

Fact Sheets of Selected Photovoltaic Applications

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Foreword

Much has been written about the prospects of photovoltaic systems for developing countries. A growing number of field trials is being undertaken worldwide and moderate success has been reported concerning the commercial introduction of standardized package units for small-scale purposes.

We in the GTZ are convinced that environmentally sound photovoltaic technology will be of increasing significance for countries of the Third World, given that system costs are expected to further decrease. By commission of the Federal Government, we have started already several years ago with testing and demonstration of photovoltaic applications, thereby taking the first steps toward market introduction.

Such units have in common that they are to serve individual electricity demands ranging from several watts like a Solar Home System to several kilowatts like a village Drinking Water Supply. Moreover, these units may differ greatly according to site and their user conditions. This specificity of photovoltaic systems along with continuing pressure from competing conventional energy supplies calls for collecting "facts and figures" about potential photovoltaic applications. Detailed insight into the user's demand and the local conditions including component prices, competitors and solar radiation data forms one of the bases for market development. Such clarification also helps both to cut cost for feasibility assessments and to standardize equipment. Finally, buying a photovoltaic unit is a major venture for a rural household; accordingly, the client ought to be well-informed about the expected financial consequences.

This collection of "Factsheets", compiled after several years of experience in the Philippines, is intended to complement strategic considerations about decentralized energy supplies through the presentation of practice oriented data.

For the example of the Philippines, but most likely also for countries with similar weather and climatic conditions and socio-economic structures, the Fact Sheets should help in designing projects and photovoltaic equipment thus serving as an input both for technical cooperation and commercial activities.

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1. Introduction

Approximately 80 percent of the world's 5.3 billion people live in rural areas of developing countries, most of them with no access to electricity. Sunrise and sunset still mark the beginning and end of the working day.

In the Philippines, an archipelago of some 2,800 inhabited islands, the "urban luxury" of electricity is still far away for 65 percent of the population. Only in a few cases is electric power produced by stand-alone generator sets. Social life in the evenings is usually extended for a couple of hours by a kerosene lamp.

There is no doubt that electricity spurs the social and economic development of rural areas: Often the availability of electric power is decisive for the supply of good drinking water, the conservation of food, the storage of medical supplies, telecommunications, radio, TV, etc.

It is obvious that along the anticipated path of development, many developing countries will increase their energy consumption. A large part of it will be covered by conventional sources like oil and coal. This will contribute to a steady increase in the world's carbon-dioxide (CO_2) production.

Solar panels are one of the very few CO_2 -free energy converters. Today, for a range of applications, they are a technically feasible and economically viable alternative to fossil fuels. A solar cell can directly convert the sun's irradiation to electricity based on a physical process that requires no moving parts. This results in a relatively long service life of solar generators.

At present about 42 Megawatts of solar panels are installed around the globe. 50 Kilowatts are in operation in the Philippines. This may seem quite impressive, but on the other hand one should not forget that a single coal-fired thermal powerplant may have a (day-and-night) capacity of 600 Megawatt.

Solar radiation provides us at zero cost with 10,000 times more energy than is actually used. Most developing countries receive as much as 50 to 100 percent more insolation than countries in temperate zones. Nevertheles, solar or photo-voltaic (PV) systems do not come for free: The introduction of such a new technology takes time and effort. The financial barrier (especially regarding the initial investment) is too high for many enterprises and families, especially in countries like the Philippines. Adequate financing schemes are a necessary prerequisite if this technology ever is to make serious progress in areas without access to other sources of electricity.

Roughly 10 years after the introduction of photo-voltaics in the Philippines and after a serious local research and development effort, several PV applications are ready for introduction and marketing on a massive scale. Of special interest are relatively simple systems such as Solar Home Systems. They may have a tremendous impact on rural development by supplying minimal amounts of electric power to each individual household. Also for some other applications e.g. telecommunication facilities in remote parts of the country, PV is a viable option. In the immediate future, PV component quality control will be of crucial importance for the successful introduction of this technology.

For all areas which, owing to physical or economic constraints, cannot be reached by conventional power supply systems, PV technology can now be considered an alternative option for rural electrification

This document provides an overview of the potential and the general impact of various PV applications in the Philippines, as well as an indication of the need for additional research and development. The majority of these applications was (field)tested under the recently completed Philippine-German Solar Energy Project (PGSEP), financed by the German Ministry for Economic

Cooperation in Bonn. The energy requirement, technical design, economic analysis of the PV system and its direct conventional competitor, plus an indication of the specific market potential, are presented on separate fact sheets. Each fact sheet covers one application. Some specific country data, relevant energy prices and PV component prices are to be found in the Country Fact Sheet. A coloured overview summarizes all fact sheets. An explanation of all methods (i.c. economic analysis and system design) and assumptions precedes the fact sheets.

This study was conducted by ITW-Consulting Ltd. on behalf of GTZ. Persons involved: P.H.A. de Bakker, K.M. Schulte.

2. Method of pv system sizing

In order to discuss the feasibility of a certain application, first a reliable system must be designed. Systems may vary according to requirements regarding their availability. In the Philippines the (estimated) system design can be based on an average insolation of 5 kWh per m per day.

2.1 Components

Considerations regarding the design of a PV system usually start with the anticipated load. The load and the period in use, meteorological conditions and required availability together determine the size of all system components.

A PV power supply commonly consists of three components:

1. Solar Generator. Photovoltaic cells, encapsulated in transparent material, convert an efficiency-dependent quantity of the absorbed sunlight into electricity. Appropriate serial/parallel connection results in any desired DC voltage and power.

2. Battery. Since in most cases not all electrical power will be consumed at once, and energy is required for periods of low or zero insolation (night-time, cloudy days), electricity storage will be needed.

3. The Battery Control Unit (BCU). This device protects the battery from being overcharged or deeply discharged. Both would negatively affect the length of the service life of the battery.

2.2 System Design

A first approximation for the design of a standard PV system can be made based on the average insolation and energy demand data. Because of the modular character of these PV systems, an additional panel can always be added without significant changes in the design.

Assuming constant efficiencies for all system components the design is based on:

$$P_{pk25} = \frac{W_{el}}{W_r} \times \frac{1kW}{m^2}$$

where

 W_{el} = electrical energy demand in kWh per day W_r = radiated solar energy in kWh per m² per day P_{pk} = measure of the size of a solar generator in kW peak, definded as the output power of a solar generator at an irradiance of 1 kW/m²

If the temperature increases, the efficiency of the panel will drop (typically 0.4 %/C). Commonly the P_{pk} power is rated at 25C, while the operating temperatures may be close to 50 or even 60C. This means that for real conditions the system design needs to be approx. 10 percent larger:

$$P_{pk25} = 1.1 \times \frac{W_{el}}{W_r} \times \frac{1kW}{m^2}$$

Efficiencies of the control unit, batteries, inverters and matching efficiency should be included as well: An inverter has a typical efficiency of 85 % - 95 %. A BCU should have a minimum efficiency of 95%.

It is assumed that all generated power is passed on to the load via batteries. Battery efficiency is assumed to be 80 percent. If an inverter is required as well (to change DC into AC), the size of the generator will be determined by:

$$P_{pk25} = 1.1 \times \frac{W_{el}}{W_r \times n_b \times n_{inv} \times n_m \times n_{bcu}} \times \frac{1kW}{m^2}$$

where

nb = battery efficiency (80 %) ninv = inverter efficiency (90 %) nm = matching efficiency (95 %) nbcu = BCU efficiency (95%)

3. Method of economic analysis

3.1 Dynamic Economic Evaluation

For the calculation of the cost annuity or the cost per unit produced, common economic evaluation methods were applied. The limitations of such calculations are likewise the limitations of all the resulting figures: They do not encompass ecological and socio-economic effects or the effect on the country's economic goals.

The dynamic approach was chosen as it also considers additional investments after the start of operation of a certain project. It takes into account the different periods at which revenues or payments occur. This means that payments are discounted if they come after a certain project is commissioned. Revenues and payments are given a higher value the earlier they fall. in PV systems, additional investments (e.g. replacement of batteries) will often be necessary.

Inflation is dealt with by computing the real interest rate (i) derived from the assumed market interest rate (p) and the inflation rate (a). The discount factor is:

q= a/e

where q = 1 + i/100;

a = 1+p/100;e = 1+a/100

3.2 Cost Annuity

As no revenues are considered in the analyses, the focus will be on the cost annuity (Ak) which is calculated according to the following formula:

$$\boldsymbol{A}_{k} = \sum_{t=1}^{T} \left[\left(\boldsymbol{K}_{0}, \boldsymbol{q}^{-t} \right) \boldsymbol{RF}(i, T) \right] + (I - L) \boldsymbol{RF}(i, T) + L.i$$

where:

 A_k = Cost annuity T = Service lifetime \sum = Summation

t=1 = Time or period one year after commissioning K_0 = Operating cost q^{-t} = Discounting factor (1 + i/100)-t i = Discount rate t = Time of the payment $\sigma^{t(q-1)}$

RF = Recovery factor
$$RF(i,t) = \frac{q^{t}q^{t}}{q^{t}-1}$$

i = Interest rate

I = Investment cost

L = Liquidation yield at the end of service life

4. Assumptions and remarks

4.1 General Remarks

Every possible application is described by a set of technical and economic criteria. Certain assumptions regarding the different criteria have to be made:

* The interest rate of 9.5 % and the inflation rate of 6 % do not reflect current rates, but are applied to the economic evaluations for long-term projects as recommended by the Asian Development Bank. These rates almost reflect the internationally accepted guideline where a real interest rate of 4 % is used, as against 3 - 3.5 % for the Philippines. For the calculation of short-term financing schemes (3-5 years) a commercial market interest rate of 15 % with an inflation rate of 9 % would be more appropriate.

* Some applications are subdivided into different case studies according to different (power) requirements. Based on the required size (e.g. for different sizes of residences) a PV power source may offer an attractive alternative, or not.

* If certain applications are found to be not feasible e.g. because of the high investment, it does not immediately imply that no further research and development activity at all can be undertaken. Maybe an activity partly powered by PV would be more acceptable.

* Assumptions for any PV application discussed always focus on rural areas:

- Only the most essential equipment is driven electrically. Other activities are still performed manually.
- More refined activities or activities which require high energy levels can only be realized in locations where energy is readily available (electrified areas).
- Energy-saving prototype applications are not discussed in the fact sheets. This overview concentrates on appliances readily available on the market. However, research and development work on energysaving prototypes is mentioned.

* The economic comparison of a PV system versus a conventional competitor is usually limited to the choice that people now have;. e.g. for lighting: In a comparison of a PV powered fluorescent tube versus a kerosene high-pressure lamp, the quantity of incident light (lux) is not considered.

* To neutralize any artificially created precision in the system pricing and cost calculations, figures in the fact sheets have been rounded off.

4.2 Lifetime of Components

A very important consideration in the economic analysis is the lifetime of a PV system. Lifetimes of the various components of a PV power supply have been estimated, based on experiences gained over the past few years.

- 1. Panels. The lifetime of PV panels is estimated at 20 years. Proper encapsulation and the use of low-iron tempered glass ensure a lifetime which may go well beyond.
- 2. Frames. Galvanized iron frames and anchors are part of most PV systems. Properly galvanized material should last as long as the panels although some maintenance way be required.
- 3. Batteries. Depending on the character of the charge/discharge cycles, the average lifetime of the so-called "Solar Batteries", according to experience gained in the Special Energy Program and the previous Philippine German Solar Energy Project, has been set at 4 years.

- 4. BCUs. Locally produced Battery Control Units are assumed to last at least 5 years, after which they may be repaired or replaced. In computations for these fact sheets it is assumed that they are replaced. imported BCUs for larger power requirements are more expensive, but should also last longer: 10 years.
- 5. Inverters. Imported inverters are assumed to last for 10 years.
- 6. General Maintenance. Includes the replenishment of distilled water (available in every local drugstore), replacing parts of destroyed cable, etc. Usually a minimal amount per year is considered sufficient.
- 7. Load. The service life of fluorescent tubes is to a large extend directly dependent on the quality of the ballast. A good quality tube in combination with a good ballast should last between 3 and 5 years.

4.3 Specific Assumptions/Remarks concerning Factsheets

After these general remarks and assumptions all topics mentioned in the separate fact sheets will be discussed.

4.3.1 Daily Energy Requirement/System Availability

The daily power consumption has been estimated based on a breakdown of the power required for each specific activity (appliance) and the required duration.

In order to discuss the availability of a system, two basic data must be present. The daily insolation (Wr) is the first important factor. Secondly a certain nominal value, defined as the insolation demand (Wrd) is needed. As long as the daily insolation is higher than the demand, there is no problem in satisfying the electrical energy demand: The availability of the system is 100 percent.

For economic reason however, one will usually be satisfied with a lower system availability, similar to or slightly better than its conventional competitors. If a high reliability is required (e.g. in the case of the telecommunication industry) a conventional back-up system may be considered in order to guarantee fully reliable operation, rather than doubling the array of solar panels.

If a system is only partially available (i.e. the demand exceeds the insolation [Wr]) then the availability factor (AF) can be defined by:

 $AF(W_{rd}) = W_r/W_{rd}$

The mean availability of a certain system defined as system availability due to the availability of solar radiation will be:

$$a(W_{rd}) = \frac{1}{N} \sum_{i=1}^{N} Afi(W_{rd})$$

in which N = number of days.

This method provides a tool for the quantification of the mean' availability of a PV system, assuming that there is battery storage of only one day. With increasing battery size, the mean PV system availability will increase accordingly.

For the meteodata of the year 1985, as gathered in the PV field laboratory at Dona Remedios Trinidad, Bulacan, the following interpretation was made for the 13.3 kWp PV powerplant.

Wrd (kWh/m2) a(Wrd)

1.00	100.0%
1.50	99.8%
2.00	99.2%
2.50	98.3 %
3.00	97.0 %
3.50	94.9%
4.00	92.4 %
4.50	89.2%
5.00	85.4 %
5.50	81.1 %
6.00	76.5%
6.50	71.6 %
7.00	66.8%
7.50	62,3 %
8.00	58.4 %

Average daily insolation 4.68 kWh/m²

Standard deviation of daily insolation 1.368 (Method and Software: A Wagner, ITW)

How is this table to be interpreted? Under meteorological conditions at Pulong Sampaloc in 1985 a load can be satisfied at all times if the design of the PV system is based on an insolation of not more than 1 kWh/m² day.

For an average daily insolation in Pulong Sampaloc, which was relatively low at that year (4.68 kWh/m²) the systems availability (according to linear interpolation) will be around 88 percent. Where there is a battery with a 3-day storage capacity the mean availability will be considerably (approx. 5 percent) higher.

4.3.2 Size of the PV Generator

- The required system availability should also be seen in relation to the performance of possible competitors. Weak points of both the alternative and PV need to be considered: PV must be equal in performance or better.
- The system sizing is based on experience and data gathered at the PV field laboratory in Pulong Sampaloc, concerning the PV power plant with only 1 day battery-storage capacity. The battery storage efficiency has been set in our system designs at 0.8, although this depends very much on the quality of the battery and the depth of the daily discharge (i.e. the size of the battery storage). In the fact sheets a 3-day storage capacity has commonly been assumed. This implies a system availability that is actually somewhat (up to 5 percent) higher than indicated.
- A system availability of 80 % does not directly imply that the system is available for 8 out of 10 days. Neither is that required in many cases. Example:

A system for industrial or commercial activities (e.g. a cinema) operating for 6 out of 7 days a week requires only approx. 85 % reliability, giving the battery storage 1 day "extra" (without or with low power requirements) to recover.

The actual system availability should in all cases come close to the required availability.

- Another consideration is that conventional diesel gensets are not more available either: 1 genset has an estimated availability of 90 % if spare parts are readily available and the logistics of spare parts and fuel cause no problems. However in most areas of the Philippines this is not the case. Achieving higher reliability, as is required e.g. in the telecom business, commonly takes 3 gensets, which dramatically influences the kWh-cost price.
- Some systems are only used seasonally. For example irrigation is mostly needed during the dry season. This phenomenon is allowed for in the analyses by choosing a lower mean system availability (and so a higher required irradiation level). For a system only operating in the dry months, an insolation level of 6 kWh/m² day may still be an acceptable standard versus approx. 5 kWh/m² day for average "Pulong Sampaloc" conditions. The exact and final design of any system will have to take local irradiation conditions for the desired period into account.
- Calculated system sizes are rounded up, thus somewhat increasing the system availability.

4.3.3 Investment for the PV power supply

- This indicates the initial capital required to purchase and install a specific PV power supply, including panels, frames, cables, batteries, controls, transport and installation.
- For smaller systems (in this case arbitrarily set at a size of 100 Wp and below) it will not be possible to reach the (international) price guideline of \$6,-/Wp (C.I.F). At any rate, such Wp-prices are only realistic if no taxes and duties are imposed. Until now, PV panels have entered the Philippines under the banner of various programs and (even commercial) projects. The common expectation for the Philippines is that future imports of PV panels will be tax-exempted or that PV panels will be given a specific heading in the import Tax Code with an import duty of a mere 5 %. For the moment (Sept. 1990) and for the purpose of system price computations, system prices will be based on \$ 6.50/VVp (installations over 100 Wp) and \$ 7.50/Wp (installations under 100 Wp), in both cases assuming panel sales on an acceptable scale.
- In most fact sheets, battery control units (BCUs) have been included as one of the PV power supply components. A small BCU developed by the PGSEP is now being mass produced. The selling price of such a commercially produced BCU has been estimated at \$30 (including materials, labor, profit margin). Where a BCU with a somewhat larger capacity is needed, a BCU for \$60 has been included. For larger applications imported control units must be considered.

Inverters (imported)	\$1.50/W
Frames (galvanized)	\$ 0.30/Wp
Control Devices	\$ 0.50/Wp
Gables (Royal # 12)	\$ 0.70/m
Local stationary batteries	\$ 100/kWh capacity
Installation and transportation	5 % of the panel cost

- Other rough guidelines for pricing of the several components:

Note: Cost of installation may vary depending on location of the system.

 Many appliances, e.g. TVs, electric fans, radios, are locally manufactured or assembled. The introduction of 12 VDC power supplies will most likely lead to an upswing in the sales of 12 VDC home appliances. The price list of each fact sheet indicates if a certain component is of local origin or not. The fact that a certain part is locally available does not, however, automatically imply that it is locally produced, although this is true in many cases.

- Some battery control units outside the ordinary range should be made to order. No mass production has yet been achieved (no demand) but local industry is thought to have the capacity to manufacture the appropriate BCU.
- Except for communal applications (e.g. national electrification projects using Solar Home Systems) a commercial mark-up of an estimated 20% of the system price has been included to cover the expenses and profit margin of the distributor (transport and installation are covered separately). The individual prices of the system components manufactured in the Philippines already include commercial mark-ups of the respective manufacturers.

4.3.4 Cost Annuity

Based on the dynamic evaluation method, the cost annuity indicates the equal yearly payments required to finance the power supply, including interest, additional investments, maintenance. Commonly only the economics of the PV power supply are considered. However in some cases (e.g. incubator, irrigation water) the power supply is inseparably connected to the load. In such cases the economics of the complete system have been considered.

4.3.5 Costs (per Unit or Month)

The units produced by a PV application may vary from hatched one-day chickens to cubic meters of irrigation water. In those cases where no other units than "abstract" kWhs are produced, the cost per month is thought to be the best possible indicator for the purpose of comparing PV systems to alternative options.

4.3.6 Competitiveness with Cost Annuity of Conventional System

- In order to indicate the PV systems' competitiveness, the most logical conventional option and direct competitor was analyzed.
- Fuel prices in the rural areas tend to be higher than in urban areas, and may differ from island to island, depending on remoteness and volumes transported.
- Data regarding the operation of different diesel gensets (as competitor for PV) regarding lifetime, fuel consumption, repair and maintenance, etc. were obtained from experience (log-books) the Philippine Telegraph & Telephone Company Inc. gained by operating gensets at its telecom relay stations.
- For those conventional applications that require an operator for the diesel genset(s), a technician, costing \$ 1000/year has been included in the economic calculations. This amount covers the monthly salary, insurances and fringe benefits.
- In a few cases (e.g. the economic analysis of kerosene pressure lamps for lighting a school building) only the end product (light) should be considered for analysis. In such cases the analysis of the PV system itself should likewise not be limited to the power supply (electricity) itself but, for the sake of fair comparison, include the investment and operation of the fluorescent tubes.

- In some cases, the PV power supply replaces several kinds of energy input at once, e.g. kerosene and dry cells for household light and a radio. This may make the choice between PV and conventional options a bit more complicated, as PV offers an integrated energy system. In such comparisons of PV versus more than one competitor, the competitors have been added up.
- If it is indicated that a certain PV power supply is competitive with a diesel genset, it is certainly competitive with a gasoline powered genset as a gasoline generated kWh tends to be more expensive than a diesel generated kWh, unless the required capacity is under 3 kVA. This is the capacity of the smallest commercially available diesel genset in the Philippines.

4.3.7 Estimated Number of Potential Customers

The number of potential customers is commonly derived from the number of people living in unelectrified areas of the Philippines, their income situation, the competitiveness of the PV alternative and common presence of certain conventionally powered systems in unelectrified areas. However, the resulting figures still remain nothing more (and nothing less) than cautious guesswork for the initial phase of the introduction of PV. Should PV technology ever become a generally accepted technology, the whole group of potential customers might be substantially larger.

4.3.8 Estimated Potential Market

The total estimated market of a certain application is the product of the number of potential customers and the size of the PV generator.

4.3.9 Status of Product Development

This reflects the availability of PV system components in the Philippines and the need for additional research and development for (1) components that condition the (DC) power supply or (2) those that adapt the load to the DC power source.

When a certain application is recommended for immediate marketing it means that the application has been tested and found to be operating acceptably. Many PV power supplies have not (yet) reached that stage. For all those systems for which there seems to be a market, but not all components are readily available or reliable, or all those applications which have not yet been thoroughly tested, additional R & D is required. For applications with poor prospects, it is proposed that no R & D activities should be considered at present.

4.3.10 Relevant conventional energy prices

Reflects only those energy prices which are in direct competition with the PV system.

