

Global  
Sustainable Electricity  
Partnership

# THE DHIFFUSHI SOLAR ICE PROJECT IN THE REPUBLIC OF MALDIVES





It is my great pleasure to announce the inauguration of the Dhiffushi Solar Ice Project in the Republic of Maldives, led by the Kansai Electric Power Company on behalf of the Global Sustainable Electricity Partnership (GSEP).

Kansai Electric has been an active member since the creation of GSEP in 1992. In 2005, we built a micro-hydro power plant in a remote Himalayan village in the Kingdom of Bhutan. In 2008, we installed a photovoltaic (PV) power system on the island nation of Tuvalu. We have also conducted a dozen capacity-building workshops with the Pacific Power Association in the Pacific Islands.

With our company's knowledge and experience in sustainable power development, we decided to take leadership of this GSEP project in the Maldives. In 2010, the Dhiffushi Solar Ice Project began and it has benefited from the support and cooperation of the Asian Development Bank and the Maldivian Ministry of Environment and Energy (MEE).

The distinct feature of this project is the installation of an ice-making machine coupled with the PV system. The machine works as a supply-demand controller by utilizing excess solar energy to produce ice. This enables the island's residents to preserve fish for sale and avoid costs linked to buying and shipping ice from nearby islands, something residents highly appreciate as fishing is the main economic activity in Dhiffushi. The key objectives of the project include the promotion of local renewable energy sources,

## MESSAGE FROM KANSAI ELECTRIC

the reduction of CO<sub>2</sub> emissions, and the transfer of technological know-how regarding the operation, installation and monitoring of grid-connected PV systems.

I would like to thank the Dhiffushi Island Community Council, MEE and the State Electric Company Limited (STELCO) for their support throughout the project. I would also like to acknowledge the government of Japan for their financial assistance to this project through the funds provided by the Grant Assistance for Grassroots Human Security Projects program. Finally, I am grateful for the persistent efforts from Kinden and Shin-Nippon-Lanka in helping us complete this project.

I strongly hope that the Dhiffushi Solar Ice Project sends a symbolic message about the importance of global and concerted action for the promotion of sustainable energy development worldwide and the fight against climate change. I also wish that this collaborative partnership we built during the project between the Maldives, Japan and GSEP will continue to develop in the future.



**Makoto YAGI**

Chairman

The Kansai Electric Power Company, Inc.

MESSAGE  
FROM KANSAI  
ELECTRIC (continued)



The Maldives is a small island nation very dependent on fossil fuels. The State Electric Company, as the major electricity utility company of the Maldives, strives to adopt clean technologies to provide services in an economic and environmentally sustainable manner.

The Dhiffushi Solar Ice Project adopted the best suited renewable energy technology for the Maldives that provides the maximum benefit to society. The 40kW solar photovoltaic system connected to the existing diesel systems has already reduced the amount of fuel used to generate power. The ice plant is enabling the island community to generate extra income while giving a boost to the fishing sector.

This GSEP project has been very beneficial to us as we intend to use the knowledge we have gained to replicate it in other islands. The project was well executed and we would like to thank GSEP for selecting one of our islands for this demonstration project and for introducing us to new concepts in the use of renewable energy technologies.

**Abdul Shakoor SOLIH**  
Managing Director  
State Electric Company Limited  
Republic of Maldives

## MESSAGE FROM STELCO



This project is a bright beginning for the use of renewable energy sources in our island. It is also a valuable asset for the community and a good incentive for the island's economy.

Thanks to the project, the Council's revenue has increased. We can use this revenue for future system maintenance and to also improve the lives of the local people.

We strongly hope that this type of hybrid PV system be replicated across the country and beyond.

A handwritten signature in black ink, appearing to read "Ibrahim ANIS".

