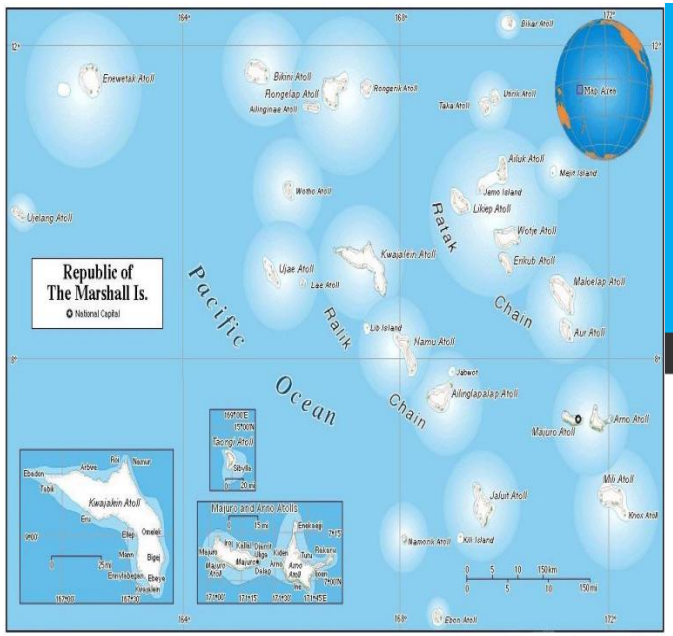
KICOFF 2023, Busan, 2023. 5.30

OTEC/DOWA program to strengthen SDGs implementation capacity for RMI



The Republic of Korea has pledged to carry out marine energy ODA programs including Ocean Thermal Energy Conversion

Ministry of Oceans and Fisheries, Republic of Korea (Government)
#OceanAction46789

DESCRIPTION | SDG 14 TARGETS COVERED | DELIVERABLES & TIMELINE | RESOURCES MOBILIZED | PROGRESS REPORTS | FEEDBACK

Description

The Republic of Korea will provide 50kW Ocean Thermal Energy Conversion(OTEC) generators as well as air conditioners and heaters which can cool and heat about 5000m2 areas. In addition, education program will be provided on how to desalinate discharge water and use it for hydroponics.

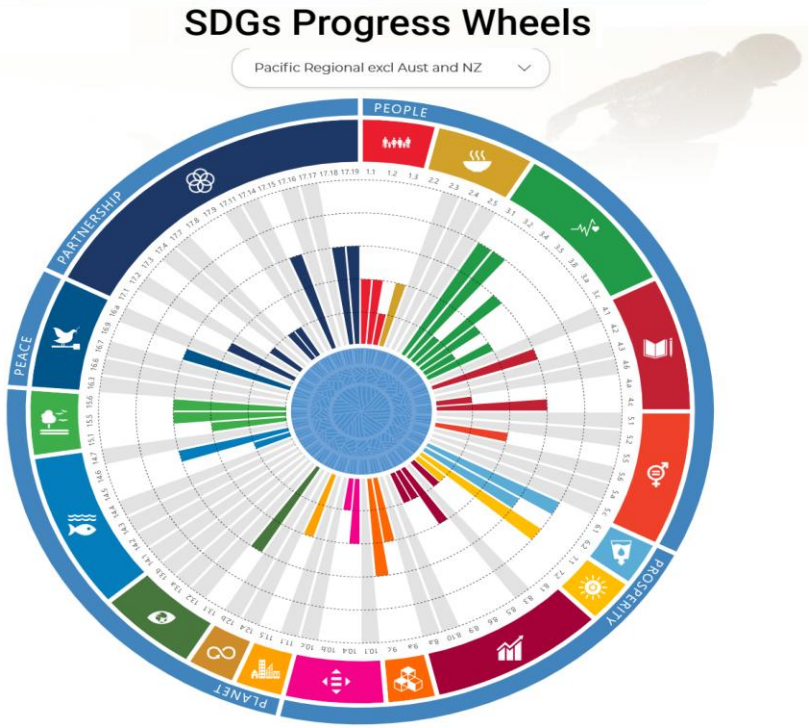
Partners

Ministry of Oceans and Fisheries(government)

