

WATenERgy CYCLE

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

WP3 Transnational Current Situation Analysis

Joint Del. 3.2 Water & Energy Audit



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

WP3: Transnational Current Situation Analysis

- Responsible partner: PP4 - University of Thessaly-Special Account Funds for Research-Department of Civil Engineering
- Partners involved: ALL
- Budget: 77,817.51 €

WP3.2: Water & Energy Audit

Water Audit:

- parameters for the water networks such as: general info & characteristics for the water distribution network (no of people supplied; area; km of pipes; SCADA; GIS; hydraulic simulation model; maintenance practices; etc.),
- parameters to estimate the water balance (SIV; consumption; seasonal fluctuations; etc.),
- parameters for specific indicators (PIs) regarding water efficiency (NRW by volume; real losses per km; ILI; ALI; etc.).

Energy audit:

- this deliverable summarizes data about the pumping energy consumption, the energy recovery, the total electrical energy consumption, and the electrical energy consumption at every phase of the full urban water system (abstraction, supply, raw water treatment, storage, distribution, administration)

Water Audit – National Level

- General data

Data	Greece	Bulgaria	Albania	North Macedonia	
Total population	10,815,197	5,204,385	2,876,591	2,000,081	
Total area covered (km ²)	131,957	110,994	28,748	25,713	
Population density (inh / km ²)	83	47	101	82.2	
GDP	18,103.97\$ / capita	88,571BGN / capita		2.9% (2016 data from the Ministry of Finance)	
Water Demand (total)	9,564.1hm ³	4,721hm ³	250Lt / capita	41.3m ³ per inhabitant	
Water demand by use	Agriculture	81.84%	7.5%	50Lt/day	44%
	Domestic	14.98%	5.5%	150Lt/day	11%
	Industrial	2.37%	85.6%	10Lt/day	14%
	Livestock farming	0.82%			

- Overview of the Water Supply Networks evaluation – National level

Data	Greece	Bulgaria	Albania	North Macedonia
NRW levels (average)	N/A	60.76%	67%	N/A
Benchmarking existing	NO	YES	YES	NO
NRW levels (locally)	25-58%	49.8%; 41.9%	27-79%	N/A

Water Audit – Regional / Local Level

General Data	Larissa (GR)	Kozani (GR)	Korca (AL)	WBN (CY)	Prilep (N. Macedonia)
Total population served	208,500	71,388	112,500	290,000	75,019
Total area covered (Km ²)	122.586	366.018	500.00	89.00	1,194.44
Total pipes' length (Km)	1,078	928.31 distribution pipes (+330.16 external network)	284.52	1,492	239.04
Mean altitude (m)	67	710	1,000	120-350	670
Mean operating pressure (atm)	4.3	5.0	6.0	1.7-4.2	3.5
Age of pipes (per material, diameter)	1930-1970 pipe networks from cast iron; 1970 – today: steel & PVC; 2007 – today: PE	1930-1970 pipe networks from cast iron; 1970 – today: steel & PVC; 2007 – today: HDPE	PE after 2000; galvanized cast iron after 2000; other metals before 2000	AC, PVC 100-150 mm: 1,261 km; AC, PVC 200-800 mm: 231 km	Galvanised, Ductile iron 2218 m; Asbestos cement 94516m; Polyethylene (HDPE, MDPE) 62016m; PVC 6278m
No. of service connections	37,500	21,064	33,839	114,000 (meters)	N/A
Billing Period	2 months	4 months	monthly	2 months	Monthly
River Basin where water is taken from	Pinios River Basin: 3 ground water systems	Aliakmonas River Basin	Seman River Basin	Cyprus River Basin, desalination, dams	Vardar River Basin

Water Audit Results – Regional / Local Level

Operational data and problems identified

Operational data	Larissa (GR)	Kozani (GR)	Korca (AL)	WBN (CY)	Prilep (N. Macedonia)
Pressure zones	4 zones (control of night pressure)	3 zones	3 zones	Yes	6 low zones and 9 high zones
DMAs	No. Only 1 DMA	1 DMA	No	26 DMAs; 70 subzones	Yes
SCADA	60 local stations; 27 at the external aqueduct	39 local stations	Yes. Reservoirs	49 local stations	Yes
Simulation model	Yes	Yes	Yes	Yes	Yes (not being used)
Maintenance policy	Yes	Yes. Special software	Yes. Specific Maintenance Department, (4 Specialized Teams)	Yes	Yes. Department for plumbing & maintenance
Problems	NRW; leaks & breaks; aged water meters; service connections failures	High pressure; high NRW	Invisible water leaks (service connections)	pipe bursts; type, age and condition of the water mains	frequency of defects; old water supply network
Actions taken	Pressure management; replacement of service connections; replacement of water meters	DMAs formation; PRVs installation; pressure management	Monitoring; detect the problematic zone; divide to subzones; check house connections	locate unreported burst; speed and quality of repairs; improved pressure management; pipeline and assets management	Installation of PRVs; pressure management

