Another Look at Renewables on India's Sagar Island

Sam Shrank

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Program on Energy and Sustainable Development
Freeman Spogli Institute for International Studies
Encina Hall East, Room E415
Stanford University
Stanford, CA 94305-6055

http://pesd.stanford.edu

About the Author

Sam Shrank is an M.S. candidate in Civil and Environmental Engineering and B.A. candidate in Economics at Stanford University. His research interests include distributed generation in the developing world, transportation policy, and the politics of energy within the United States. He recently completed his senior honors thesis analyzing the potential for solar water heating in New Zealand's tourism industry.

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Abstract

Much existing literature champions renewables implementation on India's Sagar Island as an unqualified rural electrification success story. Photovoltaic (PV) and wind systems put in place by the West Bengal Renewable Energy Development Agency (WBREDA) have clearly brought benefits to many of the island's residents. The highly-touted community management system governing the projects has been successful at instilling local pride and overcoming the traditionally thorny problem of tariff non-collection. At the same time, an on-the-ground look at the Sagar Island experience identifies some deeper liabilities of the business model guiding the renewables projects. Two of the ostensible strengths of the Sagar Island implementation – the harmonious tariff collection associated with community management and the resources, competence, and assertiveness of WBREDA itself – can at the same time be considered weaknesses limiting the scope, sustainability, and replicability of the projects. This working paper considers these questions through a case study of a typical Sagar Island facility, the Mritunjoynagar PV power plant. It finds that Mritunjoynagar's inability to recoup its full operating and maintenance costs by providing appropriate incentives for profit maximization limits the expansion of the project and threatens its long-term sustainability, or at least the relevance of its business model in the absence of a highly-visible champion like WBREDA to ensure continued support. For WBREDA and other agencies to sustain and replicate similar projects—and their attendant benefits—throughout India, they must adjust their economic model, as WBREDA is beginning to implicitly acknowledge in exploring a franchise model for future efforts.

I. Introduction

Access to energy – notably, electricity and modern cooking fuels – is crucial to relieving the stresses on the world's poor. India is home to almost a full third of the world's population without electricity (IEA 2006). The vast majority of these live in impoverished rural areas that languish without grid connection or viable distributed generation options even as cities such as Mumbai, Bangalore, and Delhi integrate themselves into the global economy. A succession of government programs in the last 20 years have aimed to increase the household electrification rate in rural areas, with largely ineffective results (Bhattacharyya 2006).

The Electricity Act 2003 (EA03) marked an increase in urgency attached to the problem at the national level, codifying the requirement to supply electricity to all villages. To implement the law, the government launched the Rajiv Gandhi Grameen Vidyutikaran Yojana initiative in 2005, with the aim of achieving universal electrification by 2012. In theory, electricity produced under the Rajiv Gandhi scheme is supposed to cover operational costs (except for households below the poverty line). The Rajiv Gandhi guidelines also emphasize distributed generation options in cases where grid extension is not feasible, with individual states required to submit proposals to the Ministry of Non-conventional Energy Sources (MNES). MNES envisions a major role for renewable sources in meeting the 2012 electricity requirement (Banerjee 2006).

Some have criticized the emphasis of the Rajiv Gandhi scheme on the initiative of the states because many of the states with the largest rural electrification needs are also those with the most inefficient or least interested bureaucracies, but it has allowed for motivated states to make large strides. Among the most successful has been West Bengal, under the direction of the West Bengal Renewable Energy Development Agency (WBREDA). WBREDA has been able to secure additional funding for its projects from state and local governments and recently from the private sector as well, and as of March 2006 provided power to more than 100,000 households in West Bengal.

Much of WBREDA's work has been done in the Sundarbans, a collection of islands amidst a mangrove swamp in the Ganges Delta. The largest of these is Sagar Island, the site of a yearly pilgrimage of more than a million Hindus looking to bathe in the waters of the Ganges Delta. It is permanent home to only 200,000, however, with six kilometers of tidal water keeping it isolated and undeveloped. Prohibitively high cost has kept Sagar Island disconnected from the grid, and until recently the only power it received was from diesel generator sets provided by the West Bengal State Electricity Board. These supplied only 650 customers four hours a day, and by 2000 were operating at a loss even with consumers paying Rs. 18-22 for a single light point (Chakrabarti and Chakrabarti 2002). With such high cost, expanding this program throughout the island was not an attractive option.