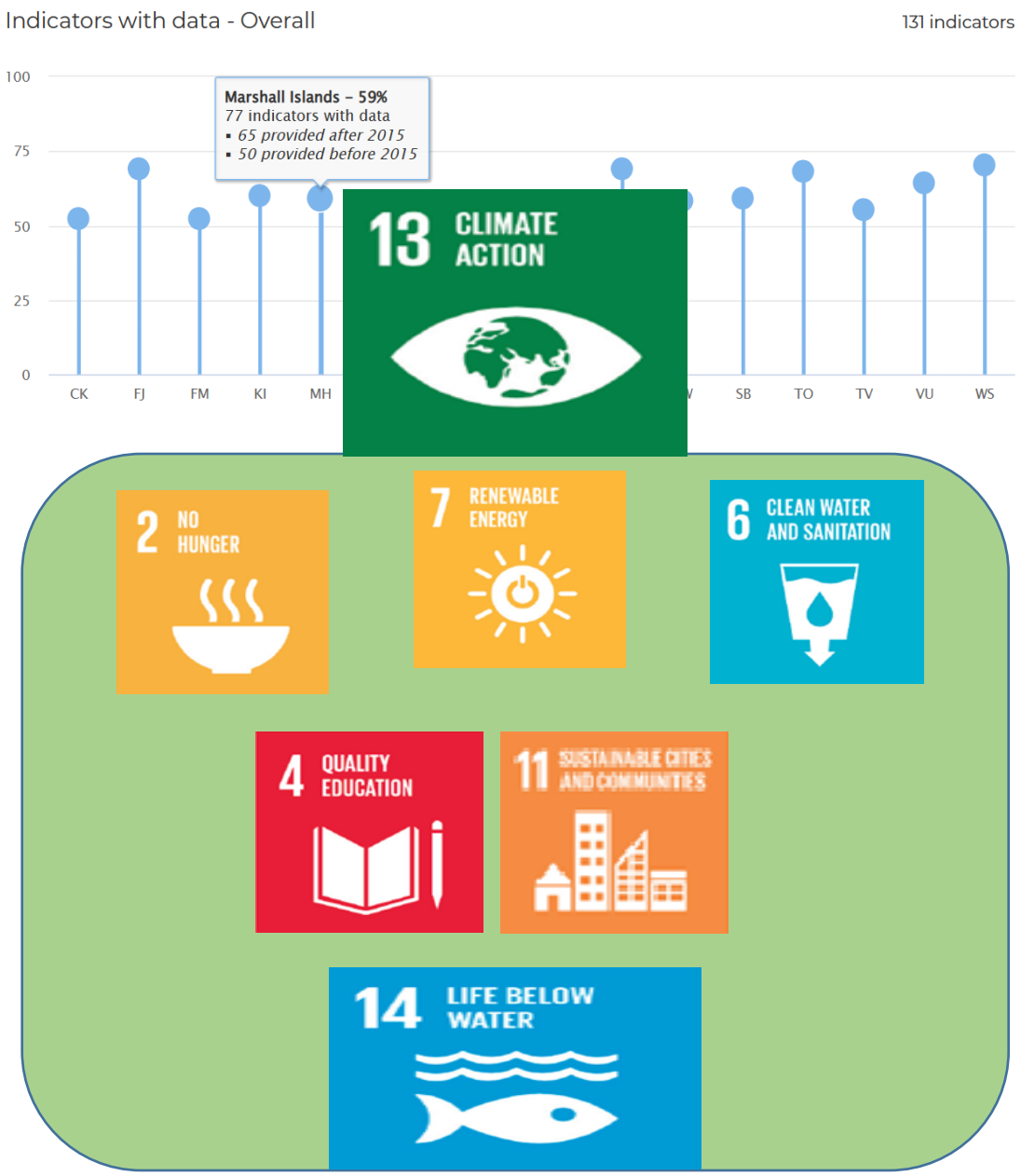
Action Network

Republic of Marshall Islands

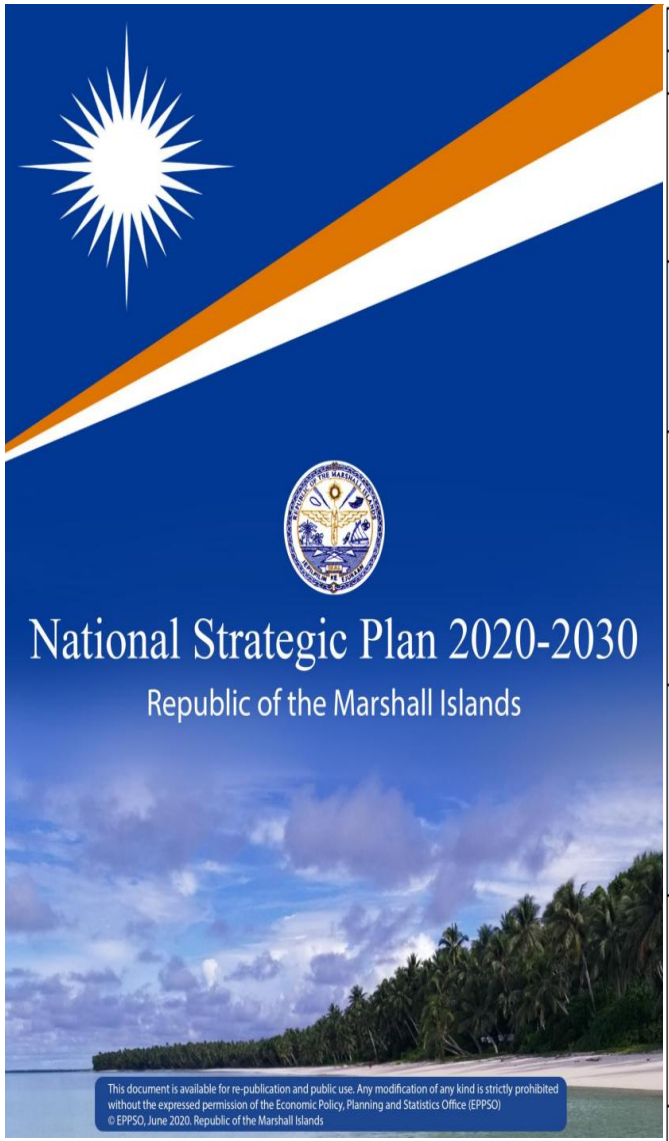
National Strategic Plan to achieve SDGs combating Climate Disasters



[17 Goals To Transform The Pacific - Pacific Data Hub]



National Strategic Plan 2020-2030

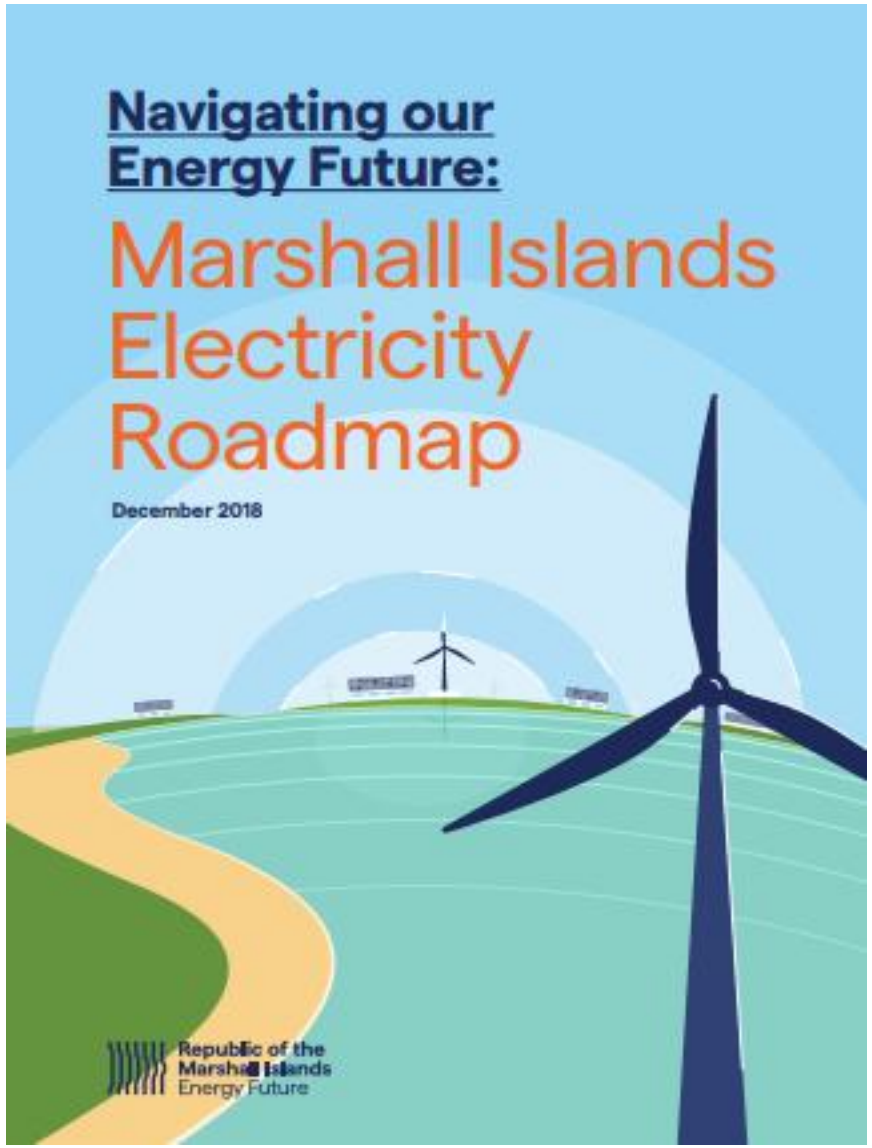


NSP Pillar Information		
	Pillars	**Strategic Areas**
1	Social and Culture	1. Health
		2. Education and Training
		3. Social Justice and Inclusion
		4. Culture and Traditional knowledge
2	Environment, Climate Change and Resilience	1. Atoll Environment
		2. Climate Change
		3. Disaster Risk Management
		4. Radiation Contamination
3	Infrastructure	1. Transport
		2. Energy
		3. Water and Sanitation
		4. Waste Management
		5. Information and Communication Technology
		6. Public Facilities
4	Economic Development	1. Land
		2. Agriculture
		3. Marine Resources
		4. Trade, Investment and Tourism
		5. Financial Sector and Services
5	Good Governance	1. Public Administration
		2. Public Financial Management
		3. Law, Justice and Public Safety
		4. Judiciary
		5. International Relations and Security
	TOTAL	**24 Total Strategic Areas**

SECTOR STRATEGIES

Sector/Thematic Area	Title	Timeframe
Education	Education Sector Plan	Under development
Health	National Environmental Health Action Plan	Ongoing
Culture	National Cultural Policy	Under development
Gender	National Gender Mainstreaming Policy	Ongoing
Youth	National Youth Policy	Under development
Nuclear	Nuclear Justice for Marshall Islands	2020-2023
Water and Sanitation	Water and Sanitation Strategic Plan	2017-2027
Energy	National Energy Policy and Energy Action Plan	Ongoing
ICT	National ICT Policy	Ongoing
Electricity	RMI Electricity Roadmap	2018-2050
Climate Change	National Climate Change Policy Framework Long Term (2050) Climate Strategy	Under Development 2018-2050
Environment	National Environment Management Strategy	2017-2022
Disaster Risk Management	National Disaster Risk Management Arrangement	Ongoing
Marine	Marshall Islands Marine Resource Authority (MIMRA) Strategic Plan	2019-2023
Agriculture	Agriculture Strategic Plan Food Security Policy	2021-2031 Ongoing
Tourism	RMI Strategic Tourism Development Plan	Under development
Infrastructure	National Infrastructure Investment Plan (NIIP) RMI National Building Code	2017-2026 Under Development

