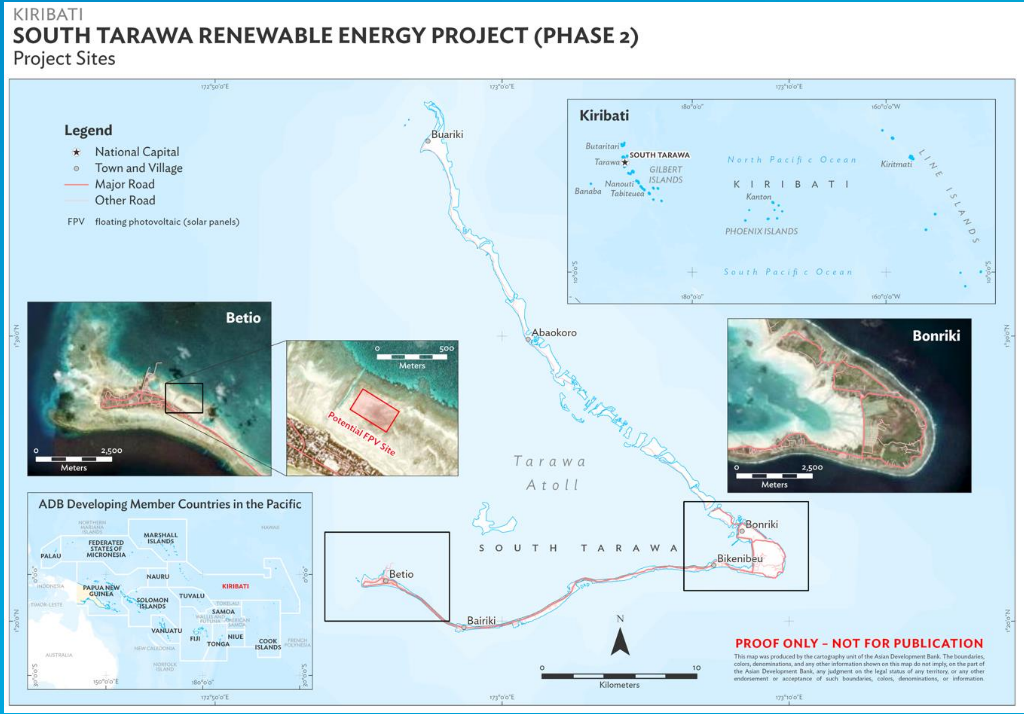
Regional Procurement:
The case of ADB's first floating solar plus projects in the Pacific



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29 August 2024

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Project Details

	Tuvalu IAREP AF ($8.5 million)	Proposed Kiribati STREP 2 ($24.9 million)
Financing Plan	ADB – $2.0 million GEF – $3.0 million URTF – $2.0 million ITF – $0.8 million GOT – $0.7 million	ADB – $22.4 million ITF – $0.5 million GOK – $2.0 million
FPV plus*	ADB, GEF, URTF	ADB
Capacity building	URTF, ITF	ITF
DBO package	~$4.2 million	~$20.5 million
Approval	8 December 2023	Q4 2024 (expected)
Effectiveness	-	-
Executing Agency	Ministry of Finance and Economic Development	Ministry of Finance and Economic Development
Implementing Agency/Employer	Tuvalu Electricity Corporation	Public Utilities Board
Project completion	2028	2029
Implementation Support	Project Implementation Consultant	Project Implementation Consultant
Project Management Support	Project Management Unit	Project Management Unit
Project preparation and procurement support	TA Consultants	TA Consultants

* Plus = including but not limited to productive uses of energy, grid upgrades, transmission system, e-vehicles and charging stations, electric reefs

ADB = Asian Development Bank, AF = Additional Financing, FPV = floating photovoltaic; GEF = Global Environment Facility, GOK = Government of Kiribati, GOT = Government of Tuvalu, IAREP = Increasing Access to Renewable Energy Project, ITF = Ireland Trust Fund; STREP = South Tarawa Renewable Energy Project, TA = technical assistance; URTF = Urban Resilience Trust Fund

Regional Procurement for the Proposed Kiribati: STREP 2 & the Tuvalu IAREP-AF

Prepared under TA-6680 REG Preparing Floating Solar Plus Projects under the Pacific Renewable Energy Investment Facility

TA 6680 is funded under the Clean Energy Financing Partnership Facility, through the Asian Clean Energy Fund established by the government of Japan, and the Clean Energy Fund with financing partners: the governments of Australia, Norway, Spain, Sweden, and the United Kingdom, and administered by the Asian Development Bank.

