WATenERgy CYCLE
Urban water full cycle: from its source to its end-users and back to the environment

WP5 Joint Pilot Actions

Joint Del. 5.3 Transnational Pilot Actions

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PP3 - Municipal Enterprise for Water Supply and Sewerage of Kozani

PP4 - University of Thessaly-Special Account Funds for Research-Department of Civil Engineering

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WP5: Joint Pilot Actions

- Responsible partners:
  - **PP3 - Municipal Enterprise for Water Supply and Sewerage of Kozani**
  - **PP4 - University of Thessaly-Special Account Funds for Research-Department of Civil Engineering**
- Partners involved: ALL
- Budget: 885,021.23 €

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WP5: Joint Pilot Actions

WP5 includes Joint Pilot Actions

- Evaluation of the pilot case prior to the pilot actions. General presentation and description of the pilot case and the pilot action; identification of problems; water and energy audit (Water Balance and Pis); conclusion

- Evaluation of the pilot case after the pilot actions. Description of the pilot action implementation; water and energy audit after the implementation of the pilot action; discussion related to the new PIs values; problems encountered during the pilot action implementation; costs estimation; conclusions

- Summary report on the implementation of the pilot action (per partner).

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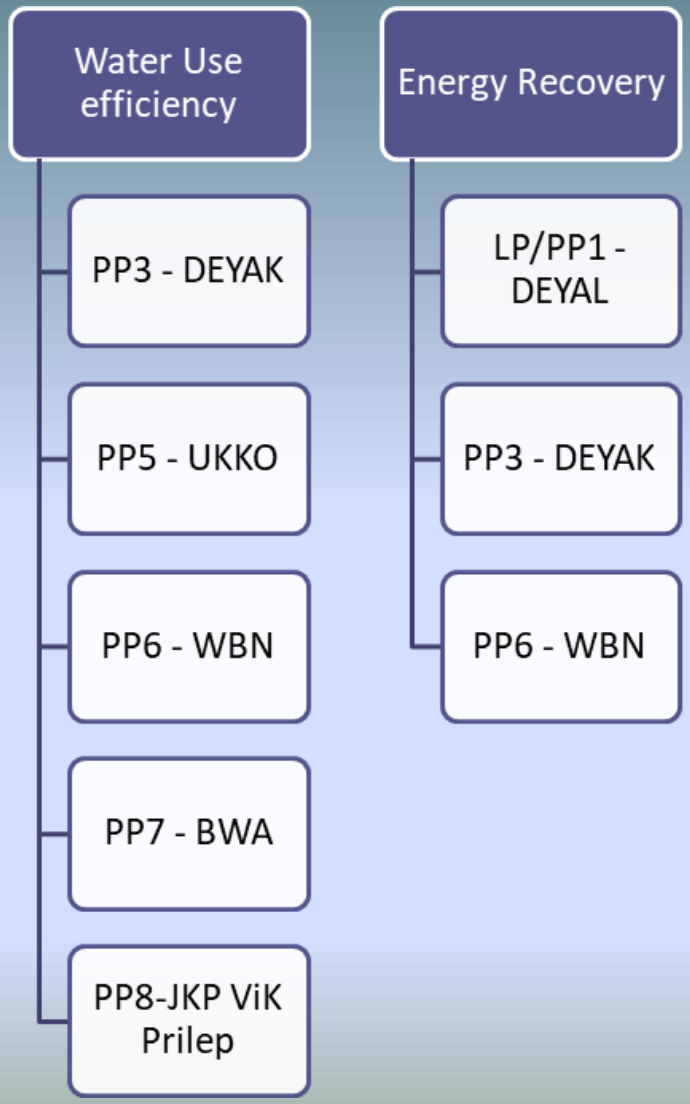
WP5: Joint Pilot Actions (1/2)

Beneficiary	Pilot action	Equipment	Feb-May 2018	June-Sept 2018	Oct 2018 -Jan2019	Feb -May2019	Jun-Sept2019
LP	Purchase & Installation of Energy Recovery System (three IE3 High Energy Efficiency Motors 250 KW two Inverters, one Softstarter: & Installation Service) at the Central Pumping Station for Larisa Water Utility (DEYAL)	three IE3 High Energy Efficiency Motors 250 KW two Inverters, one Softstarter: & Installation Service	Preparation of tender documents	Evaluation of the offers	Delay in evaluation process	Evaluation completed and the bidder is announced. Contract is to be signed	Contract signed on 8/7/2019 (contracted amount: 129.000,01€ plus VAT). The system is expected to be installed by 8/1/2020 at the latest.
PP3	Purchase of Energy Recovery System (ENR) and Automated Meter Reading (AMR) (700 AMR, 2 mobile reading systems, software, 3 ENRs DN150 & 2 ENRs DN200, training) for Kozani Water Utility (DEYAK)	700 AMR; 5 small hydroturbines	Preparation of tender documents	Launch of tender	A successful bidder was announced, and the contract is expected to be signed in the early days of March 2019.	The contract with the equipment supplier was signed in 26/03/2019. A part of the equipment has been stored in DEAK facilities at the middle of June but not installed. The equipment is expected to be installed by the end of August	Equipment installed. The first results are gathered.
PP5	Water leak detection car (equipped with facilities), Leak detection equipment flow analysis, aquaphone, analysis secorr 300. Water losses measurement database and decision support system. Korça City Zone Pressure no. 3 will represent the UKKO JSC study area that will be our pilot action area	Leak detection car with incorporated Water Leak detection Equipment	Tender almost finalized	Tender finalized. Preparation of documents for the physical transfer of the car	Training completed. Inspection started. First inspections revealed non detectable leaks. Problems due to low temperatures	Monitoring program: 1.Monitoring water consumption of pipes between two valves in 24 hours. 2. Monitoring water consumption in the main pipe about 800m between hydrants for 24hours. 3. Data analyzed. 4. Brpken pipes identified. 5. Repairs.	Monitoring process continues.

WP5: Joint Pilot Actions (2/2)

Beneficiary	Pilot action	Equipment	Feb-May 2018	June-Sept 2018	Oct 2018 -Jan2019	Feb -May2019	Jun-Sept2019
PP6	Purchase of equipment for water pressure management (PRVs) and smart water meters SCADA, PILLAR, software including training of personnel. Monitor operating parameters (pressure, flow, quality parameters). Water Balance calculation	· 700 AMR in DMA25 · PRV installation in DMA 15 · Electronic sensors for water quality monitoring · Electronic power generators	Tender issued in May 2018	AMR tender finalized. AMRs located in place. PRV tender is on-going	AMR tender is awarded - solving technical issues The tenders for the PRV, Sensors and Generators were awarded - wait for submission and installation of the goods	A. AMR system installation completed - results evaluation. B. The tender for the Smart PRV awarded and PRV installed. The provision and installation of logger with communication device is expected within June-July. C. The tender for the water quality sensors awarded and the sensor is installed and commissioned. Daily results evaluation. D. The tender for the electronic power generators was awarded and the generators are installed and commissioned.	A. AMR system installation completed - results evaluation. B.The tender for the Smart PRV awarded and the PRV installed. Logger installation with communication device completed in July 2019. C. The tender for the water quality sensors awarded and the sensor is installed and commissioned. Results evaluated daily. D. The tender for the electronic power generators awarded and the generators are already installed and commissioned.
PP7	Purchase of leak detection, monitoring and sewerage network inspection equipment. Training purposes	Water leak detection equipment to be used for training purposes	Preparation of tender	Tenderer successful. Equipment supplied: Ground microphone system, Portable ultrasonic flow meter and Manhole zoom camera	Division of the pilot actions into three smaller pilot actions each with its area of activity. Installation of loggers in WSS Blagoevgrad (March 2019)	Installation of the portable flow meter on the entry point of water supply for the populated area. The pressure loggers were installed in several key points over the network (high, middle and low points) and noise loggers were installed over a whole street where we believe there might be leakages.	
PP8	Purchase of leak detection system and measuring equipment, GIS software for “Water supply and drainage”. Water losses measurement database and decision support system	GIS software and leak detection system and measuring equipment	Preparation of technical specifications	Preparation activities Tender procedure preparation	Procurement for the GIS software and to purchase defect detection equipment published and by the end of March we expect to sign the contract	Procurement published and evaluation completed for Intelligent Networking Solution (contract signed with D.O.O Skopje for the purchase of GIS and defect detection equipment). We have organized one training for handling the equipment and one training for introducing the	

WP5: Joint Pilot Actions – Water or Energy Efficiency?



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DEYAL pilot action

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DEYAL pilot action: Municipality of Larissa

Municipal District	Cities and villages	Population (2011 census)
Larissa municipal district	Larissa city	144,651
	Amfithea	33
	Koulouri	250
	Terpsithea	1,992
Giannouli municipal district	Giannouli	7,885
	Falani	3,987
	Dasohori	624
Kilada municipal district	Kilada	628
	Amidgalia	336
	Eletheres	520
	Koutsohero	327
	Loutro	332
	Mandra	512
	Rahoula	514

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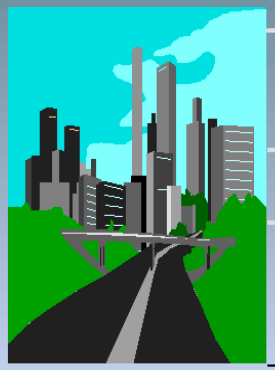
DEYAL pilot action: water supply



17 Km

13Khm

8Km

City of Larissa

GIANNOULI (5 Drillings)
Depth 100 m
Supply 1200m3/h

AMPELONAS (7 Drillings)
Depth 170 μέτρα
Supply 1800 m3/h

DENDRA (5 Drillings)
Depth 180-210 m
Supply 2000m3/h

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DEYAL pilot case

Purchase, installation and operation of electromechanical equipment for the improvement of the central pumping station of the DEYAL

Budget: 129.000 euros (VAT not included) – part of the financing is through own funds

Basic objective: Improvement of energy efficiency of the central pumping station through out the combination of more efficient operation, energy saving and more rational management of the drinking water supplied through pressure management system of the specific pumping station.

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DEYAL pilot action: Pilot action - General Description

Implementation phases:

A. Uninstallation of the 3 existing systems

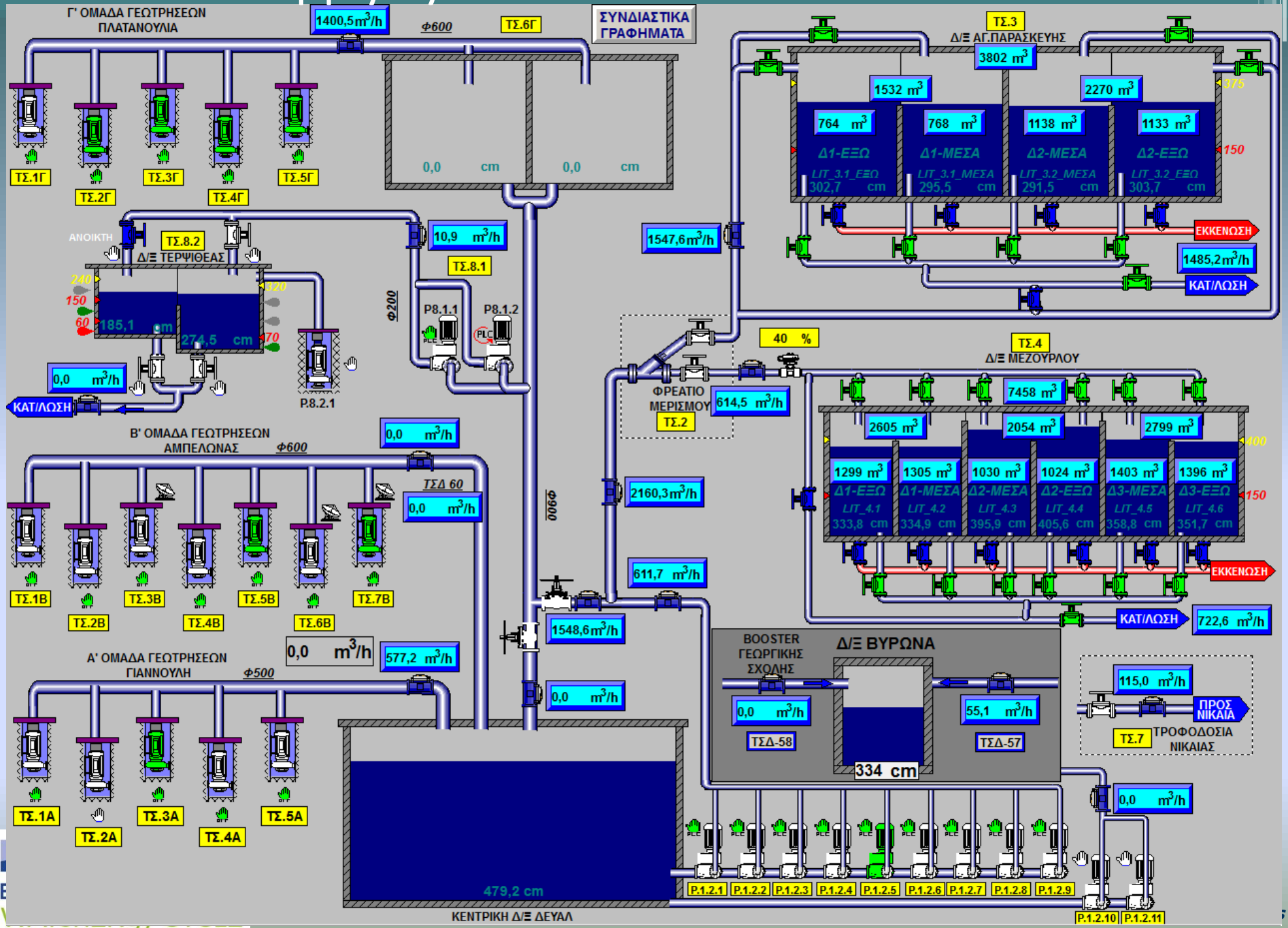
B. Installation and connection of the 3 new high energy efficiency units

C. Installation of the 3 speed controllers

D. Replacement of the central pump automation program and pump function parameters based on measured pressure values, at the point where the depressant water pipe meets the gravitational water pipe from Platanoulia, as well as the characteristics (level, consumption) measured in the reservoirs of Agia Paraskevi and Mezurlo.

E. Displaying a new operation model at the SCADA system

The Water Supply System of DEYAL



DEYAL pilot action: Central Pumping Station

- In the central pumping station of DEYAL there are nine (9) surface pressure systems (motor – pumps).
- Their role is to assist in the supply of the two main reservoirs of the city of Larissa
- These units have a power of 250 Kw and they give 600 M3 / h - 80 m

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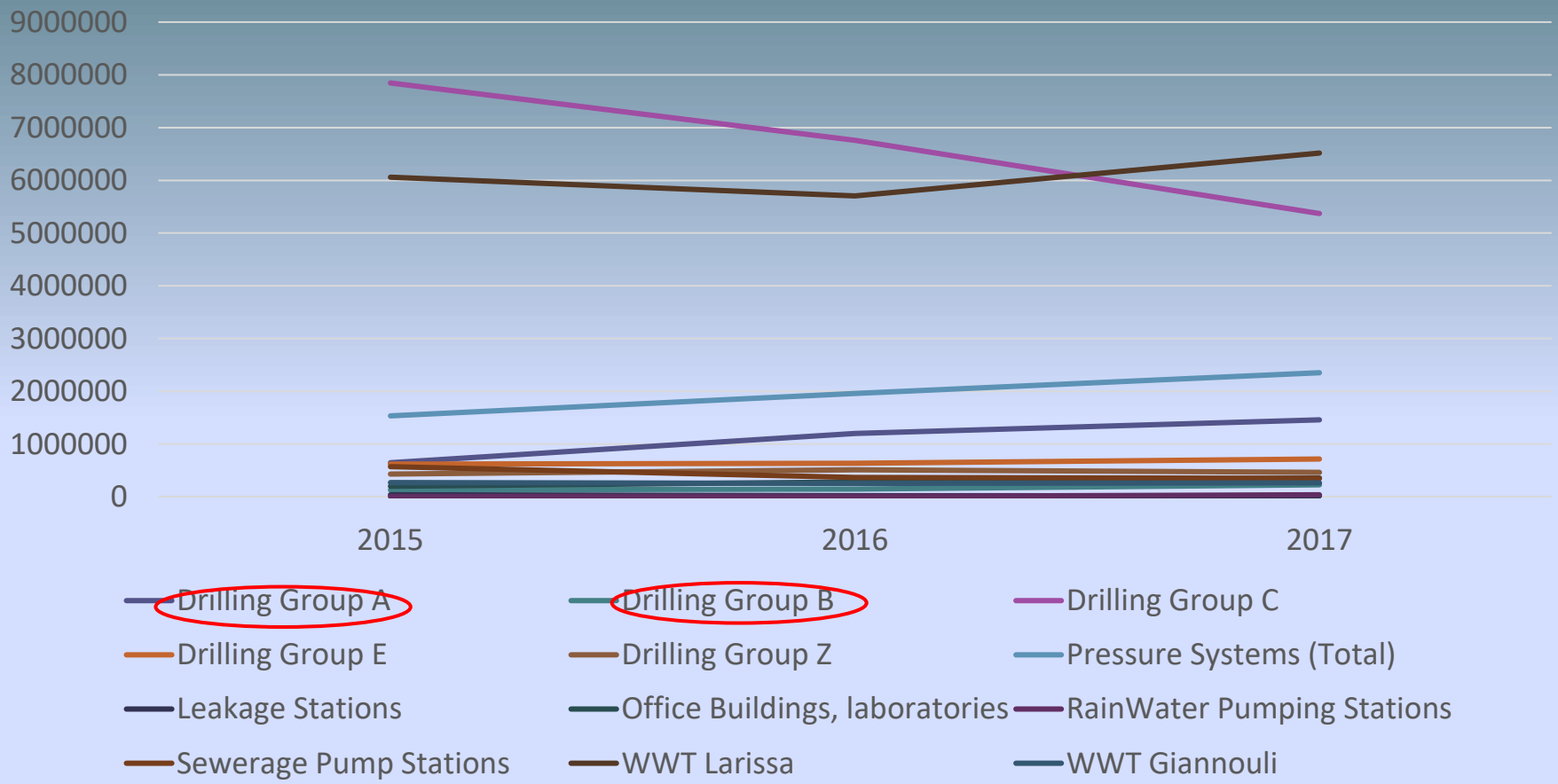
DEYAL pilot action: Pumping energy consumption (KWh)



