



ARUBA LEARNING EVENT

BY ROCKY MOUNTAIN INSTITUTE AND CARBON WAR ROOM

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VADER PIET
WIND FARM

AUTHORS

AUTHORS

Laurie Guevara-Stone, Katie Lau, and
Bradley Lyon

All authors listed alphabetically.
All authors from Rocky Mountain Institute and
Carbon War Room unless otherwise noted.

CONTACT

Katie Lau (klau@carbonwarroom.com)
Justin Locke (jlocke@carbonwarroom.com)
Roy Torbert (rtorbert@rmi.org)



Editorial Director: Peter Bronski
Editor: Laurie Guevara-Stone
Art Director: Romy Purshouse

The goal of the Aruba Learning Event (ALE) was to accelerate learning and gain insights by sharing regional experience and best practices from renewable energy implementation throughout the Caribbean, and other island nations. With Aruba's 100 percent renewable target by 2020, the event provided experiential learning to highlight the realities, barriers and solutions to transition its economy to renewable energy generation. Ultimately, the ALE provided policy makers, energy utilities, and regulators an opportunity to share lessons on renewable energy solutions and take action on common challenges islands face.

ACKNOWLEDGEMENTS

The Aruba Learning Event (ALE) was organized by the Clinton Climate Initiative, Rocky Mountain Institute and Carbon War Room, the Government of Aruba, Utilities Aruba, and the International Renewable Energy Agency (IRENA) under the umbrella of the IRENA Small Island Developing States (SIDS) Lighthouses initiative.

The IRENA SIDS Lighthouses initiative is a framework for action—led by small island developing states, development institutions and other partners—to support the strategic deployment of renewable energy on islands, to bring clarity to policy makers regarding the required steps, and to enable targeted action.

The Aruba Learning Event was made possible through the technical support and partnership of numerous agencies in Aruba, including ELMAR, WEB, Vader Piet BV, The Netherlands Organisation for Applied Sciences Research (TNO), and the Government of Aruba.



EVENT SPONSOR

Event funding was graciously provided by our partner, the International Renewable Energy Agency.

The [International Renewable Energy Agency \(IRENA\)](#) is an intergovernmental organization that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a center of excellence, and a repository of policy, technology, resource, and financial knowledge on renewable energy.

Financial support was also provided by the [Dutch Postcode Lottery](#), the [United Nations Development Programme](#), and the [Global Environment Facility](#).

ORGANIZED BY

Government Of Aruba

The Government of Aruba began its journey to sustainability with the first administration of Prime Minister Mike Eman in 2009. The new government quickly adopted a policy of promoting renewable energy. Since then, Aruba has set its goal to become 100 percent independent of fossil fuels by 2020 in electricity and potable water generation. By the end of 2017, Aruba aims to achieve 50 percent of penetration of renewables in its energy and water production. Utilities Aruba NV, together with WEB Aruba NV, NV Elmar, and all the other energy stakeholders, are working together in realizing the sustainable vision set forth by this government. They are taking practical steps to transform the energy sector from one that depends on fossil fuels to one that is fundamentally renewable, but also affordable and reliable. Aruba is also sharing its knowledge and best practices with fellow islands through events, such as its annual Green Aruba conference and the Aruba Learning Event.

Utilities Aruba

In 1990, the Government of Aruba, as sole shareholder, established Utilities Aruba NV, which became the holding company for both power and water production and distribution. Utilities Aruba acts as the liaison between the Government and working entities. In 2009, the Government of Aruba envisioned a new strategy for its utility companies. This vision, announced at the Rio+20 conference, became Aruba's flagship policy aim and the primary role of Utilities Aruba NV, which is taking a leading role in supervising this energy transition.



CARILEC (Caribbean Electricity Utility Services Corporation)

CARILEC will enhance the effectiveness of its members by providing industry-related services; creating regular networking, training, and knowledge sharing opportunities; supporting mutual assistance programs; and being an advocate for the industry throughout the Caribbean.

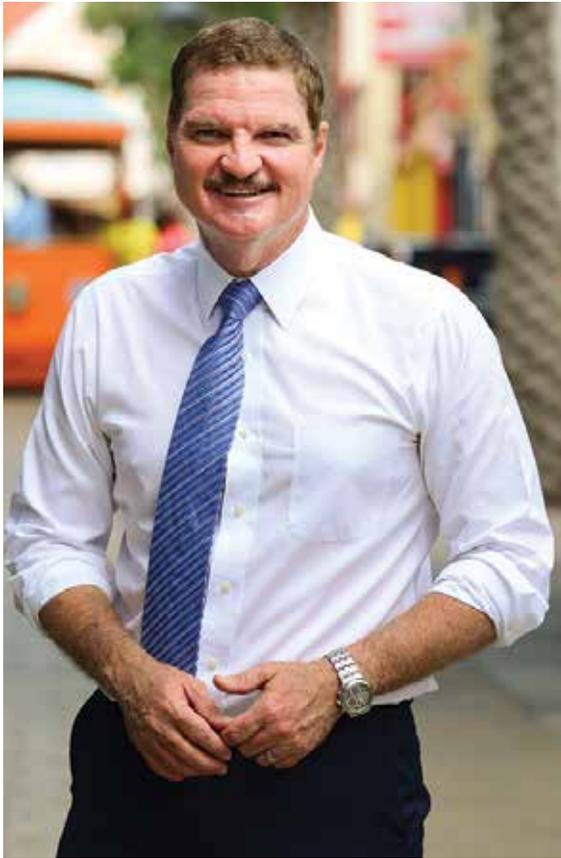
Rocky Mountain Institute (RMI)

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. In 2014, RMI merged with **Carbon War Room (CWR)**, whose business-led market interventions advance a low-carbon economy. The combined organization has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing.

The Clinton Climate Initiative

The Clinton Climate Initiative (CCI) serves as a partner to RMI and CWR to accelerate energy transition in the Caribbean. CCI launched in 2006 to implement solutions to the root causes of climate change. CCI works to improve building energy efficiency and advance building retrofits; to increase access to clean-energy technology and deploy it at the government, corporate, and homeowner levels; to help over 20 island nations reduce their reliance on diesel and adopt renewable energy; and to monitor, preserve, and grow forests in line with national governments and communities. CCI's approach addresses the major sources of greenhouse gas (GHG) emissions and the people, policies, and practices that impact them, while also saving money for individuals and governments, creating jobs, and growing economies.

FOREWORD BY PRIME MINISTER EMAN



Aruba was honored to host the Aruba Learning Event (ALE)—the first ever event of its kind in the Caribbean—drawing together Ministers of Energy, utility executives and engineers, private developers, NGOs, and others from across the region and the world with the participation of over 20 island nations. Our goal was to share lessons learned and challenges faced in transitioning to renewable energy, not only in Aruba but in other countries that have embarked on the same journey to sustainability.

We know that no single country has all the answers. As small islands and developing states, we face a more immediate and devastating threat from climate change than larger countries, even though we have not created the problem. Yet, as small countries we also have much to offer in finding solutions as we showcase the effectiveness of various technologies and approaches. Our islands can serve as living laboratories and demonstrate how such solutions can be scaled up in larger countries.

The Government of Aruba and Utilities Aruba NV hosted the event with its partners Rocky Mountain Institute and Carbon War Room (RMI-CWR), Clinton Climate Initiative (CCI), and the International Renewable Energy Agency (IRENA), with the active participation of our electric generation and distribution companies WEB NV and Elmar NV. We greatly appreciate the generous financial support of our international partners in addition to the contributions of their expertise and substantive knowledge that made the ALE such an inspiring platform.

We hope the spirit of cooperation of the ALE will itself prove sustainable and be only the first of many such efforts of regional cooperation and exchange as our countries move forward together to transition to renewable energy and sustainable development.

Thank you for attending the ALE and making it a success.

M.G. Eman
Prime Minister of Aruba

FOREWORD BY MINISTER DE MEZA



We cannot keep living on this planet as if we had another one to go to, we cannot live on this island as if we have another one to inhabit. We must address climate change and take action to reduce the threat as soon as possible.

By hosting the Aruba Learning Event (ALE), our goal was to be a catalyst in bringing together countries in the Caribbean to learn from one another as we all strive to transition our countries from dependence on fossil fuels. We are proud to share what Aruba has done, and we were pleased to learn what our neighbors have been doing.

Aruba's goal is to become 100 percent independent of fossil fuels by 2020 with electricity and potable water generation. By the end of 2017, we will have achieved 50 percent penetration of renewables in our energy and potable water production. Reaching 100 percent will not be easy, but we are already developing concrete plans for overcoming the hurdles.

Many other small islands and developing states are making similar plans. We face many common problems, so it makes sense for us to share information and to learn from one another.

We are proud of the work that Utilities Aruba NV, together with WEB Aruba NV, Elmar NV, and all our other energy stakeholders are doing to move Aruba forward and to achieve the sustainable vision set forth by the government. We commend them for their contributions to the ALE. We also greatly appreciate our partners from abroad for their expertise and financial support in making the ALE a success: the International Renewable Energy Agency, Rocky Mountain Institute and Carbon War Room, and the Clinton Climate Initiative. And I thank all the participants from other countries who traveled to Aruba to share their knowledge making the ALE a success.

Let us continue the journey of regional cooperation towards sustainability begun at the ALE.

M. de Meza
Minister of Economic Affairs, Communication, Energy and Environment

FOREWORD BY ALE PARTNER, CARILEC



It is an honour to be part of a regional movement that strives to help islands transition to sustainable energy sources. Not only in the Caribbean, but across the world, island economies are grappling with high and volatile energy costs, mainly due to a heavy reliance on fossil fuels for energy generation. The sustainable development of small island developing states (SIDS) clearly depends on reducing their fuel importation costs, and the use and development of renewable energy technologies is very critical to this achievement. However, unlocking the potential of energy production from renewable sources requires the development of a robust and dynamic enabling framework.

The commonalities of the renewable energy challenges faced by island economies create an opportunity for pooling knowledge and best practices for successfully overcoming the energy challenges. International, regional, and national key energy stakeholders must proactively explore and exploit these opportunities that can inform the Caribbean energy transition strategy, and result in the successful implementation of renewable energy projects. This is why I commend the efforts of partners to convene thought leaders and energy practitioners so islands can learn from each other, and we can begin to address the energy challenges together.

