

Clean Distributed Generation for Slum Electrification:

The Case of Mumbai

This paper discusses the lack of electrification in slums in India, focussing on the slums in the city of Mumbai as a case study. Electrification is important for the quality of life of the slum-dwellers, and is a path towards further development. For a variety of sociological, infrastructural, and economic reasons, traditional electric service is not available in the slums. A unique solution to this problem is the use of renewable distributed generation technologies, specifically solar photovoltaic and wind power. Because they are flexible, cheap, suited for Mumbai's climate, and empower the community, solar/wind arrays should be made available through micro-credit to slum-dwellers in Mumbai

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1.5 billion people, about a quarter of the world's population, do not have access to electricity, according to United Nations estimates. In South Asia alone, according to the same estimates, 800 million people have no access to electricity. While many of those in both the world and South Asia live in rural areas, remote from power generators, a rising number live in the informal urban settlements called slums. Approximately one-third of the world's urban residents, totaling over 1 billion people), live in such slums. While some of these slums do have access to electricity, many do not. In total, some 40% of the world's urban poor have little or no access to electricity (UN MDG, 2005). Lack of electricity can bring more hardships to the urban poor than the rural, as the urban poor have no agricultural economic system on which to rely. Electrification can raise the quality of life in slums dramatically, as well as serve as a gateway for further development. These slums that do not have access to electricity therefore constitute a unique problem for sustainable development.

This paper will first lay out precisely the nature of the problem, then discuss why traditional electricity service is not provided in many slums. It will then proceed to suggest that a combination of photovoltaic and wind power are uniquely able to address the difficulties of electrifying the slums of Mumbai, and similar slums situated on the Indian coast. Lastly, the paper will discuss how to implement electrification projects that rely on photovoltaic and wind power.

The slums of Mumbai, home to more than half the city's 16 million inhabitants in 2335 distinct settlements, are used as a case-study throughout this paper (Maharashtra provincial website). While some of the principles are applicable to slums in general, the reasoning and data present herein are intended to be valid with respect primarily to the

slums of Mumbai.

Throughout the paper, the word “slum” and “slum-dweller” will be used to refer to informal urban settlements and the residents of these settlements, respectively. These settlements, though traditionally extralegal, may be legally constituted. Used in this sense, in accordance with accepted academic usage, “slum” is a technical term, and is not intended to connote any sort of value judgment about these informal settlements.

Why electrification is important

The United Nations’ guide to Energy Services for Millennium Development Goals, written by the UN Millennium Project, UN Development Program (UNDP), The World Bank, and the joint UNDP-World Bank Energy Sector Management Assistance Programme (ESMAP) writes concerning the need for energy in poor urban settlements:

“The fact that electricity is often ‘tapped off’ illegally in urban poor areas is a testament to the desire of the poor to have access to the benefits that electricity provides, such as illumination, radio and television, and the ability to use machines and appliances that create jobs and incomes. In many cases, the fees recovered by informal sector middlemen who charge for these services outside of the utility structure testifies to poor families’ willingness to pay for electricity, even at a high cost. (UN MDG)”

The demand for electricity is immense among slum-dwellers. The UN report on Millennium Development Goals links this demand with the immense benefits for quality of life associated with access to electricity.

In a report on electricity for the world’s poor, the World Bank outlines a series of different kinds of benefits that electricity brings to the impoverished. The report divides the benefits of electricity for the poor into (1) Direct effects on well-being, (2) Direct effects on health, (3) Direct effects on education, (4) Direct effects on economic

opportunities for the poor, (5) Trickle-down effects of increased productivity, and (6) Fiscal space (coupled with pro-poor policies)

The first category defines goods such as lighting and non-biomass fuel as constitutive of well-being. The second category, perhaps the most compelling, includes reduced fire hazard, improved potential for effective health services (through refrigeration lighting, etc), and perhaps most importantly for slums, improved air quality. Replacing old wood stoves, which cause chronic respiratory problems with habitual use, with heating elements can substantially ameliorate health conditions among slum-dwellers. The third category includes lighting to increase time for studying, the fourth more disposable income (since labor for collecting biomass can instead be turned to income-generating endeavors and lighting at night extends the work-day), easier establishment of businesses, infrastructure development, and employment. (Waddams Price 2000).