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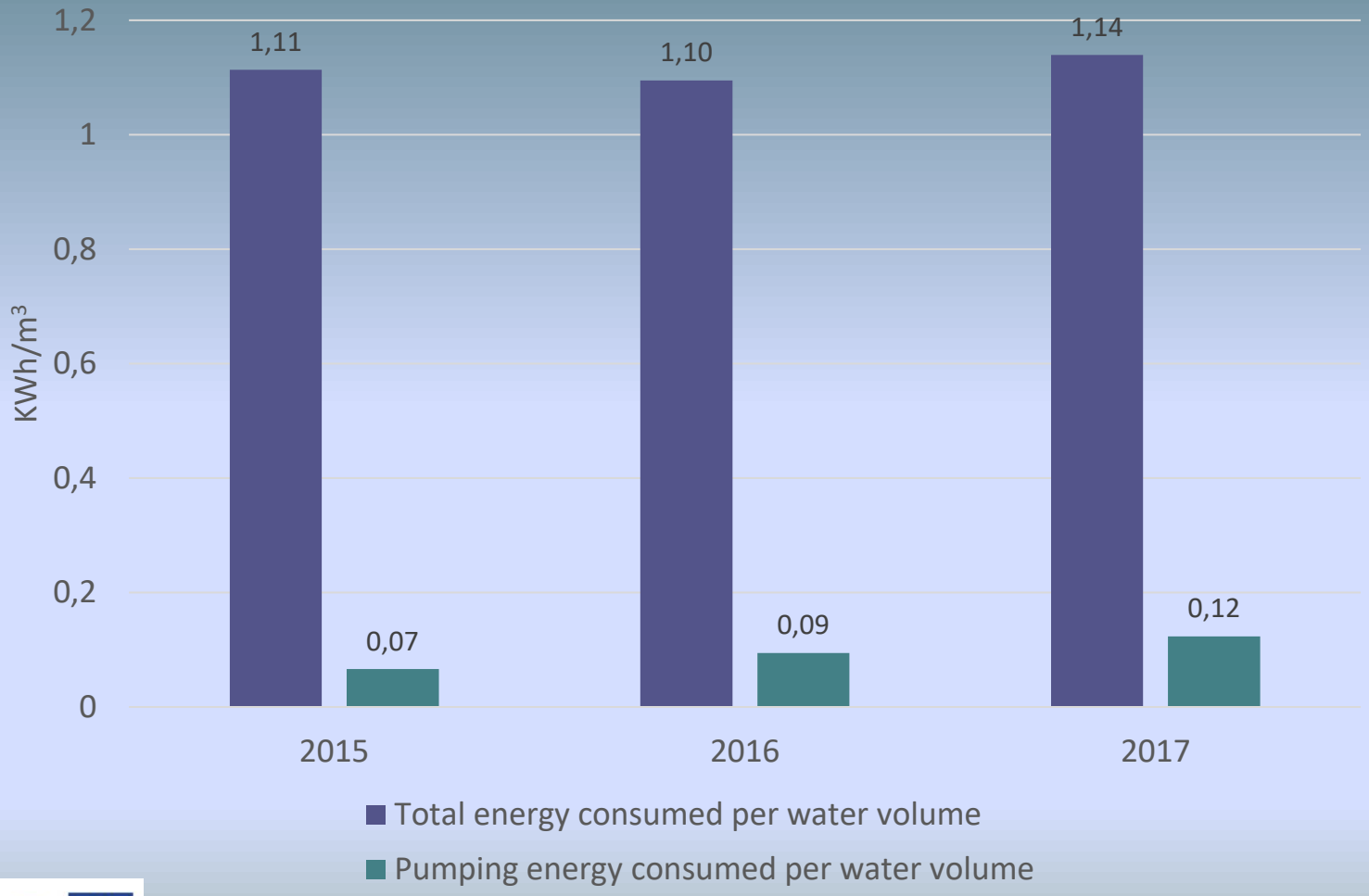
DEYAL pilot action: Total & pumping energy consumption per water volume (KWh/m³)



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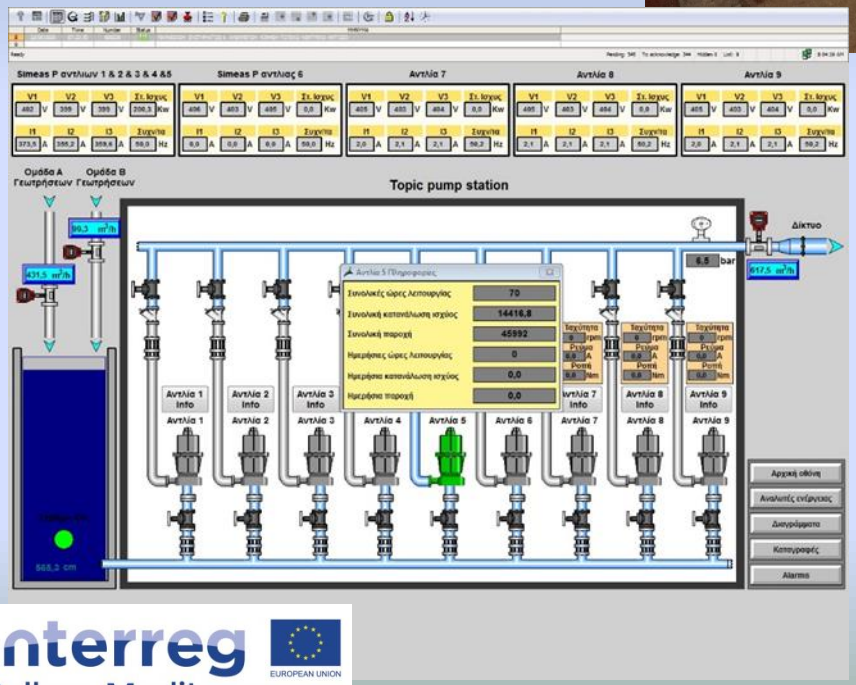

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DEYAL pilot action: results

No	Days in operation	Pump	Operation hours (h)	Mean Daily energy consumption (KWh)	Energy cost (€/kWh)	Pumped volume of water (m^3)	Mean Pump supply (m^3/h)	Maximum Average Daily Benefit (€/days)	Current Average Daily Benefit (€/days)
13	**68**		**1213**	**3224**	**0,13**	**788608**	**11597**	**106,96 €**	**65,58 €**
1	**08/07/20**	1	234	48128	206	149201	638	0,32	**22,07%**
2	08/07/20	5	244	49951	205	155894	639	0,32	
Old pumps group			**478**	**98079**	**205**	**305095**	**638**	**0,32**	
3	08/07/20	7	248	40491	163	164687	664	0,25	
4	08/07/20	8	243	40062	165	156963	646	0,26	
5	08/07/20	9	244	40578	166	161863	663	0,25	
New pumps group			**735**	**121131**	**165**	**483513**	**658**	**0,25**	

DEYAL pilot action: results

- After 68 days in operation, these 3 new pumps saved 65,58 €/day, or 23.936 €/year
- In case all pumps were of new type, the savings would have been equal to 106,96 €/day, or 39.040 €/year
- energy cost per pump decreased by 22.07%
- Cost of pumps installation: 129.000 € + VAT.
- The depreciation of the equipment takes place within 129.000 / 39.040 = **3.30 years**.

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DEYAL pilot action: Lessons learnt

- The replacement of old high-energy pumps with a new type of inverter pumps is a no risk implementation.
- The results showed that the installation of this equipment is worthwhile and should take place in all pumping stations.
- It is proposed to be installed inverter type pumps in external water supply networks throughout the country.
- The depreciation of the equipment takes place within 3.30 years, which means it is a very profitable investment.

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DEYAK pilot action

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PP3 - DEYAK
PILOT ACTIONS FOR WATER MANAGEMENT

PILOT ACTION 1 - AMR:
IMPLEMENTATION OF AN AMR SYSTEM

PILOT ACTION 2 – SMALL HYDRO-TURBINES:
INSTALLATION OF 5 SMALL HYDRO-TURBINES

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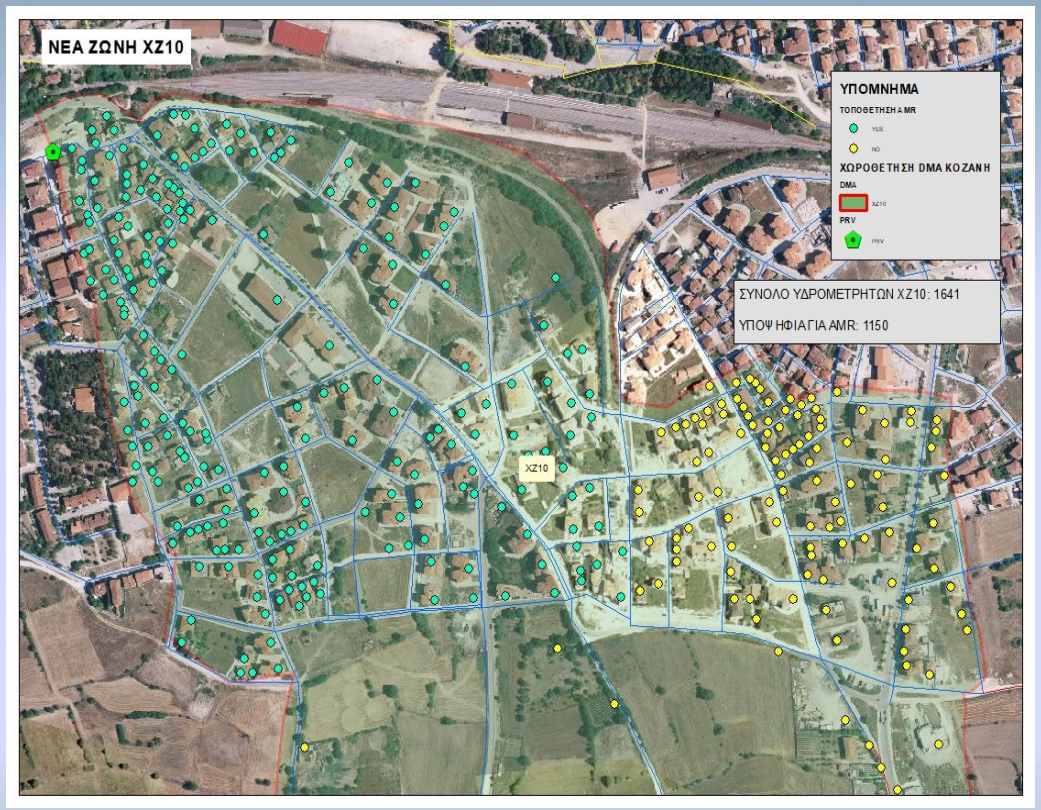
PILOT ACTION 1 - AMR

1. Introduction: Pilot Area Description

- This pilot DMA is in the low zone of the water supply network of Kozani.
- Its boundaries are shown in Figure 1.
- DMA's data are listed in Table 1 that follows.



Pilot area (2017 base year)

- Total population served = **3,462**
- Total area covered (Km^2) = **0.433 Km^2**
- Total pipes' length (Km) = **9.696**
- Mean altitude (m) = **672.9**
- Mean operating pressure (atm) = **4 atm**
- Types of pipes (material, diameters, lengths) =

MATERIAL	DIAMETER	Length (m)
PVC	63	7,428
PVC	75	165
PVC	90	575
PVC	200	1,529
		9,697

- Age of pipes (per material, diameter)

MATERIAL	DIAMETER	AGE
PVC	63	20
PVC	75	20
PVC	90	20
PVC	200	20

- No. of service connections = **235 (1,154 water meters)**

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2. Specification of the problem

- The System Input Volume (SIV) of a water supply system is divided into 2 groups, the revenue, and the non-revenue water. With the term non-revenue water (NRW) we refer to the water that has been produced and input in the water supply system, but it does not manage to give Revenue to the utility. The NRW volume is divided in:

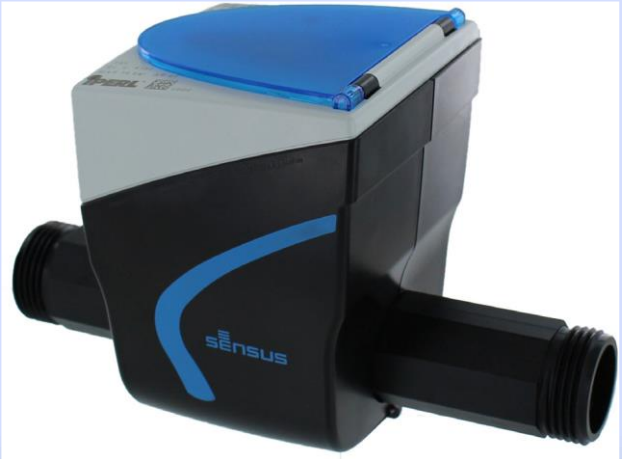
  a) **unbilled authorized consumption** (Unbilled Metered Consumption & Unbilled Unmetered Consumption),
  b) **apparent losses** (Unauthorized Consumption, Customer Meter Inaccuracies and Data Handling Errors) and
  c) **real losses** (leakage problems).

- By installing AMRs in the pilot DMA's water supply system (Pilot Action) the apparent losses from customer meter inaccuracies and data handling errors **were expected to be minimized**.
- A total of 700 AMPs was installed in the pilot DMA of Kozani, replacing 700 water meters. **82 old technology water meters remained connected to the system**, continuing to measure water consumption along with the new AMRs. Simultaneous water metering of old water meters and AMRs would demonstrate the deviations of the measurements of the two consumption-recording systems (**water meter under-registration**).

3. Equipment description

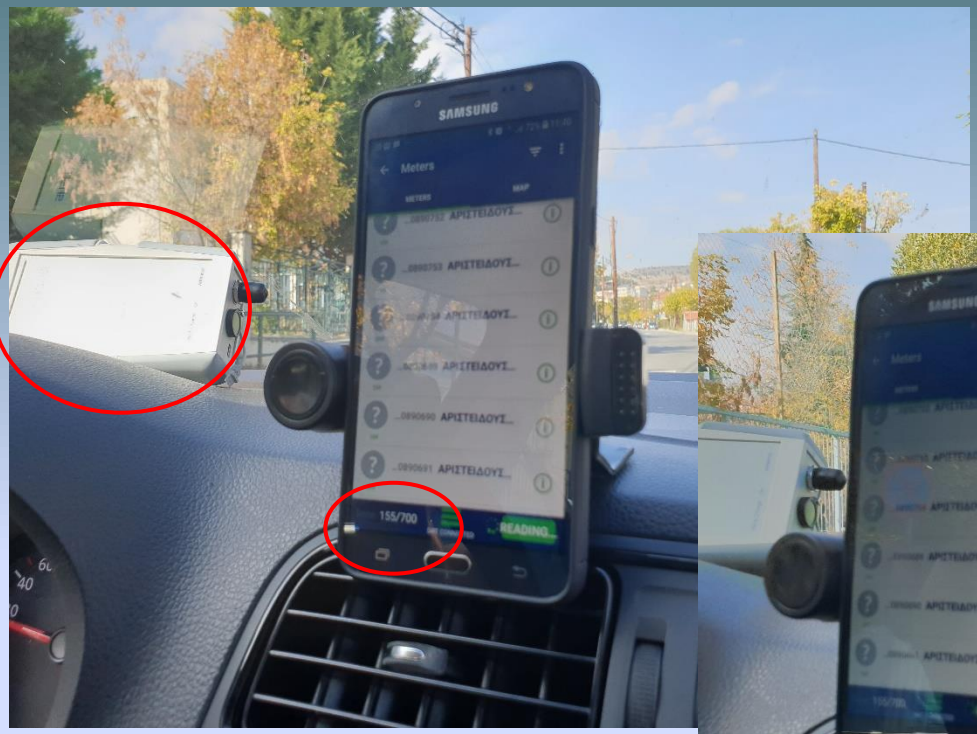
- Using a fixed AMI communications network (such as Sensus FlexNet™), iPERL can help identify potential issues, such as leakages in the network, enabling the water utility staff to address them quickly. This equipment offers unrivalled, sustained R800 measurement accuracy for all sizes from DN15 to DN40 over its expected 15 year operational life when used for clean potable water:

