REVIEW OF THE MARSHALL ISLANDS ALTERNATIVE ENERGY COMPANY

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SOPAC Secretariat

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Development and Economic Policy Division
Forum Secretariat
Suva, Fiji Islands
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### ABBREVIATIONS

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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>AGM</td>
<td>Annual General Meeting</td>
</tr>
<tr>
<td>AoI</td>
<td>Articles of Incorporation</td>
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<tr>
<td>BoD</td>
<td>Board of Directors</td>
</tr>
<tr>
<td>EAG</td>
<td>Energy Advisory Group</td>
</tr>
<tr>
<td>EO</td>
<td>Energy Office</td>
</tr>
<tr>
<td>Forsec</td>
<td>Forum Secretariat</td>
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<tr>
<td>GM</td>
<td>General Manager</td>
</tr>
<tr>
<td>JOVC</td>
<td>Japanese Overseas Volunteer Cooperation</td>
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<tr>
<td>LPG</td>
<td>Liquefied petroleum gas</td>
</tr>
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<td>MAEC</td>
<td>Marshall Alternative Energy Company</td>
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<td>MEC</td>
<td>Marshall Electricity Corporation</td>
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<tr>
<td>MIDA</td>
<td>Marshall Island Development Authority</td>
</tr>
<tr>
<td>MOU</td>
<td>Memorandum of Understanding</td>
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<tr>
<td>MRD</td>
<td>Ministry of Resources and Development</td>
</tr>
<tr>
<td>NTA</td>
<td>National Telecommunications Authority</td>
</tr>
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<td>OIEP</td>
<td>Outer Islands Energy Program</td>
</tr>
<tr>
<td>OM</td>
<td>Office Manager</td>
</tr>
<tr>
<td>PREP</td>
<td>Pacific Regional Energy Program</td>
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<tr>
<td>PV</td>
<td>Photovoltaic</td>
</tr>
<tr>
<td>RMI</td>
<td>Republic of the Marshall Islands</td>
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<td>SEP</td>
<td>Solar Energy Program</td>
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<td>SOPAC</td>
<td>South Pacific Applied Geoscience Commission</td>
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FOREWORD

In April 1998, at the request of the Republic of the Marshall Islands’ (RMI) Ministry of Foreign Affairs, the Energy Unit of SOPAC provided assistance to RMI to review the management and institutional aspects of its solar rural electrification program.

In brief the review was to:

- assess the accounting and business management practices at the Marshall Alternative Energy Company (MAEC);
- assess the adequacy and the role of the management and institutional framework in the realisation of the program's objectives;
- provide on-site advice on issues identified; and
- provide recommendations on possible follow-up measures.

ACKNOWLEDGEMENTS

The assistance of the Secretary and staff of the RMI Ministry of Resources and Development, particularly that of Mr Paul Ishoda is gratefully acknowledged. Their time and knowledge contributed much to this study. Mr Paul Fairbairn’s comments and guidance were invaluable to the writing of this report.

The financial assistance provided by the Forum Secretariat and the logistic support provided by Mrs ‘Amelia Kinahoi Siamomua of the Development and Economic Policy Division, are much appreciated.

Mr Herb Wade’s paper on the Pacific’s experience and his previous work on electrification in the region along with Mr Chris Cheatham’s work on the Kiribati Solar Energy Company have been invaluable source documents for this review.
EXECUTIVE SUMMARY

The common problem with solar rural electrification programs in the region is that donor-funded projects were accepted while the countries were not fully prepared with the appropriate policy mechanisms to manage these projects in a sustainable manner.

In the RMI, the sustainable management of its solar electrification program was to be implemented through the Outer Islands Energy Program\(^1\) (OIEP), adopted in 1994 by Cabinet and the authorisation given to establish a (Marshall Alternative Energy Company) MAEC. There was strong government commitment in RMI to make its outer islands energy program sustainable. However, major weaknesses and inconsistencies have been identified in the OIEP and MAEC’s Articles of Incorporation (AoI). There is a very urgent need for these two important documents to be reviewed and re-submitted for consideration by Cabinet.

The program was designed to utilise external funding for its initial capital equipment. The operational and maintenance costs, including the replacement of the initial capital equipment and any further expansion of the program were to be covered from the revenue generated from within the program.

While government’s commitment was there and steps were taken to turn the RMI Solar Energy Program (SEP) into a sustainable program, progress has been rather slow and efforts were not well coordinated. At the current rate of implementing the major activities in the RMI Energy Plan, the RMI SEP would not be a sustainable program.

This review is focussed on actions which should be taken in order that further progress is made with the implementation of the OIEP, thus ensuring the sustainability of the SEP in the future.

These actions include the termination of the government’s PV supply program and the incorporation of the MAEC. The termination of the government’s PV supply program would give way to a better appreciation of the MAEC and its activities. Prior to the incorporation of the MAEC, it would be worthwhile reviewing the MAEC’s AoI in the context of running the RMI SEP in a sustainable manner. Suggestions have been made that the AoI should clearly spell out that the MAEC is to be a non-profit, government-owned corporation. There are certain benefits to be gained by clearly identifying MAEC to be government-owned and non-

\(^1\) The Outer Island Energy Policy and the Outer Island Energy Plan are collectively referred to as the Outer Island Energy Program.
profit in nature. The AoI should also use sustainability as a qualification for MAEC’s prime object and that the prime object should provide a clear indication that the operations of the MAEC would never duplicate and/or interfere with that of the Marshall Electricity Corporation’s (MEC). The MAEC must be seen as a service utility providing the hardware and also the installation, maintenance and other technical assistance services for alternative energy sources and to be fully compensated for these services.

Certain irregularities have been identified in the OIEP and the policy guidelines and these should be addressed to ensure MAEC is fully focussed on its mission of running a sustainable PV program. These would include linking the MAEC’s activities to that of other public and private players in RMI’s rural/outer island development programs, avoiding any specific predetermination of how much MAEC is to collect as monthly fees and the frequency with which it would carry out its maintenance visits. The management of the MAEC should be given the freedom to structure its operation so as to ensure costs are minimised and still ensure that the efficiency of its service delivery is not compromised.

There is an urgent need that the MAEC be established and staffed. For the establishment of the MAEC, an expatriate and donor-funded General Manager (GM) and Office Manager (OM) would be needed in addition to a MAEC-funded local GM and Office Manager trainees. This would help keep MAEC’s operational expenditures down in its earlier years and for the expatriates to take MAEC into a solid financial position and train the national staff. Localisation of the expatriate positions is to occur when MAEC is in a stable financial position, by which time, the number of PV systems in the program would ensure that the increased costs of MAEC are still within the revenue generation capacity of the program.

The recording and filing problems that the RMI SEP is experiencing and its fee collection problems should be addressed by a properly staffed, equipped and structured MAEC.

Consistency in the management of the MAEC’s projects is very important and all the projects should be managed under only one policy and set of guidelines.

BACKGROUND

The Lomé II Pacific Regional Energy Program’s (PREP) photovoltaic (PV) program played a major role in the widespread use of, and the exposure to, PV in the Forum Island Countries. This program provided funding for around 69 systems in Fiji, 250 in Kiribati, 100 in Tonga and

150 in Tuvalu. In addition, more than 100 energy officials were trained in the maintenance, installation and management of photovoltaic systems/projects. PREP's objectives were to reduce the dependence on petroleum fuels through the promotion and use of technologies which would harness indigenous renewable energy resources, and to assess these technologies in terms of their technical and economic suitability for the region.

Various project concepts have been used in the region for the management of PV projects. Though their functions are predominantly the same, they do differ in the areas of component ownership, responsibility for installation, system capacity, sources of capital funding, sources of maintenance funding and maintenance responsibility. A detailed description of these various project concepts is provided in Annex 1.

Sustainability has become a common issue with the SEPs in the region. This review of the solar electrification program in the RMI is primarily aimed at addressing the issues which are hindering the sustainability of the program. It is carried out in the context of the RMI's adopted OIEP (see Annex 2) and the authorisation given by the RMI Cabinet for the Marshall Island Development Authority (MIDA) to form the MAEC.

OVERVIEW OF THE RMI SOLAR ELECTRIFICATION PROGRAM

The Energy Sector

There are three main players in the RMI's energy sector: the oil companies (Mobil and British Petroleum), the power utility (MEC) and the Energy Office (EO) which is under the Ministry of Resources and Development (MRD).

The oil companies import and market petroleum products. Most of the products are imported from Guam with frequent re-exports to the Federated States of Micronesia.

MEC is the sole supplier of reticulated electricity in the RMI, being responsible for the power stations on Majuro and Jaluit atolls. It also runs a joint venture with Boral Gas of Australia for the import and sales of liquefied petroleum gas (LPG) in the RMI. MEC owns a tank farm, which allows it to sell fuel to the RMI government and foreign fishing vessels. This operation is regarded as one of MEC's most profitable activities.
The EO is housed under the MRD. It is responsible for the formulation of the OIEP and the management of the RMI government's PV Supply Program. This OIEP is not restricted only to solar PV but it also applies to MEC’s supply of electricity and LPG to the outer islands.

The OIEP

In July 1994, the RMI Cabinet approved that the objectives of its OIEP which are to:

- contribute to the social and economic development of the Outer Islands through the provision of reliable energy services;
- encourage the use of low emission technologies and native energy resources for the production of energy on the Outer Islands of the RMI;
- ensure that the provision of energy services is based on both a least cost development strategy and on technically and commercially proven technologies that utilise decentralised alternative energy options without ruling out grid connections when such connections are the economically viable option; and
- guarantee full cost recovery from consumers for the provision of energy services while making explicit budgetary provisions for Government and Non-Government assistance when such assistance is socially justified.

Specific Policy Guidelines

The policy guidelines for RMI’s OIEP deal with five major areas. They include the tariffs and fees, subsidy funding, operations and expansion, conservation and efficiency programs and safety and the environment.

The tariff and fees are to reflect the full cost of the energy services provided. They are to protect the long-term financial viability of the OIEP.

Subsidisation of the program is to be clearly recognised and made explicit in the government’s budget.

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3 This is predominantly the current major activity of the EO. Atolls supplied with PV systems under this program include Ailuk, Aur, Maloelap, Jabat and Namorik.
Table 1 provides a list of the existing PV installations in the RMI:

Table 1: Existing PV Installations^4

<table>
<thead>
<tr>
<th>Atoll</th>
<th>Radio Tel</th>
<th>School</th>
<th>Com Hall</th>
<th>Clinic</th>
<th>H’holds</th>
<th>Total</th>
</tr>
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<tbody>
<tr>
<td>Majuro</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Kwajalein</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Ailinglaplap</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Jaluit</td>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Amo</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>18</td>
<td>26</td>
</tr>
<tr>
<td>Mili</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Namorik</td>
<td>2</td>
<td></td>
<td>2</td>
<td>1</td>
<td>133</td>
<td>138</td>
</tr>
<tr>
<td>Namu</td>
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<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Maloelap</td>
<td>3</td>
<td>3</td>
<td></td>
<td>2</td>
<td>20</td>
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<tr>
<td>Ebon</td>
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<tr>
<td>Ailuk</td>
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<td>1</td>
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<td>Ujae</td>
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<tr>
<td>Likiep</td>
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<td>Mejit</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Aur</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>Utirik^5</td>
<td>1</td>
<td></td>
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<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Lae</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>Lib</td>
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<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Jabat</td>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>Wotho</td>
<td>1</td>
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<td></td>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Bikini</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>TOTAL</td>
<td>45</td>
<td>21</td>
<td>18</td>
<td>17</td>
<td>265</td>
<td>366</td>
</tr>
</tbody>
</table>

Source: Adopted from the ADB’s 1994 outer islands electrification feasibility study report for the RMI.

The operational responsibilities of the EO in the RMI Government’s PV System Supply Program are defined in the guidelines (see page 2 of Annex 2). Prior to the development and introduction of any alternative energy system in the program, identified criteria listed in the guidelines are to be complied with first. These include affordability of the project to the outer islands, safety and the security of the energy supply, social acceptability of the project and the minimisation of CO2 emission. The guidelines also identify application that has the priority for the outer island energy sources. For instance, PV is the preferred option for baseline domestic energy needs whereas LPG is the preferred option for domestic refrigeration, cooking and peak domestic demand needs.

^4 The numbers shown are for systems installed and not for systems that are currently operational.

^5 A central village system providing electricity to some 20 households.
The guidelines also point to the need for all outer island energy users to be provided with educational material on efficient technologies and practices and that appropriate standards and Acts are to be enforced to protect people's lives and their environment.

Existing PV Projects

Solar PV was introduced into the RMI in the mid eighties while it was still a Trust Territory period. To date, it is estimated that about 366 PV systems have been installed at an approximate cost of US$1 million. Most of these projects were funded through various aid programs with the United States being the major donor.

