FY2021 Project for Ministry of the Environment Government of Japan

FY2021 City-to-City Collaboration Program

for Creating a Zero-carbon Society

(Promoting of carbon-free society and co-benefits through the implementation of EV vehicles

in the state of Koror, Republic of Palau)

〔Kitakyushu City- Koror state Collaboration Project〕

Survey Report

March 2022

ATGREEN Co., Ltd.

Table of Contents

Abbreviation

Abbreviation	Formal name
ADB	Asian Development Bank
BPW	Bureau of Public Works
COVID-19	Corona Virus Infectious Disease, emerged in 2019
EV	Electric Vehicle
EVMJ	EV Motors Japan
GHG	Green House Gas
GSE	Ground Support Equipment
IGES	Institute for Global Environmental Strategies
INDC	Intended Nationally Determined Contributions
JCM	Joint Crediting Mechanism
JETRO	Japan External Trade Organization
JICA	Japan International Cooperation Agency
JOIN	Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development
LED	Light-Emitting Diode
MPIIC	Ministry of Public Infrastructure, Industries and Commerce
MRV	Measurement, Reporting and Verification
ODA	Official Development Assistance
OECD	Organization for Economic Co-operation and Development
OOC	Our Ocean Conference
PIAC	Palau International Airport Corporation
PCC	Palau Chamber of Commerce
PPR	Palau Pacific Resort
PPUC	Palau Public Utilities Corporation
PRR	Palau Royal Resort
PV	Photovoltaics
PVA	Palau Visitors Authority
SDGs	Sustainable Development Goals

WS	Workshop
3R	Reduce/Reuse/Recycle

Chapter 1 Objective and Overview of Project and Work

1.1 Project objective

The Paris Agreement, which came into effect in November 2016 and entered the implementation phase in 2020, calls for accelerated action by central governments, as well as non-governmental actors, including municipalities and cities, to combat climate change. The "Ministerial Meeting of the 'Online Platform' on a Sustainable and Resilient Recovery from COVID-19, Climate Change and Environmental Action", held in September 2020, also affirmed the need for decarbonization policies of local authorities with activities directly linked to communities, and the importance of community-led approaches to development. Japan has also declared that it will reduce overall greenhouse gas emissions to zero by 2050 as it aims to become a decarbonized society, and the number of municipalities that have declared their intention to reach net zero CO2 emissions has risen sharply to 598 (as of February 28, 2022).

Accordingly, cities and municipalities are playing an increasing more important role in examining and implementing specific climate change measures and projects at the local level. It is necessary to accelerate the move towards building a sustainable decarbonized society, particularly in Asia, where economic growth is significant, to realize the creation of decarbonized societies throughout the world. There is a growing movement worldwide supporting urban initiatives to decarbonize and achieve low-carbon development in cities, which are hubs of activities that support socioeconomic development.

As COVID-19 continues to spread around the world, cities are under pressure to recalibrate and reconsider new measures to achieve sustainable development while simultaneously handling challenges related to the spread of the virus, rendering it crucial to develop new methods and build new cities through city-to-city collaboration. In this project, a study team of private Japanese companies, research institutions, and Japanese cities with experience and expertise in the development of decarbonized and low-carbon societies took part in a study in Koror State in the Republic of Palau to provide support to local authorities in their efforts to form decarbonized and low-carbon societies, achieve a "decarbonization domino effect", and introduce equipment and facilities that will contribute to the formation of a decarbonized and low-carbon society.

1.2 Project overview

1.2.1 Overview of work

(1) Study details

A feasibility study was conducted in the following areas with a view to developing a JCM Model Project (Table 1-1 and Figure 1-1).

Table 1-1. Overview of project

Target sectors	Outline of implementation
Tourism sector	Study and investigation into increasing the ratio of renewable energy and decarbonization through the introduction of EVs for passenger transport vehicles used for tourism (i.e., sightseeing buses, etc.)
Waste collection and transport sector	Study and investigation into the introduction of EVs for collection and transport vehicles as part of efforts to increase the ratio of renewable energy in the waste resource circulation flow
Other technology sectors contributing to decarbonization and solutions to local environmental issues	Study and investigation into the development of projects that contribute to future decarbonization by surveying local issues and needs, and examining the seeds and expertise that can be provided, mainly by companies in Kitakyushu City.

○Project Name：Project to accelerate carbon-free and to create co-benefit through EV vehicles in State of Koror, Palau
(Kitakyushu-Koror Cooperation Project)
○Project Goal：Decarbonization and co-benefit formation through the implementation of PV equipment and EV vehicles that do not load the grid
○Study overview：
1. Study on expanding for renewable energy ratio and decarbonization by implemented using EV vehicles in tourism
2. Study on expanding for renewable energy ratio (nearly 100%) in waste transportation, treatment and recycling flow by implemented using EV vehicles
3. Consider on a possible application of the theme 1 and 2 studies to JCM implementation promoting project
4. Considering expanding other JCM project in Koror State

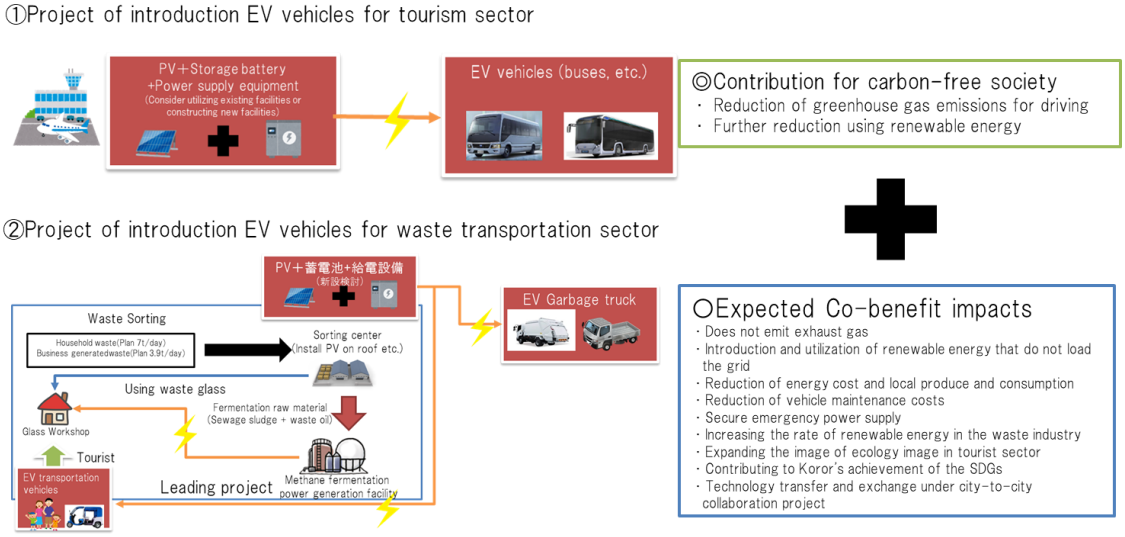


Figure1-1 ：Overview of project implementation

(2) Target area

Koror State and surrounding areas, Republic of Palau

1.2.2 Implementation methods

(1) Content of study

The detailed content of surveys conducted in the tourism sector, waste collection and transportation sector, and other technology sectors that contribute to decarbonization and solving local environmental issues, as indicated in the previous section, are described below.

Table 1-2. Content of surveys in each sector

Tourism sector
1) Survey on the feasibility of procuring electricity from existing PV power and potential locations for EV charging points Interviews were conducted with local stakeholders on PV power generation facilities that can be used to procure electricity (i.e., those introduced in other JCM, ODA projects in the past, as well as those in other projects). A survey was also conducted on EV charging points.

2) Details surveys on the project model, including implementing entities, project implementation structure and scale of facilities, as well as a feasibility study on public-private partnerships with Koror State

Interviews and discussions were held on the project model (feasibility study to confirm technical requirements and standards, such as cruising range, number of charging points, charging times, needs, etc.) with private companies (related to the local international airport), and various organizations that have expressed interest in the project.

3) Survey and investigation into cost models, implementation systems, and models on recouping investment required for the project

Hypothetical implementation systems and estimated costs were examined based on the above results to develop more cost-effective models that reflect local needs. Estimates were also conducted on initial investment costs and the number of years required to recoup cumulative losses.

4) Survey on maintenance and other issues to be resolved during operation

In this survey, local issues (e.g., consistency with communications) and measures taken to introduce and use online maintenance tools were organized as systems were examined to resolve maintenance issues in island countries. Specific issues related to the operations of public transport in Koror State were identified and the content of expertise from Japanese counterparts was examined.

5) Review and preparation of application to the JCM Model Project and MRV methodology proposal

Interviews and surveys were carried out based on the content of the surveys in items 1) to 4), and a draft MRV methodology was considered with a view to applying for the model project subsidy and other funds.

Some of the field work for surveys and analysis in items 1), 2), 4), and 5) above was outsourced to Palau International Airport Corporation (PIAC).

Waste collection and transport sector

1) Survey and investigation into the feasibility of commercializing waste collection and transport with officials from Koror State and other potential stakeholders

Interviews and discussions were held with officials and representatives from local waste management offices and the final disposal site (M-Dock) on business models for the use of EV

vehicles in waste collection and transport (confirmation of technical requirements and needs, such as cruising distance, number of chargers and charging time). The team also discussed and examined ways to organically link up with the Transportation Station Project, which is being promoted on-site, in terms of the implementation system, securing funding and other pertinent points.

2) Survey and investigation into cost models, implementation systems, and models on recouping investment required for the project

Hypothetical implementation systems and estimated costs were examined based on the above results to develop more cost-effective models that reflect local needs. Estimates were also conducted on initial investment costs and the number of years required to recoup cumulative losses.

3) Study on maintenance and other issues to be resolved during operation

Similar to the tourism sector, a system for resolving issues related to maintenance in island countries was examined together with a review of local issues and measures to be taken when introducing and utilizing online maintenance tools (e.g., consistence with communications environment, other).

4) Review and preparation of application to the JCM Model Project and MRV methodology proposal

Interviews and surveys were carried out based on the content of the surveys in items 1) to 3), and a draft MRV methodology was considered with a view to applying for the model project subsidy and other funds.

Some of the field work for surveys and analysis in items 1), 3), and 4) above was outsourced to KE+ Environmental Consulting Service.

Other feasibility studies on the development of projects that will contribute to decarbonization efforts

1) Surveys on project formation, including the specific project scale of the technology needs based on information obtained through surveys in the previous fiscal year

A survey was conducted on the technological seeds and know-how from local companies in Kitakyushu City to resolve environmental issues, including the introduction of LED lighting to streetlights on the island and the installation of renewable energy and energy-efficient equipment/facilities in hotels.

2) Conducting local online workshops

Preparations were made to participate in the international “Our Ocean Conference” (which was postponed twice due to COVID-19 and was not held within the project period), deliver presentations at a JCM webinar, and take part in panel discussions where ideas could be exchanged.

3) Presentations at and coordination of online meetings designated by the Ministry of the Environment

Projects were introduced and outcomes reported at the 2nd Zero Carbon City International Forum (on March 9 and 10, 2022).

Part of the research, analysis and preliminary coordination work for the Japanese team in items 1), 2), and 3) above was outsourced to the Institute for Global Environmental Strategies (IGES).

1.2.3 Implementation period

August 19, 2021 to March 10, 2022

1.2.4 Implementation system

The structure used to implement the work in this project is shown in Figure 1-2 and Tables 1-3 and 1-4 below.

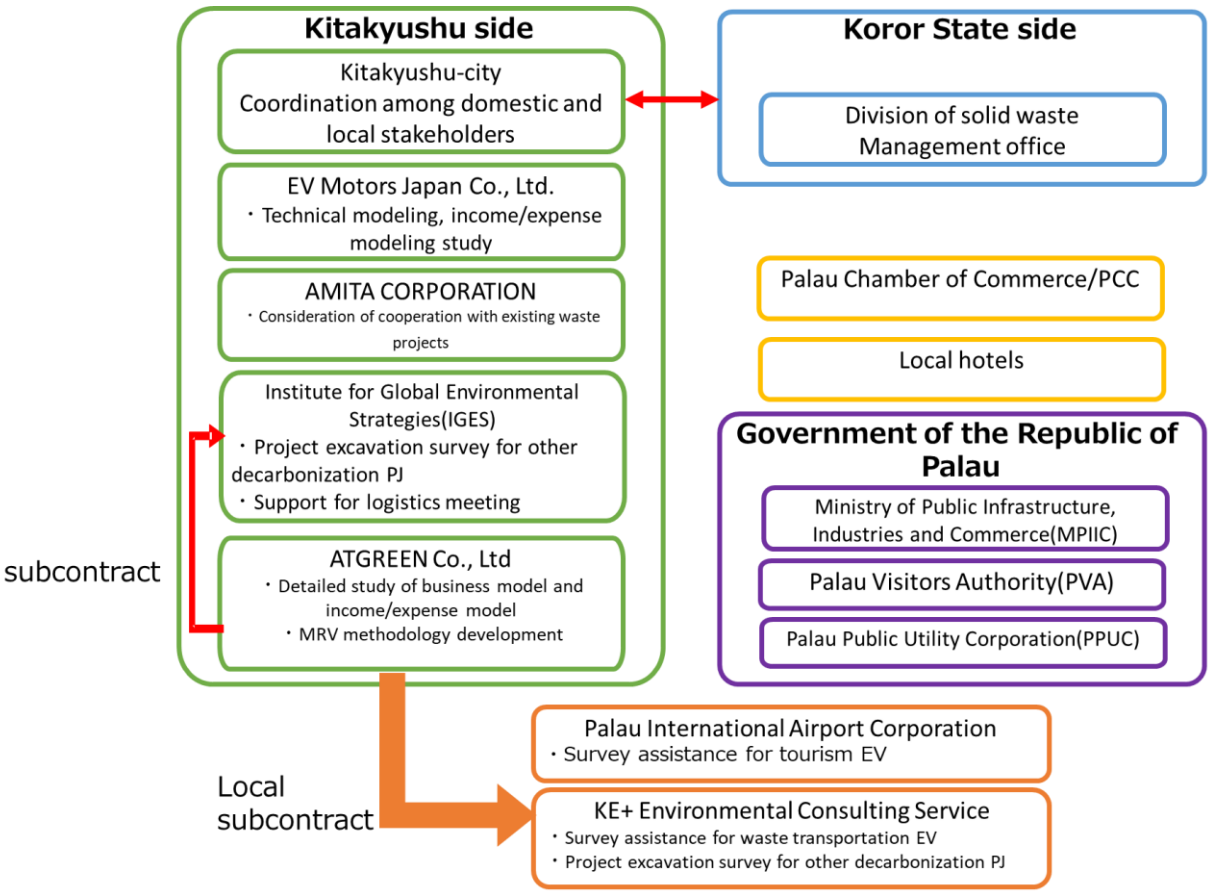


Figure1-2：Implementation system

Table 1-3. Overview of organizations in Japan and roles in the project

Organization name	Overview of organization/project	Role in project
AT GREEN Co., Ltd.	Consulting services in the environmental, energy, and waste sectors	・Project proponent ・Studies on project model ・Development of MRV methodology
International Environmental Strategies Division, Overseas Environmental Project Department, Environment Bureau, City of Kitakyushu	・Overcame damage from past pollution to become an “SDGs Pilot Model City” (selected by OECD) ・Municipality promoting advanced initiatives in multiple sectors, such as resource recycling, decarbonization, energy use, social welfare, SDGs, etc.	・Overall coordination for city-to-city collaboration ・Promotion of G-to-G cooperation ・Sharing extensive experiences and knowledge on the environment and SDGs
EV Motors Japan	・Sales and maintenance of EV vehicles (buses, trucks, and other commercial vehicles), and charging stations	・Examination of technology and equipment adapted to local conditions ・Study on business income/expenditure models
AMITA CORPORATION	・Provision of solutions to enhance the sustainability of companies and municipalities ・Waste treatment/disposal and recycling	・Feasibility studies on linkages with existing resource recycling PJs ・Adjustments to ensure consistency with existing PJs
Quando Inc.	・Development and sales of remote maintenance systems ・Selected as one of 50 startup companies under an acceleration program hosted by the Japan External Trade Organization (JETRO), Cabinet Office, and the Ministry of Economy, Trade and Industry	・Identification of issues and effectiveness of remote maintenance systems in reducing labor shortages for maintenance work in island nations
Institute for Global Environmental Strategies (IGES)	・International research institute for strategic policy research related to the environment and SDGs from an Asia-Pacific perspective	・Investigations on the introduction of additional decarbonization technologies ・Support in organizing local workshops

Table 1-4. Overview of local consultants and roles in project

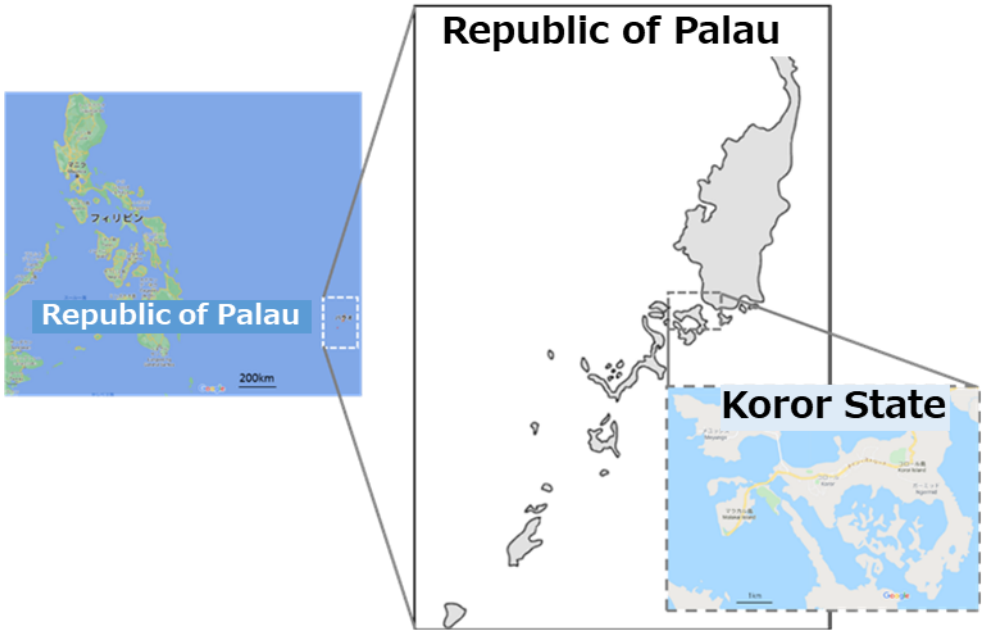
Organization name	Overview of organization/project	Role in project
Palau International Airport Corporation	・Joint venture between an intermediary holding company with Sojitz Corporation, Japan Airport Terminal Co., Ltd., and Japan Overseas Infrastructure Investment Corporation for Transport & Urban Development (“JOIN”), which holds the operational rights to Palau	・Provision of assistance for studies in the tourism sector on the introduction of EV buses for transporting passengers ・Organization of conditions and issues in introducing EV buses for transporting tourists and charging facilities at Palau International Airport

	International Airport for 20 years from 2019, and the Government of the Republic of Palau ・Add value to the Palau International Airport and enhance its value as a tourist destination	
KE+ Environmental Consulting Service	・Local environmental consulting service ・Numerous waste-related studies and research carried out in collaboration with the Koror State Solid Waste Management Office	・Assistance in surveys of local government officials and the Koror State Solid Waste Management Office on the promotion of EVs in the waste collection and transport sector

1.3 Background of work

1.3.1 Overview of Koror State, Republic of Palau

The Republic of Palau is located in the northern hemisphere in the western part of the Pacific Ocean at 2 to 8 degrees north latitude and 131 to 135 degrees east longitude on the western edge of Micronesia and the Caroline Islands. The capital was moved from Koror to Ngerulmud, Melekeok State on Babeldaob Island in 2006. The country has a total population of 17,501 (as of 2012), 66.7% of which (or 11,655 people) are concentrated in the Koror region, which is the focus of this study. Due to its geographical location as an island state, Palau faces a number of issues, including waste treatment, outside dependence on food and energy, and an economy centered on foreign investment. The tourism industry accounts for more than 50% of the country's GDP. However, as Palau depends on the marine environment, including its rich coral reefs and unique, tropical fish species, environmental protection is a priority for the country.



(Map source：Google Map)

Figure1-3：Location of Koror State in the Republic of Palau

【Climate change measures】

Palau is a member of the Secretariat of the Pacific Regional Environment Programme (SPREP), and is promoting climate change action. Palau developed its Intended Nationally Determined Contributions (INDC) in November 2015. An overview of the INDC is below.

Table1-4：Overview of INDC[1]

Item	Contents
Implementation period	Starts in 2020, ends in 2025
Reductions	Emission reduction targets in the energy sector with additional reductions from the transport and waste sectors
Base year	2005: Emissions in this year were 88,000 t-CO_2
Reduction targets	Aims to achieve the following targets by 2025

1 パラオ共和国 INDC より(http://prdrse4all.spc.int/system/files/palau_indc.final_copy.pdf)

	・Reduce greenhouse gas emissions by 22% from 2005 levels ・Increase the share of renewable energy to 45% ・Energy savings target of 35% from 2005 levels

【Energy-related policies and plans】

Palau has been implementing the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP) as a mitigation project in the energy sector since 2007 to promote the use of renewable energy.

Practical mitigation measures in Palau include shifting away from an energy dependence on fossil fuels. This is an important issue in terms of the cost of power generation for Palau, which is unable to secure fossil fuels without importing them from overseas. Palau has drawn up a roadmap to expand the introduction of renewable energy from diesel power, which accounts for around 98% to 99% of the country's electricity to date, and has set a target of 20% electricity generation from renewable energy by 2021 (the original 2020 plan was abandoned), and 45% of electricity generated from renewable energy by 2025. As part of this roadmap, five PV projects (2.5 MW) have already been installed under the JCM Model Project program, and renewable energy using PV is being introduced with support from the New Zealand and South Korean governments. The Government of Palau is also conducting an international competitive public tender for a PV-based microgrid construction project under the agency of the Asian Development Bank (ADB).

However, grid connections for this kind of large-scale PV system are problematic in terms of fluctuations over both long and short periods, and the need to absorb surplus power and sudden output fluctuations. The introduction of microgrids also runs the risk of further destabilizing electricity, as power generation from existing diesel generation facilities is subject to frequent power outages due to aging equipment, inadequate maintenance, and a lack of operational capacity.

In view of these points, it is urgent that renewable energy be introduced and utilized for self-consumption, taking into account the necessity of reducing the load on the grid, a need that the Palau side as also expressed.

【Tourism sector】

Before the global pandemic of COVID-19 (see below), Palau was a tourist destination for between 120,000 to 160,000 visitors a year. Tourism accounted for approximately half of the country's total national income of JPY 25 billion. However, the environmental impact from the tourism sector, including global warming, is also high. In addition, public transport is not completely developed, compelling the use of taxis and hotel transfer services. Furthermore, Koror Island has only one main road (Main Street), and traffic congestion is frequent, especially in the morning and evening.

【Waste sector】

In consideration of the importance of the 3Rs, the Koror State government constructed a recycling center in 2004 to strengthen waste management. Koror has introduced an organic waste composting project and sells the compost produced, and has established a deposit system where custom duties are collected on imported beverage products to cover the cost of collecting/processing empty cans, bottles, and PET bottles. Koror is actively promoting waste recycling businesses, including the introduction of a purification plant for waste plastics in 2015. Yet, only some kinds of waste can be recycled in Palau due to the lack of industries that can utilize waste within the country. However, reports have stated that the volume of waste, including household and business waste, has increased to over 27 tons per day, due in part to the increasing number of imports and tourists.[2]

The final landfill site for waste in Palau (M-Dock) is nearing the end of its remaining service life, although that has been extended by raising the levees several times. For this reason, a new final disposal site was built in Aimeliik State with grant aid from Japan, and was completed in August 2020. Over the years, each state operated a landfill site in which they landfilled their own waste. However, the new landfill site is planned for the disposal of all waste in Palau, with the exception of outlying islands. In order to make effective use of the limited capacity of the new landfill site, there is an urgent need to implement further waste reduction measures through the 3Rs. Koror State also needs to further improve the efficiency of waste treatment, since shifting waste treatment to the new final disposal site in Aimeliik State will result to increased haulage costs.

---

[2] CTI Engineering International Co., Ltd. (2018), Preparatory Survey on the Project for the Construction of a National Landfill in the Republic of Palau, Japan International Cooperation Agency

Koror State envisages waste collection and recycling businesses with a transshipment and storage facility to sort waste as the foundation for both improving recycling rates and reducing waste disposal costs. At the same time, the development of an international recycling system is desired to solve difficulties in handling waste that cannot be treated domestically.

【Impacts from the global spread of the novel coronavirus (COVID-19) on Palau】

COVID-19, which has spread to all corners of the world, had a significant impact on Palau. The country strengthened border control measures, and placed stringent restrictions on overseas travel to the country. Although the entry of overseas travelers resumed conditionally from August 2020, the impact on the tourism sector has been enormous. A large number of people are unemployed, and the government is providing compensation to those who have lost their jobs. Financially, Palau is also receiving support from other countries, including loans from the U.S. and a sovereign loan from ADB.

Most recently (as of February 21, 2022), there has been a rapid uptick in the number of COVID-19 cases, most likely caused by the Omicron strain. As of February 18, 2022, the number of infected persons in Palau stood at 3,464,[3] with approximately 19% of the population having been infected. Scheduled passenger flights to other countries have also been significantly reduced.

1.3.2 Collaborative relationship between Kitakyushu City and Koror State

City-to-city collaboration between Kitakyushu City and Koror State dates back to 2015 and is based on the establishment of a resource recycling system. Initiatives that have been carried out to date are shown in Table 1-5 below.

Table 1-5: Past city-to-city collaboration activities between Kitakyushu City (and local businesses) and Koror State

FY	Project name	Project overview
2015	Project on the establishment of a comprehensive resource	・Jointly implemented with the AMITA Institute for Sustainable Economies (AISE)

[3] Information on COVID-19 cases from the website of the Japanese Embassy in Palau (February 21, 2022) https://www.palau.emb-japan.go.jp/itpr_ja/11_000001_00409.html

	circulation system in island regions	・Conduct of surveys on landfill delivery volumes and setting the amount of material that can be disposed ・Review of specifications and costs for recycling facilities ・Review of business plans/schemes ・Consensus building with government/project stakeholders to realize the objectives of the project/business ・Visit by Palau officials to Japan and organization of workshops ・Surveys on cultivating energy resource crops
2016	Project on the establishment of a comprehensive resource circulation system in island regions	・Jointly implemented with the AMITA Institute for Sustainable Economies (AISE) ・Signing of partnership agreements (AMITA Institute for Sustainable Economies (AISE) and Koror State) ・Additional studies and consensus building on project schemes and plans, etc. ・System design, acquisition of estimates, preparation for construction
2017 2018	Feasibility study on the introduction of a comprehensive organic resource circulation system using small-scale methane fermentation technology in island areas	・Participation as external human resources in the proposed corporation, Vioce Co., Ltd., with AMITA Institute for Sustainable Economies (AISE) ・Study related to input feedstock for biogas facilities (food waste, resource crop napier grass, etc.) ・Establishment of food waste sorting and collection schemes ・Promotion of the use of liquid fertilizers ・Feasibility study on deploying systems to island areas ・Specifications and operational design of small-scale biogas facilities optimized for local regions ・Awareness raising activities for local staff (activities to receive visitors to biogas facilities to Japan)
2019	Project on the development of a waste collection, sorting, and recycling system based on a transshipment and storage facility for sorting resources in Koror State, Republic of Palau	・Jointly implemented with Amita Corporation and Beetle Engineering ・Construction of a transshipment and storage facility equipped with a resource sorting function and the establishment of integrated systems for resource sorting functions ・Consideration of international recycling system
2020	FY 2020 City-to-City Collaboration for Zero-Carbon Society: Project to promote decarbonization and create co-benefits through the introduction of EV vehicles in Koror State, Republic of Palau	・Jointly implemented with EV Motors Japan, Amita Corporation, IGES Kitakyushu Urban Centre, AT GREEN ・Conduct of online interviews with representatives from the state government, waste management offices, hotel operators, and others to verify local needs and the effectiveness of introducing EV vehicles into the tourism, waste collection and transport industries ・Identification of the formation of other decarbonization-related projects

As shown in the table above, exchanges between the two areas are ongoing, particularly in the waste sector. Kitakyushu has also been selected by the Cabinet Office as an SDGs FutureCity, as well as an SDGs Pilot Model City by OECD with the promotion of activities to achieve the SDGs at the city level. Koror State, which is also preparing to set up a department related to the SDGs to promote activities to achieve the goals, is expecting to share knowledge with Kitakyushu, and exchanges are currently taking place.

1.3.3 Overview of projects and challenges in FY 2020

This project is the continuation of a project that has been in operation since fiscal 2020. The table below provides a summary of the content, outcomes and challenges faced in surveys and verifications carried out in the project in the previous year. The work on this year's project follows the achievements and challenges below and aims to further enhance and optimize the project model.

Table 1-6. FY 2020 City-to-City Collaboration Project for Zero-Carbon Society (commissioned project): Content of studies and verifications, and outcome and challenges

Tourism sector	Content of studies and verifications	・Local traffic and passenger transport conditions ・Laws and regulations related to the introduction and operation of EVs (tariffs, road traffic laws, etc.) ・Installation and operating conditions of photovoltaic power generation equipment/facilities ・Local needs for the introduction and operation of EVs (expected benefits, concerns, important points) ・Studies and analysis on precedents in Japan and overseas (expected effects, challenges and measures for implementation and operation) ・Studies on introducing technology ・Development of hypotheses and testing project models, calculating CO_2 reduction effect ・Examination of project implementation structure and financing methods
	Outcomes	・Consideration of shuttle bus service model from airport to hotels ・Lack of public transport at this time in the country shows that a certain level of profitability can be expected if used by tourists ・Expression of expectations for the project by stakeholders from Palau, which is in line with national policies ・Cooperation with international airports as the starting point for tourists is key and will be considered going forward
	Issues	・Reduction in initial costs ・Necessary to ensure a menu of support for the tourism industry that has been hard hit economically by COVID-19 ・Difficulties in establishing maintenance systems ・Need to build capacity and knowledge of operational systems

		due to a lack of expertise in public transport
Waste collection and transportation	Content of studies and verifications	・Local waste collection and transportation conditions (vehicles in operation, collection areas, etc.) ・Transshipment and storage facility for sorting resources (preliminary study) and progress ・Positioning this study in the Koror State Policy Plan ・Laws and regulations related to the introduction and operation of EVs (tariffs, road traffic laws, etc.) ・Local needs for the introduction and operation of EVs (expected benefits, specifications) ・Studies and analysis on precedents in Japan and overseas (expected effects, challenges and measures for implementation and operation) ・Studies on introducing technology ・Development of hypotheses and testing project models, calculating CO_2 reduction effect ・Examination of project implementation structure and financing methods
	Outcomes	・Study on the introduction of waste collection and transport EVs (packer trucks) based at M-Dock ・Although it was anticipated that transport will be based on haulage to the new landfill site (Aimeliik final disposal site), the local community expected EVs to operate in the same collection and transport areas as the current packer trucks. ・Koror State expressed expectations for collaboration with the state's ongoing project to build a resource-recycling society
	Issues	・Reduction in initial costs ・Selection of optimal driving models and battery capacities ・This public project does not generate revenue, so it is necessary to secure as many subsidies as possible to reduce financial hardship. ・Difficulties in establishing maintenance systems
Other decarbonization projects	Content of studies and verifications	・Organization of know-how and candidate seeds for environmental technology that Kitakyushu City can provide ・Interviews on energy efficiency and renewable energy needs for large-scale tourist hotels ・Creating added value through the carbonization of waste tires ・Conversion of streetlights to LED lights ・Electric-powered vessels (e-ship)
	Outcomes	・Identification of large hotels that are upgrading facilities ・Difficulty in disposing of waste tires, involve high costs ・Confirmation of the need for 250 LED street lights to be installed in Koror State as stand-alone LED street lighting ・Needs exist for electric-powered vessels for eco-friendly marine recreation activities
	Issues	・Identify details on hotel energy requirements and scale of equipment required ・Additional need required for stand-alone LED street lighting in view of business potential. Should consider including states outside of Koror as well.

		・Detailed studies on cost-effectiveness and development of maintenance systems for electric-powered vessels

Chapter 2 JCM Project Feasibility Study (Study on Increasing the Ratio of Renewable Energy and Decarbonization through the Promotion of EVs for Tourist Passenger Transport Vehicles)

This chapter contains information on studies aiming not only at decarbonization by curbing the use of fossil fuels, but also at achieving co-benefits, such as decarbonization with reductions in exhaust emissions and traffic congestion, by replacing and consolidating the use of large EVs in local areas where public transport is not yet developed and tourists are transported by (white) taxis, shuttle buses, and individual transfers by hotel (all of which are powered by fossil fuels). Existing or new photovoltaic power generation is envisaged as the power source for large EVs, with projects that aim at 100% renewable energy rates considered.

2.1 Preliminary case studies and analysis

The introduction and spread of EVs has continued to expand rapidly in Japan over the past few years, with some used as tourist buses and other vehicles. This chapter provides a summary of the results of interviews with relevant parties, including Kyoto City, and on-site inspections of Keihan Bus's activities, the first attempt in Japan to electrify all vehicles in a general bus fleet on a single route that uses multiple vehicles.[4]

2.1.1 Overview of study

(1) Interview subjects and participants

The stakeholders involved in interviews and site visits, as well as participants on the survey team side are listed in Table 2-1 below.

Table 2-1 : Interview subjects and participants

Interview targets			
Organization name	Role in project	Affiliation	Name
Environmental Policy Department, Global Warming Countermeasures Office, Kyoto City	・Development and execution of plans to promote EVs in cities ・Implementation of demonstration project for	Head, Decarbonized Mobility Promotion Section	NIIJIMA Tomoyuki
		In charge of promoting energy business	TANIGUCHI Tomoya

[4] From press release by Keihan Bus (December 22, 2021)https://www.keihan-holdings.co.jp/news/upload/211222_keihan-bus.pdf

	the practical application of EV buses		
Keihan Bus Co., Ltd.	Introduction, operation and management of EV buses	Manager, ICT Promotion Department and Corporate Planning Office, ICT Division	OKUBO Sonoaki
		Manager, ICT Division	YOSHIMURA Kiyoshi
Kansai Electric Power Co., Inc. (KEPCO)	Collaboration on the development of energy management models for efficient EV bus stations	Deputy Head, e-Mobility Business Group	NAKAGAWA Takafumi
		e-Mobility Business Group	KITAGAKI Yumeno
Survey Team			
Department of Environment and International Economy, Environment Bureau, Kitakyushu City		Head, International Cooperation	ARITA Yuichi
		Manager, International Cooperation	NAGAHARA Tatsuro
		Section chief, International Cooperation	MORI Naoko
ATGREEN Co., Ltd.		Senior Manager	TOMINAGA Seiya

(2) Specifications and operating conditions of EV buses in operation

The specifications and operating conditions of EV buses that are currently in operation in Kyoto City are summarized in Table 2-2 below.

Table 2-2. Specifications and operating conditions of EV buses in operation in Kyoto City

Item	Details	
Vehicle specifications	Manufacturer	BYD, China
	Model	BYD J6
	No. buses	4
	Date introduced	December 2021
	Length × Width × Height	6,990×2,080×3,060 ㎜
	Rated output	100kW
	Charging time	Less than 3 hours
	Cruising range	150km and over (with A/C running)
	Battery capacity	105.6kWh
	Capacity	29 people (including driver)
	Other	・100-V power outlets in bus ・USB ports installed throughout the bus
Charger	Manufacturer	Daihen Corporation

specifications	No. charger bases	2 (Twin socket-type)
	Max. number. units charged simultaneously	1 unit
	Charging system	CHAdeMO Standard, DC
	Charge output	50km
	Storage battery installed/used	None
	Renewable energy resources used	None
	Backup, other	・6-kW power station for EV discharge ・Diesel generators for emergency use
Charge time while in operation	Full charge: 3 to 3.5 hours (evening) Charging during day (approx. 0.5 hours x 2 times)	
Vehicle mileage	131 km/day/bus	
Total project cost (vehicle + charging equipment, etc.)	(Vehicle cost) Approx. JPY 19,500/vehicle (Charging equipment) Not public 1/3 of the above total cost subsidized.	
Maintenance	Maintenance personnel	In-house maintenance departments for existing diesel buses (Daily, regular, legal inspections) *Group companies only carry out automobile safety inspections
	Inspection times and frequency	・Daily inspections: 10 min ・Regular inspections: 5 hours, about 1x every 1.5 months ・Legal inspections: 6 hours, about 1x every 3 months ・Automobile safety inspections: 4 days *Maintenance is not performed on charging equipment

The buses operate in two areas: Kyoto Station – Nanajo Keihan-mae, and Nanajo Keihan-mae – Umekoji/Hotel Emion Kyoto (Figure2-1), for approximately 3.3 km. This is the first case of its kind in Japan where all vehicles on a single route of a multi-vehicle bus service are electrified.

Figure2-1 ：Keihan Bus EV vehicle route[5]

(3) Activities by Kyoto City and companies

【Kyoto City】

In 2011, Kyoto City formulated the “Kyoto City Automobile Environmental Measures Plan” (target period: to FY 2020), and considered policy options in one of the priority measures on the “Promotion of the Next-Generation EV Kyoto Project” to promote next-generation vehicles as a tourism-oriented, Eco-Model City. Specific actions include a demonstration project with Mitsubishi Heavy Industries on the practical applications of EV buses, and a demonstration with Nissan Motors on reflecting the status of use of charging facilities in car navigation systems. The results from the EV bus demonstration project offered indications that emissions can be reduced by approximately 40% compared to diesel vehicles under the same conditions. Decarbonization measures in the transport sector today have been moved under the “Kyoto City Program of Global Warming Countermeasures” (period: to FY 2030). Under the current plan, GHG emission reduction targets are set to achieving at least -40% below 2013 levels by 2030, and net zero by 2050. In September 2021, the mayor stated that the 2030 target should be -46%. Currently, Kyoto City is promoting initiatives for sharing EV bike batteries, educating the next generation, light up events, and other promotional and awareness-raising activities.

【Keihan Bus Co., Ltd.】

As part of the BIOSTYLE PROJECT, a project by the Keihan Group that plans and proposes

[5] From Keihan Bus press release (December 22, 2021) https://www.keihan-holdings.co.jp/news/upload/211222_keihan-bus.pdf

"lifestyles to realize the SDGs", four EV buses have been managed and in operation since December 2021. The introduction and operation of EV buses will be the first step in this project carried out under an agreement between Kansai Electric Power (see below) and BYD Japan, with plans to conduct demonstration projects, including research into issues related to EV bus operation and optimal charging conditions until FY 2026. This agreement aims to expand the introduction of EVs on other routes in the second step, and to actually operate autonomous EV buses in the third step (Figure2-2). Servicing and maintenance for EVs is basically handled by in-house groups. The aim of this project is to compile know-how that will enable others to be able to handle maintenance for EV buses from other companies and the Kyoto Municipal Transportation Bureau in the future.

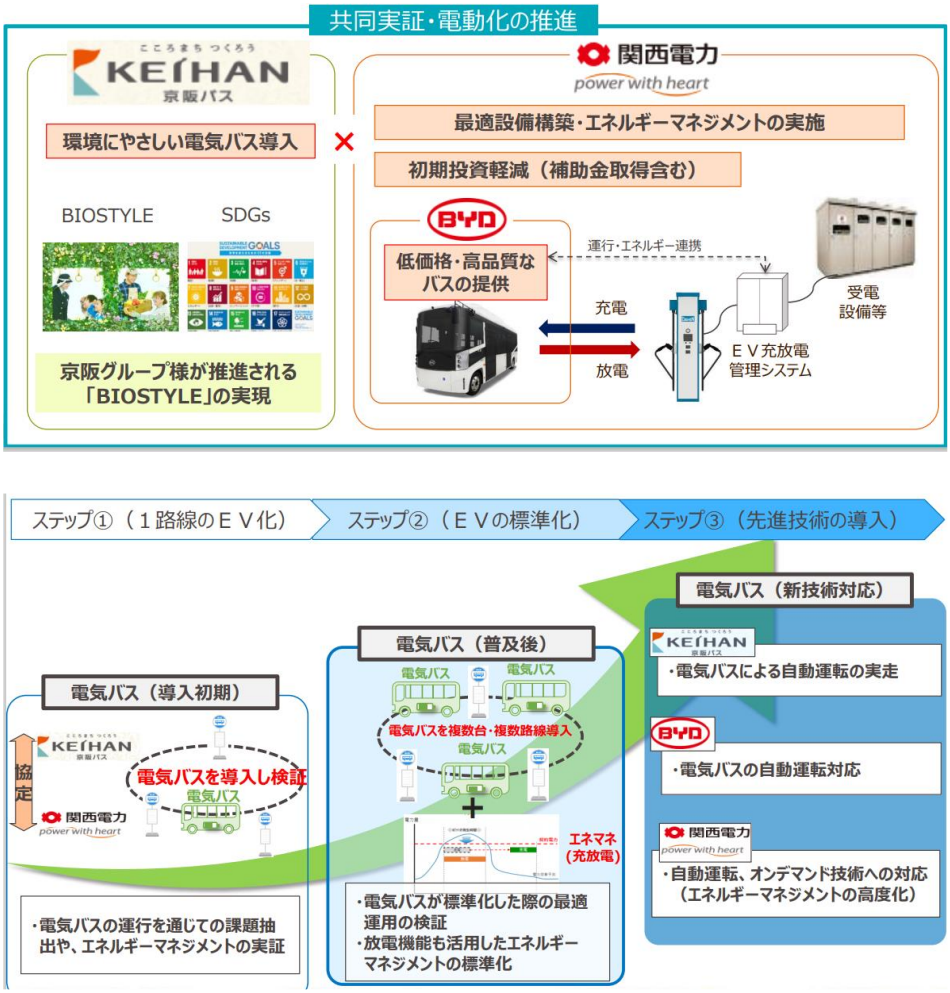


Figure2-2： Implementation system (top) and expected steps (bottom) under an agreement to expand the introduction of EV buses[6]

6 From Keihan Bus press release (December 22, 2021) https://www.keihan-holdings.co.jp/news/upload/211222_keihan-bus.pdf

【Kansai Electric Power Co., Inc. (KEPCO)】

As part of actions to realize the e-mobility vision, KEPCO is developing EV infrastructure in collaboration with Keihan Bus. KEPCO is responsible for the energy management sector in this demonstration project. Specifically, the project involves: (1) collecting driving data from EV buses and examining how to use the data, (2) optimizing operating schedules for electric buses and timing for recharging and discharging, (3) building an optimal energy management system when multiple buses are introduced, (4) developing optimal charges for the operation of EV buses and building power receiving equipment. Furthermore, equipment (EV buses, charging and discharging equipment, charging and discharging management systems, construction work) is packaged as a service to reduce Keihan Bus's initial costs and to support the promotion of EVs on city bus routes.

2.1.2 Results of studies and analysis

(1) Advantages of introducing and operating EV transit buses

Table 2-3 below provides as summary of the advantages of introducing and operating EV transit buses that were identified in interviews. The use of EV buses is expected to result in reductions in both energy and CO_2 emissions, with Keihan Bus, which operates the system, commenting that it is starting to see the effects of co-benefits that are highly compatible with transit buses. In terms of maintenance, it is important to have a system in place to respond quickly in the event of a problem. According to one comment, this was one of the key points considered when selecting a manufacturer. The study team reaffirmed that when EV buses are in operation in Palau, the challenge will lie in how a maintenance system can be expanded in an island nation that lacks the technology and supplies.

Table2-3：Advantages and impressions on the introduction and operation of EV transit buses from interviews

Category	Details
Energy and decarbonization	・Annual energy costs are estimated to be less than 1/3 that of diesel vehicles (EV: JPY 400,000/year vs. Diesel: JPY 1.43 million/year) ・Estimated CO_2 reduction: 38.8 t-CO_2/vehicle per year, or 155.2 t-CO_2/year for four vehicles ・Converts regenerative energy into electricity, so seems to work better than expected on slopes
Driving conditions	・Buses are generally quiet, so they can be driven in residential areas. ・There are few cases where pedestrians are unaware that the buses are in

	operation because the motors produce an acoustic warning sound. ・Co-benefit effects (e.g., emission gas, quiet operation, etc.), in addition to decarbonization.
Disaster response	・Buses can meet the electricity needs of 12 households in an emergency. ・A 6-kW discharge power station has been installed for V2B use in anticipation of coordinated use in the event of a disaster or if operations are suspended.
Maintenance	・Manufacturers have developed a system capable of responding to non-critical failures within 48 hours, which is important for buses that operate on a regular basis.
Other	・The manufacturer's extensive track record in Europe and the 10 years of collected know-how offer a strong sense of security. ・Batteries are mounted at the rear of the vehicle, which makes it easy to design a low-floor, high ceiling body.

(2) Issues and key points in the introduction and operation of EV transit buses

Issues related to introducing and operating EV transit buses that were identified in interviews and key points that should be kept in mind when considering the future of the project are summarized in Table2-4 below. Those interviewed commented on the importance of building an efficient integrated management system for charging and dispatching vehicles when EVs are used for transit buses (especially multiple vehicles), linking together the three aspects of vehicle conditions, energy management, and passenger movement. At present, the number of EV buses used for tourism in Palau is expected to be low (one or two) at the beginning. Although it is quite likely that this will not be an issue in the immediate future, as it is assumed to be an independent power source derived from solar power, it needs to be considered when multiple units are installed and operated in the future.

Table2-4：Issues and key points related to the introduction and operation of EV transit

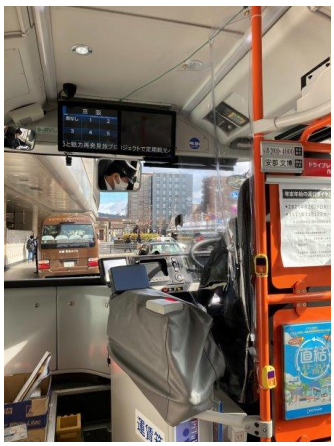
Category	Details
Cruising range	・Significantly impacted by heating in winter ・When traffic conditions are congested, braking frequency/time increases, making it more difficult to convert regenerative energy, which has an impact on cruising range.
Technical aspects	・It is important to set up charging algorithms, including bus departures and operations, and update software.

	・Battery cells need to be optimized to control capacity variations between EV battery cells (although optimization takes time). ・Importance of maintenance when introducing EVs ・Higher battery capacity and compact size
Energy management	・Difficulties in dealing with an increase in the number of facilities because operating two charging facilities (two buses) at the same time increases power consumption and affects electricity contracts (basic charges).
Operations management	・As the proportion of EV vehicles rises, there will be a need for charging and dispatching systems linked to vehicle IDs that connect EVs, energy management, and passenger movement.
	・Challenges in introducing and operating EV transit buses can be found more in ancillary areas (dispatch systems and energy management) than in areas attributable to the performance of EV buses. In cases where an organization with a large number of buses, such as a municipal bus company, introduces several EVs, it will be important to build a comprehensive operation system that combines vehicle dispatch, charging and energy management functions.
Other	・The three key elements for promoting the introduction and operation of EVs are environmental (decarbonization), economic (EMS, operating costs), and BCP (charging and discharging).

(3) Inspection tours

Side view of bus

Rear view of bus

	
USB ports at all seats	100-V outlet at bottom right
	
Battery charger (50 kW)	Discharge facility (V20)
	
Reservations can be made for charging a second vehicle	CHAdeMO charging system (BYD system on the side)

2.2 Identifying local stakeholders

The assumed stakeholders of this project are summarized in Table 2-1 below. We conducted a hearing survey with them on issues related to tourist transportation in Palau, needs for EV vehicles, and the possibility of cooperation with this project.

Table2-5：Assumed local stakeholders (Tourism sector)

Organization name	Abbreviation	Overview explanation
Ministry of Public Infrastructure, Industries & Commerce	MPIIC	Palau government ministries. Palau government ministries. It consists of six departments: Bureau of Aviation, Bureau of Public Works, Bureau of Land and Survey, Bureau of Commercial Development, Small Business Development Center, and Palau Energy Office.
Palau Visitors Authority	PVA	An independent organization established to promote tourism in Palau. A part of the Presidential Office of the Republic of Palau.
Palau Chamber of Commerce	PCC	An organization integrated by the Palau Travel Association (PTA), which was a group of the tourism industry such as travel agencies and hotels.
Palau Public Utility Corporation	PPUC	A public corporation established in February 1994 for the purpose of managing and operating Palau's electric power system. We own power generation facilities in various parts of Palau.
Palau International Airport Corporation	PIAC	PIAC operates the Palau International Airport Terminal Building. PIAC is renovating and expanding the airport terminal. Support for this survey.
Palasia Hotel	—	One of the three major local hotels (approximately 160 guest rooms). Taiwanese.
Palau Pacific Resort	PPR	One of the three major local hotels (approximately 160 guest rooms). Tokyu-Construction is the parent company.
Palau Royal Resort	PRR	One of the three major local hotels (approximately 160 guest rooms). Although it is Taiwanese, it is operated by Okura Nikko Hotels.
Cove Resort	—	A medium-sized hotel (about 70 guest rooms). Japanese staff are engaged. Australian hotel.
Garden Palace	—	A small hotel (12 guest rooms). Japanese staff are engaged.
DW Hotel	—	A small hotel (20 guest rooms).

2.3 Needs and issues from local hotels

We conducted an interview survey of local hotels regarding the transportation situation of tourists and their requests and issues regarding this project. We conducted the survey in cooperation with PIAC based on the interview sheet we prepared.

