THE BUSHLIGHT INDIA MODEL – A REPLICABLE, SCALABLE MODEL THAT ADDRESSES THE STRUCTURAL BARRIERS TO REMOTE VILLAGE ELECTRIFICATION

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ABSTRACT: The establishment of viable minigrids for remote village electrification (RVE) faces a number of structural barriers at the village level and at scale. These are interlinked such that solutions which address the village level barriers can help resolve those at scale. Implementation models are therefore needed that directly address these barriers and which are replicable, adaptable; and given the extent of energy poverty, are able to be readily implemented at scale. The Bushlight India Project saw the development of an innovative implementation model for off-grid RVE in India using renewable energy based village minigrids anchored by specially developed demand side management (DSM) hardware. Developed in close collaboration with an integrated network of Indian grassroot NGOs, RE Industry participants and government agencies, the Bushlight India Model is based on that used by the successful Bushlight Project in Australia. One of the key innovations of the model is the Urja Bandhu, a simple, low cost energy meter developed as part of the project, and the associated consultative Village Energy Planning process. The Urja Bandhu limits the daily amount of energy individual consumers can access to their 'daily energy budget' negotiated during Village Energy Planning. This approach builds community ownership, provides residents a tool to manage their energy, protects systems from overuse and allows systems to be designed that can reliably deliver electricity to all consumers 24 hours a day, 7 days a week. With this, reliable financial models can be developed with accurate projections of system revenue matched against costs over the life of the system.
Keywords: Demand-Side, Developing Countries, Rural Electrification, Stand-alone PV Systems, Sustainable

1 OFF-GRID RURAL ELECTRIFICATION & ACCESS TO ELECTRICITY

1.6 million people – almost a quarter of the world's population - do not have access to electricity and with around 90% of the worlds urban population having an electricity connection, this is largely a rural problem.

This problem and the impacts it has on health and economic development has been clearly identified and the need to address it articulated through most of the MDGs. "Without access to modern forms of energy it is highly unlikely that any of the objectives of the Millennium Development Goals will be achieved." [1]

Much of the current access to energy debate is focused on finding viable business models through which modern energy services can be provided, while also recovering most if not all of the initial capital outlay. This private sector led approach is largely driven by a perceived historic failure of large, government led programmes to achieve real progress on this front. While there is some truth in this there remains the need for a clearer recognition and more balanced analysis of the underlying reasons for these past failures and ways in which these can be remedied. Without this there is a risk of sweeping conclusions being made about the effectiveness of grant funded programs which in turn can promote a sense of mutual exclusivity with regards to funding strategies available for such work. Given the scale of the problem this is not a productive outcome and will ultimately limit both the reach and effectiveness of future work. Innovative program funding, deployment and management structures need to be developed which employ all of the available options tailored to the social, environmental and fiscal environment in which the program is to be implemented.

Poor people and poor communities are poor for good reasons; few people choose to be poor, but are so because of a range of social, geographical and economic factors which are often interrelated and usually beyond their control. Remote communities for instance are often remote because the people in them have been marginalized over time by mainstream society and driven to the geographical fringes of that society. (That said, some communities, like those of Aboriginal Australians, choose to live remote because of cultural connections to land and country)

Being remote removes people from ready access to markets and employment, leaving them financially poor, while also removing them from ready access to basic, government provided services such as education and health centers, which leads in time to further marginalization and poverty. Remoteness also has direct financial costs when it comes to the delivery of electricity; and the high costs and physical difficulties in establishing and maintaining a supply are often the bald excuse for inaction or at best a severe fiscal impediment to its provision.

With regards to the provision of electricity supply to remote communities, government led programs have failed, sometimes dramatically for a number of reasons. Grid–extension programs have failed where there has been inadequate complementary development of the generation system supporting the new and existing lines. This has resulted in either poorer service quality for all, or more often, very poor service quality for the new remote, rural connections, thereby limiting or even negating the potential benefits, including any social or fiscal returns on the investment.

Where grid is not an option, decentralised energy systems or minigrids running on RE and/or diesel gen-sets, have and continue to be an alternative. Of all the alternatives for energy provision such systems have the greatest potential to supply grid-parity power and service quality (ease, convenience, flexibility and reliability), yet they have also proved to be the most difficult to establish. Where smaller, individual level supply solutions such as lanterns have been able to match quite effectively with traditional market based business processes, these larger systems have generally defied the development of a standard, viable capital-repayment model, while also failing to sustainably deliver the services they are theoretically capable of.