As a regional leader in the Caribbean energy sector, CARILEC represents the needs of our members that are constantly looking for solutions to common challenges that many islands face. Our mandate is to enhance the effectiveness of our members by providing industry-related services; creating regular networking, training, and knowledge sharing opportunities; supporting mutual assistance programs; and being an advocate for the industry throughout the Caribbean. With our members, we are working as part of a broad network of professionals learning to take on challenges with new knowledge and dedication to growing the region's indigenous energy capacity.

Aruba is leading in many ways by demonstrating its vision and advancements in technology to integrate renewable energy sources. This year at Green Aruba VI, the Aruba Learning Event showcased the technical and political challenges that Aruba faced in recent years. The dialogue of policy makers, technical engineers, and executives from the Caribbean, as well as other islands, really surfaced the need for greater connectivity among our islands states and all CARILEC members. I commend Aruba for igniting an in-depth discussion and allowing a space for both policy and technical conversations to merge.

Moving forward, we hope to maintain this momentum, and ultimately foster an online community for energy practitioners that meets the needs of our utility members and brings investments for renewable energy projects. We are delighted to announce our collaboration with the Clinton Climate Initiative (CCI) and Rocky Mountain Institute-Carbon War Room (RMI-CWR), which will ensure local knowledge and experience is captured and shared. Our like-minded goal aligns us to assist the region to meet its energy demands and transition to sustainable energy sources in the future.

Collectively, our organizations will launch a virtual platform this year for CARILEC members and energy practitioners across the region. We look forward to your participation in this renewable energy community!

Thomas Hodge, Executive Director, Caribbean Electric Utility Services Corporation

FOREWORD BY CEO, RMI-CWR



Dear Colleagues,

Rocky Mountain Institute and Carbon War Room were honored to support the Government of Aruba in holding the Aruba Learning Event and to serve as a panelist at the sixth annual Green Aruba Sustainable Energy Week. I commend Aruba for leading the way in the renewable energy implementation space and for being so willing to openly share the barriers it faced with its peers.

Many islands have already made significant progress in their energy transitions, and together island-nations can share their successes and failures to support each other through the journey. The strong sense of community in the Caribbean is evident and I look forward to hearing of attendees applying the best practices and lessons learned in Aruba in their respective countries in the near future.

Sincerely,

Jules Kortenhorst

CEO, Rocky Mountain Institute and Carbon War Room

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY



There is an immense opportunity to transition island economies towards renewable energy generation. Island nations pay some of the highest electricity prices in the world, due in part to a heavy reliance on fossil fuels for energy generation. However, despite the availability of renewable energy sources and increasingly competitive renewable energy technologies, uptake has been slow to develop because of a gap in market solutions, and the knowledge base required to scale renewable energy investments in small island states.

With the vision of transforming their economies, island leaders are now looking to tap into wind, solar, geothermal, and waste-to-energy to transform their economies. Renewable energy generation solutions will move islands toward healthier economic development and increased energy security for the region. Yet the path between setting a vision and achieving a cost-effective and participatory energy transition is not simple or straightforward, and requires a new level of cooperation.

The Aruba Learning Event, held October 26–27, 2015, was sponsored by the International Renewable Energy Agency (IRENA) and was held in conjunction with the sixth annual Green Aruba conference that took place October 27–28, 2015.

More than 60 attendees from over 20 countries from the Caribbean, Indian Ocean, and Pacific regions including ministers of energy, utility executives, regulators, and government officials, gathered with the aim to bridge a discussion between utilities and government authorities.

Participants learned about various technologies and approaches to renewable energy integration and exchanged knowledge to better understand the technical, policy, economic, and regulatory implications of transitioning to renewables. Participants also discussed the foundation for a regional community of practice for energy professionals to lay down next steps and priority features for an online platform and additional collaboration strategies to support energy transition across islands.

The event:

- Strengthened relationships with regional development partners such as CARILEC
- Increased interest for regional knowledge exchange and sharing of energy transition best practices
- Demonstrated experience in learning tours, and leveraged the learning event as a template for future field visits
- Established new relationships and dialogue among utilities and policy makers
- Showcased Aruba's government and utility collaboration including other examples such as Montserrat and Saint Lucia

ARUBA LEARNING EVENT OBJECTIVES AND SCOPE

01



1. ARUBA LEARNING EVENT OBJECTIVES AND SCOPE

The goal of the Aruba Learning Event was to accelerate learning and gain insights by sharing regional experience and best practices from renewable energy implementation in island nations. Participants learned about various technologies and approaches to renewable energy integration and exchanged knowledge to better understand policy and regulatory implications for transitioning to renewables.

The event took place over two days and included a technical learning tour. See Appendix A to view the full agenda.

ATTENDEES

Ministers of Energy, energy officers, utility executives and engineers, and regulators from across the Caribbean, Indian Ocean, and Pacific islands. See Appendix B for full list of attendees.

LEARNING TOUR

A technical learning tour included four site visits, including three energy generation sites and Aruba's first fully sustainable energy-producing government building:

- Airport 3.7 MW Solar PV Carport
- Vader Piet 30 MW Wind Farm
- WEB Aruba Power Plant
- Multi-Functional Accommodation building

OBJECTIVES

- Understand the current landscape of renewable energy policy, technology, and best practices
- Showcase renewable penetration progress in Aruba and promote what is possible throughout the Caribbean
- Exchange experiences about policy and regulatory implications when transitioning to renewables and the various approaches to incentivize renewable integration
- Foster collaboration and coordination between Caribbean policy makers and technical engineers
- Define priority actions and next steps to address common challenges to implementing renewable energy solutions
- Collaborate on next steps to develop a community of practice and online platform to accelerate knowledge sharing among utility engineers, executives, policy makers, and regulators
- Identify capacity gaps and mechanisms to promote knowledge sharing and peer-to-peer learning

OUTPUTS

- Agreement on proposed renewable energy community of practice
- Draft mission statement for community of practice
- Priority features and structure for an online platform and collaboration tools



02

COMMUNITY OF PRACTICE



2. COMMUNITY OF PRACTICE

FACILITATORS

- Laurena Primus, Training Manager, Caribbean Electric Utility Services (CARILEC)
- Martyn Forde, Project Manager, Clinton Climate Initiative
- Bradley Lyon, Community Lead, Rocky Mountain Institute-Carbon War Room

The Community of Practice session raised awareness about what a community of practice is, how it functions, and how it can be valuable for island practitioners working in the energy sector and involved in a renewable energy transition. One of the key objectives for the learning event was to present the concept for a virtual Caribbean renewable energy community of practice, or peer network, of practitioners working to transition to renewable energy sources—including both technical and policy. The online community of practice aims to connect members to the tools, relationships, and knowledge they need—and over time will evolve into a one-stop shop for renewable energy resources and best practices for implementing projects. The session goals were to not only introduce the community concept to prospective members, but also to solicit

feedback and endorsement to further invest in community development.

As a leader in the Caribbean energy sector, CARILEC presented its case and key objectives for building a renewable energy community of practitioners that strengthens collaboration, learning, and knowledge exchange across the region and other island states. In collaboration with regional partners from CCI and RMI-CWR, the presenters facilitated the discussion and solicited feedback on the following:

1. Key concepts for a renewable energy community of practice
2. Results and analyses from a regional community survey
3. Proposed community mission statement;
4. Target audience for the community
5. Functionality for an online knowledge-sharing platform
6. Next steps towards increasing regional knowledge exchange and learning on renewable energy implementation

Based on previous sessions among three sub-groups—policy, economic, and technical—participants identified common opportunities to share knowledge among islands as well as priority challenges to address within the

community of practice. The session also helped build new relationships and dialogue among renewable energy stakeholders, both policy makers and technical and executive-level practitioners in the Caribbean, Pacific, and Seychelles. Participants also presented opportunities for collaboration among key regional and national partners including the Government of Aruba, Utilities Aruba, the Caribbean Branch Office TNO (CBOT), and the United Nations Development Programme (UNDP).

Community Mission Statement and Target Audience

During the session, participants reviewed key survey results from a regional community survey that was conducted in early October 2015. The main survey results can be found in Appendix C. Participants agreed the community of practice should serve electric utility engineers and executives, regulators, and policy makers in the Caribbean. Two proposals for a mission statement emerged from the survey:

- A body of renewable energy professionals developing and driving

A community of practice is a group of like-minded professionals coming together to solve problems and share practices. This may be done virtually to provide members unlimited opportunities to collaborate through an online platform. The objective is to close the communication gap so people do not work in isolation, share lessons learned, and solve challenges faster by enabling people to tap into a network of expertise.

innovations, standards, investments, and implementation of renewable projects for the application of primarily indigenous resources for any energy need in the islands of the Caribbean

- A forum to share ideas and lessons learned for the Caribbean integration of renewable energy within the utility generation mix

Feedback from participants resulted in a final mission statement that will be validated through an upcoming community survey expected in early 2016:

To foster a vibrant community and a forum for energy professionals, utility engineers, regulators, and policy makers, to develop and drive innovations, standards, and strategies to implement renewable energy and energy efficiency projects on islands, using indigenous energy resources that are reliable, affordable, and safe to create a more sustainable future.

The session also provided a forum to brainstorm ideas for an online community platform, including the prioritization of documents, resources, tools, and functionalities for an online renewable energy community platform, as well as mechanisms to facilitate online collaboration, knowledge sharing, and networking. Each participant contributed

series of ideas for the online platform, namely functionality, tools, and resources, and suggested over 100 ideas to be considered into its future development such as project templates, contract documents, directory of utilities, social networking and webinars, and a repository of energy-related documents including policies and legislation. A complete list of these suggestions is noted in Appendix D.

The session built new relationships among island practitioners and created excitement and momentum that will continue to inform the online community and further collaboration within the community of practice.

