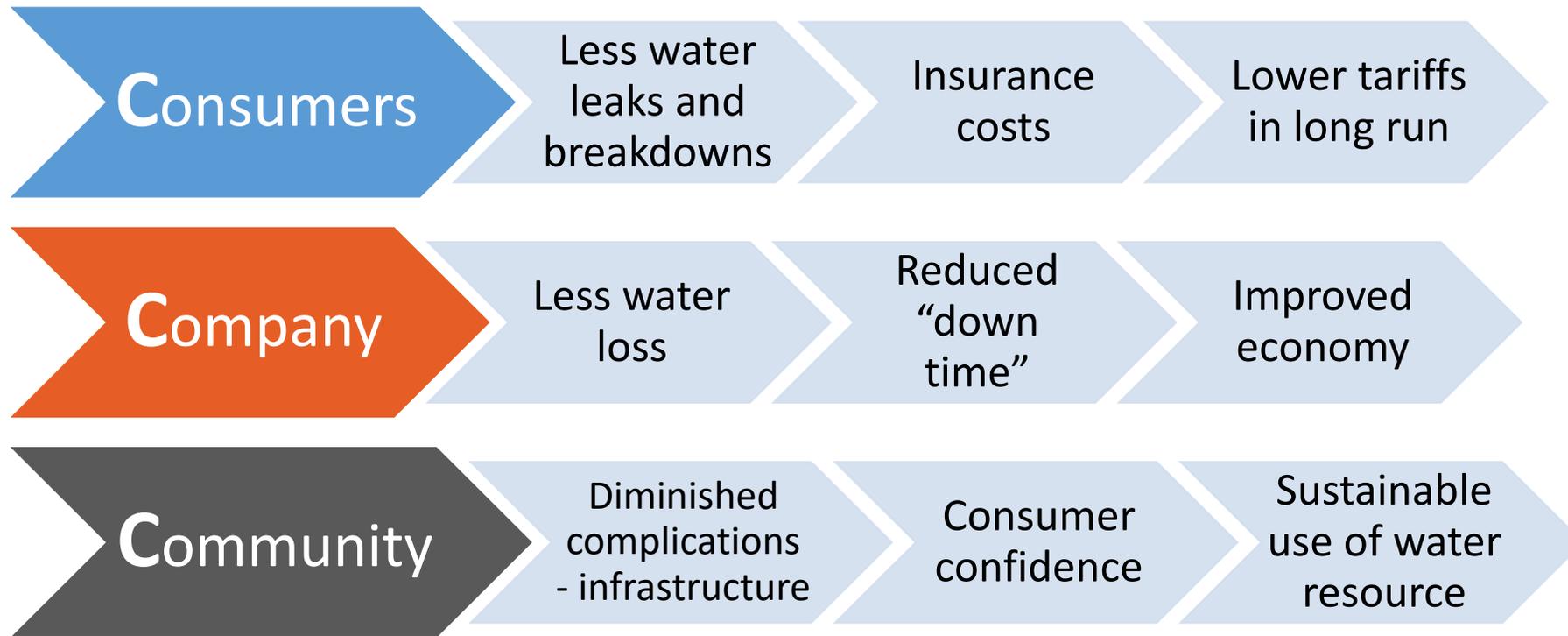
Dashboard at webpage



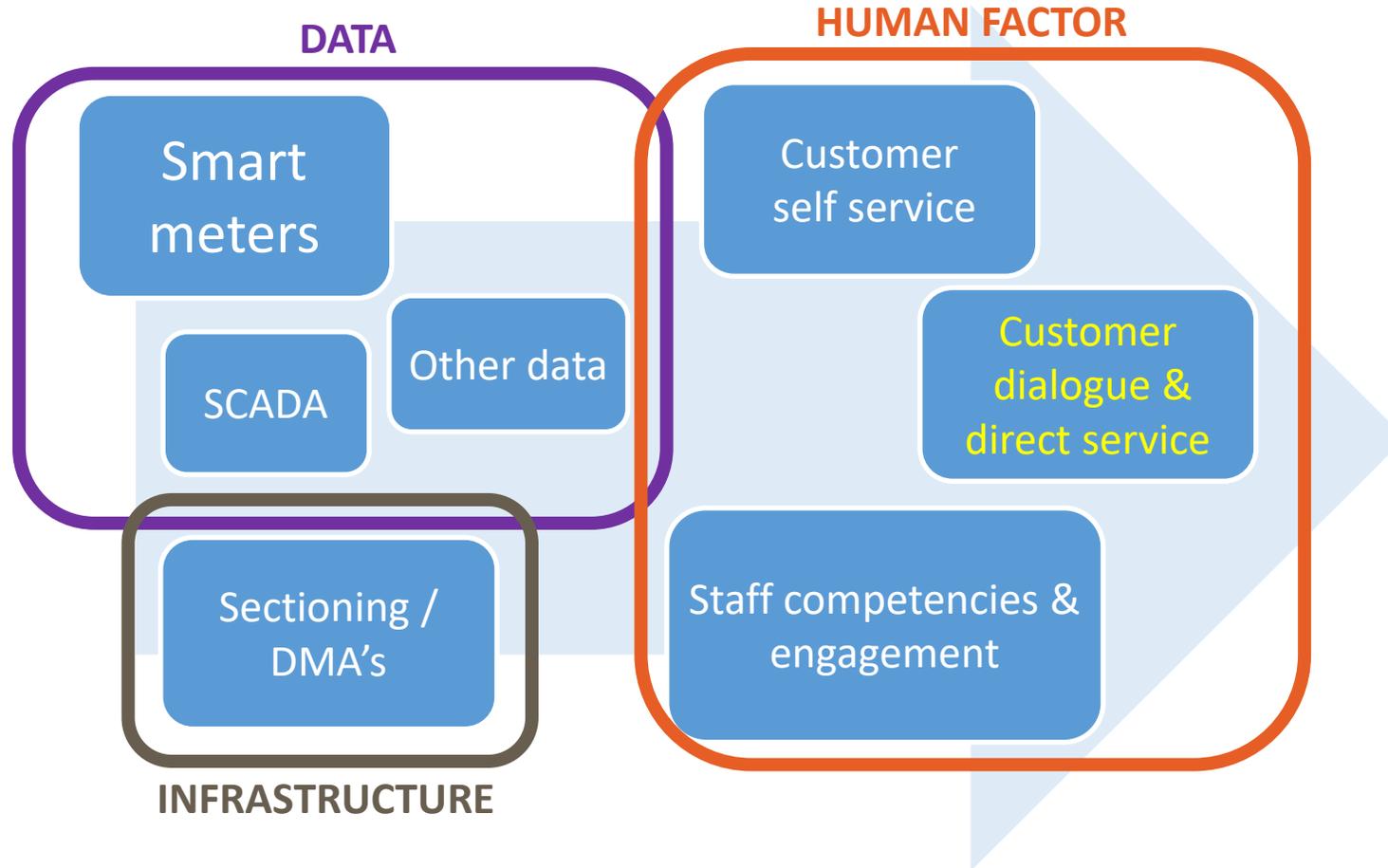
Phone apps



Value creation – “Triple C”



Leakage management strategy



Smart meters are more than billing..

they create added value!



Full Paper accessible at
www.bronderslevforsyning.dk

LEAK365: A Full Scale Digital Approach Towards Smart Water Loss Management

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Introduction

Gaining full control over water losses in network

Data from Smart Meters is the key resource for Digitized Water Leak Management

The Digitized Leak Management Strategy (LEAK365) at Brønderslev Water Company Ltd (BWC) is basically based on Smart Meter-Technology. LEAK365 has proven to be an effective, value adding tool for water loss management (WLM). Average water losses (Non-Revenue Water – NRW) in Danish water companies are around 8% (DANVA 2021). If the NRW exceeds 10%, it triggers an economic penalty from the state authority.

A new WLM-strategy was put into action in 2017. In the period from 2019 to 2022 the annual water loss is now stable around 5%. From 2022, a new fully integrated digitized WLM-system – an online GIS-based application - continuously “X-rays” the current leakage situation.

During the process of development and implementation of the new strategy, a lot of practical experiences and insights have been made as well as significant cost savings for both the BWC and the customers.

Facts about Brønderslev Water

- Water volume sold: 900,000 m³ / year
- Number of Meters: 6,500
- Number of Consumers: 16.000
- Water loss reduced: from 12% to 5%

LEAK365 is an integral part of the overall strategy for digitization of the company and it complies with EU Commission recommendations for good practices on WLM.

LEAK365

A new strategy for Water Loss Management

The Background

By 2022, approx. 16.000 customers equalling 6,500 meters are serviced by BWC. From the beginning of 2016, a series of grave and hard-to-identify leaks raised water losses from former times 5-8% of annual water loss to unexpected > 12% in 2017. One month the water loss exceeded 22%. See figure 1 and figure 2.

