

# Light and life in the bush

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## Bushlight in Kakadu

Kakadu National Park is an internationally renowned World Heritage Area. It is visited each year by more than 200,000 people from around the world who come to experience some of its outstanding natural and cultural values. Alongside the World Heritage status and large visitor numbers, the Traditional Owners of the land have continued to occupy small homeland communities within the Park boundaries.

Bushlight has been working with residents from four of these homelands since late 2007. They are a dynamic and diverse group of people with immense pride in their country and a strong determination to establish a sustainable lifestyle which enables them to live on country for years to come. Many residents have already established solid foundations for sustainable livelihoods, with some owning their own business, others working as rangers in the park and a number working for community organisations in the nearby town of Jabiru. Art and craft is also a strong industry amongst homeland residents and is sold through the local tourism market.



Billabong at Patonga Homestead, part of Kakadu World Heritage site

Essential to the achievement of their aspirations and ability to keep living on country has been their continuing access to reliable 24 hour power. Prior to working with Bushlight, residents relied on diesel generators for all their power needs. The installation of Bushlight 'remote areas power supply' systems in 2008 has ensured homeland residents have maintained access to a reliable 24 hour power supply, but has reduced the annual cost of diesel by \$130,000 across the four homelands.



Left: Residents of Spring Peak learn about energy consumption and appliance use

Far left: Elsie from Spring Peak with her household Power card Energy Management Unit

## Executive summary

At the request of the Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA) Bushlight began working with four Kakadu homelands in 2007 to create a cost effective and sustainable solution for the provision of 24 hour energy services. Considering the extremely high costs involved with the existing arrangement and the heavy energy loads that residents were accustomed to, Bushlight undertook an in depth life cycle costing exercise to determine the most appropriate alternative. This analysis led Bushlight to design and install four automatic hybrid systems.

Community residents participated in a comprehensive community energy planning process to ensure each system was designed in accordance with the needs of each household. Integral to the participatory planning approach was an ongoing educational component designed to assist residents in making the transition from unrestricted appliance use to a more conservative pattern of energy consumption that was appropriate for the hybrid system.

12 months after the hybrid systems were installed, substantial changes were recorded. The financial savings incurred from reduced diesel consumption amounted to \$130,000 across all communities. This translates into an abatement of around 160 tonnes of greenhouse gas emissions. During the first months after installation, there were a few technical problems with the systems that required an extra level of maintenance and attention, but these initial glitches have been resolved and the systems are running smoothly. From the resident's perspective, the first few months were challenging as they adapted to the new energy system, but now most permanent residents are expressing great satisfaction with their energy services and are feeling empowered to continue to apply principles of energy conservation.

The automatic hybrid system has proven to be a good solution for the Kakadu communities. The financial and environmental savings are substantial, and it provides the flexibility to accommodate large and fluctuating energy loads.



*Residents begin the planning process for improved energy services at Patonga Homestead*

### The homelands

To date, Bushlight has installed an automatic hybrid system in five homeland communities in Kakadu National Park, four of which were installed in mid 2008. This case study primarily refers to those first four homelands: Kapalga, Patonga Homestead, Paradise Farm and Spring Peak.

- Each homeland has between 2 and 6 houses
- Average homeland population of 15 people

### Pre-Bushlight energy costs

**\$150,000** worth of diesel was spent each year to run the generators 24 hours a day in 4 homelands; plus an additional \$10 000 per homeland for generator maintenance and service.

### Consumer behaviour pre-Bushlight

- High energy demand - unrestricted use of energy hungry appliances such as air conditioners and electric stoves
- Limited access to resources and education regarding principals of energy conservation
- Limited understanding of the "real" cost and value of fuel and its connection with appliance use



*Spring Peak residents help to peg out the new solar array site*

## Pre- Bushlight energy services

Before the Bushlight systems were installed, each of the homelands relied on diesel generators running 24 hours a day, 365 days a year for their electricity needs. For many years, the fuel and maintenance costs were paid for with royalty money paid to the Traditional Owners from the Ranger Uranium Mine in Kakadu. A change in policy in 2007 meant that royalty funds were no longer available for this purpose and the costs were transferred to FaHCSIA.

