



Summary Report  
Regional Workshop on  
**Metrology and Technology Challenges of  
Renewable Energy and Climate Science (RECS)**

April 14-15, 2015  
Kingston, Jamaica

**a) Workshop Objectives:**

Objectives of the OAS-NIST Workshops organized for each sub-region of SIM (Inter-American Metrology System) are to:

- 1) Assess technology, measurements, and standards needs and existing capabilities of regions and States of the Americas, and increase awareness of Government agencies interested in technology infrastructure;
- 2) Promote regional and international partnerships to share approaches and best practices for expanded utilization of renewable energy, measurement of GHGs and air pollutants, and efficient energy use and distribution systems;
- 3) Identify measurements and standards training needs to accelerate deployment of renewable energy technologies while minimizing their impact on our climate. These will be based on priorities developed by SIM members and could be provided through regional workshops and/or via collaborative research between the NMIs.

At the end of each workshop, an action plan is developed to further training and regional collaboration activities.

**b) General Observations:**

1. The Renewable Energy and Climate Science Workshop was held in Kingston, Jamaica on April 14-15, 2015. The Workshop was well organized, and well attended, with participation from 16 of the CARIMET Countries. High quality speakers from eleven countries included policy makers and technical experts. BSJ staff and contractors provided excellent logistical support, and their gracious hospitality was much appreciated.
2. The Workshop Steering Committee deserves our thanks for putting together a program that was informative and stimulated much discussion. The program allowed ample time for Q&A's and discussion which was critical for success. Unlike previous workshops, the program attempted to cover all four topics of interest (Renewable Energy, Building Energy Efficiency, Smart Grids, and GHG/Air Quality Measurements) which presented a challenge; given the diversity of the economies and needs of the Caribbean islands, this turned out to be justified.



3. Participation of the U.S. Ambassador to Jamaica, Mr. Luis Moreno, in the Plenary Session highlighted the importance U.S. places on Renewable Energy and Climate Science issues; he further emphasized these concerns as articulated by President Obama during his recent visit to Jamaica.
4. Participation of the OAS Representative to Jamaica, Ms. Jeanelle Van Glaanenweygel, in the Plenary Session also emphasized the importance OAS places on RECS activities.
5. Participation by most of the countries of the CARIMET Region was critical for the success of the workshop. About one hundred attendees participated in the workshop, representing government policy makers, the NMIs, other research organizations, and universities. Participation from metrology as well as meteorology communities enriched the discussion and encouraged future collaborations.
6. Presentations on current programs related to RECS provided clear indication that these topics are of critical importance for the region; however, the size of their economies, the natural resources and the needs of each country are quite different, and therefore their emphasis is at times on different concerns and technologies.
7. CARIMET NMIs have, in general, limited metrology capabilities. Especially Climate Science related activities present new challenges for most of the NMIs, since they require chemical metrology expertise. Collaborations, joint activities and additional training will be of benefit for most of the NMIs.
8. Three Panel Discussions helped focus us all on common experiences, issues and needs, and promoted development of a joint action plan for the CARIMET Region.

### **c) Summary of Presentations:**

Professor Winston Davidson, Chairman of the Standards Council of Jamaica, mentioned in his opening remarks “particular importance of climate change for Jamaica”, the fact that it is highly susceptible to the impact of hurricanes, it is a relatively small island, with “very little environmental reserve” and no energy resources. He stressed the need for “harmonious adaptation” with increased emphasis on renewable energy resources.

Omar Alcock, Senior Economist from Jamaica’s Ministry of Science, Technology, Energy and Mining, presented a thoughtful summary of Jamaica’s national policy initiatives on Renewable Energy, Biofuels, Energy from Waste, Trading of Carbon Credits, and Energy Conservation and Efficiency. These are highly important for Jamaica’s economy, since petroleum imports account for 90% of their energy needs. Their plans call for increasing renewable energy contribution to 20% of their energy mix, and 30% of electricity generation, by 2030. Wind, hydro, solar and bio-energy sources are expected to play an increasing role in the coming years.



The presentation by Mary-Rose Narayane, from the Ministry of Energy and Energy Affairs of Trinidad and Tobago, highlighted the contrasts present in the Caribbean. Like many other islands, they have a relatively small economy, are geographically isolated, vulnerable to climate change, with limited resources. But Trinidad and Tobago is a major petroleum producer just off the coast of Venezuela, with low energy prices and few incentives to promote use of renewable energy resources. In spite of that, the T&T Government is developing policies in support of renewable energy. T&T is a signatory to the Kyoto Protocol, and they are determined to improve their energy security and improve economic diversity, by expanding use of wind and solar energy, implementing “Feed-in-Tariff” (FIT) policies, promoting RE grid integration, and improving energy efficiency, which represents a big potential. Policies regarding GHG Measurements, reducing sulfur and vanadium in diesel fuels are expected soon.

