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

## WP5 Joint Pilot Actions

## Joint Del. 5.5 Ex-Post Energy recovery evaluation

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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**

**PP2 - General Secretariat for Natural Environment and Water**



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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**
  - **PP2 - General Secretariat for Natural Environment and Water**
- 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

| Beneficiary | | Pilot action | Equipment | Water Use Efficiency | Energy Efficiency |
|---|---|---|---|---|---|
| LP | DEYA Larissas (Greece) | 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 | three IE3 High Energy Efficiency Motors 250 KW two Inverters, one Softstarter: & Installation Service | | √ |
| PP3 | DEYA Kozanis (Greece) | 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 | 700 AMR; 5 small hydroturbines | √ Apparent losses | √ |
| PP5 | UKKO (Albania) | 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 | √ Real losses | |
| PP6 | WBN (Cyprus) | 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<br>· PRV installation in DMA 15<br>· Electronic sensors for water quality monitoring<br>· Electronic power generators | √<br>· Apparent losses<br>· Real losses | √ |
| PP7 | BWA (Bulgaria) | Purchase of leak detection, monitoring and sewerage network inspection equipment. Training purposes | Water leak detection equipment to be used for training & educational purposes | √ Horizontal training | |
| PP8 | Prilep (N. Macedonia) | 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 | √ Real losses | |

# WP5: Joint Pilot Actions – Water or Energy Efficiency?

**Water use efficiency**

- PP3-DEYAK
- PP5-UKKO
- PP6-WBN
- PP7-BWA
- PP8-JKP ViK Prilep

**Energy efficiency**

- LP/PP1 - DEYAL
- PP3 - DEYAK
- PP6-WBN

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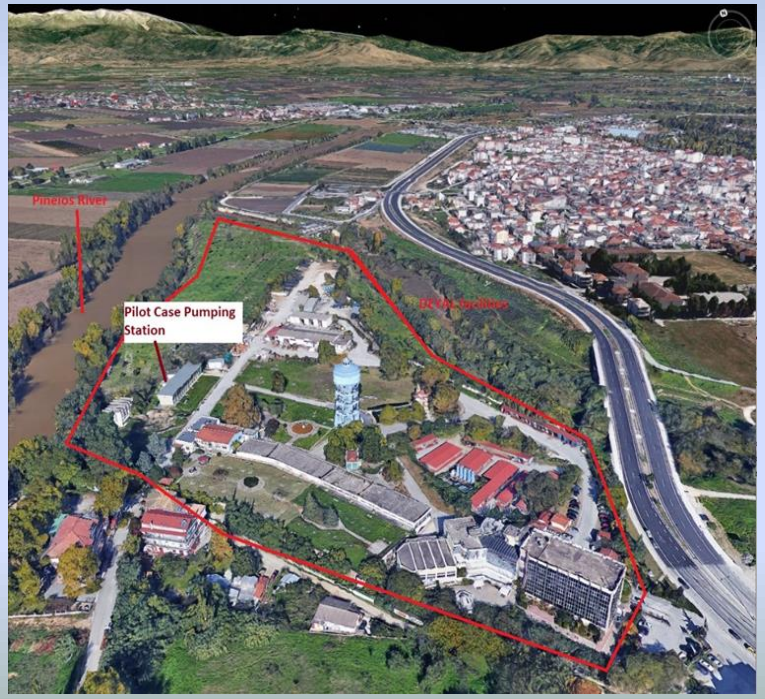
# LP/PP1 pilot action

- Larissa replaced **3 old type pumps with 3 new type (Inverter)**. The pumping station is located at the main facilities of the company and raises the manometric height of the water that comes from the drillings in the area of Giannouli-Falani.
- the pumping station consists of 9 pumps of which 5 are always working.
- With the installation of the 3 new types of pumps, **both** the old and the new pumps **work simultaneously**.
- It is **very easy to compare** the sizes of energy consumption and energy savings observed