- Palau Pacific Resort
- Palau Royal Resort
- Palasia Hotel
- Palau Pacific Resort
- Cove Resort

・Garden Palace
・DW Hotel

The results are shown in Figure 2-3. Tourists often use shuttle buses operated by their staying hotels or tourist associations. The market price is generally $20/person one-way. In many of the interviewed hotels , hotel staff members also work at the same time, and securing a driver was the biggest issue. The following issue is the cost of purchasing and maintaining a vehicle.

Because of this background, many of the respondents expressed positive interest in the project as long as the system would lead to cost reductions at their hotels without significantly compromising convenience, and the biggest concern was the maintenance system and cost burden.

Q1：What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)

1 Buses or minivans operated by hotels and tourist associations	7
2 Cabs waiting at the airport	0
3 Taxi (chartered/with driver)	2
4 Rental car driven by tourists themselves	4

5 Other

・Arrange by local travel agents

Q2：What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)

1 S ecuring drivers	5
2 Cost of purchasing and maintaining vehicles	4
3 Aging and renewal of vehicles	2
4 Traffic congestion	0
5 Road maintenance and repair	0
6 Degradation of environmental image due to exhaust gas and other fac	0

7 Others

・Insurance

Q3：If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

1 I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)	5
2 If it can be outsourced at a lower cost than before, I would consi der it. (Joint transfer between the airport and each hotel)	3
3 I would like to consider using it to promote environmental aspects.	2
4 I think it will be difficult to build a route that stops at other hotels.	1
5 I'm not interested because there are no or less issues with the current operation.	1

6 Others

・If EV shuttle fee is not too expensive will attract guest itself

・need to consider Palau guest is mainly long stay and some are diving guests and bring lot of luggage and equipment

Q4：What do you feel are the challenges in implementing this model?

1 Initial cost	2
2 Running cost	1
3 Profitability of the project	2
4 Establishment of management system	2
5 Ensuring durability and safety of vehicles and charging equipment	2
6 Maintenance and trouble shooting in case of failure	5
7 Design of operation schedule	2
8 Impact on existing employment	1

9 Others

・Tour or Shuttle bus in Palau mainly operate by local argent and drivers it is challenge how you coexistence and co prosperity

Q5：If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

1 Transfer from the airport to the hotel when entering Palau	4
2 Transfer from hotel to airport upon return	4
3 Round trip to various sightseeing spots on the island	6
4 Transfer for optional tours	2

5 Other

・Details Shopping to down town

Figure2-3 ： Results of interviews with local hotels

2.4 Survey of potential locations for vehicle recharging sites

In considering EV vehicle charging bases and project implementers, we interviewed Palau International Airport Corporation, which operates international airport, the gateway for tourists to Palau, about the status of renewable energy introduction at the airport, energy risk management, and the current maintenance system for vehicles at the airport.

【Renewable Energy Installation and Operation at Airports】

- Electricity power consumption at the airport is approximately in the low 40,000 kWh range per month. Approximately half of this is covered by solar power installed by ODA in 2011.
- Currently, there are no specific plans to install additional photovoltaic systems.
- There is land (approximately 600 m2) adjacent to the existing panels that could be considered for additional panels (Figure 2-4).

【Status of Response to Energy Risks】

- An emergency generator with an output of 1,800 KVA (approximately 1,440 kWh at a power factor of 80%) has been installed.
- There is no positive advantage to moving the power source to the new location, as it is important for the airport to have its own backup power source.

【Existing vehicle maintenance system and assumptions maintenance system for the introduction of EV vehicles】

- Company vehicles are rented, and maintenance is performed by the car rental company and not directly by the our company.
- The company's own engineers will basically handle airport special vehicles (GSE/Ground Support Equipment). For cases that cannot be handled, we ask overseas manufacturers.
- For repair parts, those that are frequently replaced are kept in stock.
- Parts not in stock are purchased from manufacturers or distributors on a case-by-case basis, but this rarely happens.
- We think it is necessary to keep some parts in stock when operating EV vehicles. Businesses will probably have their own parts, but the details of which parts they will have and the costs will need to be discussed separately.
- Regarding maintenance staff for EV vehicles, if the airport were to conduct the project, it is

possible to consider having staff on hand. However, whether appropriate personnel can be secured locally is considered an issue.

Based on the above, Palau International Airport is likely to be a suitable location for EV charging facilities powered by renewable energy. In terms of operation, there is still the issue of securing low-cost and stable maintenance in terms of both materials and human resources. PIAC also commented that it is difficult to consider new projects under the current circumstances where COVID-19 continues to expand and tourists are not expected to return.

In considering EV vehicle operation projects in the tourism sector in Palau, it is assumed that other operators are in the same situation, so it will be necessary to reexamine the situation once the impact of COVID-19 on tourists is expected to be reduced.

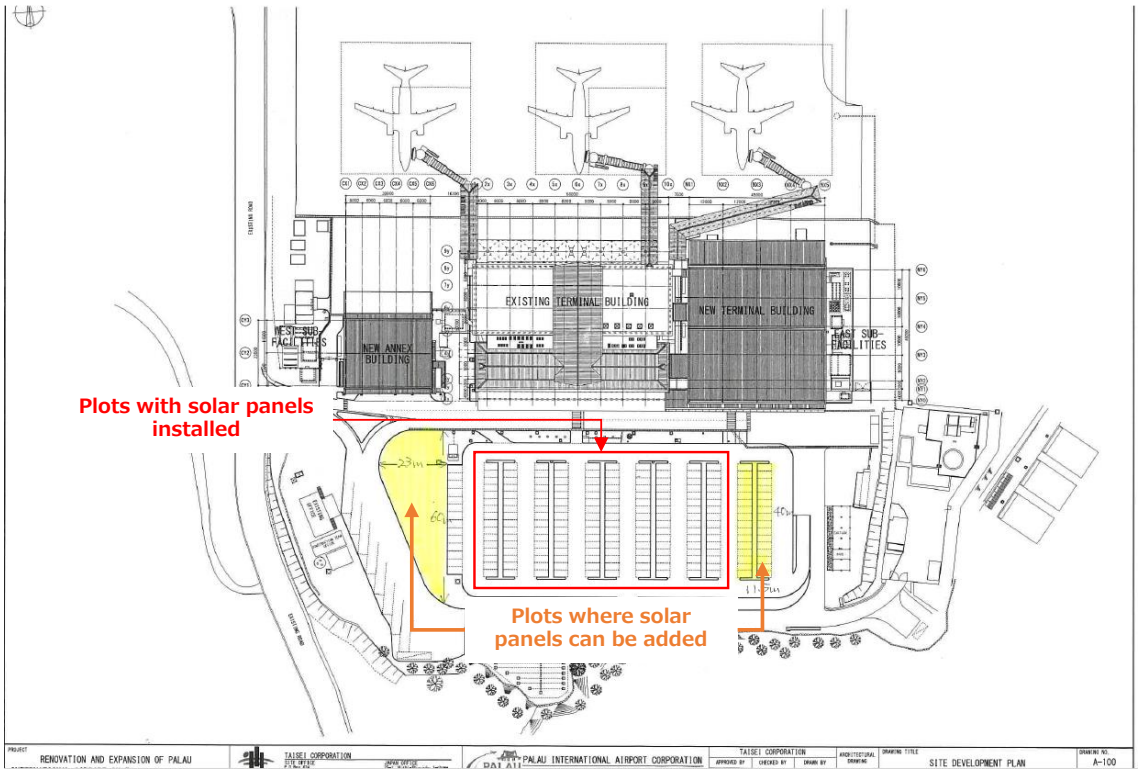


Figure 2-4：Solar panel installed parcels and possible expansion areas at Palau International Airport

Areas where additional panels can be added(Figure2-4 Left side)

Areas where additional panels can be added(Figure2-4 Right side)

Solar panels installed on parking lot roof

Figure2-5: Images of current panel installation locations and possible installation locations

2.5 Introduction and operation model under consideration

This section summarizes the results of our study of the possibility of reducing the initial cost of the sightseeing buses studied in the previous year, which has become an issue.

2.5.1 Details of Introduced Technology under consideration

The buses to be considered are the models shown in Figure 2-6 below and Table 2-6 below. See Table 2-7 below for chargers.

Figure 2-11：EV bus and charging system to be considered for introduction

Table 2-6: Specifications and features of EV buses to be considered for introduction

Items	Contents
Model	F8 siries4-mini BUS
Size	Overall length: 6,990 mm Overall width: 2,100 mm Overall height: 3,050mm
Number of seats	14 seats (including driver), 30 people
Battery capacity	114kWh
Cruising range	230km
Other features	Adoption of lightweight EV chassis frame Can also be used as a large-capacity battery in the event of a disaster Flexible solar panels can be installed on the ceiling as an option

Table 2-7: Specifications and features of charger to be considered for introduction

Items	Contents
Model	ENC-DCB100-BJ
Maximum output	100kW
Charging standard	Compatible with CHAdeMO ver2.0
Other features	IP54 waterproof

The bus to be introduced is a model equipped with a 114kWh battery and has a cruising range of 230km. This time, we are aiming to promote decarbonization by using all the electric power to be charged as a renewable energy power source, and the capacity of the photovoltaic power generation equipment required to charge this battery is 50 kW and the storage battery is 136 kWh. (Utilize reused batteries to ensure storage battery capacity)

2.5.2 Introduction and Operation Model under consideration

As discussed in the previous fiscal year, the Palau International Airport is currently the originating base for the tourist buses.

In this estimation, it is assumed that the buses will travel two routes: Route A from Palau International Airport to PPR via Central Road, which is a major arterial road, and Route B to Icebox Park, which is a scenic spot. See Figure 2-7 below for the routes.

(Map Source：Google Map)

Figure 2-7：EV bus travel route to be examined

<Planned driving route>

Route A (Palau International Airport-Palau Pacific Resort Hotel / 14.6km)

Route B (Palau International Airport-Icebox Park / 13.1km)

<Fare>

The fare will be 800 Japanese-yen for a round trip from the airport to each destination. Since the cost of the current transfer service to the hotel and taxi transfer is about 20 to 30 dollars, and in the case of bus transfer, the fee will be collected individually, the above transfer fee will be apportioned by 3 people. Furthermore, the bus transfer fee per person is set as the above price, taking into consideration the viewpoint of giving incentives for bus selection due to time constraints. In addition, a trial calculation was made assuming that 20% of local tourists (122,000 in 2017 x 20% = 24,400) will use the bus.

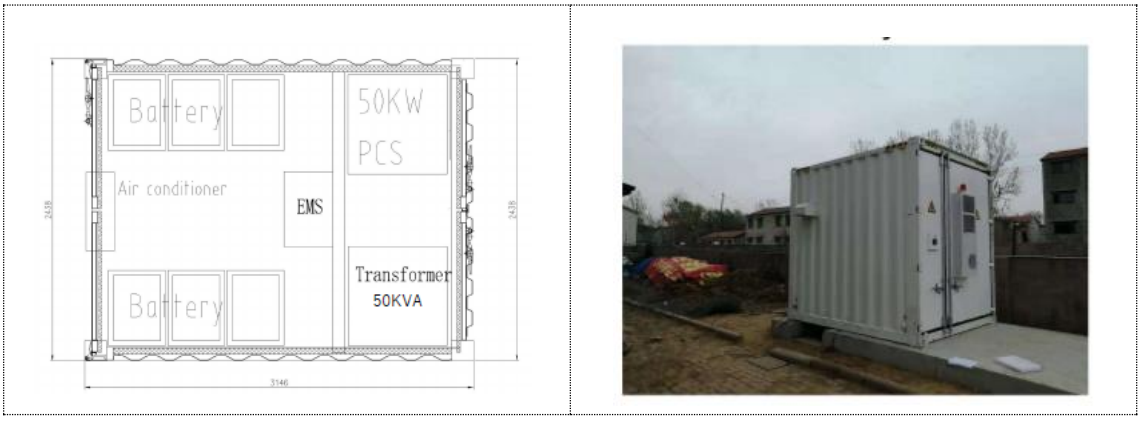


Figure2-8：Battery Container Unit

The cost of storage batteries, which had been a bottleneck in the previous year, was also examined. This time, a model that utilizes reused batteries in a mobile storage battery container unit was studied. (Figure 2-8) The aim was to reduce costs by using reused batteries. This has allowed for an increase in battery capacity. On the other hand, it is now necessary to consider increasing the installation scale of solar power generation.

2.6.3 Profitability

Under the conditions described in 2.5.1 to 2.5.2, one EV bus, a charger, a solar panel (including a power conditioner), and a storage battery were installed, and the business profitability was evaluated. The evaluation was carried out when the initial cost was 100% self-paid and when 50% self-paid. Other trial calculation conditions are as follows.

<Common calculation conditions>

- Vehicle / equipment costs
  (Approximately 85 million JPY / Various equipment, tariffs, engineering costs, training costs, etc. recorded)
- Revenue from tourists (assuming annual sales of about 20 million yen)
- 5 year borrowing
- Equipment transportation costs are not included
- Maintenance costs (5% of equipment costs are recorded every year)
- Driver costs are recorded
- Transportation business consignment costs from hotels, etc. have not been recorded.
- It was decided to reserve about 5 million yen every year as a reserve for equipment renewal.

＜Case of No subsidy: 100% self-pay project implementation＞

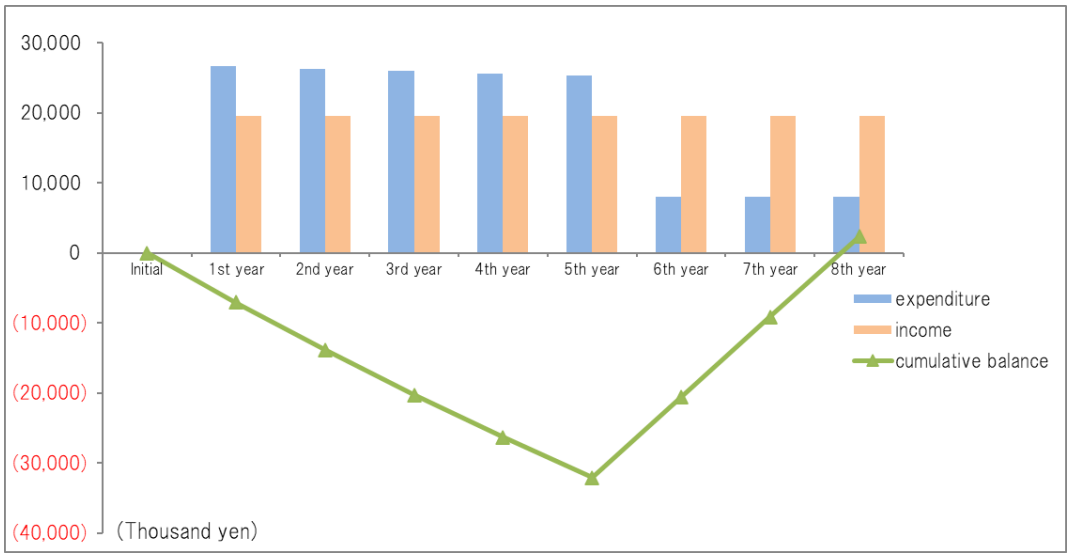


Figure 2-9：No subsidy for introducing one EV bus for tourism sector

In this case, it is expected that the company will be profitable in a single year after the 6th year when the borrowing is completed, and the cumulative balance will be expected to be profitable in the 8th year. Since the burden of repayment of the initial cost is relatively large, it is considered. Since the battery capacity is sufficient to charge two buses, it is possible to reduce non-bus costs by charging and using one charger every other day with two buses when multiple buses are installed.

＜Case of 50% subsidy and:50% self-pay project implementation＞

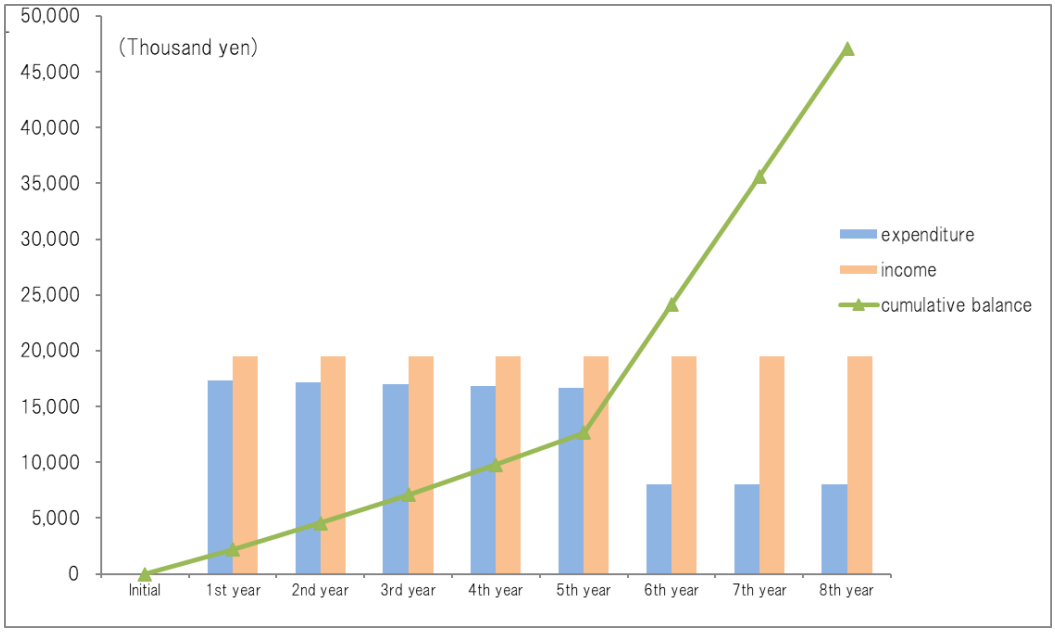


Figure 2-10：50% subsidy for introducing one EV bus for tourism sector

In this case, the result was expected to be profitable from the first year. In order to establish this model, it is important to obtain user income as expected, and it is expected that the acquisition of subsidies will greatly contribute to the improvement of profitability in this project.

2.5.4 CO_2 reduction effect

We referred to J Credit System Methodology EN-S-012 Ver3.0 “Introduction of Electric Vehicles or Plug-in Hybrid Vehicles” for the effect of reducing greenhouse gas emissions associated with the conversion of tourism buses to EVs.

$$ER = EM_{BL} - EM_{PJ}$$

Table 2-8: Concept of emission reduction

Sign	Definition	Unit
ER	Emission reduction	tCO_2/year
EM_{BL}	Baseline emissions	tCO_2/year
EM_{PJ}	Post project Emissions	tCO_2/year

Since this project is the introduction of electric vehicles, baseline emissions will be emissions from the use of fossil fuels associated with the use of (conventional) vehicles, and post-project emissions will be emissions from the use of electricity from the use of electric vehicles.

Post-project emissions are calculated by the following formula.

$$EM_{PJ} = EL_{PJ} \times CEF_{electricity.t}$$

Table 2-9: Calculation of post-project emissions

Sign	Definition	Unit
EM_{PJ}	Post project Emissions	tCO_2/year
EL_{PJ}	Electricity consumption in electric vehicles post project	kWh/year
$CEF_{electricity.t}$	CO_2 emission factor of electric power	tCO_2/kWh

Baseline emissions are organized according to the following concept.

$$D_{BL} = D_{PJ}$$

$$D_{PJ} = EL_{PJ} \times BU_{PJ}$$

Table 2-10: Concept of baseline emissions

Sign	Definition	Unit
D_{BL}	Baseline car mileage	km/year
D_{PJ}	Post project car mileage	km/year
EL_{PJ}	Post project electricity consumption in electric vehicles	kWh/year
BU_{PJ}	Post project energy consumption efficiency electricity of electric vehicles	km/kWh

The calculation of baseline emissions is carried out based on the following concept.

$$EM_{BL} = D_{BL} \times 1 \div BU_{BL} \times HV_{BL,fuel} \times CEF_{BL,fuel}$$

Table 2-11: Calculation of baseline emissions

Sign	Definition	Unit
EM_{BL}	Baseline emissions	tCO_2/year
D_{BL}	Baseline car mileage	km/year
BU_{BL}	Baseline energy consumption efficiency of fossil fuel vehicles	km/kL etc.
$HV_{BL,fuel}$	Unit calorific value of fuel used in baseline automobiles	GJ/kL etc.
$CEF_{BL,fuel}$	CO_2 emission factor per unit calorific value of fuel used in baseline automobiles	tCO_2/GJ

Based on these assumptions, the CO2 reduction effect of EV bus driving when the annual mileage is about 75,000 km is as follows.

Table2-12：CO_2 reduction amount by introducing EV bus

Number of EV buses introduced	Expected CO_2 reduction
1bus	44t-CO_2/year
10 buses	435t-CO_2/year
30 buses	1,306t-CO_2/year

If the number of buses introduced increases and economies of scale can be achieved in terms of price, the unit price per bus is expected to decrease, and the cost effectiveness of CO2 emission reduction per ton in applying for JCM facility subsidies is also expected to improve. In addition, as for other ancillary facilities such as battery chargers, solar panels, and storage batteries, if the number of buses increases, efficient operation (e.g., two buses alternately using one battery charger)

is expected to be possible.

2.5.5 Monitoring method

Regarding the methodology used to calculate the amount of reduction in certification due to the conversion of vehicles to EV, the "Promotion of Electric Vehicle Use for Taxi in Costa Rica (2014 JCM F / S)" project and the methodology in the J-credit system in Japan " Refer to "EN-S-012 Ver.3.0 Introduction of electric vehicles or plug-in hybrid vehicles".

The target is project activities that introduce EV vehicles and replace ICE vehicles (internal combustion engine vehicles). The general monitoring parameters are shown in Table 2-13 below.

Table2-13：Monitoring items

Items	Unit
Car mileage	km
Energy consumption efficiency electricity of electric vehicles	km/kWh
Power consumption for driving	kWh
Energy consumption efficiency of fossil fuel vehicles	km/L

In this project, it is assumed that the EV vehicles will be powered by renewable energy sources, but it is possible that backup power from the local grid could be used in the event of capacity shortages due to solar or power system failure or continued bad weather, etc. Therefore, when evaluating the reduction of GHG emissions, it is necessary to know where the charged power is generated from (grid power or renewable energy). In this regard, it is assumed that vehicle ID management and recharge data from storage batteries will be recorded and managed using data loggers, etc.

2.5.6 Study of project implementation scheme

Regarding the promotion structure of the project, we have received favorable comments from the Minister Obichang , Ministry of Public Infrastructure and Trade (MPIIC), in previous year, as the project is in line with the national policy.

It is necessary to consider the implementation structure of this project, including the possibility of developing the project as a public transportation system.

In addition, Palau is currently considering updating its master plan for transportation planning, and the State of Koror has expressed a desire to promote decarbonization from the transportation sector. Among these, there are expectations from both the state and the country for a shift in mobility to EVs and other vehicles in the transportation aspect of the project.

Because of the pandemic of the COVID-19 infection has prevented travel to the Palau for two years,

there are still issues in developing an implementation system and building communication with the relevant parties. In the next fiscal year, we would like to discuss the specific implementation system with interested parties again.

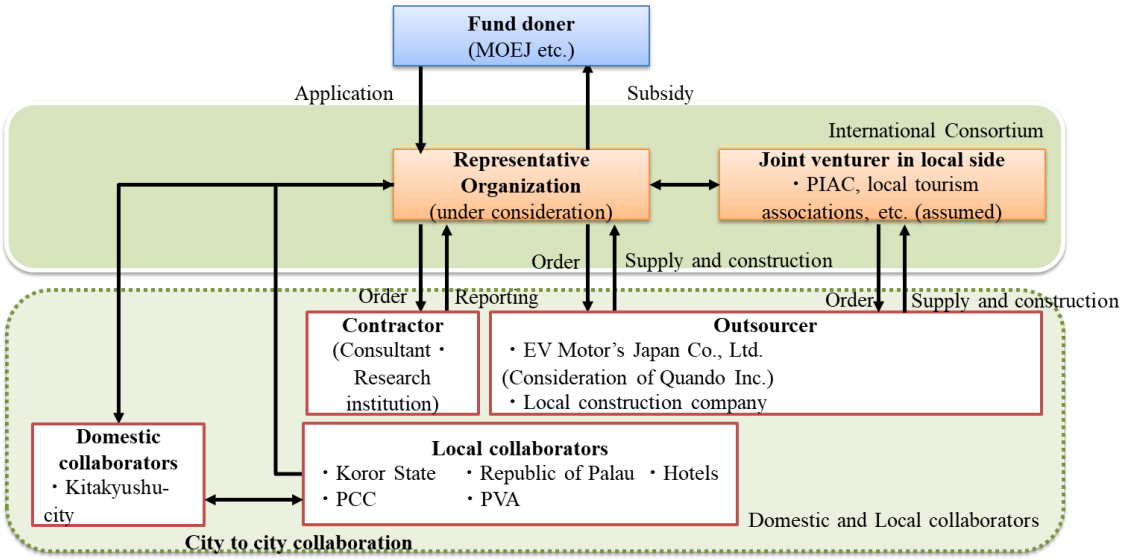


Figure 2-11: Assumptions for International Consortium

The structure of the international consortium envisioned at this time is as shown above. It will be necessary to further develop the structure by deepening the involvement of local hotels and other organizations.

2.6 Maintenance scheme and utilization system

All stakeholders have been commented Maintenance is the biggest issues. Maintenance issues exist in both the securing parts and human resources aspects. The issues of securing parts are mainly related to the cost of maintaining spare parts, etc., while the issues of human resources are related to the training of maintenance personnel, etc.

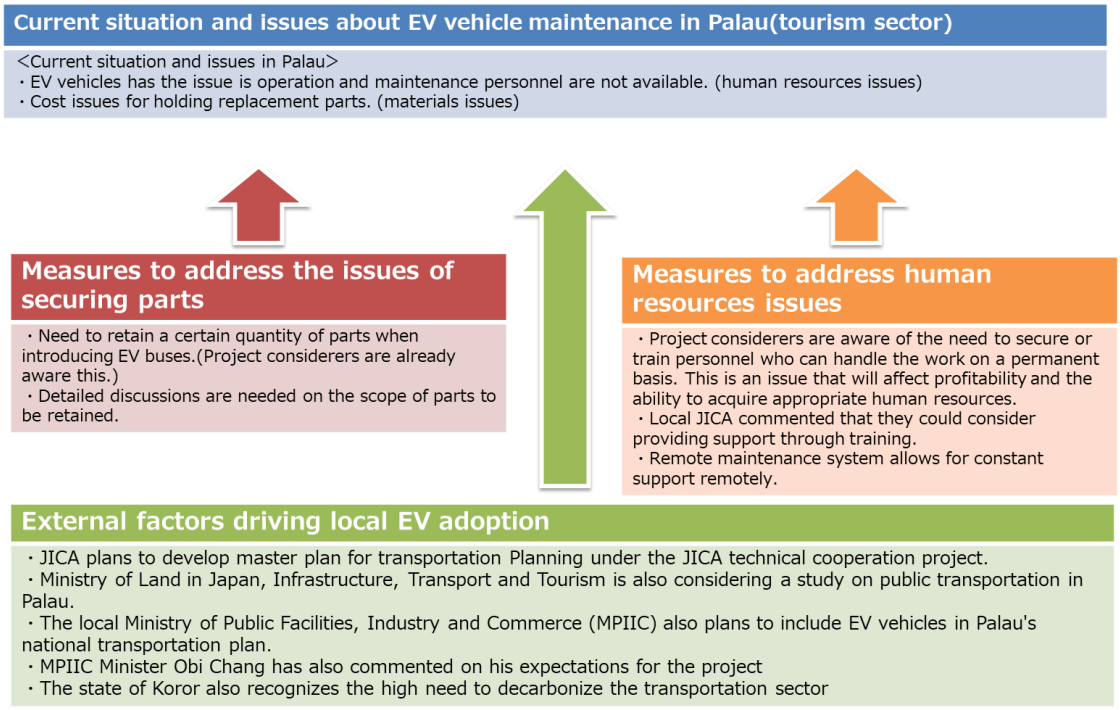


Figure 2-12: Maintenance issues and proposed measures

Project considerers are aware of the need to retain a certain quantity of parts when introducing EV vehicles. They are also aware of need detailed discussions on the scope of parts to be retained. In most cases, the majority of parts for internal combustion engine vehicles can be secured on the island. Therefore, there is a high possibility that parts used for both internal combustion engine vehicles and EVs will be available locally.

Project considerers are aware of the need to secure or train personnel who can handle the maintenance work on a permanent basis. This is an important issue that will affect profitability and the ability to acquire appropriate human resources. In any case, human resource development is also necessary, and JICA has commented that support for training sessions can be considered in this regard. In addition, it is considered necessary to take various measures, such as providing online support by utilizing "SynQ Remote" provided by Quando Inc. within our survey team.

Figure2-13： overview of the remote maintenance tool

2.7 Consideration of financing methods

Regarding funding, Minister Obi chang, ,the MPIIC, mentioned the possibility of public-private partnerships depending on the business model, but the reality is that it is difficult to generate funds in the Republic of Palau, where the tourism industry, which is the core industry, has been hit hard. On the other hand, it is considered essential to add value to the tourism sector in order to revive the Palauan economy after the Covid-19 pandemic.

Therefore, securing subsidies or other means to reduce initial costs is considered essential. Specifically, we are considering applying for the JCM equipment subsidy program, but the amount of GHG reduction per EV vehicle is inevitably limited. For example, while utilizing the JCM equipment subsidy project for solar power generation equipment and storage batteries, it is necessary to consider a multifaceted support scheme for EV buses, such as utilizing JICA and ADB funds from the aspects of infrastructure development and corona recovery, and this study should be continued.

In addition, for financing, collaboration with leasing companies is also expected. There have been an increasing number of tie-ups with leasing companies in recent years, where the Japanese representative and the local company are affiliated, and leasing companies have commented that such projects are relatively easy for them to work on. In Palau, where it is difficult to raise initial costs, the introduction of such a system should be considered.

2.8 Consideration of Project Implementation Schedule

Based on the results of this year's survey, the project implementation schedule for the Tourism EV Project is envisioned in Table 2-14 below.

Table2-14：Examination of future project implementation schedule

Items	FY2022		FY2023		FY2024	
	1st half	2nd half	1st half	2nd half	1st half	2nd half
Examination and construction of project implementation system	■	■	■			
Scrutiny of cost / introduction model	■	■				
Examination for acquisition of various subsidies	■	■	■	■		
Support application such as JCM equipment assistance			■	■	■	

The study of the tourism sector will be greatly affected by the situation of the pandemic of the COVID-19 infection and the recovery of tourism demand, but we will continue to discuss the implementation system of the project with local officials in the next fiscal year to build the system, and also promote studies for obtaining various subsidy programs, aiming to obtain the subsidy programs in FY2023 or 2024.

2.9 Summary / Issues to overcome in the future

The following is a summary of the survey for the introduction of tourist EV vehicles and future issues.

＜Summary＞

- Considering a shuttle bus operation model from the airport to the hotel
- Considered utilizing reused batteries for reducing costs and increasing capacity against for a factor of increasing costs
- Since there is no public transportation in Palau, it was found that profitability can be expected if a certain percentage of tourists can be used. However, it will be necessary to share roles and collaborate with existing pick-up and drop-off schemes conducted by hotels and tourist associations.
- When receiving equipment subsidies, it is necessary to consider applying to different fund donors for solar power generation, storage batteries, and EV buses, considering for effective operation.
- Stakeholders in Palau and Koror State commented their expectations for this project, which is

consistent with the direction of the transportation policy (master plan) review.

- Need to continue to work with international airports as a starting point for tourists and resolve issues one by one for implementation

＜Issues to overcome in the future＞

- Ongoing review of initial costs
- While tourism is a core industry, it has been hit hard economically by the pandemic of the COVID-19 infection and needs to establish a menu of support services for Palau.
- Ongoing challenge of establishing a maintenance system
- Optimal modeling of subsidies and other forms of support, further study of financing schemes, including leases, etc.

Chapter3 Feasibility study toward for Project formation about improvement of renewable energy ratio and decarbonization by introducing EV vehicle for waste treatment sector.

3.1 Understanding local issues and needs

3.1.1 Identifying local stakeholders

Table 3-1 below summarizes the organizations that are assumed to be interested parties in this study. Interviews were conducted with these interested parties regarding local needs and the possibility of collaboration for this project.

Table 3-1 Assumed Stakeholders (Waste Sector)

Organization name	Abbreviation	Overview explanation
Solid Waste Management Division, Public works Department, Koror State Government	—	It belongs to the state's Public Works Department and is responsible for Koror's recycling projects, waste collection and transportation, waste research, composting and education programs and material recovery.
Solid Waste Management Office	SWMO	An organization that aims to reduce landfill waste generated in Koror through the 3Rs and resource recovery. It consists of the Bureau of Public Services System and Ministry of Health of Palau, the Environmental Quality Protection Commission, and the State Solid Waste Management Division.
Ministry of Public Infrastructure, Industries & Commerce	MPIIC	Palau government ministries. Palau government ministries. It consists of six departments: Bureau of Aviation, Bureau of Public Works, Bureau of Land and Survey, Bureau of Commercial Development, Small Business Development Center, and Palau Energy Office.
Asian Development Bank	ADB	An international development finance institution established to foster economic growth and economic cooperation in Asia and the Pacific and to contribute to the economic development of developing member countries. A study on a project to establish a comprehensive resource-recycling society in Koror State is planned.

3.1.2 Preliminary study project "Resource segregation type transshipment storage facility" and its progress

(1)Project background and outline

In Palau, the resident population, corporate offices, hotels and stores are concentrated in Koror, and its high environmental load has been an issue for Koror. SWMO has been planning and developing a recycling center that contributes to the collection and recycling of specified waste in collaboration with AMITA CORPORATION, which is a member of this business implementation system, in order to reduce the environmental burden Since 2014. (Table3-2)。

Table3-2: Past collaboration and survey results between Koror and AMITA CORPORATION

Year	Phase	Activity
2014-15	Basic survey	Waste composition survey Demonstration of waste separate collection
2015-16	MOEJ project of Promoting Overseas Expansion Commercialization	F/S for Business plan Demonstration of liquid fertilizer Partnership agreement signed
2016-17	MOEJ project of Promoting Overseas Expansion Commercialization	Specification design of biogas plant
2017-18	JICA Knowledge co-creation program (private partnership) under the SDGs business model formulation survey (Feasibility survey)	F/S for small biogas plant Specification design of plant
2019-20	MOEJ project of Promoting Overseas Expansion Commercialization	F/S for resource-separated transshipment storage facility

Koror State and AMITA CORPORATION will use a public-private partnership (PPP) to consider the construction of a "storage facility", where is separate and sort waste using the site of the M-Dock. The relocation spot of final disposal site is the Aimeliik (located in northside in Palau) (Figure3-3)。 The reason for this consideration is that the new final disposal site in Aimeliik will be far away (about 15 km from the M-Dock) and will incur tipping fee, so it will be efficient in the state to reduce the amount of landfill waste through the implementation of waste disposal and the expansion of recycled items and quantities. Furthermore, the goal of this project is not limited to waste recycling, but ultimately it is a project that aims to create a wide range of value such as agricultural development, creation of tourism industry (green tourism), zero emission management by renewable energy (Figure 3-1).

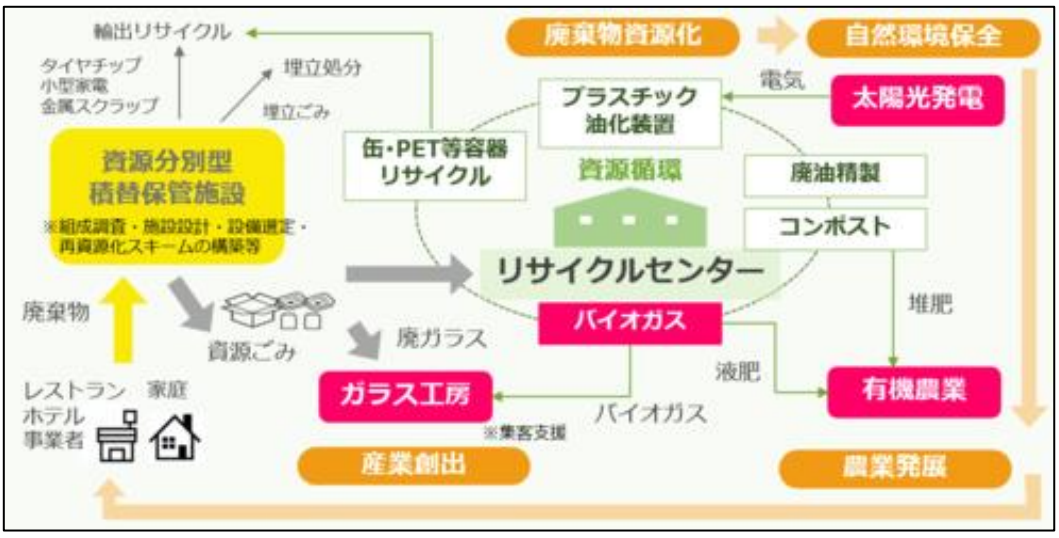


Figure 3-1：Concept for resource circular recycling model

From an energy point of view, there are several projects.

1)self-use of power generated from plastic oiling,

2)self-use of power generated by the introduction of solar power generation

3)generated gas from a biogas refining facility is used for tourists in glass workshop

The glass studio plans to use sorted and sorted waste glass, and is considering attracting tourists.

(2) Progress

The recycling center has already been stably operated as an initiative activity of the state of Koror, and has already been introduced except for the methane fermentation facility and the solid fuel conversion / gasification facility.

In addition, the glass workshop has completed the demonstration at the test workshop, and the construction work of this operation facility was completed in July 2020.

However, due to the serious economic impact of Covid-19 (due to the fact that about 50% of GDP depends on the tourism industry), PPP's consideration of "resource-separated transshipment storage facilities" is pending.

It is expected to resume with the convergence of Covid-19 and the resurgence of tourists.

3.1.3 Positioning of this EV introduction survey in the Koror State Policy Plan

The state of Koror has been considering the ideal way of "building a comprehensive resource recycling society" to promote resource recycling in the state, triggered by the consideration of "resource-separated transshipment storage facility" by PPP with AMITA CORPORATION. The study project for the introduction of the EV waste collection and transportation vehicle is also being

positively consideration in this whole project. (See Figure 3-2)

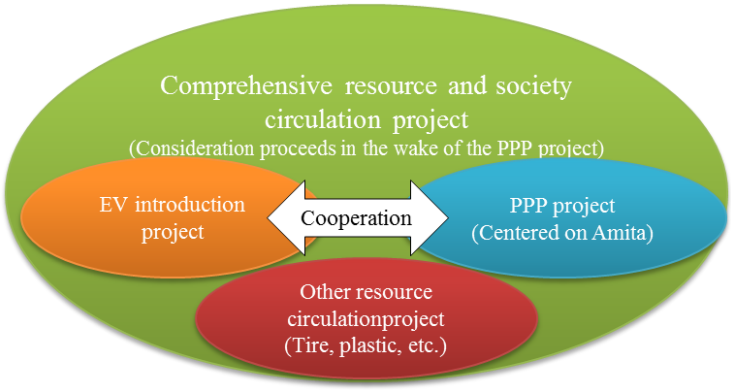


Figure 3-2: Relationship of each project in Koror State

The Asian Development Bank (ADB) is currently scheduled to conduct a feasibility study on this project as a PPP project, which will include the EV project for the waste collection and transportation vehicles.

3.1.4 Local needs, possible schemes, and issues for conversion to EV

The following is a summary of the results of interviews with Mr. Selby and Mr. Fuji regarding their impressions of the project concept and local needs for waste vehicles, EV vehicles, and specifications for charging facilities.

1) Reduce reliance on fossil fuels and reduce fuel costs when renewable energy is the source of charging.

2) Improving the image of environmental consideration in the waste management department and building a zero carbon society.

3) There are three points that contribute to the achievement of the SDGs in terms of waste management.

While these merits will lead to the creation of a clean and safe environment for the state, the following are the issues for introduction.

1) High initial cost burden required for acquisition and installation of equipment to maintain the operation of EV vehicles

2) Concerns about maintaining the durability and safety of vehicles and charging stations

3) Establishing a maintenance system in case of emergency.

The Solid Waste Management Office has commented that it will be the lead agency for this

project and will install, operate, and maintain the vehicles and equipment.

(2) Specifications of waste transportation vehicles, EV vehicles and charging equipment

The points when procuring a waste collection and transportation vehicle are as follows.

1) Economic efficiency of vehicles and systems

2) Loadable capacity

3) Resistance to salt damage

The points when procuring EV waste collection and transportation vehicles are as follows.

1) Battery capacity

2) Battery durability and service life

3) Battery control and safety (control against overheating)

4) Convenience of quick charging

5) Vehicle load capacity and salt damage countermeasures

(3) Assumptions for Procurement of Electricity and Location of Charging Facilities and Photovoltaic Power Generation

The current plan for the transportation station calls for approximately 150 kW (250 W/sheet x 600 panels) of solar panels to be installed on the roof of the facility and on adjacent land (red frame in Figure 3-3) to provide part of the power source for facility operations.

The existing biofuel generator (220 kVA) can also be used to supply power, and it is assumed that these renewable energies will be used to power the EV waste collection and transportation vehicles. The installed capacity of solar panels is currently under review by ADB, and further capacity increase is expected due to the high potential for facility expansion (black box in Figure 3-3).

In addition, the area framed in yellow plus black in Figure 3-3 is planned to be a parking lot for about 20 large vehicles. The state is considering installing photovoltaic panels on the roof of this building as well as a charging space for EV vehicles.

Figure 3-3：Planned solar panel installation at a resource separation and Transshipment storage facility

(4) Status of vehicle maintenance and maintenance when EVs are introduced

As noted above, we have received comments that SWMO expects to perform maintenance on EV vehicles as well.

Regarding the current maintenance system for internal combustion engine vehicles, SWMO has a full-time mechanic who oversees the regular maintenance of existing refuse collection vehicles and other vehicles under its jurisdiction, and currently handles minor breakdowns with no problems. When major repairs are required, inspections and repairs are carried out at vehicle maintenance stores in Koror.

The state does not keep vehicle parts in stock, and if parts cannot be procured domestically, the state can arrange for the necessary parts within two weeks, depending on the urgency, based on supply contracts with local, Japanese, and U.S. manufacturers and maintenance companies.

They recognize the need to train personnel first when introducing EV vehicles, as well as the need to stock a certain number of parts depending on the frequency and importance of replacement.

3.2 Consideration for introduction and operation model

In this section, technologies for introducing EV vehicles for waste collection and transportation will be studied, and cost estimates will be made to understand issues to be addressed in further studies in the future.

3.2.1 Contents of introduced technology

The waste collection and transportation vehicles to be considered are the models shown in Figures 3-6 and Table 3-3. See Table 3-4 for chargers.

Figure 3-4：EV waste transportation vehicle and charging system to be considered for introduction

Table3-3：Specifications and features of EV waste transportation vehicle to be considered for introduction

Items	Contents
Model	pure electric compression type garbage truck
Size	Overall length: 6,795mm Overall width: 2,100 mm Overall height: 2,400mm
Vehicle total weight	8,280kg
Load capacity	1,995kg
Battery capacity	110kWh
Cruising range	Less than 180km
Other features	Compression method: Press type

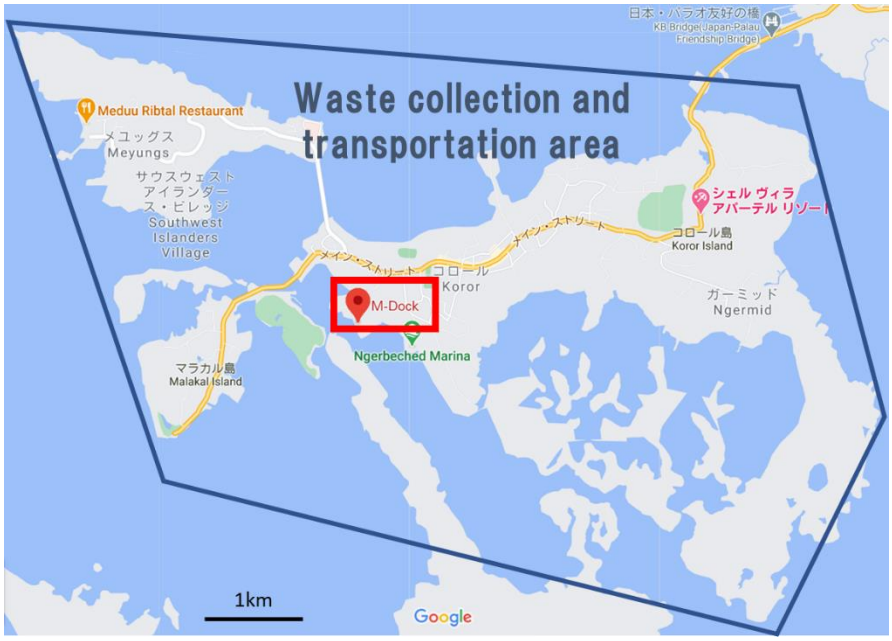
Table3-4: Specifications and features of charger to be considered for introduction

Items	Contents
Model	ENC-DCB100-BJ
Maximum output	100kW
Charging standard	Compatible with CHAdeMO ver2.0
Other features	IP54 waterproof

The EV waste collection and transportation vehicle to be introduced is a packer truck model with a 110 kWh battery and a cruising range of less than 180 km. All electricity used will be from renewable energy sources stored in storage batteries, with the aim of promoting decarbonization. The solar power generation system required to charge these batteries has a capacity of 50 kW, and the storage batteries have a capacity of 288 kWh. As for the storage batteries, the project envisions the use of container units that accumulate reused batteries, as is the case with the tourism EV vehicles.

3.3.2 Introduction and Operation Model

The State of Koror has requested the following two transportation routes using EV vehicles: 1) collection and transportation of waste within the State of Koror and 2) transportation to the new final disposal site in Aimeliik. They want to transport as much waste as possible on route 2) with a single vehicle, and requests have been received for larger vehicles. See Figure 3-5 below for collection areas. In addition, the Koror State Solid Waste Management Office has expressed a need to convert all four of its packer trucks to EV vehicles. In this regard, it was confirmed with the Koror State that one charger may be insufficient and that it is necessary to consider using two chargers in order to reduce the risk of breakdowns.



(Map source：Google Map)

Figure 3-5：Waste collection and transportation area for EV vehicles to be considered for introduction

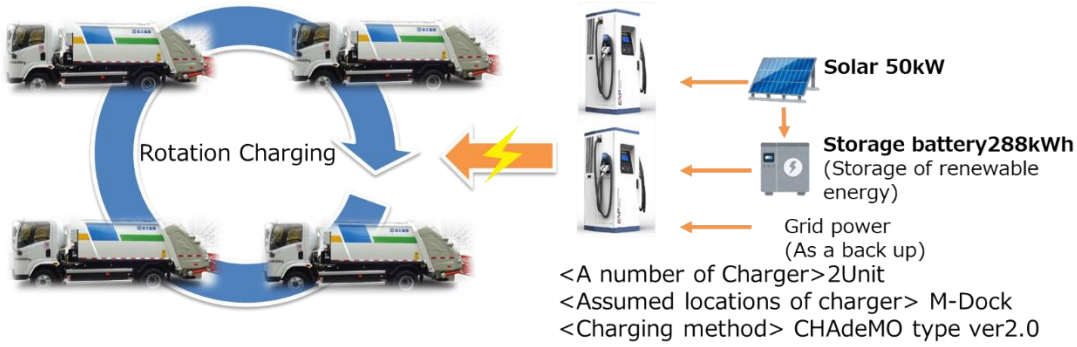


Figure 3-6: Operational image of EV waste collection and transport vehicles

3.2.3 Project Feasibility

The profitability of the project was evaluated based on the following conditions: four EV waste collection and transportation vehicles (packer trucks), two battery chargers, solar panels (including power conditioners), and storage batteries. The initial cost was evaluated in the case where 50% of the initial cost was subsidized or supported and the rest was borne by the client, and in the case where all of the initial cost was covered by subsidies, etc., and 0% was borne by the client. Other estimation conditions are as follows.

＜Common trial calculation conditions＞

・Vehicle and equipment costs(approx. 130 million JPY/accounted for various equipment, tariffs, engineering & training costs, etc.)

・Installment payments are estimated based on a five-year loan term.

・Equipment transportation costs are not included.

・Maintenance cost (5% of equipment cost is allocated annually)

・Fuel cost reduction contribution is recorded as an income component.

・The company estimates that it will set aside about 4 million yen annually for equipment renewal.