With significant amounts of money expended on such systems by governments and donors in the past it is understandable that there is disaffection for such an approach, yet this would be to ignore some of the major reasons why these failures have occurred. Primary amongst these is that to date, most projects have been no more than technology development or deployment projects, where the principle aim has been to field test and demonstrate new technologies, with any social or financial engineering components of only secondary importance. This largely correlates with the overall development curve of the technologies themselves. What funders have been funding then are not replicable models for the delivery of electricity services to remote communities but the development of the technologies themselves – through a series of demonstration systems. The critique of such work being ineffective is therefore both unjust and inappropriate. To date, there has been no large scale, government led, (largely or purely) grant funded village minigrid program using a proven, replicable implementation model that incorporates mechanisms for ensuring governance, financial and technical sustainability, and which leverages the inherent economies of scale such an approach brings. With no such program to compare against such an approach should not be ruled out for this approach alone recognises and acknowledges the social obligations extant upon governments towards their populaces in a way that private sector led models can never do.

2 KEY REQUIREMENTS FOR RELIABLE ENERGY SERVICE DELIVERY TO REMOTE COMMUNITIES

It stands to reason that people do not so much want electricity *per se* but the services it can provide such as lighting, cooling, phone charging and pumping water. Depending on their livelihood patterns (what they do, where they live, how they live) and their aspirations, their service needs and wants can be assessed with reasonable accuracy and summarized in an "energy budget": e.g. so many hours of lighting with so many lights, so many hours of fan use, etc. Device consumption rates can then be applied to quantify the daily energy demand in Wh. Due to the highly seasonal nature of people's usual primary livelihood activities in these villages (i.e. agrarian) the energy services people want and need will vary, if not from month to month, then season to season, as potentially will the overall quantum of energy.

People in remote communites already pay a significant amount for their energy services in both cash and labour. Direct substitution of expenditure on kerosene (for example) is not therefore an accurate measure of their paying capacity, nor their willingness. That said it would be equally inaccurate to assume a direct conversion of people's current expenditure in labour for procuring energy services to a cash equivalent would lead to an accurate quantification of their willingness and capacity to pay. How much people are willing to pay depends on their liquidity, which is effected primarily by existing financial burdens and livelihood patterns. But it is also impacted by their aspirations and their perception of return. The equation is complex but experiences from the Bushlight projects in Australia and India has shown that people don't just simply want cheaper energy services, or necessarily more energy, what they want is better value for money: better quality services than those they are currently accessing. They want a better quality of light, less indoor pollution and less risk of fire etc; and most importantly they want improved quality, reliability and flexibility. A reliable daily supply of electricity allows people to plan their activities to use it most efficiently on those services they want and need on a day to day basis. This flexibility in how the energy can be used provides people with the starting point for planning and developing new, productive applications of their energy, and dependability and reliability means people can structure their household budgets free from external price fluctuations.

Experiences from the Bushlight project in Australia and the Bushlight India project have reinforced the importance of this message: people want and are willing to pay for an energy supply that is sufficient to meet their livelihood needs and aspirations, but value at least equally the ability to reliably access this energy and use it for purposes they determine as the need arises.