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# LP/PP1 pilot action: results

| No | Days in operation | Pump | Operation hours (h) | Mean Daily energy consumption (Kwh) | Energy cost (€/kWh) | Pumped volume of water (m3) | Mean Pump supply (m3/h) | Maximum Average Daily Benefit (€/days) | Current Average Daily Benefit (€/days) |
|---|---|---|---|---|---|---|---|---|---|
| **13** | **49** | | **857** | **3157** | **0,13** | **543467** | **11091** | **106,11 €** | **62,87 €** |
| 1 | **08/07/20** | 1 | 234 | 48128 | 206 | 149201 | 638 | 0,32 | |
| 2 | 08/07/20 | 5 | 244 | 49951 | 205 | 155894 | 639 | 0,32 | |
| **Olp pumps group** | | | **478** | **98079** | **205** | **305095** | **638** | **0,32** | |
| 3 | 08/07/20 | 7 | 248 | 40491 | 163 | 164687 | 664 | 0,25 | **22,07%** |
| 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** | |

# LP/PP1 pilot action: results

- ✓ Energy cost per pump decreased by **22.07%**
- ✓ After 49 days in operation, these 3 new pumps saved **62,87 €/day**, or **22.947 €/year**

In case all pumps were of new type, the savings would have been equal to **106,11 €/day**, or **38.730 €/year**

- ✓ The replacement of old high-energy pumps with a new type of inverter pumps is a no risk implementation. Government policy should promote the replacement of old high-energy pumps and push for their replacement with a new type of inverter
- ✓ Cost of pumps installation: 129.000 € + VAT.
- ✓ The cost of equipment was 129.000€. At present value, the depreciation of the equipment takes place within 129.000 / 22.947 = **5.62 years**.



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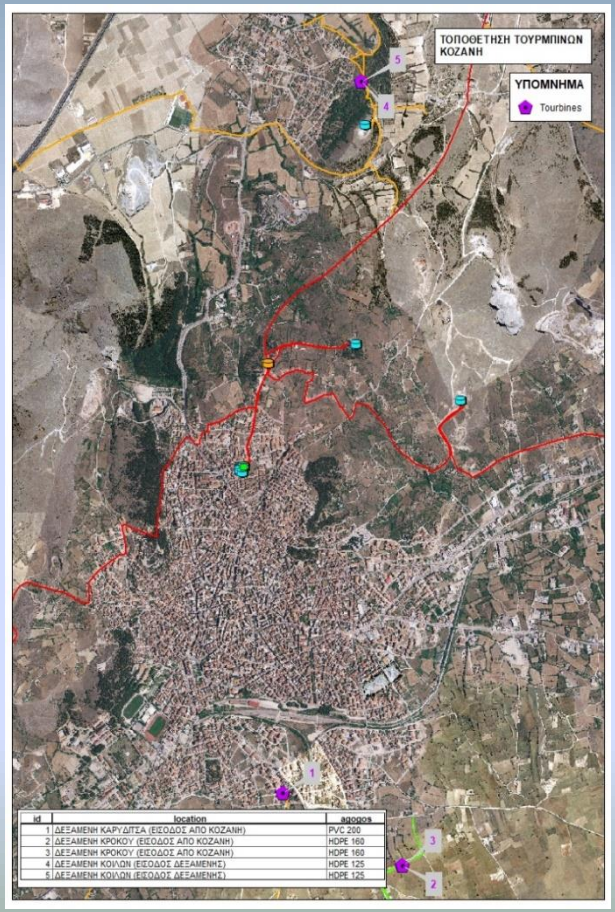
# PP3 pilot action

- DEYAK have installed 5 small hydro-turbines at selected network locations to supply existing electronic equipment that requires power supply. The sites are at the entrance and exit of tanks that receive water from the Kozani water supply network, and then feed settlements around the city. The recording equipment in the tanks takes energy from the electricity network.

| 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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# PP3 pilot action: results

- ✓ 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

- ✓ The benefit in Kwh is approximately equal to 785. The cost per kwh is 0,10158€. So the total savings in € is **80€**.
- ✓ The benefit gained from the installation of the pilot actions is indirectly related to the energy efficiency. The installation of power generators we **can** save energy spent for the replacement of batteries.
- ✓ Cost of the pilot action: 18,800.00€
- ✓ At present value, the depreciation of the equipment takes place within 18.800 / 80 = **235 years**.



