LIETUVOS IR ŠVEICARIJOS BENDRADARBIAVIMO PROGRAMA

LITHUANIAN-SWISS COOPERATION PROGRAMME

CIRCULAR ECONOMY – CLOSING MATERIAL AND ENERGY FLOWS IN INDUSTRY EFFICIENTLY

Improving efficiency of water supply systems through water loss reduction measures

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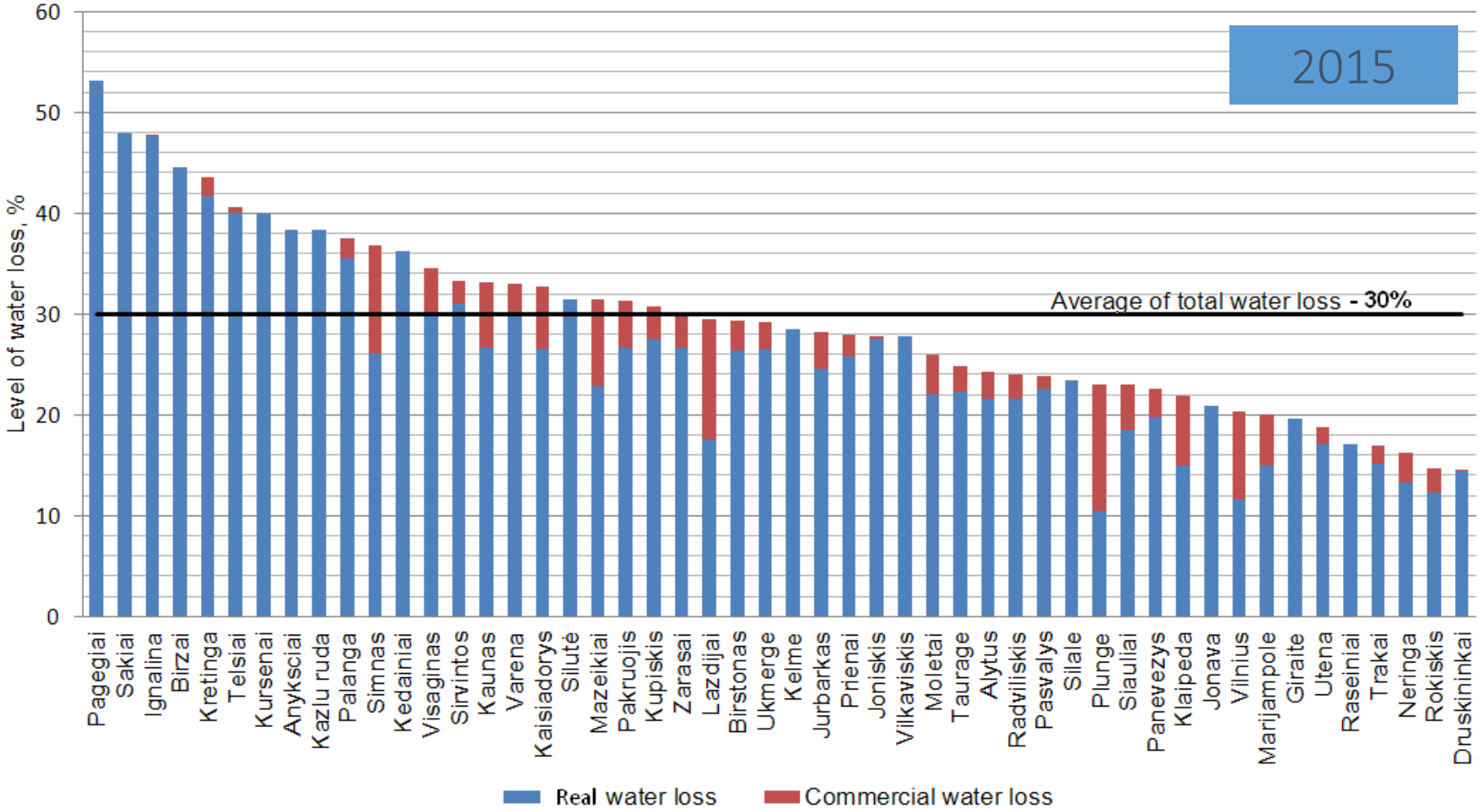
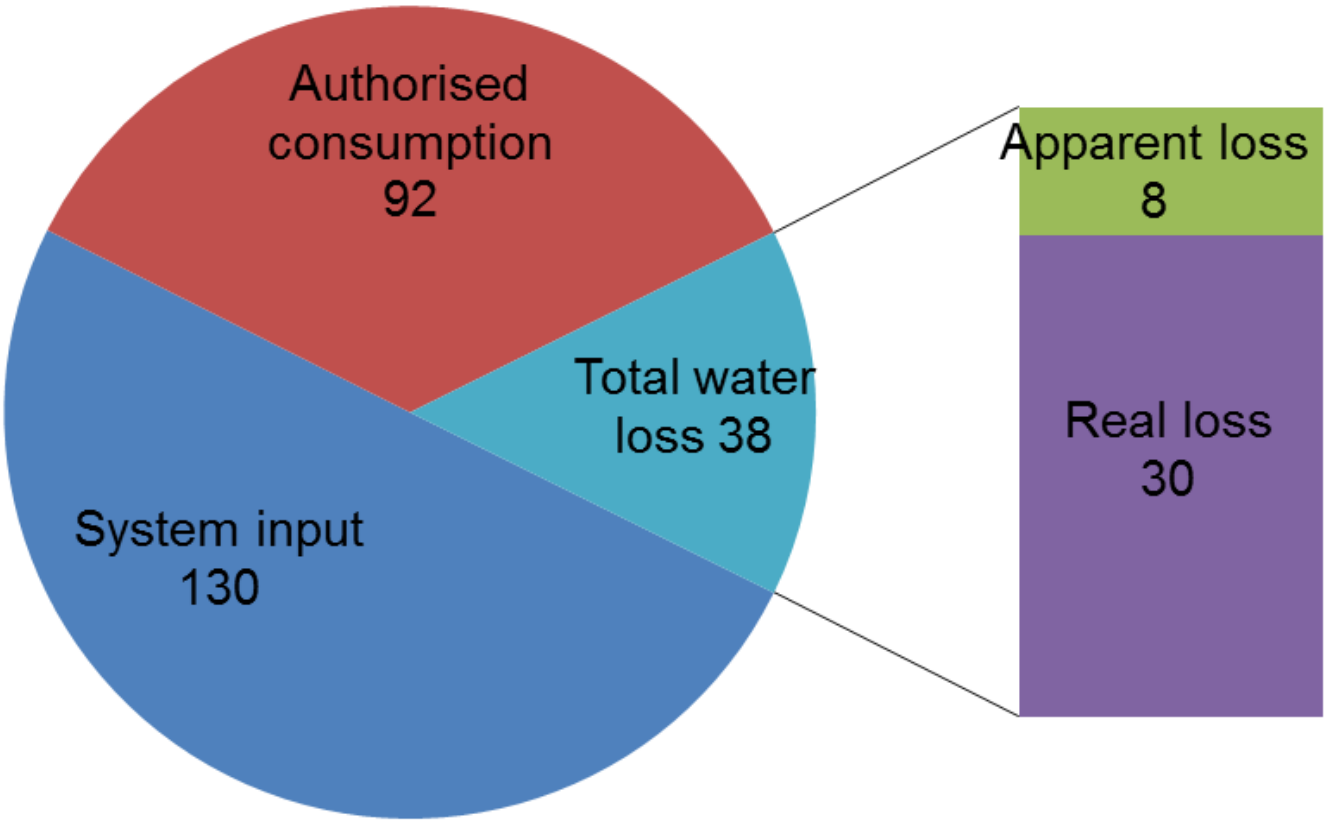
Introduction

