Response to "Powering Daintree" Sunverge/ARENA 2018

Australian Tropical Research Foundation

29May 2018

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Executive Summary

This ARENA sponsored report, '**Powering Daintree'** unveiled at a recent meeting (20/3/2018) in Diwan at Heritage Lodge, by Hon. Warren Entsch, Member for Leichhardt, ironically clearly indicates why Reticulated Power should not be supplied to the Daintree Coast area and surprisingly offers a cost-effective alternative (**Option 5**).

We support a variation of the report's Option 5 (upgrade and/or provision of appropriate Remote Area Power Supplies (RAPS) to residents and businesses in the Daintree Coast). Options 1-4 are not viable (for reasons addressed in this response).

The main reasons against provision of reticulated power are:

The assumption everyone will connect is not correct. It is likely the majority won't because they cannot afford to, have already invested in a system that works or are opposed in principle.

- Most of the residents were not consulted in this survey, and the analysis of expected loads erroneous
- It will subsidise further development. The Daintree Coast is lauded as containing one of the world's most precious (and oldest surviving) rainforests – Taxpayer's money should not be used to the detriment of the Daintree Coast environmental, economic or cultural values
- The Daintree Coast is one of the two foundations of the region's tourism industry (the other is the Great Barrier Reef) and visitors expect a civilised country to preserve such treasures.
- Provision of grid power can be expected to promote more development of every kind – residential, resort, commercial, as well as an increase in road traffic.
- The cost of getting connection to the house (est $ 500 - $1500 per meter from the boundary) and necessary wiring upgrades to become legally compliant, are additional costs which are the householder's responsibility. Our detailed analysis suggests that the costs for grid connection for each residence could be well over $50,000.
- Combined with the pressure for a bridge across the Daintree, road widening and bitumen all the way to the Bloomfield River, a power system with reticulated power on the scale proposed, will add considerable development pressure.

For about twenty million dollars, ($55,000/house x 350 = $20,000,000) a variation of Option 5 would be sufficient to upgrade all households and businesses so everyone could have a reliable RAPS system (and no connection/compliance costs). It would add to the Daintree Coast environmental reputation and massively lower its carbon footprint,

something we could all be proud of. It would cost about one third the estimated cost of **Option 1** a 65 million dollar outlay (which does not include connection and annual running costs)

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Overall comments

This Sunverge Report was commissioned by ARENA in response to local lobbying of the State and Federal Governments for provision of grid, or grid equivalent power.

Formal discussion on provision of power (or "grid equivalent" power) in the Daintree was initiated in 1995 following the World Heritage Listing of the region in 1990. The then State Government, believed that the then current residents / landholders were considerably disadvantaged compared to those with access to conventional grid supply outside the region. A Remote Energy Scheme was instituted to attempt to address this, whereby all property holders were offered grants of $15,000 for the installation of a solar (PV) Remote Power Systems(RAPs). While this scheme initially satisfied the needs of most of those who had applied, the technology was in its infancy, the installers were inexperienced, most installations were poor quality, and few householders were provided with even the basic information on the principles and operation and maintenance of their systems. As a result there was a high failure rate and a high level of dissatisfaction.

Additionally, the Daintree Coast has lower solar access than most of Australia – periods of high cloudiness are common, and uncontrolled vegetation growth can often eclipse solar systems. However, many residents are quite content with their existing RAPS systems. The maps in Appendix 1 shows the penetration of hybrid RAPS (including solar and hydro) in the areas that comprise the Daintree Coast, and also plots the property connection distances which will be involved.

There have been many past studies on providing grid power to the area:
Several early surveys were carried out under the auspices of the Australian Tropical Research Foundation:

Whybird, O. and Beaton, R. Current and future strategies for energy supply North of the Daintree. 1993 (96 responses/209)

Daintree Renewable Power Survey 1999-2000 Spencer, H. and Cowie, J. 2000 (129 responses)

Solar RAPS Systems in the Daintree Lowlands – and an assessment of the effectiveness of pulse-desulphation technology for extending battery life. Spencer H and Hollis P. 2004 (53 responses)

Formal Gov't funded surveys:-

FNQEB Preliminary Power Line Proposal 1996

GHD Proposed Daintree Poiwerliune Preliminary Environmental Impact Assessment Study Jume 1998 (2 volumes) .

Various Questionnaires and public meetings in the area 1997

Other than raising the hopes of those locals dissatisfied with their RAPS installations, no Gov't proposals were funded.

A recent survey by Compass Research (Cairns), who carried out a rather inconclusive telephone survey (date not specified, presumably late 2015). "Daintree/Cape Tribulation Electricity Survey". However, it does summarise the recent distribution of attitudes in the region. (100 responses)

There have been significant changes in the population of the area since 2000, with many recent land purchasers having sufficient capital to invest in up-to-date solar RAPS systems. This has changed the dynamics and expectations of many residents.

