

# WATER SECTOR RESILIENCE SYMPOSIUM PROCEEDINGS

**BARBADOS ENERGY EXPO 2019**

**Sponsored by the Ministry of Energy & Water Resources & The United Nations Development Program**

**LLOYD ERSKINE SANDIFORD CENTRE, CONFERENCE ROOM,  
BARBADOS**

**22<sup>ND</sup> NOVEMBER 2019, 10:30 AM TO 3:00 PM**

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**GREEN  
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**Caribbean Community  
Climate Change Centre**



**UNIVERSITY OF  
SOUTH FLORIDA**

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# TABLE OF CONTENTS

<b>TABLE OF CONTENTS</b>	<b>2</b>
--------------------------	----------

<b>ACKNOWLEDGEMENTS</b>	<b>4</b>
-------------------------	----------

<b>BACKGROUND</b>	<b>5</b>
-------------------	----------

MAYA TROTZ, PHD, ENV SP PROFESSOR, CIVIL AND ENVIRONMENTAL ENGINEERING, UNIVERSITY OF SOUTH FLORIDA

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KEITHROY HALLIDAY, ENV SP GENERAL MANAGER, BARBADOS WATER AUTHORITY

<b>WELCOME</b>	<b>6</b>
----------------	----------

KEITHROY HALLIDAY, ENV SP GENERAL MANAGER, BARBADOS WATER AUTHORITY

<b>AGENDA</b>	<b>8</b>
---------------	----------

<b>BUILDING RESILIENCE BY BRIDGING WATER AND ENERGY</b>	<b>9</b>
---	----------

<b>SOLAR WATER HEATERS, FROM LOCAL TO GLOBAL MARKETS</b>	<b>10</b>
--	-----------

JAMES HUSBANDS CEO, SOLAR DYNAMICS LTD.

<b>SMART FLEET MANAGEMENT SAVES FUEL</b>	<b>12</b>
--	-----------

KHALIL BRYAN CEO, CARIBBEAN TRANSIT SOLUTIONS INC.

KIRK PHILLIPS, ENGINEER, BARBADOS WATER AUTHORITY

<b>FINANCING FOR CLIMATE CHANGE ADAPTATION AND MITIGATION ACTIONS – FROM HOUSEHOLD TO UTILITY LEVEL</b>	<b>14</b>
---	-----------

<b>PRIVATE SECTOR FINANCING OF INFRASTRUCTURE – INSIGHTS FROM JAMAICA</b>	<b>15</b>
---	-----------

SIMONA WATKIS, CEO, NCB CAPITAL MARKETS LIMITED

<b>A REVOLVING ADAPTATION FUND FOR HOUSEHOLDS</b>	<b>16</b>
---	-----------

ERSKINE ALLEYNE, ENV SP BARBADOS WATER AUTHORITY	
<b>PRIVATE SECTOR FINANCING OF INFRASTRUCTURE – POLICY NEEDS IN BARBADOS</b>	<b>18</b>
MICHAEL MILLAR ASSISTANT VICE PRESIDENT, INVESTMENTS, SAGICOR LIFE INC.	
<b><u>REDUCING NON-REVENUE WATER &amp; ADDRESSING WATER SCARCITY</u></b>	<b><u>21</u></b>
<b>NON-REVENUE WATER STRATEGY AT THE BARBADOS WATER AUTHORITY</b>	<b>22</b>
ADRIAN CASHMAN, PH.D. AKWATIX: WATER RESOURCES MANAGEMENT	
<b>WATER RESOURCES &amp; INFILTRATION</b>	<b>25</b>
JAMIE PAUL, ENV SP HYDROGEOLOGIST, BARBADOS WATER AUTHORITY	
<b><u>BUILDING CAPACITY FOR WATER SECTOR RESILIENCE</u></b>	<b><u>27</u></b>
<b>GENDER INTERSECTIONS WITH WATER AND ENERGY</b>	<b>28</b>
TONYA HAYNES, PH.D., LECTURER AND COORDINATOR OF GRADUATE PROGRAMS, INSTITUTE OF GENDER AND DEVELOPMENT STUDIES, DAME NITA BARROW UNIT, UNIVERSITY OF THE WEST INDIES, CAVE HILL, BARBADOS	
<b>WHAT IS RESILIENCE? UTILITY PERSPECTIVES.</b>	<b>32</b>
WAINELLA ISAACS, ENV SP DOCTORAL CANDIDATE, CIVIL & ENVIRONMENTAL ENGINEERING, UNIVERSITY OF SOUTH FLORIDA	

# ACKNOWLEDGEMENTS

There are many organizations and persons to thank for this symposium. The Ministry of Energy & Water Resources and the United Nations Development Program (UNDP), first and foremost for hosting the Energy Expo. In particular, Mrs. Francine Blackman, Permanent Secretary at the Ministry of Energy & Water Resources and Ms. Destinie Gay from UNDP, , ensured this special symposium on Water Sector Resilience ensured had a platform at the expo. Lloyd Erskine Sandiford Centre staff provided conference services. The symposium would not have been possible without the presentations made by Mr. Erskine Alleyne (Barbados Water Authority), Mr. Khalil Bryan (Caribbean Transit Solutions Inc.), Dr. Adrian Cashman (AKWATIX: Water Resources Management), Dr. Tonya Haynes, Institute of Gender and Development Studies, Dame Nita Barrow Unit, University of the West Indies Cave Hill), Mr. James Husbands (Solar Dynamics Ltd), Ms. Wainella Isaacs (Civil & Environmental Engineering, University of South Florida, USF), Mr. Michael Millar (SAGICOR LIFE INC.), Mrs. Jamie Paul (Barbados Water Authority, Mr. Kirk Phillips (Barbados Water Authority), and Mrs. Simona Watkis (NCB Capital Markets Limited. The Caribbean Community Climate Change Center (5Cs) staff, especially Mr. Keith Nichols, Dr. Elon Cadogan, Mrs. Dorett Tennyson, Ms. Deidre Caliz, Ms. Zadie Neufville, and Dr. Donneil Cain. The Barbados Water Authority's (BWA) General Manager, Mr. Keithroy Halliday, for supporting the symposium and BWA's participation in the EXPO. BWA staff who participated, either as presenters or as audience members (Mr. Raymond Cumberbatch, Mr. Wayne Collymore, Mr. Anthony Franklyn, Mr. Alex Ifill, Mr. Charles Leslie, Mrs. Clovine Leslie, Mrs. Stacia Newsam, Mrs. Shelley Parris, Mrs. Lorna Shepherd, and Mr. Darien Taylor). The symposium was organized and moderated by Dr. Maya Trotz (USF), Dr. Elon Cadogan (5CS), and Mrs. Shelley Parris, Project Manager in the Project Management Office (Ag) at the BWA. Logistical support was provided by Ms. Wainella Isaacs, Dr. Elon Cadogan, Mr. Anthony Franklyn, and Mrs. Stacia Newsam. Photography was provided by Christoff Griffith, and refreshments were provided by the Lloyd Erskine Sandiford Centre.

# BACKGROUND

**MAYA TROTZ, PHD, ENV SP**  
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**ANTHONY FRANKLYN, ENV SP**  
**ENGINEERING ASSISTANT, BARBADOS WATER AUTHORITY**

**KEITHROY HALLIDAY, ENV SP**  
**GENERAL MANAGER, BARBADOS WATER AUTHORITY**

The Water Sector Resilience Nexus for Sustainability in Barbados (WSRN S-Barbados) Project, valued at USD 45.2M, is being implemented by the Caribbean Community Climate Change Centre (CCCCC) in collaboration with the Green Climate Fund (GCF), the Government of Barbados and the Barbados Water Authority (BWA). One of the project's objectives is to build capacity for climate resilience in the water sector of Barbados, including the co-creation, production and dissemination of knowledge to diverse audiences. These proceedings reflect the oral presentations made at the inaugural Water Sector Resilience Symposium held in Barbados on November 22<sup>nd</sup>, 2019 as a part of the Energy Expo.