NSP/NDC action plan of RMI



		NDC TARGET % REDUCTION GHG ECONOMY WIDE	NATIONAL EMISSIONS (KT CO_2-E/ YEAR) (EXCL FISHING)[5]	TARGET % REDUCTION GHG ELECTRICITY	ELECTRICITY (KT CO_2-E/ YEAR)	DIESEL USE MILLION USG/YEAR
2010 (baseline)	Actual	0	116	0	60	5.84
2016		–	122	–	57	5.6
2025	Target	32%	79	50%	30	2.9
2030		45%	64	65%	21	2.0
2050		100%	0	100%	0	0

Table 1: Targets for the RMI electricity sector, derived from RMI's Nationally Determined Contribution (NDC) targets under the UNFCCC Paris Agreement

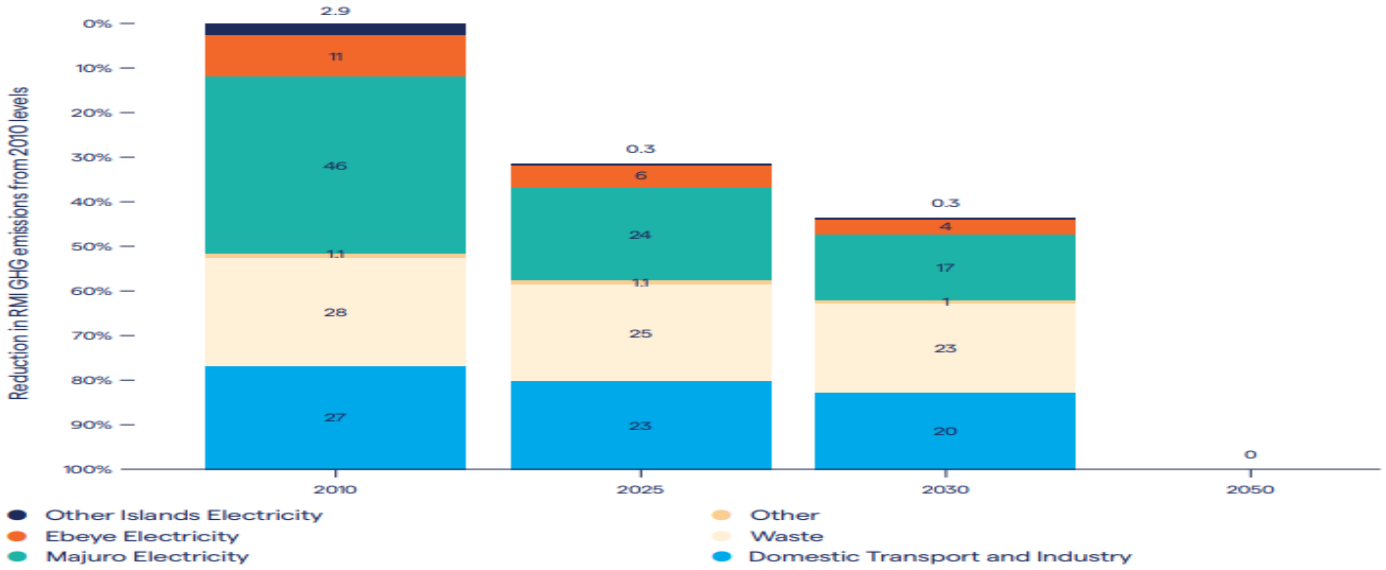
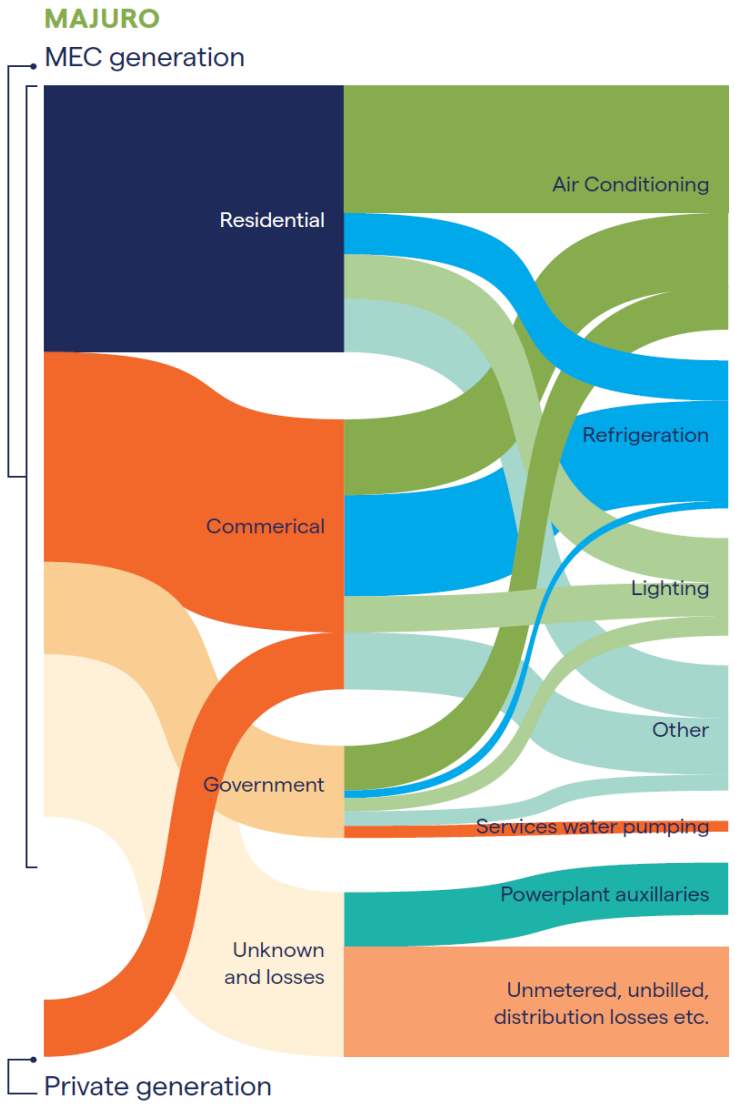
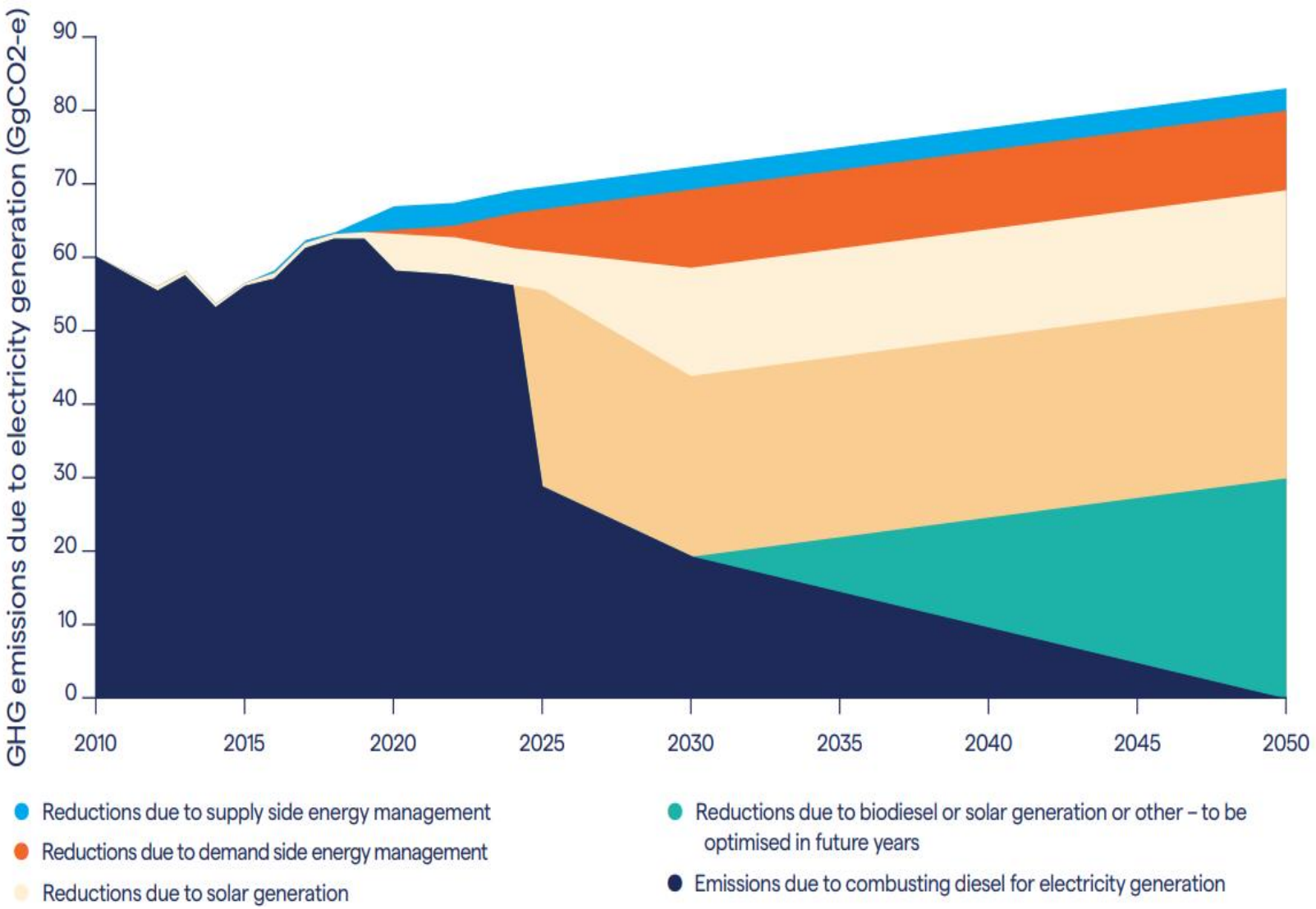