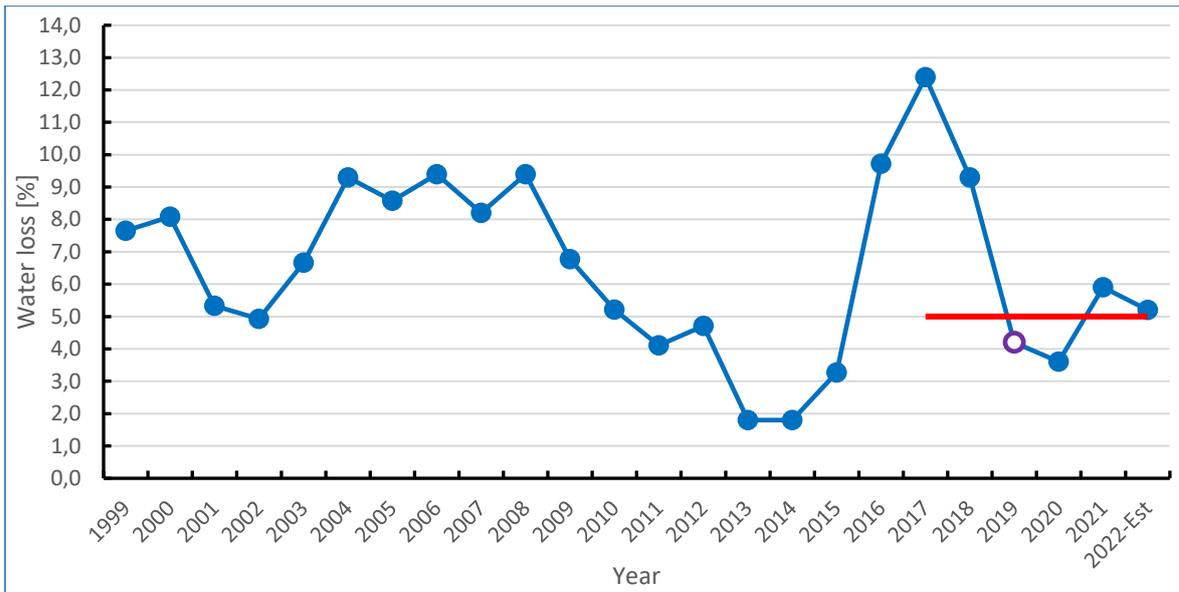


Figure 1: Yearly average water losses at BWC from 1999 to 2021. Water loss is calculated as Potable Water Volume input from Utility Treatment Works subtracted Billed Metered Consumption.

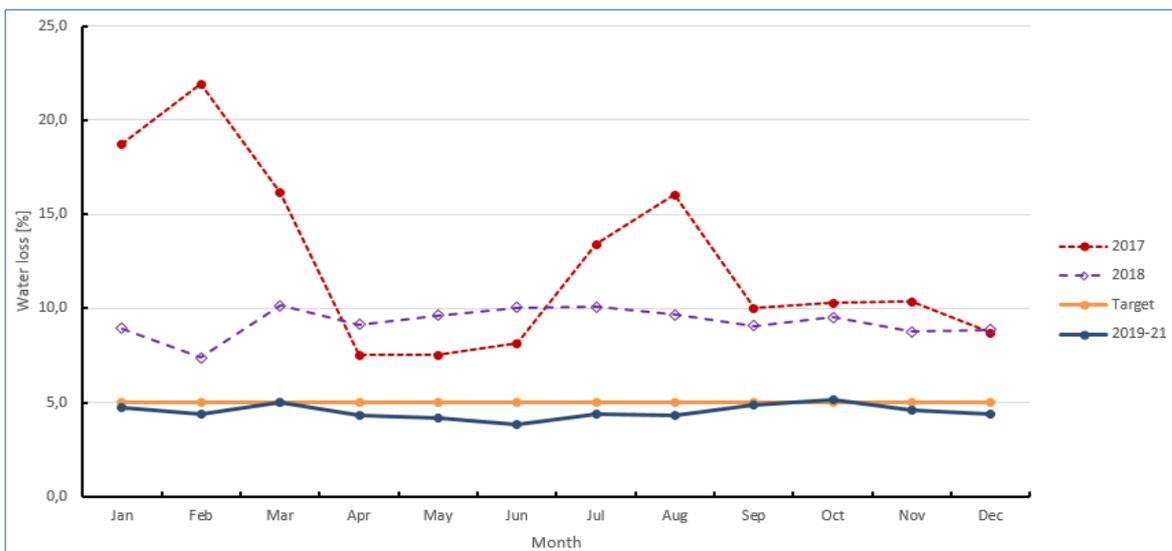


Figure 2: Monthly average water losses at BWC in from 2017 to 2021. The Water Loss is calculated as Potable Water Volume input from Utility Treatment Works subtracted Billed Metered Consumption.