4.3.11 Possible local service

Servicing in the field might often be restricted to the exchange of entire components. In such a case only a limited amount of technical know-how is required. The assessment of the possibility of servicing the PV system is based on ITW's experience in the Philipppines:

positive: system can be serviced in the nearest repair shop by anyone who has basic knowledge of electronics repair (radios etc.) or, when a company has its own maintenance personnel, who is assigned to service even the remotest PV power system (e.g. Telecom).

not clear: Possibility of servicing remains questionable due to extreme remoteness or when the repair requires more than fundamental knowledge of electronics.

negative: Whenever a certain PV system can only be serviced by repair facilities that have the appropriate technological know-how, which can only be found in the country's largest commercial centers, the possibility of local service in the rural areas is considered to be negative.

Who is able to service a PV system (and possible DC appliances)? In most cases the only components that can be repaired are the battery control unit and the bakery. The small standard BCUs are simple enough for repair by electronics repair shops for transistor radios. Such shops can be found all over the country. For this reason system diagrams should be made available nationwide.

More complicated systems (or loads) will need to be repaired by better qualified technicians who can be found in service centers in the nearest urban area. Depending on remoteness, it may sometimes be necessary to hire technicians (from service centers) for an on-the-spot-job. Bigger (e.g. telecom) companies will have their own personnel. Battery repair (overhaul) facilities may be encountered throughout the Philippines, often in combination with car (jeepney) repair shops, vulcanizing shops, battery charging stations etc. Whether a battery can be repaired (e.g. exchange of plates) depends on the design of the lead-acid battery.

4.3.12 Remarks

In this section all sorts of technical phenomena and assumptions of each application are discussed. Also mentioned are significant impacts that the system may have on the environment, or what precautions should be taken to prevent possible future contamination if disused system components are discarded.

5. Concluding Remarks

The 24 PV applications which were assessed in the individual fact sheets yield an estimated market potential of around 11,500 kWp.

By far the largest demand would arise if the technology is successfully introduced for residential applications (Solar Home Systems).

Also some communal PV applications might be worthwhile considering if, one way or the other, financing can be arranged.

Some viable commercial, industrial, agricultural and telecommunication applications which might be feasible in themselves, can support the introduction of PV as a credible and reliable alternative to conventional options.

The geography of the Philippines, which has acted as a barrier to conventional electrification by grid extensions, provides the right conditions for the introduction of decentralized, renewable energy based power supplies. A start can be made on all those islands and islets which are not part of any island electrification plan.

For some selected PV applications additional research and development is recommended on the power conditioning or on the matching of the load to the (DC) power supply.

Some relevant economic key figures on the Philippine situation, Philippine energy prices and selling prices of some PV system components as well as selected DC appliances are presented in the Country Fact Sheet.

The fact sheets for all individual applications are concluded by an overview that summarizes all technical and economic aspects.

Country Sheet; Philippines	July 1990		
Geography / Meteorology			
Landarea:	300,000 km ²	7,100 islands - approx. 2,800 inhabited islands	
Temperature range:	21 °C - 34°C	Daily average temperature:	28 °C
Rainfall:	2,080 mm Luzon	3,800 mm N.E. Mindanao	
Average daily insolation:	[~] 5 kWh/m² d Bulacan		
Population:	60-65 million 2		
Population density:	211 inhabitants/km		
Urban population:	35 - 40 %		
Population growth rate:	2.5 %		
Urban population growth	3.2 %		
rate:			
Economy			
Trade balance (1988):	~ -530 million US\$		
Total external debt (1989):	[~] 27,000 million US\$		
Energy consumption	106 million Barrels of Fuel Oil		

Country Sheet: Philippines July 1990

(1989):	Equivalent (BFOE), oil imports 46 million BFOE		
G.N.P (1989):	~ 37,200 million US\$		
G.N.P growth (1990):	5,7%		
Annual income/head (1990):	\$727		
Inflation rate	1988: 8.8%	1989: 9.5%	1990: 10.8%
Main primary products:	Rice, maize, coconuts, sugar c pineapples, bananas, coffee, ti iron, nickel, coal, crude oil.		
Major industries:	Agriculture, food processing, te mining.	extiles, chemicals, forestry, t	fishing,
Main exports:	Electrical goods (semiconducto sugar, fruit & vegetables, timbe		oconut oil,

Average manpower costs	Engineer	Technician	Utility man
	\$200-\$250/month	\$100-\$125/month	\$75-
			100/month

Fuel prices (June 1989) in \$/I based on oil price of \$16.50/barrel (\$1 = P21.50)

	Premium	Gasoline	Diesel	Kerosen
	gasoline			е
Official Retail price	0.30	0.27	0.23	0.26
of which: Customs duty	0.001	0.001	0.002	0.003
Value added tax	0.14	0.12	0.05	0.06
Hauling charge	0.003	0.003	0.003	0.003
Dealers mark Up	0.01	0.01	0.01	0.01
Retail vice in Buan, Tawi-	0.75	0.98		
Tawi				
Lube oil: \$1.20 - 1.40/1				

Kerosene pressure lamps:	\$40 - \$50	Kerosene wicklamp:	\$0.50
- Average service life:	7 - 8 years	 Average service life: 	1 year
- Yearly maintenance:	\$13		
- Fuel consumption:	0.1 - 0.21/hour	- Fuel consumption:	0.01 l/hour

Dry cell batteries	Size M	Size C	Size D	
\$0.20	\$0.25	\$0.35		

Lead acid (car) batteries	12 V DC, 40 Ah	12 V DC, 75 Ah	12 V DC, 100 Ah	
	\$30	\$40	\$55	

Electricity kWh price: \$0,12 (by Decree) Real cost of grid extensions 7,5/13,5 kV line: \$4,000 - \$5,000 / km

Diesel gensets	3 kVA	10 kVA	
\$3,100	\$5,000		
30,000-40,000 hours of operation, if overhauled every 8,000 hours			

Gasoline gensets	600 W	1,000 W
	\$550	\$700
6.000 - 7.000 hours of operation, if overhauled every 2.000 hours		

Commercial prices of selected locally available PV system components (*).

- Panel 53 Wp: approx \$400	
- G.I. panel frame (max. 3 panels of 53 Wp):	\$35
- Battery Control Unit (12 VDC, 10A):	\$30
- Solar battery (12 VDC, 100 Ah):	\$50
- DC-DC converter (12-9, 7.5, 6, 4.5, 3 VDC - 1A):	\$18
- Cables & Switches:	approx. \$0.50 / Wp

Commercial prices of locally available DC appliances (*).

- 12 VDC, 20 W fluorescent tube, incl. holder + ballast	\$18
- 12 VDC,10 W/ 15 W/ 20 W Incandescent bulb	\$0,50
- 12 VDC B&W TV 12":	\$110 (16": \$175)
- 12 VDC Videoplayer (Betamax)	\$280
- 12 VDC Electric (car) fan:	\$20
- Rechargeable NiCd batteries size D (1.25VDC, 2.000mA):	\$6

(*) subject to change. Sources: CIA: World Fact book (1988), WB, ADB, N.C.S.O, B.E.O, B.E.O, IBON, PGSEP.

Seography / Meteorology Landarea : Femperature range : Rainfall :	21°C - 34°C 2,080 mm Luzon		7,100 islands - Daily average 1 3,800 mm N.E.	emperature:) inhabited 28 °C	
Average daily insolation : Population : Population density : Urban population :	60-65 r 211 inf 35 - 40	abitants/km ²				
Population growth rate : Jrban population growth rat	2.5 % te: 3.2 %					
Economy Frade balance (1988) : Fotal external debt (1989) : Energy consumption (1989) G.N.P (1989): G.N.P growth (1990): Annual income/head (1990) Inflation rate Main primary products : Major industries :	~ 27,0 : 106 mi ~ 37,20 5,7% : \$727 1988 : Rice, m coffee, Aaricul	naize, coconuts, su timber, fish, coppe ture, food processi	% 1990 : 10 gar cane, aba ar, chrome, gol ing, textiles, ch	.8% ca, rubber, tok d, silver, iron, jemicals, fores	bacco, pin nickel, co	eapples, bananas, aí, crude oil. 1. mining
Main exports :	Electric	al goods (semicor vegetables, timber,	rductors), cloti	ning, metal or	es, coconi	it oil, sugar,
werage manpower costs		Engineer - \$250 / month	Tech	nician 25 / month	\$75	Utility man - \$100 / month
Fuel prices (June 1989) In \$					_l- · · · · · · · · · · · · · · · · · · ·	
	<u>,, 00060</u>	Premium gasoline			esel	Kerosene
Official Retail price		0.30	0.27	0.2		0.26
of which : Customs du Value adde	-	0.001 0.14	0.001	0.0		0.003 0.06
Hauling cha		0.003	0.003	0.0	-	0.003
Dealers ma	•	0.01	0.01	0.0	1	0.01
<u>Retail price in Buan, Tawi-</u> Lube oil : \$1.20 - 1.40 /l	Tawi		0.75			0.98
Kerosene pressure lamp - Average service life : - Yearly maintenance : - Fuel consumption :	7-8 \$13	- \$50 years 0.2 l/hour	Kerosene v - Average se - Fuel const	ervice life :	\$0.50 1 yea 0,01	
Dry cell batteries		SIze AA \$0.20	Siz \$0.	e C 25		Size D \$0.35
Lead acid (car) batteries	12	V DC, 40 Ah \$30	12 V DC \$4	-4	12 \	' DC, 100 Ah \$55
Electricity kWh price : \$0,12 Real cost of grid extensions			000 / km			
Diesel gensets	.,.,.,.,.,.	3 kVA	1000 / MII		10 kV/	A
	\$3,100 \$5,000					
	3	0,000-40,000 hours	of operation,	if overhauled	every 8,00	0 hours
Gasoline gensets						
	,	\$550 6,000 - 7,000 hours	of operation	if overhauled	\$700 every 2.00	0 bours
Commercial prices of selec - Panel 53 Wp : approx \$40 - G.I. panel frame (max. 3 p - Battery Control Unit (12 Vi - Solar battery (12 VDC, 100 - DC-DC converter (12-9, 7. - Cables & Switches : Commercial prices of local - 12 VDC, 20 W fluorescent - 12 VDC, 20 W fluorescent - 12 VDC, 20 W fluorescent - 12 VDC, 20 W / 15 W/ 20 Vi - 12 VDC B&W TV 12" : - 12 VDC B&W TV 12" : - 12 VDC Electric (car) fan : - 12 VDC Electric (car) fan :	cted loca: 0 DC, 10A) 0 Ah) : 5, 6, 4.5, : 11y availat tube, incl V Incande imax)	lly available PV sy i3 Wp) : : 3 VDC - 1A) : ole DC appliances . holder + ballast	stem compon \$35 \$30 \$50 \$18 approx, \$		<u>every 2,00</u>	

Fact Sheets of selected PV Applications

Fact sheet # 1-1

Fact sheet PV application: VIDEO-CINEMA Group: Commercial A commercial "cinema" consisting of a video player and a (B&W or Colour) TV provides the rural population with education and/or entertainment

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	1 US\$ = P25
date:	Sept. 1990
Relevant conventional energy prices: (urban) / rural	
Diesel/I	(\$0.21) \$0.25
Gasoline/I	(\$0.28) \$0.35

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	85 %
Daily energy required:	2 shows/day
3.5h (video + TV)	245 Wh
1.5 h (2 fl. tubes)	60 Wh
Total:	305 Wh

Possible local service: Average

Competitiveness of PV system:				
600 W gasoline gen set (\$560/5y)				
Generator housing \$130, repair & maintenance				
\$45/y, part-time operator \$210/y, fuel & oil \$305/y				
Costs: \$45/month				
Cost Annuity: \$530				

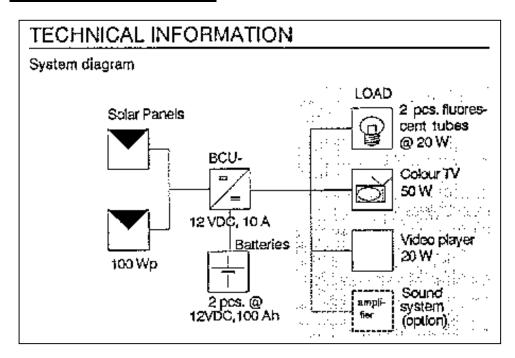
Status of product development: All PV system components locally available. R&D: Convert 220 VAC videoplayer to 12 or 24 VDC

Estimated number of potential customers: 6.5M households unelectrified 1 video cine / 20,000 households: 3250 video cinemas

Estimated potential market: 3250 cinemas x 100 Wp = 325 kWp

Present locations known:

Burias Island, Verde Island



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 100 Wp x		BCU \$30/5y
\$7.50/Wp	\$750*	Batteries \$100/4y
Battery Control Unit	\$30	General maintenance
1 frame (G.I.)	\$35	\$10/y
2 pcs. batteries	\$100	
Cables & switches	\$20	
Transport & installation	\$40	
Profit margin	\$200	
(2 pcs. fl. tubes @\$18)	(\$36)	
Initial PV system investment	\$1170	
Costs: \$10/month	Cost annuity:	\$116

REMARKS

Compared with a generator set PV offers better picture quality (no voltage fluctuations) and better sound quality (no disturbing generator noise). Video cinema should be offered as a complete system incl. videoplayer (Betamax) and TV. 220 VAC videoplayers can be converted to 12VDC.

220 VAC videorecorders need an inverter.

12 VDC TV & Amplifier locally available.

Safe disposal of fl. tubes & batteries (recycling) is recommended. For immediate marketing. Financing scheme will increase market prospects.

Fact sheet PV application:	VIDEO-CINEM		Group: Commercial
A commercial "cinema" consisting of a		or Coloury 14	provides the rural
population with education and/or enter COUNTRY: Philippines		METEORO	LOGICAL INFO
Population: 60M		Average insolat	ion: 5 kWh/m2d
Urban/rural distribution 35/65 %		Seasons:	
% electrification: 35 %			wet, 4 kWh/m2d
Currency: Pesos	1	DecMay :	dry, 6 kWh/m2d
Exchange rate: 1 US\$ = P25	4		
date: Sept. 1990			
SYSTEM INFORMATION	TECHNICAL INFORM	ATION	
System availability: 85 %	System diagram		
Daily energy required: 2 shows/day		1.00	LOAD
3.5h (video + TV) 245 Wh		··· :	- Cont tubes
1.5 h (2 fl. tubes) 60 Wh	BCL	-	_ <u>⊜</u> _@20₩
		7	
			
		, 10 A Batteries	Video player
Total : 305 Wh	- 100 Wp		20 W
Possible local service: Average			Frittin Sound
Competitiveness of PV system;	2 pc 12VDC	s.@ 100 Ah	ampli- ser (option)
600 W gasoline gen set (\$560/5y)			
Generator housing \$130, repair &			
maintenance \$45/y, part-time	System components	Price	Anticipated maintenance
operator \$210/y, fuel&oil \$305/y		(* : import)	& repair :
	PV panels 100 Wp x		BCU \$30/5y
	\$7.50/Wp	\$750*	Batteries \$100/4y
Costs: \$45/month	Battery Control Unit	\$30	General maintenance
Cost Annuity: \$530	1 frame (G.I.)	\$35	\$10/y
Status of product development:	2 pcs. batteries	\$100	
All PV system components locally	Cables & switches	\$20	
available.	Transport & installation	\$40	
R&D: Convert 220 VAC	Profit margin	\$200	
videoplayer to 12 or 24 VDC	(2 pcs. fl. tubes @\$18)	(\$36)	
Estimated number of potential customers:			
6.5M households unelectrified			
1 video cine / 20,000 households :			
3250 video cinemas	Initial PV system investment	\$1170	
	Costs: \$10/month	Cost annulty:	\$116
EstImated potential market:	REMARKS:		
3250 cinemas x 100 Wp = 325 kWp	Compared with a general	tor set PV offe	ers better picture quality
	(no voltage fluctuations) and better sound quality (no		
	disturbing generator noise). Video cinema schould be		
Present locations known:	offered as a complete system incl. videoplayer (Betamax)		
Burlas Island, Verde Island	and TV, 220 VAC videoplayers can be converterd to 12VDC.		
	220 VAC videorecorders	•	
	12 VDC TV & Amplifier Io		
	Safe disposal of fl. tubes & batteries (recycling) is		
	recommended. For immediate marketing.		
	Hecommended' Lot minue		

Fact sheet # 1-2 Fact sheet PV application: Restaurant A Group: Commercial Restaurants which need a limited amount of power for light, radio & TV can be found throughout the unelectrified areas. Power supply for a refrigerator is excluded.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35 Kerosene/I: (\$0.26) \$0.40 Dry cell Batteries: Size D: \$0.35

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	80 %
Daily energy required:	
4 fl. tubes 4h:	320 Wh
Radio 8h:	80 Wh
TV (B&W) 6h:	120 Wh
Total:	520 Wh

Possible local service:

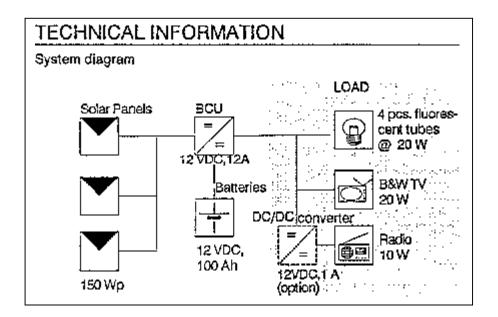
Average

Competitiveness of PV system: Gasoline gee-set 600W, \$550/5y Fuel: 4h/d x 365d/y x 0.9(avail) x		
0.751/hx\$0.35/l = \$345/y		
Oil: \$2/m x 12m/y = \$24/y		
Battery = \$50/3y		
Gen. Maintenance = \$50/y		
Costs: \$49/month		
Cost Annuity: \$582/year		

Status of product development: All PV system components locally available. BCU made to order. R&D: None

Estimated number of potential customers: For unelectrified towns & along highways, roughly 500 restaurants interested. Estimated potential market 500 x 150 Wp = 75 kWp

Present locations known: None



System components	Price	Anticipated maintenance
	(*: import)	& repair:
PV panels 150Wp		BCU \$60/5y
x \$6.50/Wp	\$975*	Batteries \$50/4y
Battery Control Unit	\$60*	General maintenance
Battery	\$50	\$15/y
Frame (G.I.)	\$35	
Cables & Switches	\$25	
(4 pcs. fl. tubes @\$18)	(\$72)	
Transport & Installation	\$60	
Profit margin	\$250	
Initial PV system investment	\$1455	
Costs: \$11.25/month	Cost annuity:	\$135

REMARKS:

Also cost-competitive with the use of 2 kerosene pressure lamps (5h/d), dry cell batteries (8 pcs/week) and a weekly recharged battery (for TV).

Cost annuity \$350 or \$30/month.

For immediate marketing.

Safe disposal of fluorescent tubes & batteries (recycling) is recommended.

Fact sheet PV applic Restaurants which nee		Restaurant A	FV can be fo	Group: Commercial ound throughout
the unelectrified areas.	Power supply for	a refrigerator is excluded.		
COUNTRY:	Philippines	Relevant conventional energy	METEOR	OLOGICAL INFO
Population:	60M	prices: (urban) / rural	Average inso	lation: 5 kWh/m2d
Urban/rutal distribution:	35/65 %	Gasoline/i : (\$0.28) \$0.35	Seasons:	
% electrification;	35 %	Kerosene/I : (\$0.26) \$0.40	June-Nov.	: wet, 4 kWh/m2d
Currency:	Pesos	Dry cell Batteries:	DecMay	: dry, 6 kWh/m2d
Exchange rate:	US\$ 1 = P 25	Size D : \$0.35		
date:	Sept. 1990			
SYSTEM INFORMA		TECHNICAL INFORMAT	ION	
System availability:	80 %	System diagram		
Daily energy required:				LOAD
4 fl. tubes 4h :	320 Wh	Solar Panels BCU		4 pcs. fluores-
Radio 8h :	80 Wh	╽ │▼┝─┬┤╱ <u></u> ╞		(m) cent tubes
TV (B&W) 6h :	120 Wh	12 VDC,T2A		
		Batter	ies 🔤	
			DC/DC conve	
Total :	520 Wh			Radio
Possible local service:	Average	100 Ah	12VDC,1 A	
Competitiveness of PV system		150 Wp	(option)	generation angeneration et de la seconda de la seconda La seconda de la seconda de
Gasoline gen-set 600W	•			
Fuel: 4h/d x 365d/y x 0	• •		1	li
0.75l/hx\$0.35/l	≕ \$ 345/ y	System components	Price	Anticipated maintenance
Oil: \$2/m x 12m/y -	= \$24/y		(* : import)	& repair :
Battery	= \$50/3y			BCU \$60/5y
Gen. Maintenance	= \$50/y		\$975*	Batteries \$50/4y
Costs:	\$49/month	Battery Control Unit	\$60*	General maintenanc
Cost Annuity:	\$582/year	Battery	\$50	\$15/y
Status of product developme		Frame (G.I.)	\$35	
All PV system compone	ents locally	Cables & Switches	\$25	
available.		(4 pcs. fl. tubes @\$18)	(\$72)	
BCU made to order.		Transport & Installation	\$60	
R&D : None		Profit margin	\$250	
Estimated number of potentia				
For unelectrified towns				
along highways, rough	-			4
500 restaurants interes	ted,	Initial PV system investment	\$1455	
		Costs: \$11.25/month	Cost annuity	: \$135
Estimated potential market:		REMARKS:		
		Also cost-competitive with t		•
500 x 150 Wp = 75 kWj	p	lamps (5h/d), dry cell batter	ries (8 pcs/\	week) and a weekly
		recharged battery (for TV).		
Present locations known:		Cost annuity \$350 or \$30/m	onth.	
		For immediate marketing,		
None		Safe disposal of fluorescen	t tubes & b	atteries (recycling)
		ls recommended.		