The conclusion is clear. Electricity is vital, not only for its direct benefits on health and welfare, but also because it can serve as a gateway for other kinds of development by means of increased access to information, facilitation of education, and reduced workload for certain mechanical tasks. A study by the World Bank and the Asia Development Bank set out to study the link between electrification (among other infrastructural projects) and standard of living, and found that while electrification is not correlated with income growth, it does allow better access to information, education, and increases quality of life (Chatterjee, S, et al. 2004).

Current electrification in slums

USAID's report on access to electricity in slums states that electricity is nearly

universally available, due to the effect of *ad hoc* “companies” that systematically steal electricity by tapping into overhead lines and selling to slum-dwellers (USAID 2005). While little information exists about these systematic efforts, many other documents mention practices of a similar nature, including the establishment of interconnections between households that are connected to the grid and those that are not, and more isolated incidences of theft (Melo, F.C., et. al. 2001; PN Energy Services 1999).

Why traditional service is not brought to the slums

Since the prices charged per unit by these illegal “companies” are often quite high, rivaling and sometimes exceeding market-rate electricity (USAID), it is worthwhile to analyze precisely why traditional service is not brought to the slums, and perhaps more importantly, why attempts to bring traditional electricity service to the slums have repeatedly failed.

A. Sociological barriers to traditional service

To begin with, there are a number of sociological problems inherent in the task of extending traditional electricity service to the slums. In some cases, there may be a “culture of non-payment,” which can mean either that the slum-dwellers are not accustomed to paying for electricity, and can resist being asked to pay, or that they are accustomed to paying for electricity when and as they are able, more as one might purchase a good in the marketplace, and not as a regularly recurring, formal bill (USAID).

In addition, slum-dwellers, though they can constitute a large proportion of a city’s population—in Mumbai’s case, around half—play only a small role in the society at large. They are marginalized and ignored by the political, economic, and social

systems that surround them. Efforts to incorporate them into the society around them, such as by extending ordinary electrical services to them, are not always seen as unambiguously positive. For instance, the periodical *The South Asian*, targeted at South Asians living in the United States, writes in a 1 March, 2005 article that slums "...are the cause of all criminal activity in our cities. They encroach on our roads, steal electricity from our wires, and illegally occupy land. They are ugly spots on our urban development. They are unhygienic and the source of much disease. / They must be rooted out, and demolished." This attitude perpetuates the desperate conditions of slum-dwellers, and obstructs projects aimed at their betterment.

B. Infrastructural barriers to traditional service

Other factors that prevent traditional service from being extended to slums are infrastructural in nature. To begin with, slum-dwellers often have no legal status. This can make dealing with them exceedingly complicated for utility companies. If, for instance, a company wanted to pursue judicial action against a slum-dweller for non-payment of a bill, it is unclear whether courts would in fact be able to accommodate this possibility.

In addition, slum-dwellers are typically squatters. That is, there is no official connection between slum-dwellers residences and themselves, and consequently, utility companies would find it extremely difficult to bill a slum-dweller successfully. Without mail service in the slums, companies would be obliged to set up their own collection service at great expense.

Finally, the very physical structure of the slums makes extending traditional service there difficult. The streets tend to be narrow and are rarely straight, making

vehicular access, such as would be necessary to maintain power cables, either impossible or dangerous.

C. Economic barriers to traditional service

There are also some important economic reasons why traditional service has not been extended to most slums. The first, and most important, is that slum-dwellers are generally extremely impoverished, and simply cannot afford to pay for it. The poverty of slum-dwellers is only a partial explanation, however, since they are often willing to pay higher than market rates to illegal companies for electricity. Perhaps rather than mere poverty, it is the structure of income that most slum-dwellers earn that makes traditional bill payment difficult. Many slum-dwellers work informally, and work when they can. This means that their income, regardless of size¹, is often occasional in nature, cannot be depended upon like a salary (Bhowmik, et al. 2001)

Even if the previous barriers were not sufficient, utility companies have scant incentive to expand to slums. Despite the enormous populations of many slums, the per-capita demand in slums is quite small compared to that in regular settlements. The same economic dilemma that faces utility companies with regard to rural settlements also applies to slums. Reaching slum residences requires a substantial investment in the expansion of their distribution network, but the potential payoff is small, even if they succeed in collecting payment. Despite that utility companies can lose as much as 3-5% of their total revenue to “non-technical losses,” (that is, thievery), it is not economically feasible for them to electrify the slums (USAID 2005).

