



Water Loss 2026

April 26–29, 2026
Rio de Janeiro



Workshop 2: Results of the IWA Global Water Loss KPI Initiative

Joerg Koelbl and Alan Wyatt

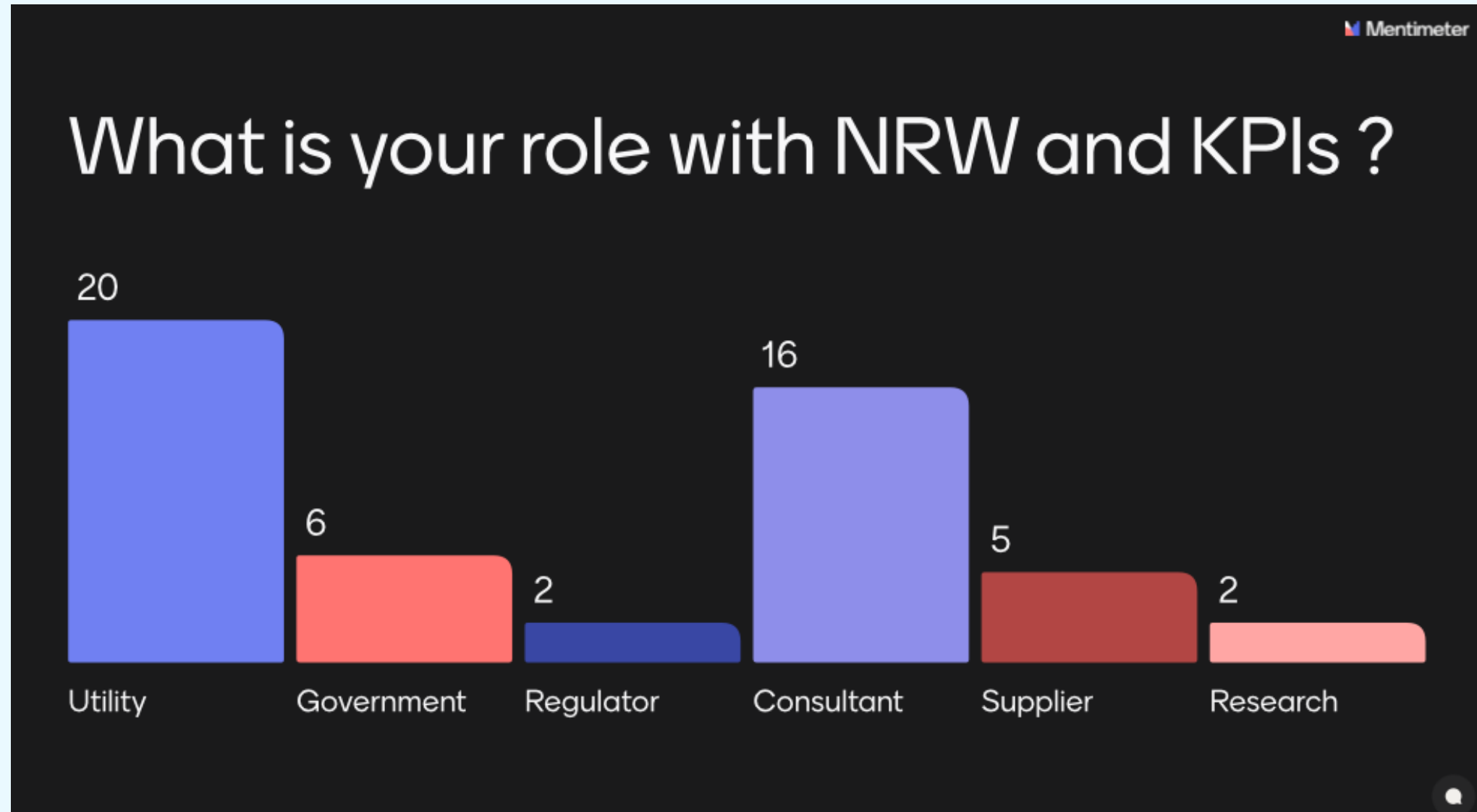
April 26, 2026

Participant Poll #1



Brazil:	35
Oman:	4
Ecuador:	3
France:	3
UK:	2
Argentina:	1
Denmark:	1
Chile:	1
Colombia:	1
Ireland:	1
Portugal:	1

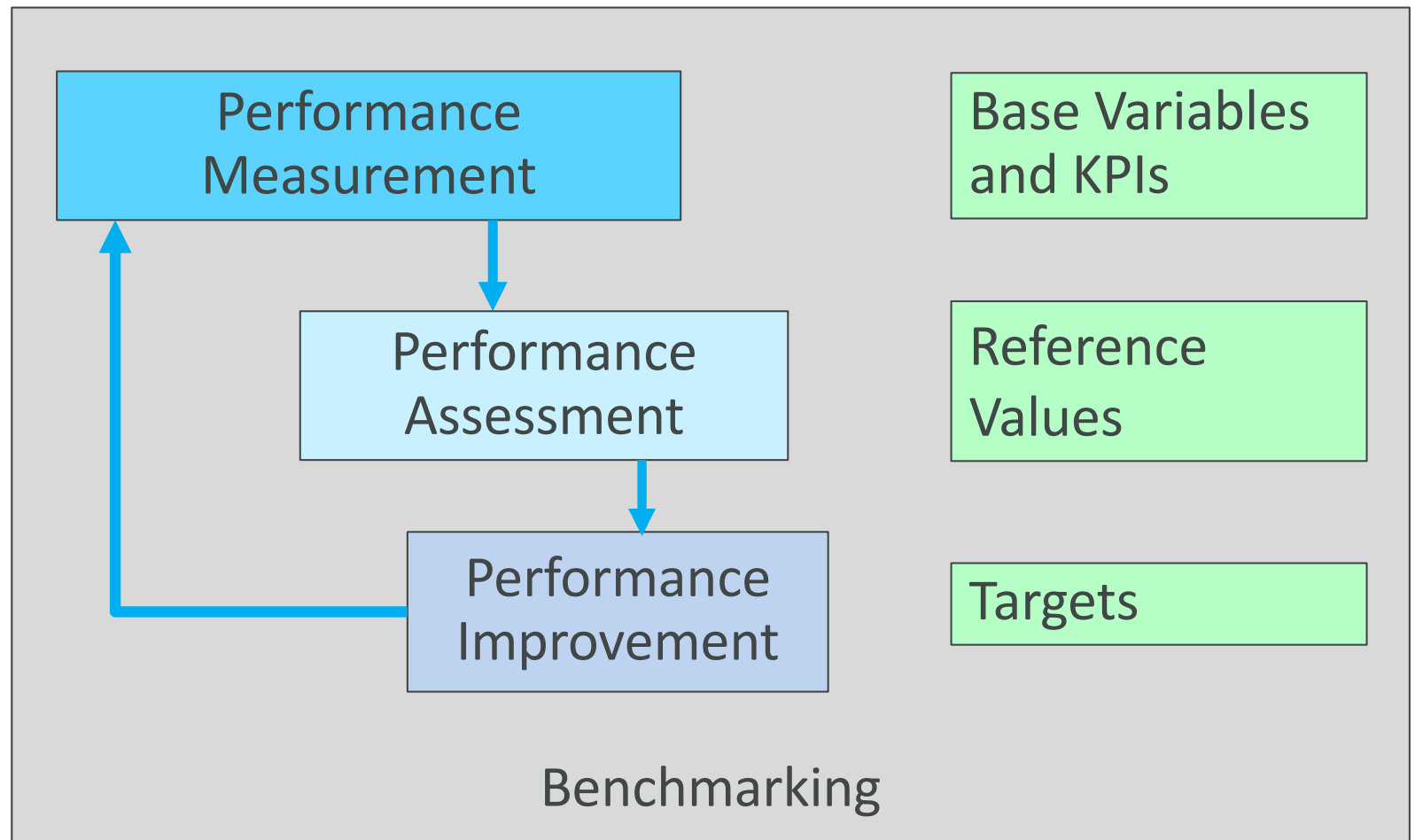
Participant Poll #2



IWA Global Water Loss KPI Initiative

Introduction

PREMISE: THE RIGHT TOOLS FOR THE JOB



There is no single indicator suitable for all purposes
A suite of indicators is best

OBJECTIVES OF THE INITIATIVE

- 1) Assess **Current Practices** in the Use of Water Loss KPIs,
 - Which indicators are being used, and for which purposes
 - Questionnaire /survey carried out

- 2) Compile a Global Set of **NRW Data** to:
 - Prepare estimates of TOTAL NRW by country, by Region and for the World
 - Identify important challenges and areas of uncertainty
 - Assess the importance of NRW in the context of Water Stress, Energy Intensity and Carbon Emissions
 - Support solid evidence-based assessment and performance improvement

- 3) Prepare **Guidance Notes** on Best Practices and Challenges in the Use of Water Loss KPIs

KEY PERSONNEL

- Joerg Koelbl, Austria – Questionnaire, Guidance Notes, Data Compilation
- Dave Pearson, UK – Chair, Data Compilation, Guidance Notes
- Stuart Trow, UK – Guidance Notes Leader
- Alan Wyatt, USA – Data Compilation Leader, Guidance Notes

- Steering Committee – Members from 22 Countries
- Volunteers – More than 100 from ~80 countries
- Members of five IWA Specialist Groups

IWA Global Water Loss KPI Initiative

Preliminary Report on Guidance Notes:

**Best Practices and Challenges in the
Use of Water Loss Key Performance
Indicators (KPIs)**

OUTLINE – GUIDANCE NOTES

1. Purpose
2. References
3. Overall Content and Progress
4. Examples of Specific Content
5. Next Steps
6. Contributors
7. Open Discussion



1. PURPOSE

- These Guidance Notes explain Best Practices and Challenges involved in calculating and applying performance indicators to non-revenue water and water losses.
- Their aim is:
 - To improve the understanding of water utility staff, consultants and regulators
 - To make recommendations on the use of the most appropriate KPIs for different purposes



2. REFERENCES

IWA the blue pages
the IWA information source on drinking water issues

Losses from Water Supply Systems: Standard Terminology and Recommended Performance Measures

SUMMARY

The quantity of water lost is an important indicator of the positive or negative evolution of water distribution efficiency, both in individual years and as a trend over a period of years. High and increasing annual volumes of water losses, which are an indicator of ineffective planning and construction, and low operational maintenance activities, should be the trigger for initiating an active leakage control programme.

However, a leak-free network is not a realistic technical or economic objective, and a low level of water losses cannot be avoided even in the best operated and maintained systems, where water suppliers pay a lot of attention to water loss control.

With the increasing international trend towards sustainability, economic efficiency and protection of the environment, the problem of losses from water supply systems is of major interest world-wide. Both the technical and the financial aspects are receiving increasing attention, especially during water shortage or periods of rapid development.

Particular problems and unnecessary misunderstandings arise because of differences in the definitions used by individual countries for describing and calculating losses. Also, traditional performance indicators often give conflicting impressions of true performance in controlling water losses¹⁾.

In 1996 the Operation and Maintenance Committee of the IWA's Distribution Division set up a Task Force to review existing methodologies for international comparisons of Water Losses from water supply systems. The main objectives were:

- to prepare a recommended basic standard terminology for calculation of real and apparent losses
- to review and recommend preferred performance indicators for international comparisons of losses.

This publication summarises the conclusions of the Water Losses Task Force, with particular reference to the preferred Performance Indicators for assessing operational performance in control of real losses (leakage and overflow) in transmission and distribution systems. The recommended terminology and the full range of preferred performance indicators for Water Supply Services are available in the IWA Manual of Best Practice Performance Indicators for Water Supply Services²⁾. The development of the equation for calculating technical minimum (unavoidable) annual real losses, based on international research is described in detail in a recent AQUA paper³⁾. The conclusions of the Water Losses Task Force are summarised in Section 6 of these Blue Pages.

This publication is intended to act as an information document only and does not reflect the policies of IWA or its members.

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Standard Definitions for Water Losses

A compendium of terms and acronyms and their associated definition in common use in the field of water loss management

David Pearson

IWA WATER LOSS the international water association

Manual of Water Supply Practices M36
Fifth Edition

Water Audits and Loss Control Programs

EU Reference document Good Practices on Leakage Management WFD CIS WG PoM

Main Report

Manual of Best Practice

Performance Indicators for Water Supply Services

Third Edition

IWA Specialist Group on Benchmarking and Performance Assessment

IWA PUBLISHING

Manual of Best Practice

Benchmarking Water Services

Guiding water utilities to excellence

Enrique Calvete Jr., Peter Danc, Scott Hudson and Hemo Theuretsbacher-Fritz

IWA PUBLISHING

INTERNATIONAL STANDARD **ISO 24528**

First edition 2021-03

Service activities relating to drinking water supply, wastewater and stormwater systems — Guideline for a water loss investigation of drinking water distribution networks

Reference number ISO 24528-2021(E)

© ISO 2021

WCB-EasyCalc

The free water and carbon balance software
Version 1.09 (April 2025)

Utility Name: Year:

The volumes used for this water balance are for a period of: days

by courtesy of Uemberger & Friends
... because the best things in life are free!

check for updates on: www.GlobalNRW.com

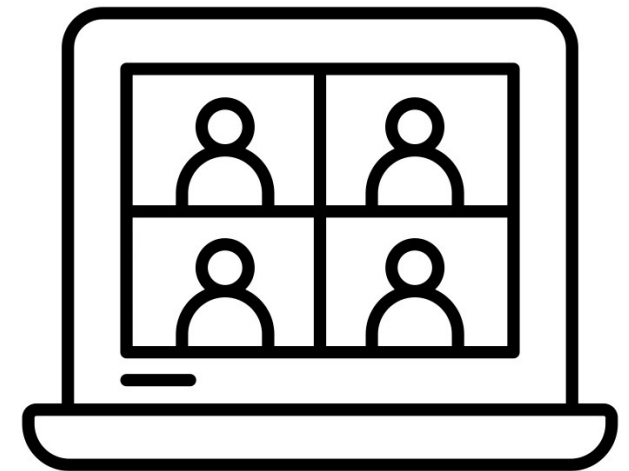
and others

3. OUTLINE OF THE CONTENT

- Introduction – purpose, background
- The Level of Non-Revenue Water and Water Losses (Boundaries, Water Balance)
- KPIs for Non-Revenue Water
- KPIs for Real Losses (Scaling denominators, Explanatory factors)
- KPIs for Apparent Losses
- Performance Assessment and Improvement
- Supplementary PIs and Context Information
- Reliability, Uncertainty and Sensitivity Analysis of KPIs
- Challenges in the interpretation of KPIs under different context conditions (Intermittent Water Supply, low- and high-pressure systems)
- Summary on the use of Water Loss KPIs
- Case Studies

WHAT WE HAVE SO FAR

- **A great and motivated team of authors**
 - Steering group for the IWA Global Water Loss KPI Initiative
 - Contributions from several members of the Water Loss Specialist Group
 - Colleagues from other specialist groups
- **Shared preparation of individual chapters** - Draft 90% complete
- **Ongoing discussion** about certain issues, e.g. classification schemes, suitability of certain KPIs, etc.



4. SPECIFIC EXAMPLES OF CONTENT

- Water Balance(s)
- NRW KPIs
- Interpretation of KPIs
- Drivers for the Use of KPIs
- Suitable KPIs for Various Purposes
- Supplementary KPIs



ISO WD 24528 (2019) WATER BALANCE

Volume from Own Sources (corrected for known error)	System Input Volume (SIV)	Water Exported (corrected for known error)					
		Water Supplied	Authorized Use	Revenue Water	Billed Authorized Use	Billed Metered Authorized Use	
Billed Unmetered Authorized Use							
Water Imported (corrected for known error)	System Input Volume (SIV)	Water Supplied	Authorized Use	Non-Revenue Water	Unbilled Authorized Use	Unbilled Metered Authorized Use	
						Unbilled Unmetered Authorized Use	
Water Imported (corrected for known error)	System Input Volume (SIV)	Water Loss	Non-Revenue Water	Apparent Water Loss	Unauthorized Use		
					User Metering Errors		
Water Imported (corrected for known error)	System Input Volume (SIV)	Water Loss	Non-Revenue Water	Apparent Water Loss	Data Handling Errors		
					Estimation Errors		
Water Imported (corrected for known error)	System Input Volume (SIV)	Water Loss	Non-Revenue Water	Real Water Loss	Leakage on Transmission and Distribution Mains		
					Leakage and Overflows at Utility's Storage Tanks		
Water Imported (corrected for known error)	System Input Volume (SIV)	Water Loss	Non-Revenue Water	Real Water Loss	Leakage on Service Connections up to point of user metering		

Imports and Exports handled correctly here!