Due to the unacceptable high water losses the Company in 2017 increased the efforts quickly to identify new leaks in the water distribution network based on current readouts from Smart Meters. Smart Meters inclusive of a new fixed network (remote automatic meter reading infrastructure) covering the complete area for distribution of potable water was installed in 2015.

Thus, in 2017 a new strategy and work plan was set into motion. The aim was to regain full control over the infrastructure and the water losses. A new ambitious fixed target for the annual water loss of less than 5% was also decided. In parallel, the already ongoing sectioning-scheme was accelerated. The subdivision of the entire water distribution network into unique and well-defined District Metered Areas (DMA's) was finalised in 2022.

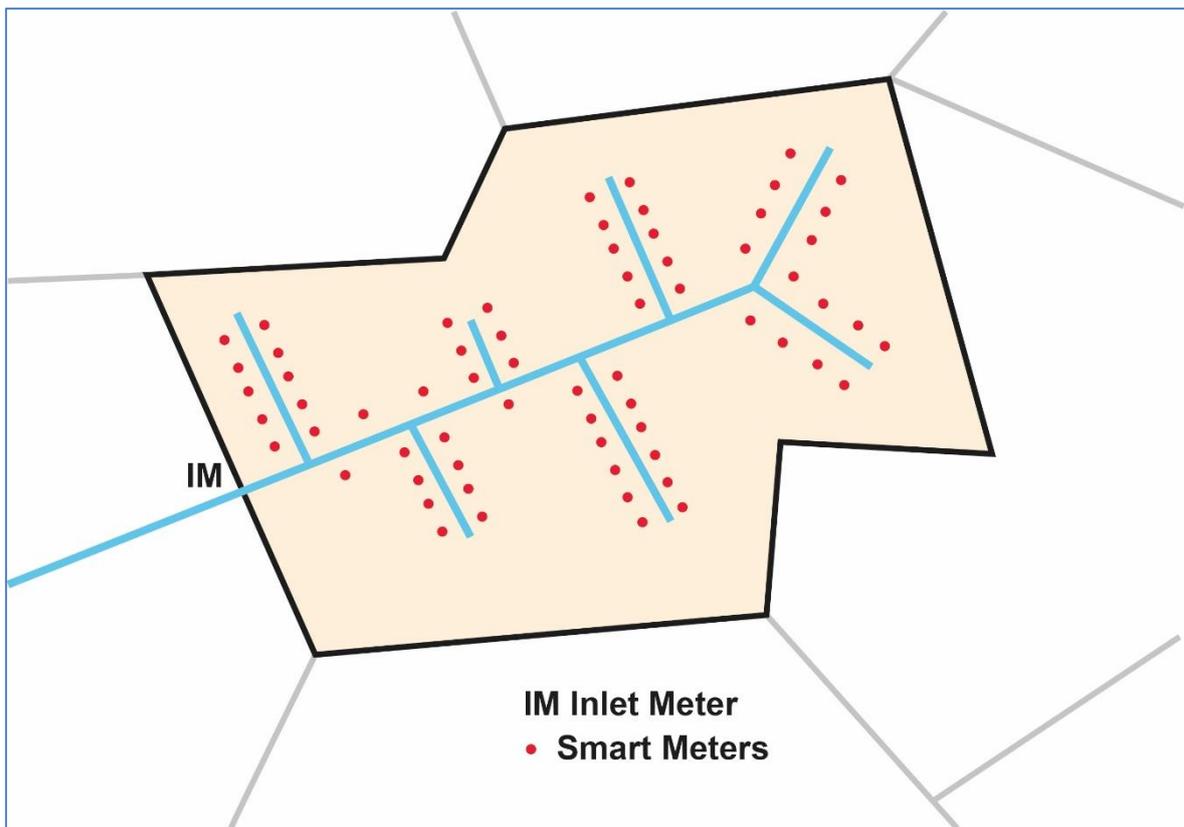


Figure 3: The principle of a DMA. The entire distribution network is divided into 22 independent and transparent DMA's. An Inlet Meter measures the volume of water delivered to the DMA, and the sum of the readouts from the Smart Meters represents in comparison the billed volume inside the area.

The Smart Water Loss Concept

Combined with data from the SCADA-system the LEAK365 automatically compares respectively the delivered and the sold volume in each DMA. The delivered volume is measured at the entrance of the DMA in a Bulk (Inlet) Meter connected to the SCADA System. The sold volume consists of the sum of the meter readings from each household Smart Meter connected to the specific DMA. See figure 3.