Fact sheet # 1-3

Fact sheet PV application: Restaurant B Group: Commercial As Restaurant A, including a refrigerator

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35 Kerosene/I: (\$0.26) \$0.40 Dry cell Batteries: Size D: \$0.35

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	85 %
Daily energy required:	
Refrigerator	3000 W/h
Lighting, radio, TV as in Restaurant A	520 Wh
Total:	3520 Wh

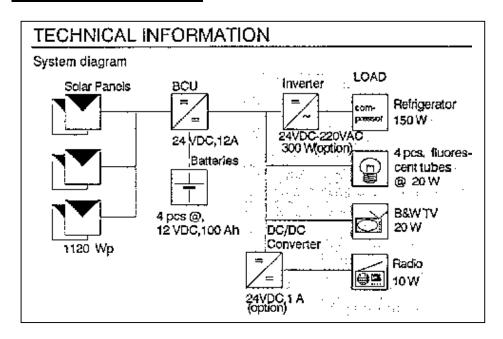
Possible local service: Poor

Competitiveness of PV system:		
Kerosene refrigerator: fuel (1 l/d) = \$146/y.		
2 pressure lamps + 8 batteries/week		
(radio) + 1 battery charge/week		
Costs: \$60/month		
Cost Annuity: \$782/year		

Status of product development: BCU made to order. R&D: efficient 24 VDC refrigerator & fl. tubes, DC-DC converter

Estimated number of potential customers: Not Clea

Estimated potential market: Not Clear



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 1120Wp	BCU \$150/7y	
x \$6.50/\Np	\$7280*	Batteries \$200/4y
Batterie Control Unit	\$150*	General maintenance
4 pcs. batteries @\$50	\$200	\$50/y
8 Frames (G.I.) @\$35	\$280	
Cables & Switches	\$40	
DC-DC converter	\$30	
(4 pcs. fl. tubes @\$18)	(\$72)	
Transport & Installation	\$350	
Profit margin	\$1500	
Initial PV system investment	\$9830	
Costs: \$60/month	Cost annuity:	\$785

REMARKS:

24 VDC system. 24 VDC fluorescent tubes not readily available on Phil. market. If only 110/220 VAC refrigerators available, a 300 W inverter is necessary.

PV system not cost-competitive with conventional system with kerosene refrigerator. Initial investment of \$10,000 for PV system is unacceptably high.

Safe disposal of old fl. tubes & batteries (recycling) is recommended.

COUNTRY: Philippines Relevant conventional energy METEOROLOGICAL INFO Production: 60M prices: (urban) / ural Average insolation: 5 KWh/m2d Conneny: Pesso Sacoline/1: (\$0.28) 50.35 June-Nov. : wel, 4 kWh/m2d Seasons: Conneny: Pesso Dry cell Batteries: June-Nov. : wel, 4 kWh/m2d Seasons: Conneny: Pesso Dry cell Batteries: June-Nov. : wel, 4 kWh/m2d Seasons: SYSTEM INFORMATION TECHNICAL INFORMATION Seasons: LoAD System dargam Bdd grand Bdd grand Bdd grand System dargam Bdd grand Bdd grand Bdd grand Bdd grand System components Poor Intores Proce Proce </th <th>Fact sheet PV application: As Restaurant A, Including a refrigerate</th> <th>Restaurant B</th> <th></th> <th>Group: Commercial</th>	Fact sheet PV application: As Restaurant A, Including a refrigerate	Restaurant B		Group: Commercial	
Population: 60M prices: (urban) / nural Average insolation: 5 kWh/m2d State estimation: 35 % Kerosener/: (\$0.28) \$0.35 Seasons: June-Nov.: wet, 4 kWh/m2d Corrency: Pesso Dry cell Batteries: Size D : \$0.35 June-Nov.: wet, 4 kWh/m2d System availability: 0 & Sept. 1990 TECHNICAL INFORMATION System alagram System availability: 65 % System alagram Sold Parels Columents System availability: 3000 W/h System alagram Sold Parels Columents Parels Competitiveness of V system: 3520 Wh Tit20 Wp System components Price Antispated maintenance Competitiveness of V system: System components Price Antispated maintenance System components Price Antispated maintenance Status of product development: S60/month System components Price Antispated maintenance Status of product development: S60/month Seson Seson Seson Seson Status of product development: S60/month Seson Seson Seson Seson R& Transport & Installation <td></td> <td>talevent excustional energy</td> <td>METEOR</td> <td></td>		talevent excustional energy	METEOR		
Uthannund distribution: 35/65 % Gasoline/1: (\$0.28) \$0.35 Seacors: June-Nov. : wet, 4 KWh/m2d Currency: Pessos Pyrocell Batterice: June-Nov. : wet, 4 KWh/m2d Currency: Pessos Size D : \$0.35 June-Nov. : wet, 4 KWh/m2d Currency: DecMay : dry, 6 kWh/m2d DecMay : dry, 6 kWh/m2d System availability: S5 % System of agram DecMay : dry, 6 kWh/m2d System availability: S5 % System of agram DecMay : dry, 6 kWh/m2d System availability: S5 % System of agram DecMay : dry, 6 kWh/m2d Cally energy required: Refrigerator 2000 W/h System of agram System of agram DecMay : dry, 6 kWh/m2d Competitiveness of PV system: Yes Sc.00, Passoc,					
% viecutification: 35 % State: Peeso Bothange rate: US\$ 1 = P 25 Size D : \$0.35 Size D : \$0.35 SYSTEM INFORMATION TECHNICAL INFORMATION System availability: 85 % Barrieres: System diagram Soldy arrengy regularized: Soldy arrengy regularized: Barrieres: Documents Outge arrengy regularized: 3520 Wh Passible local service: Poort Competitiveness of PV system: Soldy arrengy regularized regulariz		· ·····		alon. Skyrijinzu	
Currency: Pesos Dry cell Batteries: DecMay : dry, 6 kWh/m2d Size D : \$0.35 DecMay : dry, 6 kWh/m2d DecMay : dry, 6				wat 4 WWh/mOd	
Exchange rate: US\$ 1 = P 25 Size D : \$0.35 SYSTEM INFORMATION System diagram System valiability: 85 % Daily energy required: System diagram Refrigerator 3000 W/h Lighting, radio, TV as in Restaurant A sin Restaurant A 520 W/h Total : 3520 W/h Possible local service: Poor Competitivenese of PV system: Refrigerator Kerosene refrigerator: fuel (1 I/d) 5146/h. = \$146/h. State of product development: Pressure lamps + 8 batteries/week (TV) Bystem components Price Anticipated maintenance (radio) + 1 battery charge/week (TV) System former (1) why Statue of product development: Bott 5150/7y Batterie Control Unit \$ repair: PV panels 1120Wp \$7280* Statue of product development: Bott 5150/7y Batteries @\$50 \$200 Bott frigerator \$200 Anticipated maintenance \$200 & repair: Proce PV panels 1120Wp \$7280* Batteries @\$50/month				-	
date: Sept. 1990 SYSTEM INFORMATION System diagram Colspan="2">System diagram Colspan="2">System diagram Colspan="2">System diagram Colspan="2">System diagram Colspan="2">Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan="2"Colspan		1 -	DecMay	ury, o kyyn/inzu	
SYSTEM INFORMATION TECHNICAL INFORMATION System availability: 85 % Delly anergy required: Refrigerator Befrigerator 3000 W/h Lighting, radio, TV as in Restaurant A as in Restaurant A 520 Wh Possible local services: Poor Competitiveness of PV system: Poor Competitiveness of PV system: Poor Competitiveness of PV system: Poor Costs: \$60/month Costs: \$60/month Costs: \$60/month Costs: \$60/month Cost Annully: \$782/year Status of product development: 8 Frames (G.I.) @\$35 BCU made to order. 8 Solide Switches S4 fl. tubes, DC-DC converter \$30 Not Clear Profit margin Intuial PV system investment \$9830 Costs: \$60/month Status of product development: 8 Frames (G.I.) @\$35 BCU made to order. 8 colles & Switches S4 fl. tubes, DC-DC converter \$30 Not Clear Intuial PV system investment Present lo					
System diagram System diagram LOAD Daily energy required: Befrigerator 3000 W/h Lighting, radio, TV 3000 W/h as in Restaurant A 520 Wh Possible local service: Poor Competitiveness of PV system: Poor Competitiveness of PV system: Poor Costs: \$60/Wp 2 pressure lamps + 8 batteries/week Pvice (radio) + 1 battery charge/week System components PV panels 1120Wp \$28000 k 2 pressure lamps + 8 batteries/week System components PV panels 1120Wp \$2800 k Costs: \$60/month Costs: \$60/month Costs: \$60/month Cable & Switches \$40 BCU made to order. BC chicent 24 VDC refrigerator RED : efficient 24 VDC refrigerator (4 pcs. fl. tubes @\$18) Not Clear Transport & Installation Not Clear REMARKS: 24 VDC system. 24 VDC flucrescent tubes not readily valiable on PhiL market. Cost sin \$60/month Costs: \$60/month Cables & Switches <					
Date onergy required: Solur Parels					
Berry Grant 3000 W/h Lighting, radio, TV 3000 W/h as in Restaurant A 520 Wh Total : 3520 Wh Total : 3520 Wh Total : 3520 Wh Possible local service: Poor Competitiveness of PV system: Poor Kerosene refrigerator: fuel (1 1/d) = = \$146/y. PV panels 1120Wp 2 pressure lamps + 8 batteries/week (radio) + 1 battery charge/week (TV) PV panels 1120Wp Costs: \$60/month Cost Annully: \$782/year BCU made to order. 8 Frames (G.I.) @\$35 R&D : efficient 24 VDC refrigerator 8 Frames (G.I.) @\$35 & fl. tubes, DC-DC converter \$300 R&D : efficient 24 VDC refrigerator A procements Not Clear Intial PV system investment \$9830 Costs: \$60/month \$1500 Estimated number of potential customers: Profit margin \$1500 Not Clear Intial PV system investment \$9830 Not Clear REMARKS; 24 VDC system, 24 VDC fluorescent tubes not readily available on Phil. market. If only 110/220 VAC refriger		-7	Investor	LOAD	
Initial product Second Numeric Initial PV system Socond Numeric Total: 3520 Wh Possible locatiservice: Poor Competitiveness of PV system: Poor Competitiveness of PV system: BBW TV Kerosene refrigerator: fuel (1 1/d) System components Price = \$145/y. Pressure lamps + 8 batteries/week (TV) System components Price Y panels 1120Wp \$782/year System components Price Costs: \$60/month \$50.0/Wp \$7280° BCU \$150/7y Status of product development: 8 Frames (G.I.) @\$35 \$280 \$200 \$50/y BCU made to order. R&D : efficient 24 VDC refrigerator & Cables & Switches \$40 \$272, Transport & Installation \$350 Estimated number of potential oustomers: Not Clear Profit margin \$1500 \$785 Estimated potential market: REMARKS: 24 VDC system. 24 VDC fluorescent tubes not readily available on Phil. market. If only 110/220 VAC refrigerator savailable, a 300 W Inverter is necessary. PV system is unacceptably high. Safe disposal of old ft. tubes & batteries (recyciling) Is recommenided. Is recommenided. <				1 .	
as in Restaurant A 520 Wh Total : 3520 Wh Possible locat service: Poor Competitiveness of PV system: Kerosene refrigerator: fuel (1 1/d) = \$146/y. 2 pressure lamps + 8 batteries/week (radio) + 1 battery charge/week (TV) 2 pressure lamps + 8 batteries/week (radio) + 1 battery charge/week (TV) System components Price Anticipated maintenance & repair: PV panels 1120Wp x 56.50/Wp Saturic Control Unit Solution Stateries Control Unit Status of product development: BCU gate order. R&D : efficient 24 VDC refrigerator & ft. tubes, DC-DC converter Not Clear Not Clear Not Clear Present locations known: Not Clear Present locations known: None Present locations known: None Present locations known: Present locations known	-				
Last Infincted unit A Converter Description Status St			' 300 W(o	ntine)	
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Costs: \$60/month Cost annuity: \$785 Estimated potential market: REMARKS: 24 VDC system. 24 VDC fluorescent tubes not readily available on Phil. market. If only 110/220 VAC refrigerators available, a 300 W inverter is necessary. Present locations known: PV system not cost-competitive with conventional system with kerosene refrigerator. Initial investment of \$10,000 for PV system is unacceptably high. Safe disposal of old fl. tubes & batteries (recycling) is recommended.	Not Clear			-	
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Present locations known: PV system not cost-competitive with conventional system with kerosene refrigerator, Initial investment of \$10,000 for PV system is unacceptably high. Safe disposal of old fl. tubes & batteries (recycling) is recommended.			-		
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Safe disposal of old fl. tubes & batteries (recycling) is recommended.		refrigerators available, a 30 PV system not cost-compet	0 W inverter itive with co	nventional system	
is recommended.		refrigerators available, a 30 PV system not cost-compet with kerosene refrigerator.	0 W inverter itive with co Initial invest	nventional system	
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	Present locations known:	refrigerators available, a 30 PV system not cost-compet with kerosene refrigerator. for PV system is unaccepta	0 W inverter itive with co Initial invest bly high.	nventional system ment of \$10,000	
	Present locations known:	refrigerators available, a 30 PV system not cost-compet with kerosene refrigerator. for PV system is unaccepta Safe disposal of old fl. tube	0 W inverter itive with co Initial invest bly high.	nventional system ment of \$10,000	

Fact sheet # 1-4

Fact sheet PV application: Power Supply-Church Group: Commercial A 350 Wp electricity supply for sound system & lighting of a church plus residential applications for an adjescent convent.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35 Kerosene/I: (\$0.26) \$0.40 Diesel/I: (\$0.21) \$0.25

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	90 %
Daily energy required:	
Church:	
Light & amplifier(4h/d)	400 Wh
Convent:	
Light & Radio & TV	620 Wh
Total:	1020 Wh

Possible local service: Positiv

Competitiveness of PV system: Gasoline gee-set 1000W (\$700/5y) Fuel: 365 d/y x O.9(avail) x 6h/d		
x 1 l/h x \$0.35/1 = \$690/y		
Oil: \$2.50/m x 12m/y = \$30/y		
Gen. Maintenance = \$50/y		
Costs: \$77/month		
Cost Annuity: \$925/year		

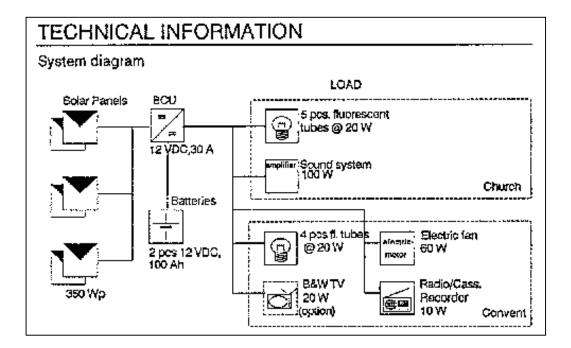
Status of product development: All components locally available. BCU made to order. R&D: power conditioning for PC computer system

Estimated number of potential customers:

Initial interest estimated at 50 churche

Estimated potential market: 50 x 350 Wp = 18 kW

Present locations known: None



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 350Wp		BCU \$90/5y
x \$6.50/Wp	\$2275*	Batteries \$100/4y
Battery Control Unit	\$90	General maintenance
2 pcs. batteries @\$50	\$100	\$50/y
3 pcs. frames @\$35	\$105	
Cables & Switches	\$50	
Transport & Installation	\$150	
Profit margin	\$550	
(9 pcs. fl. tubes @\$18)	(\$162)	
Initial PV system investment	\$3320	
Costs: \$26.25/month	Cost annuity:	\$315

REMARKS:

Immediate interest exists from mission outposts as well as regular churches/mosques in unelectrified areas.

Integration of PC computer systems for administrative purposes should be considered (with or without inverters).

Safe disposal of fl. tubes & batteries (recycling) is recommended.

Currently the diocese of Masbate province is considering PV systems for all of its 18 churches, as part of the ongoing Burias PV island electrification project.

an adjescent convent.		1	
COUNTRY: Philippines	Relevant conventional energy	METEOR	DLOGICAL INFO
Population: 60W		Average insola	ation: 5 kWh/m2d
Urban/rural distribution: 35/65 %		Seasons:	
% electrification: 35 %			: wet, 4 kWh/m2d
Currency: Peso:	,	DecMay :	d ry, 6 kWh/m2d
Exchange rate: US\$ 1 = P 28			
date: Sept. 1990			· · ·
SYSTEM INFORMATION	TECHNICAL INFORMAT		
System availability: 90 %	System diagram	LOAD	
Daity energy required:	Solar Pane's BCU		
Church: Light & amplifier(4h/d) 400 Wi		5 pcs. fluores	N
	12 VDC,30 A		n
Convent: Light & Radio & TV 620 Wi	.│,,▼∟││ │ ┆	erpilier Sound system 100 W	Church
Light & Radio & TV 620 Wi	Batteries		,,J
Total: 1020 W		e postitube @ 20 ₩	electric, co.w
Total : 1020 WI Possible local service: Positive	100 Ah	@20₩	motor OU VY
Competitiveness of PV system:		B&WTV 20W	Radio/Cass. Recorder
Gasoline gen-set 1000W (\$700/5y)		(option)	10W Convent
Fuel: 365 d/y x 0.9(avail) x 6h/d			•
x = 1 / h x = 30.35 / l = 3690 / l = 3600	/ System components	Price	Anticipated maintenance
Oil: \$2.50/m x 12m/y = \$30/	· · ·	(* : [mport]	å repair :
Gen. Maintenance = \$50/			BCU \$90/5y
	x \$6.50/Wp	\$2275*	Batteries \$100/4y
Costs: \$77/month	Battery Control Unit	\$90	General maintenance
Cost Annuity: \$925/year	2 pcs. batteries @\$50	\$100	\$50/y
Status of product development:	3 pcs. frames @\$35	\$105	
All components locally available.	Cables & Switches	\$ 50	
BCU made to order.	Transport & Installation	\$150	
R&D : power conditioning for	Profit margin	\$550	
PC computer systems	(9 pcs. fl. tubes @\$18)	(\$162)	
Estimated number of potential customers:			
Initital interest estimated at			
50 churches		ļ	
	Initial PV system investment	\$3320	
	Costs: \$26.25/month	Cost annuity:	\$315
Estimated potential market:	REMARKS:		
50 x 350 Wp = 18 kWp	Immediate interest exists fr		-
	as regular churches/mosqu		
	Integration of PC computer	•	
Present locations known:	purposes should be consid	-	
	Safe disposal of fl, tubes &	batteries (re	ecycling) is
None	recommended.		
	Currently the diocese of M	-	_
	PV systems for all of its 18		-
	the ongoing Burlas PV Isla	بالمتحد والمراجب والمراجب	Atam montons

Fact sheet # 2-1

Fact sheet PV application: Electro Repair Shop Group: Industrial A repair shop for TV's, Radios, PV system components and other appliances as a new form of income generation.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	sept. 1990

Relevant conventional energy prices: (urban) / rural Dry Cell Batteries: Size D: \$0.35 Charging lead-acid battery +transport: \$0.75/charg

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	85 %
Daily energy required:	
Soldering iron 5h	75 Wh
Testing 3h	75 Wh
Fl. tube 3h	60 Wh
Total	210 Wh

Possible local service: Positiv

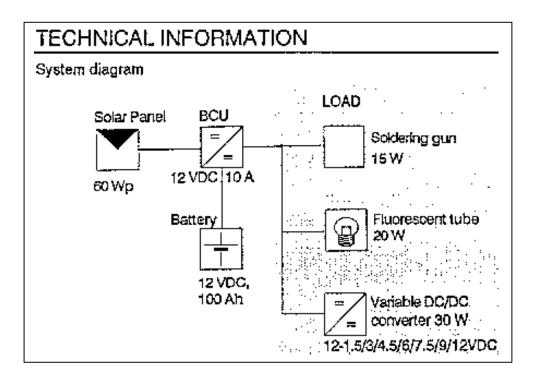
Competitiveness of PV system: No direct competition: electronics repair shops does not exist in unelectrified areas. Costs: Cost Annuity:

Status of product development: Variable DC-DC converter made to order. R&D: none

Estimated number of potential customers: 1 repair shop/ 40,000 inhabitants in unelectrified areas. 1000 repair shops

Estimated potential market:

Present locations known: Burias Island, Verde Island



System components	Price (*: import)	Anticipated maintenance& repair:
PV panel 60 Wp		BCU \$30/5y
x \$7.50	\$450*	Batteries \$50/4y
Battery Control Unit	\$30	General maintenance
Battery	\$50	\$5/y
Frame (G.I.)	\$35	
Cables & Switches	\$20	
Transport & Installation	\$30	
Profit margin	\$100	
(fl. tube & holder)	(\$18)	
Initial PV system investment	\$715	
Costs: \$5.75/month	Cost	
	annuity: \$69	

REMARKS:

Possible such enterprises can be introduced in combination with PV battery-charging stations. Such repair shops should be an integral part of any PV electrification project in order to provide instant local technical support.

income generation.		· · · · ·		
COUNTRY:	Philippines	Relevant conventional energy	METEORO	DLOGICAL INFO
Population:	60M	prices: (urban) / rural	Average Insola	ation: 5 kWh/m2d
Urban/rural distribution:	35/65 %	Dry Cell Batterles:	Seasona:	
% electrification:	35 %			wet, 4 kWh/m2d
Currency:	Pesos	Charging lead-acid battery	DecMay :	dry, 6 kWh/m2d
Exchange rate;	US\$ 1 = P 25	+transport : \$0.75/charge		
date:	Sept. 1990	TOUR NEODULT		
SYSTEM INFORMATI		TECHNICAL INFORMAT	ION	
System availability:	85 %	System diagram		
Daily energy required:	78 4/4	Sotar Panel BCU	LOAD	
Soldering iron 5h	75 Wh 75 Wh			Soldering gun
Testing 3h Fi, tube 3h	75 Wh	12 VDC 10 A	· · · · L	15 W
ri tube sh	DO YVII	60 Wp 12 100 10 K		
		Battery		Fluorescent tube
Total :	210 Wh	┃		20 W
Possible local service:	Positive	12 VDC,		
Competitiveness of PV system:		100 Ah		/ariable DC/DC
compositivenous of the system.	•		·· ·· ·· ·	converter 30 W /4.5/6/7.5/9/12VDC
No direct competition: el	lectronics			
repair shops does not ex		System components	Price	Anticipated maintenance
in unelectrified areas.			(* : import)	& repair :
		PV panel 60 Wp		BCU \$30/5y
		x \$7.50	\$450*	Batteries \$50/4y
Gosts;		Battery Control Unit	\$30	General maintenance
Cost Annuity:		Battery	\$50	\$5/y
Status of product development	t:	Frame (G.I.)	\$35	
Variable DC-DC converte	er made to	Cables & Switches	\$20	
order,		Transport & Installation	\$30	
R&D: none		Profit margin	\$100	
		(fl. tube & holder)	(\$18)	
Estimated number of potential	customers;			
1 repair shop/ 40,000 Inh	nabitants			
in unelectrified areas.		Initial PV system investment	\$715	.
1000 repair shops.		Costs: \$5.75/month	Cost annuity;	\$69
Estimated potential market:		REMARKS:		
1000 x 60 Wp = 60 kWp		Possible such enterprises o		
		combination with PV battery		
• •• •• •	· · ·	Such repair shops should be an integral part of any		
Present locations known;		PV electrification project in order to provide		
Instant local technical support.				
Dawlaa Islaad Maada (Burlas Island, Verde Island			
Burlas Island, Verde Isla				
Burlas Island, Verde Isla				

Fact sheet # 2-2

Fact sheet PV application: Vulcanizing Shop

Group: Industrial

A PV powered compressor for tire repair shops along the unelectrified parts of the national highways.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sent. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35 Kerosene/I: (\$0.26) \$0.40

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	90 %
Daily energy required:	
Compressor 1 1/2 h:	375 Wh
Light 5 h:	100 Wh
Total:	475 Wh

Possible local service: Poor

Competitiveness of PV system:

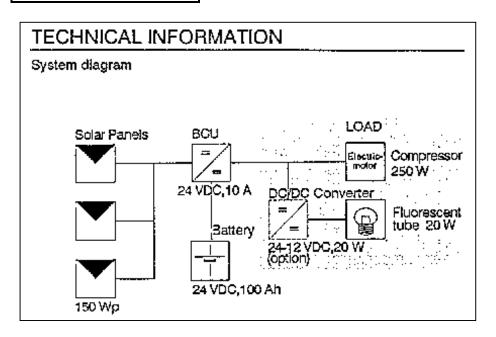
Competition with handpowered or gasoline powered compressors is unclear. PV compressor will be more comfortable than handpumps. Costs: n.a.

