WATER AND SEWERAGE CORPORATION

Committed to Growth, Committed to Quality

Water Supply, Sanitation, & Resources Management in The Bahamas; Benchmarking of the Caribbean Water Utilities along with WSC (Bahamas)

Presentation to MIYA, INDAQUA & Portuguese Water Partnership

Lisbon & Porto, Portugal (July-2018)

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Water Resources Management Unit (WRMU)

The Islands of The Bahamas

- Low lying carbonate "platform" islands with little topographic relief (62.78-m or 206-Ft max elevation above mean sea level),
- Lack of topography means little surface-water runoff, 'total' reliance on fresh groundwater floating on deeper salt water (which is now augmented by desalination – from groundwater),
- Fresh groundwater is generally encountered 0.9 to 1.5-meter (3 to 5-Ft) below ground level.

What is different about the Water Resources in The Bahamas?

- **Hydro-geology;**
  - All freshwater as a result of rainwater,
  - The freshwater lenses (< 600-mg/L chloride) float on the seawater,
  - Unlimited saltwater source (> 3,000-mg/L) below the freshwater,
- **Land Elevations;**
  - 80% of the land within 1.5-m (5-ft) of mean sea level,
  - Readily available freshwater (when present) – to 24.3-m (80-ft),
- **Subsurface Hydrology - Inverted Geothermal Conditions (OTEC & SDC Potential);**
  - The deeper you go in The Bahamas, the cooler the water at depth,
  - Indicative of a high degree of exchange with the marine resources,
- **Use Groundwater Wells for SWRO Feed-water & Brine Disposal;**
  - Sea/Salt Water is abstracted from 30.4 to 60.9-m (100 to 200-ft),
  - Brine Effluent is disposed at 60.9 to 182.8-m (200 to 600-ft),
  - Saline water from these deep wells can be abstracted/received with little need for high pressure pumping, and the process has been very successful in almost all situations throughout The Bahamas.

Water Resources in The Bahamas

Freshwater lens in an oceanic island similar to The Bahamas.

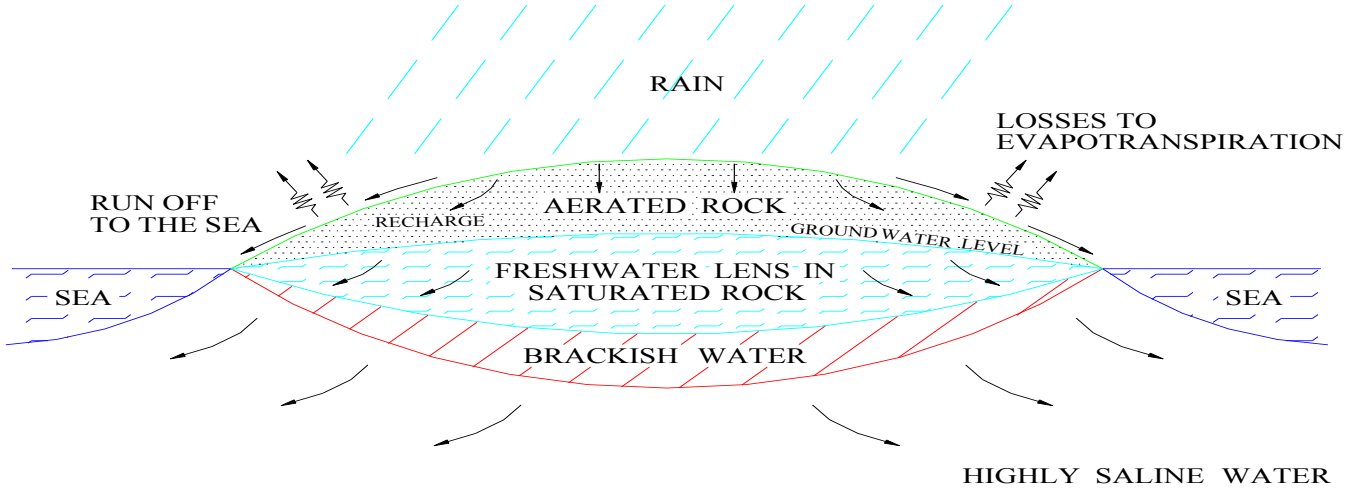
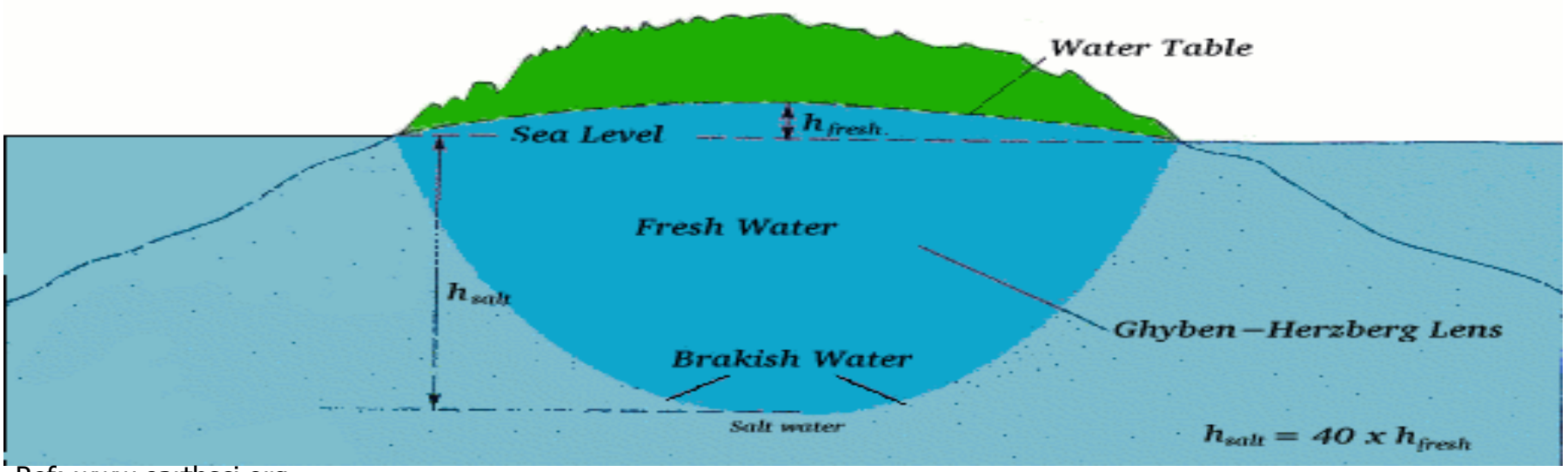
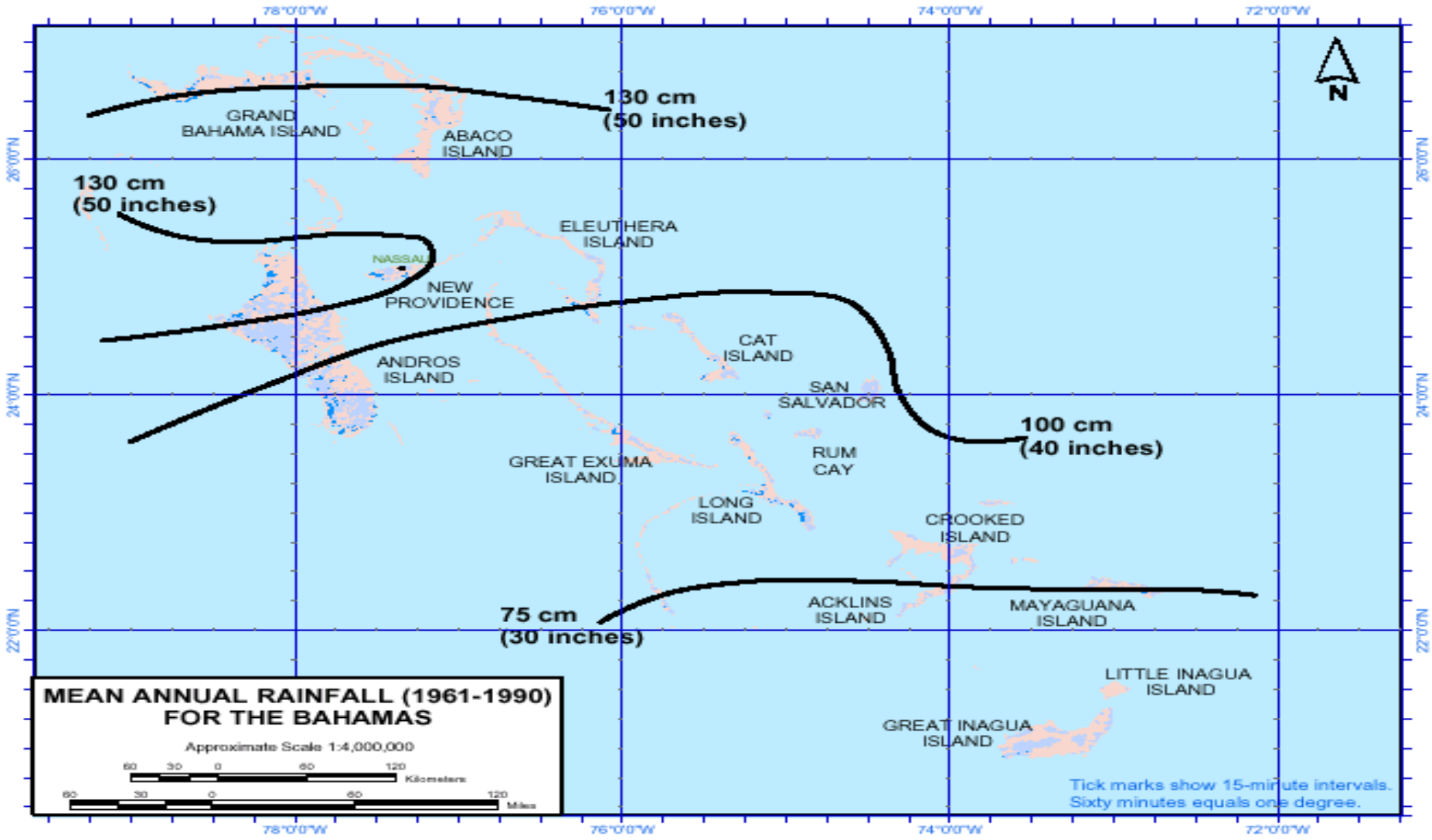


Diagram of a Freshwater Lens in an Oceanic Island
(Like The Bahamas)



Ref: www.earthsci.org

Mean Annual Rainfall for The Bahamas



Priority Areas of Concern for Water Supply, Sanitation, & Water Resources Management - Bahamas

- **Climate Change / Variation** - as it relates to rising sea levels, and storm surges associated with tropical storms. **[Sustainable Development / Vulnerability / Adaptation Measures]**.

- **Water Supply -** Transition from natural water supply areas (fresh groundwater supplies) to reverse osmosis sources and the partial/total abandonment of these areas **[Regulatory Framework / Renewable Energy]**; potential development of the unprotected groundwater areas. **[Groundwater Governance]**.

- **Operational -** Over-extraction of groundwater lenses, distribution water losses due to the antiquated systems **["NRW"]**; use of conventional energy to produce/distribute water **["OTEC/SDC"]**.

- **Environmental -** Land & coastal development, excavation of Wetland Areas, Forestry Reserves, Marina Construction, Golf Course Developments (or additional high water consumers); and other concerns {Fuel facilities, industrial and commercial effluents; their disposal, and storage}. **[Groundwater Conservation/Management/Explorations, all per IWRM Policies]**.