- Water is the most important resource for human.
- But water is one of most wasted resource on earth.
- One example: water distribution network.
- Non-Revenue Water is a crucial issue. European countries: 7% to 50% Water Loss in Water Utilities.
- NRW management is a complex issue…

Official data (LT) – water losses %



Water volumes (mio m^3/year), LT



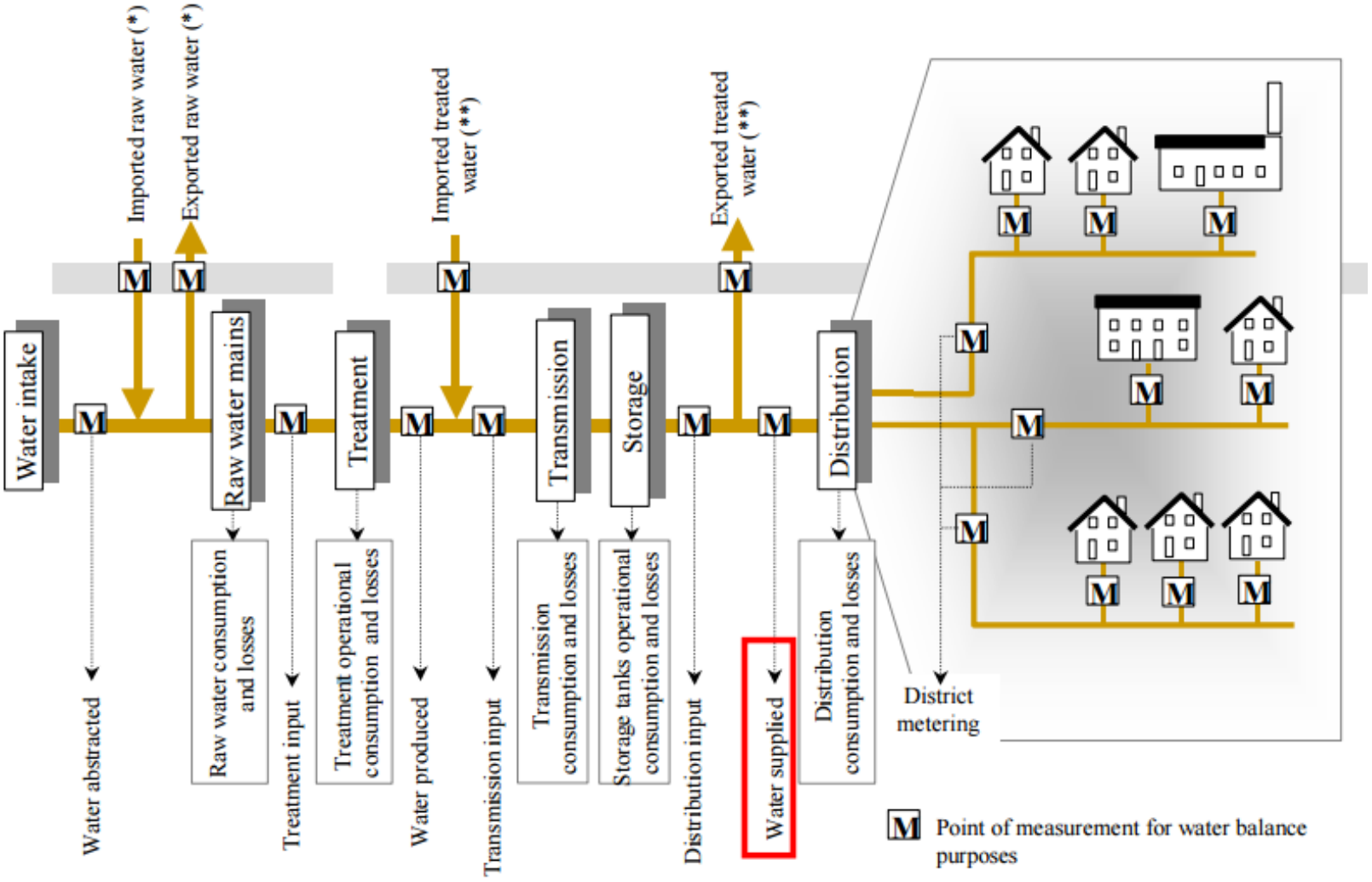
Why reduce water losses?

Hole ø = 6 mm
Pressure = 50 m
» Leakage = 43.2 m³/d

Olympic size swimming pool
V = 2,500 m³
» Filled in less than 2 months

Per capita consumptions = 136 l/cap/d
Q = 317 x 136 l/cap/d = 43.2 m³/d
» Water for 317 persons

