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Leakage Performance Indicators 'Fit for Purpose'

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Recommended Leakage Performance Indicators for operational purposes

- IWA Water Loss Task Force (1999) and IWA 1st Edition of Performance Indicators for Water Supply Services (2000)
  - litres/conn/day (or m^3/km/day if < 20 conns/km)
  - UARL, ILI for technical performance comparisons
  - don't use %s of System Input Volume

- EU Reference document 'Good Practices on Leakage Management' (2015)
  - choice of leakage PI depends on operational purpose

Overview of EU Reference Document Recommendations

OBJECTIVE	GOOD PRACTICE PERFORMANCE INDICATOR FOR LEAKAGE, FIT FOR PURPOSE						
	Volume per year	litres/ service connection	m^3/km mains	litres/ billed property	% of System Input Volume	% of Water Supplied	Infrastructure Leakage Index, with Pressure
SET TARGETS AND TRACK PERFORMANCE, FOR AN INDIVIDUAL SYSTEM	YES, for large systems	YES*	YES*	YES (UK)	NO	NO	Only if all justifiable pressure management completed
TECHNICAL PERFORMANCE COMPARISONS OF DIFFERENT SYSTEMS	NO	NO	NO	NO	NO	NO	YES
DRAW GENERAL CONCLUSIONS FROM SINGLE OR MULTIPLE SYSTEMS	NO	NO	NO	NO	NO	NO	YES, together with other context factors
* Choose services connection density > 20/km; if not, choose mains; or base choice on country custom and practice							

Also introduces influence of justifiable pressure management, and other context factors such as size of system, density of connections etc. See Table 6 in the 2015 EU Main Report Good Practices on Leakage Management

Leakage Performance Categories (LPC's)

- A/B/C/D by Liemberger (2005) in WBI Training modules
- Improved (2014) by dividing Bands into two (A1/A2 etc)

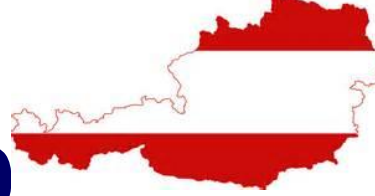
Low and Middle Income Countries ILI range	High Income Countries ILI range	Leakage Performance Category LPC	Calculated ILI for this System	General Description of LPCs A to D (LPC limits for Low and Middle Income Countries are double those for High Income Countries)
Less than 3	< 1.5	A1		Further loss reduction may be uneconomic unless there are shortages; careful analysis needed to identify cost-effective improvement
3 to < 4	1.5 to < 2	A2		
4 to < 6	2 to < 3	B1		Potential for marked improvements; consider pressure management, better active leakage control practices, and better network maintenance
6 to < 8	3 to < 4	B2		
8 to < 12	4 to < 6	C1		Poor leakage record; tolerable only if water is plentiful and cheap; even then, analyze level and nature of leakage and intensify leakage reduction efforts
12 to < 16	6 to < 8	C2		
16 to < 24	8 to <12	D1		Very inefficient use of resources; leakage reduction programs imperative and high priority
24 or more	12 or more	D2		

Objective of this Presentation

- In recent years, several countries and provinces have been reviewing their recommendations
  - Austria, Bulgaria, Croatia, Germany, South Africa (KwaZulu-Natal), Canada (Quebec), Romania
- How do their individual recommendations compare with the EU Document approach?
- What can we learn from these comparisons about ‘Fit for Purpose’ KPI’s for leakage?

Austria (OVGW)