WBREDA became interested in Sagar Island in 1994, and has since used both solar photovoltaics and wind-diesel hybrid systems to electrify much of the island (Figure 1). The program began with the installation of individual solar lighting systems, which now provide electricity for more than 2,000 families (Ashden 2003). There are now ten solar photovoltaic power plants (Figure 2) carrying a total capacity of more than 300kw and powering more than 1,600 households for six hours a day (Ashden 2003). Beginning in 2002 WBREDA initiated a wind-diesel hybrid program on Sagar Island, the first of its kind in India. The system consists of two 180kw diesel gensets connected to four 55kw wind turbines. Whenever the turbines cannot generate enough electricity to meet demand the gensets make up the difference. This system now meets the demand of more than 700 households and major commercial parts of the island (WBREDA 2007). In just the past year WBREDA has begun to add biomass capability to its hybrid system and formulated plans for the addition of six more wind turbines, further lessening the need for diesel and increasing the power WBREDA can supply to its customers.

Renewables implementation on Sagar Island has been hailed as a rural electrification success story, winning the Ashden Award in 2003 and earning praise in the academic and popular literature (TERI 2004, Chakrabarti and Chakrabarti 2002, Chaurey 2004, Basak 2004). The goal of this paper is to re-examine the situation on the ground at Sagar and consider how the implementation business model for the project fares on Hisham Zerriffi's three criteria of improved access to electricity, sustainability, and replicability (Zerriffi 2007). To this end, I performed a detailed operational and financial evaluation of the Mritunjoynagar power plant (in capacity and design typical of the ten such photovoltaic plans on the island), in the process interviewing the director of WBREDA, S. P. Gon Chowdhury, WBREDA officers who worked specifically on the Sagar Island projects, and many Sagar locals.

II. Operational Model

The Mritunjoynagar plant, built in 1998, has an installed capacity of 26kW and services 120 households. It provides power for five hours each day, from 6-11pm. Demand is very low at other times of the day, when the majority of consumers are not at home. The power plant is equipped with a set of batteries that store energy throughout the day and disperse it in the evening.

The Sagar Rural Energy Development Cooperative (SREDCOP), comprised of important local officials, oversees all renewable electrification on the island. Each power plant then has a beneficiary committee, made up of a SREDCOP member and other village leaders as well as consumer representatives, that is responsible for consumer selection, setting and collecting tariffs, and some aspects of maintenance. Though WBREDA maintains an advisory role, the beneficiary committee has the final say on all pricing decisions. It is not capable of more complex maintenance, however, and so WBREDA plays an active role in this area. SREDCOP is also responsible for dealing with non-payment and illegal activity through a Local Management Committee (LMC). A study of a solar plant on the island found that "the system of supervision through cooperatives [makes] the whole system more efficient by reducing the loss of revenue owing to lapses in collection" (Chakrabarti and Chakrabarti 2002). This is seen at the Mritunjoynagar plant as well, which according to its local managers has 100% compliance with tariffs.

Community management systems like this one on Sagar Island are represented in the literature as a boon to rural electrification. The failure of previous programs is attributed to their inability to involve the local citizenry and instill in them "a feeling of asset ownership and a sense of belongingness" (Malhotra 2004). Examples such as a 1996 study of solar water pumps installed in Hyderabad, where 34% were found not to be functioning due to a lack of local understanding and access to spare parts (Malhotra 2004), are given to show that local involvement is critical. Moreover, local involvement can also contribute to a project's success by minimizing the electricity theft and monitoring difficulties that are common throughout India. Locals are more effective at controlling subversive behavior and enforcing rules than energy utilities or government agencies, particularly when it is in their interest to do so. A case study in Orissa "clearly [showed] that it is possible to improve the operational and commercial viability of the DG scheme if the community is made an important stakeholder" (Chaurey 2004).

While the existing literature acknowledges Sagar Island's generous financing and suitable endowments of sun and wind as necessary conditions, it frequently identifies the community management system as integral to its success (see, for example, TERI 2004). Villagers performed much of the manual labor required to install the power plants and were consulted as to their interest in the project before it commenced. My own observations corroborate the way in which the community management system on Sagar Island has engaged the local populace and prevented the power theft so

common elsewhere in India. The locals' pride in their power plants is immediately evident, and they recognize the opportunities the plants have given the entire island.