Figure 3: Targeted greenhouse gas (GHG) emissions in electricity on Majuro, Ebeye and other islands, and in the other key national sectors of waste and transport [1]

Alternative energies to substitute fossil fuel in RMI





Alternative energy candidates to substitute fossil fuel in RMI

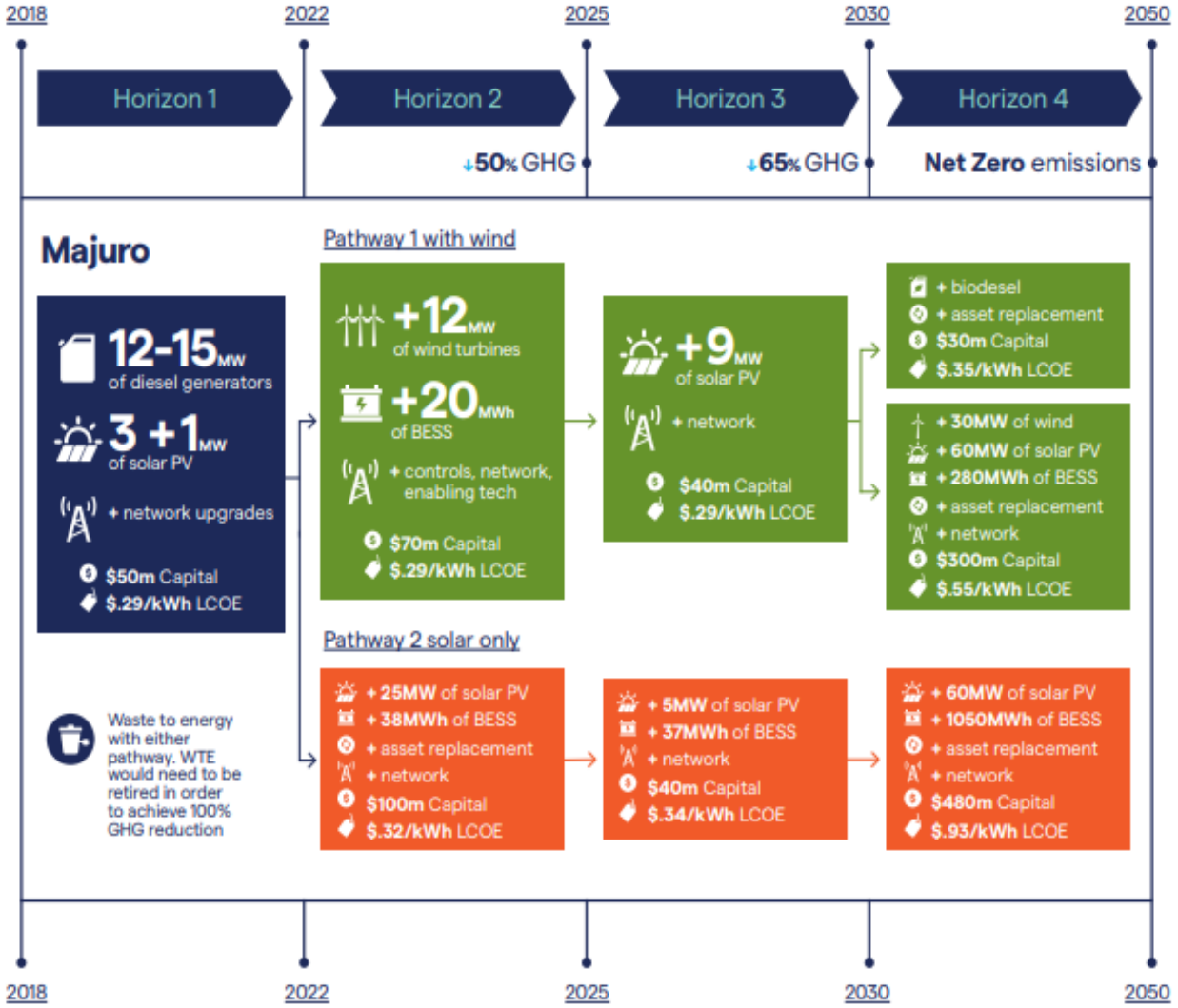


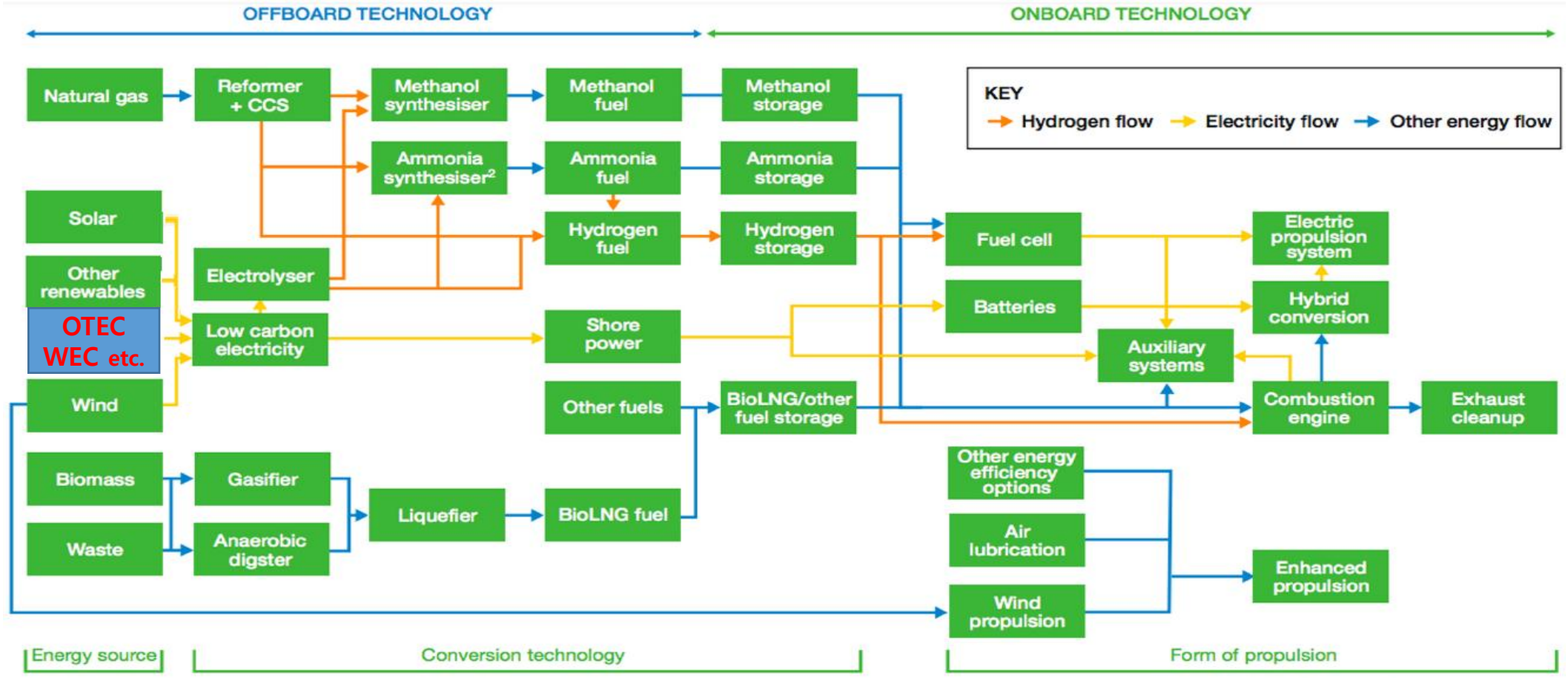
Figure 8: Majuro renewable energy pathways to 2025, 2030 targets and to net zero emissions by 2050 [2]

TECHNOLOGY	DESCRIPTION	ACTION TO BE TAKEN
Ocean thermal energy conversion (OTEC)	Uses temperature difference between ocean surface and deep water. Early stage technology, unproven for generating electricity.	Monitor development of technology and possibly revisit after 2025 or 2030 if commercially viable.
Wave, current, and tidal energy	Uses the energy of the ocean. Most technologies are early stage and require high levels of expertise and maintenance.	
Smart grids	Smart grids are an emerging, technically complex technology.	
Grid-tied household PV	At high levels of grid-connected renewables (above say, 30%) household PV would require smart grid technology to maintain grid stability.	
Vehicle-to-grid storage	As for household solar, this is more expensive than centralized utility-scale storage and requires a smart-grid.	

Table 2: Summary of technologies not suitable for RMI in the near term

Shipping emissions abatement measures & technology transition pathways (P. Nuttall et al. *<Micronesian Center for Sustainable Transport/USP>*)

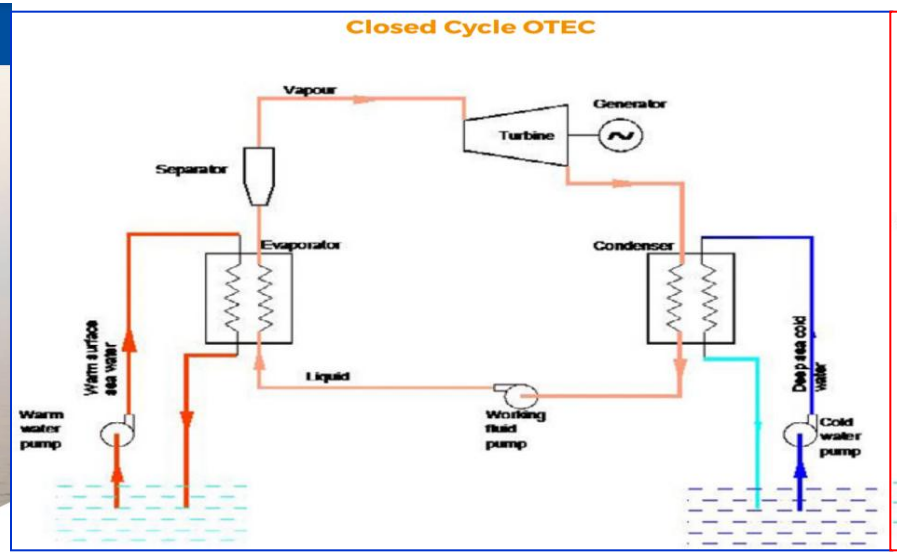
1. Technologies that can increase energy efficiency;
2. Operational or behavioural change that can increase efficiency;
