Global
Sustainable Electricity
Partnership

ANNUAL PROGRESS REPORT
2015–2016

INNOVATING

for a Sustainable Future

GLOBAL SUSTAINABLE ELECTRICITY PARTNERSHIP

The Global Sustainable Electricity Partnership (GSEP), a not-for-profit comprising the leading companies in the global electricity sector, promotes sustainable energy development through electricity sector projects and human capacity-building activities in developing nations worldwide. Our projects and activities are financed mainly by our member companies, which also contribute in-kind resources for their execution.

Together, the eleven GSEP companies serve 1.2 billion customers, and generated and delivered about one third of the electricity used in the world last year, with a capacity mix of which approximately 60% was generated with no direct carbon emissions.

MISSION

Our mission is to play an active role in global electricity issues in an international framework, and to promote sustainable energy development. This diverse international group offers electricity sector skills and practical competencies in electricity generation, transmission and distribution. With international field-proven expertise in the planning, management, design, operation and maintenance of energy facilities, member companies assist and share their know-how in the effective implementation of sustainable energy development with counterparts in developing and emerging countries.

MEMBER COMPANIES

American Electric Power
United States

Électricité de France
France

Eletrobras
Brazil

ENEL
Italy

EuroSibEnergo
Russia

Hydro-Québec
Canada

Iberdrola
Spain

Kansai Electric Power Company
Japan

RusHydro
Russia

RWE
Germany

State Grid Corporation of China
China

Message from the Chair

TRANSITIONING TO CLEANER ENERGY THROUGH GLOBAL COOPERATION

The signing of the Paris Agreement signals the need for countries to move ahead with its implementation in order to transition to a lower-carbon world. As a group of the world's leading electricity companies, the Global Sustainable Electricity Partnership (GSEP) members are well-placed to make this goal a reality. It was with this perspective that State Grid Corporation of China (SGCC) proposed to explore the theme "Roadmap for Energy Future – Moving from Today's Power Systems to a Global Energy Interconnection (GEI)" for its 2015–2016 Chairmanship year. SGCC's GEI concept is defined as global interconnected strong and smart grids with ultra-high voltage grids as the backbone. The outcome of the annual theme work shows the potential positive impact that wider, smarter interconnections developed at local, regional and global levels could provide toward the goal of reducing carbon emissions.

This has been a year marked by significant achievements for the GSEP. The GSEP companies' executives joined together to release a report which urged the policymakers at the COP21 to consider our recommendations when establishing an international climate agreement. We noted with great pleasure that the final text of the Paris Agreement aligns with our recommendations, which shows that our voice was acknowledged and heard. We believe that this Agreement promotes effective and practical cooperation for future energy development.

During this year, GSEP's renewable energy projects also advanced significantly. The Dhiffushi Solar Ice Project, led by Kansai Electric Power Company, began operating in the Maldives this year, bringing renewable energy to an island country that is almost fully dependent on fossil fuels and very vulnerable to climate change. The Uruguay Biogas Micro-Generation System and the Peru Solar- and Wind-Powered Laboratory for Aquaculture are being implemented and will help increase the penetration of renewable energies and improve the quality of living for their beneficiaries. Finally, the ownership of the Galapagos San Cristóbal Island Wind Project was transferred to the local utility after eight years of financially and environmentally sustainable commercial operations.

Our members also collaborated in capacity building efforts, strengthening our commitment to the development of human capital. We held a successful conference on public-private partnerships in Accra, Ghana in November 2015 in collaboration with the International Finance Corporation and the Millennium Development Authority. Throughout the year, our companies' experts have also been collaborating with the World Bank's Energy Sector Management Assistance Program to produce reference documents which will help countries integrate renewables into their grids. We also celebrated our commitment to education with the awarding of our 100th scholarship to support students from developing countries studying in the field of sustainable energy development. Our scholars are now working as sustainable energy professionals and improving the lives of people around the world.

Finally, we were pleased to welcome EuroSibEnergo – the largest private power company in Russia – as a new member to the GSEP.

SGCC has been honoured to serve as the GSEP Chair company and to host the GSEP meetings and Summit in China this year. I am confident that our hard work and cooperation can help the world transition to cleaner energy.

Yinbiao Shu
Chairman, State Grid Corporation of China

Rio de Janeiro Annual Summit

INDUSTRY LEADERS SHARE INTERNATIONAL PERSPECTIVES ON GLOBAL ELECTRICITY ISSUES

Every year, heads of the world's leading electricity companies gather at our Annual Summit to discuss prominent issues with other leaders and distinguished guests.