From 2022 a new integrated digitized system – accessed via a web-portal developed in cooperation with the Smart Meter-Supplier - continuously creates “X-rays” of the current leakage situation. Real-time data detects and estimates the specific water losses at each DMA 24/7/365. It is an automatic process with predefined algorithms and analytics which delivers 100% transparency of the performance of the infrastructure. The smart use of data, enhanced awareness and dedicated work have resulted in an average stable water loss in the period 2019-22 at 4.5 – 5.9% (ILI 0.1).

The result is an integrated Water Loss Management-concept named LEAK365. The key strategic elements are:

1. Installation of Smart Meters at full scale (since 2015)
2. 99,5% remote radio-based hourly readings of all meters (since 2019)
3. 22 distinct DMA's covering the complete supply area (since 2022)

4. Online 24/7 surveillance at the DMA's connected to a web-based GIS-Portal from Diehl Metering

The concept of LEAK365 will continuously be under development also in the future, but as of today the new strategy and the new GIS-application are fully established. The blend of technology, analytics and dedicated professionals will further bear fruits to sustainably reduce water losses for Brønderslev in future.

Online monitoring

A new GIS-application

The new water loss management application reports continuously its latest leakage levels through zone colour indicators in a digital map of the BWC water infrastructure. BWC defines green with a performance better than <5%, orange between 5 and 7,5% and red >7,5% of NRW. Historical values for each DMA are easily accessible, including consumption profiles, and advanced reports based on a specific period (weekly, monthly, annual water balance).

See figure 4.

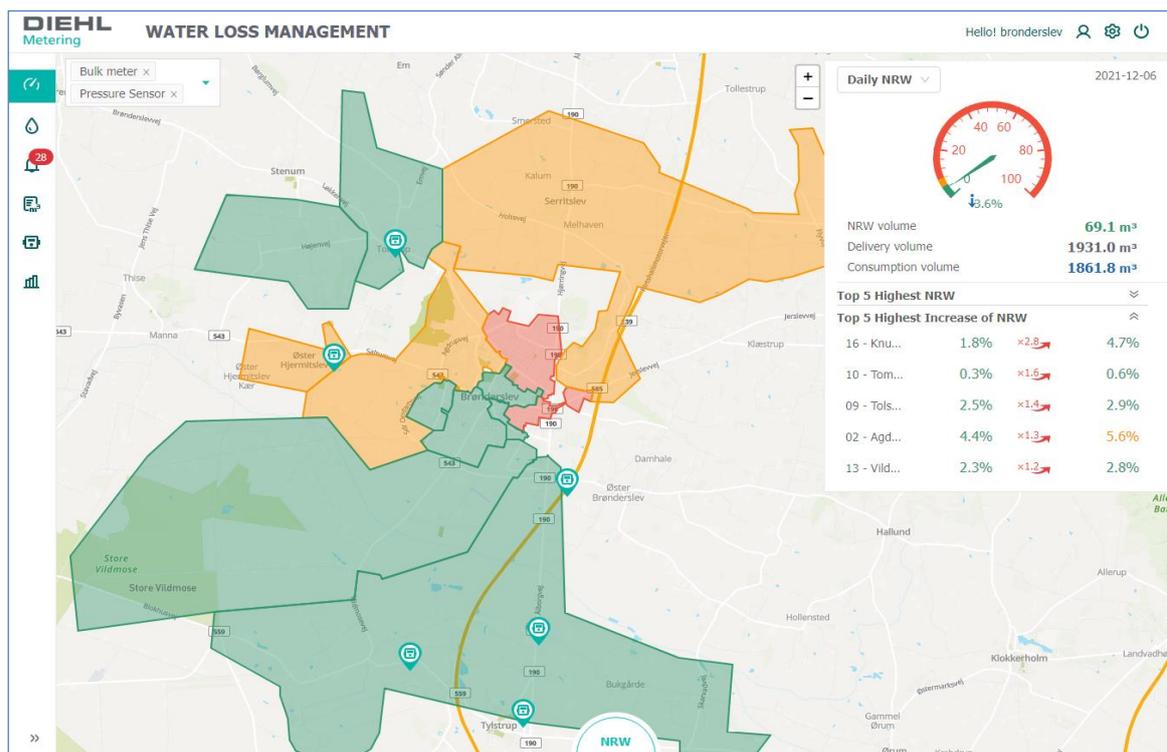


Figure 4: Digitized surveillance 365/24/7 at every District Metered Area (DMA) make quick follow up on anomalies possible. The GIS Portal offers a wide range of data drill-down facilities. The complete supply area is subdivided in 22 distinct DMA's/sub-DMA's. Every DMA has its own inlet Bulk Meter and takes it's measurements into correlation towards the many residential water meters (outlets). The system continuously, i.e. every hour, compares the amount of water delivered into the DMA versus the billed metered consumption.