Cost Annuity: n.a

Status of product development: 24 VDC system, BCU made to order. 24 VDC/250 W electromotor not avail. R&D: 24 VDC ballasts for fl. tubes, adapt. 220 VAC compressors to 24 VD

Estimated number of potential customers: Not clear

Estimated potential market: Not clear



System components	Price (*: import)	Anticipated maintenance & repair:
PV panel 150 Wp		BCU \$90/5y
x \$6.50	\$975*	Batteries \$100/4y
Battery Control Unit	\$90	General maintenance
2 pcs. Batteries @ \$50	\$100	\$20/y
Frame (G.I.)	\$35	
Cables & Switches	\$25	
Transport & Installation	\$100	
Profit margin	\$250	
(Compressor)	(\$250)	
(fl. tube & holder)	(\$18)	
Initial PV system investment	\$1575	
Costs: \$13.75/month	Cost annuity:	\$165

REMARKS

The common price for tire repairs: \$0.5 - \$1.00 per puncture.

Marketability to these marginal enterprises is questionable.

PV powered compressors might be developed for additional cottage industry activities (e.g. painting etc.).

Fact sheet PV application: A PV powered compressor for tire repair :	Vulcanizing Sho	•	Group: Industrial ne national highways.
COUNTRY: Philippines	Relevant conventional energy	METEOR	OLOGICAL INFO
	prices; (urban) / rural	Average insol	ation: 5 kWh/m2d
	Gasoline/1 ; (\$0.28) \$0.35	Seasons:	·
	Kerosene/I : (\$0.26) \$0.40	June-Nov.	: wet, 4 kWh/m2d
Currency: Pesos	(•••=•, ••••		: dry, 6 kWh/m2d
Exchange rate: USS 1 = P 25		· · · · · · · · · · · · · · · · · · ·	
date: Sept. 1990			
-	TECHNICAL INFORMAT	ION	
System availability: 90 %	System dlagram		
Daily energy required:	· ·		
Compressor 1 1/2 h : 375 Wh			
Light 5 h : 100 Wh	Solar Paneis BCU		LOAD
-			Electric Compressor
	24 VDC,10 Å	DC/DC Con	
			Fluorescent
Total ; 475 Wh		y [<u>∕</u> =]	tube 20W
Possible local service: Poor		24-12 VDC 2 (option)	
Competitiveness of PV system:	24 VDC,100 Ah		
Competition with handpowered or	150 Wp		
gasoline powered compressors is			
unclear. PV compressor will be more	System components	Price	Anticipated maintenance
comfortable than handpumps.		(* : import)	& repair ;
	PV panel 150 Wp		BCU \$90/5y
	x \$6.50	\$975*	Batterles \$100/4y
Costs: ⊓.a.	Battery Control Unit	\$90	General maintenance
	2 pcs. Batteries @ \$50	\$100	\$20/y
	Frame (G.I.)	\$35	
,	Cables & Switches	\$25	
• •	Transport & Installation	\$100	
	Profit margin	\$250	
adapt. 220 VAC compressors to 24 VDC.	-	(\$250)	
	(fl, tube & holder)	(\$18)	
	((+ 1 +)	
Not clear			
	Initial PV system investment	\$1575	
	Costs: \$13.75/month	Cost annuity:	\$165
	REMARKS:		·····
· · ·	The common price for tire r	epairs: \$0 5	- \$1.00 per puncture
	Marketability to these margi	-	• •
	PV powered compressors m	•	-
	additional cottage industry a		
	ovinago maaoli y i	(0.	a. E
Чопе			

Fact sheet # 3-1

Fact sheet PV application: Small Irrigation System Group: Agricultural Power supply for a low head (2-3m) centrifugal pumping system which can displace a maximum of 199 cu.m of water (good for approx. 1-1.5 ha riceland).

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Dry Cell Batteries: Diesel/I: (\$0.21) \$0.25 Gasoline/I: (\$0.28) \$0.3

METEOROLOGICAL INFO
Average insolation: 5 kWh/m2d
Seasons:
June-Nov.: wet, 4 kWh/m2d
DecMay: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability: 70 % Daily energy required: Variable: depending on daily demand which varies with the seasons and meteorological conditions. Total:

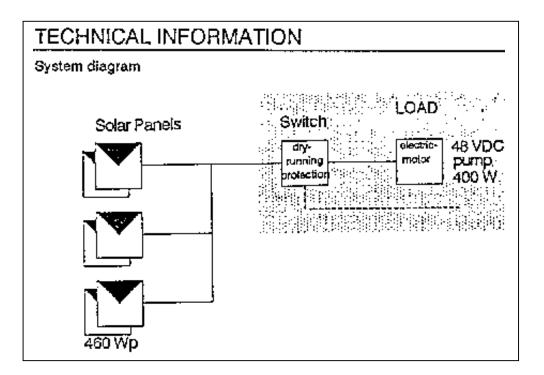
Possible local service: Poo

Competitiveness of PV system: Example riceland Irrigation:	
Dry season:	
85d x 100 cu.m	= 8500cu.m
Wet season:	
20d x 100 cu.m	= 2000 cu.m
Total/year 10,500 cu.m at	
\$0.04/cu.m	
Diesel pumped cu.m:	\$0.02-\$0.03
PV questionable for riceland Irri	gation

Status of product development: 400-500W DC pump units not available. R&D: for testing in combination with high value cash crops. Estimated number of potential customers: Not clear

Estimated potential market: Not clear

Present locations known: None



System components	Price (*: import)	Anticipated maintenance & repair:
PV panel 460 Wp		
x \$6.50	\$2990*	
		General maintenance
3 pcs. frames (G.I.) @\$35	\$105	\$50/y
Cables & Switches / 10y (incl. dry	\$100	
running protection)		
Transport & Installation	\$100	
Profit margin	\$650	
(Pumps & Pipes / 10y)	(\$500)	
Initial PV system investment	\$3945	
Costs: \$0.04/cu.m	Cost annuity:	
	\$387	

REMARKS:

Pilot applications should concentrate on drip-irrigation of cash crops e.g. vegetables, tobacco etc. Possibly in combination with farm reservoir project of the International Rice Research Institute: PV systems operating year round w/ elevated water storage (reservoirs). Another option Is the use of surplus energy for household purposes. Financing schemes should be offered to farmers.

of 199 cu.m of water (good for appro	entrifugal pumping system whi x. 1-1.5 ha riceland).	ich can displ	ace a maximum
COUNTRY: Philippin		METEOR	OLOGICAL INFO
	DM prices: (urban) / rural	Average inso	Weith
Urban/rural distribution: 35/65	% Dry Cell Batteries:	Seasons:	-
% electrification: 35	% Diesel/I ; (\$0.21) \$0.25	June-Nov.	: wet, 4 kWh/m2d
Currency: Pes	os Gasoline/I : (\$0.28) \$0.35		: dry, 6 kWh/m2d
Exchange rate: US\$ 1 = P	25		
date: Sept. 19			
SYSTEM INFORMATION	TECHNICAL INFORMA	TION	
System availability: 70	% System diagram		
Daily energy required:			LOAD
Variable: depending on daily demand	Solar Panels	Switch	
which varies with the seasons and		Gry .	electric 48 VDC
meteorological conditions,		protocijor	400 W
Total :			
	or		
Competitiveness of PV system:			
Example riceland irrigation:	460 Wp		
Dry season: 85d x 100 cu.m = 8500cu		Price	A
Wet season:	.m System components		Anticipated maintenance
•	.m PV panel 460 Wp	(* : import)	& repair :
Тоtal/year 10,500 сц.m at \$0.04/си.m	x \$6.50	\$2990*	
Diesel pumped cu.m: \$0.02-\$0.		\$233Q	General maintenanc
PV questionable for riceland irrigatio		\$105	\$50/y
Status of product development:	Cables & Switches / 10y	\$100	400,7
400-500W DC pump units not availab			
·····	Transport & Installation	\$100	
R&D: for testing in combination	Profit margin	\$650	
with high value cash crops.	(Pumps & Pipes / 10y)	(\$500)	
Estimated number of potential customers:		(4000)	
Not clear			
	Initial PV system Investment	\$3945	-
	Costs: \$0.04/cu.m	Cost annuity:	\$387
Estimated polential market:	REMARKS:		
Not clear	Pilot applications should c	oncentrate o	n drip-irrigation
	of cash crops e.g. vegetabl		• •
	in combination with farm re		•
	International Rice Researci		
Present locations known:	operating year round w/ elevated water storage (reservoirs),		storage (reservoirs),
Present locations known:	Another option is the use of surplus energy for household		
Present locations known:		of surplus en	
		it surpius en	
	Another option is the use o	-	

Fact sheet # 3-2

Fact sheet PV application: Poultry Incubator Group: Agricultural Depending on the size 200-600 chicken or duck eggs can be hatched in a PV powered Incubator.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural: n.a.

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	95 %
Daily energy required:	
Electric fan 24 h	600 Wh
Heating element 18 h	540 Wh
Inc. bulb 1 h	10 Wh
Total:	1,150 Wh

Possible local service: Average

Competitiveness of PV system:

Up to now incubators are restricted to electrified areas with generator sets for back-up purposes.

Small incubators for unelectrified areas do not (yet) exist.

Costs:

Cost Annuity: n.a.

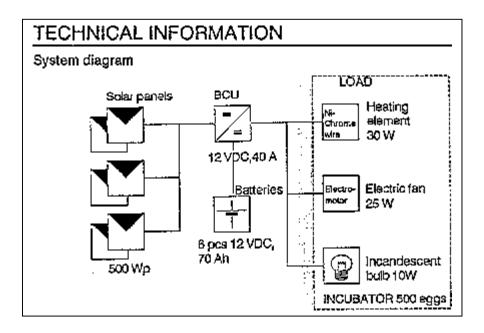
Status of product development: BCU made to order. R&D: prototype under field testing since 1986.

n.a.

Estimated number of potential customers: Off-hand estimate: 50 pc

Estimated potential market: 50 pcs. x 500 Wp = 25 kW

Present locations known: Infanta (Quezon Prov.)



System components	Price (*: import)	Anticipated maintenance & repair:
PV panel 500 Wp		BCU \$90/5y
x \$6.50/Wp	\$3250	Batteries \$240/4y
Battery Control Unit	\$90	General maintenance
6 pcs. Batteries @ \$40	\$240	\$50/y
3 pcs. frames (G.I.) @\$35	\$105	
Cables & Switches	\$20	
Transport & Installation	\$100	
Profit margin	\$750	
(Incubator complete) 10y	(\$200)	
Initial PV system investment	\$4555	
Costs: \$0.08/chick	Cost annuity: \$460	

This system can produce 16 batches of 600 chicks/year with a 21-day cycle.

At hatching success rate of 80%: 6400 chicks/y.

Incubator itself can be constructed locally by simple means.

For immediate marketing to farmer cooperatives.

Commercially sold 1-day chicks (layers) In electrified areas:

\$0.75 (excluding transport & transport losses).

COUNTRY: Philippines	Relevant conventional energy	METEOR	DLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average insola	
Urban/rural distribution: 35/65 %	······	Seasons;	• • • • • • • • • • • • • • • • • • • •
% electrification; 35 %	n.a.	June-Nov.	wet, 4 kWh/m2d
Currency: Pesos			dry, 6 kWh/m2d
Exchange rate: US\$ 1 = P 25		-	
date: Sept. 1990			
SYSTEM INFORMATION	TECHNICAL INFORMAT	ION	
System availability: 95 %	System diagram		
Daily energy required:	Solar panels BCU	· [1	OAD
Electric fan 24 h 600 Wh			Heating element
Heating element 18 h 540 Wh			30 W
Inc. bulb 1 h 10 Wh	12 VpC	40 A	
		tteries Elec	
			125 W
Total: 1,150 Wh	6 pcs 12 V	/DC, _	ł
Possible local service: Average	500 Wp 70 Ah		incandescent buib 10W
Competitiveness of PV system:			UBATOR 500 eggs
Up to now incubators are restricted		,	
to electrified areas with generator	·		n'''
sets for back-up purposes.	System components	Price	Anticipated maintenance
Small incubators for unelectrified	<u></u>	(* : import)	& repair ;
areas do not (yet) exist.	PV panel 500 Wp		BCU \$90/5y
	x \$6.50/Wp	\$3250	Batteries \$240/4y
Costs: n.a.	Battery Control Unit	\$90	General maintenance
Cost Annuity: n.a.	6 pcs. Batteries @ \$40	\$240	\$50/y
Status of product development:	3 pcs. frames (G.I.) @\$35	\$105	
BCU made to order.	Cables & Switches	\$20	
	Transport & Installation	\$100	
R&D: prototype under field testing	Profit margin	\$750	
since 1986.	(Incubator complete) 10y	(\$200)	
Estimated number of potential customers;			
Off hand estimate . 50 per			
Off-hand estimate : 50 pcs.	Initial PV system investment	\$4555	
		<u> </u>	\$460
Estimated potential market;	Costs: \$0.08/chick REMARKS:	Cost annuity:	9400
Estimated potential market: 50 pcs. x 500 Wp = 25 kWp	This system can produce 16	hatahaa of	500 objekolycer
oo poo. x ooo mp = 20 kmp	with a 21-day cycle.	varunes of	ooo omons/year
	At hatching success rate of	90% - 6400 -	hickelu
Propert locations known	Incubator itself can be cons		-
Present locations known:	For Immediate marketing to		
	For junieurate marketing 10	-	
Infanta (Quezon Prov.)	Commercially cold 1 days ab	ICVC /Inviore	
Infanta (Quezon Prov.)	Commercially sold 1-day ch \$0.75 (excluding transport &		

Fact sheet # 3-3

Fact sheet PV application: Ricemill 16 Hp Group: Agricultural

A "satake"-type of ricemill is the smallest ricemill currently available on the Philippines. It requires minimally a 16 Hp prime mover.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
data	Sent. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35 Kerosene/I: (\$0.26) \$0.40

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	85 %
ally energy required:	
10hx16Hpx746W/Hp =	120 kWh
Lights:	
pcs. x 10h =	0.8 kWh
Total:	121 kWh

Possible local service

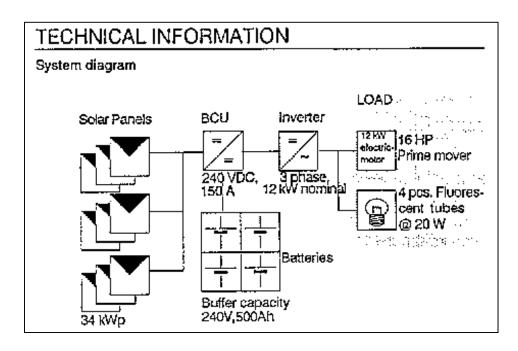
Competitiveness of PV system: Purchase 16 Hp gasoline prime mover: \$1300 Costs: Cost Annuity:

Status of product development:

Estimated number of potential customers:

Estimated potential market:

Present locations known:



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 34 kWp		
x \$6.50/Wp	\$221, 000*	
Initial PV system investment		
Costs:	Cost annuity:	

For an initial investment of approx. \$220,000 in PV panels alone, PV powered ricemills will not be considered.

Therefore any further calculations will prove to be superfluous.

	the smallest	ricemill currently available of	on the Philip	pines. It requires
minimally a 16 Hp prime mov COUNTRY:	ver. Philippines	Relevant conventional energy	METEOR	DLOGICAL INFO
	60M	prices; (urban) / rural	Average insol	
Population: Urbàn/rurai distribution:	35/65 %	Gasoline/I : (\$0.28) \$0.35	Seasons:	
% electrification:	35 %	Kerosene/I : (\$0.26) \$0.40		: wet, 4 kWh/m2d
Currency:	Pesos			: dry, 6 kWh/m2d
•	S\$ 1 = P 25			
date:	Sept. 1990			
SYSTEM INFORMATION	-	TECHNICAL INFORMAT	ION	
System availability:	85 %	System diagram		
Daily energy required:				LOAD
10hx16Hpx746W/Hp =	120 kWh	Solar Panels BCU	Inverter	LOAD
Lights:				12 EW elocutic 16 HP
4 pcs. x 10h =	0.8 kWh	240 VDC	3 051352	Prime mover
), <u>3 phase</u> , 12 kW nominal	
				(m) cent tubes
Total :	121 kWh		Batteries	
Possible local service:		┊╶ ╷ ┪┻┝╌┊┝┿┝		
Competitiveness of PV system:			pacity	
Purchase 16 Hp gasoline pr	ime mover:	34 kWp 240V,50	DAh	
\$1300				
		System components	Price	Anticipated maintenance
			(* : import)	& repair :
		PV panels 34 kWp		
		x \$6.50/Wp	\$221,000*	
Costs:				
Cost Annuity:		4		
Status of product development:			1	
		4		
Estimated number of potential cust	omers:			
			<u> </u>	-
		Initial PV system investment	<u> </u>	
—	<u> </u>	Costs:	Cost annuity:	
Estimated potential market:		REMARKS:	***	n non in DV neuels
		For an initial investment of		-
		alone, PV powered ricemili		
		Therefore any further calcu	nations will	prove to be
Present locations known:		superfluous.		
		1		

Fact sheet # 4-1

Fact sheet PV application: Telecom Relay Station Group: Telecom

A small back-to-back transceiver system (2x48W) provides telephone and telegraph links for (inter-) national communications.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
data.	Sept 1990

Relevant conventional energy prices: (urban) / rural Diesel: (\$0.21) \$0.25

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	95 %
Daily energy required:	
Transceivers: 2 pcs x 24h x 48W	
	= 2,300 Wh
2 fl. tubes 10h	= 400 Wh
Towerlight 10h	= 200 Wh
Radio 12 h	= 60 Wh
Total:	3 kWh

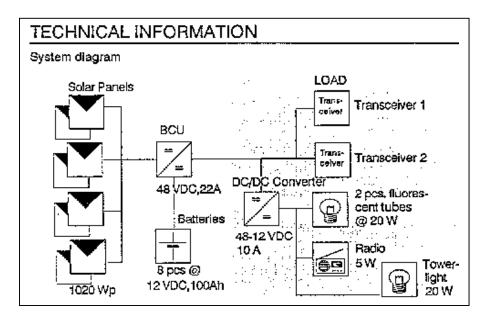
Possible local service: Positiv

Competitiveness of PV system: As hybrid system (PV+Diesel back-up) directly cost competitive with conventional system with 2 or 3 gee-sets because of reduced costs of labour, fuel, maintenance & repair. E.g. 3x3kVA diesel gee-sets: Cost Annuit \$7000 (PTT Zambales

Status of product development: Product ready. R&D: None

Estimated number of potential customers: Converting existing relay stations to PV + expansions of telecom network: 40-60 stations

Estimated potential market: 40 x 1 kWp = 40 kWp (minimum) Present locations known: Zambales (PTT) Marinduque (RCPI)



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 1020 Wp		BCU \$510/IOy
x \$6.50/Wp	\$6630*	Batteries \$400/4y
Battery Control Unit		General maintenance
(1020 Wp x \$0.5/WP)	\$510*	\$350/y.
8 pcs Batteries @\$50	\$400	
7 pcs frames (G.I.) @\$35	\$245	
DC-DC Converter	\$40	
Cables & Switches	\$100	
Transport & Installation	\$500	
Profit margin	\$1600	
Initial PV system investment	\$10025	
Costs: \$100/month	Cost annuity: \$1150	

REMARKS:

PV system to be controlled by radio operator.

Hybrid system (PV+Diesel) will have a cost annuity < \$2000. PV systems offer less air pollution & noise.

Safe disposal of batteries (recycling) is recommended.

Immediate interest by leading Phil. Telecom companies (PLDT, PTT, RCPI, Eastern, Oceanic Wireless, BUTEL) in converting existing remote relays to PV.

In a few cases a grid extension might be more cost effective. Also larger (40-80kWh/d) stations can be cost effectively operated by PV.