III. Financial Model

The successes achieved on Sagar Island so far, however, are also a product of the effectiveness of WBREDA's fundraising. WBREDA is more active and effective than most of its counterparts in this regard and is able to commandeer more national and provincial funding. WBREDA was able to attract significant funding from the Government of India (GoI) even before the Rajiv Gandhi scheme was implemented, and now that all projects must be initiated on the provincial level, WBREDA has perhaps an even larger advantage. Its less well-organized and more poorly-funded counterparts cannot match the proposals WBREDA brings to MNES. Moreover, WBREDA is able to tap local funding sources not available in other states. For many of its early Sagar plants, including at Mritunjoynagar, the entire capital cost was covered by grants from the national and state governments and international NGOs (TERI 2004).

At the outset of the Sagar project, WBREDA received grants totaling 70lakh (7,000,000Rs) that not only covered the entire capital cost but also the first five years of operations and maintenance cost. Half of the funding came from the GoI and the rest from a combination of state and local funds, the MP Local Area Development funds (MP-LADs), and soft loans from the Indian Renewable Energy Development Agency (IREDA) through its World Bank credit line. Yearly recurring O&M costs total 84,000Rs/yr, consisting of staff salary of 48,000Rs/yr and other operating expenses of 36,000Rs/yr. The other important cost to consider is battery replacement. Critical to the entire project, the set of storage batteries must be replaced every seven years at a cost of around 9lakh (900,000Rs).

The plant charges its customers a tariff based on the number of connected power points rather than the actual amount of energy used. Consumers can pay 85Rs/mo for 3 outlets, 135Rs/mo for 5, or 270Rs/mo for 10 – the vast majority of consumers have either 3 or 5 power points. There are also a certain number of bulk customers who pay a fixed rate. Officials interviewed on site put the total revenue of the plant at approximately 1.5lakh/yr (150,000Rs/yr), which corresponds to an average payment of roughly 100Rs/mo (site visit). Payment is collected twice per month at the plant site (each household needs to pay only once a month), and there is a near 100% payment rate. This unusually high compliance (when compared to most of the Indian electricity sector) is credited to the managers' close ties to the community, which provide them with detailed knowledge of their consumers. Therefore in the first five years, when all costs were covered by the original grants, the plant took in around 7.5lakh (750,000Rs) in revenue. Factoring in operations and maintenance costs and excluding battery replacement, yearly profit was around 66,000Rs/yr. The first battery replacement, undertaken in 2005, was barely covered by the plant's revenue, but without the five-year operations and maintenance subsidy for the next cycle, there will not be nearly enough money for new batteries in 2012 (Figure 3).

IV. Evaluation

(i) Improved access to electricity

The renewables implementation on Sagar Island has greatly increased the number of households with access to electricity. Before WBREDA began its work on the island only 650 households had access to electricity through diesel generators, and this power was expensive and only lasted four hours a day. The photovoltaic power plants alone now provide power directly to roughly 1,300 households, and can provide higher quality electricity more cheaply and for six hours a night

instead of four. Power now lasts from 6pm-12am instead of ending at 10pm. Demand for electricity stays very high after 10pm, and so the increase to six hours is particularly important. The Mritunjoynagar power plant itself serves 120 households directly, and through battery charging indirectly provides power to many more.

This increase in electricity access has brought attendant economic, social, and health improvements to the island as well. Two hospitals run on solar energy, and eighty streetlights installed around the island enable residents to travel and congregate more safely at night (Ashden 2003). The ability to light the streets has led to the creation of small businesses along the island's main thoroughfares whose profits are growing based on increased hours of operation. Children are now able to do their homework at night, giving them more time to study or help their parents. Within four years noticeable increases were observed in the level of education and literacy on the island (Chakrabarti and Chakrabarti 2002, Ashden 2003).

These accomplishments have led to widespread acclaim for the Sagar project. In 2003 WBREDA was given an Ashden Award for enterprise in sustainable energy for its work on Sagar Island. WBREDA has received similar praise in the academic literature. One paper states that the Sagar experience has "shown that it is possible to link activities for income generation with the provision of high quality and reliable electricity, and enable the beneficiaries to pay for the services" (Chaurey 2004), while Chakrabarti and Chakrabarti contend "a strong case [can be made] for the locally installed SPV system" over other energy options, again stressing its help to the local population (Chakrabarti and Chakrabarti 2002).

