

## The current state of power supply to remote Indigenous communities

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Ruby Heard delivering an energy literacy workshop in Mowanjum Community

### Abstract

The story of First Nations peoples in Australia continues to be a tale of systemic disadvantage, hardship and inequity. Key indicators suggest that this is most true for the peoples who live in the remote and very remote regions of the country. Electricity access and affordability plays a vital role in the quality of outcomes for these peoples. For many remote Indigenous communities across Australia, electricity continues to be unreliable, unaffordable and inequitable, impacting quality of life and the ability to remain on Country. This paper speaks to energy access challenges, the role of adequate housing in energy solutions, past successes that can be leveraged by future programs, community perspectives on energy and the interface with Indigenous culture, and emerging trends in best-practice energy delivery. It also reflects on the opportunities that a decentralised, renewables-focused energy system offers remote communities in terms of improved living conditions and self-determination.

The authors of this paper are among the most experienced professionals working in the area of energy access in remote Indigenous communities. In 2021 we came together to share experiences, stories and insights about the state of power supply to remote Indigenous communities. The paper is written in a conversational manner, with direct quotes taken from the group discussion and attributed to their originators. Hear of the significant challenges of living in remote Australia through the stories and experiences of nine energy professionals, including three First Nations descendants.

### Introduction

Across the vast continent of Australia, approximately 75% of the landmass is classified as 'very remote'<sup>1</sup>. This majority of the country is home to only 0.8% of the Australian population, with an additional 1.2% living in

<sup>1</sup> Gregory, P. (2022). The Territory Gap: comparing Australia's remote Indigenous communities. The Centre for Independent Studies, Analysis paper 39.

'remote' areas<sup>2</sup>. Indigenous Australians account for a significant proportion of these residents, making up 18.2% of people living in remote areas and 47.2% of people living in very remote areas<sup>1</sup>. This represents an estimated 17.8% of the total Indigenous population, around 150,000 individuals<sup>1</sup>. Remoteness is a key factor in many health<sup>3</sup>, education<sup>4</sup> and social outcomes<sup>5</sup> in Australia. Increasingly, availability and affordability of electricity is being recognised in the literature as another key determinant influencing those outcomes<sup>6,7,8,9</sup>.



There are a number of key issues impacting energy availability and affordability in remote Indigenous communities around Australia. Pre-payment metering is used widely across First Nations communities, resulting in frequent power disconnections when households are unable to maintain a positive credit balance<sup>10, 11, 12, 13</sup>. For the many small communities that need to purchase fuel to run a generator, the expense can be crippling and the journeys to get fuel can be long and arduous<sup>14</sup>. Community renewable energy rollouts in the 2000s were successful, but those systems are now reaching end-of-life, with no clear path for replacement<sup>15</sup>. Worse still, recent surveys show that many remote Indigenous households are still not provided with an electricity service, for example in the Northern Territory, where 14% of homelands<sup>16</sup> and outstations have no power supply at all<sup>17</sup>.

This paper discusses the historical and current challenges experienced by remote Indigenous communities and the persistent barriers to solving energy affordability and supply issues, including the effects of pre-payment meters. We explore the impact and complexities of the housing-energy nexus, which presents one of the greatest issues for implementing fully renewable energy solutions. We cover the successes of the Bushlight program in detail, as several of the authors were part of the program delivery team, which installed over 150 remote power systems across Australia. Our experiences with Aboriginal and Torres Strait Islander cultures, values and perspectives of energy create a narrative around the relationship that First Nations people have built with

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### Pre-payment meter recharge card

<sup>2</sup> Australian Institute of Health and Welfare. (2024, April 30). Rural and Remote Health. Retrieved from Australian Institute of Health and Welfare: <https://www.aihw.gov.au/reports/rural-remote-australians/>

<sup>3</sup> National Rural Health Alliance. (2023). Rural health in Australia Snapshot 2023. National Rural Health Alliance.