¹ The income variation is quite great. Sundar Burra notes that even doctors and lawyers are sometimes forced to live in slums (Burra, 2005).

Clean Distributed Generation (DG) technologies in the slums

Two renewable distributed generation technologies provide a uniquely sustainable solution to the problem of electrification in impoverished urban areas where traditional service is not possible, specifically small wind turbines and photovoltaic cell clusters to power a small number of geographically adjacent structures, whether a few houses, a block, a set of businesses, or a neighborhood.

A. Distributed generation superior to traditional generation

Distributed generation is often talked about as a solution for rural electrification needs, but it is generally assumed that in urban areas, traditional service is more economically feasible. A paper written for the World Bank on distributed generation in the developing world defines an economic tipping point past which distributed generation is superior to traditional service. Distributed generation becomes economically advantageous when “customer locations are very remote or expensive to reach,” and the demand for electricity on a per-household basis is relatively small (World Bank, Wills, et al.). The paper did not mention urban distributed generation at all, but counter-intuitively, slums are similar to rural areas in terms of the economics of electrification. While slum areas are not by any means remote or dispersed, they are expensive to reach on account of their density, their legally ambiguous status, and endemic thievery. Moreover, percapita electricity demand is, at least for the present, quite small, as is per-capita income, and some of the specific uses for urban electricity are similar to those in rural areas.

Distributed generation has many advantages over traditional generation for slums. To begin with, the initial investment required to construct a distributed generation plant,

that is, a photovoltaic-cell and turbine combination is relatively small, on the order of hundreds of dollars for individual home units, or a few thousand for more ambitious projects. On the other hand, while stringing up power lines that tap existing sources of electricity is much cheaper than establishing distributed generation plants, it may be necessary to establish sub-stations to electrify some slums, which requires a substantially larger initial investment than distributed generation plants. Since no development project is ever assured of success, the size of the initial investment ought to be an important consideration in any slum policy. Distributed generation plants, in addition to having relatively low initial costs, are physically reusable. If a distributed generation plant meets with little success in one slum, it is possible to move the physical equipment to a different slum without loss to the value of the equipment, though of course installation and siting costs will be lost.

In addition, distributed generation projects are not subject to electricity thievery, as all projects involving additional power cables certainly would be. This thievery can endanger the reliability of traditional service, and drive market prices for slum electricity higher. For distributed generation projects, thievery will not be a large problem for the simple reason that the amount of power cables will be small, and visibly connected from the source to residences. Coupled with a Low-cost Secondary Service Network — low-voltage cables placed in steel tubes on the ground (Mello, et. al. 2001)— thievery can be reduced to nothing. Not until a large majority of residences in the slum have access to electricity will thievery from existing power lines cease to be a problem.

Distributed generation does introduce a new element of theft, however, in that the distributed generation equipment itself could be stolen. There are several possible

strategies for pre-empting equipment theft. To begin with, all generators should be mounted to metal frames, themselves securely mounted to buildings. This will make attempted theft apparent and visible, at the least, since the generators could only be removed from the frames with considerable effort, and this might deter potential thieves. A more promising solution, perhaps, is placing generators that benefit entire communities in public places. Because members of the community will value these generators, they are likely to react quickly and negatively if anyone attempts to steal them.

Another compelling advantage distributed generation has over traditional service is that it can directly empower residents of the slums, who are usually marginalized in their societies at large. Because it occurs on a small scale, metering, bill collection, and even basic maintenance can be performed, with proper instruction, by actors who are themselves beneficiaries of the service. This “localness” not only empowers slum-dwellers by giving them electricity and control over that electricity simultaneously, but also in many situations might lead to better service, as municipal authorities in Indian cities have been notoriously subject to corruption and often fail to perform tasks in the slums, where there is little accountability for them (Burra et al., 1999; USAID), and local actors have a better understanding of the social fabric of the slums. The specific sociological impacts of distributed generation plans administered by neighborhood will be discussed below.

B. Clean Renewable DG has no fuel costs

One might justly ask, however, if using renewable technologies specifically is justified, since non-renewable technologies, such as the diesel generators often used in

distributed generation projects, can provide a larger amount of power and a greater degree of consistency than wind and solar power. There are at least two compelling reasons why renewable technologies are superior in slum contexts to non-renewable sources, which usually means fossil-fuel sources. The first is that, unlike non-renewable generators, wind and photovoltaic technologies have few recurring fuel costs. This is a potent objection to non-renewable sources, because one of the historic difficulties in electrifying slums is that slum-dwellers often have difficulty paying a recurring, regular expense, such as would be necessary to pay the fuel costs of a non-renewable generator (USAID 2005). Moreover, some of the same problems that prevent traditional service from reaching the slums would make establishing a fuel distribution network that reliably delivers fuel to generators extremely difficult.