The Energy Expo aims to bridge the gap between Barbados' renewable energy and energy efficiency stakeholders and the public. Water and energy, however, are interrelated. Without energy, water cannot be pumped or treated. Without water, there are disruptions to work and school schedules that impact the most vulnerable communities. In addition, the Queen Elizabeth Hospital, after about 48 hours, would be unable to function as normal. So, this symposium focused on resilience for the water sector in Barbados through 4 thematic areas: Building Capacity for Water Sector Resilience, Building Resilience by Bridging Water and Energy, Financing Climate Change Adaptation and Mitigation – from household to utility level, and Reducing Non-Revenue Water & Addressing Water Scarcity.

Presenters, gathered for the first time to address a collective interest, represented the Barbados Water Authority, a range of private sector financial, consulting, and technology firms, and academia. For these proceedings, their recorded presentations were transcribed and edited to make the material as accessible as possible to a range of readers and learners. They are meant to evoke the frank, friendly, and open atmosphere that was prevalent during the actual symposium, and serve as a way to document and share the ideas that were discussed.



## WELCOME

**KEITHROY HALLIDAY, ENV SP  
GENERAL MANAGER, BARBADOS  
WATER AUTHORITY**

It brings me great pleasure to welcome you to the first annual symposium for the Water Sector Resilience Nexus for Sustainability in Barbados Project.

I must begin by thanking the general public of Barbados for the patience and understanding that was exhibited over the past few days with respect to the water outages that occurred in various communities across the island. This is just one of the examples that most vividly illustrates the current vulnerability of the infrastructure of the Barbados water Authority (BWA). However, it also illustrates the need for projects, such as this one for the BWA, to continue to build with resilience and sustainability in mind.

Over the next decade, the BWA aims to expand its network using the concepts of sustainable infrastructure. In fact, the BWA has already started to increase its own capacity by certifying, thus far, over 10 persons as Envision Sustainability Professionals (ENV SP); a course certified by the Institute for Sustainable Infrastructure, based in the USA.

As a continuation of the BWA's efforts to increase its capacity and also to educate its major stakeholders, inclusive of the general public, this symposium serves as a medium for the Caribbean Community Climate Change Centre, the University of South Florida and the BWA to share some of the activities that are to be implemented under the Water Sector Resilience Nexus for Sustainability in Barbados Project (WSRN S-Barbados). In addition, this symposium, held in conjunction with three institutions, and partly sponsored by the Ministry of Energy and Water Resources, demonstrates not only the collaborative efforts of these institutions, but also a commitment from the Government of Barbados.

Although we are gathered here in a formal setting, I would just like to shed some light on some of the aims of the WSRN S-Barbados Project. This project started its implementation phase in January 2019 and it has been developed to create a sustainable, resilient water supply for Barbados by implementing renewable energy solutions, increasing water capacity through

rainwater harvesting and water storage, supporting adaptation funding, and raising awareness about climate change and the water cycle.

The Honourable Prime Minister of Barbados has spoken widely on the damaging impacts of Climate Change and is very aware of the real danger that it poses to Barbados and other small island developing states in the Caribbean. Climate change is expected to affect Barbados and is likely to be manifested by changing rainfall patterns, and intensity of storms. These increases in severe weather events can have a serious impact on our groundwater resources.

This project will also aim to increase Barbados' water security via the installation of photovoltaic solar and backup natural gas power for pumping stations, while implementing climate resilience actions in the water sector. One of the proud features of this Project will be the development of an adaptation fund. This fund will be set up with operational cost savings from implementing the renewable energy activities, and will provide credit lines to implement water conservation actions. Other activities will build public awareness to achieve more sustainable water usage.

Given that background, this symposium was designed around the four thematic areas of the WSRN S-Barbados Project, namely:

1. Building Resilience by Bridging Water and Energy;
2. Financing Climate Change Adaptation and Mitigation – from household to utility level and;
3. Reducing Non-Revenue Water and Addressing Water Scarcity; and
4. Building Capacity for Water Sector Resilience;

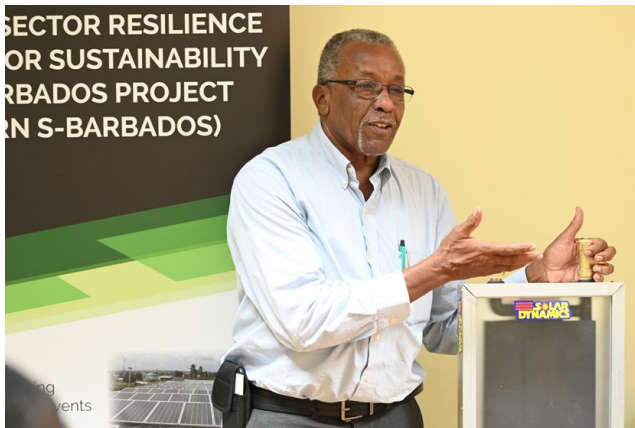
It is important that I recognize our presenters for their voluntary service as noted contributors and distinguished members of Society.

# AGENDA

Time	Topic
10:30–10:35	Opening Maya Trotz, Professor, Civil & Environmental Engineering, University of South Florida (USF) & Symposium Moderator
10:35–10:45	Welcome Keithroy Halliday, General Manager, Barbados Water Authority
<b>Building Resilience by Bridging Water and Energy</b>	
10:45–11:00	Solar Water Heaters, from local to global markets James Husbands, CEO, Solar Dynamics Ltd.
11:00–11:15	Smart Fleet Management Saves Fuel Khalil Bryan, CEO, Caribbean Transit Solutions Inc. & Kirk Phillips, Engineer, Barbados Water Authority
11:15–11:30	Discussion
<b>Financing for Climate Change Adaptation and Mitigation Actions – from household to utility level</b>	
11:30–11:45	A Revolving Adaptation Fund for Households Erskine Alleyne, Barbados Water Authority
11:45–12:00	Private Sector Financing of Infrastructure – Insights from Jamaica Simona Watkis, CEO, NCB Capital Markets Limited
12:00–12:15	Private Sector Financing of Infrastructure – Policy needs in Barbados Michael Millar, Assistant Vice President, Investments, SAGICOR LIFE INC.
12:15–12:30	Discussion
<b>Reducing Non-Revenue Water &amp; Addressing Water Scarcity</b>	
1:30–1:45	Water Resources & Infiltration Jamie Paul, Hydrogeologist, Barbados Water Authority
1:45–2:00	Non-Revenue Water Strategy at the Barbados Water Authority Adrian Cashman, Ph.D. AKWATIX: Water Resources Management
2:00–2:15	Discussion
<b>Building Capacity for Water Sector Resilience</b>	
2:15–2:30	Gender Intersections with Water and Energy Tonya Haynes, Ph.D., Lecturer and Coordinator of Graduate Programs, Institute of Gender and Development Studies, UWI Cave Hill, Barbados
2:30–2:45	What is Resilience? Utility perspectives. Wainella Isaacs, Doctoral Candidate, Civil & Environmental Engineering, University of South Florida
2:45–3:00	Discussion



# BUILDING RESILIENCE BY BRIDGING WATER AND ENERGY



## SOLAR WATER HEATERS, FROM LOCAL TO GLOBAL MARKETS

**JAMES HUSBANDS**  
CEO, SOLAR DYNAMICS LTD.

**On solar water heaters.** In terms of what have we been able to achieve over the last 45 years, Barbados has become number one in thermal performance (BTU) of solar water heaters per thousand population and number three in the world in the penetration of solar water heaters per thousand population. And even though many persons may not see that as important, the 67 countries in the world that take part in this International Energy Agency Solar Heating and Cooling Programme survey, are a little envious of our position. To a large extent, Barbados was one of the new entrants when Solar Dynamics was formed. Australia, Israel, Cyprus, Palestinian territories, were already on the market, and our penetration, thanks to the industry, has been phenomenal. Barbadians take it for granted that hot water is a normal convenience. In many countries that is not so, even though hot water provides one of the three comforts these days, particularly in the hospitality industry, and in homes. No modern home would be without air conditioning, hot water and the internet.

