

Wind Alliance for the Sustainable Development
Final Technical Report
Puerto Rico Energy Affairs Administration
September 30, 2012

Final Technical Report

Program General Information

Project Title: Wind Energy Alliance for Sustainable Development

Covering Period: September 12, 2008 to September 30, 2012

Date of Report: September 30, 2012

Recipient: Puerto Rico Energy Affairs Administration

Award Number: DE-FG36-08GO48025

Working Partners: None

Cost-Sharing Partners: None

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This report is based upon work supported by the U.S. Department of Energy.

Any findings, opinions, and conclusions or recommendations expressed in this report are those of the author(s) and do not necessarily reflect the views of the Department of Energy.

Project Overview

The Puerto Rico Energy Affairs Administration (PREAA) is actively engaged in the implementation of existing public policy for the conservation of energy and promotion of renewable energy to reduce consumer's costs and reduce environmental impact. Puerto Rico is an island in where no own reserves of gas, oil or coal exists. This severe dependence in on foreign oil is reflected in the higher cost of electricity in Puerto Rico, which is significantly higher than most of the United States. Therefore, public energy policy of Puerto Rico places emphasis on diversification of energy sources and the use of renewable energy technologies.

The Wind energy Alliance for the Sustainable Development project focused on the formation of a wind energy working group to educate and promote wind energy technologies; at the same time the evaluating the viability of wind energy in Puerto Rico. The educational outreach was performed through a series of wind energy workshops where interested parties such as, installers, sellers, engineers, general public even opposing groups participate from the activities.

Project Objectives

Create the Wind Energy Alliance for Sustainable Development in order to establish a strong partnership between the government of the Commonwealth of Puerto Rico, educational institutions, industrial entities and all interested parties to stimulate wind energy development by helping to remove market barriers, improve the knowledge of modern wind systems and benefits to stakeholders groups. At the same time initiate a series of join activities that will lead to the promotion of the viability of the use of wind energy in Puerto Rico and its benefits for a sustainable development.

Background

Puerto Rico currently depends 99% in fossil fuel for the generation of electricity, where 67% comes from oil, 17% natural gas, and 15% coal. The remaining 1% comes from renewable sources mainly from hydro plants. The Puerto Rico Electric Power Authority (PREPA) is the only electric utility within our island. PREPA is a vertically-structured electric utility providing the generation, transmission, and distribution of electricity in Puerto Rico. More than two thirds (2/3) of the overall cost of electricity in Puerto Rico comes from fuel purchases, being oil the largest contributor due to its high cost and price volatility. This model shows a significant dependency on petroleum-based fuels. Consequently, there is a direct relation between the cost of electric energy (kWh) and any variation in the price of an oil barrel. Thus, in recent years we have an electricity price increase as oil prices have increased. Average electricity price in P.R. was approximately 21.5 cents per kilowatt-hour in 2009; more than twice the average electricity price in the U.S. according to the Annual Energy Outlook 2010 data. On 2008, electricity price averaged 22 cents per kilowatt-hour (kWh), compared with the year 2007, at a price of 17.76 cents. This increase in the cost of electricity has adversely impact our economic development potential. These and other circumstances, have demonstrates that there is urgent need for action within the energy sector. Considering the previously mention facts, Puerto Rico needs to create

public awareness on the feasibility and availability of renewable energy sources (wind energy) in Puerto Rico.

Project Accomplishments

The following six activities were planned to be implemented in the framework of this project.

Task	Accomplishment
Stimulating wind development by helping to remove market barriers	• Three educational activities were held. • Educational outreach in schools, government and private activities has been performed.
Plan to support new and existing Wind Working Groups	• Wind Energy Alliance Group was form and structure is in the development process.
Support Agriculture Outreach Initiatives	• Department of agriculture activities has been supported to promote the use of renewable energy in farms.
Anemometer Loan Program	• The Anemometer was loan to Polis Group LLC to gather data at a parcel in the municipality of Carolina.
Support Small and Community Scale wind outreach	• Participation of talks in schools and public conferences. Green Bags, Post It's and educational pamphlets has been distributed in the activities.
Attendance to Annual Wind Energy Conference	• Mr. Luis M. Bernal, executive Director of PREAA, attended to the AWEA conference in Georgia.

