Non-revenue water

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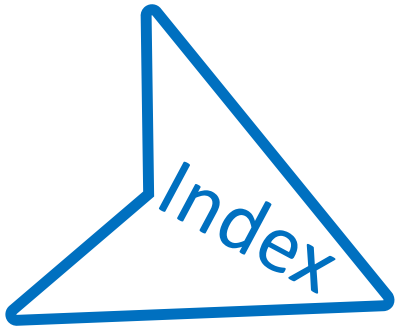
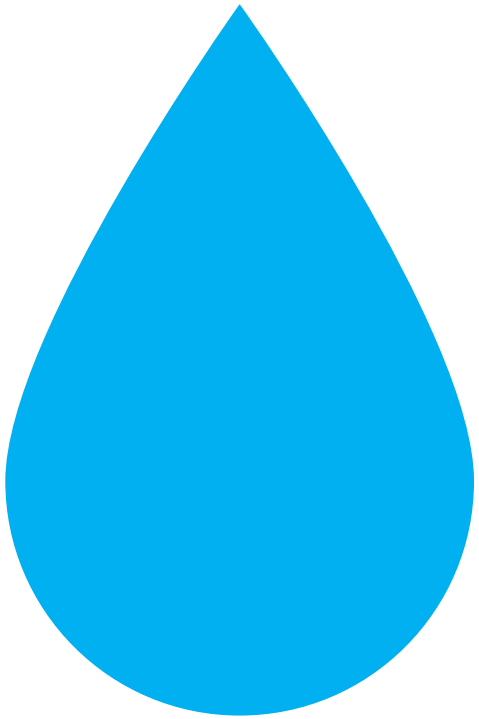


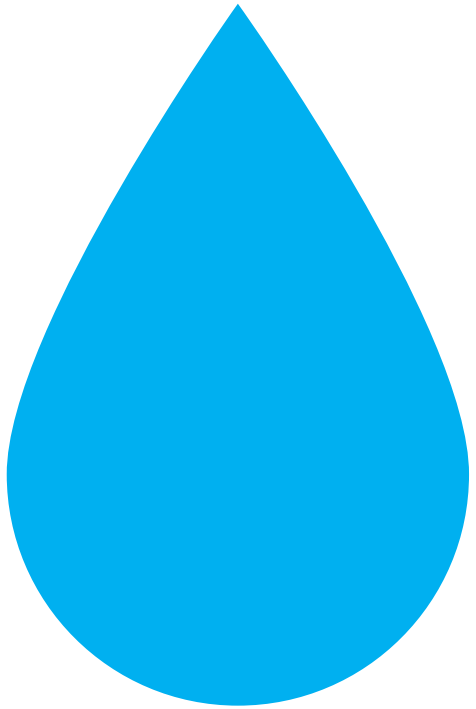
INTRODUCTION

Non-revenue water (NRW) is the difference between the amount of water that is produced by a water utility for consumption/use, and the amount of water that is billed to customers.

i.e., The Water that is pumped into the distribution network but not invoiced, and so does not generate revenue for the utility.



UNDERSTANDING NON-REVENUE WATER



Monitoring Water Flow

- Understanding the volume and distribution of water flow within the network is essential for managing non-revenue water.

Assessing Water Loss

- Assessing water loss through accurate metering techniques is crucial for identifying non-revenue water sources.

Identifying Leakages

- Proactively identifying and repairing leakages is key to reducing non-revenue water and ensuring efficient water distribution.

CAUSES OF NON-REVENUE WATER

Non-Revenue Water loss can be categorized into two main components: real losses and apparent losses

REAL (physical) LOSSES:

- Leaks
- Bursts
- Other physical issues within the distribution network

APPARENT LOSSES:

- Meter inaccuracies
- Unauthorized consumption
- Data handling errors

- **Water Theft**

  Water theft, such as unauthorized connections, contributes significantly to non-revenue water levels and must be addressed.

- **Aging Infrastructure**

  Aging pipelines and infrastructure are prone to leakages and bursts, causing non-revenue water and financial losses for utilities.

- **Illegal Connections**

  Illegal or informal water connections can lead to substantial non-revenue water and affect the financial sustainability of water utilities.

System Input Volume	Authorized Consumption	Billed Authorized Consumption	Billed Metered Consumption	Revenue Water
			Billed Unmetered Consumption	
		Unbilled Authorized Consumption	Unbilled Metered Consumption	Non-Revenue Water
			Unbilled Unmetered Consumption	
	Water Losses	Apparent Losses	Unauthorized Consumption	
			Metering Inaccuracies and Data Handling Errors	
		Real Losses	Leakage on Transmission and/or Distribution Mains	
			Leakage and Overflows at Utility's Storage Tanks	
			Leakage on Service Connections up to Point of Customer Metering	

IMPACT OF NON-REVENUE WATER

Financial Losses

- Non-revenue water results in significant financial losses for water utilities, impacting their ability to invest in infrastructure and services.