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# PP6 pilot action

- Since in some remote Areas it is difficult and expensive to have electric power for suppling energy to our ultrasonic water meters that are connected to our SCADA system, we wanted to try small inline generators.
- we chose 2 generators of OD 200mm, 2 generators of OD 150mm and 1 generator of OD 100mm. These sizes cover most of the pipe diameters used in the water network system of the Water Board of Nicosia. The water meters were powered my batteries that needed to be replaced every 21 to 30 days. This results to a cost of maintenance and travel for the replacement of the batteries as well as the time needed for the employee to go to that specific area and replace the batteries.


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# PP6 pilot action


DMA’s 1C, 2A, 2B, 8A & 16A.

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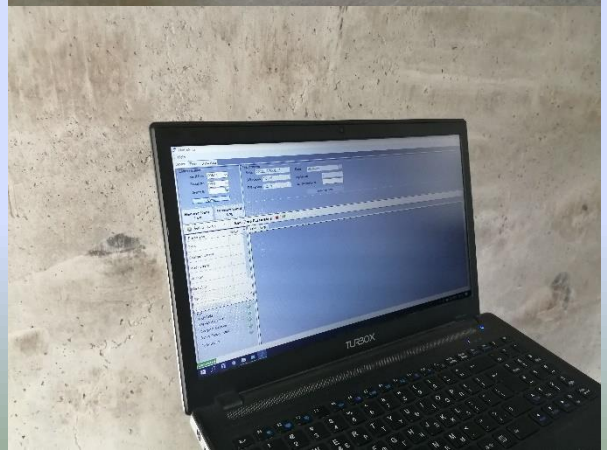

# PP6 pilot action: results

| Water Board of Nicosia Performance Indicators | | |
|---|---|---|
| | Year 2015 | Year 2016 |
| Pumping energy cost (%) | 0,76% | 0,79% |
| Electrical energy cost (%) | 1,08% | 1,05% |
| Pumping Energy consumption (kWh/m3) | 0,024 | 0,027 |
| Total Energy consumption (kWh/m3) | 0,031 | 0,034 |
| Energy recovery (%) | 0 | 0 |
| Standarized energy consumption (kWh/m3/100m) | 0,512 | 0,480 |



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# PP6 pilot action: results

**Evaluation of effect of Regular Leak Detection Intervention (permanent deployment of acoustic noise loggers) and pressure management (control of pressure through a Pressure Reducing ValveS (no.2) – Po=40m,Pred.=27m) in controlling the level of water losses and the occurrence of leakage incidents. (Estimated Non-Revenue Water during the year 2019 : 14.7% or 153 m3/day).**

**Estimation of the amount of water losses due to leakage through Minimum Night Flow analysis in DMA 20A, during November 2019**

| Month | Minimum Night Flow, in m3/hr | Total Flow, in m3/hr | Estimation of the amount of water losses due to leakage, in m3/hr | Night to day pressure variation factor | Daily amount of water losses due to | Reduction in the amount of water losses, in m3/day | % REDUCTION |
|---|---|---|---|---|---|---|---|
| 1/11/2019 | 13 | 700 | 7,8 | 21,9 | 170 | | |
| 24/11/2019 | 23 | 900 | 16,3 | 21,9 | 360 | **190** | 112% |
| 30/11/2019 | 8 | 545 | 3,9 | 21,9 | 90 | **-270** | -75% |
| **Water loss reduction** | **270** | **m3/day** | | | | | |
| **Unit Cost of Water** | **0,82** | **Euro/day** | | | | | |
| **Total Savings** | **221** | **Euro/day** | | | | | |

**COST OF PRODUCTION IN DESALINATION PLANTS**

| | | | |
|---|---|---|---|
| **1.220** | **Desalinated water production Power Consumption (kWh** | 4,52 | kWh/m3 |
| **104** | **Desalinated water production Energy Cost (EURO/day)** | 0,08519 | EURO/kWh |

Reduction in water losses due to the location of 3 unreported leakage incidents in supply connection (no.2) and distribution pipes (no.1) through the patrol of 130 Permalogs installed in the distribution network of Area 20, during November 2019.