**Ibrahim ANIS**  
President  
Secretariat  
Dhiffushi Island Council

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## MESSAGE FROM DHIFFUSHI ISLAND COUNCIL



Given its geography, fossil fuel powered grids have been a way of life to supply power to the islands of the Maldives. In 2014, ADB in partnership with the Government of Maldives and co-financiers launched the Preparing Outer Islands for Sustainable Energy Development (POISED) project to support the introduction of renewable energy, efficient diesel-based power and energy storage on the island grids. GSEP's solar PV project on Dhiffushi Island, implemented by Kansai Electric and grant-financed by the Grassroots Human Security Project of the Government of Japan has installed 40 kW of solar PV that has been combined with an ice machine and has also provided capacity building to STELCO and the island council to operate the system. The system has reduced dependence on fuel imports for electricity as well as reduced the purchase of ice, a key input for fishing – a major occupation of the island community. This project is a powerful symbol of renewable energy improving energy security and economic security in a small community and has generated a lot of interest nationally and in the region. It is expected that such projects be further replicated including under the POISED project and would provide tangible benefits to the local communities.

A handwritten signature in black ink, appearing to read "Len V. George".

**Len V. GEORGE**

Project Officer (POISED) - Energy Specialist  
Asian Development Bank

## MESSAGE FROM ADB



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# THE DHIFFUSHI SOLAR ICE PROJECT IN THE MALDIVES

Helping a climate-vulnerable nation  
build a clean energy future

# THE MALDIVES: ON THE FRONTLINES OF CLIMATE CHANGE

The Maldives is well known as a tropical paradise destination. What many don't realize is that almost 80% of the country lies less than one metre above sea level, making it particularly vulnerable to the effects of climate change and rising sea levels. In fact, the Maldives is a founding member of the Climate Vulnerable Forum (CVF), a group of countries that are disproportionately affected by climate change. The CVF pledges to not only take leadership in addressing the issue (by pledging to generate 100% of its energy from renewable sources as soon as possible), but also calls on other governments to urgently do so as well.

The country relies entirely on imported fossil fuels to satisfy energy demand. Tourism and fishing, both heavily energy-dependent sectors, drive the Maldivian economy and are expected to grow. Without diversification of the country's energy resources, the Maldivian energy sector and economy remain vulnerable to external shocks.

Fortunately, the country's warm climate and tropical location make it an ideal site for solar energy development. By tapping this resource, a sustainable energy future can be a reality for the Maldives.

[CLICK FOR MORE INFORMATION](#)

## THE PROJECT IN A NUTSHELL



- 40 kW grid-connected solar photovoltaic (PV) system
- Installed on Dhiffushi Island
- Led by our member Kansai Electric Power Company from Japan
- Commissioned in November 2016
- Successful model for the development of local renewable energy solutions
- Uses an ice-making machine instead of a conventional battery system for storage
- Excess energy is used to produce ice
- Local residents use ice to preserve fish, supporting the main economic activity in Dhiffushi.



# PAVING THE WAY FOR A SUSTAINABLE FUTURE

Combating climate change with local renewable energy solutions is at the heart of the Dhiffushi Solar Ice Project. With this project, GSEP helps the Maldives take immediate action toward building a more sustainable future and implementing its commitments to the Paris Agreement.

## PROJECT OBJECTIVES:

- Promote the use of local renewable energy sources
- Decrease CO<sub>2</sub> emissions by reducing fossil fuel consumption
- Trigger a shift away from imported diesel and other petroleum products
- Promote the growth of local economic activity
- Serve as a pilot for the replication of similar projects
- Support the country's national climate action plan.

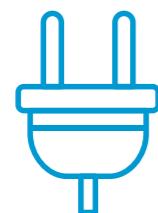
## MAKING AN IMPACT WITH TANGIBLE RESULTS



52 tonnes  
of CO<sub>2</sub>  
emissions prevented  
annually



19 tonnes  
of diesel  
displaced per year,  
representing approximately  
US \$18,000 in fuel savings



25% of  
the demand  
of Dhiffushi's population  
is supplied, under the best  
conditions



Accounts for approximately  
5% of  
annual energy  
consumption

We will monitor the system for two years, supporting the State Electric Company Limited (STELCO) to ensure that the necessary skills and know-how are in place to guarantee the project's long-term performance and sustainability.

### THE PROJECT WILL:

- Save fuel for fishermen, who no longer need to travel to other islands to buy ice
- Generate revenue for Dhiffushi Island Council, which can sell the ice at a profit.
- Help the Maldives achieve its Sustainable Development Goals
- Generate momentum for the country's shift toward more sustainable energy solutions
- Be a model for replication across other islands in the region.