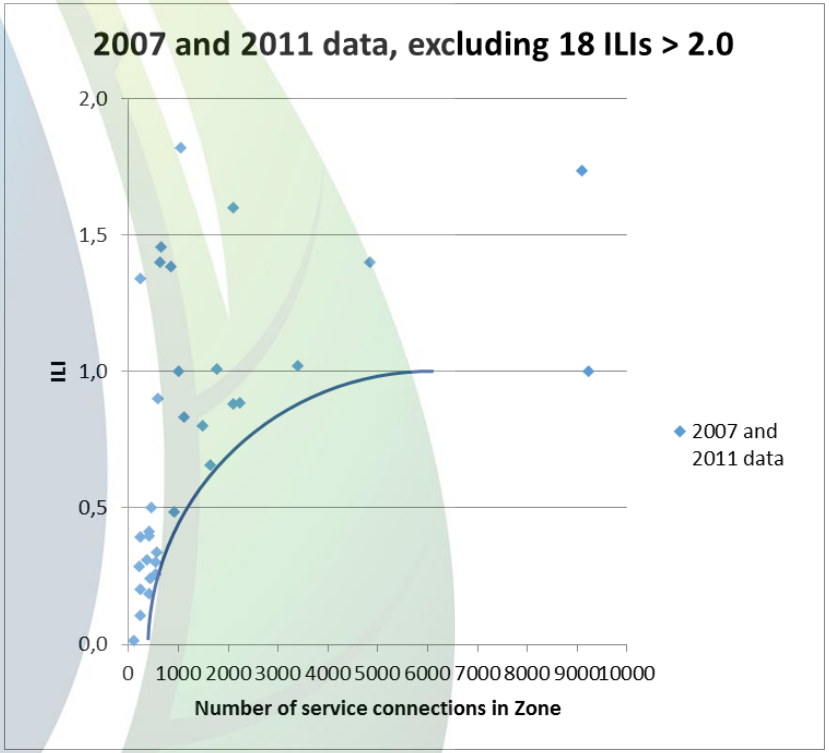
- Austria has 5 500 separate Water Utilities
  - 5 000 are ‘very small’, less than 3 000 service connections
  - 4 500 with fewer than 1 000 service connections
  - good infrastructure, almost 100% metered
  - basic pressure management considered sufficient
- Prior to 2009 (OVGW guideline W 63)
  - principal KPI’s used were typical for Europe
  - m^3/km mains/day and % of System Input Volume



Austria (OVGW) after 2009

- Detailed research studies 2005 to 2009 resulted in OVGW W63 Guideline
  - % of System Input Volume no longer used
  - litres/connection/day preferred to m^3/km/day
    - leakage category assessed using litres/conn/day and UARL formula
  - ILI adopted as most appropriate KPI for leakage
  - m^3/km/hour widely used by utilities for leakage monitoring
- Many ILI's for very small systems were less than 1.0
  - further research in 2014 on validated data in systems with less than 10 000 service connections

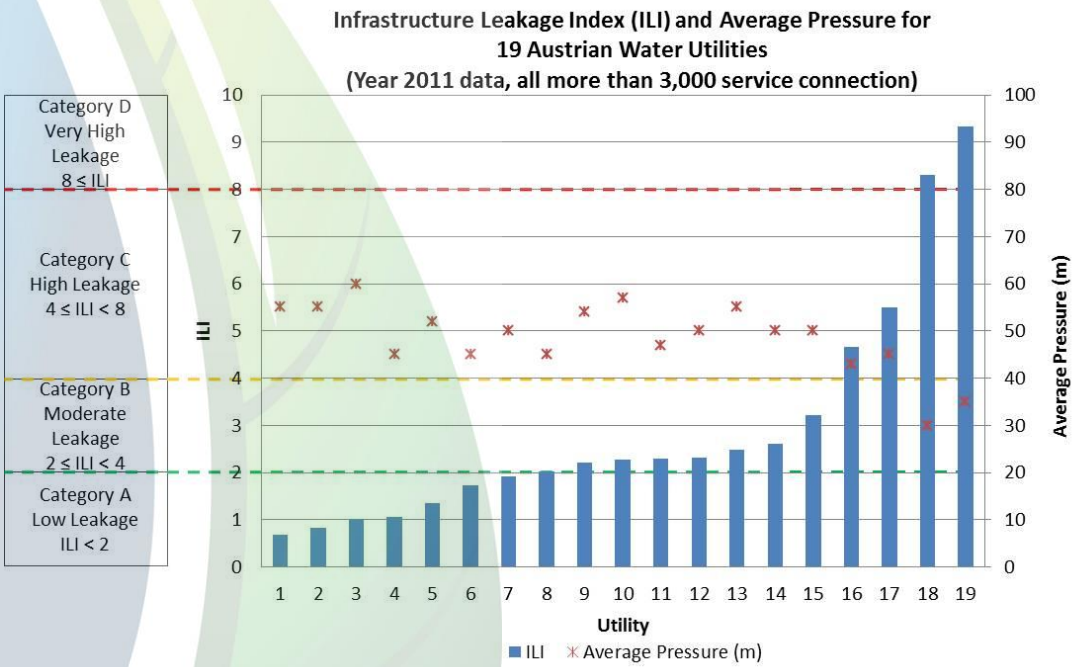
Very small systems can achieve ILI < 1



- As system size falls below 3000 service connections, ILIs less than 1.0 can occur.
- New unreported leaks can be quickly identified from night flows in very small systems

See https://www.leakssuitelibrary.com/austrian-ilis/

ILI's for Austrian systems with > 3000 service connections



- Only two of these systems have ILI's slightly less than 1.0
- So best to separate ILI comparisons into less than, and more than, 3000 service conns
- It is also recommended to show average pressure for each system on this chart
- And to categorise ILI by Leakage Performance Categories A to D

