Photovoltaics in Remote Indigenous Australian Communities: An Assessment of the Bushlight Community Energy Planning Model

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ABSTRACT: Bushlight is a 4-year program (now extended for another 2 years) funded by the Australian Government and managed by the Centre for Appropriate Technology, Australia. It aims to improve the livelihood choices of about 100 small remote Indigenous communities by providing sustainable energy services in the form of photovoltaic systems. This paper evaluates the sustainability, cost effectiveness and community outcomes of implementing photovoltaic systems using the Bushlight Community Energy Planning Model (CEPM) in remote Indigenous communities in comparison with the conventional practices. Using case studies of four remote Indigenous communities, it was found that the Bushlight CEPM was more likely to provide sustained energy services, and encourage community empowerment at a competitive life-cycle cost per person when compared with the conventional practices.

1 INTRODUCTION

There are about 900 remote Indigenous Australian communities with less than 50 people and they are some of the most disadvantaged Australians by any measure of socio-economic status (ABS, 2002). These small communities are often family groups that returned to the traditional homelands from which they were removed during the 1920's and onwards. They became known as the "outstation movement", a movement based on an ideology of 'returning to country' with frequent movement to and from a larger Indigenous settlement (Harrison, Ho and Mathew, 1996).

Electricity is used in these communities for lighting, refrigeration, cooling and entertainment using diesel generator or photovoltaic remote area power supply (PV RAPS) systems. PV RAPS consists of photovoltaic panels, batteries and electronic controls. A comprehensive survey of PV RAPS systems in remote areas in Australia conducted in 2000 showed that reliability was a major issue. 36% of the systems in Indigenous communities were not functioning, 61% had recent problems and 43% had recurring problems (Lloyd et al, 2000).

The Bushlight project was set up in response to these challenges in 2002 with the aim of improving the livelihood choices of about 100 small remote Indigenous communities through providing sustainable energy services, mainly in the form of PV RAPS systems. Bushlight has developed a Community Energy Planning Model (CEPM) to implement PV RAPS systems.

Based on case studies of 2 remote Indigenous communities using Bushlight systems and 2 communities using non-Bushlight systems compiled in 2005, this paper will assess the Bushlight CEPM when compared with conventional practices. Data was collected from existing records,

observations and interviews with community members, Bushlight staff, resource agencies and government departments. Sections 2 and 3 will describe conventional practices and the Bushlight CEPM. Section 4 will assess the model in terms of past implementation issues, life-cycle costs and the sustainable livelihoods framework. Finally, an overall assessment of the Bushlight CEPM will be given in Section 5[1].

2 CONVENTIONAL PRACTICES

PV RAPS systems in remote Indigenous homelands are usually managed by resource agencies which are dedicated to providing housing and essential services to remote Indigenous communities within a certain area. Funding for PV RAPS systems is provided by the Department of Family and Community Services (FaCS) of the Australian Government and by some State Governments. Each resource agency manages PV RAPS in its own way but some resource agencies employ a specialist agency that is familiar with PV RAPS to design and procure the system. A separate contractor supplies, installs and repairs the PV RAPS system, but routine maintenance is the responsibility of the resource agency. Larger resource agencies are able to undertake project management, equipment procurement and installation themselves.

3 BUSHLIGHT C.E.P.M. MODEL

The Bushlight CEPM works in parallel with the conventional practices and consists of five stages[2]: prepare, select, install, maintain and sustain.

Prepare Stage

Communities are visited to establish their eligibility for the Bushlight program and to start to develop an understanding of their current situation and their aspirations for the future development of the community.

Discussions are held with community infrastructure funding agencies, regional councils and resource agencies in order to incorporate their views in decision-making, secure funding commitments for energy systems and integrate with existing development plans. The amount of funds available is taken into account by community residents when choosing energy services.

At the end of the Prepare Stage an agreement is reached between Bushlight, FaCS, resource agencies and regional councils as to which communities will be targeted. Those communities will have also made an active choice to be involved in the program, and a community profile will have started to be developed.

Select Stage

Meetings with community members are held to build a community profile, including their aspirations, existing energy uses, future energy requirements and training needs. This information is used to design a PV RAPS system based on one of three standardised Bushlight system types. The design capacity of these systems typically range from 3 to more than 32 kWh per day. During the discussions, information is provided to residents about the costs, benefits and limitations of different energy supply options using culturally appropriate communication tools such as icons and storybooks. At the end of the Select Stage, a Community Energy Plan is produced that summarises the outcomes of the energy planning and service and maintenance

[1] Note that data for this paper was gathered at the midpoint of the Bushlight project. The CEPM has been refined and additional outcomes have been achieved since then. Please see www.bushlight.org.au for the latest progress.

[2] This description of the Bushlight CEPM is paraphrased from Bushlight, 2004 and 2004b.

agreements; a Community Service Agreement is signed between Bushlight, regional councils and the resource agency for the ongoing maintenance of the system, and the contract for the capital works is awarded through a tendering process.