The 2015 Summit took place on June 1–2, 2015 in Rio de Janeiro, Brazil. Hosted by the Brazilian member company, Eletrobras, the Summit centered on the theme of Eletrobras' GSEP chairmanship year: "Challenges for positive engagement of stakeholders in the operation and expansion of electric utilities' assets".

In a series of exchanges between the GSEP Chairmen and distinguished guests from the Ministry of Mines and Energy of Brazil, ANEEL (Brazilian National Regulatory Agency), the Electric Power Research Institute (EPRI), the International Electrotechnical Commission (IEC), the Edison Electric Institute (EEI), and the Global Electricity Initiative (GEI), among others, different insights and experiences were presented on how to increase engagement of different stakeholder groups in order to drive long-term, sustainable business success.

Over the course of the Summit, GSEP Chairmen also discussed the challenges ahead for utilities in: meeting regulatory and consumer needs, including all actors to harness technological innovation, and engaging electricity company shareholders and investors in the context of today's rapidly changing environment. The electricity industry is in a state of global transition and the GSEP companies are ready to lead this transition with innovative research and ideas.

Mr. Terry Tamminen, the Chief Strategic Advisor for R20 Regions of Climate Action and former Secretary of the California Environmental Protection Agency, delivered a keynote speech on the green economy and challenges for the future of the energy sector. Mr. Tamminen emphasized the need for innovation and commitment in order to adapt to the growing need and demand for renewables.

In another highlight of the Summit, the Chairmen welcomed EuroSibEnergo from Russia as the newest member of the GSEP. EuroSibEnergo is the world's largest private hydro-generation company and the largest private power company in Russia. Their pool of expertise is a great addition to the GSEP and the organization's ability to promote sustainable energy development around the world.

The Summit closed with the transfer of the GSEP Chairmanship to State Grid Corporation of China for the 2015–2016 year, for which the theme is "Roadmap for Energy Future – Moving from Today's Power Systems to a Global Energy Interconnection".

Yinbiao Shu, Chairman of State Grid Corporation of China, Chair company for the 2015–2016 year.

Jose da Costa Carvalho Neto, CEO of Eletrobras, host company of the 2015 Annual Summit held in Rio de Janeiro.

Our summits encourage major players in the international power sector to share their ideas and perspectives on global electricity issues

The GSEP Chairmen and representatives, Executive Director, and invitees at the GSEP's Annual Summit.

COP21

GSEP COMPANIES ARE READY TO LEAD THE GLOBAL ENERGY TRANSITION

Our recent report, *Powering Innovation for a Sustainable Future,* outlines key recommendations to policymakers, and was shared and advocated in Paris during the historic 2015 United Nations Conference on Climate Change (COP21).

In preparation for the COP21, we prepared a ground-breaking report in which the top executives of the GSEP companies came together to present four key recommendations to policymakers on establishing a long-term climate change agreement. The report, *Powering Innovation for a Sustainable Future,* was the product of a two-year international consultation process between GSEP companies and external technical experts in various parts of the world, including Brazil, China, India, and the USA.

In their recommendations, the GSEP executives urged policymakers to establish stable long-term energy policies, develop a systemic approach to electricity systems which considers the interrelations within the electricity value chain, promote and engage in public-private partnerships, and make urgent progress with innovative research, development and demonstrations of advanced economically viable technologies that will reduce GHG emissions and accelerate the efficient generation, delivery and end-use of electricity. The Paris Agreement negotiated at COP21 shows a strong alignment with these recommendations and can help promote effective and practical cooperation for future energy development.

The report also catalogs some 50 emerging and existing technological innovations in energy generation, distribution, storage, and end-use.

GSEP executives believe that electricity will be at the heart of the response to the global climate challenge. The electricity sector is leading the way in the global effort to avoid, and reduce carbon dioxide emissions by systematically optimizing existing technologies in the right mix, amount, time and place, and applying the full portfolio of advanced technologies as they become commercially available.

During COP21, executives of GSEP member companies convened at the Espace Fondation EDF in Paris for a high-level panel discussion on the electricity industry's role in achieving climate and energy goals.

The panelists agreed that we are entering a new era in our relationship with energy worldwide, brought about by the significant introduction of renewables and digitalization. Panelists also shared their visions on how new technologies, research, improvements in infrastructure, optimization of existing technologies, and other innovative solutions can drive the transition to a lower-carbon world.

In order to achieve an effective energy transition, companies must learn to adapt quickly to the rapid changes happening inside and outside the electricity sector. The GSEP companies are prepared to lead this transition with their industry expertise, their capacity to innovate, and their commitment to building a more sustainable future.