How to count water losses

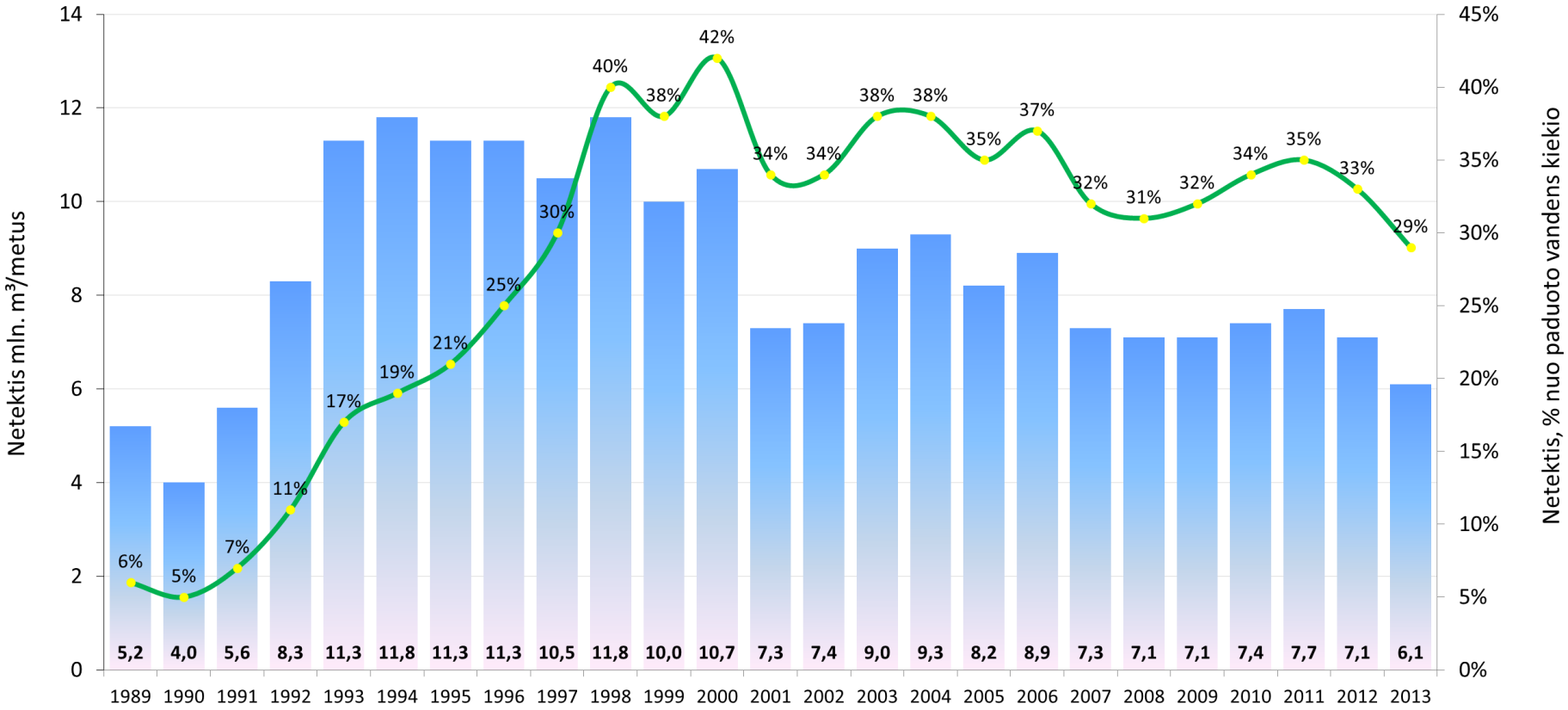


Evaluation in percentage
Kaunas case

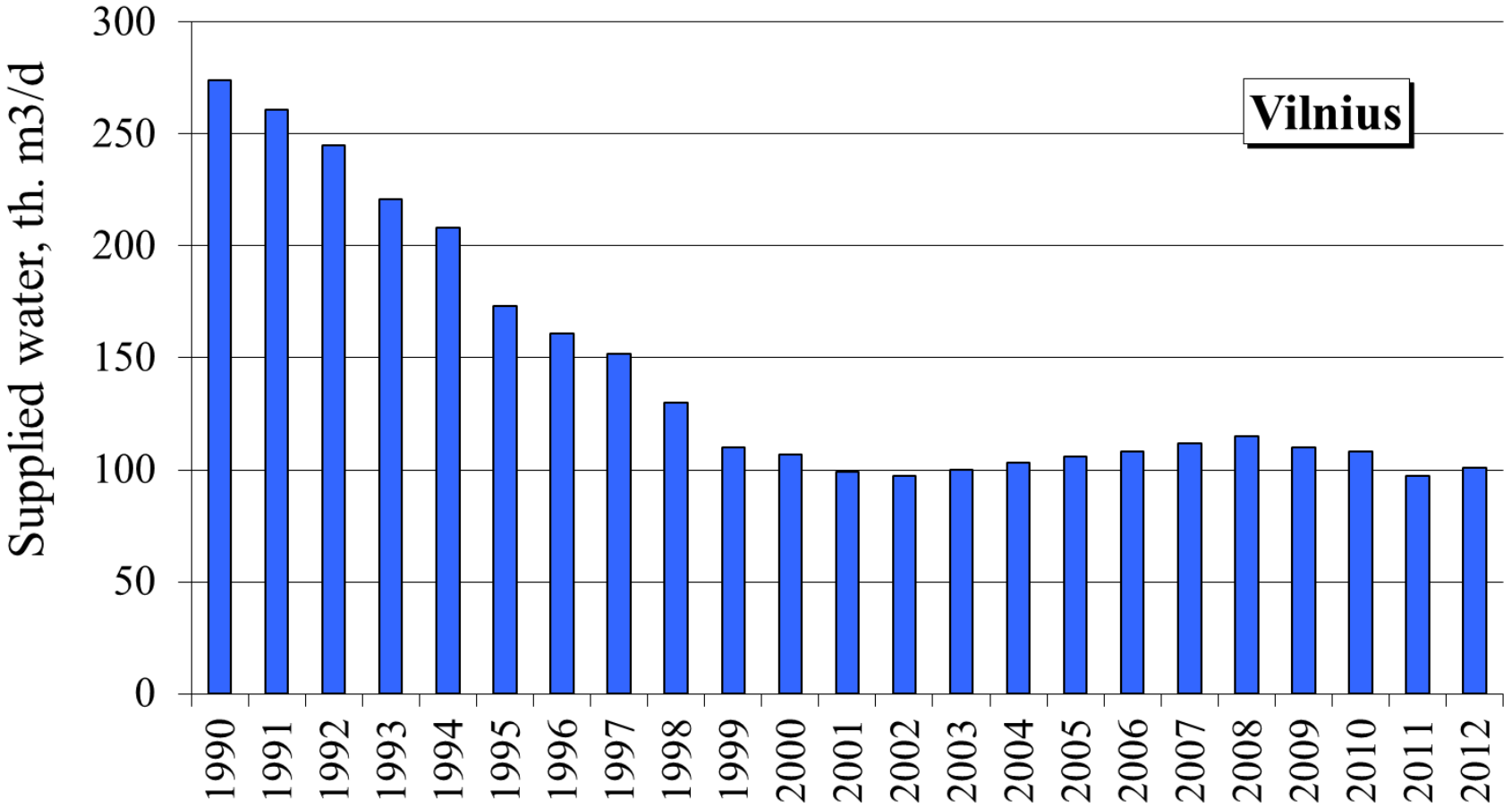
- 1992 – losses only 11%
- 2013 – losses event 29%

… but, lost water ????

- 8,3 mln. m^3/year
- 6,1 mln. m^3/year



Changes in water consumption

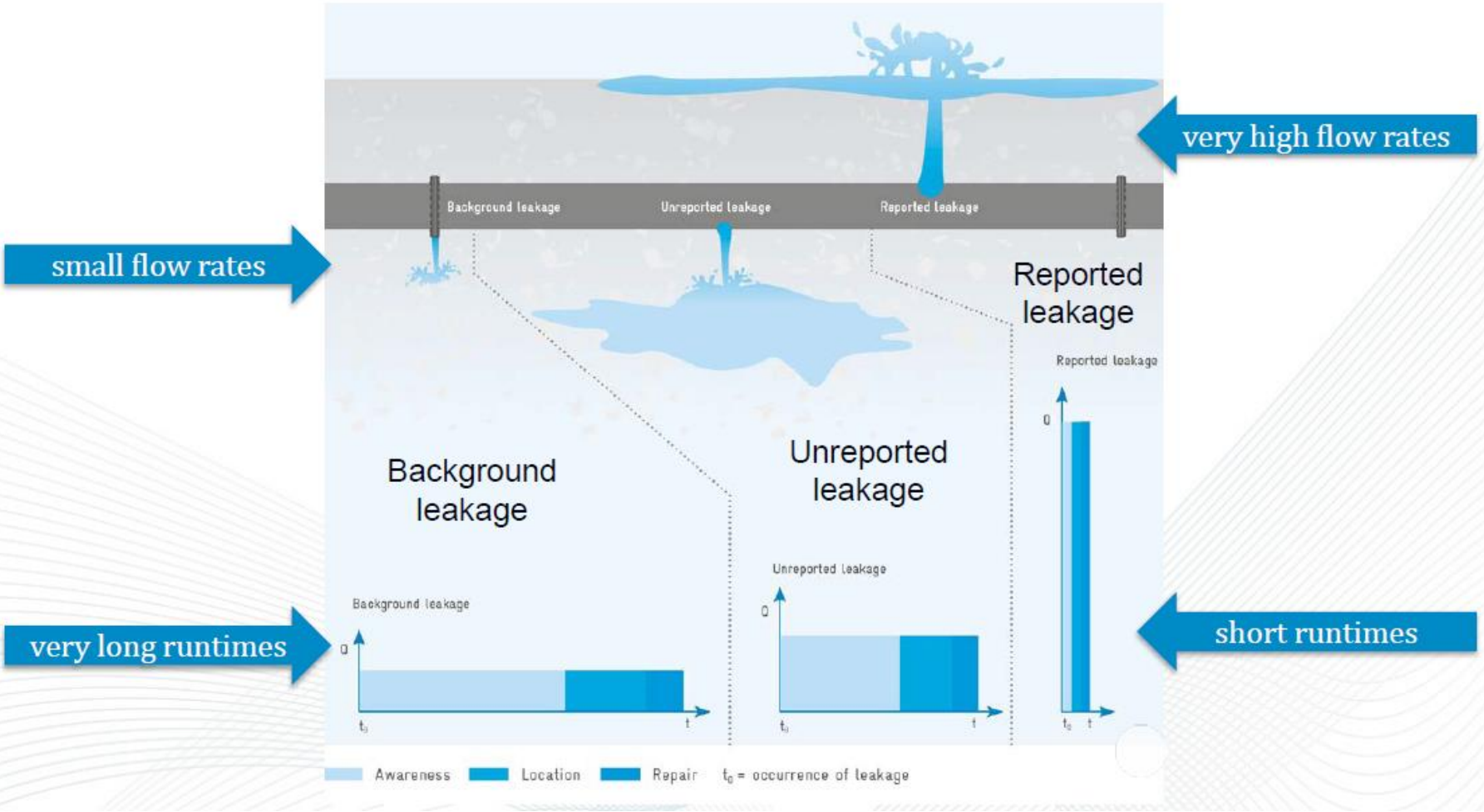


Basic terms and definitions

Water losses: The volume of water lost between the point of supply and the customer due to various reasons.