Water Scarcity

- High non-revenue water levels contribute to water scarcity, affecting communities and hindering sustainable development.

Infrastructure Maintenance

- Non-revenue water places additional strain on infrastructure maintenance, leading to increased costs and resource allocation challenges.

AMOUNT OF LOST WATER BECAUSE OF NRW

Although it is widely acknowledged that NRW levels in developing countries are very high, in fact, very few data are available in the literature regarding the actual figures, largely because most water utilities in the developing world do not have adequate monitoring systems for assessing water losses and many countries lack national reporting systems that collect and consolidate information on water utility performance. The result is that NRW data are usually not readily available, and when they are, they are not always reliable because it is common for the management of poorly performing utilities to practice “window dressing” in an attempt to conceal the extent of their own inefficiency.

The International Water Association (IWA) estimates that **34%** of all treated water worldwide is lost as NRW, amounting to about 346 million cubic meters per day or **126 billion cubic meters per year**. This represents a staggering economic loss of around **USD 39 billion annually.**

SOLUTIONS TO REDUCE NON-REVENUE WATER LOSS

REDUCING REAL LOSSES:

1. **LEAK DETECTION AND REPAIR:** This involves actively identifying and fixing leaks within the water distribution network. Technologies like acoustic leak detection, pressure loggers, and satellite imagery can be used to pinpoint leaks efficiently.
2. **INFRASTRUCTURE IMPROVEMENTS:** Upgrading aging pipes and infrastructure can significantly reduce leaks. These upgrades might involve replacing old materials with more durable ones, lining existing pipes, and improving jointing techniques.
3. **PRESSURE MANAGEMENT:** Optimizing water pressure in the system can minimize leaks caused by excessive pressure on pipes.

SOLUTIONS TO REDUCE NON-REVENUE WATER LOSS

Minimizing Apparent Losses

- **METERING IMPROVEMENTS:** Installing accurate and reliable meters for all customers ensures proper billing and reduces unbilled water use. This includes replacing old meters, implementing smart meters with remote reading capabilities, and addressing meter tampering.
- **BILLING SYSTEM IMPROVEMENTS:** Accurate billing systems help prevent errors and ensure customers are billed correctly. This involves regular data audits, addressing data inconsistencies, and implementing robust billing software.
- **CUSTOMER ENGAGEMENT:** Educating customers about NRW and encouraging water conservation behaviors can help reduce unauthorized water use and leaks on private property.

SOLUTIONS TO REDUCE NON-REVENUE WATER LOSS

Additional Strategies:

- **INVESTING IN NRW MANAGEMENT:** Allocate resources and expertise towards NRW reduction programs. This includes hiring dedicated staff, training personnel, and implementing NRW management software.
- **COLLABORATION:** Partnering with other water utilities, research institutions, and NGOs can share best practices and leverage collective expertise.
- **REGULATION AND ENFORCEMENT:** Implementing regulations and policies to penalize unauthorized water use and encourage responsible water management can incentivize adherence to NRW reduction practices.

Technologies for Non-Revenue Water Management

- **GIS Mapping for Analysis**

Geographic Information Systems (GIS) provide valuable spatial data for analyzing and addressing non-revenue water issues.

- **Remote Monitoring Solutions**

Remote monitoring technologies offer real-time insights into water distribution, aiding in the proactive management of non-revenue water.

- **Utilizing Data Analytics**

Data analytics tools enable the identification of patterns and anomalies, supporting efficient non-revenue water management strategies.

Quantifying the NRW

There are several methods to calculate the amount of NRW:

1. Water Balance Method:

1. **Function:** Compares volumes of produced/purchased water and billed water.
2. **Simple and readily available data:** production/billing records.
3. **Limitation:** Doesn't differentiate between real and apparent losses.

2. Component-Based Approach:

1. **Function:** Estimates individual NRW components through various methods.
2. **Methods:** Leak detection surveys, meter audits, customer surveys.
3. **Accuracy and detail:** Can provide insights into specific loss sources.
4. **Limitation:** Time-consuming and resource-intensive.

Quantifying the NRW

There are several methods to calculate the amount of NRW:

3. Statistical Methods:

1. **Function:** Utilize statistical models and historical data to estimate NRW.
2. **Methods:** Multiple regression analysis, artificial neural networks.
3. **Complexity and flexibility:** Can handle complex relationships and predict future trends.
4. **Limitation:** Requires extensive data and expertise for accurate application.