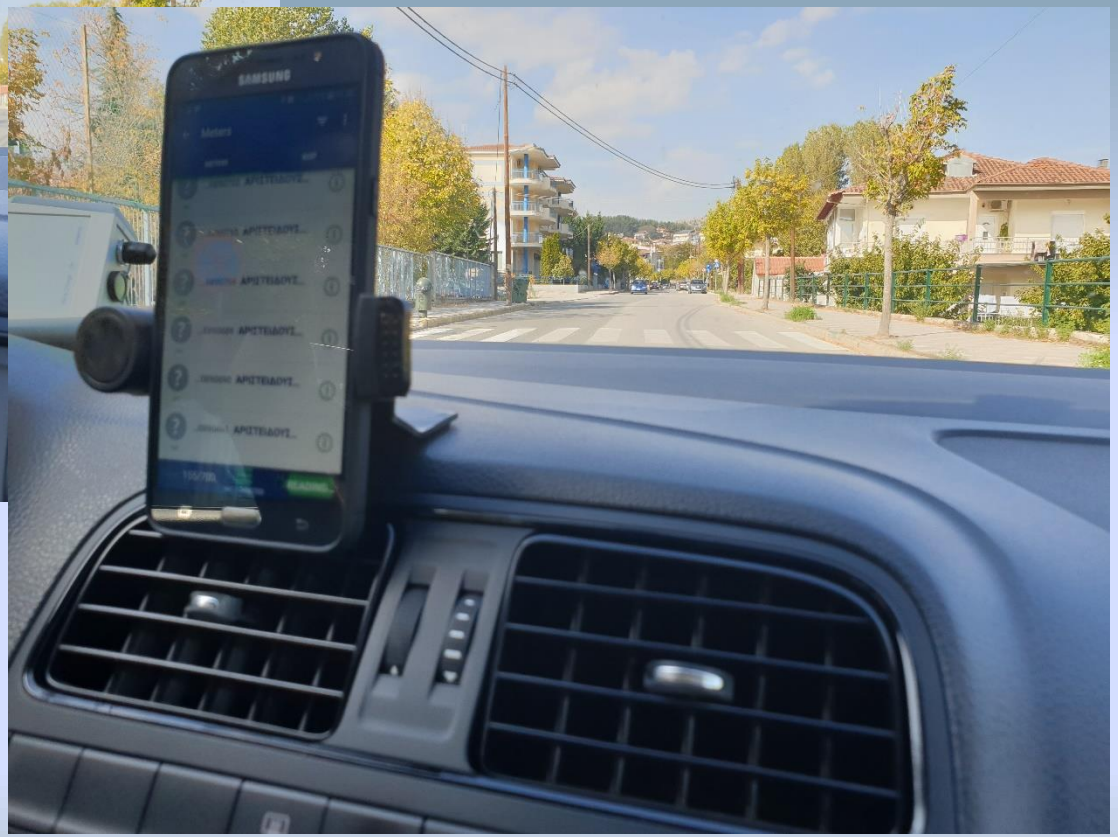
- Operating ambient temperature range of +60 °C down to -15 °C, provided that a minimum water flow rate of 100 litre / hour is ensured to prevent freezing
- A water temperature range of +0.1 °C to +50 °C (70 °C special variant)
- Water pressure up to 16 bar



3.1 Equipment Installation

3.2 Readings of the water meters





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4. Obtained Results

- 700 AMRs were installed in the pilot DMA of Kozani, replacing 700 Conventional Water-Meters (CWMs). 82 CWMs remained connected to the supply system, recording the water consumption along with the AMPs, in order to demonstrate the deviations in these two water consumption recording systems.
- To avoid biased conclusions, the CWMs that remained connected to the system were chosen according to their age, with such an analogy, to be representative of all the ages of the water meters in the pilot DMA.
- We also took into consideration, that the Consumption of the 82 CWMs were in (m^3) and the Consumption of the AMRs are in (lt).
- The water balance was recalculated.

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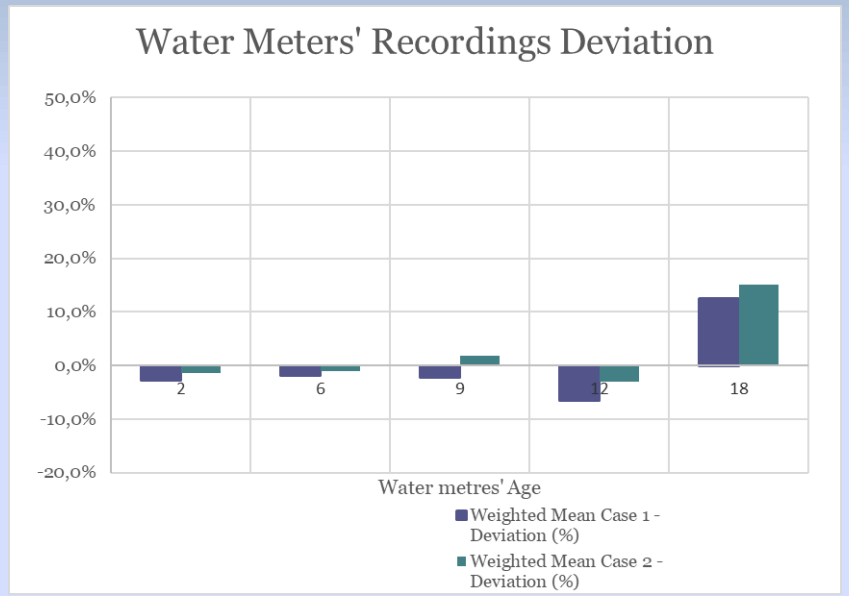
4.1 Statistical Analysis

Case 1 & Case 2 weighted deviation per group of aged water meters.

Age	Weighted Mean Case 1 - Deviation (%)	Weighted Mean Case 2 - Deviation (%)
2	-2,79%	-1,34%
6	-1,93%	-1,13%
9	-2,26%	1,88%
12	-6,50%	-3,00%
18	12,55%	15,00%

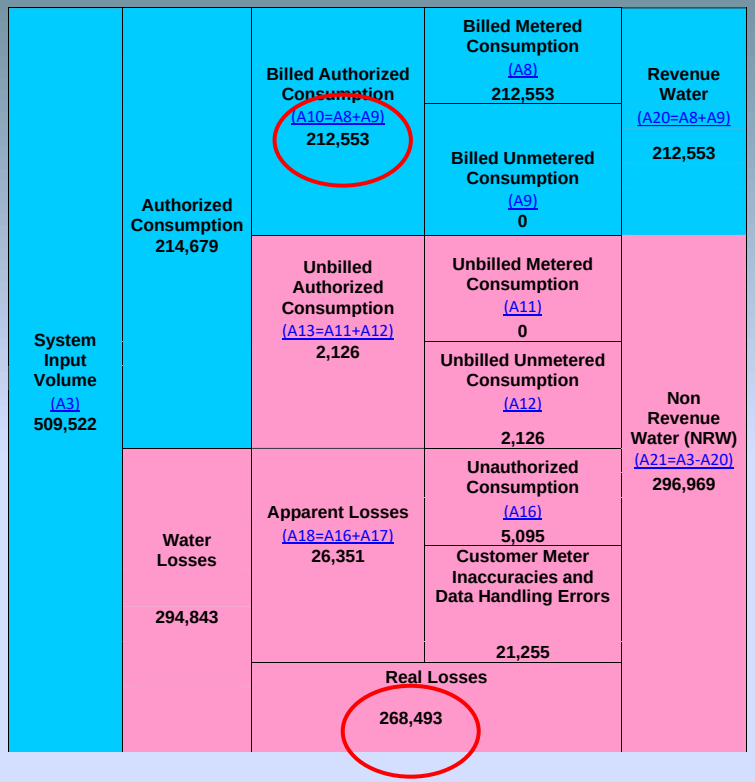
Comparison of Case 1 & Case 2 weighted deviation



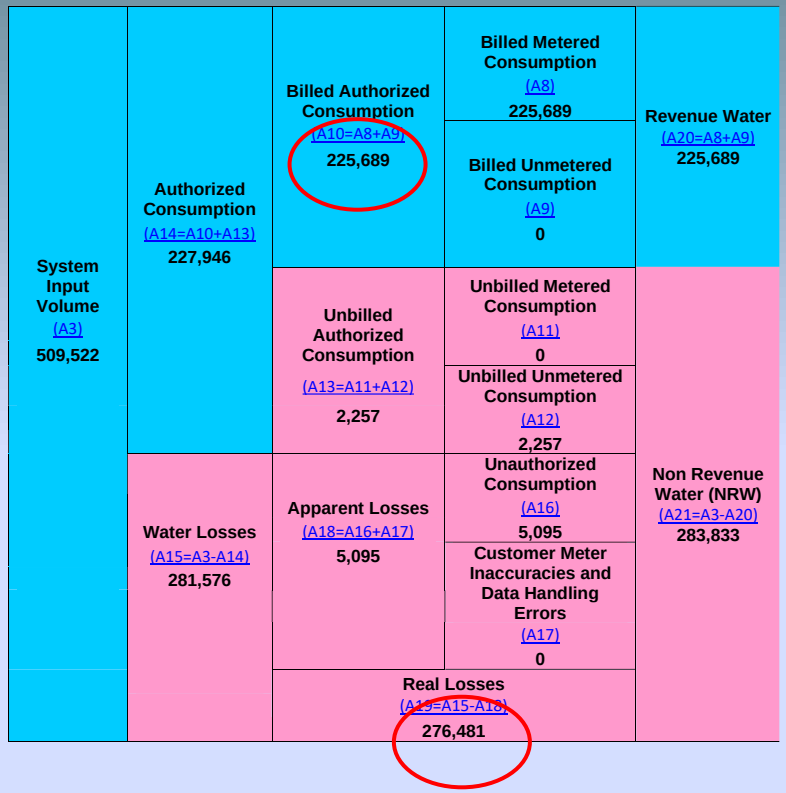
Case 1: rounding of liters to cubic meters downwards.
Case 2: rounding of liters to cubic meters upwards.

5. Water Balance Recalculation

Ex ante Water balance (2017) of pilot DMA.



Ex post Water balance (2017) of pilot DMA.



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6. Conclusions

- AMR installation did not lead to a reduction in real losses but to a reduction in apparent losses. The adjustment of the terms of the water balance modified the terms of the water balance, therefore the volume of real losses is also changed.

- The benefit from the water volume that was invoiced is approximately equal to 34,489 €. At present value, the depreciation of the equipment takes place within 3 years.

- Water meters older than 18 years recorded an under-registration between 12,55% and 15,00%. This means that due to the depreciation in a short time, their installation is very efficient and economically advantageous.

7. Lessons Learnt

- AMR should be installed throughout the network. In this way a) staff who will be released and employed in other tasks and b) metering errors and water meters under-registration will be zero, thus reducing the apparent losses.

- There was only concern about the wireless transmission of metering data. Many solutions such as permanent data transponder and Nb-IoT (Narrow-band Internet of Things) solution were taken into account for a future solution.

- Finally, the solution of the drive-by collection of measurements was chosen. The pilot application helped DEYAK to think about the solution of the transmission of information and to come up with the next applications.

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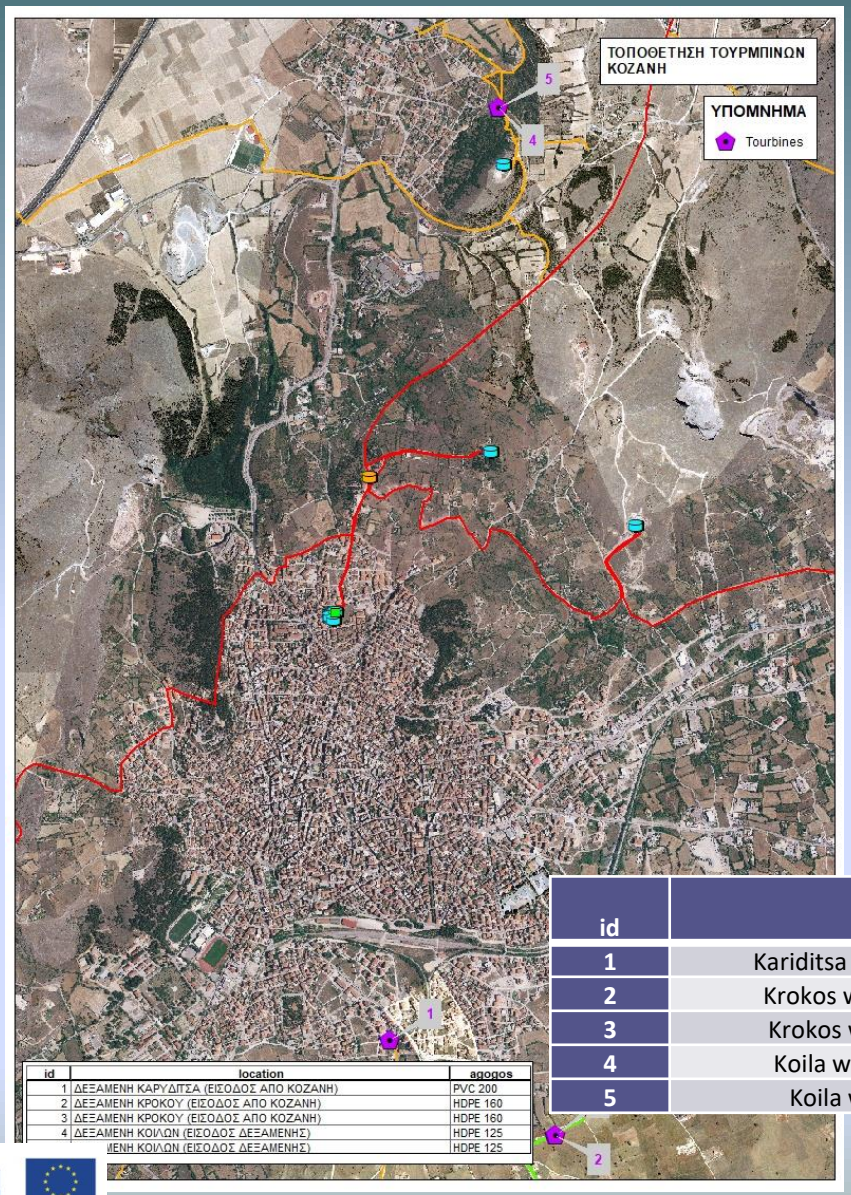
PILOT ACTION 2 – SMALL HYDRO_TURBINES

Location & characteristics of the 5 small hydro-turbines



id	location	agogos
1	ΔΕΞΑΜΕΝΗ ΚΑΡΥΔΙΤΣΑ (ΕΙΣΟΔΟΣ ΑΠΟ ΚΟΖΑΝΗ)	PVC 200
2	ΔΕΞΑΜΕΝΗ ΚΡΟΚΟΥ (ΕΙΣΟΔΟΣ ΑΠΟ ΚΟΖΑΝΗ)	HDPE 160
3	ΔΕΞΑΜΕΝΗ ΚΡΟΚΟΥ (ΕΙΣΟΔΟΣ ΑΠΟ ΚΟΖΑΝΗ)	HDPE 160
4	ΔΕΞΑΜΕΝΗ ΚΟΙΛΩΝ (ΕΙΣΟΔΟΣ ΔΕΞΑΜΕΝΗΣ)	HDPE 125
	ΔΕΞΑΜΕΝΗ ΚΟΙΛΩΝ (ΕΙΣΟΔΟΣ ΔΕΞΑΜΕΝΗΣ)	HDPE 125

id	location	Pipe (diameter / material
1	Kariditsa water tank (inlet pipe from Kozani WDS)	PVC 200
2	Krokos water tank (inlet pipe from Kozani WDS)	HDPE 160
3	Krokos water tank (outlet pipe to Krokos WDS)	HDPE 160
4	Koila water tank (inlet pipe from Kozani WDS)	HDPE 125
5	Koila water tank (outlet pipe to Koila WDS)	HDPE 125

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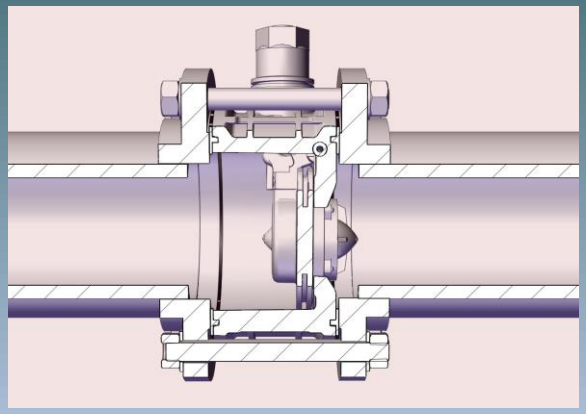
Equipment Installation



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Obtained Results

- The energy production according to technical specifications is 10W/20W (Vs flow)
- In Koila installation the energy production is 18 W/h
- After 1 year operation the energy recovered per hydrospin would be 157 kWh/year
- The group of 5 devices regarding the pilot case would be 785 kWh/year.

