THE GLOBAL MARKET POTENTIAL FOR A ROBUST FIFTY DOLLAR SOLAR LANTERN

Paul Polak, 8/25/97

Introduction

The technology focus derived from developed countries and major development donors continues to be irrelevant to the needs of poor people in developing countries that make up the majority of the world's population. The development establishment remains pre-occupied with modern motorized transport, when the majority of the world relies on walking to meet transport needs, and needs access to devices like more affordable bicycles. To improve health, the development community provides water and sanitation technologies that have to be subsidized because they cost so much, instead of facilitating access to more affordable handpump and latrine technologies which can be provided by the private sector. The smallest irrigation technologies promoted by development organizations, like 5 horsepower diesel pumps, are neither affordable nor economically sustainable for the majority of the world's farmers who cultivate less than five acres.

The recent development and rural mass marketing of thirty five dollar Treadle Pumps that irrigate three quarters of an acre and fifty dollar drip irrigation systems that irrigate half an acre have begun to reverse this trend. One and a quarter million Treadle Pumps marketed by IDE are earning 125 million dollars a year in new net income for one-acre farmers in Bangladesh. The focus on affordability and rural mass marketing that has led to the remarkable success of the Treadle Pump is directly applicable to the field of photovoltaics. IDE's experience with the successful mass marketing of other low cost rural products indicates that it takes a much bigger investment of time and money in marketing than in product development, if a product is to be successfully disseminated.

Three factors are the critical determinants of the current miniscule global sales of photovoltaic products.

1. Currently available PV products are engineer-driven instead of being market-driven.

2. There has been very little active marketing of solar products, especially in developing countries where a huge untapped market exists.

3. There has been no disciplined focus on affordability, which is the key to mass markets in developing countries.

THE PHOTOVOLTAICS INDUSTRY

In the past 20 years, the future potential attributed to the photovoltaics industry has far surpassed its actual performance. Annual global shipments of Photovoltaic cells reached 90 megawatts in 1996. , an increase of 15% over 1965[1]. The output of all of the PV cells shipped in 1996 represents only a fraction of the output of a single coal fired generating

plant. The current impact of photovoltaics on global energy use is picayune. This may well be because the cost of PV generated electricity is still extremely high compared with power from the utility grid, and may remain so. [2]

The fact is that the drop in price of PV cells over time, while significant, has consistently been much lower than the experts have predicted. This has produced the photovoltaic volume/price impasse. The price of photovoltaic cells is too high because the sales volume is too low, and the sales volume is low because the price is too high. The way out of this impasse is to take advantage of unexploited market opportunities to quickly ratchet sales volume upwards at existing prices.

THE WAY TO BREAK THE PV SALES/PRICE LOGJAM

Exactly such an opportunity exists. Until now the marketing of PV cells has been based on a top-down approach that focuses on large PV installations. At the same time, the majority of the world's population is poor, lives in rural areas and will never be connected to the electric grid. Recently, sales of solar home systems consisting of a panel, a battery, several lights, and a hookup for a black and white TV in countries have rapidly increased in countries like Kenya[3] [4]. But the solar home systems now being sold will only reach a tiny fraction of this huge potential global market, because their purchase price starts at several hundred dollars, which is far more than most of the people in the world can afford.

The starting point for the huge untapped global market is the provision of three hours of light each evening that is significantly superior to the candles and simple kerosene lanterns that are now available[5]. An affordable solar lantern, using a 5-watt solar panel, a lead acid battery, a fluorescent tube, and electronic controls can supply this. A robust fifty-dollar solar lantern can quickly reach global sales of 10 million units a year, which would increase existing global sales of PV cells by fifty percent.

Why Sales of Existing Solar Lanterns Have Never Taken Off

If there is such a huge market potential for solar lanterns in developing countries, why have sales of existing solar lanterns been so meager, especially since major brands like Siemens, Kyocera, Soltec and Solite are available? The answer to this question is readily available by asking people in developing countries about their experiences after purchasing a solar lantern. I recently had an opportunity to interview 3 rural dealers in solar home products about the failure rates of 48 solar lanterns they had sold. This information was supplemented by detailed face to face interviews with 10 of these purchasers[6]. It quickly became clear that the 12-month failure rate of the solar lanterns distributed in Kenya was in the range of 50%. This is consistent with the findings of other studies[7] [8].