While the benefits to many in the community from the Sagar projects are indisputable, we can ask whether electricity access could be spread even more widely with an altered business model. The Mritunjoynagar power plant services an area that contains some 425 households, while supplying electricity to only 120, roughly 30% (Chakrabarti and Chakrabarti 2002). These households are the ones that chose to involve themselves in the project from the beginning. Many households that do not receive electricity from the power plant charge car batteries at their neighbors' power points, suggesting that the demand for electricity exceeds the current supply directly available through household connections. It is difficult to evaluate what portion of excess demand is met by these informal battery charging services. With a more profit-oriented business model—such as tariffs that reflected real value and the cost of rivals—Sagar's managers would have more direct incentive to ensure that all available demand was being met, expanding generation if necessary.

(ii) Sustainability

In its award description Ashden called the Sagar project's impact "dramatic" and argued that as revenue covered 100% of operational costs and 20% of capital costs, it was likely sustainable as well (Ashden 2003). Our own analysis of Mritunjoynagar does not entirely bear out this assertion of sustainability. As explained above, once the money necessary for battery replacement is included, the plant's revenues do not in fact recoup its costs. Battery replacement requires setting aside almost 1.3lakh/yr (130,000Rs/yr), significantly more than the yearly profit 0.66lakh/yr (66,000Rs/yr). It would require another large infusion of capital to keep this project running past 2012. The plant's sustainability problem cannot be attributed only to the high cost of photovoltaic electricity, as the full capital grant accounted for the vast majority of this cost. Rather, the community management system has not led to the sort of profit-maximizing decisions that would allow the plant to be truly self-sufficient and would financially incentivize managers to address all available demand, as discussed in the previous section.

Entrepreneurial battery chargers extract electricity far out of proportion to the flat rate they are

charged for their power connection, a clear failure by the plant's management to recoup all possible revenue. We observed the financial model of one local battery charger. He has the capacity to charge fifty batteries every three days and charges 35Rs for each charge, for total potential revenue of 17,500Rs/mo. Yet he pays the plant only 960Rs/mo for his electricity. This leaves a potential margin of 16,540 Rs/mo. No doubt the business has other expenses it must pay, and it probably does not operate at capacity. Clearly, though, the Mritunjoynagar plant is forgoing significant revenue. By operating a battery charging service of its own the committee could recoup this revenue charging less than thirty batteries and could far surpass it by approaching the entrepreneur's capacity. This example, of course, highlights the important potential role of local entrepreneurship in rural energy schemes. At the same time, the rural electricity entrepreneur's business will itself not be sustainable if it operates on the back of an enterprise that does not recover costs.

In response one could argue that it is simply not feasible to extend the distribution system to cover all the power users currently serviced by the battery chargers or to install the meters necessary to charge consumers per watt instead of per outlet. Even so, with so many potential customers, a profit-maximizing firm would price its good so that the market clears. As previously discussed, however, the beneficiary committee simply delivers electricity to the households that involved themselves in the project at its inception. There is no direct evidence that these are not the households with the highest willingness to pay, and there is certainly a cost that would be incurred by extending distribution lines to new customers, but the failure to consider these options shows a tendency to think of electrification as a government welfare project, a mindset unlikely to lead to profit maximization and sustainability.

Moreover, there is compelling evidence that the beneficiary committee is not fully exploiting the willingness to pay of its current customers. A study conducted in 2000 found that almost half of the customers expressed a willingness to pay for electricity above the current price, with more than 80% of these willing to pay at least 6Rs/mo more and almost 40% willing to pay at least 16Rs/mo above the current price (Chakrabarti and Chakrabarti 2002). Nevertheless prices have risen only slightly in the past seven years, increasing by 15Rs/mo for both three and five power points (the ten power point option did not exist when the survey was conducted). With so many would-be customers waiting in the wings, the committee's failure to increase the price of its power is a failure to even try to maximize the financial returns that would enable the project to sustain itself and perhaps expand.

WBREDA seems to be realizing the limitations of local management, though this has had little effect so far on the operations of the PV plants. SREDCOP is involved with the wind/diesel/biomass hybrid system as well, but recently WBREDA has taken over the majority of SREDCOP's original responsibilities, including tariff setting. An independent external evaluation found that although SREDCOP was expected to handle the bulk of the implementation and management responsibilities, "SREDCOP was not in a position to take up major responsibility in project implementation and management of electricity supply as well as tariff fixation." (Hossain 2005) The evaluator attributed this to the "limitations emerging from [SREDCOP's] composition," as its members had no relevant expertise and were busy with their other responsibilities as local officials. SREDCOP's sole duty in relation to these hybrid projects is revenue collection, a task to which it is well suited and which it has performed well. WBREDA took steps to ensure continued local involvement in the running of the hybrid plant, holding regular meetings with a local group comprised of nine consumers and four village-level officials. Nevertheless, when scoring the project's success at achieving its many objectives, the lowest score the evaluator gave (2 out of 5) was for "formation / selection of a community organization for project implementation and management of electricity supply" (Hossain 2005). WBREDA's experience with its hybrid plant has clearly pointed out SREDCOP's inability to optimally manage power plants on its own. For the PV plants this manifests in a business model unable to support its own operations after a period of only 14 years.