Software version: 1.01.13						
Firmware version: 2.2.3.9						
Unit serial: 0404201600000534						
RPM [1/min]	Charger Current[A]	Load Current[A]	Voltage[V]	Generator Power [mW]	Battery Voltage [V]	Battery Current [mA]
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,045	8,09	5	8,11	-188
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,045	8,09	5	8,11	-188
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,045	8,09	5	8,11	-188
0	0,001	0,044	8,09	5	8,11	-184
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,047	8,09	5	8,11	-197
0	0,001	0,048	8,09	5	8,11	-201
0	0,001	0,047	8,09	5	8,11	-197
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,046	8,09	5	8,11	-192
0	0,001	0,048	8,09	5	8,11	-201
0	0,001	0,048	8,09	5	8,11	-201

UKKO pilot action

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Water Supply and Sewerage Company
Korçë / ALBANIA

Vision

We try our best to be the LEADING water supply and sewerage utility in Albania and in the region.

Mision

- Provide sustainable, secure, sufficient and proper-quality water to all existing and new clients in new service areas, in line with regulations in force, under the motto "CUSTOMER IS EVERYTHING TO US".
- Ensure quality collection, treatment and disposal of wastewater and sewerage to safeguard public health and in compliance with national environmental regulations.

Objectives

- Improve the financial performance to move towards full cost recovery, including actual and future loan repayments and monetary contributions into the capital reserve fund
- Reduce NRW (losses) from the current 25% in 2019 to 18% by 2022
- Increase bill collection rate to 95%

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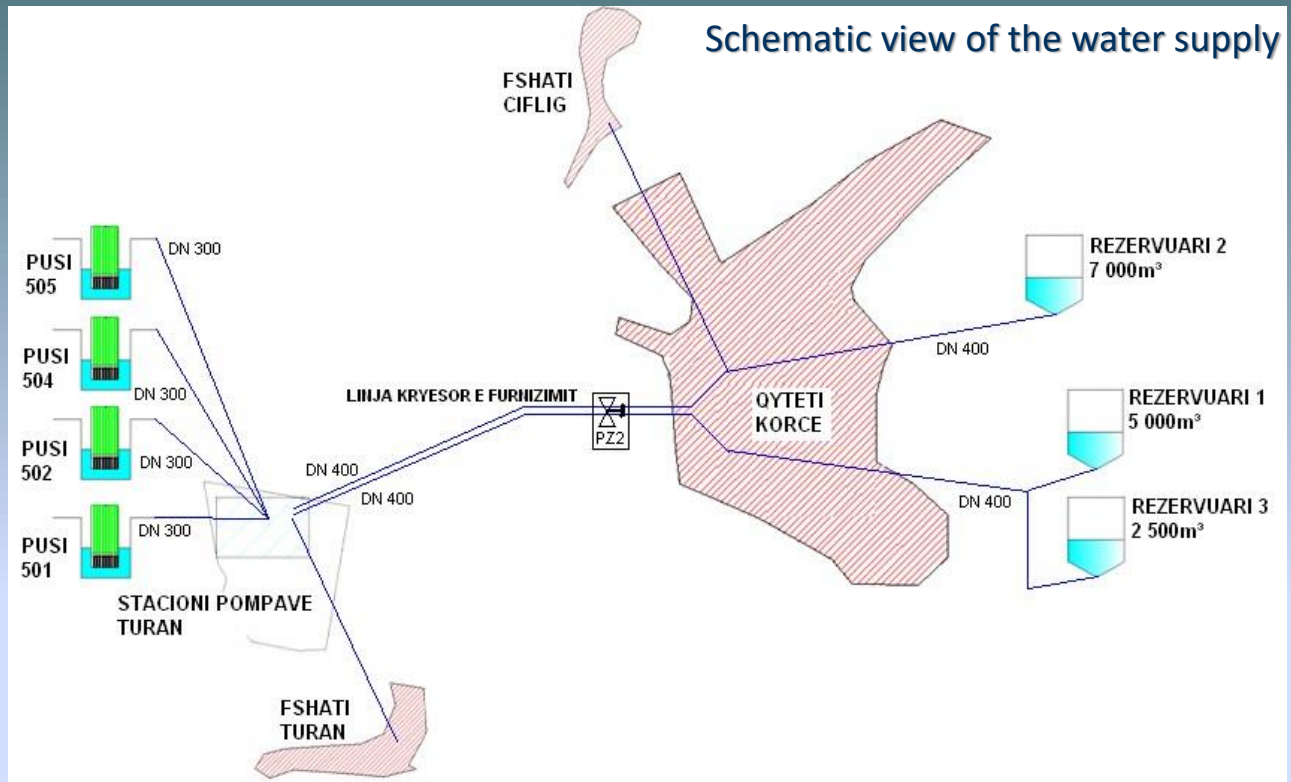
Schematic view of the water supply



UKKO URBAN

Total number of clients

23’700

UKKO RURAL

Total number of clients

5’300

Pressure zone # 1

Total number of clients

8’795

Pressure zone # 2

Total number of clients

13’874

Pressure zone # 3

Total number of clients

955

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1

Monthly Water Balance (WB)
UKKO prepares monthly water balance.
All the data from the wells, pumping stations, reservoirs, individual water meter are reflected and analysed in the water balance table

2

Non revenue Water (NRW)
Monthly WB were showing that the NRW level was "deteriorating"
While the level of the billed water amount was not reflecting any significant changes

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In depth data analyses

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aliquam tincidunt ante nec sem congue convallis.

Step 01

Step 02

Night consumption

SCADA system was used to analyse the data from the last months of the

night consumtion
3,1 l/sec up to 4,6 l/sec

Step 03

Section division

Pipe localization starting with the smallest supply zone

Step 04

On-site checks & Repairs

Presure zone #3
The team started on site checks, as per the map locations determined in advance/
Three significant cases found

Night consumtion
reduced to 0,8 l/sec

Step 05

Monitoring

The Leak Detection Team is working on daily bases on checking the whole water supply network.

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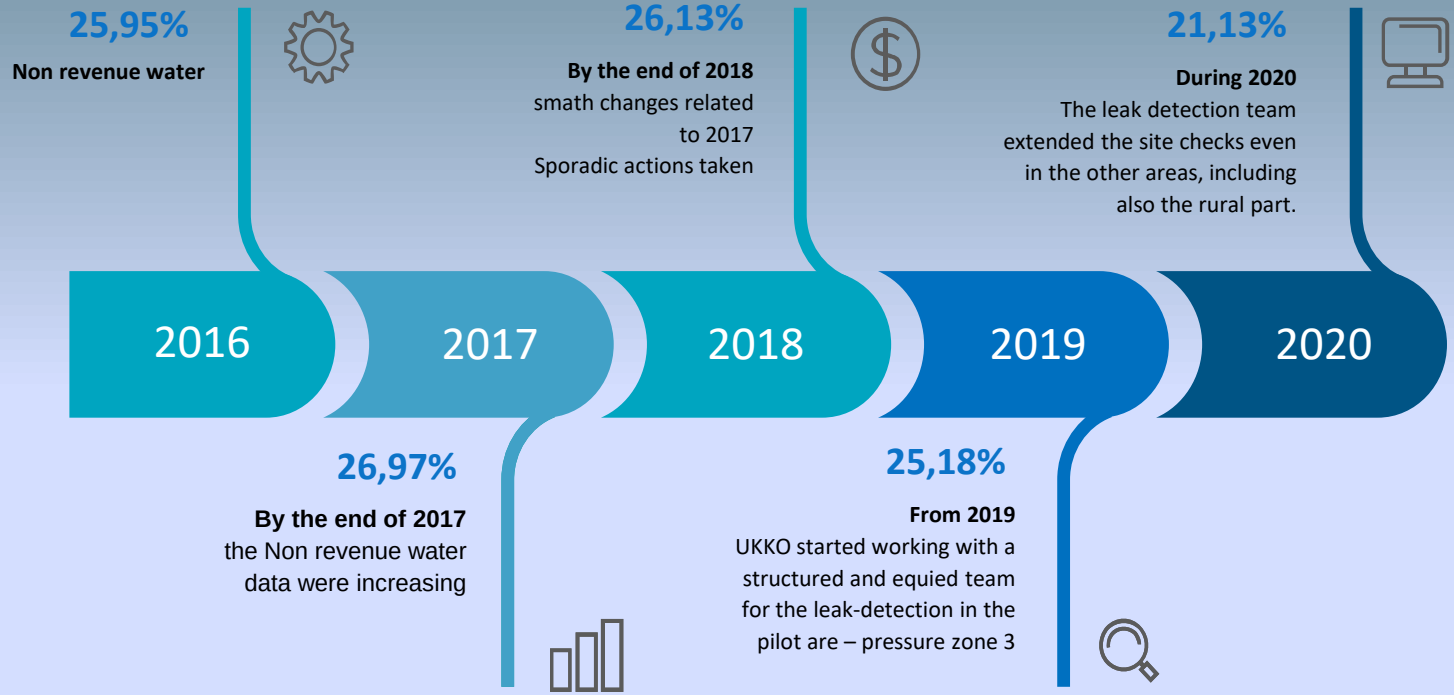
Non revenue water



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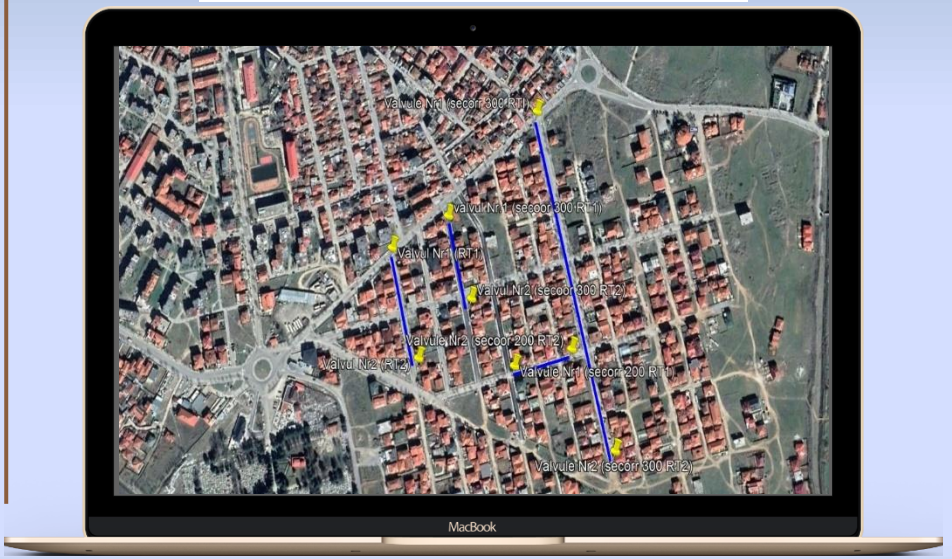
Water Leak Detection Car / equipped with

- Leak detection equipment / flow analysis
- Aqua phone
- SeCorr 300
- PC – data analysis software



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The leak detection team, has structured the intervention action, and now working day by day on continuous checks of the water supply system, urban and also rural area.

01 Mapping

First they identify the part of the network to be checked and mark it on a digital map

03 Site checks

Next step, they go down on site and start checking the pipe route with the equipment

05 Action

In case something doubtful is identified, they plan the intervention actions accordingly

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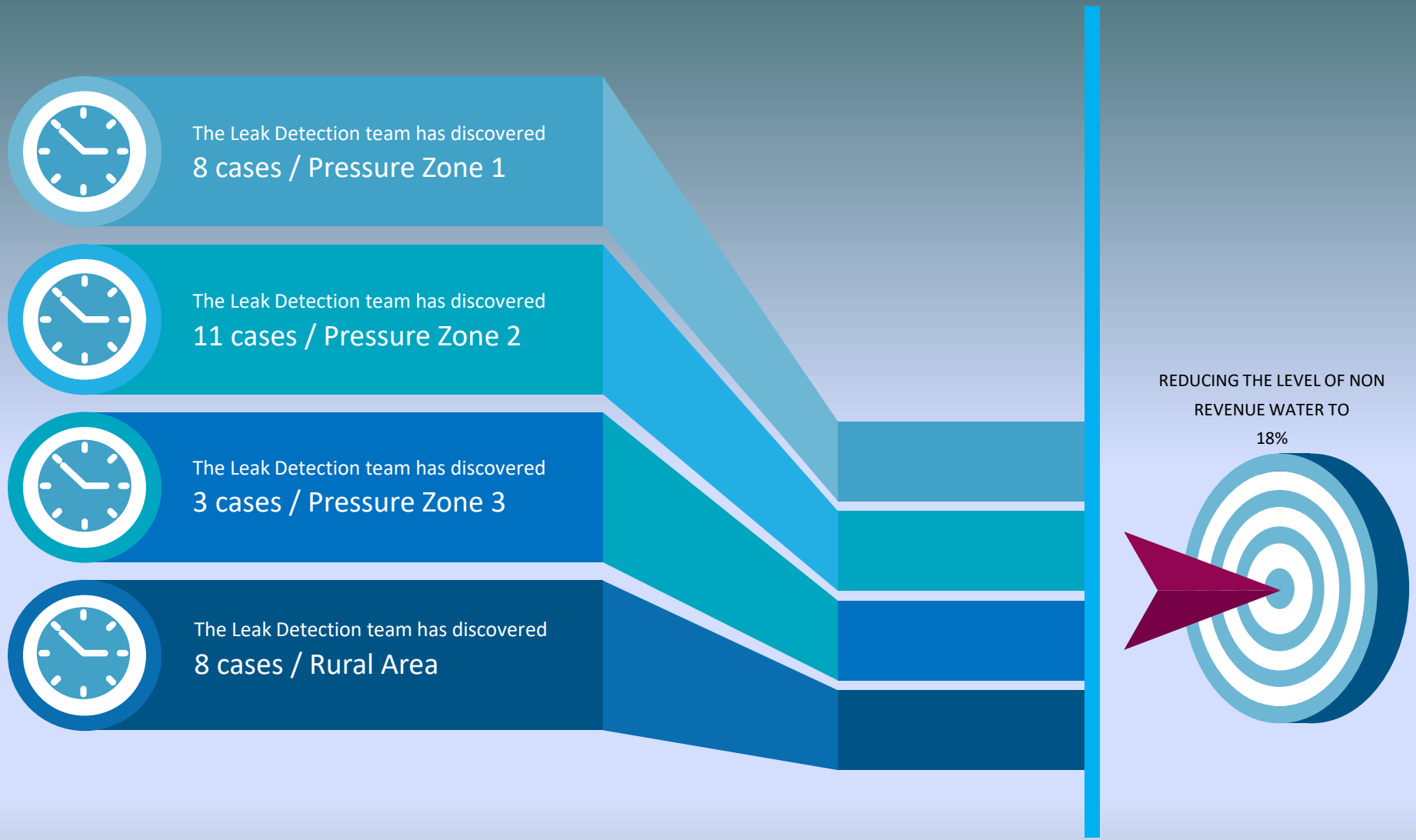

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WBN pilot action

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PP6 - WBN
PILOT ACTIONS FOR WATER MANAGEMENT

PILOT ACTION 1 - AMR:
IMPLEMENTATION OF AN AMR SYSTEM

PILOT ACTION 2 - WQS:
INSTALLATION OF A WATER QUALITY SENSOR

PILOT ACTION 3 - GENERATORS:
MICRO-ENERGY HARVESTING SYSTEMS

PILOT ACTION 4 – SMART PRV:
SUPPLY AND INSTALLATION OF A SMART PRESSURE REGULATING VALVE IN A DISTRICT METERED AREA (DMA)

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PILOT ACTION 1 - AMR

PILOT ACTION 1 - AMR:

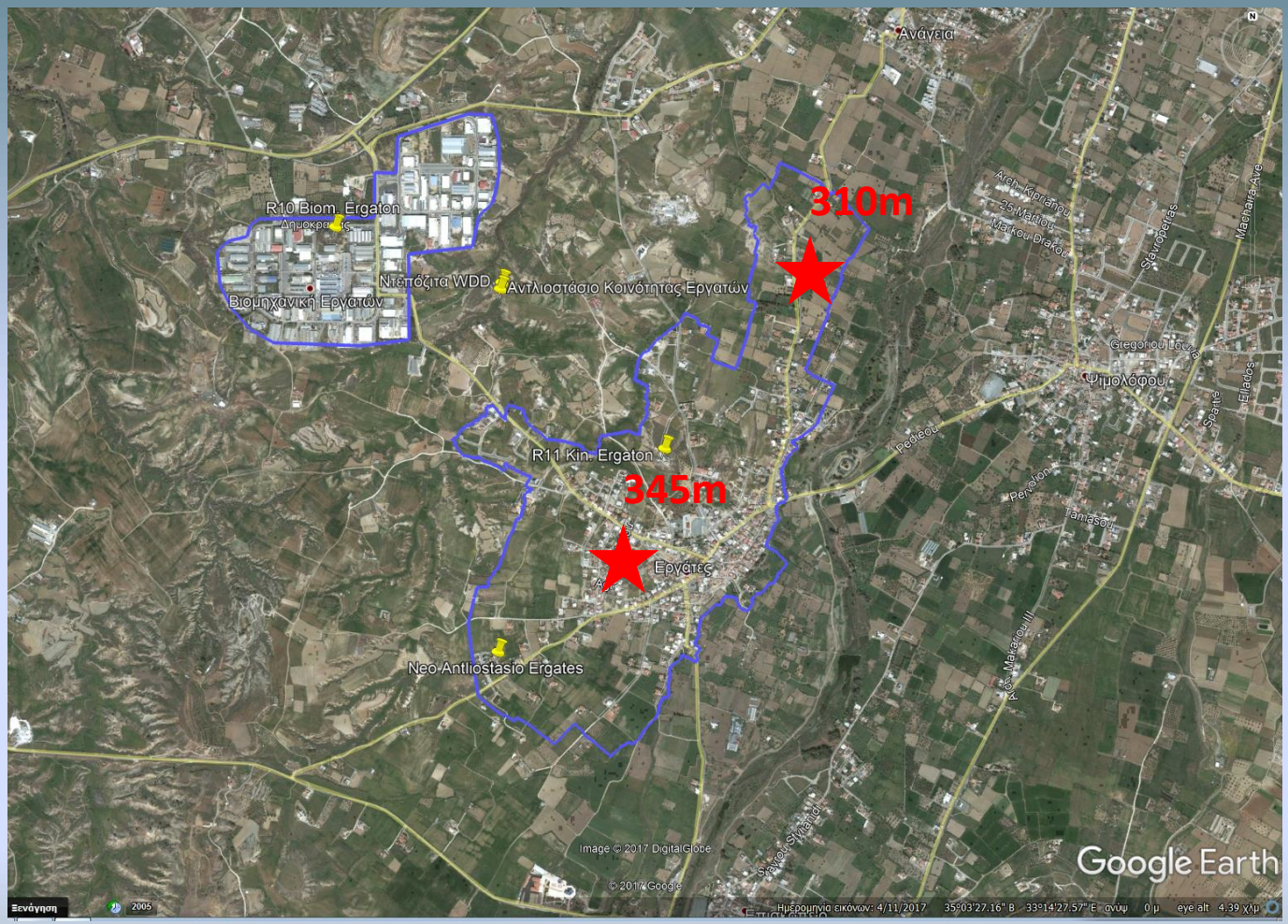
DESCRIPTION OF STUDY AREA FOR THE IMPLIMENTATION OF THE AMR SYSTEM

The area selected is DMA 25 Ergates Village.