The RMI Government's PV Supply Program

The EO manages RMI's SEP although other government offices are involved with solar-powered energy systems in the outer islands.

The Ministry of Health is responsible for the solar electrification of the outer islands' dispensaries. It has attracted donor funds for its projects, sends its own technicians to install and maintain the systems and provided funds from its own budget to cover for the maintenance costs.

The RMI National Telecommunications Authority (NTA) manages the solar-powered radio telephone systems in the outer islands. It has its own system in place where there is a resident caretaker on each island to collect the fees for the calls made. While government does not subsidise the RMI NTA, the NTA is subsidising its outer islands telephone operation.

The Ministry of Education is responsible for the PV projects in the outer island schools and provides from its own budget for their maintenance.

The EO manages the RMI government's PV supply program, which accounts for 63% of the installed PV systems in the RMI. This program provided PV systems to the islands of Ailuk (14), Aur (15), Maloelap (28), Jabat (35) and Namorik (138).

In the islands of Maloelap (installed in 1995), Aur and Ailuk (installed in 1992), their projects are on a rent-to-own system. Households have 2 panels and 2 lights and are required to pay the EO a monthly fee of US$10. Upon recovering the capital costs and the costs of any replacement components, the households are to own the systems. For the islands of Jabat 6

6 Funded from the Forum Secretariat's Small Energy Project Program.
and Namorik, they both pay a monthly fee of US$8 per system while the ownership of the systems will always be with the EO.

The Namorik project is a special one as it is not only the project with the most number of installed systems but it is also the first pilot project that was supposed to be managed by the MAEC under the newly adopted OIEP. The MAEC has not been formally incorporated by the MIDA.

Fees collected from the Namorik project are deposited in a cheque account. Signatories to this account are the Secretary of MRD, the Chief Secretary to Government and the Energy Officer. Fees collected from the islands of Aur and Aluik are deposited in a revolving account in the RMI Treasury and are utilised following the normal RMI government procedures. At the beginning of the Jabat project, the island paid their monthly fee to the EO. Recent requests from Jabat for replacement components have been turned down due to their non-payment of fees.

The EO is manned by only one Energy Officer, assisted by a resident PV technician on the island of Namorik. In the other three islands, the maintenance and the fee collection are carried out by the Energy Officer himself during his monitoring/maintenance trips.

The Namorik Project

The Namorik project was a French grant of 2.6 million French Francs (approx USD 0.5 million) to the RMI government with the MRD being the government Ministry responsible for this project. Prior to the implementation of the project, the Namorik community established their Solar Committee. A MOU was signed between the Namorik Solar Committee and the MRD. This MOU attached as Annex 3, sets out the obligations of the parties in the project.

Besides the above MOU, each recipient of a PV system also signs a Solar System Service Contract. The customer, the Namorik Solar Committee and the MAEC sign each of these service contracts. A copy of the service contract is attached as Annex 4.

The Adopted Management Structure

The SEP in the RMI is among the few rural electrification programs in the region, which is guided by a Cabinet-approved OIEP. The OIEP, though it has certain weaknesses, still

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7 This fee is set at a rate of $8 for each 2 panels system, $16 for 4 panels and $48 for the 12 panels.
8 38% of the total number of installed systems.
9 In the MOU, MRD is the representative of the MAEC, however, the Energy Division of MRD and MAEC have separate obligations.
10 The Namorik Atoll Solar Committee, MRD and the MAEC.
provides a reasonable level of management direction to the supply of energy to the outer islands.

The OIEP provides for a transitional period to the RMI’s SEP in which, by the end of 1997, it was expected that the RMI government end its EO PV supply program and to be taken over by the MAEC. Specific management direction provided by the OIEP, which have direct relevance to the SEP, include:

- the incorporation of a MAEC to engage in the business of installing, maintaining, and collecting service fees for alternative energy equipment, and to engage in any and all other business which may be lawfully conducted by a non-profit corporation;
- the formulation of the MAEC bylaws to provide details on how MAEC is to be managed;
- the securing of community, national, and international funding for the OIEP, particularly for the initial capital cost of the systems. In the long term, aim to generate through service fee charges, a capital base sufficient to eliminate the need for outside financial assistance, including capital cost assistance;
- the supervision of the works of any outer island energy company that may be doing works on local alternative energy systems;
- the adoption of a full costs tariff structure which are to be reviewed on a six-monthly basis and that any subsidies are to be fully justified and budgeted for;
- the definition of responsibilities and limits for the ongoing RMI government PV System Supply Program that is managed by the RMI EO. This program will be responsible for:
  - one maintenance check every six months for each PV system;
  - maintenance of an inventory of spare parts equal to 3% of the total number of systems installed in the RMI,
  - the collection of $8 per month per system to recover the RMI government costs for the program; and
  - tariff collection will be limited to three years for any one PV system.

- the preference given to solar energy as the energy source for baseline domestic electricity needs and for domestic and industrial hot water needs;
- the appointment of one Technical Manager (TM) for every 60 MAEC installed energy systems;
- the 100% funding by MAEC customers of all MAEC services costs after the installation of 500 systems;
• the active participation of the outer island communities, in the longer term, in the management and expansion of local alternative energy systems through the formation of alternative energy community co-operatives;

• the preference that MAEC will give priority to large community installations (60+ systems);

• the understanding that RMI government subsidies for outer islands energy systems are to go through the RMI government's EO;

• the understanding that the EO will stop supplying PV systems after the MAEC is incorporated. The EO will also abandon responsibility for government supplied PV systems after three years from their installations;

• the offer by MAEC to buy three-year-old government PV systems. This gives the communities and individuals an opportunity to make an informed choice about continued ownership or sale of their PV systems. If MAEC takes possession of these systems, the MAEC will refit the equipment for supply to the outer islands. MAEC would then meet all the maintenance costs in return for a service fee.

• the understanding that MAEC-owned systems would be disconnected after ninety days non-payment.

THE ASSESSMENT OF THE RMI SEP

The management of the RMI SEP is in transition, the functions of the EO were supposed to be transferred to the MAEC by the end of 1997, however this has not happened. This management transition is brought about by a strong RMI government commitment to run the program in a sustainable manner. RMI government realised that for sustainability, the program had to be:

• a financially and administratively independent "solar utility" to manage the program;

• a solar utility that had strong technical links with the MEC and the EO;

• properly staffed, guided by an experienced and well trained BoD;

• efficient in the delivery of technical services (replacement components and technical staff) to the areas served by the "solar utility";

• recovering costs fully from the "solar utility" customers; and

• competitive in its operation.

Current Status of the RMI SEP

It is quite difficult to accurately assess the current status of the RMI SEP, as the OIEP has not been fully implemented. However, it would be fair to say that with the current progress of the
implementation of the OIEP, the RMI SEP would not be sustainable. This is a direct result of delays in the implementation of the major activities in the OIEP, the need to review the OIEP and weaknesses in the current management of the program.

Implementation of the OIEP

It is almost four years since the adoption of the OIEP, and implementation has been very slow. Seven major activities were listed to be carried out during the period of 1994 – 97. These included:

- the adoption by the RMI Cabinet of the OIEP;
- the incorporation of the MAEC;
- the appointment of MAEC's BoD and its General Manager
- the meetings of the RMI Energy Advisory Group
- the installation and the funding of alternative energy pilot project by MAEC;
- the coordination of the LPG supply routes by MEC; and
- the termination of the RMI government's PV Supply Program.

Of these activities, it is understood that the adoption of the OIEP is the only one completed. It is also understood that the adoption of the OIEP was at a time when the French government was approached to fund the Namorik project. The adoption of the OIEP is the solid foundation upon which to build a sustainable SEP and it is therefore important that other supporting activities in the program be carried out simultaneously.

The Incorporation of the MAEC

Approval for the incorporation of the MAEC was made in 1994. The AoI is to be commended for it provides MAEC with an unrestricted object thus giving it the flexibility to expand its operations as it grows over time. However, there are a few areas of concerns in the AoI:

- the AoI does not clearly spell out that the MAEC is to be a non-profit organisation.

The AoI only made reference to the MAEC engaging in business, which may lawfully be conducted by a non-profit organisation but it does not specifically declare the MAEC to be one. This non-profit identity is important, as it should determine:

- the benefits, which the company may be entitled to (eg duty and tax exemptions);
- the level of government and external assistance to the company;

It is appreciated that MAEC’s AoI followed very closely that of MEC’s. MAEC’s AoI has been amended to take into account the differences in the two institutions.
who the owners of the company should be; and
the manner in which the company is to conduct its business.

the Aol should clearly spell out its prime object, including that its operation is to be in a sustainable manner and avoid any duplication with MEC.
The prime object of the MAEC should generally be to provide alternative energy sources in a sustainable manner to areas permitted by the MEC Regulations. Alternative Energy Sources is a very general term and it would provide flexibility for MAEC to venture into any alternative energy sources (wind, wave, bio-based, etc) as appropriate to RMI.

Sustainability of operations after initial injection of funds to set up MAEC with a proper set of administrative and financial procedures for cost recovery, should also be spelled out.

MAEC’s services should never be seen as competing with MEC’s. It is important that they be seen as complementary and willing to share experiences and information.

MAEC should be engaged in the supply and sale of alternative energy equipment.
Experience in the region has shown that the absence of a reliable supply of complete systems and spare parts is a major constraint to the sustainability of renewable energy programs. The MAEC has to be involved in the supply and the sale of renewable energy systems thereby ensuring the compatibility of systems and parts, compliance of specifications with national standards, reliability of supply to the project sites, the generation of revenue for the corporation and the presence of in-country technical back-up services.

MAEC must be seen and operated as a service utility
This is going to be a very important characteristic of MAEC as it should not be seen as just a sales outlet for alternative energy systems but it should be seen as a service provider. The services offered are the sale of the systems and parts, the provision of after-sale services in terms of maintenance, monitoring, upgrading, downgrading etc. The provision of these services should be efficient and professional. When services are of a high quality, customers would be more than willing to pay for what it cost to get that service. The provision of efficient and high quality services is therefore seen as a prerequisite for the full recovery of the corporation’s costs.

a realistic capital stock
The corporation’s initial authorised stock must be realistic so as to enable it to be established rather than relying in too high a number which it would take years to raise. It is considered that $50,000 would be a sufficient capital stock for MAEC to start with. At this level, it would be easy to attract another non-profit organisation to be a shareholder in the corporation. It is
important to note that at this level of capital, MAEC would not be able to buy all the three-year old systems in the EO PV supply program.

- **MAEC should be a government-owned corporation**

The provision of alternative energy systems to the outer islands is not considered to be a very profitable undertaking. It would therefore be hard for the general public and other profit oriented entities to buy shares in the MAEC. Government would be the best shareholder in non-profit entities. Government's association with the corporation would strengthen its social obligation to its people. This should also be beneficial to the corporation, as it would subject it to the regular auditing procedures of the RMI government. Other non-profit and conservation-oriented identities such as the US Save the Children Fund, the Foundation for the Peoples of the South Pacific (FSP), Sustainable Energy Life Fund (SELF), etc may be interested in being a partner in ventures of this nature. It appears to be that it is a government policy for local entities to hold 60% shares in corporations and this has been recommended for MAEC.

It was appreciated that three senior civil servants (Minister of Finance, Minister of Internal Affairs and the Chief Secretary) are the incorporators of the company and perhaps those three Ministries should be holders of government's shares.

- **Officers of the MAEC**

It was noted that a Consultant from the Sandia National Laboratory has been listed as one of the initial officers of the MAEC. While this appointment is only temporary, it is understood that the Consultant was doing some work on PV in RMI and has already left the country. This consultant position should be an Adviser with a lot of experience on PV. The Energy Officer at MRD's Energy Office has sufficient exposure and experience with PV and could fill this position.

- **Dividends**

It has been earlier mentioned that MAEC should be a non-profit organisation and therefore would not make any payments of dividends to shareholders.

- **All powers and authority of the company shall be vested in the BoD.**

The AoI provides for the BoD to have all the powers and authority of the company. This is a rather general provision which if not put in the right perspective could work against MAEC e.g. General provisions like this could be interpreted to mean that the BoD can run the daily operations of the company. The authority of the BoD and the GM should be specifically defined to reflect the fact that the GM is accountable to the BoD and everyone else in the company who is under the GM is accountable to the GM.
A copy of the AoI, which highlights the recommended changes, is attached as Annex 5 and urgent action is needed to review and re-submit this document for the consideration of Cabinet.

The Appointment of the BoD of the MAEC and its GM

The RMI Cabinet has authorised that the MAEC’s initial directors be the Minister of Finance, Minister of Internal Affairs and the Chief Secretary. Two characteristics that typify BoDs are that:

(i) They are made up of too many politicians. Having too many politicians on the BoD can be both a blessing and a stumbling block. On the one hand, they are a source of government/political support to the corporation. On the other, they may be too busy to attend to the affairs of a non-profit organisation and/or they are actively involved in order to turn the company into an instrument to support them politically.