**On the pay back of solar water heaters.** Fortunately, the solar water heater system is perhaps the one that has the highest return on capital in Barbados. The water system pays for itself in two years, or just over two years. With a return on investment over 50%, there's really no reason for us to use non-renewable energy to provide hot water anymore.

I surveyed Turtle Beach in Barbados and Bay Gardens Group in St. Lucia, which reported a 45% return on investment and a 95-100% rate of satisfaction with their solar water heaters. Those two installations were between 17 and 20 years old at the time. Based on my calculations, in the case of Turtle Beach, in the 17 years that that installation with its 167 rooms has worked, they have saved over \$4 million BDS. And the capital costs of that solar water heater equipment, to replace it today is \$400,000 BDS. So really and truly, you may find that it is perhaps one of the most beneficial assets there in terms of the energy saved at today's costs or when you prorate the cost of energy over those years. Within the hospitality industry and the domestic space, there's really no reason why we should be wasting fossil fuels to produce hot water.

**On good business practices.** One of the critical things we've done at Solar Dynamics is that we introduced the world's first temperature guarantee. The temperature guarantee essentially provides the recourse should the equipment fail to perform as prescribed. We typically say that our cold water is usually around 80 °F, we're going to take that water to 135 °F plus or minus 5 °F. So, our client does not need to go to court to get recourse as it's written into the contract. The temperature guarantee protects the investment of the client and puts the

pressure on the supplier to meet a performance level. This came out of a dissatisfaction one of our early clients had. And we had difficulty determining whether we met the contract. The temperature guarantee was not something imposed on us, but something we imposed on ourselves. And it has worked very well for us and for our clients. A simple thermometer checking the temperature will resolve that matter for a client. And this is how it became the world's first temperature guarantee on a solar hot water system.

What do we need to do to replicate our technology? We want to be able to work in various markets, either to supply from Barbados or St. Lucia where we have another facility. The St. Lucia facility has gone through success and setbacks. In 2006 the assets were \$3 million in that operation, but then the company with whom we were working sold to a Barbadian enterprise. And it took me seven years to get it out of their hands, by which time the assets had declined to \$262,000. So, when we advise young people to go into business, we also have to advise them that if it's their technology, if it's their idea, then they need to have some recourse should the partner decided to sell to someone else. In this case we tried to buy 2% to move from 49 to 51% ownership, but that was denied. So, it's something that we need to bear in mind as we seek to bring young people into business in terms of how they are protected. You need to do 49/49 split with the technology provider having the 2% in case there's a problem that they have the opportunity to exercise that in a crisis.

**On technology innovation.** In recent times we have addressed the challenge of uplift winds. We designed the system with a chassis that allows you to secure the collector better to roofs. All of the components are extrusions rather than sheet metal, making the entire system basically new. The performance will be as good, but certainly the resistance to uplift winds was a major challenge we needed to address.

We have also used prism blast on the surface of the collector which reduces the radiation bounce and increases the amount of absorption. Most recently we have introduced new plumbing technology. One of the challenges, both from an installation and servicing standpoint is to be able to do things on sloping roofs. Our new technology, called push fit, reduces the amount of plumbing. We've been able to design some fittings that are kind of unique to us, and unique to the industry. We hope to be able to offer these to the industry so that we can upgrade the technologies wherever we work.



## SMART FLEET MANAGEMENT SAVES FUEL

**KHALIL BRYAN**  
**CEO, CARIBBEAN TRANSIT SOLUTIONS INC.**

**KIRK PHILLIPS, ENGINEER,**  
**BARBADOS WATER AUTHORITY**

Caribbean Transit Solutions Inc. focuses on fleet management and giving robust information on how your vehicles are working. What does that mean? We take your tracking data, and we make it useful. In 2018, the Barbados Water Authority brought a fleet management system to 130 vehicles. Being able to see how these vehicles are being used - harsh braking, harsh cornering, harsh acceleration, that's one part of it. Also being able to manage their fuel more effectively, being able to manage their operations and dispatching more effectively, and being able, in a fundamental way to start to use data to drive decisions. You are now able to use the data from your vehicles to make better decisions. Am I going to switch to an electric vehicle? Am I going to keep my current vehicles or what are the other solutions out there? Through this you are then able to deploy your capital more effectively.

**On fleet management.** I always say that there is fleet management and there is tracking. Tracking is your raw material. It's like taking flour and then baking a cake. Everybody's cake comes out a little bit differently. We focus on the analytics behind the tracking. So, the tracking is the raw material that we need to be able to present the analytics around how my vehicles are performing. What is my asset utilization? How much idling do I have in my system?

We have one customer for example, who spent \$50,000 a month on diesel and 10% of their diesel cost was spent on idle time. So, \$5,000 of that \$50,000 was spent on vehicles just not being turned off. We were able to just show the owner that number and they were able to reduce that to \$2,000. So, while they didn't completely eliminate it-diesel engines have turbos that can't just be switched off-they were able to see an opportunity for saving a little bit of money in the operation. If your bill at the BWA, for example, is \$100,000 or \$200,000 a month, imagine if you could reduce that by 5%. That's a whole other person's salary per year.

**On fleet management at the BWA.** Barbados is in the top ten countries for most expensive fuels in the world; top 10 in gas and top 20 in diesel. Being able to reduce our energy dependence and make smart decisions around it, is really the focus of our business. Mr. Charles Leslie spearheaded this initiative to bring us on board at the BWA to start to collect this information to help them make decisions. Additionally, BWA engineer Mr. Kurt Philips and I recently started analyses based on actual vehicle kilometers and fuel use to determine whether Electric Vehicles (EVs) should be considered for a given fleet. Do we even have EVs that can truck water up to the remote parts of Barbados? Or do we have to stay with a traditional internal combustion

engine? Being able to see those fuel usage trends from the data specifically from the vehicles is our focus.

Currently, the system connected to the diagnostic port in the car can give you that fuel usage information. For older vehicles without a diagnostic board, manual upload of information into the system is needed. The transport group at the BWA manages all of the fuel information, and the fill up information that comes from the vehicles. But, being able to then provide that in a clean dashboard makes management's jobs much easier.

We're the reseller of a product called Fleeteo. From acquisition to disposal, it is a modern easy to use system that gives you everything you need to manage asset lifecycle on the go, create schedules, forecast service tasks based on usage, have drivers or operators perform customized installations in minutes using a smartphone, use service entries and work orders to resolve any issues that arise, and easily track parts and supplies. Its' powerful reporting tools show operation costs in real time.

From that one dashboard, you do not even necessarily have to log into the system as that information can be sent directly to your email on an exception basis, "there's a problem with this vehicle, please check this vehicle." This allows you to focus on your business, not on another platform. Realistically, being able to give you the information to manage your fuel and manage your costs a lot better is the focus, and from a Barbadian stakeholder perspective, that is what we want to help foster at the BWA.

## **Q&A**

Q. I am a customer and the water truck is supposed to come, but it doesn't come. Is it something that I can track?

A. That's one of the initiatives within the BWA that we're looking to work on to be able to then say this vehicle has been dispatched to you and here it is along the route. So, it is possible. It is just for us to now be able to build out that public facing side of the platform.

Q. Things like harsh braking, harsh cornering etc. give you information about the performance of your drivers and your staff. Can't that lead to performance appraisals.

A. Yes, performance appraisals or giving benefits for great drivers. So, performance incentives as well. We've discussed that with others within the BWA and it's for us to be able to implement that. But, that's absolutely a great idea.

Q. In the Netherlands, every 10 days I get a report on my driving performance. I get a discount on my performance

A. We have worked with Sagikor on their Drive Pal program to be able to get that discount based on good driving. So that's already built out here in Barbados, through Sagikor & Sagikor General. It's a great idea to use the data to give you discounts and give you money back in your pocket.