Beside the continuous monitoring the application serves threshold alerts for certain anomalies in its specific DMA. It further delivers information through visualized granular history for water loss, delivered and lost volume, consumption including its historical profile

and behaviour, and its pressure. These features support BWC to track the progress of the general network efficiency and water balance reporting. See figure 5 and 6.

The sectioning of the complete distribution network has made it possible to successively identify in which DMA the water loss are highest - and hence the team can target their leakage-search efforts.

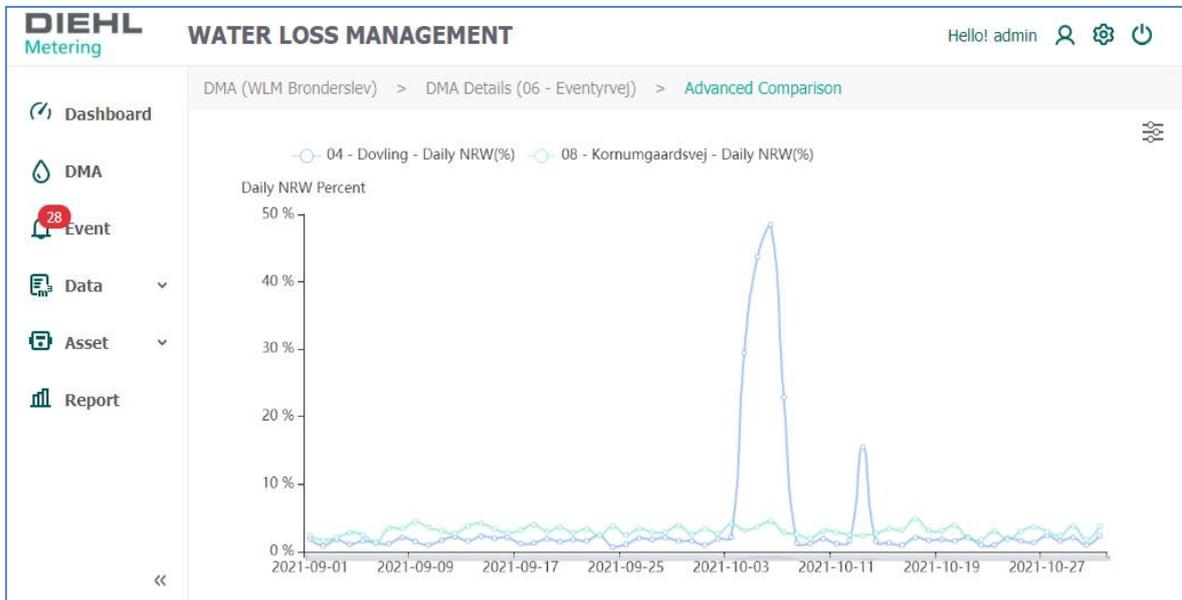


Figure 5: The application provides several different views of the analysed data. The above figure shows the performance of the DMA 4 and DMA 8 and demonstrate the easiness of detecting anomalies in the infrastructure. In fact DMA 4 detected two peaks out of the normal behaviour. As each DMA stands for the total sum of all households it represents an ideal monitoring of the entire supply network from the single Inlet to many of the hundreds household outlet meters.