The panelists at GSEP's COP21 high-level panel discussion. From left to right: François Dassa (EDF), Peter Terium (RWE), Martine Provost (GSEP), Dr. Lawrence Jones (Edison Electric Institute), Éric Martel (Hydro-Québec), Andrea Valcalda (Enel), Claude Nahon (EDF), Agustin Delgado (Iberdrola).

"We've always been following changes. The companies in our sector are used to adapting to changes and I think renewables are just another further step which we have to adapt to."

Peter Terium,
CEO of RWE

"Within Québec, Hydro-Québec is strongly involved in the electrification of transportation. Forty percent of our emissions in Québec come from cars, so we're in a situation where more electrification of transportation will help us reduce our carbon footprint."

Éric Martel,
CEO of Hydro-Québec

"We are leading a revolution today. The use of energy will be in the hands of customers. We need a system that is more bottom–up, reinventing the relationship between the customer and us."

Claude Nahon,
Sustainable Development Senior Vice-President of Électricité de France

The Education for Sustainable Energy Development Scholarship Program

SUPPORTING OVER 100 FUTURE ACADEMICS AND PRACTITIONERS

This year, our Education for Sustainable Energy Development Scholarship Program (ESED) celebrated an important milestone by awarding its 100th scholarship. Nine exceptional scholars were selected by an independent Academic Panel. The ESED Program was established in 2001 to help exceptional students from developing countries build a better future by supporting their master's level studies in sustainable energy development. Today, the need for globally-oriented practitioners and researchers is growing rapidly. We are proud to support the next generation of innovators and thinkers who will use their knowledge to create a sustainable future.

As of April 2016, the Program will be deployed under the leadership of Hydro-Québec, following in the footsteps of former lead company Kansai Electric Power.

The GSEP would like to acknowledge the renewed assistance of Ontario Power Generation (OPG) to the ESED Program and the company's long-standing commitment to the Program's success since its inception in 2001.

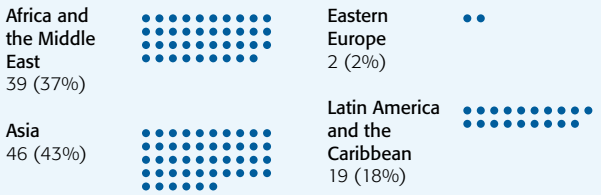
SELECTED CANDIDATES FOR THE 2016–2017 ESED SCHOLARSHIP AWARDS

- Mr. **HAILU DIMTSU TAMENE** from Ethiopia will pursue a master's degree in Solar Energy Engineering at Dalarna University, Sweden.
- Mr. **DIPTA MAJUMDER** from Bangladesh will pursue a Postgraduate Programme in Renewable Energy at the University of Oldenburg, Germany.
- Mr. **ARPAN KOIRALA** from Nepal will pursue a M.Sc. in Sustainable Energy Systems at the University of Edinburgh, United Kingdom.
- Mr. **ASUTOSH NAYAK** from India will pursue a Master of Engineering in Energy and Environmental Management in Developing Countries at the University of Flensburg, Germany.
- Ms. **RADWA MAHMOUD GABER ALGAZZAR** from Egypt will pursue a M.Sc. in Renewable Energy Systems Technology at Loughborough University, United Kingdom.
- Mr. **EDUARDO GOLDARACENA AGUIRRE** from Mexico will pursue a M.Sc. in Sustainable Energy Systems at the University of Edinburgh, United Kingdom.
- Ms. **JESSELYN ROCHELLE MALIMATA** from the Philippines will pursue the European Joint Master's in Management and Engineering of Environment and Energy.
- Ms. **JOYCE AWINBUN APANGA** from Ghana will pursue a M.Sc. in Electrical Engineering for Sustainable and Renewable Energy at the University of Nottingham, United Kingdom.
- Mr. **OSAKPOLOR EKI OBAKPOLOR** from Nigeria will pursue a M.Sc. in Renewable Energy at the University of Hull, United Kingdom.

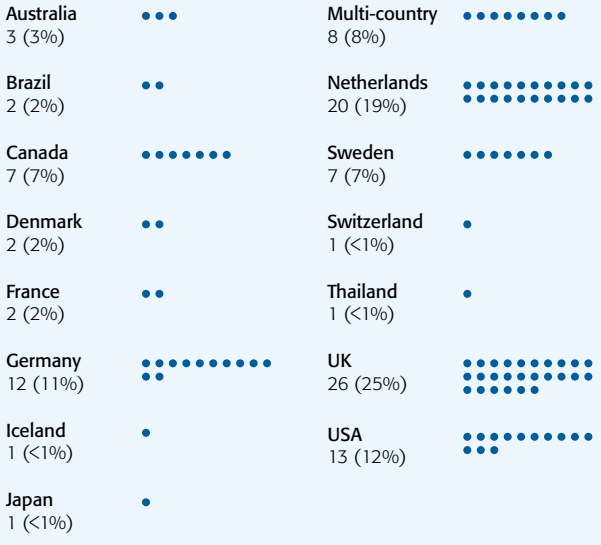
TOTAL SCHOLARSHIPS AWARDED: 106

ESED SELECTED RECIPIENTS (2001–2016)

By region of origin



By host university country



"After I graduate, I plan to go back to Vietnam and join a project which will allow me to transfer my knowledge of technologies. I want to improve the Vietnamese energy field and contribute to the sustainable development of energies and renewables."