<sup>4</sup> Mackey-Smith, K. C. (2022). Improving educational outcomes: Why don't remote schools in Australia measure up? Issues in Educational Research, 925-942.

<sup>5</sup> Andrew Amos, M. C. (2022). Remoteness and socioeconomic status reduce access to specialist mental health care across Australia. Australasian Psychiatry, 19-26.

<sup>6</sup> Longden, T., Quilty, S., Riley, B., White, L. V., Klerck, M., Davis, V. N., & Jupurrurla, N. F. (2021). Energy insecurity during temperature extremes in remote Australia. Nature Energy, 7, 43-54.

<sup>7</sup> Quilty, S., Frank-Jupurrurla, N., Bailie, R., Gruen, S., & Russell, L. (2022). Climate, housing, energy and Indigenous health: a call to action. The medical journal of Australia, Volume 217 - Issue 1, 9-12.

<sup>8</sup> Mathew, S. &. (2023). Environmental health injustice and culturally appropriate opportunities in remote Australia. The Journal of Climate Change and Health, 14.

<sup>9</sup> Fran Baum, M. P. (2023). Energy as a Social and Commercial Determinant of Health: A Qualitative Study of Australian Policy. International Journal of Health Policy and Management, Volume 12.

<sup>10</sup> Riley, B., White, L. V., Wilson, S., Klerck, M., Napaltjari-Davis, V., Quilty, S., . . . Harrington, M. (2023). Disconnected during disruption: Energy insecurity of Indigenous Australian prepay customers during the COVID-19 pandemic. Energy Research & Social Science, Volume 99.

<sup>11</sup> Queensland Council of Social Service. (2014). Empowering remote communities. Queensland Council of Social Service.

<sup>12</sup> Energy & Water Ombudsman NSW. (2014). Prepayment Meters Discussion Paper. Sydney: Energy & Water Ombudsman NSW.

<sup>13</sup> Sharam, A. (2003). Second Class Customers: Pre-Payment Meters, the Fuel Poor and Discrimination. Melbourne: Energy Action Group.

<sup>14</sup> Dwyer, A., & Vernes, T. (2016). Power usage in the Bidyadanga Community and its relationship to community health and well-being. Nulungu Research Institute. Retrieved from ABC News.

<sup>15</sup> Cain, A. (2024). Energy justice of sociotechnical imaginaries of light and life in the bush . Renewable and Sustainable Energy Transition, Volume 5.

<sup>16</sup> Outstations and homelands are small settlements of Indigenous family groups typically located on or near places of cultural significance and ancestral connection (Australia Parliament House of Representatives Standing Committee on Aboriginal Affairs, 1987)

<sup>17</sup> Martire, J. L. (2020, 04 20). Powering Indigenous communities with renewables. Retrieved from Renew: <https://renew.org.au/renew-magazine/solar-batteries/powering-indigenous-communities-with-renewables/>

electricity. The paper then concludes with a discussion of best practice and emerging opportunities in power delivery to remote communities.

This paper was authored on the back of a virtual workshop held in August 2021, which included many of the foremost experts on power systems in remote Indigenous communities in Australia.

## Barriers and challenges for remote living and energy access

Communities living in remote areas can have extremely high costs of living, particularly for energy and other essential goods. Chris Croker shared his personal experiences of energy growing up in a remote community. He remembers not being able to afford electricity bills and seeing people choose to disconnect power, as electricity was seen as their least-essential resource. This juggling of finances and resources occurred on a weekly basis. Michael Berris recalls his experiences with a community six hours' drive outside of Tennant Creek (central Northern Territory). The community was powered by diesel generators and, due to the remote location, they had to pay \$1,500 per call-out for an electrician to service them. Another community west of Doomadgee was originally supplied power by an operational mine, but after its closure the community could not afford the fuel and system maintenance to continue to power the 11 homes, small school and store. The closest electrician to provide maintenance services was located 10 hours away and seasonal flooding left the community without access to telecommunications and fuel for power. These challenges are shared by many remote First Nations communities, making it difficult for people to remain on Country and live with dignity.