## ENGAGING LOCAL PARTNERS: A KEY TO SUCCESS



**Abdul MATHEEN MOHAMED**

Maldives Minister of State  
for Environment and Energy

"This project will not only create a momentum for the shift away from full reliance on diesel generation, but also mitigate the shortage of ice demand on Dhiffushi Island, supporting their main economic activity. We are very grateful for the support from GSEP, Kansai and the Government of Japan."

To ensure the project's technical viability and to engage the local community, authorities and partners from the start, Kansai Electric conducted prefeasibility and feasibility studies in 2011 and 2012.

Dhiffushi Island was selected because it provided the site best suited to the installation of the photovoltaic (PV) system, its electricity demand was high enough to sustain the system and a collaborative relationship was established with local authorities.

It was clear that local residents wanted to find a way to produce ice themselves to preserve fish, instead of buying it and shipping it from other islands. The idea of installing an ice machine that would use the excess solar energy to make ice was well received. With this design, the ice machine would effectively work as a supply-demand controller for the PV system.

The ground-breaking began in December 2015 after finalizing the agreements between all partners and completing all procurement and equipment manufacturing. The construction of the PV system was completed in February 2016.

The total project cost was US \$730,000. Funding was provided by GSEP, via Kansai Electric, and the Government of Japan Grant Assistance for Grassroots Human Security Projects.

The project was inaugurated on November 14, 2016, with the participation of the project partners.

## ENGAGING LOCAL PARTNERS: A KEY TO SUCCESS (continued)

**Hiroshi SAITO**

JICA Resident Representative  
Maldives

We find this project is very successful and can be a great example for installing sustainable energy systems in other islands of the Maldives... the project not only introduced a solar power system but also complemented it with an ice making machine.

Local residents now have essential resources for their primary industry -fishing- and that is an attractive point about the project... The system has become a part of their lives and this encourages them to maintain it for themselves... The lives of the local islanders have been positively impacted by the results of this sustainable energy project.

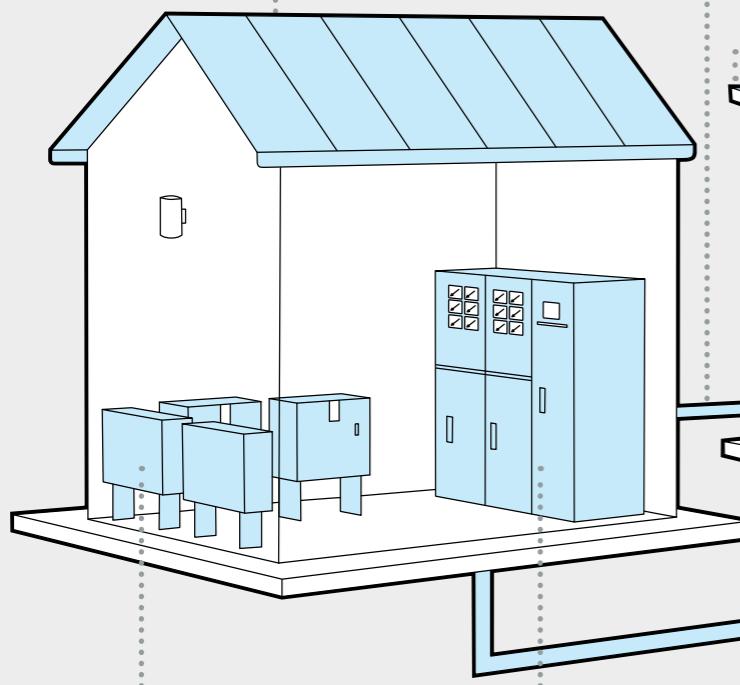
**PROJECT PARTNERS**

- Global Sustainable Electricity Partnership (GSEP), via its member Kansai Electric Power Company
- Ministry of Environment and Energy of the Maldives
- State Electric Company Limited (STELCO), the local electricity company
- Dhiffushi Island Council
- Government of Japan
- Asian Development Bank (ADB)

# PROJECT BLUEPRINT

## POWERHOUSE

New powerhouse built by STELCO for its existing diesel generators and the new PV system equipment.