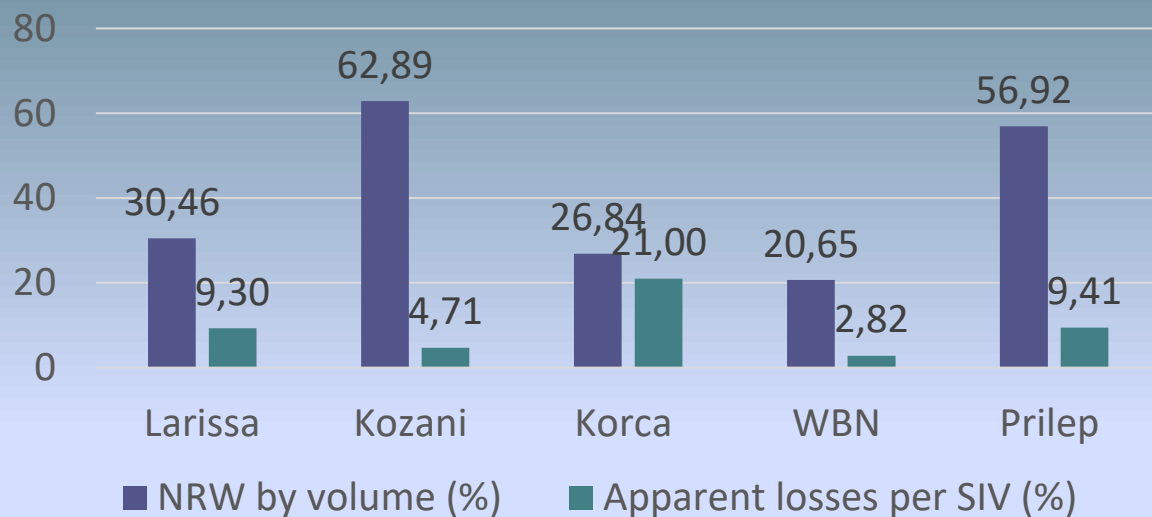
Water Audit Results – Regional / Local Level

Water Balance Results

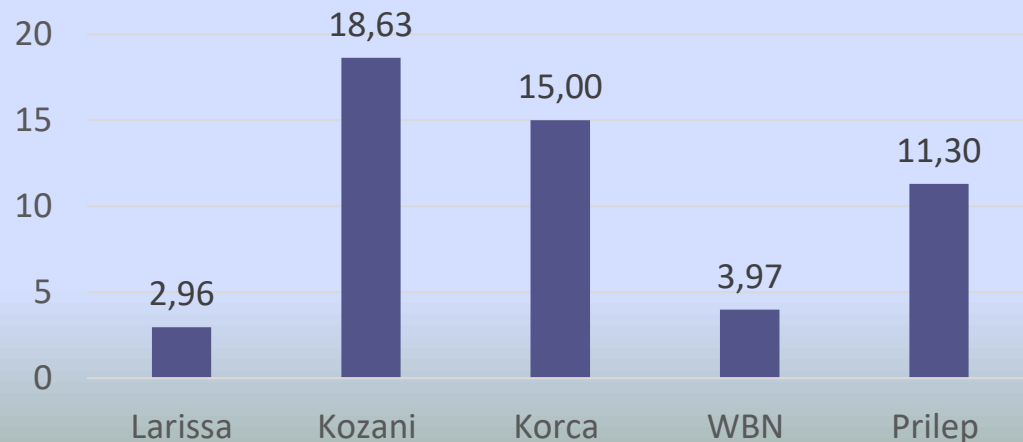
Water volumes (m ³)	Larissa (GR) 2016	Kozani (GR) 2015	Korca (AL) 2016	WBN (CY) 2016	Prilep (N. Macedonia) 2016
SIV	16,292,858	6,282,637	3,248,940	21,030,640	7,793,289
Authorized Consumption	12,257,904	2,354,520	2,406,218	16,782,320	3,395,071
Billed Authorized Consumption	11,329,034	2,331,208	2,405,618	16,687,890	3,357,446
Billed Metered Consumption	11,329,034	2,331,208	2,405,618	16,687,560	3,357,446
Billed Unmetered Consumption	0	0	0	330	0
Unbilled Authorized Consumption	928,870	23,312	600	94,430	37,625
Unbilled Metered Consumption	0	0	600	1,450	36,425
Unbilled Unmetered Consumption	928,870	23,312	0	92,980	1,200
Revenue Water	11,329,034	2,331,208	2,405,618	16,687,890	3,357,446
Water Losses	4,034,954	3,928,117	842,722	4,248,320	4,398,218
Apparent Losses	1,522,413	295,947	340,381	525,760	733,574
Unauthorized Consumption	162,929	62,826	8,000	105,150	700,000
Meter and Metering Errors	1,359,484	233,121	332,381	420,610	33,574
Real Losses	2,512,541	3,632,170	502,341	3,722,560	3,664,644
NRW	4,963,824	3,951,429	843,322	4,342,750	4,435,843
Water billed but NOT PAID for (apparent NRW)		151,529		8,000	15,000
MCD	2,965,128	311,111		3,879,410	480,000
Accounted-for NRW	1,998,696	3,640,318		463,340	3,955,843
Revenue Water (water billed & paid for)		2,179,679		16,679,890	3,342,446