Nga Phung
a 2015 scholarship recipient from Vietnam, is pursuing her master's degree in Sustainable Energy Technology at Delft University of Technology in the Netherlands.

"With all the knowledge I've acquired since I left Peru I've been able to give a bit back. I'm still in touch with my university back there and I've been able to give an online workshop (a webinar). At work, I am the business developer for South America and the Caribbean and we are trying to expand our market overseas. So far we've had two projects in the Caribbean on sustainable energy and one project in Peru on agro-exporters' adaptation to climate change."

Jessica Yearwood,
a 2010 scholarship recipient from Peru, works as a consultant at Trinomics, an economic policy consultancy.

"The scholarship helped me discover new opportunities, which led me to energy efficiency. I work with the GIZ project financed by both the EU and German government and I am currently the head of the energy efficiency unit for the Nigerian Energy Support Programme. I have gone to West African countries for the design, analysis and implementation of clean energy technologies. Every year, I also go Mali to conduct some capacity development workshops on the design and promotion of clean energy technologies in the universities, and other national and private institutions."

Charles Diarra,
a 2004 scholarship recipient from Mali, is the head of the energy efficiency unit for the Nigerian Energy Support Programme.

"Being offered the ESED scholarship has cemented my belief that working hard to achieve your goals will always open the doors for you. It is my aim to become an expert in the area of renewable energy technologies and it is my ambition to effect change towards a Green India."

Ajay Jamodkar,
a 2015 scholarship recipient from India, is pursuing his master's degree in Electrical Sustainable Energy at Delft University of Technology in the Netherlands.

1992–2016:
OUR ACTIVITIES WORLDWIDE

AFRICA AND MIDDLE EAST

Projects

Benin, Burkina Faso, Niger	• Solar energy supply systems in the W National Park, a UNESCO World Heritage Site
Rwanda, Uganda, Zambia	• Distribution of 60,000 solar lanterns worldwide

Capacity Building Activities

Algeria	• Workshop on renewable energy and energy efficiency for the sub-Mediterranean Basin
Egypt	• Seminars on institutional strengthening of the power sector
Ghana	• Workshop on strengthening public-private partnerships in the electricity sector
Jordan	• Demand-side management program • Thermal power plant efficiency improvements • Environmental management program
Lebanon	• Improving thermal power plant efficiency
South Africa	• Demand-side management assistance • Renewable mini-grid assessment
Southern Africa, based in Zimbabwe	• Environmental management workshop • Environmental strategy program • Electrification capacity building workshops
Benin, Kenya	• Regional dialogue on financing sustainable electrification
Cameroon, Kenya	• Workshop on rural electrification
Egypt, Syria, Tunisia	• Environmental impact assessment workshop
Egypt, Ethiopia, Republic of Congo	• Seminar on electricity interconnection
Based in Germany and USA for Africa and Asia	• Technical expertise workshops on coal-fired power plants

ASIA

Projects

Bhutan	• Micro-hydro plant in a remote Himalayan village, registered as a Clean Development Mechanism project
Indonesia	• Installation and monitoring of micro-hydro, solar home systems, and hybrid wind/solar renewable energy supply systems in rural areas
Maldives	• Grid-connected solar photovoltaic system and ice-making machine
Nepal	• Improving rural education with photovoltaic systems • Distribution of 60,000 solar lanterns worldwide
Philippines	• Mini-hydro plant to protect the Banaue Rice Terraces of Ifugao, a UNESCO World Heritage Site

Capacity Building Activities

Bangladesh	• Assistance to transmission and distribution companies
Bhutan	• Workshop on electric utility management strengthening
China	• Clean coal technology seminar • Demand-side management assistance • Seminar on environmental impact assessments for thermal power stations
India	• Technical assistance for environmental management • Workshop on strengthening public-private partnerships for sustainable electricity and energy efficiency
Indonesia	• Renewable energy and rural electrification workshop
Mongolia	• Thermal power plant rehabilitation
Nepal	• Wind energy planning and development workshop
Thailand	• Technical assistance training for environmental agencies • Strengthening environmental agencies program • Workshop on rural electrification • Regional dialogue on financing sustainable electrification
Malaysia, Thailand	• Environmental impact assessment workshop
Based in Germany and USA for Africa and Asia	• Technical expertise workshops on coal-fired power plants

