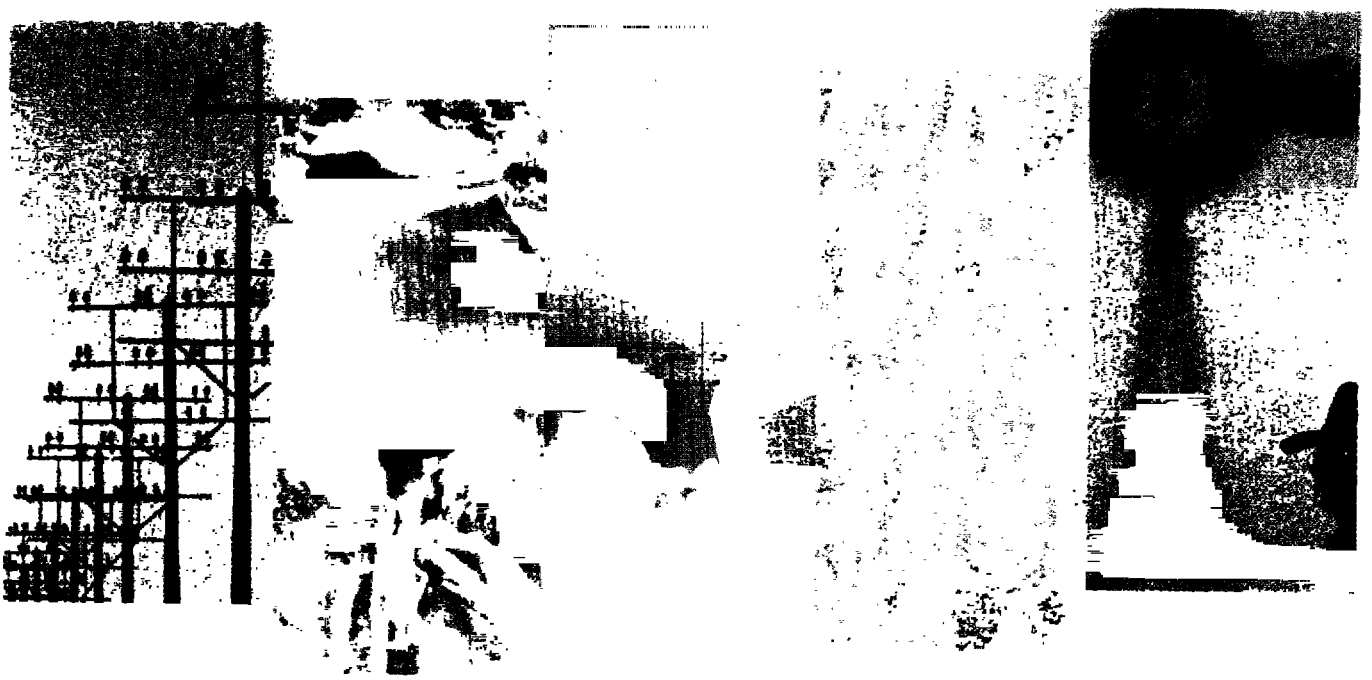
ESMAP TECHNICAL PAPER
012

The Kenya Portable Battery Pack Experience: Text Marketing an Alternative for Low-Income Rural Household Electrification



Energy

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Programme

May 2001

ESMAP

JOINT UNDP / WORLD BANK

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) is a special global technical assistance program run as part of the World Bank's Energy, Mining and Telecommunications Department. ESMAP provides advice to governments on sustainable energy development. Established with the support of UNDP and bilateral official donors in 1983, it focuses on the role of energy in the development process with the objective of contributing to poverty alleviation, improving living conditions and preserving the environment in developing countries and transition economies. ESMAP centers its interventions on three priority areas: sector reform and restructuring; access to modern energy for the poorest; and promotion of sustainable energy practices.

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FUNDING

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FURTHER INFORMATION

An up-to-date listing of completed ESMAP projects is appended to this report. For further information, a copy of the ESMAP Annual Report, or copies of project reports, contact:

ESMAP
c/o Energy and Water
The World Bank
1818 H Street, NW
Washington, DC 20433
U.S.A.

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ESMAP Management"

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Joint UNDP/World Bank Energy Sector Management Assistance Programme

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Contents

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Tables

Abbreviations and Acronyms

a-Si	amorphous silicon (module)
EAA	Energy Alternatives Africa, Ltd.
ESMAP	Energy Sector Management Assistance Programme
KSh	Kenyan shilling
NGO	nongovernmental organization
PV	photovoltaic
SHS	solar home system
VAT	value-added tax (Currently 16 percent in Kenya; rose to 17 percent for a while during project implementation)

Units of Measurement

Ah	ampere-hour
DC	direct current
LED	light-emitting diode
VDC	volts (direct-current)
W	watt
Wp	watts-peak. Used to measure peak power output of solar modules.

Currency Equivalents

74 Kenyan shillings = $1[1]

KSh 1 = $0.0135

[1] All dollar amounts are U.S. dollars.

Executive Summary

1. This project was the most recent of several ESMAP activities building the Kenya solar photovoltaic (PV) commercial infrastructure through market study and small interventions. The overall purpose of the Battery Pack and Jua Tosha Battery activities was to examine the viability of lowest-cost options for delivering reliable electricity services to the rural poor. Given the well-developed nature of Kenya's PV market (annual sales exceeding $5 million) and consumers' collective tendency to purchase very small systems in an incremental fashion, this project attempted to introduce a product that meets end-user needs in terms of both (1) low incremental purchase cost and (2) greatly improved features over old systems.

2. A battery-pack concept was seen as something that would interest rural solar buyers. After several designs were developed in previous projects financed by Ashden Trust (a private British charity), the least costly of the three prototypes was chosen as the most desirable product. Agreements were drawn up between two local companies for distinct production tasks: Voltmaster, a battery company, and Rodson, an electronics firm.

3. The initial test marketing plan was to (1) produce 100 battery packs and place them in rural stores, (2) obtain detailed feedback from users (who purchased the battery packs at cost) and dealers, and (3) develop a marketing plan for larger-scale dissemination of the product with the local companies. Initially, the intention was to manufacture the unit in Kenya. However, the local manufacturing process proved too expensive and one company was unable to meet the quality-control requirements. A similar "Battery Pack" product was identified on the international market, and it was decided that this product would be appropriate for the test-marketing exercise.

4. The project team helped Voltmaster market and promote the Battery Pack on the local market. Over six months (January–September 2000) 70 units of the local and imported products were placed in stores throughout the country. By September, however, dealers had returned many of these units unsold and, even among those dealers that had sold only a single display unit, showed almost no interest in re-purchasing units. This was attributed to the low demand period, the high selling prices and the lack of marketing and poor information to consumers and distributors about the product. Consumers and dealers mentioned that price was the largest barrier to the uptake of the product. As shown in Table ES-1, the cost per kilowatt-hour is actually significantly higher for the imported Battery Pack compared to the least-cost alternative (which is of lesser technical quality).