### ***Renewable Energy:***

Lewis Peña, from INDOCAL, DR, presented a more balanced situation for the Dominican Republic, where significant progress has been made in reducing their dependence on fossil fuels. Close to 100 MW of power is currently being generated using renewable resources (wind, solar and biogas), and new construction is underway to further expand their capacity by another 300 MW. DR National Energy Efficiency Policy is also promoting higher efficiency light bulbs, energy labelling systems, and “green buildings”. Education of the population on energy efficiency issues is also a critical part of their policy.

The next two presentations on implementation of renewable energy programs in Antigua & Barbuda (Daryl Jackson), and Grenada (Jusceno Jacob) highlighted the conflicts encountered between energy policy objectives, incentives and constraints, either as a result of regulations or pushback by utility companies (“Energy Policy Conundrum”). Both speakers emphasized the importance of establishing the right incentives and policies to promote use of renewable energy resources. “The Interconnection Challenge” is an issue that needs to be addressed, and decisions regarding “Net Metering” vs “Net Billing” approaches have to be made taking into account the benefits to the public as well as the costs and responsibilities put on “the grid” and the utility companies. In several islands, PV systems are not allowed to be connected to the grid by law.

The final presentation of the morning session was made by Earl Green of the Latin American Energy Organization (OLADE) that promotes regional and sub-regional energy integration. An excellent overview was presented on the projected global growth in energy demand, as a result of the expected population growth from the current 7 billion to 9 billion by 2050, and the economic transformation of rapidly growing economies, most of them in Africa. IEA projects a 50% growth in world energy consumption by 2030, with developing nations creating 75% of the increased demand. Climate change implications of such growth would be catastrophic, without commensurate improvements in energy efficiency and RE implementation. The World Bank predicts “catastrophic consequences” if the temperature rise reaches 4° C, with island nations with the least amount of resilience. The corresponding lack of water resources may also be the major cause of future wars. However, he was optimistic about the opportunities for sustainable energy options in the Caribbean countries, especially for wind, solar and bio energy; the main barriers may be lack of technical



capabilities, standards and specifications, and monitoring and verification capabilities, in addition to lack of capital.

### ***Energy Efficiency in Building Systems***

David Yashar, from NIST, USA, presented an overview of NIST Programs on “Energy and the Built Environment”. NIST has built a “Net-Zero Energy Residential Test Facility” (NZERTF) as a test bed to study the performance of building components and systems under “real world” conditions. NZERTF is a 2700 ft<sup>2</sup> modern house, with extensive instrumentation and control systems, where competing technologies can be evaluated and compared under realistic conditions. It includes a solar thermal water heating system, PV solar panels, 3 HVAC system options, 3 Ground Source Heat Pump Loops, and a Heat Recovery System. Presence of occupants (a family of four) is simulated via sensible heat generation, water usage, electrical loads, and appliance use. During 2014, the facility was operated with zero net energy usage over a one-year period. Research activities provide improved knowledge base for green-building standards, and performance of building components. NIST welcomes visitors to the facility during scheduled down-times.

Erwin Edwards, from Atom Solutions Inc, Barbados, discussed Renewable Energy (RE) activities in Barbados; these are driven by high dependence on imported fossil fuels, increasing energy consumption, increasing costs, and concerns about climate change. RE industry is quite active on the island; they are pushing to increase RE implementation, promote energy conservation and improved energy efficiency, and ways to adapt to climate change. Their main focus is on development of Energy Performance Indicators (EPis), metrics that would enable recognition of success, and monitoring and evaluation methods.

Anna Maria Carreño, from CLASP, USA, presented a summary of Labelling Programs for Energy Efficient Appliances, a topic that has been discussed in several of these workshops. She reviewed several national and regional approaches for implementation of Standards and Labelling (S&L) programs, and the associated testing programs, which are currently being used by some 60 economies, including developed as well as developing countries. CLASP has extensive experience in this field, and has programs in the Americas, and can be instrumental in training and implementation of such activities.

John Telesford, from Marrisow Community College in Grenada, discussed energy efficiency of AC and Refrigeration Systems, widely utilized in Caribbean countries, and their impact on climate. Also articulated methodologies developed to quantify the Total Equivalent Warming Impact (TEWI) of such AC&R Systems, and to include Life Cycle considerations, in selection of more efficient systems.