However, problems with the recurring cost of fuel and fuel distribution are a less important objection to fossil-fuel generators than their demonstrated pernicious health effects in densely populated areas. One study by the University of California Energy Institute (UCEI 2005) investigated the effects of a variety of relatively clean, but non-renewable distributed generation technologies on air quality in California. They found that because distributed generators are by definition much closer to the areas whose power they supply, their negative air quality effects are much worse than traditional non-renewable plants. Specifically, for California, the number of people exposed to pollutants emitted by distributed generation plants is an order of magnitude larger than those exposed to pollutants from traditional plants, and the total amount of pollutant inhaled from distributed generation plants is three orders of magnitude greater than pollutant inhaled from traditional plants, per unit of electricity (UCEI 2005). While California and

Mumbai are very different places, Californians generally live further apart than inhabitants of Mumbai, and the distributed generation technologies assessed all met California's state pollution standards. Given the extreme population densities of Mumbai's slums, and slums generally, and the greater likelihood the technologies that do not conform to California's air pollution standards will not be used in Mumbai, the consequences of fossil-fuel-based distributed generation for respiratory health are likely to be much worse for slum-dwellers than for Californians. Because of the prevalence of wood-burning stoves used for cooking indoors, chronic respiratory problems are already endemic in the slums. While the electricity provided by a fossil-fuel generator could diminish the use of wood-burning stoves indoors, and thus provide some health benefits, these would be reduced by the exhaust from the generator.

Wind and photovoltaic power have neither of these drawbacks. The only costs involved with them are the initial investment and occasional maintenance. This avoids the problem of regularly recurring costs for slum-dwellers and well as the difficulty of distributing fuel. In addition, wind and photovoltaic power are completely emissions free. The only known negative environmental impact either has is that large wind turbines can affect avian migration routes, but this is not a problem for small turbines, and is a small concern compared with potentially exacerbating the air quality problems that pervade many slums and contributing to global climate change through carbon dioxide emissions. In consequence, every watt generated by photovoltaic or wind power directly assists the slum population, and has the potential even to impact air quality positively by reducing dependence on wood-fuelled stoves.

C. The question of reliability

A powerful drawback of PV and wind power, however, is that they cannot provide electricity as reliably as a fossil-fuel-based generator can. Even during times of regular wind or sunlight, the electricity provided by turbines and PV cells will be intermittent, unless additional power has been stored in batteries, and even with batteries, spells of cloudiness or windlessness will not allow the technologies to provide perfectly reliable electrification.

One of the unique advantages of PV and Wind power in the slums of Mumbai, however, is that reliability is not as important for slum-dwellers as it is for inhabitants of legal settlements, and consequently one of the most important objections to the widespread use of the technologies is not fatal. While reliable, legal electricity is important for the slums, and should continue to be a long-term goal, access to even occasional electricity could improve quality of life for slum-dwellers dramatically in the areas of lighting, cooking, and telecommunications, for instance. It is tempting to consider reliability a *sine qua non* in improving slum conditions, but if reliability entails plugging slums into the regional grid and demanding fees for service, slums will continue to be left out in the cold for a long time to come. In fact, the difference between the reliability of standard generation and the reliability of PV and Wind in slums may be narrower than one would suppose, since ordinary power lines are subject to leakage and theft, and the loss of a single line can sometimes mean an outage for large sections of the slum, whereas there is little leakage and little potential for theft with PV and Wind, and individual units can be repaired, replaced, or upgraded without loss of power for large areas of the slum.

While some uses for electricity, most notably refrigeration, require uninterrupted

power to be of any use, many energy uses in slums can be useful even with intermittent service. Most notably, these are lighting, possibly cooking, and telecommunications.² Lighting is useful for slum dwellers because it can substantially augment individual productivity. Work that involves any degree of precision after nightfall will be greatly facilitated by electrification, since traditional lighting methods such as candles are less luminous than light-bulbs, generally. Incremental increases in lighting will yield incremental increases in productivity, and access to electrification at certain times will produce increases in productivity during those times.