- Real losses
  - Volume of water lost between the point of supply and the customer meter due to physical leaks from mains, pipes and valves and due to tank overflow.
- Apparent losses
  - Volume of water lost due to other factors, such as unauthorised consumption, metering inaccuracies and data handling errors.

Real water losses



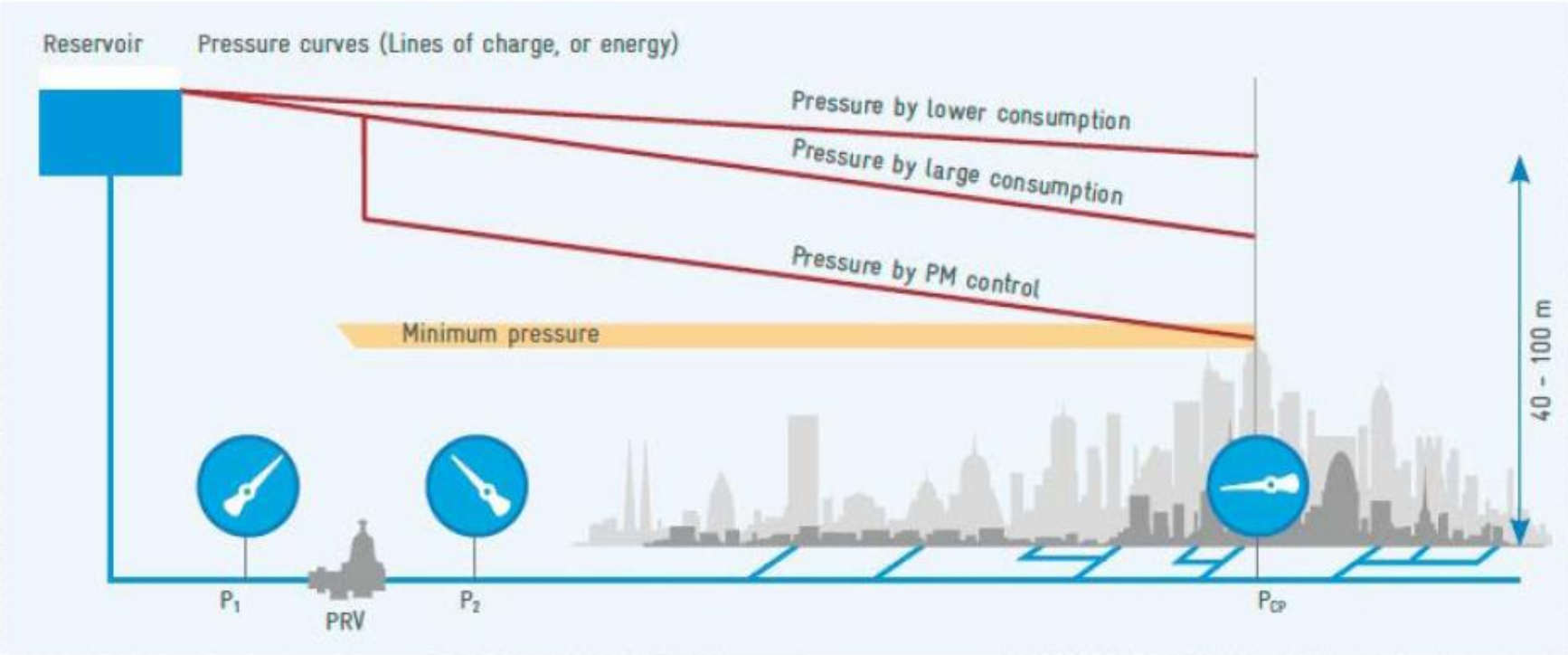
Importance and need for water loss management

- Reduced operational & capital costs
- Increased service life of water distribution systems
- Reduced health risks
- Increased security of supply
- Improved customer satisfaction
- Reduced ecologic stress
- Less infrastructure damages & repair efforts