Fact sheet PV application;	Telecom Relay S		-
A small back-to-back transceiver system national communications.	(2x48W) provides telephone	and telegra	ph links for (inter-)
COUNTRY: Philippines	Relevant conventional energy	METEORO	DLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average insola	ation: 5 kWh/m2d
Urban/rural distribution: 35/65 %	Diesel : (\$0.21) \$0.25	Seasons:	
% electrification: 35 %		June-Nov. :	wet, 4 kWh/m2d
Currency: Pesos		DecMay :	dry, 6 kWh/m2d
Exchange rate: US\$ 1 = P 25			
date: Sept. 1990			
SYSTEM INFORMATION	TECHNICAL INFORMAT	ION	
System availability: 95 %	System diagram		
Daily energy required:	Solar Panels	10 - C	LOAD
Transceivers: 2 pcs x 24h x 48W		n (a. 1977).	Transceiver 1
= 2,300 Wh	BCU BCU		
2 fl. tubes 10h = 400 Wh			Transceiver 2
Towerlight 10h = 200 Wh		DC/DC Conver	Celvon
Radio 12 h = 60 Wh	48 VDC,22A	=	2 pcs. fluores-
Total: 3 kWh	Batteries		@ 20 W
Possible local service: Positive		48-12 VDC	Radio
Competitiveness of PV system:	Bpcs@		5W Tower-
As hybrid system (PV+Diesel back-up)	1020 Wp 12 VDC,100Ah		(n) light 20 W
directly cost competitive with con-			N
ventional system with 2 or 3 gen-sets	System components	Price	Anticipated maintenance
because of reduced costs of labour,		(* : împort)	& repair :
fuel, maintenance & repair.	PV panels 1020 Wp		BCU \$510/10y
E.g. 3x3kVA diesel gen-sets:	x \$6.50/Wp	\$6630*	Batteries \$400/4y
	Battery Control Unit	CE LOT	General maintenance
Cost Annuit \$7000 (PTT Zambales)	(1020 Wp x \$0.5/Wp)	\$510*	\$350/y.
Status of product development: Product ready.	8 pcs Batteries @\$50	\$400 \$245	
Product ready.	7 pcs frames (G.I.) @\$35 DC-DC Converter	\$245 \$40	
R&D: None	Cables & Switches	\$100	
R&D: None			
Estimated pumper of potential contenents	Transport & Installation Profit margin	\$500 \$1600	:
Estimated number of potential customers: Converting existing relay stations	Lient marAm	41000	
to PV + expansions of telecom			
network: 40-60 stations.	Initial PV system investment	\$10025	
Hetwork, 40-00 stations,	Costs: \$100/month	·	1 \$1150
Estimated potential market:	REMARKS:	Cost annuity:	
40 x 1 kWp ≃ 40 kWp		hu radia and	arator
40 x 1 kwp ≕ 40 kwp (minimum)	PV system to be controlled by radio operator.		
(moanawiny	Hybrid system (PV+Diesel) will have a cost annulty		
Present locations known;	< \$2000. PV systems offer less air pollution & noise,		
n resent togations known.	Safe disposal of batteries (recycling) is recommended.		
Zambales (PTT)	Immediate interest by leading Phil. Telecom companies (PLDT, PTT, RCPI, Eastern, Oceanic Wireless,		
Marinduque (RCPI)	BUTEL) In converting existi	•	
mannaadaa firar k	· · -	+	+
	In a few cases a grid extension might be more cost effective. Also larger (40-80kWh/d) stations can be cost		
Facisheet # 4-1	effectively operated by PV.	anni ay sadu	vita vali ne vvot
·	geneetively operated by PV.		

Fact sheet # 4-2

Fact sheet PV application: TV Translator Group: Telecom An (unmanned) 10W (transmitting power) TV relay strategically situated on or near a mountain top can provide a good quality signal to settlements below.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sent. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	95 %
Daily energy required:	
16 hours x 26 W =	416 Wh
Total:	416 Wh

Possible local service: Positive

 Competitiveness of PV system:

 Competitive with grid extension of > 0.5 km. Competitive with (manned)

 gasoline-powered electricity supplies. Competitive with daily exchange of charged lead

 acid batteries incl. hauling.

 Costs:
 \$30-\$40/month

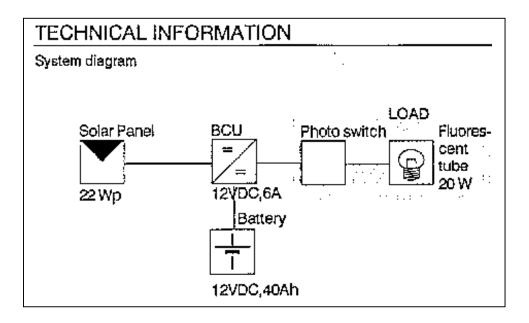
 Cost Annuity:
 \$350-\$500/year

Status of product development: PV power supply ready. High quality BCU made to order or imported. R&D: None

Estimated number of potential customers: Initial interest approx. 25 cities/towns

Estimated potential market: 25 x 200 Wp = 5 kWp

Present locations known: None



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 200 Wp		BCU \$90/5y
x \$6.50	\$1300*	Batteries \$50/4y
Battery Control Unit	\$90	General maintenance
Battery	\$50	\$100/y
2 pcs. frames (G.I.) @\$35	\$70	
Cables & Switches (autom.) \$75		
Transport & Installation	\$150	
Profit margin	\$350	
Initial PV system investment	\$2085	
Costs: \$22.50/month	Cost annuity: \$270	

Compared to the hauling of charged batteries PV charged batteries have an extended service life.

Such TV translators can increase the area of coverage of government & commercial TV stations for a relatively low investment. However current interest seems low.

Pilot project should be considered with one of the 4 national TV stations or with a regional TV station.

can provide a good qu			METEOR		
COUNTRY:	Philippines	Relevant conventional energy		DLOGICAL INFO	
Population:	60M	prices: (urban) / rural	Average insol	ation: 5 kWh/m2d	
Urban/rural distribution:	35/65 %	Gasoline/I : (\$0.28) \$0.35	Seasons:		
% electrification:	35 %			: wet, 4 kWh/m2d	
Currency:	Pesos		Decмау :	: dry, 6 kWh/m2d	
Exchange rate;	US\$ 1 = P 25				
	Sept. 1990			· · · · ·	
SYSTEM INFORMA		TECHNICAL INFORMAT			
System availability:	90 %	System diagram			
Daily energy required: 16 hours x 26 W =	416 Wh				
	410 111	Solar Panel BCU	Photo s	LOAD witch Fluores-	
				cent	
				tube 20 W	
		22 Wp 12VDC	ttery	e e la estato di sedi esto di la esto	
Total :	416 Wh		llery		
Possible local service:	Positive				
Competitiveness of PV syste		12VDC	40Ah		
Competitive with grid					
> 0.5 km. Competitive					
gasoline-powered elec		System components	Price	Anticipated maintenance	
supplies. Competitive			(* : import)	& repair :	
exchange of charged l	lead acid	PV panels 200 Wp		BCU \$90/5y	
batterles incl. hauling.		x \$6.50	\$1300*	Batteries \$50/4y	
Costs:	\$30-\$40/month	Battery Control Unit	\$90	General maintenance	
Cost Annuity:	\$350-\$500/year	Battery	\$50	\$100/y	
Status of product developme	ent:	2 pcs. frames (G.I.) @\$35	\$70		
PV power supply read	у.	Cables & Switches (autom.)	\$75		
High quality BCU mad	e to order	Transport & Installation	\$150		
or imported.		Profit margin	\$350		
R&D : None					
Estimated number of potenti	ial customers:				
Initial interest approx.					
25 cities/towns				-	
		Initial PV system investment	\$2085		
		Costs: \$22.50/month	Cost annulty:	\$270	
Estimated potential market:		REMARKS:			
25 x 200 Wp = 5 kWp		Compared to the hauling of			
		PV charged batteries have a			
		Such TV translators can inc		-	
Present locations known:		of government & commercia		•	
		low investment. However cu			
	None		Pilot project should be considered with one of the		
None		•			
None		4 national TV stations or wit	ih a regiona	l TV station.	

Fact sheet # 4-3 Fact sheet PV application: Lighthouse/Seabuoy Group: Telecom An (unmanned) 50Wp PV powered navigational light provides security at sea.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrfication:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	sept. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35 1 lead-acid battery charge (0.5 kWh): approx. \$0.75 (incl. transport)

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability: 95 % Daily energy required: 10h x 35W x 30% (time switched on) = 105 Wh Total: 105 Wh

Possible local service: Positive

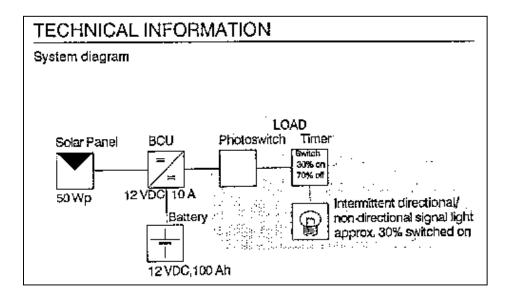
Competitiveness of PV system: Competitive with any manned gasoline powered lighthouse. Competitive with regular exchange of charged batteries, including hauling charges. Cost Annuity: > \$1000

Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None

Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate interest in 40 systems.

Estimated potential market: 40 x 50Wp = 2 kWp

Present locations known: Throughout Phillipine archipelago



System components	Price (*: import)	Anticipated maintenance & repair:
PV panel 50 Wp		BCU \$60/5y
X \$7.50	375*	Battery \$60/4y
Battery Control Unit	60	General maintenance
(weatherproof)		\$50/y (may vary
Battery	50	according to
Frame (G.I.)	35	location)
Cables & Switches	\$15	
Transport & Installation	\$50	
Profit margin	\$110	
(bulb + timer + housing)	(\$100)	
Initial PV system investment	\$695	
Costs: \$10/month	Cost annuity: \$117	

Possibility of larger PV systems for stronger light. PV charged batteries have a comparatively long service life. Safe disposal of batteries recommended. To be marketed as a complete system. Waterproof system can be mounted on sea-buoy. To be marketed through the Philippine Coastguard & municipalities (ports).

COUNTRY: Philippines	Relevant conventional energy	METEOR	OLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average insol	ation; 5 kWh/m2d
Urban/rural distribution: 35/65 %	Gasoline/I: (\$0.28) \$0.35	Seasons:	
% electrification: 35 %	1 lead-acid battery	June-Nov.	: wet, 4 kWh/m2d
Currency: Pesos	charge (0.5 kWh):	DecMay	: dry, 6 kWh/m2d
Exchange rate: US\$ 1 = P 25	approx. \$0.75		
date: Sept. 1990	(incl. transport)		
SYSTEM INFORMATION	TECHNICAL INFORMAT	10N	
System availability: 95 %	System diagram		
Daily energy required:			
10h x 35W x 30% (time switched on)			
= 105 Wh		LÓAD atoswitch Tima	er.
		Switch 30% or	1 : .
		70% 0	
	50 Wp 12 VDC 10 A		Intermittent directional/
Total: 105 Wh	Battery : '		non-directional signal light approx, 30% switched on
Possible local service: Positive		CENTRA DUPE	Taga ka kuta da sa k
Competitiveness of PV system:	12 VDC,100 Ah		
Competitive with any manned gasoline			
powered lighthouse.		······································	
Competitive with regular exchange of	System components	Price	Anticipated maintenance
charged batterles, including hauling		(* : import)	& repair :
charges.	PV panel 50 Wp		BCU \$60/5y
	x \$7.50	\$375*	Battery \$50/4y
		\$60	General maintenance
	Battery Control Unit	T	amate to an and
Cost Annuity: > \$1000	(weatherproof)		\$50/y (may vary
Status of product development:	(weatherproof) Battery	\$50	according to
Status of product development: Product ready, all components locally	(weatherproof) Battery Frame (G.I.)	\$50 \$35	
Status of product development: Product ready, all components locally available, BCU & controls made to	(weatherproof) Battery Frame (G.I.) Cables & Switches	\$50 \$35 \$15	according to
Status of product development: Product ready, all components locally available, BCU & controls made to order.	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation	\$50 \$35 \$15 \$50	according to
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin	\$50 \$35 \$15 \$50 \$110	according to
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers:	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation	\$50 \$35 \$15 \$50	according to
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin	\$50 \$35 \$15 \$50 \$110	according to
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil.	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing)	\$50 \$35 \$15 \$50 \$110 (\$100)	according to
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing)	\$50 \$35 \$15 \$50 \$110 (\$100) \$695	according to location)
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems.	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) Initial PV system investment Costs: \$10/month	\$50 \$35 \$15 \$50 \$110 (\$100)	according to location)
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems. Estimated potential market:	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) Initial PV system investment Costs: \$10/month REMARKS:	\$50 \$35 \$15 \$50 \$110 (\$100) \$695 Cost annuity	according to location) \$117
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems.	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) Initial PV system investment Costs: \$10/month REMARKS: Possibility of larger PV sys	\$50 \$35 \$15 \$50 \$110 (\$100) \$695 Cost annuity tems for stru	according to location) \$117 onger light.
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems. Estimated potential market:	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) Initial PV system investment Costs: \$10/month REMARKS: Possibility of larger PV sys PV charged batteries have	\$50 \$35 \$15 \$50 \$110 (\$100) \$695 Cost annuity tems for strut a comparat	according to location) \$117 onger light. ively long service
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems. Estimated potential market: 40 x 50 Wp = 2 kWp	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) initial PV system investment Costs: \$10/month REMARKS: Possibility of larger PV sys PV charged batteries have life. Safe disposal of batter	\$50 \$35 \$15 \$50 \$110 (\$100) \$695 Cost annuity tems for stra a comparation	according to location) : \$117 : \$117 : \$117 : \$117 : \$117 : \$117
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems. Estimated potential market:	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) Initial PV system investment Costs: \$10/month REMARKS: Possibility of larger PV sys PV charged batteries have life. Safe disposal of batter To be marketed as a comp	\$50 \$35 \$15 \$50 \$110 (\$100) \$695 Cost annuity tems for strution a comparation lets recommination lets system.	according to location) \$117 onger light. ively long service ended.
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems. Estimated potential market: 40 x 50 Wp = 2 kWp Present locations known:	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) Initial PV system investment Costs: \$10/month REMARKS: Possibility of larger PV sys PV charged batteries have life. Safe disposal of batter To be marketed as a comp Waterproof system can be	\$50 \$35 \$15 \$50 \$110 (\$100) \$695 Cost annuity tems for strue a comparate les recommendates let system. mounted or	according to location) \$117 onger light. ively long service ended, is sea-buoy.
Status of product development: Product ready, all components locally available, BCU & controls made to order. R&D: None Estimated number of potential customers: Currently 36 PV lighthouses for 15 years in operation by Phil. Coastguard. Immediate Interest in 40 systems. Estimated potential market: 40 x 50 Wp = 2 kWp	(weatherproof) Battery Frame (G.I.) Cables & Switches Transport & Installation Profit margin (bulb + timer + housing) Initial PV system investment Costs: \$10/month REMARKS: Possibility of larger PV sys PV charged batteries have life. Safe disposal of batter To be marketed as a comp	\$50 \$35 \$15 \$50 \$110 (\$100) \$695 Cost annuity tems for strue a comparate les recommendates let system. mounted or	according to location) \$117 onger light. ively long service ended, is sea-buoy.

Fact sheet # 5-1 Fact sheet PV application: NiCd Battery Charger Group: Consumer PV recharged Nickel Cadmium batteries (Size AA. C. D) replace the regular purchase of dry cell batteries for torches, radios etc.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Dry cell batteries: Size AA: \$0.20 Size C : \$0.25 Size D: \$0.35

METEOROLOGICAL INFO
Average insolation: 5 kWh/m2d
Seasons:
June-Nov.: wet, 4 kWh/m2d
DecMay: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	n.a.
Daily energy required:	n.a.
Total:	n.a.

n.a.

Possible local service:

Competitiveness of PV system:

 When the charger is used for 4 batteries/week and 50 weeks/year and batteries + panel lasts for 400 cycles including batteries, price/charge \$0.06 v. \$0.20-\$0.35 per dry cell battery

 Costs:
 n.a.

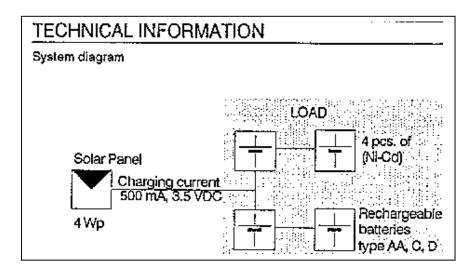
Cost Annuity:

Status of product development: Product not available

Estimated number of potential customers: 3,5M households unelectrified. initially 1 charger/500 households: 7000 units, later 1 charger/50 households: 70,000 units

Estimated potential market: 7000 x 4Wp = 28 kWp (later 70,000 x 4Wp = 280 kWp)

Present locations known: Burias Island (field test)



System components	Price (*: import)	Anticipated maintenance & repair:
PV panel 4 Wp	\$40*	
Casing	\$10	
(4 pcs. NiCd Batteries		
Size D)	(\$24)*	
Profit margin	\$10	
Initial PV system investment	\$60	
Costs: \$0.04/charge	Cost annuity: \$9	

Estimated service life of PV charger: 8 years Possibly to be equipped with A-Si panel.

NiCd batteries economically replace dry cell batteries and heir environmentally unsafe disposal.

For use in all sorts of portable appliances.

NiCd batteries locally available in all sizes.

Controlled disposal of disused NiCd batteries is recommended.

Population: 60M prices: (urban) / rural Average insolation: 5 kWh/n Urban/rural distribution: 35/65 % Dry cell batteries : Seasons: % electrification: 35 % Size AA : \$0.20 June-Nov, : wet, 4 kWh/m2d Currency: Pesos Size C : \$0.25 June-Nov, : wet, 4 kWh/m2d Exchange rate: US\$ 1 = P 25 Size D : \$0.35 DecMay : dry, 6 kWh/m2d System availability: n.a. System diagram Daily energy required: n.a. System diagram Total : n.a. Solar Panel Image: Charging current Total : n.a. AWp Image: Chargeable batteries When the charger is used for 4 Wp Image: Chargeable batteries When the charger is used for 4 batteries/week and 50 weeks/year AWp	dry cell batteries for torches, radios etc. COUNTRY: Philippines	Relevant conventional energy		OLOGICAL INFO
Urban/fural distribution: 35/65 % Dry cell batteries : Seasons: Stelectification: 35 % Size AA : \$0.20 June-Nov. ; wet, 4 kWh/m2d DecMay : dry, 5 kWh/m2d DecMay : dry, 5 kWh/m2d DecMay : dry, 5 kWh/m2d System availability: n.a. System availability: n.a. System availability: n.a. System class of PV system Pechargesble Total : n.a. System components Charaging current Pechargesble Solar Panel LOAD Pechargesble Pechargesble Solar Panel LOAD Pechargesble Pechargesble Solar Panel LOAD Pechargesble Pechargesble Solar Panel Solar Panel Pechargesble Pechargesble Solar Panel VicCo) Pechargesble Pechargesble Costanuty: n.a. System components Price Anticipated maintern Status of product development: Price Anticipated maintern Stop Product not available Size D) Stop Stop Stop Product not available Profit margin Stop Stop	· · · · · · · · · · · · · · · · · · ·			
% electrification: 35 % Size AA : \$0.20 Currency: Pesos Size A : \$0.25 Size C : \$0.25 Size D : \$0.35 date: Sept. 1990 System Availability: n.a. Sofar Panel Sofar Panel Coatarping current Price Anticipated mainten System components Price Anticipated mainten Status of product development: Profit margin Size D) System investment Size D) System components Price Anticipated mainten Size D) Profit margin Size D) Size			i -	auon: 5 Kvyn/m20
Currency: Pease Size C : \$0.25 DecMay : dry, 5 kWh/m2d Exchange rate: US\$ 1 = P 25 Size D : \$0.35 DecMay : dry, 5 kWh/m2d SYSTEM INFORMATION System valiability: n.a. DecMay : dry, 5 kWh/m2d System valiability: n.a. System valiability: n.a. Daily energy required: n.a. System diagram Total : n.a. Charging oursert Price Fossible local service: n.a. Sofar Panel LOAD Competitivaness of PV system: Wip Sofar Panel Price Yestem diagram System components Price Anticipated maintern Cycles including batteries, partic/charge \$0.06 v. \$0.20-\$0.35 per dry cell battery System components Price Cost Annutly: n.a. Size D) \$10 (\$24)* Product not available Profit margin \$10 \$10 Estimated number of potential customers: 3,5M households unelectrified. \$10 \$10 Initial PV system investment \$60 \$60 \$10 Estimated number of potential customers: 3,5M households : Coasts: \$0.04/charge	· · · · · · · · · · · · · · · · · · ·			: wet_4 kWh/m2d
Exchange rate: US\$ 1 = P 25 date: Size D : \$0.35 System availability: n.a. System availability: n.a. Daily energy required: n.a. Solar Panel COAD Yessible local service: Compatibureas of PV system: When the charger is used for 4 batteries/week and 50 weeks/year and batteries + panel lasts for 400 cycles including batteries, price/charge \$0.06 v. \$0.20-\$0.35 per dry cell battery Price Cost: n.a. System components Price Cost Annulty: n.a. Size D) (\$24)* Product not available Size D) (\$24)* Profit margin \$10 Size D) \$10 Estimated number of potential customers: 3,5M households unelectrified, initially 1 charger/50 house-holds : Initial PV system investment \$60 Folds: 70,000 units, later 1 charger/50 house-holds : REMARKS: \$9 Costs: \$0.04/charge cost annulty: \$9 Estimated notential market: REMARKS: \$60 7000 x 4Wp = 28 kWp Possibly to be equipped with A-SI panel. NiCd batteries economically replace dry cell batteries an their environmentally unsafe disposal. For use In all sorts of portable appliances.			1	•
date: Sept. 1990 System availability: n.a. System availability: n.a. Daily energy required: n.a. Total : n.a. Possible local service: Charging ourrent Compatitiveness of PV system: When the charger is used for 4 batteries/week and 50 weeks/year Availability: and batteries + panel lasts for 400 System components cycles including batteries, Price price/charge \$0.06 v. \$0.20-\$0.35 per PV panel 4 Wp Costs: n.a. Costs: n.a. Cost Annuity: n.a. Costs: n.a. Costs: n.a. Costs: n.a. Costs: Size D) Product not available Size D) Product not available Size D) Profit margin \$10 Costs: \$0.04/charge Costs: \$0.04/charge Costs: \$0.04/charge Costs: \$0.04/charge Costs: \$0.04/charge Costs: \$0.04/charge C				i diyî û kirişinîzû
SYSTEM INFORMATION TECHNICAL INFORMATION System availability: n.a. Daily energy required: n.a. System availability: n.a. Daily energy required: n.a. Total : n.a. Pressible local service: Charging ournert Competitiveness of PV system: When the charger is used for 4 batterles/week and 50 weeks/year Awp and batterles + panel lasts for 400 System components cycles including batteries, Price price/charge \$0.06 v. \$0.20-\$0.35 per PV panel 4 Wp Costs: n.a. Costarnuity: n.a. Costarnuity: n.a. Costarnuity: n.a. Costarnuity: n.a. Costar from the option opt	•			
System availability: n.a. Daily energy required: n.a. Daily energy required: n.a. Total : n.a. Total : n.a. Passible local service: Charging current Competitiveness of FV system: When the charger is used for 4 batteries/week and 50 weeks/year and batteries + panel lasts for 400 cycles including batteries, System components price/charge \$0.06 v. \$0.20-\$0.35 per PV panel 4 Wp Costs: n.a. Costanuity: n.a. Costanuity: n.a. Statue of product development: Size D) Product not available Size D) Profit margin \$10 Estimated number of potential customers: 3,5M households : 3,5M households unelectrified, Initial PV system investment \$60 Initial PV system investment \$60 Costs: \$0.04/charge Cost annuity: \$9 Estimated potential market: REMARKS: 7000 units Costs: \$0.04/charge Cost annuity: \$9 Estimated potential market: REMARKS:		TECHNICAL INFORMAT		
Daily energy required: n.a. Total: n.a. Total: n.a. Possible local service: Charging current Competitiveness of PV system: 4 Wp When the charger is used for 4 batteries, week and 50 weeks/year and batteries + panel lasts for 400 System components cycles including batteries, Price price/charge \$0.06 v. \$0.20-\$0.35 per PV panel 4 Wp Gost Annulty: n.a. Cost Annulty: n.a. Cost Annulty: n.a. Sizus of product development: Size D) Profit margin \$10 Sizus of product development: Size D) Profit margin \$10 Size for product development: Size D) Profit margin \$10 Initial PV system Investment \$60 holds : 70,000 units Costs: \$0.04/charge Cost annulty: \$9 Estimated potential customers: REMARKS; Possibly to be equipped with A-Si panel. Nicd batteries economically replace dry cell batteries an their environmentally unsafe disposel. Nicd batteries aconomically replace dry cell batteries an their environmentally unsafe disposel.		······································		
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7000 x 4Wp = 28 kWp Estimated service life of PV charger : 8 years (later 70,000 x 4Wp = 280 kWp) Possibly to be equipped with A-Si panel. NiCd batteries economically replace dry cell batteries an Present locations known: their environmentally unsafe disposal. Burlas Island (field test) For use In all sorts of portable appliances.			Cost annuity:	<u>\$9</u>
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Burias Island (field test) For use In all sorts of portable appliances.	Propert logisticase logistic			
INICO patteries locally available in all sizes.		-	••	
	Burias Island (field test)		bio in all al-	·es.
Controlled disposal of disused NICd batteries is recommended.	Burias Island (field test)	-		

