



Irrerlirre & Karrinyarra

About this Case Study

This Case Study focuses on the energy services of two Central Australian homelands and their history with Bushlight. The homelands of Karrinyarra and Irrerlirre began working with Bushlight in May 2005 and March 2006 respectively. Overall, the systems have worked well and provided reliable energy to residents, however, on occasion the daily energy budgets provided have been inadequate to the community's needs. This Case Study will look at Bushlight's Community Energy Planning model (CEPM) and how our approach to determining the size of energy budgets has changed over time.

Background: Karrinyarra community

Karrinyarra is a small homeland 260kms Northwest of Alice Springs off the Tanami Highway. Karrinyarra is sometimes referred to as Mount Wedge Station, after the mountain that can be seen rising in the distance from this community. The main language spoken at Karrinyarra is Luritja. Karrinyarra families began living in shelters at this homeland over thirty years ago. Prior to the bore being sunk at Karrinyarra in the late 1980s, community members used a water trailer to cart water from a nearby station. Soon after the establishment of a bore two shelters were constructed and in the mid to late 1990s the three current houses were built.

During the time of the Community Energy Planning

(visits in May 2005, the core population of this outstation was 12, with an additional 26 family members moving in and out of the community periodically.

Prior to the installation of the Bushlight renewable energy (RE) system Karrinyarra residents relied on a 5kW single phase generator to power the community for an average of four hours a day. A 20 Litre jerry can of diesel was used each day, purchased either from a nearby roadhouse on the Tanami Highway, or from Yuendumu, or Alice Springs. The generator provided energy to each of the three houses via extension leads as required. Prior to the installation of the Bushlight system residents spent an average of \$10,920 per year on diesel.



Mt Wedge near Karrinyarra

Community Energy Planning (CEP) at Karrinyarra

At the time of the CEP meetings in May 2005, Karrinyarra residents had several ideas for the future of their homeland. Improving living conditions was a high priority for residents and they saw having access to reliable 24 hour power as helping them achieve this goal.

Several community members were in full-time employment during the CEP phase of the project, and this is still the case today. A mine near Yuendumu provides one resident with employment and several others are active artists.

Bushlight's regional team noted during the four post-installation visits to the community that Karrinyarra is a very active place, with residents maintaining family connections across the region (a fact captured by the significant mobile population noted during CEP). It was also noted how much the state of the homeland had changed over the course of the time Bushlight was involved with the community, which coincided with the return of Nigel Andy, the Traditional Owner for this country. It was clear to the Bushlight regional team that the community was increasingly well maintained and the sense of pride was strong. Thriving, well-tended fruit trees was one indicator of this.



House 1 at Karrinyarra (June 2005)

Service Provision at Karrinyarra

Karrinyarra have long struggled to receive a consistent level of assistance from Service Providers in the region. With the facilitation of Bushlight a relationship was established with Papunya Community Government Council to administer user contributions (community payments toward the long-term replacement of RE system parts). This arrangement faltered and at the time of the 12 month review Karrinyarra was effectively on its own in terms of general service provision for the community and had chosen to stop paying user contributions.



Bushlight Energy Management Unit

Energy Budgets at Karrinyarra

The energy budgets at Karrinyarra, as with all Bushlight community systems are distributed via Energy Management Units (EMUs). At the time of installation the average daily energy budget among the three houses was adequate for meeting the core population of each house. As more people moved back to and visited the community, it became clear that the budgets were not large enough to cater for the growing needs of the community, particularly during periods of increased population.

One of the reasons identified as to why there have been energy shortfalls was that the washing machine usage allowed for in the design was much less than actual. Part of this stemmed from a practice, common at the time and a legacy of the household system design process, to promote the use of loads such as washing machine only late in the morning when there was plenty of energy available. This allowed for smaller budgets to be allocated. However, whereas household systems have fairly flexible daily budgets, Bushlight's Community systems have fixed design budgets and therefore need actual energy demands explicitly built into the design.

When the community began to report loss of discretionary power, Bushlight decided to see what options there were for alleviating the problem. Looking at the situation at Karrinyarra led the design team to rewrite the original EMU design tool which resulted in larger energy budgets being produced. The other change at Karrinyarra was a recognition by Bushlight that the refrigeration loads allowance



Prior generator at Irrerlirre

The **Community Energy Planning Model** is central to Bushlight's approach of working with communities. After the Regional Energy Planning process has been completed and eligible homelands have been identified, Bushlight's regional teams meet with communities two or three times (each meeting is usually spread out over two days). It is important that as many people are present as possible at these meetings, particularly the head of each household and community leaders. A representative from the community's service provider may also be present.