See https://www.leakssuitelibrary.com/austrian-ilis/

Bulgaria

- Bulgarian Ordinance for Regulation of the Water Supply and Sewerage Services Quality defines KPI for NRW
  - 2006 Version:
    - KPI for water losses = ratio between non-revenue water and System Input volume (%)
  - 2015 Draft Version:
    - Annual Water Balance follows basic principles of IWA
    - New KPI for NRW: m³/km of mains/day
    - No specific KPI for Real Losses
- New Bulgarian KPI for NRW (m³/km/day)
  - is 'fit for purpose' for tracking reductions in individual systems
  - has limitations for comparing performance of different Utilities or setting the same target for all Utilities
  - does not yet allow for differences in connection density and operating pressure

Bulgaria

- Bulgarian Water Loss Guideline (2015)
  - Bulgarian Water Association (BWA)
  - Prepared in cooperation with Working Group and a European Investment Bank project team

- KPI related content:
  - IWA Water Balance
  - Describes various NRW, real loss, apparent loss and failure KPIs for different purposes such as comparisons, utility internal monitoring and target setting
  - ILI for categorization of losses and for comparison of different systems
  - Leakage Performance Categories A1 to D2
    - based on international categories for developing countries (A <4, B 4 – 8, C 8 – 16, D > 16)
  - Graphs for assessing leakage categories based on $m^3/km/d$ and considering the UARL formula