In an effort to recover some of the cost of electricity generation the homeland's service agency, Warnbi Aboriginal Corporation, installed power card meters in the houses. The tariff was set at a highly subsidised rate based on the standard Power and Water Corporation tariff (~16 cents per kilowatt hour), which did not reflect the true cost of electricity generation on the homelands.

The uninterrupted, free or relatively inexpensive electricity supply to the homelands meant that residents had become accustomed to a certain lifestyle that often involved the use of large amounts of electricity. Daily electricity use in some houses was found to be more than five times the Territory-wide average.

Bushlight was subsequently approached by FaHCSIA with a request to work with the homeland residents to find a more cost effective and sustainable electricity generation solution.

### Bushlight's Community Energy Planning Model

Some years ago Bushlight developed the Community Energy Planning Model. The Model is essentially a collaborative process which is facilitated by Bushlight staff and requires significant involvement from the homeland residents. The purpose of the process is to:

- provide residents with advice and information about energy use (including demand side management), generation options and costs;
- gather information about the homelands current and future energy requirements; and
- assist residents to make informed decisions about generation options, that take into account community needs and generation costs.

Through a series of workshops and community mapping exercises, Bushlight works with residents to prepare their own Community Energy Plans. These Plans detail the community's energy, particularly where they are related to resident's livelihood aspirations. The Plans also documents an agreement between Bushlight and the residents by setting out household energy budgets and the roles and responsibilities of the residents in using and looking after their power system. The responsibilities of Bushlight, the community's service agency, and the system installer are also laid out.

After the energy planning process has been completed (and assuming a renewable energy system is decided to be the appropriate choice for future electricity generation) the system is designed by Bushlight staff, taking into account the specific needs of the homeland. Bushlight subsequently coordinates the installation of the renewable energy system and any associated works. Following installation Bushlight provides education and training in system operation and maintenance over several visits during the course of the first year and annually after that. Bushlight's approach elaborates on the typical renewable energy industry process by involving the community in all key activities and decisions.



*Spring Peak CEP meeting*



*Kapalga CEP meeting*



*Paradise Farm CEP meeting*



*Patonga Homestead CEP meeting*

## Design of the Bushlight hybrid system

Based on information gathered during the Community Energy Planning processes, and specifically looking at the community's electricity requirements and their reasonably high ability to pay for electricity, Bushlight determined that hybrid systems, which combine renewable and fossil fuel-powered generation, were the most appropriate and cost-effective solution for all four homelands.

Hybrid systems have a number of advantages over 100% renewable energy systems in circumstances where energy needs are reasonably high:

- systems can be automated to provide a seamless transition between renewable generation and generator use;
- high peak loads can be met by the generator;
- operating costs can be minimised through conservative energy use; and
- hybrid systems often have lower life cycle costs (over 10 – 15 years) in high energy use situations.
- Hybrid systems also have some disadvantages which do not make them the most appropriate choice in all circumstances:
  - operating costs are often higher (due to increased fuel use); and
  - 100% generator availability is critical, which can be negatively impacted by poor servicing regimes and low fuel availability.



The fuel tank is regularly topped up to ensure adequate diesel is available

In the case of the hybrid systems in the Kakadu homelands, the renewable energy component of the systems are designed to meet approximately 75% of the homeland's daily energy needs. The remaining 25% is met by the generators, which start automatically to meet large electricity demands and/or to charge the batteries if sufficient renewable input is not available.

Power card Energy Management Unit (below) is an interactive household unit that allows residents to monitor the use of their daily energy budget, and choose to pay for power using a power card when the energy budget is expended



The system was **“designed well for usability...it is simple and easy for people to understand. The kids can understand the green lights and reset time”**.

Peter Christophersen,  
Paradise Farm



## Incorporating the Water Supply

Under the previous generation arrangements, each of the homeland's bore pumps and associated water supply infrastructure were connected to the diesel generators. The conversion of three of the bores to solar power, with diesel back up, further reduced the requirement for regular generator runtime.