These meetings begin with basic two-way information sharing. The community tells Bushlight about the history of the homeland, service provision arrangements, and their aspirations for the future. Bushlight talks to residents about the Bushlight project, different types of energy and how they are used. Much of this discussion is focused on which appliances are 'solar friendly' and which appliances require generator energy.

During the second visit residents take Bushlight staff house to house to document appliances used and duration of use for each appliance each day. We look at the different kinds of appliances used in each house at different times of the day and year and how much energy they use. This information forms the basis of the household 'energy budgets'. Regional teams take this information (the System Design Requirements) back to the Bushlight design team who use it to design a system suited to the current and future needs of that community. During the CEP meetings, household occupancy is also discussed to get a profile of the community's population over the year, including seasonal variations. The highly mobile nature of life in many communities means that the energy budget requirements for each house is often likely to change between seasons and over time. This is compounded by the changing availability of solar energy through the year. To some extent we aim to mitigate this factor by designing systems that meet residents' energy needs during the 'worst month' when the solar insolation to load ratio is lower. In the central region, the 'worst month' is generally January or February, when fan usage is highest & fridges and freezers are cycling higher. By focussing this discussion on the time of year where energy use is highest, the system should be designed to provide sufficient power during a worst case scenario.

These energy budgets are important in designing an appropriate solar power system. It is also an important process because it allows us to start talking about how people can use energy more efficiently and manage the power available so that they never run out. This often involves putting fans and lights on timers, replacing old fridges and freezers, and changing the type of lights in a house. The household energy budget is also used to ensure an equitable share of energy to each household so that one dwelling cannot use more than their share of the system's power.

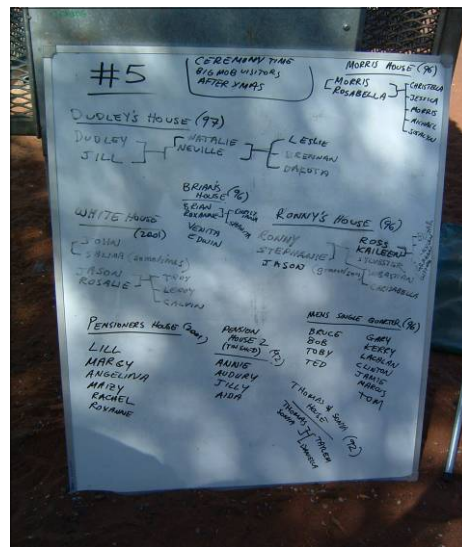
during the winter months were too small and these were also increased at this time.

Background: Irrerlirre Community

The community of Irrerlirre (also known as Number 5) is located 250kms Northeast of Alice Springs along the Plenty Highway. This outstation has a core population of 63 people and is an important ceremonial place for local Aboriginal people. During times of ceremony the population increases significantly.

Jill Kelly and her husband Dudley are the community leaders. When Irrerlirre was first established in 1986 Jill and her family were living in a few shelters. There was no infrastructure at Irrerlirre until 1992 when two shelters were built - by this time, more family groups had settled in the community. By 2001 seven houses, a school and work shed had been built.

The Bushlight system was installed at Irrerlirre in March 2006. Prior to the installation of the system, Irrerlirre relied on a seven year old 35kVA generator. This generator provided some houses with three hours of power each day, when the generator was working and when fuel was available.



Household population is recorded during CEP at Irrerlirre

The service provider for this community is Arltarlpilta Community Government Council. At the time of Community Energy Planning meetings in the winter months of 2005, Arltarlpilta were providing two 20 litre jerry cans of diesel per week. Irrerlirre residents

were purchasing another jerry can of fuel from a nearby station to supplement this supply. The fuel use pattern observed during this time was that the generator was run continuously from when fuel arrived until it was used up. Effectively, this meant the community had power each Tuesday day and night, and then no power for the rest of the week, unless another jerry can was purchased. This amounted to a total annual fuel consumption of 3210 Litres (~\$4400/year).