Table ES-1: kWh Cost of Electricity ($)

	Expected NPV Price With PV module	*Expected NPV Price Without Module*	*Actual NPV Price With Module*
Jua Tosha (actual price)	0.83	0.86	0.83
Battery Pack	0.90	1.05	1.15

5. The battery-pack product concept has not initially been successful among the low-income groups targeted by the project. None of the companies involved is continuing to market the product that was introduced, though both have learned from the project and introduced new products for different target groups. Rodson has used the experience to introduce low-cost charge regulators and battery monitors, which now sell several hundred units per month. Voltmaster developed a small, tubular, deep-discharge battery that does not need a charge controller. Competing companies have introduced higher-capacity versions of the "BatPack" product for use by upscale consumers.

6. Despite the fact that the battery pack did not proof to be the ultimate solution to a poor person's first step in the electrification process, a number of valuable lessons can be drawn from the test marketing exercise:

- The target price could not be brought down to the target retail price (including VAT) of around KSh 7000 (about $92). However, indications are that the product would sell at this target price (if volume were sufficiently high and if VAT were removed or reduced on the product).
- The market is functioning. Consumers and dealers showed some interest in the battery pack product, but quickly dismissed it for cost reasons. The exercise has shown that Kenya remains largely a *component market* (as opposed to a market for complete kits offering standard solutions for all), and that without financing or price breakthroughs, it will be hard to change this.
- Introducing a new product concept is not easy to do in a conservative market. Awareness-raising and promotional activities are costly.
- End-users and dealers have supplied useful feedback.
- Local production is not easy. Designing and manufacturing a complex product when several manufacturers are involved is not a simple process.
- Companies rapidly adapt when they have access to market research data.
- Re-targeting the product to other groups may prove more successful.
- International players are increasingly looking at new market opportunities and will not refrain from using their financial backing to crowd out local players.

1

Introduction

Project Rationale

1.1 This project is the most recent of several ESMAP activities building the Kenya solar photovoltaic (PV) commercial infrastructure through market study and small interventions. The five ESMAP studies have done the following:

- *Determined which PV system components rural people desire and how they purchased them.* A study based on a survey of 410 solar home systems (SHSs) examined how people purchase and expand PV systems.
- *Developed pilot financing mechanisms with companies and credit groups.* A multi-year effort worked with two local credit organisations to introduce SHSs as a viable credit product. PVMTI, a $5 million IFC finance project, has incorporated this effort into its loan portfolio.
- *Helped develop low-cost product concepts.* The projects have looked at the viability of solar lanterns, small batteries and the battery pack concept.
- *Increased the capacity of both urban and rural market players to serve the market.*

1.2 Energy Alternatives Africa (EEA), Ltd., managed the project on behalf of ESMAP and actively shared project data with the private sector.

1.3 The overall purpose of the Battery Pack and Jua Tosha activities was to examine the viability of lowest-cost options for delivering electricity services to the rural poor. Given the well-developed nature of the Kenya PV market (more than $5 million per year), and the tendency of consumers to purchase very small systems in an incremental fashion, this project attempted to introduce a product that met end-user needs in terms of both (1) low incremental purchase cost and (2) greatly improved features over old systems

1.4 A battery pack product was seen as something that would interest rural solar buyers for the following reasons:

- It would enable them to purchase a system incrementally, rather than all at one time.
- It would provide them with better battery life, and a more convenient way of connecting their lighting and TV appliances to the battery.
- Before they had purchased their module, it would enable them to easily carry their battery back and forth to charging stations.

1.5 The project followed an earlier initiative to help the same battery producer develop a low-cost small battery (known as "Jua Tosha") which was matched to the output of the 12-14–Wp a-Si[2] modules most commonly sold in Kenya.

Jua Tosha Project

1.6 The Jua Tosha Project demonstrated that the Kenya PV consumers would readily purchase a low cost, small-sized battery if it were sold at a convenient price. The 20-Ah Jua Tosha Battery (see Figure 1) was marketed through retailers at a price range of KSh 2300–2800[3] (about $38.30–46.70). Figure 2 shows the sales of the 20-Ah product during and after the project.

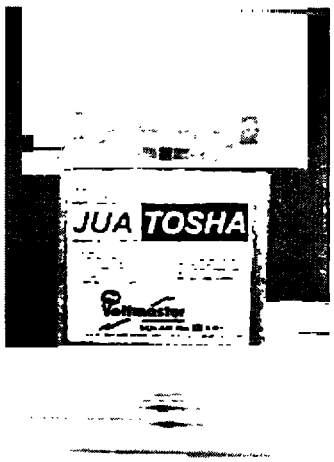
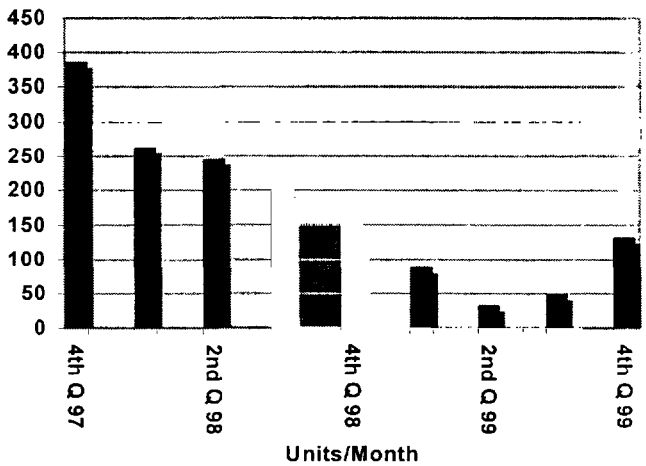


Figure 1.
Jua Tosha 20-Ah Battery

1.7 Voltmaster introduced several other sizes of batteries in the same Jua Tosha line, including a 50-Ah battery that maintained a higher market share, selling more than 10 times as many batteries per month (avg. 500/mo) than the 20-Ah product.

1.8 After the project, due to a weakening Kenya shilling, the price of the 20-Ah was raised to between KSh 3100 and 3800[4]. This increase in price, combined with the introduction of a 40-Ah battery by the competing battery company[5], reduced sales of the 20-Ah Jua Tosha battery considerably, as shown in Figure 2. Subsequent surveys showed that the competitor's 40-Ah battery immediately gained market share from the Jua Tosha when the latter's price was raised.

Figure 2. Jua Tosha Battery Sales



[2] Amorphous silicon.

[3] Includes 16 percent VAT.

[4] Includes 15 percent VAT.

[5] Voltmaster under-rated their battery (EAA's C/20 test gave the battery a 32-Ah rating while Voltmaster rated it at 20-Ah) while the competitor may have over-rated a similar battery.