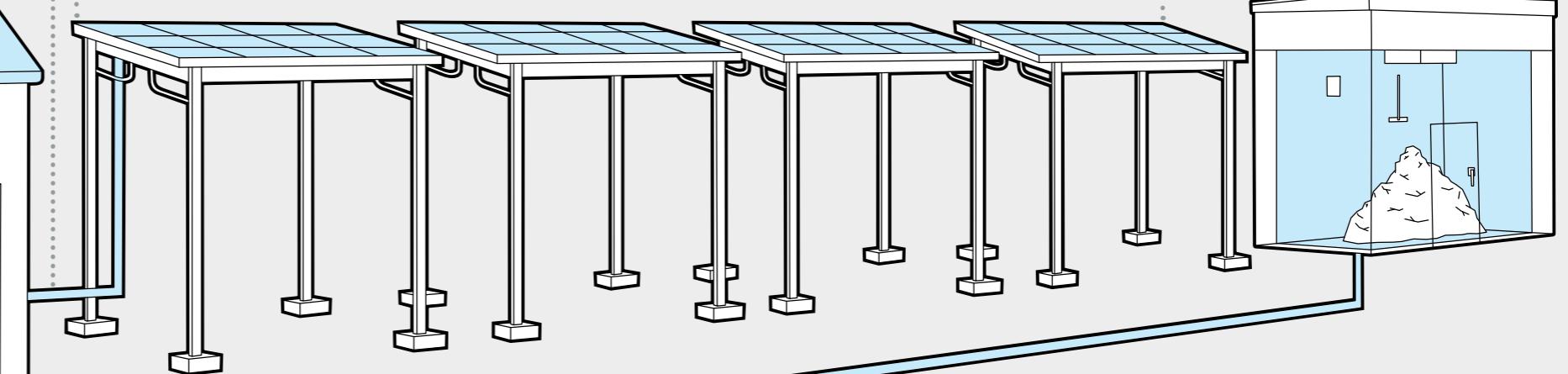


## POWER CONDITIONERS

Four power conditioners and a system controller are installed inside the powerhouse.

## HYBRID SYSTEM

40 kW PV system is connected to Dhiffushi's power grid and works in conjunction with the existing diesel generators.

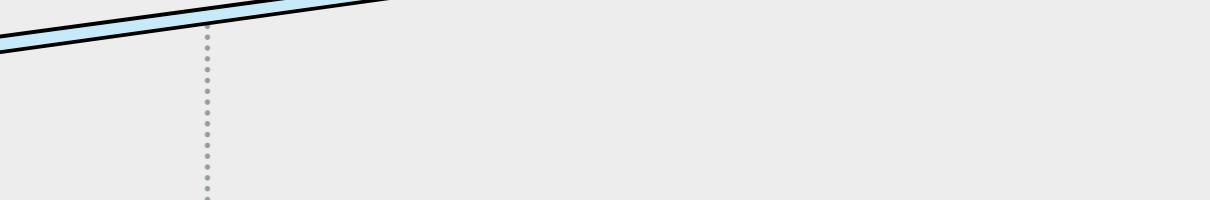


## FLEXIBLE CONTROL SYSTEM

The control system is operated in both automatic and manual mode. This flexibility helps maximize PV power generation and improve its stability, making maintenance and troubleshooting easier.

## MULTI-FUNCTIONAL FRAME STRUCTURE

3 metre-high frame structure holds four separate 10 kW PV panel arrays inclined at 5 degrees, limiting the extent of damage in case of a tsunami and providing good shade for residents.

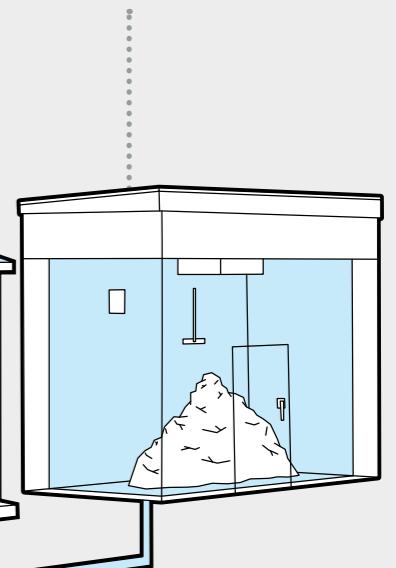


## CABLING

The PV system and ice-making machine are connected to the powerhouse through underground cables.

