

**"Project Formulation Survey" under the  
Governmental Commission on the  
Projects for ODA Overseas Economic  
Cooperation in FY2013**

**Summary Report**

**Republic of Palau/  
Republic of the Fiji islands  
Independent State of Samoa**

**ODA Feasibility Study on Diffusing  
Machinery for Converting Waste Plastic  
to Oil in the Pacific Region**

**March, 2014**

**Blest Co.,ltd / Fujitsu Research Institute / Kaihatsu  
Management Consulting Inc. Joint Venture**

The content of this report is a summary of the project formulation survey, which was commissioned by the Ministry of Foreign Affairs of Japan in the FY 2013 and is carried out by the consortium (Blest Co.,Ltd / Fujitsu Research Institute / Kaihatsu Management Consulting Inc. Joint Venture). It does not represent the official view of the Ministry of Foreign Affairs.

## **Introduction**

In the Pacific region, many countries face difficulties in acquiring proper landfill sites due to their small land size and other geographic conditions. They also have a chronic energy shortage, as many countries are fully dependent on imported fossil fuel for energy generation.

This survey aims to collect related information and analyze the conditions necessary for introducing a machine that converts plastic waste into oil. It also aims to formulate a concrete proposal for ODA projects and business development in order to contribute to solving the problem of waste management in Palau, Fiji, and other countries in the Pacific region.

## **Chapter 1:**

### **Current situation and development needs of the targeted countries**

Among the challenges faced by the countries in the Pacific region due to its geographic features, waste management is one of the most serious ones. In recent years, lifestyles have become modernized, waste components have increased in sheer variety, and the waste volume has increased as the population expands. This makes it difficult for countries with limited land area to secure proper landfill sites, and therefore the waste remains accumulated in the islands. Environmental destruction is a very critical issue affecting sustainable development in these countries, where the main industry is tourism.

In this chapter, the current situation of waste management, policies, laws, and regulations of the targeted countries is summarized.

#### <Waste management situation>

##### ➤ Palau

In Palau, 70 percent of the total population is concentrated in Koror state. Koror state is the center of the economy in Palau, and it has the largest landfill site -- M-Doc. The Waste Management Office of the Public Works Bureau in the Ministry of Public Infrastructure, Industries, and Commerce oversees the total waste management in the country, but the major responsibility for collection and recycling lies with the recycling center in Koror state.

The total volume of waste generated annually is about 6,000 tons, and the volume of plastic waste is estimated to be 2,000 tons. In Palau, a container deposit system was introduced in 2011 as one of the waste management measures. In this system, ten cents per container is collected as custom duties. Five cents is refunded to the container collectors, 2.5 cents is pooled in the governmental fund for waste management, and 2.5 cents is allocated to the management fee of the recycling center. Since the introduction

of the system, over ten million containers have been collected, and private vendors ship them overseas. In Koror state, other waste minimization efforts are also made, such as making compost with organic waste, installation of segregation stations, and conducting awareness-raising activities.

There are thirteen landfill sites in Palau, but few of these are properly managed. It is estimated that M-Doc will be filled to capacity within two to three years, and there is a plan to build a new national landfill site, but the plan is yet to be finalized with respect to details such as location, budget, and management system.

➤ Fiji

In Fiji, waste management, including setting and managing related policy laws and regulation, is controlled by the Department of Environment of the Ministry of Local Government, Urban Development, Housing, and Environment. The health department of each council controls the actual waste management at the municipality level. The total volume of waste generated annually in Fiji is 130,000 tons and 76 percent of the total volume is dumped at landfill sites. Plastic waste excluding PET is estimated to be 5.8 percent of the total waste.

In this survey, the waste management situation of four councils—Suva, Lautoka, Nadi, and Singatoka—was studied. Activities based on 3R and awareness programs such as Clean School Program are actively conducted in Lautoka and Nadi.

Seventy-six percent of the total waste is dumped at eight landfill sites, and 60 percent of the dumped waste goes to Namboro landfill site, which is the largest in the country and built with EU's financial and technical support. The management of the site has been assigned to a private company. Several private companies such as Coca Cola, resort hotels, and NGOs also conduct recycling activities in Fiji.

< Related policy, law, and regulation >

Waste management in the Pacific region is planned and conducted in accordance with the Pacific Regional Solid Waste Management Strategy endorsed at the SPREP 20<sup>th</sup> general assembly meeting. The strategy stipulates nine main strategies and related activities, including topics closely related to this survey such as the development of a regional 4R strategy and the development of new recycling methods.