Local officials offered some scenarios in which the plants' customers could continue to receive electricity past 14 years. First, the cost of batteries might fall or better batteries might become available (allowing the purchase of fewer) by 2012. Second, officials suggested that connection to the main grid could be only five or six years away for Sagar Island, and that once grid power was available the PV plants would be taken offline. In this scenario only one more battery replacement would be required over the entire remaining life of the project. The cost of grid connection, however, would be quite large, and so this outcome would by no means obviate government expenditure on rural electrification. Third, WBREDA is considering transforming the PV plants into solar/biomass hybrid systems that would provide power throughout the night (with peak demand occurring in the early evening, when the plants now provide power), as islanders are interested in greater electrification services. In such a scenario the PV installations would deliver a larger fraction of their power to customers at the time of generation and therefore would require less storage capacity and fewer batteries, reducing the cost of replacement. Nevertheless, the offering of three somewhat wishful scenarios does not instill confidence in the sustainable management of the project.

At the same time, it is highly unlikely that the showcase Sagar projects will be allowed to fail for lack of funds. Rather than shutting down, it is probable that the Mritunjoynagar plant and the others like it on Sagar Island would receive an infusion of cash large enough to cover any shortfall. WBREDA does not hold separate accounts for each project; rather, all revenue collected by the beneficiary committees is deposited in WBREDA's account with the Gramin Bank (TERI 2004). In the event of a crisis, WBREDA might choose to use this money for battery replacement, as Sagar Island is a very visible location, both in its own right and as a success story for Indian rural electrification. As mentioned above, it is a religious site well-known throughout India and the destination of a yearly pilgrimage. Perhaps more importantly, Sagar Island has been widely cited as an example of rural electrification that works, both in the Ashden Award and in a host of other literature. WBREDA features the Sagar Island projects prominently on its website and in its promotional materials. It is highly doubtful that WBREDA or the national government would let the power plants go offline before the grid reaches Sagar Island. Therefore, with revenue from the plant covering the yearly costs and good prospects for special support of big-ticket items like battery replacement, the Mritunjoynagar model is likely sustainable. However, as will be discussed in the next section, the special circumstances that make extraordinary financial support forthcoming for Sagar Island projects are unlikely to be replicable in the vast majority of other situations.

(iii) Replicability

The high visibility and aggressive support from WBREDA that make the Sagar Island plants unlikely to stop generating power any time soon at the same time call into question the relevance of the Sagar Island business model for states and regions lacking such fortuitous conditions – that is to say, the majority of cases in India. Though West Bengal is not prosperous by India's standards and has relatively low electrification per capita GDP, WBREDA is better established and more efficient than its counterparts in other states, with a correspondingly higher success rate in acquiring funds. As a general rule, organization is the major limiting factor in low-income energy implementations, with often only a small percentage of the money available for rural electrification projects ever utilized (Modi 2005). One of the motivations behind the Rajiv Gandhi scheme's stated emphasis on franchisees is to reduce the burden on state development agencies to administer scattered projects. The prospects for replicability throughout the country are low for ventures that require continuous attention and assistance from the supervising state agency, such as those on Sagar Island.

Even within West Bengal, Sagar Island is unusually suited to supporting rural electrification

projects. Though the island is by any measure rural and impoverished, the demand and willingness to pay for power is likely higher than in many other Indian villages. Development on Sagar Island has increased because of better transportation to Calcutta and because of the introduction of commercial farming and prawn fishing to the island's economy (Chakrabarti and Chakrabarti 2003). This increased economic activity has raised both the demand for and ability to afford power. Beyond any traditional activity, Sagar's importance as a pilgrimage location contributes heavily to the island's economy, especially along certain main corridors. Even during the majority of the year in which the pilgrimage is not active many islanders hang around the holy site hoping to perform rites, sell fruit, or beg from the few visitors.