Project Activities

The Wind Alliance for the Sustainable Development was composed from a series of tasks and activities that drive the project to the accomplishment of the established objectives.

Task 1: Stimulating wind development by helping to remove market barriers

As part of the project PREAA decided to hold three educational activities. The organization of the activity was started by a brainstorming of those key talks and speakers necessary to accomplish a well dissemination of the theme.

The first activity was performed on October 21, 2011 at PREAA's facilities. The activity counted with the participation of 12 speakers who held talks regarding education in wind energy, local experiences, financial aspects & economic viability and net metering & interconnection.

The activity invitation and itinerary was the following:



La Administración de Asuntos Energéticos de Puerto Rico en colaboración con el US Green Building Council Capítulo del Caribe le invitan a:

ALIANZA EÓLICA PARA EL DESARROLLO SOSTENIBLE DE PUERTO RICO

1^{er}. Foro de Discusión Pública sobre los Aerogeneradores en Puerto Rico

Viernes, 21 de octubre de 2011
7:30 a.m. a 5:00 p.m.
Centro de Adiestramiento de la Administración de Asuntos Energéticos
#200 Calle Manuel Camuñas Esq. Avenida César González
Urb. Industrial Tres Monjitas Hato Rey, PR 00918

Esta actividad se está considerando para créditos de educación continuada por el Colegio de Ingenieros y el Colegio de Arquitectos y Arquitectos Paisajistas de Puerto Rico.

Invitación intransferible | Se requiere reservación | Espacios limitados | **RSVP: 787 749 0226**



WIND ALLIANCE FOR THE SUSTAINABLE DEVELOPMENT OF PUERTO RICO		
Hour	Presentation	Speaker
7:30 a.m. - 8:15 a.m.	Breakfast and Registration	
8:15 a.m. -8:45a.m.	Welcome and Introduction	Arq. Fernando Abruña, Wind Alliance President Luis M. Bernal, PREAA Executive Director Arq. Cristina Algaze, USGBC President
8:45 a.m.- 9:30 a.m.	Basic Principles of Wind Energy and Environmental Benefits	Arq. Fernando Abruña
9:30 a.m. – 10:00 a.m.	Technical Aspects - Design, Construction and Operation	Eng. Gerardo Cosme
10:00 a.m.- 11:00 a.m.	Wind Turbine Education	Eng. Edison Pares and dr. Hector M. Rodriguez
11:00 a.m.-11:15 a.m.	Coffee Break	
11:15 a.m. -12:00 p.m.	Regulation and Processes	Eng. André Mesa Pabon Plan. Erika Rivera Felicié
12:00 p.m. - 1:00 p.m.	Lunch	
1:00 p.m. - 2:00 p.m.	Environmental Aspects - Noise Pollution	Eng. Jorge Rocafort
2:00 p.m. - 3:00 p.m.	Finance Aspects and Economic Viability	Sr. Collie Powell de Pattern Energy
3:00 p.m.-3:15 p.m.	Coffee break	
3:15 p.m. – 3:45 p.m.	Insurance for Wind Energy Projects	Sra. Raquel Irizarry Vergés
3:45 p.m. - 4:15 p.m.	Net Metering and Interconnection	Eng. Sonia Miranda – PREPA
4:15 p.m.- 4:45 p.m.	Carbon Credits	Mrs. Ada Torres Ramirez
4:45 p.m. - 5:00 p.m.	Adjourn	

A description of the presentations performed during the activity is found below.

- The first presentation *Basic Principles of Wind Energy and Environmental Benefits* counted with a summary of the background of the Wind Alliance, objectives and educational information about wind turbines including environmental information such as effect on birds and wildlife, agriculture and greenhouse gases. Also, points such as wind turbine frequency and sounds was discuss, community outreach and general information about the technology.