Apparent losses include errors from estimates of unmetered consumption

WATER BALANCE COMPARISON



If there are no exports or imports – ISO Water Balance is the same as “traditional” IWA Water Balance

Water Balance in ISO WD 24528 (2019)

Volume from Own Sources (corrected for known error)	System Input Volume (SIV)	Water Exported (corrected for known error)				
		Authorized Use	Revenue Water	Billed Authorized Use	Billed Metered Authorized Use	
Water Imported (corrected for known error)	Water Supplied		Water Loss	Non-Revenue Water	Unbilled Authorized Use	Unbilled Metered Authorized Use
		Real Water Loss			Unauthorized Use	
				Apparent Water Loss	User Metering Errors	Data Handling Errors
				Estimation Errors	Leakage on Transmission and Distribution Mains	Leakage and Overflows at Utility's Storage Tanks
					Leakage on Service Connections up to point of user metering	

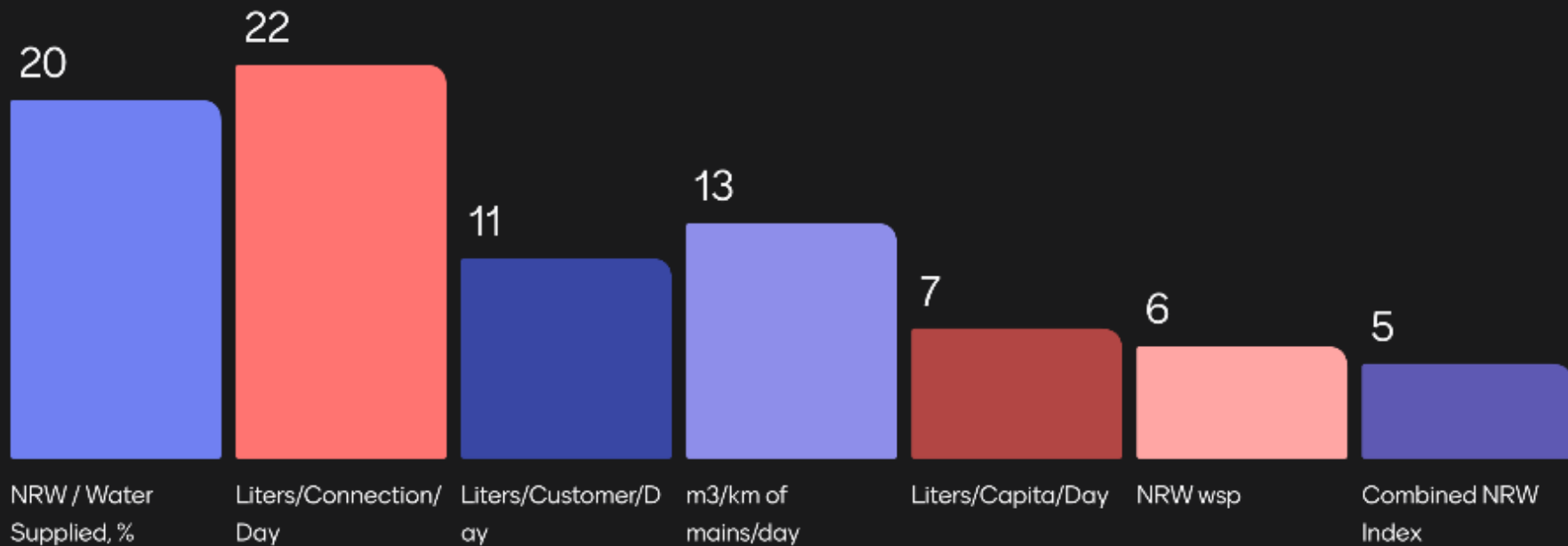
Water Balance in IWA Standard Definitions Book

System Input Volume (allow for known errors)	Authorized Consumption	Billed Authorised Consumption	Billed metered consumption	Revenue Water
		Unbilled Authorised Consumption	Billed unmetered consumption	
Water Loss	Water Loss	Apparent Losses	Unbilled metered consumption	Non-Revenue Water
			Unbilled unmetered consumption	
			Data handling and billing errors	
			Underestimation of unmeasured consumption	
			Customer metering inaccuracies	
		Real Losses	Leakage on transmission and distribution mains	
			Leakage and overflows at utility's storage tanks	
			Leakage on service connections up to the point of customer metering	

Participant Poll #3



Which are your favorite NRW KPIs ? - Choose up to 3



NRW / Water Supplied, %:	20
L / Connection / Day:	22
L / Customer / Day:	11
m ³ / km of mains / Day:	13
Liters / Capita / Day:	7
NRW wsp:	6
Combined NRW Index:	5

NRW KPI: STRENGTHS AND WEAKNESSES

Indicator	Strengths	Weaknesses	Comments
NRW / Water Supplied, %	Very simple	Misleading because it is strongly influenced by the Billed Authorized Consumption	This indicator is “wrong” - the algebra is OK. But it is only a snapshot measure and should not be used for comparisons over time and place.
Liters / Customer / Day	Simple	The number of customers is defined differently in different countries. Also, NRW is often less correlated with customers than with connections or mains length.	Could be useful in locations where the number of connections is not accurately tabulated
m ³ / km of mains / day	Simple; length of mains is commonly tabulated accurately	In general, increases with connection density - urban or rural nature of the distribution network, especially where real loss is relatively high with respect to other NRW components	Could be useful in locations where the number of connections is not accurately tabulated, but should on be interpreted In the context of population density -- urban or rural
Liters / Capita / Day	Simple and easily comparable to water use, often expressed in L / Capita / Day	Population served may not be accurately tabulated or be variable by season.	“Experimental” indicator - More information on this indicator is provided below

DRIVERS FOR THE USE OF KPI

External Drivers

- Regulation
- Public Pressure for Transparency → Benchmarking (Media, Customers, Politics)

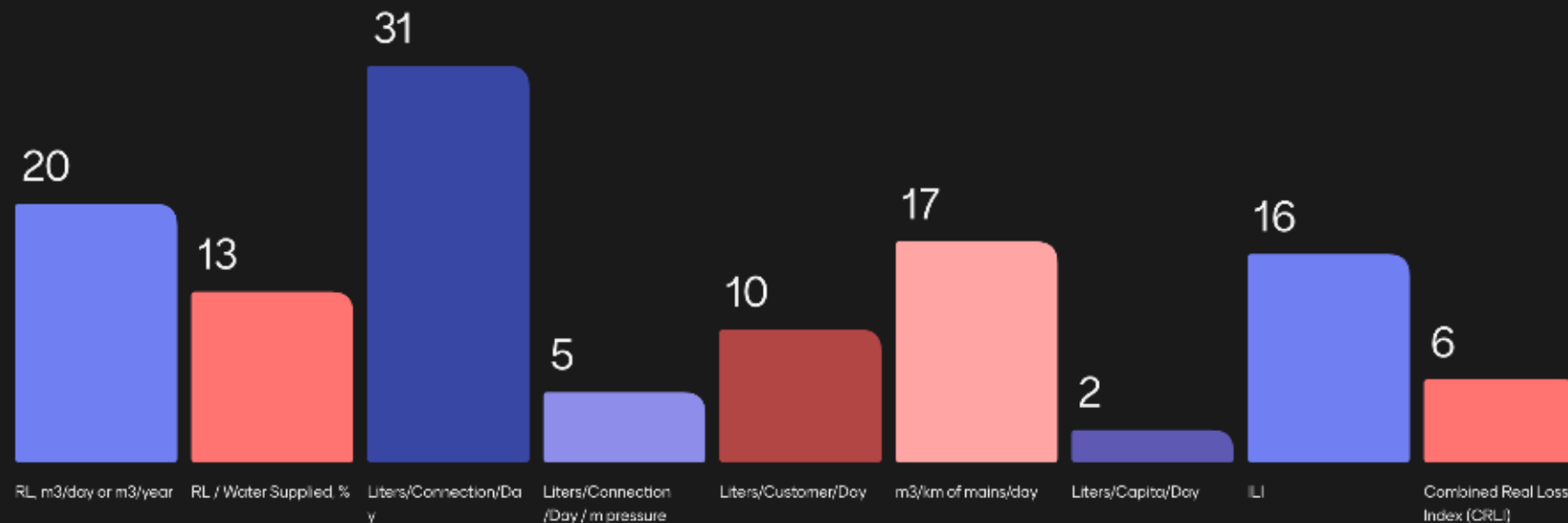
Internal Drivers

- Stakeholder Interests
- Utility internal Controlling → Target Setting - Tracking Performance
- Comparisons with others → Strengths & Weaknesses
- Identification of Improvement Actions

Participant Poll #4



Which are your favorite Real Loss KPIs ? - Choose up to 3

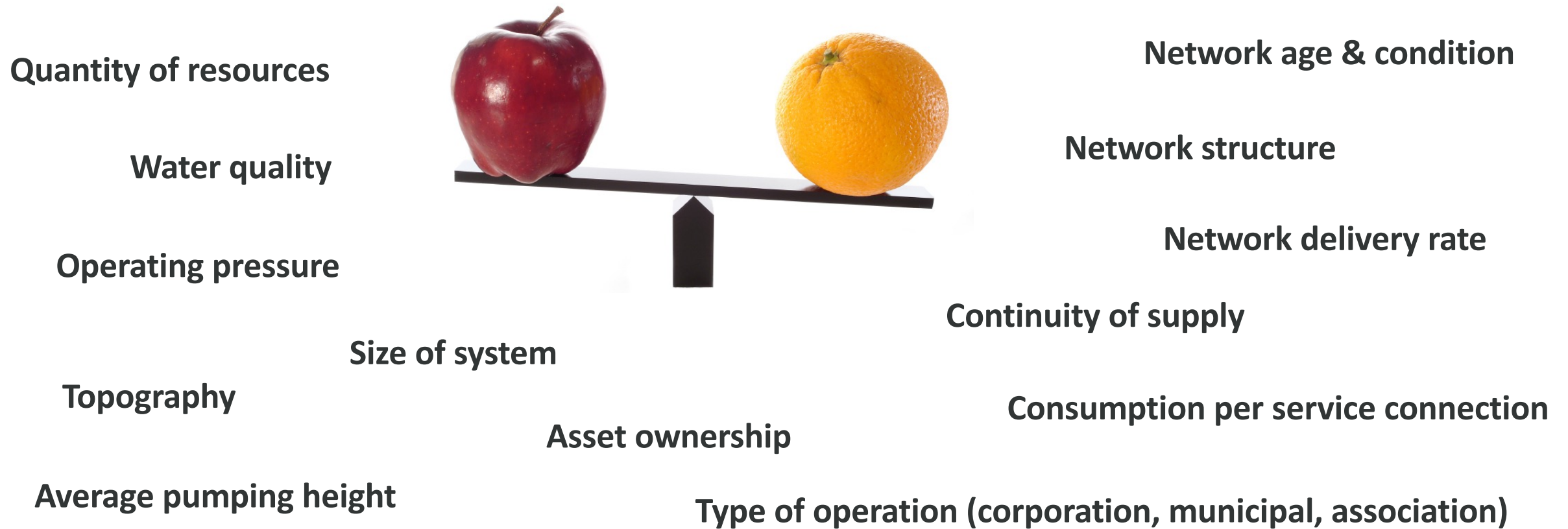


RL, m3/day or m3/year:	20
RL / Water Supplied, %:	20
L / Connection /Day:	31
L / Connection /Day / m of pressure	5
L / Customer /Day:	10
m ³ / km of mains / Day:	17
Liters / Capita / Day:	2
Infrastr. Leakage Index:	16
Combined RL Index:	6

PURPOSE: THE RIGHT TOOL FOR THE RIGHT JOB

Water Balance Component	PI	Suitable purpose (use)				Principal users	Strenght	Weakness	Comments
		Assessment	Comparisons, Benchmarking	Target-Setting	Tracking				
Real Losses	Real loss volume			✓	✓	Utilities	Very simple	Does not consider any structural parameters	Not suitable for comparisons with others
	Real losses in Liters / Connection / Day	✓	✓	✓	✓	Utilities, Regulators, Benchmarking	Simple; number of service connections is usually a stable reference parameter	In some countries the number of service connections is not accurately tabulated (but it should be).	A logical choice because a significant portion of leakage occurs on service connections, especially where connection density is high
	Real losses in m ³ / km of mains / day (or in m ³ / km / h)	✓	✓	✓	✓	Utilities, Regulators, Benchmarking	Simple; length of mains is commonly tabulated accurately	In general, increases with connection density - urban or rural nature of the distribution network	Traditionally used in many European countries and also useful in locations where the number of connections is not accurately tabulated, but should on be interpreted in the context of system structure (urban or rural), e.g. by service connection density and/or network delivery rate
	Infrastructure Leakage Index (ILI)	✓		✓	✓	Utilities	Considers most relevant structural parameters (mains length, number and length of service connections)	Pressure and length of service connections often not known accurately	Only to be used for target setting when pressure reduction is completed; pressure conditions to be considered for interpretation
	Combined Real Loss Index (CRLI)	✓	✓	✓	✓	Utilities, Benchmarking	Balances influences from number of connections and from length of mains	Requires data on both connections and mains length.	“Experimental” indicator, more experience needed

INTERPRETATION OF KPI



There is no single indicator suitable for all purposes
A suite of indicators is best

INTERPRETATION OF KPI

- **Option 1: Multi-parameter indicators:**

E.g. ILI – Infrastructure Leakage Index, which considers following parameters

- Mains Length
- No. of Connections
- Length of Connections
- Pressure

- **Option 2: In-depth analysis & comparisons:**

- Grouping, Clustering
- Explanatory Factors
- Combined View, NOT picking out the PI „most suitable“

SUPPLEMENTARY PI AND CONTEXT INFORMATION

Information about system structure:

Service connection density (IWA CI61)
Network delivery rate (IWA CI76)

ALC performance:

Network inspection rate (IWA Op3)
Leakage control (IWA Op4)

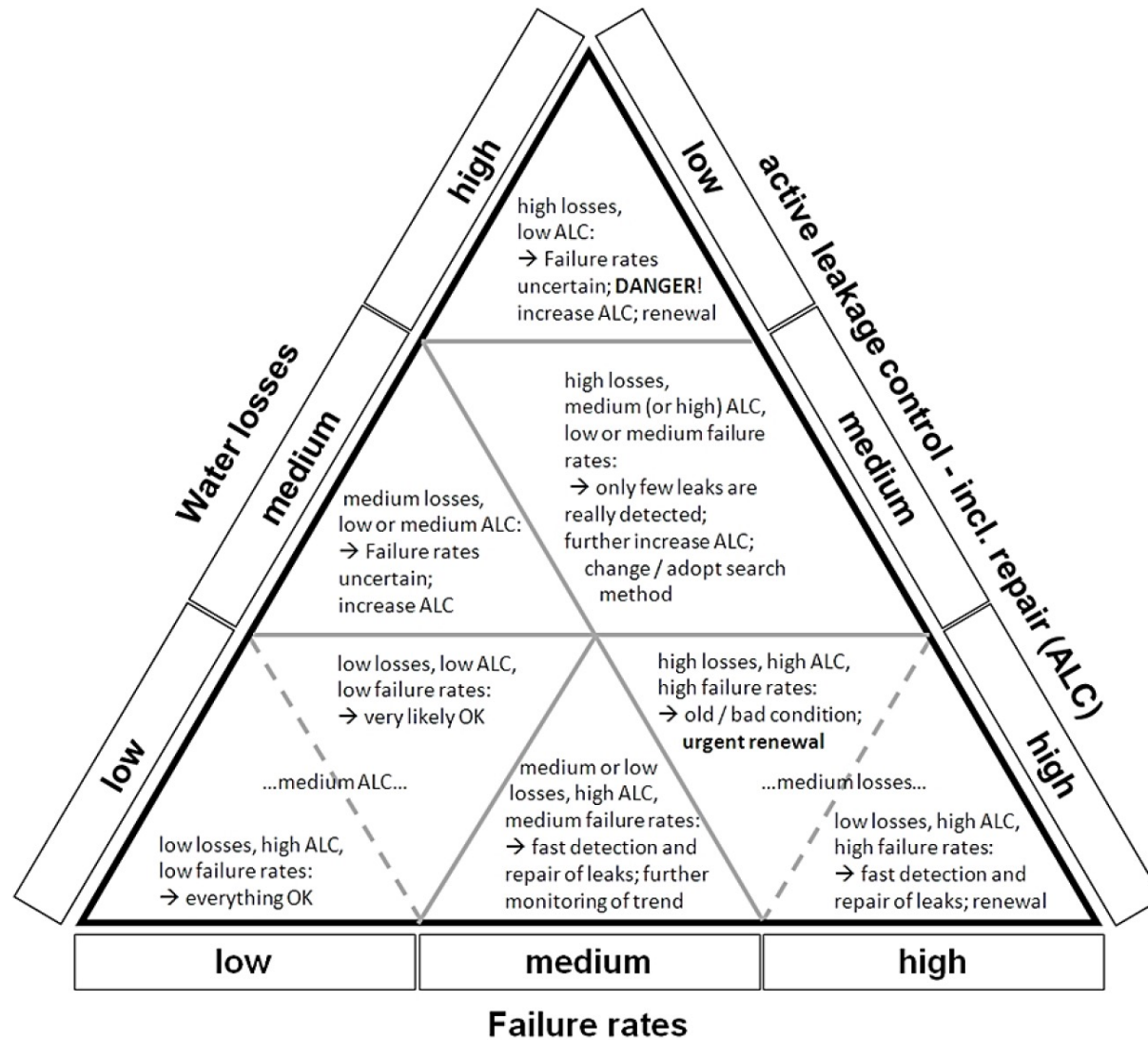
Quality of Supply:

Pressure (QS10)
Continuity of Supply (IWA QS12) and the
w.s.p. Methodology

Asset condition or health:

Mains failures (IWA Op31)
Service connection failures (IWA Op32)
Active leakage control (ALC) leaks repaired (IWA Op5)
Mains rehabilitation rate (IWA Op16)
Service connection rehabilitation rate (IWA Op20)
Network age: Average mains age (CI53) or NAX

RATING-TRIANGLE WATER LOSS, FAILURE RATE AND ACTIVE LEAKAGE CONTROL



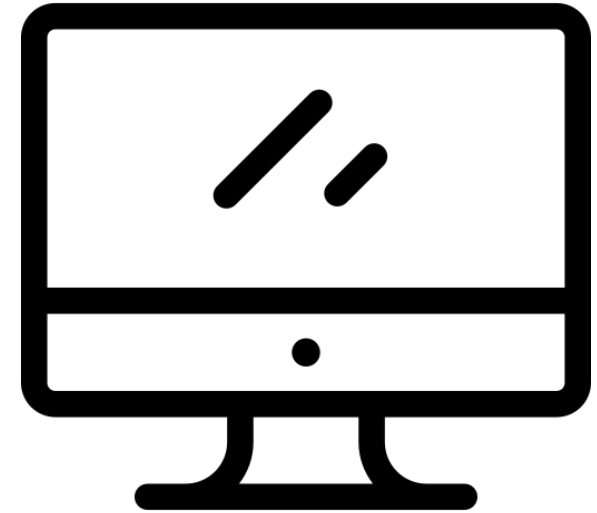
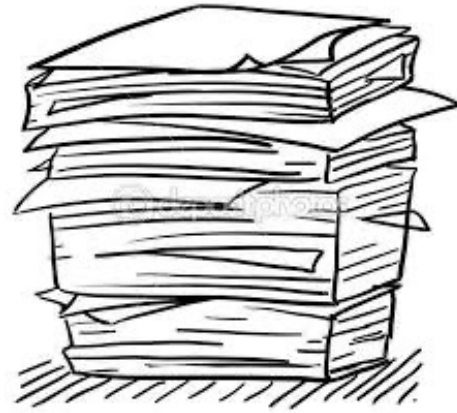
Source: Neunteufel et al., 2014

5. NEXT STEPS: KPI GUIDANCE NOTES

- Completion of draft chapters → May 2026
- **Case Studies** → June 2026
- Revision of the format (editorial editing) → June 2026
- Review by Core Team and Wider Group → July/August 2026
- Final revision → September 2026
- Presentation of final version at WWC → October 2026
- Publication (downloadable version) → October 2026

6. CONTRIBUTORS

- Peter Dane
- Stuart Hamilton
- Joerg Koelbl
- Aleksandar Krstić
- Dália Loureiro
- Daniel Manzi
- Cor Merks
- Jamie Patterson
- Dave Pearson
- Klara Ramm
- Susanna Rodrigues
- Gary Trachtman
- Stuart Trow
- Alan Wyatt
- Gary Wyeth
- Daniel Zipperer



Thank You !!!

7. OPEN DISCUSSION ON GUIDANCE NOTES

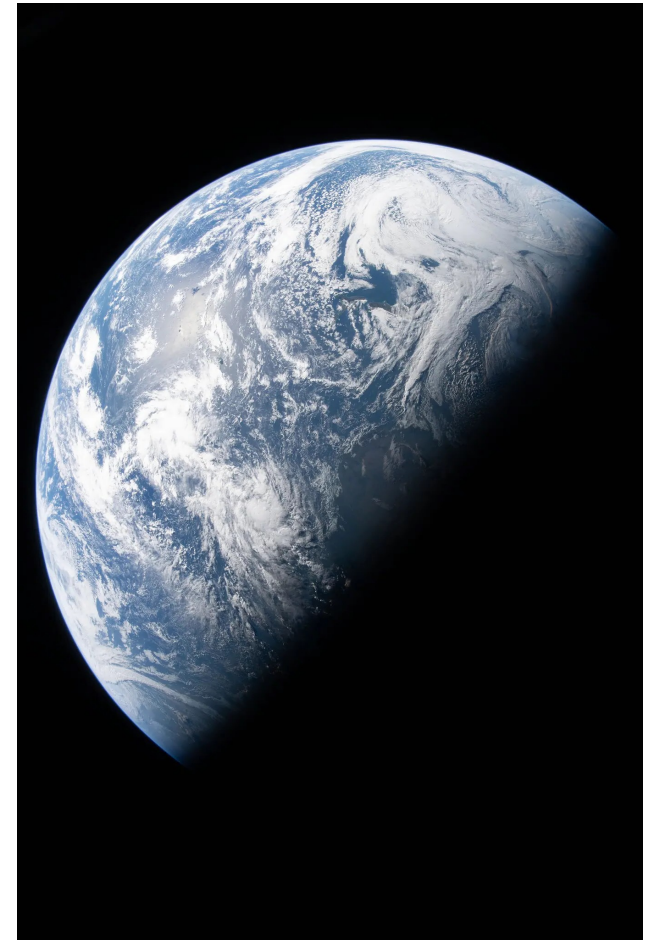


IWA Global Water Loss KPI Initiative

Preliminary Report on the Global NRW Data Compilation

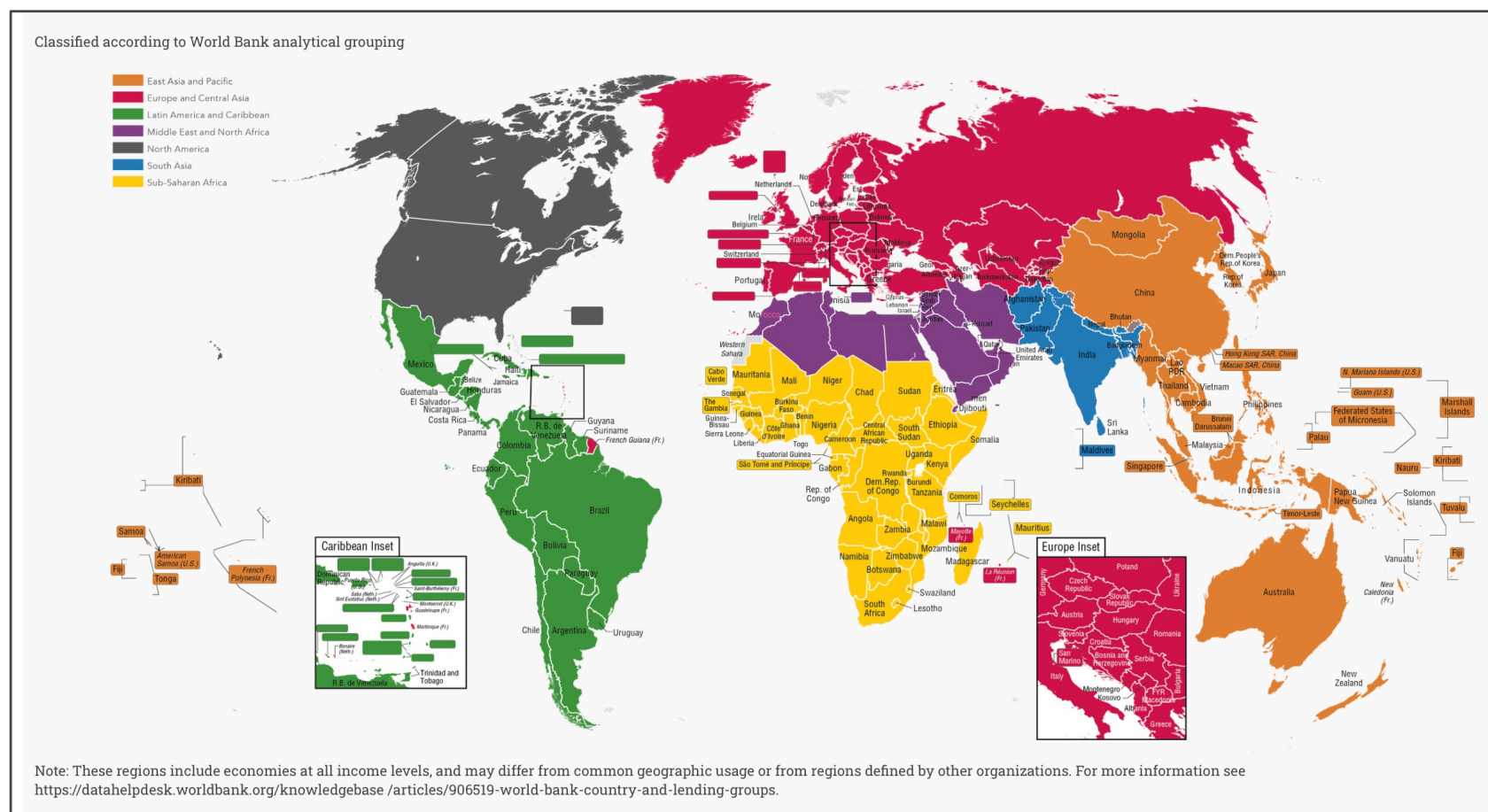
OUTLINE – GLOBAL NRW

1. Data Compilation: Scope & Method
2. Challenges and Uncertainty
3. Preliminary Results - with Uncertainty
4. Perspectives: NRW in Context
5. Perspectives: Importance of NRW
6. Next Steps
7. Contributors
8. Open Discussion



1. DATA COMPILATION - GEOGRAPHIC SCOPE

- 233 Countries and Territories as defined by WHO Joint Monitoring Program
- Classified into Regions following World Bank regions – with some adjustment



TECHNICAL SCOPE

- Focus on total NRW – NRW components next time
- 2024 data, to the extent possible

- Not including bulk suppliers
- Not including losses from raw water transmission mains and / or treatment plants
- Focus on piped distribution systems (respecting boundaries and water balance)

- No adjustments for supply continuity (wsp) to tabulate actual NRW

BASE VARIABLES AND INDICATORS

Tier 1 – Context & NRW

- Population Served
- Mains Length
- Connections
- Customers
- Supply Time
- Water Supplied (Input)
- Billed Authorized Use
- NRW
- Energy Intensity, kwh/m³

Principal Indicators

- NRW / Connection
- NRW / km of Mains
- NRW / Water Supplied, %
- Connection Density
- Supply Continuity, %
- Water Supply, Liters/Capita/Day
- Billed Authorized Use, Liters/Capita/Day
- NRW, Liters/Capita/Day

- Network Delivery Rate: Billed Use: m³/km/ Year
- Persons supplied / km of Mains
- Unbilled Authorized Consumption (if possible)

MANY DATA SOURCES

1. Regulators and Government Ministries
2. National Strategy / Planning Documents
3. National Statistics Offices
4. Professional Associations
5. Benchmarking Organizations / Programmes
6. International Development Agencies
7. Utility Annual Reports
8. Project Preparation Documents – World Bank, ADB, IDB, AfDB, EBRD
9. VOLUNTEERS to find, assemble, analyze and refine data



DATA COMPILATION METHODOLOGY

Where data is only available on a sample of utilities or data is very limited:

Country population served with piped water * NRW (Liters/Capita/Day):

- Country population served with piped water from WHO / JMP database
- Population served with piped water includes people served with direct connections and people served from standposts in distribution systems (urban and rural).
- NRW in Liters/Capita/Day, can be found from sample total NRW and sample population served, or even estimated water billed in Liters/Capita/Day and % NRW
- Total NRW = Country Population served with piped water x sample NRW Liters/Capita/Day

Same method used in previous IWA publication from 2018

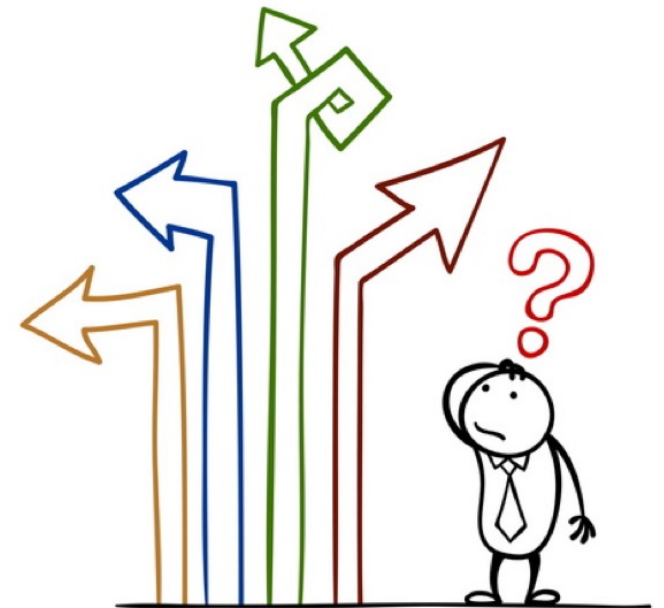
2. CHALLENGES AND UNCERTAINTY

1. Problematic Data Collection

- Data not collected or rarely collected
- Inaccurate or incomplete instrumentation
- Data scattered in many locations within a utility
- Data restricted for confidentiality

2. Confusion and Inconsistency of Terminology and Analysis

- NRW, Losses and Leakage not defined and used interchangeably
- Lack of understanding of water balance components
- Connections, customers, accounts, properties, clients not defined or used interchangeably
- Lack of data on connections in many many countries



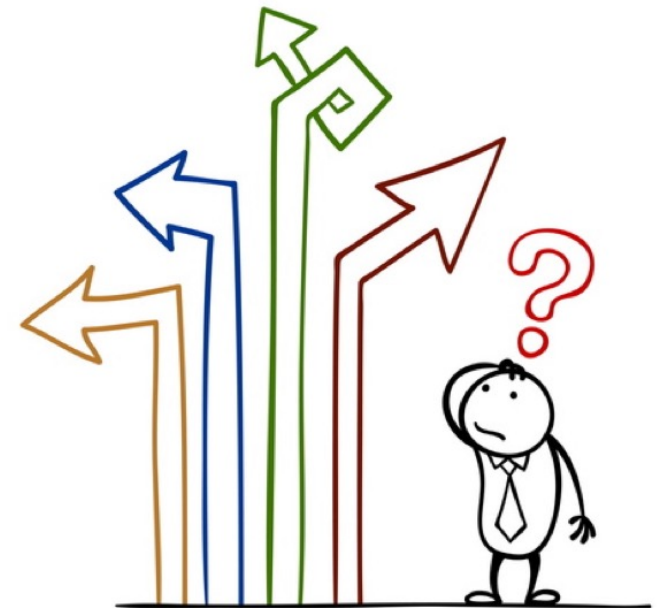
CHALLENGES AND UNCERTAINTY

3. Weak Data Compilation Systems:

- Only data for one or two large cities in a country
- Only indicators and not base variables (important for context)
- Different states or provinces have different systems
- Multiple data systems within a country for different concerns (economics or water resources)
- Data reliability or accuracy rarely considered, reported or verified

4. Uncertainty Assessment Required

- SO..... We prepared confidence intervals for data on population served with piped water, and for NRW to arrive at uncertainty of total NRW by country
- Country uncertainties “rolled-up” to Regional and Global uncertainty



UNCERTAINTY ANALYSIS

1. Percent uncertainty intervals prepared for population served with piped water: WHO/JMP data compared to country sources or other data.
2. Percent uncertainty intervals prepared for NRW (Liters/Capita/Day), based on sample size, general data quality, and comparison to other sources.
3. Percent uncertainty of Total NRW by country determined using RSS method. (Square root of sum of squares of percent uncertainties).
4. Three levels of Total NRW by country: Low, Medium, High.
5. Global or Regional NRW uncertainty determined using RSS method (Square root of sum of squares of country volumetric uncertainties).
6. RSS method assumes the uncertainties across countries are interdependent of each other.