3. Technologies specific to the capture/treatment of exhaust emissions (GHG and air pollutant emissions); and
4. Alternative fuels and energy sources and related machinery.

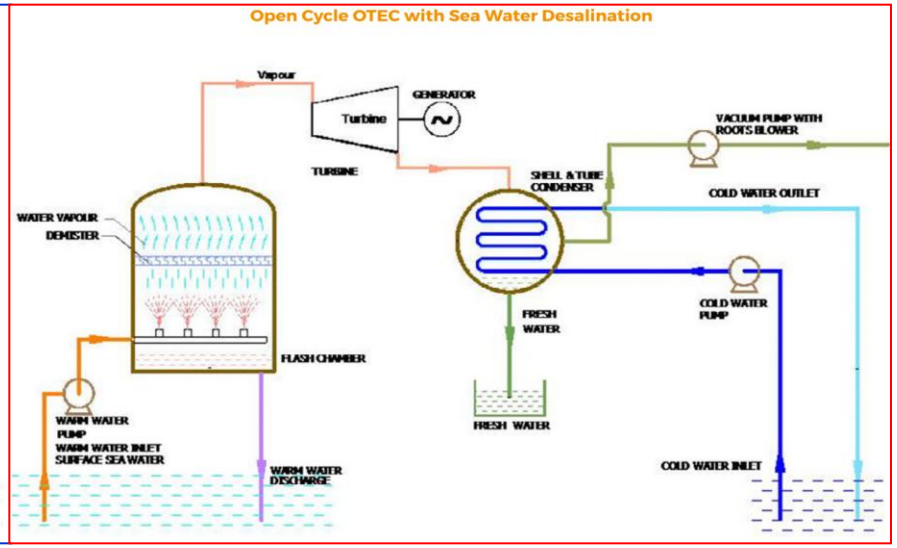


1 Steam Methane Reformer (SMR) + Carbon Capture & Storage
2 Equipment used for the Haber Bosch process

Source: Frontier Economics for DfT

Principle and classification of OTEC cycles





Closed cycle OTEC operates between pressures of 9.7 bar and 7 bar (1 bar = 1 atmospheric pressure), corresponding to the chosen working fluid (ex. NH3) at temperatures of 24°C and 14°C, respectively. In a closed cycle system liquid ammonia is pumped into an evaporator heated by warm seawater. The resulting ammonia vapor expands in a turbine producing mechanical power, which can drive a conventional electricity generator. The expanded vapor is then condensed back to a liquid using cold seawater in condenser. The liquid ammonia is then pumped back to the evaporator, thus allowing the cycle to continue.

In OC-OTEC, a warm seawater stream is partially vaporized inside a flash chamber kept under a high vacuum condition using a pump. This vapor expands inside a large diameter low-pressure turbine and generates mechanical power, which drives a generator to produce electricity. The expanded vapor is then condensed using cold seawater. The pressure difference between the flash chamber and the condenser provides the driving force for the vapor to flow towards the condenser via the turbine. If a surface rather than a spray condenser is used valuable freshwater can be produced as part of the electricity generation process.