Install Stage
The PV RAPS system is installed by a contractor and Bushlight staff commission the system by performing tests. Training is given to community members in operating and basic maintenance of the PV RAPS systems.

Maintain Stage
The PV RAPS system is maintained and serviced by Bushlight for the first 12 months after the installation. Bushlight also provides ongoing support to the community and the Resource Agency beyond this period. This support includes additional community training and visits every 3 months. During each visit, observations and issues discussed are documented in site-visit reports, and technical information from data loggers is downloaded and analysed to fine-tune the system. One year after installation, a review is carried out to assess the success and impact of the PV RAPS system.

Sustain Stage
For the next four years, visits are made to the community every 6 to 12 months to monitor the successes, problems and impacts of the project in relation to the lives of the community members.

4 BUSHLIGHT CEPM ASSESSMENT

4.1 Past Implementation Issues

It was found that the Bushlight CEPM addresses the factors that are important for successful implementation of PV RAPS that have become apparent from past experience. These were:

1. Reliability of PV RAPS system through design features and spare parts kits
2. Technical support and maintenance ensured through the Community Service Agreement and capacity building in resource agencies
3. Community involvement in planning and construction and increased understanding of PV RAPS through training
4. Demand management with devices and behavioural change in users
5. Flexibility to expand or reduce PV RAPS system after installation to meet changing energy needs of the community and changes in population in homelands due to the high mobility of Indigenous people.

The Bushlight CEPM should increase the proportion of working PV RAPS systems in remote Indigenous communities because it consistently addresses most of the implementation problems that have occurred in the past. Although, it remains to be seen how well user understanding of PV RAPS systems, demand management through user behaviour and capacity of resource agencies will be maintained given the high mobility in Indigenous Australian communities. The training aspects of the Bushlight CEPM may have to be continued beyond the 4-year timeframe of the project, to ensure information is passed on to new community members.

4.2 Life Cycle Costing

The life cycle cost of PV RAPS systems, including design, training and maintenance, was calculated for two communities using Bushlight systems and two communities who are using conventional practices. The main assumptions used in the life cycle costing model are shown in Table 1.

Table 1: Life Cycle Costing Assumptions

Variable	Assumed Value
Discount rate	7.00 % p.a.
Equipment inflation rate	2.50 % p.a.
Fuel inflation rate	8.75 % p.a.

For the two communities served by Bushlight, the Community Energy Planning activities cost 11% and 18% of capital cost.

The life cycle cost per kWh produced by the PV RAPS system of each community is shown in Figure 1. The life cycle cost per person served by the PV RAPS system in each community is shown in Figure 2.

Figure 1: Life Cycle Cost Per kWh

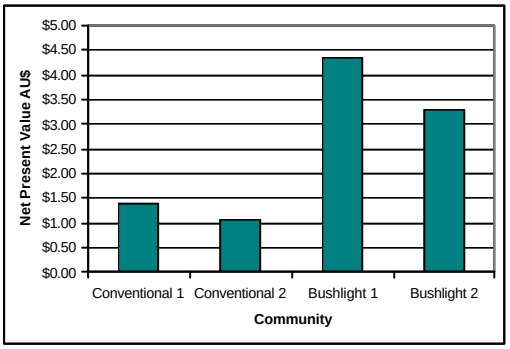
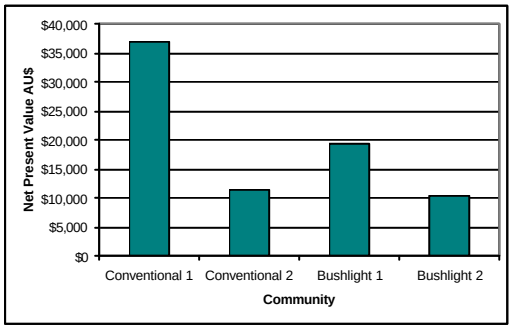


Figure 2: Life Cycle Cost per Person



The life cycle cost of Bushlight systems are higher than conventional PV RAPS systems on a per kWh basis. However, Bushlight systems appear to be cost competitive with conventional systems if compared on the basis of per person served. It was found that this was because the Bushlight CEPM provided a satisfactory level of energy service using less electricity than conventional practices.

4.3 Sustainable Livelihoods

Bushlight aims to improve the livelihood choices of the communities it works with. A livelihood "comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (Chambers and Conway, 1992, p7-8). The sustainable livelihood framework used by Bushlight is shown in Figure 3.

The impact of both Bushlight CEPM and conventional practices on the livelihood of communities derive mostly from acquiring PV RAPS systems. Energy is a basic infrastructure service that supports community aspirations to live on their homelands.

4.3.1 Assets

The largest gain in physical capital is the PV RAPS system itself. It is considered to be essential infrastructure by all the communities for living on their homeland. The PV RAPS system is purchased using grants from government departments so it does not diminish the financial capital of the community. The diesel fuel costs are often covered by the community from their ordinary financial capital streams. So, if a PV RAPS is replacing a diesel generator, the savings in fuel costs would increase the financial capital in the community.