A fifty- percent failure rate of existing solar lanterns will make their successful rural mass marketing impossible, or at best extremely difficult. In poor rural areas with limited

access to mass media, word of mouth is the most important vehicle for technology dissemination. IDE's experience with the mass marketing of thirty dollar Treadle Pumps indicates that consistent high quality, both of the product and its installation, is essential, particularly for the first products sold, if ongoing marketing initiatives are to be effective. For a successful marketing initiative for affordable solar lanterns to be launched it is essential that the factors producing high failure rates for existing solar lanterns to be remedied.

Why Existing Solar Lanterns Fail

The key reason that solar lanterns broke down was battery failure. The batteries used in existing solar lanterns are typically lead acid or gel-cell batteries, and the main reason they fail early is that they are discharged to too low a level, and not recharged adequately. Understandably, the purchaser of a solar lantern keeps the lantern on each night until the light turns off, charges the battery with the solar panel the next day, and repeats the process. For optimal life, the level to which the battery is discharged must be limited. Continuing to operate the battery in an excessively discharged state shortens battery life by 90%. Operating a fluorescent tube under the low voltage conditions of an excessively discharged battery produces early tube blackening and failure, which is the second most commonly observed solar lantern problem.

DESIGN SOLUTIONS FOR A ROBUST AFFORDABLE SOLAR LANTERN

The continued operation of the battery at a low state of charge can be solved relatively easily by installing a tamper proof low voltage disconnect switch which turns the lantern off when the battery is discharged to the long life threshold point. Using a lead acid battery modified for deep discharge would further extend battery life. These changes are being incorporated into a new affordable solar lantern being designed in Kenya under a project supported by ODA for the design and rural mass marketing of an affordable solar lantern.[9]

THE CRITICAL IMPORTANCE OF AFFORDABILITY

Cost is the critical variable that needs to be addressed for an entry-level solar lantern to reach a global mass market. Every five-dollar drop in price for the solar lantern adds hundreds of thousands of potential customers in developing countries. Optimizing affordability requires a disciplined process of identifying trade-offs that are acceptable to customers in order to lower the price. It is critical to determine the minimal standards that are acceptable to customers in the interest of reducing cost

SOLAR LANTERN TRADE-OFFS IN THE INTEREST OF AFFORDABILITY

It is easy to say that there will be a huge global market for an affordable solar lantern. But it is much more difficult to decide which desirable features need to be sacrificed in order to bring the price down to fifty dollars. In the end, this can only be accomplished by a systematic process of discovering from end users the trade-offs they are willing to make

in the interest of affordability. Here are some initial observations derived from interviews with the rural Kenyan owners of solar lanterns.

1. Zero Reserve Days of Light

Solar Lanterns are commonly designed to have three reserve days of light to provide for cloudy or rainy conditions. But all the buyers of solar lanterns interviewed used a simple kerosene lantern before they bought a solar lantern, and still had it in the house. Poor rural customers are much more likely to prefer using kerosene lamps on cloudy days than to pay a high price for reserve lighting capacity.

2. Brightness of Fluorescent Tube – 6 Watts

Rural customers in Kenya purchased several models of solar lanterns with different light sources. The Kyocera lantern for example, had two 6 watts tubes, which could be switched on singly, or in combination. While customers appreciated the one-light/two light feature, they usually used only one light for reading, because light duration was more important than brightness, and they found one 6-Watt fluorescent tube to be acceptable. Would a 5-Watt tube also be acceptable? The threshold of acceptable brightness and color needs systematic consumer studies, but the Kenya experience suggests that a single 6-Watt fluorescent tube is acceptable in an entry-level solar lantern for a poor rural customer.