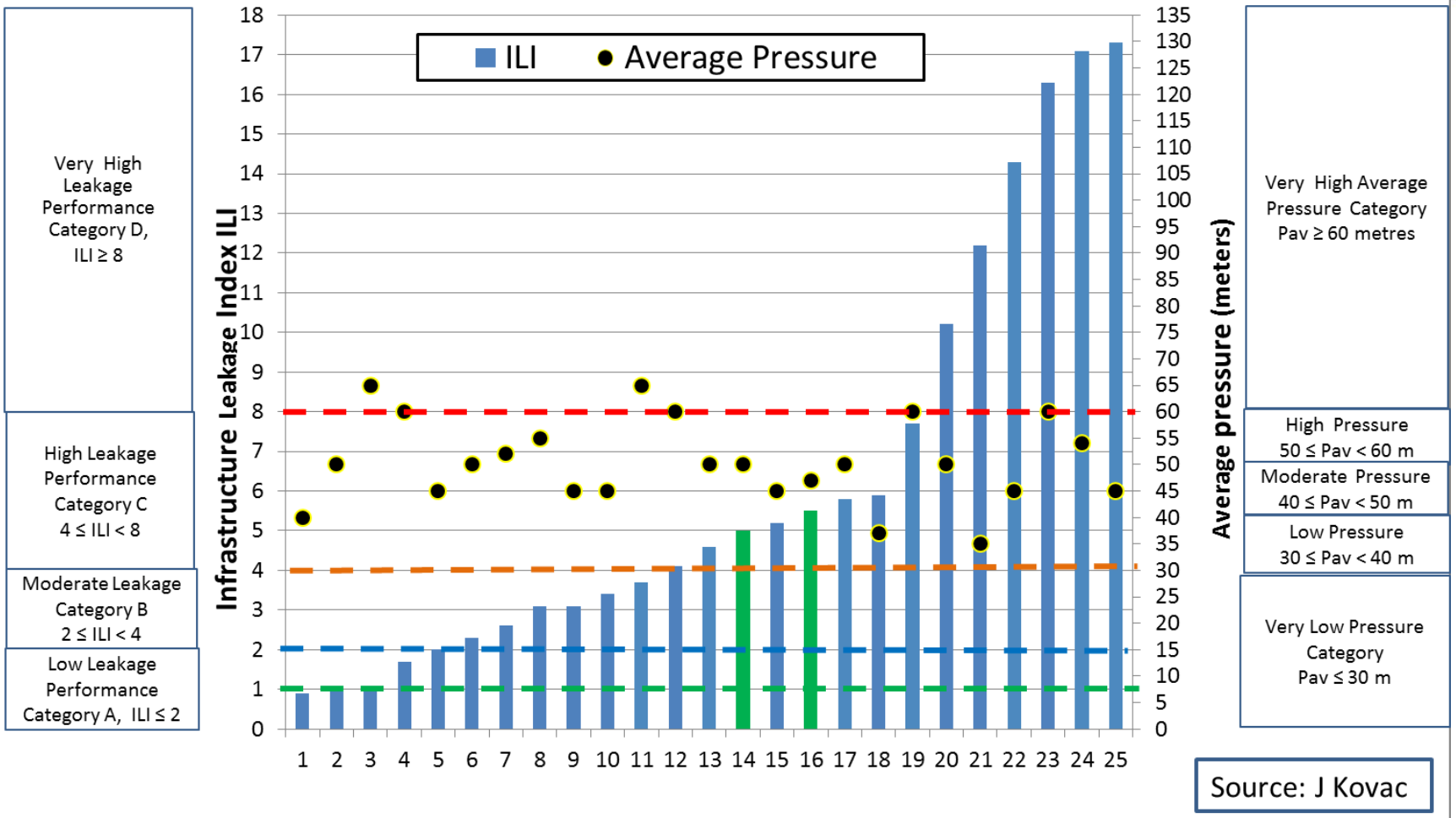
Croatia - Regulation

- Regulator (Croatia Waters Agency) is reorganising numerous (~ 160) mostly small Water Utilities to 20 large utilities by 2017 for 4.3 million population
- In 2015 regulator initiated benchmarking pilot project for evaluation of KPI according to IWA methodology using online tool for data input and analyses with consistent assumptions
- IWA methodology is officially accepted; all Utilites are required to calculate water balance and KPI (ILI) in projects aimed for EU funding
- In preparation is new water extraction fee policy; Fee/m^3 paid by Utilities to State, partly based on ILI Leakage Performance Categories A to D (lower fees for lower ILI's)

Croatia – Tools for Leakage Reduction

- Regulator has translated EU Reference document ‘Good Practices on Leakage Management’ (2015) into Croatian language, freely available to all utilities.