NEXT STEPS

The following community action items were proposed and agreed to complete by early 2016:

- Update community mission statement based on participant comments
- Conduct a technical webinar with CARILEC, either on energy storage or grid integration
- Develop and launch an interim community landing page
- Draft a platform design and solicit community feedback
- Perform ongoing market research and focus groups
- Establish regular communications with core community members and ALE participants

- Define the membership and audience for the community of practice
- Agree upon next steps for online community development (short, medium, and long term)





3. RENEWABLE ENERGY GRID INTEGRATION AND ENERGY STORAGE

03

3. RENEWABLE ENERGY GRID INTEGRATION AND ENERGY STORAGE

SPEAKER

- Ruud Kempener, Technology Roadmap Analyst, IRENA

IRENA hosted a one-hour presentation on electricity storage for islands. Approximately 50 participants attended the workshop, including the permanent UN representatives for Caribbean islands as well as local policy makers and utility representatives. The workshop provided an introduction into electricity storage technologies, their technical characteristics, their application areas in islands, and the latest cost data. Furthermore, Kempener presented the four action items for islands identified in IRENA's electricity storage technology roadmap:

- Release financing mechanisms for electricity storage
- Create local value chain models
- Build guidelines for modeling and scaling tools
- Establish a database with practical examples in islands

KEY TAKEAWAYS

- Electricity storage technologies are rapidly developing and dropping in costs.
- Batteries provide more value than simply storing energy (primary reserve, load shifting, grid stabilization, etc.).
- There are many different kinds of batteries/storage technologies and it is difficult to compare them to each other since they can be compared using different characteristics (e.g., number of cycles, depth of discharge, cost per kWh, value of deferring transmission line upgrades, value of freeing up hydro, etc.).
- The best technology really depends on the application and location (e.g., a desert site requires A/C and heat-tolerant batteries). System considerations are more important than individual characteristics.
- Participants are concerned about the environmental impacts and possibilities for recycling, both lead-acid and lithium-ion battery chemistries.
- Electric vehicles could play a role in managing variability, but a more detailed discussion on the infrastructure and necessary software is needed to ensure that EVs play a positive role in variable renewable technologies (VRE) integration (e.g., location of charging stations and control for EV charging/discharging).

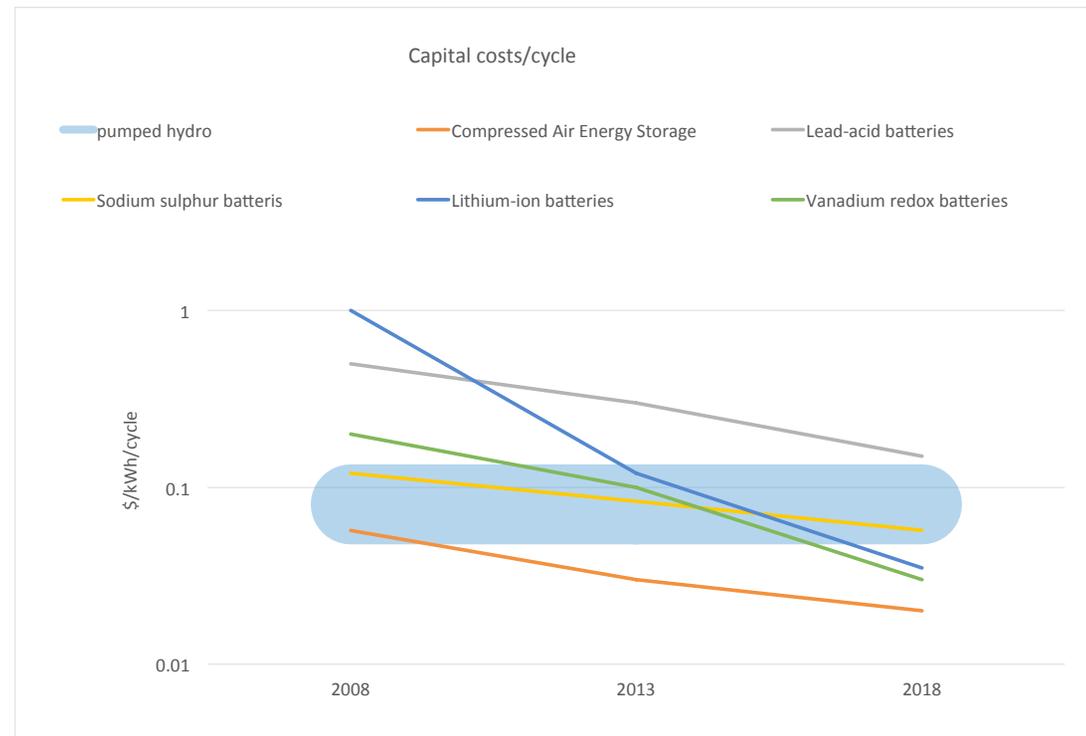


Figure 1: Cost Outlook for Energy Storage



4. ECONOMIC, POLICY, AND TECHNICAL BREAKOUT SESSIONS

04

Scott Russell
MHI (Canada)

ELISABETH
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ST VINCENT & Grenadines

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ST. VINCENT & Grenadines

IRENA's next step will be to create a platform to support financing of energy storage systems, create a database of knowledge, and disseminate a guide on the different tools available for sizing storage systems.

“ALE BREAKOUT SESSION: ECONOMIC, POLICY, AND TECHNICAL SESSIONS”



4. ECONOMIC, POLICY, AND TECHNICAL BREAKOUT SESSIONS

There were three parallel sessions—economic, policy, and technical—with approximately 10–15 attendees per group that enabled more intimate and focused discussion. The aim for each session was to delve deeper into renewable energy challenges for each stakeholder group, and agree on priority areas for further collaboration and knowledge sharing. These priorities were later presented to the plenary during the “Policy Meets Practice” session and provided inputs into the Community of Practice discussion.

ECONOMIC SESSION FACILITATORS

- Leslie Labruto, Director of Resilient Communities, Clinton Climate Initiative
- Roy Torbert, Manager, Rocky Mountain Institute-Carbon War Room

The discussion focused on the economic implications of renewable energy regarding projects, resources, and people. Participants included utility executives and business managers, and the discussion remained focused on economics and operations management.

PROJECTS: Attendees were asked what challenges exist in training, implementation, and delivery of economically viable renewable energy projects. They were also asked to explore current best models of ownership modalities and models for the future. Finally, participants addressed the varying scales (size and scope) of projects.

RESOURCES: Attendees focused on the process of attracting and securing financing. They addressed the challenges in accessing financing, the uncertainties in planning, and who the essential key partners should be. Questions included: How can partners be better organized to streamline renewable energy project finance and development? What are the biggest constraints to financing renewable energy projects, and how can those be overcome?

PEOPLE: Attendees tackled the renewable energy training requirements and approaches. They explored what additional human resources and skill sets are available on island, and what mechanisms can support ongoing training for utilities and other stakeholders. They also discussed the high degree of attrition among employees.

Participants were asked to share what bottlenecks project developers face in the Caribbean, including training, implementation, and the delivery phases from an economic perspective. The main bottlenecks and challenges that were highlighted include:

- Unknowns in timing, resource availability, cost, and regulation of geothermal postpones decision making of all renewable energy generation decisions
- Gap between policy makers and implementers—particularly in scoping projects and messaging around their potential
- Exponential implications of a high risk environment

- High cost of due diligence, which drives up the power purchase agreement (PPA) price and makes renewable energy impractical and uneconomic
- Lack of land

The economic subgroup participants were highly engaged throughout the discussion, but the utility representatives were the most vocal. They articulated a shared frustration around the difficulty in meeting expectations for renewable energy targets, while also maintaining levels of service and financial viability.

KEY TAKEAWAYS

- Renewable energy and energy efficiency interventions should be thought of within the context of larger integrated resource planning to guide investment and project prioritization.
- There is a need for a general understanding of the prerequisites; due diligence is essential.
- The act of defining project ownership is critical, and often sits best with the utilities.
- A key metric is calculating the levelized cost of energy (LCOE), and it is crucial the utility be able to use this metric.
- The transaction costs for small projects can be very high. Furthermore economics alone are not a barrier; we have to move past chatter/hyperbole, and move to the facts and the LCOE impact.

POLICY SESSION

FACILITATORS

- Richard Arends, Chief of Staff to the Minister of Economic Affairs, Communication, Energy & Environment, Sr. Advisor to the Prime Minister, Aruba
- Kate Hawley, Senior Associate, Rocky Mountain Institute-Carbon War Room
- Justin Locke, Director of Islands, Rocky Mountain Institute-Carbon War Room
- Ruurd Schoolderman, Strategic Advisor, Caribbean Green Technology Center, TNO

The main objective of the session was to investigate the regulatory issues related to energy transitions and specify the underlying issues related to four key challenges.

Participants included utility engineers and technicians responsible for grid operations, both distribution and generation. The discussions focused on identifying actionable items that can be developed into future session topics, studies, and workshops related to policy reform, and that ultimately can support the energy transition. The four key challenges are:

- **Lack of legal frameworks that enable policies and effective policy instruments:** Without a legal framework in place, policy developments and actions are difficult to achieve.
- **Relationship between the utility and policy makers:** Often utilities and governments have divergent

priorities, and the incentive structure to use renewable energy is not always economically viable for utilities.

- **Alignment of policy mechanisms and overall energy goals/vision/targets:** Sustainable development policies should be integrated across all government agencies and stakeholders.
- **Public awareness and buy-in:** Civil society lacks awareness of the energy transition process, which contributes to little community participation and support. Buy-in at the community level is necessary; there is a need to communicate periodically and effectively.

The session format enabled the group to focus on one issue at a time to drill down to the root causes of each problem. It was agreed that more time and ongoing dialogue would help to resolve specific issues and try to tackle them together as a community. The following comments highlight the issues deemed most important:

“Renewable Energy has been premised as a climate change issue, but more for large countries with a large energy demand and emissions. Our island transition is really being driven by high costs of production and volatility of fuel prices.”

“Why is the public not buying into the energy change process? There is an emerging distrust of governments. There is a need for greater transparency due to the fact that some of the utilities have larger ownership stakes from the governments.”

“We cannot study the Caribbean like a macrocosm, we are a microcosm. We are all very different and every example is going to have its unique characteristics. We need to find a model that fits the needs.”