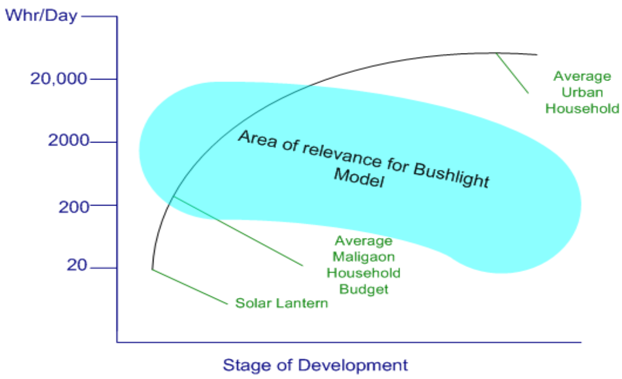

Figure 1: Daily demand vs stage of development

Figure 1 shows an approximation of the demand curve of electrical energy based on experiences in India and Australia with the Bushlight Model. It describes the level of electrical energy consumption a household identifies as its current need, which must be informed by its perception of paying capacity and its current willingness to pay, which in turn relate to its livelihoods and aspirations. The term stage of development refers to the broader status of development within the community as it translates to energy demand. This is most often characterized by the level of mechanization and industry in the village given that 'industrialization' is a reasonably reliable proxy for development. As can be seen, the demand curve rises rapidly as basic needs are met, continues to rise quite sharply as patterns of consumption change as income increases, before slowly tapering off. The "Average Maligaon Household Budget" is in reference to the village of Maligaon in western Orissa where the Bushlight India Model was implemented.

This demand curve emphasizes the journey communities embark on when they first access reliable energy services. This needs to be clearly articulated and understood when discussing appropriate solutions and the current and future costs involved. Marginalized communities remain so if they set off on this development path only to be restricted to the lower end of the curve due to the inability of their energy service infrastructure to meet their evolving needs.

2.1 Structural barriers to off-grid RVE

The funding guidelines of GEF-4 (2006–2010) rejected any continued funding of demonstration renewable energy projects because such projects resulted in neither significant development of off-grid renewable energy markets nor any meaningful reduction in greenhouse gas emissions. Such a stand at this time is justifiable, for what is needed now is not more demonstration systems but the programmatic delivery of scalable, replicable models for RVE that are able to resolve the complex and interrelated structural barriers that exist at a regional and programmatic level. Technology proofing is no longer necessary and should therefore no longer be a focus; what is necessary now is for the focus to shift to the development of the necessary social, financial and managerial aspects of project development. Unlike the technology development process though, these are not uncharted waters; models can and are being developed that innovatively apply standard project management practices to overcome the existing structural barriers.

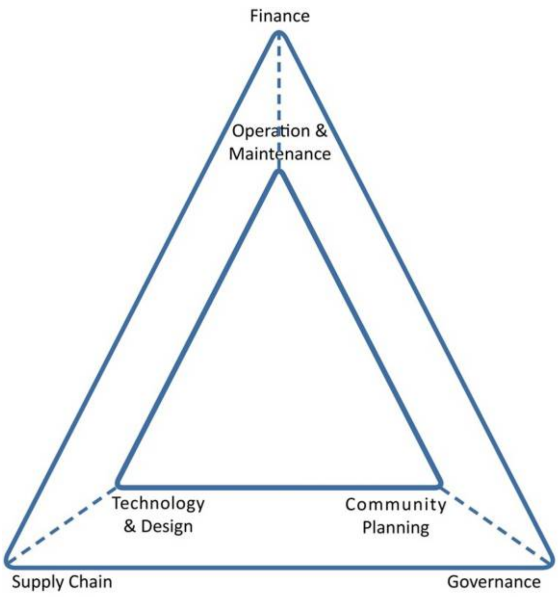

Figure 2: Structural barriers to RVE at village (inner triangle) and scale levels (outer triangle) and their interrelation.

At the village level these barriers include the need for effective community consultation during system planning, best-practice and appropriate system design processes, technology standardisation, and adequate planning for effective operation and maintenance structures. At scale the barriers center around being able to access suitable levels of finance – meaning demonstrable, sustainable revenue streams and reliable low operating cost over the system life; being able to build supply-chains appropriate to remote locations that incorporate standardized low operating cost/low failure technology at a scale where economies of scale can come into play to provide meaningful capital cost reductions; and lastly, functional and sustained governance structures to safeguard and ensure revenue collection within a village, to ensure local individual institutional structures are supported and system operation and maintenance processes are being sustained. Only with these three barriers addresses, can a sustainable business model then be built.

The sustainable business model in question however, need not refer to financing structures that draw on private finance - even where the cost of capital is low. What it should refer to is a structure whereby services that are reliable and affordable can be delivered to remote communities in a sustainable manner year after year. This is after all, what urban consumers demand and expect and what governments the world over expend vast sums of money ensuring, or at least trying to ensure.

3 THE BUSHLIGHT INDIA MODEL

The Bushlight India Model is a process for planning and establishing technically and financially sustainable, renewable energy based village minigrids that are managed by local institutional structures.

The model is premised on a service philosophy of supplying a predetermined, assured amount of energy to all consumers every day that is available round the clock, and providing people the information and tools to use this energy to complement and build their livelihoods as they need and choose on a day to day basis.