(ii) They are made of people without business management and accounting backgrounds and are not in touch with life on the outer islands. Inappropriate representation on the BoDs has been identified as a major problem with similar organisations in the region. In most cases, the BoDs were not very effective in providing policy directions to the management of the utility since they just did not have the basic business management and accounting skills.

In most utilities, there are always representatives of the consumers on the BoD. Such representation is very important as it provides the links between the consumers and the management of the company. Further, it also ensures that the consumers are part of the decision making process.

The GM position is very critical to the success of any utility. The GM plays the role of connecting the policy directions provided by the BoD with the daily operations of the utility. The GM should be a person with a mix of both the technical and management skills. A lot of utilities have, in the past, run into financial and administrative difficulties because the GM was an engineer by training with minimal management experience. It is important that the GM of the MAEC be a person who is very familiar with the technicalities of various renewable energy technologies. He/she should also be a person with management skills and be commercially oriented in his/her approach to the way in which MAEC is run (see pages 16 & 17 for further details on the GM).
The Meeting of the RMI Energy Advisory Group (EAG)

RMI's Energy Plan for 1995-2005 calls for a bi-annual meeting of the EAG. The EAG will include all energy suppliers to the outer islands and will have the primary responsibilities of:

- coordinating MEC and MAEC management of Outer Island energy systems;
- advising on appropriate and cost effective energy supply options linked to proposed new government or private development programs; and
- providing the venue for Outer Island energy service fee adjustments.

As MEC and MAEC are the two primary energy suppliers in the RMI outer islands, they will undoubtedly take a lead role in any EAG meetings. While it is very important that activities in the outer islands are well coordinated, it is also important that other issues relating to this coordination are considered.

- The benefit of common representations in the two institutions’ BoD. The GM of MEC and the Chief Secretary are both members in the two BoDs and perhaps the coordination could be done through them;
- RMI has an EO and perhaps this EO should be strengthened to carry out this coordination role; and
- Coordination is needed in order to avoid duplication. Most “solar utilities” have addressed this by incorporating in their AoI a provision which clearly spells out that its areas of operation would be restricted to areas which have not been designated as utility supply areas (see the appropriate section in the Incorporation of the MAEC above).

The Installation and the Funding of an Alternative Energy Pilot Project by MAEC

Although the MAEC has not been formally established, the project at Namorik is regarded as MAEC’s pilot project. This project has been running for two years and sufficient experience has been gained from this project. The experience is not endemic to RMI, but is common in most of the PV projects in the region:

- fee collection was only good at the first six months of the project;

People are excited about the new technology only at the beginning of the project. When the installations are completed and while the PV systems are working perfectly well, people start questioning as to why should they pay for something which was provided for “free”.

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the island solar committees have not been very helpful in managing the project; Island solar committees are established to provide the link between the communities and the solar utilities. Very often, they override the authority of the utility-employed island technicians, they want to control the fees collected and some members in the committees run the projects for their political gain.

stationing a resident technician at the project site did not solve all the maintenance and fee-collection problems; Resident technicians who are selected by the Islands Solar Committees are not always the most capable people in the communities as they are mostly selected based on social rather than technical merits. On the other hand, some capable people employed were poorly equipped to carry out the maintenance and the fee collection.

island solar committees should be regularly updated on the status of their collected fees and how they are being used; This has been a major problem with most PV programs. When the program is set up such that the communities are entitled to the fees collected, then the solar utility is accountable to the community. The absence of any reporting mechanism from the solar utility to the communities has been one of the reasons for the communities getting suspicious of what their money is being used for and therefore monthly payment of fees are not faithfully made.

the EO's recording of the payments made in this project has been unsatisfactory; As earlier mentioned, the solar utility is accountable to its consumers and therefore the revenue collected and the expenditures made have to be recorded properly. It was noted in the field mission that attempts are being made to properly record the revenue and expenditures in the Namorik project.

the procedures adopted for the transfer of the monthly fees from the island's technician to the EO is not fool proof; and The practice that has been adopted in the RMI is for the island technician to send a locked box/bag with the money through Air Marshall or a passenger from the paying island. Since there is no transfer document between the technician and the carrier, it is possible for the carrier to dispose the box/bag and claim that he/she did not carry anything for MAEC.

the policy of basing the island technician's wages on the fees collected has not been very effective. While the theory behind this incentive is reasonably straightforward, it has not really worked in practice. This is largely due to the socio-cultural ties between the island technician and the community.
The Coordination of the LPG Supply Routes by MEC

This is an ongoing activity that MEC has been working on and for which satisfactory progress has been achieved.

The Termination of the RMI Government’s PV Supply Program

At the moment, the EO is in charge of government’s PV supply program and also of the Namorik project which was supposed to be the MAEC pilot project. This is a major area of confusion in the program, however, the OIEP clearly states that the EO is currently responsible for the RMI government’s PV supply program. Once the MAEC is incorporated, the EO would totally relinquish its supply of PV systems. Therefore any further aid-funded PV projects are to be distributed and managed by the MAEC. The EO would, however, continue to maintain, service and collect monthly fees from existing projects, which are less than three years old (Namorik Atoll only). Projects and systems, which are now more than three years old, are to be owned by individual households and the participating communities. The households and the communities can choose to operate the systems themselves or sell them to the MAEC. The MAEC will refit them and provide these to the households and communities in return for a monthly fee.

THE OIEP AND THE POLICY GUIDELINES

Since 1994, the Forum Secretariat Energy Division has assisted member countries with the development of national energy sector policy statements. The regional energy program transferred to SOPAC in January 1998 and active programs such as technical assistance in the preparation of the national energy policy statements will continue to be provided by SOPAC. This initiative was aimed at assisting governments formalise their visions for the development of their energy sectors over the next 10 -15 years. These visions represent the respective governments’ goals for the planning and management of each of the subsectors that make up their national energy sectors.

The energy policy statement is different from a work program and it does not specify the tasks or the time frame necessary to achieve the policy objectives. However, the policies are meaningless unless clear policy guidelines are also provided on the major concerted efforts that are needed to achieve the policy objectives. Once the policies and guidelines are adopted, work programs are then designed according to the guidelines and on the resources that are available and are all focussed on the policy statement.

12 These are in Ailuk, Aur, Maloelap, Jabat and Namorik.
RMI's Outer Island Energy Policy is divided into five major categories; the objectives, the strategy, the guidelines, the institutional set up and the goals for outer island communities. These broad categories are considered too many for a policy statement and therefore subject the document to internal inconsistencies. It is considered necessary that the policy statement is rearranged to only two broad categories; (i) the policy statements should include the objectives, the institutional set up and the goals for outer island communities and (ii) the policy guidelines, which should include the policy strategy. It is important that the policy be very concise and as brief as possible in order to ensure consistency.

A careful examination of the existing policies shows the following interesting facts:

- the OIEP is intended to be a stand-alone program and is not intended to complement and operate in close coordination with other RMI government's rural development programs

It is very important that the OIEP complement and operate in close coordination with other rural development efforts in the RMI. For instance, most rural electrification programs in the region are set up such that the consumers pay the utility a monthly fee. Such schemes could not be successful unless it operates hand in hand with a revenue-generating scheme in the rural areas. Such schemes would include fishing, copra production, handicrafts, etc.

- there is no attempt to institutionalise close cooperative links between the MAEC and all the other public and private institutions that are involved in rural development programs;

It is important for the RMI government to identify who will be responsible for the overall coordination of its rural electrification programs. It is understood that the policy calls for annual meeting of an Energy Division Group (EAG). The membership in the EAG should not be restricted to energy suppliers only but it should also include both government and private representatives who are directly and indirectly involved in the provision of electricity to the rural areas. These may include the local governments, MIDA, US Peace Corps, etc.

- the policy calls for full cost recovery while the policy guidelines call for a monthly fee of $8.00 per system

This is rather contradictory as full cost recovery in itself would be sufficient a condition for a sustainable program. By restricting the monthly fee to $8, a restriction is also placed on how the MAEC would carry out its functions. System and operation and maintenance costs would change over time and so the monthly fee should be able to adjust accordingly.
the policy dictates that there will be a six-monthly check on every PV system in the program.

As in the monthly fees, the MAEC should not be restricted in its operations. It should be given the freedom to carry out its functions in the best possible manner according to its AOL. The above provision has pre-determined that only technicians from Majuro should do the monitoring of the PV systems. It does not give the MAEC the flexibility to utilise local island technicians and that the monthly checks be carried out less frequently. This flexibility is very important as it should give the MAEC the opportunity to implement measures which would minimise its costs while at the same time not compromising the efficiency of the services it delivers.

A sample copy of the Energy Policy and policy guidelines developed under the regional initiative is attached as Annex 6. There is an urgent need to re-write the OIEP and re-submit it for the consideration of Cabinet.

Weaknesses in the Current Management of the RMI SEP

Staffing

The management of the PV systems which are under the government's PV supply program and that of the MAEC (totalling 230 systems) is presently being carried out by only one person at the Majuro office and one outer-island PV technician at Namorik Atoll. This number of staff is considered far too small for a program of this size. The one technician at Namorik atoll looking after 138 systems is considered justifiable. In the other smaller atolls with fewer systems, it would be worthwhile placing one technician on each of the islands, depending on the difficulty of the inter-island transportation system. The number of systems under their care should determine the number of working days in a week that they would be working for MAEC. It is very important that they be employed directly by the "solar utility" and therefore subject to the rules and regulations of the utility.

On average, a properly-trained and equipped island technician should be able to properly monitor and maintain 50 systems in one seven hour working day per week and four working days per month. Payment of the island technicians should be based on days actually spent working on the project and the rate should be comparable to the RMI government's rate for a person with comparable skill and experience.

It is considered appropriate that the MAEC should have one Senior Energy Technician, stationed at the Majuro Office, after every 500 installed PV systems. The MAEC should come
into operation with the recruitment, familiarising and the training of the core staff of the MAEC. This should include, for the time being, expatriate and donor funded GM and OM positions, a local GM trainee and the outer island technicians. It is very important that at the start of the operation of the MAEC, two donor funded expatriates take up the positions of GM and OM and that only the GM trainee and islands technicians positions are localised and paid for by the MAEC.

FIGURE 1: PROPOSED STAFFING OF THE MAEC

This would strengthen MAEC’s financial position in its first five years of operation, after which, the expatriate position would be localised and the number of installed systems would justify the recruitment of more local staff. Expatriates are available through the Japanese Overseas Volunteer Scheme (JOVC), the US Peace Corps and from similar programs of Australia and New Zealand.

A proposed staffing structure for the MAEC is provided in Figure 1 and the job descriptions are provided in Annex 7.

Filing and Record Keeping

The filing of correspondence and information relating to the RMI’s SEP is very poor. It is important that historic information be retained so that the success or failure of the SEP can be assessed. There is virtually no data relating to the financial and technical details of the existing projects. There are no records on the monitoring of the systems and the spare parts, which have been supplied to the projects. The receipt that is in use for the Namorik project also serves as a monitoring record of each system (see Annex 8). Unfortunately this
technical part of the receipt is always ignored. MAEC should continue to use the same receipt and ensure that the island technicians are sufficiently trained to be able to complete the technical portion of the receipt.

The financial recording of the revenue and expenditure of the RMI SEP is very poor. During the field mission to RMI, it was found that a proper recording structure has not been set up for the fees collected from the projects and the expenditure made on each project and to each household in the program. There is an urgent need to immediately put in place a simple spreadsheet listing all the members in the program vertically and the months horizontally. This should be used by the Majuro Office to monitor the accuracy of the island technicians’ work. A sample of this recording sheet is provided in Annex 9.

**Fee Collection**

The collection of fees under the RMI SEP is very poor. Though no exact figures have been compiled, it is estimated that the collection rate is around 45%. It is interesting to note that the Namorik project has been operating for more than a year now, therefore the fees collected should be in excess of USD15000, however, the bank account for this project has a balance of only USD4500.

**The Use of the Memorandum of Understanding (MOU)**

The use of the MOUs in solar electrification programs is very common in the region. The MOU is basically to put down on paper the obligations of the “solar utility”, the recipient community and other players that are directly involved in the program. This is in situations where the systems are owned by the “utility” and community committees are established to manage the project on-site. Experience in the region has shown that the community committees have been a stumbling block to the management of the program. They have, in most cases, overpowered and interfered with the work of the island technicians and rallied the communities not to follow directions from the “utility”. In the Namorik project, the local government has not been very helpful in the coordination of the payment of the monthly fee. In other projects, there does not appear to be a good record of the monthly fees collected by the community committees.

MOU’s have been intended to be a binding document on the parties involved, however, complying with the provisions of the MOUs has been very poor. It is through this non-compliance that solar utilities cannot disconnect customers who do not pay their monthly fees because customers feel that the solar utilities have not fully performed their obligations in the MOU.
It is interesting to note that in the MOU for the Namorik project (see Annex 2), the monthly fee is set at USD10 whereas the policy guidelines clearly set it at USD8.