- **Sanitation –** While septic tanks do serve as primary treatment (separation), the effluent discharge is via drainage field into the lens. **[Regulatory Framework – Environmental]**

WATER AND ENERGY COST IN THE BAHAMAS

Both water supply (or the provision of), and energy demand are constraints of achieving sustained economic growth throughout the islands of The Bahamas.

Bahamas Water Tariff - Water & Sewerage Corporation (WSC)

VAT INCLUSIVE TOTAL COST PER QUARTER
NEW PROVIDENCE WATER (RESIDENTIAL)

2,001 gallons – 13,000 gallons (**7,574.60 – 49,210.35 liters**)	$13.01
13,001 gallons – 26,000 gallons (**49,214.13 – 98,420.70 liters**)	$20.37
26,001 gallons, or greater (**98,424.49 liters, or greater**)	$16.40

(Source: Bahamas Tariff - Water & Sewerage Corporation 2016, http://wsc.com.bs/Tariff.aspx)

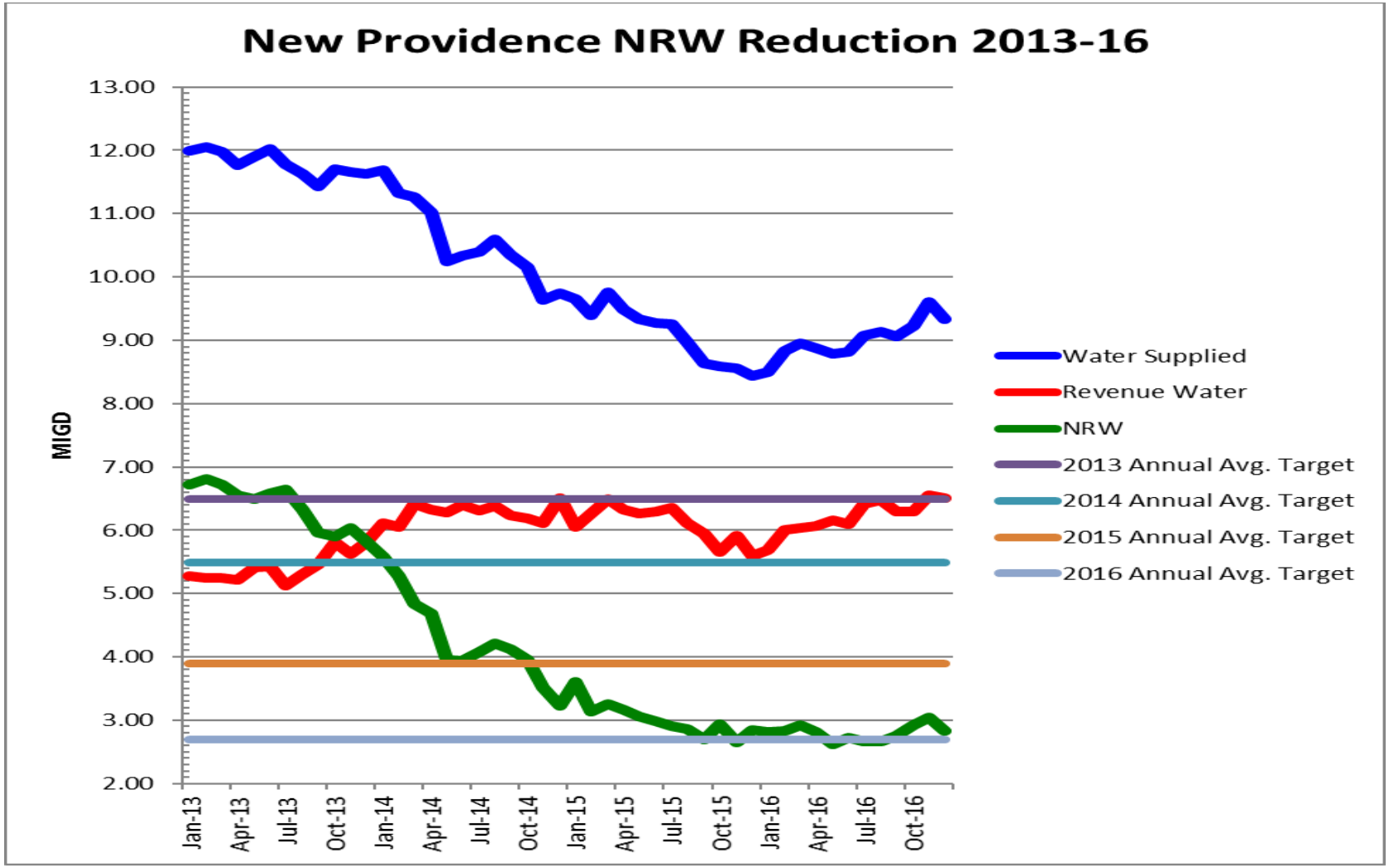
Bahamas Electrical Rates

"The Bahamas' dependence on imported oil and diesel for generation, along with its high electricity prices, highlights the need for renewable energy…" "Bahamian retail electricity prices remain high, but they decreased by 10% from an average of **$0.295 per kWh** in 2014 to **$0.266 per kWh** in 2015 due to a reduction in the cost of generation fuel. In 2013, its average electricity retail rate was 50% above the average price in the Caribbean." (Source: Bahamas - Climatescope 2016, http://global-climatescope.org/en/country/bahamas/)

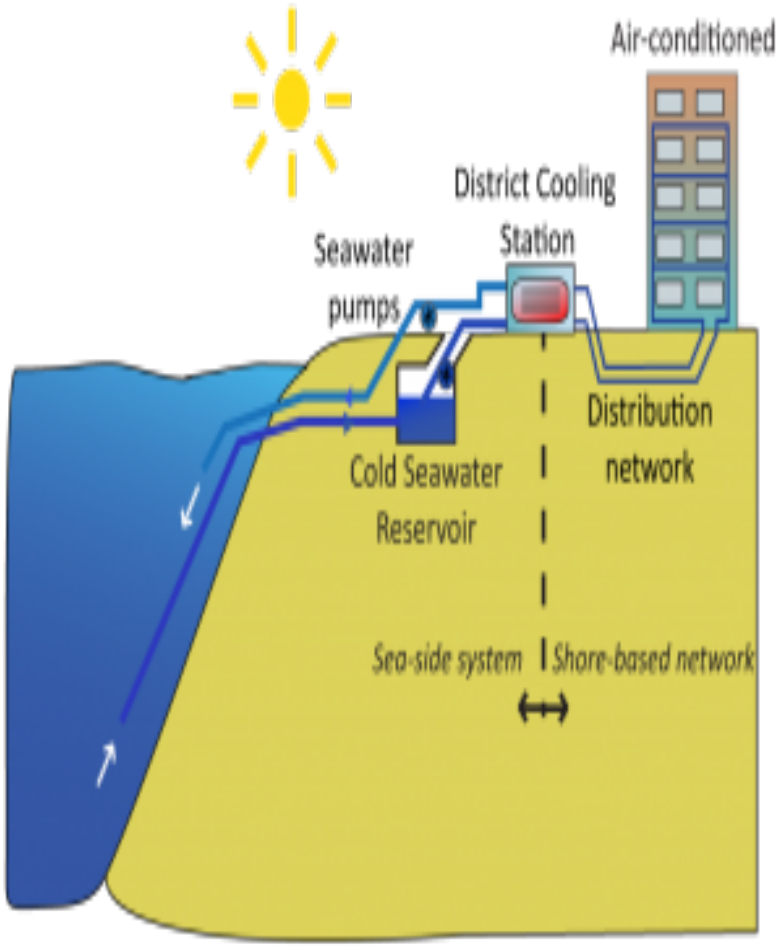
- Non Revenue Water (NRW) -

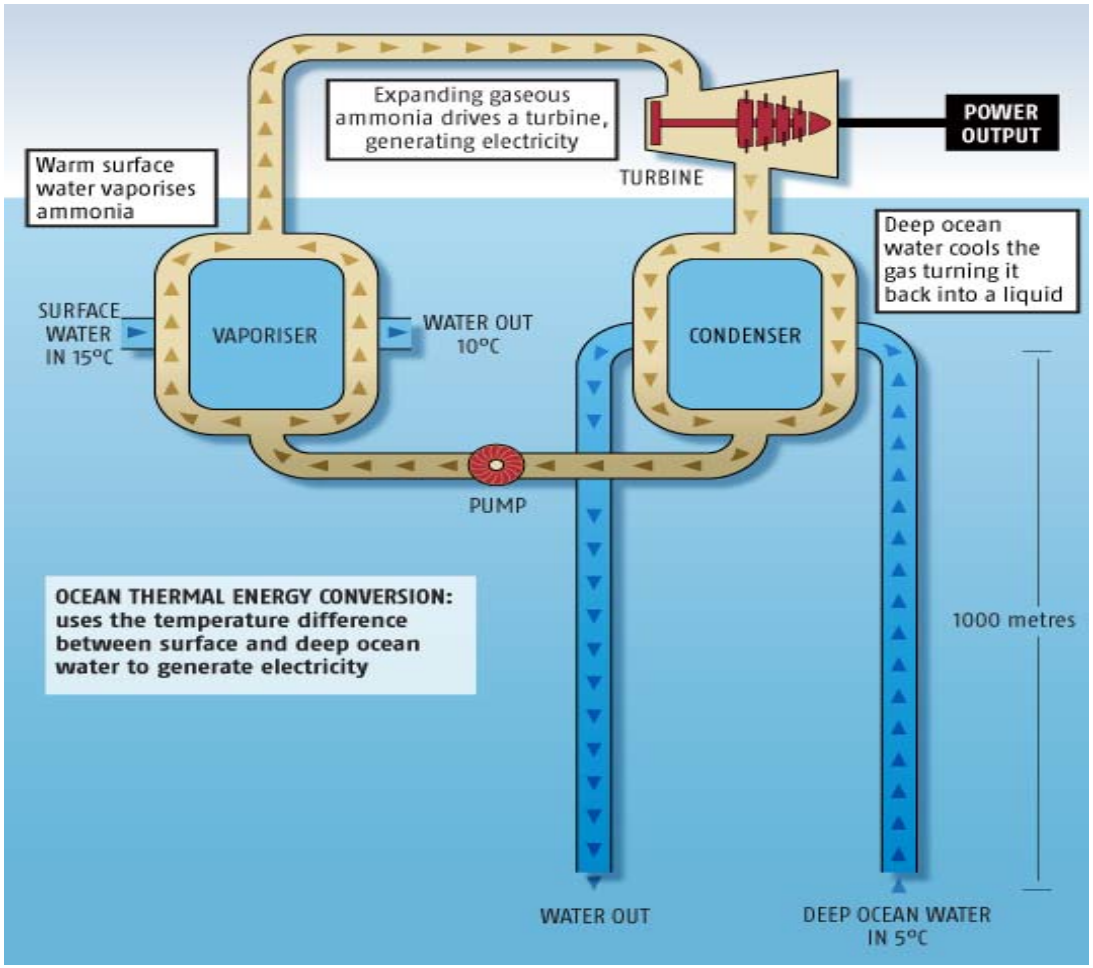
Utility Company Response to NRW on New Providence:

Water Conservation / Management of Distribution System Losses



TYPICAL SEAWATER DISTRICT COOLING (SDC) & OCEAN THERMAL ENERGYCONVERSION (OTEC)