1.9 However, the Jua Tosha project successfully stimulated the small-size end of the battery market, and demonstrated the following:

- At the right price, a small battery is a very good entry point for getting electric services (TV, radio, light).
- Making smaller products is not less expensive, especially for the manufacturer.
- Local manufacturers have a key role in the development of the PV market, and, battery companies have a crucial (and sometimes underestimated) role to play in the PV market.

The Battery Pack Concept: Developing a Prototype (1997–98)

1.10 With support from Ashden Trust, Energy Alternatives AFRICA and ApproTEC (Nairobi) developed prototypes for a portable battery enclosure with control electronics, switches and connection points. ApproTEC developed the housing and metal carrying frames that enabled the batteries to be far more portable than the common box-type units.

1.11 Three product designs were developed and tested (see Section 2, "Manufacture and Assembly of the BatPack"):

- A fully enclosed unit with LED display, switches and connections supported by a metal frame and handle.
- A partially enclosed unit with fewer features than the fully enclosed unit.
- A unit with the electronics housed in a "cap" on top of the battery and a metal frame supporting the battery. This was the least-cost unit.

1.12 Feasibility of local production was established by investigating the capacity of local manufacturers. The following key points were highlighted in the work:

- The housing would, most likely, have to made from plastic because industrial capacity with metals, fibreglass and other materials is not developed enough in Kenya make a suitable housing. Production of the plastic moulding would require a significant investment (at least $20,000) and would require minimum sales of several thousand units to be profitable.
- The metal carrying frame could be easily fabricated by *jua kali* artisans in the informal sector.
- Capacity to develop the electronics and the components of the unit was found to exist in Kenya. Three firms provided EAA with suitable electronic samples, and one, Rodson was given the contract to develop the electronics.

1.13 The project team estimated that a Battery Pack unit could be sold at retail for $85 or less when produced at sufficient volumes (i.e., more than 5,000 units per year).

The ESMAP Project: Producing and Test marketing the Battery Pack Unit

1.14 ESMAP funding was made available to move forward with test production and test marketing of Battery Pack units in April 1999. The least costly of the three prototypes was chosen as the most desirable product, and agreements were drawn up between Voltmaster and Rodson for their respective production tasks.

1.15 The initial test marketing plan involved the following steps:

- Produce 100 battery packs and place them in rural stores;
- Obtain detailed feedback from users (who purchased the battery packs at cost) and dealers;
- Develop a marketing plan for larger-scale dissemination of the product with the local companies;
- Look at what was happening with similar technologies elsewhere in the Kenya market and around the world and how they are being taken up.

1.16 A successful indicator of the project would be that people are purchasing the unit and that rural dealers would request additional units, at which point the companies would no longer need support from the project.

2

Manufacture and Assembly of the BatPack

2.1 The ongoing recession in Kenya delayed the local production of the BatPacks as both companies focussed on survival issues rather than on developing new products. Because of the depressed nature of the Kenya business environment, it was a poor time to "test market".

2.2 Initially, the project sought to manufacture the unit in Kenya, with two companies sharing responsibility for the components of the product, and one having long-term responsibility for its marketing. However, as explained in this section, the local manufacturing process proved too expensive and one company was unable to meet the quality-control requirements. A similar product was identified on the international market, and it was decided that this product would be appropriate for the test-marketing exercise.

Local Assembly

2.3 If the work was successful, Voltmaster planned to manufacture the control housing from plastic. Voltmaster spent a considerable amount of effort investigating options for production of the plastic mold. Both local and imported plastic molding would be prohibitively expensive. Therefore, before investing in a mould (which would cost about $14,000) they decided to test market the proposed model (with a metal frame; see Figure 3) using a carved wood housing for the electronics.

2.4 If this proved acceptable among consumers, they planned to purchase a mould and go into production. Initially, 20 units of this type were produced by the two companies involved as follows:

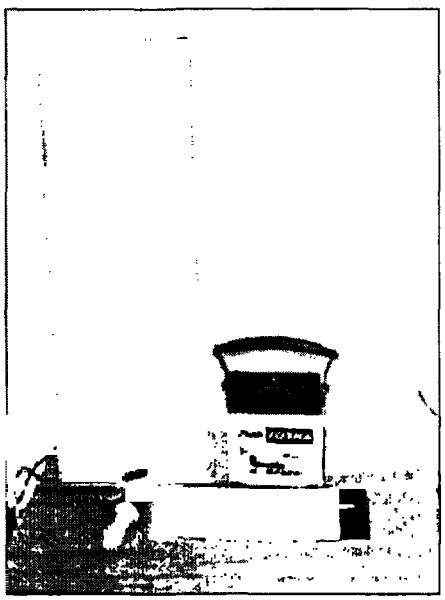


Figure 3.
The Kenya-made Battery Pack

- Rodson Electronics manufactured the control units for the local assembly. They also carried out the control electronics assembly.
- Voltmaster manufactured the housing and handles, while Voltmaster and EAA conducted the testing and quality control.

2.5 Initial testing of the local prototypes revealed calibration problems in the control parameters. These were corrected after several attempts and the units were re-tested before being sent out to retail shops.

2.6 All 20 locally assembled power packs were delivered to Voltmaster in November 1999 after testing. However, there were some problems with the 20 test units. Over the course of the project, Rodson was not able to meet the quality requirements of the Kenya market. The company found it difficult both to (1) fit the electronics into the small wooden housing and (2) calibrate the electronic circuitry.

2.7 Due to price problems of developing the mold[6], uncertainties about the return on the mold investment, difficulties in electronics quality control and lackluster initial consumer response (see below)—as well as the identification of a superior product that appeared to offer a lower-cost solution—the project team decided to give up on the local production of the Battery Pack.

Imported Unit: The Sundaya Battery Pack

2.8 At the same time as the project team was having problems the developing the local unit, it obtained information on a similar product being used in Indonesia (see Figure 4). As shown in Table 2.1, the Indonesian "Battery Back" product, manufactured by a company named SundayaEnergia Surya, closely matched the specifications of the product required in Kenya. Discussions were held with a Sundaya representative and a sample unit was procured for testing. The Sundaya technical specifications were acceptable and the sample was much appreciated in Kenya. Several units were then ordered for test marketing alongside the Kenyan-manufactured models.

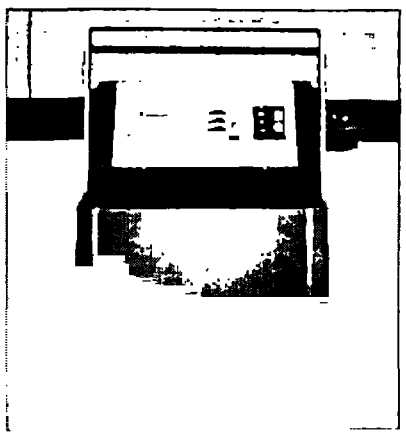


Figure 4.
The Sundaya Battery Pack

2.9 The Battery Pack's price was found to be low enough for the Kenya market (see Table 3.1, column 3, in Section 3). Table 2.1 shows a comparison of the specifications for the power pack and the test results of both the local and Indonesian

[6] The cost of making a plastic mold (locally or internationally) would be in excess of $15,000, not including production of the units.

models. Because the ESMAP activity's focus was to test-market a product, and because no other examples of successful battery packs were available in Kenya, it was decided to order from the Indonesian company.