As noted above, all the parties to the Namorik Project MOU are not complying with the provisions of the MOU and therefore its value should be looked at.

While the RMI OIEP has implied that the management of the MAEC be as described above, it would be worthwhile considering a management system where the islands committees do not directly participate in the management of the program. In such a system, the islands technicians are directly employed by the “solar utility”, just as in a power utility operation. The community itself can then establish its own solar committee if it wishes. Such committees could deal with community efforts to raise monthly fees; to support the less fortunate in the community; to collate grievances and suggestions on the program; and to forward these to the utility management in Majuro.

Management Systems

The different management systems that are used in the RMI SEP have been an added difficulty to an organisation, which is understaffed and ill equipped. Some projects are on a “rent-to-own basis” and there are others, which are on perpetual lease to the consumers. Experience in the region has shown that a lot of people/communities prefer that at some stage in the program, they be given full ownership of the systems. In a “rent-to-own” program, there would be no need for a “solar utility” and the Energy Office would be playing a greater role in the provision of advisory and technical assistance to the rural communities. In addition, there would be a greater participation of the private sector in the provision of the PV systems, spare parts and the provision of maintenance services.

For MAEC’s operations, it is very important that all the projects are managed under one policy with consistent guidelines and that the same monthly fee structure is applied consistently to all projects. A template for the calculation of the monthly fees, is attached as Annex 10.

CONCLUSION

It is quite obvious that the RMI government is committed to making its outer islands energy program sustainable. This sustainable program is one in which the program would need external funding for the purchase of initial equipment with operating and maintenance costs, including the replacement of the capital equipment and any further expansion of the program.
being covered from the revenue generated from within the program. While commitments have been made and steps taken towards the sustainability of the RMI SEP, progress has been rather slow and the efforts are not well coordinated.

Out of the OIEP's seven major activities planned for 1994-97, only one has been successfully implemented. This is the adoption by the RMI Cabinet of the OIEP. There is urgent need to carry out the remaining six activities.

Priority activities to be implemented are the termination of the government's PV supply program and the incorporation of the MAEC. The termination of the government's PV supply program would give way to a better appreciation of the MAEC and its activities. Prior to the incorporation of the MAEC, it would be worthwhile reviewing the MAEC's AoI in the context of running the RMI SEP in a sustainable manner. Suggestions have been made that the AoI clearly spell out that the MAEC is a non-profit, government-owned organisation. The AoI should also use sustainability as a qualification for MAEC's prime object and that the prime object should provide a clear indication that the operations of the MAEC would never duplicate and/or interfere with that of the MEC's. The MAEC must be seen as a service utility providing the hardware, installation, maintenance and other technical assistance services for alternative energy sources.

Certain irregularities have been identified in the OIEP and the policy guidelines and these should be ironed out to ensure MAEC is fully focussed in its mission of running a sustainable PV program. These would include linking the MAEC's activities to that of other players in the RMI rural/outer island development programs, avoiding any specific predetermination of how much MAEC is to collect as monthly fees and how often it would carry out its maintenance visits. The management of the MAEC should be given all the freedom to carry out all the cost minimisation measures it can undertake provided the efficiency of its service delivery is not compromised.

There is an urgent need that the MAEC be established and staffed. For the establishment of the MAEC, an expatriate and donor funded GM and OM would be needed in addition to MAEC-funded local GM and DM trainees. This would help to take MAEC into a solid financial position and train the locals. Localisation of the expatriate positions is to occur when MAEC is in a stable financial position, by which time, the number of PV systems in the program would ensure that the increased costs of MAEC are still within the revenue generation capacity of the program.

A properly-staffed and equipped MAEC should immediately take care of the recording, filing and fee collection problems that the RMI SEP is experiencing.

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Consistency in the management of the MAEC’s projects is very important. All the projects should be managed under only one policy and set of guidelines.

**PEOPLE CONSULTED DURING THE REVIEW**

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<tr>
<th></th>
<th>Name</th>
<th>Position and Organization</th>
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<tbody>
<tr>
<td>1</td>
<td>Mr Walter Myazoe</td>
<td>Secretary, Ministry of Resources and Development</td>
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<tr>
<td>2</td>
<td>Mr Paul Ishoda</td>
<td>Energy Officer, Ministry of Resources and Development</td>
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<td>3</td>
<td>Mr Abna Abon</td>
<td>Operations Manager, Mobil Oil</td>
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<td>4</td>
<td>Mr Bill Roberts</td>
<td>General Manager, Marshall Electric Company</td>
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<td>5</td>
<td>Mr Berman Laukon</td>
<td>Assistant Manager, Marshall Electric Company</td>
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<td>6</td>
<td>Mr Philip Kabua</td>
<td>Chief Secretary, Office of the President</td>
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<td>7</td>
<td>Mr Arata Nathan</td>
<td>Supervisor, Outer Islands Dispensary, Ministry of Health</td>
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<tr>
<td>8</td>
<td>Mr Jefferson Butuna</td>
<td>Chief, office of Statistics and Planning</td>
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<td>9</td>
<td>Mr Terry Sasser</td>
<td>Director, Pacific Mission</td>
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<td>10</td>
<td>Mr Danny Jack</td>
<td>Deputy Director, MIMRA</td>
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<td>11</td>
<td>David Kabua</td>
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<td>12</td>
<td>Japanese Embassy</td>
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ANNEX 1 – VARIOUS PROJECTS CONCEPTS
ANNEX 1 - VARIOUS PROJECTS CONCEPTS AND LESSONS LEARNT IN THE PACIFIC

Aid-funded, government installed, village cooperative owned and maintained individual home systems with government technical support.

This model has been used in Fiji in 1982-84. Village co-operatives were formed with the tasks of monthly fee collection and self-maintenance. The program consisted of 100 systems each with a single 42 Wp panel, a 45AH gel-cell battery, a discharge controller with “D” cell Ni-Cd charging capability, and two 12V DC fluorescent lights. After installation, the Fiji Department of Energy was available to the cooperatives for technical assistance and spare parts.

The experience with this program has not been satisfactory. There were design flaws in the systems and parts failed within the first year. Most of the Ni-Cd “D” cell batteries were also lost, damaged or destroyed within six months of installation. Many Ni-Cd chargers failed due to general misuse. Fee collections were good at first and soon became sporadic and in the end, government made virtually all purchases of replacement parts and most systems were abandoned.

Aid/government funded, government installed, government owned, basic maintenance by owner with energy office technical assistance on call.

This model has been used in a few countries in the region. Systems used a single panel between 40 and 50 Wp capacity. Batteries ranged from inexpensive open cell lead acid batteries to expensive ones specially designed for PV systems. Most had charge/discharge controllers, some did not have any and others had only charge control. Lamps used were in the range of 13 - 18 W. Fees were charged on the users.

The experience with this model has not been satisfactory. Systems have been abandoned, are operational at reduced capacity or have had maintenance problems. While the intention was for the users to do the maintenance, government effectively provided nearly all the maintenance though often after long delays. Systems were damaged through ignorance of the users and the fee collections ceased after a few months.

Commercially installed, user financed, owned and maintained with commercial maintenance available on call.

This model has been used in a few countries. The customers are mostly the religious institutions and well-off individuals while the suppliers were private businesses, PV being a very small part of their undertakings. The experience with this model has not been satisfactory. Inferior equipment has been sold to customers and both customers and the private businesses were not fully knowledgeable of PV system designs, installations and maintenance.

Commercially installed and owned, commercial maintenance on call.

This model was used in Fiji in the period of 1983-1985 where a foreign owned private company claims to have installed 200 systems under a leasing arrangement. For a basic lighting system with a single panel and two lights, a monthly fee of F$15 was charged and it included maintenance which were to be carried out by local field agents. This business failed as a result of poor collection rate and the inefficiency of the local agents.
Commercially installed and owned, commercial periodic maintenance, pay as you use system

This model used a “key access” system where it was necessary for the user to buy a plastic key and by inserting the key into a receptacle in a box and then turning it until it broke off power was provided for a 24 period. This business failed largely as a result of a collapse in the financing arrangements for the project.

National co-operative owned and installed, periodic maintenance and fee collections by the cooperative

This model is a private, commercial enterprise charged with implementing and managing household solar lighting projects. The enterprise does not have direct links with government though government through the Cooperative Act regulates it. The enterprise also has access to external resources through a government agency, which provides services to cooperatives. The major undertaking of the enterprise has been to install grant aid funded projects, sell spare parts and carries out the maintenance for a fee. The enterprise operates on the fees collected.

This model has faced problems. Management has embezzled funds of the enterprise. The Board of Directors has not been very efficient in the performance of their tasks. Field agents have not been very effective and the fee collections have declined dramatically.

Corporate owned and installed periodic maintenance and fee collections by the corporation.

This model has been used in Kiribati. It is a private enterprise with a charter to act as a retail outlet for PV systems and to provide technical assistance where needed for their installation and maintenance. During the period of 1984-89, about 270 PV lighting systems were sold to private from the enterprise and despite grants and a regional approach to the private sale and support of PV RE systems, by 1989 the enterprise was effectively bankrupt. A diagnosis of the enterprise recommended that it be changed from a sales oriented organisation to a service organisation based around a rural electricity utility concept. A recent review of the enterprise pointed to a need for the enterprise to immediately obtain grant aid funds for a new project and/or to review the existing monthly fees charged on its customers. There was also a need for the enterprise to improve on its fee collection rate. While this model has been reported to appear sustainable, it should be noted that in the medium term strategy of Kiribati, the private sector is to take over the operations of the corporation.
ANNEX 2 – RMI'S ADOPTED OUTER ISLAND ENERGY POLICY
Outer Island Energy Policy
May 25, 1994

1. Policy Objectives

- To contribute to the social and economic development of the Outer Islands through the provision of reliable energy services.

- To encourage the use of low emission technologies and native energy resources for the production of energy on the Outer Islands of the RMI.

- To ensure that the provision of energy services is based on both a least cost development strategy and on technically and commercially proven technologies that utilize decentralized alternative energy options without ruling out grid connections when such connections are the economically viable option.

- To guarantee full cost recovery from consumers for the provision of energy services while making explicit budgetary provisions for Government and Non-Government assistance when such assistance is socially justified.

2. Policy Strategy

- Encourage sustainable development of the Outer Islands by organizing a bi-annual RMI Energy Advisory Meeting that will:
  1) include all energy suppliers to the Outer Islands,
  2) coordinate MEC and MAEC management of Outer Island energy systems,
  3) advise on appropriate and cost effective energy supply options linked to proposed new government or private development programs,
  4) provide the venue for Outer Island energy service fee adjustments.

- Help secure community, national, and international funding for the Outer Island Energy Program, particularly for the initial capital cost of the systems. In the long term, aim to generate, through service fee charges, a capital base sufficient to eliminate the need for outside financial assistance, including capital cost assistance.

- Oversee the development of, and maintain authority over Outer Island energy companies which appoint, train, manage and equip district level field technicians and managers who will be responsible for the operation, minor maintenance, fee collection and administration of the local alternative energy systems.

- Specify the fee basis and charges for alternative energy systems on the Outer Islands and, through the Outer Island energy companies, oversee collection and accounting.
3. Specific Policy Guidelines

a. Tariffs and Fees

- Where feasible, guarantee that fees charged to Outer Island consumers, both Government and private, reflect the full cost of the energy services provided and that the tariff structure includes a mechanism for adjusting service fees every six months, the basis of which is clear to the consumer.

- Protect the long term financial viability of the Outer Island Energy Program by including in the tariff structure a component for future capital expenditure requirements and a minimum rate of return on net fixed assets.

b. Subsidized Funding

- Where subsidized funding for Outer Island Energy management and supply has been approved for Government assisted institutions, (e.g. medical, educational, community), ensure that these subsidies are clearly recognized and are made explicit in Government budgets, and

- Ensure that such subsidies are not cross-subsidized by full fee enterprises but that, instead, such subsidies are an explicitly denoted budget allocation for each Government assisted institution that can then revert to the institution's general revenue if not fully expanded.

c. Operations and Expansion

- Secure improved performance of existing alternative energy systems by better definition of responsibilities and limits for the ongoing RMI Government Photovoltaic (PV) System Supply Program managed by the RMI Energy Office. This Program will be responsible for:
  1) one maintenance check every six months for each PV system,
  2) the maintenance of an inventory of spare parts equal to 3% of the total number of systems installed in the RMI, and,
  3) the collection of $8.00 dollars per month, per system to recover RMI Government costs for the Program.

The RMI Energy Office will limit tariff collection to three years for any one PV system.

- Assure that technology choice for newly installed energy systems will be selected on a case by case basis, and will encompass only those options that are technically proven and are able to be adequately serviced.