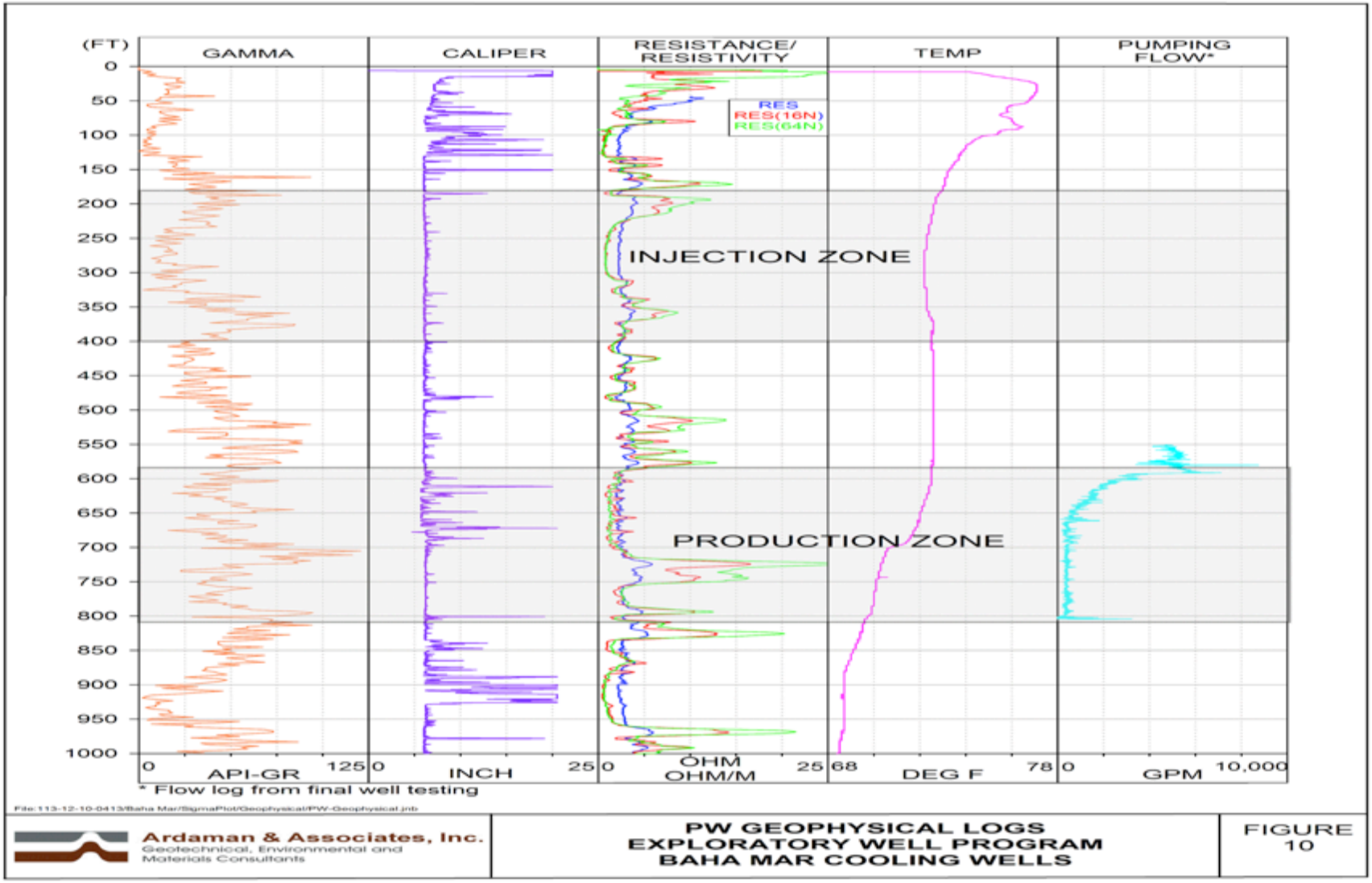


SDC or Seawater Air Conditioning (SWAC) uses & cool water supply for the chiller system. OTEC requires a 20°C (36°F) temperature differential of cool / warm sea to run a heat engine.

Ref: http//infranetlab.org, http//investinggreenenergy.com

Available Geophysical Logging Data from New Providence SDC Project

[OTEC Research towards Alternative Energy]



Sustainability of SWRO {Water}, SDC/SWAC {Cooling}, and OTEC {Energy} – The Commonwealth of the Bahamas

- There is relatively good access to deep cold water, a demand for high cooling usage, and present high electrical rates. SWRO/SDC/OTEC can all serve as renewable energy source, resilient to changes in climate (climate adaptation).
- OTEC also serves to supply freshwater (at a lower cost), by the provision of the required energy for the SWRO process.
- No fuel storage is associated with SDC/OTEC (renewable energy).
- SDC/SWAC replaces refrigerants used in cooling systems (sustainable).
- Average surface water temperatures are typically very warm in the Bahamas, at 27^{O}C (80.6^{O}F).
- Utilizing vertical wells & the reverse geothermal gradient for OTEC; the capital cost of the project is 'considerably less' and the process is transferable throughout the islands of the Bahamas.
- The use of groundwater wells for warm or cold saltwater, poses minimal threat to coastal and marine environments. A minimum temperature gradient of 20^{o}C (36^{o}F) is required between the surface water and water at depth to support SDC/OTEC.
- An additional pilot well should be drilled to a depth of 914.4 meters (3,000-feet), for geophysical logging and pump testing – towards the ideal cold-water temperature of 7^{o}C (44.6^{o}F).
- Regulation & legislation reform of the energy & water sectors is required, towards climate mitigation / climate change adaptation.

BENCHMARKING
OF CARIBBEAN UTILITY FIRMS

Source: Castalia Advisors Presentation (CWWA Forum, Guyana 2017)

CASTALIA
Strategic advisors

Current Governance and Performance of the Water Supply and Sanitation Sector in The Caribbean

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3 May 2017

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Benchmarked Water Utilities

	Name	Jurisdiction	Annual Revenues (US$ 000)	Number of Customers
BWA	Barbados Water Authority	Barbados	>$120,000	106,580
BWS	Belize Water Services	Belize	$21,551	55,483
WAC	Water Authority Cayman	Cayman Islands	$34,487	17,000
AQUA	Aqualectra	Curaçao	$56,400	79,303
DOWASCO	Dominica Water and Sewerage Company Limited	Dominica	$7,275	22,171
GWI	Guyana Water Incorporated	Guyana	$15,900	176,748
NAWASA	National Water & Sewerage Authority	Grenada	$10,945	42,563
NWC	National Water Commission	Jamaica	$225,659	345,846
PRASA	Puerto Rico Aqueduct and Sewer Authority	Puerto Rico	$1,054,488	1,237,935
WASCO	Water and Sewerage Company Inc.	Saint Lucia	$21,586	47,362
SWM	NV Surinaamsche Waterleiding Maatschappij (NV Suriname Water Company)	Suriname	$13,702	105,054
WASA	Water and Sewerage Authority	Trinidad and Tobago	$10,161	419,152
WSC	Water and Sewerage Corporation	The Bahamas	$45,928	59,001

Transparency and information availability

- The benchmarking analysis used publicly available data from water utilities and data provided by the utilities
- Note regarding availability and quality of information
  - Great water utilities have an immediate and deep understanding of their business.
  - In an effective governance framework, utilities make much of this information readily available
  - The availability and accuracy of this information is a strong indicator of a well-performing utility within a transparent and accountable governance framework

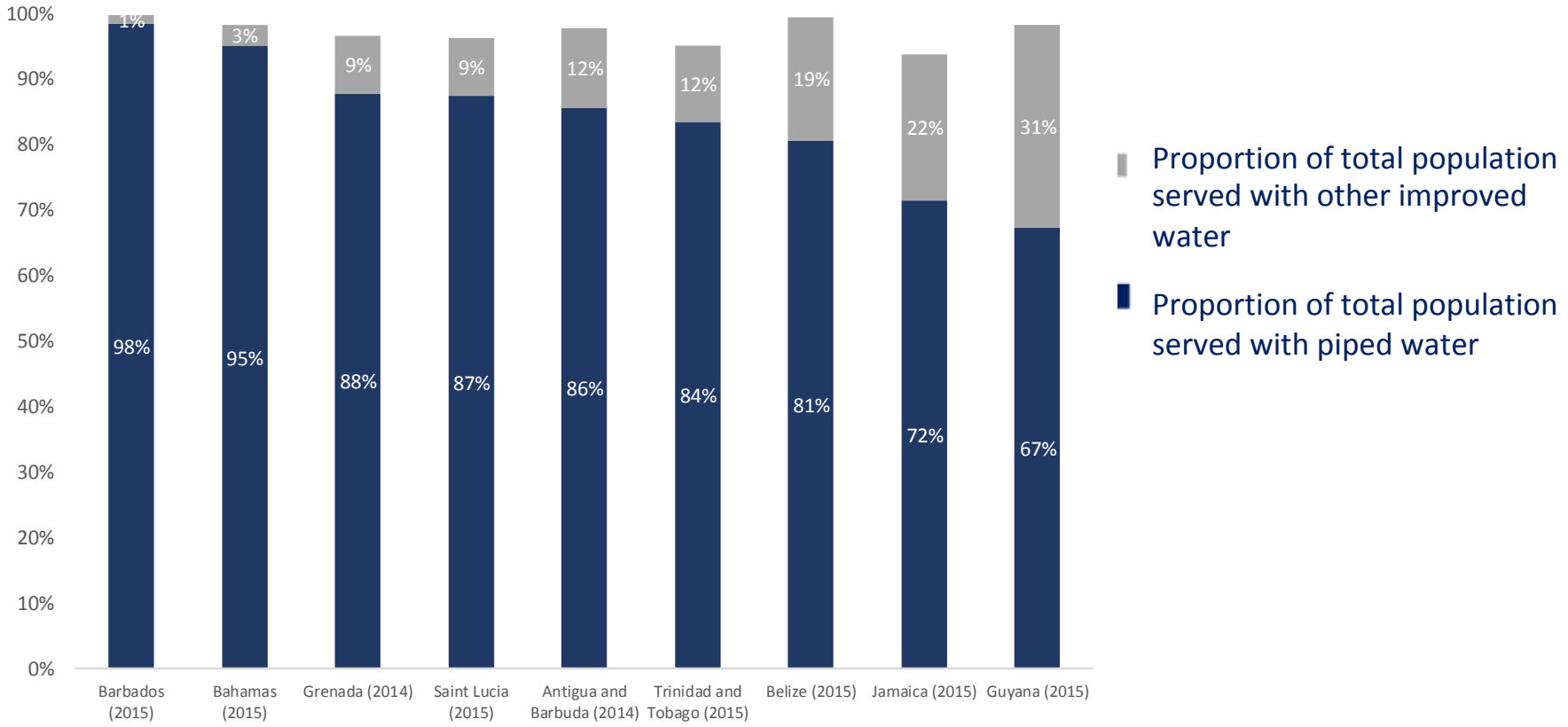
Information provided by each utility

Utility	Quality of Service	Financials	Water Balance	Other Operating Information	Coverage	Rating
BWS	2016	2016	2016	2016	2016	4
NWC	2012	2016	2016	2016	2016	4
WSC	2015	2015	2015	2015	2015	4
AQUA	2015	2015	2015	2015	2015	3
WASA	2016	2012	Not provided	2016	2016	2
DOWASCO	2013	2015	Not provided	2015	2015	2
NAWASA	2015	2015	2015	2015	2014	2
SWM	Not provided	Not provided	2015	2015	2015	2
WASCO	2015	2014	Not provided	2015	2015	1
GWI	Not provided	Not provided	Not provided	Not provided	Not provided	0