It is located 16km southwest of the city of Nicosia center.

The proposed zone is an isolated area of about 1,94 Km² and a perimeter of 9.3 Km.
Max G.L= 345m
Min G.L = 310m

Non-Revenue water = 42% until July 2018.
After the installation of the new domestic WM the NRW went down from 36% to 23% on domestic water meters



PILOT ACTION 1 - AMR:

DESCRIPTION OF STUDY AREA FOR THE IMPLIMENTATION OF THE AMR SYSTEM

The water is pumped to the two reservoirs (G.L = 358m) that have a total capacity of 390m³ . (140 m³ & 250 m³)

The pilot area has only one feeding point.

- 704 consumer water meters
- supply of water by gravity
- Pipe materials
  AC, UPVC, MDPE
- Pipes OD
  75mm to 160mm
- total network length 17 km.
- mean consumption Sept. 2018
  500 m³/day

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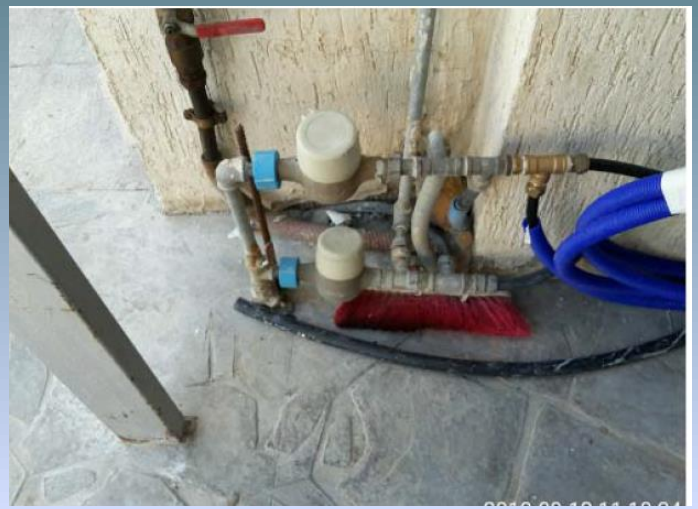
PILOT ACTION 1 – AMR - BEFORE: Existing situation in Ergates Village (Area 25)

Area meters (Sept. 2018): Planning and progress of AMR instalment.

PILOT ACTION 1 – AMR - BEFORE: Existing situation in Ergates Village (Area 25)

Consumer meters (Sept. 2018): Planning and progress of AMR instalment



PILOT ACTION 1 – AMR - AFTER: Installation of AMRs in Ergates Village (Area 25)

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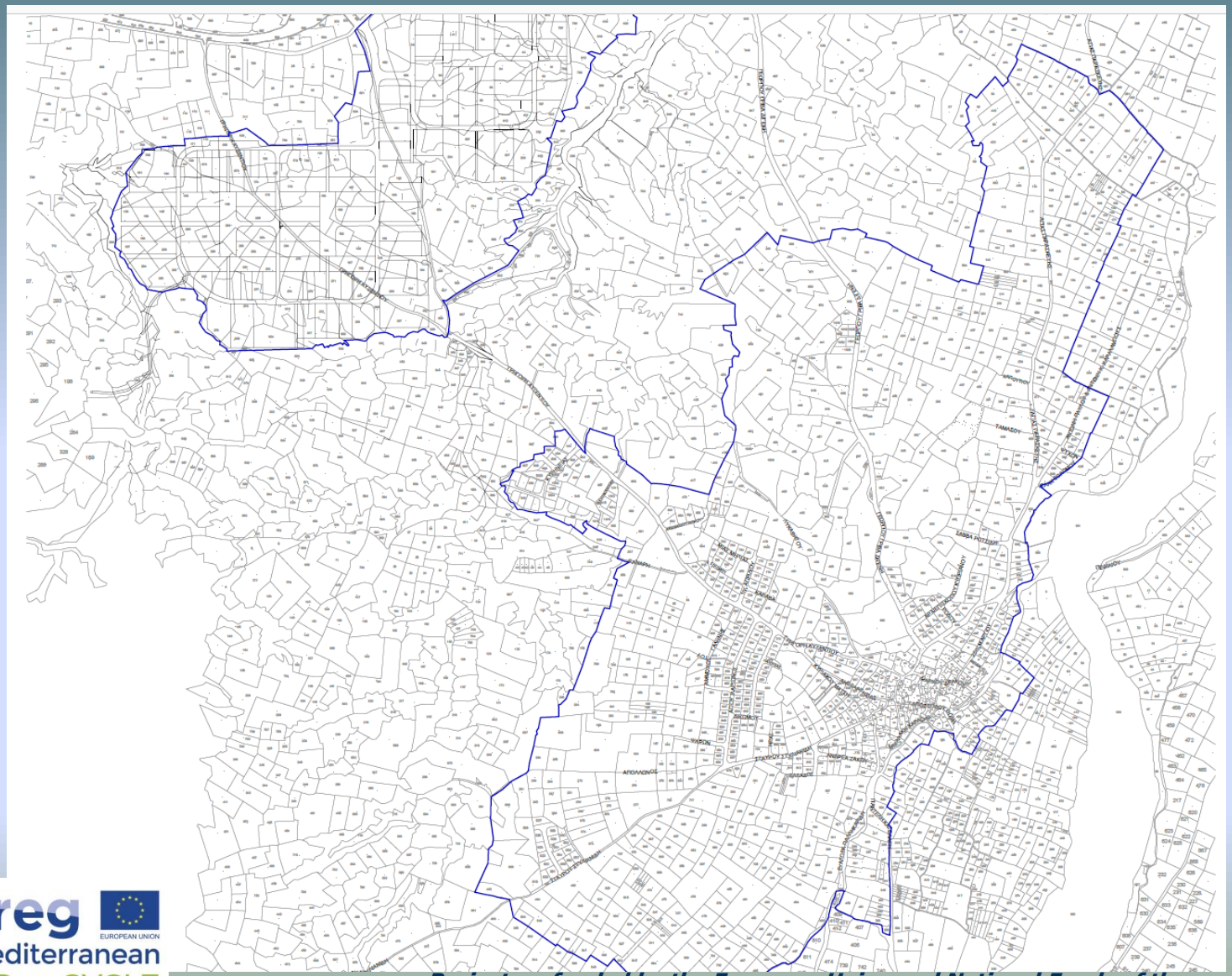
PILOT ACTION 1 - AMR:

Map of Ergates Village (Area 25) given to the provider.



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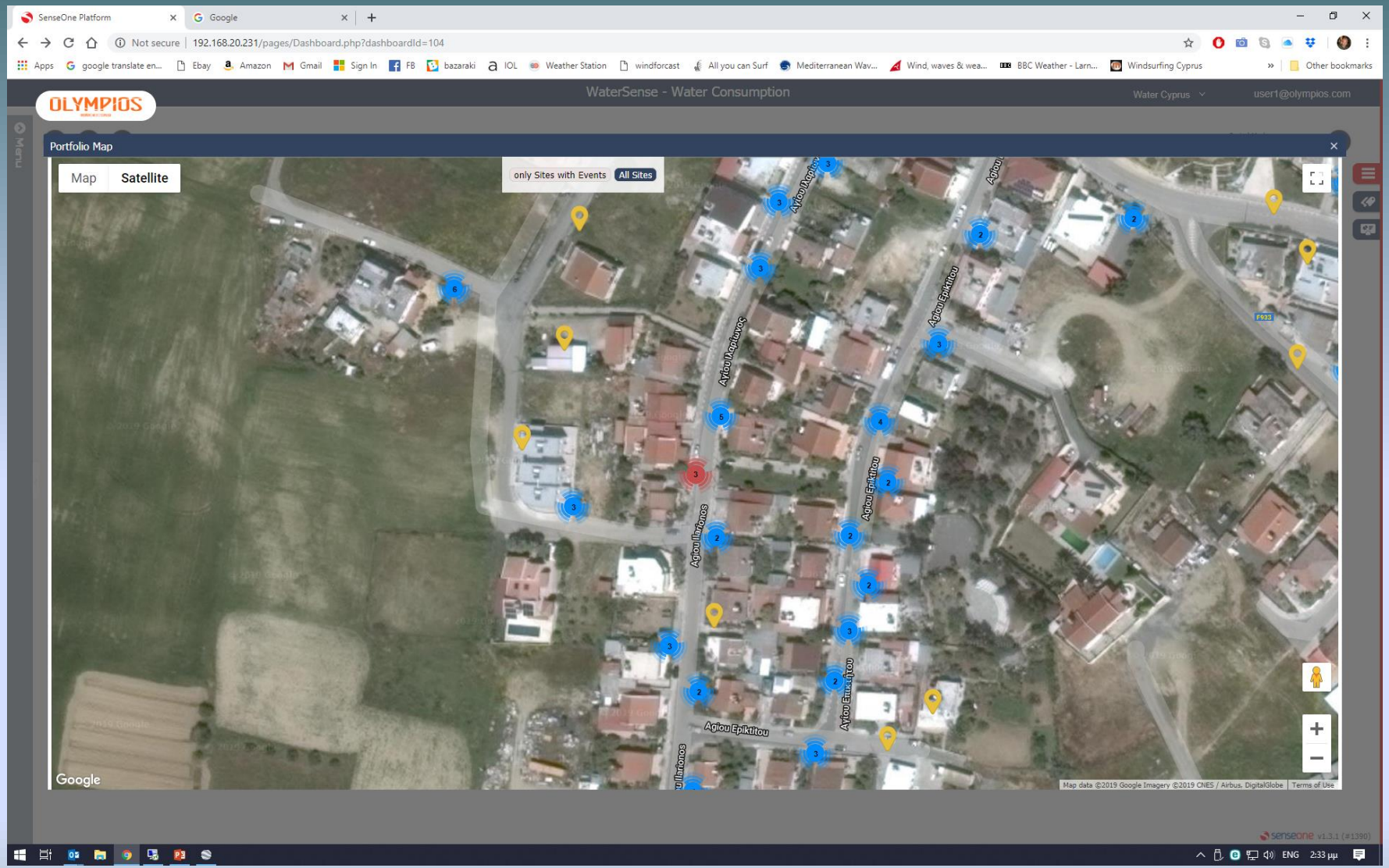

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PILOT ACTION 2 - WQS:

Water Quality Sensor

Kapta Water Quality Sensor

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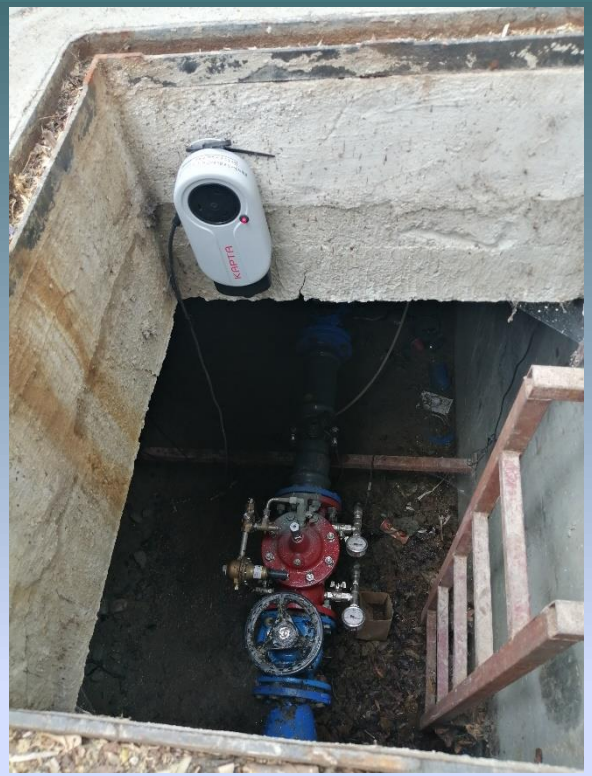


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VEOLIA


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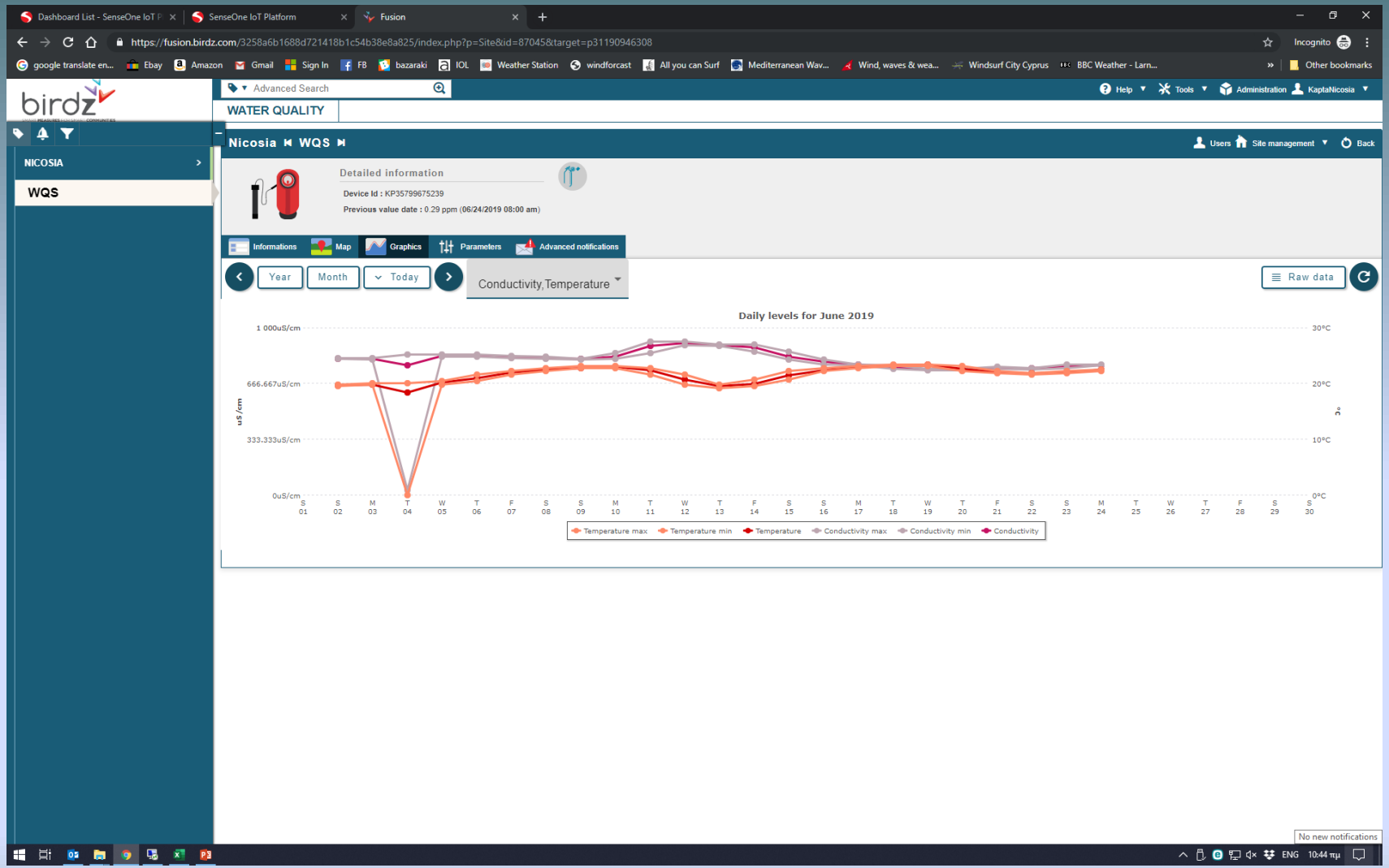