- Ensure the performance of newly installed alternative energy systems satisfies the following list of criteria to the highest extent:
  1) energy services provided by energy management companies will be
affordable to the Outer Island community,
2) energy systems will deliver a safe and consistent product,
3) energy services will be acceptable to Outer Island communities, both socially and educationally, and
4) energy systems will be managed so as to emit as little CO₂ as possible over the course of their work life.

These options are preferable for the RMI, 1995-2005:

1) Liquid Petroleum Gas (LPG) systems for domestic refrigeration, cooking, and peak domestic demand needs,
2) Solar Electric Photovoltaic (PV) systems for baseline domestic electricity needs,
3) Solar Thermal systems for domestic and industrial hot water needs,
4) Wind Energy systems and/or Internal Combustion Generator systems for heavy (over 10 kW) Community and Commercial loads (e.g. Dispensary or Commercial Fishing refrigeration needs),
5) Biomass utilized for the following purposes and in this order; a) Native Crafts, b) Compost, c) Cooking Fuel.

d. Conservation and Efficiency Programs

- Ensure that educational materials will be given to all Outer Island energy users concerning efficient technologies and practices.

e. Safety and the Environment

- Secure the protection of the Outer Island community;

  (1) through the enforcement of safety and electrical standards (U.S. National Electric Code) and operational procedures, and

  (2) through implementation and enforcement of the environmental guidelines and principles spelled out in both the RMI Environmental Protection Act and the Rio Declaration on Environment and Development, 1992.

4. Institutional Setup

- Ensure that two RMI Government companies manage the Outer Island energy sector. There will be no annual limits on the provision of alternative energy systems to the RMI Outer Islands during the years 1995-2005.

1) The Marshall's Energy Company (MEC) home office is in Majuro and the MEC will staff all large (>320 kW) diesel facilities and offices throughout the RMI. These diesel-supplied grid systems are expected to be operated on Majuro, Kwajelain, Wotche, Jaluit, and Eniwitok Atolls during the 1995-2005 period. MEC will determine and develop funding sources for these operations. All MEC Outer Island LPG supply services will be 100% funded by MEC supply fees.
2) The Marshall's Alternative Energy Company (MAEC) home office is in Majuro and the MAEC will staff every RMI Outer Atoll with an average of one Technical Manager per 60 MAEC-installed energy systems. MAEC will determine and develop funding sources for these operations. All MAEC Outer Island alternative energy services will be 100% funded by MAEC customer service fees after the installation of 500 systems.

- Ensure that future expansion by either MEC or MAEC will be shown by these companies to be economically viable (i.e. supply and system services are fully recovered by user fees), and will be in accordance with the priorities outlined in this Outer Island Energy Policy of 1994;

- Guarantee that planning will adopt a "least cost to the consumer" approach to determining system designs and services, based on full and un-subsidized costing of inputs for each alternative.

5. Goals for Outer Island Communities

- Neighborly cooperation with alternative energy field technicians and managers who will be responsible for the daily operation, minor maintenance, fee collection and routine administration of local alternative energy systems and appliances.

- Participation in the ongoing upkeep of local alternative energy systems through the;
  1) provision of assistance (e.g. recent system performance characteristics) during times of repair, and,
  2) regular payment of the appropriate supply and service fees for services provided.

- In the longer term, an active role in the management and expansion of local alternative energy systems through the formation of alternative energy community co-operatives.
Outer Island Energy Plan
May 25, 1994

1. Plan Objectives:

   - Ensure sustainable and coordinated development of energy systems infrastructure on the Outer Islands.
   - Ensure that Outer Island energy institutions and system management techniques provide for high customer satisfaction while the Outer Island energy infrastructure is developed.
   - Guarantee that the stringent environmental and educational principles required of Outer Island energy suppliers, by the Outer Island Energy Policy, are upheld.
   - Ensure a quick transition from Outer Island dependence on inconsistent and marginally sustainable energy sources, to a confidence in consistently available and indigenous energy sources.

2. Plan for RMI Outer Island Energy Sector, Years 1995-2005:

   - The Republic of the Marshall Islands adopts the 1994 Outer Island Energy Program and a new company is incorporated to handle all solar energy matters on the Outer Islands of the Republic.
   - Aid money from outside the RMI will be solicited and applied by the MEC and the MAEC. The RMI Government also may solicit foreign aid for the advancement of the RMI Outer Island Energy Program.
   - The Marshall's Energy Company (MEC) and the Marshall's Alternative Energy Company (MAEC) meet bi-annually (or more often as required) to coordinate Outer Island energy sector supply.
   - All LPG and LPG supply systems will be supplied and managed by the Marshall's Energy Company (MEC) in Majuro. Fees for supply and management services will be collected and accounted for by the MEC.
   - The MEC Board staffs the Company in accordance with MEC Article's of Incorporation. RMI Government subsidies for LPG systems will be granted to the MEC and MEC Board.
   - MEC expansion strategies from the year 1995 to the year 2005, will be approved by the MEC Board and carried out by the MEC.
The Marshall's Alternative Energy Company (MAEC) will primarily supply and manage a line of standardized solar energy production systems, and secondarily, promote the use of high efficiency electrical appliances and LPG refrigeration. Fees for supply and management services will be collected and accounted by the MAEC. The Company will start operations in the RMI with a pilot project on one RMI Outer Atoll.

MAEC expansion strategies from the year 1995 to the year 2005 will be approved by the MAEC Board and carried out by the MAEC. Large community installations (60+ systems) will be the priority installation for the MAEC. Although, anywhere a MAEC Outer Island manager can be established is where the MAEC can install systems.

The MAEC Board staffs the Company in accordance with MEAC Article's of Incorporation. RMI Government subsidies for solar and wind energy systems will go through the RMI Government Energy Office to ensure coordination with other RMI Government Development Programs and Policies, and granted to the MAEC and MAEC Board.

The RMI Energy Office will meet all costs of maintaining existing solar energy systems supplied by that Office. Any current cost recovery tariff structures may continue, but the Energy Office will stop supplying Photovoltaic (PV) systems after the MAEC is incorporated. The Energy Office will abandon responsibility for Government supplied PV systems three years after any PV system user authorized installation of an Energy Office PV system.

MAEC will offer to buy three year old Government PV systems. This gives the communities and individuals an opportunity to make an informed choice about continued ownership or sale of their PV systems. If MAEC takes possession of these systems, the MAEC will refit the equipment for supply to the Outer Islands. The MAEC would then meet all maintenance costs of the systems while service fees are collected. Service fees will be collected by MAEC Outer Island managers, who have the authority to take systems out of service after 90 days of non-payment.

3. Activities 1994 to 1997

1) Outer Island Energy Program is passed by the RMI Cabinet.
2) Marshall's Alternative Energy Company (MAEC) is incorporated.
3) MAEC's Board and first General Manager is chosen.
4) RMI Bi-Annual Energy Advisory Meetings begin.
5) MAEC funds and installs alternative energy pilot project.
7) RMI Government ends Energy Office PV Supply Program.
MEMORANDUM OF UNDERSTANDING
BETWEEN THE
MARSHALL'S ALTERNATIVE ENERGY COMPANY,
ENERGY DIVISION, MINISTRY OF RESOURCES AND DEVELOPMENT,
AND THE NAMDRIK SOLAR ENERGY COMMITTEE,
REPUBLIC OF THE MARSHALL ISLANDS

This Memorandum of Understanding (MOU) gives details of the photovoltaic (PV) lighting system project coordinated by the Energy Division, Ministry of Resources and Development and funded by the French Government under the Small Energy Projects Programme on Namdrik Atoll in the Republic of the Marshall Islands. It further outlines the obligations of the parties involved in the maintenance and collection of Service Fees for the PV systems.

Background

In August, 1994, the RMI Government requested that the French Government fund the capital costs involved with setting up a PV electrification scheme on an Outer Island in the RMI. The aim of this project was to assess and evaluate both the PV electrification technology and the infrastructure required to successfully provide a sustainable alternative to diesel or kerosene/gasoline powered appliances.

Obligations of the Marshall's Alternative Energy Company (MAEC)

The Marshall's Alternative Energy Company will undertake to provide the following:

1) Collection of the monthly Service Fee, initially set at $10 dollars US for a basic lighting system. The MAEC will have a Service Contract signed by each customer that outlines customer obligations. These obligations will include, but are not limited too; default on the Service Fee by more than three months will result in the removal of the entire PV system from the customer's home, reconnection fee of $20 dollars US minimum, collection of outstanding debts before reconnections, liability for damage to any part of the system due to willful
destruction, and forfeiture of part or all of customer deposit for willful destruction or outstanding Service Fee debt to the MAEC.

2) Perform the day-to-day construction and maintenance of the PV electrification project. The MAEC will consist of a Board of Directors, General Manager, Treasurer, Secretary and Outer Island Branch Managers that will act on behalf of the MAEC Home Office in Majuro, and carry out the duties specified by the MAEC Home Office. These duties will include, but are not limited to, maintenance of all PV systems, aid in collection of the monthly Service Fees, recording all duties performed and Service Fees collected in a Log Book, communication with MAEC Home Office in Majuro, and management of a MAEC spare parts inventory of PV components.

3) Training of all Outer Island Branch Managers (PV technicians) and office personnel.

4) Quick response to, and full communication with Namdrik Atoll Solar Committee.

Obligations of the Energy Division, Ministry of Resources and Development

The Energy Division will undertake to provide the following:

1) Supply of all components provided by the French Government (or any other funding source specified for the MAEC), required for PV electrification projects in time for installation or use.

2) Technical and supervisory expertise necessary to install and make operational all PV electrification projects.

3) Assistance in training technicians from Namdrik and participation in training of technicians working at both the MAEC and the Energy Division.

4) Maintenance of copies of MAEC Outer Island Branch Manager Log Books.

5) Assistance to, and communication with the MAEC and Namdrik Atoll Solar Committee to ensure the safe operation and maintenance of the PV electrification project.
6) Open a bank account for the MAEC in Majuro. One of the trustees will be from the MAEC and one will be from the Energy Division. Both trustees, along with the MAEC Board of Directors, will help maintain the account. At their request, the Namdrik Atoll Solar Committee will have access to records of this account. Account Statements from the bank will be sent to both trustees.

7) Advise the MAEC and Namdrik Atoll Solar Committee on the collection of deposit and Service Fees, assist in management of the collections, and aid in the procurement and delivery of spare parts to the MAEC Outer Island Branch Manager and Namdrik customers.

Duties of MAEC Outer Island Branch Managers

The MAEC technicians will be required to perform the following duties:

1) Check and service the PV electrification systems quarterly (including battery electrolyte levels, which will be topped up with distilled water as necessary).

2) In cooperation with the Treasurer of the Namdrik Atoll Solar Committee, the MAEC Outer Island Branch Manager will collect Service Fees, Deposit Fees, Reconnection Fees and charges for damaged MAEC property. The MAEC technician will also monitor the location of the MAEC Fee Collection Box at all times and ensure the Box is transferred to the AMI Majuro Flight in a timely manner. This cooperation with the Treasurer will include the notification and subsequent removal of any MAEC customer PV System if a customer is in arrears by more than three months.

3) The MAEC technician will assist any MAEC customer in the operation of their MAEC PV systems and aid the customer in entering their sixteen digit code into the MAEC PV Metering Boxes if such assistance is requested.

4) Maintain a MAEC spare parts inventory that will be used to replace defective, damaged or worn out components in any MAEC PV system.

5) Repair all minor faults that occur on any PV system as soon as possible after notification that an emergency service is required. This will require that the MAEC technician remain in close communication with MAEC customers and the Namdrik Atoll Solar Committee.
6) Ensure MAEC Customer Log Books are filled in at every quarterly and emergency service, recording estimates of operating hours, maintenance undertaken, and replacement parts used.

7) Report on the entire Namdrik PV project operation on a quarterly basis, by sending copies of the Log Book Sheets to the Ministry Of R&D Energy Division. This will include a summary of the Log Books, records of service fees collected, and turnover of on-island spare parts inventory.

Duties of the Namdrik Atoll Solar Committee

1. Chairperson

The Chairperson of the Committee will be the Namdrik Atoll Council Mayor (or Acting Mayor) and shall preside at all meetings and shall be responsible for all areas of its operation. The Chairperson shall coordinate all communication between the MAEC customers, the MAEC Outer Island Branch Manager and the MAEC Home Office in Majuro. The Chairperson shall provide the link between the service provider (MAEC) and system users to help ensure customer satisfaction. The Chairperson shall also serve notice to the Namdrik Atoll Solar Committee Treasurer so that he/she is aware of impending visits by MAEC Home Office personnel, donor parties, or other parties so that proper arrangements can be made.

2. Secretary

The Secretary shall be the Namdrik Atoll Council Secretary, who shall give notice and prepare the agenda for the meetings, and record the minutes of all meetings. The Secretary will ensure that MAEC customer needs are recorded and expressed at Committee meetings. The Secretary shall be the custodian of all records of the Committee, including executed copies of MAEC Service Contracts, minutes of the meetings and all correspondence.