Water Audit Results – Regional / Local Level

WB assessment and PIs



Infrastructure Leakage Index (ILI)



Water Audit Results – Regional / Local Level

- NRW levels range from 20.65% of SIV in WBN to 62.89% of SIV in DEYAK
- Apparent Losses per SIV range from 2.50% in WBN to 10.48 in UKKO
- It must be stressed that apparent losses are estimated using hypotheses
- Real Losses are the major part of NRW, ranging from 50.6% of NRW (DEYAL) to 91.9% (DEYAK)
- The use of the 2nd modified WB revealed that although NRW values are high (20.65% - 62.89%), due to the fixed charge existing in water bills, accounted-for-NRW levels range from 2.20% of SIV (WBN) to 57.94% (DEYAK)

Water Audit Results – Regional / Local Level

- The results showed that real losses per connection range from 22.47 lt/connection/day (UKKO) to 472.72 (DEYAK)
- Real losses per mains length range from 4.21 m³/km/day (UKKO) to 46.97 (DEYAK)
- ILI values range from 2.96 (DEYAL) to 18.63 (DEYAK)

Energy Audit Results – Regional / Local Level

Total Energy and Pumping Energy consumption

2015	Larissa (Greece)	Kozani (Greece)	Korca (Albania)	Nicosia (Cyprus)	Prilep (N. Macedonia)
Total Energy Consumption	18,347,092kWh	22.097.359 kWh	2,654,402kWh	-	-
Energy Consumption for Pumping	9,668,931kWh	19.439.201 kWh	2.497,162kWh	-	-

2016	Larissa (Greece)	Kozani (Greece)	Korca (Albania)	Nicosia (Cyprus)	Prilep (N. Macedonia)
Total Energy Consumption	17,841,770kWh	20,040,414 kWh	2,525,071kWh	-	26,989 kWh
Energy Consumption for Pumping	9,251,020kWh	19,439,201 kWh	1.963,187kWh	-	26,989 kWh

Energy Audit Results – Regional / Local Level

Total Electricity Cost & Total Pumping Energy Cost

Electricity Cost (Total)	Larissa (Greece)	Kozani (Greece)	Korca (Albania)	Nicosia (Cyprus)	Prilep (N. Macedonia)
2015	1,716,293 €	2,471,715 €	361,489 €	No data	3,535,109den /57,415 €
2016	1,573,744 €	2,174,385 €	383,976 €	No data	2,481,993den /40,311 €

Electricity Cost (Pumping)	Larissa (Greece)	Kozani (Greece)	Korca (Albania)	Nicosia (Cyprus)	Prilep (N. Macedonia)
2015	No data	2,397,563 €	212,868 €	No data	No data
2016	No data	2,109,153 €	217,824 €	No data	No data

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