Fact sheet # 5-2

Fact sheet PV application: Portable PV Group: Consumer A 10 Wp portable PV power supply for lighting & radio for outdoor activities (camping, trekking, boating).

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	1 US\$ = P25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Kerosene/I (\$0.26) \$0.40 Dry Cell Batteries: Size AA \$0.20 Size C \$0.25 Size D \$0.30

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	65 %
Daily energy required:	
Portable radio 2h	10 Wh
Light 4h	40 Wh
Total:	50 Wh

Possible local service:

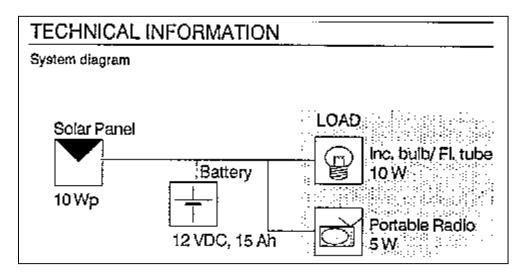
Poor

Competitiveness of PV system: Competitive with the use of kerosene pressure lamps & dry cell batteries. E.g.: When In use for 60 d/y, PV system replaces 32 dry cell batteries (\$11.20) and 241 kerosene (\$9.60). Cost: \$20.80/y

Status of product development: Product not available. R&D: product manufacture

Estimated number of potential customers: For pilot marketing: 1000 pcs.

Estimated potential market: 1000 x 10 Wp = 10 kWp



System components	Price (*: import)	Anticipated maintenance & repair:
PV panel 10 Wp x		Battery \$20/5y
\$7.50/Wp	\$75*	
1 battery	\$20	
Cables & switches	\$10	
Profit margin	\$20	
Initial PV system investment	\$125	
Costs: n.a.	Cost annuity: \$18	

Estimated lifetime portable PV power supply: 10 y.

Possible use of A-Si PV panels.

PV system easier to operate, replacing the use (and disposal) of dry cell batteries. For pilot production & marketing.

Fact sheet PV appli A 10 Wp portable PV p		Portable PV lighting & radio for outdoo	r activities	Group:	Consumer
(camping, trekking, bo		······································			
COUNTRY:	Philippines	Relevant conventional energy	METEORC	DLOGICAL	INFO
Population:	60M	prices: (urban) / rural	Average insola	tion:	5 kWh/m2d
Urban/rural distribution;	35/65 %	Kerosene/I (\$0.26) \$0.40	Seasons:		
% electrification:	35 %	Dry Cell Batteries :	June-Nov. :	wet, 4 kWh/	/m2d
Currency:	Pesos	Size AA \$0.20	DecMay :	dry, 6 kWh/	m2d
Exchange rate:	1 US\$ = P25	Size C \$0.25	,	• ·	
date;	Sept. 1990	Size D \$0.30			
SYSTEM INFORMA	TION	TECHNICAL INFORM	ATION		
System availability:	65 %	System diagram			
Daily energy required:					
Portable radio 2h	10 Wh			OAD	
Light 4h	40 Wh	Solar Panel			
			+	XI IZ 1: · · · ·	b/Fl.tube
			tery	😇 10 W	
		10Wp			
Total :	50 Wh	12 VDC	, 15 Ah		le Radio
Possible local service:	Poor]	· · · ·		
Competitiveness of PV syste	em:				
Competitive with the u	ise of kerosene				
pressure lamps & dry	cell batteries.				
E.g.: When In use for 6	60 d/y, PV	System components	Price	Anticipated m	aintenance
system replaces 32 dry	y cell batteries		(* : Import)	& repair :	
(\$11.20) and 24 keros	sene (\$9.60).	PV panel 10 Wp x		Battery \$20	0/5y
		\$7.50/Wp	\$75*	-	
		1 battery	\$20		
A 14	*** ***	Cables & switches	\$10		
Cost:	\$20.80/y	Cables & switches	1414	1	
Cost: Status of product developme		Profit margin	\$20		
Status of product developme Product not available.	ent:				
Status of product developme	ent:				
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Status of product developme Product not available. R&D: product manufac	ent: ciure				
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Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pllot marketing:	ent: ciure	Profit margin	\$20	\$18	
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pllot marketing:	ent: ciure	Profit margin Initial PV system investment	\$20 \$125	\$18	
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pilot marketing: 1000 pcs.	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a. REMARKS:	\$20 \$125 Cost annuity:		
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pllot marketing: 1000 pcs.	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a.	\$20 \$125 Cost annuity: Te PV power s		
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pllot marketing: 1000 pcs.	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a. REMARKS: Estimated lifetime portabl	\$20 \$125 Cost annuity: le PV power s anels.	supply: 10 y	
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pllot marketing: 1000 pcs.	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a. REMARKS: Estimated lifetime portabl Possible use of A-SI PV p	\$20 \$125 Cost annuity: le PV power s anels.	supply: 10 y	
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pilot marketing: 1000 pcs. Estimated potential market: 1000 x 10 Wp = 10 kW	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a. REMARKS: Estimated lifetime portabl Possible use of A-Si PV p PV system easier to opera of dry cell batteries.	\$20 \$125 Cost annuity: Te PV power s anels. ate, replacing	supply: 10 y	
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pilot marketing: 1000 pcs. Estimated potential market: 1000 x 10 Wp = 10 kW	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a. REMARKS: Estimated lifetime portabl Possible use of A-Si PV p PV system easier to opera	\$20 \$125 Cost annuity: Te PV power s anels. ate, replacing	supply: 10 y	
Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pllot marketing: 1000 pcs. Estimated potential market: 1000 x 10 Wp = 10 kW Present locations known:	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a. REMARKS: Estimated lifetime portabl Possible use of A-Si PV p PV system easier to opera of dry cell batteries.	\$20 \$125 Cost annuity: Te PV power s anels. ate, replacing	supply: 10 y	
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Status of product developme Product not available. R&D: product manufac Estimated number of potenti For pllot marketing: 1000 pcs. Estimated potential market: 1000 x 10 Wp = 10 kW Present locations known:	ent: Cture ial customers:	Profit margin Initial PV system investment Costs: n.a. REMARKS: Estimated lifetime portabl Possible use of A-Si PV p PV system easier to opera of dry cell batteries.	\$20 \$125 Cost annuity: Te PV power s anels. ate, replacing	supply: 10 y	

Fact sheet # 6-1 Fact sheet PV application: School Lighting Group: Communal Providing adequate & trouble-free lighting to e.g. a 6-room school building will facilitate the implementation of night-class programs which seem appropriate for the education of the rural population.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date.	Sept. 1990

Relevant conventional energy prices: (urban) / rural Kerosene/l: (\$0.26) \$0.4

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	85 %
Daily energy required:	
4 h (2 fl. tubes/room) x	
6 rooms =	960 Wh
Total:	960 Wh

Possible local service: Average

Competitiveness of PV system: Kerosene pressure lamps/classroom (\$40/pc.): 12 pcs. x 4h x 0.1 l/h x 5a/week x 40 w/y x \$0.40/1 = \$384 Maintenance 12 pcs x \$13/y = \$156/y

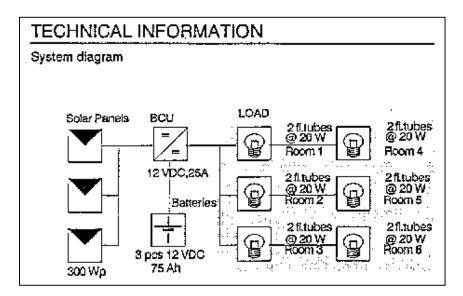
Costs: \$52 / month Cost Annuity: \$ 618

Status of product development: Product ready, components locally available. BCU made to order.

Estimated number of potential customers: 1 night school/50,000 inhabitants: 600 schools

Estimated potential market: 600 schools x 300 Wp = 180 kW

Present locations known: on



System components	Price (*: import)	Anticipated maintenance & repair:
PV panel x 300 Wp	• •	BCU \$90/5y
x \$6.50	\$1950*	Batteries \$150/4y
Batterie Control Unit	\$90	General maintenance
3 pcs. Batteries @ \$50	\$150	\$35/y
2 pcs. frames (G.I.) @ \$35 \$70		
Cables & Switches	\$50	
Transport & Installation	\$100	
(Profit margin excl.)	(\$400)	
(12 pcs. fl. tubes)	(\$216)	
Initial PV system investment	\$2410	
Costs: \$22/month	Cost annuity:	
	\$260 (incl.	
	tubes)	

Cost annuity incl. purchase & maintenance of fl. tubes.

PV provides classroom with troublefree and safe lighting no fire hazard) while improving the classroom atmosphere (no fumes).

Safe disposal of fl.tubes & batteries (recycling) is recommended.

For immediate Introduction through rural education programs by both government and N.G.O.'s

tation of night-class programs which see	em appropriate for the educa	tion of the r	ural population.
COUNTRY: Philippines	Relevant conventional energy	METEOR	OLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average insol	ation: 5 kWh/m2d
Urban/rural distribution: 35/65 %	Kerosene/I : (\$0.26) \$0.40	Seasons:	
% electrification: 35 %		June-Nov.	: wet, 4 kWh/m2d
Currency: Pesos		DecMay :	: dry, 6 kWh/m2d
Exchange tate: US\$ 1 = P 25			
date: Sept. 1990			
SYSTEM INFORMATION	TECHNICAL INFORMAT	ION	
System availability: 85 %	System dlagram		
Daily energy required:			
4 h (2 fl. tubes/room) x	Solar Panels BCU	LOAD	<u>1</u>
6 rooms = 960 Wh		@20	w 21 tubes @ 20 W
		Room	
	12 VDC,25A	@20	
	Batteries	Hoom	2 G Room 5
Total : 960 Wh			2fl.tubes
Possible local service: Average	3 pcs 12 VDC	- Hoom	
Competitiveness of PV system:	300 Wp 75 Ah 🦨	an tan 1917 (Terr	an na 1940 an 1970 ang na 19
2 Kerosene pressure lamps/classroom			
(\$40/pc.) :	0		H
12 pcs. x 4h x 0.1 l/h x 5d/week x 40 w/y x \$0.40/l = \$384	System components	Price	Anticipated maintenance
Maintenance 12 pcs x \$13/y = \$156/y	PV panel x 300 Wp	(* : import)	& repair : BCU \$90/5y
$\text{Mathematice 12 pcs } \mathbf{x} \neq 13/\mathbf{y} = 3156/\mathbf{y}$	x \$6.50	\$1950*	Batteries \$150/4y
Costs: \$52 / month	Batterie Control Unit	\$90	General maintenance
Cost Annuity: \$ 518	3 pcs, Batteries @ \$50	\$150	\$35/y
Status of product development:	2 pcs. frames (G.I.) @ \$35	\$70	, , , , , , , , , , , , , , , , , , ,
Product ready, components locally	Cables & Switches	\$50	
available.	Transport & Installation	\$100	
BCU made to order.	(Profit margin excl.)	(\$400)	
	(12 pcs, fl, tubes)	(\$216)	
Estimated number of potential customers:	/		
1 night school/50,000 inhabitants:			
600 schools			
	Initial PV system Investment	\$2410	
	Costs: \$22/month	Cost annuity:	\$260 (incl. tubes)
Estimated potential market:	REMARKS:		,
500 schools x 300 Wp =	Cost annuity incl. purchase & maintenance of fl. tubes.		
180 kWp	PV provides classroom with troublefree and safe lighting		
-	(no fire hazard) while improving the		
Present locations known:	classroom atmosphere (no fumes).		
none	Safe disposal of fl.tubes & b		cycling) is
	recommended.		
	For Immediate Introduction through rural		
	education programs by both government and N.G.O.'s		

Fact sheet # 6-2

Fact sheet PV application: Battery Charger I

Group: Communal

A 5 channel (@200 Wp) battery charging station could charge enough batteries to supply up to 70 rural households with the most basic electricity needs for lighting & radio.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Diesel: (\$0.21) \$0.25 Gasoline: (\$0.28) \$0.35 1 charge lead-acid battery (0.5kWh) \$0.75 (incl. transport)

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	90 %
Daily energy required:	
5 batteries charged/day	
x 0.5 kWh/battery	= 2.5 kWh
Total:	2.5 kWh

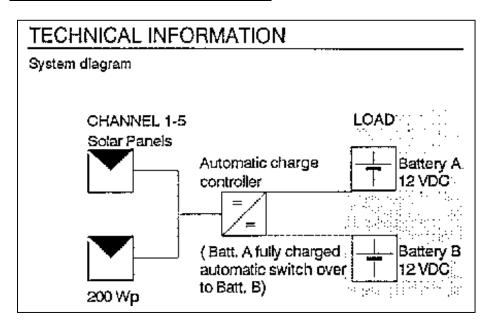
Possible local service: Average

Competitiveness of PV system: PV battery station charged/y: 5 bats/d x O.9(avail) x O.9(station occupancy rate) x 365d/y = approx. 1500 batteries/y (750kWh) Current commercial charging rates vary per area and battery size: Costs: \$0.50-1.50/charge(excl. transp) Cost Annuity: n.a.

Status of product development: Functioning automatic charge controller locally produced, made to order. R&D: improvement charge controllers, durability of batteries.

Estimated number of potential customers: Initial interest: 500 systems for remote small island communities & mountain settlements

Estimated potential market: 500 x 1000 Wp = 500 kW Present locations known: Bulacan, Verde Island, Burias Island



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels: 5 channels	· · ·	BCU \$750/IOy
@ 200 Wp @ \$6.50/Wp	\$6500*	General maintenance
5 pcs autom. Battery		\$100/y.
Control Units @\$150	\$750	Salary operator
Frames & Cables \$0.50/Wp	\$500	\$0.10/battery =
Transport & Installation	\$500	\$150/year
Simple housing	\$500	
(Profit margin excl.)	(\$1750)	
Initial PV system investment	\$8750	
Costs: \$0.6/0.5kWh charge	Cost annuity:	\$895

REMARKS:

The relatively low charging currents of this PV system will result in extended service life of the batteries. Such battery charging stations will be typically suited for small, remote communities (e.g. fishermen, mountain villages). The remoteness makes battery charging elsewhere impractical, expensive (transport up to \$0.5/battery) and unreliable (landslides, rough seas). Batteries used in local PV charging station will live longer (less transport damage). Financing scheme for battery & fl. tube package seems appropriate. For introduction through non-profit electrification plans.

Fact sheet PV application: A 5 channel (@200 Wp) battery chargin	Battery Charger g station could charge enoug		Group: Communal o supply up to
70 rural households with the most basi			
COUNTRY: Philippines	Relevant conventional energy	METEOR	OLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average insol	ation: 5 kWh/m2d
Urban/rural distribution: 35/65 %	Diesel : (\$0.21) \$0.25	Seasons:	
% electrification: 35 %	Gasoline : (\$0,28) \$0,35	June-Nov.	: wet, 4 kWh/m2d
Currency: Pesos	1 charge lead-acid battery	Dec,-May	: dry, 6 kWh/m2d
Exchang rate: US\$ 1 = P 25	(0.5kWh) \$0.75	_	
date: Sept. 1990	(Incl. transport)		
SYSTEM INFORMATION	TECHNICAL INFORMAT	ION	
System availability: 90 %	System diagram		
Daily energy required:			
5 batteries charged/day	CHANNEL 1-5		LOAD
x 0.5 kWh/battery = 2.5 kWh	Solar Panels		
		tic charge	Battery A
		भ /	
		=	
Total : 2.5 kWł	Batt. A	fully charged	Battery B
Possible local service: Average	automa	tic switch over	
Competitiveness of PV system:	200 Wp to Batt.	l)	ie werglanter Staal
PV battery station charged/y:			
5 batt/d x 0.9(avall) x 0.9(station			
occupancy rate) x 365d/y =	System components	Price	Anticipated maintenance
approx. 1500 batteries/y (750kWh)		(* : împort)	å repair ;
Current commercial charging rates	PV panels: 5 channels		BCU \$750/10y
vary per area and battery size:	@ 200 Wp @ \$6.50/Wp	\$6500*	General maintenance
Costs: \$0.50-1.50/charge(excl. transp)	5 pcs autom. Battery		\$100/y.
Cost Annuity: n.a.	Control Units @\$150	\$750	Salary operator
Status of product development:	Frames & Cables \$0.50/Wp	\$500	\$0.10/battery =
Functioning automatic charge controlle	r Transport & Installation	\$500	\$150/year
locally produced, made to order.	Simple housing	\$500	
R&D: Improvement charge controllers,	(Profit margin excl.)	(\$1750)	
durability of batteries.			
Estimated number of potential customers:			
Initial interest: 500 systems for			
remote small island communities &	Initial PV system investment	\$8750	
mountaln settlements.	Costs: \$0.6/0.5kWh charge	Cost annuity;	\$895
Estimated potential market:	REMARKS:		
$500 \times 1000 \text{ Wp} = 500 \text{ kWp}$	The relatively low charging	currents of	this PV system will
	result in extended service li	fe of the ba	teries. Such battery
	charging stations will be typ	oically suite	d for small, remote
Present locations known:	communities (e.g. fishermen, mountain villages). The		
	remoteness makes battery of	remoteness makes battery charging elsewhere impractical,	
Bulacan, Verde Island,	expensive (transport up to \$	0.5/battery)	and unreliable
urias Island (landslides, rough seas). Batteries used in local PV charg		itteries used	f in local PV charging
	1	trananart d	amene) Financing
	station will live longer (less	uansport d	anage, rnanoug
	station will live longer (less scheme for battery & fl. tube	-	- · ·

Fact sheet # 6-3

Fact sheet PV application: Streetlight Group: Communal PV stand-alone lighting system for street, square or compound illumination.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural n.a.

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

SYSTEM INFORMATION

System availability:	85 %
Daily energy required:	
fl. tube 4h	= 80 Wh
Total:	

Possible local service: Average

Competitiveness of PV system: No direct competitio

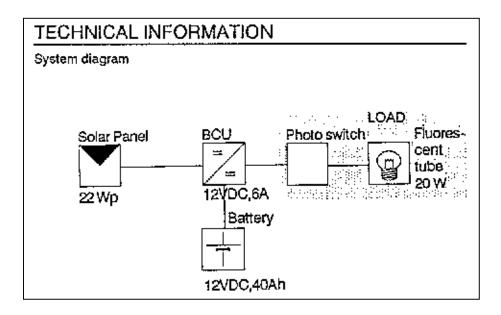
Cost Annuity

Status of product development: All components locally available. R&D: cheap ballasts (miniverters) for energy saving bulbs (7W, 9W & 13W)

Estimated number of potential customers: 1 streetlight/5000 inhabitants in unelectrified areas: 7500 unit

Estimated potential market: 7500 x 22 Wp = 165 kWp

Present locations known: Quezon City, Bulacan, Cebu island, Naga City



System components	Price (*: import)	Anticipated maintenance & repair:
V panel 22 Wp	· · · /	BCU \$30/5y
x \$7.50	\$165*	Battery \$35/4y
Battery Control Unit	\$30	General maintenance
Battery	\$35	\$5/y
Photoswitch	\$5	
Frame (G.I.)	\$35	
Cables	\$5	
(fl. tube + holder)	(\$18)	
Transport & Installation	\$20	
(Profit margin excl.)	(\$50)	
Initial PV system investment	\$326	
Costs: \$3.40/month	Cost annuity:	\$40

Using a 50 Wp (\$375) panel will result in double the hours of operation/night or enable the use of bigger capacity lamps. In order to maximize the output & minimize power consumption, the development of "miniverters" (ballast) for energy saving bulbs is recommended. Such lights would also seem suitable for guardhouses etc.