Public availability of data

Utility	Audited financial statements	Annual reports	Key performance indicators	Current tariff schedule	Ongoing business plan	Rating
BWS	2015	2015	Yes	2015	2015-2020	4
PRASA	2016	2016	Yes	2012	2014-2018	4
NWC	2016	2014	Yes	2013	2014-2018	3
AQUA	2015	2015	No	2015	2013-2018	3
WSC	2015	2015	Yes	2015	No	3
WAC	2015	2015	No	2012	No	3
NAWASA	2014	2014	No	2010	No	2
WASCO	No	2013	No	2008	No	1
BWA	No	No	No	2009	No	0
DOWASCO	No	No	No	2011	No	0
GWI	No	2008	No	2002	No	0
SWM	No	No	No	2016	No	0
WASA	No	No	No	1993	No	0

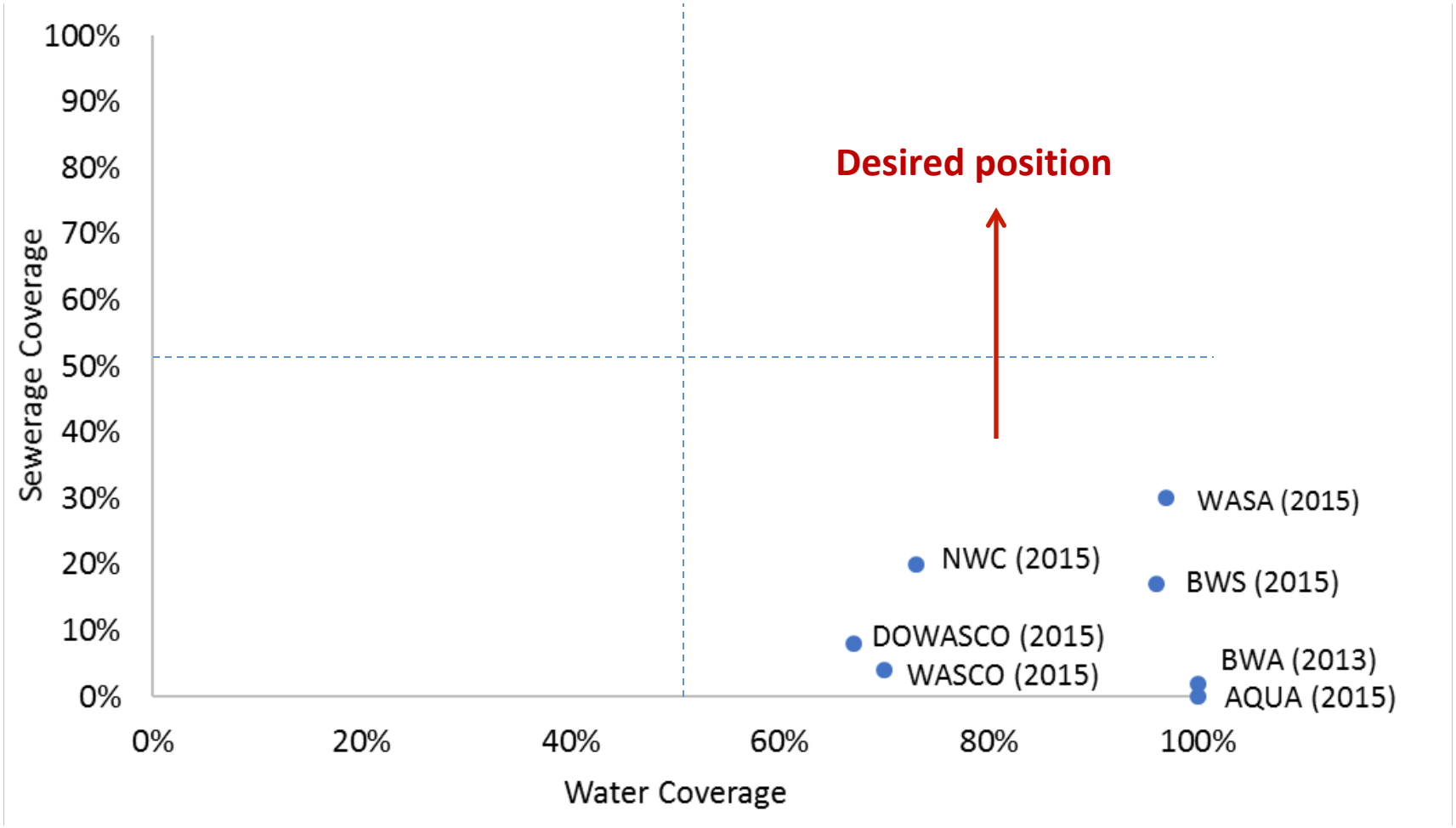
Improved water coverage at the country level is almost universal



Source: WHO/UNICEF Joint Monitoring Programme, 2015

Belize, Guyana, Jamaica, Suriname, and Trinidad and Tobago have piped water coverage below the Latin American and Caribbean average of 89%

Water and sewerage coverage by utility



BENCHMARKING QUALITY OF SERVICE, AND OPERATING AND FINANCIAL PERFORMANCE OF WATER UTILITIES IN THE CARIBBEAN

- Information available indicates quality of service needs to improve
- Operating efficiency in many utilities is low
- Not all utilities are financially sustainable (>2)
- Some utilities are not investing at an adequate rate

Information available indicates quality of service needs to improve

Utility	Quality of Water Supplied	Continuity of Service	Average Water Pressure	Customer Service	Overall
BWS	96%	24	24	25	3
WASA	97%	24	43	TBD	3
WSC	100%	24	22	85	3
BWA	94%	TBD	TBD	TBD	TBD
GWI	TBD	12	TBD	TBD	TBD
NWC	98%	TBD	36	TBD	2
SWM	95%	24	TBD	TBD	TBD

Source: Information provided by utilities

Note:

- Quality of water supplied refers to the percentage of water-quality tests that meet the WHO standards
- Continuity of service refers to the average of hours of service per day
- Customer service refers to complaints per year per 1,000 customers
- Water pressure is measured in pounds per square inch (PSI)

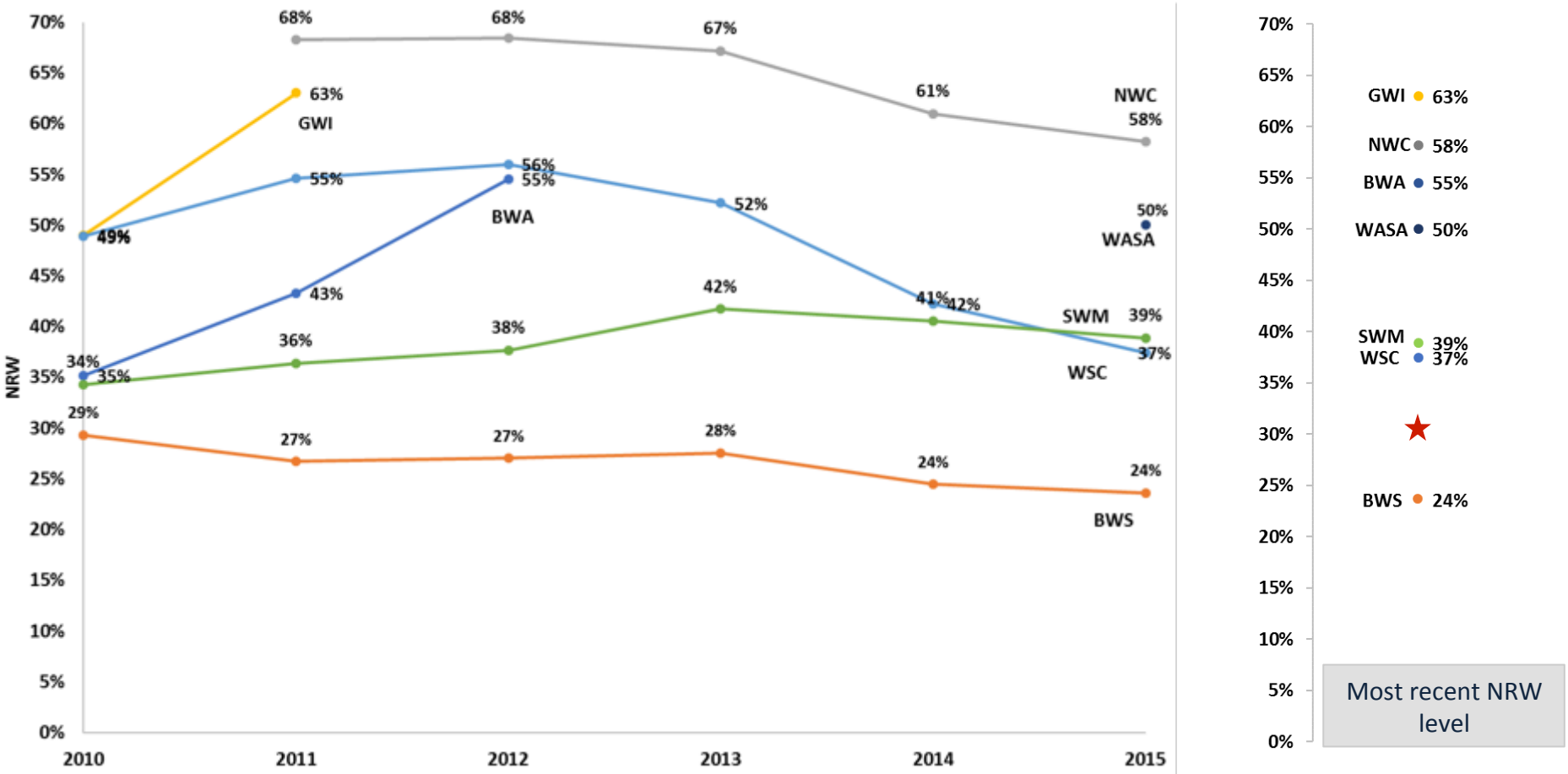
Operating efficiency in many utilities is low

Utility	Non-Revenue Water		Collection Efficiency	Staffing		Overall
BWS	4	24%	4	3	4.8	3
DOWASCO	2	40%	2	2	5.7	2
WSC	2	38%	3	1	7.3	2
NAWASA	3	28%	2	2	6.5	2
NWC	1	58%	2	2	5.5	2
WASCO	1	50%	1	2	6.0	1
WASA	1	50%	0	0	12.8	1
BWA	1	55%	TBD	1	7.7	1
SWM	2	39%	TBD	1	8.9	1
GWI	1	63%	TBD	TBD	TBD	1

Note: Harvey Balls are round ideograms used for visual communication of qualitative information. They provide a range from 0 to 4 to show the extent to which each data point applies. A 4 indicates high level of success and a 0 indicates low level of success