- Software EurWB&PICalcs, for calculating KPIs according to EU Reference document, translated to Croatian language by J.Kovac, also free to all Utilities
- KPIs : ILI, l/conn/d, m^3 (%’s of Input Volume no longer used)
- ILI range: 1 to 17
- Improved management of operating pressures is recognized as fundamental part of leakage reduction strategy

ILIs for 25 Utilities in Croatia, 2005 to 2014



Germany (DVGW)

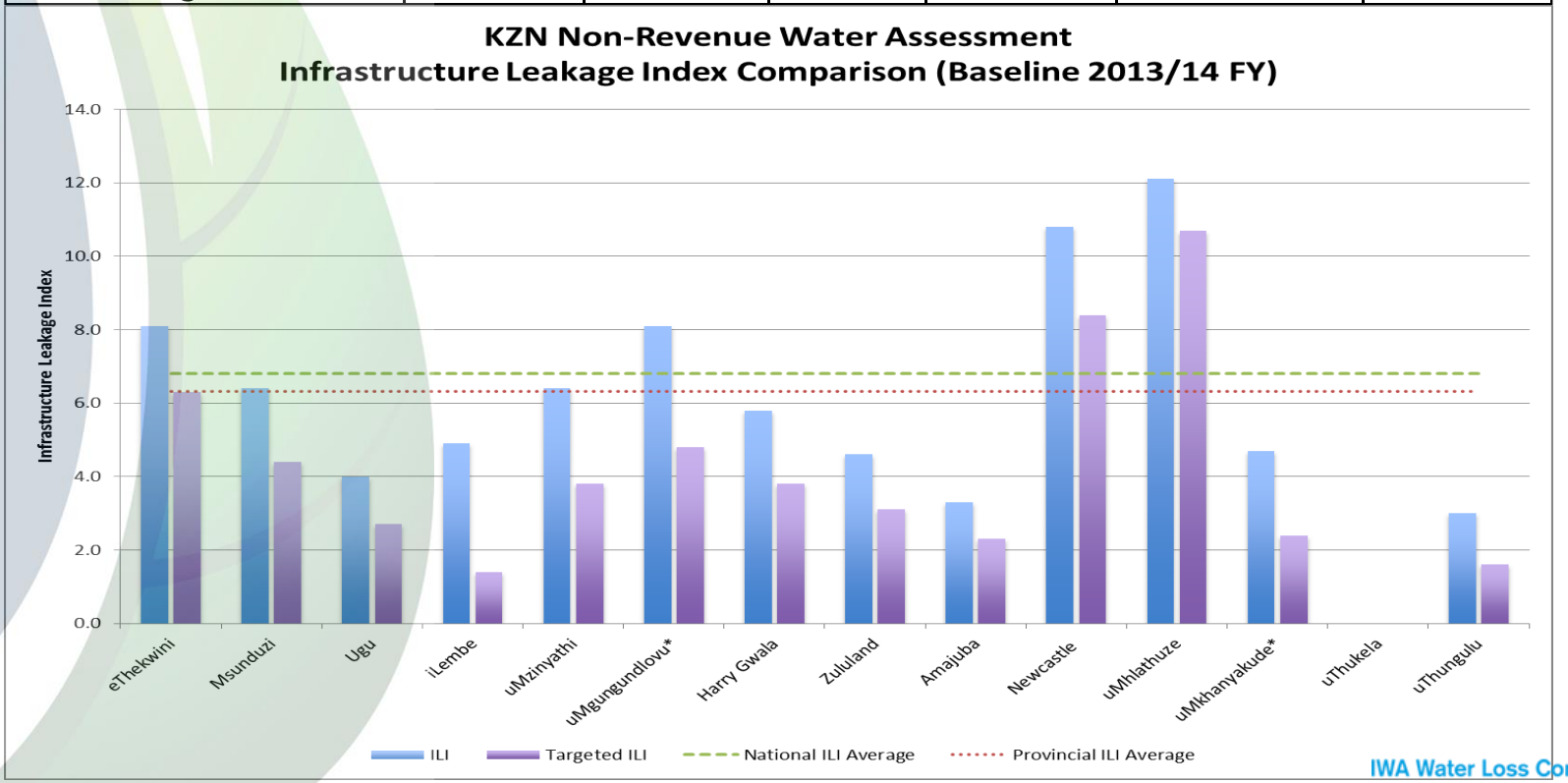
- Germany has 6 000 separate Water Utilities
  - service connection numbers not available
  - good infrastructure in most regions, 100% metered
  - basic pressure management considered sufficient
- Prior to 2009 (DVGW 392, 2003)
  - m^3/km mains/hour (Specific Loss)
  - % of System Input Volume NOT recommended
- DVGW W 392 Review nearing completion
  - ILI and m^3/km mains/hour likely to be recommended