➤ Palau

The draft of the “National solid waste management plan” was prepared in 2008 and obtained ministerial approval in 2011. The goal of the plan is to build a sustainable solid waste management system through waste minimization with the 3R policy, selection of

proper technology, and promoting stakeholders' participation. The budget allocation for waste management is minimal in Palau; on the other hand, in Koror state, waste management is allocated 10 percent of the total budget, which indicates the state's strong commitment to the issue.

➤ Fiji

Waste management in Fiji is conducted based on the "National solid waste management strategy 2011–2014." The goal is to increase the proportion of solid waste that is managed in a cost-effective, financially sustainable, legally compliant, and environmentally sound manner. A 3R policy has also been prepared, and it is waiting for final cabinet approval as of December 2013. The proportion of the budget for waste management in the total national budget is 0.23 percent (2013).

## **Chapter 2:**

### **Possible applicability of the SME's products and technologies, and prospects for future business development**

The machine proposed in this study converts plastic waste to mixed fossil fuel/oil through a simple mechanism that liquefies and distills it using heat. The oil produced does not require any further treatment and can be used in boilers and generators instead of diesel oil. The machine is also able to distill mixed oil to gasoline, diesel oil, kerosene, and heavy crude oil if required. It can run on a generator fuelled by the oil it produces and does not require electricity from power grids. Thus, the machine offers a compact integrated recycling facility to any island that faces difficulties in constructing or maintaining a landfill.

The manufacturer will make its entry into the Pacific region by first establishing a prototype business in Palau. It aims to reduce waste by using the machine, and it will set up more businesses in the other parts of the region. With the cooperation of the Koror State Government, the first prototype business will be set up in the state owned recycling center using the smallest machine, NVG220, converting 200kg of plastic per 24 hours, a crusher, and a plastic generator. The recycling center will use the oil produced to run the machine as well as the other facilities in the center. The machine is designed to create enough fuel to replace up to 40 percent of the electricity currently used by the center. Once the center proves that it has set up a regular operation for the collection and segregation of plastic waste in the community, the system will be scaled up to produce enough fuel to power both the center and another premise, such as the Koror State Assembly Hall, through the public power grids or batteries.

This model can be applied in part to the other islands in the Pacific Rim; in addition,

it could be offered to the private sectors in islands that have larger populations and more industries, like Fiji. Therefore, the manufacturer will approach both governmental agencies and private entities.

### **Chapter 3:**

#### **Verification of the adaptability of the SME's products and technologies to the surveyed countries (demonstration and pilot survey)**

This study aims to verify the adoptability of the machine in:

- 1) The recycling center in the Koror state of Palau by analyzing the details of the dumped waste, collection systems, and the current capacities of waste management
- 2) Educational organizations that act as stations to collect and segregate plastic waste from households in the Koror state of Palau
- 3) The public and the private sectors in Fiji and other Pacific countries in the future

The first part of the study captured the estimated amount of waste dumped into the Koror State and its breakdown, and analyzed how to collect and segregate plastic waste more efficiently within the recycling center. It also observed, through a monitoring survey stated in the second part of the study, whether the staff is capable of further segregating collected plastics in the state into different categories. The result suggests that the staff demonstrated competence in managing the machine and plastic wastes. There are existing groups/people to be added to the current collection and segregation systems in order to efficiently collect plastic waste. The recycling center, in fact, decided to install the smallest machine in the financial year 2013; however, it transacts only 0.9 percent of the full amount of plastic waste currently dumped into the landfill. It is expected that the center will move up to the next stage by saving electricity and utilizing it to collect and segregate plastic waste in greater quantities. The shift will lead the recycling center to adopt the machinery on a larger scale.

The second part of the study was conducted to analyze the effectiveness of the desktop machine when used for educational purposes, the possibility of forming a waste collection system in schools, and the competence of the staff operating the machine at the recycling center. The analyses were extracted from questionnaires and a monitoring survey of four classes selected from three elementary schools. To show students in the four classes how the environment was valuable and the machine could help to protect it, the study team and the staff together conducted an educational program by running two desktop machines. After the demonstrations, the team collected 108 questionnaires in total and placed a waste bin in each class to start collecting plastic for the monitoring

survey. The result from the questionnaires revealed that almost 100 percent of the students understood the meaning of the educational program, and 60 percent of them were motivated to work on collecting and separating waste to dispose in the waste bin.