## ICE HOUSE

Industrial ice machine installed in new ice house on the pier effectively functions as the supply-demand controller for the grid-connected PV system.



## INNOVATION AT THE CORE

A unique feature of this project is the installation of an ice-making machine coupled with the PV system. Traditionally, similar PV electrical systems use batteries to absorb and store the excess electricity. In this case, the ice-making machine will store excess solar energy by producing ice when solar energy supplied to the system is greater than the electricity demand.

This innovative feature not only provides a solution to the need expressed by Dhiffushi's residents, but also prevents the creation of unnecessary industrial waste by avoiding the use of conventional batteries.

This ice machine uses seawater to produce around 1 tonne of flake ice per day, providing a simple yet sustainable way for local fishermen to preserve fish and save costs, as they no longer need to travel to other islands to purchase expensive ice. By using excess electricity in a productive matter, the project will help stimulate Dhiffushi Island's local economy.



We are very pleased to use ice made from sustainable solar energy. A lot of fishermen from other islands hope to have the same structure in their local harbors too.

**Mohamed MUJAAZU**



Fishing is a vital part of our lives and ice is absolutely imperative for it. As an ice user, I thank the project a lot for the economic and environmental benefits we are getting.

**Ali RIFAU**

## LOOKING TO THE FUTURE

Small Island Developing States (SIDS) like the Maldives are particularly at risk from climate change and are looking to develop sustainable energy sources to safeguard their future. Successful models of local renewable energy development, like this project can be important accelerators of change. For instance, the Asian Development Bank (ADB) aims to increase solar energy development in the region through its Asia Solar Energy Initiative (ASEI), using the Dhiffushi Solar Ice Project as a model.

The ease of replicability of this project stems from the design of the PV system itself. The project was designed to maximize stability with simple control logic while incurring low costs in order to be easily replicated and deployed to other islands where potential PV output is higher than the load capacity of the local grid. This approach maximizes the percentage of PV energy used without the need to install any special countermeasures.

## LOOKING TO THE FUTURE (continued)

The GSEP designed and implemented a full training program to develop local abilities and skills to ensure that the PV system continues to operate smoothly in the years to come. This training also increases local confidence for carrying out other similar projects. A three-day workshop, in addition to on-the-job-training sessions, was completed to train 19 local engineers and operators in basic knowledge of PV components and systems, practical design of PV systems, grid connectivity, construction, operation and maintenance, and editing PV system texts for replicability.

The Dhiffushi Solar Ice Project is helping the Maldives harness its renewable energy sources to build a more sustainable future. It can also serve as a model for other SIDS that want to move away from fossil fuels and jumpstart their national climate action plans. This bottom-up approach of promoting local renewable energy solutions not only supports the most vulnerable countries, it also builds a cleaner tomorrow for all.



**Shoko NODA**

UN Resident Coordinator & UNDP Resident Representative in Maldives

As an advocate for the Sustainable Development Goals (SDGs), I strongly support the Dhiffushi Solar Ice Project (DSIP) promoting the use of local renewable sources. SDG 17 calls to ensure access to affordable, reliable, sustainable and modern energy for all. DSIP not only provides clean energy, but also greatly supports the fisheries industry, a vital source of income for the community.

Collaborations beyond our traditional development partners is necessary to address the complex and adverse effects of climate change faced by the local communities. UNDP Maldives recently launched [Make My Island](#) platform, inviting private sector partners to invest and work together with us to provide sustainable development solutions for Maldivian communities. I am pleased to see a prominent electricity company like Kansai Electronic Power Company being directly involved in the community development, and I sincerely hope that others can also follow their lead to join this kind of partnership to help communities become more resilient within broader sustainable development.

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## **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 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 over 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.

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United States

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Italy

### **EuroSibEnergo**

Russia

### **Hydro-Québec**

Canada

### **innogy**

Germany

### **Kansai Electric Power**

Company

Japan

### **RusHydro**

Russia

### **State Grid Corporation of China**

China

### **Tokyo Electric Power**

Company (TEPCO)

Japan

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