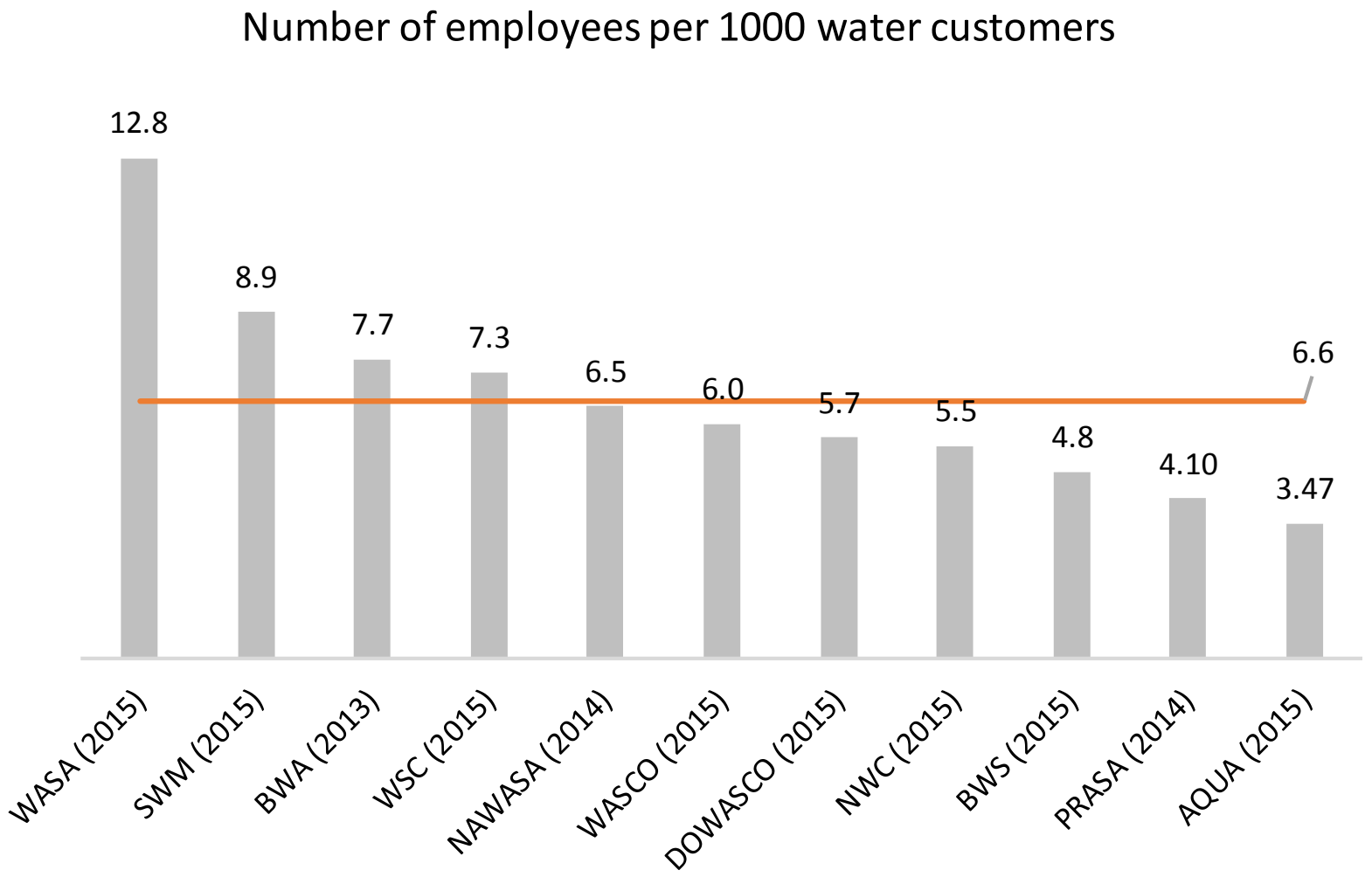
The value for 'Staffing' is the number of employees per 1,000 water customers

Some utilities improved their NRW levels

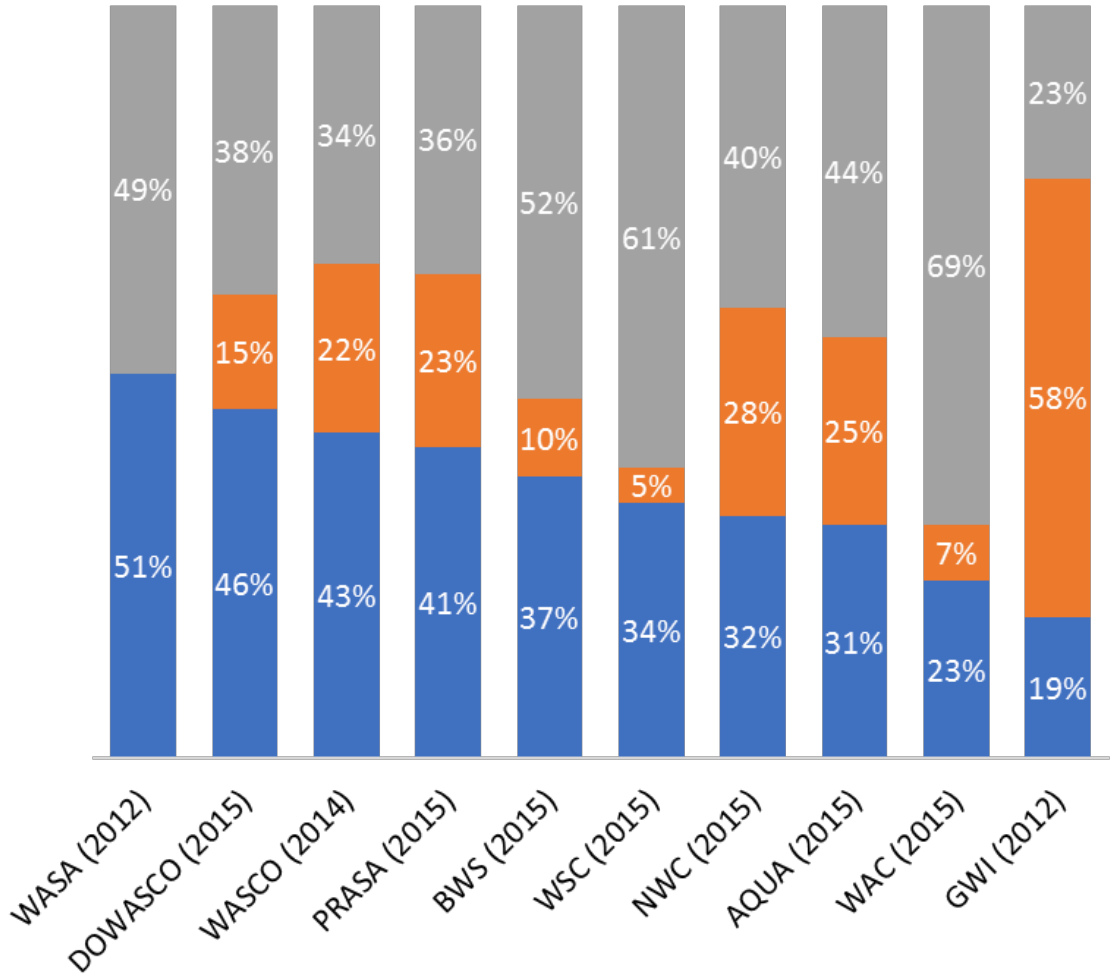


★ According to the World Bank, utilities will benefit from reaching NRW levels below 30%