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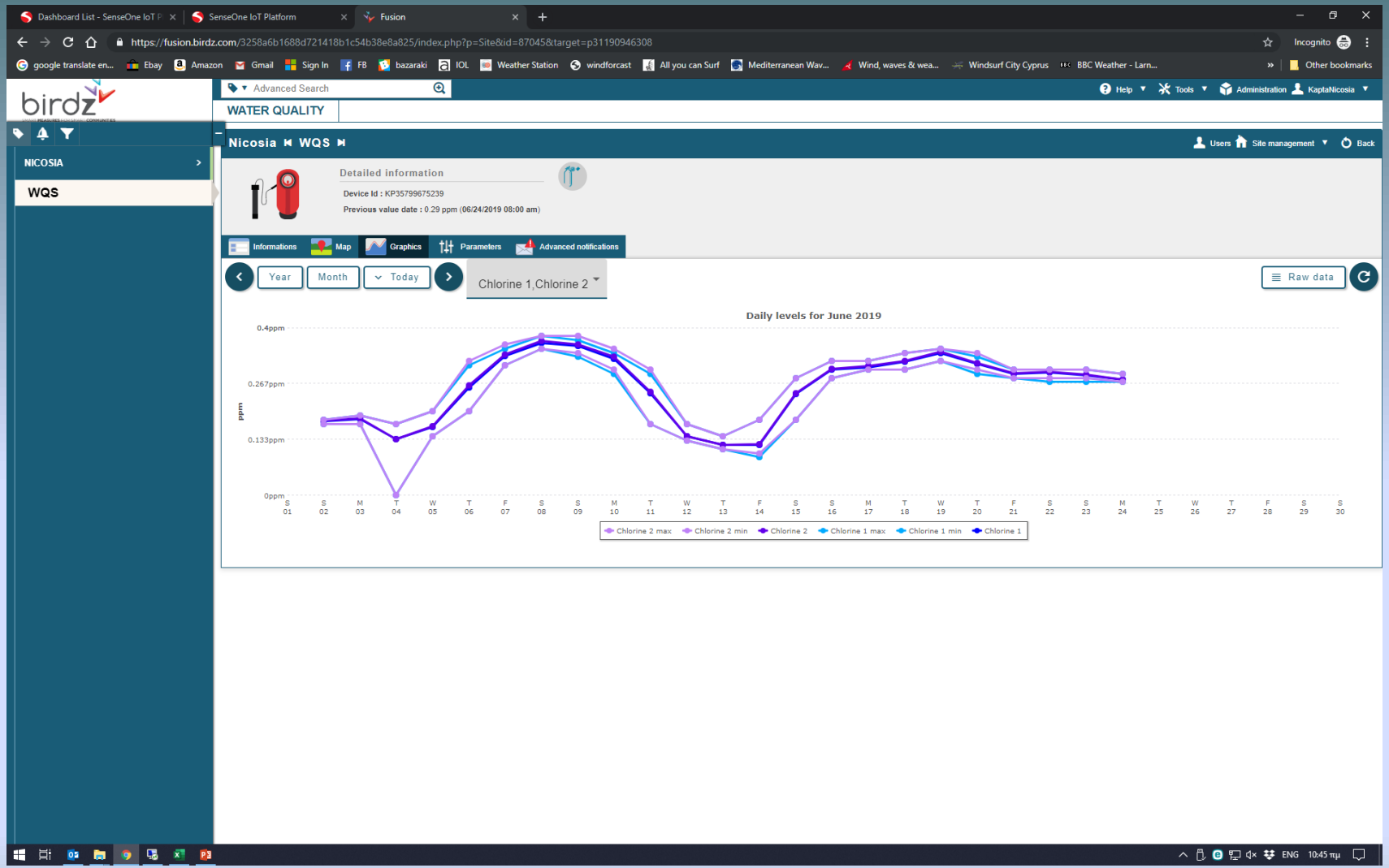

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PILOT ACTION 3 - Generators:

Micro-energy harvesting systems

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Hydrospin Hydro Power Unit (Generator)

DMA’s 1C, 2A, 2B, 8A & 16A.

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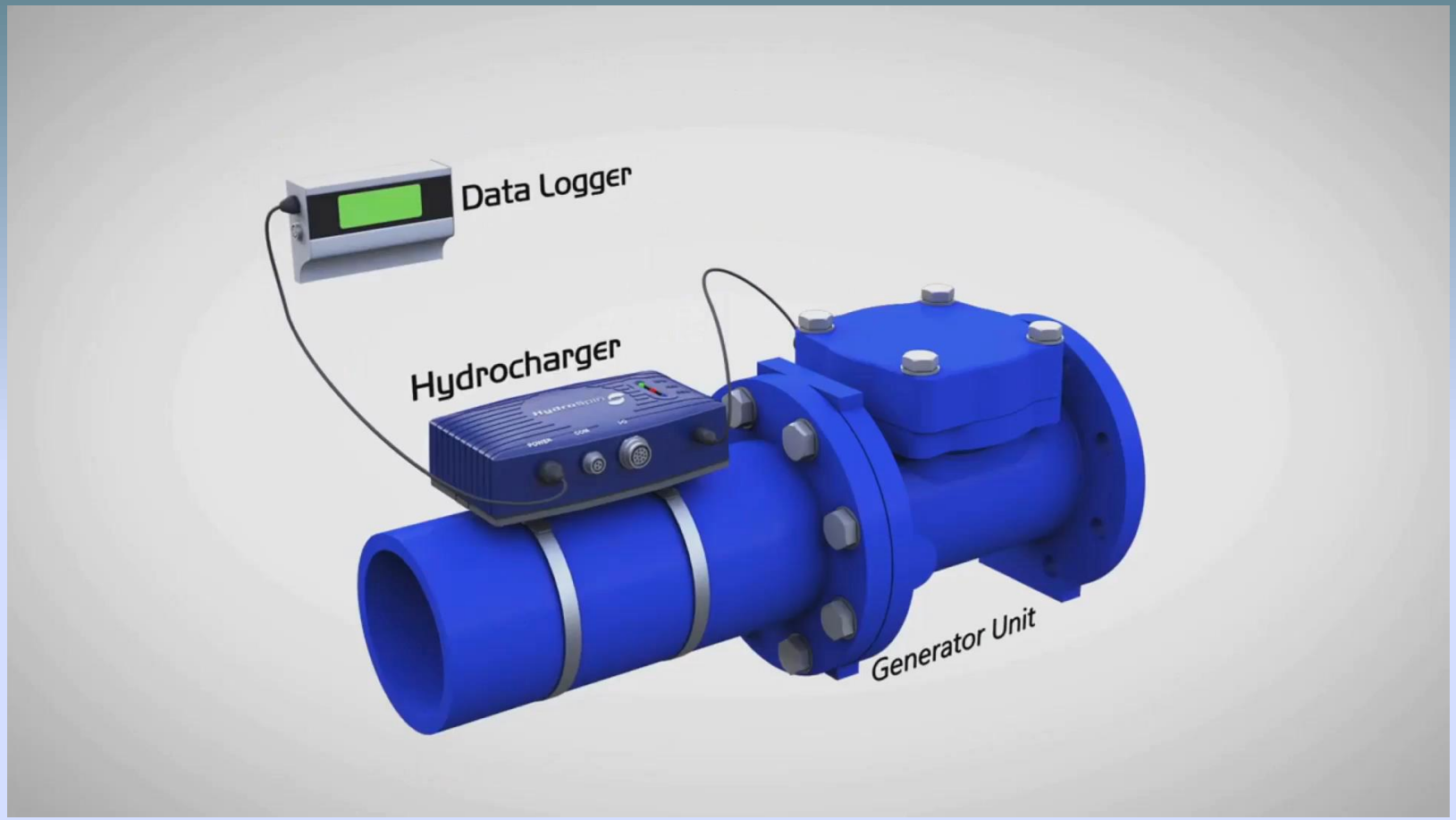
Video for Hydrospin Generator



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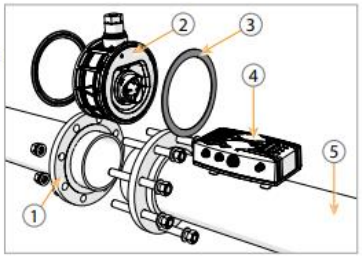
Major Components

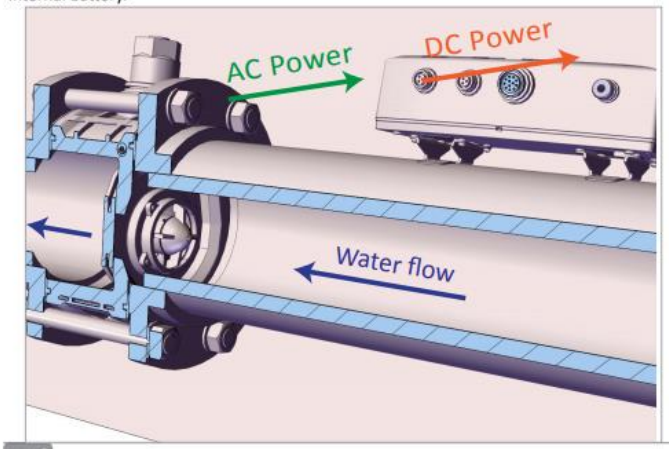
- **Main Unit (2) –** connected to the pipeline (5) using gaskets (3) and two flanges (1) and converts kinetic energy from the water flow into electrical AC power.
- **HydroCharger (4) –** receives AC voltage from the generator and converts it to DC power.



Principle of Operation

The Yogev 10W, connected to a water pipeline, converts kinetic energy from the water flow into an electrical charge that powers devices in a smart water network. Water flow activates a turbine that produces AC voltage, and charges an internal battery.

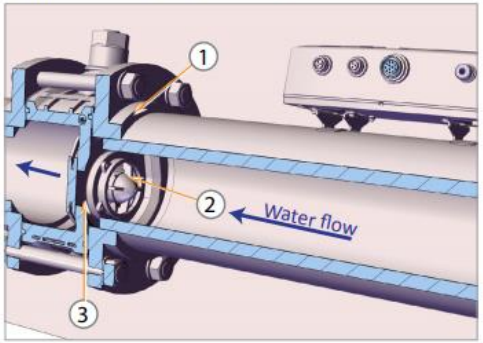
Even in low water flow rate levels, optimal energy harvesting is possible as the HydroCharger maximizes the power produced by the generator, in dynamic flow and voltage, to charge its internal battery.



Main Unit

The Yogev 10W main unit consists of the following parts:

- **Unit housing (1) –** houses the turbine. Connects to the water pipe using two flanges.
- **Turbine (2) –** the water flow in the pipe spins the turbine blades and rotates the generator rotor.
- **Turbine plate (3) –** holds the turbine. In high flow rate levels, the turbine plate rotates, allowing water flow with reduced head loss.



NOTES:

The main unit must be connected to the pipeline in correct orientation in relation to the water flow (see "Unit Orientation" on page 12). The arrow on the unit must match the water flow direction.

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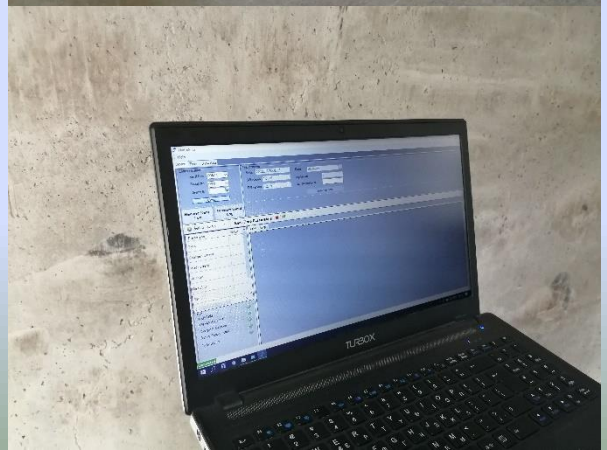

PILOT ACTION 4 – Smart PRV:

Supply and Installation of a Pressure Regulating Valve in a District Metered Area (DMA)

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Smart PRV Installation.

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PRV Controller Installation.

Installation of the PRV.

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Installation of the Critical Point Logger.

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Results from the PRV Controller.

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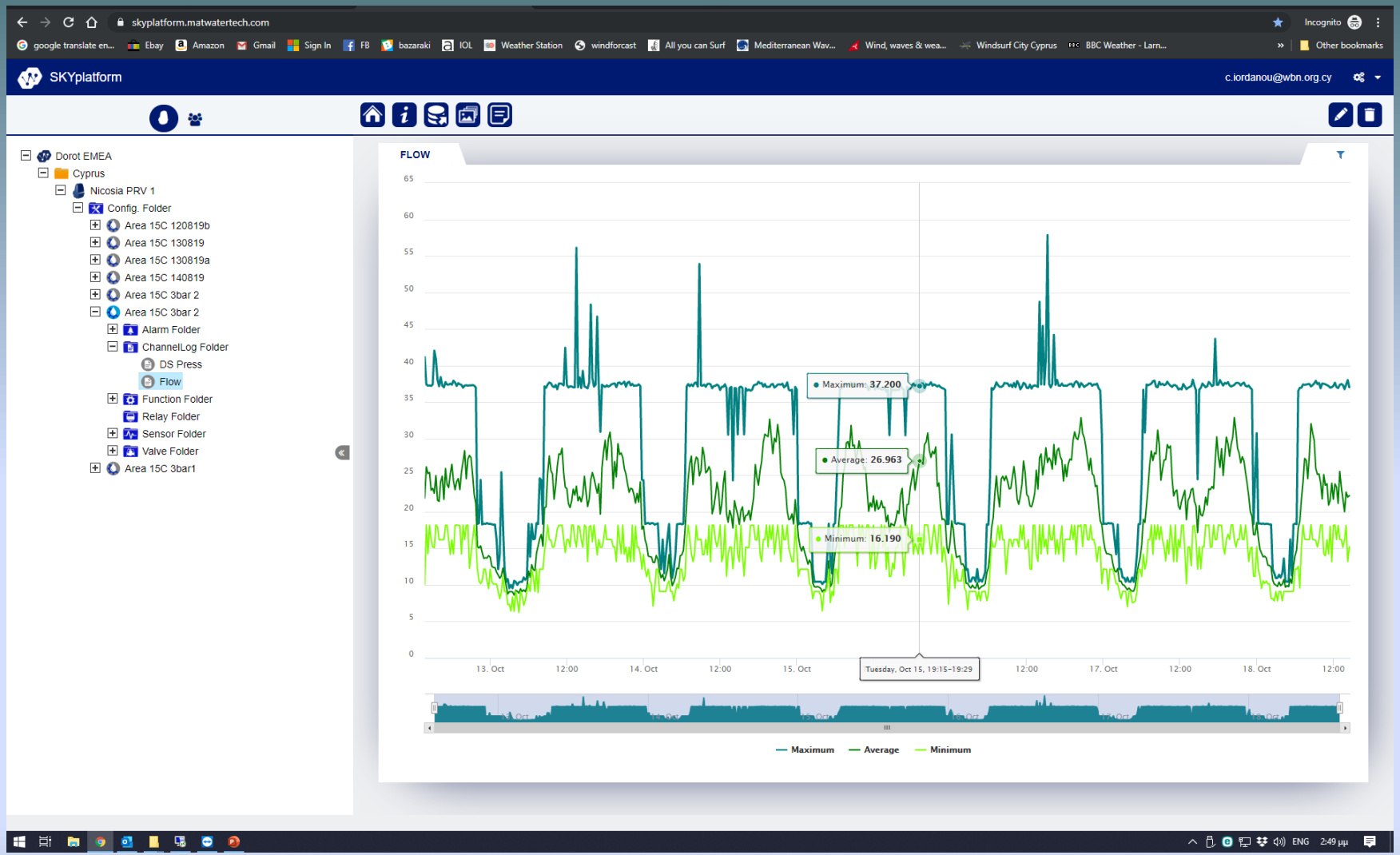
Results from the PRV Controller.



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Results from the Critical Point Logger.