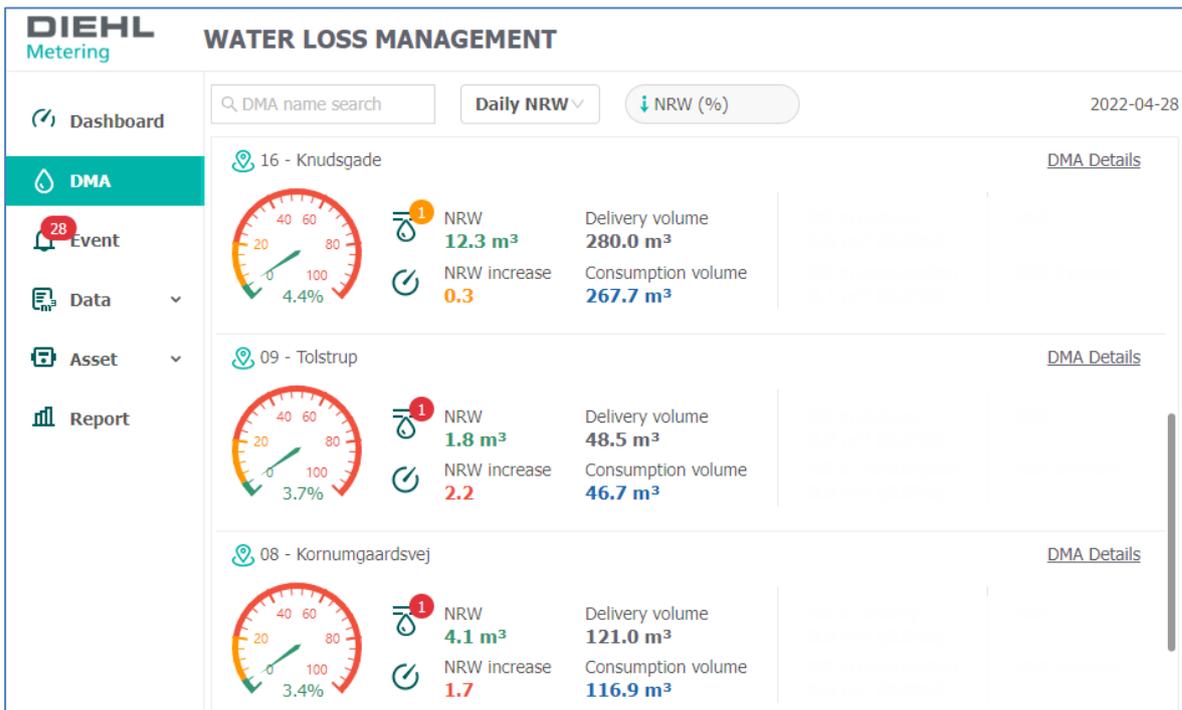


Figure 6: The GIS-application provides excellent possibilities to drill down in the data of each DMA.

Furthermore, the Company have provided a much appreciated extended “old-school” service towards the end-consumers, utilising the daily readouts to monitor deviating consumption i.e. potential leakages at the households. In severe cases we directly alarm and contact the consumers by mail or phone. Thus, water losses within the households are identified and stopped immediately resulting in less ruined furniture and floors etc. In addition, the household saves money on both the water and the sewage bill, as the latter bill in Denmark also is calculated on the basis of the consumption of potable water - i.e. the meter reading.

Empowering the Organization

The uptime-target for reading performance from the meters within 24 hours is 99.5%. As this aim turned out to be very demanding to reach, the process of implementation more practical parts of the strategy has given us a series of valuable experiences in trying to obtain the target.

Throughout the period, the relatively small water distribution team has worked purposefully to find water losses while developing and refining the use of data collection. Several practical experiences have been gained with the expansion of the remote meter reading fixed network in order to achieve a high degree of coverage and reduce the need for mobile drive-by catchment of meter-data, as well as the use of new covers for pits and strategic implementation of individual meter-pits outside each household during the ongoing renovations of the distribution network.

Rapid action and a focused organization are required. It is therefore not only a question of implementing the right technical solutions but just as much a managerial task and prioritization. A dedicated and motivated team responsible for the daily surveillance and operations is mandatory. Without this, many potential gains will be lost.

Additionally, BWC has linked the strategic goal of a maximum water loss of 5% to the SDG No. 6, Clean Water and Sanitation, to demonstrate, among other things, how the daily operations are related to and support the Sustainable Development Process and the green transition of the society. Furthermore, BWC uses LEAK365 to motivate and communicate the efforts to meet the SDG's, especially SDG no. 6 and no. 12 (Ensuring accessibility, sustainable water management, consumption and production). The Board of Directors since 2019 has approved incorporation of selected SDG's into the overall strategy of the company.

Implications and improvements for the future

The Outcome

The outcome of LEAK365 can be measured as a “Triple-C Benefit”:

- **C**ustomers face less severe breakdowns in the distribution system and quicker repair of leaks in domestic installations. In addition, cost for water losses, repair and insurance costs for covering ruined floors and spoiled household effects etc. are diminished and customer satisfaction increases.

- Community gains as new leaks are rapidly identified leading to diminished complications on infrastructure and reduction of external costs for repairing streets, boardwalks, pipes etc; traffic is bothered less. Water consumption is diminished
- Company gets lower OPEX and improved Asset Management through rapid identification of leakages, reducing unsustainable losses in terms of water, machine time, energy, repair costs and "downtime". It further protects the natural resource water and empower a sustainable future.