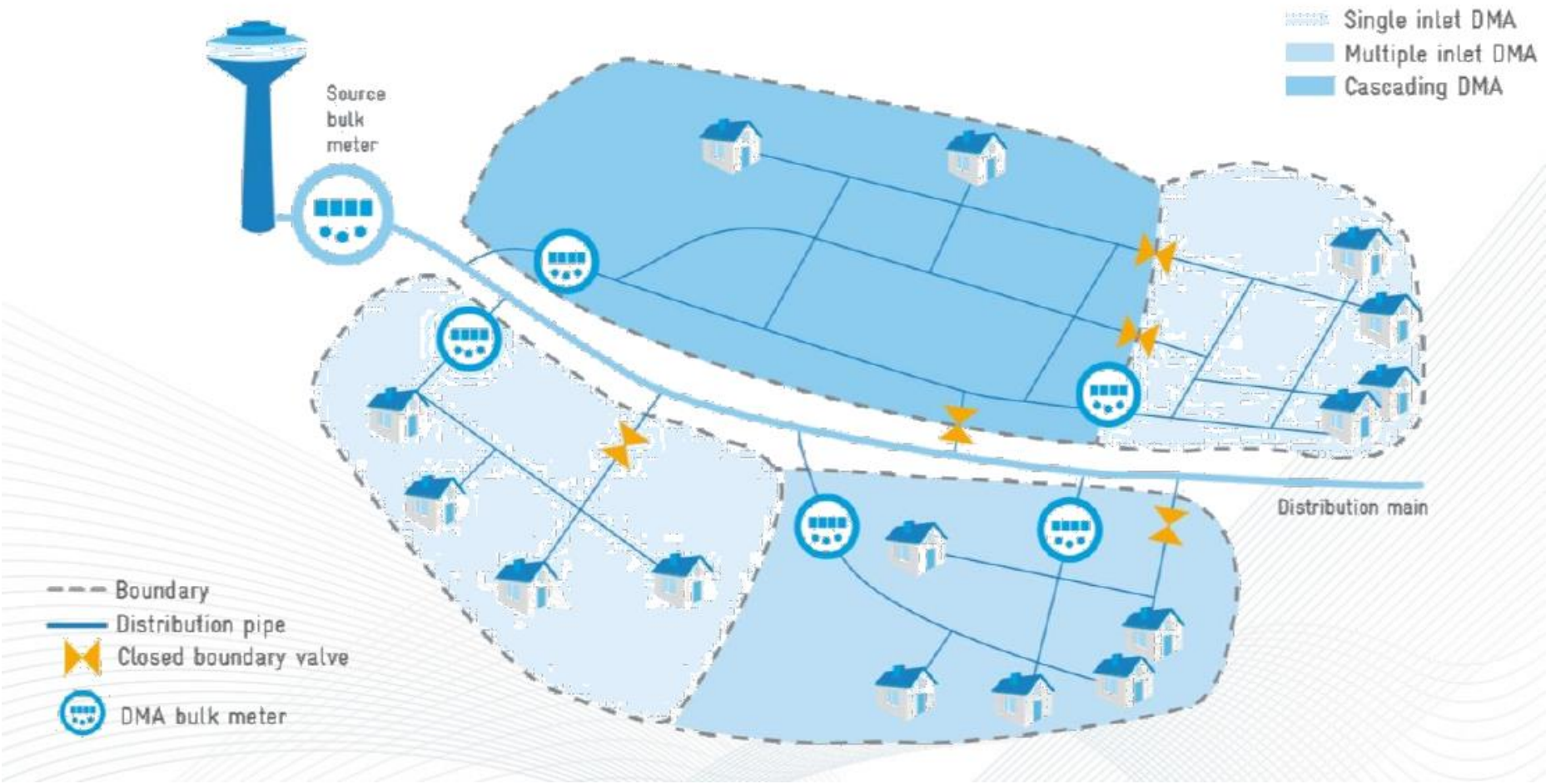
Strategies for Water Losses

Pressure management

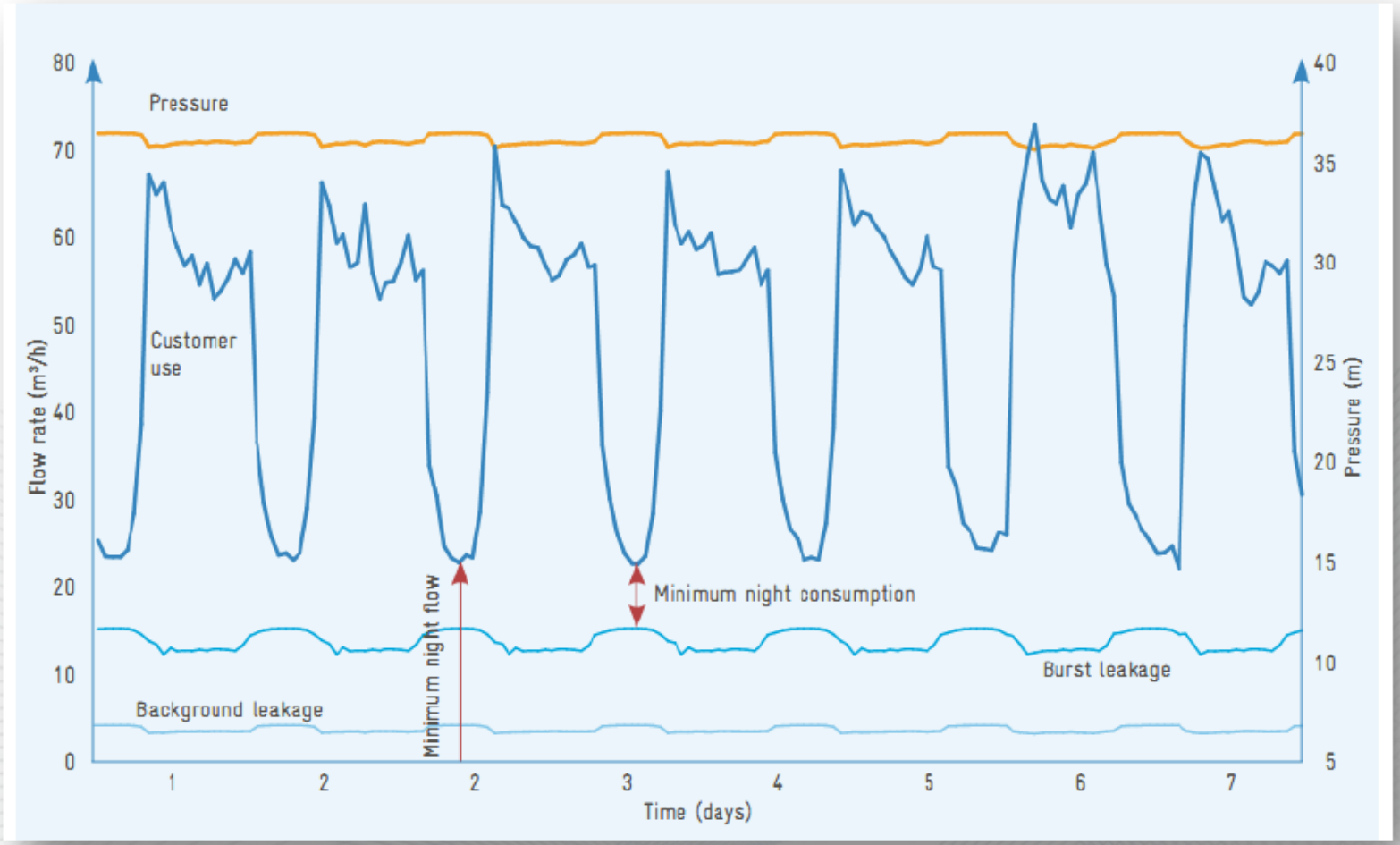
- Pressure management = Adjustment and control of water pressure in water supply systems to an optimum level.



Types of district metered areas

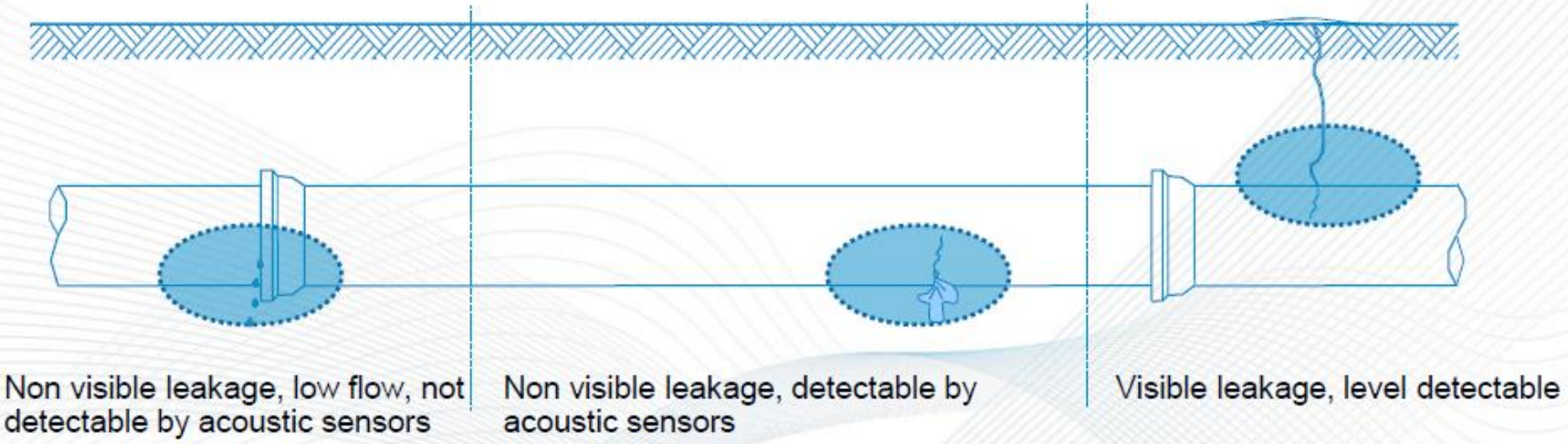


Operation and maintenance of DMAs



Pressure management

- Pressure reduction eliminates excess pressures systematically:
  - Number of pipe breaks directly depends on pressure rate
  - Pressure management is tackling the problem right at the source and does not relocate it within the system
  - Reduction of supply pressure leads to reduction of water losses at every leak in the district metered area (DMA).