While many First Nations outstations and homelands continue to have to provide their own power via small generators, many larger communities have some form of power network and electricity service provider. These households generally have the option of receiving a regular electricity bill after usage or having a pre-payment meter, which requires households to pre-load credit to access electricity. Pre-payment metering and the Powercards that go with them can cause major issues for families. If an account runs out of credit, the power is disconnected with no back-up option for essential loads. Brad Riley explained the consequences of this: 'So when you lose power you lose a fridge and when you go to the store you don't just buy a Power card, you buy food to replace the food that's spoiled, or insulin, to replace the insulin that's spoiled'. Recent studies show that disconnections due to insufficient credit are common and are correlated with periods of extreme heat<sup>6</sup>. Pre-payment metering credit can be purchased either by loading digital credit onto an account or by purchasing physical cards to upload directly to the meter, depending on which system is available in the community.



Ruby Heard with Claude Carter and his Bushlight system

An audit conducted on remote power systems in 2000 found that many remote community energy systems had consistent problems<sup>18</sup> [Paul]. ‘Sixty-one per cent of community systems [the auditors] visited had problems in the few previous days, so the actual outcomes were really quite staggering’ [Brad Riley]. Those were technological problems, but there were also issues around supporting systems, enabling systems and communication with the communities themselves. Consultation showed that generally the communities wanted self-determination and independence, but there were issues with communities maintaining systems over the long term. ‘Some people in communities have exceptional mechanical and intellectual skills; they just don’t have a piece of paper to go with it’ [Michael Berris]. ‘The idea of communities fixing stuff is really good but it’s complicated, because sometimes you train people up and then those people leave the community’ [Paul Rodden].

There is also some risk that certain individuals may actually set out to damage the power systems. During the discussion, vandalism was generally not seen as a big problem, but it was observed in some communities. Preventing vandalism came down to the effectiveness of community engagement and imparting a sense of ownership as well as an understanding of the community benefit. ‘Because if you don’t engage people and you stick stuff on buildings they live in they will reject it, they will vandalise it; it’s a bad idea’ [Paul Rodden]. ‘It’s seen as an opportunity to vent frustrations about some of the inequities’ [Michael Berris].

To summarise, the key barriers and challenges to providing effective power systems to remote Indigenous communities include:

- affordability issues (for power, maintenance and living remotely in general)
- technical issues
- lack of maintenance and ongoing funding for maintenance (for energy systems and appliances)
- serving large air-conditioning loads and the increased need for air-conditioning for quality of life
- energy-inefficient appliances
- low energy literacy
- energy-inefficient housing
- pre-paid metering and frequent disconnections
- developers not following through with commitments to Traditional Owners
- vandalism where a sense of ownership and benefit has not been established
- the transient nature of communities
- legislation that prevents power-sharing between property boundaries without an electrical retailer licence.

## The housing–energy nexus

Michael Berris described some of the small communities he worked with near Tennant Creek. The houses were steel construction, including the frame and cladding. He remembers arriving on a warm day where it was 30 degrees in the shade; meanwhile, the temperature inside the buildings was above 45 degrees. ‘The house was actually an oven.’ All surfaces radiated heat inside the home and the generator had to be used to power air-conditioners if people wanted to go inside. Michael installed a 12-kW rooftop solar system on the house. Not only did it reduce the reliance on diesel to power the air-conditioners, but the passive shading effect from the panels reduced the temperature inside the house to match the temperature under the tree. He sees this as one of the most critical benefits of solar in the outback. However, in some Indigenous communities, the housing is in such poor condition that the rooftops may not be structurally capable of supporting solar systems.