Staff productivity: most utilities below efficient levels



Composition of operating expenses



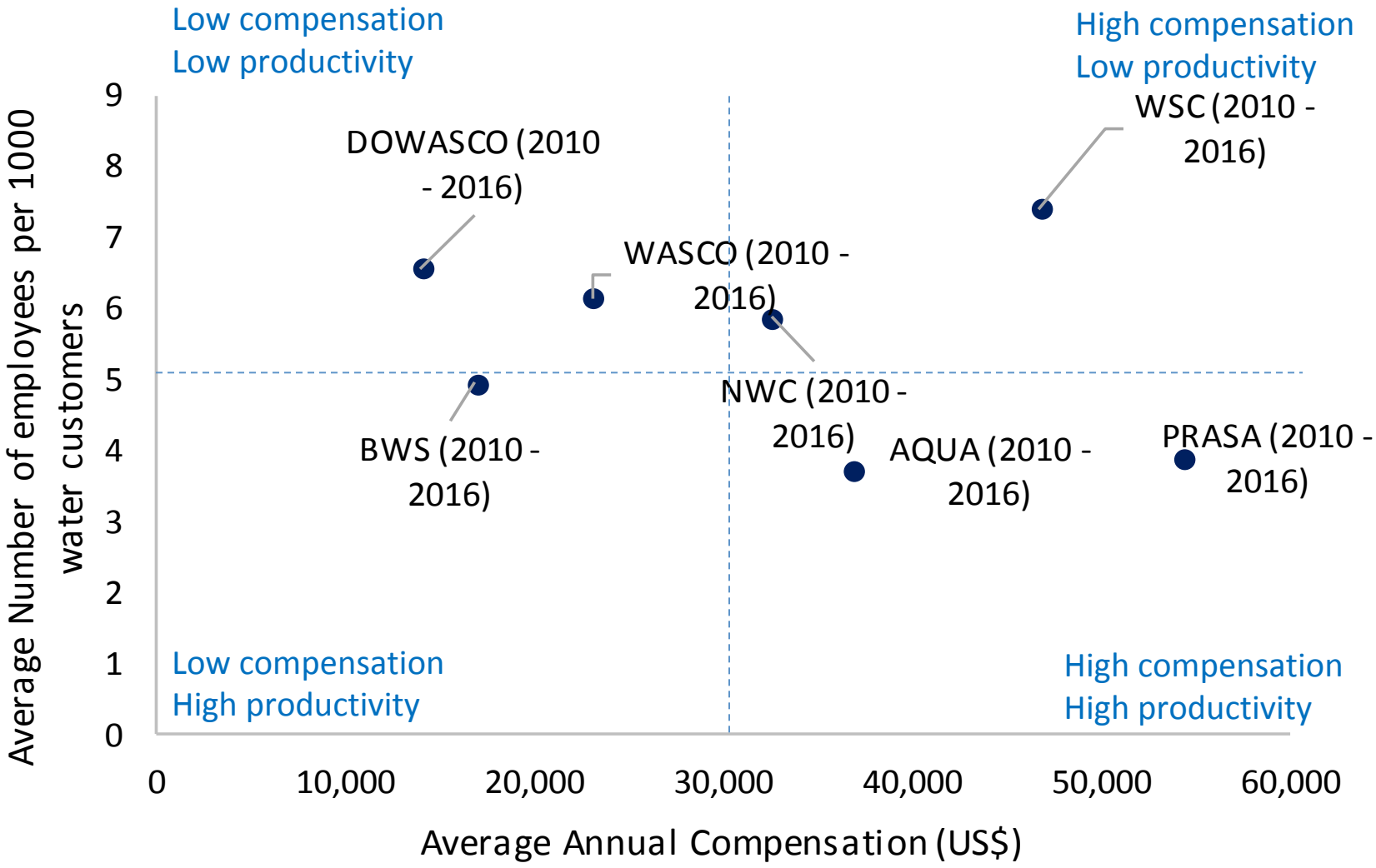
Other operating costs

Electricity costs as percentage of OPEX

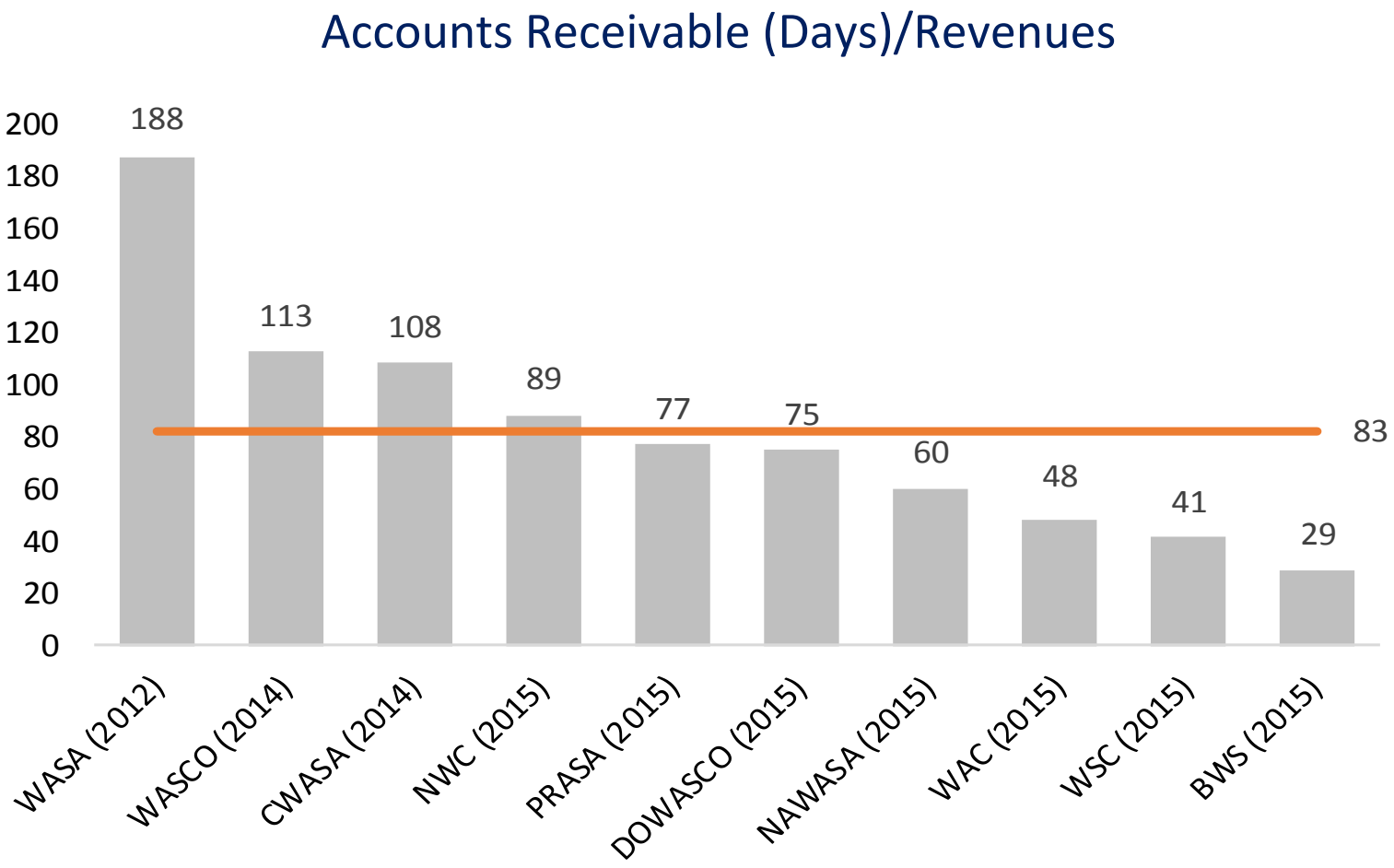
Staff costs as percentage of OPEX

Note: WASA did not provide the information to calculate electricity costs as a percentage of operating expenditures

Comparing staff compensation with productivity



Some utilities need to increase collection efficiency



Definition of financial sustainability for water utilities

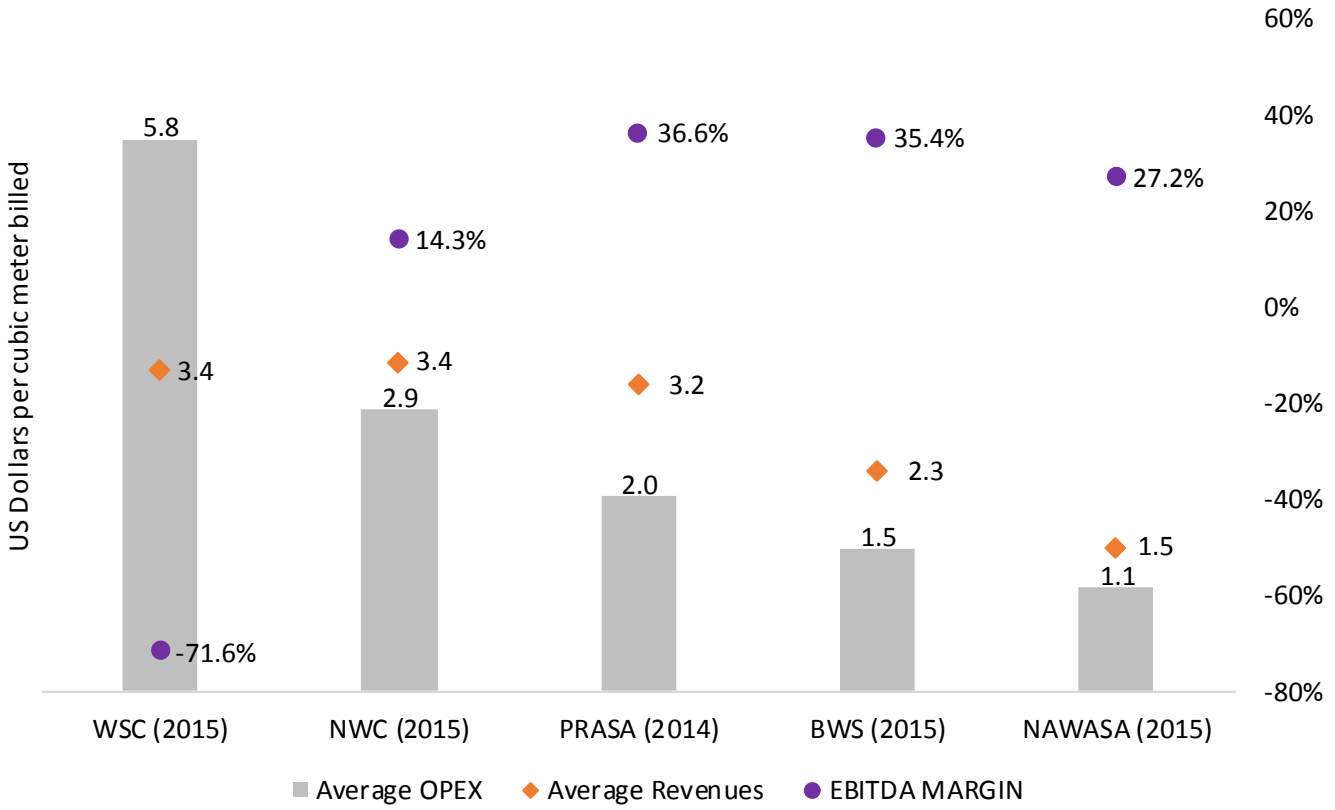
A water utility that is financially sustainable :

- Covers its operating expenses with cash from operations
- Offers service at affordable tariffs
- Meets and has a reasonable plan to meet targets for access and quality of service for at least 5 years
- Is able to access finance to cover financing needs
- Provides expected returns to equity providers

Financial performance of the utilities

Water Utility	EBITDA Margin	Net Income / Revenues	Return on Assets	Debt Service Coverage Ratio	Reliance on Government
DOWASCO (2015)	40%	11%	1%	1.6	No
BWS (2015)	35%	17%	4%	2.2	No
NAWASA (2015)	27%	18%	6%	TBD	No
WASCO (2014)	22%	14%	5%	6.4	Yes
NWC (2015)	14%	-5%	-2%	1.1	Yes
WSC (2015)	-46%	-27%	-4%	-5.2	Yes
GWI (2012)	-55%	-20%	TBD	TBD	TBD
WASA (2012)	-167%	6%	0.7%	TBD	Yes
SWM	TBD	TBD	TBD	TBD	TBD
BWA	TBD	TBD	TBD	TBD	TBD
Average	**-16%**	**2%**	**2%**	**1.23**	

How the EBITDA margin results from a utility's operating efficiency and tariff



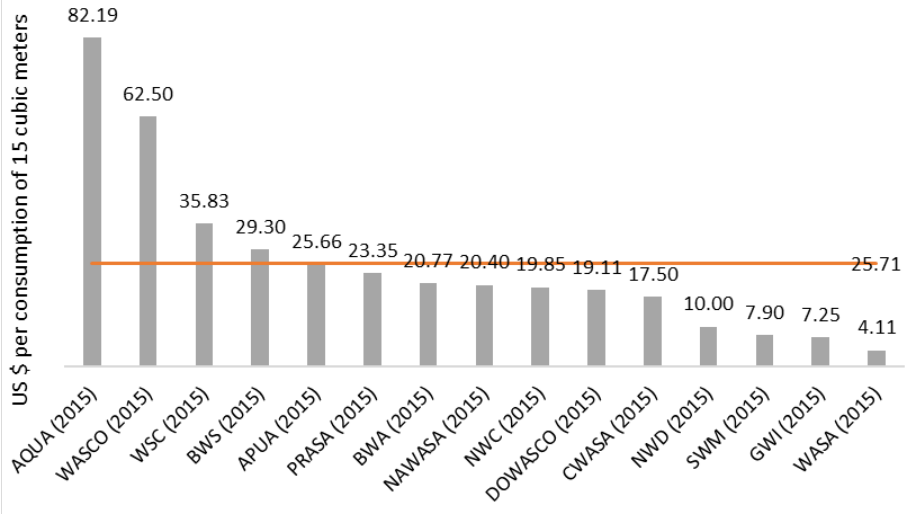
- There are utilities with relatively high tariffs—such as WSC—that have even higher average OPEX and, therefore, negative EBITDA margins
- Other utilities with lower average tariffs can produce positive EBITDA margins since they have lower average OPEX

Comparing CAPEX and Fixed Assets

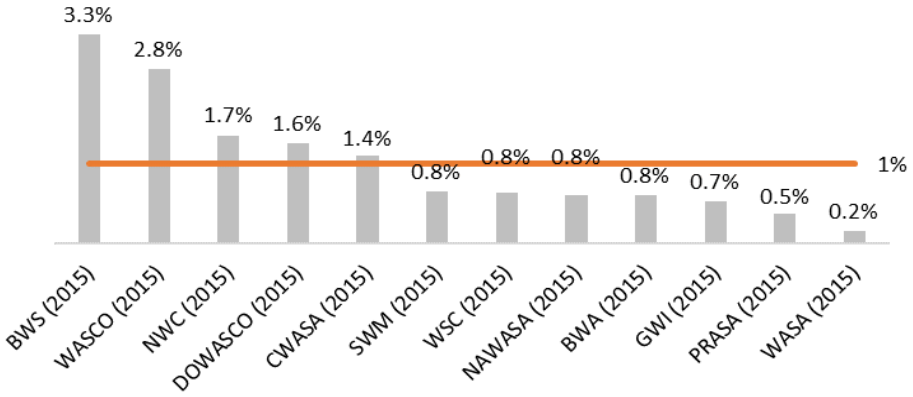
Utility	Average CAPEX per customer (US$/year)	Average CAPEX / Depreciation	CAPEX / Revenue	Gross book value per customer (US$)	Accumulated depreciation / Gross book value
WSC (2011-2015)	481	2.3	70%	7,722	45%
DOWASCO (2011-2015)	202	2.4	58%	3,550	31%
NWC (2011-2015)	202	1.7	28%	3,493	52%
WASA (2012)	129	1.7	49%	TBD	TBD
BWS (2011-2016)	115	2.9	31%	1,762	21%
NAWASA (2011-2015)	39	1.0	18%	1,258	47%
WASCO (2011-2014)	24	0.3	3%	2,316	65%
BWA	TBD	TBD	TBD	TBD	TBD
GWI	TBD	TBD	TBD	TBD	TBD
SWM	TBD	TBD	TBD	TBD	TBD
Average	**170**	**1.76**	**37%**	**3,348**	**40%**