KEY TAKEAWAYS

- Every island is different, so the energy transition effort needs to be a country driven process.
- There is an opportunity to identify countries with a similar legal framework or structure, and match them up with islands with similar profiles that can learn from their experiences.
- A legal framework is necessary to enable policy implementation and legislature.
- There are numerous issues that underlie the legal framework problem including:
 - Stakeholder alignment
 - Competing interests
 - Lack of an overarching goal or vision
 - Political interests and party alignment
 - Constant change in leadership
 - Long-term versus short-term perspectives
 - Lack of incentives to encourage renewable energy adoption by utilities
 - Top-down instead of bottom-up legal framework development

TECHNICAL SESSION

FACILITATORS

- Kaitlyn Bunker, Senior Associate, Rocky Mountain Institute-Carbon War Room
- Chris Burgess, Islands Operations Manager, Rocky Mountain Institute-Carbon War Room

The objective of the technical session was to discuss the technical challenges and opportunities around increasing the use of renewable energy in island grid systems. Participants included utility representatives and other engineers, and the discussion remained focused on technical topics, without diving into economics or policy.

The group discussed three main challenges:

1. LIMITED CAPACITY OF TECHNICAL STAFF TO INTEGRATE RENEWABLE ENERGY AND ENERGY EFFICIENCY TECHNOLOGIES

Participants discussed the challenge of integrating renewables into their grid with technical staff that has limited knowledge of these new components. There is a need for training to transition strong technical skills that exist today in order to successfully operate a grid that contains more renewables. A few ideas for addressing this problem surfaced within the group:

- Creating an exchange program, where utility engineers from one country could

visit another, both before and during an installation of new equipment, in order to learn from each other and take that knowledge back to their own utility

- Developing a standard control protocol, so that each time a new renewable component is added to the system, utility engineers do not need to learn new material, but can follow the standard control procedures
- Building specific expertise through certification programs, including building a solid, common foundation through university education for future utility engineers
- Creating a central list of training opportunities that might be of interest to island utility engineers, and looking for opportunities for cross-training

The group acknowledged that awareness of renewable energy technologies now exists, and that what is needed going forward is more practical training, which could be included in contracts when procuring new equipment. In addition, education about renewable technologies for all residents is important, especially for decision makers.

2. CHALLENGE: LACK OF UNDERSTANDING OF GRID CAPACITY WITH RENEWABLE ENERGY TECHNOLOGIES

Participants agreed that in general, 20 percent renewable penetration based on energy

used to meet load is possible, without a major change to how the grid is operated and controlled. However, the group also agreed that technical studies are extremely important in order to understand the potential impacts of renewables, where it is best to connect them, the potential needs for system upgrades, etc. These studies should be completed at both the transmission and distribution levels. The results of the technical studies should inform policy, and help avoid setting goals before understanding the available opportunities.

The group also acknowledged that demand-side opportunities are often overlooked. Examples include energy efficiency and load shifting opportunities, which may fit the role of “low hanging fruit” since their cost is lower than adding new generation. Amory Lovins (RMI Co-founder and Chief Scientist) refers to these opportunities as “negawatts.” Demand side opportunities can be financially beneficial for residents as well as for the utility, since it can result in improved load factors and reduced capital investments. Utility business models may change in the future, and may include energy efficiency as a way to remain profitable. Training and incentive programs for residents could increase participation.

Stability of the grid was highlighted as a primary concern. The participants discussed various ownership structures, and how they can affect operation of the system. For example, if a utility owns all generation assets,

it can control the whole system as well as gain economies of scale. On the other hand, some participants' utilities are using a different approach with a third party owning some of the generation assets. The group agreed that when it comes to controlling the grid and achieving reliable operation, software is as important, or more, than hardware.

3. CHALLENGE: AWARENESS OF ENERGY STORAGE OPTIONS AND HOW TO INCORPORATE THEM INTO OVERALL TRANSMISSION AND DISTRIBUTION SYSTEMS

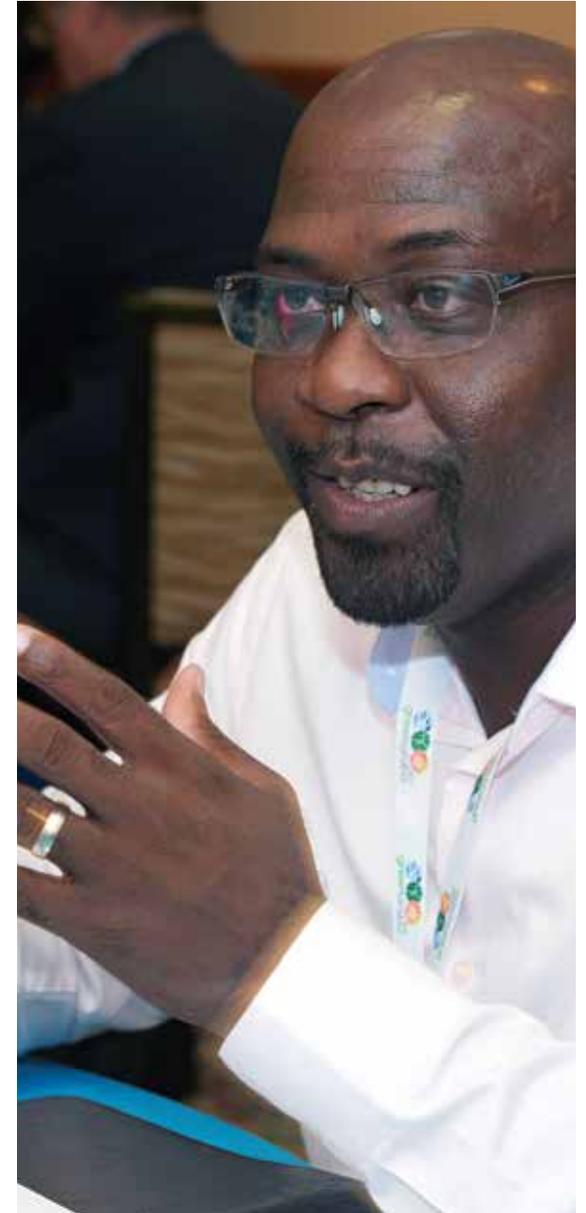
Participants reported challenges and fears related to energy storage, including the costs—although these are coming down—and the lifecycle, including the need to dispose of or recycle used batteries.

Participants then discussed opportunities they encounter related to energy storage:

- The ability to use various technologies (batteries, flywheels, thermal, etc.) for various storage needs
- The ability to use different types of batteries
- The opportunity for storage to contribute to new business models (e.g., a utility that operates a wind farm might use extra energy from the wind when the load is low to make ice, and sell that to hotels for their cooling needs)

KEY TAKEAWAYS

- There is a need for more coordinated training and/or exchange programs for utility engineers to gain experience with renewable technologies.
- In general, an island grid can handle 20 percent renewable penetration without other changes; technical studies are key in determining what else is possible, and should be used to inform national goals and policies.
- Demand-side opportunities have been largely overlooked, and can be beneficial for utilities.
- Energy storage provides new technical and economic opportunities for utilities.





POLICY MEETS PRACTICE

05

5. POLICY MEETS PRACTICE

The goal of the Policy Meets Practice session was to start a conversation between an island's policy makers and technical experts. The session highlighted the common themes from the breakout sessions—economic, policy, and technical—allowing participants to express what resonated with them and the tangible actions they will be applying in their respective countries. By developing an awareness of the common challenges and opportunities, as well as the unique and local challenges and opportunities, we can accelerate the renewable energy transition, and reduce costs, time, and effort.

Attendees stated they plan to engage with countries that have undergone a similar energy transition process successfully; stating that collaboration within the Caribbean is key. Some attendees plan to launch a renewable energy public education and awareness campaign to mitigate risk and negative public perceptions. Overall, there was a sense of momentum to get the renewable energy ball rolling, and attendees feel more equipped to address the challenges in their energy sectors.

KEY TAKEAWAYS

- There is a need for an efficient, clear benchmarking process.
- Technical assistance is available, and financing is becoming more readily available.

- The airport solar park in Aruba brought a sense of optimism, illustrating that large projects are feasible on a small island.
- Even on very small islands with limited land space, wind and solar projects can work.
- The process of negotiating with the government should be streamlined.
- Other learning events, like those offered by CARILEC, are useful.
- There is a need for better communication with customers and stakeholders.
- Grant financing should go to the utilities rather than the policy maker.
- There is a lot of funding available to the Caribbean region for renewable energy and energy efficiency projects but there is a gap in accessing the funding due to the lengthy and inconsistent requirements for due diligence.



LEARNING TOUR

06



6. LEARNING TOUR

Attendees visited four sites for technical learning tours across the island: a solar carport at the Aruba airport (hosted by N.V. ELMAR), the Vader Piet wind farm, the WEB Aruba power plant, and a multifunctional accommodation building. The learning tours included informative videos, Q&A sessions, and the ability to interact with site employees.

Attendees deeply appreciated the hospitality, consideration, and deep knowledge of Utilities Aruba, WEB Aruba, and N.V. ELMAR. At the conclusion of the tours the attendees agreed there is still a need for the following:

- Access to research related to wind power pricing data, wind forecasting, and LIDAR
- Training opportunities for renewable energy technicians (e.g., certifying installers, maintenance training) from training organizations like CARILEC
- Guidance on how the utility can set renewable energy/energy efficiency targets:
 - How was it driven? How is it being translated to being executed? How is the utility able to change from being a power generation company to a sourcing company?
- Advice on how to structure policy correctly—it is nearly impossible to move forward without it
- Access to power storage information and data

- Direction on how to gain added value from energy efficiency and renewable energy, not only from the government, but also from the private sector.

The four tours are described below. For more detailed information see Appendix E.

ELMAR SOLAR CARPORT SPEAKERS

- James Fazio, CEO of Aruba Airport Authority
- Hendrik Croes, Public Relations for Aruba Airport Authority
- Elthon Lampe, Business Development Officer, N.V. ELMAR

ELMAR is Aruba's electricity distributor. The 3.474 MW solar carport, completed in

March 2015, is the largest of its kind in the Caribbean and one of the largest in the world. It is estimated that it will produce 6 million kWh/year. The carport was designed to be redundant, so if any equipment fails, the maximum failure rate would be 50 percent of production.

The total project—including security cameras, LED lighting, and car battery charging stations. The system is very low maintenance; but scheduled maintenance checks for the panels were built into the total project price. While there are not yet charging stations for electric vehicles (EVs), they are being considered as more EVs are utilized on the island.