Comparison between diaphragm and plunger valve

PRESSURE MANAGEMENT CONSTRUCTION KIT

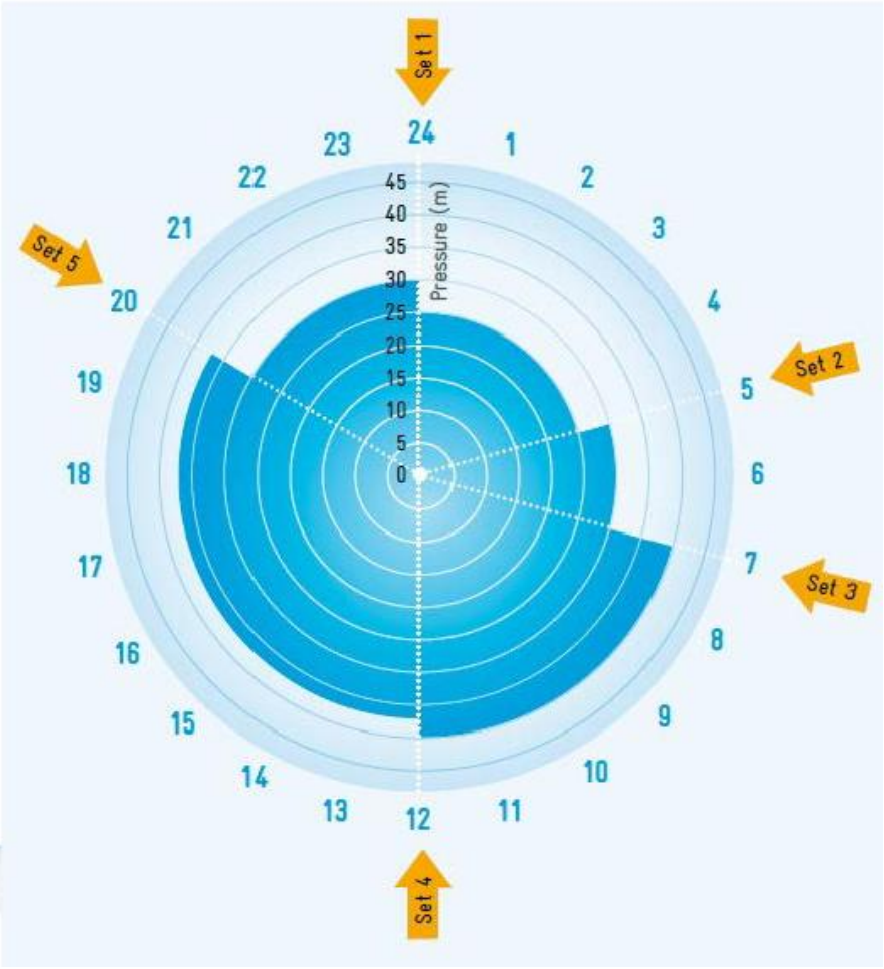
- Diaphragm valve
- Self actuated
- Interesting for pipe sizes < DN300
- No power supply required

- Plunger valve
- Precise control characteristic
- Maintenance free
- Cavitation free
- Especially interesting for pipes ≥ DN300

Modulation type – time-based

- **Time-based** - allows higher downstream pressure P_2 to be set for daytime and lower pressure at night when consumption decreases.

Setting	Time (hh:mm)	Pressure (m)
Set 1	0:00	25
Set 2	5:00	30
Set 3	7:00	40
Set 4	12:00	38
Set 5	20:00	30



Development of Water Utility Compass

- Holistic and easy-to-use Excel Tool to support calculation, WU-efficiency assessment, identification of measures and action planning.
- Baseline data: data input, calculation of IWA water balance and performance indicators.
- Includes error estimations and calculation (95% confidence limit).
- Situation analysis: water utility efficiency assessment.
- Based on a self-assessment questionnaire.
- Action plan: strategic objectives, pre-selected measures, reporting.
- Learning: general information, benchmarks.

Baseline data

System Input Volume		Authorized Consumption		Billed Authorized Consumption		Billed Metered Consumption		Revenue Water	
3'074'753.0 [m³*a⁻¹]	2.0 [%]	2'371'034.0 [m³*a⁻¹]	2.0 [%]	2'370'064.0 [m³*a⁻¹]	2.0 [%]	2'365'864.0 [m³*a⁻¹]	2.0 [%]	2'370'064.0 [m³*a⁻¹]	2.0 [%]
						Billed Unmetered Consumption			
						4'200.0 [m³*a⁻¹]	25.0 [%]		

Water Losses
703'719.0 [m³*a⁻¹]

Real Losses

Performance indicator	Unit	Indicator value	Error [%]	Performing grade
ILI - Infrastructure Leakage Index	[-]	1.4	23.6	A
PMI	[-]	1.3	2.0	average
Real Losses per service conn. per m pressure (w.s.p.)	[l*conn^{-1}*d^{-1}*m H_2O^{-1}]	3.5	23.0	B
Real Losses per service conn. (w.s.p.)	[l*conn^{-1}*d^{-1}]	208.4	22.9	B
Losses per main	[l*km^{-1}*d^{-1}]	3214.1	22.9	good

Input:

Estimated value: 25% error

Metered value: 2% error

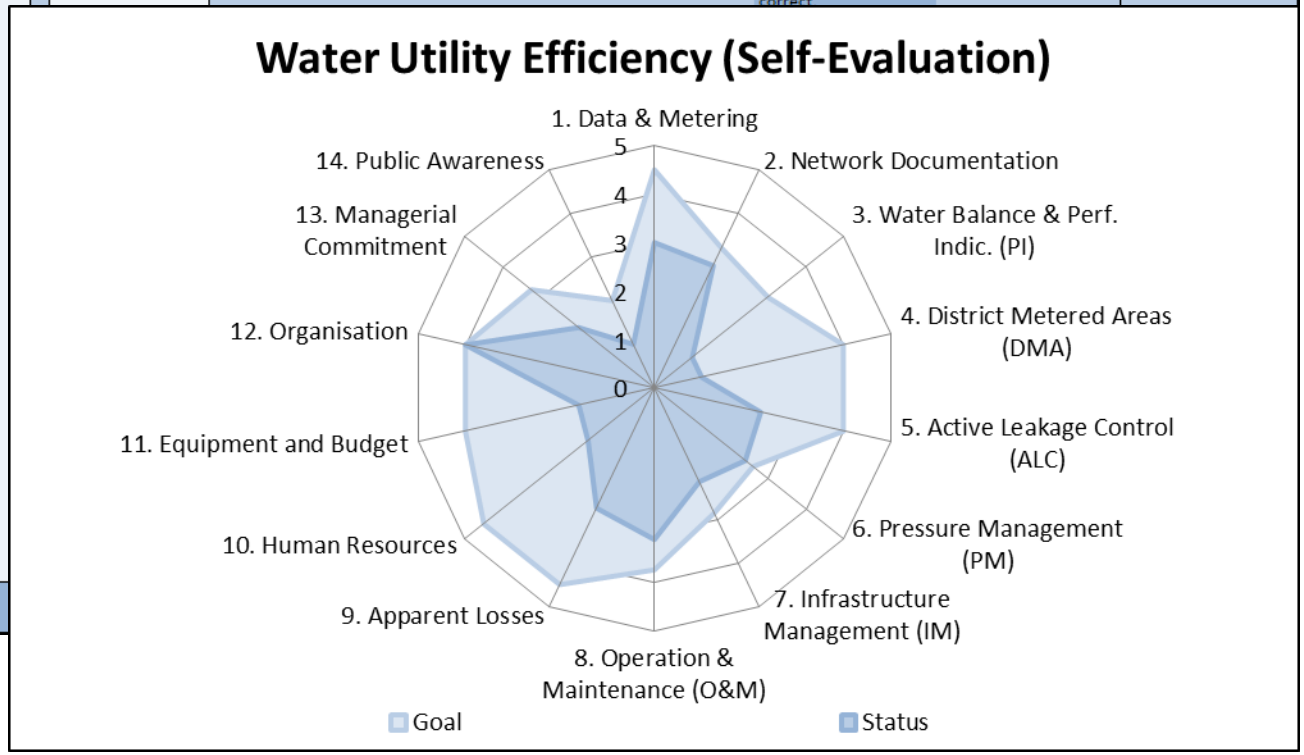
Computed values:

$$V_t = V_x + V_y \rightarrow E_t = \sqrt{(V_x * E_x/1.96)^2 + (V_y * E_y/1.96)^2} * 1.96/V_t$$

$$V_t = V_x * V_y \rightarrow E_t = \sqrt{{E_x}^2 + {E_y}^2}$$

Situation analysis: Questionnaire & Assessment

9. Apparent Losses	Self-Assessment		Efficiency Level					Reference
Issues / Questions	Your grade	Your goal	1 (poor)	2 (fair)	3 (average)	4 (good)	5 (excellent)	
9.1 Meter Installing	4	4	We do not expand our meter park. Unmetered areas remain unmetered.	We install some meters in unmetered areas but often do not calibrate and install them correctly.	We install some meters in unmetered areas and generally calibrate and install them correctly.	For most of the unmetered connections we install new water meters. Calibration and installation of the meters are mainly correct	We install new meters at unmetered connections and take care to calibrate and install our meters correctly.	
9.2 Meter Accuracy Testing	5							
9.3 Fraud: Illegal Connections, Meter Tampering, Bypasses	3							
9.4 Meter Reading and Data Transfer	2							
Performing grade [1-5]	**3.5**							



Action Plan

1. Define strategic objectives (up to 10)

Objectives

Number	Category	Title
1	6. Pressure Management (PM)	Focus on pressure management improvements
2	3. Water Balance & Perf. Indic. (PI)	Streamline water balance calculations
3	4. District Metered Areas (DMA)	Structure the network properly

2. Select measures from a list pre-filtered ones (Over 250 measures)

Objective 2 — **3. Water Balance & Perf. Indic. (PI)** — **Streamline water balance calculations**

Measures Filtered **Search filter:**

126 - Compute the confidence intervals for your water balance
145 - Determine accuracy and reliability of your water balance
152 - Establish a bottom-up analysis
275 - Regularly calculate apparent losses performance indicators
276 - Regularly calculate real losses performance indicators

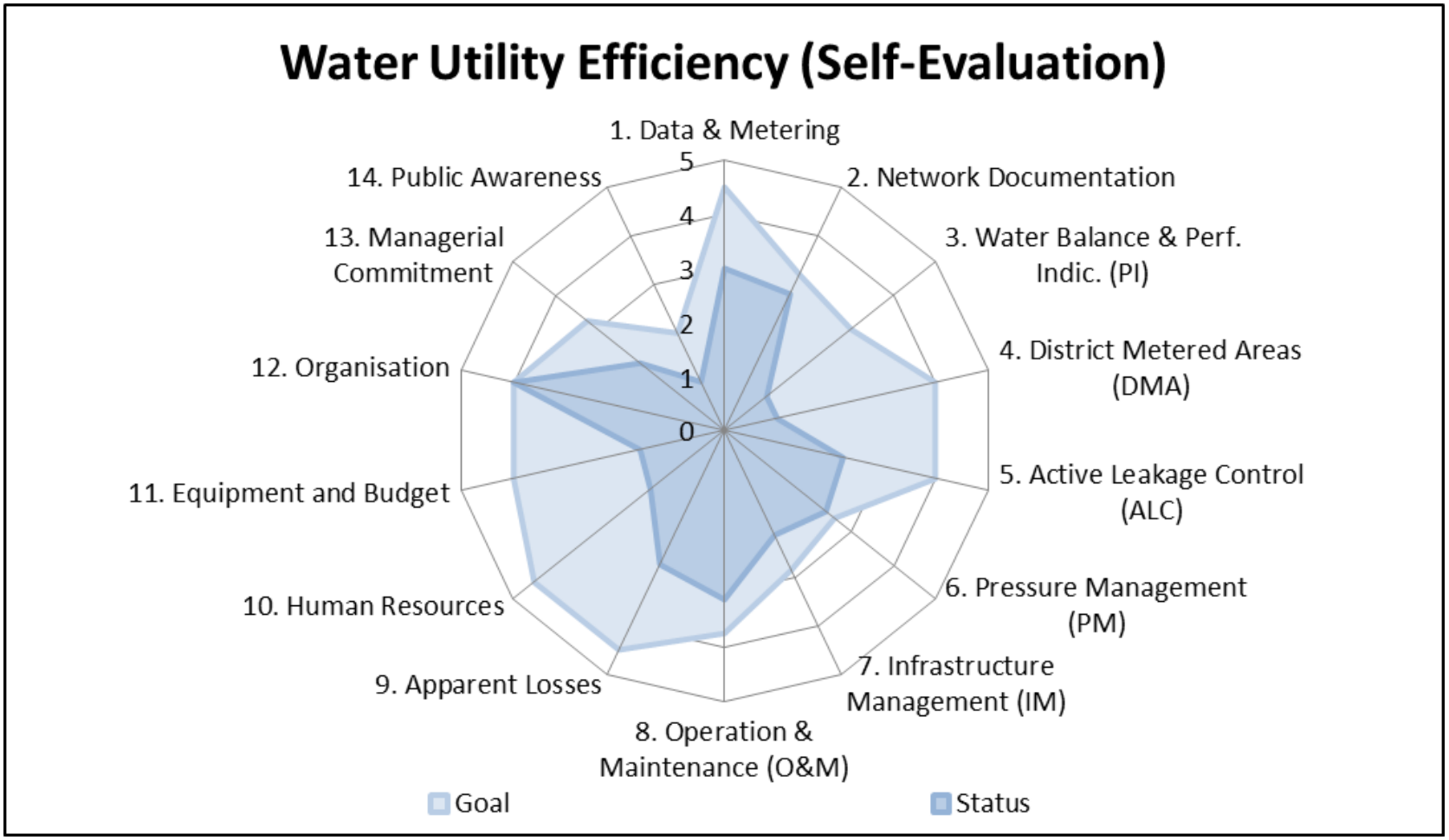
ID	Measures
275	Regularly ca
276	Regularly ca

3. Resulting action plan draft

Action plan

What	Details	Responsibility	Deadline
Objective 1	Focus on pressure management improvements		
Pressure management	Adjust the pressure in the network by using boosters and PRVs accordingly		
Pressure management	Increase the coverage of DMAs using pressure management and perform intensive funcitonal testing of the system		
Pressure management	Perform pressure management on the whole system and test it regularly and intensively		
Active Leakage Control (ALC)	Use pressure variations to localize leakage and water loss		
Objective 2	Streamline water balance calculations		
Performance Indicators	Regularly calculate apparent losses performance indicators		
Performance Indicators	Regularly calculate real losses performance indicators		
Objective 3	Structure the network properly		
DMA	Check boundary valves. Try to adapt DMA borders to natural boundaries. Use suitable meters and PRV's.		
DMA	Keep track of the type of custerms in the DMAs and create requirement lists for each type of customer.		

WU-Compass // Self-Evaluation Report // Alytus Water Utility (LT)



WU-Compass – Alytus Water Utility (LT)

- The holistic decision support system allows to prioritise and set up the action plan considering the 14 categories.