DATA CHALLENGES IN LARGE COUNTRIES

1. **AFRICA:** Angola, Chad, Mozambique, Madagascar, Nigeria, Somalia, Sudan
2. **CENTRAL ASIA:** Azerbaijan, Kazakhstan, Tajikistan, Uzbekistan
3. **EAST ASIA:** Myanmar, North Korea, Viet Nam
4. **SOUTH ASIA:** Afghanistan, Bangladesh, Nepal, Pakistan, Sri Lanka
5. **EUROPE:** Belarus, Greece
6. **LATIN AMERICA:** Cuba, Haiti, Guatemala, México, Venezuela
7. **MENA:** Egypt, Iraq, Iran, Morocco, Saudi Arabia, Syria, Yemen



But all countries are important !!!

Still Need Help!!!

3. PRELIMINARY RESULTS WITH UNCERTAINTY

- Estimated Global NRW Volume – with uncertainty range
- Estimated Regional NRW Volume – with uncertainty range
- Estimated Country NRW Volume – with uncertainty range

- Comparison to 2015 IWA Journal publication (2018)
 - Growth in Population Served
 - Change in Total NRW
 - Change in NRW (Liters/Capita/Day)



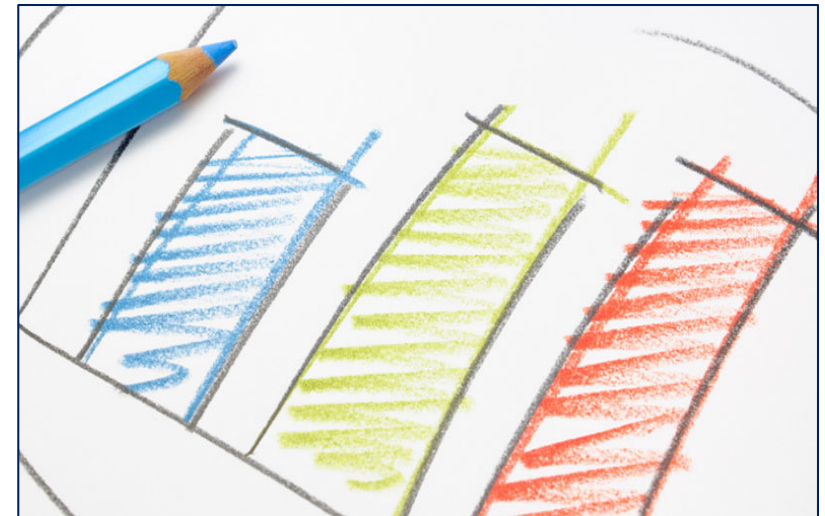
GLOBAL NRW WITH UNCERTAINTY – 2024

- Estimated Population Served with Piped Water: 5.76 Billion (71% of World Population)
- Uncertainty of Population Served (using RSS): 0.33 Billion (+/- 5.7%)




Estimated Global NRW 2024:

- LOW: 141 Billion m³/year
- MEDIUM: 149 Billion m³/year
- HIGH: 156 Billion m³/year

- UNCERTAINTY: 7.4 Billion m³/year
(+/- 5.0 %)



GLOBAL NRW: COMPARISON OF 2015 TO 2024

- Population served with piped water: 4.50 to 5.75 Billion people 
- Total NRW Volume: 126 to 149 Billion m³/year 
- NRW in Liters/Capita/Day: 77 to 71 Liters/Capita/Day 

149 BILLION M³ PER YEAR IS ABOUT:

- 4,710 m³/second
- Almost twice the average flow of the Rhine
- Equal to the average flow over Victoria Falls
- 73% of the average flow of the Danube
- 28% of the average flow of the Rio Paraná

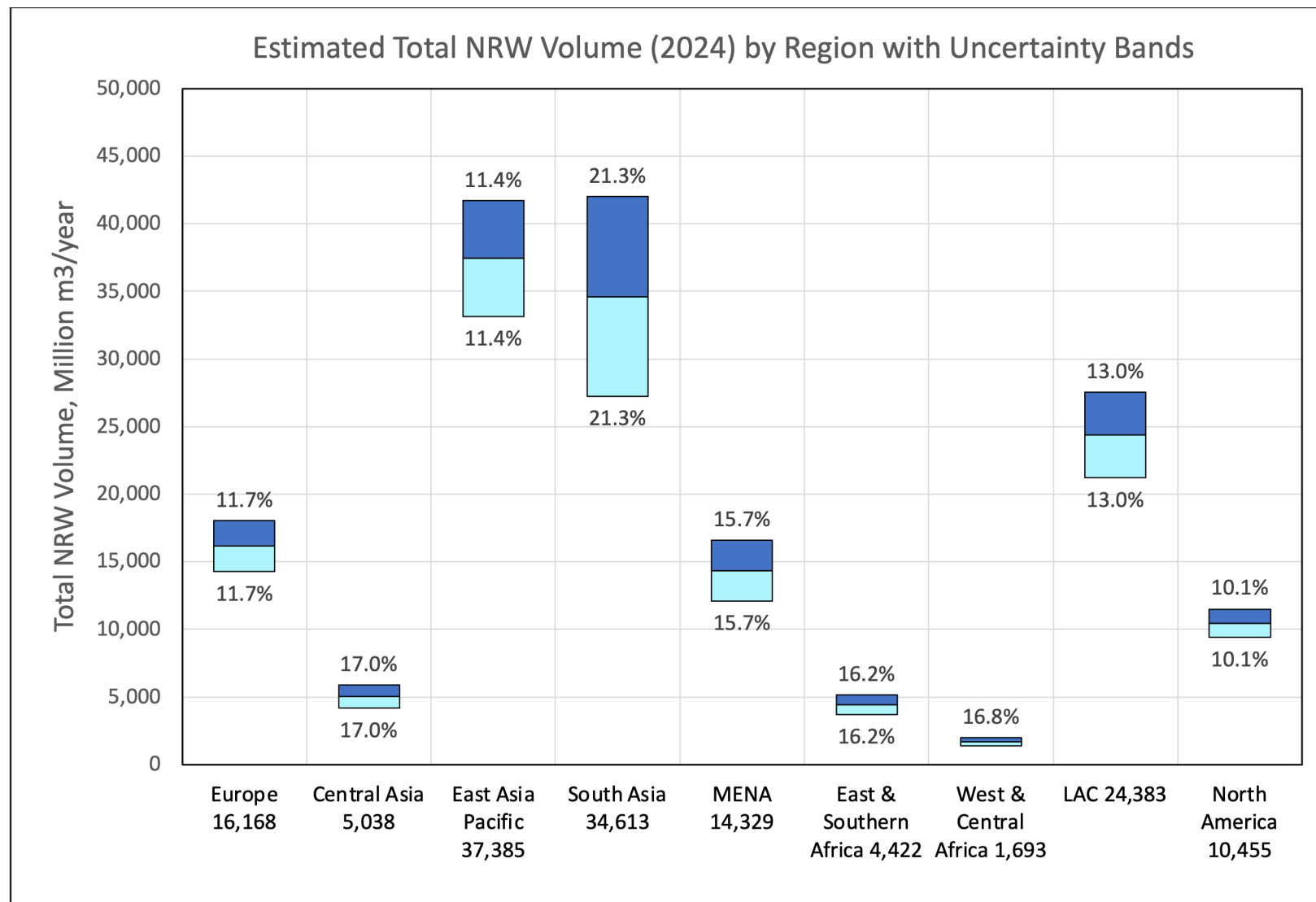


If the total NRW were cut by one third, this water could supply
~770 Million people with 125 Liters/Capita/Day

REGIONS: POPULATION SERVED AND NRW

World Region	Number of Countries / Territories	Total Population 2024, Thousands	Population with Piped Water, 2024, Thousands	% Population with Piped Water	Estimated Total NRW, Million m3 / year	Weighted Average NRW, L / Capita / Day
Europe	49	688,265	650,182	94%	16,177	68
Central Asia	9	242,878	203,137	84%	5,038	68
East Asia Pacific	41	2,397,354	1,845,503	77%	37,430	56
South Asia	8	1,972,489	1,297,949	66%	34,613	73
MENA	21	517,769	426,214	82%	14,329	92
East & Southern Africa	25	623,112	228,895	37%	4,422	53
West & Central Africa	26	669,167	183,659	27%	1,693	25
LAC	50	663,461	551,834	83%	24,383	121
North America	4	385,239	358,816	93%	10,455	80
TOTAL	233	8,159,733	5,746,189	70%	148,540	71
Estimates from 2015	223	7,325,241	4,501,492	61%	126,270	77
Ratio 2024/2015		1.11	1.28	1.15	1.18	0.92

REGIONS: NRW UNCERTAINTY

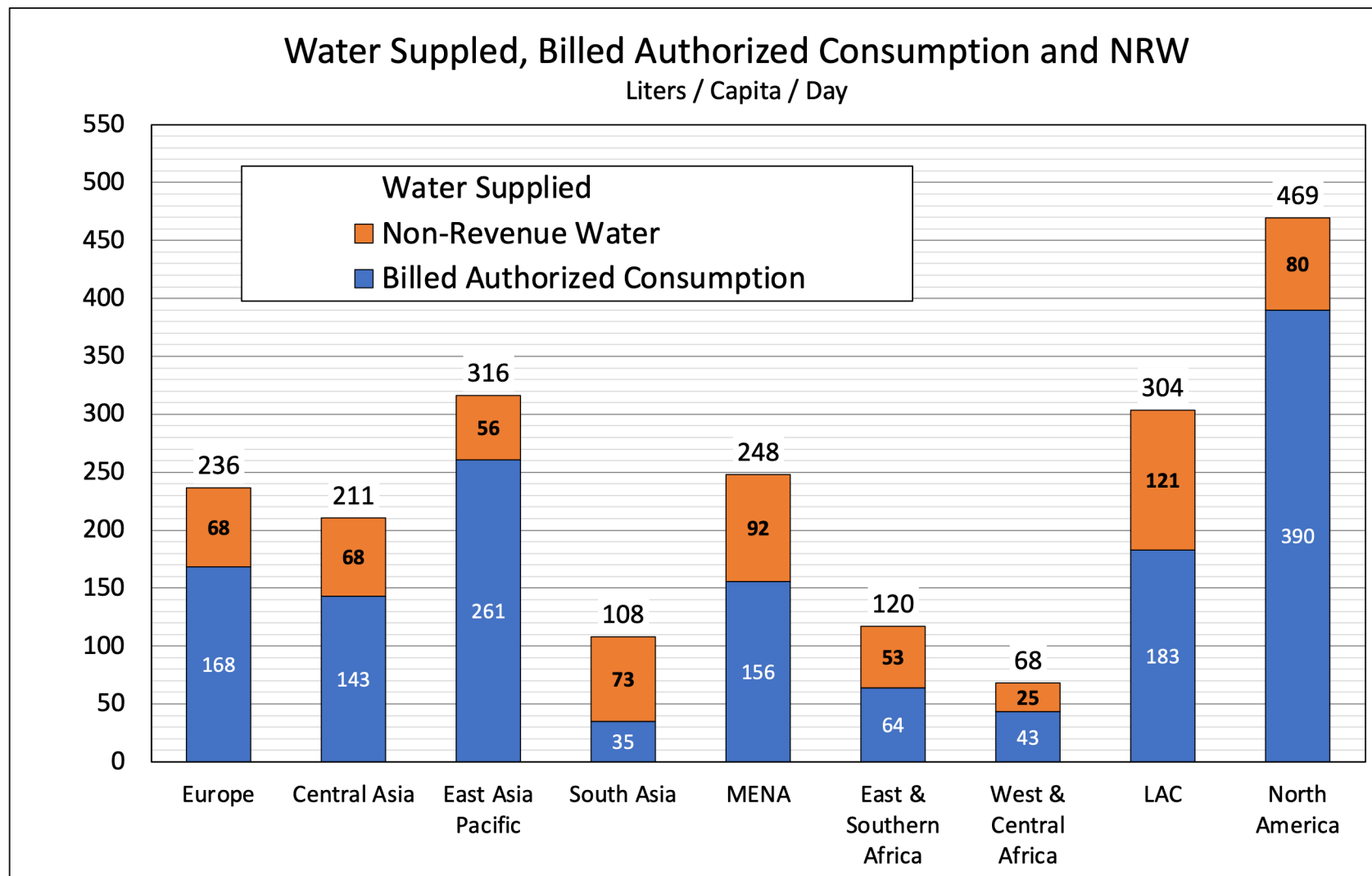


Range of NRW / Capita

World Region	NRW, L / Capita / Day - Low	NRW, L / Capita / Day - Medium	NRW, L / Capita / Day - High
Europe	60	68	76
Central Asia	56	68	79
East Asia Pacific	49	56	62
South Asia	57	73	89
MENA	78	92	107
East & Southern Africa	44	53	61
West & Central Africa	21	25	30
LAC	105	121	137
North America	72	80	88
All Regions	67	71	74

Must be careful about considering NRW in L/Capita/Day as a performance indicator – context factors are different in different Regions

REGIONS: WATER SUPPLIED, WATER USE & NRW



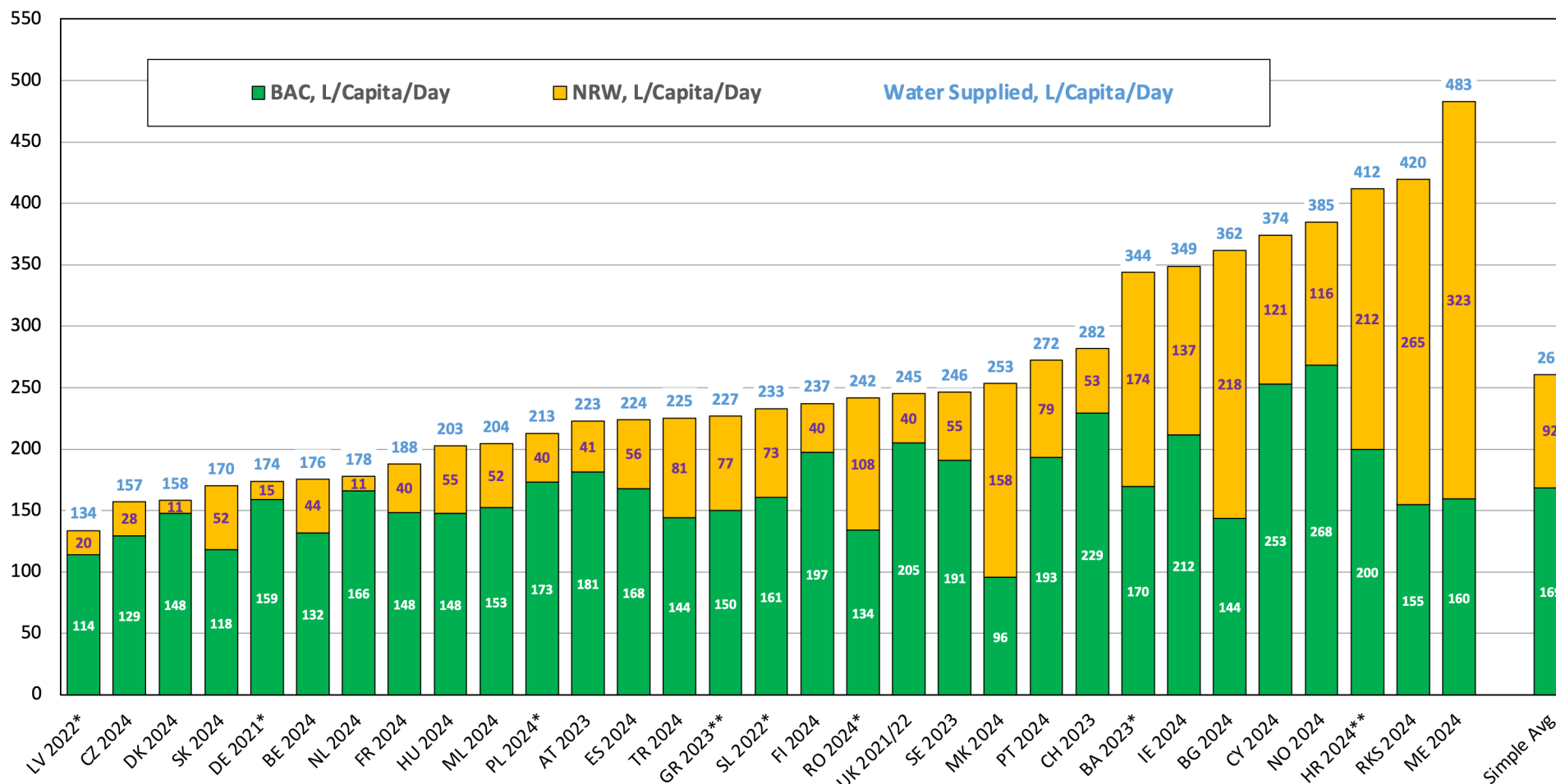
Estimates of Supply Continuity

- Europe: ~75% - 100%
- Central Asia: ~50% - 100%
- East Asia / Pacific: ~10% - 100%
- South Asia: ~10% - ??%
- MENA: ~20% - 100%
- East & Southern Africa: ~20% - 100%
- West & Central Africa: ~20% - 100%
- LAC: ~35% - 100%
- North America: ~100%