Paul also visited the Ali Curung community and confirmed the key issue there is housing. ‘The houses were so badly designed and built that they put a huge load on [solar] systems that they could never actually meet’. The houses were metal clad, metal structure with no visible insulation, ‘Basically just hot boxes’. They may have five or six ‘window rattlers’ (old inefficient box-type air-conditioners which can be mounted in a wall cavity or in a window). This trip was part of an Indigenous Business Australia (IBA)-funded review. Paul’s recommendation to

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<sup>18</sup> Lloyd, B., Lowe, D., & Wilson, L. (2000). Renewable Energy in Remote Australian Communities (A Market Survey). Murdoch: Australian CRC for Renewable Energy Ltd.

IBA was to fix the houses before they even looked at the solar systems. 'There's a strong link between housing and energy, it's a really important link ... you [should] design a decent house to start with, with low energy needs and that's what communities definitely lack (in most cases, not all)' [Paul Rodden].



**Box AC in window with infrared image showing heat coming into the house around it**

Another issue for installing distributed rooftop solar systems on housing is the complexities around home ownership in many communities. Ownership structures vary across Australia, but many dwellings in Indigenous communities are owned by the State government or a housing provider and may be managed by a separate entity. This system creates complexity around accountability for purchase and ongoing maintenance of housing fabric upgrades (e.g. insulation), switching to energy-efficient appliances and for rooftop solar installation<sup>19</sup>. This is a key reason why very few remote Indigenous households have solar systems.

Communities sometimes build or acquire poorly performing buildings after an effective power system is designed and installed, creating issues later. Communities often have access to mining community dongas (prefabricated temporary structures) which have poor ventilation and end up being heavily reliant on air-conditioning. Paul Rodden and Andre Grant saw dongas brought into a Bushlight community, where they began depleting the stored energy by 2 am each day, causing the community to feel negatively towards the solar system.

Brad shared that, at some point in Alice Springs, pot-belly stoves were taken out of houses and replaced with bar heaters. Household energy bills increased enormously overnight. 'Housing and energy are intrinsically connected' [Brad Riley]. In Ruby Heard's conversations with First Nations households in Western Australia, she heard that families continue to trade-off between different fuel sources, with several people indicating they cook on a wood fire when needing to reduce their electricity costs or when they have been disconnected.

<sup>19</sup> Riley, B., White, L. V., Quilty, S., Longden, T., Frank-Jupurrurla, N., Nabanunga, S. M., & Wilson, S. (2023). Connected: rooftop solar, prepay and reducing energy insecurity in remote Australia. *Australian Geographer*, 325-346.

## The Bushlight program

Several authors of this paper were directly involved in the Bushlight program, a federally funded initiative delivered by the Centre for Appropriate Technologies (CfAT). The program ran between 2002 and 2013, installing around 150 off-grid power systems for remote Indigenous communities across the country. Bushlight is often considered to be the exemplar of remote power systems in Australia, with its success also leading to it being trialled overseas. The program was developed in response to the issues raised in the ACRE audit report<sup>18</sup>, to demonstrate a methodology that would address all the problems identified.

The stand-out features of the program include:

- an emphasis on community engagement, which led to genuine co-design of energy systems and a feeling of ownership over the energy systems
- an intuitive user interface, which allows community members to interact with the energy system in real time and manage their own usage
- power reserves for dedicated critical load circuits
- colour-coded visual representations of energy sources for easy communication of power availability
- using control systems to allocate energy budgets to different households based on community consultation
- setting aside funds for the long-term maintenance of the systems (until the program was defunded)
- training community members to use the systems optimally and provide some level of maintenance for over the long term.



Community Energy Planning with Mulga Bore Community

Throughout the discussion there was clear admiration for the Bushlight program legacy. Andre continued to work at CfAT long after the Bushlight program was terminated. ‘Our hearts break to not see it [Bushlight] there’ he said.