Table 2.1: Specifications and Test Results of the Power Pack Prototypes

Parameter	*Specified*	*Local Assembly*	*Indonesian Unit*
High-voltage disconnect	14.4 ± 0.2 V	14.4 V	14.45 V.
High-voltage Reconnect:	12.5 ± 0.2 V	13.32 V	13.15 V
Low-voltage disconnect:	11.4 ± 0.05 V	11.48 V	11.58V
Low-voltage reconnect:	12.6 ± 0.2 V	12.62 V	12.45V.
Current limit on charge	2.5-3 ± 0.5 A	8A	8A
Current limit on discharge:	3A[a]	6A	6A
Full	14.4–12.5 V	14.6–13.5V	14.45–12.55 V
Normal/OK	12.5–11.8 V	12.5–11.8 V	12.69–14.1 V
Low	11.7–11.4 V	11.6–11.4 2V	

[a]Continuous electronic fuse setting 10A for 20 milliseconds.

2.10 The only major difference between the Indonesian product and the desired product was portability: the imported unit was designed for stationary applications. However, Voltmaster was able to add braces and handle onto the imported unit to make it portable. In addition, Sundaya agreed to consider developing a smaller product for the Kenya market that would be fully portable[7].

2.11 Voltmaster ordered 100 units from Sundaya. These units were ready for delivery by December 17, 1999 and were cleared in Kenya shortly before Christmas 1999. Sundaya also manufactures several types of lights and DC-DC converters that fit the Battery Pack, and Voltmaster ordered a set of these to go with the units.

[7] This development is on-going at the time of this report.

3

Setting the Test Price

3.1 Test prices were based on actual component costs and prevailing business overheads, as shown in Table 3.1 (see following page).

3.2 From the beginning of the project it was agreed that the collaborating partner, Voltmaster, would have final say in setting the retail price. This was because the company wanted to avoid disappointing customers by selling a low-cost subsidised product during the test marketing, then a raising prices afterward. Prices were set to be as realistic as possible.

3.3 Retail prices for the local unit were set at $128 for a unit with the metal frame (see Figure 3 in the previous section) and $111 for a unit with plastic handles.

3.4 The Indonesian product price was much higher than the $123 originally projected due to incorporation of extra-ordinary costs into the price build-up (for example, air freight costs and demurrage; see Annex A). The first consumer price was $167, but this was reduced to $130 in May 2000 following an extremely negative response from customers.

3.5 Of the final retail price of the Indonesian unit ($130), markups constituted 22 percent while duties and taxes made up 14 percent. These prices were unacceptable for most dealers and customers, as explained in Sections 4 and 5.

Table 3.1: Price Build-Up of Units (KSh)

	Local Unit (Metal Frame) (KSh)	*Local Unit (Plastic Handles)* (KSh)	*Indonesian Unit (Projection)* (KSh)	*Indonesian Unit (Actual)* (KSh)	*Indonesian Unit (April Price)* (KSh
Component costs					
1 Battery (Jua Tosha)	2450	2450	2450	2450	2450
2 Electronics (landed)	1200	1200	2726	3,953	3,215
3 Casing (wood)	850	850	n/a	n/a	n/a
4 Stickers, booklets etc	40	40	40	100	100
5 Metal works (handle)	940	220	100	500	500
6 Paint, glue, etc	395	295	0	0	0
7 Assembly	100	100	0	200	200
Parts total	5975	5155	5316	7203	6465
Business Overhead Costs					
Mark-up (15%)	896	773	797	1729	485
Import duty	0	0	491	0	0
Ex-factory	6871	5928	6604	8932	6950
VAT (15%)	1031	889	991	1340	1043
Dealer cost	7902	6817	7594	10272	7993
Dealer mark-Up (20%)	1580	1363	1519	2054	1599
Total retail price (KSh)	9482 ($128)	8181 ($111)	9113 ($123)	12327 ($167)	9591 ($130)

n/a = not applicable.
Note: KSh 74 = US$1.

4

Distribution, Marketing and Promotion of the Sundaya Battery Pack

4.1 The project team helped market and promote the locally made version of Sundaya's Battery Pack ("BatPack") product. It supported seminars to promote the concept around Mt. Kenya, Western Province and Nairobi. Further, two advertisements for the product were placed in local newspapers.

4.2 Starting in November 1999, EAA and Voltmaster began test marketing the locally made prototype units with dealers who had earlier collaborated with the Jua Tosha Battery project. Outlets were carefully selected based on ability of dealers to track end-users. Annex B gives a list of participating dealers.

4.3 EAA introduced the locally produced prototypes to all short-listed dealers. Dealers were educated about the product during interactive seminars. Features that enabled improved performance over simple batteries were explained to the dealers and selected groups of customers. Dealers were shown how to market the product as part of a package (i.e. BatPack, PV module and light) or alone.

4.4 Those interested and willing to retail the product were given samples. Conditions for involvement included following up on the units and being able to make a 50 percent down payment for the samples retained. Because of the high retail price for the unit, only three dealers in the initial round of test marketing took up samples. These included Kiru Electricals (Chuka), American Solar Technologies (Meru) and Bright Homes (Bungoma). In addition, the Center for Wildlife Management Studies bought five locally assembled units for use at their training sites in Olitokitok and Athi River. These were later replaced with the imported model.

4.5 In November, the decision to change type of product was made and the Sundaya products were ordered from Indonesia. However, due to delays in ordering and importing them, the project missed the peak-buying season of November/December. Voltmaster and Sundaya took some time to come to an agreement and, when the units were eventually air-freighted, they arrived the day before Christmas—by which time most Kenyans

had made their seasonal investments and amenity purchases. The first quarter of the year (i.e., January–March) is generally considered a "dead" period for the solar market, so the test marketing work—conducted in the low season of a recession year—was not indicative of Kenyan demand in a good year. Many dealers mentioned this problem in their reports (see below).

4.6 Beginning in January 2000, Voltmaster used its other dealer network, much of which was in Western Kenya, to distribute the power pack. It provided them with whole kits, and explained the need to market the unit as a kit with lights and/or solar modules. To date, there are 30 dealers spread throughout the country displaying the unit. The list of current distributors and number of units is show in Annex B.

4.7 By the end of June, 58 units had been placed in stores by Voltmaster. Although most of the distributors initially targeted opted out because of price, they remain willing to sell the power pack if the price is made attractive.

5

Dealer and Customer Feedback

Initial Reactions to Prototypes

5.1 During the distribution trip made in November 1999, the project team asked all short-listed dealers for their opinions on the locally made Battery Pack (see Table 5.1).