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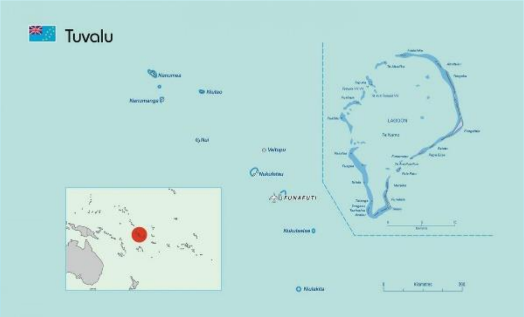
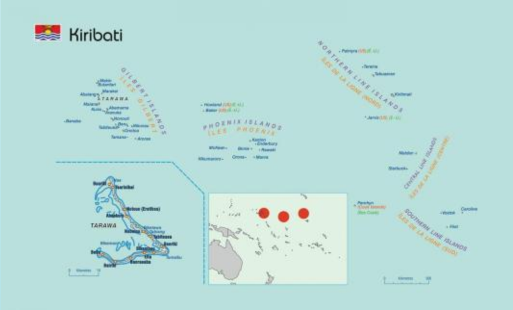
Pacific Islands and FPV

The policies of the Government of the Republic of Kiribati (GoK) and the government of Tuvalu (GoT) target the reduction of imported petroleum supplies and the decrease in the cost of electricity as issues to be addressed. Solar energy is inexhaustible and PV cost-effectiveness is proven globally.





While floating PV (FPV) requires stricter standards given the exposure to water, it has added advantages over land-based PV in that it

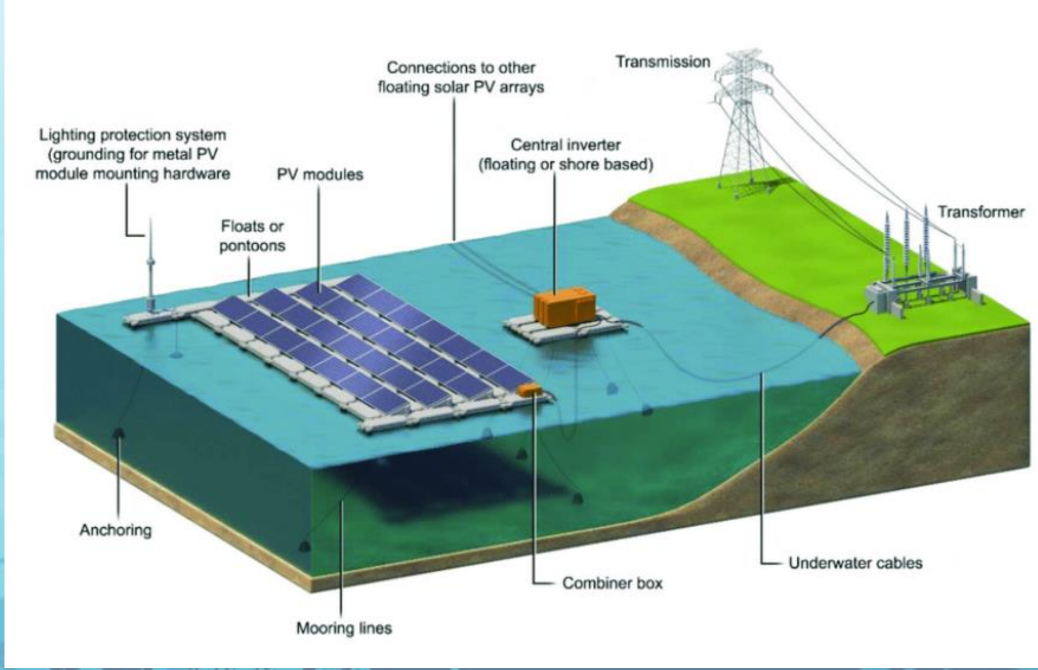
i) frees up land for other use and saves on land acquisition and preparation costs;
ii) allows higher yields due to the cooling effect of water;
iii) conserves water through reduced evaporation;
iv) is quick to install; and,
v) addresses issues related to the energy-water-food and climate nexus.