- *Technical Aspects - Design, Construction and Operation* was a presentation regarding general information about the technology description and background in Puerto Rico, the wind resource and Puerto Rico, small and large turbines, operational aspects and design criteria's to consider.
- *Wind Turbine Education* presentation was divided in two parts. The first section of the presentation was a discussion of wind power, the importance of the wind resource, wind energy production and structural aspects to take into consideration. The second part of the presentation was a summary of the course taken by the certified wind turbine installers in Puerto Rico. The presentation counted with a brief introduction to wind power system, how to measure the wind, estimating output power, tower selection, structural design & installation, wind power system components, interconnection with the utility & testing, off- the-grid power system & testing, sitting parameters calculation , operation, performance, & maintenance aspects, safety and finally a summary of the Puerto Rico codes and laws.
- *Regulation and Processes* presentation was divided in two parts. The first section of the presentation was a discussion of the new Permits Integrated System in Puerto Rico and the scope of the new General Inspector Office regarding renewable energy projects including wind systems. The other section was a discussion of the expedited process for the development of renewable energy projects. PREAA is in charge of evaluating and distribution the declarations environmental impacts.
- *Environmental Aspects - Noise Pollution* presentation started with an audio of the sound of a wind turbine, quiet impression from the participants that the noise was lower than when a group of people are talking. During the presentation important aspects about wind turbine noise pollution were discuss during the presentation.
- *Finance Aspects and Economic Viability* presentation discussed important aspects of Puerto Rico challenges and opportunities in terms of permits, financial viability and project development. During the presentation a description and discussion about the first wind farm in Puerto Rico was developed.
- *Insurance for Wind Energy Projects* presentation described the cost effective strategies for insurance. It was also discussed the benefits and opportunities under the green insurance policy.
- *Net Metering and Interconnection* presentation discussed themes such as generated distribution interconnection, net metering, adoption of regulations and procedure for approval of interconnection and net metering.

The second forum of the Wind Energy Alliance was held last February 9, 2012; the activity was a total success with approximately 60 participants. The activity was held at the PREAA Training Center. A total of 5 speakers participate of the activity and 4 talks were held. At the afternoon participants were encourage to filled a registration form as part of the Wind Energy Alliance, a total of 45 persons agree to be part of the Wind Energy Alliance. During the forum a summary of the last activity was performed along with a talk about the potential of wind energy in Puerto Rico and its challenges. Also the community groups gave two talks where they expressed their opinion about the technology in a positive and negative way. During the afternoon section, as mention before, the attendees were encourage to be part of the alliance which was a total success and a summary of what we expect as a group was discuss. The activity invitation and itinerary was the following:



U.S. CARIBBEAN
CHAPTER

Alianza Eólica

para el Desarrollo Sostenible de Puerto Rico

2do. Foro de Discusión Pública

sobre los Aerogeneradores en Puerto Rico

Viernes, 10 de febrero de 2012
8:00 a.m. a 2:00 p.m.
Centro de Adiestramiento de la
Administración de Asuntos Energéticos
#200 Calle Manuel Camuñas Esq. Avenida César González
Urb. Industrial Tres Monjitas Hato Rey, PR 00918



Aprobado por la Comisión Estatal de Elecciones

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Wind Alliance for the Sustainable Development of Puerto Rico		
Hour	Presentation	Speaker
8:00 a.m. -8:30 a.m.	Breakfast and Registration	
8:30 a.m. - 8:45a.m.	Welcome and Introduction	• Arq. Fernando Abruña, Wind Alliance President • Damarys González Camacho - PREAA
8:45 a.m.- 9:45 a.m.	Last Meeting Summary	Arq. Fernando Abruña
9:45 a.m.-10:10 a.m.	The Potential of Wind Energy in PR: Opportunities and Challenges	Eng. Agustin Irizarry / Eng. Efrain Oneí'll
10:10 a.m. – 10:30 a.m.	Citizens of the Karso	Luis Jorge Rivera-Herrera
10:30 a.m.- 10:50 a.m	Sierra Club	Camilla Feibelman
10:50 a.m – 11:20 a.m	Departamento de Agricultura de Puerto Rico	Mrs. Jesus Santiago (Dept. of Agriculture)
11:20 a.m – 11:50 a.m	Wind Alliance Purposes Discussion	• Arq. Fernando Abruña, Wind Alliance President
11:50 a.m. – 1:00 p.m	Lunch	
1:00 p.m. - 2:00 pm	Group Constitution - Wind Alliance	• Arq. Fernando Abruña, Presidente Alianza Eólica • Damarys González Camacho - AAE

A description of the presentations performed during the activity is found below.