3. Treasurer

The Treasurer shall be the Namdrik Atoll Council Treasurer, who shall assist in the collection of MAEC Fees by the MAEC Outer Island Branch Manager, and then ensure that the MAEC Fee Collection Box is safely stored until the Box is transferred to the AMI Majuro Flight. The Treasurer will inform MAEC PV customers, and then monitor the MAEC technician during the removal of any
MAEC PV system from a customer in arrears. The Treasurer shall keep accurate accounts of MAEC Fees collected and then prepare and submit quarterly financial reports to the MAEC and to the R&D Energy Division. These reports will be compared against the MAEC Outer Island Branch Manager financial reports to ensure accuracy. The Treasurer will also ensure that in-kind contributions (accommodations, food and labor) for MAEC Home Office personnel, government employees, and/or donor parties are arranged.

Chairperson
Namdrik Atoll Solar Committee
Namdrik Atoll, RMI

Robert Muller
Secretary, Ministry of R&D
MAEC Representative
ANNEX 4 – SOLAR SYSTEM SERVICE CONTRACT
This agreement is made on this day 19 between , hereinafter called “Customer” and the Marshall’s Alternative Energy Company, hereinafter called “MAEC”.

WITNESSETH

Whereas, the Customer has requested that MAEC supply and install solar energy service to his/her location on the island of as follows;

1. Customer requests that MAEC install a Solar Energy System with # solar panels provided:
   - the Customer agrees to pay MAEC a non-refundable Wiring Fee of $10 dollars per solar panel for installation, or re-installation, of any MAEC Solar Energy System,
   - the Customer agrees to pay MAEC the sum of $ monthly for power system maintenance, lighting, repair and service, and a comparable storage battery replacement after 4 years (if necessary),
   - the Customer agrees that solar energy service will be terminated if applicants account is in arrears by more than two months (62 days),
   - the Customer agrees that MAEC may remove the system from the Customer’s home if the Customer ‘s account is in arrears by more than three months (93 days), OR the Customer rewires, bypasses, adds to, removes, or replaces any part of the MAEC Solar Energy Systems,
   - the Customer agrees that all solar energy equipment remains the property of MAEC,
   - the Customer agrees to grant right-of-way necessary for MAEC technicians to perform construction, maintenance services, and operation of MAEC Solar Energy Systems,
   - the Customer agrees to pay MAEC a reconnection fee of $20 dollars (plus all past due monthly service fees) upon his/her request for reconnection of the MAEC Solar Energy System.
2. The Customer agrees that any expansion of the MAEC Solar Energy System to be covered under this contract will be reviewed by MAEC and that a new contract may be developed.

3. The Customer may request one visit each month by the MAEC Technician. One visit per month is free. Second visit and beyond will cost the Customer $5.00 dollars and is payable immediately to the MAEC Technician after the work is complete.

4. The Customer agrees that this document shall at all times be subject to changes or modifications by MAEC.

5. The Customer agrees that this agreement shall become effective on the date hereof and remains in force until such time as the Customer is in arrears by more than 93 days and/or the MAEC Solar Energy System is removed by MAEC.

IN WITNESS WHEREOF, the parties hereto have executed this agreement;

SIGNATURES OF CUSTOMERS

________________________________________________________________________

WITNESS

________________________________________________________________________

Namdrik Solar Committee

By: __________________________

Title: __________________________

WITNESS

________________________________________________________________________

Marshall's Alternative Energy Company (MAEC)

By: __________________________

Title: __________________________
ANNEX 5 – ARTICLES OF INCORPORATION OF THE MARSHALL’S ALTERNATIVE ENERGY COMPANY, INC.
ARTICLES OF INCORPORATION
OF THE MARSHALL’S ALTERNATIVE ENERGY COMPANY, INC.

KNOWN ALL MEN BY THESE PRESENTS:

That the undersigned do hereby mutually agree upon and enter into the following articles of
the company.

ARTICLE I - Name

The name of this company shall be the Marshall’s Alternative Energy Company (MAEC).

ARTICLE II - Place of Business

The principal place of business shall be located at Majuro, Republic of the Marshall Islands, and the mailing address of the initial office shall be P.O. Box 1727, Majuro, RMI 96960.

ARTICLE III - Nature of Business

The MAEC shall be a non-profit company carrying out its businesses on a full cost recovery basis.

ARTICLE IV - Duration

The period of existence and duration of the life of this company shall be perpetual.

ARTICLE V – Objects Purpose and Powers

Section 1. The prime objects for which this company is organized are the following: the MAEC is to provide alternative energy sources, in a sustainable manner, to households and organizations that have not been designated as MEC supply areas, (quote appropriate provisions from the MEC Regulations), and more particularly to:

- purchase, lease or otherwise acquire alternative energy equipment, fixtures, and other assets necessary to carry out the prime object;
- maintain, repair, replace, sell, trade in, scrap or otherwise dispose of alternative energy equipment and fixtures and other property as necessary;
- apply for grants and loans in the name of the company for the purpose of conducting the business of the company;
- collect from customers the full costs of services provided by the company;
- to engage in any or all other businesses which may lawfully be conducted by a non-profit organisation; and
- to enter into agreement with any other company, company or person carrying on, or about to carry on, any business capable of benefiting the company.
Section 2. In furtherance of the said nature of business and objects, this company shall have all powers, rights, privileges and immunities, and shall be subject to all of the liabilities and benefits conferred or imposed by law upon companies of this nature. and shall be subject to and have all the benefits of general law with respect to companies.

ARTICLE VI – Stock

The initial authorised capital stock of this company shall be in the aggregate amount of US$50,000 divided into 50,000 shares of common stock, of the par value of US$1 per share.

ARTICLE VII – Incorporators

The titles, mailing addresses and citizenship of and the shares allocated to each of the incorporators of this company are as follows:

<table>
<thead>
<tr>
<th>Title of Subscriber</th>
<th>Allocation of Shares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Secretary</td>
<td>1 ordinary share</td>
</tr>
<tr>
<td>Minister of Finance</td>
<td>1 ordinary share</td>
</tr>
<tr>
<td>Minister of Internal Affairs</td>
<td>29998 ordinary shares</td>
</tr>
<tr>
<td>Non-govt. and non-profit organizations</td>
<td>20,000 shares</td>
</tr>
</tbody>
</table>

ARTICLE VIII – Officers and Directors Generally

Section 1. The officers of the company shall be President, one or more Vice-Presidents, an Energy Adviser Consultant, a Secretary, and a Treasurer. The same person may not hold the position of President and Secretary at the same time.

Section 2. The number of Directors of the company, shall not be less than three nor greater than five shall be fixed from time to time by the bylaws and the number may be altered as therein provided. In case of any increase in the number of directors, the additional directors shall be elected as provided by the bylaws, by the directors of the shareholders, at any annual or special meeting. In case of any vacancy in the board of directors, the remaining directors, in accordance with the provisions of the bylaws, may elect a successor to hold office for the unexpired portion of the term of the director whose place is vacant and until his/her successor shall be duly elected and qualified.
Section 3. All the powers and authority of this company shall be vested in and may be exercised by the board of directors except as otherwise provided by law, these articles of incorporation or the bylaws of the company.

**ARTICLE IX - Initial Directors**

The title, address and citizenship of the first directors, who shall serve until their successors are chosen and qualified are as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Mailing Address</th>
<th>Citizenship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief Secretary</td>
<td>PO Box 15</td>
<td>RMI</td>
</tr>
<tr>
<td>Minister of Finance</td>
<td>PO Box D</td>
<td>RMI</td>
</tr>
<tr>
<td>Minister of Internal Affairs</td>
<td>PO Box 18</td>
<td>RMI</td>
</tr>
</tbody>
</table>

**ARTICLE X - Initial Officers**

The title, mailing address and citizenship of the initial officers who will serve until their successors are chosen and qualified are as follows:

<table>
<thead>
<tr>
<th>Name</th>
<th>Mailing Address</th>
<th>Citizenship</th>
</tr>
</thead>
<tbody>
<tr>
<td>President</td>
<td>Chief Secretary</td>
<td>RMI</td>
</tr>
<tr>
<td>Vice-President</td>
<td>Secretary of Resources and Development</td>
<td>RMI</td>
</tr>
<tr>
<td>Energy Adviser</td>
<td>Sandia National Labs, Division 6218 / DAC</td>
<td>USA, RMI</td>
</tr>
<tr>
<td>Secretary</td>
<td>General Manager</td>
<td>UK</td>
</tr>
<tr>
<td>Treasurer</td>
<td>MIDA</td>
<td>RMI</td>
</tr>
</tbody>
</table>

**ARTICLE XI - Limited Liability**

No shareholder shall be liable for the debts of this company beyond the amount, which may be due or unpaid upon any share of stock of this company, owned by him/her.
ARTICLE XII – Voting

Each share of stock of the company shall be entitled to one vote in any shareholder election for any purpose.

ARTICLE XII – Dividends

The Board of Directors of the company may pay dividends on its outstanding shares in cash, property, or its own shares, only from the profits and earned surplus of the company as is provided by law, but only when the company does not have a loss and the payment of a dividend would not create a capital deficit.

ARTICLE XIII – Dissolution

The company may be dissolved in the manner prescribed by law; and in the event of any liquidation, dissolution or winding up of the affairs of the company, its assets shall first be used in the payment of all its debts and claims against it, and those remaining shall then be distributed among the shareholders in proportion to the number of shares held by them.

ARTICLE XIV – Service of Process

Service of legal process may be made upon the company in the manner provided by law.

ARTICLE XV – Amendment

These articles of incorporation may be amended by the vote of the holders of not less than three-fifths of all of its stock issued and outstanding and having voting power.

ARTICLE XVI – Limitation on Stock Ownership

The ownership of the shares of stock is not to be limited to representatives of the government citizens of the Republic of the Marshall Islands who shall, at all times, hold not less than 60% of the shares of stock, shall be made available to citizens of the Republic of the Marshall Islands.

IN WITNESS WHEREOF, the incorporator hereinbefore named have hereunto set their hands effective as of .............

Chief Secretary
PO Box 15
Majuro, MH 96960

Minister of Finance
PO Box D
Majuro, MH 96960

Minister of Internal Affairs
PO Box 18
Majuro, MH 96960
ANNEX 6 – SAMPLE RURAL ELECTRIFICATION POLICY & POLICY GUIDELINES
ANNEX 6

A Sample Rural Electrification Policy and Policy Guidelines

Appropriate electrification of the rural areas /outer islands are a primary focus for the Government’s rural development effort. However, the Government recognises that international experience to date has shown that rural electrification (RE) leads to spontaneous economic development in the rural areas.

Additionally, the government recognises that the success of RE programs both internationally and in the Pacific, has often been poor. This has been for financial and administrative reasons rather than technical reasons. RE programs failed because they have not been self-sustaining, but instead have been dependent on external funding for capital investment and, in many cases, recurrent expenditure. The failure by governments and the rural consumers to recognise the need for financial independence of the RE installations will immediately throw the cost of the program back onto the limited resources of Government or the urban electricity consumer through tariff generated subsidies.

For these reasons, the extent and form of Government’s RE Program will be determined by the assessed requirements of the individual rural community and/or development project, and by their ability and willingness to pay for the service.

The need for (and cost of) adequate and skilled institutional support for RE schemes, both large and small, will not be underestimated. Successful RE programs are the result of financial independence, administrative competence, technical support and cultural fit.

Policy

- To contribute to the economic and social development of the rural areas through the provision of financially viable, cost effective and reliable electricity supplies to rural areas;
- In line with the rural electrification (RE) planning/coordination function of the Energy Office, to formulate, adopt and implement a financially and technically sustainable RE Program that will complement and operate in close coordination with other rural development programs;
- To institutionalize close cooperative links between the Energy Office as overall Coordinator of the RE Program, the “solar utility”, the power utility, and other participants in rural programs;
- To assist where necessary in the maintenance of an efficient, commercially oriented and financially independent solar energy organisation which is able to install, maintain and effectively manage solar PV systems, including the establishment and collection of a commercially based tariff/fee service with disconnection of service being the result of non-payment of fees;
- To ensure that electricity is supplied on a commercially sustainable basis, with tariffs/fees based on full cost recovery from consumers for all recurrent costs and for as much of the capital investment as is possible. Where government subsidies are justified, they will consist only of capital investment subsidies, they are to be provided for and made explicit in Government budgeting, and they are not to be cross subsidised from other operations of the solar utility or the power utility;
- To ensure that the provision of electricity is based on a least cost development strategy utilising technologies that are technically and commercially proven, are able to be adequately supported using local manpower and resources, and are suited to the needs of the user and the characteristics of the site. In situations where connection with the
power utility's grid proves the least cost option, extension of the grid should be encouraged;

- Subject to their commercial sustainability, to ensure that sites for rural electrification systems are selected to maximise the benefit/cost ratio, to maximise system sustainability, and to meet existing economic and social development needs;
- To ensure that rural electrification systems are implemented and operated in a manner that minimises detrimental impact on the environment, particularly ensuring that rechargeable batteries are recycled or disposed of in a manner that will not cause harm to the land, air or marine environment.