KwaZulu-Natal, South Africa

- All Water Utilities in South Africa currently need to report on status of NRW (and plans to reduce NRW) on a quarterly basis)
- Current main KPI's used are:
  - % NRW
  - litres/capita/day
- As part of recent Provincial review of NRW in KwaZulu-Natal, all EU Report KPI's were calculated and Utility systems ranked according to the different KPI's, with very varied outcomes
- Current mandatory KPI's did not address not reflect extent and nature of problem

KwaZulu-Natal, South Africa

	eThekwini	11 District Municipalities				Grand Total
	(Durban)	Minimum	Median	Maximum	Total or average	
Mains Length km	11,829	388	1,958	3,930	22,854	34,683
Service Connections '000s	488.3	4.3	34.6	79.0	433.4	921.6
Density of Connections/km	41.3	10.9	17.5	38.8	19.0	26.6
Average Pressure metres	54.0	40.0	61.5	70.0	58.3	56.0
2013/14 Baseline ILI	8.1	3.0	5.4	12.1	6.2	6.3
Target ILI	6.3	1.4	3.5	10.7		

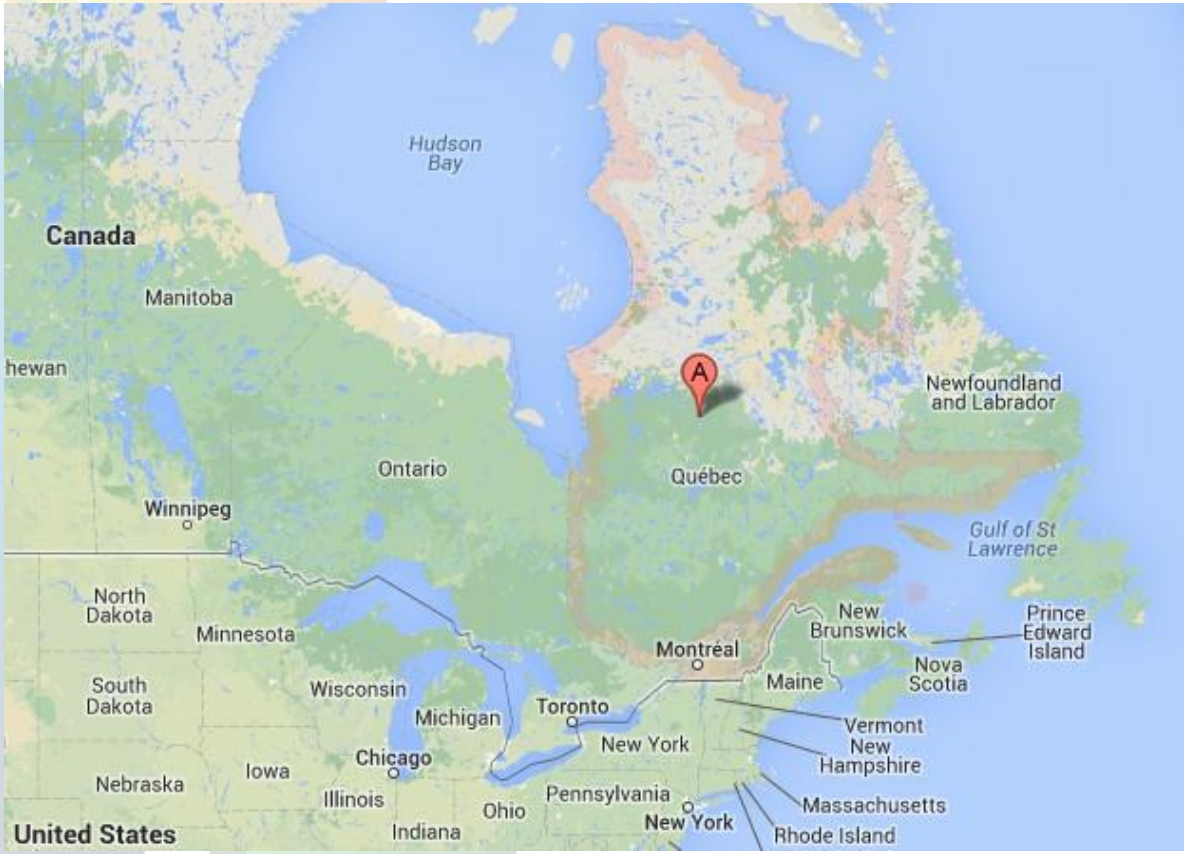


Classifying NRW using WB2Ways Approach

- KwaZulu-Natal uses Liemberger's 2005 classification of ILI's A1, A2, B1, B2 etc for Low/Middle Income countries
- Apparent losses are also high in South Africa, so classify using Liemberger's 2010 ADB apparent loss categories A1, A2, B1, B2 etc
- NRW components can then be classified for both Apparent and Real Losses
  - for example B2:A2 (B2 for apparent losses, A1 for Real loss)

Band Limits for Unbilled Authorised Consumption & Apparent Losses						
A1:A2	A2:B1	B1:B2	B2:C1	C1:C2	C2:D	Source: R. Liemberger & ADB (2010)
3.0%	6.0%	9.0%	12.0%	16.0%	20.0%	of metered PRW exc. Water Exported.
Band Limits for Real Losses, Low/Middle Income Countries						
A1/A2	A2/B1	B1/B2	B2/C1	C1/C2	C2/D	Source: R. Liemberger & WBI (2005)
3	4	6	8	12	16	x UARL

Province of Quebec, Canada



3 % of renewable fresh water of the planet

800 municipalities with potable water supply (85 % of them with less than 7 500 people served)

7 M people served

41 500 km of mains

%s of properties metered:
Non-residential **34 %**
Residential : **10 %**

2013 KPI :
Water supplied per person (leaks + consumption) : 596 l/pers/d
Water losses estimation : 30 m³/d/km & 28 % of water supplied

Quebec Water Efficiency Strategy

Since 2011 :

- Data loggers installed on verified flowmeter and level sensors for MNF calculation
- Night Flow Analysis completed each year
- Annual leak detection (systematic sounding of all fire hydrants) unless water losses (real + apparent) are less than 15 $m^3/d/km$ **and** 20 % of water supplied.
- Municipal by-law on water use adopted
- AWWA Manuals translated into French