The last presentation of the day was by Ruth Potopsingh, from the University of Technology in Jamaica, who discussed workforce issues associated with capacity building in Renewable Energy and Energy Efficiency technologies. She emphasized that most of the workers employed by RE & EE industries are trained on the job (45% of Jamaican workforce is female). They need shared training resources both among the Caribbean islands, and among public and private sector employers. Sustainable Energy education is of critical importance for the future of the region.



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At the end of the day, a Panel Discussion was held to promote further discussion and sharing of ideas among workshop participants.

### ***Renewable Energy and Smart Grids***

Opening presentation of the session was provided by David Wolmann, from NIST, U.S., on “Smart Grid as an Infrastructure Platform”. He provided a brief history of NIST involvement in Smart Grid activities in the U.S. and the public/private partnerships already implemented to develop the national infrastructure; in fact, the system has already progressed from Grid 1.0 (Legacy Grid) to Grid 2.0 (Smart Grid), and now working on implementation of Grid 3.0 (Future Grid). There are many driving forces for this rapid progress, which include adoption of renewable energy technologies (especially since PV systems costs are dropping fast), national policies and incentives, efforts to enhance energy efficiency of systems, development of energy storage systems, adoption of electric vehicles, development of utility-scale wind farms, Renewable Portfolio Standards (RPS) adopted by many jurisdictions, and GHG emission targets. Wide use of the internet has enabled rapid adoption of Smart Grid technologies, and extension of these technologies to Microgrids. High electricity costs, significant dependence on oil imports, and climate change resilience issues is driving Caribbean countries toward higher usage of RE; many islands are also adopting RPS (for example Virgin Islands, Bonaire, etc). These developments make Smart Grid and Microgrids an important infrastructure for the future of Caribbean countries, provided timely plans can be developed for integration of physical and cyber systems. NIST can facilitate participation of CARIMET nations in the international standards activities.

Orlando Olmberg, from Guguplex Technologies in Suriname, highlighted some of the challenges faced by countries where 80-85% of the people live along coastal urban areas that account for 15% of the land; remaining highly rural areas that account for 85% of their territory is very sparsely populated where only 15-20% of the population lives. As a result, only about half of those villages have access to electricity. A 180 MW hydro power generator was built to supply an aluminum smelter plant; that plant is now closed, and the power now goes to the grid. Two other hydro power projects are under construction which will more than double their power generation capacity, They also have other RE initiatives, including ethanol and biomass energy projects, and large and small PV solar projects. Microgrid systems are being implemented to interconnect RE systems with the grid. Lack of government policies and capital are hampering progress. Regional cooperation with neighboring countries would benefit their rate of progress.

The presentation by Ricardo Case, of the Jamaica Public Service Co., illustrated the fact that, at least in some Caribbean countries, the utilities are prepared to meet the challenges presented by rapid deployment of Variable Renewable Resources (VRR). Their assessment is that, in most large scale grids systems, VRR of less than 10% of peak capacity will have little impact on system operations; however, larger shares will present challenges for system operators. Jamaica’s current RE capacity is 7.5% of total (900 MW), but it is projected to increase to 17% by 2030. System flexibility, both on the generation and consumption side, is a key to success along with Smart Grid solutions. Intelligent



management of demand-side, delivery-side and market modulation (via price incentives) can be utilized to meet these challenges.

Kenroy Questelles, from St. Vincent and Grenadines, described the unusual challenges SVG faces with an economy that is totally dependent on imported fossil fuels for electricity production, has a population of about 100,000 located on some thirty islands. They have 9 generating plants (3 of them hydro) on 4 islands; as expected, the cost of electricity is quite high. But, SVG has a thrust toward expanded use of RE technologies in the country; many of these are small systems, some micro-hydro systems, some solar, wind, and geothermal systems, and a new 370 KW PV field. They are also switching from “Net Metering” to “Feed-in Tariff” and “Net Billing” systems. Their vulnerability to climate events was again stressed when 12 lives were lost during a storm on 2013 Christmas eve.

The next two presentations were on renewable energy efforts in Belize, which has its own, and different, challenges since it is not an island economy. Glenford Eiley, from GSR Energy Ltd of Belize, described one of their efforts to diversify their energy production. Currently Belize depends on Mexico for 75% of its electricity production. This is the first time, since their independence from Britain in 1981, that they have reclaimed the rights to their sugarcane crop. Their 2012 National Energy Policy has established preference for RE from sugarcane Bagasse Cogen and hydroelectric power generation systems. They have also decided to use E-10 and Bio-Diesel for transportation systems, which will also significantly reduce their carbon footprint. Their Ethanol production cost are also significantly lower than Brazil (\$0.70 vs \$1.35 per gallon). The biorefinery being built by GSR is under construction, which will provide social and economic benefits.