Policy Guidelines

Institutional Requirements

- Provide staff within the Energy Office to be responsible for the efficient coordination and overall management of the RE program and to advise government on all aspects of RE; and
- Place a high priority on managerial and technical training of RE staff.

Responsibilities of the Energy Office

- Within the scope of the rural electrification policy, prepare and adopt a rural electrification program that will operate in cooperation with other rural programs. The program will recognise the financial and institutional imperatives necessary for the program’s success, particularly the key role of the commercially orientated implementing agencies and the recipient rural communities; and
- Maintain co-ordination and overall management of the work plan of the program in close cooperation with the implementing agencies and rural authorities.

Responsibilities of the Implementing Agency

- In close cooperation with the Energy office and rural authorities, assist in the formulation and ongoing update of the RE program and its work plan;
- Be responsible and accountable for its respective components of the RE program on a commercially orientated and technically sustainable basis, with management responsibility for:
  * specification of sites, customer requirements and system design;
  * the procurement, installation, maintenance and replacement of systems;
  * connection and disconnection of systems
  * the efficient administration and tariff/fee setting and collection; and
- Maintain appropriate managerial, financial, operational and staffing procedures for the management of the RE systems;
- Secure Government and international funding for RE, particularly for the initial capital investment. Subsequently, the consumer tariff/fees will generate a sufficient capital base to eliminate the need for financial assistance;
- Appoint, train, manage and equip district/village level field technicians and supervisors who will be responsible at the local level for the installation, connection/disconnection, minor maintenance, fee collection and minor administration of their local RE systems; and
- Monitor major maintenance, refurbishment and replacement of RE systems, and ensure that they are undertaken in a timely manner.
Operations and Expansion

* Optimise the performance of RE systems through loss reduction programs, full and regular maintenance and refurbishment, and the maintenance of an appropriate inventory of spare parts;
* Maintain a detailed program for refurbishment, replacement and expansion of systems, including a full audit of equipment both in operation and in stock;
* Future expansion will be shown to be commercially viable, and will accord with the priorities of the RE program;
* Planning for new and replacement facilities will consider all energy sources and technology options. It will adopt a least cost approach to determining system design and technology, based on a full and unsubsidised costing of inputs for each alternative. The least cost approach will also include consideration of demand side management as an integral component. Only when, for similar return, the cost of investment in expanding or refurbishing the system is less than the costs of investment in efficiency maximization or conservation initiatives should the decision to proceed with the system expansion/refurbishment be approved; and
* Technology choice and system design will be selected on a case by case basis, but will encompass only those options that are technically and commercially proven and are able to be adequately supported. As a rule, energy technologies that are consistent with sustainable development practices shall be preferred over non-sustainable approaches for rural electrification.

Tariffs/Fees

* Ensure that tariff/fees for consumers, both government and private, reflect the full cost of supply. This provides rural consumers with the information and financial incentive to better manage and conserve their electricity demand; and
* To ensure the long term financial viability of the RE program and the individual systems, the cost of supply will include an automatic costs adjustment mechanism, a component for future capital requirements and a reasonable return on investment.

Subsidised Funding

* Where subsidised funding for tariffs/fees has been approved for government assisted institutions (eg. medical, educational and community), ensure that these subsidies are clearly identified, are made explicit in Government budgets, are strictly controlled, and do not disadvantageously impact on the commercial viability of the implementing agency; and
* Such subsidies are not to be financed (cross-subsidised) by tariff/fee paying consumers or the implementing agency.

Conservation and Efficiency Programs

* Provide information to rural electricity users about efficient technology and practices, targeting initially those areas showing the greatest potential impact.

Safety and the Environment

* Protect the rural community through the enforcement of appropriate technical and safety standards and procedures; and
* Protect the rural environment through the implementation and enforcement of appropriate environmental guidelines and regulations.
Responsibilities of the Rural Community

- Assist the implementing agency with the installation of its community's systems and ensure the systems long term efficient operation through assistance with minor maintenance and the regular payment of stipulated tariffs/fees;

- Where the diesel system is installed in a community under the RE program, that community will be responsible for providing and supporting a field technician who will be responsible for the system's daily operation, minor maintenance, and minor administration; and

- Seek advice/assistance from the implementing agency in all matters concerning their electrification systems.
ANNEX 7 – JOB DESCRIPTIONS
ANNEX 7

JOB DESCRIPTIONS

GENERAL MANAGER

The General Manager directly reports to MAEC's Board of Directors (BoD) and will be responsible for the day-to-day management and operation of the MAEC. Specifically he/she will be responsible for:

- Servicing the meetings of the BoD as secretary;
- Ensuring that the MAEC is run and managed in accordance with its Article of Incorporation, directions of the BoD and any byelaws of the MAEC;
- Implementing measures to improve efficiency in service delivery and to make the MAEC a self-sustaining commercial entity;
- Identifying local and grant aid funding for the expansion of the RMI's OIEP;
- Supervising the staff of the MAEC to ensure the efficient and cost effective implementation of projects and the timely submission of reports to the program's funding sources; and
- Providing of counterpart on-the-job management and technical training to the Trainee General Manager and to other staff of the MAEC.

Qualification

The appointee must have at least a degree in renewable energy engineering or a degree in a similar related field such as appropriate/rural technology, rural development, etc. He/she must have at least five years of management experience in a utility-type organisation and in developing, remote and island environments.

TRAINEE GENERAL MANAGER

The Trainee General Manager (TGM) directly reports to the General Manager and will be performing the functions of the Senior Technicians and receiving hands-on management experience from the GM. While the overall management of the MAEC would be with the GM, the TGM would act as GM in the absence of the GM and will take on the full authority and responsibilities of the GM.

Qualification

The appointee must have at least a diploma in rural technology or a related discipline with some background knowledge and experience in management and accounting. She/he must also possess sound technical knowledge of the various renewable energy technologies and in particular, photovoltaic.

OFFICE MANAGER

The Office Manager (OM) will be responsible for all the records and accounting works of the MAEC and will report directly to the GM. Specifically he/she will be responsible for:

- maintaining the office’s filing system;
- the word processing works of the office;
ensuring the efficient flow of both outgoing and incoming correspondence;
- maintaining an up-to-date record of the assets and financial resources of the office;
- maintaining a record of customers payments and the recommendation of service disconnection;
- the timely preparation of the financial records of the office;
- ensuring the smooth inflow of revenue and the timely execution of payments; and
- providing on the job training to the Office Manager Trainee as well as training of the island technicians on their fee collection and recording functions.
- providing training to the island technicians on their fee collection and recording functions.

Qualification

The appointee must have at least a diploma in management, commerce or other related field. He/she must have at least five years of management experience in a developing country.

OFFICE MANAGER TRAINEE

The office manager trainee works directly under the expatriate office manager and will be assisting the office manager with the recording and accounting works.

Specifically he/she will assist in:

- maintaining the office's filing system;
- the word processing works of the office;
- ensuring the efficient flow of both outgoing and incoming correspondence;
- maintaining an up-to-date record of the assets and financial resources of the office;
- maintaining a record of customers payments and the recommendation of service disconnection;
- the timely preparation of the financial records of the office;
- ensuring the smooth inflow of revenue and the timely execution of payments; and

Qualification

The appointee must have at least passed the University Entrance examination with good passes in mathematics, accounting and English. Experiences with the use of computers and previous working experiences in areas directly relevant to the responsibilities of the position would be a bonus.

SENIOR ENERGY TECHNICIANS

The Senior Energy Technicians (SET) reports directly to the GM. They will be responsible for supervising the works of the island technician and carrying out all the technical functions of the MAEC. Specifically they will be responsible for:

- the implementation of renewable energy projects and the timely submission of installation reports;
- carrying out grass root national training program on the maintenance of PV systems;
- carrying out technical training of the island technicians;

13 By the time the SET is recruited, it is assumed that the GM position would have been localised.
• ordering of spare parts; and
• maintaining an up-to-date record on the movements of equipment bought for and/or supplied through the MAEC, their performance and the maintenance works carried out on of each PV system.

Qualification

The appointees must be RMI nationals who have sat for the equivalent of the NZ University Entrance examination with good passes in maths and science.

ISLAND TECHNICIANS

The Island Technician (IT) reports directly to the Senior Technicians. They will be the on-site representatives of the MAEC in its areas of service. Specifically he/she will be responsible for:

• monitoring the performance of the PV systems, carrying out all the necessary maintenance works and carrying out the disconnection of service to consumers who fail to abide with the policies of the MAEC;
• safekeeping of spare parts and equipments that are required for his/her monitoring and maintenance functions;
• collecting of the monthly rental fees and the transmission of the fees to the MAEC main office;
• assist in the installation of projects; and
• liaising between the communities and the MAEC management.

Qualification

The appointees must be RMI nationals who have sat for the RMI School Certificate examination with good passes in maths and science.
ANNEX 8 – MONITORING RECORD
## MONTHLY RENTAL PAYMENTS RECORD FORM
(for the Island Technicians)

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## MONTHLY RENTAL PAYMENTS RECORD FORM

**Deposited to Account No:**

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**Total Collected:** 22.80

**Less expenses:** 13.00

**Deposited IEO:** 9.80

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### TO BE COMPLETED BY THE HEADQUARTER STAFF ONLY

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<th>February</th>
<th>March</th>
<th>April</th>
<th>May</th>
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<td>1. Total Collected</td>
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<td>30.40</td>
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<td>2. Less arrears paid</td>
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<td>7.60</td>
<td>7.60</td>
<td>30.40</td>
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<td>3. Less advance payments</td>
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<td>4. Total paid for the month 1-(2+3)</td>
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<td>5. Total for the month (4@$7.60)</td>
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<td>6. Amt in arrears for the month (5-4)</td>
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<td>15.20</td>
<td>22.80</td>
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<td>7. Total in arrears as of end of the month (5+6)</td>
<td>38.00</td>
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<td>68.40</td>
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ANNEX 10 – CALCULATION OF MONTHLY FEES
How Costly is PV Power?

All too many consultants, when asked "What is two and two?" respond, "What did you have in mind?"

Norman R. Augustine
Chairman, Martin Marietta Corporation

It depends on how you look at it!

To explore costs construct an accumulated cash flow sheet as shown in the attached two sample spreadsheets "Costs of electricity generation with PV-Systems". This method will show the financial risks and costs involved in electricity generation by a PV-system.

Step 1: List the years that represent the technical life of the system. Label the row "At the end of year" to make it clear that all cash flows are done at the end of a year. Note that the end of the year 0 is the beginning of the year 1.

Step 2: The row labelled "Panel(s), $" represents the accumulated costs for the panel and the electrical wiring. Note that at the end of the year 0 we invest say $500 for a 70 Watt(p) panel and the wiring. At the end of year 1 the accumulated costs remain at $500 because no more panels were bought. At the end of year 20 the accumulated costs still remain at $500 because it is assumed that the panel will last 20 years. In other words after the first initial investment there is no more investment for panels and consequently the accumulated costs for the panel component of the system remain constant over the entire observation period.

Step 3: The row labelled "Batteries, $" represents the accumulated costs of all batteries needed over the technical life of the panel (20 years). At the end of year 0 we invest $150 for batterie(s). Next assume a technical life for the battery. Three years is an average figure and equivalent to about 600-1000 recharging cycles. Depending on the quality of the battery controller, the battery, its design and treatment by the user the number of recharging cycles may vary from 75 to 1300. The decisive factor is the battery discharge level. A car battery that is discharged only 5-10% per cycle may last 800 cycles and more. Discharging a car battery by 80% down to 20% of nominal capacity will yield only 75-100 cycles.

Note the battery is replaced at the end of year 3 in the example. Consequently the number sequence of accumulated cost starts with 150, 150, 150, 300...... In other words at the end of the third year the user has spent a total of $300 for batteries.
At the end of year 6 another battery must be bought. The number sequence of accumulated costs is expanded by the numbers 300, 300, 300, 450 to a sequence 150, 150, 150, 300, 300, 300, 450, 450, 450........

The user may change the replacement cost for a battery as well as the technical life in the first row of the spreadsheet under "Bat" and "Cost".