＜Case of 50% subsidy and:50% self-pay project implementation＞

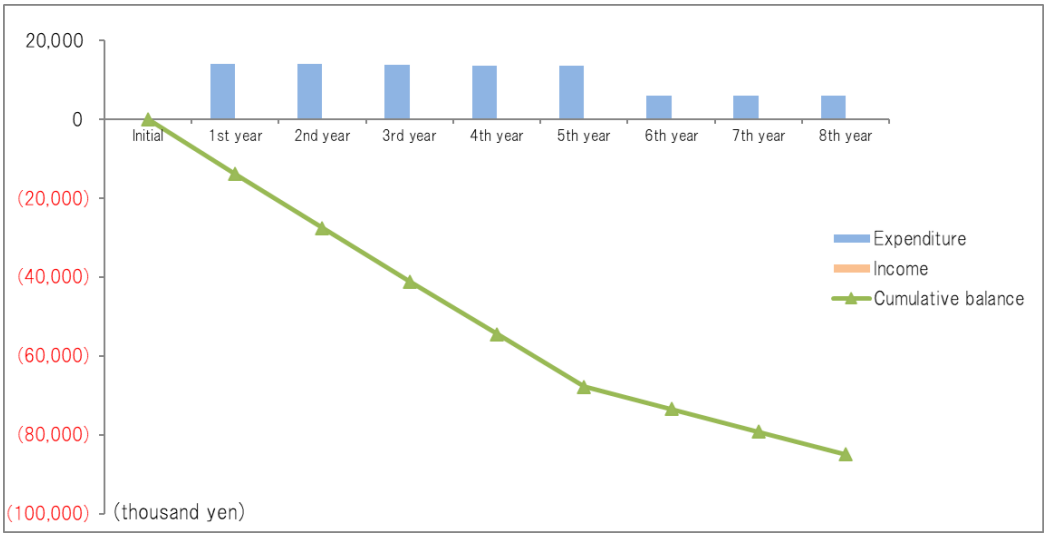


Figure3-7：50% subsidy for introducing one EV garbage truck

＜Case of 100% subsidy for initial cost＞

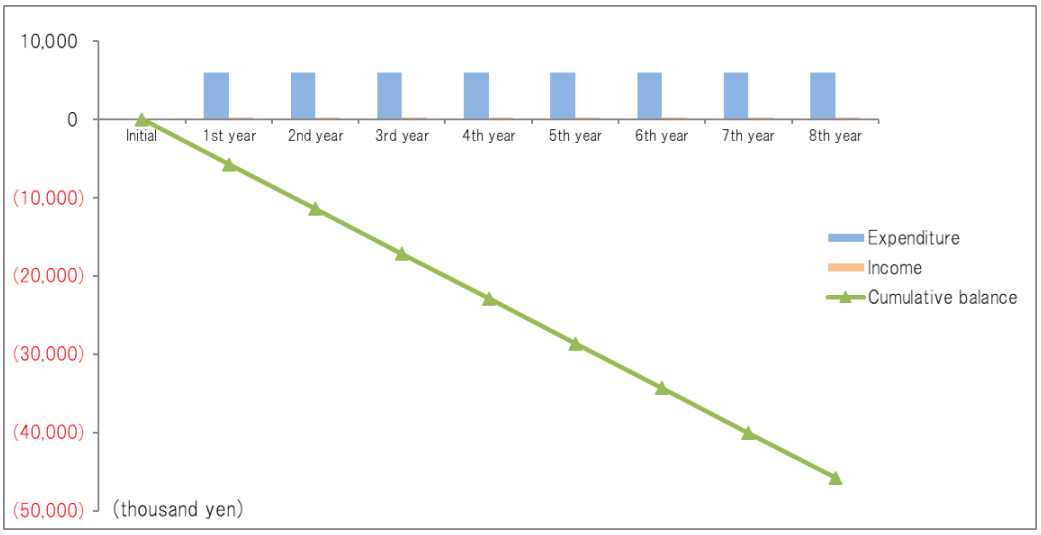


Figure3-8：100% subsidy for introducing one EV garbage truck

In each case, the project is a public project, and it is difficult to secure profitability only by reducing energy costs, since EV vehicles are introduced in a non-revenue-generating project. It is clear that this project would be difficult to implement without obtaining subsidies as well as reducing initial costs. (Note that this estimate is positive if 100% subsidy is received and the accumulation of maintenance and equipment renewal is excluded.)

Further investigation is needed to determine whether the benefits of introducing EV vehicles, including maintenance costs, can be increased. In general, it is said that the use of EV vehicles will reduce maintenance costs, but it remains to be seen to what extent this will be applicable in island areas.

3.3.4 CO_2 reduction effect

We also referred to J Credit System Methodology EN-S-012 Ver3.0 “Introduction of Electric Vehicles or Plug-in Hybrid Vehicles” for the effect of reducing greenhouse gas emissions associated with the conversion of waste transportation vehicles to EV.

Based on the concept of this methodology, the CO2 reduction effect of EV waste collection and transportation vehicle running when the annual mileage is set to about 6,000 km based on the results of hearings in Koror is as follows.

Table3-5：Amount of CO_2 reduction when introducing EV waste collection and transportation vehicles

The number of EV waste collection and transportation vehicles introduction	Expected CO2 reduction
1 car	4.35t-CO_2/year
4 cars	17t-CO_2/year

Unlike tourism buses, it is not a profitable business and there are no economies of scale, so it is difficult to secure the cost-effectiveness of reducing CO_2 emissions per t when applying for JCM equipment subsidies. In this regard, it would be useful to form a fund in the resource circulation project to be studied and examined by the ADB, and to receive financial assistance from the fund. On the other hand, this initiative is in line with the effects of co-benefits and the philosophy of building a comprehensive resource-recycling society in the region. Therefore, it is required to design the business from the next fiscal year onward with a view to funding the deposit system and forming various project finance.

The possibility of applying for a JCM equipment subsidy project for only PV power generation or only PV power generation and storage batteries will be discussed in the future. Since it is thought that this will lead to supporting the realization of the above-mentioned projects, we will consider this issue in cooperation with the ADB's investigation.

3.2.5 Monitoring method

Regarding the methodology used to calculate the amount of reduction in certification due to the conversion of vehicles to EV, the "Promotion of Electric Vehicle Use for Taxi in Costa Rica (2014 JCM F / S)" project and the methodology in the J-credit system in Japan " Refer to "EN-S-012 Ver.2.0 Introduction of electric vehicles or plug-in hybrid vehicles".

The target is project activities that introduce EV vehicles and replace ICE vehicles (internal combustion engine vehicles). The general monitoring parameters are shown in Table 3-9 below.

Table 3-6: Monitoring items

Items	Unit
Car mileage	km
Energy consumption efficiency electricity of electric vehicles	km/kWh
Power consumption for driving	kWh
Energy consumption efficiency of fossil fuel vehicles	km/L

In this project, it is assumed that the power source for EV vehicles will be a renewable energy power source. However, there is a possibility of using a backup power source from the local grid power when the capacity is insufficient due to a failure of solar power or a power conditioner or unseasonable weather.

Therefore, when conducting a reduction evaluation of greenhouse gas emissions, it is necessary to understand where the charged power is generated (renewable energy or non-renewable energy).

In this regard, it is assumed that vehicle ID management and recharge data from storage batteries will be recorded and managed using data loggers, etc.

3.2.6 Study of project implementation scheme

As for the implementation structure of the project, as mentioned above, the Koror State Waste Management Office has expressed its willingness to positively incorporate the project into the project to establish a resource-recycling society, which is currently under study and consultation by the ADB, so the project can be implemented while reducing the financial burden. It is necessary to consider the implementation structure of this project. The promotion scheme is shown in Figure 3-9 below.

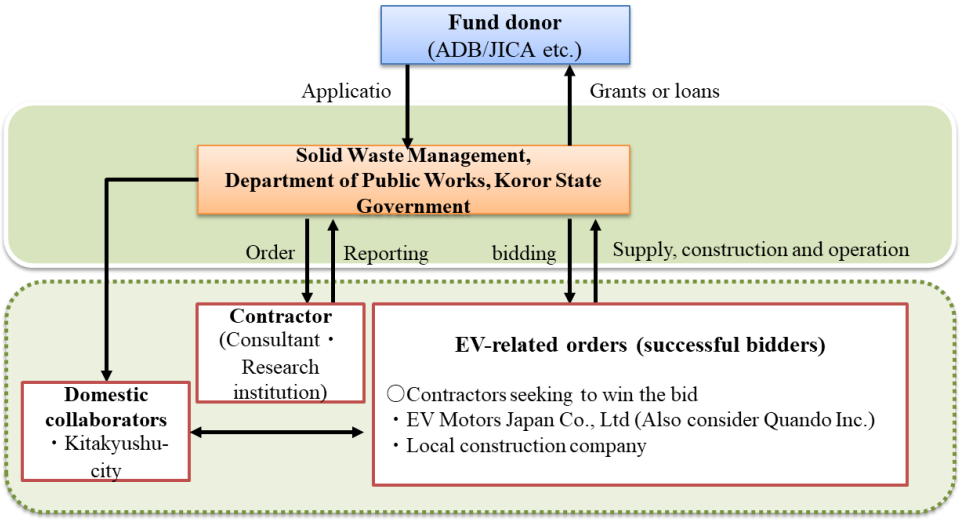


Figure3-9：Study of project implementation scheme

3.3 Maintenance and utilization scheme

As in the tourism sector, all stakeholders have commented maintenance is a major issue. The issue of maintenance exists in both the parts and human resources aspects, as previously mentioned.

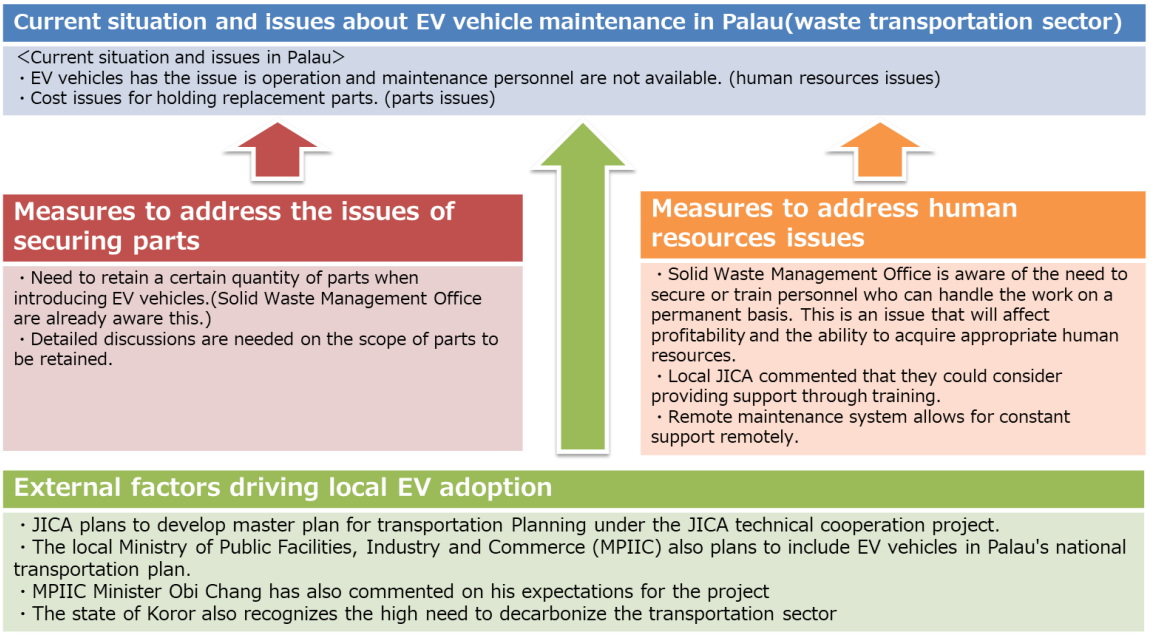


Figure 3-10: Maintenance issues and actions

The Solid Waste Management Office of Koror is aware of the need to retain some of these hardware parts, and has indicated its intention to do so. However, detailed discussions with the manufacturer are required regarding the retention of detailed parts.

On the other hand, there are some soft aspects that cannot be completed in the short term, and the state solid waste management office has expressed a desire for assistance in training maintenance personnel. In this regard, as mentioned previously, JICA has commented that support for training sessions, etc., could be considered. In addition, it is necessary to promote measures by providing online support through the use of "SynQ Remote" by Quando Inc.

3.4 Discussions for funding

It is essential to secure subsidies to reduce the burden of fundraising for this project, which is a public project. It is necessary to consider a multifaceted support scheme that includes JICA and ADB funds from the aspect of infrastructure development, as well as JCM facility subsidy projects. As one of the possibilities, we exchanged opinions several times with the Koror State Solid Waste Management Office and ADB officials of the Public-Private Partnership Division on how to procure funds in cooperation with the "Comprehensive Resource Recycling Project" in Koror State, as described in 3.1.3.

【Summary of exchange of opinions. Comments by ADB staff unless otherwise noted】

(1) History in Palau and ADB to date

・ADB has been paying attention to the waste management project currently planned by the state government (referring to the project to establish a comprehensive resource-recycling society) as a candidate for a regional model project. Solid Waste Management Office in Koror State is willing to promote the project through public-private partnership.

・The ADB's Public-Private Partnerships Department is responsible for advising the government on projects that use the vitality of the private sector to build social infrastructures. Technical assistance is deployed on a project-by-project basis to support project implementation.

・The project was for solar power generation (13 MW) in Palau, and the company provided advice to the government on this project as well.

(2) Obtaining funds for waste management projects, including the introduction of EV vehicles

・We believe that the funds being considered are not only ODA from ADB, but also the possibility of collaboration with JICA and the Ministry of Environment, Japan. JFJCM and others could also be a possibility.

・The project is being considered in order to maximize results by securing a certain level of scale from an overall project perspective.

(3) Comments after the explanation of the project regarding the introduction of EV vehicles

・The project is considered to be useful as a model because it contributes to the utilization of renewable energy and decarbonization.

・The fact that the battery can be moved in a container unit may also be useful from the viewpoint of resilience.

・For container units, trucks are needed to move them. However, the Solid Waste Management Office does not currently own any vehicles, so the cost of renting a vehicle is an issue (comment from Koror Province).

・If the project is to be supported by ADB in the future, it is highly likely that it will be an international bid, so it would be desirable to have some strong points in this regard.

・We would like to study the model in cooperation with the survey that ADB will conduct in the future.

3.5 Project implementation schedule

Table3-7 is assumed for the project implementation schedule of the waste collection and transportation EV project based on the survey results of this year.

Table3-7：Examination of future project implementation schedule

Items	FY2022		FY2023		FY2024	
	1st half	2nd half	1st half	2nd half	1st half	2nd half
Examination and construction of project implementation system						
Scrutiny of cost / introduction model						
Examination for acquisition of various subsidies						
Support application such as JCM equipment assistance						

In collaboration with the ADB study to be launched in the future, we will finalize the model, create the strengths of the project, prepare for bidding, and build a scheme for bidding. At the same time, we will examine the possibility of JCM facility subsidy projects in which only a portion of the facilities are cut out, and move toward obtaining various other subsidy programs, with the aim of obtaining subsidy programs in FY2023.

3.6 Summary / Challenges to overcome in the future

The following is a summary of the study and future issues for the introduction of EV vehicles for waste collection and transportation.

<Summary＞

・Study on introduction of waste collection and transportation EV vehicles (packer trucks) based at M-Dock was conducted.

・Solid Waste Management Office expressed a desire to convert all four packer trucks to EV vehicles, and estimates were made based on this request.

・After discussions with ADB, the company commented that it would conduct a survey and study on a project to introduce EVs in waste collection and transportation vehicles as part of a project to build a comprehensive resource-recycling society in Koror State.

<Future issues＞

・Ensure competitiveness with international bidding in mind

・Continued reduction of initial price

・Conducting surveys on local needs for larger vehicles, unique, etc.

・Ongoing concrete establishment of a maintenance system

Chapter 4 Feasibility Survey on Collaboration in Promoting Carbon-free Projects in Koror State and Other Locations

In addition to the survey on the introduction of EVs in Koror State, which is the main theme of this work, this study investigated the technological needs of a wide range of local stakeholders and the technological seeds in Japan, including companies in Kitakyushu City, with the aim of identifying low-carbon projects in Koror State (and possibly in Palau as a whole, including other states) that would be useful for decarbonization and promotion of the SDGs, and examined possible candidates. Stakeholders interviewed and related projects are listed in the table below.

Table 4-1：Assumer local stakeholders (Carbon-free Projects)

Organization name	Abbreviation	Overview explanation	Related Projects
Palau Public Utility Corporation	PPUC	Private company established in 1994 to manage and operate the electric power system in Palau.	LED conversion
MPIIC Palau Energy Administration	PEA	It is the administrative arm of Palau's renewable energy and energy efficiency projects. It is also the country's point of contact for energy-related conferences abroad.	LED conversion・Offshore solar power generation・海洋温度差発電
Palau Pacific Resort	PPR	One of the three major local hotels (160 guest rooms). Tokyu Corporation is the parent company.	Energy savings in large hotels
Koror State Department of Conservation & Law Enforcement	DCLE	The agency responsible for the management and implementation of the management plan for Rock Island South Lagoon. It is in charge of the tour guide program and safety management to minimize the impact of tourism on the ecological environment.	Electric-powered ships (E-ships)
Environmental Quality Protection Board Office	EQPB	An executive branch agency of the government organized under the "Environmental Quality Protection Act" (24 PNCA) of the Palau National Law of 1981. It implements essential environmental protection programs that safeguard the quality of the	Recycling and utilization of lead-acid batteries

		environment and ensure the conservation of adequate resources, while at the same time enabling development in line with the social and economic goals of the nation.	
Surangel & Sons Comapy	—	Established in 1982. Offers home design, auto repair, and equipment rental. Sells groceries, scuba gear, and boats. One of the main importers of lead-acid batteries from overseas.	Recycling and utilization of lead-acid batteries
Western Caroline Trading Company	WCTC	Established in 1948. Operates a local shopping mall. One of the major importers of lead-acid batteries from overseas.	Recycling and utilization of lead-acid batteries

4.1 Energy savings in large hotels

Palau is one of the Pacific countries with the highest dependence on tourism, which accounted for 36.5-53.4% of GDP in FY 2010-2019 before the COVID-19 pandemic[7]. In Palau, where there are many small-scale businesses, large tourist hotels are among the major energy consuming sectors. Therefore, in the last fiscal year's survey, interviews were conducted with two major large-scale hotels to confirm their needs for updating facilities with high CO2 emission reduction potential. As a result, the Palau Royal Resort (PRR) indicated that they have no immediate plans to upgrade their facilities as their facilities are relatively new, while the Palau Pacific Resort (PPR) indicated that they have plans to upgrade their diesel generators and chillers due to their old facilities.

Since it has been difficult for the hotel industry in Palau to make a decision on facility renewal due to the disruption of tourist arrivals (i.e., income) caused by COVID-19, this year, the JCM equipment subsidy program was explained in detail to PPRs for reference when updating their equipment in the future, and further interviews were conducted on their needs for facility renewal.

[7] ADB (2021) Recovery through Improved Systems and Expenditure Support Program, Subprogram 1: Report and Recommendation of the President. https://www.adb.org/projects/documents/pal-54284-001-rrp

(1) Interview with PPR

As a result of interviews with PPR, in addition to the needs for updating diesel generators and air-cooled chillers identified in the previous fiscal year, we were able to identify a new need for updating 20KW mercury lamp to LED lighting. In addition, we were able to identify issues such as problems caused by the long-term shutdown of facilities due to COVID-19, deterioration of facilities due to salt damage, replacement of parts when facilities fail, and lack of personnel who can perform maintenance (see Annex 4).

(2) Possibility of using the JCM Model Project in PPR

【Diesel generator cogeneration system】

JCM states, "In principle, it should not be a business related to thermal power generation using fossil fuels, except equipment that effectively utilizes the heat generated during power generation and equipment that contributes to decarbonizing technology such as carbon capture and storage (CCS)" (FY2021 Guidelines for Submitting Proposals). Therefore, if fossil fuels are used to generate electricity, the facility must be able to effectively use the heat generated. In the PPR, an existing diesel generator is used for cogeneration to boil and supply hot water using exhaust heat, so a high-efficiency facility with a similar cogeneration system could be eligible for subsidies. As for cogeneration systems, five JCM Model Projects have been selected so far (as of February 2022), all of which are gas cogeneration systems (Table4-2).

【Air-cooled chillers】

As for chillers, there are many adoption cases in JCM. Generally, water-cooled chillers have higher cooling efficiency than air-cooled chillers, but even air-cooled chillers can be expected to have energy efficiency and conservation effects compared to the baseline if they are the latest high-efficiency equipment. In fact, one air-cooled chiller has been adopted for the JCM Model Project (Table 1.1.1).

Table4-2： Similar projects selected for the JCM Model Project (cogeneration and air-cooled chiller) (Source: GEC website)[8]

Technology	Adopted JCM project name	Partner country	Adopted year
Gas co-generation	Introduction of Gas Co-generation System and Absorption Chiller to Fiber Factory	Thailand	2018
	Introduction of Gas Co-generation System and Absorption Chiller to Motor Parts Factory	Indonesia	2017
	Introduction of Co-generation System to Motor Parts Factory	Thailand	2016
	Installation of Co-Generation Plant for On-Site Energy Supply in Motorcycle Factory	Thailand	2015
	Installation of Gas Co-generation System for Automobile Manufacturing Plant	Indonesia	2015
Air cooled chiller	Introduction of High Efficiency Air-conditioning System and Air Cooled Chillers to Office Buildings	Vietnam	2019

【LED Lighting】

LED lighting consumes about 1/3 to 1/4 of the power and lasts 4 to 10 times longer than mercury lamp lighting, so the benefits of replacing it are great, including the reduction of running costs (electricity bills). If we compare 1000W mercury lamps (20 units) and 1000W equivalent LED lighting (20 units) for a 5-hour use per day, we can reduce the monthly electricity bill from US$930 (about 100,000 yen) to US$269 (about 30,000 yen) (Table4-3).

Table4-3：Comparison of energy consumption and electricity rates for LED lighting with the same illuminance as 1000W mercury lamps

Specifications	Power consumption and electricity rates
1000W mercury lamps	Power consumption: 1,000 W x 20 units x 5 h x 30 days = 3,000 kWh/month Electricity rates: 3,000 kWh x US$0.31/kWh[9] = 930 US$/month
LED lighting equivalent to 1000W (RZNA-1000-50RT[10])	Power consumption: 289.2 W x 20 units x 5 h x 30 days = 867.6 kWh/month Electricity rates: 867.6 kWh x US$0.31/kWh = 269 US$/month

[8] GEC homepage “JCM projects” https://gec.jp/jcm/jp/projects/

[9] Palau Energy Snapshot: Energy Transitions Initiative: https://www.energy.gov/sites/default/files/2020/09/f79/ETI-Energy-Snapshot-Palau_FY20.pdf

[10] RZNA-1000-50RT (NIINUMA): Power consumption 289.2 W, consumption efficiency 159.8 lm/W

4.2 LED conversion

Since last fiscal year's survey showed that there seemed to be a certain amount of potential for LED streetlights, additional surveys were conducted through local consultant.

According to the interview with the PPUC, the PPUC has completed the conversion of almost all of the streetlights along the public roads, including the main roads in Koror and the compact roads in Babeldaob, to a total of 1,943 LED units. The PPUC has also completed the conversion of secondary and tertiary roads in Koror and other roads in Babeldaob to LED. The cost of electricity for streetlights is borne by the PPUC for all public roads and by the respective states for secondary and tertiary roads. In addition, the PPUC is responsible for the maintenance of the streetlights.

From the interview with the Palau Energy Administration (Annex4), it was also found that there would be no particular need for LED streetlights, as the introduction of LED streetlights has largely been completed. On the other hand, we found out that there is a need for LED installation in public facilities. While the necessary specifications and number of units will need to be investigated in the future, consideration should be given to the introduction of a package with unified standards, as well as an automatic detection function to turn off the system when no one is present.

4.3 E-ship

In small island nations such as Palau, ships are an important means of transportation, and the electrification of ships, along with the electrification of vehicles, is an important issue in the decarbonization of these small island nations. EV Motors Japan (EVMJ) is also involved in the development of electric-powered ships (E-ship), so we conducted a survey and study on the possibility of introducing E-ships in Palau.

(1) Outline of E-ship

The propulsion system of a ship is generally divided into three types: (1) "inboard", in which the power is placed around the center of the hull and the shaft drives the propeller outside the ship; (2) "outboard", in which the propulsion unit, consisting of the engine, transmission, rudder, and propeller, is installed outside the ship; and (3) "inboard/outboard", in which the engine itself is installed inside the ship and the drive unit is installed at the stern. Of these, EVMJ proposes to replace the inboard engines of existing ships with electric motors, and to install batteries and inverters for electrical power, as well as lightweight, foldable CIGS flexible solar power as an auxiliary power source (Fig.4-1).

E-ship is basically electrification by converting a ship with existing inboard motor specifications. EVMJ has experience in providing technology for the development of "vibes one," a catamaran equipped with a high-capacity lithium-ion (120kWh) and motor[11]. The ship's engine is easily removable, and the motor and propeller are connected by a flexible shaft, so there is no need to be sensitive about the installation of the motor, as is the case with converted EVs, which has the advantage of easy introduction. Also, since ships are not as weight-sensitive as cars, inexpensive lead-acid batteries can be used instead of expensive lithium-ion batteries.

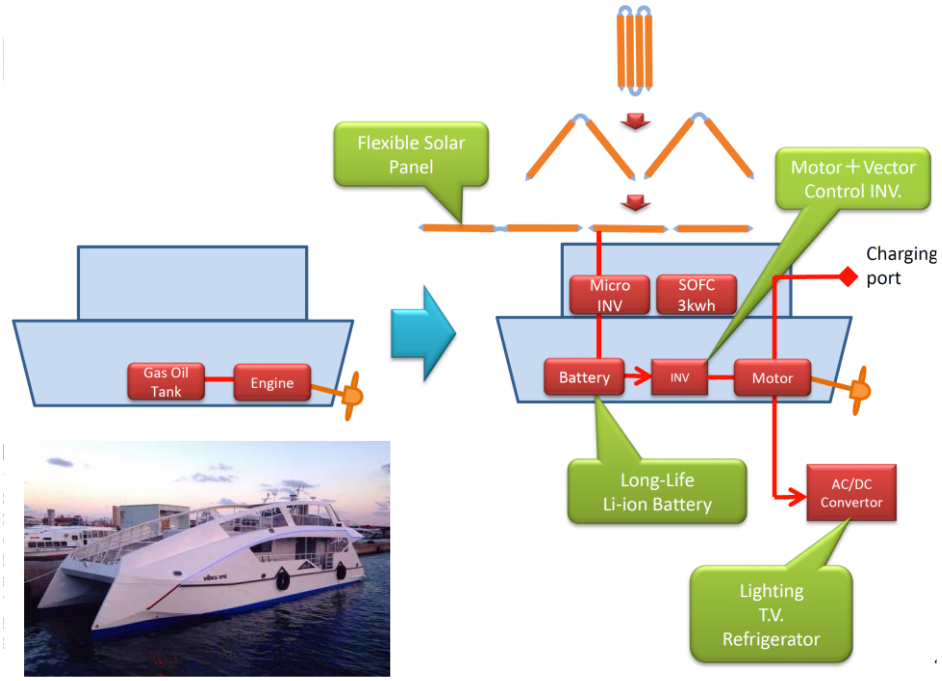


Figure 4-1 Conceptual diagram of the E-ship and the E-ship demonstration cruise ship "vibes one" (Source: EVMJ)

(2) CIGS flexible solar

Ordinary solar cells use silicon as the semiconductor, but CIGS (copper, indium, gallium, selenium) solar cells, which use a mixture of CIGS instead of silicon, are now in practical use. This technology absorbs light more easily, allowing for thinner panels while retaining the advantages of silicon-based solar cells[12]. EVMJ is dealing with CIGS flexible solar that can be bent for installation on curved surfaces (Fig.4-2).

[11] Chiburian Okinawa Media (2015.03.12) Demonstration of the electric propulsion cruise ship "vibes one" begins on Ishigaki Island. http://www.tibulian.com/2015/03/vibe-2/

[12] National Institute of Advanced Industrial Science and Technology: CIGS Solar Cells. https://unit.aist.go.jp/rpd-envene/PV/ja/about_pv/types/CIGS.html

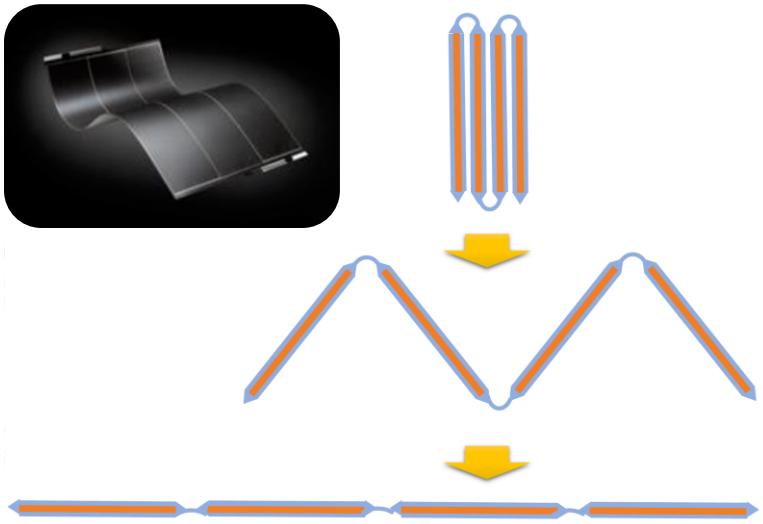


Figure 4-2 Conceptual diagram of CIGS flexible solar (Source: EVMJ)

The main features of CIGS flexible solar are as follows:

- 1/3 the thinness of regular solar panels
- 1/6 the weight of regular solar panels
- Long life span
- High power generation efficiency
- Low cost
- Can be bent and stored freely
- Angle can be changed according to the position of the sun
- Unaffected by temperature changes
- Waterproof structure

When comparing ordinary polycrystalline solar panels and CIGS flexible solar panels, the theoretical "conversion efficiency" is higher for polycrystalline solar panels, but the annual power generation is almost the same. Also, the system installation cost is almost the same, but since CIGS flexible solar has a longer life, the average annual profit when the generated electricity is sold is higher for CIGS flexible solar (Table4-4).

Table4-4：Comparison of 30 kW roof-mounted solar power systems

(Source: extracted from EVMJ)

Item	Polycrystalline Solar	CIGS Flexible Solar (2015-2016 models)
Conversion efficiency (%)	16	13
Light absorption efficiency	1	1.08
Weight (kg/m2)	12	2.5
Installation area (m2)	284	256
30kW System cost	¥8,700,000	¥8,391,000
Annual power generation 2,000 h/y x 30kW (kWh)	60,000	60,000
System life (years)	20	25
Average annual profit / 20 years (Purchase price ¥36/kWh)	¥1,725,000	¥2,280,450

(3) Number of ships registered in Palau

Through a local consultant, the registration status of ships in Palau was surveyed. The information we obtained is as follows.

- Vessels over 65 feet (about 20 meters) are registered in the ship registry maintained by the Palau Ministry of Public Works and Industry.
- Ferryboats (mainly for passenger and cargo use) between Koror and other inhabited islands are also managed by the central government, and 26 vessels over 50 feet (about 15 meters) are registered (Table4-5).
- Motorboats are registered and managed by each of the 16 states. The state of Koror, which has the largest number of boat registrations, has 355 registrations as of 2022. The majority of these are gasoline engine outboard motors, and less than 10 are inboard/outboard motors (Table4-6).

Most of the boats with gasoline engine outboard motors are used for sightseeing tours such as diving or for fishing purposes by fishermen, who travel at high speed from Koror to the site, which takes more than an hour each way.

Table4-5：List of specifications for ferry boats connecting Koror with other inhabited islands

(Source: Palau Ministry of Public Works and Industry)

	Length (m)	Engine	Application
1	15.54	YANMAR CO., LTD / 50.2KW X 2	PASSENGER
2	16.56	TWIN VOLVO D13-800 / 800HP X 2	PASSENGER
3	16.75	VOLVO D16 / 551KW	FISHING
4	18.2	TWIN YANMAR 6CXBM-GT / 394HP X 2	PASSENGER /CARGO
5	19.11	TWIN CATERPILLAR CD12 / 526KW X 2	PASSENGER
6	19.6	MAN / 900HP X 2	PASSENGER
7	19.9	2 X CATERPILLAR 3406 / 300HP EACH	PASSENGER /CARGO
8	20.4	TWIN YANMAR 6CH-WVTE / 255HP EACH	PASSENGER /CARGO
9	21.28	CUMMINS / 500 BHP	FISHING
10	21.38	TWIN CUMMINS NTA-855 / 480HP	CARGO
12	22.123	2 X DETROIT / 257KW EACH	CARGO
13	22.85	MITSUBISHI S6A3-MPTK / 2 X 477.42KW	CARGO
14	23.05	VOLVO PENTA / 553KW	FISHING
15	27.35	TWIN G.M. / 2 X 170KW	PASSENGER
16	32.22	TWIN CATERPILLAR / 2 X 783 KW	PASSENGER
17	32.3	TWIN CATERPILLAR / 2 X 783.0KW	PASSENGER
18	33.72	YANMAR / 2 X 302KW	PASSENGER
19	34.76	MITSUBISHI (MHI SAGAMIHARA S6R2-MTK / 2 X 478KW	PASSENGER
20	38.35	TWIN PROPMECH CAT / 330KW X 2	PASSENGER
21	41.46	MITSUBISHI 6D-22 / 480HP	PASSENGER
22	46.8	CUMMINS / 2 X 477 KW	PASSENGER
23	47	MWM/TDB / 398.0HP EACH X 2	PASSENGER
24	51.4	AKASAKA DIESEL / 2,698HP	PASSENGER
25	54	CUMMINS / 2 X 316.93KW EACH	CARGO
26	15.54	YANMAR CO., LTD / 50.2KW X 2	PASSENGER

Table4-6 ：Actual boat registrations in Koror State in FY2022(Source: Koror Stat Government e).

Registered ship type	Number of registrations
Inboard engines	0
Outboard engines	345+
Inboard and outboard engines	10 or less
Total	355

(4) Potential of E-ship in Palau

The conversion of existing ships to E-ships is not yet at a realistic level, due to the increased cost of installing batteries and the limited cruising range. In fact, the aforementioned cruise ship "vibes one" is equipped with a 120 kWh lithium-ion battery, but its cruising time at a cruising speed of 8 knots (about 15 km/h) is limited to about 2 hours on a full charge[13] On the other hand, ships at anchor or moored are powered not only by batteries, but also by generators that run through the engines, so the engines are often running even when the ship is not underway. If such ships can be equipped with CIGS flexible solar to provide auxiliary power, it will help reduce CO2 emissions from engine operation. Although the hurdle of converting a ship to an E-ship, including the replacement of the engine, is high, it is relatively easy to introduce CIGS flexible solar power if it is installed only on the ship.

4.4 Electric outboard motors

Since outboard motors are widely used in Palau, except for large vessels, the potential for the spread of electric outboard motors is greater than that of E-ships, which are limited in scope. In Japan, Yamaha Motor Co., Ltd. has announced its next-generation electric outboard motor "HARMO," and Honda Motor Co., Ltd. has also announced a concept model of a small electric outboard motor. In this survey, we first conducted a web search to find out about trends in electric outboard motors in Japan and overseas, and then interviewed Yamaha Motor.

(1) International trends in electric outboard motors

Table4-7 shows the manufacturers of electric outboard motors and the output range of their products extracted from the web search. Currently, there are many new entrants to the EV market around the world, and the same trend can be seen in the electrification of ships, with many electric outboard motor manufacturers in disarray, mainly in Europe. The overall trend seems to be that there are few large, high-powered (about 50 horsepower or more) outboard motors of 30 kW or more, and the mainstream seems to be small outboard motors of less than 30 kW. In Palau, large, high-power outboard motors that can navigate long distances to dive sites in a short time are widely used.

---

[13] Chiburian Okinawa Media (2015.03.12)The demonstration of the electric propulsion pleasure boat "vibes one" has started on Ishigaki Island.

Table4-7： Electric outboard motor manufacturers and product power ranges (Compiled by the survey team from a web search, based on information available as of December 2021)

Region	Manufacturer	Country	Power (kW)												URL
			1	5	10	20	30	40	50	60	70	80	90	>100	
Europe	TORQEEDO	Germany	■	■	■	■			■						https://www.torqeedo.com/
	Evoy	Norway												■	https://www.evoy.no/
	e'dyn	Slovenia	■	■	■	■									https://www.edyn-marine.com/
	Remigo	Slovenia	■												https://remigo.eu/
	Mitek	Italy	■	■	■										https://www.mitekitaly.com/
	Huracan	Italy			■	■	■								https://www.huracanpower.com/
	Aquamot	Austria	■	■	■	■									https://aquamot.at/
	Aquawatt	Austria			■	■		■							https://www.aquawatt.at/
	Krautler	Austria	■	■											http://www.kraeutler.at/
	Bellmarine	Netherlands		■	■	■									https://ecoboats.com.au/products/
	Propel	Netherlands			■										https://plugboats.com/
	Rim Drive Technology	Netherlands	■	■	■										https://rimdrivetechnology.nl/
	Combi Outboards	Netherlands	■												https://combi-outboards.com/
	Elva	Netherlands	■												https://www.elva.nl/buitenboordmotoren/
	Electro-Mobile	Sweden	■	■	■										https://www.electro-mobile.se/
	Stream	Sweden				■	■								https://stream-propulsion.com/
	E-Tech	Poland	■	■	■	■									https://starboats.eu/
	Karvin	Czech Republic	■	■											https://www.karvin.eu/
	Navigaflex	Switzerland	■	■	■										https://www.navigaflex.ch/
	RAD Propulsion	UK			■	■		■							https://www.radpropulsion.com/
North America	Flux Marine	USA			■		■		■						https://www.fluxmarine.com/
	Pure Watercraft	USA				■									https://www.purewatercraft.com/
	Elco	USA	■	■	■	■									https://www.elcomotoryachts.com/
	Stealth Electric Outboards	USA			■		■								https://www.stealthelectricoutboards.com/
	EP Carry	USA	■												https://www.electricpaddle.com/
	Ray Electric Outboards	USA				■	■		■						http://rayeo.com/
Asia	ePropulsion Technology	China	■	■											https://www.epropulsion.com/
	Golden Motor	China	■	■	■										https://www.goldenmotor.com/
	Parsun	China	■	■											http://www.parsunmarine.com/
	LGM	Korea		■	■			■		■				■	http://www.lgmarines.com/
	Yamaha	Japan	■												https://www.yamaha-motor.co.jp/
Oceania	EClass Rechargeable Boats	Australia	■	■	■	■	■								https://eclassoutboards.com.au/

(2) Possibility of introducing electric outboard motors in Palau

According to the interview with Yamaha Motor (Annex 3), the current performance and cost of batteries are still limited to practical applications because the batteries quickly run out when a ship with high wave resistance sails at high speed. Since the HARMO developed by the company is designed to navigate at a slow speed of about 10 km/h in quiet inland waters such as canals, it is not suitable for the main application in Palau (high-speed navigation at sea). In addition to such usage environment, the advantages of introducing electric outboard motors will be diminished in a country that does not have a renewable energy power supply infrastructure, so the market conditions must be met in order to introduce electric outboard motors. Considering these factors, the introduction of electric outboard motors is likely to start with boats used for slow cruising over short distances, such as mangrove tours and glass boats. Although electric outboard motors may be eligible for the JCM equipment subsidy program, a certain number of lots will be required for application due to the small scale of each piece of equipment.

4.5 Offshore solar power generation

In island countries where land area is limited, there are restrictions on the installation of solar power generation equipment on land, so some cases of solar power generation on the ocean, where there are fewer restrictions, are beginning to appear. Through discussions with EVMJ, the company proposed the application of its CIGS flexible solar system to offshore solar power generation, and we examined the possibility of its application in Palau.

(1) Trends in the introduction of offshore solar power

Swimsol (headquartered in Austria) announced the world's first offshore solar power generation system, SolarSea, in 2014, and has been in practical operation in the Maldives since 2019. The company has built a robust system that does not degrade over time (lifespan of about 30 years), and has constructed a floating solar platform consisting of 196m^2, 25kW units (capable of powering about 25 households per platform) (Fig4-3). The company also offers a PPA contract system (a financing model that allows for zero initial investment and a return on investment in monthly electricity bills) that uses a hybrid system of diesel generators and solar power to provide electricity at more than 50% lower cost[14].

Similar offshore solar power generation systems are also being introduced in other countries such as the United Arab Emirates (80kW system) [15], South Korea (100MW system) [16], and the Netherlands (50kW system) [17].

These examples show that the advantages of offshore solar power are: (1) there is more space than on land; (2) there is no need to pay for land or go through cumbersome installation procedures like on land; and (3) there is no obstruction at the sea surface, and the reflection and cooling effect of the sea surface allows for 5-10% more power generation than on land.

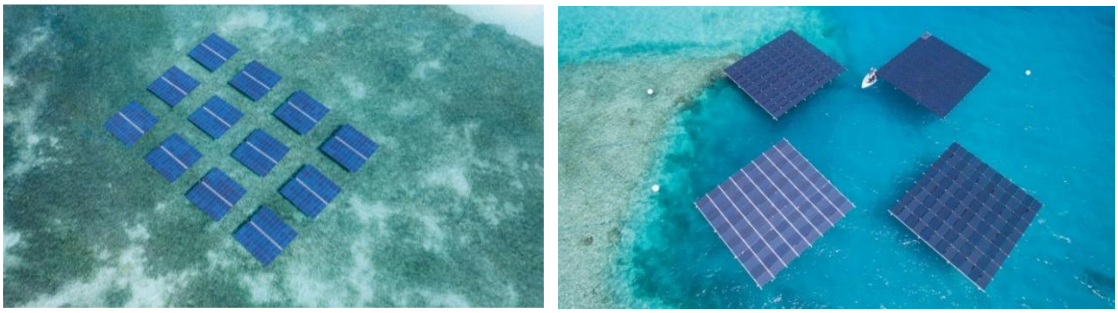


Figure4-3：A view of SolarSea, an offshore solar power system provided by Swimsol in the Maldives (Source: Swilmsol[18])

(2) Offshore solar power concept using CIGS flexible solar

[14] SolarSea (Swimsol): https://swimsol.com/
[15] WAYA Media (2020/02/25) MENA's First Floating Solar Power Plant to Begin Production. https://waya.media/uaes-first-floating-solar-power-plant-to-begin-production/
[16] Offshore Energy (2020/07021) Ocean Sun lands floating solar deal in South Korea. https://www.offshore-energy.biz/ocean-sun-lands-floating-solar-deal-in-south-korea/
[17] Oceans of Energy (North Sea 1): https://oceansofenergy.blue/north-sea-1/
[18] SolarSea (Swimsol): https://swimsol.com/

EVMJ offers a foldable CIGS flexible solar system. This will allow the panels to concentrate light for a longer period of time than a horizontal installation by adding a certain tilt angle, and will also allow for better drainage even when covered with water splashes (since the surface is fluorinated). In addition, since the panels themselves are light, the structure and strength of the floating platform can be simplified, and cost reductions can be expected.

In offshore solar power generation, submarine cables are usually laid to supply the generated power to the grid on land, but depending on the surrounding environment and the distance from shore, there are concerns that the cables may not be laid, or that the cost may increase. Therefore, it is thought that the problem associated with cable laying can be solved by preparing two ships with batteries (battery ships) as an option, and exchanging (towing by ship) a charged battery ship and a discharged battery ship once a day at the sunset. Since battery ships are not weight-sensitive, it is thought that inexpensive lead-acid batteries can be used (Fig.4-4).

(3) Potential for introduction in Palau

We examined whether it would be possible to reenergize the power supply on inhabited islands, etc., by combining an offshore PV power generation system with a backup power source on land (PV power generation + batteries) instead of diesel generators that depend on imported fossil fuels (Fig.4-5). However, as Palau is not as land-scarce as the Maldives, and projects to introduce renewable energy are already underway on several inhabited islands (Annex6), the needs were considered to be limited.

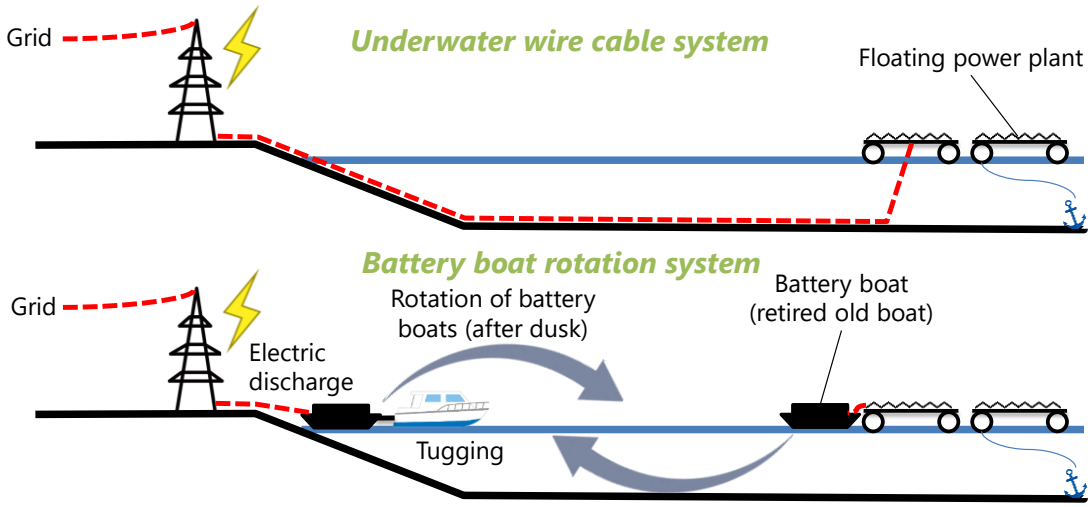


Figure4-4：Conceptual diagram of transmission options via submarine cables (top) and battery ship replacement (bottom) for offshore solar power generation.

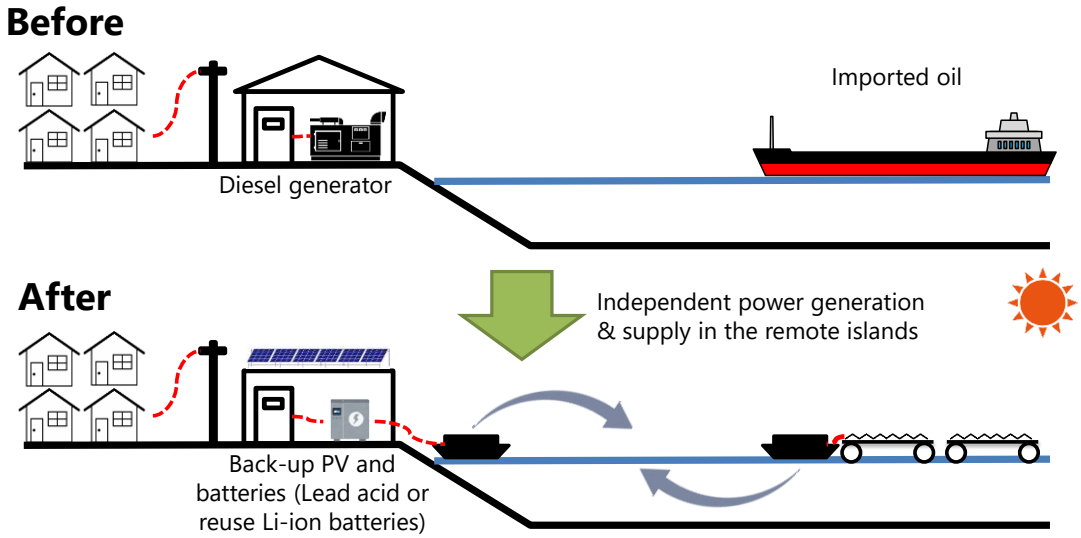


Figure4-5：Conceptual diagram of the expected effects of introducing offshore solar power generation on remote islands

4.6 Recycling and utilization of lead-acid batteries

Storage batteries were an issue for the offshore PV power generation and ship electrification examined in this study, but it was suggested that the widely used lead-acid batteries could be substituted for the expensive and difficult-to-recycle lithium-ion batteries, so the regeneration technology for lead-acid batteries was investigated.

(1) Lead-acid battery reconditioning technology

In lead-acid batteries that have been used for a long time, the surface of the negative electrode plate crystallizes, causing a sulfation phenomenon that diminishes the charging function. If this sulfation is eliminated, the charging capacity can be restored. Therefore, methods such as applying pulsed current and chemical decomposition are known. Among the various battery reconditioning technologies found through the web search, we looked for technologies that met the following three conditions: (1) they are already commercialized, (2) major reliable companies are involved, and (3) they have been introduced in developing countries.

As a result, the patented technology (lead-acid battery regeneration unit: SOTO WW1) developed by Reconsulting was deemed to meet these requirements. IGUAZU Corporation has signed an exclusive sales contract for this technology in Japan, and is providing the MOTTA forklift battery restoration service. Idemitsu Energy Solutions has also partnered with IGUAZU

Corporation to start demonstration tests of "ReBS", a low-cost energy storage solution that uses recycled lead-acid batteries. Reconsulting is continuing its overseas business, and is involved in the regeneration of backup power sources (lead-acid batteries) for cell phone base stations in developing countries where grid power sources are unstable. Therefore, we conducted an interview with IGUAZU Corporation (see Appendix 6).

This technology decomposes sulfation by passing a special waveform current through the lead-acid battery, and it can be used with a wide variety of lead-acid batteries. However, since the reconditioning process uses electric power, it is necessary to be located in a place with a certain level of stable electric power, and since there are concerns about structural deterioration, it is necessary to be careful about batteries made overseas that have a weak structure. It was mentioned that there is no need to worry about the safety of the reconditioning process, even in developing countries, as long as the proper procedures are followed.