Technologies used

FPV technology

A floating solar PV system results from the combination of PV plant technology and floating technology and consists basically of four main components:

- Floating system,
- Mooring/anchoring system
- Electrical cables
- PV modules



FPV technology

Why FPV?

- Cost of water surface is lower than land
- Land has alternative uses
- Reduces evaporation rates, algae growth
- Lower visual impact
- Higher energy yield (site specific)
- Costs balance (Land vs moorings & output)
- It can be used with/without water (depending on bottoms)
- Optimal for Pacific Island nations

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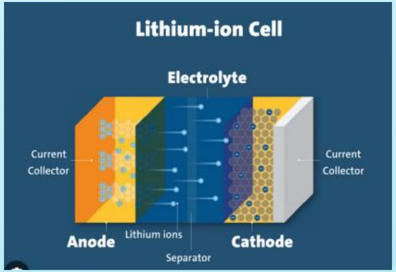
Battery Storage technology

The primary functions of batteries in PV systems are:

- **Energy Storage and Autonomy** - store electrical energy produced by PV modules and supply energy as needed for the load in time when the solar PV modules is not producing or is producing insufficiently.
- **Voltage and Current stabilization** - supply power to electrical loads at stable voltages and currents.
- **Supply peak currents** - high peak operating currents required for electrical loads or appliances.
- **Grid operation support** as ancillary services: peak shifting or power smoothing



The allowed technologies to be used are:

i. VRLA (valve regulated lead acid batteries), waterproof, gel, maintenance free
ii. AGM (absorbed glass mat), waterproof, maintenance-free
iii. Lithium ion (Li-on)
iv. Other battery technologies with equivalent or better performance (e.g., redox flow, sodium-sulfide, zinc-air, etc.)

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Grid Infrastructure

Electric poles

There are several options for the ABC overhead electric poles, namely:

- Wooden electric Poles
- Concrete Electric Poles
- Steel Tubular Electric Poles

Tubular pole

The Towers shall ,

i. be designed to carry the ABC cables

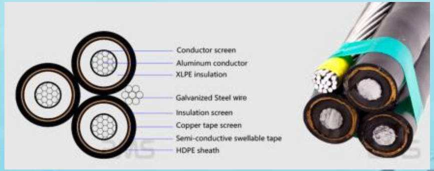
ii. have a minimum duration of 40 years. This shall be the value to be guaranteed against corrosion.

iii. Be placed at a minimum height of 12 meters.

Electrical Cables

The use of Aerial Bundled cables or ABC cables with wire messenger is recommended for the 33 kV line crossing South Tarawa

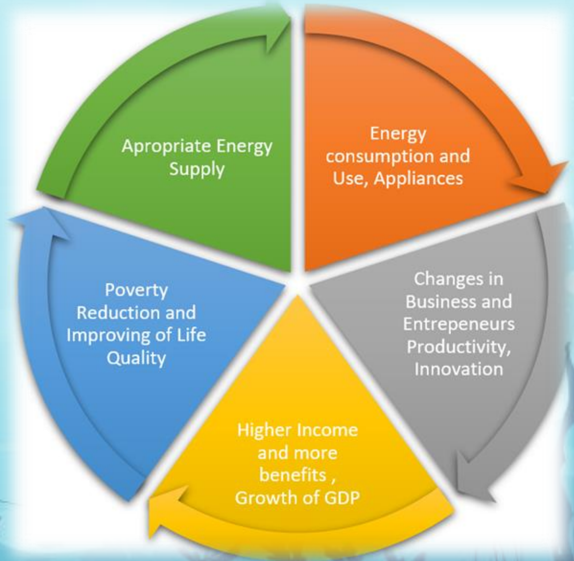
The ABC cables are overhead power lines using several insulated phase conductors bundled closely together, normally with a bare neutral conductor and a wire messenger that carries the load of the cable.



FPV enables Productive uses

The project involves a pilot for the incorporation of productive uses of energy associated with the FPV in Kiribati and Tuvalu.