EUROPE: WATER SUPPLIED, WATER USE & NRW

Europe Billed Authorized Consumption and NRW, in Liters / Capita / Day

Countries with 100% Supply Continuity, Data as of April 24, 2026



More asterisks indicate more uncertainty

Data missing for:

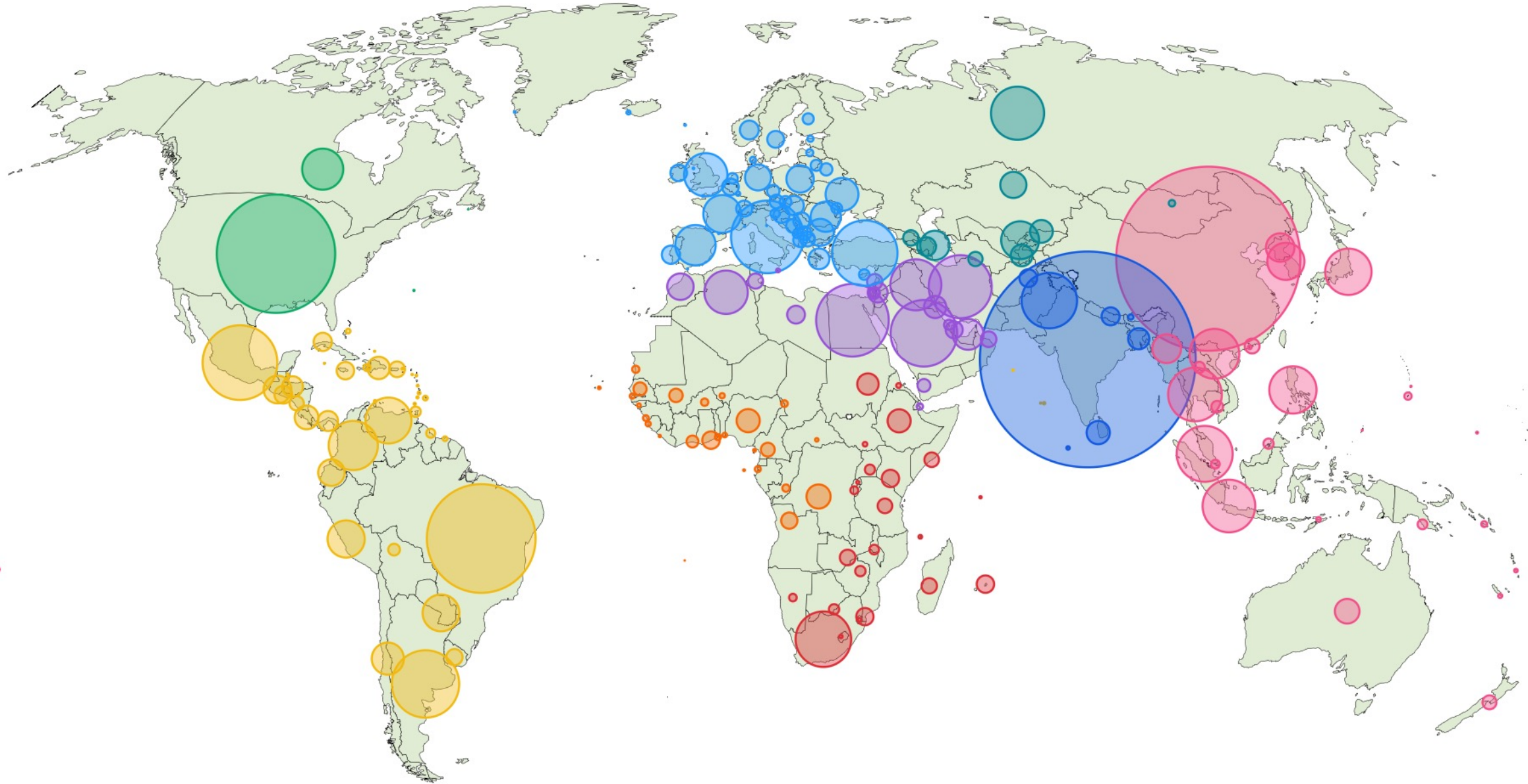
- Belarus
- Estonia
- Lithuania
- Luxembourg
- Moldova
- (Serbia)
- (Ukraine)

Countries with IWS:

- Albania
- Italy

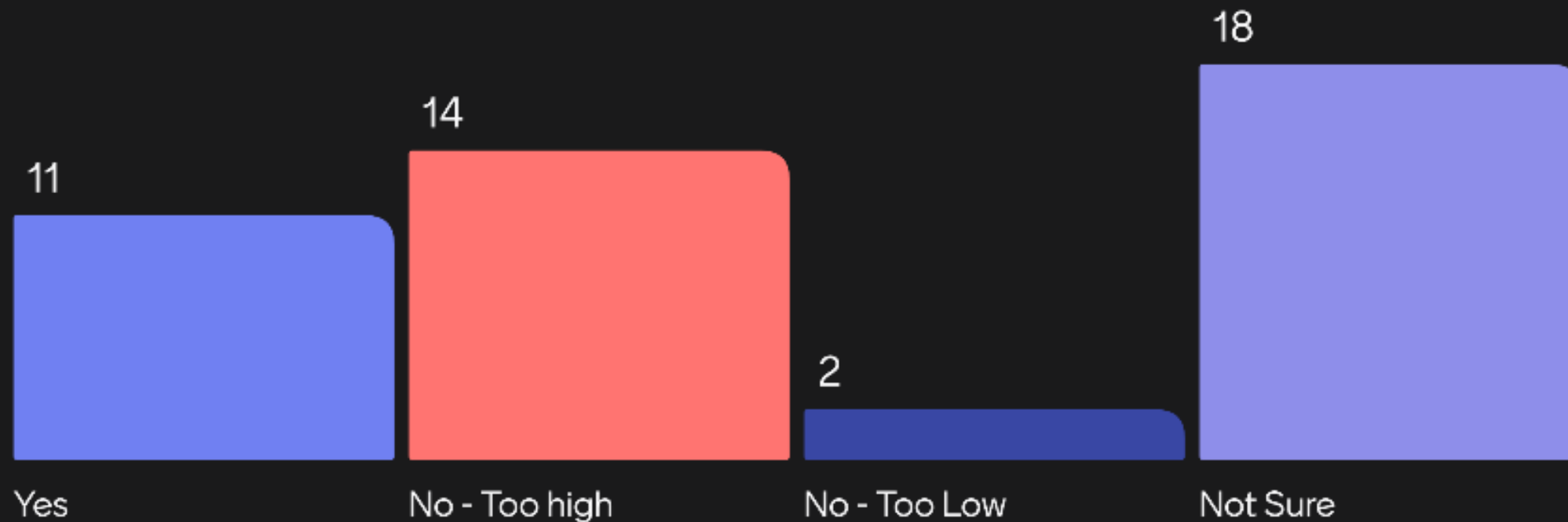
Total NRW by Country 2024

Million m³/year 400 ● 800



Participant Poll #5

Does the Total Global NRW look reasonable?



4. PERSPECTIVES: NRW IN CONTEXT

NRW is best interpreted in the context of local conditions

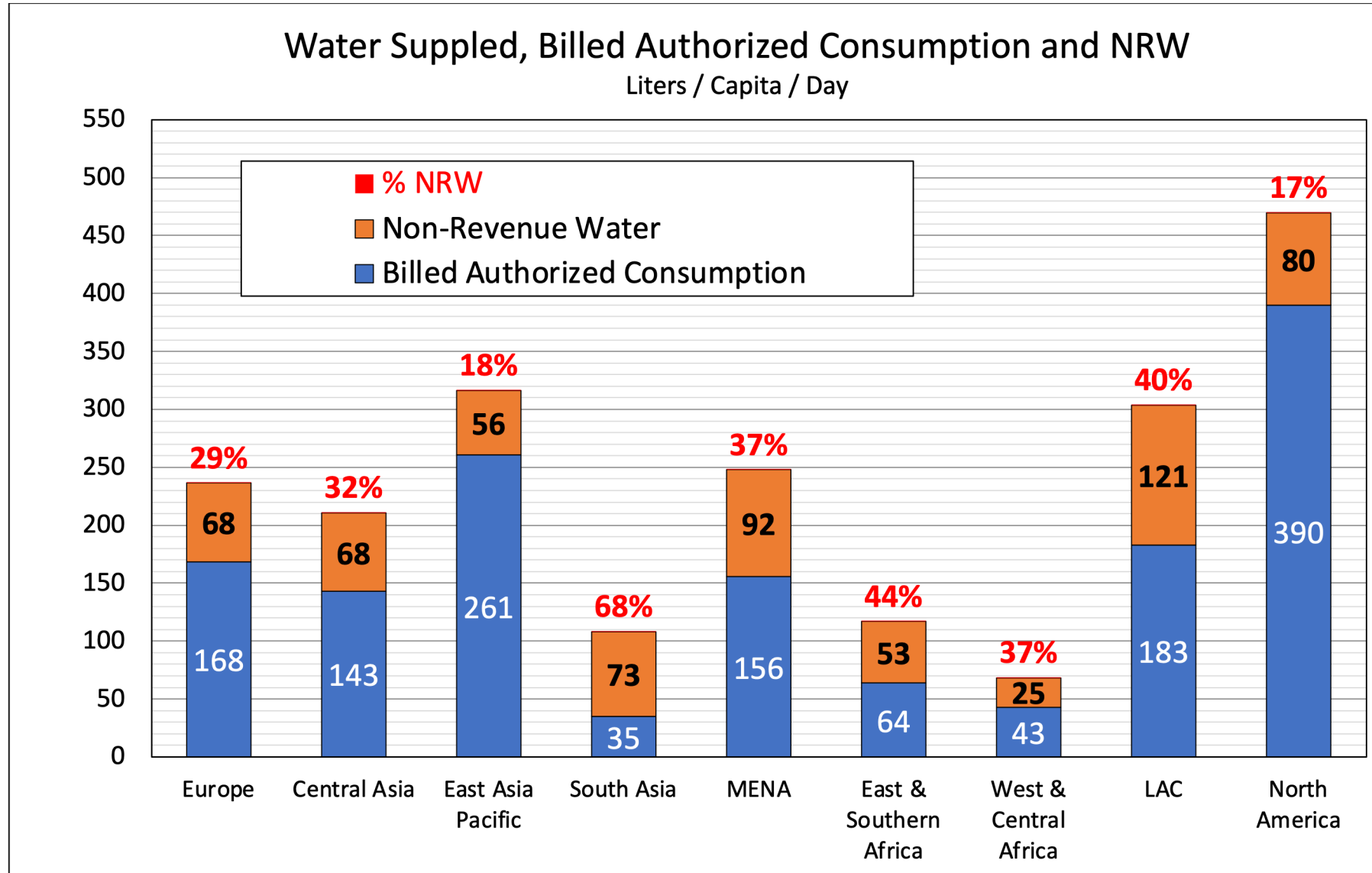
Examples:

- Billed Authorized Consumption
- Utility Size
- Service Continuity
- Connection Density

Which NRW Indicators are suitable?

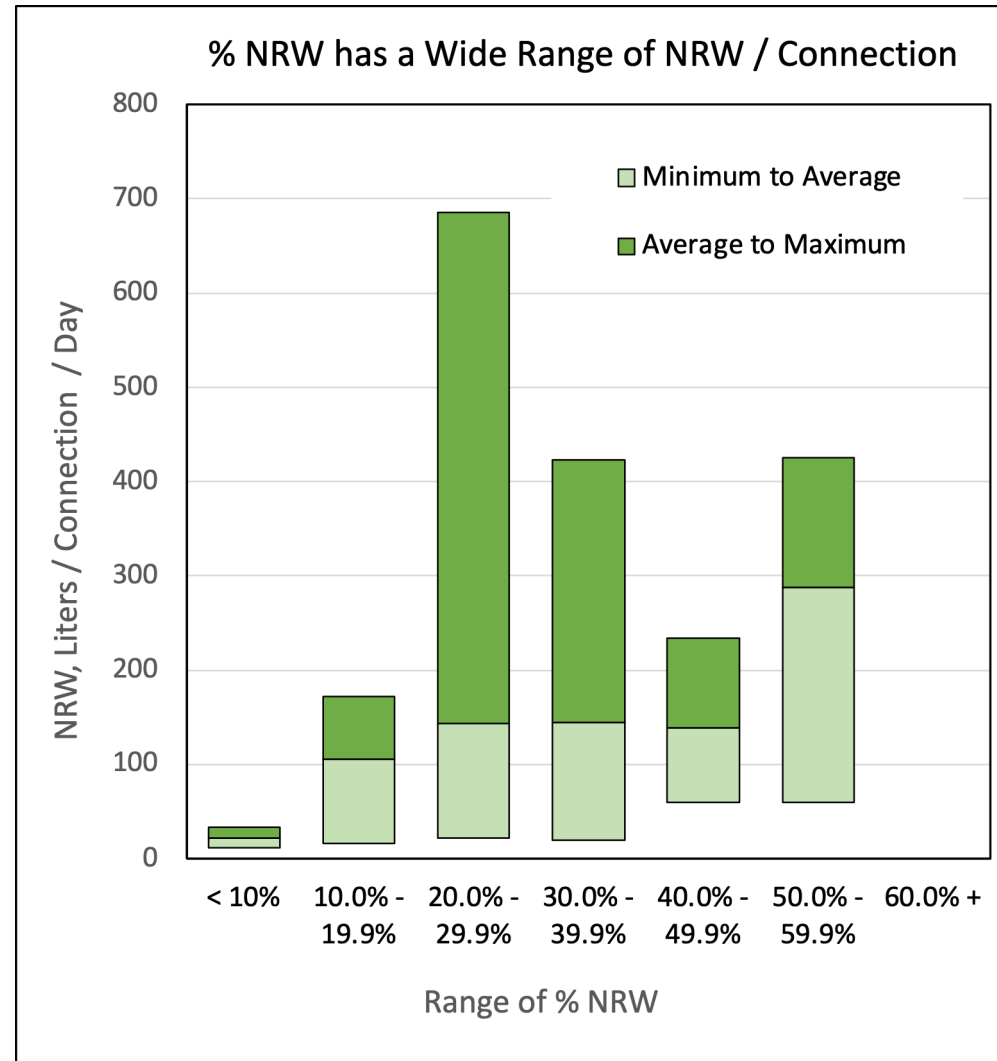
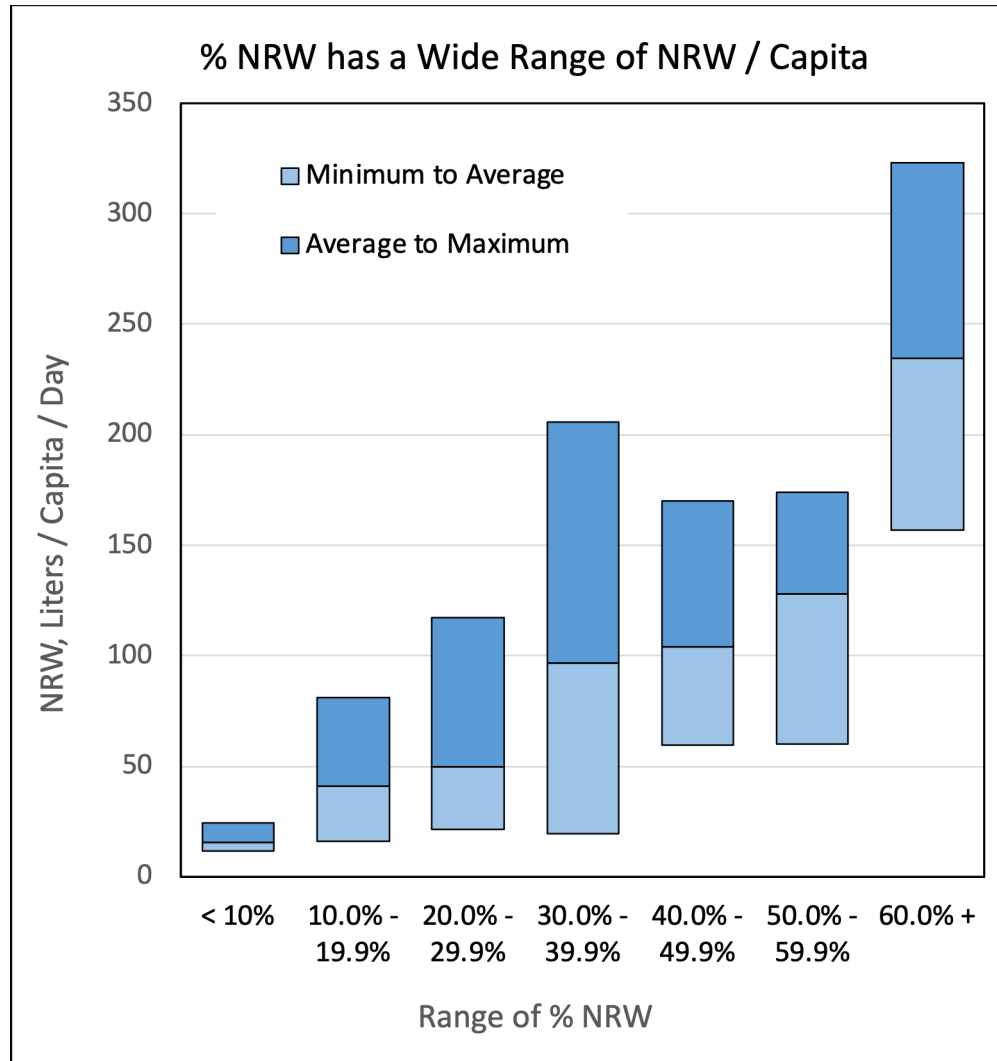