(2) Actual status of lead-acid batteries in Palau

The status of the use of lead-acid batteries as ascertained through the collection of information through local consultants and interviews with the Palau Environmental Quality Protection Board (EQPB) (Appendix 4) is as follows:

- Lead-acid batteries are imported mainly from the United States, Japan, and Taiwan.
- In addition, used lead-acid batteries attached to second-hand automobiles imported from Japan (about 30 units are imported once a month on a regular cargo ship operated by Kyowa Shipping Co., Ltd.
- The following two companies are the main importers of lead-acid batteries, with a total of approximately 9,000 lead-acid batteries imported in a single year of 2021:
  - Surangel & Sons Company: approx. 4,800 units
  - Western Caroline Trading Company: approx. 4,200 units
- EQPB is responsible for the management of hazardous waste, including batteries, and has introduced a buy-back guarantee system for used lead-acid batteries in order to reduce illegal dumping and promote recycling. The obligation to collect lead-acid batteries is clearly stated in the EQPB regulations[19].
- The guaranteed purchase price used to be $1.00 per unit regardless of size or condition of the batteries, but is now $2.00 per unit for collection. Battery collection points are located

[19] Chapter 2401-31 SOLID WASTE MANAGEMENT REGULATIONS: https://www.palaugov.pw/wp-content/uploads/2021/11/Chapter-2401-31_Solid-Waste-Regulations.pdf

at M-Dock, and batteries can also be brought to other scrap dealers for the same price.

- Since used lead-acid batteries are guaranteed to be purchased at a valuable price, few people dump them illegally, and it is believed that most of them are collected.
- The collected lead-acid batteries are exported to overseas countries for recycling through vendors. On average, about 1,500 used lead-acid batteries are stored in a 20-foot container and exported overseas once every three months.

(3) Possibility of introducing lead-acid battery reconditioning technology in Palau

Since a system to guarantee the purchase of used lead-acid batteries has already been established, the introduction of lead-acid battery reconditioning technology can be expected to have a number of advantages, including extending the service life of storage batteries, reducing the economic burden on users, reducing GHG emissions associated with transportation, and facilitating the securing of stationary storage batteries for solar power generation. In particular, it is conceivable that the system could be utilized as a stationary storage battery to store electricity generated by PV modules in areas such as remote islands where grid power is not supplied, and provided as a set with a battery reconditioning system (Fig.4-6).

On the other hand, in order to introduce the technology, it will be necessary to clear various issues such as securing business feasibility (financing), ensuring safety, developing the capabilities of operators, establishing an inspection system and judgment criteria for batteries to be recycled, and establishing a system to encourage the recycling of batteries.

Under the JCM Model Projects, the equipment must be "equipment that directly contributes to GHG emission reductions, including energy-derived CO2", and since the equipment in question does not contribute to direct GHG emission reductions, it is not considered eligible.

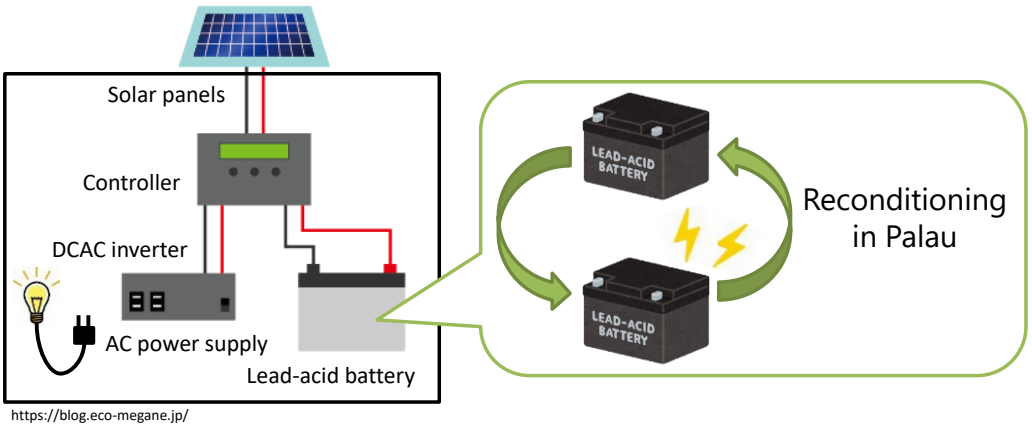


Figure4-6： Conceptual diagram of an in-house power generation system that provides a set of PV

power generation, lead-acid stationary storage battery use, and storage battery reconditioning systems in off-grid areas, etc.

4.7 Ocean Thermal Energy Conversion (OTEC)

Based on the interview with the Palau Energy Administration (Appendix 6), which expressed interest in the introduction of Ocean Thermal Energy Conversion (OTEC) on Angaur (or Peleliu) Island, the possibility of introducing this technology was examined.

(1) OTEC technology

OTEC is a power generation technology that utilizes the temperature difference between the warm surface water and the cold deep sea water (sea water of 1 to 7°C at depths of 600 to 1,000 meters). It can be used as a base power source because it is a stable energy source with little fluctuation like solar power and wind power (facility operation rate is about 90%). In order for OTEC to be economically viable, the temperature difference between surface seawater and deep seawater must be at least 20°C on average per year[20,21].

In Japan, a 50kW demonstration plant (Okinawa Ocean Thermal Energy Conversion Demonstration Test Facility) has been in operation since 2013 on Kume Island in Okinawa Prefecture[22]. In Japan, the Institute of Ocean Energy of Saga University has been conducting research on OTEC, and the institution signed a MOU for academic research exchange with Palau in April 2001[23].

(2) Introduction environment

The islands of Peleliu and Angaur are located at the southern end of the Palau archipelago, both of which are served by regular ferry services from Koror. The population of Peleliu is 484, and that of Angaur 119 (according to the 2015 census[24]), which is relatively large among inhabited islands.

---

[20] Xenesys Inc. Ocean Thermal Energy Conversion. http://www.xenesys.com/products/otec.html

[21] NEDO (2010) NEDO Renewable Energy Technology White Paper. Current Status and Roadmap of Ocean Thermal Energy Conversion Technology. https://www.nedo.go.jp/library/ne_hakusyo_2010_index.html

[22] Okinawa Ocean Thermal Energy Conversion Demonstration Test Facility: http://otecokinawa.com/

[23] Institute of Ocean Energy, Saga University: https://www.ioes.saga-u.ac.jp/jp/

[24] Office of Planning and Statistics (2015) 2015 Census of population, housing and agriculture for the Republic of Palau. https://www.palaugov.pw/wp-content/uploads/2017/02/2015-Census-of-Population-Housing-Agriculture-.pdf

On Peleliu Island, One Energy Island Co. Ltd. of South Korea, with support from the Korea Energy Agency (KEA), has signed an MOU with the PPUC to promote the introduction of renewable energy in Palau, and is conducting a study and demonstration starting in 2019. Peleliu Island is currently powered by a 2.2 MW diesel generator and a 164 kW PV, and the study is working to optimize the power supply, including the introduction of renewable energy, while making effective use of existing power sources[25, 26]. On the other hand, as for Angaur Island, there are still no projects such as the introduction of renewable energy.

Both islands have a unique topography with steep slopes descending from the coast to a depth of over 1,000 meters. The surface seawater temperature in the Palau Sea is stable at 27.5 to 30℃ per year, and when the surface seawater temperature is 30℃, it is said to drop to about 17℃ at a depth of about 180 meters[27]. In the case of Kume Island, where the demonstration project is being conducted in Japan, the surface seawater temperature varies widely from 22 to 29℃, and the water temperature at a depth of 200 meters is about 20℃ throughout the year[28]. This suggests that Angaur and Peleliu Islands are more suitable for the introduction of OTEC.

(3) Feasibility

Assuming that ordinary households use about 10 kWh of electricity per day (about 3,600 kWh per year) and that the equipment utilization rate is 80%, a plant with an output of 50 kW, which is the same as the one on Kume Island, would generate enough electricity for about 97 households, and a plant with an output of 100 kW would generate enough electricity for about 194 households. Taking into account the fact that both Angaur and Peleliu islands have small populations and limited night-time electricity demand, a small-scale demonstration plant with an output of 50 to 100 kW seems realistic. However, the scale of the plant is inversely proportional to the cost, and the cost of 1 MW class plant is estimated to be about 50 yen/kWh (Table4-8). Considering that the electricity price in Palau is about 36 yen/kWh (commercial and government facilities)[9], even smaller small-scale plants would not be economically viable. In addition, in terms of electricity

[25] PPUC (2019) PPUC signed a Memorandum of Understanding (MOU) with One Energy Island Co. Ltd: https://www.facebook.com/palaupuc/posts/ppuc-signed-a-memorandum-of-understanding-mou-with-one-energy-island-co-ltd-oei-/293494101225289/

[26] Korea Energy Agency (2019) The Feasibility Study of Micro-grid Project at South Pacific Island Countries and Territories (PICTs).

[27] Colin P.L. (2009) Marine Environments of Palau. Coral Reef Research Foundation.

[28] Kumejima Town (2017) Kume Island Deep Sea Water Combined Use Basic Research Report: https://www.town.kumejima.okinawa.jp/docs/eepocean_water_inspection_slip/

demand and utilization of deep sea water, it would be more advantageous to introduce the system on Peleliu Island, which has a larger population, but there are concerns about clashes with a Korean company that is already engaged in a project to introduce renewable energy on the island. Therefore, it is necessary to consider these factors in a comprehensive manner.

Table4-8：Approximate power generation cost of ocean thermal energy conversion (Source: NEDO[29])

Plant size	Cost
Several 100 kW or less	Not yet calculated
1MW	Approx. 50 yen/kWh
5MW	30.4 to 45.7 yen/kWh
10MW	Approx. 20 yen/kWh
100MW	Approx. 10 yen/kWh

4.8 Finance

In Palau, tourist traffic has been disrupted due to COVID-19, and the economy dependent on tourism income has been severely hit. With no prospect of when the tourist traffic will resume, many institutions do not have the financial resources to bear the remaining initial capital investment, even if they receive a certain amount of subsidy from the JCM Model Project. Therefore, we investigated and examined the possibility of financing through the intervention of financial institutions to reduce the amount of the initial burden on local businesses and repay it through instalment payments. In particular, we interviewed Tokyo Century Corporation, which has a great deal of experience in JCM Model Project and JCM Eco Lease Scheme, and asked them about the possibility of providing cross-border financing from Japan (Appendix 6).

(1) Instalment payment schemes in JCM

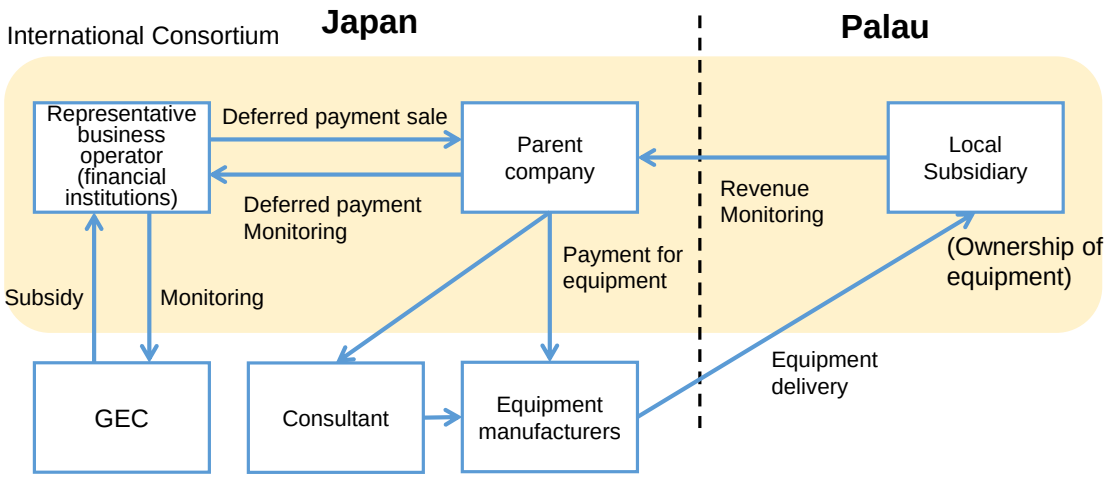
In the JCM Model Project, restrictions on projects using leasing were relaxed in 2017. In this scheme, a Japanese leasing company acts as the representative business operator and its local

[29] NEDO (2014) NEDO White Paper on Renewable Energy Technologies, 2nd Edition: https://www.nedo.go.jp/library/ne_hakusyo_index.html

subsidiary holds the equipment while leasing it. In addition, restrictions on cross-border deferred payments were relaxed in 2019. In this scheme, even if the leasing company does not exist in the partner country, it is possible to buy and sell in instalments across the border, and a Japanese leasing company becomes a representative business operator and conducts cross-border deferred payment trade from Japan or a third country (assuming a local subsidiary of the representative business operator in the third country) [30].

(2) パラオにおける適用可能性

Since we could not confirm any branch of the Japanese leasing company in Palau, we examined the possibility of cross-border deferred payment. As a result of the interview, it is possible to make cross-border deferred payment by taking the corporate risk of the Japanese parent company, if the equipment is delivered to the local subsidiary through the Japanese parent company (Fig.4-7 above). It is also possible to make a cross-border deferred payment to a local company in dollars (Fig.4-7 bottom), but the issue is whether or not the local company can obtain credit. Particularly in developing countries, the credit rating of government agencies and state-owned companies is not necessarily high, so caution is needed. When the possibility of installing specific equipment and applying for the JCM Model Project arises, these financing schemes should be considered as an option.



[30] Call for Proposals for JCM Model Projects in FY2021 Guidelines for Submitting Proposals. https://gec.jp/jcm/jp/kobo/r03/mp/jcmsbsdR3_koboyoryo.pdf

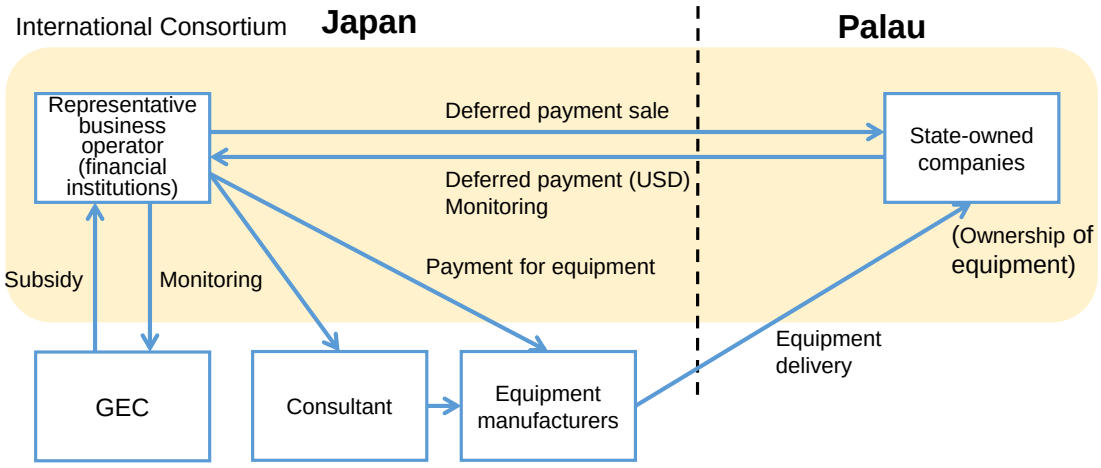


Figure 4-7：A schematic diagram of the financing method for a JCM Model Project using cross-border deferred payment envisioned for Palau. A case in which equipment is installed in a local subsidiary through a Japanese parent company (above) and a case in which equipment is installed in a local company without a Japanese parent company (bottom).

Chapter 5 Consideration for further strengthening city-to-city collaboration

Further strengthening city-to-city collaboration is expected to contribute not only to the direct introduction and deployment of superior decarbonization technologies, but also to the resolution and mitigation of other local policy issues. We conducted a study on the current policy initiatives and issues in the Koror State, as expanding the decarbonization dominoes will also create opportunities for the transfer of excellent technologies from Japan and Kitakyushu.

5.1 The efforts and support needs of Koror State for decarbonization

The Republic of Palau as a whole has set targets for the introduction of renewable energy and reduction of greenhouse gas emissions in the energy sector. The following responses were received from the State of Koror.(Table5-1)

Table5-1 : The efforts of Koror State for decarbonization

Item	Contents
Target Setting for Decarbonization	No clear goal setting exists.
Specific reduction action plan	No clear plan exists.
Current efforts	Promoting the following activities, mainly in the waste sector ● Composting ● Recycling for beverage container ● Utilization of energy from waste plastic through oil conversion
Issues (policy)	The following points are perceived as issues ● Current greenhouse gas emissions are not yet understood. ● The amount of reduction in the specific initiatives described above is also not yet understood.
Emission Reduction Focus Areas	The following areas of reduction are considered important ● Emission reductions in the transportation sector, including traffic congestion, is a priority. ● Consumer (household/business) sector ● Hotel / Resorts ● Power generation ● Waste management sector

The above results were obtained. Currently, Koror State is not able to grasp the situation, and therefore, Koror State is not able to effectively consider measures for reduction. Palau has a weak power grid, and many hotels and other facilities do not use power from the grid, but only generate their own power. It can be inferred that it is difficult to keep track of energy consumption, especially electricity consumption, from these points of view, and this is an issue that needs to be addressed.

On the basis of these backgrounds, the following points were raised as expectations from the Koror side.

- Assessing and evaluating greenhouse gas emissions in Koror
- Recommendations to Koror for emission reductions based on the assessment results

The issues raised by Koror are of great importance, as they are fundamental to the consideration of future decarbonization measures, and we will consider the framework for support in the next fiscal year of this project.

5.2 The efforts and support needs of Koror State for promoting SDGs achievement

Kitakyushu city was selected as one of the first SDG Future Cities by the Cabinet Office, Government of Japan and was also selected as a "Global Model City for SDG Promotion" by the OECD. Koror State has expressed a desire for collaboration based on this experience from the beginning.

At first, we first conducted a survey and study on the current status of goal setting and activities toward achieving the SDGs in the state.

Table 5-2: Current Status of Koror State's Efforts to Achieve the SDGs

Item	Contents
Target Setting for SDGs achievement	Although no clear set of goals exists, they are focusing on achieving the following goals. (Goals 6, 7, 8, 9, 11, 13, 14, 15, and 17) 
Specific action plan for SDGs	No clear plan exists.
Current Initiatives Promoting	the following activities, focusing on the waste sector ● Recycling activities (composting/beverage container recycling/use of energy from waste plastic oil) ● Integrated waste management (Urban Grower's Program) ● Marine environment conservation ● Biodiversity Protection  Urban Grower's Program
Issues (policy)	The following points are perceived as challenges ● Limited funding makes it difficult to address only the above priority areas (transportation, marine conservation, waste management, agriculture, and power generation).

The above results were obtained. Currently, the SDGs are being achieved on an individually specific activity basis, depending on the priority level for achieving the SDGs promoted by the government.

In light of these points, the following points were raised as expectations from the local side.

- Introduction of Japanese Cities' Efforts to Achieve the SDGs
- Assistance in developing a plan to achieve the SDGs in the State of Koror
- Implementation of joint projects in the areas of solid waste management/transportation/power generation (also applicable to this project)

Koror State has expressed a need to develop a plan to achieve the SDGs.

Since there is a high affinity between decarbonization measures and activities to achieve the SDGs, this is also highly important, and we will consider a framework for support in the next fiscal year of this project.

Chapter 6 Participation in Workshops, International Conferences and Seminars

A workshop with local stakeholders was held online as an opportunity to share content and exchange views on the study. The workshop was attended by Koror State, Kitakyushu City, JICA Palau Office, and local counterparts.

In addition, internal meetings with SWMO have been held separately several times since its adoption.

The project was scheduled to be presented at the Our Ocean Conference scheduled to be held in Palau in February 2021, but due to the impact of COVID-19, the meeting was postponed to April 16, 2022.

6.1 Workshop with local stakeholders

Date/time: March 1, 2022, 14:00-15:30

Location: Zoom (online)

Participants:

Solid Waste Management Office, Koror State: Katsuo Fuji, Selby P. Etibek

Kitakyushu City: Yuichi Arita, Tatsuro Nagahara, Naoko Mori

Palau International Airport Corporation (PIAC): Manabu Yoshida

JICA Palau Office: Yasutoshi Sagami

AT GREEN Co.,Ltd.: Seiya Tominaga, Sho Koizumi, Naoyuki Taya

Institute for Global Environmental Strategies (IGES): Kohei Hibino

1. Summary of project survey results

(1) Feasibility Study on the Introduction of EV Vehicles (Tourism Sector, Waste Sector) (Seiya Tominaga, ATGREEN) (Appendix7)

An explanation was given on the feasibility study conducted this fiscal year on the introduction of EV vehicles for sightseeing (courtesy buses and light vehicles for sightseeing) and EV waste packer trucks. Quick chargers and battery containers were also discussed.

(2) Feasibility study on other low-carbon technologies (Kohei Hibino, IGES) (Appendix7)

A survey was conducted to identify candidate projects for low-carbon technologies other than EVs. In this fiscal year, surveys on the introduction of energy-saving equipment in

hotels, electrification of ships, offshore solar power generation, lead-acid battery regeneration technology, ocean thermal energy conversion, and deferred payment finance, were conducted.

2. Questions and Answers

- Moving the battery containers to other locations is beneficial. On the other hand, we need a trailer to move them, and we do not have a trailer, which is a problem. Rental fees for trailers are high. (State of Koror)

- A trailer is needed to move the battery containers to other locations, and the rental fee for the trailer is high. (State of Koror)

  - Noted about the situation. (ATGREEN)

- I would like to know about the process of disposal of waste tires. (State of Koror)

  - The disposal of waste tires is still in the conceptual stage and there is no prospect of its realization yet. (IGES)

- The government of Palau has expressed interest in public transportation, so the project is scheduled to start next year as a technical cooperation project, and a preliminary survey will be started this year. The Ministry of Land, Infrastructure, Transport and Tourism is also considering conducting a survey on public transportation in Palau. The Ministry of Land, Infrastructure, Transport and Tourism is also considering conducting a survey on public transportation in Palau. In addition, it has been decided to start a system survey of small EVs on remote islands as early as this year as a private sector collaborative project. (JICA)

  - Thank you for the information. Are electric vehicles and FCVs going to be included in the master plan? (ATGREEN)

  - The Ministry of Public Infrastructure, Industry and Commerce (MPIIC) is also interested in EVs, and is considering including them in its master plan. (JICA)

  - Currently, maintenance is an issue when EVs are introduced, but is it possible for JICA to support the development of human resources for maintenance? (ATGREEN)

  - JICA has been conducting various training programs including climate change training programs and EV training programs. It is possible to utilize these opportunities. (JICA)

- Since the end of last year, JICA Palau Office has been investigating the potential for energy efficiency in hotels, hospitals, and department stores. Since Palau has no factories, we

believe that energy efficiency in these buildings (air conditioning, lighting, heaters/boilers, etc.) would be effective. Although the use of LEDs is progressing, it is not yet at 100%. In particular, since the central air conditioning systems in hospitals and other facilities are aging, we believe that the energy saving effect of updating the air conditioning systems will be significant. In addition, many of the large hotels in Palau use diesel generators to generate their own electricity due to the instability of the grid power. Although the individual projects may be small, we believe that if they are bundled together, the potential for JCM will emerge. We can introduce you to the PPUC and other related parties who are working together on this project, and we would like you to consider forming a JCM project. (JICA)

- Thank you for the information. Since we were not able to travel to the area at all last year or this year, we lacked information on the area, so this kind of information would be appreciated. It would be great if you could introduce us to the key people involved in the research for next year and beyond. (IGES)

3. Kitakyushu city's SDGs and decarbonization efforts (Naoko Mori, City of Kitakyushu) (Appendix7)

   Introduction of Kitakyushu City's experience in overcoming pollution, efforts toward decarbonization, and international cooperation.

4. Questions and answers

   None in particular.

Figure 6-1 : Workshop (online)

6.2 Our Ocean Conference

Our Ocean Conference is an international conference where heads of state and other representatives from around the world, as well as representatives of international organizations, research institutions, and non-profit organizations, gather to discuss ocean-related issues and announce their commitments. The first meeting was held in 2014 in the United States and has been held annually since then. The government of Palau, as a representative of the island nations, has committed to the meeting and announced that it will host the 7th meeting in Palau on August 17-18, 2020[31].

In this work last year, a planning application had been submitted to organize a side event in participation with the Our Ocean meeting. In addition to the side event, a new commitment, "Development of Transportation Station at the former landfill site (M-Dock) in Koror State: As an important base for building a resource circulation society" was submitted as a joint proposal by Koror State, AMITA CORPORATION, and Kitakyushu City[32]. However, due to the global spread of COVID-19, the event was postponed to December 7 and 8, 2020, and since there was no improvement in the situation after that, it was decided to postpone it for another year.

This year, we were preparing to travel to the site in conjunction with the field survey, to hold a side event there, and to resubmit the commitments submitted last year. However, the meeting that was scheduled to be held on February 16 and 17, 2022 was further postponed due to COVID-19, and the meeting is currently scheduled to be held on-site (physically) on April 13 and 14, 2022 (as of February 2022). Since this falls outside the work period of this study and the possibility of holding the meeting online was not mentioned, we had to abandon our participation.

[31] 7th Our Ocean Conference: https://www.ourocean2020.pw/

[32] ATGREEN Co.,Ltd. (2021) FY2020 Commissioned Project for City-to-City Collaboration to Realize a Decarbonized Society (Project to Promote Decarbonisation and Create Co-benefits through the Introduction of EVs in Koror, Republic of Palau [Kitakyushu City - Koror State Collaboration Project]) Report. Ministry of the Environment.

Appendix

- Appendix 1：Presentation material of Kick off meeting for Ministry of Environment Government of Japan
- Appendix 2：Domestic Leading Case Study (Kyoto City Hall and Keihan Bus) Visit Report
- Appendix 3：Local Hearing Sheet Responses (Tourism sector)
- Appendix 4：Local survey summary report (Waste treatment sector)
- Appendix 5：ADB Meeting Record
- Appendix 6：Project identification study for decarbonization projects Meeting Record
- Appendix 7：Local Workshop Materials
- Appendix 8：Presentation material of achievement briefing session for Ministry of Environment Government of Japan
- Appendix 9：Pamphlet about Introduction consideration EV vehicle

Appendix 1

キックオフ資料

令和3年度 脱炭素社会実現のための都市間連携事業委託業務

パラオ共和国コロール州におけるEV車両導入を通じた脱炭素化促進およびコ・ベネフィット創出事業

(コロール州・北九州市都市間連携事業)

2021年9月

北九州市 (環境局環境国際戦略課)
アミタ株式会社
株式会社EVモーターズジャパン
株式会社クアンド
公益財団法人地球環境戦略研究機関 (IGES)
株式会社ATGREEN

関係者限り

【リマインド】提案・検討プロジェクト概要

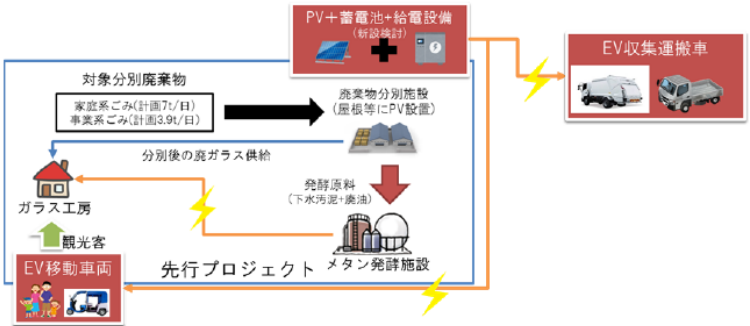
今回の提案・検討プロジェクトでは、コロール州・北九州市の都市間連携スキームに基づき、脱炭素化及びコ・ベネフィットを図る手段として以下の内容の検討を行います。

【主要検討事項】※A・Bについては下図中赤枠内参照
A. 観光分野でのEV車両(バス等)の導入可能性　B. 廃棄物分野でのEV車両(パッカー車など)導入可能性
C. その他、脱炭素化に資する取組の案件組成

①観光EV車両導入プロジェクト

◎脱炭素への貢献
・走行時の温室効果ガスの排出抑制
・再エネ利用による更なる排出抑制

②廃棄物収集運搬分野導入プロジェクト



○期待されるコ・ベネフィット効果
・排ガスの排出抑制
・系統負荷を与えない再エネ導入・利活用
・エネルギーコスト削減、エネルギー地産地消
・車両メンテナンスコストの低減
・災害時の非常用電源活用
・廃棄物事業での再エネ率向上
・観光地としての環境イメージ向上・PR
・コロール州のSDGs達成への貢献
・都市間連携による技術移転・交流

関係者限り

Appendix 1

【リマインド】パラオ国内の各セクターにおける想定課題(赤字は前年把握済)

パラオは多くの観光客が訪れるリゾート観光大国ですが、観光業に伴うエネルギー利用増や廃棄物問題、公共交通インフラ・渋滞等が想定されます。エネルギー、観光、廃棄物における想定課題は以下の通りです。

分野	課題	詳細
エネルギー	高い化石燃料依存度	・排出されるGHGの環境への影響 ・排ガスの発生 ・エネルギー調達コストの変動リスク
	再エネ導入による系統への負荷増加	・大規模PV導入の加速が進み、系統への負荷が増加 ・余剰電力や急激な出力変動を吸収する必要性あり ・短周期変動、長周期変動双方のリスク
	既存ディーゼル発電設備の老朽化	・停電発生 ・再エネ率導入計画を中心としたエネルギーモデル構築
観光	観光客増加に伴う環境負荷の増加	・廃棄物増加、特に海洋汚染の進行 ・観光地としての景観や環境配慮イメージの維持・向上
	渋滞発生による環境への影響	・移動方法の集約がなされていない (民間タクシーやシャトルバス、ホテル送迎サービス等で利用者が分散) ・排ガスや騒音の増加
廃棄物	廃棄物運搬処理コストの増加	・観光客の増加による廃棄物関連コストの増加 ・遠方の新最終処分場への運搬費増加 ・運搬に係る化石燃料使用量の増加 ・廃棄物からのエネルギー回収が進んでいない

分野	想定課題	詳細
政策	脱炭素社会に向けた方向性やプラン検討	・2025年までのRE率達成に向けた具体的な実施 ・2030年、2050年に向けた脱炭素ビジョン・施策の具体化

【参考】期待されるコ・ベネフィット効果(赤字は現地の期待が大きい効果)

EV車両導入は、脱炭素の観点のみならずコ・ベネフィットの観点が重要です。期待されるコ・ベネフィット効果は以下の通りです。また、パラオは観光地・観光国家でありコロナで大打撃を受けた観光産業の再興に資する取組はコロナ後のリカバリーを考えるうえでも重要なプロジェクトと考えます。

コ・ベネフィット効果	
排ガスの緩和	EV車両活用による排気ガスの排出減少
渋滞緩和	観光バス等のEV化推進により車両集約化による渋滞緩和への貢献
エネルギーコスト削減・エネルギー地産地消	化石燃料の調達回避によるコスト削減、エネルギー地産地消が期待される
メンテナンスコスト削減	内燃機関が無いシンプルな構造となり、メンテナンス費用の抑制が期待される
災害時の非常用電源としての活用期待	EV車両ボディユニットを活用する場合等、災害時の移動式非常用電源としての活用が可能
イメージ向上	【観光分野】観光客へのイメージ向上及びグリーン・ツーリズムの訴求 【廃棄物分野】廃棄物リサイクルにかかるエネルギーをほぼ再エネ化することによる事業のPR効果
SDGsへの貢献	・コロール州で進められているSDGs達成への貢献 (設置検討中のSDGs推進部局にも寄与)

Appendix 1

1. EV車両導入に向けた検討

【観光分野】課題と検討事項

前年度調査を通じて判明してきた課題、まだ積み残している部分と今年度の検討事項をまとめたものです。

項目	課題	今年度調査事項・実施事項
導入モデルの更なる精査	充電設備や蓄電池のコストが重いので、効率的な運用・導入モデルの検討が必要	効率的な運用台数・バスのスペック・バッテリー容量・充電器数等の詳細を詰めて纏める。 →ホテル側で実施している旅客運搬サービス取り込みについてヒアを行い、集約化の可能性を探る
事業実施体制	上記モデルの内容を固めたうえで、官民連携も視野に入れた事業実施体制の調整	PIACを中心に利害関係者の以降も含めたうえでの運行体制の整理
現在の車両利用状況への対応	運行管理システムのノウハウが不足しており、支援ニーズも寄せられている オプションツアー等でのニーズ把握	市バス等の運行管理ノウハウの共有検討 小型トライシクル車両の導入可能性検討
補助金や助成金の獲得	イニシャルの負担を低減することで観光分野の収益を確保しながら脱炭素を推進できる部分があり、負担低減策を入れて投資回収年数を早める必要がある	GEC・MOEJ・ADB等のファンドドナーとの協議を行い、島嶼部の支援の在り方、バンドリング申請等について協議を行うとともに申請準備を進める
メンテナンス体制	ノウハウの不足、資材調達に課題	リモートメンテナンスシステムのテスト運用を行い、現地の課題解消に対する寄与度を確認

Appendix 1

【観光分野_参考】 検討EV車両導入モデル

ホテルと空港を結ぶシャトルバスの導入モデルについて検討を進めています。充電器については空港近隣への設置を想定。併せて、PVパネル(+パワコン)・蓄電池を整備し、PV発電分を蓄電し、再エネで走行する観光EVモデル構築を想定しています。

<乗客数> 30(運転席含)　<バスバッテリー容量>114kWh　<航続可能距離> 230km
<充電方式> CHAdeMO (日本式EV車両の充電方式)
→EVバスの主要生産国である中国BYD社のバスは独自規格の充電器。今回のプロジェクトを通じて、CHAdeMO式充電器の導入が進めば、日本国のEV車両の充電に使用される為、将来的な日本車EVの拡大・展開戦略にも有利になる可能性有

パラオ観光の拠点となる国際空港に充電拠点を整備することで、主要なホテルや景勝地へのアクセスを確保(台数が増えてくれば、中央部での充電拠点整備の検討も必要)

<計画走行ルート>
Route A (パラオ国際空港～Palau Pacific Resortホテル/14.6km)
Route B (パラオ国際空港～アイスボックス公園/13.1km)

関係者限り　7

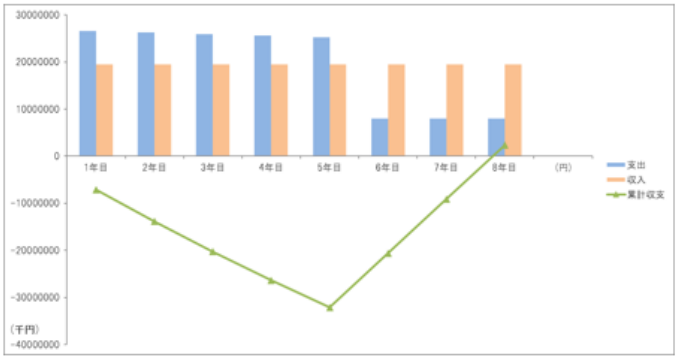
【観光分野_参考】コスト試算

現地での調査が出来ていない点も有り、現時点で判明している範囲の概算でコスト試算を実施しました。観光客の一定利用があれば、設備更新の積み立てをしながら採算性を確保することが期待出来る結果となりました。但し、EV車両＋PV(パワコン含)＋蓄電池＋充電器全体のイニシャルコストの負担は8千万円近くと大きく、イニシャルコストを低減するファンドの確保を行うことが望ましい結果となりました。

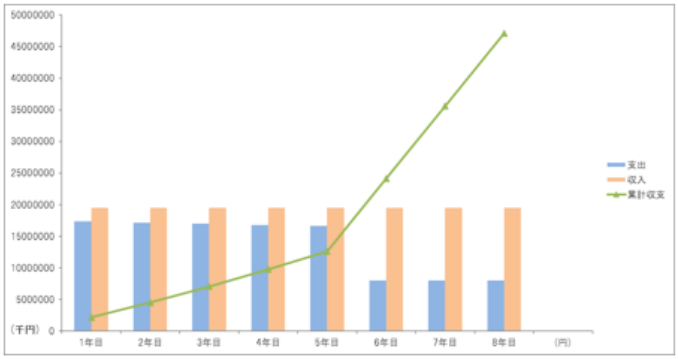
<試算条件>

・設備費一式：6,300万円(車両・充電器・蓄電池・PV・パワコン)
・エンジニアリング費用・トレーニング費用等は計上
・観光客からの収入 (年間2,000万円近くの売上を想定)
・5年借入
・関税は考慮(現地確認済)、設備運搬費は非計上
・メンテナンス費(設備費5%/年)、ドライバー費用は計上、ホテル等からの輸送業務委託費は未計上

設備費補助無しの場合



50%設備費補助を受けた場合



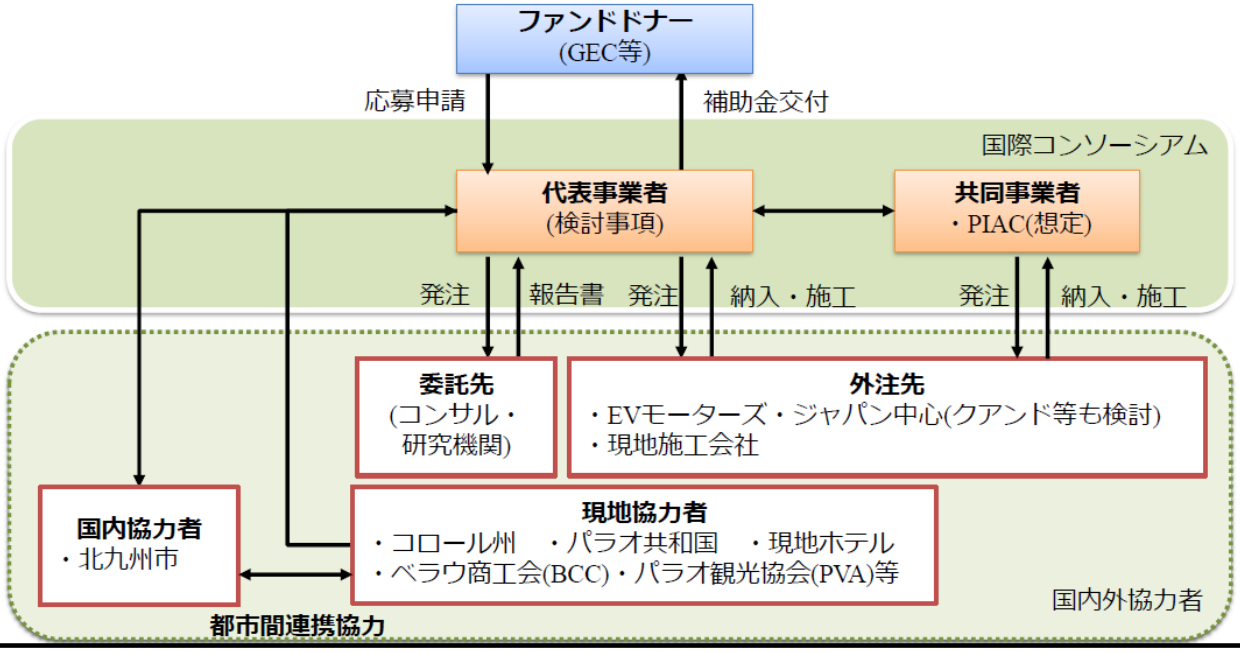
設備補助無しだと回収は単年度黒字は返済後の6年目以降。累損解消は8年目以降。
50%の設備補助があれば単年度から黒字化の可能性有。現状は観光客の2割(コロナ前2万5千人程度)が往復800円で利用した場合で試算を実施しています。

関係者限り　1

Appendix 1

【観光分野】実施体制(現時点の検討状況)

現時点での検討案です。JCM設備補助やコ・イノベ事業を想定した場合の実施体制案です。



○主な検討事項
・代表事業者の検討(下記の問題含め、リース会社等の検討も必要)
・設備補助を前提としつつ、不足分の穴埋め
→現地観光業の落ち込みなどを考えると、観光分野における設備投資意欲の問題がある。
イニシャルを低減するためにリース会社等も含めた検討が必要

【廃棄物収集運搬分野】課題と検討事項

前年度調査を通じて判明してきた課題、まだ積み残している部分と今年度の検討事項をまとめたものです。

項目	課題	今年度調査事項・実施事項
導入モデルの更なる精査	充電設備や蓄電池のコストが重いので、効率的な運用・導入モデルの検討が必要	4台あるパッカー車を全部EV化したいという意向や車両の大型化に関する希望を現地より受けており、スペック・バッテリー容量・充電器数等の詳細を詰めて纏める。
事業実施体制	州が進める包括的資源循環型社会構築プロジェクトの全体像が確定しない	本構築との連携を検討しつつも、単独でのPJ組成についても検討を重ねていく
補助金や助成金の獲得	そもそも収益事業ではないので収益性確保が課題 燃料費削減効果では投資回収を行うことが出来ない	コロール州の包括的資源循環型社会構築プロジェクトでの資金獲得の協議を進めながらも、コ・イノベ事業なども含めてGEC・MOEJ・ADB等のファンドドナーとの協議を行い、島嶼部の支援の在り方、バンドリング申請等について協議を行うとともに申請準備を進める
メンテナンス体制	ノウハウの不足、資材調達に課題	リモートメンテナンスシステムのテスト運用を行い、現地の課題解消に対する寄与度を確認

Appendix 1

【廃棄物収集運搬部門_参考】　検討_EV車両導入モデル

コロール州にある廃棄物処分場M-Dockは、埋立処分場として延命措置が取られてきましたが最終処分場は北部のアイメリーク州に移っています。そこでM-Dockでは、廃棄物資源化を通じた循環型社会形成を進め、埋立最終処分量の縮減に繋げるとともにガラス工房による観光客誘因や農業プロジェクト等に繋げる計画を立てています。このプロジェクトにはアミタ株式会社がコロール州と連携してPPPとして進めているプロジェクトも含まれています。今回はこのM-Dockにおける廃棄物回収・収集運搬車両のEV化を図り、廃棄物処理分野における温室効果ガスの排出削減を目指すものです。

<バッテリー容量>110kWh
<航続可能距離>180km未満
<積載量> 1,995kg
<車両総重量> 8,280kg

<充電設備想定設置箇所> M-Dock
<充電方式> CHAdeMO方式

The main parameters	
Lenstth (mm)	6795
Width (mm)	2100
Height (mm)	2400
Wheelbase (mm)	3360
Curb Weight (kg)	6090
The rated load quality (kg)	1995
GVW (kg)	8280
The dog house feeder volume (nf)	1.1
The dog house feeder size (wide) (mm)	990
Compression way	双方向圧縮
The cycle time of loading	<16s
Waste discharge time	<20s
The garbage box effective volume (nf)	6
The sewage tank (L)	200
Compression ratio	1:3
Hydraulic system pressure (MPa)	16.2
Power Train	
Type	Pure EV
Motor Type	TZ365XS-YBM303
Rated power (kw)	60

当初アイメリーク⇔M-Dockの運搬をベースにモデルを想定していましたが現地ヒアリングを経て州内の回収・収集運搬を主に据えております。(おおよそ35~40km程度)

関係者限り　11

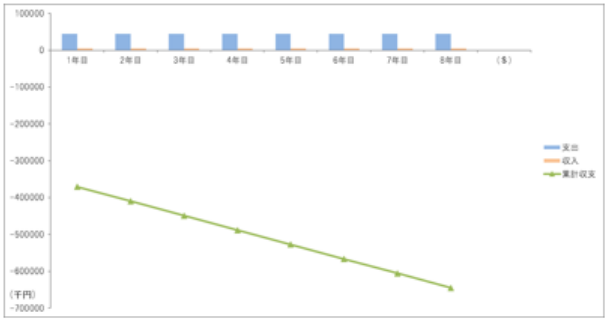
【廃棄物収集運搬部門_参考】 コスト試算

観光分野と同様に現地実地調査が出来ておりませんので現時点で判明している範囲の概算でコスト試算を実施しました。観光バスと異なり、EVパッカー車を導入することによる収益確保要素が化石燃料コストの低減しか無く、50%あるいは100%の設備助成を受けたとしても採算性の確保は厳しい結果となりました。但し、本試算においては車両や充電器等の更新に備えて毎年300万円程度の積み立てを行っていること、初回導入時に必要となる充電器や蓄電池などの費用がそのまま計上されていることで不利な試算となっていることには留意が必要です。

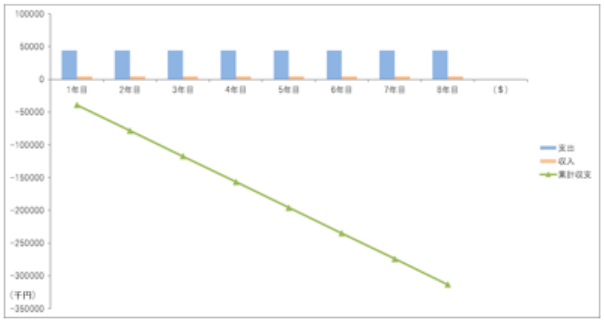
<試算条件>

- 設備費一式：5,300万円(車両・充電器・蓄電池・PV+パワコン)
- エンジニアリング費用・トレーニング費用等は計上
- 燃料費用削減貢献は計上
- 5年借入
- 関税は考慮(現地確認済)、設備運搬費は非計上
- メンテナンス費(設備費5%/年)は計上、ドライバー費用は非EV車両と同一と考え非計上

50% 設備補助



100% 設備補助



なお、いずれにしてもイニシャルコスト低減は重要テーマとなりますので、輸送距離に合わせたバッテリー容量のリサイズ、蓄電池の容量見直し等に拠ってイニシャルコストの見直しの余地はまだあるものと考えられます。

関係者限り　3

Appendix 1

【廃棄物収集運搬部門】 現地ニーズに合わせたコスト試算

コロール州廃棄物管理事務所からは4台のパッカー車を1度に変更したい意向が寄せられています。また、車両の大型化(積載量増)についてもニーズが出ているので、この点について検討を行っています。

<現地ニーズに合わせた再検討条件>

・パッカー車について現在の4台を全てEV化、充電環境は1基でローテーションで充電させる体制を検討
⇒現在想定している利用状況なら運用上可能な見込み

※車両の大型化について別途検討予定

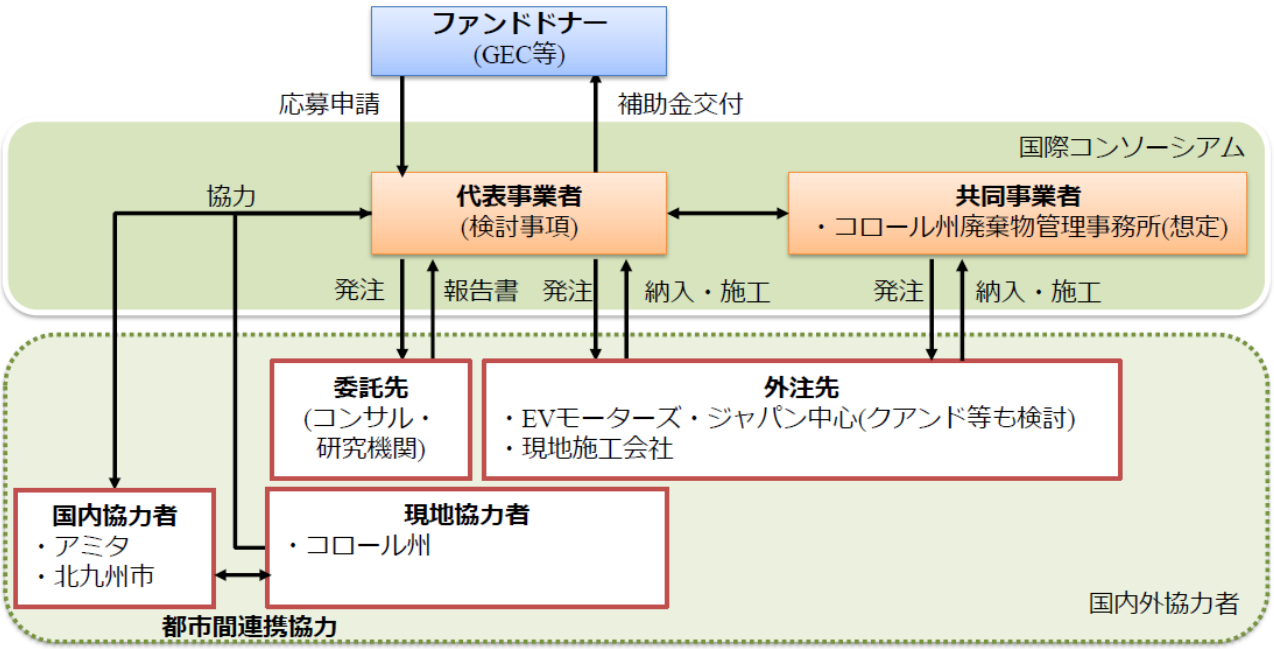
<バッテリー容量>110kWh×4台
<航続可能距離>180km未満
<積載量> 1,995kg×4台
<車両総重量> 8,280kg/台

太陽光40kW
蓄電池136kWh
(再エネの蓄電)
系統電力
(バックアップとして)

<充電設備数>1基
<充電設備想定設置箇所> M-Dock
<充電方式> CHAdeMO方式
⇒充電器のバックアップが課題の為、2基導入は要考慮

【廃棄物収集運搬部門】実施体制(現時点の検討状況)

現時点での検討案です。観光分野と同様、JCM設備補助やコ・イノベ事業を想定した場合の実施体制案です。



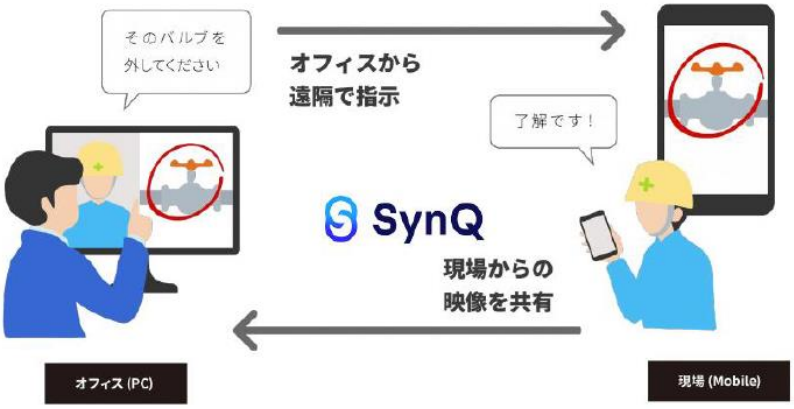
○主な検討事項
・代表事業者の検討
・設備補助を前提としつつ、不足分について州での予算獲得
→州ではADBとOverallプロジェクトについての予算協議を行っており、こちらとの連携可否は検討事項