VADER PIET WIND FARM SPEAKER

- Henk Hutting, CEO, NuCapital Inc.

The Vader Piet wind farm was developed by WEB Aruba (the island’s electricity generator) in 2008 to reduce the production costs of electricity. It has a 63 percent capacity factor over the last year and its max peak is at 82 percent. In addition to standard hourly meteorological predictions, the Vader Piet Wind Farm also utilizes LIDAR technology that can predict energy output at one-minute timescales, 15 minutes in advance. Aruba is planning a second wind farm at Urirama—26 MW—which would bring Aruba to approximately 40 percent wind power. This will distinguish Aruba as the country with the largest percentage of wind energy, followed by Denmark at 34 percent.

The LIDAR technology is especially interesting as it can accurately predict wind conditions 24 hours in advance, with very high reliability. LIDAR is also beneficial to Vader Piet because of the unique power purchase agreement (PPA). WEB is obligated to purchase a limited amount of power and any additional purchases result in a discount. With more accurate predictions, Vader Piet can more efficiently generate electricity and maintain profitable operations.



Vader Piet is paid on a kWh delivered basis and does not pay or get a capacity charge. The average cost to the grid is \$0.10/kWh.

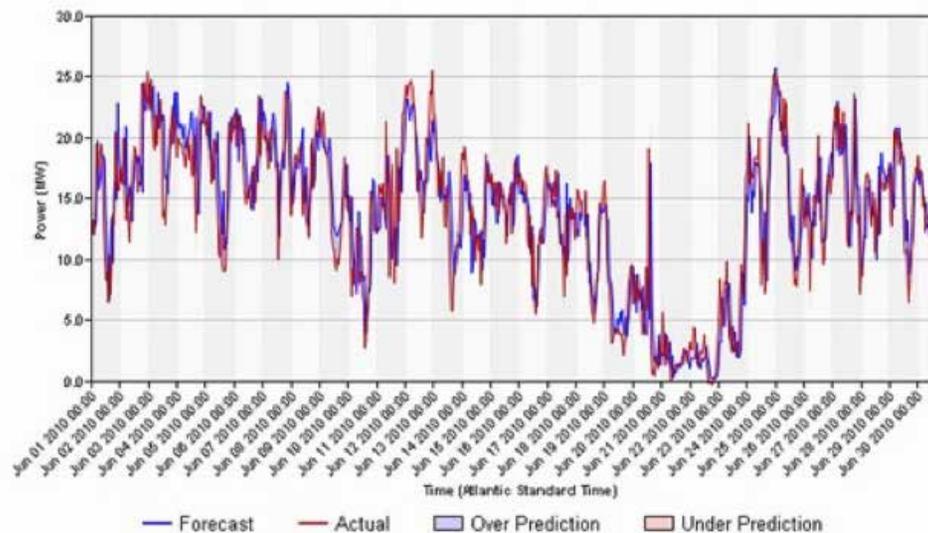


Figure 2: Standard prediction results 1 hour ahead

The total project cost \$75 million. The biggest project challenges were related to construction—importing a crane from Europe—and public acceptance. The project was first discussed in 1991 and since wind power was a new concept in Aruba, it took years to gain acceptance. The first wind feasibility study was conducted in 1996, the site was selected in 2003, and an RFP was issued in 2005 for a 10 MW wind farm. Once the PPA was awarded, the entire process of contracting, permitting, and arranging of finance only took 6 months, and construction began in January 2009 with the wind farm coming on line in December 2009.

It should be noted that Aruba's wind power is exceptionally greater (average 10 m/second) than that of other Caribbean islands and many other areas of the world.

WEB ARUBA POWER PLANT SPEAKERS

- Luis Oduber, Managing Director, WEB Aruba
- Richard Frank, Division Manager Production, WEB Aruba

WEB has been desalinating water since 1932 and producing power since 1958. Aruba has a target of 100 percent renewable energy water and power production by 2020. The island's average demand is 103.5 MW. Until a few years ago, WEB's electricity was almost entirely based on fossil fuels. By utilizing

state-of-the-art machines such as sea water reverse osmosis (SWRO) and reciprocating internal combustion engines (RECIP), WEB now consumes not only a great deal less fossil fuel for production, but also emits a great deal less carbon.

Currently WEB's system includes:

Wind: The wind farm at Vader Piet consists of 10 turbines of 3 megawatt each. The future second wind farm at Urirama will increase wind energy with eight additional turbines of 3.3 MW each.

Solar: The solar park at the International Airport of Aruba produces more than 0.7 percent of the required energy. In a few years, solar energy is projected to increase 3 percent by a second solar park and solar rooftops installed on schools and public buildings.

Biogas: WEB will soon start using biogas, formed through gasification. The biogas, supplied by EcoGas, goes through a pipeline to the WEB Aruba facilities and turns waste into renewable energy.

Storage: Technologies like flywheel technologies will help WEB prevent unexpected instability issues caused by renewable energy. In the future WEB will store excessive renewable energy by compressing air under water and use it to produce power when the demand is high through a technology called Hydrostor. WEB will also use ice storage.

When power demand is low, ice is created. When power demand is high, that ice is used to cool buildings and decrease power production.

Intelligent Generation Management System:

An optimal mix of renewables and non renewables requires an Intelligent Generation Management System (IGMS). IGMS will enable automated monitoring, adjusting, and control for reliable water and power production for Aruba.



MULTI-FUNCTIONAL ACCOMMODATION (MFA), NOORD, ARUBA SPEAKERS

- Ir. Orlando Hoevertsz, founder and director, Hoevertsz ArchiDesign
- Mr. John Reyes, Owner, Retraco Aruba NV

The Multi-Functional Accommodation building has a “tropical-roof” concept as its main architectural theme. This consists of a light upper roof and a well-insulated main building with ventilation between both roofs. There are 90 kW of solar photovoltaics on the roof, which provide enough power for the main building while also providing shade. The building uses double-paned argon-filled windows, and a tilted roof design to take maximum advantage of daylight. The entire building uses LED lighting and reuses air-conditioning water for landscape irrigation. See Figure 3.

The location of the building was of critical importance. For example, the building design and structure was adjusted to minimize the amount of tree loss and maximize the tree shade potential.

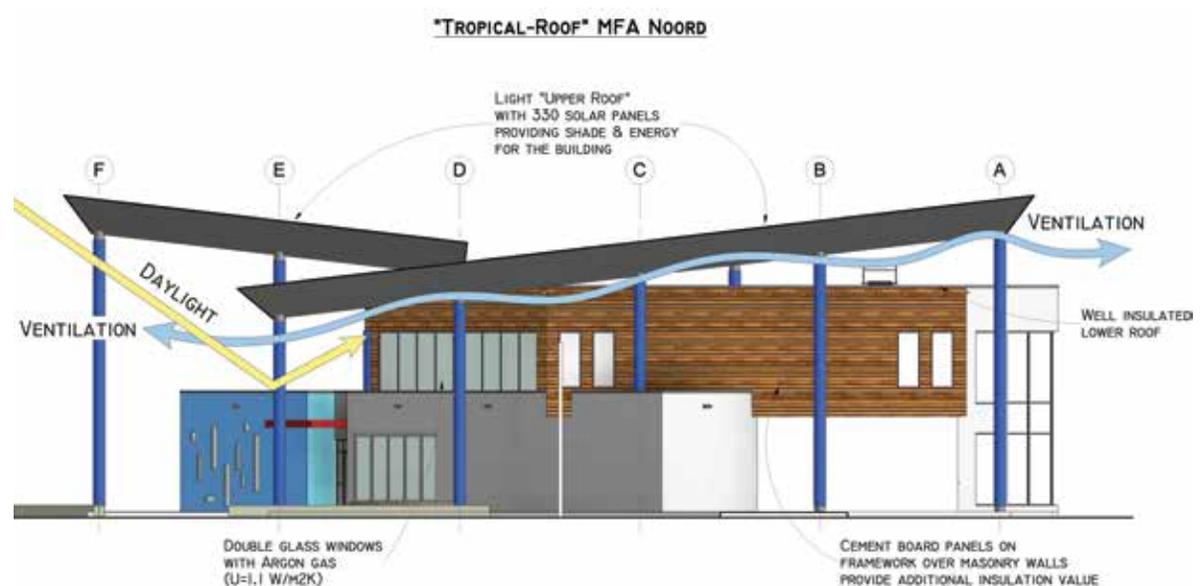


Figure 3: Illustration of the building's energy efficiency components and design



CONCLUSION

07

7. CONCLUSION

The Aruba Learning Event showcased both the successes and the challenges of implementing renewable energy projects in Aruba, and provided a forum to exchange lessons across island economies.

The event highlighted economics, policy-making, and technology as crosscutting issues, stressing that renewable energy strategies need to be approached holistically. Together, participants and partners shared the need for close collaboration across ministries, utilities, regulatory bodies, and regional agencies. This knowledge sharing is critical to learn directly from island experiences across the Caribbean, as well as from the Pacific and Indian Ocean. Thus, the Aruba Learning Event proved the demand and need for a community of practice.

OUTCOMES

- Strengthened relationships with regional development partners such as CARILEC
- Increased interest for regional knowledge exchange and sharing of energy transition best practices
- Demonstrated experience in learning tours, leveraged the learning event as a template for future field visits
- Established new relationships and dialogue among utilities and policy makers
- Showcased Aruba's government and utility collaboration including other examples such as Montserrat and Saint Lucia



A photograph of three people at a social event. On the left, a man in a dark suit and light-colored checkered shirt is looking towards the center. In the middle, a woman with glasses and a blue patterned top is smiling broadly. On the right, another man in a dark suit and light-colored checkered shirt is smiling. They are all wearing lanyards with badges. The background shows a window with vertical blinds and some indoor lighting.