Pensioners' House at Irrerlirre

The existing generator was positioned next to the 'pensioners house' which caused annoyance because of their proximity to diesel fumes and noise. The power from the generator was distributed between the houses via hundreds of meters of extension leads.

One of the comments made during the 12 month review was that the Bushlight system was "more better, because it gives peace and quiet". For communities that have experienced the incessant noise of generator power this is a common response.

Community Energy Planning (CEP) at Irrerlirre

Over the course of two weeks in April 2005, Bushlight met with Irrerlirre residents on their homeland to talk about their plans for the future and how energy services may be able to help. During this time residents talked about lots of plans for the future of Irrerlirre. One of the energy service goals identified during CEP was enabling the operation of fridges and freezers so, that when a 'killer' (beef carcass) was obtained the meat could be stored at the community rather than having to take it into nearby Atitjere. It was anticipated that having fridges would also result in less frequent trips into town to get food. It was foreseen that having reliable 24 hour power for entertainment equipment and space cooling through fans would make the community more comfortable for living and encourage more people to stay on the community.

Energy Budgets at Irrerlirre

At the time of installation the average population per dwelling was seven people and the biggest load budgeted for was fridges and freezers (on essential circuits).

The first system design notes that:

The system design assumes 100% occupancy throughout the year by the core occupants. The system does not take account of a large number of visitors to the community in January and potentially at other times of the year. The community has agreed to meet any additional loads during these times through the use of local and/or the centralised genset.

Refrigeration at Irrerlirre

At the time of the CEP several old inefficient fridges and freezers were in operation in the community. At the time of installation, Bushlight's policy on replacing inefficient appliances was less consistent than it has now become and which fridges & freezers were swapped out was decided on a case by case basis. This issue was discussed during Irrerlirre's CEP meetings and the decision was made that the community were to buy new appliances themselves. This, however, did not eventuate. The first community newsletter for Irrerlirre stated that "the fridge at Jill and Dudley's house uses too much energy. People will need to buy new efficient fridges and freezers to run off the solar system".

New fridges and freezers were eventually secured for the community in April 2007, however the continued use of the old inefficient fridges, combined with increased energy demands from visitors meant that several houses were often losing discretionary power.

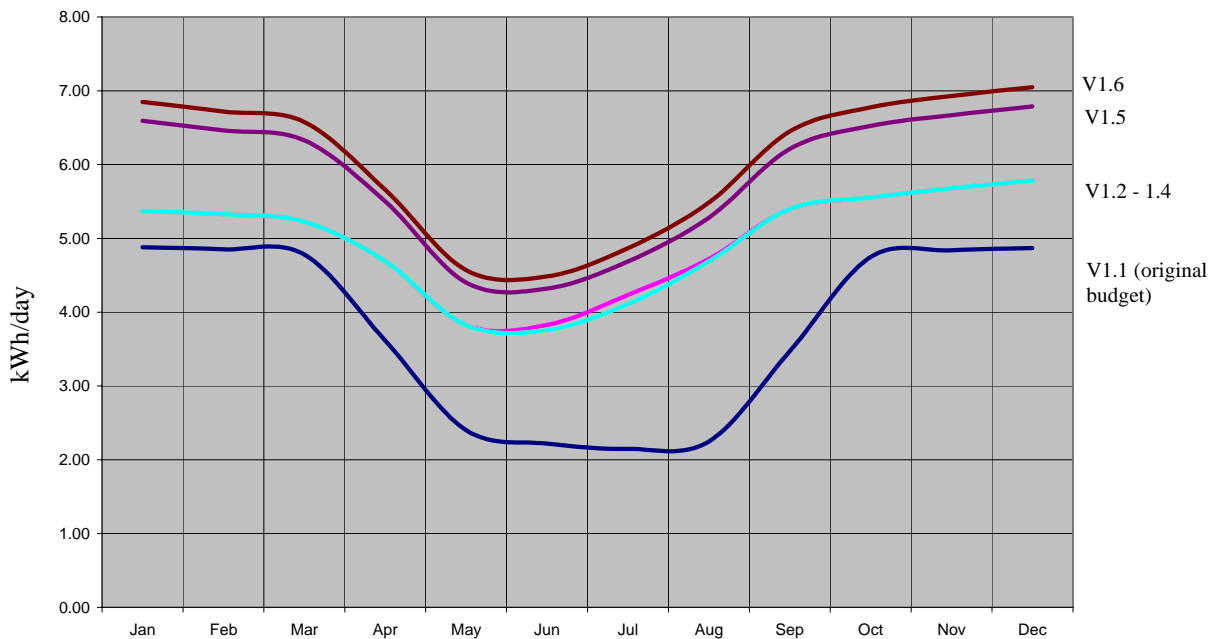
Changes to Energy Budgets at Irrerlirre

The chart on the next page shows how the changes to the EMU budget has affected one sample house.