Appendix 1

【補足情報 】リモートメンテナンスツール “SynQ”の活用

今年度の調査に北九州市のスタートアップ企業「クアンド社」が開発しているメンテナンス業務に活用しやすい遠隔コミュニケーションツール ”SynQ” の活用を行い、リモートメンテナンスのテストを行う予定です。

SynQ Remote はオフィスや自宅など、離れた場所にいても
まるでその場にいるかのように現場とコミュニケーションがとれる
現場に最適なリモートワークツールです



PCとスマホで動画会話をしながら、強調やテキスト指示、図面表示をしながら効果的な遠隔メンテナンスの実施をサポートするツールです。

現地に技術者が不足していること、他の島への展開なども見越して、EV車両のオンラインメンテナンス活用の可能性を検討します。

【参考】設備導入に向けた補助事業・委託事業・資金援助メニュー

EV観光バス導入PJおよび廃棄物収集運搬車のEV化PJの設備導入資金に活用できる見込みがある事業や投融資メニューを纏めたものです。
JCM設備補助事業もしくはコ・イノベーションによる脱炭素技術創出・普及事業をベースとしながら、検討調査を進めています。

事業名	事業/償還期間	支援内容	担当部局・執行団体	応募へ向けての課題	ファンドドナーへの確認事項
JCM 設備補助事業	最長3か年	対象経費補助率30～50%(上限2,000百万円)	GEC(公益財団法人 地球環境センター)	・国際コンソーシアム構成と代表事業者選定 ・費用対効果(原則4千円/tCO_2eq 以下)を満たせるか ・対象経費を先に支払う必要があるため、資金繰り計画を策定する必要がある(出来高分の概算払いも可)	・太陽光発電＋蓄電池＋充電設備＋EV車両といったパッケージで申請することは可能か ・同一国で2つのPJ(観光・廃棄物)について応募は可能か
コ・イノベーションによる脱炭素技術創出・普及事業	最長3か年(初年度にまとめて交付決定)	補助率3分の1～3分の2	GEC(公益財団法人 地球環境センター)	・国際コンソーシアム構成と代表事業者 ・対象経費を先に支払う必要があるため、資金繰り計画を策定する必要がある(出来高分の概算払いも可) ・相当な収益が生じる場合、補助金の返納を求められる場合がある→事業終了後は廃止しているケースもある	・太陽光発電＋蓄電池＋充電設備＋EV車両とパッケージで申請することは可能か ・他資金支援(委託・融資)を受けられるか
JCM 日本基金(JFJCM) ソブリン案件	要確認	総事業費の10%(上限1,000万ドル)	ADB(アジア開発銀行)	・費用対効果($1tCO_2e \leq \$40$)を満たせるか ・案件組成機関が長く、審査事項も多くなる(2・3年)	・償還期間 ・他ファンドとの組み合わせ可否 (JCM 設備補助事業は併用不可)
JCM 日本基金(JFJCM) ノンソブ案件	要確認	総事業費の10%(上限1,000万ドル)	ADB(アジア開発銀行)	・費用対効果($1tCO_2e \leq \$40$)を満たせるか	・償還期間 ・他ファンドとの組み合わせ可否(JCM 設備補助事業は併用不可)

Appendix 1

【参考】設備導入に向けた補助事業・委託事業・資金援助メニュー

補助・委託・支援名	事業/償還期間	交付額・率/融資割合	担当部局・執行団体	応募へ向けての課題	ファンドドナーへの確認事項
普及・実証・ビジネス化事業(中小企業支援型)	1～3年間程度	1～2億円	JICA(独立行政法人 国際協力機構)	・対象国とミニッツを締結する必要がある。国によっては締結に時間を要し、結果として事業開始が遅くなる傾向が多い(事業スピードとのミスマッチが生じる可能性) ・設備等は対象国へ寄贈の形となる ・基本的に対象経費を先に支払う必要があるため、申請者としては資金繰りの問題あり(前払い・部分払いも可)	
JICA 海外融資	原則として20年(最長25年)	原則、総事業費の70%。(特に認められる場合80%)	JICA(独立行政法人 国際協力機構)	・事業期間中の資金計画(完済までのキャッシュフロー)の構築 ・リスクの感度分析、リスク分担、担保・保証をどのようにするか	・他資金支援(委託・融資)を受けられるか
JICA 海外投資	事業特性に寄る	出資比率25%以下(原則、現地企業等への直接出資)	JICA(独立行政法人 国際協力機構)	・事業期間中の資金計画(完済までのキャッシュフロー)の構築 ・リスクの感度分析、リスク分担、担保・保証をどのようにするか	・他資金支援(委託・融資)を受けられるか

【参考】設備導入に向けた補助事業・委託事業・資金援助メニュー

補助・委託・支援名	事業/償還期間	交付額・率/融資割合	担当部局・執行団体	応募へ向けての課題	ファンドドナーへの確認事項
JCM特別金融スキーム(外国直接融資(バイヤーズ・クレジット(B/C)、バンクローン(B/L))	仕向国、設備等の内容、契約金額などに寄る	輸出(販売)契約金額、技術提供契約金額の範囲(上限5～6割)	JBIC(株式会社国際協力銀行)	・事業期間中の資金計画(完済までのキャッシュフロー)の構築 ・要件、審査基準の確認が必要	・融資要件 ・償還期間 ・審査基準 ・他ファンドとの組み合わせ可否
ICTインフラ事業及びICTサービス事業における海外展開支援	規定なし(5～7年がメイン)	上下限規定無し(10億～50億円がメイン)	JICT(株式会社海外通信・放送・郵便事業支援機構)	・事業期間中の資金計画(完済までのキャッシュフロー)の構築 ・JICTは最大出資者になれないため、他ファンドとの組み合わせが必要	・事業スキームが対象事業要件に沿うか要確認(想定連携例として電動タクシーはある) ・審査基準 ・他ファンドとの組み合わせ可否
海外の交通及び都市開発等インフラ事業支援	要確認	要確認	JOIN(株式会社海外交通・都市開発事業支援機構)	・事業期間中の資金計画(完済までのキャッシュフロー)の構築 ・JOINは最大出資者になれないため、他ファンドとの組み合わせが必要 ※パラオ国際空港運営事業(双日)はこのファンドを活用(投資決定額約2.5億円)	・事業スキームが対象事業要件に沿うか要確認(EVの事例は無い模様) ・投資金額の目安 ・審査基準 ・償還期間 ・他ファンドとの組み合わせ可否

Appendix 1

【参考】類似のプロジェクトにおける各支援メニューの適用事例

補助・委託・支援名	対象国	代表事業者	PJ名	PJ概要
JCM 設備補助事業	インドネシア	北酸株式会社	スマラン市公共交通バスへのCNGとディーゼル混焼設備導入プロジェクト	富山市とスマラン市の協力協定を踏まえ、スマラン市の交通公社が所有する141台 のディーゼルバスのうち、大型バス25台及び中型バス47台の合計72台を対象に、ディーゼルエンジンをCNG利用可能なハイブリッドエンジンへ改造
コ・イノベーションによる脱炭素技術創出・普及事業（旧 途上国向け低炭素技術イノベーション創出事業）	ベトナム	株式会社ソフトエナジーコントロールズ	ハイフォン市カットバ島に適した太陽光発電連携によるゼロエミッション型EVバスの開発	坂道の多い地形、高温多湿の気候、観光客向け等の運行条件に適したEV路線バスの開発。バッテリー交換方式を採用。蓄電には曇天に有利なCIGS方式の太陽光発電システムを導入。
コ・イノベーションによる脱炭素技術創出・普及事業（旧 途上国向け低炭素技術イノベーション創出事業）	フィリピン	株式会社駒井ハルテック（共同事業者：本田技研工業株式会社）	小規模離島向け台風対策風力発電機および多用途バッテリーによる余剰電力活用システムの開発・実証	フィリピンの離島に適した300kWの中規模風力発電機とバッテリー充電ステーションをネットワークで結び、制御システムにより風車の余剰電力を利用してモバイルバッテリーを充電することで、風力発電機の出力抑制を緩和する。更に充電したバッテリーを主に電動二輪車の電源として利用
案件化調査(中小企業支援型)	マレーシア	株式会ピューズ	中型サイズEVバスの開発・普及案件化調査	マレーシアにおけるEVバス製造サービス体制の構築と、EVバス運行システムの構築、運用ノウハウの移転により、日本のEVバス導入を目指す
普及・実証・ビジネス化事業(中小企業支援型)	ラオス	株式会社プロッツァ	三輪電気自動車を活用した低公害型交通システムの普及・実証事業	脱着式のリチウムイオン電池搭載の3輪EVの定時定路線運行をラオス国公共事業運輸省と共同で実施。EV技術者の育成、サポート体制を確立するとともに現地生産体制の確立による製造コストを削減し、現地での事業拡大を目指す。

2. その他案件組成に向けた調査
3. 会議やWSに向けた検討

Appendix 1

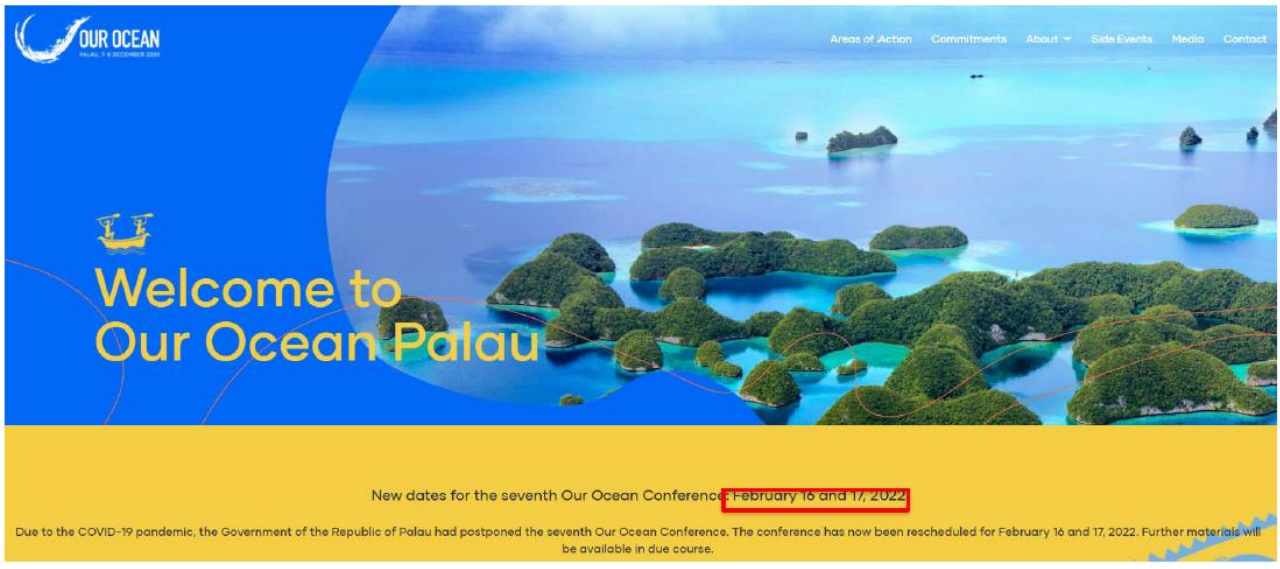
【その他案件組成に向けた調査】提供可能なノウハウとシーズに関する今年度の検討

パラオ国は人口が1万5千人強と少なく、産業も観光分野に特化していることから一般的にJCMで提案される工場等での省エネ案件の形成・提案が難しい点があります。その中で昨年度得られたニーズと今年度の方針を以下に記載します。

項目	課題	今年度調査事項・実施事項
街灯LED案件	現地の現状の独立型照明ニーズ(250基)は博したが、ボリュームはまだ不足している 州を跨いで検討するならば実施体制の検討	現地での導入本数拡大に関する深堀調査 →これらを基に案件組成判断を行う。
電気船(EV船)	現地ニーズの把握	現状の船舶運用実態、メンテナンス体制、市場ポテンシャルの把握 →これらを基に案件組成判断を行う
ホテルの 省エネ・再エネ導入	PRR(パラオ・ロイヤル・リゾート)は設備更新予定なし PPR(パラオ・パシフィック・リゾート)は設備更新検討中	現地ホテルのエネルギー利用状況を聞き、必要設備規模を把握 →これらを基に案件組成判断を行う。
PICRC(パラオ国際珊瑚礁センター)/追加	センターのニーズ把握	センターの再エネ導入可能性検討と海上での発電事業可能性ヒアリング

【キャパビル関係・会議・WSなど】Our Ocean国際会議について

会議実施は2022年2月16日・17日で予定されており、オンラインではなくフィジカルな開催で進められています。
今年度もサイドイベント参加を前提とした準備を進めます。
ただし、現実的な短期の渡航可否(現在のパラオはワクチン接種者を中心に日本人の長期滞在者は入ってきている状況)についても考慮が必要であり、国内外の情勢を見極めながらの判断になると想定しています。



Appendix 1

【キャパビル関係・会議・WSなど】今年度の検討

今年度の現地側との情報共有やワークショップ開催については以下のような計画でおります。

項目	現状・課題	今年度調査事項・実施事項
脱炭素都市としての連携	2025年までに以下の計画を立てている 1）CO2排出量を22%削減(2005年比) 2）電源の45%を再生可能エネルギーとする 3）2005年比35%のエネルギー削減 今後の目標が見えていない点がある	現地側の脱炭素に向けた将来像の把握 市の経験やノウハウの提供・紹介 →脱炭素ドミノを図るための意見交換を行う。
SDGsの都市間連携	現地では専門部署が設立される予定であり、姉妹都市締結の可能性も議論されている。	現地でのキャパビルニーズを把握。 →SDGs未来都市やOECDモデル都市の経験を基に知見の共有を図る。(ワークショップでの発表枠確保を想定)
現地ワークショップ		MPIICやPIAC、PVA、BCCやホテルなど観光関係者を集めたワークショップ開催 Our Oceanサイドイベントと併せて開催できないかを検討中 →交通部門のEV化やコ・ベネフィット効果の重要性の共有を行い、機運醸成を図る

全体のまとめ

今年度調査における論点等は以下の通りです。

- 今年度調査を通じて得られた課題の検証と解決策の検討
  - ✓ より利用実態に即した車両や設備モデルの検討
    →最適なバッテリー容量や充電器モデル等を再検討する
  - ✓ 設備補助など資金の獲得に向けた検討
    →JCM設備補助は勿論、ADBやJICA等の資金獲得に向けた検討
    コロール州の進める包括的資源循環社会構築(Overall)プログラムの推進への協力
  - ✓ メンテナンス体制の構築に向けた検討
    →既述のリモートメンテナンスツール活用や人財育成等の体制検討
  - ✓ バス運行等のノウハウの確保
    →ノウハウを保有する組織との連携やプログラム化の検討
  - ✓ 細かい製品仕様ニーズ把握(バスのドアの向きや床の高さ・段差・荷物積載等)
- その他新規案件候補について具体的案件化に向けた検討・国内企業との協議・調査等の実施スキーム検討

参考資料２

京都市役所・京阪バス様訪問調査レポート(簡易版)

2022 年 1 月 27 日

株式会社 ATGREEN

京都市役所 環境政策局 地球温暖化対策室 脱炭素モビリティ推進係長 新島 智之 様

京都市役所 環境政策局 地球温暖化対策室 エネルギー事業推進担当 谷口 友哉 様

京阪バス株式会社 ICT 事業部 ICT 推進部兼経営企画室 課長 大久保 園明 様

京阪バス株式会社 ICT 事業部 課長 吉村 潔 様

関西電力株式会社ソリューション本部

開発部門 e モビリティ事業グループ 副長 中川 貴文 様、北垣 佑芽乃 様

北九州市 環境局 環境国際経済部 国際連携推進担当課長 有田 雄一 様

国際連携推進係 係長　永原 達朗 様

国際連携推進係 主任　森 直子 様

株式会社 ATGREEN シニアマネージャー 冨永 聖哉

○走行している EV バスについて(京阪バス様から)

・導入バスは 4 台

・バッテリーは 105kWh

・100V コンセント搭載

・USB 端子は車内各所に搭載

・非常時は家庭 12 軒分相当の容量に相当

・バッテリーは基本後部である為、低床、高天井な設計にしやすい

・走行可能距離について冬は暖房による影響を受ける

・下り時に回生エネルギーを活用して充電できる為、坂道は想像より苦としていない印象。

・路面バスはこれらの観点から EV には適していると考える

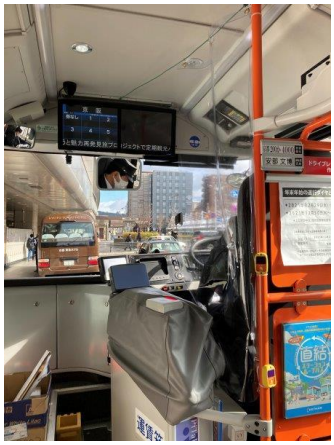
・走行距離については一番影響を受けるのは渋滞によるものである

・渋滞時でも航続距離として 150 ㎞程度は確実に見込めている状況(メーカー公表値は 200 ㎞)

・年間のエネルギーコストは 1/３程度になることを想定している

・音は全般的に静かで住宅街などの走行にも適している。全く音がしないとなるとそれはそれで問題となるが、モーター稼働音は出ており、走行していることに気が付かないというケースは少ないと考えられる。

参考資料２

	
バス横景	バス後部
	
USB 端子を全席に装備	右下に 100V コンセント

○国内外の EV 車両メーカーについて

・まず、日本メーカーと海外メーカー間での価格差が大きい。

・BYD はメンテナンス体制も力を入れている。彼らは 48 時間ルールと呼んでいるが、根本的な故障(心臓部)以外については基本的に 48 時間以内に対応できる体制を構築している。日本法人も有り、日本人スタッフが在籍していることも大きい。

・機能面は一長一短な部分もある。だが、BYD も欧州への豊富な導入実績を含めて水準は高く、何よりも 10 年に及び海外での EV バス運航実績を豊富に保有している点は強みであると感じる。

○充電設備及びエネマネについて(京阪バス洛南営業所)

・50kW のツインソケットタイプが２基(同時充電は出来ない)

・単純に 2 台を動かせばいいという問題ではなく、消費電力の問題があり調整が必要。そうしないと基本契約が上がってしまい、電気料金が大きく上昇してしまう。

・営業所の建屋の消費電力が 44kW、充電器が各 50kW なので単純合算では 144kW になってしまう。実際の運用では電気料金も考慮して 80kW となるようにエネマネを行っている。これは今後国内で商用 EV の充電ステーションが増える上で問題となる点と考えている。(受変電設備を通る関係で契約は別々にならない)

・別途新たに 6kW の EV 放電用のパワーステーションを導入した。V2B として災害時利用や運休時などに調整

利用することを想定している。

・バスの出庫を管理した充電のアルゴリズム設定が重要でソフトウェアの更新を行っていく必要がある。

・バッテリーの状態管理、制御を上手く行うことが重要で、ここができればバッテリーの寿命を延ばしながら使用することが期待される。

・バッテリー交換は数百万円で可能とは聞いている。

・充電をしながら、建屋全体のエネルギー利用との利用エネルギーバランスとバッテリーとしての最適な充電方式を両立させていくことが重要。

・EV バッテリーは一般的にセル間の容量のばらつきが発生してしまい、このばらつきの中で最大の容量値を示すセルをベースに充電率を表示してしまう。このバランスを整える最適化を行うことが重要となる。実際最適化を行うことで期待している走行可能距離を出せるようになっている。(作成者追記：おそらくアクティブバランス調整を指す)

・関西電力様とはこれらの効率的な EV バスステーションのエネルギー管理モデルの構築について連携を行っている。

・ディーゼルの発電機を非常用電源として保有している。

・最終的には、EV が増えれば増えるほど EV、エネマネ、人の動きの 3 つを連動させた充電と配車のシステムが必要になってくる。これらを車両 ID と紐づけて管理していくことが必要と考える。(BYD はこのデータを取ることが出来ない)

	
50kW 充電器	放電設備(V2O)
	
2 台目の充電予約が可能	CHAdeMO 方式充電(横は BYD 方式)

参考資料２

○関西電力様での協議

＜京都市様の取り組み＞

・「京都市自動車環境対策計画」(以下、前計画と記載)は 2011～2020 年(2021 年 3 月まで)が対象期間。

・その後の交通分野の脱炭素施策は「京都市地球温暖化対策計画」(以下、現計画)にて引き継いでいる(2030 年度まで)

・前計画では公害と低炭素が主のテーマであった

・重点施策については 10 のテーマがあり、「次世代 EV 京都プロジェクトの推進」において観光に立脚した環境モデル都市として次世代自動車の普及政策を検討してきた

・その中で三菱重工業と EV バスの実用化に向けた協定を調印し、実証事業に取り組んだ

・上記実証事業では、同じ走行条件のディーゼル車と比較して 40%程度の排出量を削減することが出来た。

・関係者からのコメントによる成果としては、脱炭素は勿論、コ・ベネフィットの効果(排ガス・静音等)が挙げられる。

・コメントから寄せられた課題としては、電池の大容量化とサイズ小型化、多数導入するには充電も含めた運行の前提条件を大きく見直す必要性等が挙げられた。

・その後、本格導入を検討するうえでネックとなったのがバッテリー容量と車両価格になった。(半分以下の容量で価格が大きく高い)

・現計画では GHG 削減目標を 2030 年に 2013 年比マイナス 40%以上、2050 年は実質ゼロを掲げている。更に 2021 年 9 月には市長が 2030 年目標についてマイナス 46%を目指すとした。

・現在は EV バイクのバッテリーシェアリング事業の取り組みや次世代教育、ライトアップイベント等普及啓発の取り組みを推進している。

・今後市営バスに EV を導入していくうえでの課題となるのは、EV バスの性能に起因する部分よりも、付随する領域(配車システム・エネマネ)等の部分となっている。

・特に市営バスのような多くのバスを保有する組織が EV を複数台導入するうえでは配車、充電、エネマネを含めた総合的な運行システムを再考していく必要がある点が今後の課題である。

＜京阪バス様の取り組み＞

▼EV バス関連

※ここまででお聞き出来なかったことを中心にコメント頂く

・導入した EV バスエネルギーコストは机上計算では EV40 万/年、ディーゼルは 143 万円/年

・CO_2 削減見込量は 38.8t-CO_2/台・年、4 台で 155.2t t-CO_2/年

・メンテナンスについて基本は整備を行うグループ会社にて対応している。ノウハウを蓄積していき、他社の EV を受け入れていくことなども視野に入れていく。

・その他は調査票記載事項の通り。

参考資料２

＜関西電力様の取り組み＞

・e モビリティビジョンの実現に向けた取り組みの一環として EV インフラの整備に取り組んでおり、京阪バス様との連携を行っている

・本ビジョンは、脱炭素化・分散化・デジタル化が大きなコア

・デマンド＋サプライサイド双方でのゼロ・カーボンを目指す(水素活用等も視野に入れている)

・車載電池はエネルギーとモビリティの双方に貢献。自動車だけでなく、空飛ぶ車両、バス、船なども視野に入っている

＜その他意見交換_京阪バス様中心＞

・これらを推進するうえでの重要な要素は、環境性(脱炭素)・経済性(EMS・運行コスト)・BCP(充放電)の 3 側面

・EV の電力コストは基本料金、従量料金、工事、リース費用などがベースになっている

・ブラックアウトスタートについても検討していきたい(費用が別途出る)

・EV 導入に際してはやはりメンテナンスが重要。

・自社グループでメンテナンスができる体制を作ることで他社や京都市交通局のバスをメンテナンスしていくような体制を構築していきたい。この中でメーカーの 48 時間ルールが重要だと考えている。

以上

Hearing target	Hotels　Palau Royal Resort
Answer date	February 22, 2022
Respondent's name	Yoshinari Fujii
Respondent affiliation	Executive Office

Since last year, the project members in Japan have been investigating the possibility of introducing EV vehicles(bus) for tourism from the Palau international airport to the resort hotels under the following conditions.

<Seats>　30(including driver)　　<Battery capacity>114kWh　　<Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)

【Assumed EV vehicle introduction model】
＜Assumed driving route / Either or both＞
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)
＜Assumed car type＞
Medium-sized EV buses (the number is under consideration; vehicle length is expected to be 7 to 8 meters)
＜Implementation entity＞
The installation and operation of the equipment is expected to be done by the Koror State Government, hotel operators, tourism associations, or Palau International Airport (or a joint venture).
＜About the cost＞
Part of the initial cost is expected to be covered by external funds.
(e.g., JCM equipment subsidy project under the bilateral credit system, ADB contribution, etc.)
We will consider a model that generates income from user fees paid by bus users, tourist associations and hotels.
We will also consider the possibility of utilizing the Pristine Palau Tourism Tax if it is operated by the public.
＜Use of Renewable Energy＞

The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. In other words, we are aiming to run EV vehicles on renewable energy. (We are considering both existing and newly built charging stations.)
We would like to propose a mobile storage container unit when considering charging units for EV vehicles.
And, we would like to use reused batteries.

Theme1 : Passenger transportation to your hotel(This is the same question I asked last year.) (Before the COVID-19 pandemic)

Q1 : What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)
1. Buses or minivans operated by hotels and tourist associations
2. Cabs waiting at the airport
3. Taxi (chartered/with driver)
4. Rental car driven by tourists themselves
5. Other (details:　Arrange by local travel agents)

Answer【　1,3,4,5　】

Q2: What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)
1. Securing drivers
2. Cost of purchasing and maintaining vehicles
3. Aging and renewal of vehicles
4. Traffic congestion
5. Road maintenance and repair
6. Degradation of environmental image due to exhaust gas and other factors
7. Others (Details: Insurance)

Answer【　1,2,3　】

参考資料3

Q3 : If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

1. I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)
2. If it can be outsourced at a lower cost than before, I would consider it. (Joint transfer between the airport and each hotel)
3. I would like to consider using it to promote environmental aspects.
4. I think it will be difficult to build a route that stops at other hotels.
5. I'm not interested because there are no or less issues with the current operation.
6. Others (Details: If EV shuttle fee is not too expensive will attract guest itself / need to consider Palau guest is mainly long stay and some are diving guests and bring lot of luggage and equipment)

Answer【 5 】

Q4 : What do you feel are the challenges in implementing this model?

1. Initial cost
2. Running cost
3. Profitability of the project
4. Establishment of management system
5 Ensuring durability and safety of vehicles and charging equipment
6. Maintenance and trouble-shooting in case of failure
7. Design of operation schedule
8. Impact on existing employment
9. Others (Details: Tour or Shuttle bus in Palau mainly operate by local argent and drivers it is challenge how you coexistence and co-prosperity)

Answer【 6,8 】

Q5 : If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

1. Transfer from the airport to the hotel when entering Palau
2. Transfer from hotel to airport upon return
3. Round trip to various sightseeing spots on the island
4. Transfer for optional tours
5. Other (Details Shopping to down town)

【 1.2..3 】

Hearing target	Hotels
Answer date	Feb23, 2022
Respondent's name	Hidetaka Sadamori, Sales & Marketing Manager
Respondent affiliation	Palau Pacific Resort

Since last year, the project members in Japan have been investigating the possibility of introducing EV vehicles(bus) for tourism from the Palau international airport to the resort hotels under the following conditions.

<Seats> 30(including driver) <Battery capacity>114kWh <Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)

【Assumed EV vehicle introduction model】

<Assumed driving route / Either or both>

Route A (Airport~Palau Pacific Resort/14.6km)

Route B (Airport~Icebox/13.1km)

<Assumed car type>

Medium-sized EV buses (the number is under consideration; vehicle length is expected to be 7 to 8 meters)

<Implementation entity>

The installation and operation of the equipment is expected to be done by the Koror State Government, hotel operators, tourism associations, or Palau International Airport (or a joint venture).

<About the cost>

Part of the initial cost is expected to be covered by external funds.
(e.g., JCM equipment subsidy project under the bilateral credit system, ADB contribution, etc.)

We will consider a model that generates income from user fees paid by bus users, tourist associations and hotels.

We will also consider the possibility of utilizing the Pristine Palau Tourism Tax if it is operated by the public.

<Use of Renewable Energy>

参考資料3

The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. In other words, we are aiming to run EV vehicles on renewable energy. (We are considering both existing and newly built charging stations.)
We would like to propose a mobile storage container unit when considering charging units for EV vehicles. And, we would like to use reused batteries.

Theme1 : Passenger transportation to your hotel(This is the same question I asked last year.) (Before the COVID-19 pandemic)

Q1 : What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)

1. Buses or minivans operated by hotels and tourist associations
2. Cabs waiting at the airport
3. Taxi (chartered/with driver)
4. Rental car driven by tourists themselves
5. Other (details:)

Answer【1.3.4】

Q2: What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)

1. Securing drivers
2. Cost of purchasing and maintaining vehicles
3. Aging and renewal of vehicles
4. Traffic congestion
5. Road maintenance and repair
6. Degradation of environmental image due to exhaust gas and other factors
7. Others(Details:)

Answer【 1 】

Q3 : If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

1. I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)
2. If it can be outsourced at a lower cost than before, I would consider it. (Joint transfer between the airport and each hotel)
3. I would like to consider using it to promote environmental aspects.
4. I think it will be difficult to build a route that stops at other hotels.
5. I'm not interested because there are no or less issues with the current operation.
6. Others (Details:)

Answer【 1,3 】

Q4 : What do you feel are the challenges in implementing this model?

1. Initial cost
2. Running cost
3. Profitability of the project
4. Establishment of management system
5 Ensuring durability and safety of vehicles and charging equipment
6. Maintenance and trouble-shooting in case of failure
7. Design of operation schedule
8. Impact on existing employment
9. Others (Details)

Answer【 5,6 】

Q5 : If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

1. Transfer from the airport to the hotel when entering Palau
2. Transfer from hotel to airport upon return
3. Round trip to various sightseeing spots on the island
4. Transfer for optional tours
5. Other (Details)

Answer 【 1,2,3 】

参考資料3

Hearing target	Garden Palace Downtown Koror
Answer date	Feb. 23, 2022
Respondent's name	Naohisa Oya
Respondent affiliation	

Since last year, the project members in Japan have been investigating the possibility of introducing EV vehicles(bus) for tourism from the Palau international airport to the resort hotels under the following conditions.

<Seats> 30(including driver) <Battery capacity>114kWh <Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)

【Assumed EV vehicle introduction model】
<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)
<Assumed car type>
Medium-sized EV buses (the number is under consideration; vehicle length is expected to be 7 to 8 meters)
<Implementation entity>
The installation and operation of the equipment is expected to be done by the Koror State Government, hotel operators, tourism associations, or Palau International Airport (or a joint venture).
<About the cost>
Part of the initial cost is expected to be covered by external funds.
(e.g., JCM equipment subsidy project under the bilateral credit system, ADB contribution, etc.)
We will consider a model that generates income from user fees paid by bus users, tourist associations and hotels.
We will also consider the possibility of utilizing the Pristine Palau Tourism Tax if it is operated by the public.
<Use of Renewable Energy>

The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. In other words, we are aiming to run EV vehicles on renewable energy. (We are considering both existing and newly built charging stations.)
We would like to propose a mobile storage container unit when considering charging units for EV vehicles. And, we would like to use reused batteries.

Theme1 : Passenger transportation to your hotel(This is the same question I asked last year.) (Before the COVID-19 pandemic)

Q1 : What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)
1. Buses or minivans operated by hotels and tourist associations
2. Cabs waiting at the airport
3. Taxi (chartered/with driver)
4. Rental car driven by tourists themselves
5. Other (details:)

Answer 【 1 】

Q2: What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)
1. Securing drivers
2. Cost of purchasing and maintaining vehicles
3. Aging and renewal of vehicles
4. Traffic congestion
5. Road maintenance and repair
6. Degradation of environmental image due to exhaust gas and other factors
7. Others(Details:)

Answer 【 2,3 】

参考資料3

Q3 : If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

1. I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)
2. If it can be outsourced at a lower cost than before, I would consider it. (Joint transfer between the airport and each hotel)
3. I would like to consider using it to promote environmental aspects.
4. I think it will be difficult to build a route that stops at other hotels.
5. I'm not interested because there are no or less issues with the current operation.
6. Others (Details:)

Answer 【 1 】

Q4 : What do you feel are the challenges in implementing this model?

1. Initial cost
2. Running cost
3. Profitability of the project
4. Establishment of management system
5 Ensuring durability and safety of vehicles and charging equipment
6. Maintenance and trouble-shooting in case of failure
7. Design of operation schedule
8. Impact on existing employment
9. Others (Details)

Answer 【 3,4,6 】

Q5 : If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

1. Transfer from the airport to the hotel when entering Palau
2. Transfer from hotel to airport upon return
3. Round trip to various sightseeing spots on the island
4. Transfer for optional tours
5. Other (Details)

Answer 【 2 】

Hearing target	Hotels
Answer date	2/22, 2022
Respondent's name	Cove Resort Palau / Kazuo Osada
Respondent affiliation	General Manager, Cove Resort Palau

Since last year, the project members in Japan have been investigating the possibility of introducing EV vehicles(bus) for tourism from the Palau international airport to the resort hotels under the following conditions.

<Seats> 30(including driver) <Battery capacity>114kWh <Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)

【Assumed EV vehicle introduction model】

<Assumed driving route / Either or both>

Route A (Airport~Palau Pacific Resort/14.6km)

Route B (Airport~Icebox/13.1km)

<Assumed car type>

Medium-sized EV buses (the number is under consideration; vehicle length is expected to be 7 to 8 meters)

<Implementation entity>

The installation and operation of the equipment is expected to be done by the Koror State Government, hotel operators, tourism associations, or Palau International Airport (or a joint venture).

<About the cost>

Part of the initial cost is expected to be covered by external funds.
(e.g., JCM equipment subsidy project under the bilateral credit system, ADB contribution, etc.)

We will consider a model that generates income from user fees paid by bus users, tourist associations and hotels.

We will also consider the possibility of utilizing the Pristine Palau Tourism Tax if it is operated by the public.

<Use of Renewable Energy>

参考資料3

The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. In other words, we are aiming to run EV vehicles on renewable energy. (We are considering both existing and newly built charging stations.)
We would like to propose a mobile storage container unit when considering charging units for EV vehicles. And, we would like to use reused batteries.

Theme1 : Passenger transportation to your hotel(This is the same question I asked last year.) (Before the COVID-19 pandemic)

Q1 : What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)

1. Buses or minivans operated by hotels and tourist associations
2. Cabs waiting at the airport
3. Taxi (chartered/with driver)
4. Rental car driven by tourists themselves
5. Other (details:

Answer【 1. 】

Q2: What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)

1. Securing drivers
2. Cost of purchasing and maintaining vehicles
3. Aging and renewal of vehicles
4. Traffic congestion
5. Road maintenance and repair
6. Degradation of environmental image due to exhaust gas and other factors
7. Others(Details:)

Answer【 2. 】

Q3 : If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

1. I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)
2. If it can be outsourced at a lower cost than before, I would consider it. (Joint transfer between the airport and each hotel)
3. I would like to consider using it to promote environmental aspects.
4. I think it will be difficult to build a route that stops at other hotels.
5. I'm not interested because there are no or less issues with the current operation.
6. Others (Details:

Answer【 2. 】

Q4 : What do you feel are the challenges in implementing this model?

1. Initial cost
2. Running cost
3. Profitability of the project
4. Establishment of management system
5 Ensuring durability and safety of vehicles and charging equipment
6. Maintenance and trouble-shooting in case of failure
7. Design of operation schedule
8. Impact on existing employment
9. Others (Details

Answer【 7. 】

Q5 : If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

1. Transfer from the airport to the hotel when entering Palau
2. Transfer from hotel to airport upon return
3. Round trip to various sightseeing spots on the island
4. Transfer for optional tours
5. Other (Details

Answer【 3. 】

Hearing target	Hotels
Answer date	2/23/22
Respondent's name	Jennifer Mengloi
Respondent affiliation	Palau Central Hotel

Since last year, the project members in Japan have been investigating the possibility of introducing EV vehicles(bus) for tourism from the Palau international airport to the resort hotels under the following conditions.

<Seats> 30(including driver) <Battery capacity>114kWh <Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)

【Assumed EV vehicle introduction model】

<Assumed driving route / Either or both>

Route A (Airport~Palau Pacific Resort/14.6km)

Route B (Airport~Icebox/13.1km)

<Assumed car type>

Medium-sized EV buses (the number is under consideration; vehicle length is expected to be 7 to 8 meters)

<Implementation entity>

The installation and operation of the equipment is expected to be done by the Koror State Government, hotel operators, tourism associations, or Palau International Airport (or a joint venture).

<About the cost>

Part of the initial cost is expected to be covered by external funds.

(e.g., JCM equipment subsidy project under the bilateral credit system, ADB contribution, etc.)

We will consider a model that generates income from user fees paid by bus users, tourist associations and hotels.

We will also consider the possibility of utilizing the Pristine Palau Tourism Tax if it is operated by the public.

<Use of Renewable Energy>

The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. In other words, we are aiming to run EV vehicles on renewable energy. (We are considering both existing and newly built charging stations.)

We would like to propose a mobile storage container unit when considering charging units for EV vehicles.

And, we would like to use reused batteries.

Theme1 : Passenger transportation to your hotel(This is the same question I asked last year.) (Before the COVID-19 pandemic)

Q1 : What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)

(1) Buses or minivans operated by hotels and tourist associations
2. Cabs waiting at the airport
3. Taxi (chartered/with driver)
(4) Rental car driven by tourists themselves
5. Other (details:)

Answer [1, 4]

Q2: What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)

(1) Securing drivers
(2) Cost of purchasing and maintaining vehicles
3. Aging and renewal of vehicles
4. Traffic congestion
5. Road maintenance and repair
6. Degradation of environmental image due to exhaust gas and other factors
7. Others(Details:)

Answer [1, 2]

参考資料3

Q3 : If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

(1) I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)

2. If it can be outsourced at a lower cost than before, I would consider it. (Joint transfer between the airport and each hotel)

(3) I would like to consider using it to promote environmental aspects.

4. I think it will be difficult to build a route that stops at other hotels.

5. I'm not interested because there are no or less issues with the current operation.

6. Others (Details:)

Answer [1, 3]

Q4 : What do you feel are the challenges in implementing this model?

(1) Initial cost

2. Running cost

3. Profitability of the project

4. Establishment of management system

5 Ensuring durability and safety of vehicles and charging equipment

(6) Maintenance and trouble-shooting in case of failure

(7) Design of operation schedule

8. Impact on existing employment

9. Others (Details) 1, 6, 7

Answer [~~3~~]

Q5 : If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

(1) Transfer from the airport to the hotel when entering Palau

(2) Transfer from hotel to airport upon return

(3) Round trip to various sightseeing spots on the island

(4) Transfer for optional tours

5. Other (Details)

Hearing target	Hotels
Answer date	2/25/22
Respondent's name	Doris Chin
Respondent affiliation	Palasia Hotel

Since last year, the project members in Japan have been investigating the possibility of introducing EV vehicles(bus) for tourism from the Palau international airport to the resort hotels under the following conditions.

<Seats> 30(including driver) <Battery capacity>114kWh <Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)

【Assumed EV vehicle introduction model】

<Assumed driving route / Either or both>

Route A (Airport~Palau Pacific Resort/14.6km)

Route B (Airport~Icebox/13.1km)

<Assumed car type>

Medium-sized EV buses (the number is under consideration; vehicle length is expected to be 7 to 8 meters)

<Implementation entity>

The installation and operation of the equipment is expected to be done by the Koror State Government, hotel operators, tourism associations, or Palau International Airport (or a joint venture).

<About the cost>

Part of the initial cost is expected to be covered by external funds.

(e.g., JCM equipment subsidy project under the bilateral credit system, ADB contribution, etc.)

We will consider a model that generates income from user fees paid by bus users, tourist associations and hotels.

We will also consider the possibility of utilizing the Pristine Palau Tourism Tax if it is operated by the public.

<Use of Renewable Energy>

参考資料3

The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. In other words, we are aiming to run EV vehicles on renewable energy. (We are considering both existing and newly built charging stations.)
We would like to propose a mobile storage container unit when considering charging units for EV vehicles. And, we would like to use reused batteries.

Theme1 : Passenger transportation to your hotel(This is the same question I asked last year.) (Before the COVID-19 pandemic)

Q1 : What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)

(1) Buses or minivans operated by hotels and tourist associations
2. Cabs waiting at the airport
3. Taxi (chartered/with driver)
(4) Rental car driven by tourists themselves
5. Other (details:)

Answer [1,4]

Q2: What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)

(1) Securing drivers
2. Cost of purchasing and maintaining vehicles
3. Aging and renewal of vehicles
4. Traffic congestion
5. Road maintenance and repair
6. Degradation of environmental image due to exhaust gas and other factors
7. Others(Details:)

Answer [/]

Q3 : If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

(1) I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)
(2) If it can be outsourced at a lower cost than before, I would consider it. (Joint transfer between the airport and each hotel)
3. I would like to consider using it to promote environmental aspects.
(4) I think it will be difficult to build a route that stops at other hotels.
5. I'm not interested because there are no or less issues with the current operation.
6. Others (Details:)

Answer [1, 2, 4]

Q4 : What do you feel are the challenges in implementing this model?

1. Initial cost
2. Running cost
3. Profitability of the project
4. Establishment of management system
(5) Ensuring durability and safety of vehicles and charging equipment
(6) Maintenance and trouble-shooting in case of failure
7. Design of operation schedule
8. Impact on existing employment
9. Others (Details)

Answer [5, 6]

Q5 : If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

1. Transfer from the airport to the hotel when entering Palau
2. Transfer from hotel to airport upon return
(3) Round trip to various sightseeing spots on the island
(4) Transfer for optional tours
5. Other (Details)

参考資料3

Hearing target	Hotels
Answer date	2/23/22
Respondent's name	Ayako Yamamoto
Respondent affiliation	DW Hotel Manager

Since last year, the project members in Japan have been investigating the possibility of introducing EV vehicles(bus) for tourism from the Palau international airport to the resort hotels under the following conditions.

<Seats> 30(including driver) <Battery capacity>114kWh <Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)

【Assumed EV vehicle introduction model】
<Assumed driving route / Either or both>
Route A (Airport~Palau Pacific Resort/14.6km)
Route B (Airport~Icebox/13.1km)
<Assumed car type>
Medium-sized EV buses (the number is under consideration; vehicle length is expected to be 7 to 8 meters)
<Implementation entity>
The installation and operation of the equipment is expected to be done by the Koror State Government, hotel operators, tourism associations, or Palau International Airport (or a joint venture).
<About the cost>
Part of the initial cost is expected to be covered by external funds.
(e.g., JCM equipment subsidy project under the bilateral credit system, ADB contribution, etc.)
We will consider a model that generates income from user fees paid by bus users, tourist associations and hotels.
We will also consider the possibility of utilizing the Pristine Palau Tourism Tax if it is operated by the public.
<Use of Renewable Energy>

The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. In other words, we are aiming to run EV vehicles on renewable energy. (We are considering both existing and newly built charging stations.)
We would like to propose a mobile storage container unit when considering charging units for EV vehicles.
And, we would like to use reused batteries.

Theme1 : Passenger transportation to your hotel(This is the same question I asked last year.) (Before the COVID-19 pandemic)

Q1 : What are the main means of transportation used and utilized by tourists? (Multiple answers are acceptable)

(1) Buses or minivans operated by hotels and tourist associations
2. Cabs waiting at the airport
3. Taxi (chartered/with driver)
4. Rental car driven by tourists themselves
5. Other (details:)

Answer [/]

Q2: What are your hotel's challenges in transporting tourists? (Multiple answers are acceptable)

(1) Securing drivers
2. Cost of purchasing and maintaining vehicles
3. Aging and renewal of vehicles
4. Traffic congestion
5. Road maintenance and repair
6. Degradation of environmental image due to exhaust gas and other factors
7. Others(Details:)

Answer [/]

参考資料3

Tourism sector for carbon-free projects

Q3 : If there is ever an EV shuttle bus running between the airport and the hotel, would you be interested in using it as transportation for hotel guests?

(1.) I'm interested if it will reduce the cost and burden on my hotel. (As a direct connection between the airport and my hotel.)

(2.) If it can be outsourced at a lower cost than before, I would consider it. (Joint transfer between the airport and each hotel)

3. I would like to consider using it to promote environmental aspects.

4. I think it will be difficult to build a route that stops at other hotels.

5. I'm not interested because there are no or less issues with the current operation.

6. Others (Details:)

Answer [1, 2]

Q4 : What do you feel are the challenges in implementing this model?

(1.) Initial cost

(2.) Running cost

(3.) Profitability of the project

(4.) Establishment of management system

5 Ensuring durability and safety of vehicles and charging equipment

6. Maintenance and trouble-shooting in case of failure

7. Design of operation schedule

8. Impact on existing employment

9. Others (Details)

Answer [1, 2, 3, 4]

Q5 : If the operation of EV buses were, what type of transportation would you like them to cover for travelers?

(1.) Transfer from the airport to the hotel when entering Palau

2. Transfer from hotel to airport upon return

(3.) Round trip to various sightseeing spots on the island

4. Transfer for optional tours

5. Other (Details)

参考資料４

The following is a “Summary Report” for the above mentioned project. It sums up the answers to inquiries made through the provided hearing questionnaire.

Hearing Conductor: **KE+ Environmental Consulting Service on behalf of ATGREEN Co., Ltd.**

Respondents:
- **Mr. Katsuo Fuji, Consultant, Solid Waste Management, Department of Public Works, Koror State Government**
- **Mr. Selby Etibek, Manager, Solid Waste Management, Department of Public Works, Koror State Government**
- **Palau Public Utilities Corporation**
- **Koror State Department of Conservation & Law Enforcement**
- **Mr. Keefe Techitong, Bureau of Commercial Development, Ministry of Public Infrastructure & Industries**
- **Environmental Quality Protection Board Office**
- **Surangel & Sons Comapy**
- **Western Caroline Trading Company**

“Summary Report”

Primarily a total of three (3) individuals were interviewed face to face and three (3) public offices and two (2) private companies were contacted through telephone interviews during the survey.

In the cases of **1) Introduction of EV vehicles for waste collection and transportation and 2) Climate Change measures and promotion of the SDG’s in Koror State**, Mr. Katsuo Fuji and Mr. Selby Etibek from Koror State Solid Waste Management were the primary respondents. Interviews covered a period of 2 days, from February 15 to February 16, 2022 and a single day follow-up was conducted on February 18, 2022 at the Koror State Recycling Center in M-Dock, Koror.

In the case of **Other potential projects for carbon free society,** the respondents were as follows: **Theme 1: LED Street lighting-** Palau Public Utilities Corporation, **Theme 2: e Ship-** Koror State Department of Conservation & Law Enforcement, Mr. Keefe Techitong from the Bureau of Commercial Development, Ministry of Public Infrastructure & Industries, the Environmental Quality Protection Board Office, Surangel & Sons Company, and Western Caroline Trading Company.

参考資料４

Introduction of EV vehicles for waste collection and transportation

The assumed EV vehicle introduction model is accurate as depicted in the hearing form.

- Routes:
  - Initially, Koror State Solid Waste Management will continue to utilize the M-Dock Landfill site in Koror for waste disposal until it reaches its full capacity in approximately 4 to 6 years. After the M-Dock Landfill is capped and officially closed, and a Sorting & Transportation Station is installed, the following waste collection and transportation system will ensue:
    1) Garbage collection and transportation is conducted in central Koror and deposited into the Transportation Station in M-Dock
    2) Recyclable materials are sent to Recycling Center
    3) Non-Recyclable waste are transported to final disposal site in Aimeliik

- Vehicle Type:
  - EV Garbage Truck
  - EV 4T Flatbed Truck

- Project implementation entity:
  - Koror State Government Solid Waste Management will be responsible for vehicle and equipment installation, operation and maintenance

- Cost
  - Part of the initial cost is expected to be covered by using external fund (JCM subsidy project under the bilateral credit system, ADB fund, and JICA ODA.

- Electricity to be used
  - The charging station for electric vehicles will be located next to a solar power generation system and will use the electricity generated by the system. New photovoltaic (PV) power generation system will be installed on the roof of the M-Dock **Transportation Station** to supply renewable energy for the facility as well as the EV vehicles

THEME 1: Renewable energy and charging facilities

In the original plan for the Comprehensive Resource Recycling System Project in Koror State, the scale for solar power generation through installation of photovoltaic solar panels is approximately 150 kW. This plan is laid out as follows:

- 600 pieces of photovoltaic solar panels at a generation rate of 250 W per panel
- Installation space: 450 m2 on the rooftop and 400 m2 on Embankment Slope adjacent to the

参考資料４

Transportation Station (Field standing) *Please see map in figure 1 below.*

However, this project is being further reviewed by ADB and there is a very high possibility for expansion of facilities, therefore allowing for more rooftop space for additional PV panels to increase. Expansion information will be available in March or April 2022.