APPENDICES

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APPENDIX A

AGENDA: SUNDAY OCTOBER 25TH

TIME	ACTIVITY	LOCATION
12.00 – 6.00 pm	Check-in & ALE Registration	Aruba Marriott Stellaris
7.00 – 9.00 pm	<p>ALE Welcome Dinner</p> <p>Remarks by:</p> <ul style="list-style-type: none">• Frank Hoevertsz – Managing Director Utilities Aruba• Daniela Schmidt – Programme Officer SIDS Lighthouses Initiative, International Renewable Energy Agency (IRENA)• Leslie Labruto - Director of Resilient Communities Islands Energy Program, Clinton Climate Initiative (CCI)• Justin Locke – Director of Islands Rocky Mountain Institute, Carbon War Room (RMI-CWR)	La Vista Patio/Vela Beach

AGENDA: MONDAY OCTOBER 26TH - MORNING

TIME	ACTIVITY	LOCATION
7.00 am	ALE Breakfast & Registration	Amsterdam
8.00 – 9.00 am	<p>Welcome Remarks, Introductions & ALE Objectives</p> <p>Remarks by:</p> <ul style="list-style-type: none"> Justin Locke – Director of Islands, RMI-CWR Jose Maria Figueres – Chairman of the Board, RMI-CWR Minister Mike de Meza – Ministry of Economic Affairs, Communication, Energy & Environment, and Deputy PM Prime Minister of Aruba, Mike Eman <p>Overview by:</p> <ul style="list-style-type: none"> Roy Torbert – Manager, RMI-CWR 	Amsterdam
9.00 – 10.15 am	<p>Site Visit 1 – Airport Solar PV</p> <p>Presentations by:</p> <ul style="list-style-type: none"> Hendrik Croes – Public Relations for Aruba Airport Authority James Fazio – CEO of Aruba Airport Authority Elthon Lampe – Business Development Officer, N.V. ELMAR 	Aruba International Airport
10.15 – 11.30 am	<p>Site Visit 2 - Vader Piet wind farm</p> <p>Presentation by:</p> <ul style="list-style-type: none"> Henk Hutting – CEO, NuCapital Inc. 	Control Room
12.00 – 1.15 pm	ALE Lunch	O’Niels Restaurant

AGENDA: MONDAY OCTOBER 26TH - AFTERNOON

TIME	ACTIVITY	LOCATION
1.30 – 2.45 pm	<p>Site visit 3 – WEB Aruba Power Plant Bus Tour & Presentations by:</p> <ul style="list-style-type: none"> • Luis Oduber – Managing Director, WEB Aruba • Richard Frank – Division Manager Production, WEB Aruba 	
2.40 – 3.30 pm	<p>Site visit 4 – Multi-Function Facility (MFA) Overview by:</p> <ul style="list-style-type: none"> • Frank Hoevertsz – Managing Director, Utilities Aruba • Alfred Rafine – Policy Advisor, Utilities Aruba 	
3.30 – 4.00 pm	Coffee Break	Amsterdam Foyer
4.00 – 5.00 pm	<p>Renewable Energy Grid Integration & Energy Storage Presented and moderated by:</p> <ul style="list-style-type: none"> • Ruud Kempener – Technology Roadmap Analyst, IRENA 	Amsterdam
5.00 – 5.30 pm	<p>Site Visit debriefing Facilitated by:</p> <ul style="list-style-type: none"> • Roy Torbert – Manager, RMI-CWR 	Amsterdam
5.30 – 6.30 pm	Free Time	
6.30 – 8.00 pm	<p>Green Aruba Welcome Reception Remarks by:</p> <ul style="list-style-type: none"> • Prime Minister Mike Eman – Aruba • Jose Maria Figueres – Chairman of the Board, RMI-CWR • Edward Cheung – Principal Engineer & Researcher, NASA 	Entrance of Ballroom (outdoors)

AGENDA: TUESDAY OCTOBER 27TH - MORNING

TIME	ACTIVITY	LOCATION
8.30 – 10.00 am	<p>Green Aruba VI Opening</p> <p>Remarks by:</p> <ul style="list-style-type: none"> • Mike Eman – Prime Minister of Aruba, • Frank Hoevertsz – Managing Director, Utilities Aruba <p>Video address:</p> <ul style="list-style-type: none"> • President William J. Clinton, Clinton Foundation <p>Keynote:</p> <ul style="list-style-type: none"> • Secretary General Mr. Luis Almagro Lemes, Organization of American States (OAS) 	Ballroom
10.00 – 10.30 am	Networking Exhibition & Café Brea	Ballroom
10.30 – 12.00 pm	<p>Partnership Forum</p> <p>Moderated by:</p> <ul style="list-style-type: none"> • Prime Minister of Aruba, Mr. Mike G. Eman <p>Panelists and speakers:</p> <ul style="list-style-type: none"> • Thomas Hodge – Executive Director • Caribbean Electric Utility Services Corporation (CARILEC) • Dymphna van de Lans – Chief Executive Officer Clinton Climate Initiative • Jules Kortenhorst – Chief Executive Officer Rocky Mountain Institute – Carbon War Room • Daniela Schmidt – Programme Officer, SIDS Lighthouse Initiative, IRENA • Mr. Homazd Kanga – Acting Consul General Curacao, US State Department 	Ballroom
12.00 – 1.30 pm	ALE Lunch	Ruth's Chris Restaurant

AGENDA: TUESDAY OCTOBER 27TH - AFTERNOON

TIME	ACTIVITY	LOCATION
1.30 – 3.00 pm	<p>Working Group Sessions:</p> <ol style="list-style-type: none"> 1. Policy – Facilitated by: Kate Hawley, RMI-CWR, Justin Locke, RMI-CWR, Ruurd Schoolderman, TNO, & Richard Arends, Government of Aruba 2. Technical – Facilitated by: Kaitlyn Bunker, RMI-CWR & Chris Burgess, RMI-CWR 3. Economic – Facilitated by: Leslie Labruto, CCI & Roy Torbert, RMI-CWR 	Amsterdam I/II & Board Room
3.00 – 3.15 pm	Coffee Break	Amsterdam Foyer
3.15 – 4.15 pm	<p>Debriefing & Policy Meets Practice Facilitated by:</p> <ul style="list-style-type: none"> • Roy Torbert – Manager, RMI-CWR 	Amsterdam
4.15 – 5.30 pm	<p>Community of Practice Facilitated by:</p> <ul style="list-style-type: none"> • Martyn Forde – Project Manager, CCI • Laurena Primus – Training Coordinator, CARILEC 	Amsterdam
5.30 – 6.00 pm	ALE Closing Remarks	Amsterdam
6.00 – 7.00 pm	Cocktails	Great Room

AGENDA: WEDNESDAY OCTOBER 28TH

TIME	ACTIVITY	LOCATION
8.30 – 10.00 am	Green Aruba Presentations & ALE Testimonials	Ballroom
10.00 am – 5.00 pm	Green Aruba Conference	Ballroom
7.00 – 10.00 pm	Green Aruba Closing Event & Reception	

APPENDIX B

FULL LIST OF ATTENDEES

COUNTRY/ISLAND	NAME
Anguilla	Mr. David Carty, Advisor, Government of Anguilla
Aruba	Mr. Robert Henriquez, Managing Director, NV Elmar Aruba
Aruba	Mr. Luis Oduber, Managing Director, WEB Aruba NV
Aruba	Mr. Frank Hoevertsz, Managing Director, Utilities Aruba NV
Bahamas	Mr. Mark Martyak, Chief Sales Officer, Power Secure
Bahamas	Dr. Rhianna Neely, Advisor, Ministry of Environment & Housing
Bahamas	Mr. Burlington Strachan, AGM Technical Planning & IT, Bahamas Electricity Corp.
Bahamas	Mr. Robert Hall, Manager Family Islands, Bahamas Electricity Corp.
Bahamas	Mr. Ronnie Brannen, Chief Revenue Officer, Power Secure
British Virgin Islands	Dr. the Hon. Kendrick Pickering, Deputy Premier and Minister, Ministry of Natural Resources & Labour
Colombia	Mr. Ivan Salcedo, General Director, SOPESA S.A. E.S.P.
Colombia	Ms. Karen Schutt, Advisor, Department of Infrastructure and Sustainable Energy
Colombia	Ms. Olga Lucila Restrepo, Project Engineer, SOPESA S.A. E.S.P.
Comoros	H.E. Mr. Mohamed Soilih, Ambassador, Permanent Representative United Nations
Dominica	Mr. Dave Stamp, Generation Manager, DOMLEC
Dominican Republic	Mr. Napoleon, Beras, Deputy Ambassador, United Nations
Fiji	Mr. Peter Thomson, Ambassador, United Nations
Grenada	Mr. Robert Blenker, President, WRB Energy
Grenada	Mr. Clive Hosten, Chief Engineer, GRENLEC
Guyana	Guyana Ms. Niebert Blair, Project Manager, Guyana Power & Light Inc.
Montserrat	Mr. Owen Lewis, Board Director / Project Manager, Montserrat Utilities
Montserrat	Mr. David Thomson, Managing Director, Montserrat Utilities
Saint Lucia	Mr. Sylvester Clauzel, Permanent Secretary, Ministry of Sustainable Development, Energy, Science and Technology
Saint Vincent and the Grenadines	Mr. Ellsworth Dacon, Director of Energy, Ministry of National Security
Samoa	Mrs. Maureen Strickland-Simonet, Deputy Ambassador, United Nations
Seychelles	Mr. Theodore Marguerite, Principal Energy Policy Analyst, Ministry of Environment, Energy and Climate Change
Seychelles	Ms. Cynthia Alexander, Principal Officer, Ministry of Environment, Energy and Climate change
Seychelles	Mr. Francis Sam, Energy Engineer, PUC
St. Kitts & Nevis	Hon. Ian Liburd, Honorable Minister, Ministry of Public Infrastructure, Post, Urban Development and Transport
St. Kitts & Nevis	Mr. Jervan Swanton, General Manager, Nevis Electricity Company Limited
Turks and Caicos	Hon. Amanda Misick, Hon. Minister, Ministry Infrastructure, Housing & Planning
Turks and Caicos	Ms. Susan Malcom, Permanent Secretary, Ministry Infrastructure, Housing & Planning
Turks and Caicos	Ms. Kathy Walkin, Head of Secretariat, Ministry Infrastructure, Housing & Planning
Turks and Caicos	Ms. Sparkle Prentice, Energy Analyst, Ministry Infrastructure, Housing & Planning
Tuvalu	H.E. Mr. Aunese Makoi Simati, Ambassador, United Nations
Vanuatu	H.E. Mr. Odo Tevi, Ambassador, United Nations