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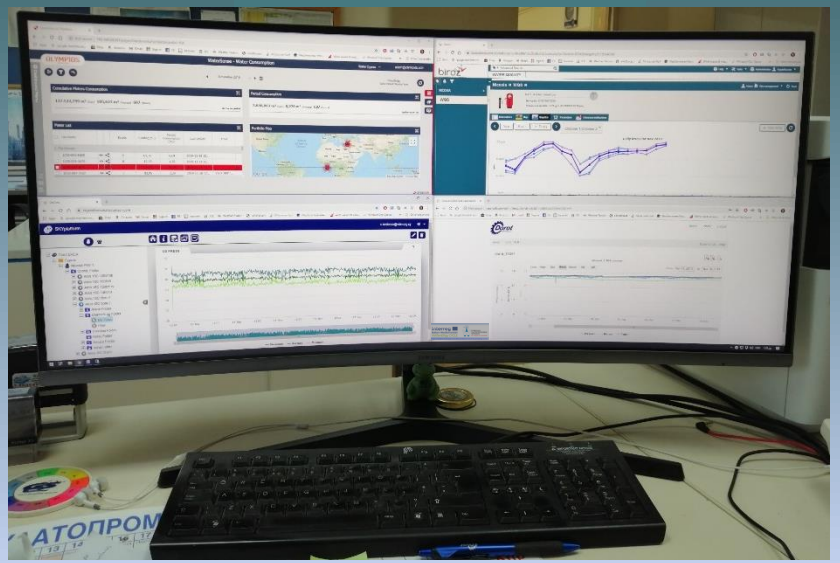
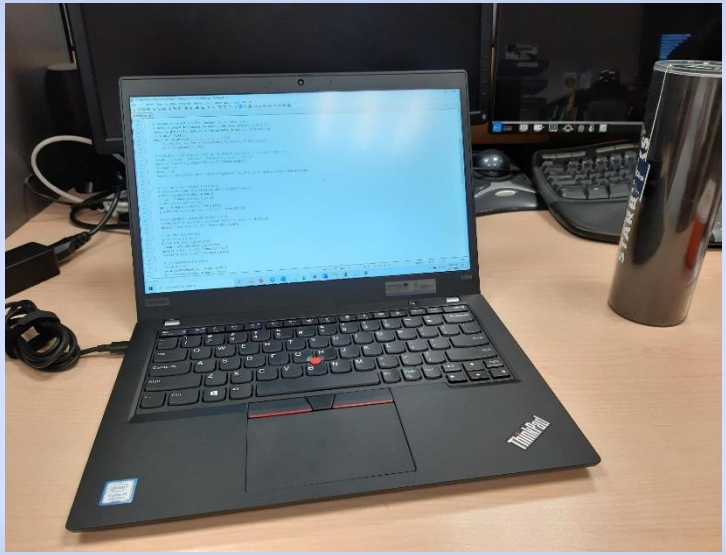
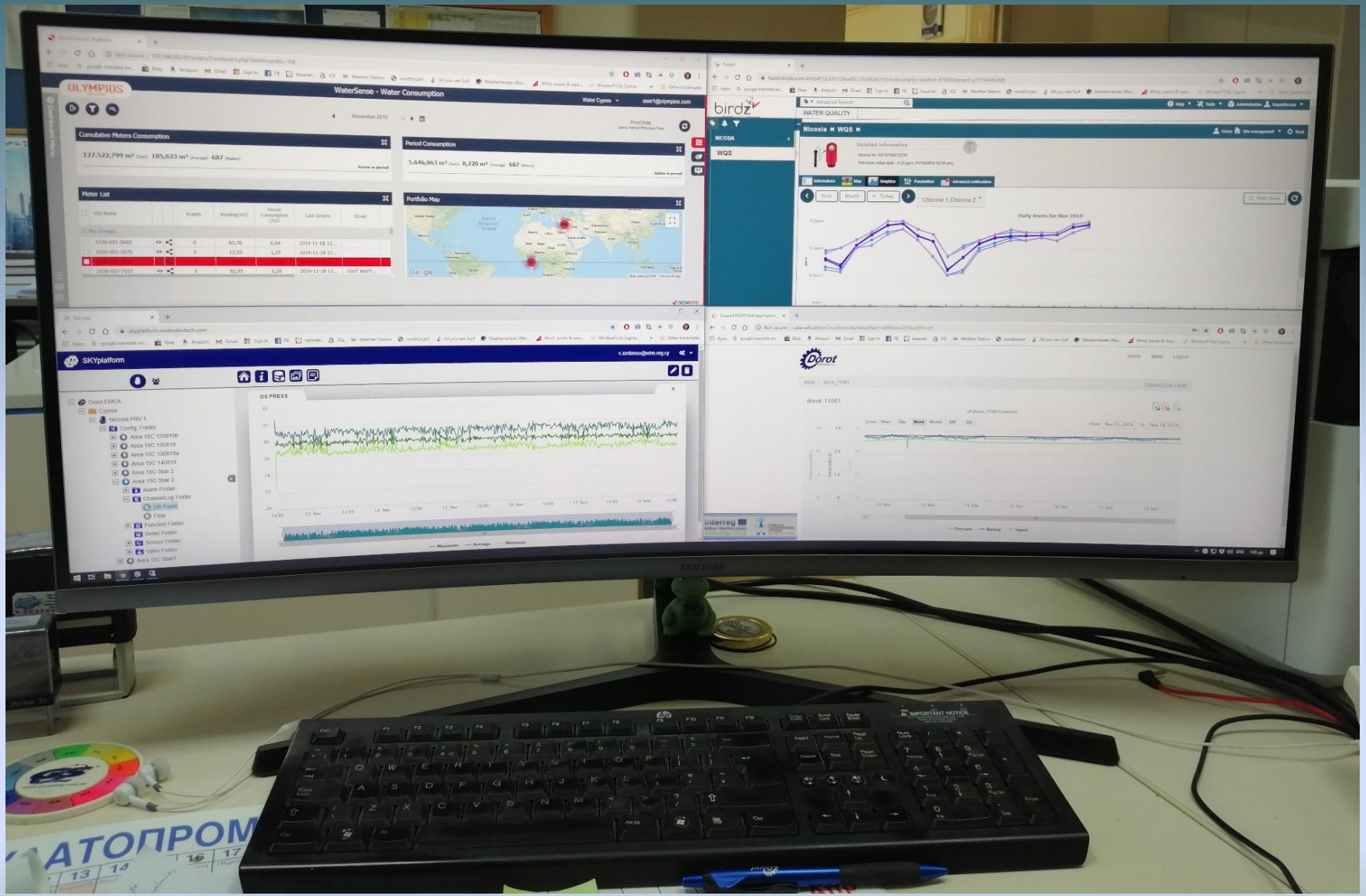
Equipment bought for monitoring the results from the pilot actions.







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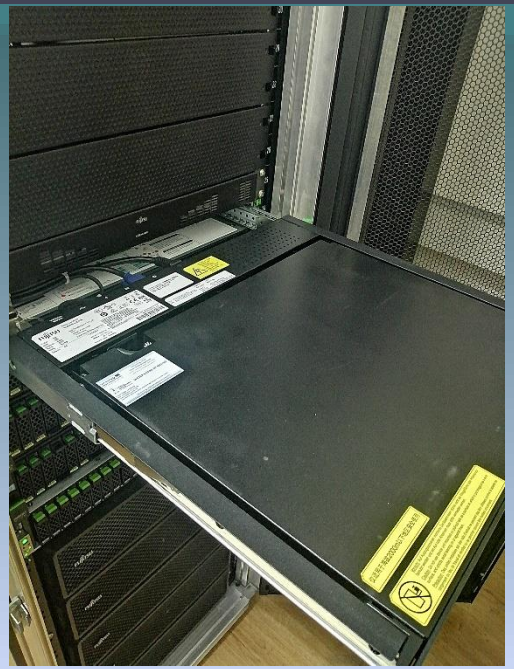
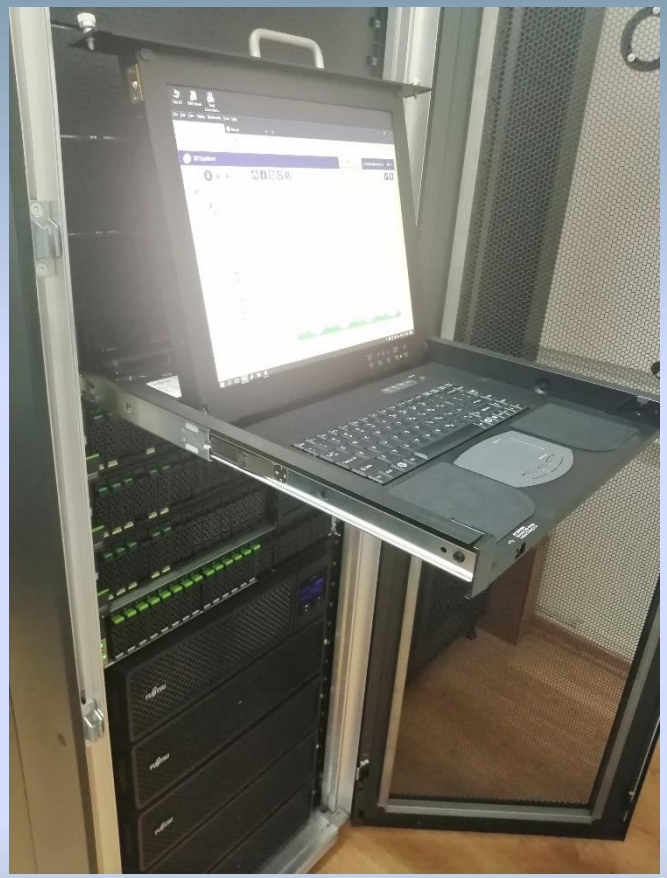
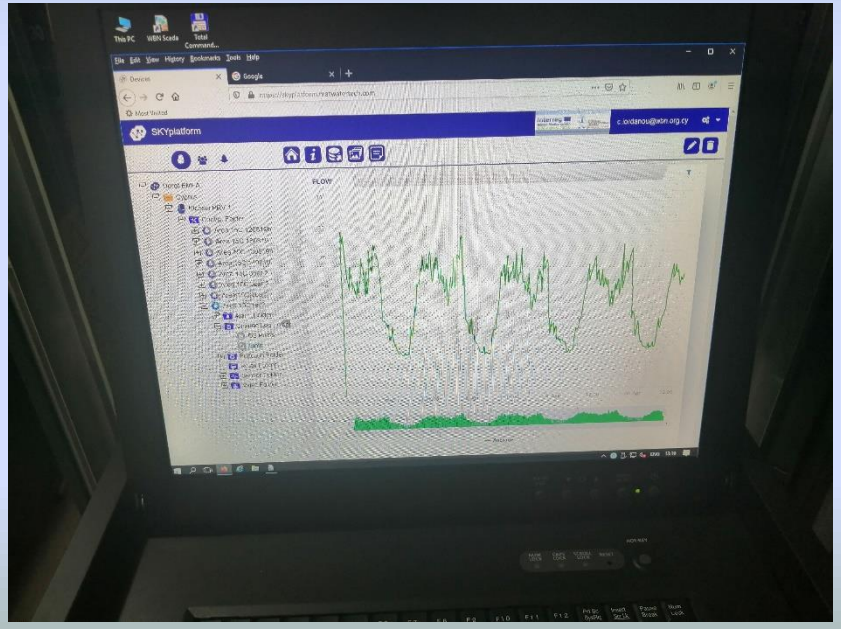
Server hosting the results from the pilot actions.







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PP6 - WBN
PILOT ACTIONS FOR WATER MANAGEMENT

Pilot action	Results	Cost
AMRs	- NRW reduction from 36% to 23% - Reduction of labor cost for meter readings (4,250€/year) - Early leak detection - Water use profiles recording	85,000.00€ (+VAT)
Water Quality Sensors	- continuous monitoring of the pressure, conductivity, temperature, and residual chlorine	15,600.00€ (+VAT)
Energy generators	- sufficient electric power for suppling energy to five ultrasonic water meters connected to SCADA system - cost for batteries purchase and labor are reduced	16.600,00€ (+VAT)
Smart PRV	- Reduction of average NRW from 33.39% to 30.56%	10,680.00€ (+VAT)

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BWA pilot action

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BWA's role - Introduction

1. **BWA's role in the project**

2. **Equipment for water flow measurement, leakage detection and sewerage inspection**

3. **Equipment for water hammer detection**

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BWA's role

BWA's role in the project as non-governmental organisation is mainly in knowledge sharing and awareness increase among the experts working in Water supply and sanitation sector as well as other National interested stakeholders (such as Ministries, Municipalities, Universities, etc.)

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First part of equipment

- We have bought the following devices, connected to water flow measurement, leakage detection and sewerage inspection:
  - Water flow meter for pressurized pipes;
  - Noise and pressure sensitive loggers;
  - Ground microphone and correlator;
  - Water flow meter for open canals;
  - Sewerage inspection camera.

- All of the mentioned equipment was presented to a WSS operator experts and workers, as well as students from the University of Architecture, Civil Engineering and Geodesy in Sofia, Bulgaria.

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First part of equipment

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First part of equipment

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First part of equipment

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First part of equipment

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First part of equipment

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First part of equipment

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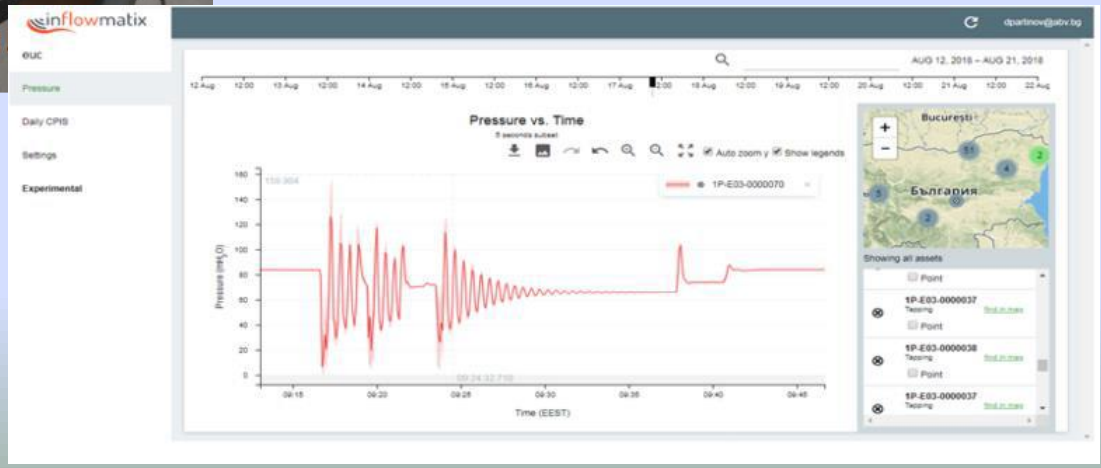
Second part of equipment

We have bought additionally two devices for measurement of water hammer, which we presented and provided for some period to the Water operator of Blagoevgrad where most of the pilot activities have been carried out.



JKP ViK Prilep pilot action

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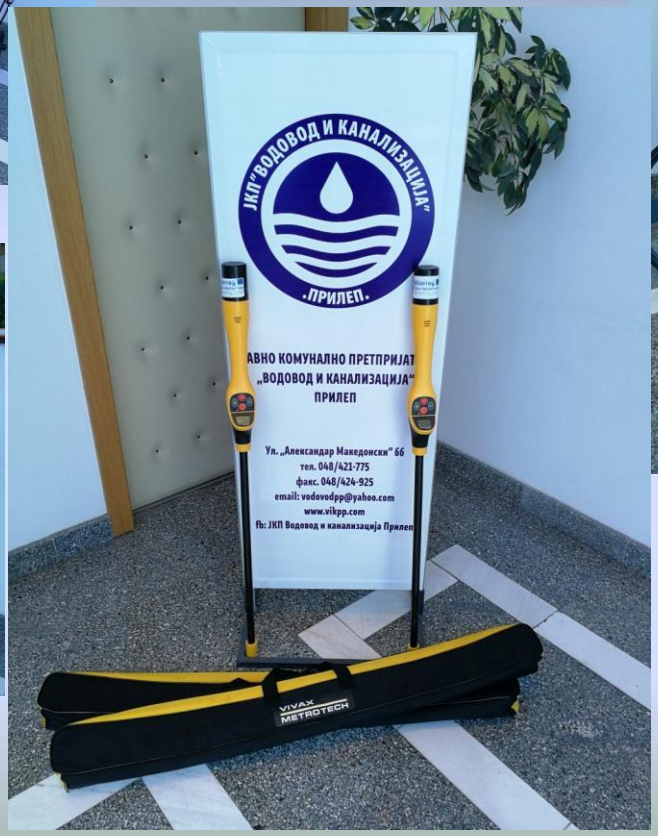
JKP ViK Prilep pilot action: General Description

Total population served	**76,768**
Total area covered (Km^2)	1,194.44
Total pipes' length (Km)	247.76
Mean altitude (m)	670
Mean operating pressure (atm)	3.5
Age of pipes (per material, diameter)	Over 40 years
Type of pipes	PVC, MDPE, HDPE, ZINK
No. of service connections	19,144

- The problem: The water utility is facing high water losses, more than 57% of drinkable water, from which the bigger parts are due to illegal connections and due to real losses.
- The main reason is that the water supply and distribution network is more than 40 years old and the water utility has no adequate equipment for the leaks detection and there is no underground cadastre.