# Ex-post – PIs (2019 base year)

| | Energy Production / Energy reduced (Kwh/year) | Cost Savings(€/year) | Cost of equipment (€) | Time of depreciation (years) |
|---|---|---|---|---|
| **DEYAL** | 9.307.500 | 22.947€ | 129.000€ | 5,62 |
| **DEYAK** | 785 | 80€ | 18.800€ | 235,00 |
| **WBN** | - | - | 15.600€ | - |



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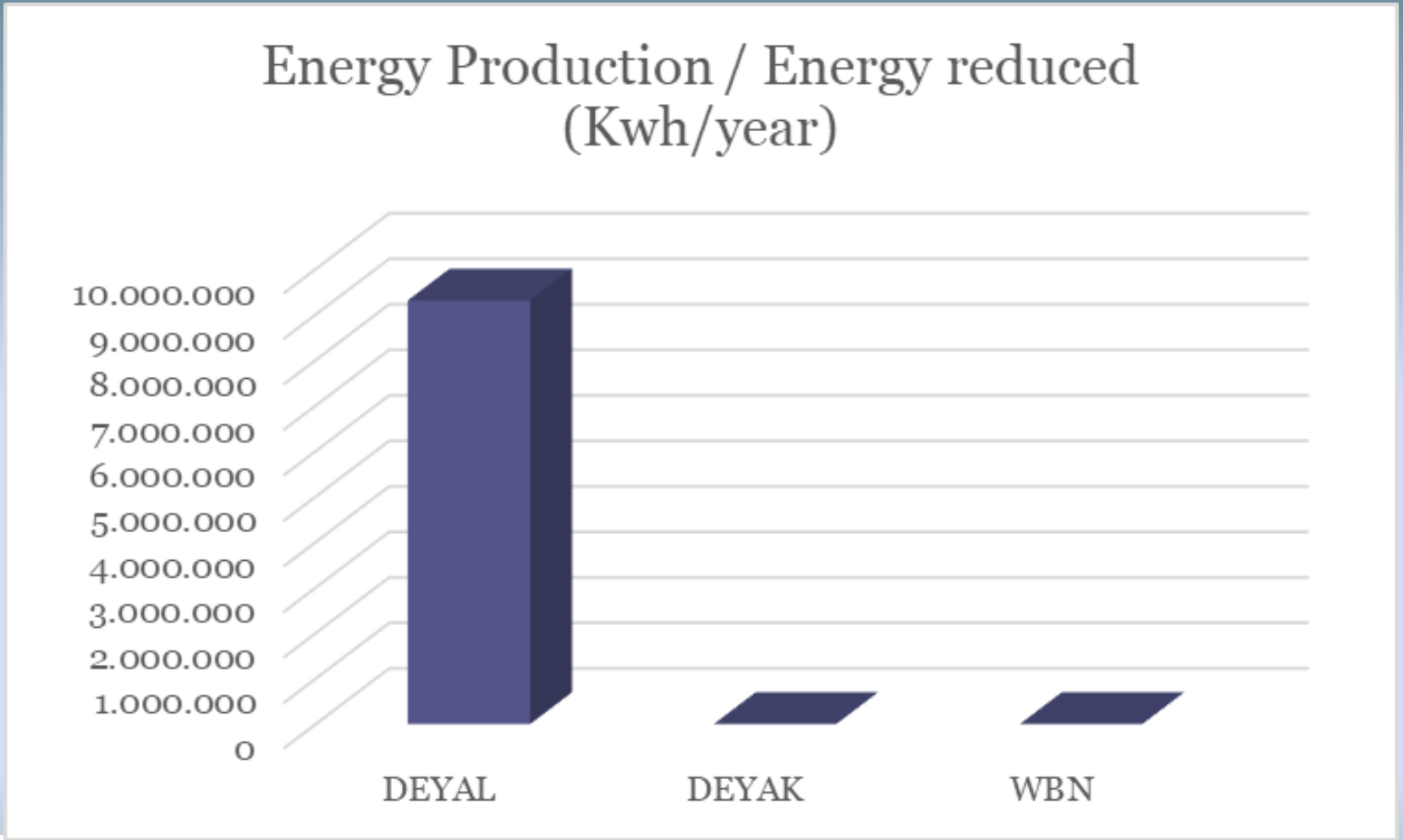
# Ex-post – PIs (2019 base year)