FACILITATORS/PRESENTERS

COUNTRY/ORGANIZATION

Aruba
 Aruba
 Aruba
 Aruba
 CARILEC
 CARILEC
 Clinton Climate Initiative
 Clinton Climate Initiative
 Curacao
 IRENA
 IRENA
 RMI-CWR
 RMI-CWR
 RMI-CWR
 RMI-CWR
 RMI-CWR
 TNO Caribbean

NAME

Mr. Richard Arends, Chief of Staff to the Minister of Economic Affairs, Communication, Energy & Environment, Sr. Advisor to the Prime Minister
 Mr. Elthon Lampe, Business Development Officer, Elmar
 Ms. Asja Dongen, PR Officer, WEB
 Ms. Wanda Broeksema, Department Manager, ELMAR
 Ms. Sophia Primus, Training Manager
 Mr. Thomas Hodge, Executive Director
 Ms. Leslie Labruto, Director of Islands, Islands Program
 Mr. Martyn Forde, Project Manager, Islands Program
 Mr. Kanga Homazd, Acting Consul General, Consulate General - US State Dept.
 Mr. Ruud Kempener, Technology roadmap analyst, Renewable Energy Grid integration & Energy Storage
 Ms. Daniela Schmidt, Programme Officer, SIDS Lighthouse Initiative
 Mr. Justin Locke, Director of Islands, Islands Program
 Ms. Kaitlyn Bunker, Senior Associate, Islands Program
 Mr. Roy Torbert, Manager, Islands Program
 Ms. Kate Hawley, Senior Associate, Islands Program
 Mr. Chris Burgess, Operation Manager, Islands Program
 Mr. Ruurd Schoolderman, Strategic Advisor Energy, Caribbean Green Technology Center

OBSERVERS & PARTNERS

Aruba
 Aruba

Hon. Mike Eman, Prime Minister of Aruba & Minister of General Affairs, Science, Innovation and Sustainable Development
 Hon. Mike de Meza, Minister & Deputy Prime Minister, Minister of Economic Affairs, Communications, Energy and Environment
 Mr. Alfonso Boekhoudt, Plenipotentiary Minister, The Hague
 Mr. Alfred Rafine, Policy Advisor, Utilities Aruba NV
 Mr. Carlos Tapias, Financial analyst, Utilities Aruba NV
 Mr. Patrick Schmidt, Advisor PM, Government of Aruba
 Ms. Juliet Carvahal, Special Coordinator Green Agenda, Government of Aruba
 Mr. Jan Ebbing, Director, TNO
 Mr. Wim Nagtegaal, COO Executive Board, TNO
 Mr. Alfonso Boekhoudt, Plenipotentiary Minister, The Hague
 Ms. Jocelyne Croes, Council Advisor, Government of Aruba
 Mr. Glenn Thode, Rector, University of Aruba
 Ms. Lucia White, Policy advisor/deputy director, Freezone Aruba
 Ms. Sharon Erasmus, Director, Aruba Investment Agency (ARINA)

COUNTRY/ORGANIZATION

British Virgin Islands
CARILEC
Clinton Climate Initiative
Clinton Climate Initiative
Clinton Foundation
DNV GL
Manitoba Hydro International Ltd.
Manitoba Hydro International Ltd.
RMI-CWR
RMI-CWR
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NAME

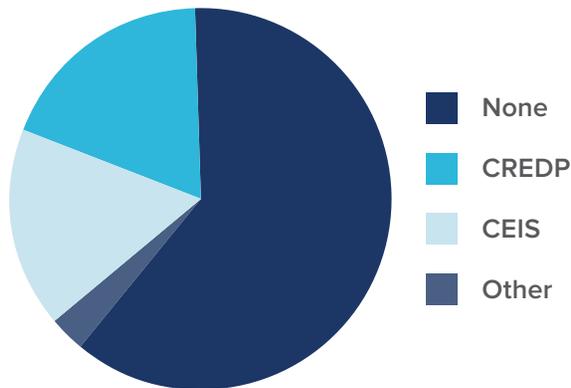
Ms. Michelle Bhajan, Private Secretary to the Deputy Premier & Minister, Ministry of Natural Resources & Labour
Mr. Andrew Thorington, Project Manager
Mr. Jesse Gerstin, Senior Policy Manager
Ms. Siana Teelucksingh, Project Manager, Islands Program
Ms. Dymphna Van De Lans, Chief Executive Officer, Clinton Climate Initiative
Mr. Chad Nancarrow, Senior Engineer, DNV GL
Ms. Alisa Kreynes, Business Development Manager
Mr. Scott Russell, Project Manager
Mr. Jules Kortenhorst, Chief Executive Officer
Mr. Jose Maria Figueres, Chairman of the Board
Mr. Stephen Doig, Managing Director, Islands Program
Mr. Bradley Lyon, Knowledge Manager, Islands Program
Ms. Katya Whyte, Project Coordinator, Islands Program
Ms. Katie Lau, Marketing Manager, Islands Program
Ms. June Marie Mow, National Project Coordinator, Islands Program
Mr. Richard Blewitt, Resident Coordinator, UNDP
Ms. Rosemary Lall, Program Officer, UNDP Center of Excellence
Ms. Danielle Evanson, Programme Manager, Climate Change and Disaster Risk Resilience
Ms. Hind Bindaoui, Permanent Mission of the Kingdom of the Netherlands, United Nations

APPENDIX C

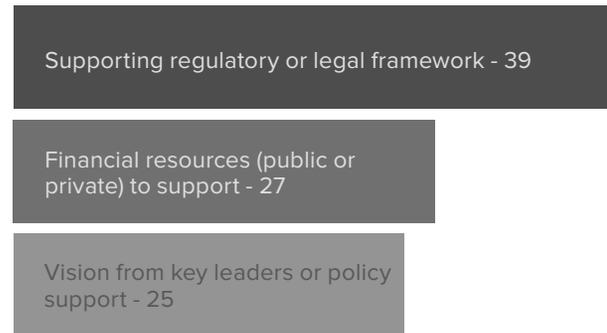
PRELIMINARY COMMUNITY SURVEY RESULTS

In September, CARILEC, CCI, and RMI-CWR began to assess the specific needs, services, and resources for prospective community members through an online survey, which demonstrated a clear desire from Caribbean energy professionals to learn, exchange, and gain access to new, innovative decision-making support tools in order to advance renewable energy projects in the region.

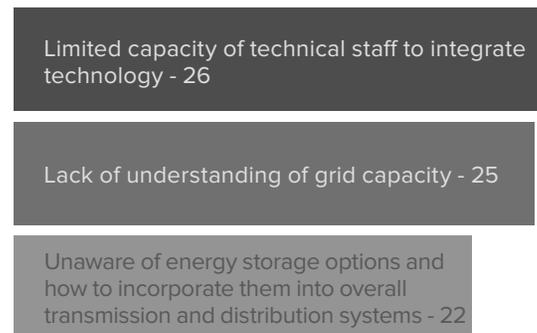
1. WHICH NETWORKS IN THE CARIBBEAN DO YOU PARTICIPATE IN (BESIDES CARILEC)?



2. LIST THE KEY CHALLENGES YOU EXPERIENCE AT WORK?



3. WHAT TECHNICAL CHALLENGES HAVE YOU OBSERVED INTEGRATING RENEWABLE ENERGY?



4. WHAT IS THE MOST VALUABLE KNOWLEDGE-SHARING ACTIVITY?



APPENDIX D

COMMUNITY OF PRACTICE ONLINE PLATFORM FUNCTIONALITY

Participants were asked what key functionalities and documents they would like to see on a virtual community platform for renewable energy professionals. A full list of proposed functionalities and categories are noted in the table below.

During a group exercise, the follow functionalities were proposed for an online community, and categorized below.

RESOURCES	TOOLS	OTHERS (UNCATEGORIZED)
<ol style="list-style-type: none"> 1. Diligence checklist 2. Project documents 101 3. Templates for due diligence requirements and examples of the process 4. Industry standards and guidelines (eg., ISOs) 5. Standard docs (e.g., interconnection agreements) 6. Project preparation 7. Vetted contractor list 8. Membership directory/government partners listing 9. Project repository on an interactive Google map 10. Project management templates (spreadsheets, formats, etc.) 11. List of funders and financing team 12. Support directory 13. Direct contacts to other partners in utilities 14. More of a comprehensive directory 15. Issue for RFPs and IPC to increase dissemination and more easily share details of contract 	<ol style="list-style-type: none"> 1. Project management tools 2. Project calendar/ongoing phases/database on projects 3. Roles of everyone in the project calendar, including ongoing projects, phases, days to call, and contacts 	<ol style="list-style-type: none"> 1. Subject matter experts 2. Face to face diverse meetings 3. Access to technical support 4. How to improve learning and knowledge sharing (e.g., Aruba) 5. Since we may not participate in all activities, having videos of conferences, presentations may help 6. Public exchanges with the communities/in-person visits 7. In-person meetings every year 8. Having people from different backgrounds together: i) technical person, ii) project manager, iii) economics/finance, iv) utility, v) decision makers 9. Establishment and sharing of different roles