The productive uses of energy concept has been gaining popularity in recent years and is used in many development programs as it has shown strength in improving socio-economic situation of many people using energy and renewable energy in particular.



What is a productive use of energy?

"Agricultural, commercial and industrial activities involving energy services as a direct/indirect input for production of goods or provision of services with increase in income or productivity"

FPV and reef growth

Reefs are the main indicators of ecosystem health and **a source of economic income in the PIC**,

Coral reefs are currently severely endangered due to several factors such as overfishing, ocean acidification, ocean temperature rise, diseases, mismanagement of the land, among others

FPV electricity may be used to rehabilitate and improve coral reef health and growth in the PIC.

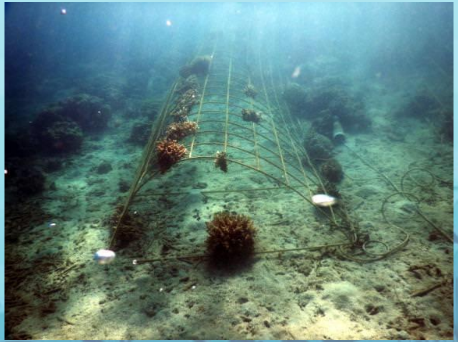
Several rehabilitation programs have been implemented and technologies like **Biorock or mineral accretion method has been successful in accelerating reef growth.**

Steel covered by Biorock fostering the creation of Coral Reefs (sample shown grew 6 mm diameter in one year according to Global Coral)

FPV and reef growth

How does the Biorock or Mineral Accretion method work?

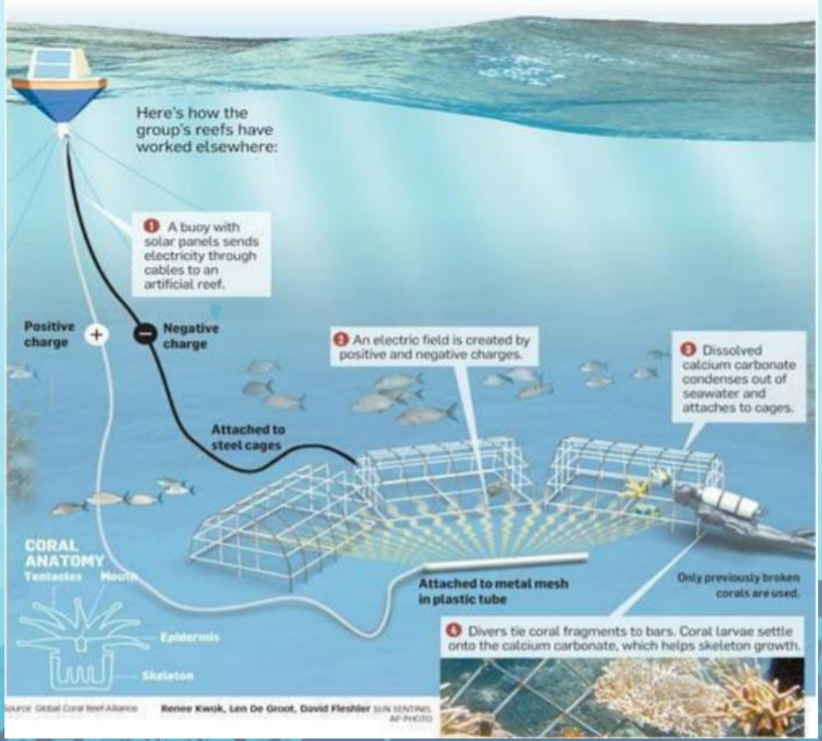
1. Use of electrically conductive materials(ex: steel ,being cheap) to build the marine structure
2. Steel is protected from corrosion | Structure is prepared and submerged |Coral fragments are incorporated
3. Low-voltage electricity is given (for example by FPVs) to the submerged structure
4. Seawater electrolysis foster the production of calcium carbonate that adhere to the structure .
5. Corals and other marine life adhere to the calcium carbonate and grow faster.



Photos: Vanuatu Biorock Workshop |
Global Coral Reef Alliance

FPV and reef growth

Integrating FPV with the Biorock method:



It is estimated that the process of coral reef growth can be accelerated up to 4 times using the Biorock method!