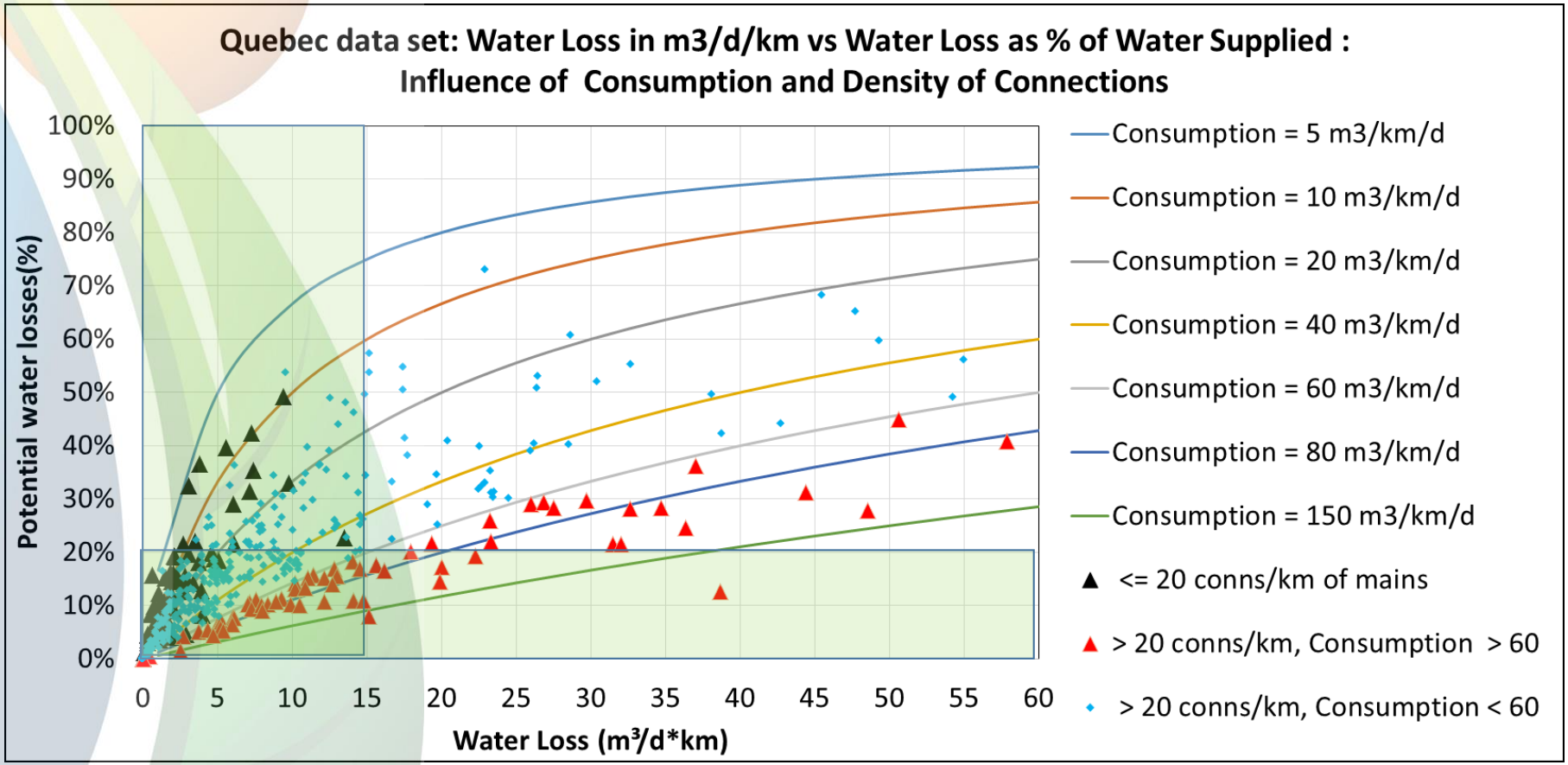
By 2017 :

- Water metering installation (all non-residential + sample residential) if Strategy goals are not met

As of 2018 :

- Water pricing implementation if Strategy goals are not met

Some Implications of Using Two KPI's



- using % of water supplied as a KPI does not promote consumption reduction
- using m³/d/km implies most of annual water losses are on mains – is this true?
- Litres /connection /day could be used for connection densities > 20/km