PV stand-alone lighting system for stree	t, square or compound illum	nation.	
COUNTRY: Philippines	Relevant conventional energy	METEOR	DLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average insolation: 5 kWh/m2d	
Urban/rural distribution: 35/65 %		Seasons:	
% electrification: 35 %	n.a.	June-Nov.	: wet, 4 kWh/m2d
Currency: Pesos		DecMay :	: dry, 6 kWh/m2d
Exchange rate: US\$ 1 = P 25			
date: Sept. 1990			
SYSTEM INFORMATION	TECHNICAL INFORMAT	ION	
System availability: 85 %	System diagram		
Dally energy required:			
fl. tube 4h = 80 Wh		···	LOAD, sage the
	Solar Panel BCU	Photo s	switch Fluores-
	Ĭ ▼ [≖] ∕_		
	22Wp 12VD	 C.6A	_ €? _20₩
		attery	
Total :]	
Possible local service: Average			
Competitiveness of PV system:	12\/D	C,40Ah	
No direct competition	1		
	0	Price	Anticipated maintenance
	System components	(* ; import)	& repair :
	PV panel 22 Wp	(, importy	BCU \$30/5y
	x \$7.50	\$165*	Battery \$35/4y
	Battery Control Unit	\$30	General maintenance
Cost Annuity:	Battery	\$35	\$5/y
Status of product development:	Photoswitch	\$5	· · · · · ·
All components locally available.	Frame (G.I.)	\$35	
	Cables	\$5	
R&D: cheap ballasts (miniverters)	(fl. tube + holder)	(\$18)	
for energy saving bulbs (7W, 9W & 13W		S20	
Estimated number of potential customers:	(Profit margin exci.)	(\$50)	
1 streetlight/5000 inhabitants			
in unelectrified areas:			
7500 units	Initial PV system investment	\$326	1
	Costs: \$3.40/month	Cost annuity:	\$40
Estimated potential market;	REMARKS:		
7500 x 22 Wp = 165 kWp	Using a 50 Wp (\$375) pane	l will result i	n double the
	hours of operation/night or	enable the	use of bigger
	capacity lamps. In order to	maximize th	e output &
Present locations known:	minimize power consumption, the development of		
	"miniverters" (ballast) for energy saving bulbs		
Quezon City, Bulacan, Cebu Island,	is recommended. Such lights would also seem suitable for		
	guardhouses etc.		
Naga City.			
Naga City.			

Fact sheet # 6-4

Fact sheet PV appilcation: Drinking Water Supply Group: Communal A PV powered (336 Wp) jackpump may pump 2000 I/day over a 16 m head. This is sufficient water for approx. 30 families (10 I/person)

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Diesel/I: (\$0.21) \$0.25 Gasoline/I: (\$0.28) \$0.3

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2

SYSTEM INFORMATION

System availability: 90 % Dally energy required: Variable, depending on required water volume. Total: max 1150 Wh/d

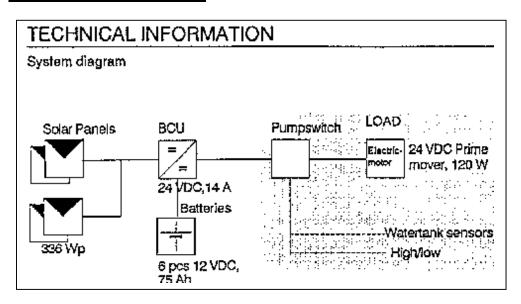
Possible local service: Averag

Competitiveness of PV system:		
Gasoline powered jac	ckpump:	
Pump, housing, tank	& well \$2000	
1 Hp prime mover \$5	00/5y	
Fuel: 4 h/d x 0.9 (avail) x 365 d/y x \$0.35/1 = \$460/y. Oil \$30/y		
Gen. Maintenance \$50/		
Costs: \$1.17 /cu.m.		
Cost Annuity: \$775		

Status of product development: Jackpump technology present. 24 VDC, 120 W electric motor not locally available, pump switch & BCU made to order. R&D: system optimization

Estimated number of potential customers: Barangay - drinking water programs initial estimated interest: 100 system Estimated potential market: 100 x 336 Wp = 34 kW

Present locations known: Bulaca



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 336 Wp	\$2185	BCU \$90/5y
x \$6.50		Batteries \$210/4y
Battery Control Unit	\$90	General maintenance
3 pcs. Frame (G.I.) @\$35	\$105	\$25/y
6 pcs. Batteries @? \$35	\$210	(General mains.
Cables & autom. switches	\$100	pump etc.: \$90/y)
Transport & installation	\$150	
(Well/pump/housing/tank)	(\$2000)	
(Profit margin excluded)	(\$500)	
Initial PV system investment	\$2840	
Costs: \$0.77/cu.m.	Cost annuit \$505 (incl. pump etc.)	

REMARKS:

Watertank (2000 I) for additional reliability. Jackpump type of waterpumps typically suit relatively small volumes and high heads (>15m). In terms of capacity .

Gasoline & diesel powered pumps above the well may pose a hazard to the drinking water quality.

PV pumps could possibly fill the niche between handpumps and the much bigger diesel-powered pumps.

Safe disposal of batteries (recycling) is recommended.

for approx. 30 families (10 l/person) COUNTRY: Philippines	Relevant conventional energy	METEOF	OLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average inso	
Urban/rural distribution: 35/65 %	F	Seasons:	
% electrification: 35 %	Diesel/I : (\$0.21) \$0.25	June-Nov.	: wet, 4 kWh/m2d
Currency: Pesos	Gasoline/I: (\$0.28) \$0.35	T I	: dry, 6 kWh/m2d
Exchange rate: US\$ 1 = P 25			
date: Sept. 1990			
SYSTEM INFORMATION	TECHNICAL INFORMATION	ON	
System availability: 90 %	System diagram		·
Daily energy required:			
Variable, depending on required			LOAD
water volume.	Solar Panels BCU	Pumpswite	h LOAD Elecule: 24 VDC Prime
			motor mover, 120 W
	24 YDC,14 A		
	Batteries		
Total : max 1150 Wh/d	336 Wp		Watertank sensors
Possible local service: Average	6 pcs 12 VDC,		High/low
Competitiveness of PV system:	75 Ah		
Gasoline powered jackpump:			
Pump, housing, tank & well \$2000			
1 Hp prime mover \$500/5y	System components	Price	Anticipated maintenance
Fuel: 4 h/d x 0.9 (avail) x 365 d/y		(* : import)	& repair :
x \$0.35/i = \$460/y. Oil \$30/y	PV panels 336 Wp	\$2185	BCU \$90/5y
Gen. Maintenance \$50/y	x \$6.50		Batteries \$210/4y
Costs: \$1.17 /cu.m.	Battery Control Unit	\$90	General maintenance
Cost Annuity: \$775	3 pcs. Frame (G.I.) @\$35	\$105	\$25/y
Status of product development:	6 pcs. Batteries @ \$35	\$210	(General maint.
Jackpump technology present.	Cables & autom. switches	\$100	pump etc.: \$90/y)
24 VDC, 120 W electric motor not locally		\$150	
available, pump switch & BCU made	(Well/pump/housing/tank)	(\$2000)	
to order. R&D: system optimization.	(Profit margin excluded)	(\$500)	
Estimated number of potential customers:			
Barangay - drinking water programs			
Initial estimated interest:		00040	
100 systems	Initial PV system investment	\$2840	
	Costs: \$0.77/cu.m. REMARKS:	Cost annuit	\$505 (incl. pump etc.
Estimated potential market:	Watertank (2000 I) for addition	nal rallahi	ity lacknuma
100 x 336 Wp = 34 kWp	type of waterpumps typically		
	volumes and high heads (>1		•
Present lagations known	Gasoline & diesel powered p	•	
Present locations known: Bulacan	a hazard to the drinking wate	-	e me wen may pose
Duiavall	PV pumps could possibly fill	• •	hetween
	handpumps and the much bl	loger diese	-bowered numps

Fact sheet PV application: PV Pump System Group: Communal Example of a high-head (50 m dynamic) PV pumping system with a capacity of approx. 36 cu.m/day, as will be introduced through a PV pumping dissemination program.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribute	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$1 =DM1.60=P25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Diesel/I: (\$0.21) \$0.25 Gasoline/I: (\$0.28) \$0.3

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2

SYSTEM INFORMATION

System availability:	80 %
Power required:	
for 36 cu.m/d (10,500 cu.m/y):	
P hydr. =	300 m4/h
P el. = 0.82 kW	
P gent =	2300 Wp
Pp=	3500 Wp

Possible local service: Average

Competitiveness of	PV system:		
5 kVA diesel genset	: \$5000/7y; el. pump + conn:\$1875/10y;		
	controls \$1000/7y; piping \$2500/10y; genset housing \$2000/20y;		
Install+tank\$1000; Fuel+Oil \$950/y; Gen. Maint. \$600/y;			
Personnel \$350/			
Costs: \$3800			
Cost Annuity:	uity: \$0.36/cu.m		

Status of product development:

Initial systems completely imported.

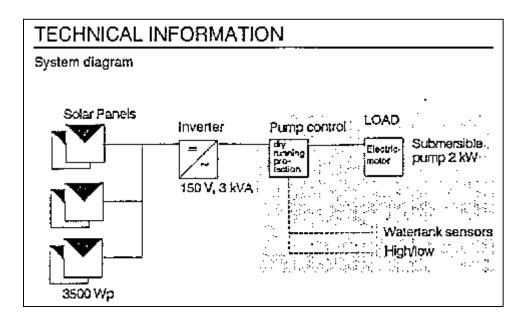
At later stage possibility of integration of locally available components (pumps etc.)

Estimated number of potential customers: After successful field test 2,5 M people i coastal areas (low head) require 750,000 m4/d. 2 M people in mountain regions (high head) require 4,000,000 m4/d

Estimated potential market: Not clear: only after successful field test estimate: 9,000 kW

Present locations known:

Field test: Approx. 15 Installations to be realized in 1991 around Cebu. (GTZ



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels	\$37500*	Inverter/Controls/
Inverter/Controls/Frames	\$6250*	/Frames \$6250/10y
Pump unit & connections	\$1875*	Pump unit + connect
Piping	\$2500	tions \$1875/10y
Lightning protection etc.	\$3750	Piping \$2500/10y
Transport GerPhils.	\$1900	General maintenance
Installation incl.		incl. Personnel
foundations etc (estimate) \$500	\$750/y	
(Profit margin excl.)	(\$10000)	
(welldrilling & water		
tank excluded)		
Initial PV system investment	\$54275	
Costs: \$0.48/cu.m	Cost annuity:	\$5050

REMARKS:

System designed for an insolation level of 6 kWh/m2d.

In case inverter & pump only last for 5 years, water cost: \$0.56/cu.m. Water vendors sell water per 20 I can for \$1.00 up to \$5.00 per cu.m.

Such water deliveries can be quite irregular.

PV pumping systems will be more hygienic compared to water deliveries. PV pump systems will be of special interest to a) coastal communities with fresh water only available in the interior, or b) mountain communities with required pumping heads of approx. 50 m.

	DV/ Duman Overtex		
Fact sheet PV application:	PV Pump Syster		Group: Communal
Example of a high-head (50 m dynamic)		врасиу от ар	pprox. 36 cu.m/day,
as will be introduced through a PV pump COUNTRY: Philippines	Relevant conventional energy	METEOR(DLOGICAL INFO
Population: 60M	prices; (urban) / rural	Average insola	ation: 5 kWh/m2d
Urban/rural distributi 35/65 %	Diesel/i : (\$0.21) \$0.25	Seasons:	
% electrification: 35 %	Gasoline/I : (\$0.28) \$0.35		: wet, 4 kWh/m2d
Currency: Pesos		DecMay :	∶ dry, 6 kWh/m2d
Exchange rate: US\$1=DM1.60=P25			
date: Sept. 1990 SYSTEM INFORMATION	I TECHNICAL INFORMAT	1 <u>0N</u>	
System availability: 80 %	System diagram		······································
Power required:	oyatem diagram		
for 36 cu.m/d (10,500 cu.m/y):	Solar Panels		
P hydr. = 300 m4/h	Invener	Pump contro	
P el. = 0.82 kW		Cry Nunning	Electric Submersible
P gen. = 0.32 kW		Pro- Hection	
P gen. = 2300 Wp P p = 3500 Wp			
F p = 5500 mp			Watenank sensors
Possible local service Average	┤┱┻┝──		High/low
Competitiveness of PV system:		n - English ann an Anna	and the second large of the sould
5 kVA diesel genset \$5000/7y; el. pump	3500 Wp		
+ conn:\$1875/10y; controls \$1000/7y; piping \$2500/10y; genset housing		Price	Anticipated maintenance
	System components		· ·
\$2000/20y; Install+tank \$1000; Fuel+Oil		(* : import) \$37500*	& repair : Inventor/Controlo/
\$950/y; Gen. Maint. \$600/y;	PV panels		Inverter/Controls/
Personnel \$350/y	Inverter/Controls/Frames	\$6250*	/Frames \$6250/10y
Costs: \$3800	Pump unit & connections	\$1875*	Pump unit + connec-
Cost Annuity: \$0.36/cu.m	Plping	\$2500 \$3750	tions \$1875/10y
Status of product development:	Lightning protection etc.		Piping \$2500/10y General maintenance
Initial systems completely imported.	Transport GerPhils.	\$1900	
At later stage possibility of	Installation incl.	6500	incl. personnel
integration of locally available compo-	foundations etc (estimate)	\$500 (@topoo)	\$750/y
nents (pumps etc.).	(Profit margin excl.)	(\$10000)	
Estimated number of potential customers:	(welldrilling & water		
After successful field test 2,5 M people i			:
coastal areas (low head) require 750,000		Ar 4075	
m4/d. 2 M people in mountain regions	Initial PV system investment	\$54275	0 65050
(high head) require 4,000,000 m4/d.	Costs: \$0.48/cu.m	Cost annuity:	\$5050
Estimated potential market:	REMARKS:		ALC LAND IN COL
Not clear: only after successful	System designed for an ins		
field test estimate : 9,000 kWp	In case inverter & pump on		
	water cost : \$0.56/cu.m. Wa		sen water per
Present locations known:	20 I can for \$1.00 up to \$5.0	-	
Field test :	Such water deliveries can b	•	
Approx. 15 Installations to be	PV pumping systems will be		•
realized in 1991 around Cebu.	water deliveries. PV pump s	•	•
(GTZ)	interest to a) coastal communities with fresh water		
only available in the interior, or b) mountain communities			
Pactahéet # 6-6	with required pumping head	ds of approx	. 50 m.

Fact sheet # 6-6 Fact sheet PV application: Dental Clinic Group: Communal A simple PV powered supply for the most essential power requirements of a dental chair (lighting, drilling. suction/spraying)

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.3

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2

SYSTEM INFORMATION

System availabilty:	95 %
Daily energy required:	
Lighting chair 6h:	300 Wh
Motor drill 2h:	170 Wh
Motor suction/	
spraying 2h:	100 Wh
Lighting room 2h:	40 Wh
Total:	610 Wh

Possible local service: Poor

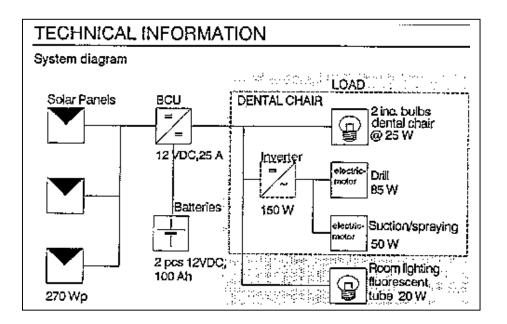
Competitiveness of PV system: 1000W gasoline genset (\$700/5y), gasoline: 6h/day x 6d/w			
40w/y x 11/h x \$0.35/1 = \$504/y			
Oil 21/mxl2m/yx\$1.50/l = \$36/y			
Gen. Maintenance: \$50/y			
Costs: \$65/month			
Cost Annuity: \$780/year			

Status of product development: PV power supply ready. BCU made to order, 12 VDC motors not available. R&D: for testing (pilot project)

Estimated number of potential customers: 50 dental chairs In combination with rural clinic

Estimated potential market: 50 x 270 Wp = 14 kW

Present locations known: Non



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 270 Wp		BCU \$90/5y
x \$6.50	\$1755*	Batteries \$100/4y
Battery Control Unit	\$90	General maintenance
2 pcs. batteries @\$50	\$100	\$40/y
2 pcs. frames (G.I.) @\$35	\$70	
Cables & Switches	\$40	
Transport & Installation	\$125	
(Profit margin excl.)	(\$350)	
(fl tube + holder)	(\$18)	
(dental chair estimate)	(\$1500)	
Initial PV system investment	\$2180	
Costs: \$18.75/month	Cost annuity: \$225	

REMARKS:

If AC equipment is considered an inverter (12 VDC - 220 VAC, 150W, \$200) will be necessary. A modern standard dental chair requires approx. 4 to 6 kWh/day. For a PV powered dental chair the power consumption should be reduced to the most elementary power needs.

PV powered dental chairs will be less mobile and less noisy as dental chairs powered by small gee-sets.

	upply for the mos	Dental Clinic t essential power requireme	nts of a den	Group: Communal tal chair (lighting,
drilling, suction/sprayi COUNTRY:	ng) Philippines	Relevant conventional energy	METEOR	OLOGICAL INFO
Population:	60M			
Urban/rural distribution:	35/65 %	prices: (urban) / rural Genealizes (L.) (\$0.08), \$0.25	Average inso	lation: 5 kWh/m2d
	-	Gasoline/I : (\$0.28) \$0.35	Seasons:	
% electrification:	35 %			: wet, 4 kWh/m2d
Curtency:	Pesos		DecMay	: dry, 6 kWh/m2d
Exchange rate:	US\$ 1 = P 25			
date: SYSTEM INFORMA	Sept. 1990 TION	TECHNICAL INFORMAT	1 10N	
System availability:	95 %	System diagram		·· ·
Daily energy required:			a reesees.	LOAD
Lighting chair 6h :	300 Wh	Solar Panels BCU	DENTAL CHAI	R
Motor drill 2h :	170 Wh			2 inc. bulbs dental chair @ 25 W
Motor suction/		12 VDC,25 A	Inunder	ġ @25₩
spraying 2h :	100 Wh		Inverter	atactric- Drill
Lighting room 2h :	40 Wh		$\Box \sim \Box$	85 W
Total :	610 Wh	Batteries :	150 W	
Possible local service:	Poor			electric Suction/spraying
Competitiveness of PV syste		2 pcs 12VDC		Room lighting
1000W gasoline gense		100 Ah 270 Wp		fluorescent tube 20 W
gasoline: 6h/day x 6d/\	• • • • •	2/0 mp		
40w/y x 1l/h x \$0.35/l	= \$504/y	System components	Price	Anticipated maintenance
0il 21/mx12m/yx\$1.50/l	•	eyetem vemponoma	(* : import)	& repair :
Gen. Maintenance:	\$50/y	PV panels 270 Wp	(BCU \$90/5y
·	+, ,	x \$6.50	\$1755*	Batteries \$100/4y
Costs:	\$65/month	Battery Control Unit	\$90	General maintenanc
Cost Annuity:	\$780/year	2 pcs. batteries @\$50	\$100	\$40/y
Status of product developme		2 pcs. frames (G.I.) @\$35	\$70	\$40/Y
PV power supply ready		Cables & Switches	\$40	
BCU made to order, 12		Transport & Installation	\$125	
not available.	100 1101013	(Profit margin excl.)	(\$350)	
R&D : for testing (pliot	nrolost)	(fl tube + holder)		
Estimated number of potentia		. ,	(\$18) (\$1500)	
50 dental chairs in com		(dental chair estimate)	(\$1000)	
with rural clinics	Dination			
			\$2180	
		initial PV system investment Costs: \$18.75/month	,	0007
Estimated potential market:		Costs: \$18.75/month REMARKS:	Cost annuity:	\$225
stimated potential market: 50 x 270 Wp = 14 kWp				
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		If AC equipment is consider		
		(12 VDC - 220 VAC, 150W, \$	,	
		necessary. A modern stand		
Present locations known:		requires approx. 4 to 6 kWh	•	
lono		powered dental chair the po		-
None		be reduced to the most elen		
		PV powered dental chairs w		-
		as dental chairs powered by	/ small gen-	sets.