Table 5.1: Dealer Comments on the Local Kenyan Product

Company	*Suggested max. Retail Price*	*Likely to order*	*Comments and Suggested Modifications*
Maina Electrical, Embu	7,000	---	Too expensive. May consider selling if price comes down.
Kiru Electrical, Chuka	6,000	1[a]	Attractive and practical product, but overpriced. Would have sold all five units if price had been right.
AST, Meru	6,000	---	Get the price low and you will see the sales.
Meru Automobiles, Meru	6,000	---	Should be offered in various sizes for different battery sizes.
Mohammed Moti & Sons, Meru	6,500	5	The shell should be able to take batteries of all sizes, not just the Jua Tosha.
Nanyuki Electrical, Nanyuki	Not interested	---	Would rather sell small systems.
Modern Sanitary, Nanyuki	Not interested	---	Highly priced and up-market product.
Ladies Tailoring, Nyeri	6,000	20	Good product, but should take all battery sizes.
Tetu General Trading, Nyeri	7,000	2	Limited market. Users not particularly after mobile systems. Practical for Europe or the United States.

[a]Sundaya.

5.2 The dealers voiced a unanimous concern over the high proposed selling price of the power pack. The locally made battery pack is *more expensive* than a battery plus a controller, and customers do not immediately see the benefits. Dealers suggested retail prices ranging between KSh 6,000 and KSh 7,000 with an average of KSh 6,400 (about $86).

5.3 In summary, customers did not appreciate the value added by having a portable unit. Instead, they merely compared the component costs and summed it up to arrive at the ideal price of the Battery Pack (an average of KSh 3,000 for a battery and KSh 3,500 for control unit). This demonstrates the sophistication and deep understanding of the Kenyan market players. Furthermore, the dealers, who are used to selling over the counter, were not motivated to "push" the product or its advantages to customers.

Prototype 1 (Local Model)

5.4 Despite some user interest in the Battery Pack, most of the dealers said they could not sell the units at the suggested prices.

- Sales were impeded mainly by the high retail price. Fewer than 10 of the locally made units were ordered by dealers initially.
- All of the locally manufactured power packs were returned within three months due to malfunctioning control units and the inability of the dealers to sell the product. (Shortcomings are described in Table 5.2.) For those customers who required a replacement, Indonesian units were supplied at the same price.

5.5 On the basis of initial feedback and unit performance, the local model was found to be undesirable, and no further steps were taken to produce or market the local unit.

Table 5.2: Dealer Comments on the Local and Imported Battery Pack Products

Problems on the Local Kenya Design	*Desired Improvements on the Indonesian Design*
• Discharge sockets were not firm enough and sank in whenever the power jacks were inserted. • The Low and high voltage disconnects either shut-off too early or did not work at all. • The status indicator LEDs showed more than one situation at a time and in some cases sent the wrong messages. • The general value added aesthetics of the unit to the end-users was not appealing; i.e., it was very similar to an ordinary Jua Tosha battery.	• Using a sealed service free battery if the unit is to be completely portable. As at now spills are likely to occur in transit. • Charge input terminals for the unit need to be more accessible and easy to connect. This has been communicated to the manufacturer who has now added this facility at an extra cost of $2.50 per unit. • To show the value added unit must be sold as a fairly priced package. To this effect Voltmaster has revised the prices. These are given in Table 3.1.

Prototype 2 (Indonesian Sundaya Model)

5.6 From a technical perspective, this model has performed better than the locally assembled unit did, and it was far more attractive to both the dealer and customer. Initial customer feedback shows that the control unit works according to specifications and that users are satisfied with the product's performance.

5.7 However, price is still an issue, and it has constrained sales all over the country. In addition, although dealers agreed that the import model is superior to the local version, they suggested modifications for both units (see Table 5.2).

5.8 Table 5.3 presents information from dealers who had been stocking the Sundaya product. It is notable that Voltmaster's competitor (Chloride) introduced a similar product shortly after Voltmaster, and the price being charged by Chloride was significantly lower than that charged by Voltmaster in the test market.

Table 5.3: Dealer Interviews about the Sundaya Product in Western Kenya

Dealer	*Price Offering (KSh)*	*Comments*
Autospares, Kitale	19,000 (NAPS 12W module and 2 Sundaya lights)	It was expensive and the season was bad.
Bungoma Merchandise Stores	10,000 (BatPack and 2 local lights)	Only delivered one week beforehand. Not enough time to make a comment.
Wakakia Unit Traders	20,000 (Intersolar module, 2 Sundaya lights)	Took it to fishermen who found it too expensive. Was also selling a Chloride "Solar Generators" with NS 40 battery, 2 lights and module at 14,000. 4 sold already; these had a poster.
Lake Auto Parts	9000 (alone)	Too costly.
Western Emporium	10,000	High cost. Low season.

5.9 After numerous meetings with customers and dealers, Voltmaster observed that the market for the Battery Pack product is actually more sophisticated and up-market than expected. Such groups would like a larger unit with a greater capacity—customers would like to power hi-fis and even colour TVs. Voltmaster has attempted to introduce the Battery Pack at sugar company and paper mills worker credit unions as a financed product.[8]

[8] This "deal" has not been made yet. It is, however, indicative that Voltmaster sees the product as an "up-market" product more suitable to higher income groups that the established and competitive low end commercial market.

6

Problems Encountered During the Test Marketing Activity

6.1 From January through September 2000, 58 units of the imported Sundaya product were placed in stores throughout the country. By September, 11 of these had been returned unsold by dealers and, even among those dealers that had sold only a single display unit, there was almost no interest in re-purchasing units. The main reason given was the high cost of the unit.

6.2 For Voltmaster, the test marketing of the Battery Pack was less successful than it had been for the earlier Jua Tosha battery. Low sales were attributed to the following:

- *Bad timing.* The project was undertaken during a period when the economy was struggling. In the first 2 quarters of the year, fewer consumer purchases are made than in the second half of the year. Delays in delivery of product from Indonesia in November/December caused the effort to miss the peak buying/selling period of Oct-Dec.
- *High price.* As mentioned in Section 5, the dealers estimated that less than KSh 7000 (about $95) would be an appropriate price for the unit. The initial price for the unit, $167, was totally unacceptable to end-users. Even when the price was reduced to $130, sales did not pick up.
- *Lack of marketing and poor information about the product.* The Battery Pack is a product that demands some user and dealer education. It is a concept that must be "sold" through marketing. Unlike other solar companies in Kenya, Voltmaster does not make use of the media to sell its products. The campaign to introduce the product was not sufficiently developed. Since the product is a new concept, a considerable effort is required to educate dealers about its superiority to a simple battery PV module system. Many dealers did not understand (or agree with) the advantages of the system and therefore did not promote the product.