Step 4: The row labelled "Lights, $" represents the accumulated costs for the lights to be installed and replaced over 20 years. Assume $100 are spent on lights at the end of year 0. The technical life of the lights depends on the design, brand, the ambient temperature, the way they are installed and most important on the quality of the battery control unit and its cut in/ cut out voltage as well as the wire gauge. If everything is perfectly designed we may expect 5000 hours or 5 years (at 1000 hours per year). However field experience has shown that due to inadequate combination of wire gauge and battery control unit, lights may last only 1000-2000 hours. In the spreadsheet example all lights are replaced at costs of $50 at the end of the year 3. The number sequence of the accumulated costs for the light starts with 100, 100, 100, 150, 150, 150, 200, 200, 200........ The user may change the technical life as well as the replacement costs for the lights in row 2 of the spreadsheet. As shown in the example replacement costs for lights may not always equal initial investment costs, because most lights can be separated in two major parts, the ballast and the lamp. The ballast usually lasts longer than the lamp.

Step 5: The row labelled "BCU, $" represents the accumulated cash flow for the replacement of the battery control unit (BCU) that controls the current inflow from the PV panel(s) to the battery and the current outflow from the battery to the electrical appliances. High quality BCU’s are protected against overload and do not overheat under tropical conditions. They are completely encapsulated and feature a large heat exchanger like surface area for good heat dissipation. They may last 7 years and longer. In the example BCU costs of $120 for a 6 Ampere load on both sides were assumed. The accumulated cash flow is 120, 120, 120, 120, 120, 120, 120, 240, 240, 240, 240, 240, 240, 240, 240........ The technical life of the BCU as well as its replacement costs may be changed in row 3 of the spreadsheet.

Step 6: The row labelled "NPV(costs) at the end of the year" represents the accumulated total discounted costs for the end user in any respective year, called the Net Present Value. In the example the initial total costs are $870 at the end of the year 0. The costs remain constant in the year 1 and 2 because no additional expenses occur. However at the end of the year 3 a new battery for $150 and new lamps for $50 are bought. In other words the accumulated discounted costs at the end of the year 3 will be $1070.

Step 7: The row labelled "NPV(kWh) at the end of the year", represents the accumulated and discounted net energy (measured in “useful kWh”) consumed by the lights or other appliances. The “harvested kWh” depend strongly on panel design,
size, and average annual solar radiation at the installation site. In addition the choice of wire size and BCU design influence the amount of net energy ("useful kWh") delivered to the lights. Note there is a difference between "harvested kWh" and "useful kWh". Losses of up to 30 % of harvested kWh are not so uncommon in badly designed systems. In the example it is assumed that a 70 Watt(p) system generates 80 "useful kWh" per year. This translates into average 219 Wh(useful) of electricity per day. The latter is a good average figure for tropical climates with extended rainy periods.

Step 8: The row labelled "Average economic costs per kWh" are the costs a user pays for electricity under the assumption that the system lasts for 1, 2, 3, 4, 5......20 years. Assume the system lasts 2 years. Consequently the user has paid so far $ 870 for the system and received 160 kWh(useful) of electricity. Consequently the electricity costs are 870/160=5.44 $/kWh at the end of the year 2.

Step 9: The row labelled "Monthly costs, $" are the monthly costs a household has to pay for its PV power if all initial equipment costs and the periodic replacement of batteries, lights and BCU are recovered at a given discount rate. Assume the system lasts only two years. The accumulated costs for two years are $ 870 and consequently 870/24= $ 36.25 are the monthly costs.

Step 10: The above presentation is in constant prices and has neglected inflation for the hardware or interest paid for the capital. In a real world situation a so called discount rate is applied that takes into account interest paid and inflation on replacement parts. Applying a positive discount rate makes everything a little bit more expensive and calculations more complex. The second example "Costs of Electricity generation with PV-Systems: Example 2" shows all cash flows and costs at a discount rate of 20 %. The latter is a realistic minimum discount rate for private firms selling, installing and maintaining PV systems for profit.

Explanatory notes

Note 1: The discount rate d is viewed as the opportunity costs of the capital for the PV power station system and costs to periodically replace parts such as lights, batteries, and the BCU. For simplicity the discount rate is defined as:

\[ d = \text{Bank interest rate (\% per year)} - \text{Inflation rate for components (\% per year)} \]

The above equation is accurate enough for most calculations where bank interest rates and inflation rates are below 20%. The correct mathematical equation is:

\[ d = \frac{100 + i}{100 + a} - 100 \]

with "i" the annual bank interest rate and "a" the annual inflation rate in %.

The discount rate d may be negative, zero or positive. The discount rate becomes zero if bank interest rates equal inflation, or negative if preferential interest rates are lower than the inflation rates for system components.
Note 2: There are no provisions in the spreadsheet to separately list the labour and general overhead costs to repair and maintain the system by a company. Overhead costs are usually added to the hardware costs and labelled handling fees. Typical handling fees are 10-30%.

Note 3: The row labelled "Average economic costs $/kWh" shows the cost development on a year by year basis. Specific generation costs are defined as NPV(costs)/NPV(kWh). Observe that the corresponding graphic called "Electricity costs" is a curve that is very steep at the beginning and becomes flat with little difference in costs from one year to the next. The larger the discount rate the faster the curve becomes flat. We say, it asymptotically approaches a constant value.

Note 4: The row labelled "Monthly costs, $" represents the monthly costs a household has to pay or should be charged (if they have nothing to do with the financing of a system and its periodic maintenance and repair). Observe that the corresponding graphic labelled "Monthly minimum costs" exhibits the same behaviour as the first graphic.

Note 5: In the examples the technical life of lamps, batteries and BCU are:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries:</td>
<td>3 years</td>
</tr>
<tr>
<td>Lights:</td>
<td>3 years</td>
</tr>
<tr>
<td>BCU:</td>
<td>7 years</td>
</tr>
</tbody>
</table>

The above technical lives represent average values of a 50-70 W(p) household system. Observe that the necessary periodic replacement of major parts of the system are responsible for the flat characteristic of the costs graphics. Monthly minimum costs are strongly influenced by the technical life of the above system components. Assuming too optimistic technical life times is the best strategy to lower PV power costs on paper. A typical high cost scenario should assume a battery technical life of 2 years and lamp technical lifetimes of 2 years for systems that are used almost daily. The correlation of battery costs versus technical life and acceptable discharge level is one of the most interesting issues in lowering PV power cost.

Note 6: The last row of the spreadsheet labelled "Recovery factor RF(d,T)" is a factor needed to calculate the monthly costs. It is defined as:

\[ RF(d,T) = \frac{q^n(q-1)}{q^n-1}, \text{ where} \]

\[ q = 1 + \frac{d}{100} \]
\[ d = \text{discount rate in \%} \]
\[ T = \text{the year } T \]

Observe that the value for RF(d,T) depends on the selected discount rate d and the year T.

Note 7: The annual system costs (annuity) are calculated as the product:
Dividing the above product by 12 results in the monthly minimum costs for a household.

Note 8: The calculation of monthly minimum household costs is the key figure for any project appraisal. Cost per kWh (used) are only given for completeness and for comparison with conventional systems. A firm that sells, installs, and maintains PV systems is interested in economic risk reduction and not in subsidization of PV systems or cost comparison between PV and other electric power sources. Consequently the technical life of the total system is the important variable parameter and the year where the costs "level out" an important date. All sample calculations will show the same trend of marginally changing costs beyond a technical life of 12 years. Whether the panel lasts 10 years, 15 years or 25 years is only of academic interest and will neither change the generation costs nor the retailers risk significantly. The often heard argument "Let's assume a longer life expectancy of the system to lower generation costs" is based on misconceptions about the real cash flows over 20 years.

Note 9: Often very low positive or even negative discount rates are applied to calculate economic costs of PV power. This may be acceptable for power supply to improve social infrastructure. It is not acceptable and may even create social conflicts for power supply to private households. In a real life situation a discount rate of 20 % and higher is more appropriate and gives investors a better chance to recover their money at a reasonable profit. It is noted that international financing institutions may calculate with negative discount rates. This is justified in a situation where loans carry an interest rate that is below market inflation rates and the loan is paid back in local currency.

Note 10: The spreadsheet is protected and you cannot change its settings without a password. All input is clearly marked and the output data rows are shaded. The user must provide a discount rate in %, the power capacity of the panel in Watt(p), and the annual electricity available from the system in "useful kWh/year" in addition to the cost input figures and replacement intervals for system parts. Mathematical background functions are given on the spreadsheet. For further questions and comments contact:

Forum Secretariat
PREP Programme
Private Mail Bag
Suva, FIJI
Fax: +(679)-303828

A.Kaupp, PREP "How costly is PV power??", 7/08/97
# Costs of Electricity Generation with PV-Systems

## Costs of PV Power (A. Kaupp, 11/95)

<table>
<thead>
<tr>
<th></th>
<th>Technical life, years</th>
<th>Bat</th>
<th>4</th>
<th>Cost 100</th>
<th>Energetica International Inc. e-mail: <a href="mailto:energetica@aol.com">energetica@aol.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount rate, %</td>
<td>10</td>
<td>q</td>
<td>1.1</td>
<td>Light 1</td>
<td>Cost 80</td>
</tr>
<tr>
<td>Nominal capacity, Watt(p)/panel</td>
<td>70</td>
<td>BCU</td>
<td>7</td>
<td>Cost 80</td>
<td></td>
</tr>
<tr>
<td>At the end of year</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Panel(s), $</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Batteries, $</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Lights, $</td>
<td>80</td>
<td>153</td>
<td>219</td>
<td>279</td>
<td>334</td>
</tr>
<tr>
<td>BCU, $</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>NPV(costs) at end of year</td>
<td>460</td>
<td>533</td>
<td>590</td>
<td>659</td>
<td>782</td>
</tr>
<tr>
<td>NPV (kWh) end year</td>
<td>80</td>
<td>153</td>
<td>219</td>
<td>279</td>
<td>334</td>
</tr>
<tr>
<td>Average economic cost, $/kWh</td>
<td>0.63</td>
<td>0.39</td>
<td>0.41</td>
<td>0.40</td>
<td>0.29</td>
</tr>
</tbody>
</table>

## Electricity Costs

![Electricity Costs](image1)

## Monthly Minimum Costs

![Monthly Minimum Costs](image2)

**ENERGETICA INTERNATIONAL Inc.**
e-mail: energetica@aol.com
## Costs of Electricity Generation with Genset Systems

### Costs of Diesel Power

<table>
<thead>
<tr>
<th></th>
<th>Technical life, years</th>
<th>D/T</th>
<th>Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discount rate,</strong> %</td>
<td>15</td>
<td>q</td>
<td>GenS</td>
</tr>
<tr>
<td><strong>Nominal capacity, kW</strong></td>
<td>10</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td><strong>Number of customers</strong></td>
<td></td>
<td></td>
<td>50</td>
</tr>
</tbody>
</table>

| At the end of year       | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|--------------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| GenSet (+Generator and Housing), $| 5000 | 5000 | 5000 | 5000 | 5000 | 5000 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 | 6236 |
| Distrib. and Transmission lines, $ | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 | 1000 |
| Repair and Maintenance, $ | 0 | 100 | 187 | 263 | 328 | 385 | 435 | 478 | 516 | 549 | 577 | 602 | 623 | 642 | 658 | 672 | 685 | 695 | 705 | 713 | 720 |
| Fuel+Lub. Costs, $ | 0 | 1800 | 3365 | 4726 | 5910 | 6939 | 7834 | 8612 | 9289 | 9877 | 10389 | 10834 | 11221 | 11557 | 11850 | 12104 | 12325 | 12518 | 12685 | 12830 | 12957 |
| NPV(costs) at end of year | 6000 | 7900 | 9552 | 10989 | 12238 | 13324 | 14269 | 15091 | 15805 | 16426 | 18202 | 18672 | 19080 | 19435 | 19744 | 20012 | 20246 | 20449 | 20626 | 20779 | 20913 |
| NPV (kWh) end of year | 0 | 10000 | 18696 | 26257 | 32832 | 38550 | 43522 | 47845 | 51604 | 54873 | 57716 | 60188 | 62337 | 64206 | 65831 | 67245 | 68474 | 69542 | 70472 | 71280 | 71982 |

| At the end of year | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|-------------------|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| **Average economic cost, $/kWh** | 0.79 | 0.61 | 0.42 | 0.37 | 0.36 | 0.33 | 0.32 | 0.31 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.29 | 0.29 | 0.29 | 0.29 | 0.29 | 0.29 |
| **At the end of year** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Monthly Cost,** $ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Recovery factor RF(i,T)** | 1.150 | 0.615 | 0.438 | 0.350 | 0.298 | 0.264 | 0.240 | 0.223 | 0.210 | 0.199 | 0.191 | 0.184 | 0.179 | 0.175 | 0.171 | 0.168 | 0.165 | 0.163 | 0.161 | 0.160 |

### Electricity Costs

![Electricity Costs Graph](image1)

### Monthly Minimum Costs

![Monthly Minimum Costs Graph](image2)

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A. Kaupp, Suva, Fiji 12/95
Power Generation Costs with Genset

$ / kWh

Technica fe age
Genset Power monthly costs per customer

Genset kWh-Month