FINANCING FOR CLIMATE CHANGE  
ADAPTATION AND MITIGATION ACTIONS –  
FROM HOUSEHOLD TO UTILITY LEVEL



## PRIVATE SECTOR FINANCING OF INFRASTRUCTURE – INSIGHTS FROM JAMAICA

**SIMONA WATKIS, CEO, NCB CAPITAL MARKETS LIMITED**

For this presentation Professor Trotz, the moderator, interviewed Ms. Watkis, asking the following questions, some of which answers are summarized here: 1. Who is NCB Capital Markets Ltd (NCBCM)? 2. What does utilities infrastructure funding look like in Jamaica now? 3. Tell us more about how NCBCM was able to fund the National Water Commission (NWC) without requiring the support of Central Government and why is this significant to the region? 4. Just as NCBCM Jamaica has “changed the game”, how has NCB Barbados made a difference in the domestic market and what role does the Barbados office play in the Eastern Caribbean? 5. The NCB Financial Group is indigenous to the Caribbean. What role do indigenous institutions play now, and into the short to medium term the future? And how does this affect the future of infrastructure financing in the region? 6. How does NCB Capital Markets Ltd integrate climate change risks into its decision making for infrastructure investment?

NCB Capital Markets Limited is the wealth and asset management arm of the NCB group of companies offering a range of equity, money market, bond and mutual fund products, as well as corporate finance and portfolio management services for individual investors. It is one of the largest stock brokers in Jamaica consisting of 11 branches.

NCBCM invested in two major infrastructure projects in Jamaica, one in the energy sector and one in the water sector. Founded in 2014, New Fortress Energy, delivers integrated and customized energy solutions to help its customers benefit from natural gas. In Jamaica they are constructing a new combined heat and power plant in Clarendon and NCBCM served as the arranger for an US\$180-million bond to help support that construction. Once operational the plant will supply entities like the utility provider Jamaica Public Service Company and alumina producer Jamalco with electricity and steam respectively. In the water sector, Jamaica's National Water Commission (NWC) issued a \$15 billion bond to clear its' foreign debt, and NCBCM was selected as the arranger for that venture. NCBCM agreed to support the bond for a 40-year tenure at an interest rate of 13.5% in Jamaican Dollars, with \$5 billion being used to help clear any current debts. Immediate access to capital allows NWC to immediately address some of the challenges it faces with water services. While the policy and regulatory landscape to facilitate financing for infrastructure in Barbados is not yet developed like Jamaica, the NCBCM Barbados Limited is interested in providing any assistance to guide that process.



## A REVOLVING ADAPTATION FUND FOR HOUSEHOLDS

**Erskine Alleyne, ENV SP**  
**Barbados Water Authority**

**Barbados Water Authority Overview.** The Barbados Water Authority (BWA), Barbados' sole public water utility, is a statutory organization with the responsibility of supplying the public with potable water and wastewater services. In order to achieve distribution, water is pumped from stations and substations utilising mechanical and electrical equipment during the BWA's daily operations. However, we face some challenges. Some of these challenges are that the equipment such as electrical transformers, pumps, and generators, are aged, and they are in need of being upgraded. Though some of this has started, the process is ongoing. We have the potential impact of climate change on the water supplies in Barbados. Droughts destabilize the capacity of the water supply for example, at the Belle pumping station which provides the island with a third of the overall water supply to the population. There is no backup mechanism in place to mitigate a power failure. There are similar challenges for the agricultural sector as there is less water penetrating the soil to the underground aquifers.

**The RAFF – Revolving Adaptation Fund Facility.** The RAFF is designed as a response to needs for increased climate change adaptation and mitigation action in the water sector in Barbados. The enabling framework for the RAFF involves raising public awareness through educational media engagement at all levels and strengthening legislation and regulation.

For the Water Sector Resilience Nexus for Sustainability in Barbados (WSRN S-Barbados) proposal, the output is that a revolving adaptation fund is established. The project will establish the fund and its' administration, including having an MOU in place with the financial entity, and protocols and guidelines for the funds. The funds are expected to come from the renewable energy implementation at the BWA which should reduce the utility's electric bill. The BWA will supply the monies which will be deposited into, and processed by a financial institution. Applications will be made to the fund and those will be assessed by a means test. Approved applications will have funds disbursed for their proposed project. At the stipulated time the applicant will repay the money to the fund.

The rate of interest for a loan from the fund will be determined based on the household income. For example, households with annual income earning capacity between 12,000 and 20,000 BDS may get a zero interest rate loan, while those with income earning capacity of above 20,000 BDS will have interest rate will be established based on various factors. These will be determined through one of the WSRN S-Barbados activities.



**Eligible uses for the RAFF.** An applicant may apply to the RAFF for one or more of the following types of projects:

- Efficient storage and distribution systems for potable water.
- Systems that reduce water consumption and promote recycling and reuse.
- Rainwater harvesting system for new and existing housing development.
- Rainwater harvesting for new and existing farms.
- Water efficient irrigation system for the agricultural sector.
- Improve water supply to communities and healthcare institutions.
- Integrate small scale renewable energy systems into the water supply, and
- Increase water supply security through decentralized water systems for women and children and the differently-abled.

**Conclusion.** Barbados is already experiencing the impacts of climate change, and therefore, inaction is not an option. Adaptation and mitigation actions are needed in the near terms, to combat the impact associated with climate change. The BWA is championing changes within the water sector in Barbados to build climate resilience in our economic, social and environmental systems.

### **Q&A**

Q. What happens if my household earns less than say \$6,000 BDS or the minimum you determine after your studies are completed?

A. It is possible that that household qualifies for another level of support through the BWA and the WSRN S-Barbados project when it comes to potable water storage tanks where those are provided for free. The WSRN S-Barbados project will be doing a needs assessment to identify households that will be eligible for installation of those systems.



## PRIVATE SECTOR FINANCING OF INFRASTRUCTURE – POLICY NEEDS IN BARBADOS

**MICHAEL MILLAR**  
**ASSISTANT VICE PRESIDENT,**  
**INVESTMENTS, SAGICOR LIFE INC.**

**On economic infrastructural opportunities.** Infrastructure is really critical to a successful functioning economy as it facilitates the connection of products, people and markets. It is critical for growth, and productivity. Barbados' infrastructure continues to deteriorate across multiple industries simultaneously, which creates a competing critical funding need. Research by the IADB, essentially highlights some of the key deficiencies. Across the water and sewage, they highlight the weakness in the central system, the fact that there are institutional challenges at the Barbados Water Authority. In terms of energy, they highlight the fact that we are highly reliant on fossil fuel, and obviously the need for the government to move towards 100% reliance upon renewable energy by 2030 creates a greater emphasis in that sector, and the evolving regulatory environment. In terms of transportation, our roads are aged. In terms of the airport, there's need for an upgrade, and that is on the way, and capacity building. In telecommunications, there is a lack infrastructure and low competition.

However, we feel as though the need to evolve and adjust to the global circumstances such as climate change creates essentially a need for funding within this area, and as such, creates some challenges for the government to undertake alone. In terms of the infrastructural funding, the investment in infrastructure is a continuous and ever ongoing cycle, and government financing has always been at the forefront of these initiatives. However, governments are now under increasing strain to meet this revolving commitment, especially those economies with fiscal imbalances and heavy debt burdens. The IADB highlighted that between 2000 and 2008 the average spend on infrastructure would have been around 5% of GDP and that has now trended down to 2% between the period 2014 to 2018. It still represents a significant spend, and clearly there's some level of shortfall. Therefore, it is now incumbent upon other sources to backfill and seek to provide the necessary support as it relates to ongoing funding.