Tariffs charged by utilities are affordable to consumers

Residential monthly bill



Household expenditure on water as a percentage of household income



BENCHMARKING GOVERNANCE EFFECTIVENESS OF THE WATER SUPPLY AND SANITATION SECTOR IN THE CARIBBEAN

- Few countries have sector policies that have **clear objectives**, **measurable targets**, as well as associated **financial plans**
- There is often a **discrepancy** between the sector policies a country develops and the overall performance of its utility
- Responsibilities and procedures are **not well defined**
- There is a **lack of transparency and consumer involvement**
- In some countries, **managerial autonomy is limited** and there are **weak incentives** for operating efficiency

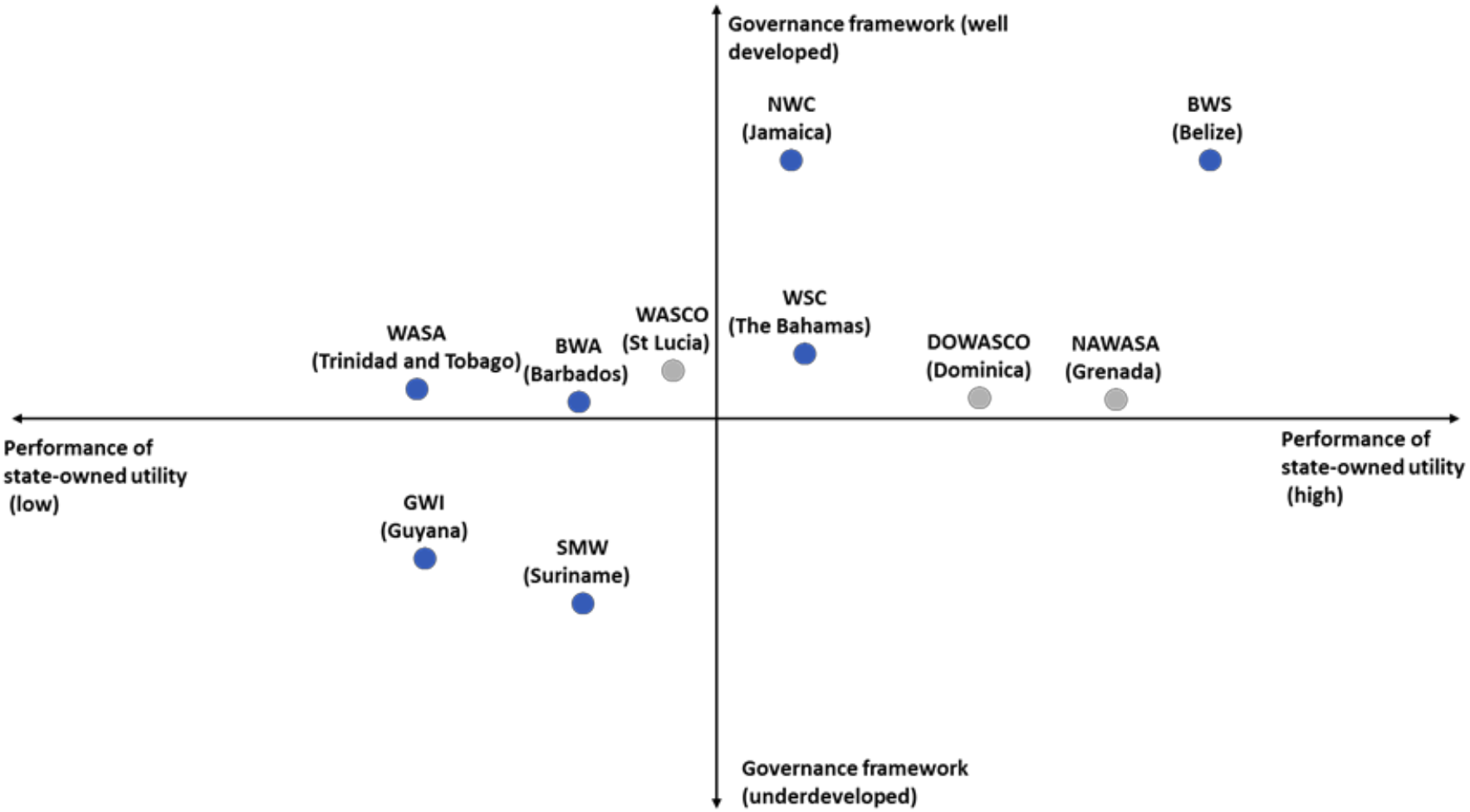
Comparing sector policies and regulatory frameworks

Country	Includes sanitation	Clear objectives	Measurable targets	Financial Plan	Tariffs reflect costs	Tariffs cover operating expenditures	Body responsible for setting tariffs
Barbados	✓	✓	✓				Government
Belize	✓	✓			✓	✓	PUC
Guyana	✓	✓					PUC
Jamaica	✓	✓	✓	✓	✓	✓	OUR
Suriname		✓					Government
Trinidad and Tobago	✓	✓	✓				RIC
The Bahamas	✓	✓					Government

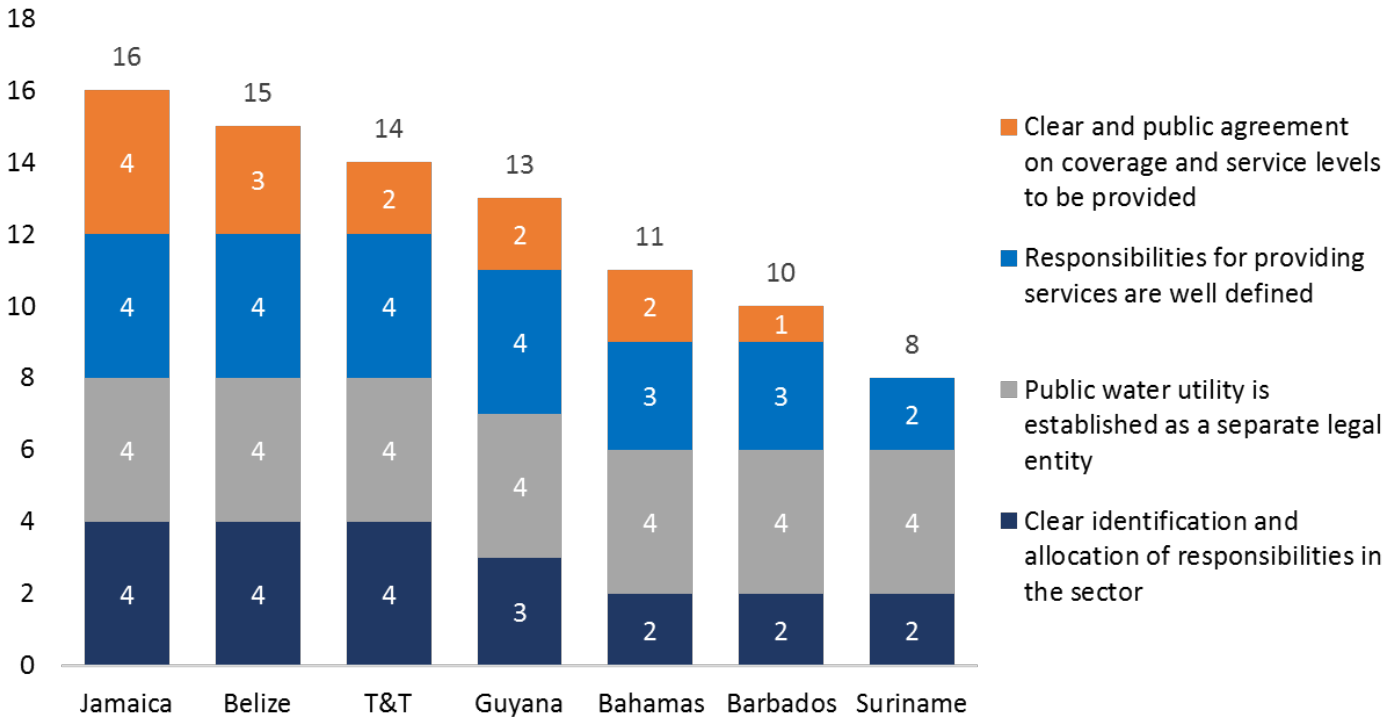
An effective sector policy has the following characteristics:

- **Clear objectives**—Governments should set objectives that clearly state the specific outcomes or results that expected from the water and sanitation sector for a given period
- **Measurable targets**—Governments should establish targets with concrete criteria for measuring progress towards the main objectives. These targets must be quantifiable and trackable, with a specified time frame for completion
- **Financial planning**—Governments should include a funded plan with their policies to ensure that the targets are financially realistic and attainable

Comparison of governance framework and utility performance



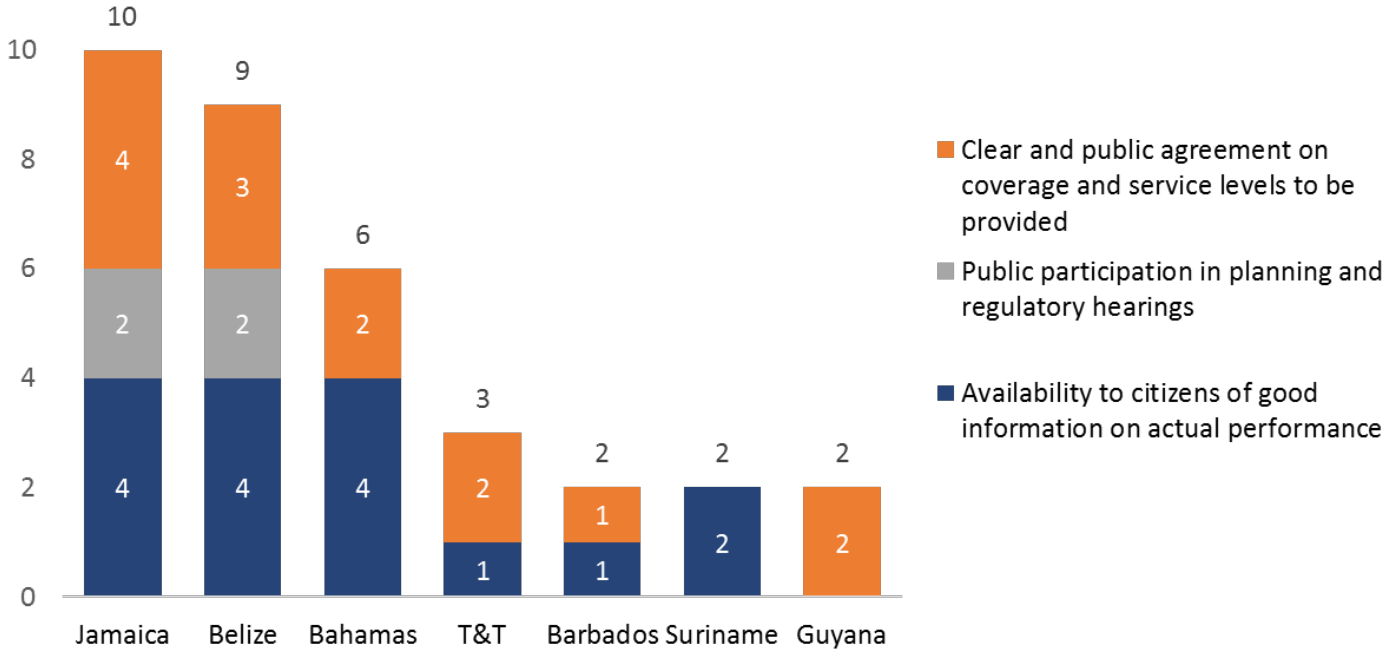
Definition of responsibilities in the sector