The monitoring survey was carried out for two months by six members of the staff from the recycling center whom the study team trained regarding purpose, methodology, data collection, using the machine, and separating plastics by category. The staff collected 12.3 kg of plastic waste in total, of which 11.4 kg, more than 90 percent, was compatible with the machine. The plastic waste was precisely separated into four kinds by the staff and converted to oil, which was verified for usability by burning. Furthermore, the staff motivated themselves and demonstrated educational programs with the machines on their own. Overall, it appears that the staff at the recycling center has the training and skills to discriminate between different plastics and to use the machine.

It was found from the third part of the study that the Palau model can be replicated by some local governments, such as Nadi Town Council, that are currently working on the segregation of wastes, and it could also be sold to the private sector. Enterprises in Fiji are interested in reducing their waste as dumping fees are high. The economic performance of this machine could be high enough for a resort in the remote islands to invest in, since it costs more to send waste to the closest island where there is a landfill. However, business entities in a large island with landfills need to collaborate with others in order to share a machine. A council or an association could take the initiative and organize an industrial plastic waste collection system.

#### **Chapter 4:**

### **Expected development impact and effect on business development of the Blest in the target countries through proposed ODA projects**

The machine proposed in this study will comprehensively help to solve common challenges faced by the island countries. The main developmental issues and the contribution of the proposed machine to resolve these issues are summarized in the table below.

<b>Developmental issue</b>		<b>Solutions by the product</b>
Environmental protection	Waste minimization	Volume of waste can be reduced by using the machine to convert plastic waste to oil. Plastic accounts for 5–32% of the total waste and has no treatment method. This will also reduce management and treatment costs for the landfill site. It promotes the segregation of waste and 3R activities.
	Creation of renewable energy	Waste can be converted to renewable energy and utilized for power generation, transportation, fuel, boiling, air conditioning, etc. It also contributes to CO <sub>2</sub> reduction.
Strengthening the foundation of economic development	Promotion of tourism development	A beautiful environment unspoiled by garbage and smell can contribute to tourism development and economic impact.
	Human resource building	When installing the machine, it is necessary to provide technical support for its sustainable utilization. Environmental education is also important for promoting segregation. As Blest can provide both hard and soft support, it can contribute to the development of human resources by imparting the latest knowledge in technology and advocacy, which is necessary for national development.
	Employment generation	By increasing the revenues from converted oil, implementing agencies can create new demand for engineers or 3R promoters. There might also be an indirect impact on employment in the tourism industry.

When considering the developmental impact of introducing the machine, the following points can be noted: 1. Cost reduction by reducing waste, 2. Creation of renewable energy, and 3. Human resource development and employment generation by promoting 3R. In the case of points 1 and 2, the construction and development cost of landfill sites can be reduced by extending the life of the existing landfill sites, and the dumping fee paid by the municipality can also be reduced. A very high economic impact can be expected in Palau and Fiji where the fuel cost is very high. As for point 3, Blest has many years of experience in developing technical support for the sustainable utilization of the machine. Technical support includes not only engineering and maintenance but also environmental education for collecting and segregating plastic waste. This will help to develop human resources who can envisage and plan for sustainable national development. The economic incentive from generating oil can also drive increased employment in the area of 3R promotion and segregation.

The feasibility of installing the machine in each potential location based on the DAC 5 evaluation criteria is summarized below.

	Palau	Fiji			
Municipality	Koror	Suva	Lautoka	Nadi	Singatoka
Validity	◎	◎	◎	◎	◎
Effectiveness	○	△	○	○	△
Efficiency	○	×	○	○	×
Impact	◎	◎	○	○	○
Sustainability	○	○	○	○	○

## Chapter 5: Proposals for formulating ODA projects

In this chapter, based on the development needs and the company's business plan mentioned in Chapter 1 to Chapter 4, a direction and an outline are examined for concrete ODA projects, which benefit both the development needs of the country and the business expansion plan of the company. Applicable ODA schemes are i) Pilot Survey for Disseminating SME's Technologies, ii) Grant Assistance for Grassroots Human Security Projects, iii) Grant Aid, iv) Technical Assistance Project, and v) Japan Overseas Cooperation Volunteers (JOCV).

The bases by which to prioritize among possible ODA projects are i) whether or not the ODA project generates synergies through the grant of the machine (hard component) and technical assistance (soft component), ii) whether or not the ODA project fits the mid-term and long-term business expansion plan of the company, and iii) whether or not the ODA project, by applying the latest Japanese technology, is effective and sustainable. Based on the above-mentioned points, the following prioritized ODA schemes and concrete project ideas are developed.