3. Light Duration – 4 Hours

For the rural people who bought solar lanterns in Kenya, duration of light provided by the solar lantern was its most critical feature, and all of them wanted the light to stay on as long as possible. The threshold duration for an acceptable solar lantern is likely to be 4 hours. In countries with poorer access to sunlight than Kenya, the light duration may need to be adjusted downward to stay within fifty dollar threshold purchase price.

Tracking the Sun with the Solar Panel

Prior to my trip to Kenya, I had talked to a wide variety of solar experts, who all stated emphatically that the owners of solar home systems would never take the time to track the sun by shifting the solar panel during the day. Imagine my surprise when I found that 40 percent of the owners of solar lanterns were spontaneously moving the solar panel two or three times a day to optimize the energy they could collect from the sun? This is, after all, not so difficult to explain. It is clear that the most important feature of a solar lantern to rural buyers is the amount of light-giving time that can be coaxed out of it. If you can squeeze a half-hour or hour more light out of a solar lantern by tracking the sun with he panel, it makes sense for rural Kenyan consumers to do it.

This has profound implications for the design of an affordable solar lantern. The efficiency of electricity storage can be improved by twenty to thirty percent by tracking

the sun with the solar panel, which translates into 20 to thirty percent more hours of light. This allows the option of changing the design of the lantern to further lower its cost, or increasing the duration of light without increasing the cost of the lantern. It is clear that communication effectively with customers about how to track the sun with the panel will need to be an essential part of marketing initiatives for low cost solar lanterns.

MAKING SOLAR LANTERNS BOTH VISIBLE AND PROFITABLE

IDE's experience in mass marketing low cost tools to poor rural families in developing countries clearly indicates that the capacity of the product to generate income that contributes to the family's economic survival is a vital feature of a product's capacity to generate exponentially increasing sales. A solar lantern can be used to generate income.

Since solar lanterns are seen as highly desirable by rural families who become familiar with it, the key to exponentially increasing rural sales is facilitating the exposure of large numbers of potential rural purchasers to properly working solar lanterns. Rapid exponential increases in initial sales can be accomplished by focussing initially on two features of solar lantern applications.

1. Target initial purchasers who use solar lanterns to generate income.

2. Target initial sales of solar lanterns to highly visible locations.

The small shops in Kenya provide a perfect example of using solar lanterns in both visible and profitable applications.

Solar Lanterns for Kenyan Dukas

Village shops, or Dukas, play an important part in the informal sector in rural, urban, and peri-urban areas in Kenya. These small shops, typically consisting of nothing more than a small wooden shack, stock basic items like matches, candles, cigarettes, soap, toothpaste, and a few vegetables and canned goods. In most rural areas and in many urban areas in Kenya, electricity is not available. Where electricity is available, it usually is not reliable. After dark a shopkeeper can use a kerosene lamp or close early.

I interviewed four shopkeepers who bought solar lanterns in Kenya, and most of them said that their income was increased because they could stay open longer, and once they bought the solar lantern, their expenses were cut because they no longer used kerosene. Most importantly, every shopkeeper with a solar lantern generated sales of solar lanterns for the dealers who sold them. Everybody in a rural village visits a shop to buy basic goods. A single solar lantern sold to a village shop is seen by hundred families, which predictably attracts the interest of rural families who visit the shop. Targeting initial sales of lanterns to purchasers like shopkeepers both increases the probability of further sales by other shopkeepers attracted by the income generating features of the lantern, but also

generates additional sales to rural families because of the high visibility of each lantern in the shop. All the shopkeepers I interviewed were quite willing to put up a poster, and provide brochure information on solar lanterns to potential customers.

Solar Lanterns for Village Entrepreneurs

There are many other highly visible and income generating applications for solar lanterns in developing countries. Flower selling carts, peddlers carts, tailors, village healers, blacksmiths, and cobblers are examples of visible income generating applications for solar lanterns in developing countries. Fishing offers another income generating opportunity for solar lanterns. The Dagaa fishery for example on Lake Victoria supplies thousands of sun dried, sardine like fish to the interior of Kenya by airfreight. The Dagaa fishery depends on large pressure kerosene lanterns to attract the fish to nets on moonless nights. Replacing the high operating cost of large pressure kerosene lanterns with solar lanterns designed specifically for fishing would increase the income of Dagaa fishermen.