At the heart of Bushlight was the community engagement process. According to Brad, although the technology was great, this is where a lot of the innovation was. ‘It [the Bushlight program] had two parts – community and technology – and they were equally weighted. Even in staffing, we had essentially equal numbers.’ The projects always started with frank communication with the communities and consistent engagement over the long term’ [Brad Riley]. Michael Frangos agreed that, through his experience, Bushlight and his work today is all about engagement and trust first and foremost, which then informs the technical design. The Bushlight team went out to communities to have discussions and conduct energy audits in an engagement process that ran over a 12-month period. They asked communities, ‘What are your main energy priorities? What do you want? You tell us what you want to power’ [Paul Rodden]. ‘When people said, “This is what we need” or “This is what we want”, the conversation would go along the lines of, “Great, we put it through the pricing tool and it’s a million dollars”’ [Brad Riley]. Because of the established relationship, upfront honesty and the collaborative nature of the design process, communities accepted the limitations and would then

work with the Bushlight team to establish realistic goals. Communities were not simply told that they could not have what they wanted; CfAT took the time to explain why.

The engagement side of the program fell into what CfAT called the Community Energy Planning Model<sup>20</sup>. Andre described the process as a set of tools for having a conversation with the community. Brad explained that the first step was to find a language to talk about energy. CfAT developed the program around visual aids and they used big, illustrated books to sit down and yarn with community. The planning process started by describing energy and talking about fire. 'We'd have a picture of a little fireplace and people bringing wood and that was the energy, and we'd talk about vehicles and fuel' [Andre Grant]. Vehicles were used because they were relatable, and in fact the displays on the Bushlight interface known as Energy Management Units or EMUs were based on the design of a Landcruiser instrument cluster. The conversations then directly fed into the technical design and hardware development. 'I really love that we had a yarn with the community that actually turned into a really technical output for how to program the EMUs' [Andre Grant].

The most essential electrical need tended to be refrigeration, as it would allow communities to do a big monthly grocery shop and cut down on travel. Lighting and cooling also ranked highly among the community needs; however, back then (and even today) air-conditioning could only be achieved by running a generator [Paul Rodden]. The team would then work with the community to establish a load hierarchy by asking what loads were critical and what was negotiable. Colours were assigned to represent the types of loads that required generator power – yellow for essential energy, green for discretionary energy and blue for premium energy. 'That was an Aboriginal innovation, which came out of discussions on the ground with folks in early energy planning around power... And that was really powerful and was the basis of them being able to use an energy budget' [Brad Riley].



**Paul Rodden and Sam Mitchell (Ekistica) auditing Bushlight systems in 2024**

A Bushlight system was comprised of an outdoor switchboard and an indoor display panel. The panel had five green lights to represent stored energy, with lights going out as the energy storage allocation in that budget declined. 'Energy isn't visible – Bushlight made energy visible' [Brad Riley]. The communities understood that they were in control of how fast the lights went out and that no lights would mean the end of their discretionary power budget. At that point only essential circuits remained on, which was generally the fridge and a single light. 'And of course you could have your fridge circuit plugged in and someone could come and pull that out and put something else in there, but that's a decision they had to make' [Paul Rodden].

Programmable logic controllers (PLCs) enabled Bushlight to establish what the team called 'energy budgets' – fixed maximum energy allowances for different circuits and/or households. The communities were responsible for deciding how to allocate energy between themselves. 'In the community energy planning we would ask, "How do you want to share energy? Which household gets what?"' [Andre Grant]. They might then allocate more power to homes with children and less to younger adults in smaller households. This process of allocating and agreeing on the energy split up-front was a way to ensure there was no conflict over how

much energy each household was using. 'That was just gold to me coming in to work for Bushlight. It's something you just wouldn't think about – how to avoid conflict through good energy, good technology and good hardware. That's a really fascinating and beautiful part of Bushlight.' [Andre Grant]. Although energy limits were imposed,

<sup>20</sup> Centre for Appropriate Technology. (2011). Bushlight's Community Energy Planning Model. Alice Springs: Centre for Appropriate Technology.

the community members determined how the budgets were allocated across their households and how they managed their power allowance.