JKP ViK Prilep pilot action



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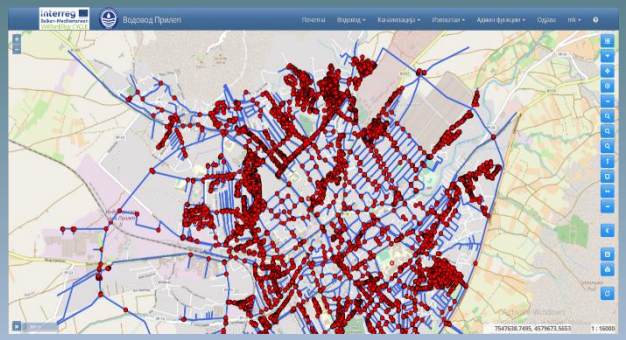
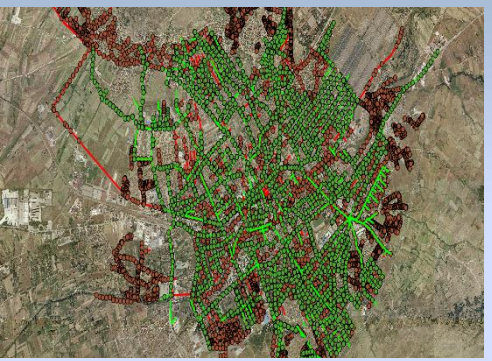
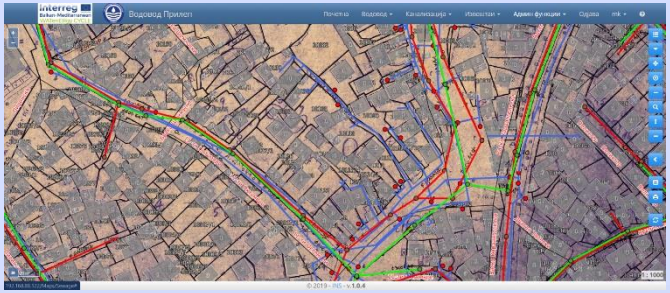
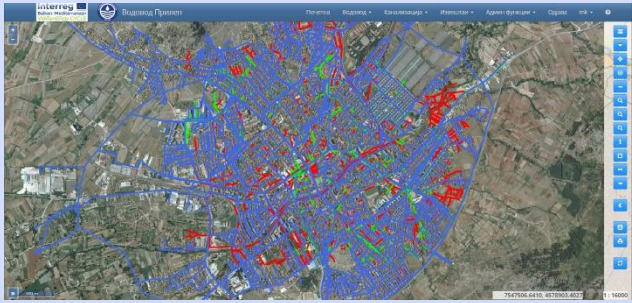
JKP ViK Prilep pilot action: GIS









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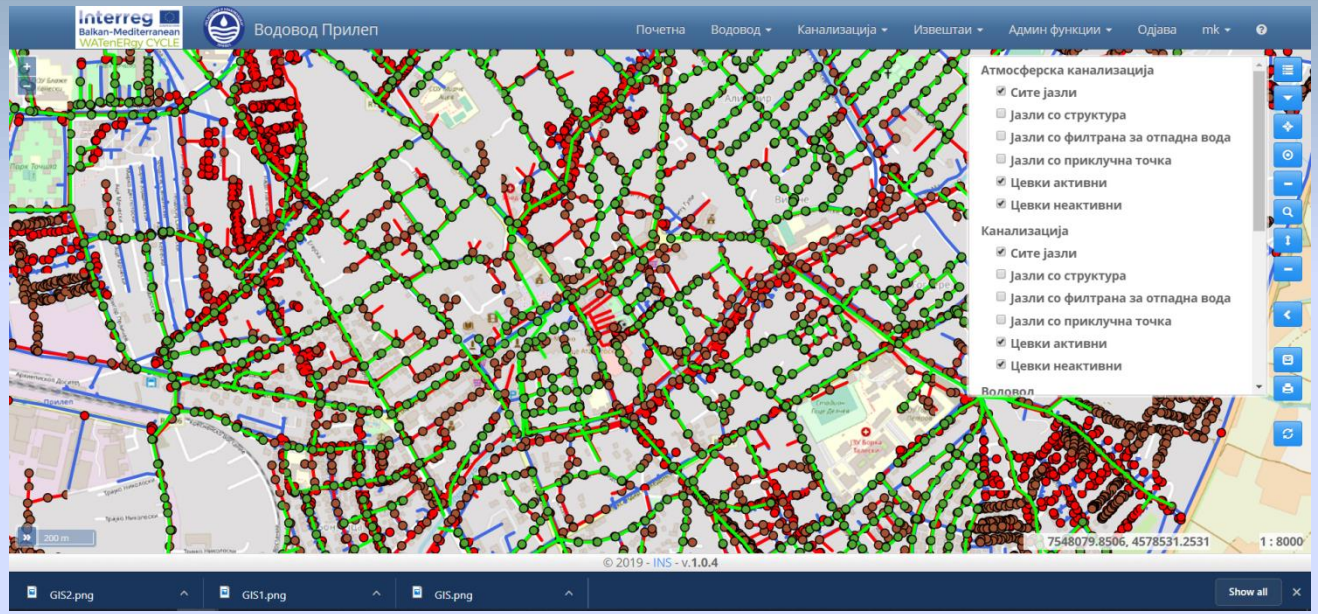
JKP ViK Prilep pilot action: GIS



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JKP ViK Prilep pilot action: Results

- 58 leaks are detected, 38 of which are found in private connections and 20 are found in the water supply network.
- The water saving for 3 months of the pilot action implementation compared to the same period in 2018, is 6,653m^3

Indicator	2017	2019	Difference (%)
NRW (m^3 / year)	4,435,843	4,711,383	6.21%
NRW (% SIV)	56.92	56..09	-1.46%
Apparent Losses (% SIV)	9.41	0.70	-92.56%
Real Losses (m^3 /year)	3,664,644	4,387,582	19.73%
Real Losses (% SIV)	47.02	52.23	11.07%
Real Losses (%NRW)	82.61	93.13	12.73%
Real Losses per connection (lt/connection/day when system is pressurised)	400.77	479.83	19.73%
Real Losses per mains length (lt/km/day when system is pressurized)	40,523.57	50,422	24.43%
ILI	10.38	15.51	20.52%
Water saving (m^3/year)	-	26,612	-
Water savings cost (€/year)	-	11,443.16	-
Cost of the investment (€)	-	129,700.00	-
Cost / benefit ratio*	-	0.57	-
Payback period (years)		11.33	

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Results and Conclusions

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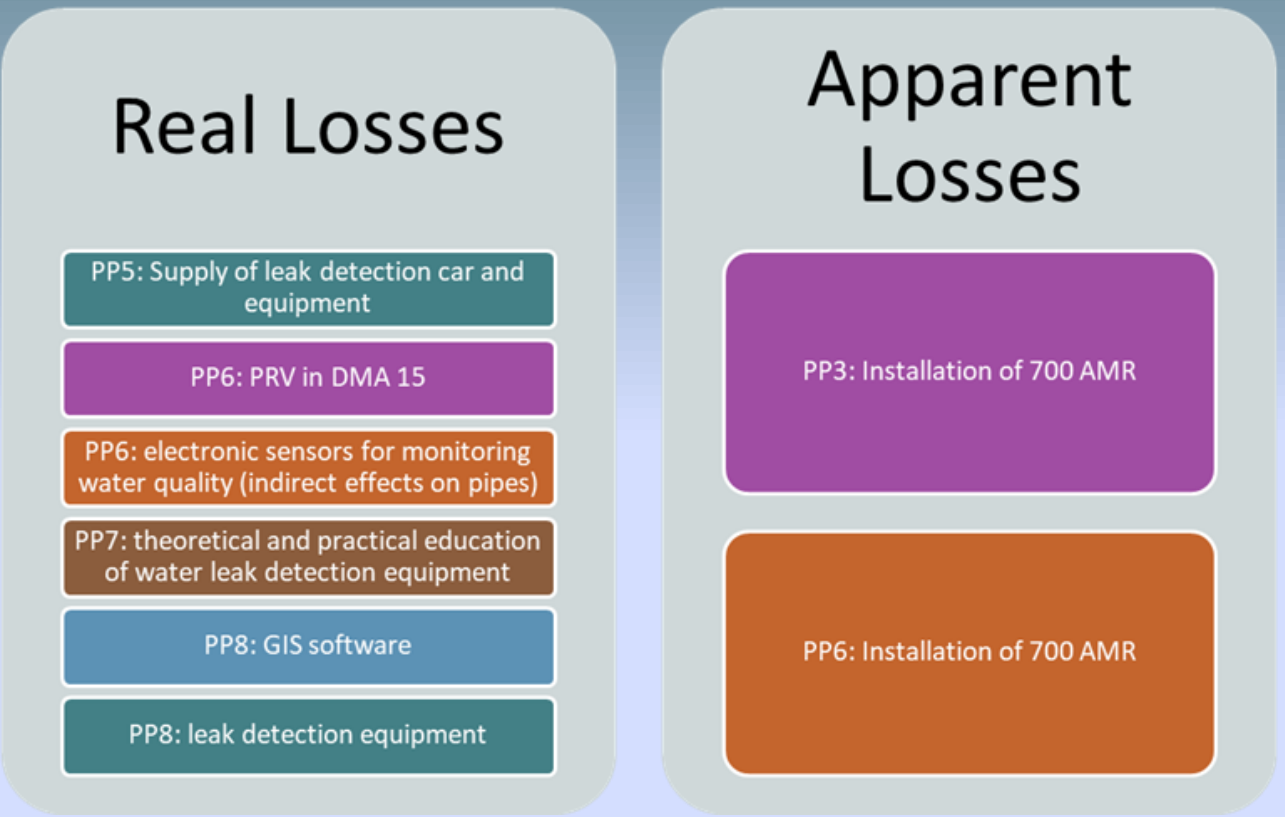
Pilot areas characteristics

General Data	Larissa (GR)	Kozani (GR)	Korca (AL)	WBN (CY) – DMA25	WBN (CY) – DMA15	BWA (BG)	Prilep (FYROM)
Total population served	162,591 (2011 census)	3,462	4,150	1,909	22,766	212,877	76,768
Total area covered (Km^2)	335.12	0.433 Km^2	1.2	2.0	8.0	6,400	1,194.44
Total pipes' length (Km)	1,078	9.696	25	21.5	85.0	1,497	247.76
Mean altitude (m)	67	672.9	945	325	135.0	400	550-700
Mean operating pressure (atm)	4.3	4 atm	6-8	1.8	3.3	7	3.5
Age of pipes (per material, diameter)	1930-1970 pipe networks from cast iron; 1970 – today: steel & PVC; 2007 – today: PE	PVC as follows:					
Diameter	Length (m)	Age (years)					
63	7,428	20					
75	165	20					
90	575	20					
200	1,529	20					
Total	9,697		High Density polyethylene; since 2000	MDPE, AC, UPVC 75 - 160mm; 30 year	AC, UPVC 100-160mm; 30 years	Eternit, steel, galvanized steel, ductile iron, PVC and PE; Since 1936	DN700mm; DN600mm; DN500mm; DN400mm; DN300mm; DN315mm; Secondary network LN 200-50 mm;
No. of service connections	37,500	235	965	704	4,469	52,083	19,144
No. of water meters	82,737	1,154	N/A	N/A	N/A	N/A	N/A

Ex-ante & ex-post WB evaluation

	DEYAL		DEYAK		SH.A UKKO		WBN – DMA 25		WBN – DMA 15		JKP ViK Prilep	
	2017	2019	2017	2019	2017	2019	2017	2019	2017	2019	2017	2019
System Input Volume	15.899.359	15.779.607	509.522	509.522	258.258	243.002	1.331.267	1.304.180	174.305	212.390	7.793.289	8.399.875
Authorized Consumption	12.532.914	12.211.089	214.679	237.275	188.612	182.330	852584	868.766	112.524	124.516	3.395.071	3.953.170
Billed Authorized Consumption	11.599.694	11.283.286	212.553	234.926	188.572	182.290	845924	868.766	112.524	123.454	3.357.446	3.688.492
Billed Metered Consumption	11.599.694	11.283.286	212.553	234.926	188.572	182.290	845.924	868.766	112.524	123.454	3.357.446	3.688.492
Billed Unmetered Consumption	0	0	0	0	0	0	0	0	0	0	0	0
Unbilled Authorized Consumption	933.220	927.803	2.126	2.349	40	40	6.660	0	0	1.062	37.625	264.678
Unbilled Metered Consumption	933.220	927.803	0	0	35	40	0	0	0	0	36.425	14.678
Unbilled Unmetered Consumption	0	0	2.126	2.349	5	0	6.660	0	0	1.062	1.200	250.000
Revenue Water	11.599.694	11.283.286	212.553	234.926	188.572	182.290	845.924	868.766	112.524	123.454	3.357.446	3.688.492
Water Losses	3.366.445	3.568.518	294.843	272.247	69.646	60.672	478.683	435.414	61.781	87.874	4.398.218	4.446.705
Apparent Losses	1.550.957	1.511.790	26.350	5.095	31.302	50.386	33.290	32.600	4.360	18.560	733.574	59.123
Unauthorized Consumption	158.994	157.796	5.095	5.095	23.949	320	6.660	6.520	870	1.062	700.000	40.588
Meter and Metering Errors	1.391.963	1.353.994	21.255	0	7.353	50.066	26.630	26.080	3.490	17.498	33.574	18.535
Real Losses	1.815.488	2.056.728	268.493	267.152	38.344	10.286	445.393	402.814	57.421	69.314	3.664.644	4.387.582
Non-Revenue Water	4.299.665	4.496.321	296.969	274.596	69.686	60.712	485.343	435.414	61.781	88.936	4.435.843	4.711.383
MCD	3.001.845	3.439.716	-				292.300	336.425	26.334	27.746		
Accounted for NRW	1.297.820	1.056.605	296.969	274.596	69.686	60.712	193.043	98.989	35.447	61.190	4.435.843	

WP5: Joint Pilot Actions



Pilot Actions Results

- ❑ NRW reduction
- ❑ Real losses reduction
- ❑ Leak events reduction
- ❑ Leaks detection
- ❑ Energy cost reduction
- ❑ Water production cost reduction
- ❑ Apparent losses reduction
- ❑ Labour cost reduction
- ❑ Recording of water use profiles
- ❑ Define areas with high water use
- ❑ Maintenance and operation costs minimization
- ❑ Continuous supply of information without depending in the maintenance of the power supply
- ❑ Underground cadastre
- ❑ Improved customer service

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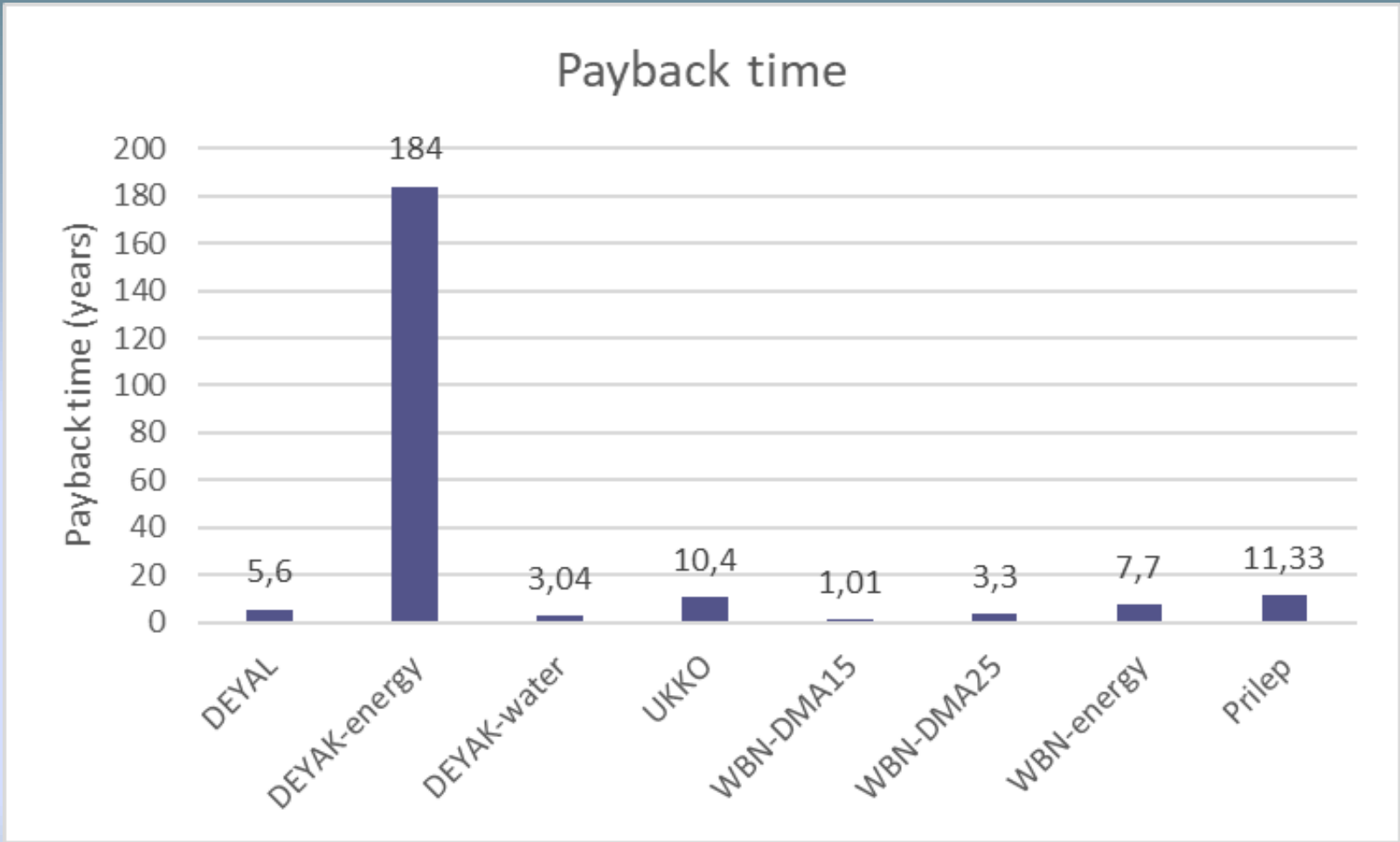
Payback time



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WATenERgy CYCLE
Urban water full cycle: from its source to its end-users and back to the environment

WP5 Joint Pilot Actions

Joint Del. 5.3 Transnational Pilot Actions

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PP3 - Municipal Enterprise for Water Supply and Sewerage of Kozani

PP4 - University of Thessaly-Special Account Funds for Research-Department of Civil Engineering

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