REGIONS: CONSUMPTION IMPACTS % NRW



% NRW and Volumetric NRW are not well correlated due to differences in Billed Authorized Consumption

REGIONS: % NRW DOES NOT INDICATE VOLUME

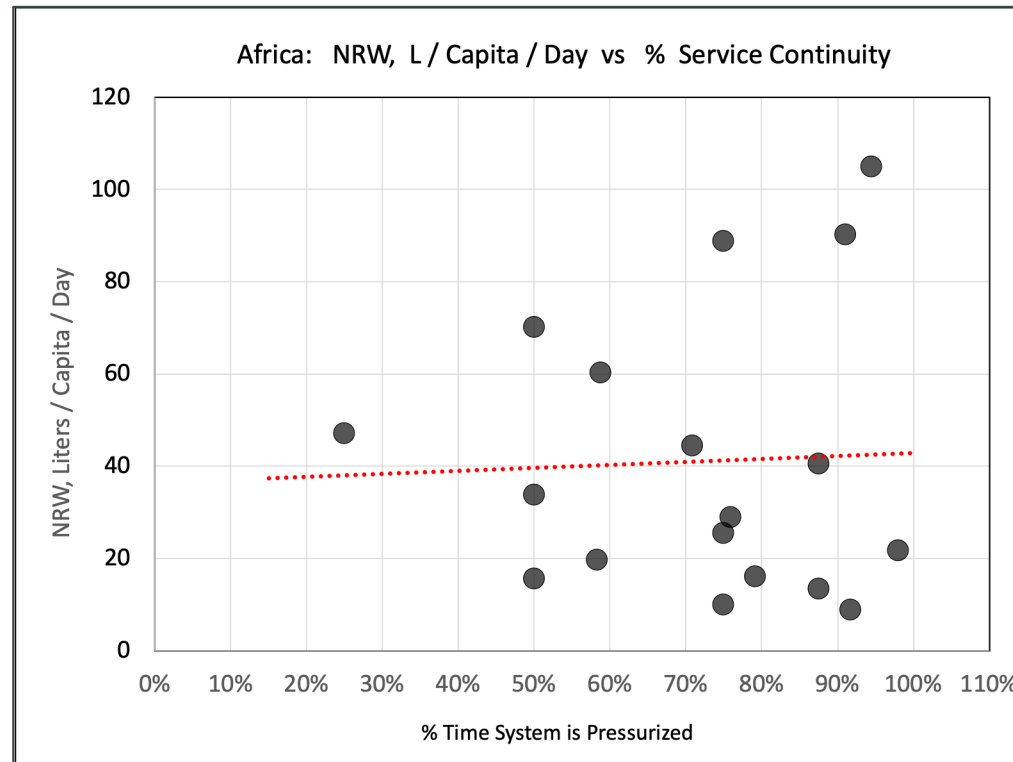
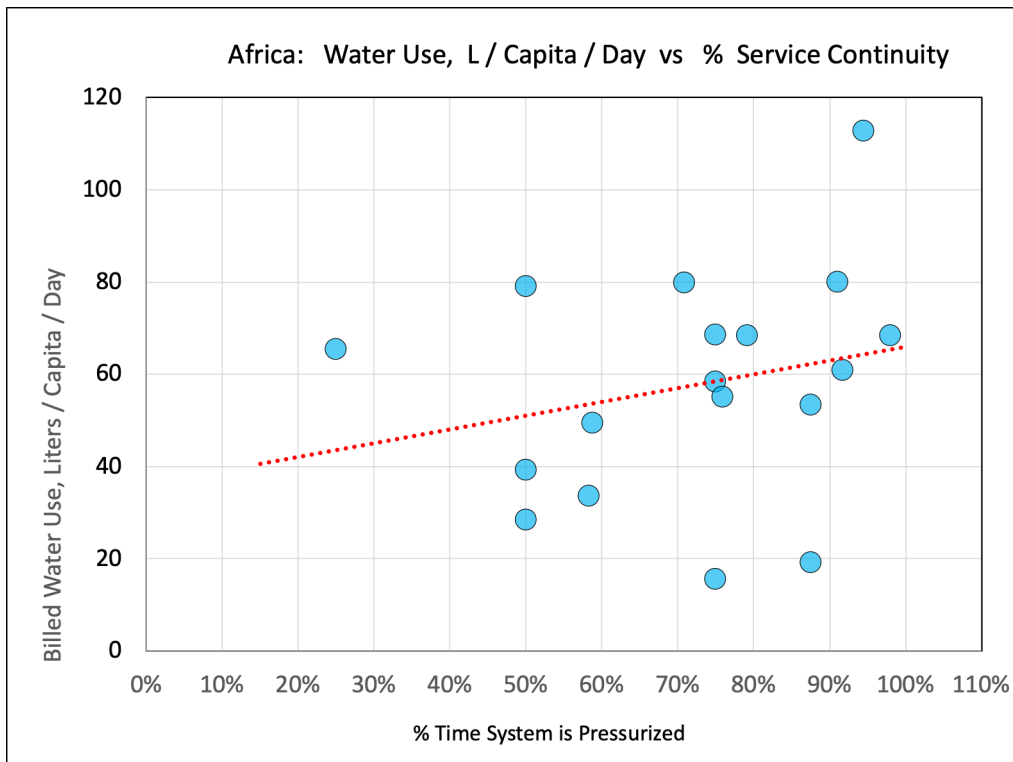


From a sample of 55 countries with good data reliability

Target Setting with % NRW is illogical !!

LIMITED DATA ON SERVICE CONTINUITY

- Continuity affects Water Use and NRW in many complex and important ways
- Good data hard to find – we have estimates for only 40% of countries in Africa
- Hard to separate the impact of continuity from other context factors



Should
w.s.p. apply
to NRW or
just Real
Losses?

ARE REGIONAL COMPARISONS POSSIBLE?

	Higher Income Countries	Lower Income Countries
Service Coverage	Very High	Moderate to Low – Mostly Urban
Type of Service	Direct Connections, Continuous Service	Direct Connections, Standposts, Tankers, Vendors; Intermittent Service
Population and Infrastructure	~2 – 5 people served per connection ~75 – 200 people served / km of mains	~5 - 15 people served / connection ~300 – 800 people served / km of mains
Water “demand” per person	~ 150 – 350 L/Capita/Day; many appliances, more industry	~ 25 – 80 L/Capita/Day; less direct access, fewer appliances, less industry

The scaling denominators and explanatory factors are very different

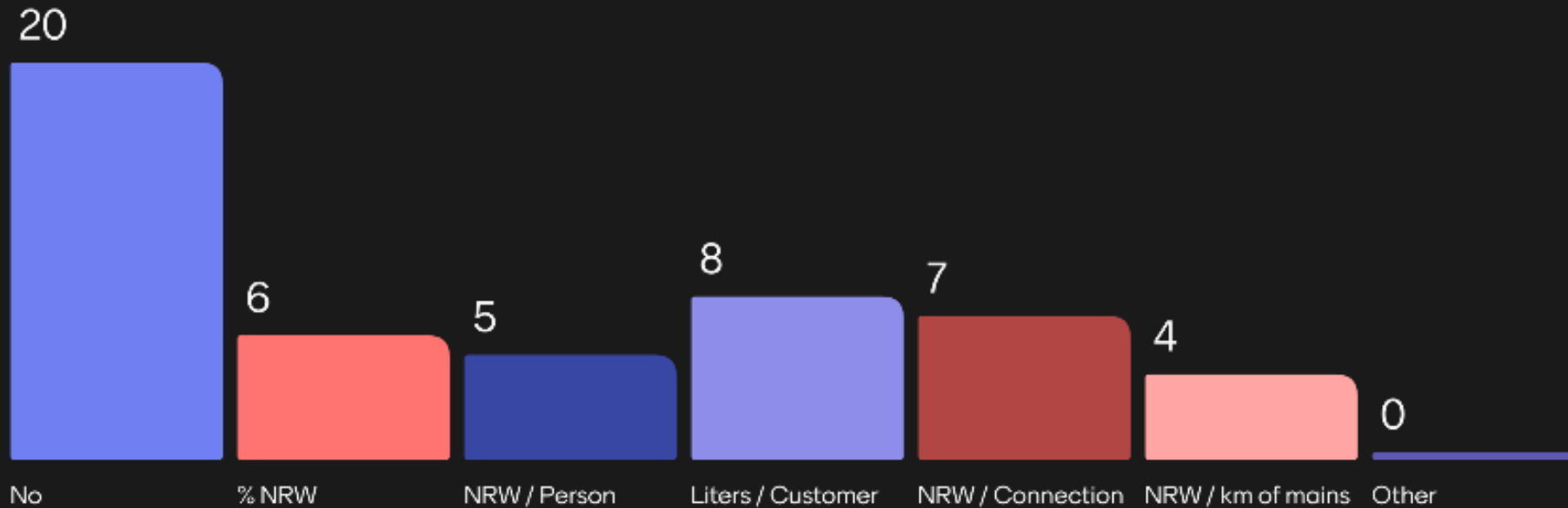
(How) Can we Assess NRW across Contexts?

- Just peer to peer comparisons, cohort analysis, or clustering ?
- Liters / Capita / Day ?
- Combined NRW Index = $(\text{NRW/Connection} * \text{NRW/km of mains})^{1/2}$?

Participant Poll #6



Is there a high-level NRW Indicator suitable for assessment across the World ?



No :	20
% NRW :	6
NRW / Person:	5
Liters / Customer:	8
Liters / Connection:	7
NRW / km of mains:	4
Other:	0

5. PERSPECTIVES: IMPORTANCE OF NRW

The Importance of NRW is best understood in the context of other local conditions which the utility may or may not be able to control:

- Baseline Water Stress (or Future Water Stress)
*100 Liters/Capita/Day in a desert is not the same as
100 Liters/Capita/Day in a rain forest.*