The end result of the Bushlight projects was truly appropriate energy systems, built for purpose in collaboration with the communities they served. This established a deep sense of ownership over the systems and a responsibility to maintain and sustain the systems. 'One of the questions we always asked [during Bushlight projects] was, "Who owns this system?". Communities generally responded that they owned it, which is a really unusual situation for infrastructure in remote communities' [Brad Riley]. This strong sense of ownership has played a big part in the longevity of the Bushlight projects. Brad and Paul had only seen one act of vandalism against a Bushlight system. They put that low figure down to the success of the engagement process and establishing the feeling of community ownership.

The Bushlight business model was fortunate to have been funded through federal and state government initiatives.

This model provided funding for the installation and for maintenance, while communities were encouraged to save funds over time to replace the systems at their end-of-life. In most communities, these funds were not accumulated and funding for maintenance (now delivered by the Outback Power program) waned after the Bushlight program was defunded<sup>15</sup>.

Today, not a lot has changed in this space, and we still see problems like 'the jurisdictional accountability for who's going to look after it [energy systems], [and] the fractured relationships between state and federal governments around central service provision...' [Brad Riley]. Sadly, the Bushlight program was never re-funded, and a similar replacement program has never been implemented by federal or state governments.

## Indigenous culture, values and perceptions of energy

Aboriginal and Torres Strait Islander traditional culture has a very communal approach to resources. From his youth living on Country, Chris remembered communities that had only one power outlet, which they would use for a communal fridge/freezer. Even when energy is split up and provided to individual households, they can still find ways to share this around the community. 'If I think about if my next-door neighbour ran out of power, I probably wouldn't run an extension cord out the window to power their house ... but that's routine in a lot of these communities' [Brad Riley]. Michael Frangos explained that there are often negative responses to the fact that there is no term meaning 'thank you' in Aboriginal languages, but he said this just reflects the difference in culture. Sharing and connectiveness is the expectation. 'To me it's an Aboriginal theory or concept [connectiveness and sharing among the community], and probably not Western. Western is more focused on keeping all the nuts to yourself and not sharing them' [Michael Frangos]. This reflects the dominant capitalist mentality that influences the Western worldview and our energy system.

Brad spoke about his experiences in the Kimberley, where there is a very strong ethic of Wunan, a concept of trade and exchange, reciprocity and cooperation. 'I think looking after people, these are really strong ethics surrounding energy. Making sure that if you go to your Nan's house, that you take a stack of Powercards' [Brad Riley]. In recent years we have been seeing emerging trends in the energy space that could promote greater connectivity, local participation and sharing within the electricity system. But Brad cautions that the other side of Wunan is avoiding conflict, which is also important because there are times when people don't want to share, so we need to be aware of that in service delivery also. For example, having one communal amount of energy that everyone can access may lead to a 'tragedy of the commons' scenario, so a technical design decision could end up creating conflict or cultural stress<sup>14</sup>.

In Michael Berris's experience, communities 'wanted to be engaged with the entire world. But they still wanted to be on Country in the places that were important, vitally important and significant to them' [Michael Berris]. Anna Cain noted that energy systems are a public good which should enable and support people to live their lives the way they want to, including living on their traditional country. Communities are looking to have the same level of facilities that people have access to in towns. They don't want to be utterly reliant on others for services that cost many times more than in town, but they also don't need to be completely self-sufficient to feel



empowered [Michael Berris and Paul Rodden]. 'People are the same everywhere in some ways – they don't want to be imposed upon and they want to have some sort of agency in what's going on in their lives, and that has to do with anything' [Paul Rodden].

There is an enabling effect of energy: it unlocks a range of economic and social determinants, one of these being telecommunications. 'It's really important to look at energy from that enabling point of view and its ability to unlock and springboard social progression' [Michael Frangos]. 'Six of the nine healthy living practices in the Closing the Gap targets are related to energy – for example washing (clothes, bedding etc)<sup>21</sup> [Brad Riley]. Donna Fraser highlighted lack of education as a key factor. 'While people across the board have heard about solar, generally they don't know anything else about it' [Donna Fraser]. She shared that energy insecurity is having a huge impact on quality of life, which was evident in survey results where it came up as the major concern for people. 'They've got to pay their electricity bills or they've got to go without decent food or medicine for weeks at a time' [Donna Fraser].