Investors will seek safety and profitability of investment as the main catalyst for deployment of funds. Let's face it, all of us in this room, as investors, you know, what we want is our principal back. And we want a level of return that we believe is commensurate with the level of risk we assume. Therefore, we believe that private investment will be primarily attracted to economic infrastructural opportunities. And these typically will include things like utilities across water, energy distribution, sanitation, renewable energy, transportation, and communication. There's also a further bias generally to what we consider wrong Brownfield investments where cash flows

are deemed to be more certain, risk is viewed as relatively acceptable and somewhat low. And this is relative to Greenfield investments where obviously, there tends to be a higher degree of uncertainty, project viability, and obviously higher upfront developmental costs calls.

However, when we look at the subset of economic infrastructure, investors again will be selective as it relates to the opportunities and even the stage at which the participation in an investment suitable and therefore we require within infrastructure financing, increased level of flexibility, innovation and creativity in terms of the structures to maximize the uptake by the private investors.

Just to reiterate, there remains an abundance of opportunities for investment within this space and generally we believe that private financing can provide somewhat of a bridge, especially when it comes to the economic infrastructure or even completely crowd out that investment, especially with the nature of the Brownfield investment (purchase or lease of existing production facilities to launch a new production activity) because of the fact that we believe that there is considerable return opportunity and other aspects of diversification etc. that will be attractive to investors. However, it must be done within an environment that provides the appropriate incentives that facilitate facilitative and progressive regulation and sound institutional policy practices and governance.

When we look at the financial stability report, we see that the entire financial system accounts for \$12.4 billion, representing up to 245 % of GDP. The longer term investors, inclusive of pension plans and pension funds and insurance companies, accounted for about 26% of total assets or 65% of GDP. The structure and very nature of investments being Greenfield versus Brownfield infrastructure provides various risk reward profiles and allow for participation by various investors at varying risk tolerances. We believe there could be further refinement based on the stages and this would allow for niche financing and even tailored solutions for specific classes of investors.

In terms of the advantages of infrastructure investing as an asset class, it generally provides long term low risk inflation protection and also low sensitivity to economic and market cycle returns. Given the scarcity of optimally yielding domestic securities, coupled with the absence of the crowding out of the issuances of government paper, there is excess liquidity searching for suitable investment opportunities across the risk spectrum. Through private infrastructure financing we believe we can match alot of that excess liquidity with value propositions for our investment returns. The industries of pensions and insurance remain under immense pressure as traditional investment portfolio returns are often below the funding targeted rate given interest rates generally have been on a downward trajectory while counter intuitively, volatility has increased across traditional asset classes.

**On regulatory needs for investment.** With respect to the regional landscape, the current legislation and the ultimate investment profile is predominantly biased towards traditional stocks and bonds with very limited exposure to alternative asset classes, including infrastructure. In terms of regulatory oversight for the insurance industry, there's an 80/20 kind of rule where 80% must be held locally and that would have been largely absorbed within the fixed income space with the further 20% to non-sovereigns. Generally, for those long dated portfolios like life

insurance and pensions, the preference is for longer term, steady income streams. Due to the regulatory constraints and the limited eligible investable universe this is largely filled by a fixed income debt which consists of bonds and loans, mortgages etc..

So, it is incumbent upon us locals to effectively build our economy. Sagicor, naturally by virtue of its product range, offers pension investment and insurance products. Those are two categories of investment that generally have a good fit for longer term investment opportunities, which is in sync with infrastructure financing. However, for us to move off the sidelines and aggressively go into this space, we need the regulatory framework to be facilitated. We also need to ensure that there's a level of operation and governance in terms of efficiency, and in terms of management of these projects, so that we are comfortable that we can deploy and get a reasonable return for our investors, shareholders alike.

As it relates to the investment portfolio, the regulatory environment and policy, we need to broaden the spread of investments. While Barbados is not under a risk based model as Trinidad whereby you have capital requirements associated with the level of risky assets you take on, it is progressively getting there. At the same time, we need to be able to adjudicate on the level of risk. Look at government paper which was once considered default free. Now you're seeing defaults - Barbados in 2018, Grenada in 2015, St. Kitts in 2012, Jamaica twice in 2010, and you can go on. A person assessing government paper certainly today cannot give it a zero in terms of risk profile. So, there is no risk free asset per se. And at the same time, some of these assets may be a little more difficult to access, but when you look at the cash flow pattern and so forth, you may be better off taking a collateralized mortgage over some government paper sometimes. At least there you have recourse as you can sell the property.

In terms of assessing risk, we need accurate adjudication so that when we consider it as an eligible asset class within the context of changing the regulatory climate, the associated capital charges when they come into being will not be overly onerous and a disincentive to facilitate further build out. Research by the OECD in 2017 on global pensions found that for out of 63 reported jurisdictions 36 had excess of 75% of their pension portfolio made up of traditional investments like bonds, bills, and stocks. So, generally, there would have been a lack of opportunities domestically for investment where the legislation largely restricted the investment outside of traditional asset classes.

Investors look for commitment on behalf of governments to efficiently deploy capital. Public private partnerships may be a leg in, in terms of the opportunity and first tier to securing full-fledged private infrastructural financing. In some instances this may be the only way for private engagement to collaborate and fund various segments more suitable for each investor. Infrastructure investment remains a potentially attractive asset class in light of the low interest rate environment. The time is ripe for policymakers domestically to address the regulatory framework, especially for those investors such as pension funds, and life insurance that are not naturally aligned to investment in infrastructure.

## REDUCING NON-REVENUE WATER & ADDRESSING WATER SCARCITY



## NON-REVENUE WATER STRATEGY AT THE BARBADOS WATER AUTHORITY

ADRIAN CASHMAN, PH.D. AKWATIX:  
WATER RESOURCES MANAGEMENT

**Presentation Overview.** I'm going to go through a few key questions to guide this discussion on non-revenue water (NRW). I'm going to call some names. And then ask, do we have a problem? And if we have a problem, what are we going to do about it? Or what can we do about it?

**On questions to guide non-revenue water work.** A key question when we're talking about non-revenue water, that we need to be answering to find out if we have a problem, is how much water is being lost. If it's very little, do we have a problem? Because one of the things, to bear in mind is something called the economic level of leakage. What is that? The economic level of leakage is that point at which it is going to be cheaper for you to develop a new source rather than reducing leakage. Question is how do you define that point? If you do it just purely in financial terms you may find that actually it's cheaper to develop new sources a lot sooner. If you then start rolling in environmental and social aspects, you may find that that tipping point shifts.

One of the big debates in non-revenue water, and certainly the regulation of it is, "where is that point - the economic level of leakage?" How do we decide on it as a whole? There's a lot of literature on this. And where is it being lost from? We need that because that will help guide us in terms of where we're going to put our efforts, and also how much it's going to cost.

So, if we're losing a lot from very large mains, addressing that problem is different to all your service pipes. Remember, when we say leakage, it's not just on the utility side, but there's leakage also from the household side. Usually we're talking on the utility side. Why would we say that? I'm being provocative for the record, because on the household side, we could say we don't care. Why would a utility not care? Because we've sold it. We've received money for it. And what are we in the business of doing? Selling water. So, the more we sell, the better we're doing. Actually, we have a social and environmental and economic responsibility, which mitigate that. In fact, many utilities have been given the responsibility for assisting customers with leakage on their property. It depends on the jurisdiction as to how far that goes.

What is being lost and why is it being lost? What can we do about it? When we're talking about non-revenue water strategies, these are the sorts of questions that we're asking ourselves, and we're trying to provide answers for.

**On terms used for NRW.** People at the International Water Association (IWA), have a whole group that looks at non-revenue water. They spent an awful lot of time looking at what goes on around the world and they have produced a diagram that provides a general way of thinking about water, and particularly non-revenue water.