Water is pumped from the billabong (left) and treated in water treatment plant at Patonga Homestead (right). This system is now powered by the Bushlight automatic hybrid system.

## Post installation issues

As with any significant changes to infrastructure, there were a number of issues that emerged post system installation. A number of technical issues were resolved via careful oversight by Bushlight staff of the contractor's defect liability period obligations.

Three of the four Bushlight systems now have remote monitoring arrangements using the 3G mobile network. This cost-effective solution allows Bushlight technical staff to access real time data on each of the systems. The remote monitoring system was invaluable during the post-commissioning phase as it enabled Bushlight staff to monitor the system performance, optimise the running efficiency of the system and identify faults. In some cases the problem could be solved remotely, and in others it allowed the maintenance staff to be better prepared for their maintenance visit to the communities. Technical solutions such as this one are critical to ensure Bushlight provides informed, effective and timely responses to any issues that arise.



The new solar bore at Spring Peak which replaced a diesel run bore

## Financial and environmental outcomes

A substantial reduction in diesel consumption occurred during the 12 months after the installation of the Bushlight systems. Reduced diesel consumption was expected, due to the contribution of the solar panels to the energy supply, but the size of the reduction was higher than anticipated. At the time the systems were designed Bushlight engineers expected to achieve fuel savings of around 75%. Actual savings in three of the communities is around 90%, and in Patonga Homestead around 80% (fuel use is higher in this community due to the high energy requirements of a water treatment plant, that also supplies water to the nearby community of Patonga Airstrip).

Residents using the power card in the Kakadu homelands are charged at 57 cents per kWh for power above and beyond the daily energy budget, which accurately reflects the real cost of diesel. Despite the higher per kWh cost for diesel, residents reported that overall they were spending less than before or around the same amount. The amount of power card power used largely depends on the season, as during the wet season the air conditioners run more often.

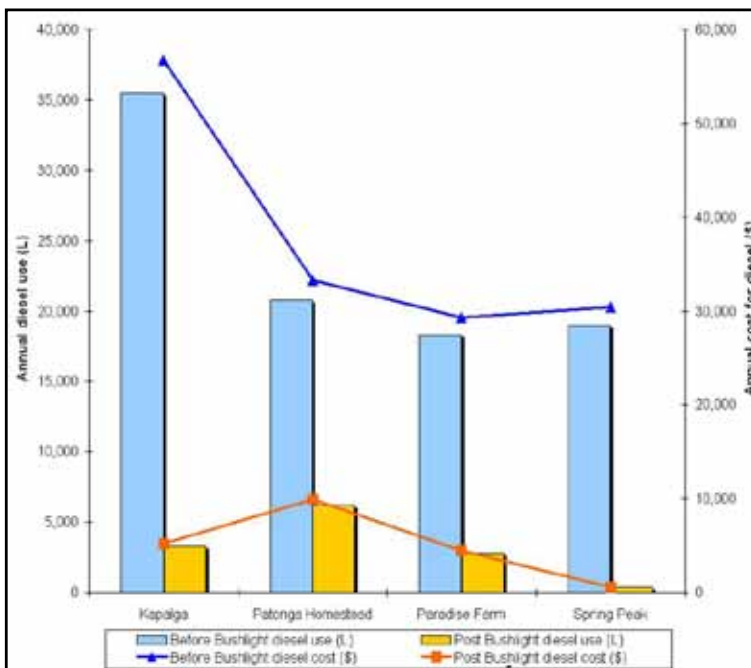
Prior to Bushlight's work in these communities the average greenhouse gas emissions for each community was around 50 tonnes. In the 12 months following the installation, this figure had dropped to just 8 tonnes. This amounts to an overall abatement of over 160 tonnes of greenhouse gases over the 12 months.

**\$130,000**

total cost of fuel saved across the four homelands in the first 12 months after installation

**160 tonnes**

total greenhouse gas abatement in first 12 months after installation this is the equivalent to taking 50 cars off the road



This graph compares the fuel use and associated costs before and after Bushlight (based on a cost of \$1.60 per litre of diesel). The data was provided by Warnbi Aboriginal Corporation, who are responsible for delivering the fuel to the homelands.