According to WBREDA officials, Sagar Island has an unusually high literacy rate of 99%, which these officials believe increases the willingness to pay for electrification. Projects in West Bengal are sited at the request of local panchayats, or village elders, who approach WBREDA to ask for assistance. Sagar Island's relative wealth and high educational level have created well-informed and active panchayats who are better able to make a case and secure assistance from WBREDA. All of these factors make the replicability of the Sagar Island model throughout India low.

V. Conclusion

For all its redeeming qualities, the community management system employed at Mritunjoynagar does not create the incentives necessary for profit-maximizing behavior amongst the plant's local managers, with negative effects on sustainability, replicability, and perhaps even the scope of electrification achieved on Sagar Island. A key question is whether the community management system is inherently incompatible with more profit-oriented behavior (for example, because people are not willing or politically able to increase tariffs on their friends and neighbors), or whether a better-designed system could preserve the benefits of community management (for example in reducing the non-payment rate) while improving financial performance. WBREDA, and other agencies in India, settled on the most obvious mechanism for community involvement – through program management – with adverse economic consequences. Locals may not have the business experience or objectivity to set profit-maximizing tariffs. Moreover, without a direct financial stake in the project, they lack the incentives to create a self-sustaining system.

WBREDA has started to deploy an alternative model which it hopes will improve performance. Instead of handing control of projects to local community organizations, WBREDA is now auctioning off its grid electrification projects to franchise bidders from the private sector. Franchisees may still be community organizations, but they have to pay for their management role. Capital costs continue to be covered, but once the projects are under the franchisees' control no more financial assistance is provided. This scheme is intended to realign managers' incentives towards profit maximization, as they now will have a direct stake in the amount of revenue they bring in. The risk is that this approach will alienate locals through higher prices and less familiarity. There may still be effective ways to involve the local community, perhaps by using community leaders to ensure payment or to spread awareness of the project and the benefits it brings.

One way or another, achieving India's ambitious electrification goals requires development of business models that are widely applicable and inclined to spread of their own accord. WBREDA has expressed its intent to fully electrify Sagar Island with renewable energy by 2012 (WBREDA 2007, Basak 2004). Further detailed research therefore needs to be conducted on the merits of different management mechanisms. There may be much worth keeping in the Sagar Island approach, but it clearly does not yet represent the optimal rural electrification business model. A better understanding of the workings of the Sagar plants would provide more information on whether better-designed

community involvement can be effective. While it could be that the local managers are in fact unwilling to raise prices because of their ties to the community and lack of stake in the project's profitability, it could also be simply a lack of information and proper training. Or perhaps the governance and structure of the local management team needs to be improved, and incentives modified. The private franchisee model is also little understood, so it will be important to follow WBREDA's efforts and examine how franchisees are able to work with the community to assure compliance and cooperation, while at the same time pursuing profit maximization.

Type	Capacity	Households	Hours/day	Year of initial installation
Diesel	variable	650	4	Pre-1994
Solar Home Systems	30-70W per house	5000	6	1994
PV	356kW	1600	6	1996
Wind/Diesel hybrid	580kW	700	6	2002

Figure 1: Electricity production on Sagar Island

Location	Capacity (kW)	Year of Installation
Kamalpur	26	1996
Mritunjoynagar	*26*	*1998*
Khasmahal	25	1999
Gayazbazar	25	1999
Mahendranagar	25	1999
Natendrapur	28.5	2000
Uttar Haradhanpur	32.5	2000
Mandirtala	28.5	2001
Koyalapara	120	2006
Rudranagar Hospital	20	2006

Data from WBREDA 2007

Figure 2: The Sagar Island Photovoltaic plants

Year	Est. Revenue	Est. Operating Cost	Battery Cost	Est. Cash Available
1999	150,000	Covered by grant		150,000
2000	150,000	Covered by grant		300,000
2001	150,000	Covered by grant		450,000
2002	150,000	Covered by grant		500,000
2003	150,000	Covered by grant		750,000
2004	150,000	(84,000)*		816,000
2005	150,000	(84,000)	900,000	882,000**
2006	150,000	(84,000)		66,000
2007	150,000	(84,000)		132,000
2008	150,000	(84,000)		198,000
2009	150,000	(84,000)		264,000
2010	150,000	(84,000)		330,000
2011	150,000	(84,000)		396,000
2012	150,000	(84,000)	900,000	462,000
2013	150,000	(84,000)		(438,000)

Figure 3: Estimated annual revenues and costs of the Mritunjoynagar plant

*This includes yearly staff salary of 48,000Rs and other costs of 36,000Rs.
**These numbers being estimates, the system was in fact able to pay this full cost.

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