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FPV and reef growth

Integrating FPV with the Biorock method: It is estimated that one kilowatt hour of electricity results in the accretion of about 0.4 to 1.5 kg of bio rock in the structure, varying accordingly to depth, electric current, salinity and water temperature.

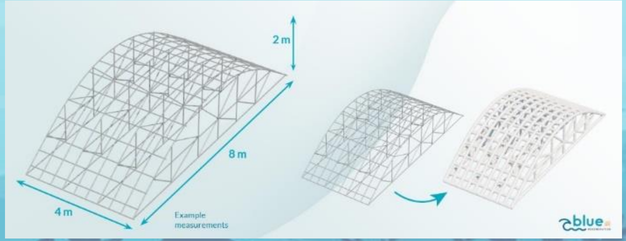
Using circular economy: The structure of the Biorock can have different shapes, with the possibility of using recycling materials such as scrap from construction sites and used iron that is treated for anti-corrosion.

In the PIC-11, connecting the current goals of improving the infrastructure sector can be combined with waste materials management for reef restoration, using renewable energies from floating PV technology .

Near shore FPV and coastal protection

Beach regeneration & shore and floating PV protection

Concept of Biorock sunken structure for wave attenuation and reef growth



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FPV and mobility

FPV can power directly charging stations located inland or through the existing electric grid at the premises of domestic, commercial or industrial consumers. Both the public and the private sectors can play a role and several opportunities for creation of businesses and jobs may be enabled in several related economic sectors.

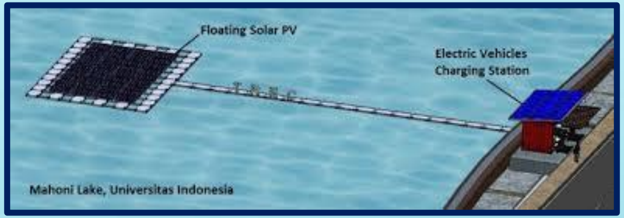


image: Hanwha Q Cells

Mobility aims to decrease the number of vehicles, but increase mobility of people, connectivity and utilization of the vehicles. The limited size of the PIC-11 makes them ideal for utilization of e-vehicles without having to worry about mileage.

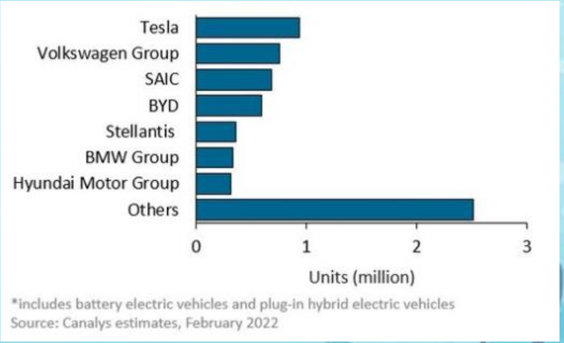
Investment in electrical charging stations would revolutionize mobility in the PIC both inland and on the water.

FPV and mobility

E-vehicles

In the last years, EV sales have been increasing exponentially. The sales of electric vehicles (EVs) have doubled in 2021 from the previous year to a total number of 6.6 million.

There are several major car companies involved in the EV car making, mainly European, American and Chinese car makers such as Tesla, VW, Volvo, Renault, BYD, etc. Currently, the industry is producing EVs for each important segment, ranging from tiny, inexpensive city cars to mainstream and premium sedans and SUVs.



Major EV car makers worldwide and units sold

- Evs are built from different electrical components such as:
  - battery pack,
  - the on-board charger and
  - the Electric Panel Control Unit (EPCU),
  each presenting a share of the total cost, with the battery being one of the most expensive parts.