- Energy Intensity and Carbon Intensity = CO₂ Emissions



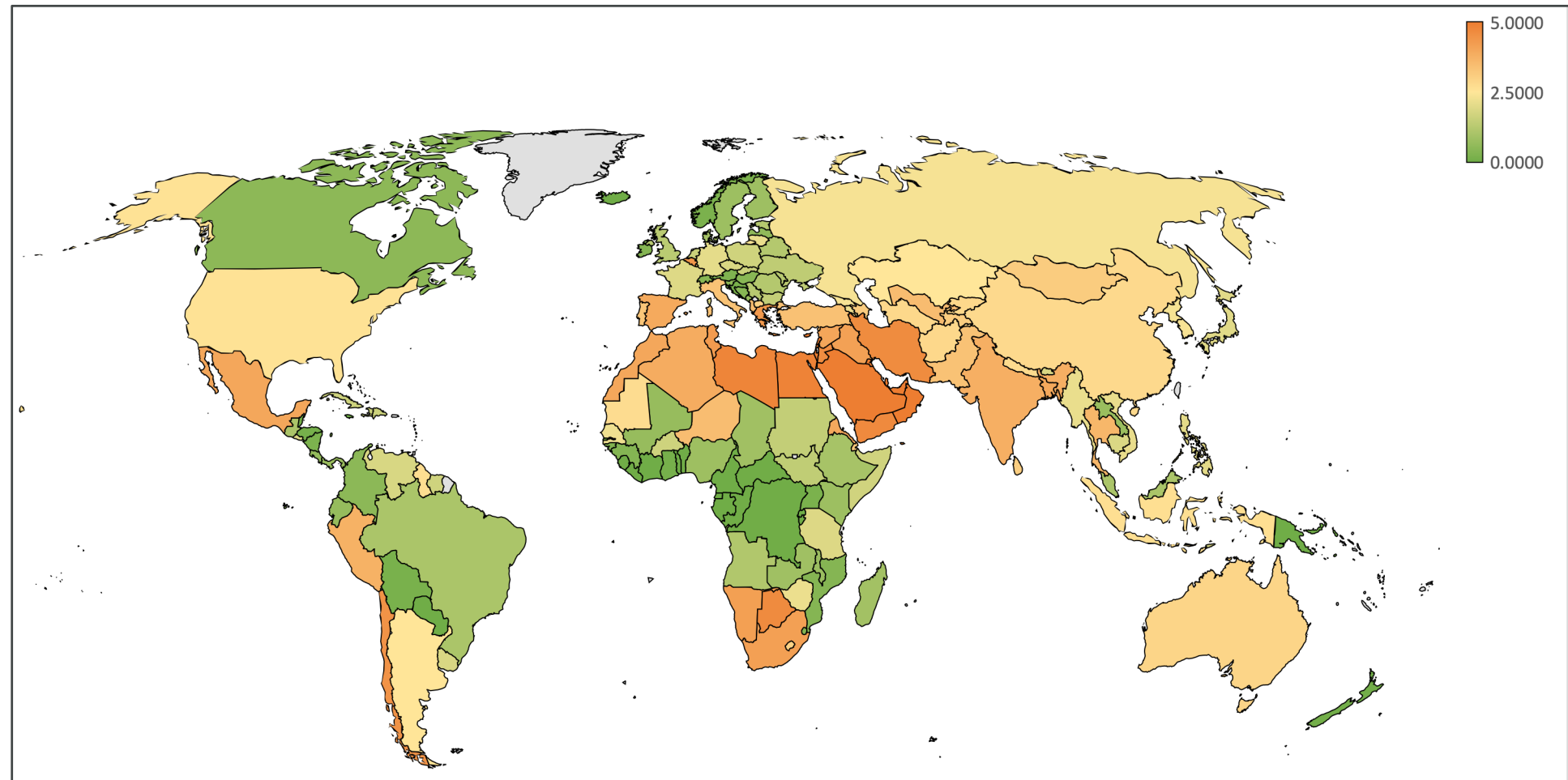
NRW AND BASELINE WATER STRESS

World Resources
Institute: Baseline Water
Stress

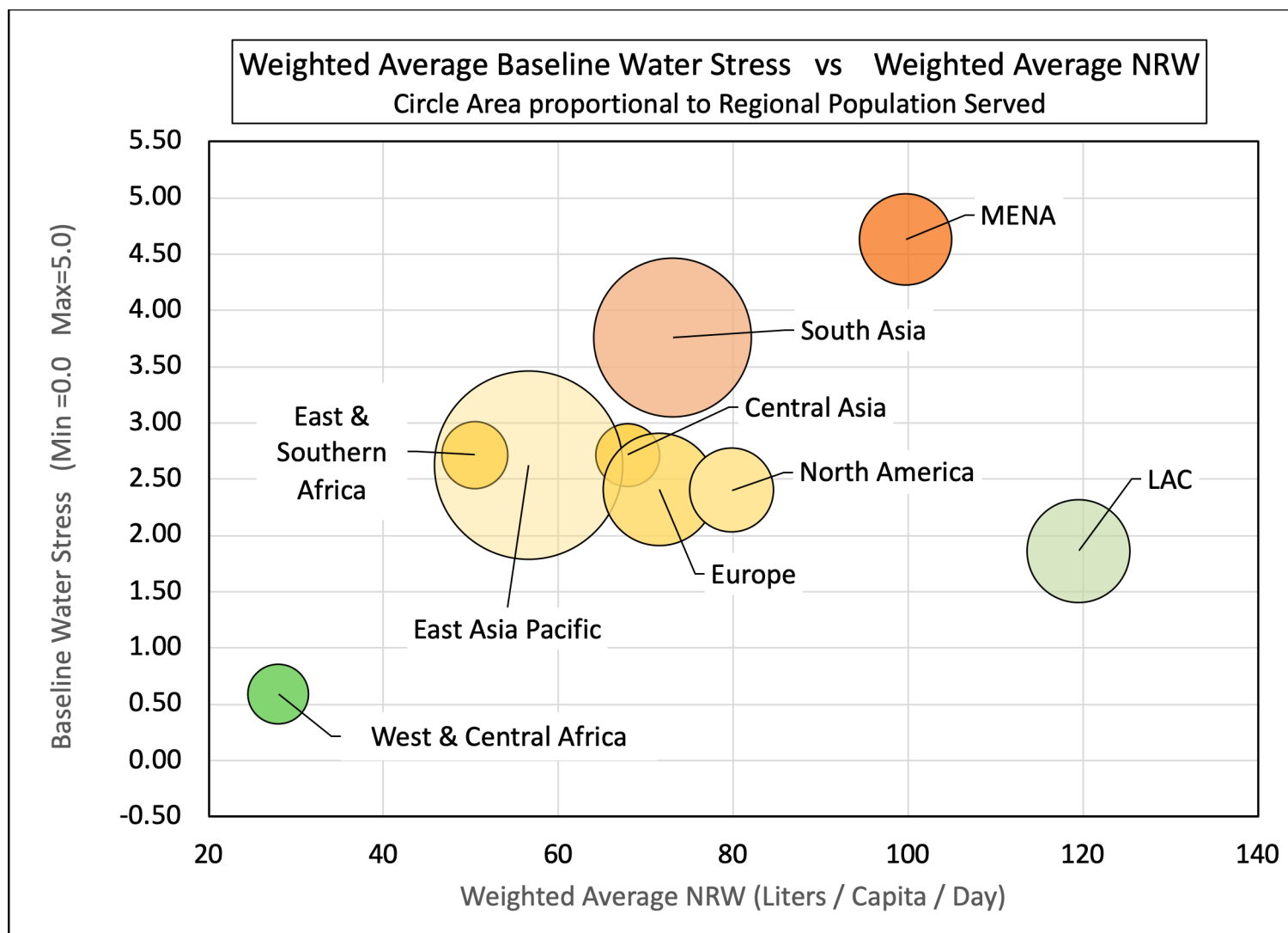
$BWS = \frac{\text{Total Demand}}{\text{Renewable Surface and Groundwater Supplies}}$
(1979-2019)

Scale:
0 = No Stress
5 = Very High Stress

Desalinated or Recycled
Water are not counted

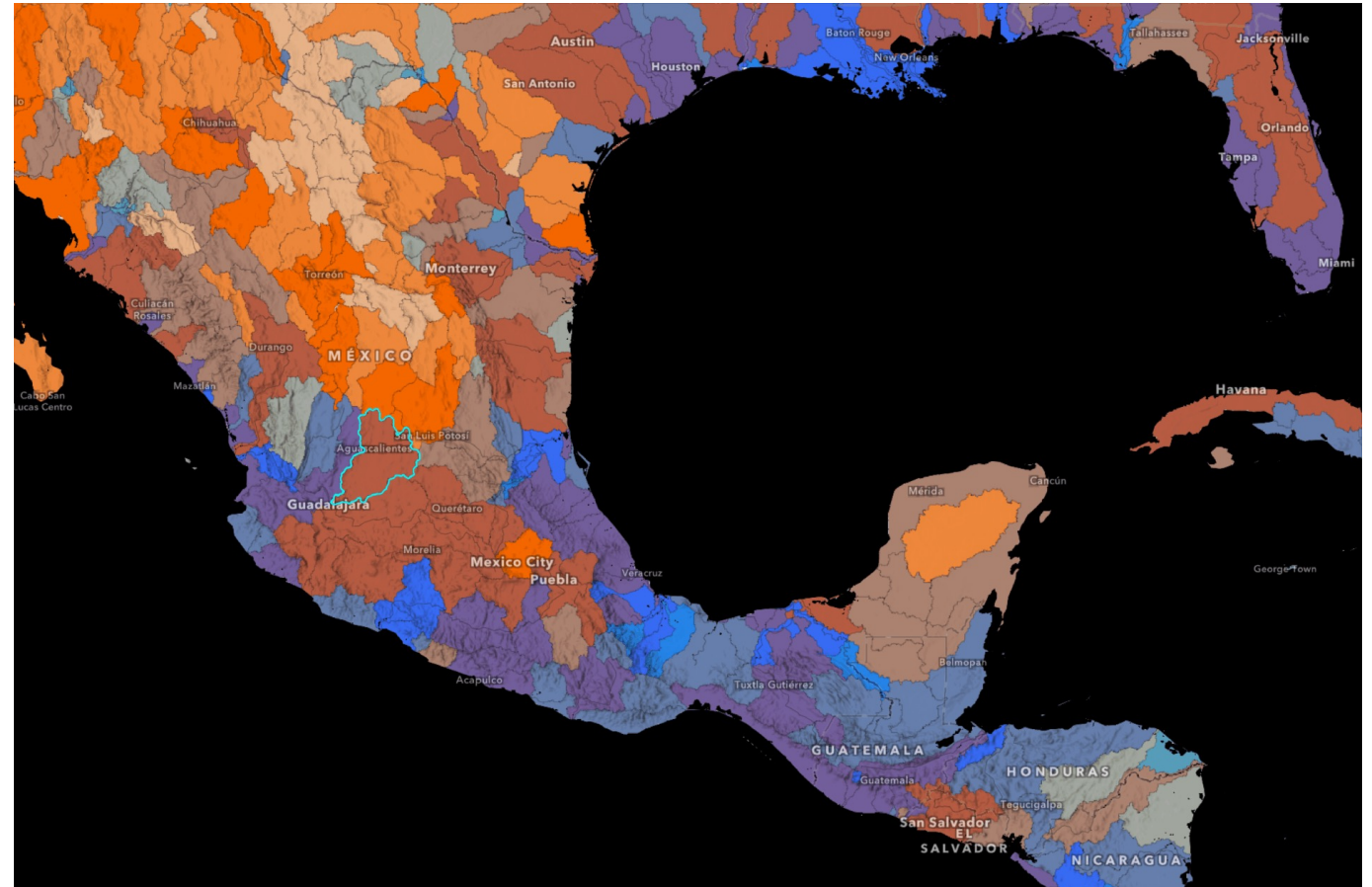
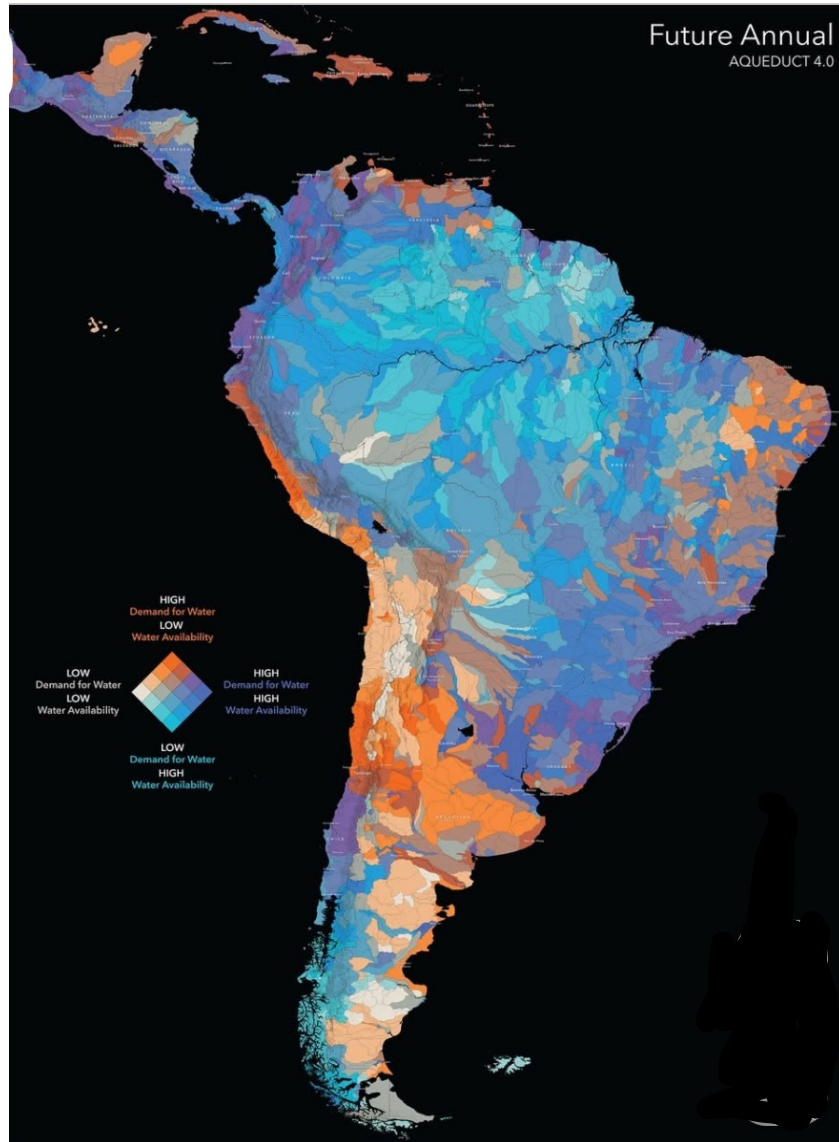


WORLD: NRW AND BASELINE WATER STRESS

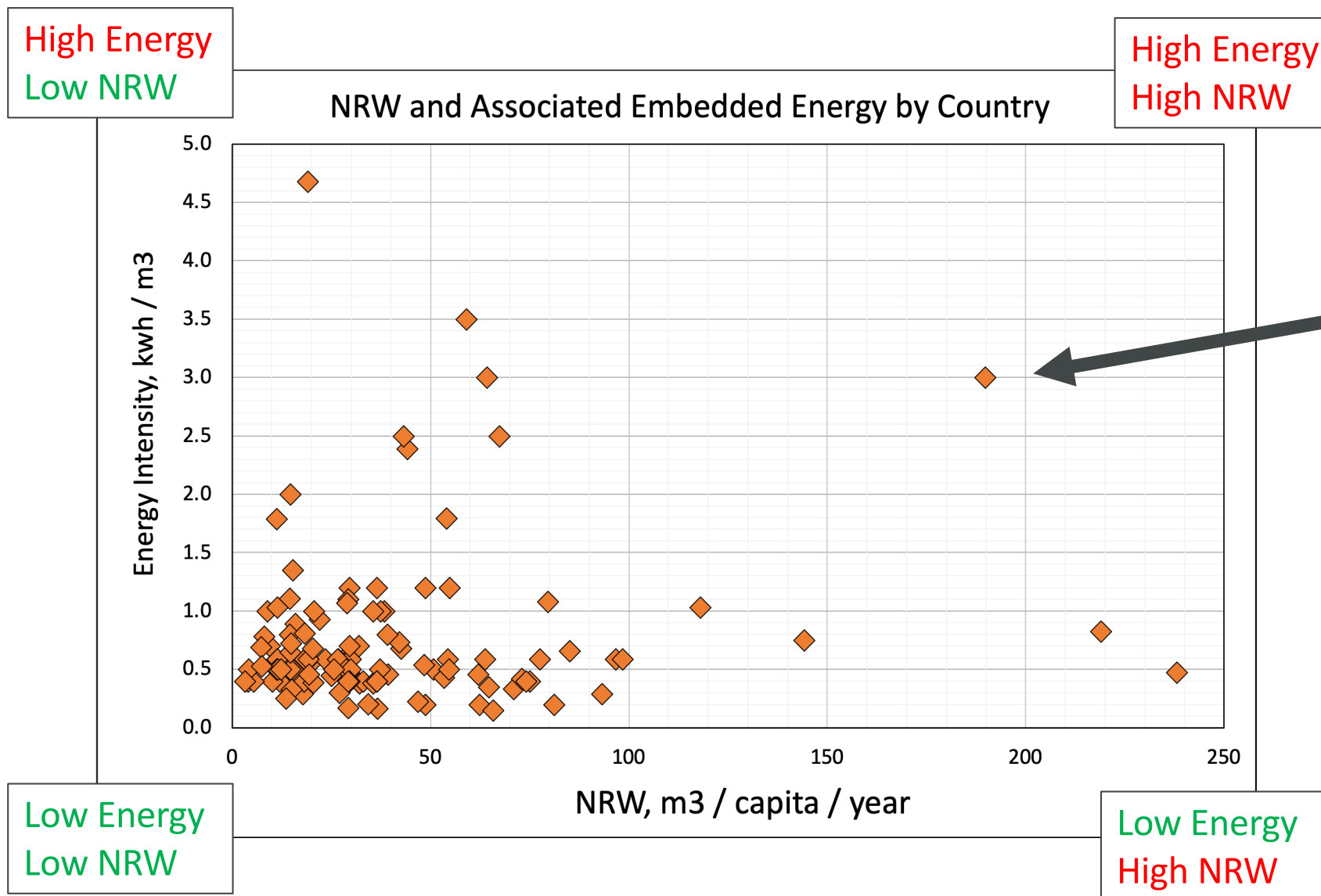


- MENA has high NRW and high Baseline Water Stress
- LAC has high NRW but moderate Baseline Water Stress
- West & Central Africa has low NRW (supply shortages and intermittency ?) and low Baseline Water Stress

LAC: A GLIMPSE AT FUTURE WATER STRESS



COUNTRY: NRW AND ENERGY INTENSITY



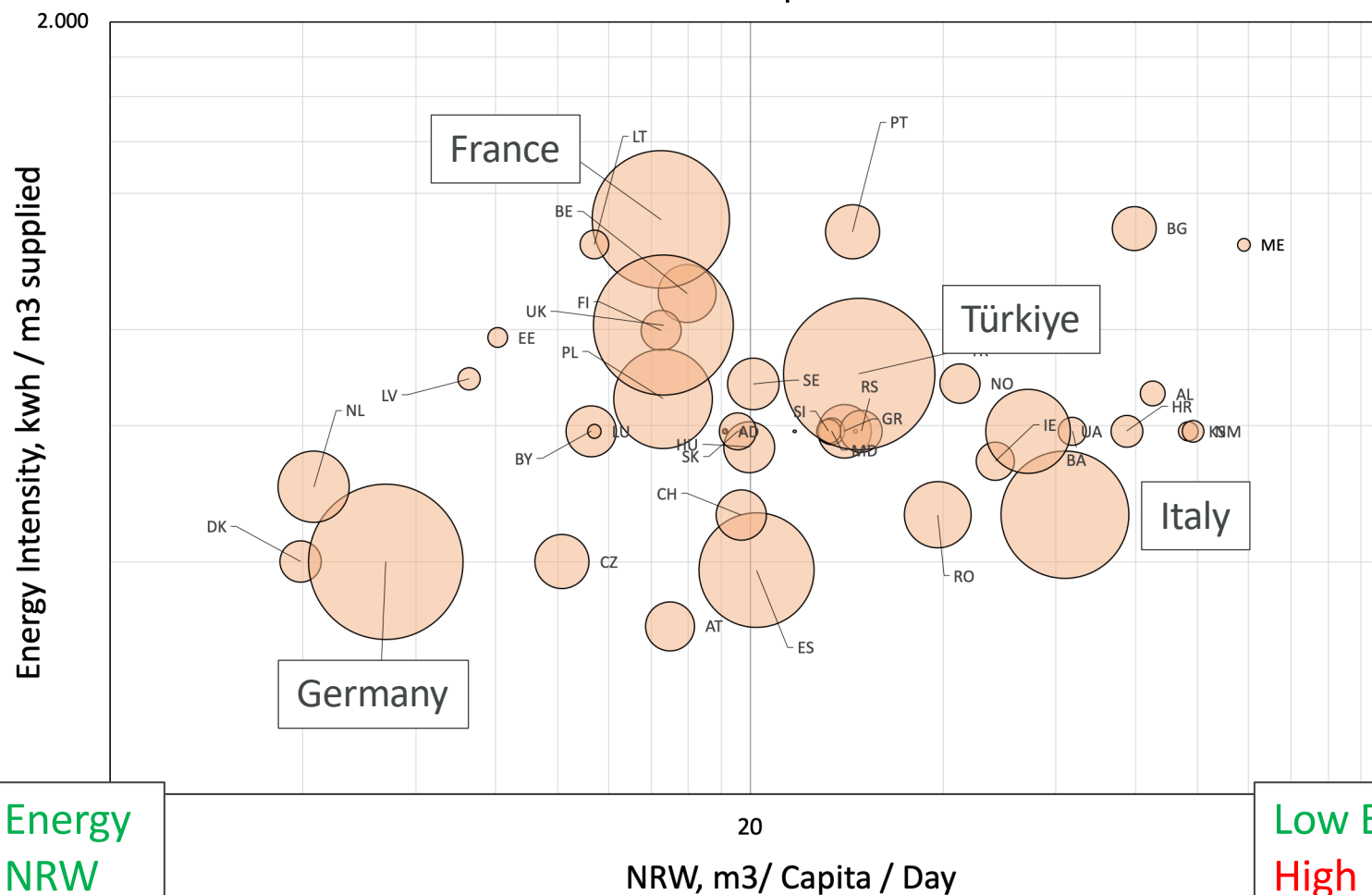
One country has high losses and high energy