Rueben Chow, from CE-CAM Energy Ltd, of Belize, briefly described a new undertaking to build a Tech Center in Belize for design, engineering, and construction of Solar PV Power Plants. They have experience in the field; they had already built a 7.5 MW Solar PV Power Plant in southern California. The new facility in Belize City will operate in the regional space for the Caribbean, Central America, and Mexico. Their staff from the U.S. will train local workforce for specialized services. They expect to break ground in about 6-9 months, and be operational in 18-24 months. Their plan is to build 1 MW plants over a 5 acre area.

### ***GHG and Air Quality Monitoring:***

James Whetstone, from NIST, U.S., presented a summary of NIST Programs on Renewable Energy and Climate Science. He briefly discussed the international climate policy drivers, implications of the Bali Action Plan, and the concepts of Measureable, Reportable, and Verifiable (MRV) GHG Inventories, and their implications for measurement standards provided by NMIs. GHG Emission Reduction Targets established by the U.S. and by many other countries were discussed; to demonstrate progress towards and realization of such targets will require high accuracy measurements (quantification at the 1-5% of the target level using internationally recognized methodologies). Objective of NIST programs is to develop measurement tools and standards to achieve such measurement accuracies. New approaches for accurate measurement of emissions from power plants, and validation of such measurements were presented. GHG Measurements carried out as part of recent undertakings in Indianapolis (INFLUX) and Los Angeles (LA Megacity



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Project) were discussed. Similar undertakings are being contemplated for South America (São Paulo) and in Asia to develop the Framework for Verifying GHG Measurements in Urban Environments.

Jody Ann Marston, from the National Environment and Planning Agency (NEPA) of Jamaica, discussed Air Quality Measurements performed in Jamaica, as part of Jamaica's Air Quality Monitoring Program (JAQMP). Jamaica developed ambient air quality standards in 1996. Air quality regulations were promulgated in 2006, requiring major facilities to be licensed. NEPA has developed strategies to monitor compliance by large facilities. Their goal is to control emission of criteria pollutants, GHGs, and other priority pollutants. Their overarching goal is to monitor ambient air quality, develop air dispersion modelling capabilities, limit sulfur content of fuels used by licensees, and perform emission monitoring. They have established 62 monitoring sites. Continuous and daily monitoring of TSP, PM<sub>10</sub>, SO<sub>2</sub>, NO<sub>2</sub>, CO and O<sub>3</sub> is performed. Most of the monitoring sites are near bauxite plants. Current legal framework excludes mobile sources and minor sources; resource limitations are hampering some of their work.. There are new initiatives to expand measurements to motor vehicles and PM<sub>2.5</sub> measurements.

Donnie Boodlal, from the University of Trinidad and Tobago, gave a frank and informative review of T&T petrochemical industry operations. T&T is the world's largest ammonia exporter, and the seventh largest methanol producer. Energy related operations account for more than 50% of the GDP. Other major industries include iron, steel and cement plants, which are also energy intensive operations. 80% of T&T's GHG emissions come from petrochemical and power sectors. Emissions per capita are ranked # 2 in the world, only after Qatar. T&T is trying to implement some "low hanging" mitigation efforts, such as use of CNG, Enhanced Oil Recovery, and Energy Efficiency improvements, which represent a significant potential for the country.

Odessa Shako, of the Ministry of Agriculture in Guyana, described their attempts to measure the impact of climate change on their country by long term monitoring of temperature, humidity, atmospheric pressure, precipitation, etc. Her presentation was primarily focused on temperature and precipitation monitoring. Guyana's Hydrometeorological Service operates a Climate Stations Network that involves 20 automated weather stations across Guyana; they have added six stations recently. In addition, they have 9 synoptic weather stations, and numerous precipitation measurement stations monitored by volunteers. Measurements are made according to WMO 2010 guidelines. The closest metrology center is located in Barbados where instruments are sent for calibration. The Hydrometeorological System has implemented an ISO 9001 Quality System and has been certified. Significant improvements in measurement accuracy remain to be implemented. It was also noted that they are also measuring ozone levels, and have phased out CFCs and HCFCs effective in 2008.