Figure 1. Bird's eye view of M-Dock Landfill site. Location for the planned Transportation Station Project. *Red boxes indicate locations for installation of solar PV panels. Black boxes are potential areas to install additional solar PV panels. Yellow box indicates available roofed parking space (parking space can accommodate more than 20 large vehicles and a charging station) and additional rooftop space for PV panels.*

At present, the total capacity and power consumption for the Transportation Station is not clear yet as the facility is still under planning and there are possibilities of further expansion from the original plan. Additional surveys will be conducted by a Japanese private consulting company through funding by the Asian Development Bank. This survey is expected to commence as early as March 2022. However, it is clear that intentions are to provide 100% renewable energy to cover the total energy consumption of the Transportation Station and EV vehicles altogether. Main targets for renewable energy are solar PV panels and Generator using bio-fuel derived from Koror State's plastic recycling activity.

The surrounding areas around the dumpsite have available space that can accommodate additional PV panels as indicated in the map shown in Figure 1 above. In addition, the planned parking space will be a roofed space which can also accommodate additional PV panels as well as a charging station for EV vehicles. An estimated 1000 m2 or more of additional space is projected to be available for additional PV panels.

参考資料４

THEME 2: Addressing energy risks

The Koror State Solid Waste Management Office and its recycling facilities are equipped with backup power supply through generators which utilize plastic derived bio-fuel. This backup power supply can produce 220 kWh of energy. In addition, the planned Transportation Station will also be equipped with the same type of generator and Solar PV panels as the primary source of power for the facility. The public utility grid is expected to be the backup power supply in cases where the renewable energy sources are not adequate to meet power demand.

The mobile battery, backup power supply is a great idea and there is a great need for it. However, Koror State is not equipped to move such container. To make the proposal more convenient, a trailer is a necessary component that must accompany the mobile battery.

THEME 3: Maintenance scheme for EV vehicles

The Koror State Solid Waste Management employs a full-time mechanic who oversees regular maintenance of garbage collection vehicles as well as all other vehicles assigned to the Solid Waste Management. Minor breakdowns are easily handled by this mechanic. However, in cases where major repairs are needed, the vehicles are usually referred to the Koror State Auto Shop or to a private auto shop for further assessment and repairs.

Koror State does not stock up on vehicle parts. This is because most common auto parts are available locally. In cases where special parts are needed, Koror State has an overseas supply chain which can supply needed parts as quickly as within 2 weeks or even less, depending on the urgency of the need.

The most common suppliers of auto parts for Koror State are 1) Local maintenance companies, 2) Japanese manufacturers and maintenance companies, and 3) US manufacturers and maintenance companies.

Special considerations may be made for keeping certain number of parts in stock for the maintenance of EV vehicles. However, if prices are too high, it can be very difficult.

The Koror State Solid Waste Management is very open and willing to assign staff members to receive training necessary for daily maintenance of EV vehicles.

参考資料４

Climate Change measures and promotion of the SDG's in Koror State

THEME 1: Climate Change measures

Koror State does not have a specific target pertaining to the reduction of greenhouse gas emissions. However, many of its Solid Waste Management activities are aligned with the SDG's in terms of GHG emissions reduction. Such projects include but are not limited to Composting, Beverage Container Recycling, and Plastic conversion to oil as a source for renewable energy. The National target for Palau as a signatory to the Paris Agreement is to achieve 45% renewable energy to replace the conventional use of diesel-generated energy by the year 2025 and a 22% reduction in its energy sector emissions below 2005 levels.

There are no specific plans or targets set for achieving a zero-carbon city by 2050 for the state of Koror. But as mentioned previously, many activities and projects, ongoing as well as under planning, aim toward reducing carbon emissions. However, greenhouse gas emissions and the reductions achieved through the aforementioned activities are not being tracked.

Koror State is the most populous state in Palau and therefore, it accommodates nearly 75% of Palau's total population. It is also the economic center and social activity center for the Republic. One of the most visible issue in Koror State is traffic congestion during rush hours from 7:30 am to 9:00 am, from 11:30 am to 12:30 pm, and from 3:30 pm to 5:30 pm during weekdays. This sector (transportation) should be a prioritized target for reducing GHG emissions through introduction of environmentally-friendly passenger vehicles and/ or introduction of a public transportation system. In addition, all other sectors, Home, Office, Hotel and resort, Power generation, and Waste management should continue to step up efforts to reduce greenhouse gas emissions.

If Koror State is able to receive support from the Japanese side, it would be in the area of calculating current GHG emissions and proposing ways to reduce emissions. Currently, there is no specific department in Koror State Government which is solely responsible for promoting a carbon free society. However, a proposal is in place to organize the Department of Resource and Development to undertake the responsibility for activities and programs related to GHG emissions reduction and the SDG's.

参考資料４

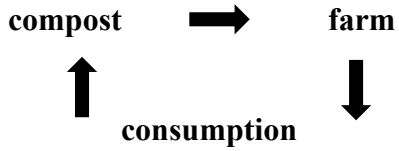
THEME 2: Promotion of the SDG's

Koror State has taken actions to achieve the SDG's in the following fields:

Solid Waste Management:

- Recycling activities- Composting, Beverage Container Recycling, Plastic conversion to oil as source for renewable energy.

- Integrated Waste Management- Urban Grower's Program. Resource circulation and food security initiatives



Marine Environment:

- Conservation efforts
- Bio-diversity protection

Generally, the State of Koror through its government efforts focus their attention and resources specific to the following SDG goals:

- Goal #6 Clean water and sanitation
- Goal #7 Affordable and clean energy
- Goal #8 Decent work and economic growth
- Goal #9 Industry, Innovation and Infrastructure
- Goal #11 Sustainable cities and communities
- Goal #13 Climate Action
- Goal #14 Life below water
- Goal #15 Life on land
- Goal #17 Partnership for the goals

Difficulty to access adequate funding for related activities is an issue related to the SDG's. This has to do with National priorities and whereas other non-priority agendas are not given access to funding sources.

Koror State Government would prioritize working in the area of Transportation, Marine Conservation, Waste Management, Agriculture and Power generation to promote and achieve the Sustainable Development Goals. Therefore, Koror State would seek support from Japan in, 1) Introduction of Japan's Efforts to Achieve the SDG's; 2) Planning for SDG's in Koror State; 3) Implementation of joint projects in the field of Solid Waste Management, Transportation, and Power Generation.

参考資料４

Other potential projects for carbon free society

THEME 1: LED street lighting

Palau Public Utilities Corporation (PPUC) has replaced nearly all of the street lights in Palau with LED. 1,943 LED Street Light have been installed on the main “public” road in the city center of Koror to the Compact Road around the big island of Babeldaob. They have also installed LED Street Lights in Koror secondary road and tertiary roads including local village wharfs and docks. PPUC has also installed LED Street Lights in the states on the big island of Babeldaob. PPUC pays for the power cost of street lights on the main public road in the city center of Koror and the Compact Road. Each State government pays for the power cost of the street lights on their secondary and tertiary roads. PPUC owns the power poles and the street lights and has management over them. Street light repair and maintenance are also the responsibility of PPUC.

THEME 2: e SHIP

- Palau does not have any e-Ship or electric drive ship boats or vessels. The Palau Ministry of Public Infrastructure & Industries (MPII) oversees the ship registry in Palau of boats over the length of 65 feet.

- Twenty-six (26) Vessels over 50 feet in length are registered under the National Government and are used primarily for transporting passenger and cargo between the commercial center of Koror and the out-lying islands.
-

- Palau has 16 States and each state registers their motor boats.

- Koror State which is the biggest state and the commercial center of Palau has the most number of motor boats registered with 355 in 2022.

- Of the 355 boats registered in Koror State, almost all of them use gasoline with some using diesel fuel. Almost all of them utilize Outboard Engine motor. Less than 10 are Inboard Engine/Inboard Engine Outboard Drive.

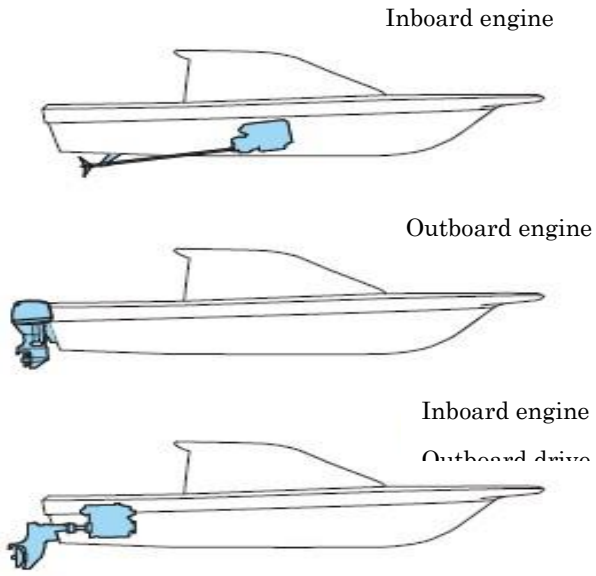
- Most gasoline motor boats in Palau are used in the Tour Industry for their power and fast-transporting of scuba diving customers to-and-from dive sites which are about an hour boat-drive from the city center of Koror State.

- Most local fishermen also use gasoline motor boats for their power and speed to bring fishermen to distant fishing spots and return to shore before sundown.

参考資料４

I. Data on registered power vessels in Palau

Data source		**Koror State- Department of Conservation & Law Enforcement**
Data year		**2022**
Data URL (if available online)		**None available yet**
Number of vessels	inboard engine	
	outboard engine	**345+ vessels**
	inboard engine outboard drive	**Less than 10 vessels**
Number of total vessels		**355 Vessels**



II. List and specifications of inboard engine ships in Palau

Ships that are 50 Feet or Longer in length registered with the Palau National Government Registry.
(Inboard Engine type)

	Length(meters)	Engine type(diesel/gasoline)	Purpose of use
1	15.54	YANMAR CO., LTD / 50.2KW X 2	PASSENGER
2	16.56	TWIN VOLVO D13-800 / 800HP X 2	PASSENGER
3	16.75	VOLVO D16 / 551KW	FISHING
4	18.2	TWIN YANMAR 6CXBM-GT / 394HP X 2	PASSENGER/CARGO

5	19.11	TWIN CATERPILLAR CD12 / 526KW X 2	PASSENGER
6	19.6	MAN / 900HP X 2	PASSENGER
7	19.9	2 X CATERPILLAR 3406 / 300HP EACH	PASSENGER/CARGO
8	20.4	TWIN YANMAR 6CH-WVTE / 255HP EACH	PASSENGER/CARGO
9	21.28	CUMMINS / 500 BHP	FISHING
10	21.38	TWIN CUMMINS NTA-855 / 480HP	CARGO
12	22.123	2 X DETROIT / 257KW EACH	CARGO
13	22.85	MITSUBISHI S6A3-MPTK / 2 X 477.42KW	CARGO
14	23.05	VOLVO PENTA / 553KW	FISHING
15	27.35	TWIN G.M. / 2 X 170KW	PASSENGER
16	32.22	TWIN CATERPILLAR / 2 X 783 KW	PASSENGER
17	32.3	TWIN CATERPILLAR / 2 X 783.0KW	PASSENGER
18	33.72	YANMAR / 2 X 302KW	PASSENGER
19	34.76	MITSUBISHI (MHI SAGAMIHARA S6R2-MTK / 2 X 478KW	PASSENGER
20	38.35	TWIN PROPMECH CAT / 330KW X 2	PASSENGER
21	41.46	MITSUBISHI 6D-22 / 480HP	PASSENGER
22	46.8	CUMMINS / 2 X 477 KW	PASSENGER
23	47	MWM/TDB / 398.0HP EACH X 2	PASSENGER
24	51.4	AKASAKA DIESEL / 2,698HP	PASSENGER
25	54	CUMMINS / 2 X 316.93KW EACH	CARGO
26	15.54	YANMAR CO., LTD / 50.2KW X 2	PASSENGER

III. Status of lead-acid batteries (LAB) in Palau

	Data	Data year	Data source
Total units of LAB import per year	9000+	2021	Surangel & Sons Company and Western Caroline Trading Company
Total amount of LAB import per year (USD)	N/A	N/A	N/A
Origin of import	LAB’s are	2021	Surangel & Sons Company

(exporting country); If multiple countries, specify the allocation	imported mostly from USA, Japan, and Taiwan		and Western Caroline Trading Company
Status of used LAB in Palau - treatment, disposal ways - waste category (hazardous waste?) - regulations on used LAB treatment	- Government only encourages and urges public not to discard used/old LAB in dumpsite or environment, but to bring them to designated local private company for proper storage, acid neutralization and off-island shipment. - LAB is categorized as hazardous waste - 2401-31-29 Lead Acid Batteries (A) Lead Acid Batteries shall be transported to the battery recycling facility at M-Dock or other EQPB approved facility in a safe and secure manner. Batteries may be staged at the national landfill and then transferred to the approved facility. (Excerpt from the Envinronmental Quality Protection Board- EQPB Regulations, Palau's National Regulatory Agency)		Palau Government- Environmental Quality Protection Board office
Availability of LAB regeneration business in Palau - any business doing LAB regeneration?	No availability of LAB regeneration business in Palau. Government offered token cash for used LAB, and ship out used LAB off island for recycling and disposal. Now government has		Palau Government- Environmental Quality Protection Board office

- What type of machines are used for regeneration? - Amount of regeneration per year?	outsourced process to a local private company (Magic Metal & Spices) but continues to monitor.	

There are two major companies that import (LAB) Lead Acid Batteries to Palau. One is Surangel & Sons Company; the other is Western Caroline Trading Company. Surangel & Sons Company imported over 4,800 units in year 2021. Western Caroline Trading Company imported over 4,200 units in year 2021. To prevent the disposal of used Lead Acid Batteries (LAB) into the landfill and the surrounding environment, and encourage recycling of used batteries, the Palau Environmental Quality Protection Board office (EQPB) offered token cash for used/old batteries. Because of the lack of LAB regeneration business in Palau, the government packed the used/old LAB and shipped them off island for recycling and proper disposal.
Now, the government has outsourced the service to a local private company but continues oversight to ensure processes are followed from storage to packaging to shipping.

On the average, one 20-foot container containing 1,500 used/old LAB is shipped out of Palau every 3 months for recycling and disposal.

End of Report

参考資料５

打ち合わせメモ

件　　名	アジア開発銀行・コロール州協議 （令和３年度脱炭素社会実現のための都市間連携事業委託業務）		
開催日時	令和３年 12 月 19 日(日)　　14:00～15:00	**場　所**	オンラインにて実施
参 加 者	・アジア開発銀行　官民連携部：神田氏 ・パラオ国コロール州：藤氏 ・ATGREEN 冨永		

内容

質疑応答(Q＝質問、A=回答、C＝コメント)

１．パラオ国と ADB におけるこれまでの経緯について

C1：州政府が現在計画している廃棄物管理には地域モデル事業の候補として ADB としても注目している。官民連携でプロジェクトを進めたいという藤氏のご意向を受けた。ADB 官民連携部は社会基盤構築を民間の活力を用いて進める案件に対して、政府側に立って助言をするポジション。テクニカルアシスタンスを案件ごとに配備し、案件推進を支援している。これまでパラオでは太陽光発電(13MW)の案件があり、その際も政府側への助言を実施。廃棄物管理についても 2 年前より協議してきた。今回の廃棄物収集運搬車両の EV 化については環境省と密に話をされていると聞いている。現在の事業モデルや諸条件(台数や充電設備等)についてお伺いしたい。廃棄物管理プロジェクトの重要パーツの１つとして検討したい【神田氏】

Q1：今後は実証実験のフェーズに移るという認識で良いか？【神田氏】

A1：その意向であるが、イニシャルに係るファンドをどのように獲得するかが現在の論点。よって今回の廃棄物管理 PJ との連携は重要な検討内容である【冨永】

２．「EV 車両導入を通じた脱炭素化促進およびコ・ベネフィット創出事業」について

（冨永より既存資料を用いて説明）

C2：前提として本事業は環境省 地球環境局の国際協力・環境インフラ戦略室が毎年公募している「脱炭素社会実現のための都市間連携事業委託業務」にて採択を受け、実施している。北九州市とコロール州の都市間で脱炭素等に関して連携を図ることを目的としている。現在はまだ FS 段階であり、実導入はまた別のフェーズとなる【冨永】

C3：現在は既存の 4 台のパッカー車(2t 車)の電化を想定。イニシャルコストの圧縮と州側からの車両の大型化および平ボディー車両の要望について検討している。費用についても大まかに積算済みであるが、廃棄物収集運搬は公共サービスであり、営利事業でないことから、何らかの補助を受ける必要がある。蓄電池コストが最も負担であるため、移動式リユースバッテリーの活用も含めて検討中。イニシャル圧縮ついては日本側と現地側でコンソーシアムを組織して JCM 設備補助事業へのトライを検討していたが、条件の 1 つである 4,000 円/t-CO_2 の費用対効果の達成が困難であるため、他ファンドも検討していたところである【冨永】

Q2：リユースバッテリーということは途中で取り換える可能性もある？【神田氏】

A2：メーカー側の話では 4000 回の充放電耐久の保証はするとのこと。概ね 10 年は使用できると思われる【冨永】

３．EV 車両導入に向けたファンド獲得・費用感について

Q3：JCM 設備補助事業は JICA の ODA 事業と同時に活用できる？【神田氏】

A3：JICA は別枠で環境省と連携した JCM 関連の事業がある。基本的に環境省も JICA も日本政府支援であり、ADB とはセクション分けを行った上で検討を進める必要があると思われる【冨永】

C4：ADB のパブリックセクターが出す ODA もあるが、JICA も関心を示しており、JCM と併用できればもう一つの大きな可能性となり得る。ADB パブリックセクターから迅速に資金供給ができない場合もある【神田氏】

C5：JCM 設備補助事業と JICA は同一プロジェクトで併用は基本的には不可能であるという認識である。詳細を詰める段階で確認は行う【冨永】

Q4：その場合は尚更、ADB と連携した方が良い？【神田氏】

A4：そこは期待できると有難い。【冨永】

C6：トランスポーテーション施設の件で以前、J-PRISM(JICA 大洋州地域廃棄物管理改善支援プロジェクト)と話をした。その際はバックウエスト(欧州ファンド)と JCM 更に草の根事業も組み合わせる(協調融資)ことは可能という回答であった【藤氏】

C7：JCM にも 3 つ(環境省設備補助事業・ADB との JFJCM・JICA スキームによる支援)のパターンが存在する。いずれのパターンも 100%補助にはならないため、どのファンドと組み合わせるかがポイントとなる【冨永】

C8：例えば太陽光、コンバーター、充電設備は JCM、車両は他ファンドといった同じものに複数ファンドの資金を用いるという見せ方をしなければ複数ファンドを活用できる可能性もあると思われる【神田氏】

C9：移動式蓄電池であれば脱炭素ではなく、離島のレジリエンスというアプローチも考え得るため、切り

参考資料５

分けて考えることも検討している【冨永】

４．プロジェクトのタイムラインについて

Q6：ADB で進める調査は 1 年程か？【冨永】

A6：1～1 年半を想定。調査(マスタープラン策定)＋実行(民間事業者との PPP、コンセッションのプロセス/入札/評価/コンセッション)が大まかな実施内容。【神田氏】

以上

参考資料５

打ち合わせメモ

件　　名	アジア開発銀行・コロール州協議 （令和３年度脱炭素社会実現のための都市間連携事業委託業務）		
開催日時	令和 4 年 1 月 15 日(土)　　15:00～16:00	**場　所**	オンラインにて実施
参 加 者	・アジア開発銀行　官民連携部：神田氏 ・パラオ国コロール州：藤氏 ・ATGREEN 冨永		

内容

質疑応答(Q＝質問、A=回答、C＝コメント)

1. イニシャルコストの再考を行ったモデルの紹介

（冨永より資料を用いて説明）

C1：バッテリーがコンテナユニットで動かせるというのは災害対応などで一定のメリットが期待できそうである【神田氏】

2. 実施プロセスについて

C2：最終的には調査が終わった後、事業者を選定する際にはこの案件については国際入札を開催することになると思われる。【神田氏】

C3：価格だけでなく様々な観点からの総合的な評価も検討される。各国との競争になることから何らかの差別化要因は必要であると考える。【神田氏】

C4：本件については融資となるか補助となるかによって話が変わってくると考えられ、詳細は確認を要するが、融資であれば補助事業の活用が検討できるかもしれない。反面、補助の場合は補助金を重複させられない建付けとされているので難しくなると考える【冨永】

3. 今後について

C5：今後、事業モデルの検討などもしていく必要があるので引き続きやり取りをさせて頂きたい【全員】

以上

参考資料６

Meeting Record: Palau Pacific Resort

Date/time: February 17, 2022, 3:00 p.m. - 4:30 p.m.
Location: Zoom (online)
Participants: Seiji Sone, Palau Pacific Resort
Katsuo Fuji, Koror State Solid Waste Management Office
Seiya Tominaga, AT GREEN Co.,Ltd.
Kohei Hibino, Institute for Global Environmental Strategies

Interview was conducted on the needs and issues of introducing energy-saving equipment at the Palau Pacific Resort (PPR) upon providing information on the structure and benefits of JCM.

Operational status of facilities

- PPR was forced to suspend the operation of various facilities due to the lack of guests as a result of COVID-19, and various problems have arisen due to the long period of suspension of facility operation. In anticipation of a large number of guests for the Our Ocean Conference to be held in April 2022, PPR is currently busy with the maintenance and restoration of the facilities.

Chillers

- Of the three chillers, one air-cooled chiller installed 6-7 years ago is no longer available, so PPR is considering installing an air-cooled chiller. Since water is precious in Palau, air-cooled chillers are used rather than water-cooled chillers, which are more efficient.
- Chillers are susceptible to rust due to salt damage (due to their proximity to the ocean) and also due to the exhaust gas from the steam boiler. To prevent rusting, stainless steel frames and covers are specially installed, which costs more than usual.

Diesel generator

- A 600KW diesel generator went down. Since it is an old piece of equipment, it was deemed impossible to revive it. PPR need to install a new generator.
- PPR is hurrying to take measures to cope with the situation with the existing equipment so that they will not have a power outage during the Our Ocean Conference in April.
- PPR has negotiated with the PPUC to be able to receive grid power in the event that their own power generation system fails. However, PPR is located at the end of the grid and there are four power fuses in between, so if one of the fuses blows, the power goes out. As a stopgap measure, PPUC has responded to increase the capacity of the fuse so that it would be harder to fall out.

Chilled water and hot water supply facilities

- Chilled water is supplied by a central system. A water-cooled turbo chiller with high cooling effect has been installed,

but since the inverter failed, it has been reinstalled without an inverter to cope with the problem. The capacity of the system is not sufficient for full operation. The underfloor piping is not properly insulated. Increasing the effectiveness of heat retention is expected to reduce wasteful power consumption in that area.

- Hot water is usually supplied by boiling it using the exhaust heat from the diesel generator. The boiler is used for steam supply and is not used for hot water supply except in emergencies.

Solar power generation

- PPR has already installed a solar power generation system, but it is only generating about 2% of the total electricity. Since it is not sunny all year round in Palau, they have the impression that it is not generating as much power as they have initially expected.

Refrigerators and freezers

- All the refrigerators and freezers in the kitchen were installed with Japanese equipment, but since there is no after-sales service, PPR has been having troubles replacing parts when they break down. When they try to import spare compressors from Japan, it takes a long time to obtain an export certificate.

LED lighting

- PPR is considering of replacing the lights for two tennis courts (mercury lamp 1KW x 20 = 20KW) with LED.

Others

- In Palau, there is a shortage of engineers who can perform maintenance, and in particular, there are almost no personnel who can perform comprehensive management. It is necessary to train human resources before introducing equipment. This would be much more cost effective.

参考資料６

Meeting record (Palau Energy Administration)

Date/time: February 9, 2022, 10:00 - 11:30 a.m.
Location: Zoom (online)
Participants: Keefe Techitong, Energy Planner, Palau Energy Administration
Kohei Hibino, Institute for Global Environmental Strategies

Discussions were held on energy issues and the possibility of introducing renewable energy in remote islands and areas where grid electricity does not reach in Palau.

LED needs

- In Palau, 90% of the residents live in the states of Koror and Airai, and LED streetlights are well developed in the residential areas. Therefore, the need for LED streetlights is limited.
- Lighting fixtures in government buildings (public facilities) have a high occupancy rate, and older buildings have not yet been converted to LED, so it would be good if they could be installed in bulk. Research is needed to determine the necessary specifications and number of units.

Battery reconditioning

- In Palau, all batteries are taken over by the Palau Environmental Quality Protection Board (EQPB), but we do not have information on what happens to the batteries after they are taken back.
- It would be good if lead-acid batteries could be reconditioned in Palau.

Renewable energy needs and trends in remote islands, etc.

- Koror, Airai, and Aimeliik are covered by the grid, but remote islands and other areas are being addressed with individual diesel power generation.
- On Peleliu Island, a backup power system including solar power has been installed by a Korean company. In the future, the same system will be installed on Kayangel Island, but Angaur Island does not have such a system yet.
- On Angaur, there is interest in the possibility of introducing ocean thermal energy conversion (OTEC). For OTEC, we have not yet decided on a specific partner.

Electric boats

- In Palau, it will not be easy to transition to slow sailing (to reduce battery consumption) because people want to speed at sea and dive spots are far away.
- Installing CIGS flexible solar on cruisers and yachts is a good idea because it can shut down the engine while at anchor.

Offshore Solar Power

- Palau is not as densely populated as the Maldives and has more land available, so the need for the offshore solar power may not be as great.

参考資料６

- The Palau Network of Marine Protected Areas (PAN) [33] has outpost offices in various locations adjacent to protected areas, so there may be a need for offshore solar power to supply electricity to the offices.

[33] Palau Protected Area Network: https://www.palaugov.pw/executive-branch/ministries/natural-resources/protected-areas-network/

参考資料６

Meeting record (Yamaha Motor Co., Ltd.)

Date/time: January 26, 2022, 14:00 - 15:15
Location: Zoom (online)
Participants: Kazuyuki Kitajima, Marine business unit, Yamaha Motor Co. Ltd.
Atsushi Watanabe, Ocean Policy Research Institute, Sasakawa Peace Foundation
Kohei Hibino, Institute for Global Environmental Strategies

In order to explore the possibility of decarbonisation in the marine sector in Palau, interviews were held on the trends of electric outboard motors and the issues of introducing them to island countries.

Yamaha Motor's electric outboard motors

- Yamaha Motor has begun accepting orders for its next-generation HARMO electric outboard boat control system[34] for the European market. This model uses a rim drive system that is more efficient than conventional propeller-driven systems, and is suitable for navigating at a slow speed of about 10 km/h in quiet inland waters such as canals.
- As the No. 1 brand in reliability when it comes to electric outboard motors, it is aiming to create differentiated products that are unique to Yamaha Motor, and HARMO is part of that effort.
- The small outboard electric motor[35] is used for auxiliary steering of fishing boats and fishing boats.

Development status and international trends of electric outboard motors

- As part of its efforts to address climate change, Yamaha Motor is studying outboard motor models powered by renewable energy sources, including electric models and the use of "e-fuel," a synthetic fuel that uses hydrogen or hydrogen derived from renewable energy sources, with the aim of shifting to models powered by such renewable energy sources for approximately 80% of its fleet by 2050[36].
- Yamaha Motor is not ruling out the possibility of converting internal combustion engines to hydrogen engines and FCVs (fuel cell vehicles), but it is a prerequisite that the hydrogen infrastructure be developed and that hydrogen itself be derived from renewable energy sources. e-fuel is technically established, but the cost of producing fuel is an issue.
- Since ships are moored for relatively long periods of time, the installation of solar panels may be beneficial in areas where there is sufficient sunlight and under conditions where ships sail slowly like HARMO. However, if the ship were to sail at speed, the solar panels would be quickly consumed, so for now they are limited to supplementary uses.
- The state of California, which is considered to have the strictest power engine regulations in the world, has announced (but not finalized) a guideline[37] that all outboard motors with an output of less than 19 kW must be converted to electric power within a certain transition period starting in 2029. We are keeping a close eye on that trend.

[34] HARMO: https://global.yamaha-motor.com/jp/news/2021/0915/harmo.html

[35] Small outboard electric motor: https://www.yamaha-motor.co.jp/marine/lineup/outboard/marinemotor/

[36] Integrated Report 2021: https://global.yamaha-motor.com/jp/ir/integrated-report/integrated2021/

[37] 2020 Mobile Source Strategy (California): https://ww2.arb.ca.gov/resources/documents/2020-mobile-source-strategy

参考資料６

Conditions, issues, etc. for introducing electric outboard motors to developing countries such as Palau

- Electric outboard motors will be introduced sequentially from countries and regions where the following two conditions are met: (1) where renewable energy power supply infrastructure is in place, and (2) where the operating environment is in place. As for (1), it is meaningless if the electricity itself is generated from fossil fuels, so the infrastructure for renewable energy sources must be widespread. As for point (2), unlike cars, ships have a high resistance to wave formation, so if they navigate in wavy waters or at high speed, their batteries will quickly run out. Based on the current performance and cost of batteries, a large number of batteries will need to be loaded for use at sea, where higher reliability is required than on land, and depending on the balance between the size of the boat and the intended use, the number of practical applications will be limited.
- Even in developing countries, if these conditions are met, the deployment of electric models can be considered. Also, if there are opportunities such as demonstration projects to introduce them on a trial basis, it is possible to consider them.
- It is understood that Palau has a large share of the market for Yamaha outboard motors, but even so, the absolute size of the market is so small that it is not a high priority market.

参考資料６

Meeting record (IGUAZU Corporation)

Date/time: January 19, 2022, 14:00-15:45
Location: Zoom (online)
Participants: Manabu Kumada, MOTTA Sales Department, Business IGUAZU Corporation
Reo Ominato, Idemitsu Energy Solutions
Kohei Hibino, Institute for Global Environmental Strategies

Since storage batteries are indispensable for promoting the introduction of renewable energy on remote inhabited islands in Palau, an interview was held on the possibility of reconditioning lead-acid batteries instead of lithium-ion batteries, which are expensive and difficult to recycle.

Organization and Business Structure

- The lead-acid battery reconditioning technology (SOTO LAB®) is a patented technology developed by Reconsulting and an exclusive sales contract for lead-acid battery reconditioning equipment (SOTO WW1) and testing equipment (SOTO EV2) was signed with IGUAZU Corporation (December 2016). IGUAZU Corporation provides MOTTA, a forklift battery reconditioning service that utilizes the said equipment.
- Idemitsu Energy Solutions partners with IGUAZU Corporation to start demonstration tests of "ReBS", a low-cost energy storage solution that uses recycled lead-acid batteries (April 2021).
- The domestic business in Japan in Reconsulting has been transferred to IGUAZU Corporation, but the overseas business continues to be conducted by Reconsulting. MOTTA and ReBS are both targeted at the domestic market in Japan.

Reconditioning technology for lead-acid batteries

- There are two types of deterioration in lead-acid batteries: structural deterioration and deterioration caused by sulfation (crystallization of lead sulfate) of the electrodes. Structural deterioration cannot be regenerated, but sulfation deterioration can be regenerated by decomposing the crystals.
- The reconditioning time depends on the degree of degradation, and may take only a couple of hours, or close to 10 hours in some cases.
- The number of times the battery can be reconditioned can be repeated if only from the perspective of recovering from sulfation degradation. However, in consideration of the deterioration of the battery structure (safety), the number of times it can be reconditioned is limited to less than its capacity.
- In Japan, the number of times it is reconditioned is limited to once for quality assurance purposes. In overseas cell phone base stations, the battery is reconditioned about twice.
- Image of the cycle when a battery is reclaimed twice overseas: Since the life cycle of a new battery is usually about 2 years, the first reconditioning is done 2 years after the purchase of the new battery, and the second reconditioning is done 1.5 years after that. After another 1.5 years of use, the life cycle is completed (=> the battery is then collected and refined for material recycling).
- Reconditioning technology can be used for a wide variety of lead-acid batteries. However, due to concerns about structural deterioration, care must be taken with batteries made in China, which have a weak structure. Batteries made

in Japan are safe.

- There is no need to worry about the safety of the reconditioning process (e.g., harm from lead) in developing countries if the proper procedures are followed. It is already in operation in several developing countries. However, care must be taken to ensure that batteries that have been reconditioned are not illegally dumped.
- MOTTA has received two types of certification (EcoLeaf "Type III" Environmental Declaration (EPD) and Carbon Footprint (CFP)) under the EcoLeaf environmental labelling program operated by the Sustainable Management Promotion Organization (SuMPO).

Overseas business development (backup power supply for mobile phone base stations)

- In Myanmar, Azerbaijan, Georgia, Cyprus and other countries, reconditioned lead-acid batteries are being used as backup power sources for cell phone base stations. In these countries, the grid power supply is unstable and power outages are common, so there is demand for cell phone base stations to have backup power.
- A local subsidiary has also been established in Indonesia (in Bandung). In Indonesia, due to local regulations, the main purpose is not mobile base stations, but backup power for AI's data centre.
- These mobile base stations recondition batteries in the order of 3,000 to 4,000 per month. Compared to renewing new batteries every two years, this is a huge cost savings.
- Because the reconditioning process uses electricity, it must be in a location with a certain amount of stable power. For this reason, even in these countries, reconditioning sites are chosen in urban areas where grid power is relatively stable (reconditioning of renewable energy using solar power is also theoretically possible).

Overseas business development (small unit independent power supply)

- Currently, we are considering a service to provide independent power sources (on a scale of two to three households) in small units that combine recycled lead-acid batteries and used solar panels for un-electrified areas in developing countries. Instalment sales (PPA) are envisioned to eliminate the initial cost burden.
- High quality Japanese-made storage batteries will be reconditioned and used.
- The independent power supply for the small unit is intended to be installed in Africa. We are assuming countries that we have connections between investors and local telecom companies in places like Cote d'Ivoire and Ghana, but we are not particular about where those conditions exist.
- The independent power supply of the small unit can take power generation logs, so monitoring of electricity usage is possible (possibility of applying for JCM Model Project may also be considered).
- In many countries in Africa and elsewhere, Chinese battery manufacturers are currently operating a business in which they bring used batteries back to China for refining and exporting as new batteries (not reconditioning). This business model has a short battery life cycle and little local benefit.
- We are preparing to announce the outline of the independent power supply for small units in early February 2022.

参考資料６

Meeting record (Palau Environmental Quality Protection Board)

Date/time: February 24, 2022, 10:00-11:00 a.m.
Location: Zoom (online)
Participants: Palau Environmental Quality Protection Board (EQPB):
Kimie Ngirchechol, Olkeriil Yaoch, Darwin Florencio, Bernie Besebes, Rebecca Schuster
Kohei Hibino, Institute for Global Environmental Strategies

In order to study the possibility of reconditioning lead-acid batteries in Palau, an interview was held with EQPB, which is responsible for the management of hazardous waste such as batteries.

Current status of lead-acid batteries

- In Palau, the demand for lead-acid batteries is great because of the large number of vehicles and boats (each person owns several) in spite of the small population.
- New lead-acid batteries are also imported, but because of the high cost of Japanese and U.S.-made lead-acid batteries, many people buy less expensive third-hand products.
- A regular cargo ship (operated by Kyowa Shipping Co., Ltd.) makes a port call once a month, and as approximately 30 used vehicles are usually imported at a time, the used lead-acid batteries installed in these vehicles also come in.

Status of recovery and recycling of lead-acid batteries

- EQPB regulations stipulate that hazardous wastes such as batteries must be collected and properly disposed of.
- In order to facilitate the collection of lead-acid batteries, the EQPB has set up a collection point for used batteries at M-Dock and offers a guarantee that the batteries will be taken back for a valuable price. In the past, the cost was $1 per battery regardless of size or condition, but now they are being collected for $2. The price is the same for taking them to other scrap dealers.
- Because used lead-acid batteries are guaranteed to be taken by valuable price, few people dump them illegally, and it is believed that most of them are being collected.
- Collected lead-acid batteries are recycled in the countries to which they are exported.
- Since lead-acid batteries contain hazardous liquids, packaging regulations are in place to ensure safety during transportation. There is also a limit to the amount of lead-acid batteries that can be exported due to the limited number of containers that can be allocated for each export.

Interest in the reconditioning of lead-acid batteries, etc.

- There is interest in lead-acid battery reconditioning technology from the perspective of promoting appropriate hazardous waste disposal.
- Further study is needed on the safety, cost, number of times the batteries can be reconditioned, and criteria for judging structural deterioration when reconditioning is carried out.

  - ➢ It was explained that safety is not a problem as long as the appropriate procedures are followed since no liquid is taken out.
- Once the effectiveness of the lead-acid battery recycling technology and the possibility of introducing it have been confirmed, regulations can be created to encourage reconditioning (for example, regulating the types of storage batteries that can be recycled).
- An interest in the recycling of dry cell batteries was also expressed.

参考資料６

Meeting record (Tokyo Century Corporation)

Date/time: January 18, 2021, 10:00-11:00 a.m.
Location: Zoom (online)
Participants: Tokyo Century Corporation: Aoki, Hirai, Yasufuku, Harada
Kitakyushu City: Arita, Nagahara, Yamane, Mori
ATGREEN Co. Ltd.: Tominaga
IGES: Hibino

One of the issues in Palau is that it is difficult to structure financing for JCM projects because the local companies are small and their payment capacity is generally low, and Japanese financial institutions do not have a presence in the country. Therefore, we interviewed Tokyo Century Corporation, which has a wealth of experience in JCM Model Projects and JCM Eco Lease Scheme, about the possibilities and issues of cross-border instalment sales, loans, and other forms of financing.

Cross-border deferred payment to a Japanese company

- It would be possible to make deferred payments to the Japanese parent company. As a financial institution, it is difficult to take risks in project finance from a technical point of view, but we can take corporate risks for the Japanese parent company.
- If the Japanese parent company has the money, there would be no need for a financial institution to stand in as the representative business operator.
- If the counterparty to the deferred payment is a large Japanese company with local subsidiaries and affiliates, it would be safe, and it would be possible to structure a JCM Model Project through the way the roles are shared.

Cross-border deferred payment with local companies

- It is possible to make cross-border deferred payments in dollars, but the issue is whether or not you can get credit from local companies (state-owned companies).
- In Japan, government agencies (such as state-owned companies) have the highest credit rating, but in overseas (especially developing countries), the opposite may be true. Also, banks may not want to do business with state-owned companies because they may not have money or may be selfish.

Lease or deferred payment

- Cross-border leasing is not impossible, but it has few advantages because it often has many negative effects, such as needing permission from the central bank in some countries, withholding tax on the whole thing, or needing to return the equipment to Japan after the lease period (e.g. Vietnam).
- If you want to do cross-border, a loan or deferred payment trade is better. This is a method of selling the equipment in instalments by removing the ownership of the equipment (handing it over to the local owner), and can be handled in places where foreign currency remittance is possible.

参考資料６

- For example, in Vietnam, there are cases where equipment was purchased in Japan (by a financial institution) and then sent to the local market for instalment sales (cross-border deferred payment trade).
- It is important to note that some countries have strict foreign currency regulations. In the case of Palau, there is no problem because the US dollar is in circulation.

Needs for financial institutions

- There is a need for companies that have no experience in JCM or are struggling with the administrative work of JCM to have us handle the administrative work (scheme management) on their behalf.
- There are a number of companies and consultants that we know of that are interested in being representative business operator, so we can introduce (share information with) such companies depending on the content and location of the project.
- It is important to have sufficient knowledge of new technologies, as various projects come in through overseas alliance partners. Otherwise, it is impossible to take risks.

Others

- As there were some issues with conventional JCM financing, we helped the Ministry of the Environment to establish a system to introduce leasing (2017) and cross-border deferred payment (2019) in JCM.
- We have been involved in 10 JCM Model Projects overseas so far, and it is sometimes difficult to deal with counterparts from overseas.
- When individual projects take shape in the future, we will be able to consult with them if there are any issues with financing.

参考資料７

Project Overview

FY2021 City-to-City Collaboration for Creating a carbon-free Society

Feasibility Survey of promoting of carbon-free society and co-benefits through the implementation of EV vehicles in the state of Koror, Republic of Palau
(City to City collaboration between Koror state and Kitakyushu city)

1st, March, 2022

Kitakyushu City (Kitakyushu City, Bureau of Environment)
AMITA CORPORATION
EV Motors Japan Co., Ltd
Quando Inc.
Institute for Global Environmental Strategies
ATGREEN Co., Ltd

0. Background of project

参考資料７

City-to-city collaboration history between Koror State and Kitakyushu City

City-to-city collaboration between Koror State and Kitakyushu City has been ongoing since 2015 with the main theme is construction of resource recycling systems. This feasibility survey project has been carrying out and based on this collaboration and JCM scheme.

Koror State

Challenges of Koror (Our Assumption)

- Expansion of using renewable energy
- Improvement of waste resource circulation
- Reduction of exhaust gas in transportation sector
- Lack of experience to construction the environmental plans and system
- Promoting SDGs Know-how

Kitakyushu City

Experience and know-how from Kitakyushu

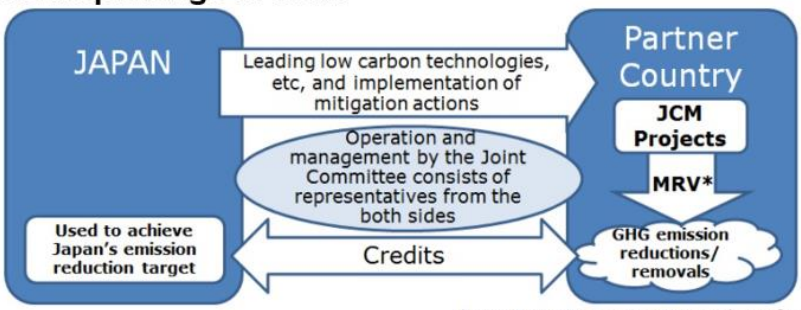
- Experience of overcoming pollution
- Experience of establishment of recycling system
- Experience of EV-bus transportation in public transportation
- Experience to construction the environmental plans and system
- Experience and know-how of promotion of SDGs

Participants only

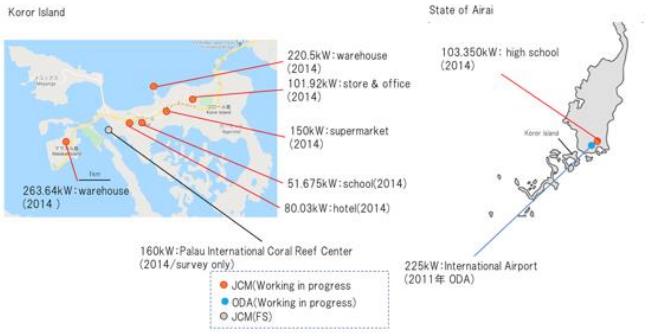
JCM in Palau

JCM is a mechanism to promote carbon-free society in the other country by transferring superior lowcarbonization technologies for overseas, and to contribute to the reduction of carbon emissions in both countries by generating carbon credits.

Concept image of JCM



*measurement, reporting and verification



Palau and Japan have a JCM agreement.
Solar power is being installed in several locations.

There are no introduction project of anything other than solar.

Participants only

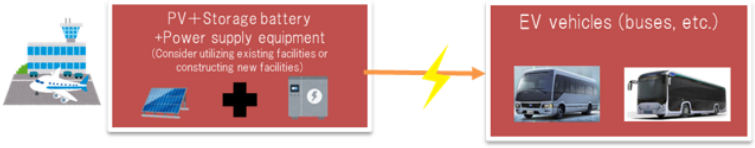
参考資料７

1. Overview of the project

Overview of Project

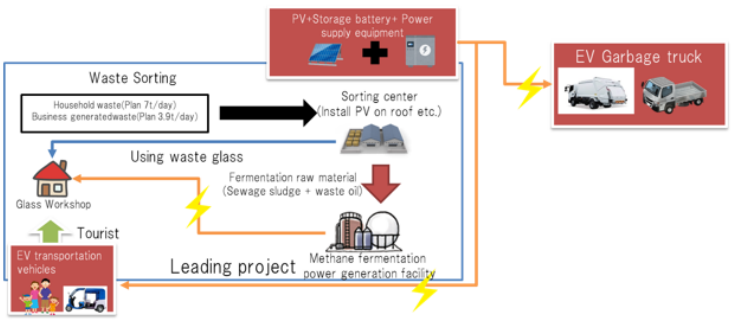
We are currently considering two projects to study the feasibility of introducing EV vehicles.
1) Project of introduction EV vehicles for tourism sector
2) Project of introduction EV vehicles for waste transportation sector

①Project of introduction EV vehicles for tourism sector



◎Contribution for carbon-free society
- Reduction of greenhouse gas emissions for driving
- Further reduction using renewable energy

②Project of introduction EV vehicles for waste transportation sector



○Expected Co-benefit impacts
- Does not emit exhaust gas
- Introduction and utilization of renewable energy that do not load the grid
- Reduction of energy cost and local produce and consumption
- Reduction of vehicle maintenance costs
- Secure emergency power supply
- Increasing the rate of renewable energy in the waste industry
- Expanding the image of ecology image in tourist sector
- Contributing to Koror's achievement of the SDGs
- Technology transfer and exchange under city-to-city collaboration project

参考資料７

Issues in Palau (including some issues before the COVID-19 pandemic)

We assume that Palau faces the following issues in the sector of energy, tourism, waste, etc.

Sector	Issues	Detail
Energy	High dependence rate for Fossil fuel	・Impact of GHG emissions ・Increased exhaust gas ・The risk of changes in energy procurement costs
	Increase in load on grid due to introduction of renewable energy	・Increasing load on grid due to acceleration of large-scale PV introduction ・Response to surplus power and sudden output fluctuations ・Risk of both short-period fluctuations and long-period fluctuations
	Consideration for renewal for existing diesel power generation equipment due to aging	・Power outage ・Expanding for renewable energy according to national energy plan
Sightseeing & Transportation	Seriously environmental impact due to increasing tourists	・Increased waste, especially progress of marine pollution ・Improving the landscape and environmental image of tourist destinations
	Impact on the environment due to traffic jam	・There are many means of transportation, but it is dispersed (e.g. Taxi, Shuttle Bus, Hotel pick-up service) ・Increased exhaust gas and noise
Waste Treatment	Increasing costs of waste transportation and treatment	・Increased waste by tourists ・Increased transportation costs to landfill site in Aimeliik State ・Increased fossil fuel consumption due to transporting for landfill site ・Energy recovery from waste

Co-benefit effects expected from the introduction of EV vehicles.

The introduction of EVs is important not only low-carbon, but also co-benefits. The expected co-benefits are as follows. In particular, Palau is a tourist nation, and efforts to contribute to the revival of the tourism industry, was damaged by COVID-19 pandemic, is an important project in terms of recovery.

Co-Benefit effects(expected)	
Emission mitigation	Zero exhaust gas from EV vehicles
Traffic jam mitigation	Traffic jam mitigation by reducing the number of vehicles
Energy cost reduction / local production for local consumption	Cost reduction by avoiding fossil fuel procurement and promoting for using local production energy
Maintenance cost reduction	EV vehicle is a simple structure without an internal combustion engine. It is expected to reduce maintenance costs.
Used as an emergency power source in the disaster	EV vehicle can be used as a mobile emergency power source in the disaster
Image up	【For tourism sector】 Improving the image of tourists and promoting green tourism 【For waste treatment sector】 Renewable energy can be used throughout the waste recycling flow
Contribution for SDGs	・Contribution to achieving for the SDGs in Koror 

参考資料７

【Tourism sector】 Consideration of introduction model

We are studying a model for introducing a shuttle bus connecting the hotel and the airport. Chargers are expected to be installed near the airport. And, we are planning to introducing of EV model that runs only using renewable energy by PV power generation panels and storage batteries.

Solar power generation
40kW~80kW

Mobile Storage Battery
Container Unit 288kWh
(Storage for Renewable energy)

or

or
Only Mobile Storage Battery
288kWh
(Not container type)

Grid power
(as backup power)

<Seats> 30(including driver)
<Battery capacity>114kWh
<Driving Distance> 230km
<Charger type> CHAdeMO type(Japan origin)

＜Assumed driving route / Either or both＞
Route A (Airport～Palau Pacific Resort/14.6km)
Route B (Airport～Icebox/13.1km)

【Tourism sector】 Additional considerations

We are also studying the possibility of small tricycles that can be used to transport tourists or for small lot distribution.

Solar power generation

Mobile Storage Battery

Grid power
(as backup power)

A refrigerated type is also available, making it possible to transport fresh products.
The rear unit is removable and can be towed.

参考資料７

【Waste transportation sector】 Consideration of introduction model

Solid Waste Management Office of The Koror State is using four packer trucks. We are considering a model to change all of these to EV vehicles. Solid Waste Management Office has needs to increase the size of the vehicles (increase the loading capacity), so we are continuing to study the possibility.

＜Charging and operation system＞

In consideration of risk, two charging units are assumed to be installed.

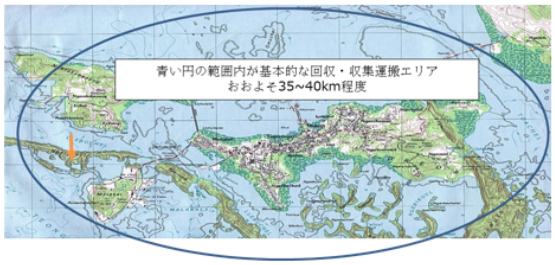
<Battery capacity>110kWh x 4 units
<Range> Less than 180km
<Load capacity> 1,995kg x 4 units
＜Gross vehicle weight: 8,280kg/vehicle

<Number of charging equipment> 2 units
<Assumed location of charging equipment: M-Dock
<Charging method> CHAdeMO method

Participants only

【Waste transportation sector】 Consideration of introduction model

We assumed two routes for waste collection and transportation vehicles.
In addition, the following considerations are being made due to the need to secure energy during emergencies.