Distribution of OTEC potentials and projects in the world

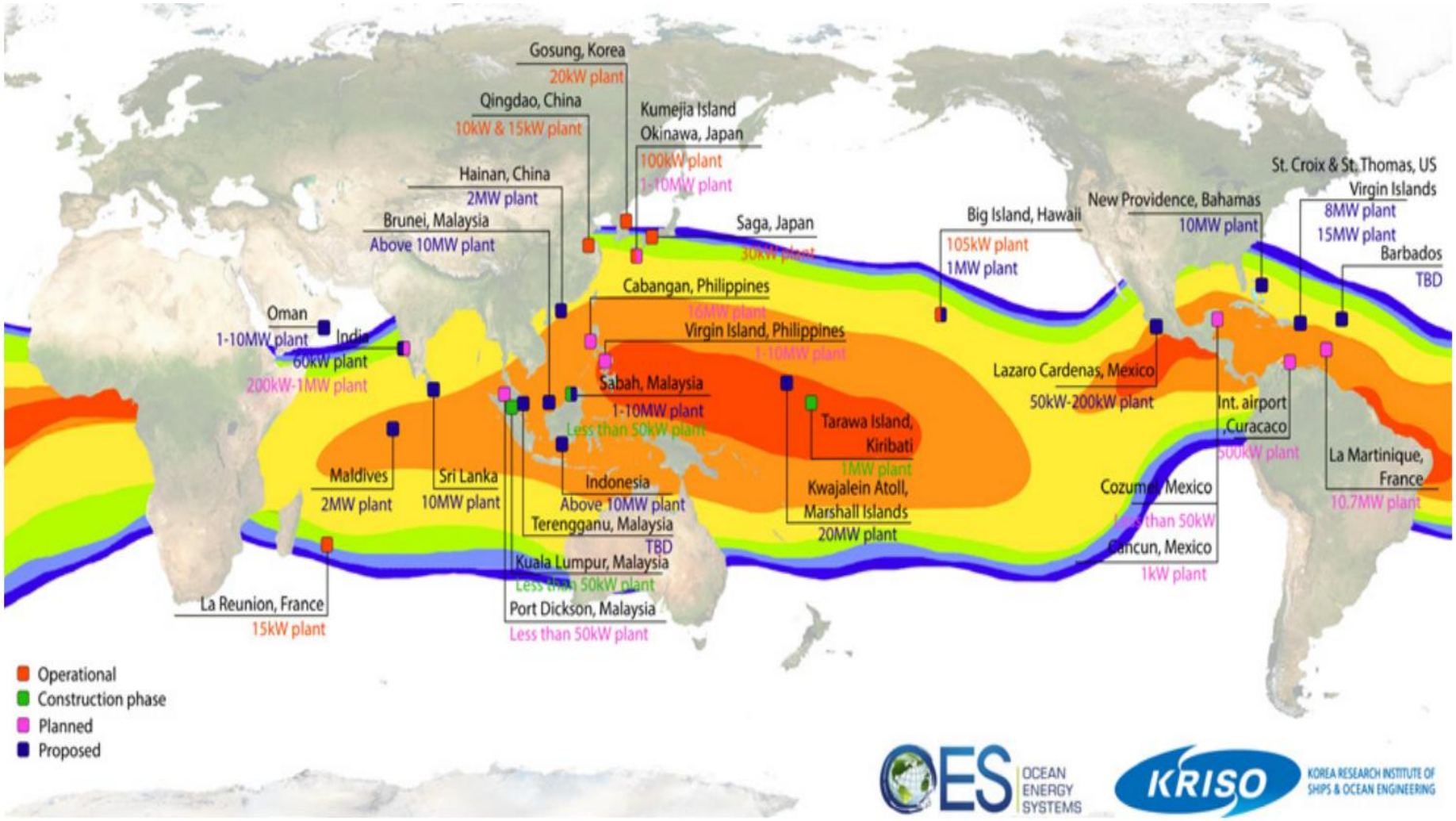


Figure 4.6 Present and future planned OTEC/SWAC projects around the world

History of challenging to host OTEC system in RMI (1)


THE MARSHALL ISLANDS JOURNAL

Lights go off in Ebeye
Page 3

OTEC key to Kwaj deal

Pedal power

Bill's new AMI job

Whoppers on Kwaj P21 • Hawaii help P14

Over the past 10 years, the Marshall Islands promoted OTEC power as an energy option for the country with the hope of developing a large-scale commercial OTEC plant to provide power to the US Army's missile testing base at Kwajalein.

Rechercher

PROJECT RATAK - A POTENTIAL OTEC POWER PLANT FOR THE MARSHALL ISLANDS

IOA News Letters Summary

by James G. Wenzel President, Marine Development Associates, Inc. (USA)

Introduction & Background

Due to the price instability of hydrocarbon fuels, the major impact of such imported fuels on economics, and significant concerns for the environment, many Pacific Island and other developing nations have expressed great interest in finding competitive alternate energy concepts. Ocean Thermal Energy Conversion (OTEC) has been shown to be one of the most promising environmentally benign, alternative energy concepts available for producing baseload electricity in tropical waters. Enormous resources of solar energy are stored in the surface waters surrounding many Island nations, that dwarf the energy required to support and maintain aggressive economic development.

OTEC power plants are also capable of producing multiple products including electricity, fresh water, and cold seawater for meeting critical cooling needs---all fundamental requirements for economic growth. In addition, the cold, nutrient-rich seawater can provide the basis for new Industry opportunities, such as high-value aquaculture products and unique and specialized cold water agriculture.

With the above characteristics in mind, plus the availability of low-risk, closed-cycle OTEC technology, the Government of the Marshall Islands elected to conduct a Design, Economic, and Financial Feasibility Study of a 5-10 MW, multi-product OTEC plant, to meet the future energy needs for Majuro. Grant funding for the Study was obtained from the U.S. State Department's Trade and Development Agency (TDA), a competition was conducted, and Marine Development Associates, Inc. (MDA), of Saratoga, California, selected as the study contractor. The Study Industry team included support by Makai Ocean Engineering, Inc. (Hawaii), Fluor Daniel Corporation (Texas), and Pacific International, Inc. (RMI).

OTEC NEWS

OCEAN THERMAL ENERGY CONVERSION NEWS

HOME | NEWS | WHAT IS OTEC | ABOUT | OCEAN THERMAL ENERGY ASSOCIATION

Marshall Islands sees OTEC as way out of emergency

July 4, 2008 Archive Pacific Ocean 0

Yokwe Online reports that the Marshall islands president has declared an economic state of emergency, due to energy prices. One part of the declaration looks at the long term and states that OTEC should be investigated as renewable energy source, the only alternative other than conservation mentioned by name.

MAL ENERGY ASSOCIATION

OTEC for Marshall Islands

February 15, 2010 Archive Ocean Thermal Energy Conversion, Pacific Ocean 0

I have in my hand, figuratively if not literally, a letter which shows that an OTEC development company has approached the government of the Marshall Islands and proposed a 10 MW OTEC plant which also will produce 2 million gallons/day water (which I presume is drinking water). The letter, issued in early January 2009, which is from the Marshall Island government, says that several ministries are authorised to go ahead and negotiate terms with the company.