The final presentation of the workshop was made by Courtney Mark, from the T&T Electricity Commission, which is a state owned and sole Transmission and Distribution Utility in T&T. Their customers enjoy one of the lowest electricity charges (6 US Cents per kWh) in the Americas. There is major concern about the impact of climate change on their operations; these include extreme wind and rain events, extended draughts that could result in fires and resulting damage to distribution lines, and subsequent impact on industrial operations and the economy. Natural Gas infrastructure, situated offshore, is also highly vulnerable, as well as platforms that are abandoned during major storms. These events are also putting much pressure on water resources; to meet projected needs



for desalination, plans are made for an additional 33 MW power generation capacity over the 2013-2017 period. Recycled water systems may require an additional 8 MW power capacity. Accelerating sea level rise is another major concern, which has caused river flooding of substations. T&T National Climate Change Policy is now committed to reduce GHG emissions, and increasing the use of RE technologies, by providing suitable fiscal incentives. “Net Metering” is considered a non-starter; “Net Billing” is the preferred approach. They are also making a major effort to expand use of LED for street lighting. The island of Tobago has the potential for wind energy, which is being studied.

A Panel Discussion on GHG/Air Quality Measurements provided the opportunity for further discussion and identification of common areas of concerns.

Finally, a Panel Discussion was held towards development of an Action Plan for the Region. The participants were asked to keep the following three questions in mind during the discussions:

- Is your country prepared to meet Metrology and Technology Challenges presented by Renewable Energy and Climate Science policies?
- Does your NMI have the necessary metrology and technology capabilities to meet these challenges?
- What type of assistance would be useful for your NMI (specific areas, equipment needs, training needs, etc.)? Would regional cooperation be productive?

Participants generally agreed that the Workshop was highly valuable; it catalyzed interactions and much discussion among NMIs of different countries, among members of the metrology and meteorology communities, and among policy making organizations and NMIs. It also highlighted much of the R&D activities on Renewable Energy and Climate Science that are being carried out in the Caribbean, and emphasized the importance of metrological contributions to these efforts.

It was also agreed that:

- Policy makers don't always understand the measurement and other infrastructural requirements to implement policies.
- Policies are not always synchronized among Ministries.
- Current energy consumption levels are not sustainable; in many cases, large fossil fuel imports are driving the economy.
- There is a general lack of resources; regional efforts would be much more effective for more efficient use of resources.
- Most of the countries in the region have only some of the metrology capabilities at hand; they need to develop additional tools and capabilities.
- Many Caribbean countries are reporting on their GHG emission inventories, but they are not mandatory; quality of this data is questionable at best.
- Carbon footprint issues are closely coupled to international competitiveness.
- Most of the Caribbean countries would benefit from public awareness efforts.
- Germany is supporting some energy efficiency efforts in Eastern Caribbean; some infrastructure is in place; need complementary efforts.
- Increasing use of small PV systems creating conflicting policies regarding connectivity to the grid; in some countries, government policies are discouraging connectivity to the grid..



- Solar panel market is dominated by China, but capabilities for quality control of imported panels is still needed. Local capabilities have to be developed.
- Much more work is needed for implementation of Smart Grid.
- Training in implementation of building energy efficiency systems would be valuable.

**d) Action Items under Consideration:**

There were many, in some cases disparate, needs were identified. Highest priority action items identified during this Panel Discussion, as well as during the earlier discussions, are summarized below:

1. Hold a Workshop on GHG measurements to develop a regional plan (perhaps for all of Latin America) to develop GHG instrument calibration capabilities and initiate joint efforts to develop CRMs that could be shared regionally. (Items 1 and 2 may be combined)
2. Develop training opportunities for measurement of emissions from fixed and mobile sources (e.g., automotive vehicle emissions); this is an area of interest for CAMET, SURAMET and ANDIMET countries as well.
3. Develop training opportunities for Energy Efficiency labelling for appliance (e.g., refrigerators), lighting, solar panels, and building energy systems to establish ratings (e.g., LEED ratings). CLASP offered to follow up on this item.
4. Develop opportunities for discussion of various RE Policies, such as time-of-use tariffs, net metering, net billing, etc.; and discussion of potential response (including "Dynamic Response") utilizing Smart Grid systems. Participation in upcoming international conferences in Orlando, FL and New Orleans, LA was encouraged. NIST will facilitate participation of Caribbean countries in SG standards organizations.
5. Provide training opportunities for implementation of Building Energy Efficiency Systems; NIST will provide training opportunities in NZERTF.
6. Organize Regional Human Resource Training activities to meet HR needs of RE technologies.
7. Promote enhanced collaboration among NMIs of CARIMET.

A complete agenda and copies of all presentations can be found at the following website:

<http://www.nist.gov/iaao/upload/CARIMETWorkshop.pdf>

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