LATIN AMERICA AND THE CARIBBEAN

Projects

Argentina	• Installation of a micro-hydro facility and a wind-diesel plant in isolated communities in the Patagonia desert
Bolivia, Guatemala, Haiti, Peru	• Distribution of 60,000 solar lanterns worldwide
Ecuador	• Galapagos San Cristóbal Island Wind Project, which includes two solar photovoltaic systems, and is registered as a Clean Development Mechanism project
Peru	• Solar- and wind-powered laboratory for aquaculture
Uruguay	• Biogas micro-generation system project

Capacity Building Activities

Argentina	• Workshop on the role of public-private partnerships in scaling-up renewable energy projects
Brazil	• Regional workshop on best practices for large hydropower development • Workshop on public-private partnerships and energy storage for sustainable development • E3 assessment of a manufacturing plant in Manaus
Chile	• Assessment of a wind energy and electrification project in the Chiloé Archipelago • Regional dialogue on financing sustainable electrification
Ecuador	• Micro-solar distance learning program
Mexico	• Environmental assessment of transmission line projects
Based in Chile	• Regional dialogue on financing sustainable electrification
Ecuador, Nicaragua	• Workshop on the Clean Development Mechanism and power sector development
Mexico, Paraguay	• Environmental impact assessment workshop

EASTERN EUROPE AND CENTRAL ASIA

Capacity Building Activities

Bulgaria	• Energy efficiency in public buildings workshop
Georgia	• Inspection of the Inguri Dam • Seminar on regulation, institutional relations, and tariffs
Russia	• Regional workshop on best practices for large hydropower development
Serbia	• High-level dialogue on strengthening public-private partnerships for sustainable energy and energy efficiency
Tajikistan	• Emergency assistance to the city of Dushanbe's electricity distribution system
Based in Switzerland for Eastern Europe	• Regional dialogue on financing sustainable electrification

OCEANIA

Projects

Tuvalu	• Installation of a grid-connected solar power system

Capacity Building Activities

Pacific Islands: Fiji, Guam, Marshall Islands, Palau	• Development of sustainable energy sites workshop • Solar photovoltaic systems workshop • Demand-side management workshop • Grid-connected solar photovoltaic workshop • Energy efficiency improvement workshop • Tariff structure development workshop

Activities

PUBLIC-PRIVATE PARTNERSHIPS

for Sustainable Electricity Development Program

KEY OBJECTIVES:

- To empower decision-makers through regional conferences worldwide that help define best strategies and practices for the successful implementation of public-private partnerships in the sustainable electricity sector.

CONFERENCES HELD IN:

Argentina, Brazil, Ghana, India, Serbia

Panelists and participants at the GSEP–IFC–MiDA joint PPP workshop in Accra, Ghana.

Since its official launch in 2013, the GSEP's Public-Private Partnerships (PPP) for Sustainable Electricity Development Program has empowered decision-makers in developing and transitioning economies worldwide to define the best strategies for successful PPPs. By sharing lessons learned and best practices, this program creates a bottom-up approach to sustainable electricity development.

FIRST AFRICAN PUBLIC-PRIVATE PARTNERSHIP CONFERENCE IN GHANA

The GSEP partnered with the International Finance Corporation (IFC) and the Millennium Development Authority (MiDA) to organize and host a high-level dialogue on PPP targeting the African region in Accra, Ghana. Some 40 high-level policymakers and representatives from ministries, energy regulators, banks, public and private utilities, and sector experts attended the conference, which was held from November 16–17, 2015.

The Hon. Dr. Kwabena Donkor, the Ghanaian Minister of Power, opened the conference. Other notable attendees included: the Hon. Mona Quartey (Ghanaian Deputy Minister of Finance), Ing. Owura Sarfo (CEO of MiDA), Ronke Ogunsulire (IFC Country Manager for Ghana), Nika Gilauri (former Prime Minister of Georgia, former Minister of Energy of Georgia), Raphael Lotilla (former Secretary of Energy, the Philippines), and Praveer Sinha (CEO, Tata Power Delhi Distribution Limited).

During the conference, panelists openly discussed the steps taken to reform the sector in Nigeria and Ghana. Lessons learned, case studies, and experiences were shared from abroad, namely from Georgia, the Philippines, and India. It was noted that there are many factors that contribute to a successful public-private partnership including: a clear vision with appropriate risk sharing, a proper contract with clearly defined obligations, a commitment on the part of all parties, participation and transparent communication between all parties, the installation of meters at the consumption points, and payment collection. All these elements are needed to attract private developers in the electricity sector and to have a successful PPP.