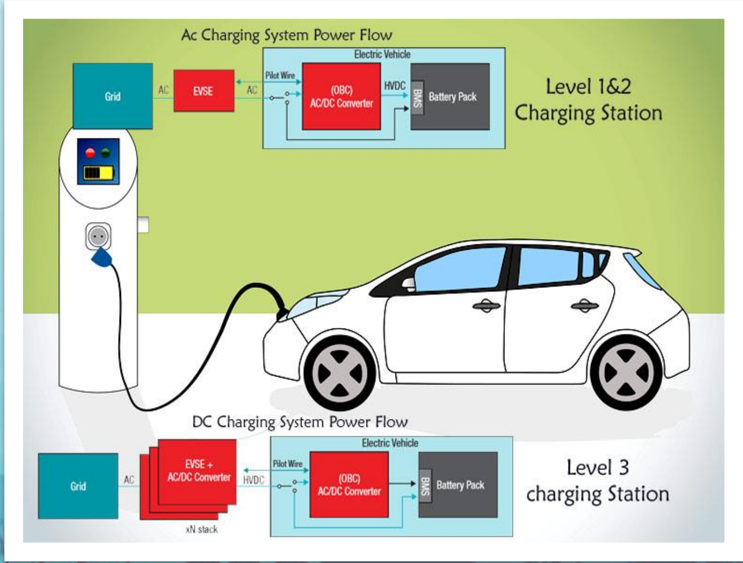
FPV and mobility

Charging Station

To accompany the growth of the EV market, charging stations have been expanding significantly, mainly in China, Europe and the US. In 2021, publicly accessible chargers worldwide reached 1.8 million charging points, with most being slow chargers and a third of them being fast chargers, that are used mostly for long distances.

Main features of a charging infrastructure are:

- the station location,
- the EVSE port (EVSE stands for electric vehicle supply equipment) ,
- the connector, which is plugged into the vehicle to charge it.



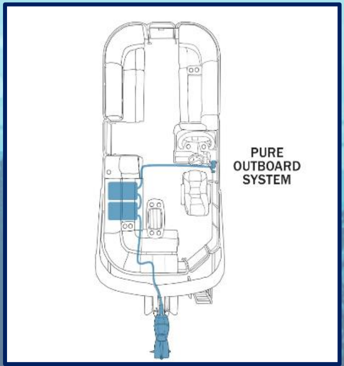
FPV and mobility

E-boats

The electric maritime industry is in its infancy and the market for maritime transport and infrastructure is less mature than for electric vehicles.

In recent years, however, the e-boat market has been evolving specially for electric ferries, given that they are the leading vessel type in terms of number of electrified vessels, accounting for 43 % of the world´s known battery ships, with other electric vessel types, such as leisure crafts and fishing boats, being less predominant.

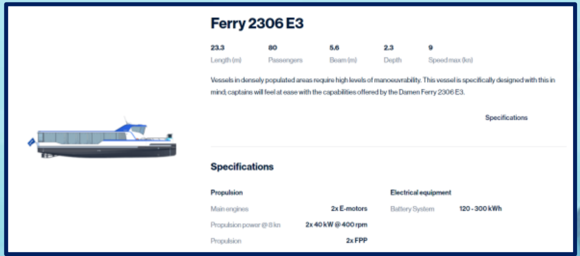
Retrofitting recreational boats by incorporating an electrical package is one of the least costly solution



E-boats for fishing

One of the companies that specializes in e-mobility services on the water in emerging markets is ASOBO. Torqeedo electric motors, are hired out to the local fishermen for a monthly fee that includes training, maintenance, and a solar powered battery charging service

E-ferry, built by Damen



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Scope of the Project

Scope of Work

The floating PV projects to be implemented by the Contractor will displace diesel generation and augment power generation in each of the power systems to meet rising demand.

The floating solar projects under this tender were prepared under TA-6680 REG (49450-028) Preparing Floating Solar Plus Projects under the Pacific Renewable Energy Investment Facility, namely,

- Proposed KIR 49450-030 -- South Tarawa Renewable Energy Project (Phase 2) or STREP 2*; and
- TUV 49450-032 -- Increasing Access to Renewable Energy Project (Additional Financing) or IAREP AF**.