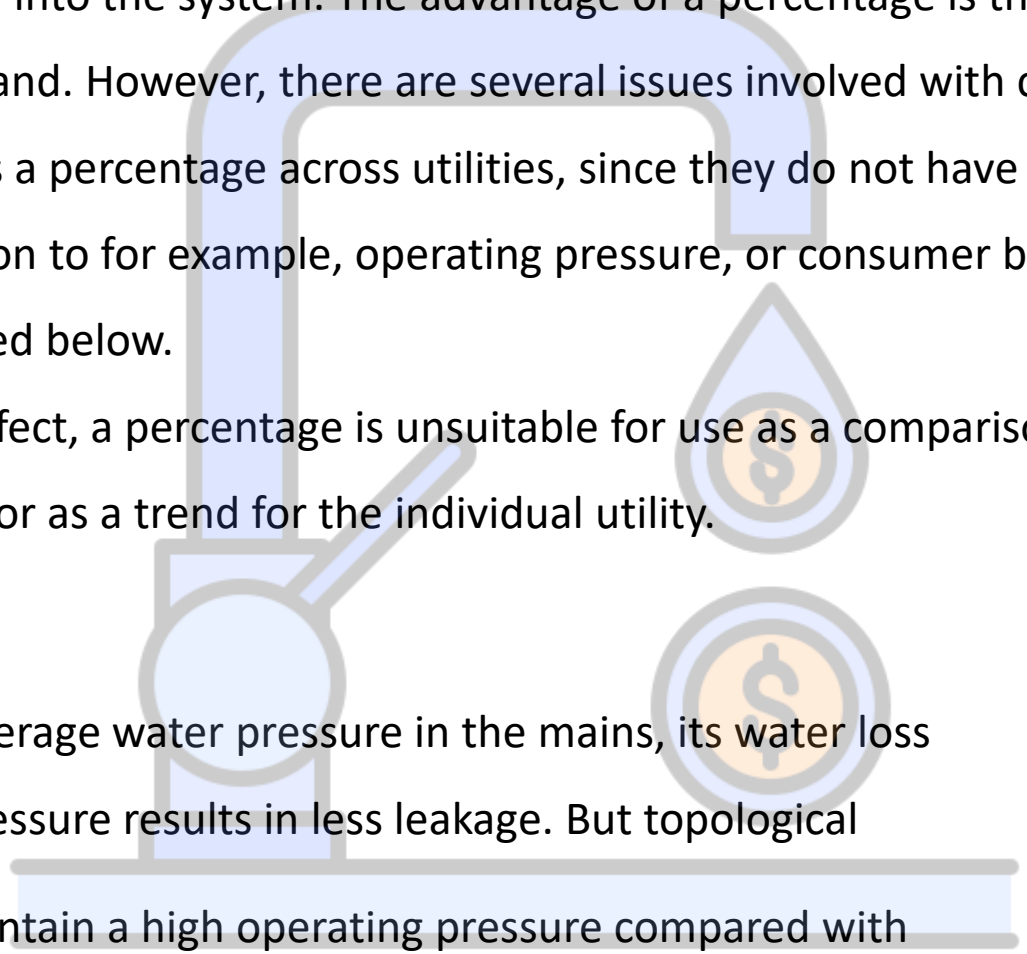
4. Commercial Loss Software:

1. **Function:** Specialized software utilizing various data sources and algorithms to estimate and analyze NRW components.
2. **Benefits:** Provides detailed insights, automates calculations, and facilitates scenario planning.
3. **Limitation:** Requires investment, data integration, and expertise.

Quantifying the NRW

Water loss is traditionally calculated as a percentage of the water volume pumped into the system. The advantage of a percentage is that it is easy to understand. However, there are several issues involved with comparing water loss solely as a percentage across utilities, since they do not have the same conditions in relation to for example, operating pressure, or consumer behavior, which is illustrated below.

So, in effect, a percentage is unsuitable for use as a comparison of water loss across utilities or as a trend for the individual utility.



Operating pressure

If a utility for example, maintains a low average water pressure in the mains, its water loss will be relatively small, since the lower pressure results in less leakage. But topological conditions may force some utilities to maintain a high operating pressure compared with other utilities, which in terms of percentage, leads to a higher leakage level.