The advantages of cooking with an electric heating element are also non-discrete. There are two principle disadvantages over biomass-fuelled stoves, the primary cooking tool in the slums. First, the daily expense for fuel often sometimes represents a large percentage of a slum family's daily income. Though a World Bank report found daily energy expenditures for the poorest quintile in a wide-range of countries to be under 5% of total income, the time required to gather fuel can have a substantial opportunity cost (Townsend 2000). Secondly, and perhaps more importantly, burning biomass without proper ventilation, as it is usually burned in the slums, has highly pernicious long-term health effects. Cooking by electric heating element, even if not always available, can save money for families dependent on biomass cooking whenever it is, since, as noted, families often spend large amounts of time collecting fuel.

² While electricity is used for cooking typically at the higher end of the energy ladder, most likely for a variety of sociological (resistance to cooking without fire) and technical (stoves typically require higher voltage and amperage compared to other appliances) reasons, this paper will treat cooking as a potential application of electrification in slums. It should be born in mind, however, that this use for electricity is unlikely to become widespread immediately after electrification without additional projects implemented, such as low-voltage heating elements that can generate sufficient heat to cook, or education about the health utility of electric cooking over against biomass cooking

Moreover, every occasion when a family uses electric cooking instead of burning biomass represents the diminishment of the health-risks associated with inhaling smoke, which will eventually result in a lower community-wide incidence of chronic respiratory problems.³

Telecommunications is another potential use for even intermittent electric power, though its precise utility is less concrete. Telecommunications, in the form of radio, television, and possibly even two-way communications (e.g. community cell phones) are powerful instruments for political and social empowerment within a society. Any small amount of access to information about the world outside the slum is empowering, and incrementally more empowering as the level of access increases.

In addition, one of the unique benefits of distributed generation technology in slums is that those most directly interested in reliability can take responsibility for power generation in their neighborhood. Turbines and PV panels, set up for small neighborhoods or blocks, thereby become the responsibility of those receiving power from them in that neighborhood, simultaneously allowing for empowerment of slum-dwellers, and giving them incentives to find ways to improve reliability.

D. Local conditions suited for PV and Wind

Of course, renewable technologies must be implemented in a manner that is informed by local climate conditions. The city of Mumbai is well suited to a combination of photovoltaic and wind power, as would be most tropical and sub-

³ Though it is important to note that proper ventilation and other methods might be more effective in rapidly improving respiratory health.

tropical coastal cities.

There are two main seasons in Mumbai, namely a monsoon season and a dry season. The monsoon season is characterized by heavy rainfall and strong, persistent westerly winds, conditions ideal for wind power. The dry season is characterized by heat and sunlight, conditions ideal for photovoltaic power (Maharashtra provincial website).

The use of Vertical Axis Wind Turbines (VAWT) instead of traditional horizontal axis turbines could be quite effective. To begin with, some VAWT systems are capable of 45% efficiency, where regular turbines are usually closer to 25-40%. More importantly, however, VAWTs are capable of safe operation in much higher velocity winds than regular turbines, which is important for Mumbai, since during the monsoon season winds regularly reach extreme velocities. In addition, VAWT components, unlike traditional wind turbine propellers, do not need to be precisely and delicately manufactured (Economist 2006)

Implementing Clean DG in slums

Distributed generation plant costs are relatively cheap to manufacture and install. A wind turbine costs around \$1000 per kilowatt of capacity, and has a footprint on the order of 0.01 kilowatts per square meter. Due to the poor construction of many slum settlements, wind turbines would need to be supported at ground level. Wind turbine operation costs for distributed generation vary with the size of the rotor, wind “density” (very high in a low-lying city like Mumbai), and average wind-speed. Typically they fall between 4¢ and 12¢ per kilowatt-hour. For photovoltaic cells, a

much higher cost of \$6000 per kilowatt of capacity is necessary, though most of the proposed distributed generation arrays will not have close to a kilowatt of capacity. PV footprint size is also much larger than for wind turbines, but because it can be easily mounted on rooftops, this is of small concern. Operational costs for PV cells fall between 18¢ and 20¢ per kilowatt hour (Petrie, et al.).