Marketing Opportunities in Developing Countries

The effective global marketing of a low cost solar lantern will require a major investment in marketing in each of the countries where solar lanterns are likely to be popular. This includes major promotional initiatives, like soap operas, entertainment, and demonstrations in places where people gather, like markets and bazaars. It means significant investment in popular education about the advantages of solar lanterns, how they work, and how they can best be operated. It means major initiatives to activate and strengthen private sector mechanisms in each country for the profitable and reliable production, distribution, and marketing of solar lanterns.

An Initiative to Design and Market a Robust Fifty Dollar Solar Lantern in Kenya

A project is currently underway to design and market a fifty-dollar solar lantern in Kenya.[10] First prototypes of the low cost solar lantern will undergo field tests and market tests in the first half of 1998, with full scale marketing in Kenya scheduled to start in 1999. If successful, this project can serve as a model for the global marketing of a robust fifty-dollar solar lantern.

GLOBAL MARKET POTENTIAL

From interviews carried out with a representative sample of one thousand Kenyans, Hankins et al concluded that there is a market for just under 1. 4 Million solar lanterns in Kenya at the existing price of approximately one hundred dollars.[11]. Assuming that the potential market for an acceptable fifty dollar lantern would be at least two million, and that thirty percent of the potential market would eventually become buyers, translates into total sales over time of 600,000 lanterns, which represent about 3% of the total population of Kenya. If all these buyers could be reached over a fifteen-year period, annual sales of 40,000 –50,000 could be expected in a mature market.

If the population of Kenya is broadly representative of the 3 billion people who live in developing countries, the global market for an affordable solar lantern would be in the

range of 3% of billion, or 90 million, with annual sales of 9 million in a mature market. The sale of nine million lanterns a year, each with a five-watt solar panel, would create annual sales of PV panels totaling 45 megawatts. This would increase current annual sales of PV panels by 50%, at the present prices.

SUMMARY AND CONCLUSIONS

While global sales of PV cells are on a steady upward course, increasing by 15% a year, present global sales in the range of 90 megawatts represent are miniscule on a global scale. The fact is that future potential of the global photovoltaic industry has always been far greater than its capacity to generate current sales. This is in large part due to a vicious cycle- sales volume stays low because the price is too high, and the price is too high because sales volume is too low. One way to break this logjam is to identify opportunities to generate a significant jump in global sales volume at present day prices for PV cells.

It is our contention that the design and mass marketing of a robust fifty dollar solar lantern represents just such an opportunity. Sales of PV cells have focussed on larger scale applications. The solar home market is expanding rapidly, but costs of existing solar home systems start in the $400-600 range. Solar lanterns provide a solution to a high demand key component of solar home systems- the provision of good quality light. But global sales of solar lanterns have been impossible because of the unreliability of current lanterns in the $100 price range, primarily because of early battery and light failure. It is our contention that these design problems are readily solvable, and those significant cost reductions for an entry-level solar lantern are also feasible. A robust fifty dollar solar lantern not only can provide a source of reliable light for huge numbers of the world's population that will never have access to the electric grid. Perhaps significantly, the resultant 50% increase in sales of solar cells is likely to kick-start significant drops in the price of PV cells, which in turn is likely stimulate rapid increases in global sales of photovoltaic products.

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[7] Hankins, Mark. Ibid.

[8] Acker, Richard, and Kammen, Daniel. Ibid.

[9] This project is funded by a grant ODA (UK) managed by Ray Holland and Mike Hornsby, of Intermediate Technology Consultants, Myson House, Railway Terrace, Rugby CV21 3HT, UK and ITDG Kenya, with leadership on marketing from International Development Enterprises, 10403 W Colfax St, Lakewood, Colo, 80215, and Kenyan marketing studies conducted by Mark Hankins et al, Energy Alternatives AFRICA Ltd., Nairobi. Private sector partners in this initiative are Associated Battery Manufacturers, Doug Lanbert, managing director, PO Box 48917, Nairobi, Kenya, and Sollatech

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