The Contractor's scope of work and services in respect of the **floating solar PV sites** includes:

a) detailed design of the project sites
b) manufacture, supply, factory testing, finishing, packing for export shipment, insuring, shipping and delivery to the site
c) installation and construction work
d) provision of drawings, as-built drawings, O&M manuals and other documents
e) rectification of defects; and
f) operation and maintenance of the facilities for a period of no less than 12 months

* Grant financing from ADB and cofinanciers for ADB consideration in Q4 2024
** Grant financing from ADB and cofinanciers approved in December 2023 and awaiting effectiveness

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Scope of Work

South Tarawa Renewable Energy Project (Phase 2) in Kiribati

4 MWac of Floating PV and a minimum of 5 MWp at Betio;

3 MVA/3MWh battery energy storage system (BESS);

Grid infrastructure upgrade:
New 33 kV ring including upgrades at RMU 63 (Betio), RMU 39 (Bonriki) and RMU 27 (Bikinibeu) with 33 kV ABC lines between these RMU

Pilot for the incorporation of productive uses of energy:

Charging stations and electric vehicles to reduce transport emissions:

- 4 e-vehicles (small to medium size) and
- 2 charging stations (1 for 11 kV and another for 33 kV; including associated civil works to connect it to the main grid and also the car ports)

Coastal protection and disaster risk reduction measures - Wave breaker made of geotubes and Biorock made of vertical structures up to 1.6 m high

FPV location:

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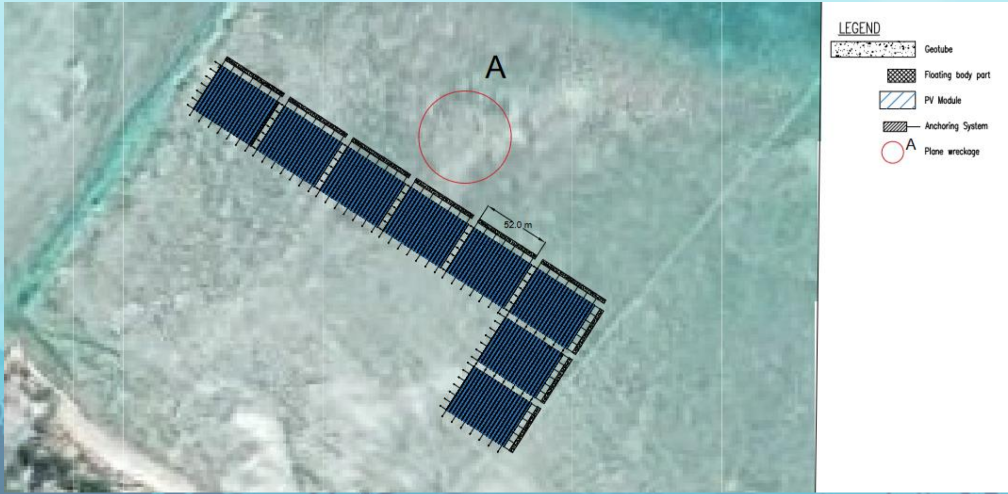
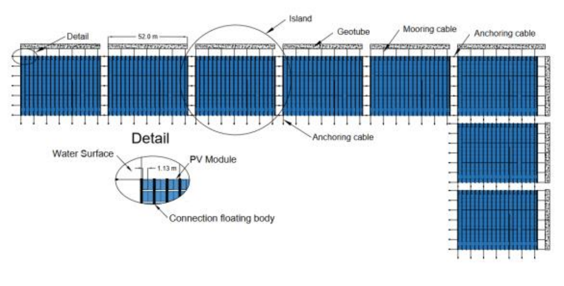
Indicative layout

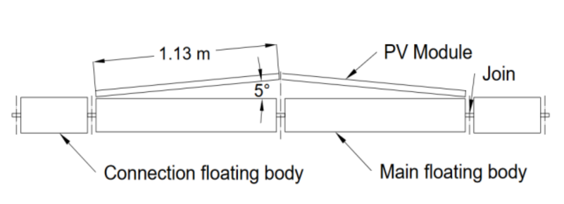
Kiribati South Tarawa Renewable Energy Project (Phase 2),

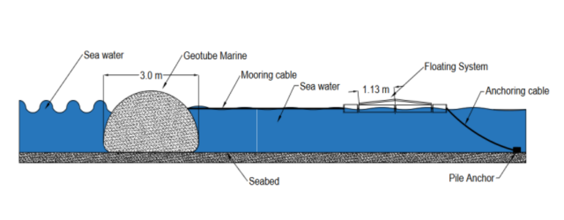
For the indicative configuration,

- two arrays with different orientations (-90° and 90°) are used.
- Both arrays have 15 modules in series attached to 291 strings.
- These arrays will then join to form a several islands, with a minimum of 4 islands and maximum of 8 islands.