## Changes in consumer behaviour

12 months after the Bushlight systems were installed, Bushlight staff spoke to some residents about their experience of living with the Bushlight Hybrid system. Those residents that were present during all the planning and training sessions have adapted well to the new circumstances. They are very aware of how much energy different appliances use, and over time have learnt how they can stay within their daily energy budget. When heavier appliances are required, residents have learnt to minimise the duration of use and keep their eye on the power card meter to see how much money it is costing.

Victor from Kapalga observed that \$1 of power card power around 1 hour of air conditioner run time. He also expressed he enjoys trying to stay within his energy budget that he to design, "there's more responsibility (with the solar), you to look after it and care for it". This comment highlights the of responsibility and ownership that residents acquire through intensive engagement and training involved in the Bushlight Community Energy Planning process. This is a critical element in ensuring the long term sustainability of the Bushlight systems.

*"It's habit when you get used to it... When you finish in a room you turn the lights off"*

Tony, Paradise Farm

## Training

Although some of the households are permanently occupied by the same families, there are other households that change occupancy regularly. In these transient households, it can be difficult to ensure all people who stay in the community have been involved in Bushlight's training in system operation and energy use. As a result, some of the untrained residents or visitors expend their daily energy budget prior to the 12pm reset, these residents consequently spend more money on the power card, or go for a significant portion of the day with a limited power supply (restricted to essential appliances such as refrigeration, medical equipment and one light).

In one way, this demonstrates the importance and success of the Bushlight training program and participatory planning process, as those residents who were involved from the beginning are better able to manage their energy use. The limitation is that new people to the community do not have experience to draw on. Bushlight works to overcome this by leaving instruction posters and resources in each house, encouraging permanent residents to carry out informal training with visitors and by regularly visiting the communities to provide training to new residents. In addition, the design of the household Power card Energy Management Unit (EMU) interface means that household members have a user friendly tool to manage and monitor their energy use.

Peter from Paradise Farm was very satisfied with the educational component of Bushlight's service. "Education has gone over and beyond what we ever expected". He lives in the house with his wife and 4 children and learning about the system was a family affair. He sat down and discussed the User Manual and Community Energy Plan booklets with his children, and they are all involved in managing the energy budget and telling visitors about how the system works.



*Ian Foster from Bushlight shows Samson Henry from Kapalga how a solar system works using the Bushlight demonstration kit*

## Conclusion

The Bushlight systems designed for the Kakadu homelands have proven to be the appropriate solution for the circumstances, with each system having sufficient flexibility to allow for varying electricity requirements. The lower initial capital costs combined with the savings in ongoing diesel costs contribute to the overall cost effectiveness of the systems. The power card system allows for a longer term sustainable solution to the energy services at the communities as residents are making regular financial contributions to their own power supply at a rate that reflects the actual costs.

The flexibility of the automatic hybrid system can be demonstrated at Kapalga, where there is an existing building that is being renovated. The system will be able to accommodate the energy needs in the new house by extending the required generator and with the participation and input of residents, re-distributing energy budgets. The additional cost can be recovered through cards.

Behavioural change is not always easy to achieve. Habits around energy use can be hard to alter, particularly when there is a perception that such changes will have a negative effect on one's quality of life. Despite some residents having reservations during the period of adjustment after installation, 12 months on most residents are very pleased with their new energy arrangements.

***“Everyone should have a Bushlight, it’s so quiet, I can hear all the animals”.***

Violet Lawson,  
Paradise Farm

***“Better than before. It’s quieter, got your own (energy) budget to look after. Before there were problems with the gen stopping and everything stopping”.***

Victor, Kapalga



***“I spend a lot less money (on power cards) than before”***

***“It’s good to know your not pumping all those fumes into the atmosphere”***

Peter Christophersen,  
Paradise Farm

Violet Lawson from Paradise Farm shows her traditional weaving to Murray Schneider and Melissa Schliebs from Bushlight