The main reason why each plot on the chart shows the values fall after March and rise in September is the change in fan usage. This is part of the decision making made during the CEP process. A typical Central Australian region design reduces the fan load to 50% in April and then 0% until September when it rises to 50% and back to 100% in October through to March. Part of the reduction is caused by the reduction in refrigeration load, allowing for reduced usage caused by low ambient temperature. In the central region this also causes a significant reduction in the original design.

The chart below illustrates the increases in daily household energy budgets allowed under the various energy budgeting calculations developed by the project. It shows the daily energy budget for one house under the consecutive versions of the budgeting calculation.

Irrerlirre House 12 Daily Energy Budget Values using various means of calculation



V1.1

As a result of problems with the energy budgets in winter being low and residents being unhappy with this situation, a review of the formulas used to calculate the refrigeration load was undertaken. This was enhanced by data logging of similar refrigerators and chest freezers. It resulted in a new formula that effectively increased the budgets.

V1.2 - V1.4

These represent two slight variations of the new formula.

V1.5

With the gathering of further data from the site it was found that additional energy could be allocated across all the EMU's without comprising the systems integrity. A trial increase of budgets was put in place in April 2007 along with the addition of a data-logger to gather better data for use in validating the changes. A new EMU calculation spreadsheet was developed to achieve this trial.

V1.6

The results of the v1.6 trial show an increase in power use by residents that is within the increased EMU limits. The latest data results show that the system handles the increased budgets well and this includes positive data captured during a period of extended low solar insolation.



Dudley and Jill's House, Irrerlirre



Bushlight array and shed at Irrerlirre

Bushlight data logging

Bushlight's data logging allows us to monitor energy use over time, and in the case of Irererlirre it has meant that we have amended the energy budgets allocated in this community. In April 2007, performance data gathered from the PS1 inverter indicated that additional energy could be allocated to the Irererlirre households without detriment to the batteries. At this time many of the houses did not have fridges or freezers in place, which would constitute the bulk of the essential energy load. The Bushlight system works in such a way that in the absence of refrigeration appliances, this energy is not quarantined off, but remains part of the energy available through the discretionary circuit.

Lessons Learnt

In the earlier years of the Bushlight project there was a tendency to minimise costs wherever possible. In communities such as Karrinyarra and Irererlirre, this led to energy budgets being allocated that were occasionally inadequate for the community's needs when there were transitory increases in the population. Through reviews, system performance data and other feedback from community members we are seeing that this approach has on occasion been to the detriment of community satisfaction and confidence in the RE system, two factors that Bushlight strives to achieve.

In the community of Irererlirre, Bushlight has responded to the situation by reassessing the design process, trialling new EMU limits using new calculations and monitoring system performance with the new limits in place. To date, these trials have proved successful and the data collected have been very useful in further refining our design process to better meet community needs and expectations. The changes implemented have effectively improved the system operation and user satisfaction at Irererlirre.

In Karrinyarra a similar approach was taken with EMU budgets revised upwards to better account for the loads associated with refrigeration and washing machines, leading to higher community satisfaction.

Bushlight's understanding of energy use and demand in communities has developed as the project has matured. As the number of communities Bushlight works with has increased, we have gained greater experience in assessing community needs and designing RE systems to meet these. This has involved at times some major rethinking about our processes; one of which being how energy budgets are calculated. What has really helped Bushlight pursue this ongoing development process is the post-



Richard Swan of Karrinyarra reading a Bushlight Newsletter

installation component of the CEPM in which communities receive ongoing support from regional teams, and the 12 month post-install review which aims to assess how effectively the community engagement process was carried out in the community and to identify any issues that need to be addressed. Both the post-install visits and the 12 month review allow Bushlight an opportunity to actively gauge community satisfaction and to redress any shortcomings residents may be experiencing. Community feedback is used to continually inform and if necessary adjust our processes.