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"The provision of adequate and affordable energy is a fundamental prerequisite for the economic and social development of any country."

Dr. Kwabena Donkor,
Minister of Power, Republic of Ghana

Activities

COLLABORATION WITH ESMAP

In 2015, the Energy Sector Management Assistance Program (ESMAP) of the World Bank expressed its interest in collaborating with the GSEP on ESMAP'S Variable Renewable Energy (VRE) Grid Integration Support Program. This global program aims to support World Bank client countries to achieve a cost-effective and sustainable scale-up of VRE by providing technical assistance, capacity building and knowledge products for the development and implementation of planning, regulatory, market and operational best practices in VRE integration.

GSEP experts are leading three working groups to provide guidelines for: procurement of VRE forecasting tools, conduction of grid connection studies, and basic specifications and standards for VRE-associated generation, transmission and distribution system equipment. In the first half of 2016, the working groups will produce reference documents which will be used by ESMAP to support policymakers and electric utility employees in client countries to integrate renewables into their grids.

"This conference is quite timely, considering that Ghanaians are asking questions in respect to how power supply along the whole chain can be enhanced."

Ing. Owura Sarfo,
CEO, Millennium Development Authority

Activities

DHIFFUSHI SOLAR ICE PROJECT

KEY OBJECTIVES:

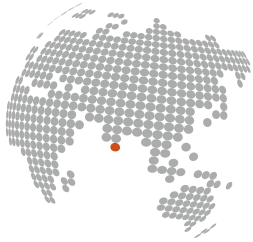
- Promote the use of local renewable energy sources
- Reduce CO_2 emissions by reducing fossil fuel consumption
- Provide momentum for a shift away from full reliance on diesel and other petroleum products
- Promote the growth of local economic activity
- Serve as a pilot for the replication of similar projects

LOCATION:

Dhiffushi Island, Republic of Maldives

LEAD COMPANY:

Kansai Electric Power Company



CONCEPT

Completed in February 2016, the Dhiffushi Solar Ice Project features a 40 kW grid-connected solar photovoltaic (PV) system installed on the island of Dhiffushi in the Maldives. A unique feature of this project is the installation of an ice-making machine coupled with the PV system. Instead of using a conventional battery system for storage, the ice-making machine stores any excess solar energy, effectively working as a supply-demand controller. If the amount of solar energy supplied to the system is greater than the electricity demand, the system will use the excess energy to make ice. The ice machine will enable the island's residents to preserve fish for sale, as fishing is the main economic activity in Dhiffushi.

IMPLEMENTATION

The GSEP worked closely with the Ministry of Environment and Energy (MEE), the State Electric Company Limited (STELCO), and the Asian Development Bank (ADB) to ensure the success of the project. The project was funded mainly by Kansai and partially through a Japanese government development grant. The equipment was manufactured in Japan and transported to Dhiffushi for installation. Foundation work began in December 2015 and construction was completed by February 2016.

Local engineers receive training from GSEP experts on PV system design, construction, operation, and maintenance.

IMPACT

SUSTAINABLE DEVELOPMENT FOOTPRINT

The Maldives is listed by the United Nations Education, Scientific and Cultural Organization (UNESCO) as a Small Island Developing State (SIDS). SIDS are particularly vulnerable to global climate change and sea-level rise. In this case, the islands that make up the Maldives are, on average, less than 2 meters above sea level. The Maldives, like many other SIDS, is also reliant on imported petroleum to meet energy demands. Fluctuating oil prices and growing concerns about climate change have driven many SIDS to pursue more sustainable energy solutions.

The Dhiffushi Solar Ice Project will prevent the emission of 49 tonnes of CO_2 per year and will generate momentum for the shift away from full reliance on diesel generation.

The PV system will account for approximately 10% of annual energy consumption, and under the best conditions, will supply around 50% of the demand of the more than 1,000 households in Dhiffushi. The ice machine will enable the efficient use of solar energy while also helping the island's residents to preserve fish for sale. Fishing is the main economic activity in Dhiffushi and, following tourism, is the second-most important economic activity in the Maldives.

The project, which was carried out in partnership with the ADB's Asia Solar Energy Initiative (ASEI), will serve as a pilot for the replication of similar projects across other islands in the Maldives and other SIDS.

CAPACITY BUILDING

To facilitate deployment, replication, and maintenance of the PV system, GSEP and ADB carried out a workshop on PV system design, construction, operation, and maintenance for local engineers in April 2012. A second workshop is planned for the near future. The local staff have also been trained in the maintenance and operation of the PV system.