Fact sheet PV application: Solar Home System I Group: Residential A 50 Wp PV powered supply, satisfies the most basic electricity needs of a rural household (lights. radio & TV or electric fan)

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	1 US\$ = P25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Kerosene/I (\$0.26) \$0.40 Dry Cell Batteries: Size AA \$0.20 Size C \$0.25 Size D \$0.3

METEOROLOGICAL INFO
Average insolation: 5 kWh/m2d
Seasons:
June-Nov.: wet, 4 kWh/m2d
DecMay: dry, 6 kWh/m2d

### SYSTEM INFORMATION

System availability:	85 %
Daily energy required:	
4 h (fl. tube) =	80 Wh
1 h (incandescent) =	15 Wh
4 h (TV) =	60 Wh
4 h (radio) =	20 Wh
Total:	175 Wh

Possible local service:

Positive

Competitiveness of PV system:			
Kerosene pressure lamp (\$45/7y)			
0.5 I kerosene/night, maintenance			
& repair \$13/y,			
+ 8 batteries size D/mont			
Costs:	\$10		
Cost Annuity:	\$115		

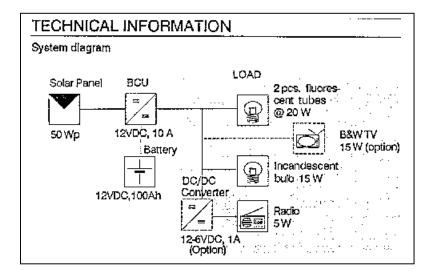
Status of product development: All PV system components locally available. R&D: increase reliability & durability BCU, battery, el. ballas

Estimated number of potential customers: 6.5 M households unelectrified

20 % have earnings between \$800-\$2000/y 10 % initially interested: 130.000 household

Estimated potential market: 130,000 households x 100 Wp = 6,500 kW

Present locations known: Rural electrification projects in Bulacan, Verde Island, Burias Island Cebu Island (Logon



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 50 Wp x		BCU \$30/5y
\$7.50/Wp	\$375*	Batteries \$50/4y
Battery Control Unit	\$30	General maintenance
1 frame (G.I.)	\$35	\$10/y
1 battery	\$50	
Cables & switches	\$15	
Transport & installation \$40		
(Profit margin excluded) (\$100)		
(2 pcs. fl. tubes @\$18) (\$36)		
Initial PV system investment \$545		
Costs: \$6/month	Cost annuity: \$70 (incl. tubes)	

### **REMARKS**:

Compared with the use of kerosene for lighting PV offers a safer alternative (no fire hazard) while improving the indoor atmosphere and replacing environmentally unsafe disposable batteries. Safe disposal of old fl. tubes & batteries (recycling) is recommended. 12 VDC home appliances (e.g. radio & TV) locally available.

Introduction through rural development projects, electrification projects or consumer cooperatives using financing schemes or through hardware stores on cash-on-delivery basis.

A 50 Wp PV powered supply, satisfies	Solar Home Sy the most basic electricity n			
(lights, radio & TV or electric fan)	·			
COUNTRY: Philippine	Relevant conventional energy	METEORO	LOGICAL INFO	
Population; 60N	prices: (urban) / rural	Average insola	tion: 5 kWh/m2d	
Urban/rural distribution; 35/65 ?	Kerosene/I (\$0.26) \$0.40	Seasons:		
% electrification; 35 %		June-Nov. :	wet, 4 kWh/m2d	
Gurrency: Peso	Size AA \$0.20		dry, 6 kWh/m2d	
Exchange rate: 1 US\$ = P2	5 Size C \$0.25			
date: Sept. 1990	Size D \$0.30			
SYSTEM INFORMATION	TECHNICAL INFORM	ATION		
System availability: 85 %	System diagram		- · · · · · · · · · · · · · · · · · · ·	
Daily energy required;		LOAD		
4 h (fl. tube) = 80 Wt	Solar Panel BCU	LUAD	2 pcs. fluores-	
1 h (incandescent) = 15 Wi			cent tubes @ 20 W	
4 h (TV) = 60 Wi	50 Wp 12VDC, 10 A			
4 h (radio) = 20 Wi			B&W TV 15 W (option)	
			Incandescent	
Total : 175 Wi		onverter	bulb 15W	
Possible local service: Positive		- / / /	Radio	
Competitiveness of PV system:		/=	5W	
Kerosene pressure lamp (\$45/7y)	1	2-6VDC, 1A (Option)	n ha ban ha shi na shi ku Bartin dashi na shi shi ya	
0.5 I kerosene/night, maintenance		• • •		
& repair \$13/y,	System components	Price	Anticipated maintenance	
+ 8 batteries size D/month		(* : import)	& repair :	
	PV panels 50 Wp x		BCU \$30/5y	
	\$7.50/Wp	\$375*	Batteries \$50/4y	
Costs; <b>\$10</b>	Battery Control Unit	\$30	General maintenance	
Cost Annuity: \$115	1 frame (G.I.)	\$35	\$10/y	
Status of product development:	1 battery	\$50		
All PV system components locally	Cables & switches	\$15		
available.	Transport & Installation	\$40		
R&D: increase reliability &	(Profit margin excluded)	(\$100)		
durability BCU, battery, el. ballast	(2 pcs. fl. tubes @\$18)	(\$36)		
Estimated number of potential customers:		(+++)		
6.5 M households unelectrified				
20 % have earnings between				
\$800-\$2000/y 10 % initially interested:	Initial PV system investment	\$545		
130.000 households	Costs: \$6/month	Cost annuity:	\$70 (incl. tubes)	
Estimated potential market:	REMARKS:			
I30,000 households x 100 Wp =		kerosene fo	r lighting PV offere a	
3,500 kWp	Compared with the use of kerosene for lighting PV offers a safer alternative (no fire bazard) while improving the			
- , <b></b>	safer alternative (no fire hazard) while improving the			
Present locations known:	Indoor atmosphere and replacing environmentally unsafe			
Rural electrification projects in	disposable batterles. Safe disposal of old fl. tubes & batterles (recycling) is recommended.			
Bulacan, Verde Island, Burlas Island	12 VDC home appliances		TVA locally available	
Cebu Island (Logon)				
(449411)	Introduction through rural development projects,			
	electrification projects or consumer cooperatives			
		using financing schemes or through hardware stores		
actsheet # 7-1	on cash-on-delivery basis	_	alamaic 0(0160	

Fact sheet PV application: Solar Home System II Group Residential Compared with a 50 Wp basic Solar Home System, this system offers more power and a somewhat higher system availability. For marketing to rural upper-middle class households.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	US\$ 1 = P 25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I: (\$0.28) \$0.35 Kerosene/I: (\$0.26) \$0.40 Dry Cell Batteries: Size AA \$0.20 Size C \$0.25 Size D \$0.3

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2d

# SYSTEM INFORMATION

System availability:	90 %
Daily energy required:	
2 fl. tubes 5h =	200 Wh
2 inc. bulbs	
(indoor/outdoor)	130 Wh
Radio 8h =	80 Wh
TV 5h =	100 Wh
Total:	510 Wh

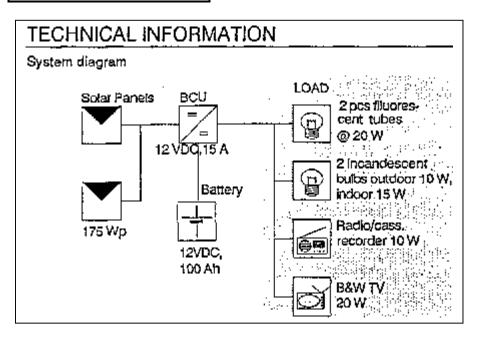
Possible local service: Positive

Competitiveness of PV system:		
Gasoline gee-set 600W, 3h/d + battery		
storage: Fuel: 365 d/y x O.9(avail) x 3h/		
x 1 l/h x \$0.35/1 = \$345/y		
011:\$2.50/m x 12m/y = \$30/Y		
Gen. Maintenance = \$50/y		
Battery \$50/3y	= \$50/3y	
Costs:	\$48/month	
Cost Annuity: \$570/year		

Status of product development: Products ready, BCU made to order. R&D: 12 VDC appliance Estimated number of potential customers: 3% of 6,500,000 rural households earn \$2000-\$4000/year. 10% seriously Interested: 20,000 unit

Estimated potential market: 20,000 x 175Wp = 3500kW

Present locations known: Bulacan, Burias Islan



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 175 Wp		BCU \$60/5y
x \$6.50	\$1140*	Batteries \$50/4y
Battery Control Unit	\$75	General maintenance
Battery	\$50	\$20/y
Frame (G.I.)	\$35	
Cables & Switches	\$35	
Transport & Installation	\$50	
(Profit margin excl.)	(\$275)	
(2 pcs. fl tubes @\$18)	(\$36)	
Initial PV system investment	\$1385	
Costs: \$12/month	Cost	
	annuity:	
	\$143	

# **REMARKS**:

Immediate interest present. For introduction through rural electrification programs. When profit margin included: Cost annuity \$155 or \$13/month.

Safe disposal of old fl. tubes & batteries (recycling) is recommended. Compared to the use of a gasoline gee-set the PV system is less noisy and easier to operate.

COUNTRY: Philippines	to rural upper-middle class Relevant conventional energy		DLOGICAL INFO
Population: 60M	prices: (urban) / rural	Average insolu	
	Gasoline/I : (\$0.28) \$0.35	Seasons:	
6 electrification: 35 %			: wet, 4 kWh/m2d
	Dry Cell Batteries:	L	: dry, 6 kWh/m2d
•	Size AA \$0.20	beomay	, ury, o kinginzu
	Size C \$0.25 Size D \$0.35		
SYSTEM INFORMATION	TECHNICAL INFORMAT		
Aystem availability; 90 %	System dlagram		
Daily energy required:	oyotem oldgram	LOAD	
2 fl. tubes 5h = 200 Wh	Solar Panels BCU		2 pcs fluores-
2 inc. bulbs	│		cent tubes @ 20 W
(Indoor/outdoor) 130 Wh	12 VDQ.15 A		2 Incandescent
Radio 8h == 80 Wh	Battery		DUIDS OLLOOOF 10 W.
√V 5h = 100 Wh			indoor 15 W
otal : 510 Wh	175 Wp		Radio/cass. recorder 10 W
Possible local service: Positive	12VDC, 100 Ah		
Competitiveness of PV system:	100 All		B&W TV
Gasoline gen-set 600W, 3h/d + battery			20 W
torage: Fuel: 365 d/y x 0.9(avail) x 3h/d			
(1 l/h x \$0.35/l = \$345/y	System components	Price	Anticipated maintenance
Dil: \$2.50/m x 12m/y = \$30/y		(* : import)	& repair :
Sen. Maintenance = \$50/y	PV panels 175 Wp	, <u></u> ,	BCU \$60/5y
Battery \$50/3y = \$50/3y	x \$6.50	\$1140*	Batteries \$50/4y
Costs: \$48/month	Battery Control Unit	\$75	General maintenance
Cost Annuity: \$570/year	Battery	\$50	\$20/y
Status of product development:	Frame (G.I.)	\$35	
Products ready,	Cables & Switches	\$35	1
BCU made to order.	Transport & Installation	\$50	
	(Profit margin excl.)	(\$275)	
R&D: 12 VDC appliances	(2 pcs. fl tubes @\$18)	(\$36)	
Estimated number of potential customers:			1
% of 6,500,000 rural households			
earn \$2000-\$4000/year.			
0% seriously interested: 20,000 units	Initial PV system investment	\$1385	l
	Costs: \$12/month	Cost annuity:	\$143
stimated potential market:	RÉMARKS:		
20,000 x 175Wp = 3500kWp	Immediate interest present. For introduction through		
	rural electrification program	-	-
	included: Cost annuity \$155 or \$13/month.		
Present locations known:	Safe disposal of old fl. tubes & batterles (recycling) is		
	recommended. Compared to the use of a gasoline gen-set		
Bulacan, Burias Island	the PV system is less noisy and easier to operate.		

Fact sheet PV application: Solar Home System III Group: Residential A 1100 Wp PV generator will supply sufficient power to an upper class rural household.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	1 US\$ = P25
date:	sept. 1990

Relevant conventional energy prices: (urban) / rural Gasoline/I (\$0.28) \$0.3

METEOROLOGICAL INFO Average insolation: 5 kWh/m2d Seasons: June-Nov.: wet, 4 kWh/m2d Dec.-May: dry, 6 kWh/m2

### SYSTEM INFORMATION

System availability:	90 %
Daily energy required:	Radio 8h 80 W
3 pcs fl. tubes 5h	300 Wh
Color TV & video 5h	350 Wh
Electric fan 2h	100 Wh
Small refrigerator	2000 Wh
3 pcs inc. bulbs	150 Wh
Total:	3000 Wh

Possible local service: Average

 Competitiveness of PV system:

 Gasoline gee-set 1000W (\$700/5y) + 6 storage batteries (\$300/3y) for boost charging.

 Fuel: 365d/y x 0.9(avail) x 4h/d x 1 l/h x \$0.35/1 = \$460/y

 Oil: \$2.50/month x 12 m/y = \$30

 General maintenance \$50/y

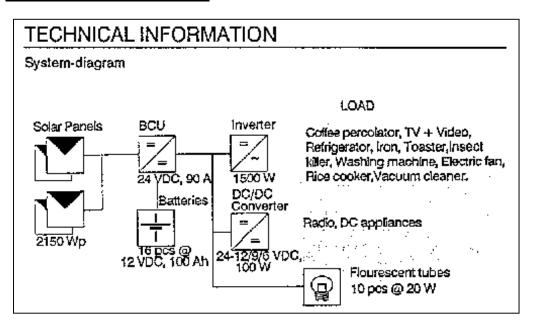
 Cost:
 \$68

 Cost Annuity:
 \$820

Status of product development: BCU & DC-DC converter made to order R&D: 24 VDC fl. tubes, convert video to 24 VDC

Estimated number of potential customers: Not clea Estimated potential market: Not clea

Present locations known: Non



System components	Price (*: import)	Anticipated maintenance & repair:
PV panels 1100 Wp x		BCU \$120/IOy
\$6.50/Wp	\$7150*	Batteries \$600/4y
Battery Control Unit	\$120	General maintenance
12 pcs batteries @\$50	\$600	\$50/y
(inverter)	(\$250)	
8 pcs frames (G.I.) @\$35	\$280	
Cables & switches	\$100	
Transport & Installation	\$350	
Profit margin	\$1700	
Initial PV system investment \$10300		
Costs: \$74/month	Cost annuity:\$890	

**REMARKS**:

An 1100 Wp Solar Home System offers no economical advantage over a gasoline powered gee-set In combination with storage batteries. Possibly other than purely economic motives (e.g. noise/air pollution) might be considered. Recommended for Pilot marketing.

COUNTRY:	Philippines	Relevant conventional energy	METEORO	LOGICAL INFO
Population:	60M	prices: (urban) / rural	Average insolation: 5 kWh/m2,d	
Jrban/rural distribution:	35/65 %	Diesel/I (\$0.21) \$0.25	Seasons:	
% electrification:	35 %		June-Nov. : wet, 4 kWh/m2,d	
Currency:	Pesos		DecMay :	dry, 6 kWh/m2,d
Exchange rate:	1US\$ = P25			•••
date:	Sept, 1990		-	
SYSTEM INFORMATIO		TECHNICAL INFORM	ATION	
System availability:	90 %	System-diagram	· · · · · · · · · · · · · · · · · · ·	
Daily energy required:				
AC home appliances + D	C lighting		1	LOAD
estimated at	6 kWh	Solar Paneis BCU		ee percolator, TV + Video, igerator, Iron, Toaster, Insect
			- kille	r, Washing machine, Electric fan,
		24 VDC, 90 A Batteries	DC/DC	a cooker,Vacuum cleaner,
			Converter	io, DC appliances
Fotal :	6 kWh	2150 Wp	<b> ∕∍</b>   ⇒:	
Possible local service:	Poor	12 VDC, 100 Ah	24-12/9/6 VDC, ⁱ 100 W	Flourescent tubes
Competitiveness of PV system:			(p	10 pcs @ 20 W
4.5 kVA Diesel gen-set (S	i4000/7y)			
Fuel: 8h/d x 365d/y x 0.7	5 l/h x			
\$0.25/I = \$550/y. Oil: 3I/n	nx	System components	Price	Anticipated maintenance
\$1.50/I x 12 m/y = \$55. G	ieneral		(* : Import)	& repair :
Maintenance \$100/y. Sto	rage batteries	PV panels 2150 Wp x		BCU \$120/10y
3 pcs \$400/4y. Operator :	\$200/y.	\$6.50/Wp	\$13975*	Batteries \$800/4y
Cost:	\$140	Battery Control Unit	\$300*	General maintenance
Cost Annuity:	\$1675	16 pcs batterles @\$50	\$800	\$150/y
Status of product development:	:	Inverter	\$4000*	
Product ready.		DC-DC converter	\$60	
BCU & Inverters imported	d.	15 frames (G.I.) @\$35	\$525	
DC-DC converter made t	o order.	Cables & switches	\$300	
R&D: 24 VDC appliances		Transport & installation	\$700	
Estimated number of potential of	customers:	Profit margin	\$3500	
Not clear				
		Initial PV system investment	\$24160	
		Costs: \$170/month	Cost annuity:	\$1985
Estimated potential market:		REMARKS:		
Not clear		PV system not economic		-
		operation, but may offer	-	
		noise and daily power av		•
Present locations known:		Not recommended for ac	tive introduct	ion.
None				

Factsheet PV application: Solar Home System IV Group: Residential A luxury home with all common AC appliances powered by a 2150 WP solar generator.

COUNTRY:	Philippines
Population:	60M
Urban/rural distribution:	35/65 %
% electrification:	35 %
Currency:	Pesos
Exchange rate:	1US\$ = P25
date:	Sept. 1990

Relevant conventional energy prices: (urban) / rural Diesel/I (\$0.21) \$0.2

METEOROLOGICAL INFO Average insolation: 5 kWh/m2,d Seasons: June-Nov.: wet, 4 kWh/m2,d Dec.-May: dry, 6 kWh/m2,

SYSTEM INFORMATION

System availability:	90 %
Daily energy required:	
AC home appliances + DC lighting	
estimated at	6 kWh
Total:	6 kWh

Possible local service: Poor

 Competitiveness of PV system:

 4.5 kVA Diesel gee-set (\$4000/7y)

 Fuel: 8h/d x 365d/y x 0.75 l/h x \$0.25/1 = \$550/y. Oil: 31/m x \$1.50/l x 12 m/y = \$55.

 General Maintenance \$100/y. Storage batteries 8 pcs \$400/4y. Operator \$200/y

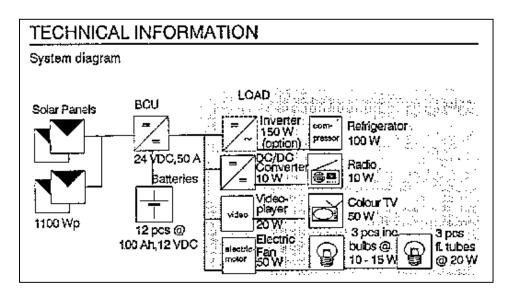
 Cost:
 \$140

 Cost Annuity:
 \$1675

Status of product development: Product ready. BCU & inverters imported. DC-DC converter made to order. R&D: 24 VDC appliances

Estimated number of potential customers: Not clear

Estimated potential market: Not clea Present locations known: Non



System components	Price(*: import)	Anticipated maintenance & repair:
PV panels 2150 Wp x		BCU \$120/IOy
\$6.50/Wp	\$13975*	Batteries \$800/4y
Battery Control Unit	\$300*	General maintenance
16 pcs batteries @\$50	\$800	\$150/y
Inverter	\$4000*	
DC-DC converter	\$60	
15 frames (G.I.) @\$35	\$525	
Cables & switches	\$300	
Transport & installation \$700		
Profit margin 53500		
Initial PV system investment	\$24160	
Costs: \$170/month	Cost annuity: \$1985	

### **REMARKS**:

PV system not economically competitive to diesel gee-set operation, but may offer advantages in terms of less pollution, noise and daily power availability (24h/d). Not recommended for active introduction.

COUNTRY:	Philippines	Relevant conventional energy	METEORO		
	Fimpphies 60M	•••	Average insolati		
Population:	35/65 %	F	Seasons:	on, oktropined	
Jrban/rural distribution: % electrification:	35/65 %	Gasoline/( (\$0.20) \$0.35	June-Nov. : wet, 4 kWh/m2d		
Surrency:	Pesos		DecMay : dry, 6 kWh/m2d		
Exchange rate:	1 US\$ = P25			.,,, ·	
date;	Sept. 1990				
SYSTEM INFORMAT		TECHNICAL INFORMA	TION	· · · · · · · · · · · · · · · ·	
System availability:	90 %	System diagram			
	Radio 8h 80 W	1			
3 pcs fl. tubes 5h	300 Wh	Solar Panels BCU	LOAD		
Color TV & video 5h	350 Wh		Inverter 150 W	com- Refrigerator	
Electric fan 2h	100 Wh	24 VDC.50 A	Coption)	pressor 100 W	
Small refrigerator	2000 Wh	Batteries	= Converte	Radio 10 W	
3 pcs inc. bulbs	150 Wh		Video-		
Total :	3000 Wh	1100 Wp 12 pcs @	video player	©] 50 W	
Possible local service:	Average	100 Ah,12 VDC	Electric Fan	3 pcs inc 3 pcs bulbs @ fl. tubes	
Competitiveness of PV system	n:		50 W	<u> </u> <b>⊌</b>  10-15₩ <b>⊌</b> @20₩	
Gasoline gen-set 1000W	V (\$700/5y) +				
6 storage batteries (\$30	0/3y) for boost				
charging. Fuel: 365d/y >	x 0.9(avail) x	System components	Price	Anticipated maintenance	
4h/d x 1 l/h x \$0.35/l = \$	-	ļ	(* : imporl)	& repair :	
Oil: \$2.50/month x 12 m	/y = \$30	PV panels 1100 Wp x		BCU \$120/10y	
General maintenance \$	50/y.	\$6.50/Wp	\$7150*	Batteries \$600/4y	
Cost:	\$68	Battery Control Unit	\$120	General maintenance	
Cost Annuity:	\$820	12 pcs batteries @\$50	\$600	\$50/y	
Status of product developmer		(inverter)	(\$250)		
BCU & DC-DC converte	er made to order	8 pcs frames (G.I.) @\$35			
		Cables & switches	\$100		
R&D: 24 VDC fl. tubes,	convert vídeo	Transport & installation	\$350		
to 24 VDC.		Profit margin	\$1700		
Estimated number of potentia	I customers:				
M					
Not clear			010000		
		Initial PV system investment	\$10300	<u> </u>	
		Costs: \$74/month	Cost annuity:	\$890	
Estimated potential market: Not clear		REMARKS: An 1100 Wp Solar Home System offers no economical			
tant elegt		advantage over a gasoline powered gen-set in comb			
			• •		
Present locations known:		with storage batteries. Possibly other than purely economic motives (e.g. noise/air pollution) might be considered.			
LINE OF THE PROPERTY OF THE SECTION OF THE SECTIONO		Recommended for pilot n			
None		I second a plat in	·		
		1			