＜Assumed driving route / Either or both＞

1) Collection and transportation of waste within the state of Koror
2) Transportation between M-DOCK and the final disposal site in Aimeliik Province

<Introduction of container units loaded with storage batteries>

By installing storage batteries in container units, it is expected that they will not only be used for recharging EV vehicles, but will also be used as mobile batteries to reduce the energy risks of the island and strengthen its resilience. It is also possible to consider the use of energy from the M-Dock to improve the rate of renewable energy using. We are considering reducing the cost of storage batteries, which is a bottleneck, by using reused batteries.

Assumed using 10ft container
- ✓ Battery Capacity 288kWh
- ✓ Output 50kW
- ✓ Power conditioner 50kW

Participants only

参考資料７

Future Considerations　Expectations and Challenges

We were collected comments and opinions from local stakeholders. And, there were many similarities in terms of the expected benefits and perceived challenges for both sector.(tourism and waste transportation). In addition, we understand many of the stakeholders have expectations for this project as a measure to reduce greenhouse gas emissions.

	Expectations	Challenges
Tourism sector	・Improve image as a tourist destination ・Reduce traffic congestion	・Securing Profitability ・Recovery of tourism demand ・Bus operation know-how (if the number of buses has increased) ・Project driver ・Coordination with stakeholders(hotels and tourist associations etc.)
Waste transportation sector	・Securing power source in case of emergency ・Reducing GHG emissions from waste treatment flows ・Collaboration with the transportation station project in Koror State	・Increase in vehicle size ・Higher power vehicles
Common	・Initiatives leading to decarbonization ・Promotion of the use of renewable energy ・Reduction of exhaust gas ※The minister commented positively on the project, which will utilize renewable energy.	・Securing of human resources and know-how for maintenance ・Securing maintenance parts

Thank you for your attention!

参考資料７

Feasibility study of other low-carbon technologies in Koror State & Palau

1st March 2022

Kohei Hibino, Kitakyushu Urban Centre
Institute for Global Environmental Strategies

IGES
Institute for Global Environmental Strategies

FY2020

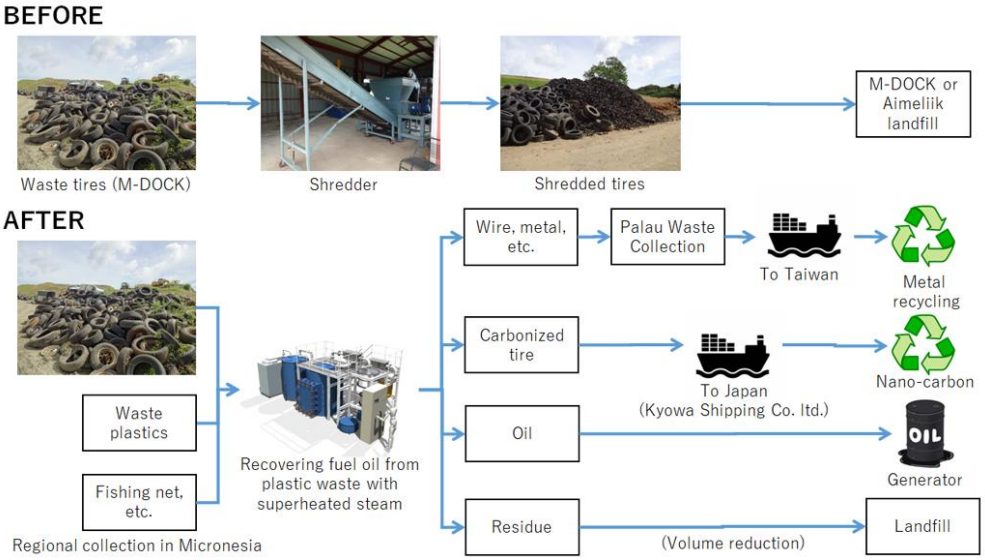
1. Energy savings in hotels
2. Off-grid LED street lighting
3. Waste tire recycling ?

FY2021

1. Energy savings in hotels
2. Off-grid LED street lighting ~~X~~
   ⇒LED for government buildings
3. E-ship and electric outboard motors
4. Off-shore solar power plants
5. Lead-acid battery reconditioning
6. Ocean Thermal Energy Conversion
7. Financing

参考資料７

Waste tire recycling at M-Dock (FY2020)



Palau Pacific Resort (PPR)

Diesel generator co-generation system

http://www.mhi-eng.com/products/energy/cgs/diesel_generator.html

Air-cooled chillers

https://www.daikinaircon.com/central/chiller/aircool_heatcb.html

LED conversion

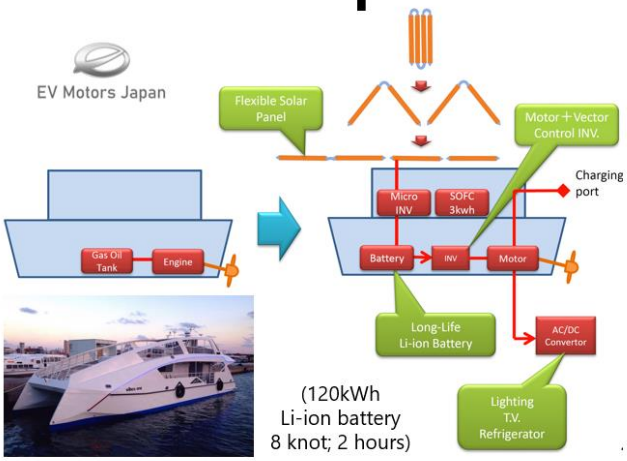
Mercury lamp 1,000 W x 20 units

LED 289.2 W x 20 units

https://led-clair.jp/high/red/rzna/rzna-1000-50rt/

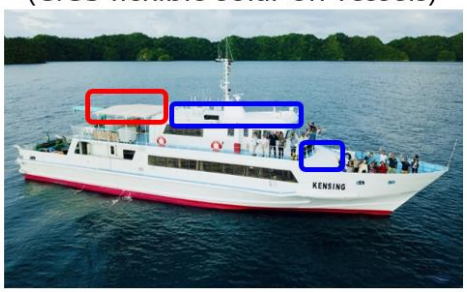
参考資料７

E-ship and electric outboard motors

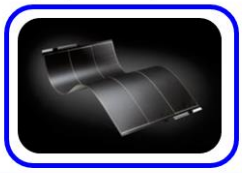


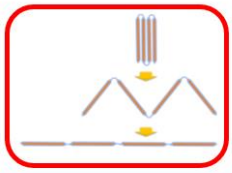
(120kWh Li-ion battery 8 knot; 2 hours)

Realistic tentative solutions
(CIGS flexible solar on vessels)



KENSING (Medical inspection ship)
https://peace-winds.org/news/20580

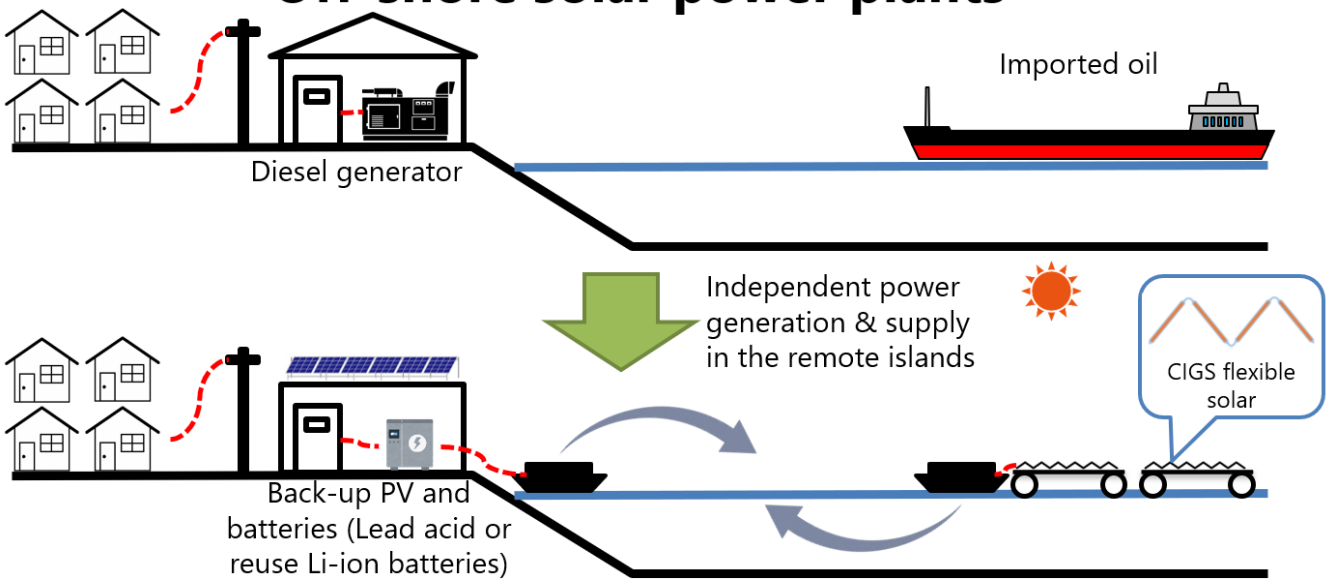




Potential target:

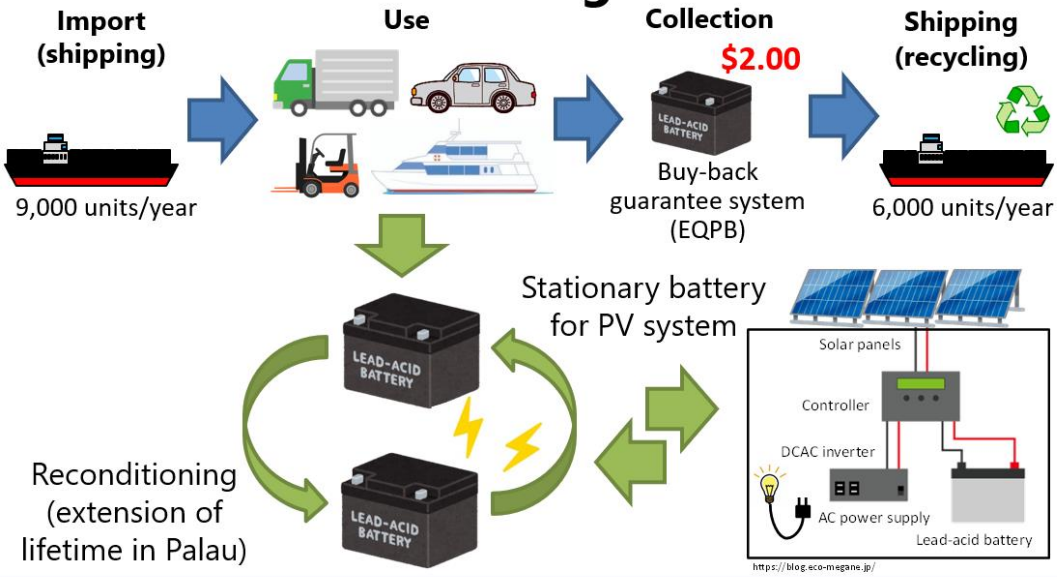
- Inboard engine: Ferryboats (> 50 feet): 26 vessels
- Outboard engine: 345 boats registered in Koror State

Off-shore solar power plants



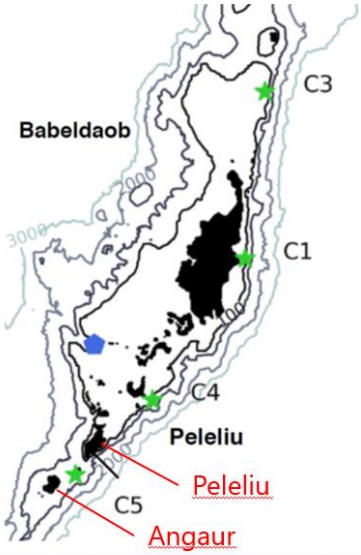
参考資料７

Reconditioning of lead-acid batteries



Reconditioning machine (above) and tester (below)
http://www.sotolab.co.jp/

Ocean Thermal Energy Conversion (OTEC)



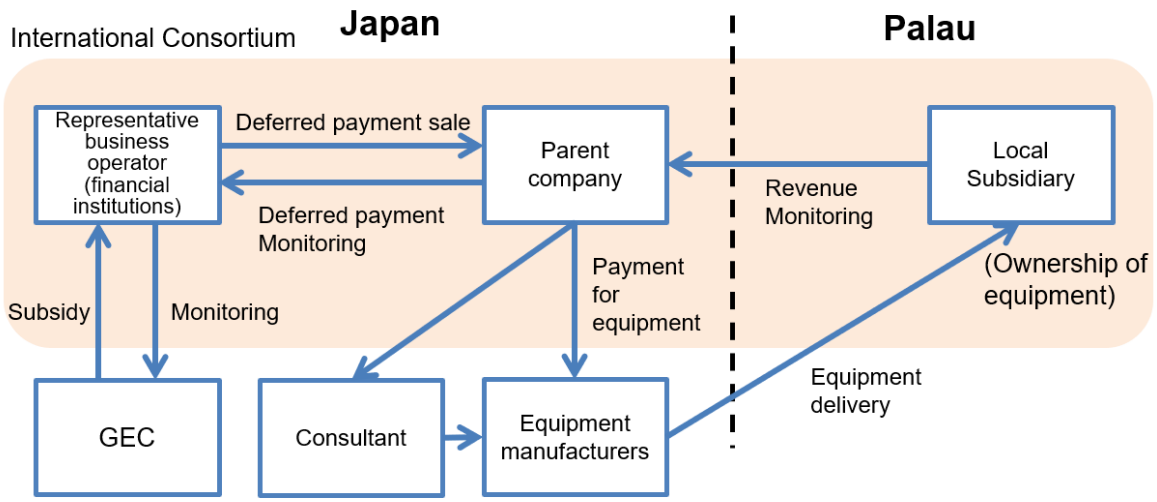
Approximate power generation cost (Source: NEDO)

Plant size	Cost
Several 100 kW or less	Not yet calculated
1MW	Approx. 50 yen/kWh
5MW	30.4 to 45.7 yen/kWh
10MW	Approx. 20 yen/kWh
100MW	Approx. 10 yen/kWh

Ocean Thermal Energy Conversion Demonstration Test Facility (50kW) Kume Island, Okinawa

参考資料７

Cross-border deferred payment in JCM



参考資料７

Efforts for achieving the SDGs and Zero-Carbon city

1 Introducing Kitakyushu City

2 Down the Path of History in Overcoming Pollution

3 Sustainable Initiatives Sparked by the Environmental Power of Kitakyushu's People

- Trinity of Waste Management (3R) Initiatives
- Initiatives for achieving the SDGs

4 Initiatives for Realizing a Decarbonized City

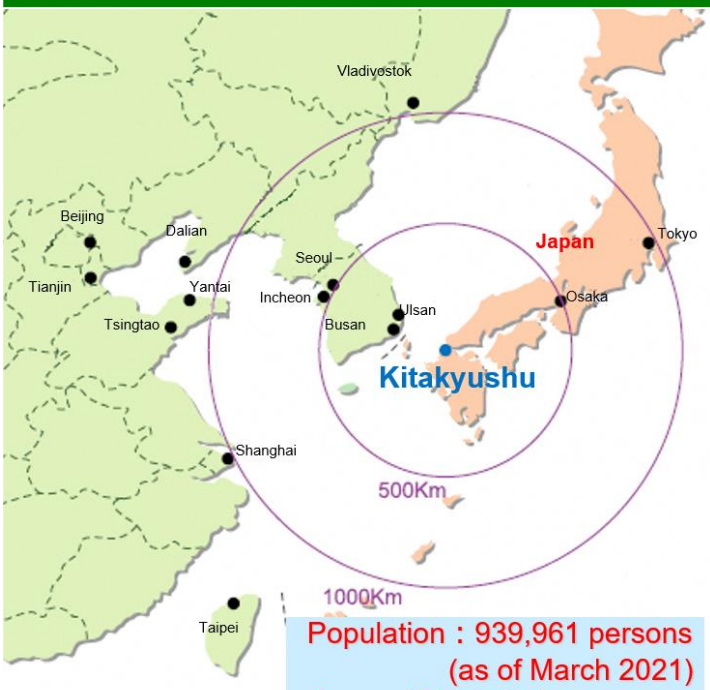
- Goals for a decarbonized society through a virtuous cycle between the environment and economy
- Examples of select initiatives

5 Global contributions

The City of Kitakyushu supports the Sustainable Development Goals (SDGs).

March 1 , 2022
City of Kitakyushu, Japan

About Kitakyushu City



Population：939,961 persons (as of March 2021)
Area：491.95 Km^2

Abundant nature and special local agricultural and marine products


Karst plateau and Hiraodai


Northern shore of Wakamatsu


Kokura Beef


Buzen sea oyster


Wakamatsu specialty tomato

Representative Enterprises of Kitakyushu


Nippon Steel


Yaskawa Electric Corporation


TOTO

2

参考資料７

Experience in Overcoming Pollution

1901

Start of operations at Yawata Steel Works

Development as an iron-producing city

1950

Intense pollution problems

1960～

Pollution control policies

Anti-pollution movement by women's groups

Residents

Businesses

Government

Company initiatives

Governmentinitiatives

Overcame pollution

3

Trinity of Waste Management (3R) Initiatives

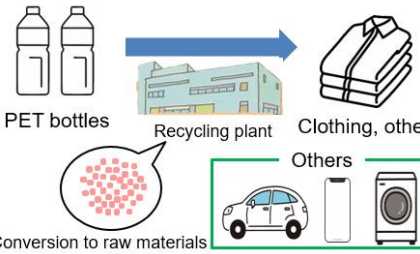
Kitakyushu Eco-Town Project

Japan's first and largest recycling complex

Regional impact (1997 to March 2021)

- Direct investment: JPY 86.3 billion
- Jobs created: 1,088 people
- No. visitors: 1.85 million
- CO_2 reduction effect: ▲433,000 t/year (FY 2016)

Example of recycling at Eco-Town



Companies

Trinity initiatives

Leverage the power of the people carefully shaped over the process of overcoming pollution

Residents

Government

Resource recycling through group and instore collection

Introduction of designated garbage bags

Prevention of illegal dumping

参考資料７

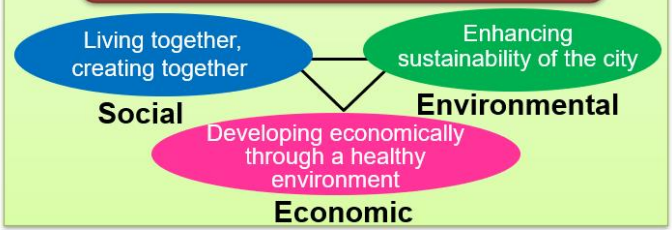
Aiming for the Top Runner of SDGs

Grand Design towards the Creation of a "World Capital of Sustainable Development" completed in 2004

COMMITMENT OF THE RESIDENTS OF KITAKYUSHU
TO ALL PEOPLE, THE EARTH AND FUTURE GENERATIONS, born after many discussions by citizen, NPOs, businesses, and administrations etc

Period for development: 2 years
Citizen's opinion: more than 1,000
Holding of Citizens Forum: 2 times
Examination meeting (34 members): General meeting 4 times, sectional meeting 10 times

Basic Philosophy
Creation of a city with true wealth and prosperity, inherited by future generations



Kitakyushu Basic Environmental Plan incorporating the SDGs (Nov. 2017)

Addressing various issues in Kitakyushu, Japan and the world from an environmental point of view

- Political goals
  - Basic objectives
    - Individual project measures

SDGs Future City Initiative
by Gov. of Japan (Jun. 2018)

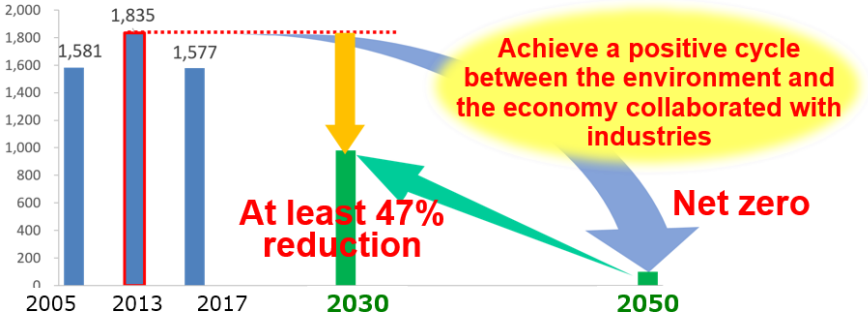
SDGs Pilot Model City for territorial approach by **OECD**
(Apr. 2018)

5

Kitakyushu's Ambitions as a Zero Carbon City

FY 2030 (Target)	2050 (Goal)
At least 47% reduction from FY 2013 levels	Aim for net zero greenhouse gas emissions in city

Image of reduction target



Five Pillars to Achieve Zero-Carbon Status

Ⅰ Use low carbon energy
Ⅱ Advance innovation
Ⅲ Change our lifestyle
Ⅳ Become a resilient city that tackles climate change
Ⅴ Contribute to the international community

"Kitakyushu Green Growth Strategy"

i) **Strategically secure low carbon energy sources**
①Wind Power **②Storage Batteries** **③Hydrogen**

ii) **Encourage innovation for early realization**

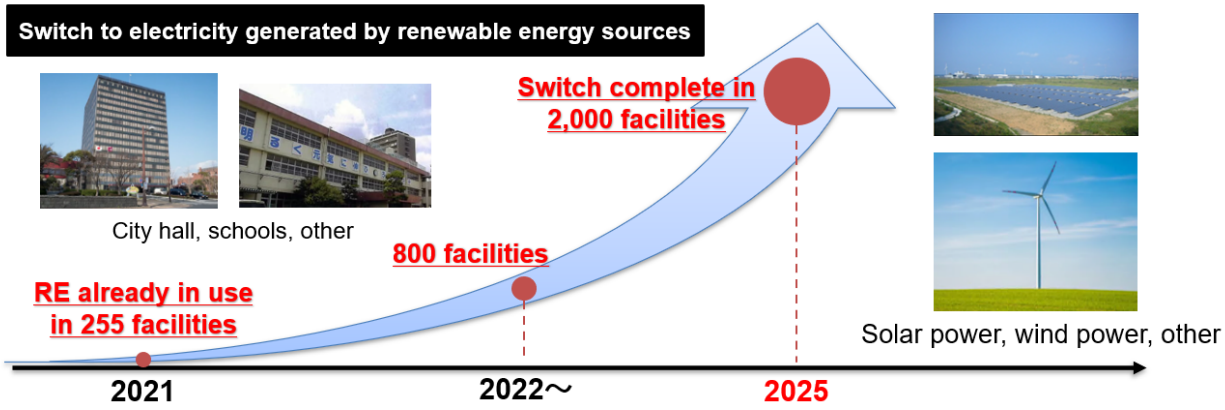
6

参考資料７

Establishment of “Kitakyushu Model for 100% Renewable Energy”

Kitakyushu Model for 100% Renewable Energy

1 Fastest* conversion of public facilities to 100% renewable energy in Japan
(*Prefectures and designated cities)

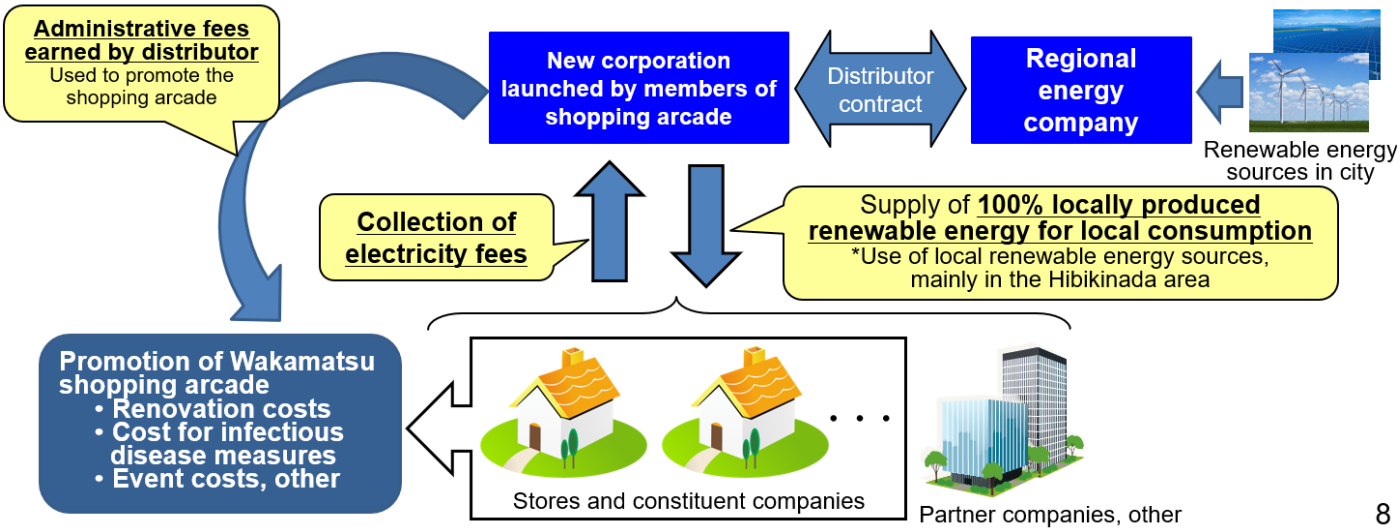


2 Installation of solar + energy storage facilities and procurement on-site through third-party Power Purchase Agreements (PPA)

7

Initiatives to Supply 100% Renewable Energy to Public Facilities

- Introduction of 100% renewable energy in common areas in shopping arcades
- Launch of a new initiative called "100% Renewable Energy x Local Production for Local Consumption” where electricity from renewable energy power plants concentrated in the Hibikinada area will be supplied to private facilities by a new corporation in the shopping arcade acting as a distributor for local energy companies
- Administrative fees earned by the distributor will be used for renovating the shopping arcade and for infectious disease measures



8

参考資料７

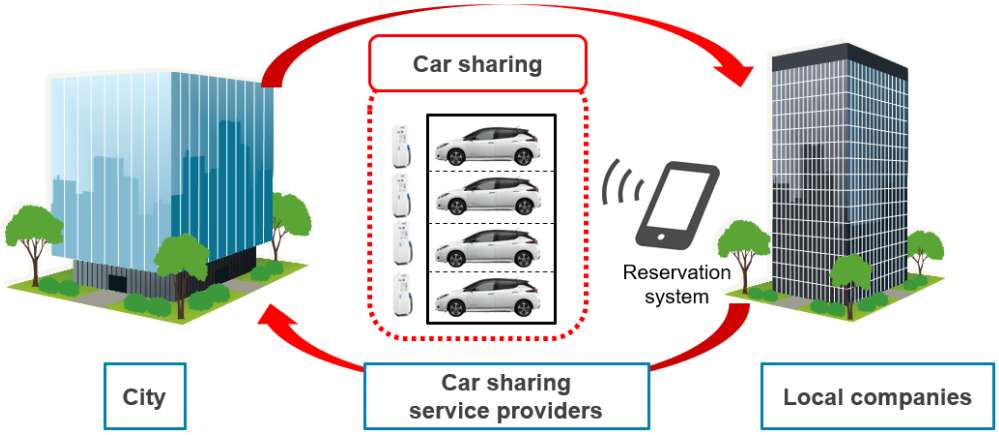
Promoting the Electrification of Public Vehicles & Car Sharing Demonstration

■ Promoting the electrification of public vehicles

Aim at **100% electrification** of general public vehicles (approx. 800), excluding special vehicles, **by FY 2030**

■ Car sharing demonstration project with private companies (FY 2022~)

Collaborate with companies to promote the introduction of EVs



9

Creation of a Comprehensive Base for Wind Power Industries

Features of the Hibikinada area

- Expansive industrial site located adjacent to the port
- Well-developed port facilities
- Concentration of companies supporting the manufacturing industry located behind the port
- Favorable wind conditions

Development of a comprehensive base for wind power industries

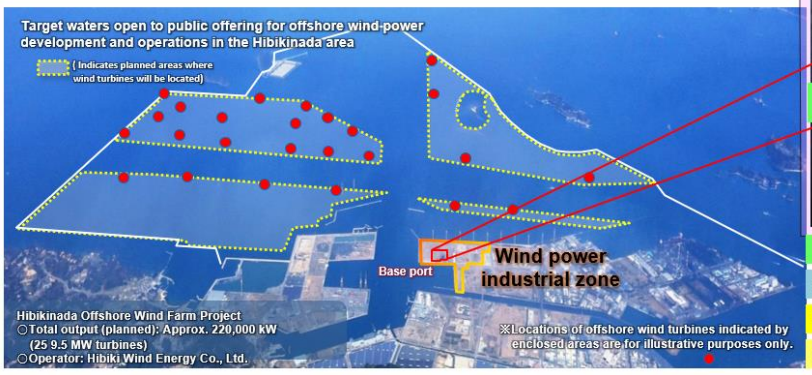
Promotion of wind power | **Revitalization of industries, logistics, and local economy**

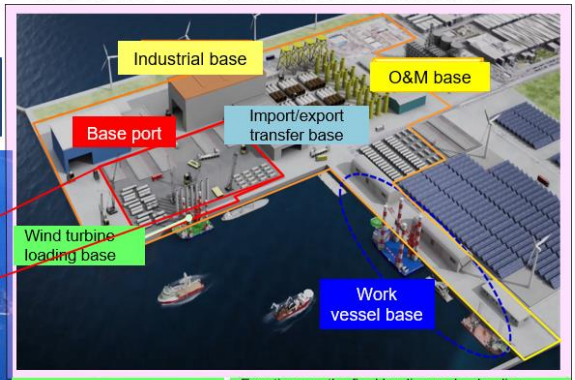
Status of specific activities

Phase 1: Attracting empirical research facilities

Phase 2: Attracting large-scale offshore wind farms

Phase 3: Improving the environment to develop the foundation for a comprehensive base and initiatives to enhance base functions





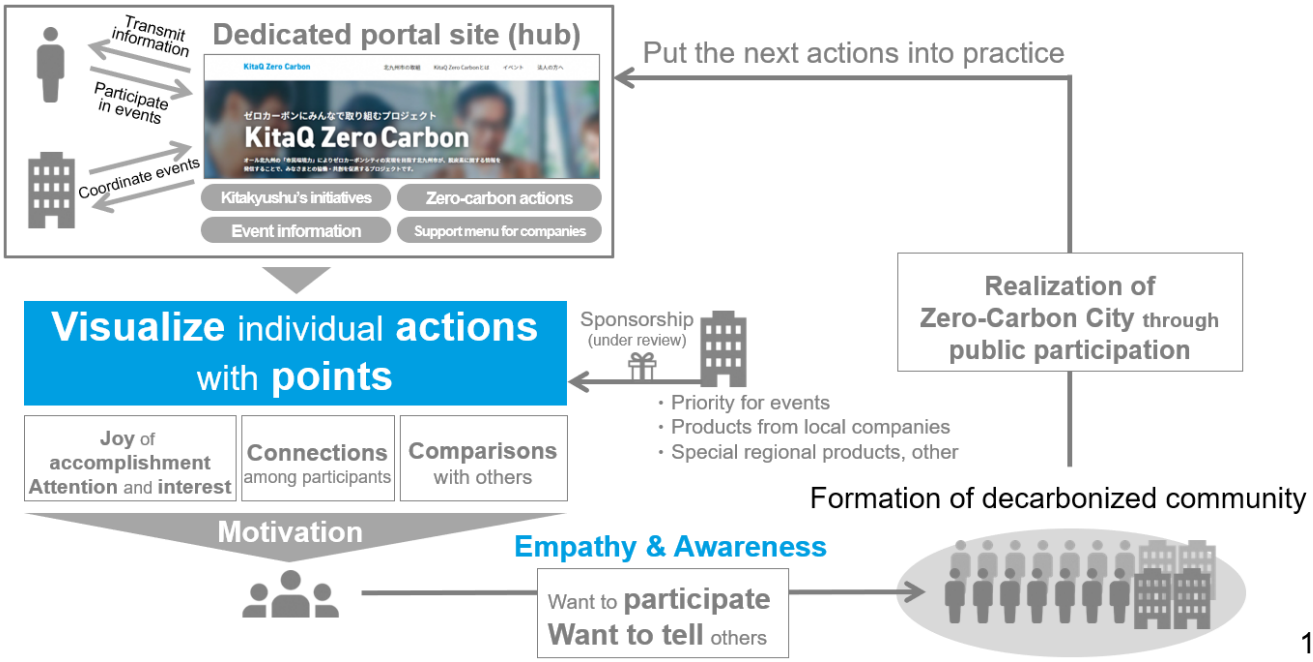
1. Wind turbine loading base	Functions as the final loading and unloading station for parts to wind turbine installation sites
2. Import/export transfer base	Functions as a base for the import, export and transfer of wind turbine parts
3. O&M base	Functions as a base for the operation and maintenance of wind turbines
4. Industrial base	Functions as an industrial base with a concentration of wind turbine-related industries in back lying areas

10

参考資料７

Initiative Designed to Encourage Changes in the Behavior of Local Residents

KitaQ Zero Carbon Project

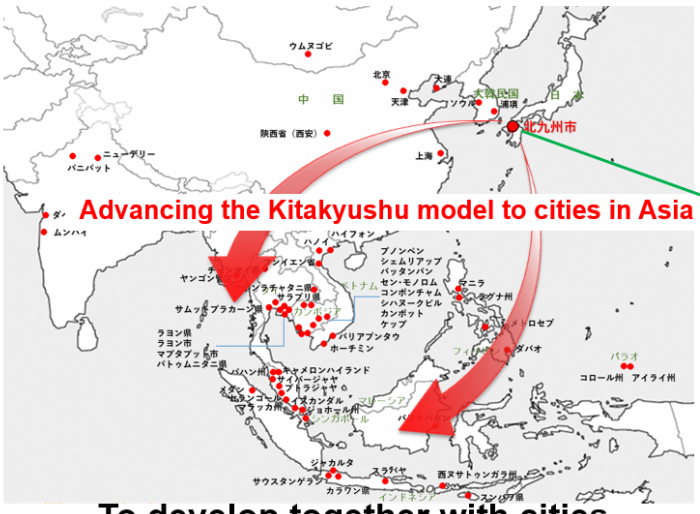


11

Future Prospect (Measures for Climate Change and Advancement to Cities in Asia)

Partnerships with Asian countries for mutual prosperity

Progress of low carbon project in Asia: 16 countries and areas, 84 cities, 238 cases, over JPY 25 billion
Trainees accepted: **9,956 people from 166 countries** Sending specialists: **215 people to 25 countries**



Advancing the Kitakyushu model to cities in Asia

To develop together with cities through mutual connection

Export base of city infrastructures
Asia's Low Carbon Hub

Talent training (KITA) → Technology export → Research study (IGES)

Joint operation through mutual connection

Overall capability of leading environmental city (Kitakyushu City)

Experience of overcoming pollution	Advanced social system (Kitakyushu Eco Town and more)	Outstanding environmental technologies

Promoting low carbon in Asia through an environmental business technique

Creating an eco-friendly city to meet varying needs

12

参考資料７

Ambition to Contribute to Global Decarbonization

Project on the formation of an eco-industrial park to promote decarbonization in Haiphong, Vietnam (Supported by the Ministry of the Environment, Japan)

Kitakyushu City's expertise on introducing renewable energy

Customized and deployed

Industrial park in Haiphong

Image of deployment

Supply of renewable energy

Industrial park management company

Installation of renewable energy facilities

Export "system + technology + finance" package

Installation of energy-efficient facilities

Local financial institutions, other

JCM project application in collaboration with Japanese companies

Customized and deployed

To other regions

To other regions

Joint Cooperation Plan on Climate Change toward Carbon Neutrality by 2050 between JAPAN and VIETNAM, Nov.24, 2021

Decarbonization domino effect!

13

Finding Solutions to Common Global Issues with Kitakyushu's Environmental Technologies

Kitakyushu's environmental technologies

Decarboni zation

Waste plastic measures

Solving common global issues

Economic growth

SUSTAINABLE DEVELOPMENT GOALS

and helping the world achieve the SDGs!!

14

参考資料８

最終報告会資料

令和3年度 脱炭素社会実現のための都市間連携事業委託業務

パラオ共和国コロール州におけるEV車両導入を通じた脱炭素化促進およびコ・ベネフィット創出事業

(コロール州・北九州市都市間連携事業)

2022年3月

北九州市 (環境局環境国際戦略課)
アミタ株式会社
株式会社EVモーターズジャパン
株式会社クアンド
公益財団法人地球環境戦略研究機関 (IGES)
株式会社ATGREEN

関係者限り

0. プロジェクト概要

関係者限り

参考資料８

これまでの提案・検討プロジェクト概要

今回の提案・検討プロジェクトでは、コロール州・北九州市の都市間連携スキームに基づき、脱炭素化及びコ・ベネフィットを図る手段として以下の内容の検討を行います。

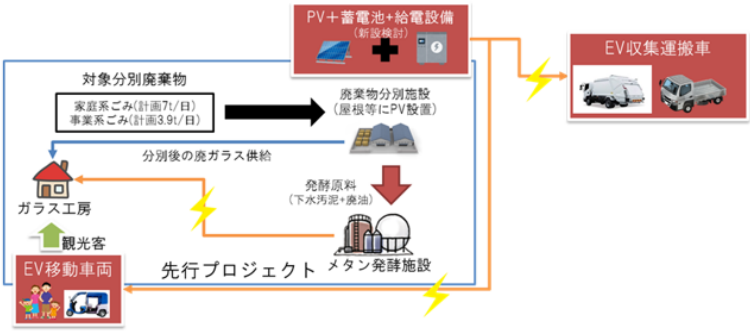
【主要検討事項】※A・Bについては下図中赤枠内参照
A. 観光分野でのEV車両(バス等)の導入可能性　B. 廃棄物分野でのEV車両(パッカー車など)導入可能性
C. その他、脱炭素化に資する取組の案件組成

①観光EV車両導入プロジェクト

◎脱炭素への貢献
・走行時の温室効果ガスの排出抑制
・再エネ利用による更なる排出抑制

＋

②廃棄物収集運搬分野導入プロジェクト



○期待されるコ・ベネフィット効果
・排ガスの排出抑制
・系統負荷を与えない再エネ導入・利活用
・エネルギーコスト削減、エネルギー地産地消
・車両メンテナンスコストの低減
・災害時の非常用電源活用
・廃棄物事業での再エネ率向上
・観光地としての環境イメージ向上・PR
・コロール州のSDGs達成への貢献
・都市間連携による技術移転・交流

関係者限り

前年度の検討　ー成果と課題ー

観光・廃棄物EVともに期待されるメリットと課題と感じている点について、概ね共通している点が特徴として挙げられました。また、現地の利害関係者の多くから温室効果ガスの排出削減に向けた施策としての期待が寄せられている点も特徴と考えられ、本プロジェクトの現地での親和性は期待できるものと考えられます。

A. 観光分野のEV車両導入検討

- 空港からホテルへのシャトルバスを検討
- パラオ国の利害関係者からは本プロジェクトへの期待の声が寄せられた
- 観光客の起点となる国際空港との連携は重要と考えられる
- イニシャルコストの低減と共にメンテナンス体制の構築が課題
- 公共交通のノウハウが乏しいので運行システムに対するキャパビルや知見に明るい体制構築が必要

B. 廃棄物回収・収集運搬分野におけるEV車両導入検討

- 廃棄物回収・収集運搬時のパッカー車の導入検討(トラックは走行距離が短い点が課題)
- 新規の埋め立て地への運搬をベースで想定していたが、現地からは回収時の運行に対する期待が寄せられた。
- コロール州からは州の進める包括的な資源循環社会構築プロジェクトとの連携への期待が寄せられた。
- イニシャルコストの低減とメンテナンス体制の構築は廃棄物分野においても課題

課題と次年度以降の検討・対応策(案)

✓ イニシャルコスト低減･･･ADBやJICAなど多様な支援・財源の確保と車両仕様の精査
✓ メンテナンス体制･･･リモートメンテナンスなど島嶼部に適したシステムの検討
✓ 実施体制・推進体制･･･観光分野では運行システム含めた検討・対策が必要

関係者限り

参考資料８

1-1. EV車両導入に向けた検討 (観光分野)

【観光分野】課題と検討事項(再掲)

前年度調査を通じて判明してきた課題、まだ積み残している部分と今年度の検討事項をまとめたものです。

項目	課題	今年度調査事項・実施事項
導入モデルの更なる精査	充電設備や蓄電池のコストが重いので、効率的な運用・導入モデルの検討が必要	効率的な運用台数・バスのスペック・バッテリー容量・充電器数等の詳細を詰めて纏める。 →ホテル側で実施している旅客運搬サービス取り込みについてヒアを行い、集約化の可能性を探る
事業実施体制	上記モデルの内容を固めたうえで、官民連携も視野に入れた事業実施体制の調整	PIACを中心に利害関係者の以降も含めたうえでの運行体制の整理
現在の車両利用状況への対応	運行管理システムのノウハウが不足しており、支援ニーズも寄せられている オプションツアー等でのニーズ把握	市バス等の運行管理ノウハウの共有検討 小型トライシクル車両の導入可能性検討
補助金や助成金の獲得	イニシャルの負担を低減することで観光分野の収益を確保しながら脱炭素を推進できる部分があり、負担低減策を入れて投資回収年数を早める必要がある	GEC・MOEJ・ADB等のファンドドナーとの協議を行い、島嶼部の支援の在り方、バンドリング申請等について協議を行うとともに申請準備を進める
メンテナンス体制	ノウハウの不足、資材調達に課題	リモートメンテナンスシステムのテスト運用を行い、現地の課題解消に対する寄与度を確認

参考資料８

【観光分野】前年度の検討EV車両導入モデル(再掲)

ホテルと空港を結ぶシャトルバスの導入モデルについて検討を行いました。充電器については空港近隣への設置を想定。併せて、PVパネル(+パワコン)・蓄電池を整備し、PV発電分を蓄電し、再エネで走行する観光EVモデル構築を想定しています。

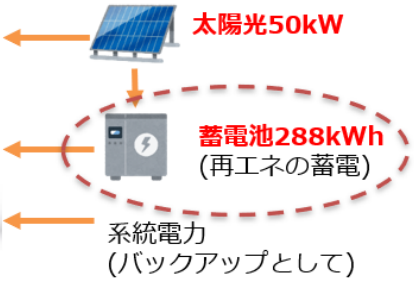
<乗客数> 30(運転席含)　<バスバッテリー容量>114kWh　<航続可能距離> 230km
<充電方式> CHAdeMO (日本式EV車両の充電方式)
→EVバスの主要生産国である中国BYD社のバスは独自規格の充電器。今回のプロジェクトを通じて、CHAdeMO式充電器の導入が進めば、日本国のEV車両の充電に使用される為、将来的な日本車EVの拡大・展開戦略にも有利になる可能性有

パラオ観光の拠点となる国際空港に充電拠点を整備することで、主要なホテルや景勝地へのアクセスを確保(台数が増えてくれば、中央部での充電拠点整備の検討も必要)

<計画走行ルート>
Route A (パラオ国際空港～Palau Pacific Resortホテル/14.6km)
Route B (パラオ国際空港～アイスボックス公園/13.1km)

【観光分野】価格面含め再考しているEV車両導入モデル(再掲_追記有)

価格の低廉化と導入モデルの再検討を行う中で、車両積載バッテリーの低用量化についてはメーカーとも協議しましたが、バッテリー劣化を考慮すると余力を持たせたい意向がありました。もう1つ重たいコストである蓄電池についてリユースバッテリーを活用し、コスト低減を図りつつ大容量化の検討を行っています。



<蓄電池積載コンテナユニットの導入>
蓄電池を積載した移動可能なコンテナユニットを導入することで、
EV車両の充電用途での使用は勿論、離島のエネルギーリスクの低減やレジリエンス強化にも繋げることが狙いです。
ボトルネックとなる蓄電池コストについてリユースバッテリーを活用することでkWh単価の低減に繋げています。

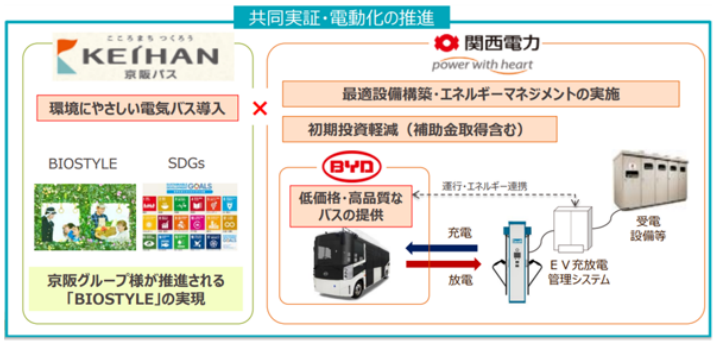
【追記】
→空港には自家発電設備1,800kVA(力率80%で1,440kW相当)が既に存在することを確認しました。また、バッテリーを移動させることが出来る点については空港としてはメリットが乏しいとのコメントが有りました。とはいえ、台数が増える可能性があること等を想定するとコストを下げて蓄電池の大容量化を図るモデルにはメリットがあることからリユースバッテリー活用については継続して検討しています。

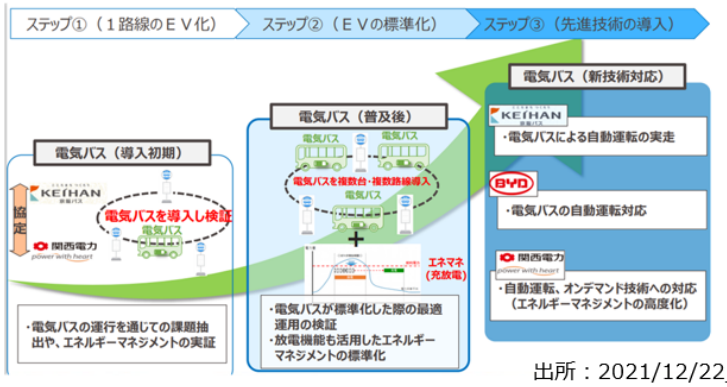
参考資料８

【観光分野】運用面の課題について

観光分野でのバスの導入についてはイニシャルコストの面だけでなく、運用面でも課題が複数あります。日本国内においてもEVバスを複数台投入して、一般路線バスの一路線を全て電動化した取り組みを行っている地域はなく、今回初めて取り組んだ京都市の京阪バスを訪問し、必要なノウハウや手応え、課題等をヒアリングさせて頂きました。

●京阪バス、関西電力、BYDジャパンによるEVバスの拡大に向けた取り組み





EVバス導入の狙い・メリット・工夫等

・脱炭素社会が進む中で先鞭を打つためにも取り組んでいる
・知見の集積により、横展開やメンテナンスビジネス化も想定
・ランニングコストは従来比3分の1以下
・CO_2削減量は1台で40t程度の見込み
・排ガスの少なさや静音性のメリットは実感している
・採用メーカー(BYDジャパン社)が**トラブル時に原則48時間以内に対応する体制を構築**している点が大きい
・EVバスを専門に10年取り組んでいる採用メーカーの運用ノウハウの蓄積は大きいと感じている

EVバスの課題

・暖房利用時の走行距離低下
・渋滞時の走行距離低下
・充放電のアルゴリズムの設計
(バッテリー容量低下を防ぐ最適化の実施)
・バッテリー大容量化とバッテリーサイズ小型化の両立

EVバスを複数台拡大していくうえでの課題

・複数台を同時充電すると消費電力が高まり、電気料金に影響が出てしまう。(系統を使う場合の問題)
・蓄電池容量と適切な充電量やタイミングのコントロール(再エネ利用時の問題)
・EV車両の走行状況/エネルギーマネジメント(充電設備やVtoB含)/さらに乗客の動きも含めたうえでの充電や配車システムを構築することが難しい
・バスの性能よりも運用システムの構築が課題になる。市営バスのような台数が多い場合はとても困難であると考える

出所：2021/12/22_京阪バスプレスリリース

【観光分野】運用面の課題について

運用体制を検討するうえで現地ホテルへのヒアリングを行い、メンテナンスやEVバスの活用方法(空港→ホテルへのシャトルバスとしての活用以外で期待される用途や運行するEVバスへ求めたいこと)について調査を行いました。

自社ホテルへの宿泊者の主な利用移動手段

・ホテルや観光協会が運営するミニバン(7社)
・自らレンタカーを借りて運転(4社)
・チャータータクシー(ドライバー付き)(2社)

各ホテルの課題

・ドライバー確保(5社)
・車両購入費及び維持費(4社)
・車両の老朽化と更新(2社)

EVバスのその他需要が高そうな活用シーン

・島内の様々な観光スポットへの往復(6件)
・入国時の空港ホテルへの移動(4件)
・出国時のホテルから空港への移動(4件)
・オプションツアーへの送迎(2件)
<その他の意見>
・ダウンタウンへの買い物

EVシャトルバスを運行させる場合の関心

・空港と自社ホテルの直接接続で自社コストの削減に繋がるかどうかについて興味ある(5社)
・共同送迎なども活用しながら外注できると良い(3社)
・環境保全の推進にも活用したい(2社)
・周遊ルートは困難　・現状に不満無し(各1社)
<その他の意見>
・安価に利用できるならば魅力的
・長期滞在のダイバーも多いので荷物が多い方への対応も必要

導入時の課題になりそうな項目

・故障時のメンテナンスとトラブルシューティング(5件)
・イニシャルコスト(2件)　・全体の採算性(2件)
・運行マネジメント体制(2件)　・運用スケジュール設計(2件)
・設備の耐久性と安全性(2件)　・ランニングコスト(1件)
・既存雇用への影響(1件)
<その他の意見>
・既存運用者との共存(地元エージェント等)