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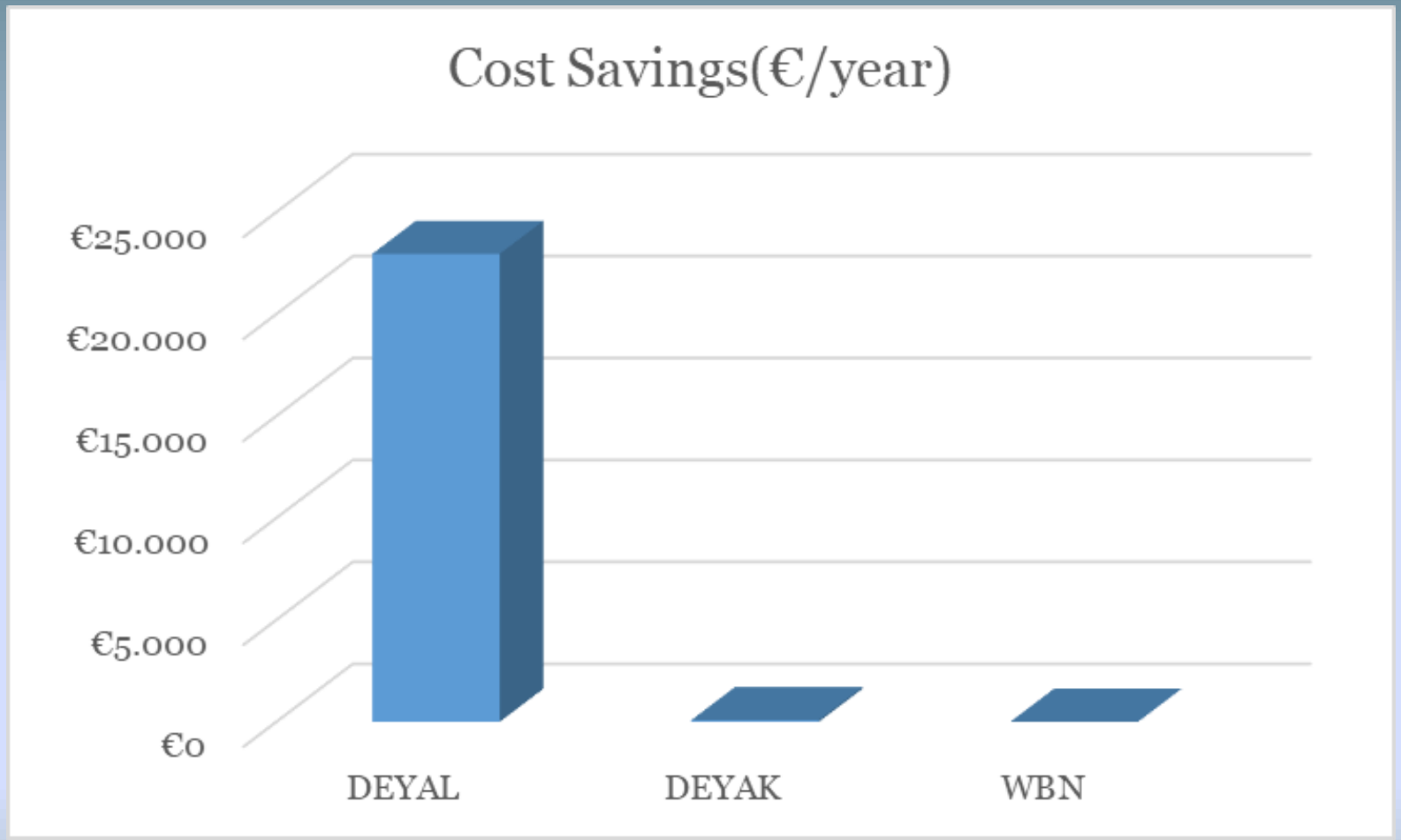
# Ex-post – PIs (2019 base year)