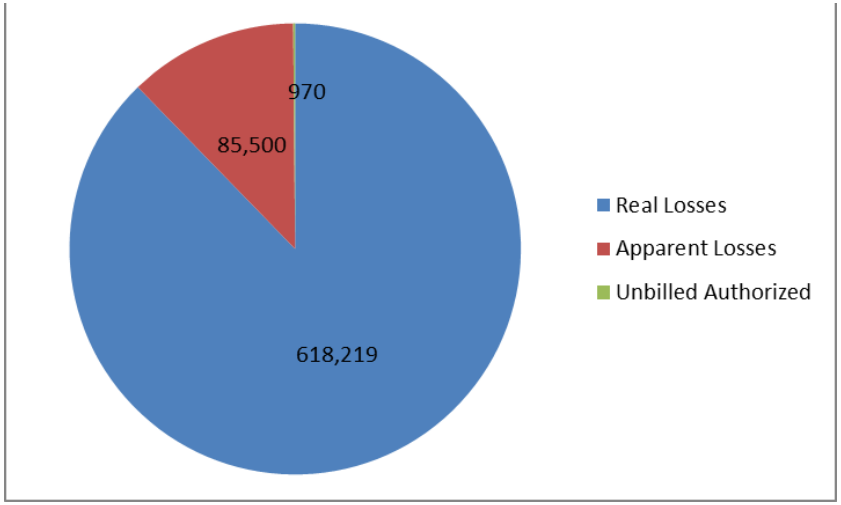
- Five categories for water reduction were selected, where the water utility has the weakest efficiency and the highest potential for improvement:
  - Category 4. **District Metered Areas (DMA);**
  - Category 5. **Active Leakage Control (ALC);**
  - Category 9. **Apparent losses;**
  - Category 10. **Human Resources;**
  - Category 11. **Equipment and budget.**

Category 4. District Metered Areas (DMA)

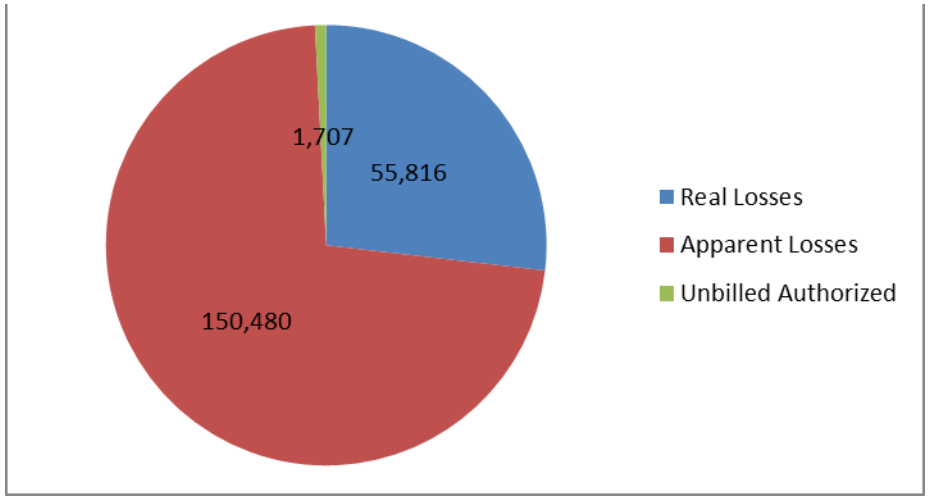
- Install appropriate size meter to measure the inflow to the DMA;
- Install logging equipment for continuous flow monitoring;
- Establish some DMAs and start analysing the data;
- Check boundary valves. Try to adapt DMA borders to natural boundaries. Use suitable meters and PRV's;
- Keep track of the type of customers in the DMAs and create requirement lists for each type of customer;
- Night step-testing (reducing the size of the area by closing valves);
- DMAs with minimum night flow measurement and calculation.

Data from Water Balance, Alytus WU (2011)

Annual water losses, m^3/yr.

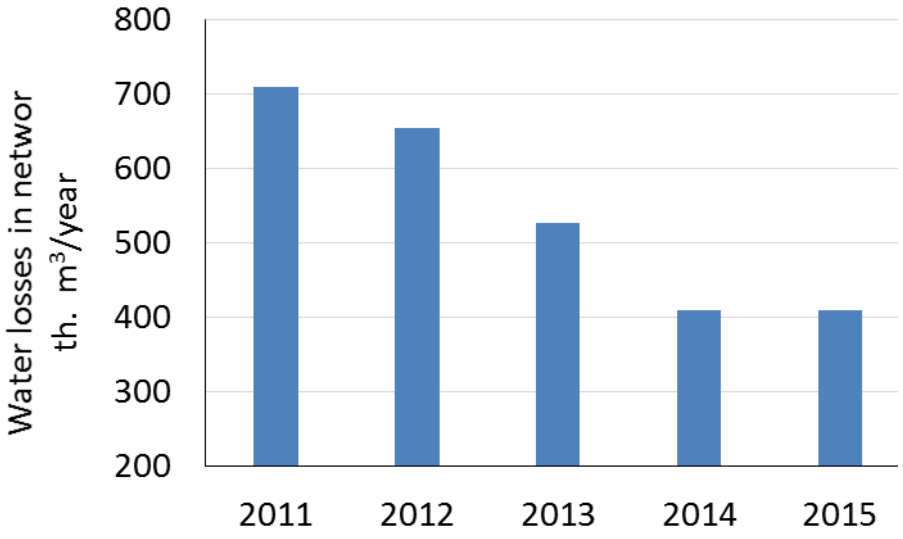


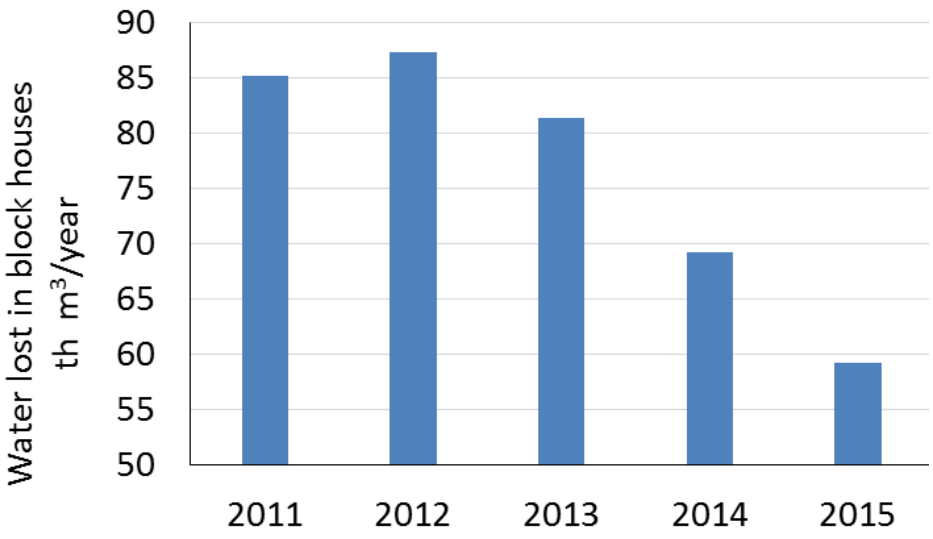
Annual saving potential Eur/yr.



Alytus Water Utility, LT (2011 – 2015)

- WU-Compass Tool helps the user to find appropriate measures.
- Find relationship of water loss components.
- Clarify the individual situation.
- Water Utility found the tool really useful.





Performance Indicators (2011 – 2015)

Performance Indicators	Value 2011	Value 2015	Grade 2011	Grade 2015
Infrastructure Leakage Index (ILI)	2.8	1.4	B	A
Pressure Management Index (PMI)	1.3	1.3	average	average
Real Losses per service connection *[l/conn./d]*	435	208	C	B
Losses per main *[l/km/d]*	6’530	3’214	good	good
Percentage of Non-Revenue Water	22.9	13.8	D	C
Apparent Losses per service connection *[l/conn./d]*	60	36	B	A
Apparent Losses Index (ALI)	0.7	0.5	A	A

Conclusions

- Perfect project.
- Good cooperation.
- New ideas.
- Cross-connection.