The indicative module capacity considered for configuration is 550 Wp and the total number of modules for the project are 8730 units.

For the inverter, a 500 kWac or 1000 kWac rating of outdoor central inverters has been selected. As the total AC capacity of the plant is 4 MWac, 4 or 8 units of the inverter will be used.

Scope of Work

Increasing Access to Renewable Energy Project (Additional Financing) (IAREP-AF) in Tuvalu

1 MWac of Floating PV and a minimum of 1,25 MWp at Fongafale and associated grid infrastructure

Climate proofing measures should be taken to protect infrastructure from all potential weather effects

Pilot for the incorporation of productive uses of energy:

1. Coastal protection and disaster risk reduction measures - **Wave breaker made of geotubes and Biorock** made of vertical structures up to 1.6 m high.
2. Charging stations and electric boats to reduce transport emissions: 1 **e-boat, 2 spare motors, 2 charging stations** (including associated civil works to connect it to the main grid) and **electric golf carts.**

LV upgrades

FPV location:

a..i Replacement of Deteriorated Pillar Boxes: Procurement and installation of more climate-proof pillar boxes to replace deteriorated ones.

a..ii Fuse Base and Fuses: Supply and installation of fuse base and fuses.

a..iii Construction of Concrete Shelters: Construction of concrete shelters for substations No. 4, 5, and 6 to ensure protection and longevity.

a..iv Substation Feeder Pillar: Procurement and installation of a substation feeder pillar to enhance the functionality of the electrical system.

a..v 11kV Non-Extensible RMU at S/S No. 5: Supply and installation of a non-extensible RMU at substation No. 5 to optimize voltage distribution.

a..vi Replacement of Deteriorated 11kV Extensible RMU: Procurement and replacement of deteriorated 11kV extensible RMUs at substations No. 4 and 6 for improved performance.

a..vii Replacement of Deteriorated 11kV Free Standing Oil Switch: Replacement of deteriorated 11kV free-standing oil switches at substations No. 4 and 6 to ensure reliable operation.

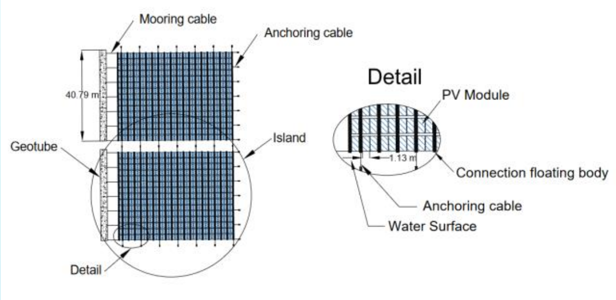
a..viii Other HV Accessories: Provision of various HV accessories including Raychem boots and cable termination kits to support the efficient functioning of the electrical system.

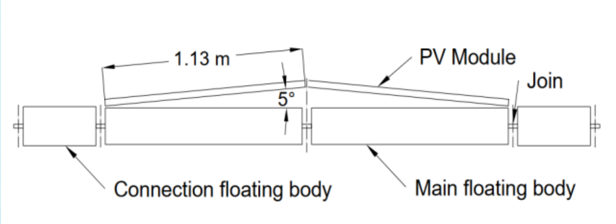
Indicative layout

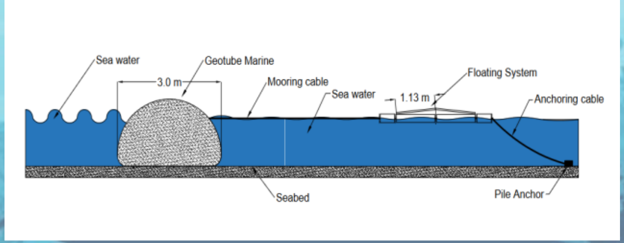
Tuvalu Increasing Access to Renewable Energy Project (Additional Financing) (IAREP-AF)

For the indicative configuration,

- two arrays with different orientations (-90° and 90°) are used.
- These arrays will then join to form a several islands, with a minimum of 2 islands and maximum of 4 islands.







Thank you!