It is a comprehensive, structured, stage-wise implementation process with the required activities, processes and outputs for each and every stage clearly documented and supported by a range of image based resources including facilitator guides, manuals and design and planning tools.

It follows a logical process that begins with a selection process whereby villages are surveyed to see if a Bushlight India system is appropriate to their capacities, livelihoods and aspirations. If a village is assessed to be suitable, preliminary financial modeling is carried out to estimate the system size and the required service fee structure for the different available energy budgets, taking into account the project financing arrangements, people's capacity to pay and the expected demand in the village.

Once a village is selected an in-depth collaborative planning process is carried out with the people. This process is described in detail in the Bushlight India, Village Energy Planning Facilitators Manual. Village Energy Planning involves a series of introductory meetings with the whole village, followed by education and information sessions with smaller groups, after which the village is asked to decide whether they want to participate in such a project. If so, they are then asked to constitute a committee or cooperative to represent the village during the planning process. Energy budgeting is then carried out on an individual basis with every household, community and commercial establishment to be connected. A detailed village survey is also conducted and a village map prepared. The institutional management structure to be adopted to manage the system is also determined during these discussions.

Once Village Energy Planning is complete, the information collected is used to design a system with the capacity to meet the identified needs of the community. Various spreadsheet based design tools are used to do this which have been specifically developed for the project based on international best-practice. A comparative life cycle cost analysis is also carried out to assess whether a Bushlight India system presents the most cost-effective solution for supplying the village's electrical energy needs over a fifteen year design life. All systems include additional capacity to account for growth in demand - the extent being determined based on information collected during the VEP and considerations for capital as well as ongoing operation and maintenance costs.

The output of the design process is a System Design Report which is reviewed with the village before being finalized and incorporated into a Supply and Installation Tender with full contractual details, a scope of works and technical specifications for the supply and installation of the system. Once installed the system is commissioned through a visual inspection process that checks all work and materials against that specified in the contract. The supplier/installer is then formally notified of any rectification work that needs to be done before a final certificate of completion is issued and outstanding money paid.

A contract for the delivery of scheduled annual and unscheduled maintenance services is also negotiated at this time. This includes details of all required scheduled maintenance activities to be carried out. Costs are fixed for the term of contract – usually 5 years – and to help ensure appropriate service delivery, payment is on a pay-as-you-go basis instead of fixed annual payments.

Figure 3: 9.63kWp Bushlight India solar PV system installed on Satjelia Island in the Sundarbans region of West Bengal, India. The system has a maximum design load of 23kWh/day.

Once the system is commissioned, training is conducted with the identified local operators and technical service provider staff in the operation and maintenance of the system, and problem troubleshooting procedures. Image based user manuals and logbooks in local language have been developed for this purpose. Management and financial training and support is also provided to the local committee/cooperative responsible for managing the system.

When implemented as designed, the Bushlight India Model ensures systems are only installed in villages where they are the most appropriate technical and economic option; that consumers are provided with the necessary support, information and tools to use their energy to complement and build their livelihoods as they need and choose; and that systems incorporate fail-safe protection against damaging overuse, while also maintaining the quality, reliability and equity of supply to all consumers.

The Bushlight India Model is a service delivery model with no equivalent in India today, providing unprecedented levels of service delivery quality and reliability. Where existing approaches provide power only for the evening hours, Bushlight India systems make power available 24 hours a day; and where reliability of supply is elsewhere often heavily compromised by uncontrolled use and power theft, Bushlight India systems provide a controlled, reliable supply of electricity seven days a week. Specifically, it differs from existing approaches to remote village electrification in India through:

- People determining their own 'daily energy budget'
- Providing assured availability of a selected daily energy budget every day (24/7)
- Service fees are paid as per the daily energy budget selected, not on an ad-hoc 'points basis'
- System financial modeling that allows for accurate projections of income required to meet known costs, so service fee levels can be fixed to meet the 'real' costs of operating and managing the system
- Numerous measures are employed to prevent unauthorized energy use
- Extensive work carried out during the whole process to demystify the technology and provide people with the tools and information to understand how their system is working; including image based manuals, operation charts and informative, intuitive interfaces on the hardware itself
- With their energy budget 'refilled' each day, residents choose how and when they use their energy budget on a day to day basis.