- *Wind Energy Alliance - Last Meeting Summary* presented a conglomeration of all the important aspects occurred in the first forum. A summary of the objectives and goals of the wind alliance were also discussed looking to engage those new participants.
- *The Potential of Wind Energy in PR: Opportunities and Challenges* presentation discuss those main important factors to consider by the desired of installing a wind energy turbine. During the talk a presentation of the NREL maps was performed a discussion of the investigation Renewable Energy Targets in Puerto Rico was done by the two main researched of the investigation performed in the 2008.
- *Citizens of the Karso* presentation were basically to discuss the importance of the community integration in renewable energy projects. They were very emphatics that is not true that they are not in favor of the development wind energy or other renewable

energy projects. However, is very important to incorporate, gave importance to the communities near the land that is going to be develop.

- *Sierra Club* presentation was composed of a brief overview of the objectives of the club which are: work for a safe and healthy community in which to live, develop smart energy solutions to combat global warming and an enduring legacy for America's wild places. At the same time the club as Citizens del Karso emphasize in the importance of work together with the communities.
- The Wind Alliance Purposes Discussion counted with a participants conversation of what they expect from the wind alliance, what they think should be the focus, what does communities, government, private sector and non for profits need from the wind alliance. The discussion was very interesting and productive a more standardized object for the wind alliance was established.
- Wind Alliance Group Constitution during this section of the activity participants were encourage to sign the agreement that makes them part of the wind alliance also participants show their interest of been part of the wind alliance directive.

The third dissemination forum was performed in collaboration with the State Energy Program. A Green Energy Business Conference to develop the renewable energy market, the main concentration of the presentations was solar and wind technology. Three talks were driven to educate the participants on the wind energy market. A description of the presentation and the activity logo is found below.



The poster for the Green Energy Business Conference features a grid background. At the top left is the logo for the 'Ministerio de Desarrollo Económico y Comercio' (Ministry of Economic and Trade Development) with the acronym 'AAE'. At the top right is the Puerto Rico flag. The main text reads: 'La Administración de Asuntos Energéticos le invitan al: GreenEnergy Business CONFERENCE'. The 'GreenEnergy' part is in green and orange, while 'Business' and 'CONFERENCE' are in orange. To the right of the text is a stylized green line graph with three circular icons: a wind turbine, a solar panel, and a battery. Below the main text, it states: 'que se efectuará el día 21 de junio de 2012, de 7:30a.m. a 3:30p.m. en el Centro de Convenciones de Puerto Rico en San Juan'. At the bottom right, in small text, it says 'Autorizado por la Comisión Estatal de Elecciones: CEE-SA-12-8513'. The bottom of the poster has a green bar with white text: 'Información y reservaciones: T (787) 749 0226 | Espacios limitados'.

Ministerio de Desarrollo Económico y Comercio
AAE

La Administración de Asuntos Energéticos le invitan al:

GreenEnergy
Business
CONFERENCE

que se efectuará el día 21 de junio de 2012, de 7:30a.m. a 3:30p.m.
en el Centro de Convenciones de Puerto Rico en San Juan

Autorizado por la Comisión Estatal de Elecciones: CEE-SA-12-8513

Información y reservaciones: T (787) 749 0226 | Espacios limitados

- The first presentation was *Renewable Energy: Projects Development, Challenges and Financing*. The first part of the presentation was a summary of the basic principle of renewable energy and the different technologies available. Then an overview of the costs of energy in Puerto Rico and cost of these systems was performed. Followed by the description of the process to install a PV system or Wind system, including the available incentives and financing methods available in the island.
- A Wind Energy Alliance presentation was held, been catalog as the presentation with most participants in all the activity, to inform and educate the participants of the importance and market development of wind energy. The presentation was held by Arq. Fernando Abruña, Wind Alliance President, successfully managing to capture the attention of participants on topics such as historical background of PR with wind turbines, trustworthy of the resource, wind alliance history, past forums important facts summary, types of wind turbines, environmental aspects and other important themes. Arq. Abruña reach to have the attention of all participants and engage participants to be part of the wind alliance, interested participants signed as new members of the wind alliance.
- The third presentation was Wind Energy as a Business Model. The presentation started with a video of all the process steps carried out during the installation of a wind energy turbine in Germany. The video was very interesting and a good way for people to see from another perspective the technology and not just as a technical conversation. The speaker then continue to talked about the different operational structures available for the development of a wind project, financing models available in the market, quantity of projects developed in Puerto Rico including residential, commercial and utility scale and project risks and mitigation. The presentation showed the participants the market availability in wind technology and growth through the years.