Effective energy systems are not only essential for Indigenous people to live on Country, but they also present an opportunity for equity and self-determination. The Bushlight program is a unique example of where Indigenous values were centred, Indigenous perspectives influenced system design and communities were given the opportunity to self-determine. The clean energy transition we are experiencing gives us an opportunity to transform energy systems for greater inclusivity and equity; however, this will not happen without intentionality and new strategies [Anna Cain].

## Best practice, new concepts and opportunities

The following sections are commentaries and guidance on best practice, new concepts and emerging opportunities for energy in remote communities.

### Engagement

Organisations wanting to improve power supply to remote Indigenous communities need to focus on building strong, respectful relationships and delivering on promises. Michael Frangos recounted his experience speaking with a Traditional Owner (TO) in South Australia about a wind farm on their land. 'The TO was quite upset and hurt and the biggest thing wasn't that the jobs and the revenue and all of that didn't come, it was that there was no meaningful relationship.' It's vital to build strong, genuine relationships when working with Aboriginal communities. This is the first step, and it is crucial: 'If you don't get that right, forget about it, you might as well pack your bags and go home' [Donna Fraser]. As mentioned, this was a foundational principle of the Bushlight program, which led to many desirable and successful outcomes.



Ruby Heard and Kathryn Thorburn (Nulungu Research Institute) yarn with Bungardi community about their energy situation

<sup>21</sup> Health Habitat. (n.d.). Housing for Health – the Guide. Retrieved from Health Habitat : <https://www.healthhabitat.com/resources/housing-for-health-the-guide/>

## Academia and engineering practice

Some of the problems we encounter in the remote energy space are around the limitations of researchers and engineers with regard to their worldview, research methodologies and design inflexibility. Michael Frangos points to the divergent/convergent nature of problem-solving and notes that engineers are often going into projects already having the answer in their minds before doing the work. Michael Berris echoes this, saying that engineers were never meant to use science to justify what they were doing – they were meant to use it to solve problems within the community: '[Engineers are] servants of the community. The needs of the community should and must remain the priority.'

There are some emerging trends in academia which may be promising, including decolonising research methodologies<sup>22</sup>, participatory action research<sup>23</sup>, Indigenous research methodologies<sup>24</sup>, and adaptive-iterative methodologies as well as the field of humanitarian engineering.

## Power-sharing

One of the new design trends being trialled around the world but is held back by regulations in Australia, is community power-sharing. The advantage for communities is that their distributed energy resources (DER) could be shared among the households rather than sold back into the grid for a small feed-in-tariff. Due to the transient nature of people in remote Indigenous communities, often houses are left vacant for the short-to-medium term. When this happens, tenants could choose to share excess power generated by their rooftop solar system (if they had one). Even with a centralised system under a Bushlight power-sharing arrangement, a flexible power-sharing mechanism that responds to actual system production could allow more power to be allocated to a particular household, for example if they needed more to cover additional occupants for a certain period.

One impact of the reduced maintenance on Bushlight systems is that the static energy budgets may not be adjusted to respond to the dynamic nature of the communities they serve. Ruby witnessed a Kimberley-based community with a large-scale Bushlight system that supplied five buildings. Many years after the initial installation, the community was living in only one of the buildings. The family had access to only 6 kWh a day due to the original programmed energy budget, while the rest of the available energy went unused every day. In future, systems could be more flexible, with either community members able to make adjustments for changing needs or better management by the system operators.

## Communications and controls

For most of the Bushlight program's duration, telecommunications service was limited in the outback and, where available, was prohibitively expensive for the equipment to utilise it. So, although remote monitoring technology may have been available, most systems could not benefit from it until the final few years of the program. Today, the availability of new satellite networks has dramatically reduced these costs. This helps to mitigate the need to send electricians out to communities as the system builder can monitor and provide remote assistance up to a certain level [Paul Rodden]. Communities now also have a greater level of mobile phone service to be able to connect with a remote technician; however, there are still many communities with no or extremely limited phone coverage. Remote assistance should also not be considered a replacement for establishing trusted relationships between communities and service providers [Anna Cain].