- *The need to concentrate on "survival" issues.* Slow sales forced Voltmaster to concentrate on other products, as neither the initial returns nor the indications from the public were favourable to the Battery Pack product.
- *Unexpected competition.* Almost immediately after Voltmaster's initial campaign, Voltmaster's chief competitor imported a container load of a similar (though slightly larger) product called "Solar Generator". They strategically priced their product below the price offered by Voltmaster, and they launched a promotional campaign (see Section 8) targeting higher-income groups.

7

The Battery Pack and Electricity Costs

7.1 The main justifications for test marketing the new Battery Pack product on the Kenya market were as follows:

- Increased convenience in managing charging and appliances with a Battery Pack;
- Ease of expanding the system for low-income users. In theory, having a Battery Pack and battery alone would enable purchasers to charge their battery at a station before buying a module;
- Portability of the unit;
- Lowered electricity cost due to longer life of batteries.

7.2 However, key to the product's success is (1) whether the per-kilowatt-hour cost of the Battery Pack is *actually lower* over time and (2) whether indeed the Kenyan consumer "perceives" this lower cost. For the effort to be successful, the low income Kenyan consumer would have to *understand* that the enclosure and electronics of the Battery Pack actually lower the lifetime system costs for them.

7.3 Table 7.1 compares the calculated costs of electricity based on the expected and actual price of the Battery Pack with the cost of electricity to the consumer if he/she uses a battery alone. As can be seen, the *actual* price of the Battery Pack (Sundaya unit) with an a-Si module is significantly more expensive than simply using a Jua Tosha battery with a module, even when you consider the much longer lifetime of the battery in the Battery Pack. The Kenyan consumer thus was right in deciding not to purchase the Battery Pack. However, if the Indonesian Battery Packs were to be sold in larger quantities and shipped using sea freight, the NPV price would be equal to or lower than that of the Jua Tosha.

Table 7.1: Kilowatt-Hour Cost of Electricity ($)

	Expected NPV Price With PV module	*Expected NPV Price Without Module*	*Actual NPV Price With Module*
Jua Tosha (actual price)	0.83	0.86	0.83
Battery Pack	0.90	1.05	1.15

7.4 Table 7.1 clearly demonstrates that, for the consumer, price is the most important issue, and that a long-term view must be taken by the consumer to consider the Battery Pack a viable investment. Clearly, a Jua Tosha battery alone satisfies the customer, and the extra benefits of the Battery Pack do not justify the extra costs of its electronics, housing and added convenience. Even if the Battery Pack extends the life of the battery by a year or two, this is not what "low-end" consumers expect or desire.

7.5 As mentioned earlier, consumers and dealers mentioned that price was the largest barrier to the uptake of the product. Indeed, many consumers and dealers simply compared the price of the Battery Pack with the price of a battery and regulator, and decided that the BatPack was too expensive. The suggestion that this product be enlarged (greater Ah capacity) and targeted at more affluent rural consumers is probably a good one: the test market activity shows that, for low-income consumers, price is a far more important constraint than convenience, portability or long-term cost reductions.

8

Kenya Product Developments Similar to the Battery Pack Concept

8.1 The Kenyan companies (Rodson, Voltmaster and others) have rapidly learned from the experiences with the Battery Pack and have applied these experiences to their product development and sales strategies. Both Voltmaster and Rodson have now developed alternative technologies. Moreover, other companies have picked up on the battery pack concept or developed ideas completely on their own.

8.2 In addition, experiences with similar battery pack products are occurring around the world (see Annex C), and within about two years the enclosed battery/charger concept has become attractive for developing country applications and for high-end portable power unit applications in developed countries.

Telesales

8.3 Telesales, the local agent for Kyocera and FREE Energy Europe modules, has been selling SHSs and PV components over the counter since the mid-1980s, mostly to customers who wish to power small black-and-white televisions. Telesales staff noticed several years ago that some customers do not want to be inconvenienced with wiring batteries, charge regulators and solar modules. To solve the problem, they pre-wire all of the components onto wooden assembly "boards" and offer this to the customer (who is purchasing the whole kit) as a free service. Telesales also provides this free service to customers who buy inverters for powering colour televisions and larger systems.

Rodson

8.4 Rodson decided that the Kenyan market was not ready for the Battery Pack product, as it was too expensive and too novel a concept. During the test-marketing experience, they did notice a demand for low-cost charge regulators and battery monitors. Using the electronics developed for the Battery Pack, they developed and introduced to the market new products that address the niches they observed (see Table 8.1). They were able to greatly improve their new products based on experience gained from the project.

Table 8.1: New Rodson Products

Product	*Description*	*Sales*
Free-standing battery monitor unit	Product enables consumers to measure the state of charge of their battery, and it contains an indicator that shows their module is working.	More than 140 units sold at KSh 800 ($11) over the course of the project.
Low-cost charge regulator	Product is a standard charge regulator with LVD, charge indicator and over-charge protection.	Initial 10 prototypes sold at KSh 1800 ($25) for in pre-sales launch activity. As of January 2001, they were averaging over 80 sales per month and had captured about 10-20% of the local charge-regulator market.

Voltmaster

8.5 Voltmaster observed that the Battery Pack would be a "high-end" product whose development as a mass-market product would be unlikely. According to their view, most consumers are willing to buy a product only if it is inexpensive and reliable. A 12 W module connected directly to a small battery for powering a TV has been the norm in Kenya, and any new products need to be compared to this market. The Battery Pack failed this test because it did not fit the price needs of rural consumers.

8.6 Consequently, Voltmaster has re-focussed attention on low-cost battery development for television power, the chief rural market. They have now prototyped a 13-Ah tubular plate battery able to withstand constant deep-discharging and able to last three years (more than 1000 cycles) under rigorous use *without* a charge regulator. They have tried selling this product at a price similar to that of the Jua Tosha. A small number (less than 10) have been manufactured and tested, and the product will shortly be introduced commercially.

8.7 Voltmaster now intends to market the "high-end" BatPack product as a power supply not just for lights, but also for DC-powered colour televisions and stereos. When visiting a number of groups in the field to market the BatPack, they learned that consumers are far more interested in what devices the unit can power than in the unit itself.

Chloride

8.8 As mentioned in Section 6, Chloride, the other large battery manufacturer in Kenya, imported "Solar Generators" and components (fluorescent lights) from Sundaya shortly after Voltmaster imported its units. Its first container was cleared in April 2000, and products began appearing in the shops in May. As shown in Table 8.2, the prices offered for the "Solar Generator" are more competitive than Voltmaster's. Although fewer than 10 had been sold by October 2000, by January 2001 several hundred had been sold, and the product was being offered with finance by at least one PVMTI consortium.

Table 8.2: Chloride Prices on Sundaya Equipment

Unit	*Contains*	*Cost (KSh)*
250 Series	• 3 lights • TV connection • 50-Ah battery	11,750
400 Series	• 6 lights • 1 TV • 75-100–Ah battery	15,950
Sundaya lights	n/a	950 plus 15% VAT

n/a = not applicable.