	ODA scheme	Concrete project ideas
1	Pilot Survey for Disseminating SME's Technologies	<ul style="list-style-type: none"> <li>• To install NVG1000, which processes one ton of plastic per day, along with other necessary equipment, at Koror Recycling Center in Palau, and to install, as a pilot project, NVG220, which processes 200kg of plastic per day, with necessary equipment, at Rautoka City Council or Nadi Town Council in Fiji</li> <li>• To provide technical assistance such as training for machinery operation, advice on awareness activities, knowhow on garbage collection and segregation, and an evaluation of the project</li> </ul>
2	Grant Assistance for Grassroots Human Security Projects	<p>&lt;Option 1&gt;</p> <ul style="list-style-type: none"> <li>• To install NVG80, which is portable, at local governments or NGOs in Fiji for their awareness activities</li> </ul> <p>&lt;Option 2&gt;</p> <ul style="list-style-type: none"> <li>• To install NVG220 as a pilot project at local governments in Fiji</li> </ul>

The Koror state in Palau and local governments in Fiji are highly interested in installing the machine in their administrative areas. In Palau, the recycling center of Koror state has already installed NVG220 as a pilot project using their own funds, and it has been managing and maintaining the machine by themselves. In addition, the recycling center continues the awareness activities by using a small portable type of the machine, Be-H, which is lent through this survey. Moreover, the recycling center requested additional finances from the Koror State Government in order to expand the central warehouse to accommodate the new machine, to implement 3R awareness activities, and to increase the staff in the center. The availability, willingness, and morale of the staff at the recycling center is worth mentioning.

In the case of Lautoka City Council, Nadi Town Council, and Sigatoka Town Council in Fiji, the CEO and the Special Administrator, SA, who form the top management of the organizations, are very interested in the installation of the machine. Nadi Town Council, in particular, proposed to provide space for the machine, expand and prepare the warehouse, and allocate staff for 3R awareness activities.

(Project Formulation Survey)  
Republic of Palau, Republic of Fiji, Independent State of Samoa  
The Study on Disseminating Machinery for Converting Waste Plastic to Oil in the Pacific Region

**SME and Counterpart Organization**

- Name of SME: Blest Co.,Ltd
- Location of SME: Kanagawa Pref. Japan
- Survey Site ▪ Counterpart Organization: Korol State Government of Palau (Recycle Centre), Ministry of Local Government, Urban Development, Housing, and Environment of Fiji

**Concerned Development Issues**

- **[Increased Dumped Waste]** Plastic waste is non-biodegradable. Every year, it accumulates and occupies landfills. Modernised lifestyles further aggravates the situation.
- **[Impact to Natural Environment]** Tourism is a key industry for the economy of these countries. The sustainability of its breathtaking sceneries hinges on environmental protection. In addition, debris brought by typhoons and storms aggravates marine pollution.
- **[Energy Issue]** They are dependent on imported refined diesel oil to produce power. Increased prices of oil will impact on the countries' people.

**Products and Technologies of SME**

- **[Products/Functions of Machines]** The machine converts plastic waste to fossil fuel through a simple mechanism. It can run automatically for 24-hours with electricity. There are five sizes and the capacity ranges from the ability to convert a minimum of 200 kg to a maximum of 8-tonnes. No VOC gas after catalytic filters attached. Small, light, simple mechanical structure and maintenance. No specific techniques required to operate.
- **[Creation of Value from Waste]** The machine is capable of accepting impurities like labels, dirt etc. while processing. Oil extracted can be used as fuel without further treatment - add to diesel oil, put into plastic oil generators and boilers and etc. 80% productivity in weight. Consume 1.2kwh for 1kg of plastic.

**Proposed ODA Projects and Expected Impact**

- **Mid-Large Machines:** They produce oil from waste dumped into landfills. It contributes to reducing wastes, prolonging life of landfills, and reducing usage of imported fossil energy resources.
- **Portable-Small Machines:** They promote paradigm shift on waste management and waste segregation through educations on environment and energy resources especially to children in schools.

**Future Business Development of SME**

- Create more business opportunities through sale of the waste management and alternative energy/fuel concept and model to other business entities and governmental agencies where similar waste and energy issues exist.
- Develop the SME model in the Hiratsuka community, to revitalise the community's economy by returning profit through activities of environmental education and employment.