More innovative initiatives lie ahead

To ensure continued low water loss and at the same time secure and improve efficiency and effectiveness also in the future, new smart possibilities are continuously being investigated and evaluated for combining different data into even smarter and more integrated digital solutions.

- Night flow. Data from the SCADA-system continuously records the waterflow into each DMA, and for each DMA a limit for "minimum night flow" is defined, helping us to identify new leaks.
- "Smart Temperatures". We aim to use semantic modelling approach for precise prediction of water consumption. An example is the use of temperature data from the Smart Meters to set up a machine-learning algorithm in order to identify and localize new leaks within the DMA's even quicker based on unexpected variances in the water temperature in the distribution net. See figure 7.
- Water quality. BWC runs since many years an ongoing operating water quality monitoring-program called "Bactiquant" with regular analysis measuring the total bacteria in the distribution net. This knowledge helps us tracking and delineating pollution events caused by, among other things, leaks. A future ambition is to integrate these data in LEAK365.

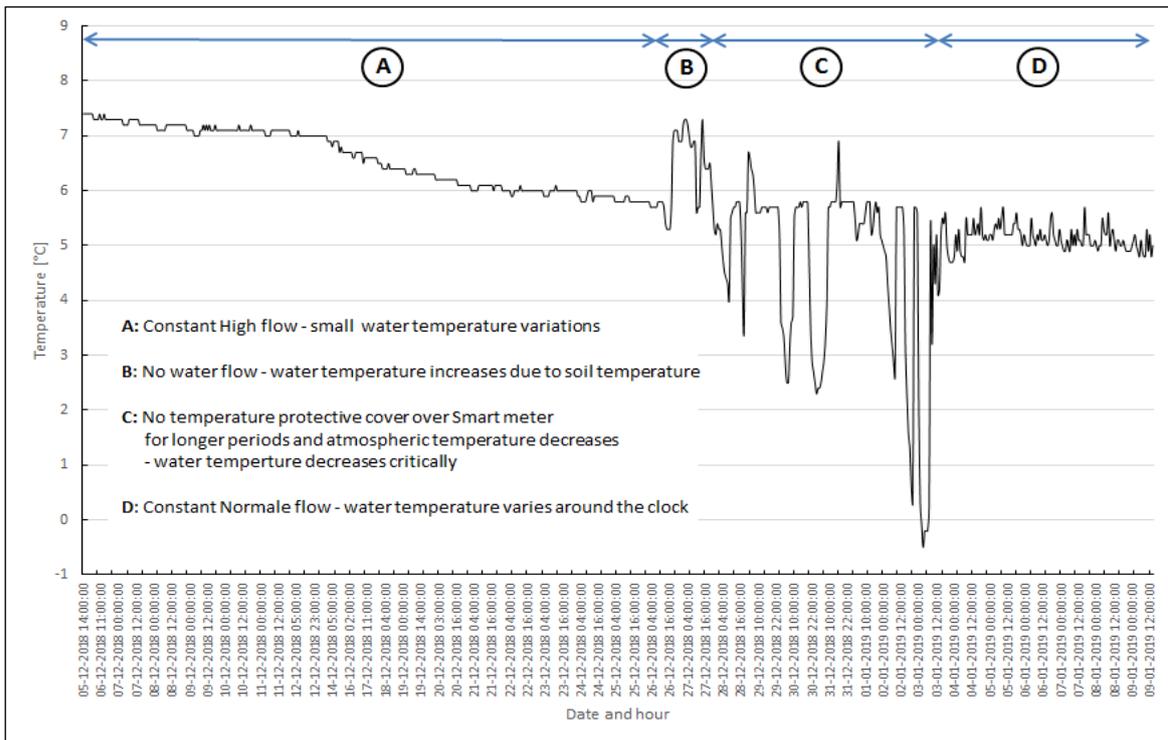


Figure 7: Example of temperature readouts from Smart Meter during different operational conditions.

REFERENCES

Report: EU 2015 *EU Reference document Good Practices on Leakage Management WFD CIS WG PoM*. Main report from the European Commission 2015.

Report: DANVA 2021 *Vand i tal (Water in figures)*. Yearly report from DANVA (Danish Water and Wastewater Association), 2021.

Journal: Kirstein, J.K, Høgh, K., Ryggard, M. & Borup, M. A semi-automated approach to validation and error diagnostics of water network data. *Urban Water Journal* 2019, DOI: 10.1080/1573062X.2019.1611884.