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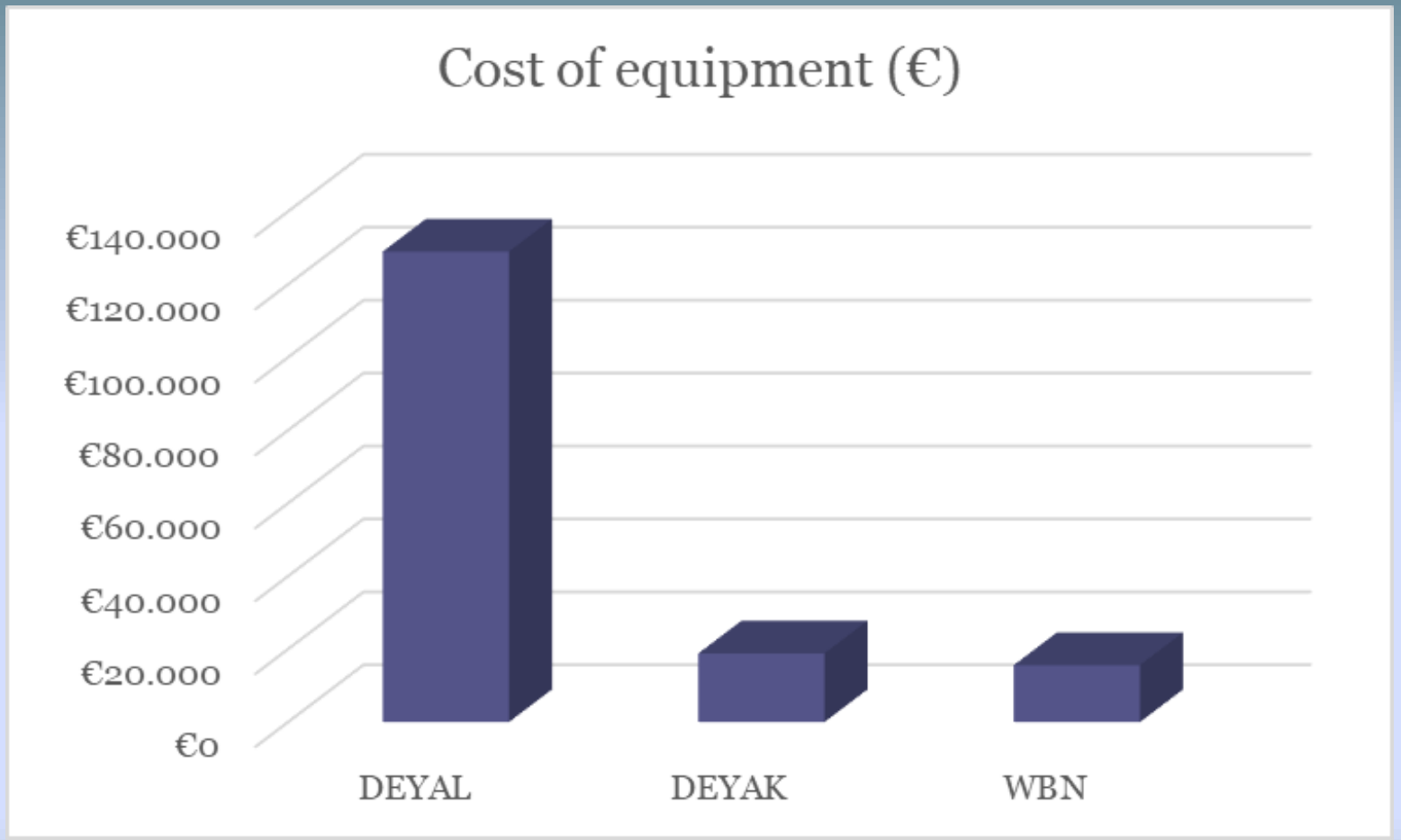
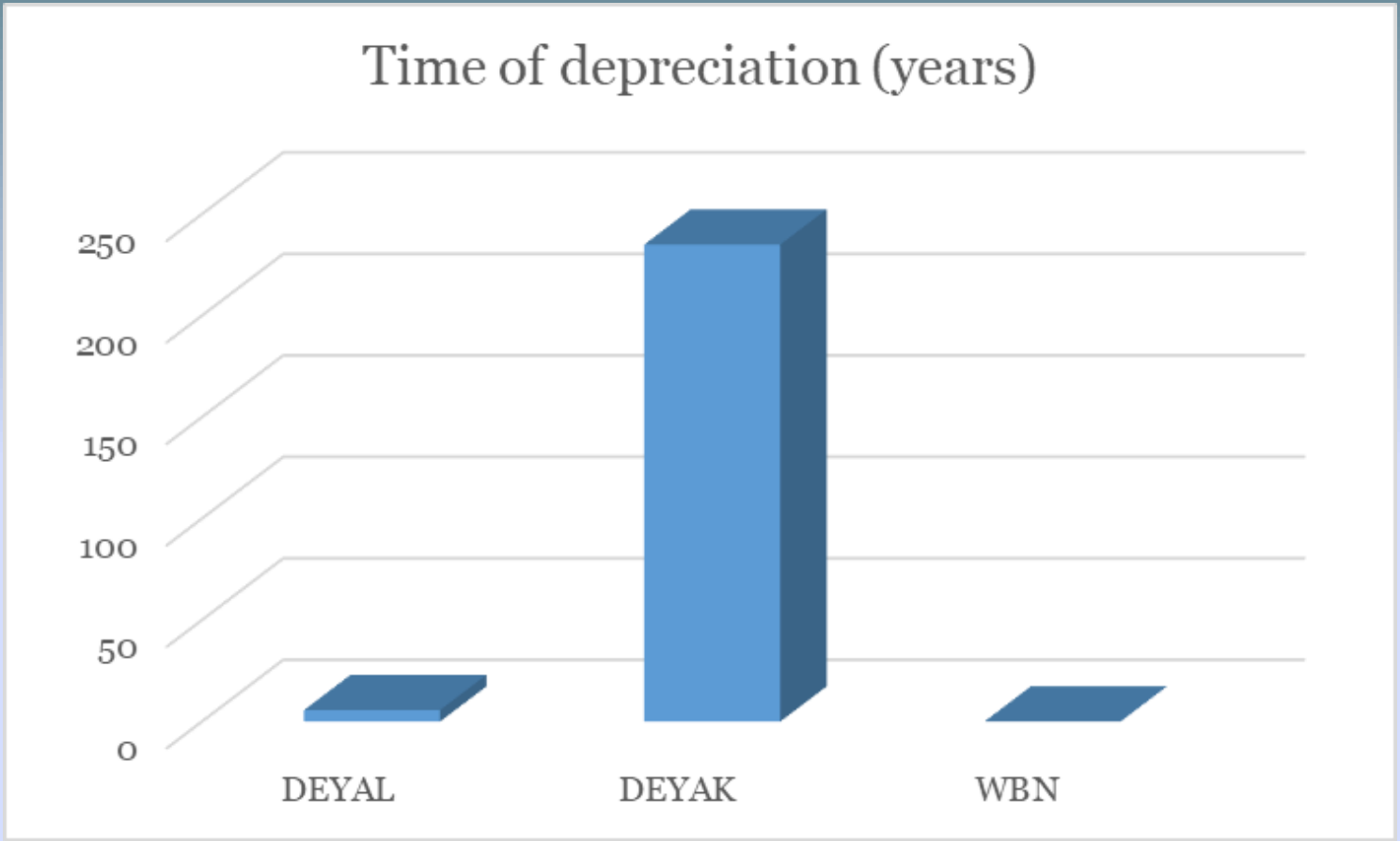
# Ex-post – cost of equipment



# Ex-post – depreciation period

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# Ex-post – Conclusions

- In **DEYAL pilot case**, the results showed that the installation of this equipment is worthwhile and should take place in all pumping stations.

- In **DEYAK pilot case**, it turned out that the energy produced is very small, so the investment is not worthy. The application of these small devices will be useful only in case of remote flow meters, where there is no constant power supply and not enough sunshine to install small photovoltaics.

- In **WBN pilot case**, the results in energy production are the same as in Kozani. However, it turned out that their installation is advantageous only for the replacement of batteries, where there is no constant power supply.



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