History of challenging to host OTEC system in RMI (2)

Marshall Islands pioneers sustainable technology solutions to climate change

Elisabeth Braw

Tue 5 Nov 2013 15.23 GMT

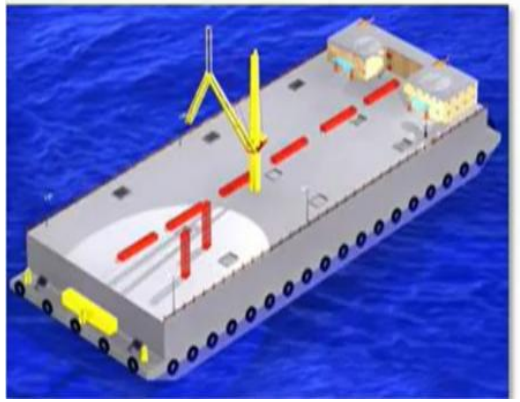
The vice president of the Pacific nation at risk of being submerged says displacement is a lingering threat but new opportunities lie ahead

Tony de Brum, vice president of the Marshall Islands, says the country's experience with climate change is of value to the rest of the world. Photograph: Thom Woodroofe

Admit it: you haven't been paying attention to the Marshall Islands. And why should you? It's populated by a mere 69,000 who live on 1,156 islands. But climate change has propelled the Pacific Ocean nation to the international centre stage. With its exposure to rising sea levels, the Marshall Islands are in peril of being the first country obliterated by climate change, but the country has seized this threat as an opportunity and positioned itself as a lab for new, clean technologies. It is in negotiations with some of the world's largest companies about commercialising new ocean thermal energy conversion (OTEC) energy. Tony de Brum, vice president (minister-in-assistance to the president) and the minister in charge of climate change adaptation, talks to Guardian

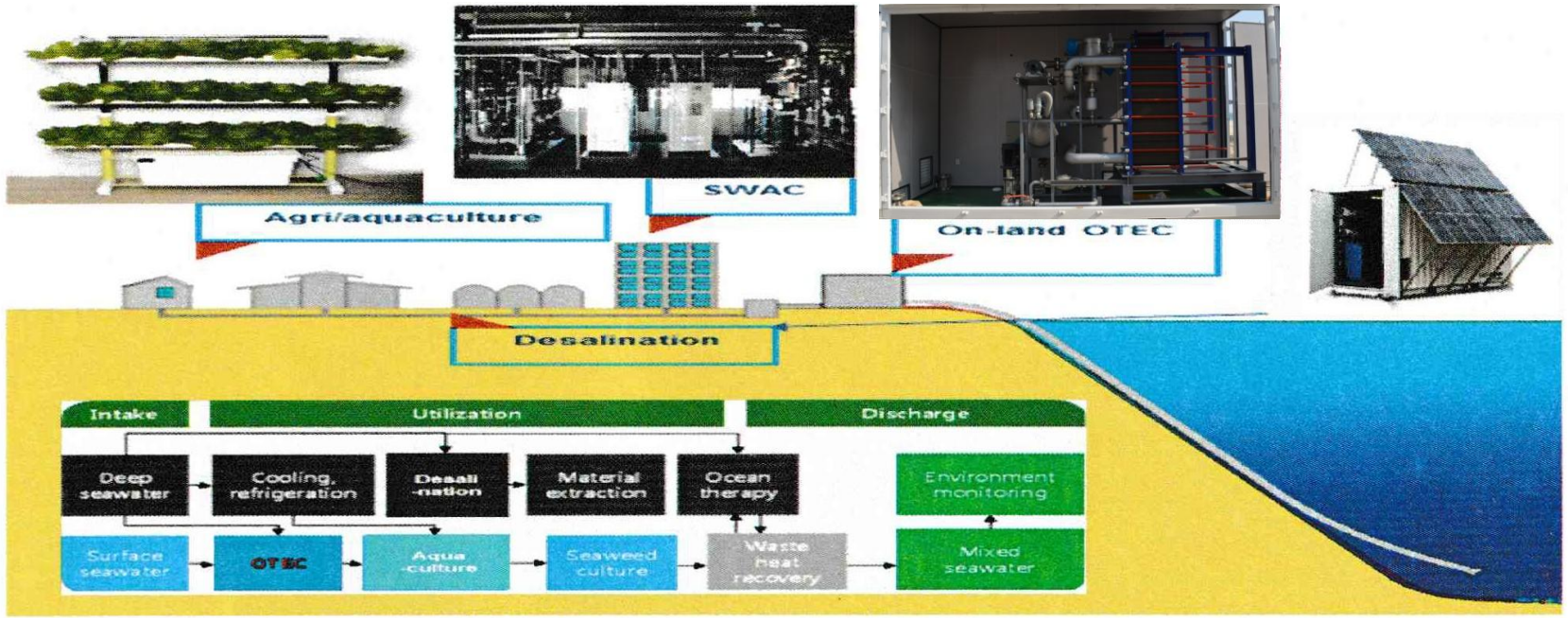
125 MW OTEC PLANTSHIP

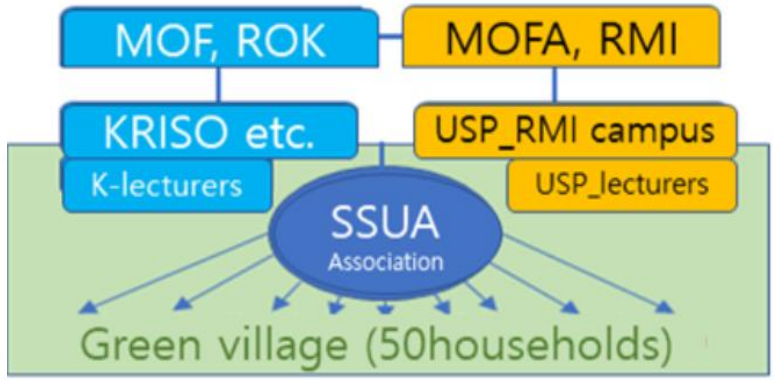
60 MW OTEC PLANTSHIP

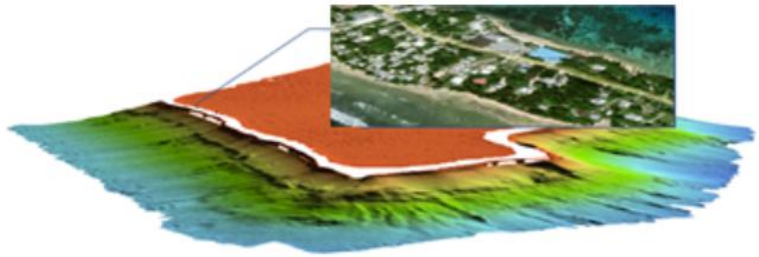


10 – 17 MW OTEC PLANTSHIP

Planned OTEC ODA project based on SSUA program
(Majuro, Marshall Islands; 2023~2026)