8.9 Demand for components from Sundaya (namely, fluorescent lamps) is higher than for the Solar Generator. Chloride is likely to have sold more than 500 light units thus far from the container that arrived in April. At least five other companies, including Solagen, Kenital and ASP, also sell Sundaya lamps and Solar Generators. Kenital has sold several thousand lamp units, while ASP is only now introducing the Solar Generator unit. This demonstrates that the battery pack concept has its merits despite the results of the ESMAP project.

9

Lessons Learned

9.1 The Battery Pack product concept has not initially been successful among the project's targeted low-income groups. None of the companies involved is continuing to market the product introduced, though they (and others not associated with the project) have learned from the experience, and have re-targeted market groups and introduced new products.

9.2 A number of valuable lessons may be drawn from the test marketing exercise:

- *The target price must be competitive.* The target retail price (including VAT) of the battery pack unit is around KSh 7000 (~$92). If this price could be reached, it is likely that many dealers would stock the unit. Thus far, even the price of the imported unit from Indonesia has not been able to reach this level.
- *The market is functioning.* Consumers and dealers showed some interest in the battery pack product, but quickly dismissed it for cost reasons. To the low-end consumer, the added value of the enclosed battery casing and the portability of the unit do not make up for the increased price. The exercise has shown that Kenya remains largely a component market, and that without financing or price breakthroughs, it will be hard to change this.
- *The competition is strong.* As the imports by a competing battery company show, market players are closely watching each other and try to use market information to obtain an edge over each other.
- *Designing and manufacturing a complex product when several manufacturers are involved is not a simple process.* Local manufacturers were unable to team up together in the project to produce a product more efficiently than could be done in the Far East. However, both of these manufacturers are able to profitably manufacture their core products on their own.

- *Kenya's policies regarding imports and taxation are crucial in promoting products for the low-income rural population.* Lowering consumer prices on the battery pack will be difficult. Import duties and VAT (and two mark-ups that occur on the price build-up) add close to 40 percent to the price. If the Government is serious about providing alternatives to KPLC rural electrification, it should consider removing taxes on some of the popular solutions.
- *End-users and dealers have provided useful feedback.* This feedback indicates that, although appreciation of the product is there, low-income groups are not willing to pay for the extra convenience.
- *Introducing a new product concept is not easy to do in a conservative market.* To introduce a new product, consumers must grasp its value and marketing agents must buy into the value-added of the product.
- *Awareness-raising and promotion are costly.* For a highly conservative market like Kenya, a systematic effort is required to properly introduce a new product. Voltmaster did not did not sufficiently wage such a campaign. On the contrary, Chloride did do this and was able to sell many more battery packs over the same period than Voltmaster.
- *Companies rapidly adapt when they are able to learn from market research.* Both companies were able to use their experience from the project to develop new projects as a direct result of learning what the consumers wanted. Rodson introduced a battery monitor, charge regulator, and DC-DC converter. Voltmaster is preparing to introduce smaller tubular plate batteries. Although Chloride was not associated with the project, it closely watched the performance and successfully acted on the information obtained.
- *Re-targeting the product to other groups may be more successful.* Most of the consumers who were interested in the product were from more-affluent rural families. Such high-end consumers were more interested in a 50-Ah or larger battery than a 20-Ah package.

Annex A: Landing and Importation Costs of the Indonesian Units

Table A-1. Indonesian Electronics: Summary of Import Costs

		December Price		*April Price*	
Cost		*$*	*KSh*	*$*	*KSh*
Electronics FOB		31.20	2309	33.70	2494
Air Freight	25%FOB	7.80	577		0
Sea Freight	8.5%FOB	0.00		2.86	212
Insurance	1%FOB	0.31	23	0.34	25
CIF Nairobi		**39.31**	**2909**	**36.90**	**2731**
Duty	5%CIF	1.97	145	1.85	137
CBK Fees	2.75%CIF	1.08	80	1.01	75
Clearing & Forwarding	7%CIF	2.75	204	2.58	191
LC Fees	3%CIF	1.18	87	1.11	82
Landed Cost		46.29	3425	43.45	3215
Demurrage		7.14	528		
Total Landed Cost		53.43	3953	43.45	3215

Annex B: Participating Distributors

Table A-2. Participating Distributors

Town	*Dealer*	*No. of Units*
Nairobi	Atlas Electronics	1
	Shopper credit	3
	Bunyala Wholesalers	5
	Solagen	15
	Bahtt Electronics	1
	Travelers Check	1
Kericho	Kericho Motor Works	1
	Kericho Motor Spares	1
	Kenai General Agencies	1
Kisumu	Wakahaya Ltd.	2
	Lake auto Parts	1
	Western Emporium	1
Nakuru	Flamingo Motor Spares	1
	High Life Tyres	1
	Telesonic Ltd.	1
	Oline Ltd.	1
Nanyuki	Mt. Kenya Service Station	1
Kerugoya	GC Spares	1
Nyeri	Turbo Ltd.	1
Mombasa	Karsam Sanji & Sons Ltd.	1

Annex C. Global Experiences with Similar Products

1. Other manufacturers and assemblers have noticed market opportunities and have developed products for similar product niches as the battery pack pursued in Kenya. These can be divided into two general categories, namely:

- Products for developing country markets, and
- Products for the "recreational" or "off-grid" market in developed countries.

2. Of the products developed, all tend to include power production and conditioning equipment (batteries, modules, charge regulators, connections). In the products marketed for developing countries, lights are usually included as part of the package.

3. The lessons from the products described in the following are the same as this report in general. Clearly, kits or all-inclusive packages are up-scale market items, purchased primarily by people who are in higher income groups and/or who have access to finance.

Developing-Country Products

4. Numerous companies are involved in sales of SHS to developing countries. Most companies have focussed on kits or components, and relatively few have attempted to address the low end of the market, focusing instead on the "standard" 50-Wp system. Below, a few examples are given of companies that have departed from standard approaches and developed new products or packages.

Sundaya (Indonesia)

5. This company developed as an offshoot of Shell RES in the mid-1990's in Indonesia. It was started to address the large SHS market in such countries as Indonesia and the Philippines as well as elsewhere in the Far East. The company pioneered the approach of having a battery and charge regulator enclosed in the same container. There was little interest in making the unit portable, as virtually all sales were to end-users who also had a solar module.

6. The Sundaya market provides much of its equipment to financed projects and companies in Indonesia, Nepal and Sri Lanka (there are substantial World Bank PV projects in two of these countries). The most common sizes sold are 40–70-Ah units to go with a module and several lights. Sales volumes are in the tens of thousands per year. It should be noted that Sundaya also concentrates on manufacture of appliances, including 12 VDC fluorescent lights and 12 VDC televisions for the PV market. In the main report the smallest-sized Sundaya product is described in paragraph 5.6, and its price and technical details appear in Table 5.3.