Bushlight communities often complained about timers that were put on lighting and fan circuits – considered a necessity to manage the very limited energy production. Andre noted that it was like it insulted the communities to suggest they couldn't turn their own appliances off. But visitors to the community who weren't familiar with a Bushlight system would often leave things on and run the battery system flat. The timers would run for six or 10 hours and then cut the power, sometimes inconveniently cutting off a fan at 4 am in someone's bedroom. Paul's

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<sup>22</sup> Tuhiwai Smith, L. (1999). *Decolonizing methodologies: Research and indigenous peoples*. Zed Books.

<sup>23</sup> Huang, H. B. (2010). What is good action research? *Action Research*, 8(1), 93-109.

<sup>24</sup> Wilson, S. (2008). *Research is ceremony: Indigenous research methods*. Fernwood Publishing.

reflection is that maybe there was a little too much control in the Bushlight systems, even just from a technical perspective, as more controls and automation lead to more points of failure.

## Interconnectedness

The discussion clearly demonstrated that there is more to designing effective remote energy solutions than just focusing on the technical aspects of electrical systems. Paul proposed that an engineer also needs to look at water, communications, housing and more, because they all form part of an integrated system that cannot be separated. 'We [engineers/designers] can't just look at energy services; we have to look at all the services together ... It's all a "nexus". You can't just go to site and only look at the energy services – you won't succeed' [Paul Rodden]. In addition, engineers need to incorporate the human element, relationality<sup>25</sup>, culture, engagement and co-design.

## Conclusion

Power delivery to remote Indigenous communities is a complex puzzle that remains unsolved for many First Nations households in outback Australia. There is no silver bullet that can save the day and nor should we be searching for one. Communities are unique and dynamic, requiring flexible solutions that are place-based and fit-for-purpose. Equally as important as the technology and the construction of a power system is a sustainable plan for operating, maintaining and protecting those systems for the long term. Success in this area is predicated on a sense of community ownership and responsibility which, as the Bushlight program demonstrated, is fostered through community involvement in design and decision-making. When we attempt to solve the energy problems of a community we need to think holistically, as energy is woven into the tapestry of life, interconnected with other services and resources (water, telecommunications, firewood, shelter) and with the human experience (health, wealth, education, wellbeing, connectedness). There is the opportunity for energy to play a leading role in uplifting communities and closing the gap on the non-Indigenous/Indigenous divide if approached in a way that focuses on self-determination, agency and equity.

## About the Lead Author

*Ruby holds a Bachelor of Electrical and Electronic Engineering from Victoria University and has been working as a consulting engineer for over a decade. Her early career involved working for Arup in both Melbourne and San Francisco. In 2018, Ruby founded Alinga Energy Consulting, a small firm providing energy research, feasibility and design services with a focus on improved energy systems for Indigenous communities. She is a founding member of the steering committee for the First Nations Clean Energy Network and a board member of the Australian Renewable Energy Agency (ARENA).*

*Over the years Ruby has contributed to publications on the topics of microbial fuel cells, DC power in buildings, microgrid applications for public transit in the United States and humanitarian engineering. In 2020 Ruby became a PhD candidate with the University of Melbourne. Her research centres on energy justice for remote Indigenous communities and using traditional Indigenous values to augment energy service delivery in Australia. In 2019 she was awarded as Young Professional Engineer of the Year – Victoria by Engineers Australia and was also featured in their top 100 Engineers Making a Difference list. She received recognition again in 2024 as a finalist for Professional Engineer of the Year Queensland.*

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<sup>25</sup> The multiplicity of relationships that humans have with each other and the natural world (Wildcat & Voth, 2023)