Quantifying the NRW

The Infrastructure Leakage Index (ILI)

For a more accurate picture of water loss, utilities should consider it based on the Infrastructure Leakage Index (ILI)

The calculation of ILI is based on the utility's operational data and is a more nuanced and accurate basis for benchmarking, since it takes different parameters into consideration. Using ILI, it is possible to make comparisons across for example, consumer behavior, population density and different types of utilities. However, ILI is also more complex to calculate, since it requires a larger data basis.

Quantifying the NRW

Infrastructure Leakage Index (ILI) is an expression of the water loss, and it is calculated by dividing the annual real losses (CARL – Current Annual Real Losses) by the lowest technically achievable annual losses (UARL – Unavoidable Annual Real Losses), i.e. the water loss that is unavoidable.

ILI = CARL/UARL

CARL is calculated by subtracting the unauthorized consumption from the total water losses

CARL = total water losses – unauthorized consumption

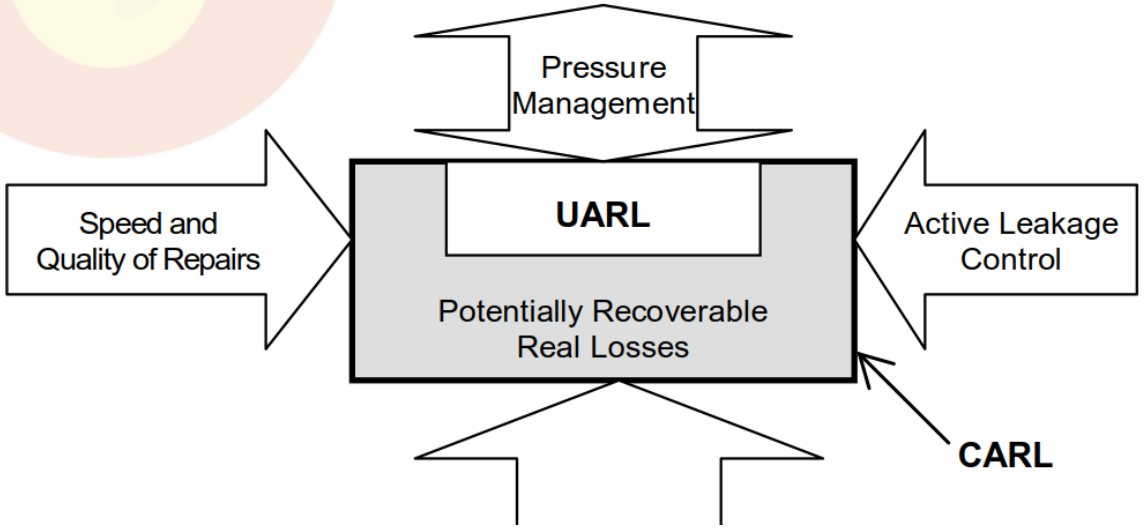
UARL is calculated on the basis of:

- **LM:** Length of mains (km)
- **Ns:** Total number of service connections (mains to property line)
- **Lp:** Average length, property line to meter (metres)
- **P:** Average pressure (metres)

UARL = (18 x LM + 0.8 x Ns + 25 x Lp) x P l/24 hours

Quantifying the NRW

ILI can be better explained using below Figure, which shows primary components of leakage management. The area of the large rectangle represents the Current Annual Real Losses (CARL) for any specific system. As the system ages, there is a tendency for natural increasing rate of real losses through new leaks and burst, some of which will not be reported to the utility. This tendency is controlled and managed by some combination of the four primary components, namely (i) pipeline and assets management, (ii) pressure management (which may increase or decrease the pressure), (iii) speed and quality of repairs, and (iv)active leakage control to locate unreported leaks.



NRW Management

Key Strategies for Water Conservation

- Key strategies for water conservation play a vital role in reducing non-revenue water and ensuring sustainable water management.

Sustainable Water Management Practices

- Sustainable water management practices are essential for addressing non-revenue water challenges and ensuring long-term utility sustainability.

Achieving Financial Sustainability

- Achieving financial sustainability through effective non-revenue water management is critical for the viability of water utilities and the well-being of communities.

CONCLUSION

- While Non-Revenue Water (NRW) is the difference between System Input Volume and Billed Authorised Consumption, and there is no function of Correlation between NRW and ILI, the indicators like ILI is to identify losses which is a factor of having NRW.

- by identifying, measuring and calculating the amount of water that constitutes the apparent losses, the amount will generate revenue for the utility rather than be an expense.

- it is not possible for the utility to manage and work proactively with its water resources, if it does not know how much water is lost, and how the water is lost.

- To gain an accurate picture of water loss, it is therefore advisable to calculate the water loss based on ILI rather than the traditional percentage.

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Thank You