Romania

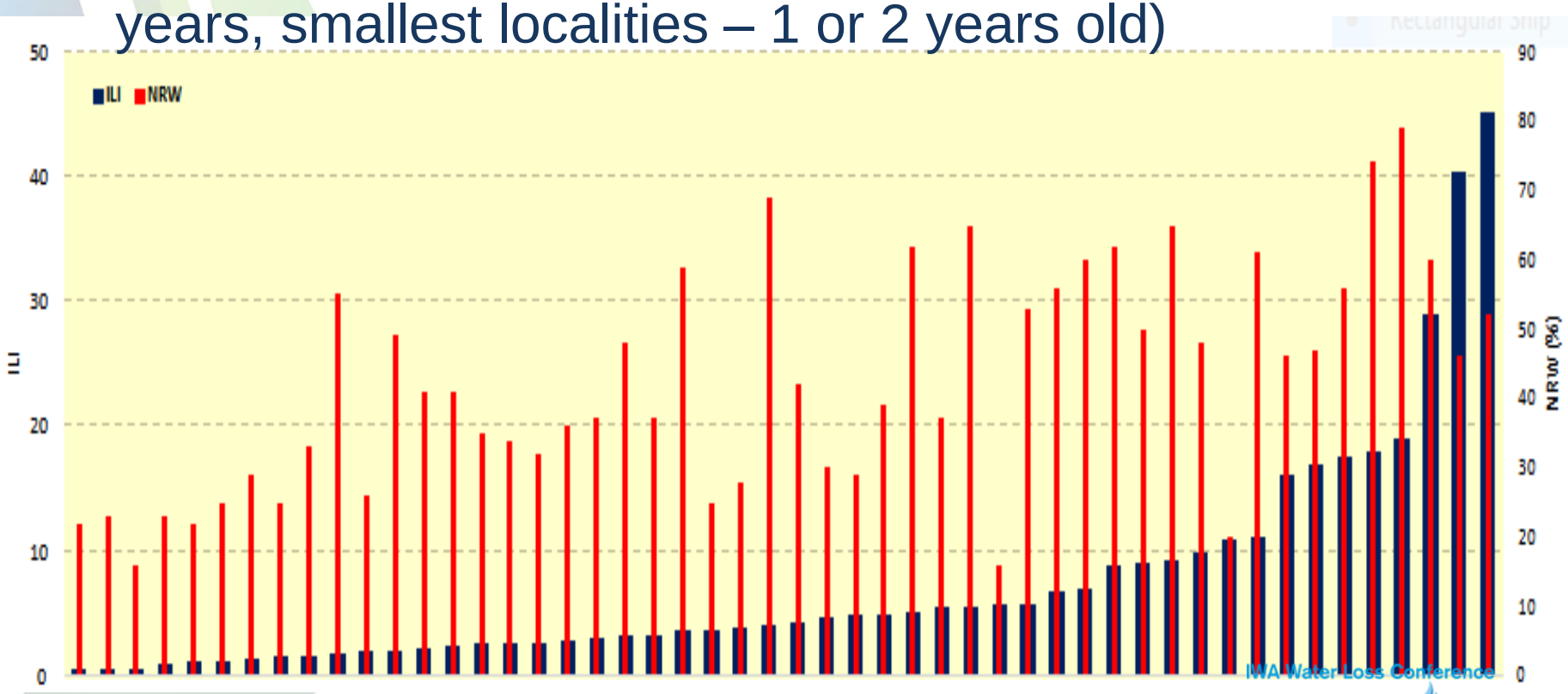
- Romania has 42 large water utilities designated as Regional Water Operators
  - Each Regional Operator comprises several administrative branches, varying from 1 to approx. 50 small utilities (depending on each individual branch)
  - Every Regional Operator is administered by the local county council which owns 51% to 100% of the shares
  - 2 big cities (Bucharest and Ploiesti) have private management
- Current situation in Romania
  - NP-133/2013 regulation for designing new and upgraded water networks impose IWA water balance and KPI's (ILI and l/conn./day)
    - The benchmarking matrix used is the World Bank Matrix for developing countries, however the formula for UARL is different
  - National Manual for Water Utilities (2008,2010) is a document elaborated by various consultancy companies and was promoted by the Ministry Of Environment
    - Although the water balance and KPI's respects the IWA Good Practice Manual, the benchmarking matrix is different from NP-133, often leading to contradictory results

Romania

- Waterloss management in Water Utilities
  - Every Regional Operator in Romania has at this moment at least one leakage detection team with performing equipment, but in most cases it is insufficient for the wide operating area (exception in Bucharest, where are 24 leak detection teams)
  - Every Regional Operator has received extensive training in waterloss management and leak detection according to IWA best practices
  - Every Regional Operator has the knowledge to calculate KPI's, using various software (WB-EasyCalc being the most used)
- Current Challenges
  - The National Regulation Agency for Public Services (ANRSC) insists on NRW as an performance indicator (a NRW limit of 30%-35% was set for every Regional Operator)
    - As a result the water companies are solely interested in this figure and tend to disregards the other KPI's
  - Leak detection is far more advanced than waterloss management
    - There is still need for an active management to keep up with the advances in leak detection work

Romania: typical situation for a Regional Operator's Water Utilities

- A typical supply zone comprises one or two big cities and the adjacent smaller localities.
- The age of the network differs (big cities – approx. 60 years, smallest localities – 1 or 2 years old)



Conclusions

- More regions/countries now recognise flaws of % of System Input volume, and no longer use it
- Increasing use of ILI for technical comparisons, using A1 to D2 Leakage Performance Categories
  - often with litres/conn/day or m^3/km mains/day for tracking changes in performance
  - good practice to always state the average pressure
- Consider Apparent Loss Performance Categories?
- Using 2 basic leakage KPIs for the same purpose may confuse interpretation of true performance

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