We have authorized consumption and water loss. Authorized consumption, we break down into stuff that is authorized and for which we either bill or don't bill like fire hydrants. There are two types of water losses, apparent losses and physical losses. The apparent losses are from things like readings being wrongly entered into the system. Others would be malfunctioning water meters themselves. So apparent losses, unauthorized consumption, otherwise known as theft, illegal connections, metering inaccuracy system data and then the leakage of what we call the real losses. Real losses come during the transmission in the distribution system, overflows from reservoirs, and leakage from service connections. All of these real losses are not revenue as we're not actually selling that amount of water.

We can start thinking to ourselves what is the effect of that? If I am spending money to produce more water than I need, the cost of producing the water that I don't need has to be rolled into the revenue, if we were going to fully recover cost. We could say that there is an expectation or presumption that our customers are paying for the inefficiencies in what we do.

That's why when you look at a regulated environment, where the economic regulator sets a level of leakage, the economic regulator is looking after the interest of the consumer to make sure that the consumer is getting a good deal. And that's why the economic regulator will look at this figure because the customer should not be paying for poor operation. It's not right.

**On NRW at the BWA.** Based on a water audit done by Halcrow for the BWA billed (the revenue) water is between 51% and 56%. This was done over only a few months, and there were some issues around it, which is why there is both a high and a low figure. A water audit should actually be done over a 12 month period. This was sort of the last full survey that was done, and are the numbers used by the BWA. If we were just to take in round terms, half the water that is being produced, we're not getting paid for. On the non-revenue side, which is between 44% and 49%, where is the problem? Answering that question helps us to focus on what needs to be done by understanding, is it unbilled authorized consumption? Is it apparent losses because of meter system errors? Or is it actually in the real losses?

Based on that report, between 35% and 40% of the water is actually in real losses, suggesting that quite a lot of our focus should be looking at the water distribution system itself. That's not to say we can neglect the apparent losses, but our investment is likely to produce the highest returns if we start looking at reducing the real losses.

**On addressing NRW at the BWA.** The stated goal at the BWA is to reduce non-revenue water to 23% from more or less 50% over five years. Whether or not that is realistic and how we would go about it are debatable, however, what can we do? We have to understand the problem and one way we understand the problem is by taking a top down approach. This was

done before by undertaking annual water audits. What do I mean by that? What we do is we measure how much water goes into the system. We measure how much water we sell. And from that we can come up with that breakdown. That should be institutionalized so that every year we can track how well we're doing.

Bottom up approaches, where we are not trying to understand the big picture, are trying to look at what we can do to address the situation. Many companies across the Caribbean have in the past, done what they called reactive leakage management. In other words, somebody phones up, says there's a leak, it goes on the workbook, and eventually, sooner, sometimes later in other cases, somebody comes along and does something about it.

Another tool is pressure management. Why pressure? The more pressure there is in a pipe that has leaks, the more water will leak from it. So, one of the ways that you can reduce this is to reduce your pressure. And there's a case in a Caribbean country to the north of us, where they hired contractors to assist them with their non-revenue water management strategy. They set performance standards, and the contract met the target by reducing pressure. The intention was that they would actually reduce the leaks, but they met the performance standard. So, when you're dealing with contractors, be careful how you specify what you want.

Active leakage management which is actually under the WSRN S-Barbados project, is where we're going. We are actively going out. We're not reacting, we're going to go looking for where the leaks are. How do we go about it? Well, we divide and conquer. We have District Metered Areas (DMAs) or others would call it Demand Management Areas. This is where we break the system up into small chunks. We look at how much water is going into these defined areas. We look at how much water is being used in that defined area and ask, "Do we have a problem here?" If we have a large problem, then we might go along to active leak detection, which is going in with ultrasound, and meters in particular areas, so that we can try to isolate the problem.

How will we do this? Some good steps we need to take: 1) You need someone who is going to be responsible for this, 2) Set targets are needed, and 3) Required reporting on activities are needed.





## WATER RESOURCES & INFILTRATION

**JAMIE PAUL, ENV SP  
HYDROGEOLOGIST, BARBADOS  
WATER AUTHORITY**

**On Barbados' water supply.** As a Hydrogeologist at the Barbados Water Authority some of my main functions are to monitor the water resources, the quantity and some quality across the island, advise the utility on our pumping regime, and give advice to national and international bodies when they are looking at water resources in Barbados. I share these duties with Mr. Alex Ifill, our water quality specialist, and our water quality technologist, Ms. Nicole Austin.

Barbados has a nice coral cap on top of the ocean, and we know that we receive the majority of our drinking water from rainfall. We rely heavily on groundwater. At the BWA we have over 20 water wells, 2 springs, and 2 desalination plants, one of which is out of commission at the moment because of high salinity levels at the plant. That plant was designed to deal with brackish water, and we're now pumping saltwater instead at that location. Some of the solutions to that challenge under consideration include additional wells that we would have used in the past, and commissioning a new desalination plant that is capable to clean the water in that location.

**On threats to Barbados' water supply.** Barbados is water scarce. A lot of people don't like to hear that, but if we do not consider man-made water sources or non-conventional source of water like desal plants and wastewater reuse, Barbados is actually absolutely water scarce. This can be very scary when you hear that term and you live on an island. You wonder, "where are we going to get water from?"

In addition to water scarcity we have other threats: contamination from agriculture, and contamination from ourselves, especially from how we use the land and what we do every day. It's our job at the BWA to ensure that this contamination does not pass on to our end user. This applies to us employees also as we work here, and we have to drink the same water. Making sure that our children can drink water, and our children's children can have water, is something that's always on our minds.

A threat that many people don't consider is over exploitation. They say, "Oh, drill a new well, find a new source," but that can lead to different problems. Firstly, that new source has to be in a place that's not surrounded by development already. Firstly, you have to ensure that any abstraction in that area will not lead to sink holes. You can't take the water out of the land, removing the structure that's holding the land up, end up with a series of sinkholes, and then wonder why that is happening. Barbados is highly karstic with amazing conduits and pathways,

many of which we are uncertain about how they are changing. Although we perform many tests, karst is quite unpredictable, and the seriousness of the matter requires more attention.

Climate change is one of the biggest threats that we have. We know that climate change can lead to more intense rainfall events. How are we dealing with that? We know that it can lead to longer dry spells. How are we planning to deal with that? We know that it contributes to sea level rise. What solutions do we have for our coasts? For potable water supply, most of the time we hear that more desal plants are the solution. While they provide an alternative, we cannot leave our natural freshwater resources without considering things like production costs, carbon footprint, and the need for back-up systems. Resilience to climate change is a multi-pronged approach that suggests we may opt to depend on more than one way of doing something. In Barbados we like to focus more on the engineering solutions, but a step back to consider different approaches requires us to share ideas on how we are going to change our practices.

**On converging to change practices.** My colleague Mr. Alex Ifill and I, for example, have been discussing artificial recharge to increase infiltration into the groundwater aquifer. Choosing a location already showing problems with contamination or saltwater intrusion, might be a first step. For the latter, increasing recharge would also reduce saltwater intrusion at that location. While conceptual right now, tools like isotope hydrology will assist with tracking the actual age of the groundwater, and the sources of contamination. Information from previous studies and observations linking rainfall to where water collects, will be used to reverse particle track with the isotope technology. We would measure certain isotopes in rainfall, and compare to our hypothesized locations of where it goes. This will also contribute to better judgment with development across the island.

Lastly, we must think about our behavior and the adjustment needed in our behavior. As humans, we don't like to change, but we have to make some adjustments. Part of these adjustments requires us to using what we have better. For example, our usual approach to flooding during rainfall events is to make sure that we get it off the land and out to sea as fast as possible. A more sustainable approach would be to use the available rainfall that we have in the best way possible. That might mean getting it into the ground instead, or wherever needs to store it for later use.

Many of us understand the impacts that climate change is going to make on our everyday lives. I'd like to encourage us all to share our ideas, and feelings with each other and with others. During our everyday interactions we should not just get people to understand the climate change impacts and the problems that we have today, but encourage each other to think about how we move forward in the best way possible.