Chinese Products (SETC-GEF.newenergy.org.cn)

7. The Chinese market was quick to recognise the added value of packaging together the entire "kit". As early as 1990, there were rudimentary "battery-box/regulator" products on the market, and companies recognised the need to downsize products to meet low-end customer needs. Initially, their products mainly found their way to the Far East and Chinese markets. Recently their products have become more sophisticated and are beginning to appear on markets around the world.

Leisure Lamp Battery by Maxlite (www.maxlite.com)

8. In 1998, this South African company launched a low-end kit based on a 14-Ah, 4-volt, lead-acid battery originally intended for use in miner's cap lamps. The kit is small enough and sufficiently low-cost ($75) to warrant attention. It comes with a state-of-charge indicator and two plug sockets for the solar panel and the output. The kit contains a 5-Wp module, one suspended luminaire with wall mounted lever switch and a 9-volt radio adapter. Optional battery chargers are for 240-volt wall charger or cigarette plug attachment.

9. Maxlite has a host of DC luminaires designed specifically for rural markets. An example is the popular Indishi lamp, which has won design awards in South Africa. It ranges from 5 to 11 watts and is completely pre-wired with a supply cable (from regulator to wall-mounted switch) and a 4.5-meter cable (from switch to luminaire).

10. Maxlite also manufacturers regulators specifically designed for easy installation, repair, and comprehension by lay users.

Free Energy Europe 14 Watt PV Kits (www.free-energy.net)

11. Between three and five companies are marketing low-power (12-14–Wp) amorphous silicon modules into the African market (primarily Morocco, Zimbabwe and Kenya). The leader is Free Energy Europe, which has commercially developed its products and balance of systems to meet the consumer needs. It supplies a kit including a module, charge regulator and several lights for developing countries. Despite the kit's low cost, the company has found that it is easy to sell its modules into the market and let local assemblers provide the balance of systems. Often, the charge regulator is left out as consumers find that, for the price of the regulator, they can almost afford to purchase a second module.

12. This company's experience of selling several hundred kilowatts of PV into the Kenyan market per year (about 10 thousand systems), without regulators, is important as a background for this study. Their low-end customers are interested in the appliance, the battery and the module (in that order). These are the customers who evaluated the Battery Pack and found it much too expensive for their needs.

Developed-Country Products

13. At least two established manufacturers of electronics have addressed the need for portable power (albeit in small amounts) for developed countries. Their products are targeted for the leisure market, the off-grid market and the emergency/security market to power lights, music, TV, small tools or computers:

- **StatPower Portawatt (www.statpower.com)**. Statpower, a successful inverter manufacturer, has incorporated a 300-watt inverter, a sealed 18-Ah lead acid battery, control electronics into a portable plastic package that includes a sturdy handle. The unit can be recharged from the mains, car or solar.
- **Steca Portable Solar System (www.steca.de)**. Steca, a well established manufacturer of charge regulators, has developed two sizes of portable "solar systems" which include a sturdy case with handle, 6.5- or 24-Ah batteries, charge regulators and LED displays, and connections for 12-VDC charging and appliances. The device does not include an inverter, and instead has connections for 12-VDC lamps.

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Uganda	Report on the Uganda Power Sector Reform and Regulation Strategy Workshop	08/00	004/00
Kenya	The Kenya Portable Battery Pack Experience: Test Marketing an Alternative for Low-Income Rural Household Electrification	05/01	012/00
	EAST ASIA AND PACIFIC (EAP)		
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ESMAP

The World Bank

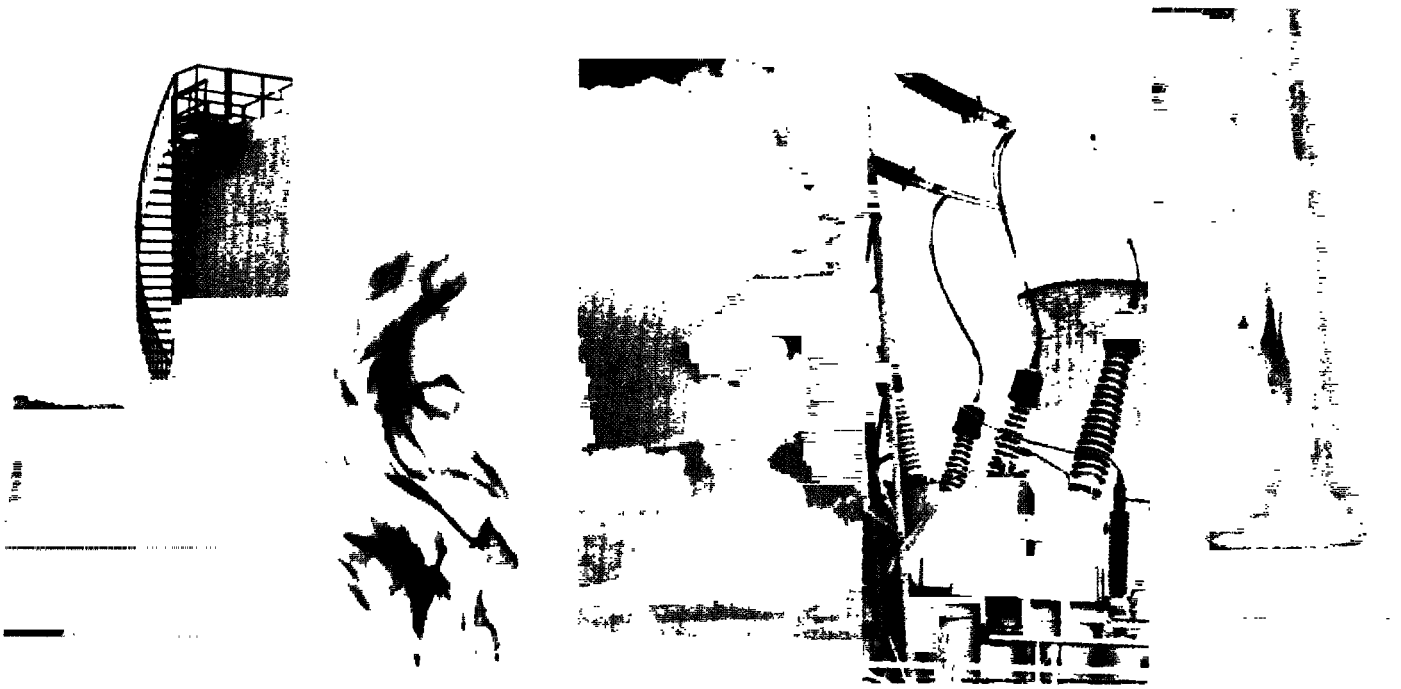
1818 H Street, NW

Washington, DC 20433 USA

Tel.: 1.202.458.2321 Fax.: 1.202.522.3018

Internet: www.esmap.org

Email: esmap@worldbank.org



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