3.1 The development process

The Bushlight India Model is adapted from the work of the Bushlight project in Australia: a government funded program that works with small, remote Aboriginal communities across central and northern Australia to reduce reliance on diesel generation and to establish reliable, sustainable energy services. This work takes place within the context of a comprehensive community engagement and energy planning framework which aims to understand communities' energy needs from a livelihoods perspective and use this understanding to design and install robust renewable energy systems that respond to communities' livelihood and economic aspirations and constraints and enhance their sustainability. Bushlight systems are generally solar energy based and provide a high quality electricity supply to meet the needs of residents of remote communities. Recognized nationally and internationally as a best practice model for rural electrification this has been successfully deployed in over 120 remote Indigenous communities across Northern and Central Australia resulting in over 140 household and community-scale systems that are supporting a broad range of energy services at the household and community level. (see www.bushlight.org.au for more information)

The Bushlight India Project was established by CAT Projects to share the successes, skills and experiences gathered through the Bushlight project with the rural energy sector in India.

The aim of the Project was to develop an optimised model for remote village electrification using renewable energy that could address the structural barriers to RVE in India. Given India's long history of renewable energy technology development and the significant differences between remote Aboriginal communities and India's remote villages, a collaborative approach to the development of the model was needed. The process adopted involved an initial series of workshops and ongoing review and communication that effectively brought together the skills and experiences of the Bushlight Project in Australia, with those of a range of organisations and individuals working in the rural energy sector in India including grassroots community organisations, technology developers and suppliers and government RE promotion and development agencies.

One of the most important initial discussions centered around the identification of major lacunae in current models and approaches to RVE through village minigrid systems. Three of the major issues identified during these discussions which it was decided the model should try and address were: equity, reliability and safety.

Equity related to being able to ensure that each and every user connected to a system could reliably access a known amount of energy for which they would pay a fixed cost. Most village minigrids operate for only a fixed number of hours every day (evening) with no control over actual energy use at a household level, meaning tariffs were not reflective of actual energy use and availability usually dependent on others usage.

Reliability related to the importance of being able to ensure access to energy every day, with quality of power also a major factor. Energy, specifically electricity, is a major enabler of livelihoods, however, people are unable to effectively plan or develop electricity dependant livelihood activities without a reliable supply; reliability of access being more important than the actual quantum of energy accessible.

Safety related to both personal safety as well as safety of supply. Power theft is a common problem even in isolated minigrid systems so deterring 'hooking' was a major issue that needed to be addressed as was ensuring the safety of the power system itself from theft.

3.2 Village Energy Planning

Village Energy Planning is a key component of the Bushlight India Model. It involves a set of community level meetings, smaller group workshops and household level planning sessions that explore, identify, map and quantify a community's energy needs and financial capacities. It is a well documented, standardised process supported by a range of intuitive and easy to use image based media resources. Applied correctly, it provides accurate and reliable information for use in designing an energy system appropriate to a villages' current and future energy needs.

Energy Budgeting is a core activity of the Village Energy Planning process. Begun only once all the introductory and education and information sessions have been run, it involves a facilitated session with each consumer (household, business etc) wherein after completing a household socio-economic survey they create a pictorial representation of their energy needs on a floorplan using 'appliance icons'. They then reference their estimate total need (in Wh/day) to the tariff structure (cost per fixed budget level being offered eg 70 Rupees/month for 200Wh/day). They then decide their final energy budget based on their need/want and capacity to pay.

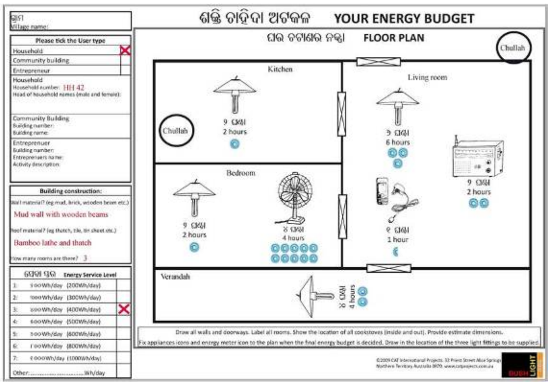

Figure 4: Energy budget floorplan with appliance icons. (Note: one blue star = 20Wh)