# BUILDING CAPACITY FOR WATER SECTOR RESILIENCE



## GENDER INTERSECTIONS WITH WATER AND ENERGY

TONYA HAYNES, PH.D., LECTURER AND COORDINATOR OF GRADUATE PROGRAMS, INSTITUTE OF GENDER AND DEVELOPMENT STUDIES, DAME NITA BARROW UNIT, UNIVERSITY OF THE WEST INDIES, CAVE HILL, BARBADOS

What I wanted to share with you relates to thinking about the intersections of gender and infrastructure with specific reference to water and energy. I will outline what we mean by gender and hopefully bringing you towards an understanding of gender that we prefer to work with in the Nita Barrow Unit and gender relations. And then, particularly for those of you who are practitioners in the field doing a very different type of work than I do, for you to reflect on the ways in which what I share might inform some of the work that I do.

**On what is gender.** Gender is important because gender is central to how our societies, our economies, and our labour forces are structured. Gender is fundamental to the structuring and ordering of society. Anything that you can think of is going to have implications for relations of gender, even if you assume that they do no. When I use the term gender, I'm really drawing on Barriteau's definition to think of gender systems as “complex systems of personal and **social relations of domination and power** through which women and men are socially created and maintained and through which they gain **access to, or are allocated status, power and material resources** within society.”<sup>1</sup> Instead of gender roles, we are thinking about gender systems, we are thinking about the ways in which gender functions as a relation of power, and how in many ways it determines outcomes in relation to access to status, power, decision making, and material resources.

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<sup>1</sup> Barriteau, Violet Eudine. “Confronting Power and Politics: A Feminist Theorizing of Gender in Commonwealth Caribbean Societies.” *Meridians*, vol. 3, no. 2, 2003, pp. 57–92. *JSTOR*, [www.jstor.org/stable/40338575](http://www.jstor.org/stable/40338575).

Taking your energy or water, who are the main decision makers, and what are the particular uses and access? When you're designing a project with these kinds of components, if you're not paying attention to relations of gender as you propose to expand adaptation and mitigation from a fund, you may actually exacerbate existing unequal relations of gender in terms of who has access and control to those funds.

But fundamentally, gender relations are relations of power. It's very important to understand that when we are doing this understanding of gender that sees it as structural and systemic, that it centers around power. And you can think of that power in terms of access and control of resources, for example. In terms of doing a Gender Analysis for any project, it's important to think about how relations of gender intersect with other forms of stratification that exist in society. If we think about things like ability or disability when speaking of access to infrastructure services, for example, you can think about how gender and ability or disability might intersect with access. So, if people are no longer getting water in their homes through the pipe, and have to buy water commercially, or fetch water and you are a person with a disability or if you are a person who gives primary care for other people who are ill or young, you think about those intersections. Intersectional analysis suggests for us that these different sorts of variances of power don't act independently, but they affect people in multiple, overlapping ways. If you think about the poorest parishes in Barbados and then the high number of women headed households in those parishes, the way in which that location as well as these class and gender relations are compounded will affect project outcomes.

**On unequal manifestations of gender relations.** Poverty data shows different ways in which unequal relations of gender are manifested. An IADB 2016 Country Assessment of Living Conditions showed that Barbados' overall poverty rate was 17.6% with the parishes of St. John and St. Joseph having the highest burden of poverty (~20%)<sup>2</sup>. Across the island, at every level of what is categorized as extreme poor or persons who are vulnerable to becoming poor, women have a higher share. Hence, the way in which gender and gender as a relation of power manifests, must be considered when assessing access to water.

Another significant feature of Barbadian society from that assessment is the high number of households headed by women, over 50%. For the fifth quintile, which has the highest level of consumption, and consumption is being used here as kind of a proxy for thinking about socioeconomic status, women have a high share of household headship of 37.85%. Households headed by women also experienced greater poverty than those headed by men. This information

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<sup>2</sup> Beuermann D, Flores Cruz R, Barbados Statistical Service (2018). Barbados Survey of Living Conditions: 2016. IADB Publication. DOI <http://dx.doi.org/10.18235/0001208>

is important to know, particularly for the WSRN S-Barbados project, when we're thinking about what might be done at the level of the household in terms of mitigation and adaptation.

There are other markers of unequal relations of gender. Men in Barbados as a group earn about 18% more than women as a group. If you look only at men and women who are the same age and level of education, the gender earnings gap is actually wider. All of these are ways that suggest how gender structures society, and structures distribution of resources, including income.

Very significant for thinking about infrastructure and access to infrastructure, is social reproduction. All activities required to reproduce us as social beings, tend to be unpaid, and they also tend to typically be done by women. These are the activities that underwrite the entire economy. The care work that women do often results in negative outcomes for things like income or seeking employment or seeking work. In the 2010 Country Assessment of Living Conditions, women were much more likely to report that caring for someone was the reason that they were not working or not seeking work.<sup>3</sup> And likewise, when we turn to young people's employment, you also see that the young unemployment rate far outstrips young men. As another marker to think about the structural nature of gender quality.

For entrepreneurship in Barbados, men's current assets as entrepreneurs or business owners tend to be five times that of women. If you want your interventions not to reproduce these kinds of inequalities or exacerbate them, you need to have that sort of understanding and knowledge of these things.

Lastly, gender based violence is also part of the way in which we understand gender inequality. A recent crime trend survey found that nearly half of adolescent girls who were surveyed in nine different Caribbean countries, said that their first sexual experiences were forced or somewhat forced. Boys also had a very high rate of responding; a little over 30% saying the same thing. We thus have societies of high levels of sexual violence against children, as well as high levels of gender based violence. A very recent study coming out of Guyana found that half of the women surveyed experienced intimate partner violence<sup>4</sup>. So, we know that this is part of the way in which gender

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<sup>3</sup> Sir Arthur Lewis Institute of Social and Economic Studies. 2012. Barbados Country Assessment of Living Conditions 2010 Volume 1: Human Development Challenges in a Global Crisis: Addressing Growth and Social Inclusion. Submitted to the Government of Barbados, National Assessment Team, and the Caribbean Development Bank. Cave Hill, Barbados: University of the West Indies.

<sup>4</sup> Contreras-urbina M, Bourassa A, Myers R, Ovince J, Rodney R, Bobbili S (2019) Guyana women's health and life experiences survey report. UN Women. <https://www2.unwomen.org/-/media/field%20office%20caribbean/attachments/publications/2019/guyana-womens-health-and-life-experiences-survey-report-2019.pdf?la=en&vs=4309>

inequality manifests itself. One of our graduate students has researched transgender women's access to employment and found significant gender based violence, discrimination and exclusion.

**On Gender and Water.** Most water sector decisions are made on the false assumption that they are gender neutral. So, with unequal relations of gender being structural and systemic, no decision is neutral. An intervention in adaptation and mitigation will not necessarily reach everyone equally if it does not take into account the existing social arrangements. Social reproduction is central to a gender analysis of infrastructure planning and development. but is also often lacking. One of the gaps that we've found is that there's a lack of analysis of infrastructure as a whole, as opposed to the different sectors individually. And part of what this gap means is that many areas of potential synergy are missed. So, for this particular project, where the focus is on water and energy simultaneously, you get to think about the synergies there. There are still ways in which not addressing structural barriers in one area might replicate or exacerbate inequalities in another, but thinking about infrastructure as a whole is something that I want to challenge us to do.

You also see the differential impact of infrastructure planning and development on women and men because power dynamics are underlying resource allocation with gender inequality a critical structuring force in this. Gender differences that are manifested in access to, and use of infrastructure services are not meant to be understood as behavior (men do one thing and women do another), but rather to be understood as structure. Even though the World Bank has had a much longer history of attention to gender, up to 2013, of 836 active worldwide water projects, only 10 of them had gender listed as a theme and the allocation to gender was about 1% of the overall project<sup>5</sup>. This new partnership with the Institute of Gender and Development Studies suggests that this project will not be replicating that significant global trend.