These training and workshops have helped develop the technological know-how and expertise of Maldivian engineers to ensure that the PV system will continue to operate smoothly in the years to come.

MONITORING

As per the memorandum of understanding, STELCO will be responsible for the operation and maintenance of the PV system following completion of construction. GSEP will continue to monitor the project for two years and will support STELCO to ensure that the necessary skills and know-how are in place to guarantee the long-term sustainability of the project.

The solar PV panels and ice house installed on Dhiffushi Island, Maldives.

Fishing is the main economic activity in Dhiffushi. Local fishermen and residents will be able to use the ice produced to preserve fish for sale.

Activities

URUGUAY BIOGAS MICRO-GENERATION SYSTEM

(only phase 1 under the GSEP capital projects portfolio)

KEY OBJECTIVES:

- Reduce the environmental impact of animal waste on water resources
- Use biogas produced from animal waste as a source of electricity and heat
- Reduce CO_2 emissions and promote the use of local renewable energy sources
- Serve as a pilot for the replication of similar projects
- Advance research on the socioeconomic benefits of biogas technology projects

LOCATION:

Colonia Delta, San José de Mayo, Uruguay

LEAD COMPANY:

Eletrobras

CONCEPT

The project (divided into three different, consecutive phases of implementation) in phase 1 will have a biogas production system, which includes biodigesters and related equipment, on six small dairy farms in the Colonia Delta community in the Department of San José, Uruguay.

Animal waste will be fed into the biodigester, which, by means of a bacterial biofermentation process, breaks down the waste into biogas and a leftover material known as biofertilizer. The biogas produced will be used by the community as a source of electricity and heat. The remaining biofertilizer will be used by local farmers to enrich the soil. The installed system will produce 2 × 75 kW of electricity, to be sold to the grid mainly during the peak load period. The installed capacity of the generating facility is still under economic analysis in order to have the optimized solution in terms of investment (CAPEX) and revenues (coming from the electricity sold to the grid)

IMPLEMENTATION

This project is being developed in collaboration with the Colonia Delta Cooperative, the United Nations Development Programme (UNDP), UTE (the public utility in Uruguay responsible for generation, transmission and distribution), the National Energy Department (DNE), the National Institute for Research in Agriculture and Live Stock (INIA), the National Environmental Agency (DINAMA), the Government of the Department of San José, BioValor, and CIBiogas/Itaipu – PTI.

Site preparation on the farms was completed in 2015. With the support of GSEP, Eletrobras has been continuing the training of local residents in order to guarantee the long-term operation and maintenance of the project. The Government of the Department of San José (with the technical support of BioValor) will proceed with the procurement process in 2016 for purchase of the biodigestors, pipeline, motor-generator groups, and preparation for the implementation of this biodigestion system.

The project team with representatives from Eletrobras, CIBiogas, the CAF Development Bank of Latin America, and the Government of the Department of San José.

IMPACT

The first phase of the biogas system will prevent the emission of 445 tonnes of CO_2 per year, and the fully-implemented system will prevent the emission of 1.77 kilotonnes of CO_2 per year. The system will also improve living conditions in the area by protecting surface and groundwater resources from contamination by manure, providing farmers with biofertilizer to replace chemical fertilizers, and preventing the proliferation of flies (which may spread disease) and odours.

The project will serve as a model for replication in other similar contexts of farming communities in the area, in Uruguay, and in South and Central America.

Activities

PERU SOLAR- AND WIND-POWERED LABORATORY FOR AQUACULTURE

KEY OBJECTIVES:

- Promote the use of local renewable energy sources
- Reduce CO_2 emissions by reducing fossil fuel consumption
- Promote the growth of local economic activity
- Improve local access to potable water
- Promote gender equality by involving women in local economic activities

LOCATION:

San Juan de Marcona, Ica Region, Peru

LEAD COMPANY:

Enel

CONCEPT

The Peru Solar- and Wind-Powered Laboratory for Aquaculture will provide electricity to an algae and urchin cultivation plant (a hatchery) in the coastal fishing community of San Juan de Marcona, Peru. The hatchery will be powered by an off-grid hybrid system consisting of: a 63 kWp solar photovoltaic (PV) system, a 60 kW mini wind system, a diesel generator, and electrochemical batteries for storage (70 kWh).

In addition to the hybrid power supply system for the hatchery, 16 rooftop mini solar lighting systems have been installed at check points along the coast to improve the security of the fishermen during the night. The main beneficiaries of the project will be the 500 local fishermen who gather and sell algae.