The community gains human capital if they acquire knowledge on how to operate and maintain PV RAPS systems. The Bushlight CEPM outperforms the conventional practices in this aspect because Bushlight gives systematic training to communities. The Bushlight CEPM may also build up a community's confidence in their own ability to get things done and thus encourage them

Figure 3: Sustainable Livelihoods Framework *

* Where H, S, P, F and N represent human, social, physical, financial and natural capital respectively.

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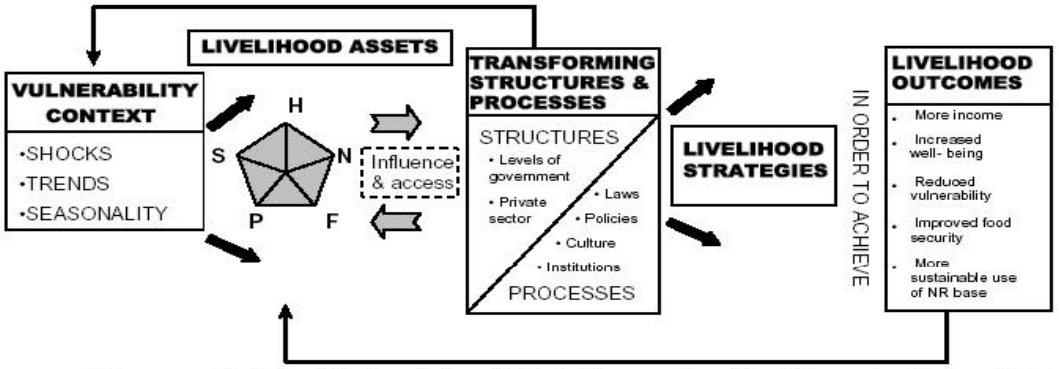

to plan for the future. This new-found confidence and organisational ability is another form of human capital. The conventional practices did not change the organisational capacity of the communities in the case studies.

4.3.2 Livelihood Strategies

The availability of electricity means that art and crafts can be made for sale and workshops can be conducted to bring income into the community.

Where a PV RAPS is replacing a diesel generator, it reduced the number of trips to town for purchasing diesel fuel and food. This makes time and resources available for other livelihood strategies to be pursued.

4.3.3 Livelihood Outcomes

The most important livelihoods outcome that all the communities identified was that PV RAPS systems allowed them to occupy their homeland on a permanent basis without having to transport fuel to their homeland. This has many links to assets. It flows back to increased social capital because:

?? Dreaming stories can only be told and passed on if people are on their own land, thus keeping family and Indigenous identity alive.

?? Young people stay at the outstation more because entertainment run from PV RAPS systems can counter boredom and remove the stigma attached to living at an outstation because they can keep up to date with contemporary culture. When young people stay at an outstation, it keeps them away from negative influences in urban environments.

?? There is improved community coherence, as the homeland becomes a gathering place for the family group.

Permanent occupation also increases the community's access to further funding (financial capital) from government departments and reduces their vulnerability to changes in land rights legislation because they can show a continued use of the land. Residency on homelands means that human capital in the form of spiritual connection with the land can be maintained and passed on to others.

PV RAPS powers refrigeration, which means that the community can store fresh food. This leads to better health outcomes through improved diet and so adds to human capital.

4.3.4 Discussion on Livelihoods

Most of the positive impacts that occur in a community flow from the availability of power. The Bushlight CEPM should be able to provide energy services more reliably than conventional practices because it consistently addresses the past implementation issues as discussed in Section 4.1. Thus, the Bushlight CEPM should provide the positive benefits associated with the availability of power more reliably than conventional practices.

In addition, the Bushlight CEPM increases a community's human capital through training and social capital through increased organisational capacity. Thus, the Bushlight CEPM offers benefits that go beyond the provision of electricity.

5 CONCLUSIONS

Overall, the Bushlight CEPM is a definite improvement over the conventional model. At a comparable cost per person serviced, it is likely to be more sustainable and offer more benefits to Indigenous communities than the conventional model.

The Bushlight model is more likely to provide reliable energy services to communities using PV RAPS systems than conventional practices because it addresses past implementation problems more consistently. However, the communities will require ongoing technical support and training from a specialist agency.

The Bushlight model is able to deliver the energy services at a competitive life cycle cost when compared with the conventional practices. Even though the cost of a Bushlight PV RAPS system is more expensive than a similar conventional PV RAPS system, the Bushlight model increases the efficiency of energy use so that the Bushlight system can serve more people. That is, the cost of supplying a set level of energy services for one person in the Bushlight model is comparable to the conventional model.

In addition to providing energy services, the Bushlight CEPM empowers communities to make changes in their lives outside of energy issues through better organisation. Besides serving remote Indigenous Australian communities, the Bushlight CEPM process could be readily and successfully applied in other Australian or international infrastructure or service delivery programs with appropriate modification.

6 REFERENCES

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