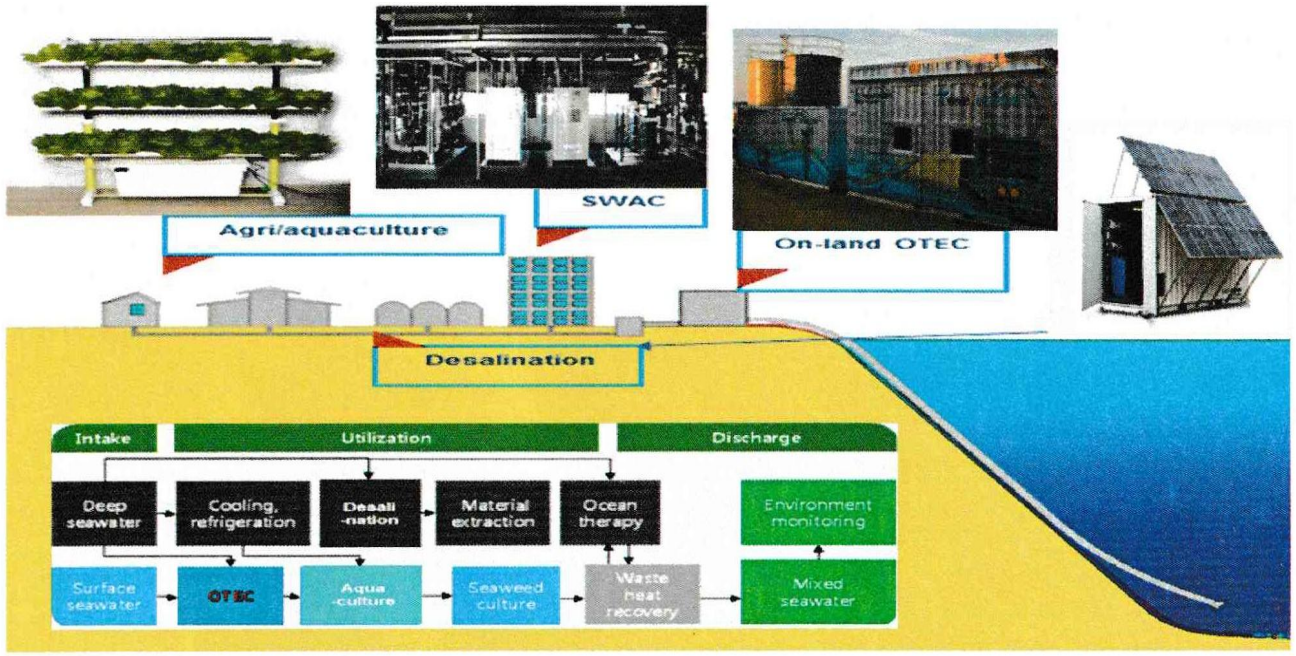


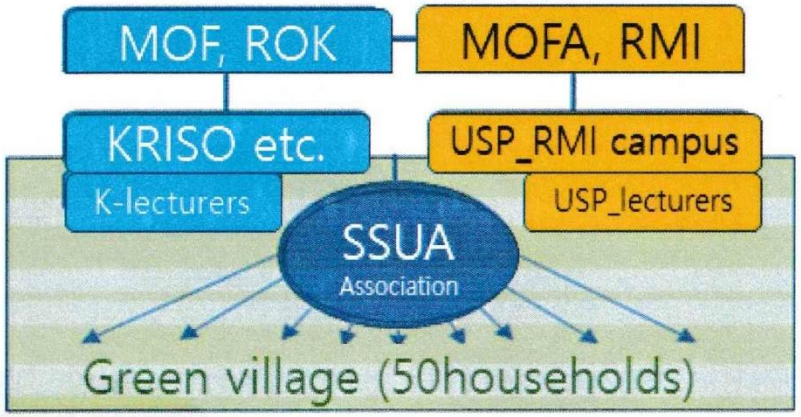


Component	Details	2023	2024	2025	2026
SSUA	Collaboration with the USP Marshall Islands Campus	■	■	■	■
Power supply & cooling	50㎾ OTEC + 150RT SWAC		■	■	
Renewable desalination	PV power supply type 20㎥/day				■
Renewable hydroponics	100 sets of hydroponic cultivation equipment (3-stage type)	■	■	■	

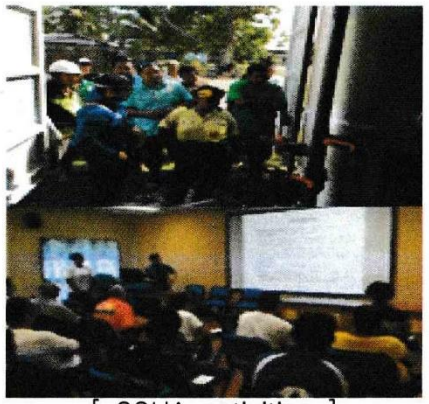
=> To create an energy-independent green village for 50 homes

Expectation of OTEC/DOWA ODA project





[Implementaion organization]



[SSUA activities]

Achieving energy independence for about 50 households scale

- Power: 249,660 kWh/year
- Cooling: 766,500 kWh/year

Demonstrating an energy-water-food nexus

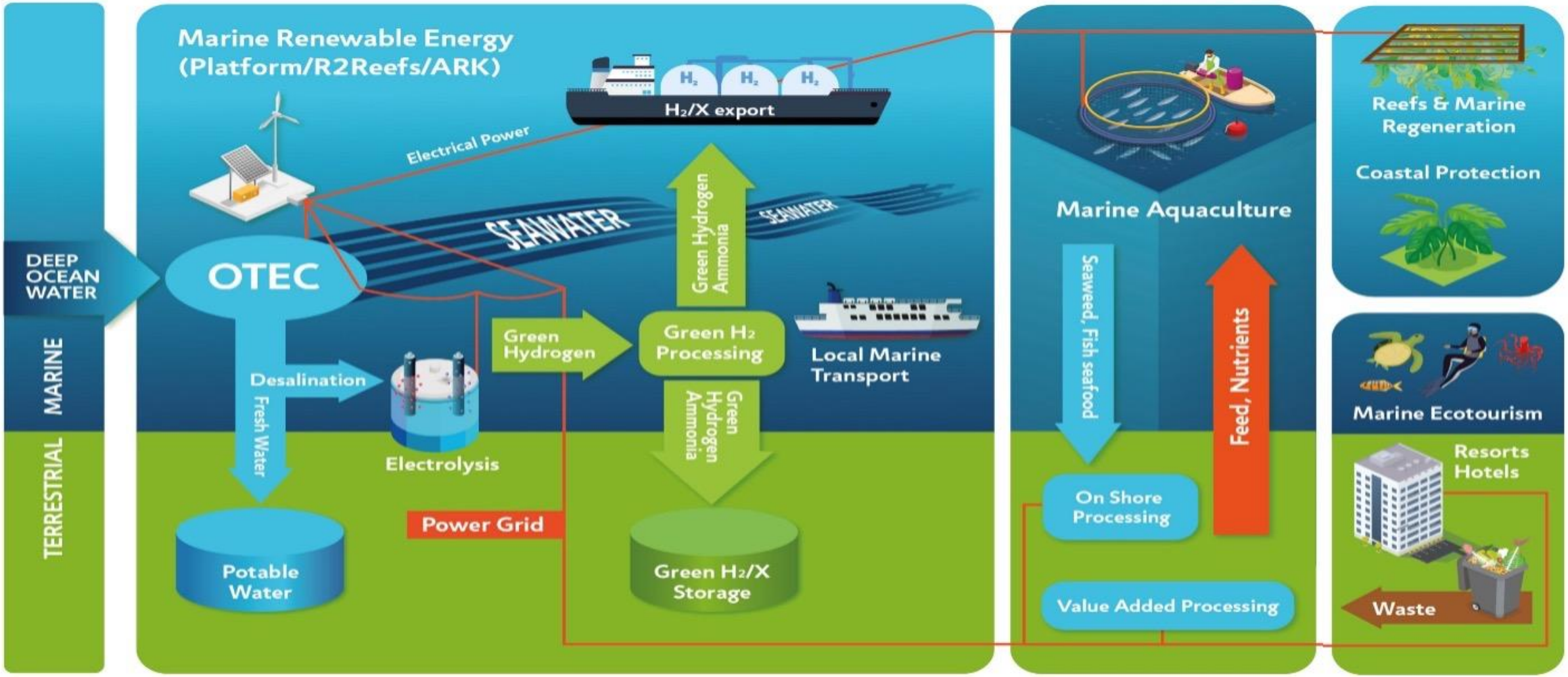
- Fresh water: 6,570㎥/year
- Vegetables: 24,000 head/year

Building consensus on the potential for carbon-neutral marine energy

- CO_2 uptake: 485 tCO_2/year

Future plan to spread OTEC by multi-lateral cooperation program

MARES - Multifunction Approach (ADB)



Conclusion

1. The RMI is suffering from climate change and is working to mitigate it in line with the United Nations' SDGs.

2. The RMI, which has a large ocean and marine resources, has been hoping to secure energy, water and food, and promote industrial development by building education and infrastructure based on this.

3. In particular, Ocean Thermal Energy is abundant, and the possibility of technological development and commercialization has been investigated, and the national energy roadmap also lists it as a candidate to replace fossil fuels after confirming its applicability.

4. The OTEC ODA project, which will be supported by Korea, will be a regional application living-lab to achieve the SDGs in the local community in Majuro, and will be a process to consider its availability to an alternative energy source.

5. We have high expectations for OTEC to realize carbon neutral 2050 and hope that it will be expanded to include not only clean power but also green hydrogen, and the Maritime Green Corridor so on.


Sustainable Utilization of Food-Energy-Water
from OTEC Plant to achieve RMI-SDGs

Thank you!