IMPLEMENTATION

Enel, with the support of the GSEP, is working closely with the Ministry of Production in Peru, and the local fishing community board, COPMAR, to implement the project. Permitting activities are ongoing.

The above-mentioned mini solar lighting systems have already been installed. Construction should be completed by the end of 2017.

IMPACT

SUSTAINABLE DEVELOPMENT FOOTPRINT

The hybrid power supply system will generate 70% of its total energy from renewable sources and will prevent the emission of 261 tonnes of CO_2 per year in comparison with a full diesel supply.

In addition to its environmental impact, the cultivation plant will also improve the local fishing economy by diversifying the products produced by the community, which will assist with commercial competitiveness and long-term economic sustainability.

Finally, potable water will be produced as a by-product of the hatchery's water purification system. This water can be used by the community for drinking and other purposes.

CAPACITY BUILDING

Workshops led by Enel have helped train the local fishermen in safe diving techniques and first aid. More training will be conducted in 2016 to guarantee the proper long-term operation and maintenance of the facilities. Part of the training program includes technical training for women, who will now be empowered and educated to play a more active role in the economic activities of the community.

Rooftop mini solar lighting systems have been installed along the coast to improve the security of the fishermen at night.

TRANSFER OF THE GALAPAGOS SAN CRISTÓBAL ISLAND WIND PROJECT

- **Supplies approximately 30% of the island's annual electricity needs**
- **Financially stable and sustainable, with a total revenue of $3.4 million over eight years under a Power Purchase Agreement with ELECGALÁPAGOS S.A., the local utility company**
- **Reliably generating electricity available 92% of the time, with little downtime for repairs and maintenance**
- **A replicable model employing innovative technologies for similar projects being developed in the Galapagos Islands, South America, and worldwide for affordable, reliable and clean power that meets customer and regulator expectations**

For more information: www.globalelectricity.org/galapagos

This year marks an important milestone for the Galapagos San Cristóbal Island Wind Project, with the ownership of the project transferred to the local utility, ELECGALÁPAGOS S.A. Since its commissioning on October 1, 2007, the project has been operating sustainably, both environmentally and financially. GSEP has provided sufficient training and monitoring over the past eight years to ensure that ELECGALÁPAGOS S.A. is ready to continue the tradition of excellence in the operation and maintenance of this project.

The project was the first large-scale wind project in Ecuador and consists of three 800 kW turbines which have provided more than 26 million kWh of energy, complemented by two 6 kW solar photovoltaic (PV) systems which have produced 136,000 kWh of electricity. The project has displaced one-third of the diesel consumption on San Cristóbal and has become a symbol of successful sustainable energy development.

As the project is located in the fragile ecosystem of the Galapagos Islands, a UNESCO World Heritage site, GSEP companies were committed to designing and constructing the project in strict compliance with environmental laws and the recommended environmental safeguards. Since the project's commercial start-up, no Galapagos petrels, an endangered indigenous bird on the islands, have been injured or killed because of the wind turbines. On the contrary, there are encouraging signs that the bird population is actually increasing.

Besides regular operation and maintenance, the project has continued to develop and improve in response to changing technologies, environmental policies, and customer demands. The GSEP, led by member companies AEP, RWE, and Enel, has conducted three studies to support recommendations for optimizing the project's generation potential and improving the distribution grid efficiency on San Cristóbal Island.

The project's success would not have been possible without the support of the local community and the government of Ecuador's initiative to incorporate more renewables in order to meet the country's energy needs. The GSEP recognizes the end-use energy efficiency initiative being conducted by the Ministry of Electricity and Renewable Energy (MEER) and ELECGALÁPAGOS S.A. to replace older household appliances, such as refrigerators and ovens which use liquefied petroleum gas (LPG). This is one of many initiatives that are helping to moderate electricity demand on the island and promote efficient energy use.

We are proud that the Galapagos San Cristóbal Island Wind Project has been a national pioneer in the use of wind resources and we are confident that ELECGALÁPAGOS S.A. will continue to operate the project successfully. ELECGALÁPAGOS S.A. is able to transition to more renewable generation because it has adopted innovative technologies such as wind turbines that start generating power at very low wind speeds and computerizing the wind-diesel hybrid system for optimized use of wind. The company's employee culture has been changing as a result of the project to become innovative and take advantage of new technologies. Furthermore, the training provided to the project facilities' operations and maintenance staff has ensured the existence of highly qualified professionals on the Galapagos Islands. Developing the technical and management skills of the local population has also increased its confidence in renewable energy projects.

As an organization committed to sustainable energy development, the GSEP is pleased to see the success of the Galapagos San Cristóbal Island Wind Project being replicated, both locally and worldwide.

www.globalelectricity.org

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