Note: Each indicator has been given a value that ranges from 0 to 4. A 4 indicates high level of success and a 0 indicates low level of success

A good governing environment relies on frameworks that clearly define the actors, their responsibilities and powers, and the concrete measures they are authorized to take

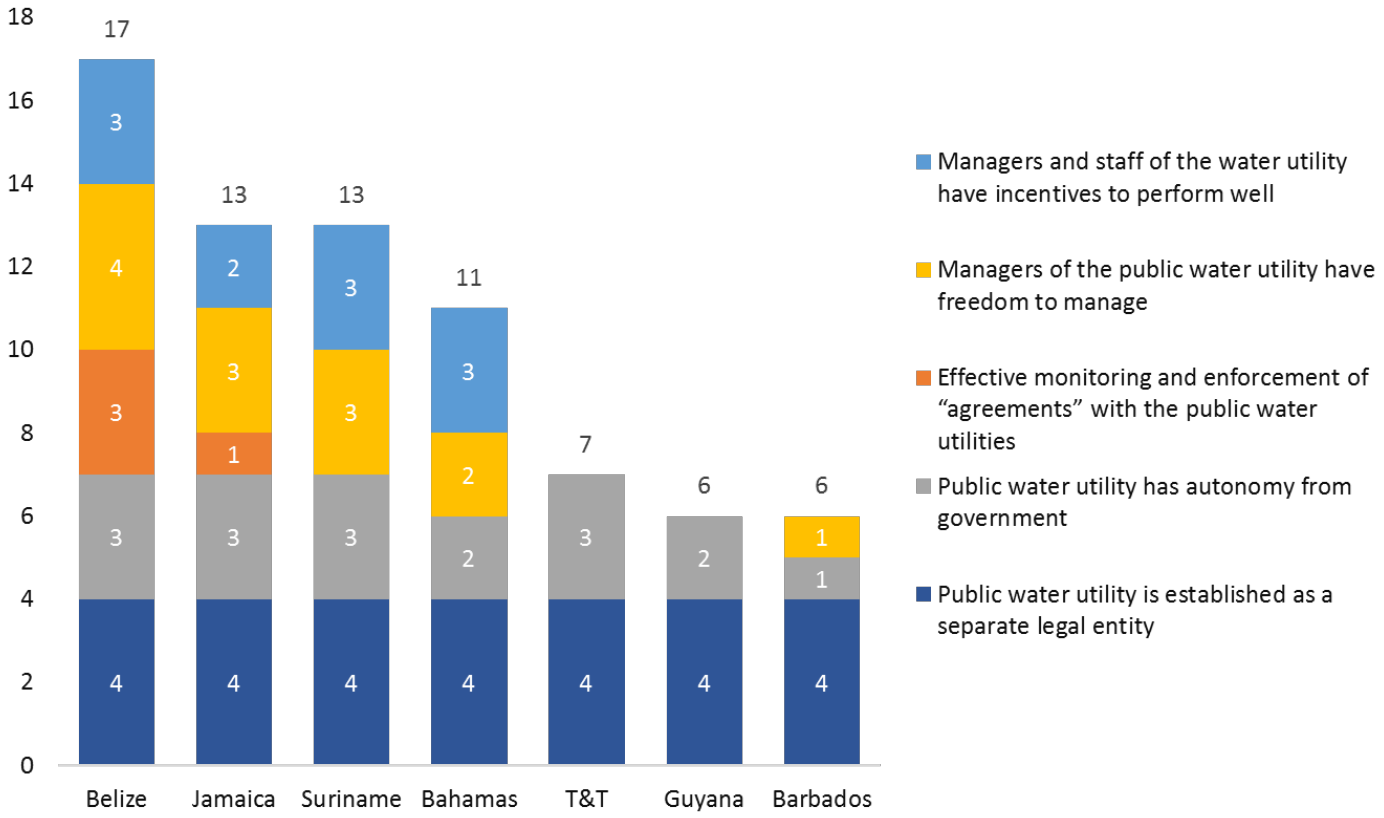
There is a lack of transparency and consumer involvement



Note: Each indicator has been given a value that ranges from 0 to 4. A 4 indicates high level of success and a 0 indicates low level of success

- Most countries do not have mechanisms for monitoring complaints or managing public consultations on tariff issues
- There are few requirements for water utilities to publicly disseminate information on performance, costs, and investments
- Few utilities have information on the quality of service they provide.

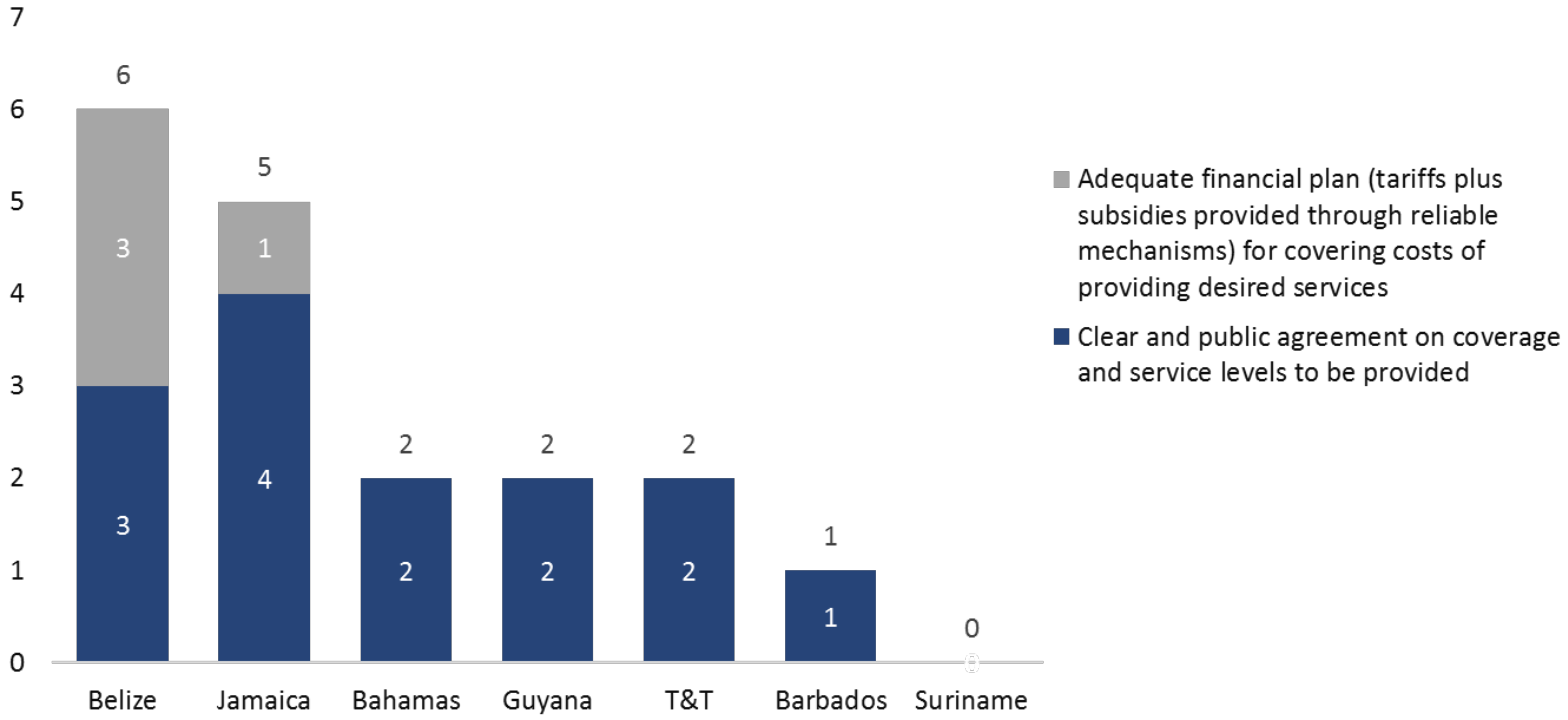
In some countries, managerial autonomy is limited and there are weak incentives for operating efficiency



Note: Each indicator has been given a value that ranges from 0 to 4. A 4 indicates high level of success and a 0 indicates low level of success

- Most utilities are not reviewed to ensure costs are reasonably efficient, nor do the utilities have strong incentives to reduce these costs
- Some utilities have limited autonomy

Financial planning does not consider the costs for expanding and improving services



Note: Each indicator has been given a value that ranges from 0 to 4. A 4 indicates high level of success and a 0 indicates low level of success.
Note: There is no information on financial planning for Barbados and Suriname

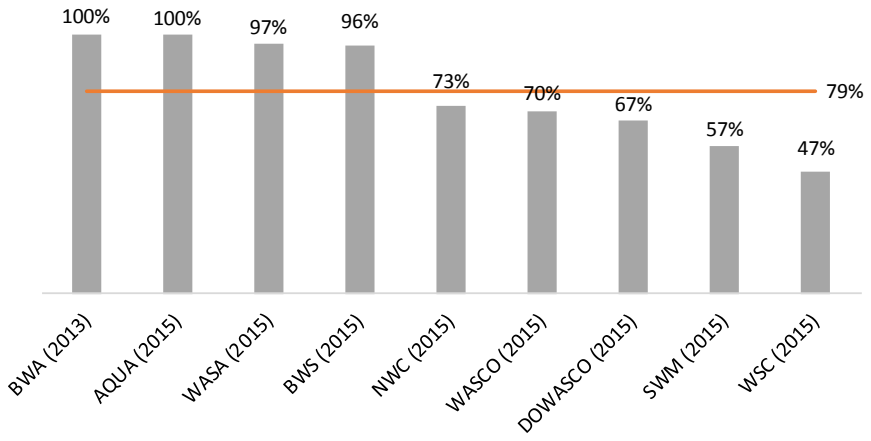
- None of the public water utilities have tariffs that fully cover the cost of expanding and improving services, particularly wastewater collection and treatment
- Except for BWS and NWC, utilities in the other countries did not have tariffs that covered their cost of service as it stands
- Financial planning for most utilities is vastly inadequate. This is true for BWS and NWC as well, since both utilities do not consider the higher cost of service associated with increasing wastewater collection and treatment

REFERENCE MATERIAL

- Water and sewerage coverage

While most utilities provide adequate water coverage, sewerage coverage is inadequate

Water Coverage



- Only 3 of the benchmarked utilities provide coverage above the average of 79%
- SWM and WSC rank the lowest, providing service to 57% and 47% of the population in their service area

Sewerage Coverage

- Of the benchmarked utilities that provided information regarding this indicator, the average coverage was 12%
- WASA is the one with the most extensive coverage, reaching 30% of the population in its service area