Very little Africa data

Update numbers

EUROPE: NRW AND ENERGY INTENSITY

Europe: Energy Intensity and NRW
Circle area is scaled Population Served



High NRW and High Energy Intensity is a “Double” Problem

- Germany: Low NRW Low Energy
- France: Medium NRW High Energy
- Italy: High NRW Low Energy
- Türkiye: Medium NRW Medium Energy

High Energy
Low NRW

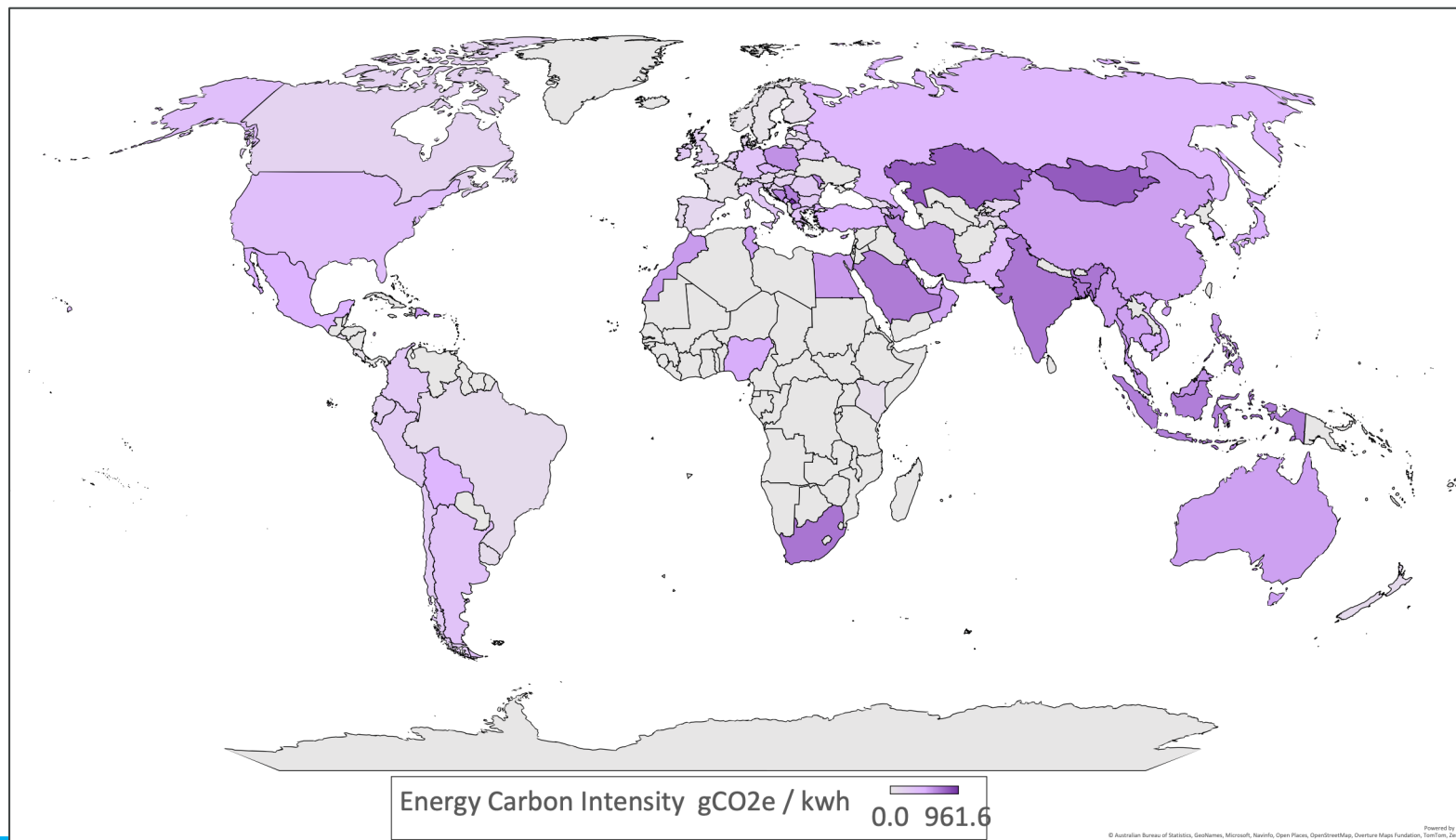
High Energy
High NRW

Low Energy
Low NRW

Low Energy
High NRW

NRW AND CARBON EMISSIONS

- Data was obtained on Energy Carbon Intensity (gCO₂eq / kwh) for 89 countries
- Those countries have ~5.1 Billion people and ~135 Billion m³/year of NRW



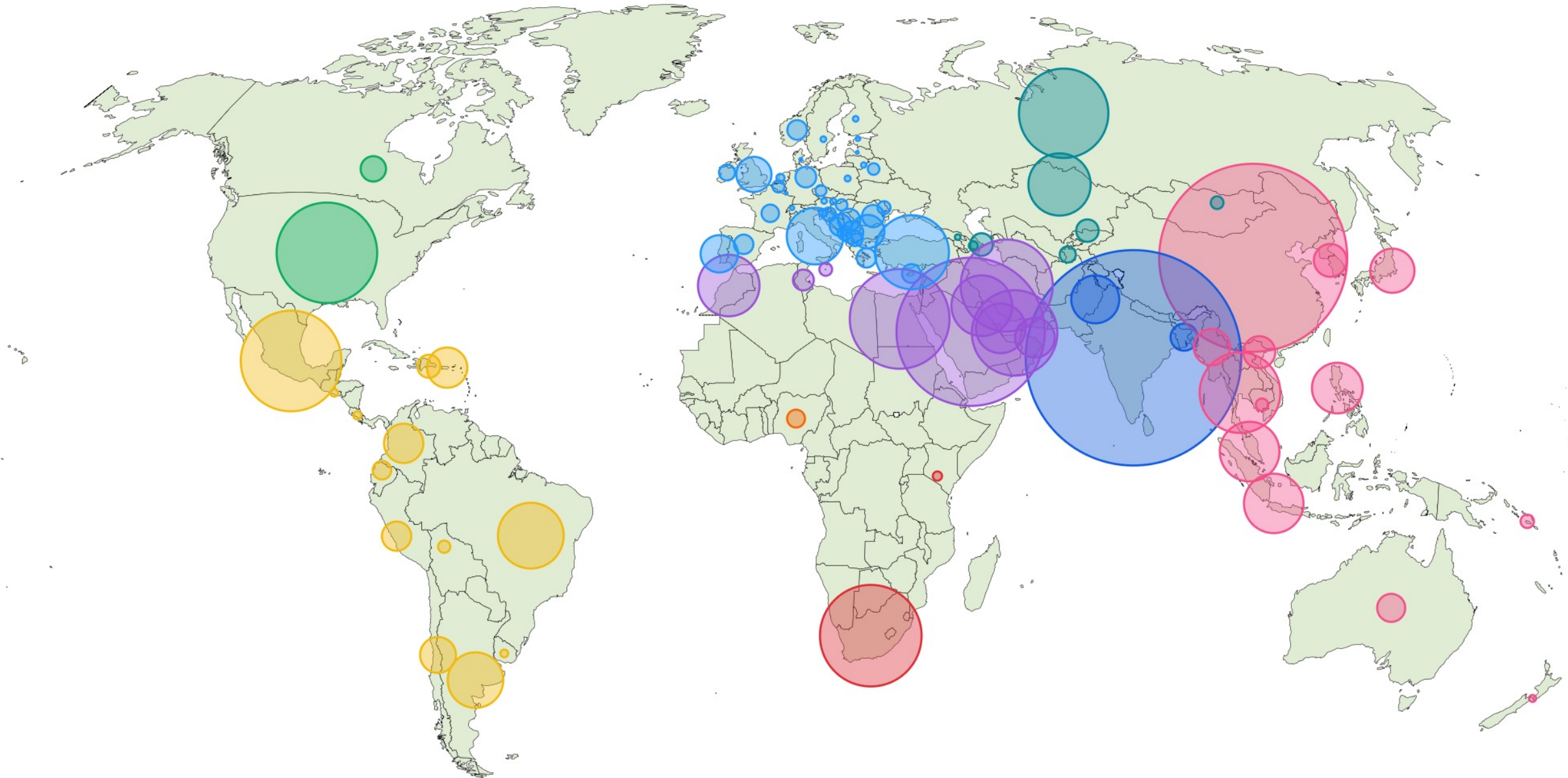
Source:
OurWorldinData,
Oxford, UK

NRW AND CARBON EMISSIONS

- The NRW carbon emissions in the 89 countries is ~33.8 Million MT / year
- World total is ~38.3 Million MT / year which is equivalent to emissions from:
 - 425 Billion commercial airline passenger-km / year
 - 10.6 million people flying around the world every year
 - Combustion of 89 Million barrels of oil / year = about 89 large crude oil tankers
- Ten large countries emit ~22.7 Million MT / year or 59% of the World total, including: China, Egypt, India, Iran, México, Russia, Saudi Arabia, South Africa, United Arab Emirates, and United States of America
- The 27 EU Member States emit ~1.4 Million MT / year - ~3.6% of the World total.

Total NRW Carbon Emissions

MT CO2 eq / Year 50,000 ● 100,000



FACETS OF NRW AND CARBON EMISSIONS

Sample Estimates of NRW, Associated Energy and Carbon Emissions – Sorted by Population

Country	Population Served, M	Total Emissions from NRW, MT CO ₂ eq / Year	NRW, m ³ / Capita / Year	Energy Intensity of Water kwh/m ³	NRW Energy Use, kwh / Capita / year	Carbon Energy Intensity, gCO ₂ / kwh	Emissions from NRW, gCO ₂ e / Capita / Year
China	1,290	3684	18	0.29	5.1	555	2853
USA	320	1452	29.6	0.40	11.8	384	4540
Brazil	190	621	42.0	0.73	30.8	106	3269
Russia	125	1147	15.3	1.35	20.6	446	9190
South Africa	54	1482	38.3	1.00	38.3	713	27283

MULTIPLE FACTORS CONTRIBUTE TO EMISSIONS

$$\text{NRW} \times \text{ENERGY} = \text{NRW Energy}$$

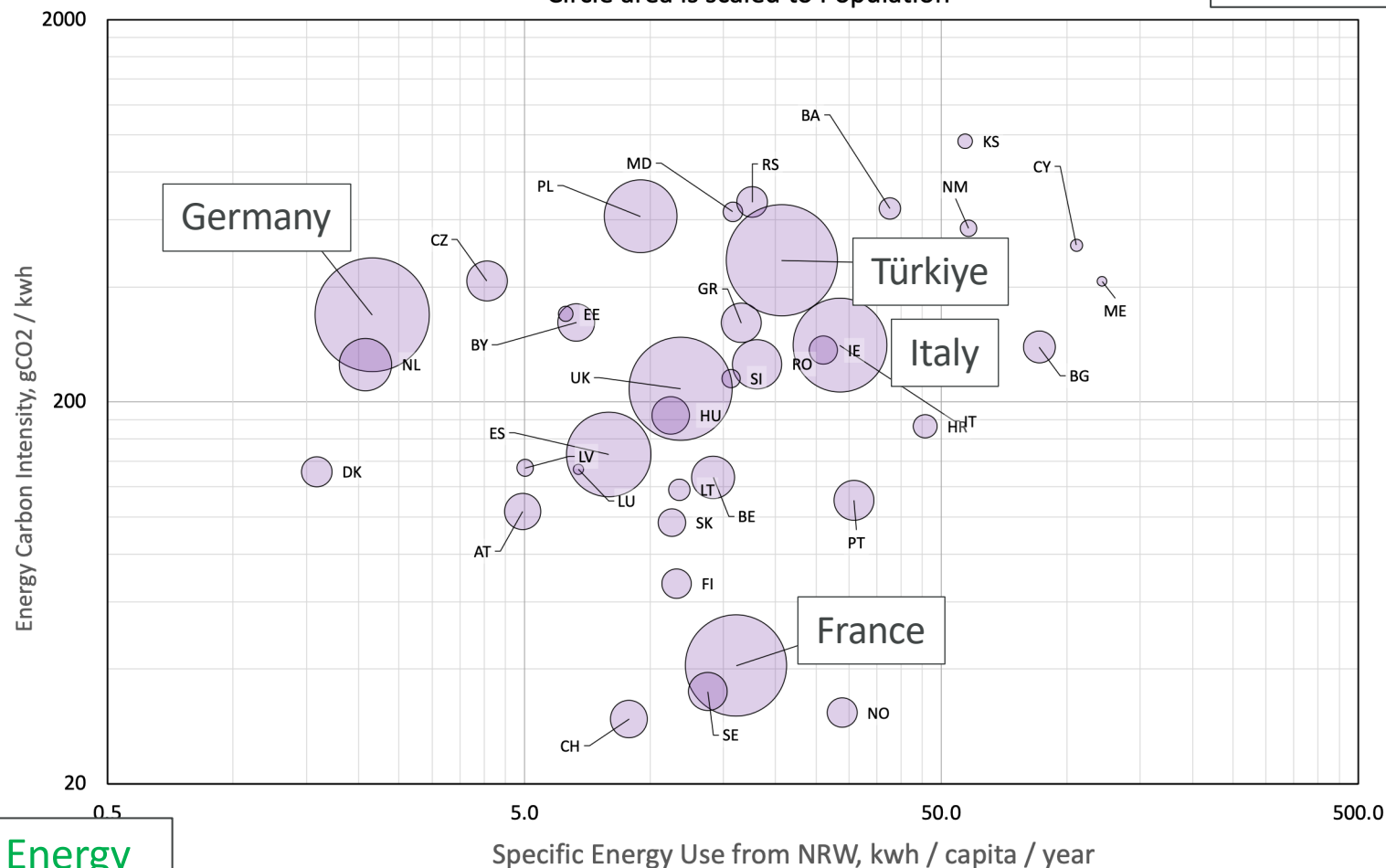
$$\text{NRW Energy} \times \text{CO}_2 \text{ Intensity} = \text{Emissions/Capita}$$

EUROPE: NRW AND CARBON EMISSIONS

Europe: Specific Energy Use from NRW and Energy Carbon Intensity
Circle area is scaled to Population

High Energy
High Carbon

High NRW , High Energy Intensity and High Carbon Intensity is a “Triple” Problem



Low Energy
Low Carbon

Germany:	Low NRW & Energy	High Carbon
France:	Medium NRW & Energy	Low Carbon
Italy:	Medium NRW & Energy	High Carbon
Türkiye:	Medium NRW & Energy	High Carbon

6. NEXT STEPS: GLOBAL DATA COMPILATION

Planned Next Steps

- IWA WLSG Webinar May 13, 2026
- Review of Methods
- Review / Update of Data – until May 31, 2026
- Data Compilation Report
- IWA Publication
- If you can help, email: waterlossdata@gmail.com



Next Steps - To be formulated

- Construct an online platform for data and indicators ???
- Prepare a Guidance document on water loss reporting and assessment ??
- Conduct more analysis on NRW Components, IWS, Context Factors ???
- Organize ongoing data compilation ???

Participant Poll #7



Which are the Most Important Next Steps: (Choose 2)

- Online Data Platform : 51
- NRW & Water Loss Reporting Guidelines: 20
- Data Compilation on NRW Components: 18
- Do Another Data Collection in a few Years: 15
- Other: 0

7. CONTRIBUTORS

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- Michael Thompson
- Gary Trachtman
- Stuart Trow
- RL Vijay Kumar
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- Gareth Williams
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- Gary Wyeth
- Daniel Zipperer

THANK YOU!!!!

8. OPEN DISCUSSION



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