3.3 DSM hardware

The solar PV village minigrids established as part of the Bushlight India Project are a standardised technology package that utilise a number of project specific hardware which provide both centralised as well as decentralised load management functionality. The systems are comprised of a solar PV array that feeds to a central Power Conditioning Unit (PCU - a single unit combining an inverter, charge controllers and battery charger), which manages the charging of the centralised battery bank and outputs high quality 50Hz, 230V AC electricity to a main System Control Board (SCB) which doubles as the main AC distribution board and directly feeds power onto the distribution system with dedicated lines for the different load types in the community (households, community and commercial buildings, streetlights and the powerhouse). Each building is connected via an Urja Bandhu. Bushlight India systems also have the capacity to accept direct input from an alternative source (eg generator). All hardware was manufactured and sourced in India.

As mentioned, a number of major lacunae in existing RVE models were identified during the initial planning process. The issue of safety was principally managed through the use of materials readily available in the market (insulated and armoured cables, cable piercing clamps, security bolts and secure compound fencing and lighting). It was realised however that to adequately address the issues of equity and reliability DSM hardware with a specific set of functionality and cost was required. Although unexpected at first, these now look to have significant potential impact on all such future work in the country.

The first of these, the Urja Bandhu or 'Energy Friend' is a small electrical metering device that makes available an individually programmable amount of electricity to each consumer every 24 hours. Designed by CAT Projects, engineered and manufactured in India, and cost equivalent to standard household electrical meters (in India), Urja Bandhus are installed in all buildings connected to a village minigrid and limit the total amount of energy a consumer uses each day to their agreed 'daily energy budget' (Wh/day). This allows the system designer to accurately size the system to a fixed daily demand (including any additional capacity for growth) while also ensuring that each consumer has assured access to a known amount of energy every day. Urja Bandhus can be used with any supply or fuel constrained system to help ensure power can be made available 24 hours a day, 7 days a week without the design capacity of the system ever being exceeded. It also has application where alternative distribution and revenue management models are required such as slums.

Figure 5: The Urja Bandhu energy meter with integrated switchboard and universal UB Programmer.

Each Urja Bandhu is programmed using the universal 'UBProg' With this the operator can check and set: the 'daily energy budget' (in 50Wh increments); the internal clock; and the budget reset time. The UBProg can also be used to read the cumulative kWh consumption through the unit to date. The UBProg runs on standard AA batteries and is password protected. The five display lights on the Urja Bandhu show the amount of 'energy budget' currently available in real time. At the programmed reset time every day all the lights come on, showing that the full budget is available. As energy is used the lights go out one at a time; if all of the energy budget is used before the programmed reset time the next day, power is cut and the bottom light turns red. Budgets are not transferable from day to day.

The UB has tabs for installation of standard meter security tags and space for security stickers on each end. It also incorporates a sensor that registers when the box is opened, triggering the budget to reset to 0 and the two bottom lights to come on (bottom one red) as a warning.

The units installed in the two systems established as part of the Bushlight India Project included a custom made switchboard installed below the Urja Bandhu, with the whole unit mounted on a standalone steel post fixed into the floor. The total cost of this unit was a little over Rs 3000, or $65 USD.

Figure 6: The System Control Board – centralised control and distribution board.

The System Control Board (SCB) is a PLC based centralised load management unit that doubles as a main AC distribution board. During the Village Energy Planning process, the load types in the village are differentiated into either households, or community and commercial buildings, with streetlights, and the powerhouse and system compound also differentiated. These are then allocated to each of the four lines available on the SCB. Individual distribution lines run from each of these to the different loads within the village.

Based on the load assessment made during Village Energy Planning the total daily energy budget for each line (the total of all energy budgets for all connected building types/streetlights) is then programmed directly into the PLC. If this amount is exceeded, the "Daily Budget Exceeded" light will come on for that line, warning the operator that power theft is occurring and identifying which line it is occurring on. The SCB also has a total system meter and individual line meters that record the total cumulative energy consumption through each line.

To avoid complete power loss and potential damage to the batteries during extended periods of low solar insolation, the SCB also incorporates a smart load-shedding system whereby power is cut on a prioritized basis to the different load types, based on a set of incremental, programmable temperature adjusted battery voltage levels. Indicator lights show when this has occurred. When load shedding does occur, power is not reinstated to those lines until battery voltage has returned to the Battery Voltage OK preset level (float with a boost period).