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<sup>5</sup> Lucy Ferguson and Sophie Harman, Gender and Infrastructure in the World Bank, Development Policy Review, 2015, 33 (5): 653—671.



## WHAT IS RESILIENCE? UTILITY PERSPECTIVES.

**WAINELLA ISAACS, ENV SP  
DOCTORAL CANDIDATE, CIVIL &  
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UNIVERSITY OF SOUTH FLORIDA**

**On Research Motivation.** Resilience. This trending word was actually voted the 2012 development buzzword of the world booting sustainability from the top spot. And it's trending all over in your media, from funding agencies, every time you turn on the radio. When you're talking about resilience, it's usually 1) resilience of something, and 2) resilience to something. For example: resilience of infrastructure to climate change, or resilience of people to disasters, of resilience of your organization to operational disruptions. And in general, resilience really came to the fore in the Caribbean region, when we talk about infrastructure after the 2012 hurricane season after we would have seen the infrastructure absolutely flattened in many of the island territories that were hit by Hurricane Maria and Irma.

Pictures of the destruction in 2019 on the Abacos Islands, in the Bahamas due to the hurricane Dorian, show disruptions to water supply. Disruptions to infrastructure need not only be due to hurricanes. Taken two days ago from a google search, we can see reports of disruption to the water supply as a result of the electrical supply going down across Barbados. In this case, its resilience of your waters service delivery to operational disruption.

**On Research Framework.** I want to understand how do you define and build resilient water services using a framework that we call a socio-technical system framework. In this framework we see infrastructure service delivery is a combination of interactions between you:

1. physical system assets (e.g. your drinking water treatment plant, your wastewater treatment plants),
2. governance and management arrangements in this space. For example: so what are your policies?, who is responsible for what?, what do you your contracts look like?, what are your compliance mechanisms?, and
3. your people, including your workforce and your service users who are usually overlooked, but who have agency and provide critical feedback and recommendations for level of service improvement. Your service users are not a homogenous group. They have different characteristics such as age, income, gender, household size, and all of these other factors.

When you take this sort of framework, “how do you define and build resilient water services?”

**On Methodology & Results.** To answer this question, the methodology applied included



1. Interviews with utility management, as well as management stakeholders, such as your union, and your regulator, and
2. A survey instrument was completed by 138 persons across 10 departments within utility. This provided a larger pool of perspectives on water sector resilience from persons who are not only in management levels. The survey allowed identification of any gaps between what people on the ground says important versus what utility management says is important.
3. Dedoose software (interviews) and or excel (survey) were used analyze the results and generate descriptive statistics.
4. Secondary document review was also conducted for clarification and verification (triangulation) of interview and survey results.

Data collection started in June of 2018 and concluded in October of 2019. The department numbers have changed over that space of time, but generally 10 departments participated. Interviews and surveys took between 20 to 90 minutes across the board for both instruments. Persons employed in the utility spanned two months to 40 years.

For a cloud map of all the different themes that came up during these interviews on “what is resilience,” people in general used words like survival and recovery and bouncing back. But if we were to break down “**what does general resilience for the sector mean**”, I can break these down into five areas:

1. Use of multi-dimensional or multi-pronged approaches to address sector challenges, which can include your drought, hurricane, equipment failure and these sorts of things.
2. And then there was this other theme or thought of you have to have adaptive planning funding approaches, so that only the strategies that are working are used, and those become a part of your standard operating procedures.
3. Then this idea of when there is service interruption, how long does it take you to recover? So, persons thought that recovery must be quick.
4. They also identified that there are two tiers of recovery, you have your essential services, to vulnerable populations e.g. your hospitals and other critical service areas, and then recovery of your standard services as defined by the Fair Trading Commission standards of service.
5. The last idea of you cannot plan for Everything. There's a certain level of uncertainty that will remain. Since you can't plan for all eventualities, you need to have a robust system so you can address multiple challenges. There was an emphasis on challenges at the water-energy Nexus, which is critical and I think everybody can agree on.

Further breaking these five general areas down we get “Properties of a resilient Barbados water sector”:

1. the ability to meet challenges (anticipate and adapt)
2. survival of the fittest, (which is this whole idea of you must learn)
3. the ability to bounce back quickly (so rapid recovery),
4. restoration of essential services (which can be described as minimum level of service), and

5. then overcoming severe challenges or uncertainty to achieve restoration of services (which has embedded coping, robustness and resourcefulness.)

I broke it down into these types of terms, because in literature in general, when you are talking about water sector resilience, they've been able to identify these properties, and define them. And some people have even gone on to even measure some of these properties. So in the Barbados context we're talking about resilience in terms that can be mapped on to literature.

Also know that in engineering resilience, how literature is organized, you have general or attribute-based resilience, which are some of the words I was saying. And then there is specified our performance-based resilience, which can be thought of as whatever metrics you're using within your system. And then you could think of resilience in terms of technology, e.g. today we've had a lot of conversations on the types of technologies that we use. This short recap of literature is to tell you that resilience can be viewed in multiple dimensions.

So that was in terms of general sector resilience. And then when I analyzed from the perspective of the utility, five main areas also came up when people talked about “**what does it mean for the BWA to be resilient?**” The five areas that were prominent include: water, energy, finance, planning and compliance. This was in terms of what is needed to have more storage, being able to manage your non-revenue water, having (reserve) pumping capability that is not impacted every time something goes wrong with the power, as well as some issues with water quality due to saltwater intrusion.

Then in terms of energy supply, things that people are saying that is important is to have more renewable energy integrated into the BWA's energy mix. However, there were concerns about if you're going to have a mandate of at least 25% of the country renewable energy production generated by the BWA, is there the requisite skilled workforce to achieve this goal? Will the BWA be held to similar standards or other energy producers e.g. with respect to type and efficiency of technology used? Will a reduction of the energy bill result in cost savings to the customer?

For finance, what does utility tariff sustainability look like? Can the commercial tariff rate be increased if a domestic increase is not possible? As of September 2019, the BWA no longer receives subventions from the government. They actually have started making a \$2 million increase in revenue since the implementation of the Garbage and Sewage Contribution (GSC tax). So, on the books BWA is making money, so we'll just have to wait and see how this continues into the future.

Planning was also another major area where people are talking about an environment in which your leadership needs to be proactive, and not just reactive, with the appropriate follow-through on everything that identified that's necessary and not just contracting consultants to conduct studies with nothing being implemented. There is also the need for contingencies, succession planning, and workforce training. These are all things that people believe were important for building a resilient organization.

For compliance there was reference to organization culture, which refers to the way how things are done which directly impacts utility operations and service delivery. Under culture persons expressed the need to feel appreciated, being treated like people and having a closer and a more trusting relationship between management. All of these factors affect persons abilities to perform their roles, which is further compounded by concerns over job security at this point in time due to the ongoing IMF restructuring in Barbados. Staff retrenchment and reduced performance have impacted the BWA's ability to comply with industry standards. In August 2019, the Fair Trading Commission (FTC) would have completed their first assessment of the BWA's standards of service agreement. Utility performance was below par, and they referenced loss of staff, manual nature of data collection as contributory reasons for this result. With increasing regulation in the sector, this could potentially be another area that will significantly impact how the utility operates, and will also dictate how it should be performing (a measure of resilience).

So, in conclusion, for **“Barbados water sector resilience can be defined as the ability to cope with uncertainty anticipate, adapt to and learn from challenges, and rapidly recover from disruptions in order to maintain services for people now and in the future”**. When using the framework of looking at your physical systems and people and your governance structures and thinking of the intersection of these places, the following items were identified as some of the key areas for moving from where we are now to building a resilient water sector:

- Physical Systems: supply augmentation, repair and replacement of aging infrastructure
- People: a workforce of adequate complement and required specific skillsets that are being used in the most appropriate roles,
- Governance and institutional support: collaboration across departments sharing information across departments, institutionalization of approaches, and inter agency partnerships.

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