FEATURES	CONTENT	KNOWLEDGE
<ol style="list-style-type: none"> 1. Rating system for the content 2. Document drive or link to documents such as legislations, regulations 3. Capacity building and technical interactive training 4. Interactive calendar 5. Virtual meeting space to discuss challenges in “real time” and hands-on 6. Accessibility/ease of use issues 7. Webinars 8. Live chat with other members 9. Achievements and recognition (of members?) 10. Recognition awards for contributors or experts 11. Celebration page (tracker of goal vs. installations “20% by 2020”) 12. News blurb on most recent achievements link to country profile 13. Event info & calendar 14. Meeting request and calendar integration 15. App for mobile phone 16. Uploads quickly 17. It should be as user-friendly as Facebook, which transcends: i. generation gaps, ii. geographical boundaries, iii. management levels, and iv. technical expertise 18. Searchability within the site 19. “Community ABC” 20. Q&A forum exchanges (all levels) 21. Rating system (not only for members, but content too) 22. Benchmarking 	<ol style="list-style-type: none"> 1. Existing RE projects in the Caribbean (3x) 2. Country energy data (fuel usage, energy consumption, production) 3. Island snapshot (summary, electricity, specifics, contact for the CoP) 4. Utilities profiles (up-to-date) 5. Sample or model legislation 6. RE regulations examples 7. Energy policies (samples? templates?) 8. Country profile, island snapshot, add that into the Pacific Ocean 9. Directories of specialists and contact information 10. Project preparation documents/process and due diligence 11. Repository of documents on policy/regulation/legislation 12. Support directory 13. List of contractors 14. Subject matter expert involvement 15. List of vendors, companies, consultants, etc. 16. Direct contacts in government agencies, departments, and utilities 17. Vetted contractor list 18. Background information on participants (members?) 19. Email and phone numbers of energy professionals and utilities 20. Vetted contract, gov’t, partner, utility, directory 21. Support directory 22. Organization charts of the islands 23. Rating or benchmarking of RE/EE products 24. Including ratings of contractors by performance and countries who have used them 25. Tariff structures 26. Country map with project sites, size of project, energy source, cost 27. Project and \$/unit Information database projects (e.g., 2016 show progress of 10 MW of wind installed) 28. Levelised cost of energy for various renewable energy technologies 29. Tenders and work to region 30. Repository of: i) RE/MW, ii) contacts, iii) link/photos Google earth style 	<ol style="list-style-type: none"> 1. Case studies 2. What worked and what didn’t work (RE specific) 3. Project case studies 4. Case studies 5. Lessons learned 6. Case-study analysis (full access) 7. Best practices 8. Other regional best practices for RE on islands 9. Something about the specifics, lessons learned, tariff structures, country 10. Functional focus groups (e.g., finance) 11. Online technical trainings 12. Capacity building (webinars, scholarships, technical studies, etc.) 13. Capacity building/ training apps 14. Finance/funding assistance 15. Full report analysis 16. Renewable energy cost and economics

APPENDIX E

Site Visit: ELMAR's Solar Carport at Airport Reina Beatrix



Basic ELMAR Information:

ELMAR is the electric distribution utility in Aruba, with a goal to "provide our customers with reliable power and to do this in a friendly and courteous manner". Visit www.elmar.aw for more information.

How long has the Solar Carport been operating here:

The first phase of the solar park was completed in mid October 2014. The completion of the project was at the end of March 2015.

Size of facility (total MW capacity):

The total installed capacity of solar is 3,474 MW. It is to date the largest Solar Carport in the Caribbean and one of the largest in the world.

Installed equipment:

Equipment	Capacity per unit	Quantity	Total
Solar module (Poly Crystalline)	250 Watt	13,896	3,474 kW
Central Inverters	800 kVA	4	3,200 kVA
Transformers	1800 kVA	2	3,600 kVA

Operating voltage and type of installation:

The Solar Carport operates at 1000VDC. The inverters convert this DC voltage to AC and deliver this at 360VAC to the transformers. The transformers are connected to a 12kV grid. The solar carport at night is well illuminated by SMD LED lights. With the highest efficiency standards. It was designed to give daylight colors (5000K) to bring the best details and improve security levels at night of cars parking beneath.

Annual generation and reliability:

The estimated yearly production is 6 million kWh. Regarding reliability, the design of the Solar Carport was made to be redundant. If any equipment fails, the maximum failure would be 50% production. All equipment complies with IP66, which means that everything is water, dust, and corrosion proof.

ELMAR's corporate responsibility towards sustainability:

The Solar Carport at the Airport (Solar Park AAA known is one of the largest of its kind. So far, the production exceeds expectation, however it is too soon to derive any conclusions. The full carport has been operating for less than one year, and the rainy season is yet to come. The impact on the grid regarding voltage fluctuations seen so far is considered minimum.

Partners and stakeholders in the Solar Carport project:

- PFIXX – Solar Carport Owner
- AAA NV – Aruba Airport Authorities is the airport owner
- NV ELMAR – Owner of the transmission and distribution grid.
- Government of Aruba – Project Support

For questions or clarifications, please contact
Wanda Broeksema: w.broeksema@elmar.aw
Roy Torbert: rtorbert@rmi.org



IN COLLABORATION WITH:



Site Visit: Windpark Vader Piet



Installed capacity: 30 MW

Equipment:	10 Vestas V90 – 3 MW wind turbines
Average annual production:	140 GWh
Average annual capacity factor:	54%
Peak monthly capacity factor:	84% (June 2015)
Average plant availability:	98%
Average contribution to total demand:	15%
In operation since:	December 2009
Total investment:	\$ 75 million
Shareholders:	Hutting Windenergie, NuCapital & Bright Capital

Development

The project was developed by WEB Aruba, who issued an RFP of 15 MW in April 2008 in order to reduce the production costs of electricity. As an alternative Vader Piet offered 30 MW together with proof of feasibility based upon additional measures to facilitate integration of such high amount of wind energy into the supply system of Aruba. This alternative was the most economical solution for WEB Aruba and therefore selected in July 2008 out of 5 bids.

The 6 years of operation have provided proof of the feasibility of having a high amount of wind energy without problems and to the decision to have even 26 MW of wind energy more on the island to reduce the dependency on oil. That project is currently under development by Vader Piet based on a negotiated PPA.

The entire process of contracting, permitting and arranging of finance was done within 6 months and therefore construction could start January 2009. There was not a single objector to the project and all governmental departments worked very fast to have the permitting process done in 2 months including a 6 week statutory public consulting period.

The substation on site and the 5.6 km 60 kV evacuation line to the nearest general substation was purpose built by WEB Aruba. The balance of plant of the wind farm was built by several contractors under the management of Vader Piet. Vestas was responsible for supply, transport, erection and commissioning of the turbines.

Windpark Vader Piet N.V.
L.G Smith Boulevard 22 - Oranjestad, Aruba
E-mail: henk@nucapital.nl - tel: 0031 646 181 888
Roy Torbert: rtorbert@rmi.org



IN COLLABORATION WITH:



Site Visit: WEB Facility



Basic Facility Information: visit www.webaruba.com

How long WEB has been operating here:

WEB has been desalinating water since 1932 and has been producing power since 1958. For more about desalination and power production history, visit:

- <http://www.webaruba.com/water-production/water-production-history> and
- <http://www.webaruba.com/energy-production/energy-production-history>

Size of facility (total MW capacity)

Installed equipment (how many of each generator type):

Boilers:	4
Steam turbines:	4
RECIP Engines:	12
Gas turbines:	1
Wind turbines:	10

Annual generation and reliability:

EQUIPMENT	INSTALLED CAPACITY
BOILERS	544.00 Tons per hour
STEAM TURBINES	136 MW
RECIP ENGINES	99.88 MW
GAS TURBINES	22.00 MW
WIND TURBINES	30.00 MW
AVERAGE ARUBA DEMAND	103.50 MW
AVERAGE WEB PEAK	135.00 MW



IN COLLABORATION WITH:



- We desalinate seawater through a combination of Multi Stage Flash (MSF) Evaporation and Sea Water Reverse Osmosis, (soon to complete 100% SWRO). SWRO desalination offers the same high-quality product our customers are used to, and is considerably more efficient than MSF systems.
- The SWRO technology consists of electric pumps that generate high pressure, forcing seawater through semi-permeable membranes, converting seawater into drinking water. We are currently running two fixed SWRO plants, one Mobile unit and complement with MSF if needed. View video below.
- Water production figures:

EQUIPMENT	INSTALLED	CAPACITY
SEAWATER REVERSE OSMOSIS PLANTS (SWRO)	44000	m3 per day
ION EXCHANGE PLANTS	3000	m3 per day

CONSUMPTION	USAGE	CAPACITY
AVERAGE PRODUCTION	54000	m3 per day
AVERAGE ARUBA USAGE	22000	m3 per day
AVERAGE WEB USAGE	7000	m3 per day

WEB's Efforts to Reduce Emissions

What is the Goal? WEB Aruba is actively working towards a future which is less dependent on fossil fuels and that has a minimal impact on our environment.

What are the recent and current efforts?

Reduced CO₂ emissions YTD
93,684,878 kg
 Equivalent to: 19,411 Passenger vehicles off the road annually

On our road to 2020...
 Highest level of clean energy production will be less than 10%
 18 years ago: 6,180 (MW/day)
 2013 YTD: 3,562 (MW/day)

Renewable Energy %

Month	Renewable Energy %
Jan	17.2%
Feb	18.4%
Mar	18.8%
Apr	22.8%
May	23.8%
Jun	23.9%
Jul	25.1%
Aug	25.1%
Sep	25.1%
Oct	25.1%
Nov	25.1%
Dec	25.1%

2013 Yearly Average: 21.4% YTD

Site Visit: WEB Facility



What are the recent and current efforts?



Partnerships (who was involved to get this done?)

WEB has partnerships with:

- Wartsila (RECIP Engines)
- General Electric (SWRO),
- Ecogas NV (Biogas, waste to energy),
- Windpark Vader Piet NV (Wind turbine park, VESTAS),
- Stork (Biogas Boiler),
- Caterpillar (Biogas Engine)
- ABB (Plant Automation),
- Temporal (Flywheel Technologies),
- Hydrostor (Energy Storage),
- NREL (National Renewable Energy Laboratory),
- The Brattle Group (Plant modeling)

For questions or clarifications, please contact
 Asja Dongen: addongen@webaruba.com
 Roy Torbert: rtorbert@mi.org



IN COLLABORATION WITH:



MULTIFUNCTIONAL ACCOMODATION (MFA)- NOORD

Key Facts MFA Noord:

- “Tropical-Roof” concept as main architectural theme;
Light upper roof and a well insulated main building with ventilation in-between both roofs
- Light upper roof with dual function; Solar panels (total of 330) and creating shade for the main building



- Self-sustainable building; solar panels sufficient power generation (approx 90 kW) for entire MFA usage
- Position building on property in such a way to maintain as much existing trees as possible
- Cement board panels (wood appearance) elevations first floor with frame work on top of block-wall as a double (insulated) wall
- Double-glass windows with Argon 100% gas in-between (U=1.1 W/m2K)
- Large windows and tilted roof design for influx of daylight into the building



Mechanical-Electrical-Plumbing;

- Energy efficient VRF air-conditioning system
- LED lighting thru entire MFA
- Condense water A/C system in separate tank for landscaping irrigation