Application of the SCB is not limited purely to solar PV systems, but to any distribution network where the prioritization of loads would be beneficial (eg mobile phone base stations with additional 'non-core' loads), and where the segregation and individual monitoring of different lines would assist management of the supply.

In the project systems the SCBs are installed next to the PCUs on a raised platform in the main control room of the powerhouse and are designed to be the main 'point of contact' for the system operator, providing all the information they need to know about the status of the system.

The SCB provides the functionality to allocate, monitor and manage the distribution and use of the energy available from the system to the various consumers in the village. When installed alongside Urja Bandhus, these provide an intuitive set of tools to provide reliable supply to all consumers and ensure the long term technical and social sustainability of a solar PV community minigrid.

3.4 Financial sustainability

The Village Energy Planning process ensures peoples involvement in the planning process and the establishment of local institutional management structures. It also allows for the design of systems that have capacity to meet peoples' actual livelihood needs while also being technically optimized, avoiding overdesign and unnecessary capital expenditure and O&M costs. Standardized design processes and hardware meanwhile address issues around technical appropriateness and allow for the development of economies of scale within supply chains if employed at a large programmatic scale. They also facilitate easy operation and maintenance both at the individual village level and again at scale, thereby reducing O&M costs.

The third point of the structural barriers triangle concerns finance. Securing finance depends on being able to develop a financial model where costs are constrained and income known. The installation of Urja Bandhus in every consumers house or shop, means not only technical certainty for the system but also certainty in terms of revenue. The Bushlight India financial model allows planners to accurately estimate all costs associated with the system and to project revenue based on the energy planning process, over its fifteen year design life. Other income, be it from capital grants or subsidies can also be included and service fees then structured such that income can match costs.

Bushlight India systems and the DSM hardware employed by them help ensure the technically capacity of the system to reliably provide power; and maintaining a high quality service will help ensure peoples continuing willingness to pay for these services. Functional and sustained governance structures however are also needed to safeguard and ensure revenue collection, to ensure local individual institutional structures are supported and system operation and maintenance processes are being sustained. Addressing these three barriers is the key to the development of a sustainable large scale business model.

5 CONCLUSION

The Bushlight India Model is a new approach to rural electrification in India, one that addresses the structural barriers to RVE using technical innovation coupled with people centered planning processes, local engagement in system management and effective project management processes.

One of the key innovations of the model is the unique DSM hardware: the Urja Bandhu and System Control Board. This innovation builds a practical and concrete link between the load management provided by the Urja Bandhu and the energy consumers access every day, and the people driven Village Energy Planning process. The development and use of the Urja Bandhu allows for a planning process to take place with residents whereby they quantify their energy demands, relate this to a fixed tariff structure, then decide what budget level they want and can afford. This allows systems to be designed and established that can reliably deliver agreed amounts of electricity to all consumers, and for reliable system financial models to be developed based on a fixed tariff structure and accurate projections made of income over the system life.

The Bushlight India Model has been successfully implemented in two remote villages in different geographic locations in India, with two 9.63kWp solar PV minigrids installed in each connecting a total of 95 households, nine shops and four community buildings. The project has also proved that with the involvement of experienced local partners, the "Bushlight model" can be readily adapted to different cultural and geographic settings. A further key outcome is the proofing of the importance of building high quality, high reliability energy systems. The actual supply technology utilized will vary depending on the specific characteristics of each site however, solar PV will be an obvious candidate in many villages across India as well as elsewhere.

The Bushlight India Model is an RVE project implementation model that effectively integrates the key social, economic and technical issues associated with delivering reliable energy services to remote unconnected communities. It provides community residents with the technical and cost knowledge necessary to determine and decide their daily energy 'budget' (in Wh/day); and the physical means to manage this energy flexibly to meet their livelihood needs from day to day. When correctly delivered, the Village Energy Planning process component of the model produces an accurate assessment of total current and future electrical demands in the village, negotiated in consultation with the community, thereby helping to ensure community satisfaction with the system over the design life and the establishment of the effective governance structures needed to manage the system. The model has now been shown to be relevant and successful in a range of different cultural and environmental settings, and to be readily adaptable to other supply technologies.

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