Task 2.0 Plan to support new and existing Wind Working Groups

The Wind Energy Alliance Group was form with a total of 26 members. During the February forum the participants were encourage to form part of the Wind Alliance group, looking to create a voice and a trustworthy organization over the wind energy theme. Wind Alliance members meetings have been constituted three times at PREAA's facilities. The meetings are held at 6:00 p.m. thru 7:30 p.m. the alliance will continue to meet monthly to organize all the needed point for the group. A draft of the statutes of the alliance has been worked and the group is expecting to register the alliance as a non for profit organization and have solid base.

The Wind Alliance efforts will centered in the following:

- Centered efforts to gather all available information on the topic of wind energy and their sustainable uses for the island.
- Provide communities, government, investors and developers and general public knowledge for sustainable development of wind power in Puerto Rico.
- Promote the union of all sectors to share information and practical results for local and global sustainable and efficient use of wind energy.
- Promote conditions of equal access to information for all sectors can participate in the benefits of sustainable wind energy.
- Raising awareness of the strategic importance of sustainable wind energy as a renewable source in the process of socio-economic development
- Promote the development of a humanist wind industry, based on scientific ethics, technological and social sustainability.
- Develop educational and outreach activities on scientific, technological, environmental and social aspects as they relate to wind energy development.
- Promote training, education and discussion, providing support to technical scientific local communities, production structures, civil organizations, etc., participating responsibly in the social field, with independence of criteria and constructive attitude.
- Generate an independent and innovative institutional framework for the development of activities including educational and research, among others, ensuring standards of excellence.
- Enhance the generation of sources of "green" jobs for residents of Puerto Rico on interdisciplinary work by making use of our socially useful expertise.
- Participate in the decision of the final mixture ("Portfolio") of renewable energy sources available for the production of electricity in PR.
- Discuss the strengths and weaknesses of proposed projects using an open methodology and transparent evaluation.
- The Wind Alliance for Sustainable Development of Puerto Rico does not endorse private or public projects. With this vision and to maintain an impartial and objective, the ALLIANCE developers or consultants will not accept wind power developers or consultants (which give it services to contractors and developers) in the evaluation process. These may assists suggestions on the methodology to be used but may not be part of decisions.

Task 3.0 Support Agriculture Outreach Initiatives

PREAA has been completely engaged in supporting the Department of Agriculture in all initiatives regarding the support of energy efficiency and renewable energy. PREAA made an agreement with the United States Department of Agriculture to promote the USDA Rural Development program and direct the clients on the right path. Various meeting promoting the implementation of wind energy systems has been performed on the agency.

Task 4.0 Anemometer Loan Program

As part of the wind energy research and education outreach PREAA with state fund bought an anemometer that was assigned for the program purposes. PREAA available the opportunity to loan the anemometer for research purposes on wind energy studies. The anemometer was loan to Polis Group LLC to gather data at a parcel in the municipality of Carolina. Various studies were performed by the loaner and satisfactory results were obtained.

Task 5.0 Support Small and Community Scale wind outreach

PREAA is engaged in participating in public conferences with educational purposes on wind energy. Educational outreach in schools, government and private activities has been performed. In collaboration with the State Energy Program educational presentations were performed in around 75 schools. A power point presentation of the importance of energy efficiency and renewable energy was the main focus. Educational souvenirs such as wind energy informative pamphlets, coloring books, Wind Alliance Green Bags and post it's distributed in the schools.

Task 6.0 Attendance to Annual Wind Energy Conference

Mr. Luis M. Bernal, executive Director of PREAA, attended to the AWEA conference in Georgia. During the conference Luis M. Bernal participate in many talks such as:

- The importance of extending the Production Tax Credits for wind energy.
- The concept of Community Winds. Distributed generation model were the investments rounds between \$2-\$30MM.
- Discussion of the availability of lease back an attractive vehicle for the financing of wind projects, the financing term may be up to 20 years.
- In terms of Offshore Wind a discussion of the challenges that the technology confront was performed. AWEA and NREL are working on the issue of guidelines that facilitate the integration of these projects.

The information provided during the conference is very significant to analyze and identify the position of PR from the rest of the world. In particular, given the fact that the first wind farm will be Operational in PR 2012.