パラオへ到着する国際便は夜に多くが到着します。従って、空港とホテルのシャトル便をメインとすると日中の稼働率が落ちてしまい、非効率なものとなります。そこで現地のホテルとも連携を深め、観光スポット間の移動を日中行うことも検討する必要があると考えています。
但し、朝・昼・夕方前には渋滞もある為、バッテリーの消耗が懸念される点も留意が必要です。

参考資料８

【観光分野】運用面の課題について

前々頁・前頁のヒアリングからも課題として挙げられていたメンテナンスについては離島かつEVノウハウが全くないパラオにおいては大きな導入障壁となります。これらについて現時点で検討できることを纏めます。

●EV車両の導入に掛かる課題とその解消に向けたアプローチ

パラオの現状とEVバス導入メンテナンスの課題

<パラオの現状>
・ハイブリッド含め電動車両・EV車両については長く運航実績が無く、メンテナンス人材がいない(ソフト課題)
・物理的に生じうる交換部品について、保有するコストの問題(ハード課題)

ハード課題への対応策

・EVバス導入時にはパーツを一定数量保持することが必要
・上記の必要性は事業検討者も認識済
・ただし、保持するパーツの範囲等については詳細な協議が必要という認識

ソフト課題への対応策

・常駐で対応できる人材を確保or育成する必要性を事業検討者も認識している。ただし、採算性にも影響する要素であり、そもそも適正な人材を獲得できるかは課題。
・現地JICAからは本件について、人材トレーニングの側面から研修等による支援を行うことは検討できるというコメント有。
・リモートメンテナンスシステム(クアンド社)を活用することで遠隔でも一定のサポートが可能

現地でのEVを後押しする外部的な要因

・JICA技術協力プロジェクトにおいて、パラオ国の「交通計画マスタープラン策定」の検討がなされている。
(プレ調査を今年実施/来年より本格着手予定)
・日本の国土交通省も公共交通に関する調査を実施検討中
・現地公共施設・産業・商業省(MPIIC)も、上記マスタープランの中で電気自動車についても盛り込んでいく意向がある。
・MPIICのオビアン大臣からも本PJについては期待のコメントを頂いている
・コロール州も交通分野の脱炭素については高い必要性を認識している

政策的後押しでEV化が進むならば、メンテナンスノウハウを蓄積することでビジネスとすることも検討されると考えられます。(京阪バス様と同様の視点)

関係者限り　11

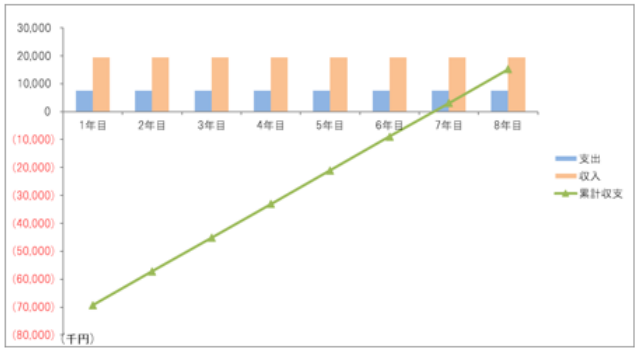
【観光分野】コスト試算(現時点での推計)(再掲)

前頁の内容を踏まえたコスト試算を再度行いました。現時点で判明している範囲での試算ですが、イニシャルコスト自体は400万円程度の減額に繋がり、更にバッテリー容量が倍近くになることで自家消費での活用によるコスト低減や災害時リスクの低減効果の向上が期待されます。

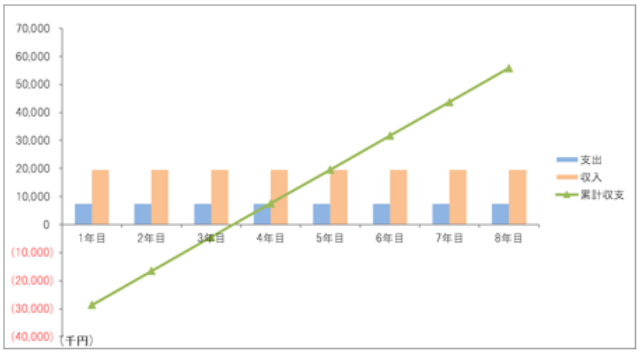
<試算条件>

・設備費一式：6,080万円(車両・充電器・蓄電池・PV・パワコン)
・エンジニアリング費用・トレーニング費用等は計上
・観光客からの収入 (年間2,000万円近くの売上を想定)
・5年借入
・関税は考慮(現地確認済)、設備運搬費は非計上
・メンテナンス費(設備費5%/年)、ドライバー費用は計上、ホテル等からの輸送業務委託費は未計上

設備費補助無しの場合



50%設備費補助を受けた場合



設備補助無しだと累損解消は7年目。
50%の設備補助があればより早期で累損解消の可能性有。現状は観光客の2割(コロナ前を基に試算/2万5千人程度)が往復800円で利用した場合で試算を実施しています。

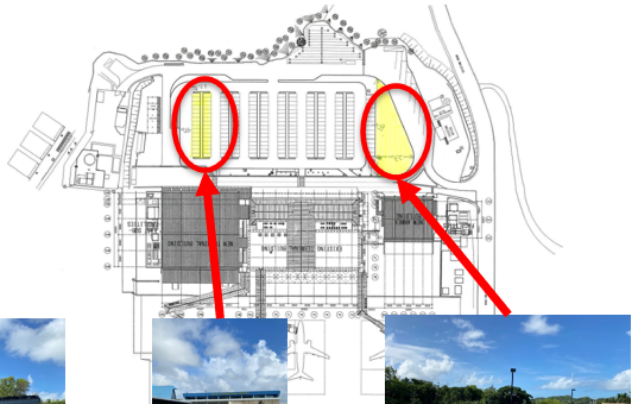
関係者限り　1

参考資料８

【観光分野】設備設置個所の検討

仮にパラオ国際空港に太陽光パネルや充電設備を設置するとした場合の可能性について検討を行いました。

＜検討条件＞
- 太陽光パネルの出力毎の必要面積はおおよそ10~15m²/kW(設置角度等に異なるケースもあり)
- 新規の土地取得ではなく、あくまでど現状の空港敷地内での活用検討
- 今回はバッテリー規模を勘案し、40kW~80kW程度での可能性を検討



既に5カ所の駐車場は屋根に太陽光発電パネルを設置済

残り1か所の駐車場屋根にも同様に太陽光発電パネルの設置は検討可能
(40m×11.5m＝460m²程度)

空きスペースとして活用可能な場所(60m×最大23m≒690m²程度)

・既存の駐車場の屋根に既に太陽光パネルが設置されています。1か所だけ設置されていない箇所(460m²)程度があり、そこに40kW程度の出力のパネル設置検討可能。

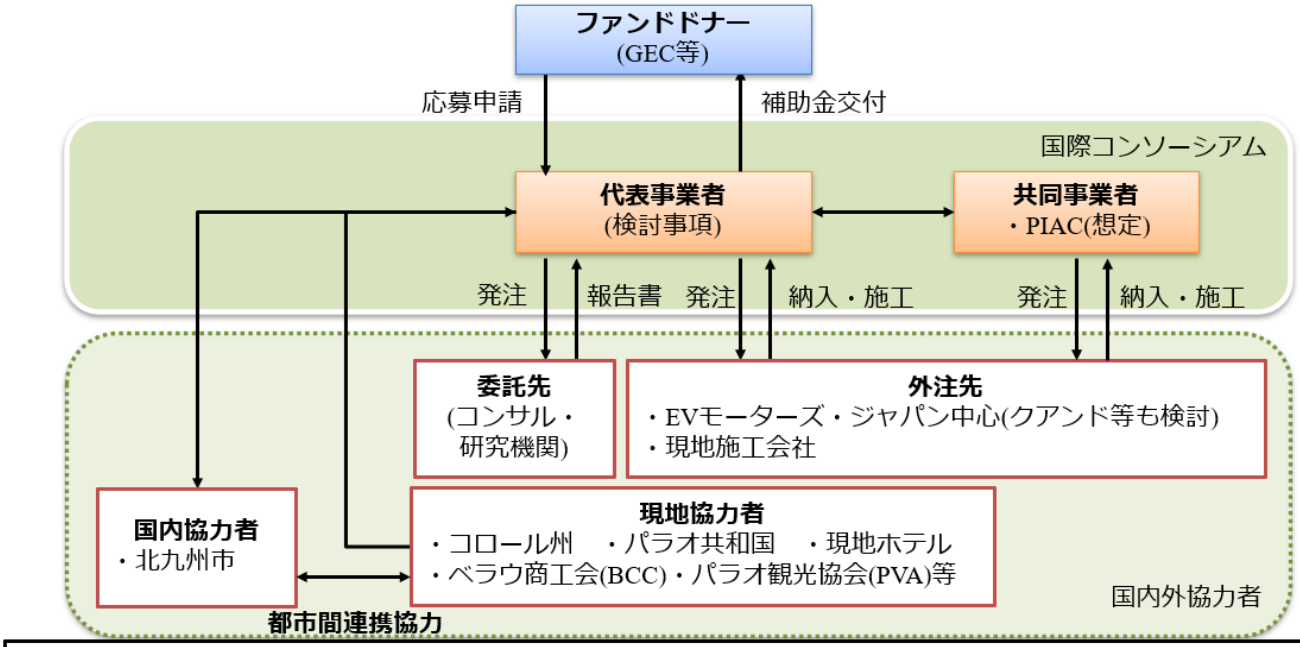
・更に600m²強の空きスペースがあり、こちらも設置は検討可能。

・充電器スペースなどを勘案したとしても、想定している出力については対応が可能であると考えられます。

・なお、現状でソーラーパネルで約半分の電力消費量をカバーしています。

【観光分野】実施体制(現時点の検討状況)(再掲追記)

現時点での検討案です。JCM設備補助やコ・イノベ事業を想定した場合の実施体制案です。



○主な課題
・代表事業者の検討(リースモデル含)
→設備補助を前提としつつ、不足分の穴埋めをする必要があり、依然として続くCOVID-19の影響による現地観光業の落ち込みなどを考えると、観光分野における設備投資環境の醸成に課題があります。イニシャルの負担を低減するため、リースも含めた検討を行い、リース会社にもヒアリングを実施しました。与信がある本邦法人と現地の関連法人であれば案件の検討をしやすいとのコメントを受けています。

参考資料８

【観光分野】継続検討事項

今後の検討事項について以下に記します。

● 代表事業者の検討

現状のEVバスは国際空港を起点にした導入・整備を想定しており、観光客が主要なターゲット。本事業の参画を検討するうえでもCOVID-19のリカバリーが遅れる中で観光客の動静が読めず、事業についても計算が立てにくい状況となっている。反面、外側では公共交通計画にEVも含めた検討の動きも有り、州も交通分野に課題感を持っている。後押しを受けやすい状況ではあるので、観光客の見通しを見ながら継続して検討を進める。

● メンテナンス側面のハード・ソフトの更なる検討

メンテナンスについては、現状ハードとソフト両面での課題がある。具体的な部品ストックの在り方やソフト側面でのリモートメンテナンス体制の検討、外部機関との連携も含めた人材教育体制が今後の検討課題である。

1-2. EV車両導入に向けた検討 (廃棄物収集運搬分野)

参考資料８

【廃棄物収集運搬分野】課題と検討事項(再掲)

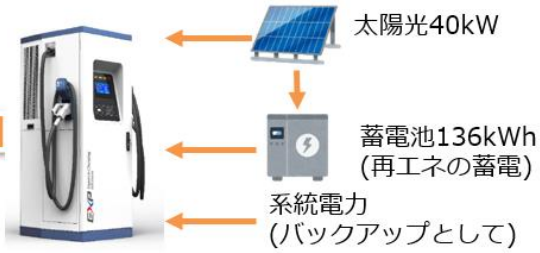
前年度調査を通じて判明してきた課題、まだ積み残している部分と今年度の検討事項をまとめたものです。

項目	課題	今年度調査事項・実施事項
導入モデルの更なる精査	充電設備や蓄電池のコストが重いので、効率的な運用・導入モデルの検討が必要	4台あるパッカー車を全部EV化したいという意向や車両の大型化に関する希望を現地より受けており、スペック・バッテリー容量・充電器数等の詳細を詰めて纏める。
事業実施体制	州が進める包括的資源循環型社会構築プロジェクトの全体像が確定しない	本構築との連携を検討しつつも、単独でのPJ組成についても検討を重ねていく
補助金や助成金の獲得	そもそも収益事業ではないので収益性確保が課題 燃料費削減効果では投資回収を行うことが出来ない	コロール州の包括的資源循環型社会構築プロジェクトでの資金獲得の協議を進めながらも、コ・イノベ事業なども含めてGEC・MOEJ・ADB等のファンドドナーとの協議を行い、島嶼部の支援の在り方、バンドリング申請等について協議を行うとともに申請準備を進める
メンテナンス体制	ノウハウの不足、資材調達に課題	リモートメンテナンスシステムのテスト運用を行い、現地の課題解消に対する寄与度を確認

【廃棄物収集運搬部門】 前年度の検討EV車両導入モデル(再掲)

前年度の検討モデルです。この時は4台あるパッカー車を1台EV化することを想定して検討を行いました。

<バッテリー容量>110kWh
<航続可能距離>180km未満
<積載量> 1,995kg
<車両総重量> 8,280kg



<充電設備想定設置箇所> M-Dock
<充電方式> CHAdeMO方式

The main parameters	
Length (mm)	6795
Width (mm)	2100
Height (mm)	2400
Wheelbase (mm)	3360
Curb Weight (kg)	6090
The rated load quality (kg)	1995
GVW (kg)	8280
The dog house feeder volume (nf)	1.1
The dog house feeder size (wide) (mm)	990
Compression way	双方向圧縮
The cycle time of loading	<16s
Waste discharge time	<20s
The garbage box effective volume (nf)	6
The sewage tank (L)	200
Compression ratio	1:3
Hydraulic system pressure (MPa)	16.2
Power Train	
Type	Pure EV
Motor Type	TZ365XS-YBM303
Rated power (kw)	60

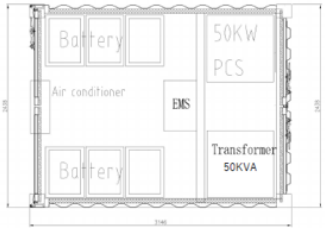
当初アイメリーク⇔M-Dockの運搬をベースにモデルを想定していましたが現地ヒアリングを経て州内の回収・収集運搬を主に据えております。(おおよそ35~40km程度)

参考資料８

【廃棄物収集運搬部門】 価格面含め再考しているEV車両導入モデル(再掲追記)

廃棄物収集運搬モデルについてもリユースバッテリーを活用した蓄電池積載コンテナユニットを導入することで充電のみでない、設備での再エネ活用率向上や災害時のレジリエンス対応力の向上などを図るモデルを検討しています。

<蓄電池積載コンテナユニットの導入>
廃棄物収集運搬モデルにおいてもコンテナユニットを導入することで、EV車両の充電用途での使用は勿論、離島のエネルギーリスクの低減やレジリエンス強化にも繋げることが狙いです。M-Dockのエネルギー利用についても再エネ活用率の向上に繋げる運用も検討可能です。
ボトルネックとなる蓄電池コストについてリユースバッテリーを活用することでkWh単価の低減に繋げています。(追記)→コロール州廃棄物事務所としては移動できる点に利点は感じて頂いている。ただし、コンテナを運ぶトレーラー車の保有が無いことから実際に移動させるとなると課題があるという認識です。



10ftコンテナタイプを想定しています
✓ バッテリー容量288kWh
✓ 出力50kW
✓ パワコン50kW

【廃棄物収集運搬部門】 現地ニーズに合わせたコスト試算の見直し(再掲)

コロール州廃棄物管理事務所からは4台のパッカー車を1度に変更したい意向が寄せられています。また、車両の大型化(積載量増)についてもニーズが出ているので、この点については引き続き可能性の検討を行っています。他にも4tユニック車の導入についても相談が来ており、出力の問題含めて現在検討を実施しています。

<現地ニーズに合わせた再検討条件>
・パッカー車について現在の4台を全てEV化、充電環境は1基でローテーションで充電させる体制を検討
⇒現在想定している利用状況なら運用上可能な見込みだが、リスクを考慮して2基導入で想定
※車両の大型化について別途検討中→現時点では車両ラインナップ構築は困難な状況

<バッテリー容量>110kWh×4台
<航続可能距離>180km未満
<積載量> 1,995kg×4台
<車両総重量> 8,280kg/台

<充電設備数>2基
<充電設備想定設置箇所> M-Dock
<充電方式> CHAdeMO方式

参考資料８

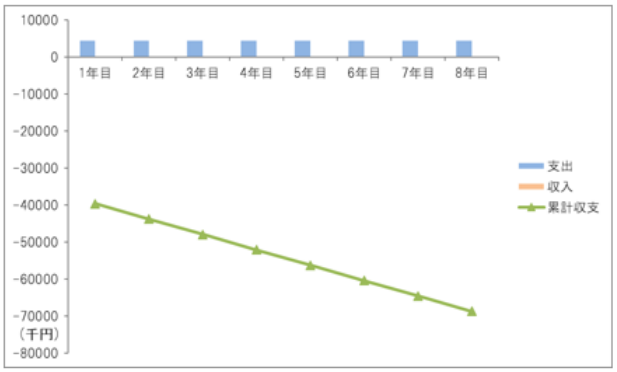
【廃棄物収集運搬部門】 コスト試算　1台1基導入時(再掲)

前頁の内容を踏まえたコスト試算を再度行いました。現時点の情報での試算ですが、トータルのイニシャルコストは変わらなかったものの、充電器を1基増強したうえで更にバッテリー容量が倍近くになることで安定した運用や自家消費活用によるコスト低減や災害時リスクの低減効果が期待されます。観光バスと異なり、化石燃料コストの低減だけでは50%あるいは100%の設備助成を受けたとしても採算性の確保は厳しい結果となっており、設備補助を受けるための費用対効果の要件を充足することもハードルがある状況です。 (但し、本試算においては車両や充電器等の更新に備えて毎年300万円程度の積み立てを行っていること、初回導入時に必要となる充電器や蓄電池などの費用がそのまま計上されていることで不利な試算となっていることには留意が必要です。

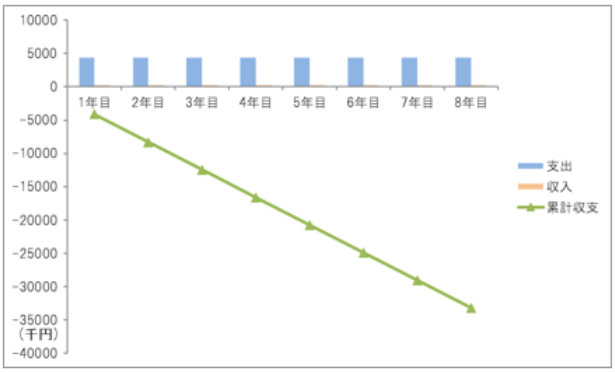
<試算条件>

・設備費一式：5,080万円(車両・充電器・蓄電池・PV・パワコン)
・エンジニアリング費用・トレーニング費用等は計上
・燃料費用削減貢献は計上
・5年借入
・関税は考慮(現地確認済)、設備運搬費は非計上
・メンテナンス費(設備費5%/年)は計上、ドライバー費用は非EV車両と同一と考え非計上

50% 設備補助



100% 設備補助



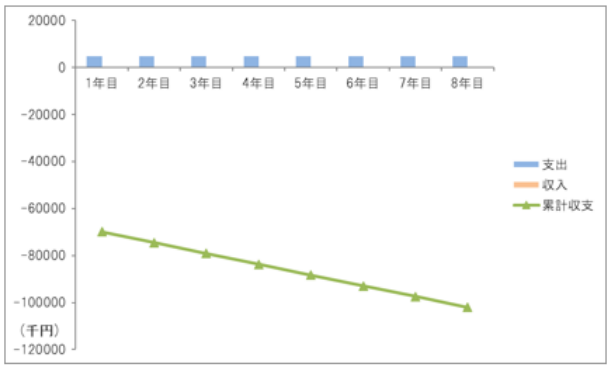
【廃棄物収集運搬部門】 コスト試算　4台2基導入時(再掲)

コロール州の要望やメーカーとも協議したうえでパッカー車を4台、充電器を2基導入した場合の試算です。蓄電池はコンテナユニットで試算をしています。この場合CAPEXは1億円以上になります。

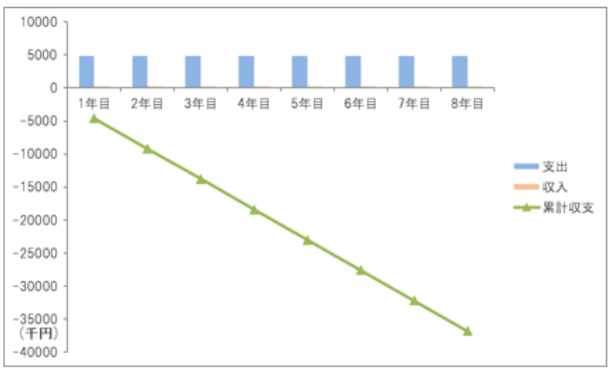
<試算条件>

・設備費一式：10,780万円(車両・充電器・蓄電池・PV・パワコン)
・エンジニアリング費用・トレーニング費用等は計上
・燃料費用削減貢献は計上
・5年借入
・関税は考慮(現地確認済)、設備運搬費は非計上
・メンテナンス費(設備費5%/年)は計上、ドライバー費用は非EV車両と同一と考え非計上

50% 設備補助



100% 設備補助



参考資料８

【廃棄物収集運搬部門】設備設置個所の検討

M-Dock内で太陽光パネルや充電設備を設置するとした場合の可能性について検討を行いました。

<検討条件>
・太陽光パネルの出力毎の必要面積はおおよそ10~15m²/kW(設置角度等に異なるケースもあり)
・今回はバッテリー規模を勘案し、40kW~80kW程度での可能性を検討

赤枠部分は既に太陽光発電の導入が計画されている場所

黄色枠は屋根付き駐車場とし、充電ステーションと追加の太陽光発電パネルの設置を想定している場所

黒枠部分は追加的な太陽光発電の導入が今後検討される場所

・元々よりコロール州では総合資源循環システムプロジェクトでは150kWの太陽光発電を設置する計画していました(パネル600枚)屋上450m²と堤防斜面400m²の活用を予定しています(左図赤枠部分)

・廃棄物処理施設においては大型車両20台以上と充電ステーションを収容できる駐車場を検討しています。このスペースは1,000m²程度を予定しており、この屋根にPVを設置して充電器等を整備することで検討をしています。

【廃棄物収集運搬分野】運用面の課題について

観光分野でも課題として挙げられていたメンテナンスについては州の廃棄物管理事務所として重要性を認識していただいており、部品ストックや人材トレーニングも検討を頂いています。

●EV車両の導入に掛かる課題とその解消に向けたアプローチ

パラオの現状とEV廃棄物収集運搬車両導入メンテナンスの課題

<パラオの現状>
・ハイブリッド含め電動車両・EV車両については長く運航実績が無く、メンテナンス人材がいない(ソフト課題)
・物理的に生じうる交換部品について、保有するコストの問題(ハード課題)

ハード課題への対応策

・EV廃棄物収集運搬車両を導入するうえでパーツを一定数量保持することが必要です。
・上記の必要性は事業検討者も認識済(廃棄物管理事務所としては、高価なものだとストックが難しい認識です)
・現状の収集運搬車両のパーツは大半が島内で手に入る為にストックはしていないとのこと。島内に在庫が無い部品も独自の調達ネットワーク、契約によりおおよそ2週間で手配が出来るようにはなっています。

ソフト課題への対応策

・常駐で対応できる人材を確保or育成する必要性をコロール州廃棄物管理事務所も認識している。人材を育成する前向きな意向もあります。
・現地JICAからは本件について、人材トレーニングの側面から研修等による支援を行うことは検討できるというコメント有。
・リモートメンテナンスシステム(クアンド社)を活用することで遠隔でも一定のサポートが可能(アイメリーク州など僻地でのトラブル時に活用できるかは要検証)
・現状としては専任の整備士がおり、通常のメンテナンスは実施している。特殊な際は車のメンテナンスショップに依頼しています。

現地でのEVを後押しする外部的な要因

・JICA技術協力プロジェクトにおいて、パラオ国の「交通計画マスタープラン策定」の検討がなされている。
(プレ調査を今年実施/来年より本格着手予定)
・現地公共施設・産業・商業省(MPIIC)も、パラオ国の交通マスタープランの中で電気自動車についても盛り込んでいく意向がある。
・コロール州は交通分野/廃棄物分野の脱炭素については高い必要性を認識している

参考資料８

【廃棄物収集運搬部門】ファンドに関する関係者との協議(再掲追記)

ADBとコロール州は「循環型社会構築プロジェクト＝Transportation Station Project」についてのF/S(1.5Mドル)についてほぼ合意に達しており、サインを待つ状況になっています。これは最終的にはADBがアレンジするODAとソブリンローンとして予算を設定する為の調査となります。本件F/S調査の中には「我が国循環産業の海外展開事業化促進業務」で北九州市とアミタ社が連携して調査検討を行ってきた廃棄物のPPP事業の内容に加えて本事業での廃棄物収集運搬車両EVプロジェクトについても対象に含まれたうえで検討を進めていくことになっています。

＜ADB官民連携部との協議について＞

● ADB官民連携部について(担当：神田様)
✓ 同部は官民連携の案件を政府側に対して支援するポジション
✓ ADBはパラオに対して過去に13MWの太陽光発電の案件についても支援を行っている

● ADBが支援するF/Sについて
✓ 上記1.5MドルのF/Sについては1月頃にサイン、業務開始を2022年3月頃で想定している
✓ この事業の検討結果が共有頂けるとPJ全体の中で組み込みやすいので検討頂きたい
✓ 調査期間は1年~1年半程度を想定している

● 最終的なファンドについて
✓ ADBのパブリックセクターが出すODA(ソブリンローン含)もあるが、JICAも本件に関心を示しており、協調の形になる可能性もある。(J-PRISMのPhase3との連携も視野に有)
✓ 想定している規模としては5M~10Mドル程度。現在の分別施設やバイオガスプラントだけでは、規模感が足りないため本EVプロジェクトについての参画は検討できると考えている。
✓ 環境省のJCM設備補助事業との連携などは検討できるか(例えば、ある機器はJCM設備補助を活用、その他の機器はADB支援を活用等)
✓ (追記)最終的には国際入札になる可能性も高く、何らかの付加価値性や優位性を持たせて欲しい

【廃棄物収集運搬部門】継続検討事項

残る検討事項について以下に記します。

●活用するファンドの検討

✓ ADB側のF/Sとの連携の継続
✓ JCM設備補助と今回のファンドを連携させることの検討
✓ 今後検討されるのは以下の形と考えています。
1)車両＋充電器と太陽光＋パワコン＋蓄電池ユニットを一体でADBファンドを中心に扱う
2)車両系と再エネ・蓄電池系を分けて、再エネと蓄電池でJCM設備補助を申請する

国際入札等を睨み比較優位性を出す必要があるとのコメントもあったことから、イニシャルコストの低減を目指す設備補助等の申請は検討が視野に入ってきている。ただし、日本側の代表事業者を誰とするかは論点となる。

●検討モデルについての精査

✓ メーカーと連携して大型パッカー車の可否とユニック車の可否についての継続検討

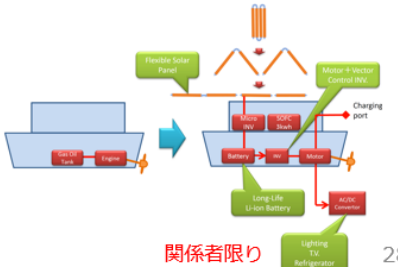
参考資料８

2. その他案件組成に向けた調査

関係者限り

【その他案件組成に向けた調査】提供可能なノウハウとシーズに関する今年度の検討

項目	課題	今年度調査で確認した事項
街灯LED案件	昨年度調査で、独立型照明ニーズ(250基)を確認していたことから、コロール州以外の州も含めてニーズを再度調査	エネルギー管理局へのヒアリングと現地コンサルによるPPUCのヒアリングいずれからも、独立型の街灯照明はLEDが整備済みでニーズはないことを確認。
		エネルギー管理局から、政府系ビル（公共施設）のLED化についてニーズがあることを確認。
ホテルの省エネ・再エネ導入	昨年度調査で、PRR(パラオ・ロイヤル・リゾート)は設備更新予定はなく、PPR(パラオ・パシフィック・リゾート)は設備更新検討中であることを確認済み	PPRでは、ディーゼル発電機（コジエネ）、空冷式チラー、水銀灯のLED化（1KW×20基）の設備更新ニーズがある。JCMの活用メリットについても説明。
Eシップ	船舶の脱炭素化ニーズに応えるため、EVMJの技術の適用可能性について検討	コロールと離島を結ぶ政府管理の渡船26隻（50フィート～）がEシップのコンバート候補になり得るが、コンバート可否の確認やバッテリー容量等の検討はまだできていない。
		CIGSフレキシブルソーラーをクルーザーやヨット等の停泊中のバックアップ電源として活用するのは現実的なソリューションだと考えられる。

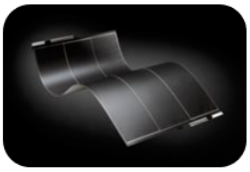
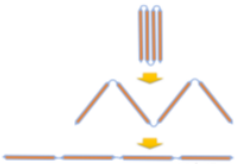
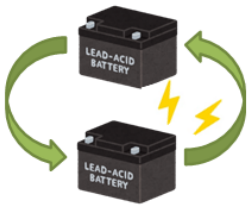


関係者限り

参考資料８

【その他案件組成に向けた調査】提供可能なノウハウとシーズに関する今年度の検討

項目	課題	今年度調査で確認した事項
電動船外機	船舶の脱炭素化ニーズに応えるため、パラオで多く普及している船外機の電化の可能性について検討	コロール州だけで船外機付きボートは345隻登録されていることを確認。ヤマハ発動機にヒアリングした結果、電動船外機は高速走行に適しておらず、グリッド電力の再エネ比率が低いなど、パラオは導入環境がまだ未成熟であるとの指摘があった。
洋上太陽光発電	EVMJが有しているCIGSフレキシブルソーラーを活用した洋上太陽光発電について検討	CIGSフレキシブルソーラーのメリット(軽量、折り曲げ可能、高効率、低コスト等)を活かせる可能性が示唆されたが、パラオは(モルディブ等と比較して)陸地に余裕があるため、わざわざ洋上で発電する必要性は低い。⇒ニーズは少ないと判断。
鉛蓄電池再生	高価なリチウムイオン蓄電池の代わりに、鉛蓄電池の再生技術を導入することによって、島内でのライフタイムを伸ばし、再エネの定置蓄電池としての活用可能性を検討。	日本国内やいくつかの途上国で鉛蓄電池の再生を事業化している企業にヒアリングを行い、技術的にはパラオで導入可能であることを確認。 パラオでは約9,000個／年の鉛蓄電池が輸入されている一方で、約6,000個／年の中古鉛蓄電池が輸出されている。EQPBのヒアリングより、鉛蓄電池の有料回収(2ドル／個)に取り組んでいることを確認。鉛蓄電池の再生技術には高い関心あり。
海洋温度差発電（OTEC）	エネルギー管理局から、アンガウル島でOTEC導入に関心が示されたため、検討。	OTECを導入する地形的環境条件は良いようだが、離島の人口は限られており、規模が小さい程コスト採算性が悪化することから、慎重な検討が必要。

関係者限り

3. 脱炭素やSDGsの観点からの都市間連携の可能性

関係者限り

参考資料８

コロール州の脱炭素に向けた検討状況と日本・北九州市側への支援ニーズ

● コロール州における脱炭素の計画等に関する状況

✓ 現在、明確な目標設定及び具体的な削減活動の計画はされていない。
✓ 州としては、例えば以下の排出削減に繋がる活動や検討を行っている。
  - ➢ コンポスト
  - ➢ 飲料容器のリサイクル
  - ➢ 廃プラスチック油化によるエネルギー活用

✓ 現状の排出量の把握や上記の活動による温室効果ガス排出量の削減量の把握が出来ていない点は課題
✓ 系統が不安定であることから大手ホテルを中心に系統に頼らない運用、化石燃料による自家発電を採用しているケースが多く、電力消費の排出が把握しにくい部分が有る(とはいえ、燃料燃焼由来で把握することでカバーはできると考える)
✓ コロール州では交通渋滞が課題であり、運輸部門のGHG排出削減(環境配慮車両や公共交通機関導入)は優先課題として捉えられている。(その他民生(家庭/業務)事業、ホテル/リゾート、発電事業、廃棄物処理分野で削減をする必要があると考えている)

● コロール州からの日本側への期待

✓ 州における現状の温室効果ガス排出量の評価
✓ 計算結果を基にした排出量削減に向けた州への提案(コンサル的側面からの提案)

※(参考)パラオ共和国における脱炭素の計画等に関する状況
✓ 国では2025年までに再エネ率を45%にすることを掲げている。(NDCとしても表明)
✓ 同じくエネルギー部門の排出量を22%(2005年比)削減することを目標としている。
  - ➢ パラオ共和国として、大規模太陽光発電設備検討(無償資金協力＋ADBのコンサル)を行っている。

コロール州のSDGs達成に向けた活動推進の状況と日本・北九州市側への支援ニーズ

● コロール州におけるSDGs達成に向けた行動の状況

✓ 州としては、例えば以下のSDGs達成に資する活動を行っている。
  - ➢ 固形廃棄物管理
    - リサイクル活動(コンポスト/飲料容器リサイクル/廃プラスチック油化)
    - 統合的な廃棄物管理(Urban Grower's Program/右図参照)
  - ➢ 海域環境(海洋環境保全/生物多様性保護)


Urban Grower's Program

✓ コロール州は右記のSDGsゴール達成に力を入れている。

✓ 課題としては、資金が限られていることがある。これは国の優先順位と関係があり、優先順位度が低いゴールには取り組むことが難しい。従って、コロール州では交通・海洋保全・廃棄物管理・農業・発電の分野での活動を優先させる考えである。

● コロール州からの日本側への期待

✓ 以下の支援を求めたいとのコメントが寄せられている
1. SDGs達成に向けた日本の取り組みの紹介
2. コロール州におけるSDGsの計画づくりの支援
3. 固形廃棄物管理/交通/発電の分野における共同プロジェクトの実施(本事業でも実施中)

参考資料８

4. 会議やWSの開催

【キャパビル関係・会議・WSなど】検討・進捗

項目	今年度調査事項・実施事項
Our Ocean Conference	2020年12月の予定から数度の延期(2021年秋→2022年2月)を経て2022年4月13日・14日に対面形式で開催予定。 サイドイベントを企画していたが、オミクロン変異株流行による入国規制強化などもあり参加を断念。
現地ワークショップ	【日時】　2022年3月1日(火)14：00～15：30 【参加者】コロール州廃棄物管理局,北九州市,Palau International Airport Corporation(PIAC),JICAパラオ事務所, 公益財団法人地球環境戦略研究機関、株式会社ATGREEN 【欠席者】Bureau of Public Works, Ministry of Public Infrastructure, Industries and Commerce、 日本大使館, KE+ Environmental Consulting Service, Farm ＆Development Company 【議題】 1．調査結果報告(観光EVプロジェクト/廃棄物EVプロジェクト/その他の脱炭素案件可能性調査) 2．北九州市の脱炭素化取組とSDGs推進の紹介 3．上記に対する質疑応答と意見交換 【主な論点】 • バッテリーコンテナは異動できるメリットがあるが、移動のためのトレーラーのレンタル料が高価である。コロール州） • パラオ政府は公共交通に関心を持っており、来年から技術協力プロジェクトを開始予定。国土交通省もパラオで公共交通の事業を検討中。また、民間連携事業で、離島での小型電動車両のシステムの調査が今年から開始予定。（JICAパラオ事務所） • JICAパラオ事務所では、ホテル、病院、デパート等を対象に、省エネの可能性を調査中。関係者を紹介できるので、今後のJCMの案件形成について検討してもらいたい。

参考資料８

5. 来年度事業について

来年度事業について　検討中活動案

COVID-19の影響により2年間の間で現地渡航が一度も出来ていない部分もあり、

● 廃棄物収集運搬EVに関するファンドドナー側との協議・検討

- ✓ ADB側で行う「循環型社会構築プロジェクト＝Transportation Station Project」に関する全体的な検討と連携しながら、廃棄物収集運搬PJの設備内容の最終案化
- ✓ 差別化や付加価値化を図るうえで、太陽光＋蓄電池のJCM案件化を検討する場合、代表事業者の検討

● 観光EVに関する活用する現地実施体制の検討

- ✓ (観光需要に依存する部分が大きいものの)公共交通化やEV化が国・州で検討される中で現地実施体制の詳細検討(空港運営会社・その他代理店・ホテル等との役割)
- ✓ 代表事業者の検討

● 脱炭素・SDGs推進に関する州政府のキャパビルニーズへの対応

- ✓ 現状排出量の把握とそこから考えられる施策の提案
- ✓ SDGsの計画に関する支援ニーズ

● その他の案件化検討事項のフォローアップ

- ✓ PPR等一部ホテルで寄せられている設備更新ニーズへのフォローアップ
- ✓ 現地JICAで行われている省エネ等の調査との連携・フォローアップ

参考資料９

EV Motors Japan　Wisdom (Fujian) Motor

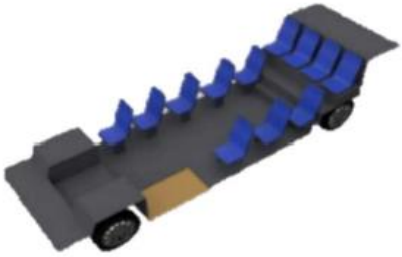
Full electric　Hydrogen

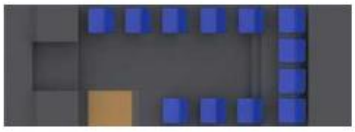
F8 series4-mini BUS　7m マイクロ e-BUS Specification

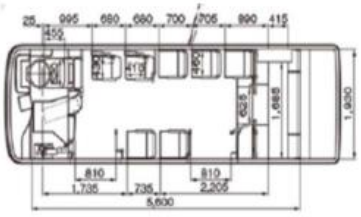
特長

1. 低床･フルフラット構造の都市バス仕様　全長:7m
2. 軽量化　:最新の長寿命･軽量コンポジット素材による EV 専用シャーシ、フレーム採用
3. 長寿命　:最新のシャーシ、フレーム材料の採用により 20 年の長寿命保証
4. 航続距離　最大 230km　:世界最高クラスの低消費電力システムによる長距離走行の実現
5. 長寿命バッテリー　:世界最高クラスのバッテリー制御システムによりバッテリー劣化を防止
6. 災害時には、大容量バッテリーを搭載した移動電源車として機能
7. 世界最高パーツ、ユニットの採用　:日本、EUを始めとして世界で最高のパーツ、ユニットにて構築
8. 最新デザイン　:一目で EV と分かる最新のデザインにて環境配慮へのイメージアップ
9. 用途に応じて、各種のバッテリーを選択可能
   長寿命タイプ、寒冷地タイプ、不燃仕様、超急速充電タイプ、ローコストタイプ
10. オプションにて天井、側面にフレキシブルソーラーパネルを搭載可能
11. 内装は座席仕様、座席レイアウト共に、カスタムメイド可能
    標準仕様の他に、豪華ファブリックシート、VIP 対応本革仕様

シートレイアウト







参考資料９

Wisdom (Fujian) Motor　EV Motors Japan

外形





内装




座席オプション



送迎用豪華ファブリックシート



VIP 席仕様皮革シート

参考資料９

Wisdom (Fujian) Motor　EV Motors Japan

F8 series4-mini BUS (WSD6690BLS1EV) Specification

タイプ Type	コミュニティユース・マイクロ e-BUS　Urban use Micro e-BUS
型式 Model	F8 series4-mini BUS (WSD6690BLS1EV)
全長（mm）Overall length	6,990
全幅（mm）Overall width	2,100
全高（mm）Overall height	3,050
ホイールベース Wheel base	4,800
座位数 seat Capacity	13+1 / 30 名

No.	項目 Item	標準配置 Standard SPC	備考 Remark
1	モーター Motor	East lake	
2	バッテリー Battery System	CATL battery	
3	バッテリー容量 Battery power (kwh)	114kwh	
4	航続距離 Range	230km	
5	ブラストポンプ Blast pump	3kw Ingersoll rand	
6	フロントアクスル Front axle	DANA Axle 2700kg	
7	リアアクスル Rear axle	Electric drive integrated rear 3,500kg	
8	フロントサスペンション Front suspension	複合材料サスペンション composite material suspension	<Option> Air bag E-CAS
9	リアサスペンション Rear suspension	複合材料サスペンション composite material suspension	<Option> Air bag E-CAS
10	ブレーキシステム Brake system	空気圧ブレーキ、ABS 付ディスクタイプ pneumatic brake, disk type with ABS	
11	ステアリングシステム Steering system	Electro-hydraulic power steering system	
12	タイヤ Tire	Goodyear 215/75 R17.5	
13	ホイール Rims	JWL-T 付 6.0＊17.5 Alcoa アルミニウム合金ホイール 6.0*17.5 Alcoa Aluminums rim with JWL-T	<Option>
14	エアコン A/C	DENSO AC Cool & Heat dual mode type	
15	デフローザー Defroster	DENSO デフロスター Denso AC defrost	
16	中央ドア middle passenger door	シングルスライドドア single sliding door	
17	後方ドア Rear Passenger door	シングルスライドドア single sliding door	<Option>
18	運転座席 driver seat	ISRI NTS 6860 布製 3 点シートベルト ISRI NTS 6860 Fabric type with 3 point safe belt	
19	乗客座席 Passenger seat	クッション布製 sponge fabric chair	
20	床 Floor	アルミ+PVC+アルミラミネートフロア Aluminum + PVC + Aluminum laminated floor	
21	フロア カバー Floor cover	レザーフロア Gerford import floor leather	
22	手すり Hand rails	アルミニウム製（黄色）手すり Yellow aluminum hand rails	
23	停止ボタン Stop button	ワイヤレス停止ボタン Wireless stop button on the stanchions	<Option>
24	前方ウィンドスクリーン Front windscreen	ラミネート前方ウィンドウ 1piece laminated front windscreen	
25	後方ウィンドスクリーン Rear windscreen	ラミネート後方ウィンドウ 1piece laminated rear windscreen	
26	サイドグラス Side glass	4mm 固定強化ガラス 4mm fixed tempered glass	
27	ブラインド Blinds	運転席側ブラインド + 電動フロントウインドブラインド driver side blind + electric front windscreen blind	<Option>
28	チェアランプ chair ramp	車椅子用スロープ wheel chair ramp	
29	ワイパー Wipers	Feipeng wiper	
30	Audio/PA システム Audio/PA system	ラジオ/CD/DVD プレーヤー,ドライバーマイク radio/CD/DVD player & driver's microphone on flexible arm	<Option>
31	カメラ Cameras	内部カメラ×2、中央ドア用×1、背面ドア用×1 Two cameras to be fitted internally; One for middle door & one rear door	<Option>
32	行先標 Destination sign	Tongda	<Option>
33	エクステリアライト Exterior Lights	Hella	
34	インテリアライト Interior lights	Tongda	
35	バックミラー Rear view mirror	電動ミラー Shanghai shengshi top mounted Electric mirror	<Option>
36	リバーシングカメラ Reversing camera	後方確認カメラ rear view camera	<Option>
37	自動消火器 Auto fire extinguisher battery cabin	付属	
38	バッテリーキャビンの煙検知	煙検知とアラーム Smoke detection and alarm	
39	車体構造 Body structure	モノコックボディ Monocoque body	
40	ボディスチール Body steel	ステンレススチール stainless steel	
41	ボディパネル Body panel	複合材料 composite material	

Remarks
1. If the specification is not specified, it shall be implemented according to the design standard of EVM-Japan.
2. If there is no special requirement, it shall be executed according to the standard process requirements of EVM-Japan.
3. The technical data involved in this document are owned by EVM-Japan, In case of infringement, the company reserves the right to retroactively.
4. Warranty: 1 Year (or) 100,000Km, Whichever occurs first after product arrived at destination port.

参考資料９

EV Motors Japan　XCMG　Full electric　Hydrogen

pure electric compression type garbage truck

The main parameters	
Length (mm)	6795
Width (mm)	2100
Height (mm)	2400
Wheelbase (mm)	3360
Curb Weight (kg)	6090
The rated load quality (kg)	1995
GVW (kg)	8280
The dog house feeder volume (m³)	1.1
The dog house feeder size (wide) (mm)	990
Compression way	双方向圧縮
The cycle time of loading	<16s
Waste discharge time	<20s
The garbage box effective volume (m³)	6
The sewage tank (L)	200
Compression ratio	1:3
Hydraulic system pressure (MPa)	16.2
Power Train	
Type	Pure EV
Motor Type	TZ365XS-YBM303
Rated power (kw)	60

Remarks

1. If the specification is not specified, it shall be implemented according to the design standard of EVM-Japan.
2. If there is no special requirement, it shall be executed according to the standard process requirements of EVM-Japan.
3. The technical data involved in this document are owned by EVM-Japan, In case of infringement, the company reserves the right to retroactively.
4. Warranty : 1 Year (or) 100,000Km, Whichever occurs first after product arrived at destination port.

株式会社 EVモーターズ・ジャパン

www.evm-j.com

北九州本社
〒802-0007 福岡県北九州市小倉北区船頭町 2-6-1805

北九州エンジニアリングセンター
〒802-0001 福岡県北九州市小倉北区浅野 3 丁目 8-1

東京営業本部
〒102-0094 東京都千代田区紀尾井町 3-29 第 2 山本ビル 5F

取り扱い代理店

本書の一部または全部の複製は固くお断りします。
記載内容は予告なく変更する場合があります。
© EV Motors Japan Co., Ltd 2019

参考資料９

新・CHAdeMO Ⅱ 急速充電設備　外観と仕様　120kwh

EV Motors Japan

750VCHAdeMO Ⅱ充電設備

主な仕様

1．CHAdeMO、CCS1、CCS2、BGT規格に対応
2．IP65防水仕様
3．OCPP1.6J対応
4．最大出力120kw　出力電圧　750V
5．FUSE、EPO、SPD、RCD、漏れ電流検出
6．７"TFT液晶モニターサポート

Technical parameters

Input parameters	
AC Frequency	45~65Hz
AC Voltage	3-phases+N+PE, 260Vac-530Vac
Power Factor	>0.99
Total harmonic current	<5% (Rated input)
Output parameters	
DC Voltage accuracy	<±0.5%
Output DC voltage range	DC 150V-750V / DC 150V-550V / DC 150V-500V
Max DC output current	200A (750V120kW) / 280A (550V120kW) / 320A (500V128kW) Each charging cable's max output current is 200A/CCS, 250A/GBT, 125A/CHAdeMO
Max DC output power	120kW / 120kW / 128kW
Max system efficiency	>94.5% (Rated input and output)
AC output	AC type2 22kW/32A
Working environment	
Ambient temperature	-20 ~ +70℃, full power output below 45℃, Power derating 5%/ ℃ above 45℃
Storage temperature	-40 ~ +75℃
Working humidity	0 ~ 95%
Working altitude	2000 m
Standard	
CCS PLC communication	DIN70121 and ISO15118
CHAdeMO	CHAdeMO V1.2
GBT	GB/T 18487.1-2015, GB/T 27930-2015, GB/T 20234.1~3-2015
EMC/Safety	CE, EN61000-6-3/EN61000-6-1 Class A ; EN 61851-1-2001/EN 61851-21-2001/EN 61851-22-2001
Protection Class	IP65/K10
Function and Interface	
HMI	7" TFT Touch Screen LCD, RFID, Power(G) /Alarm(R) /3-Charging(Y) panel LED
Metering	1 AC energy meter and 2 DC energy meter , GB/T 50063-2008 and DL/T 5137-2008 standard
Monitor interface	OCPP 1.6J , LAN 10M/100M and optional inner LTE wireless modem support
Charging Mode	Auto basis, Time basis, Amount basis, Energy basis, SOC basis
Power Distribution Mode	Stand alone, Current switch, Plug switch, Full hold, Master slave
Mechanical	
Dimention (W * H * D mm)	700 * 1750 * 760 mm
Weight (Kg)	150 +11 * N (N is the charger module configuration number)
Charging Protection	
	Overcurrent protection, Short circuit protection, Overvoltage protection, Undervoltage protection Insulation monitoring, Protect Earth connect monitoring Reverse polarity protection, Overtemperature protection RCD-A mian protection and RCD-B for AC connector protection
Configuration	
Charger module configuration	8 charger power module slots, 750V15kW / 550V15kW / 500V16kW Charger power modules selection
Charging connector configuration	2 CCS /2GBT /1 CCS+1 CHAdemo / 1 CCS+1 GBT, AC type2 cable or AC type2 socket
Charging connector capacity	200A/1000V for CCS, 125A/500V for CHAdeMO, 250A/750V for GBT, 32A for AC Type2

リサイクル適正の表示：印刷用の紙にリサイクルできます
この印刷物は、グリーン購入法に基づく基本方針における「印刷」に係る判断の基準に従い、印刷用の紙へのリサイクルに適した〔A ランク〕のみを用いて作製しています。
Recycling Proper Indication: Can be recycled to print paper
This printed matter is produced using only [A rank], which is suitable for recycling into printing paper, in accordance with the criteria for "printing" in the basic policy based on the Law on Promoting Green Purchasing.