The financing of the initial investment ought to involve both actors in the slums who will be directly affected through micro-credit options, and utility companies, who want to see theft eliminated, since it can amount to 3-5% of total revenue (USAID 2005). Entrepreneurship in implementing these projects should arise from within the slums and NGOs that work closely with slum-dwellers. The materielle necessary for construction of such plants should be provided by a third party that specializes in their construction, possibly a private company under long-term contract to the Indian Renewable Energy Development Agency (IREDA), which is an agency within the Indian government responsible for promoting renewables and financing their implementation. The World Bank and the Asian Development Bank have both extended large (\$195 million and \$150 million, respectively) lines of credit to IREDA for renewable energy projects, and some of this credit should be mobilized in the service of slum electrification through renewable distributed generation (IREDA).

Since IREDA is not a micro-credit agency, and the capital costs for photovoltaic and wind arrays will be smaller than the bank typically deals with, this credit should be distributed by micro-credit banks, such as the Grameen Bank, for whom the IREDA credit would minimize risk (since defaulting clients would not diminish capital holdings), or, since this model has not been used before, a new micro-credit sub-bank

dealing exclusively with such projects could be created by the Indian government as part of IREDA, or in connection with local municipal or provincial governments. The capital for micro-credit loans would then simply be earmarked for this purpose, and the sub-bank would receive proposals for projects from NGOs and possibly individual slum-dwellers.

IREDA does not give loans exceeding 80% of total project cost or 90% of equipment cost (IREDA). The remainder of the capital required could come from the slum-dwellers, other micro-credit banks, or possibly the utility companies themselves, who have a financial incentive to provide loan capital to the sub-bank as a step towards eliminating electricity theft. In addition, these companies could provide subsidized assistance or expert advice on the installation of wiring, including transformers and transmission.

Throughout the process, the local entrepreneurs, whether NGOs or individuals, should be given the freedom to experiment with different strategies for payment and the number of households connected to a single plant. For instance, metering could be conducted in non-traditional manners such as upfront payment. In the past this approach has worked well in slums (PN Energy Services 1999).

Though allowing for entrepreneurship from local actors guarantees some measure of sociological sensitivity, there are several factors the whatever agent is ultimately responsible for micro-credit must keep in mind while making decisions about credit to ensure that the benefits of projects will extend throughout the community. While providing loans for single-dwelling units, for instance, is not likely to hurt the community, projects that focus on neighborhoods (for instance, a collectively used array

or streetlight installation) will be especially useful in promoting neighborhood investment in projects. One of the single most important factors in successful infrastructural development projects that benefit the slum community is gender-consciousness. A multitude of past experience has taught the world that women are not only the beneficiaries of electrification, they are much more likely to take responsibility for the development (Batliwala, Srilatha & Amulya K.N. Reddy 2003).

If possible, the agencies providing credit for the projects should request that the third-party companies that will procure and install the equipment use slum labor in the process of installation. This will both bring income into the slums and encourage slum-dwellers to view the projects as long-term investments.

Conclusion and Recommendations

Renewable distributed generation technologies can provide sustainable energy services for the slum-dwellers of Mumbai. While no approach to slum electrification in Mumbai to date has made use of renewables⁴ (Burra, email), the ever-falling costs of wind power due to technical innovations and Mumbai's climate make the city's slums perfect for a distributed-generation-with-micro-credit approach. The following actions are recommended:

The government of India, in cooperation with local governments around Mumbai, should direct IREDA either to establish a micro-credit sub-bank or form partnerships with existing micro-credit institutions to establish a line of micro-credit for

⁴ Attempts at slum electrification in Mumbai have been sporadic, and have mostly focused on extending traditional service (Burra, 2005)

distributed generation projects using renewable technologies in the slums of Mumbai.

The sub-bank, or micro-credit banks, should receive as clients both NGOs and qualified individuals from within the slums who wish to establish photovoltaic and small VAWT arrays, allowing for flexible business models and experimental approaches.

This sub-bank, or micro-credit banks, should consult with local companies capable of procuring and installing photovoltaic and small VAWT arrays, and encourage the entrepreneurs to insist on the use of local labor during installation by contract, if possible.

This sub-bank should work with entrepreneurs to find capital sources for costs not covered by IREDA capital, looking to other micro-credit banks, utility companies, and individual slum-dwellers.

The Commission on Sustainable Development should indicate to the Indian government that a distributed generation electrification project using renewables in India's slums would further the policy goals of the Johannesburg Plan of Implementation, thus acknowledging the importance of electrification for the urban poor and giving their pre-emptive support to such a project.

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