Social attitudes

While there has always been a serious resentment by some residents about the constraints imposed by the World Heritage listing of the area (especially after the power supply promises made by the developer did not materialize), other residents accept the constraints as the price that they must pay to live in this particular place.

Social Economics

This is a low-income area – many residents are on pensions or retired (see Compass report) The use of overseas young people on work-holiday visas, especially by resorts and backpackers establishments, has severely distorted the work availability in the area. Additionally what work there is available, is very seasonal. This must be taken into account when assessing capability of residents to pay for installation or wiring upgrades.

Absentee landowners (who may or may not have caretakers on the property), further complicate the situation. Many bought the properties for investment and/or conservation.

On-the-ground realities.

A significant proportion of the settled blocks have temporary dwellings (sheds), or dwellings which have never received Council building approval. As a result, even if mains-equivalent power were made available, a significant number of residents would not be able to connect until their systems met current wiring code, and if not Council approved, would not be able to connect anyway. Even some of the newer installations would require significant upgrades to be code compatible. This can be a very expensive procedure.

This environment is also exceedingly tough on modern electronics, which tend to have short lifespans unless kept under controlled (dehumidified) environments, or are designed for tropical humid environments (a rarity).

This reality has had a major impact on the satisfaction of residents with renewable energy systems. The electronics become invaded (insects, geckoes and fungus) – and fail. While there are relatively simple solutions to this problem, they are not part of our culture – and most system installers, builders (or residents) are unaware of them, so fail to install or suggest them **http://www.livingindaintree.org.au/power**

All the early RAPS installations (1995 and after) used “flooded cell” lead acid batteries, and the information supplied to householders implied that they required constant monitoring of their specific gravity to assess the state of charge (and water top-up). Given that many battery installations were placed under buildings, or in difficult-of-access situations, the apparent requirement for this frequent monitoring also generated a lot of resentment by householders – and also caused early cell failure through contamination (through dirty hydrometers). Of course battery voltage is a fairly reliable reflection of state of charge (but not battery capacity), but such monitoring systems did not come until later.

Gel cells (Absorbed glass matt - AGM) which are maintenance-free lead acid batteries has relieved householders of these duties, came later.

System Maintenance

One big issues here appears to be system maintenance (or lack thereof) – we do not have any local person who is in the position to maintain and repair RAPS systems. So unless the resident has the understanding and skills necessary, system failures require a very expensive service call from an outside company

From earlier surveys, it has become evident that solar RAPS systems are “black boxes” to many of the residents, and because of this, easily avoidable issues rapidly escalate to major expenses. Efforts in the past to obtain government-supported service (to support the 1995 installations) failed, despite the presence of capable locals. This has increased the general level of dissatisfaction.

Basic maintenance such as cleaning solar arrays (or adjusting angle for summer / winter) can be difficult (and dangerous) for roof-mounted arrays on sloping roofs, although addressing this could provide a valuable occupation for some locals

The **Sunverge Report.**

This is a biased report. It depends on data obtained from 5 "friendly sites" (p19 "Powering Daintree"). It does not represent the views or aspirations of most of the residents of the Daintree Coast.

This factor needs to be taken into account when evaluating the Sunverge Report.

The report appears to draw heavily on the Compass survey (2016) for their demographic facts, as well as Ergon's Developer's Handbook (Version 8) Ergon Energy for their energy assumptions. These all assume, it appears, urban energy use levels. There is no attempt at even suggesting energy conservation.

It should be noted that Sunverge are an American company associated with microgrid and "virtual grid" installation.

There are 5 supply options suggested by Sunverge.

Sunverge Option 1

Single Microgrid

- 120 Km reticulated underground cable
- 3.4MW synchronous generator –
- S2G2 facility (ultra high-efficiency power-to-gas to power (fuel cell) 4.7 MW
- Hot water load balancing / control
- Utilization of LNG (methane) as a fuel

(Presumed is a requirement for significant directional drilling in the Alexandra range section).

Austrop Comments on Option1

See Appendix 1 (Attached)

This is a considerable body of work undertaken locally, offering a more detailed insight into possible demand. The distribution of distances from the road for both private and commercial properties has been measured in all precincts of the Daintree Lowlands.

Existing solar/hybrid use is also identified and mapped

The Sunverge Report does not attempt to assess either of these key issues. It makes no mention of these additional householder/business cost issue. They will have a damping effect on uptake – the report assumes a high level of acceptance of connection on unsubstantiated grounds.

This proposal suggests a single (we assume 20KV high voltage spine) from the ferry to Cape Tribulation and multiple low voltage feeders (4KV). Proposed Solar farms – Forest Creek, Cape Kimberly, Cow Bay (2 solar 'farms'), none at Cape Tribulation. These seem to be a bit of an afterthought.

Large fuel cells at Cape Tribulation – using surplus electricity for hydrogen production. A major issue is that hydrogen has a low energy density – you need a lot of hydrogen and a very big fuel cell to balance loads – Tesla-style batteries are better (or flow cell batteries). Plus, unless hydrogen is liquefied, you would need a very large storage capacity.

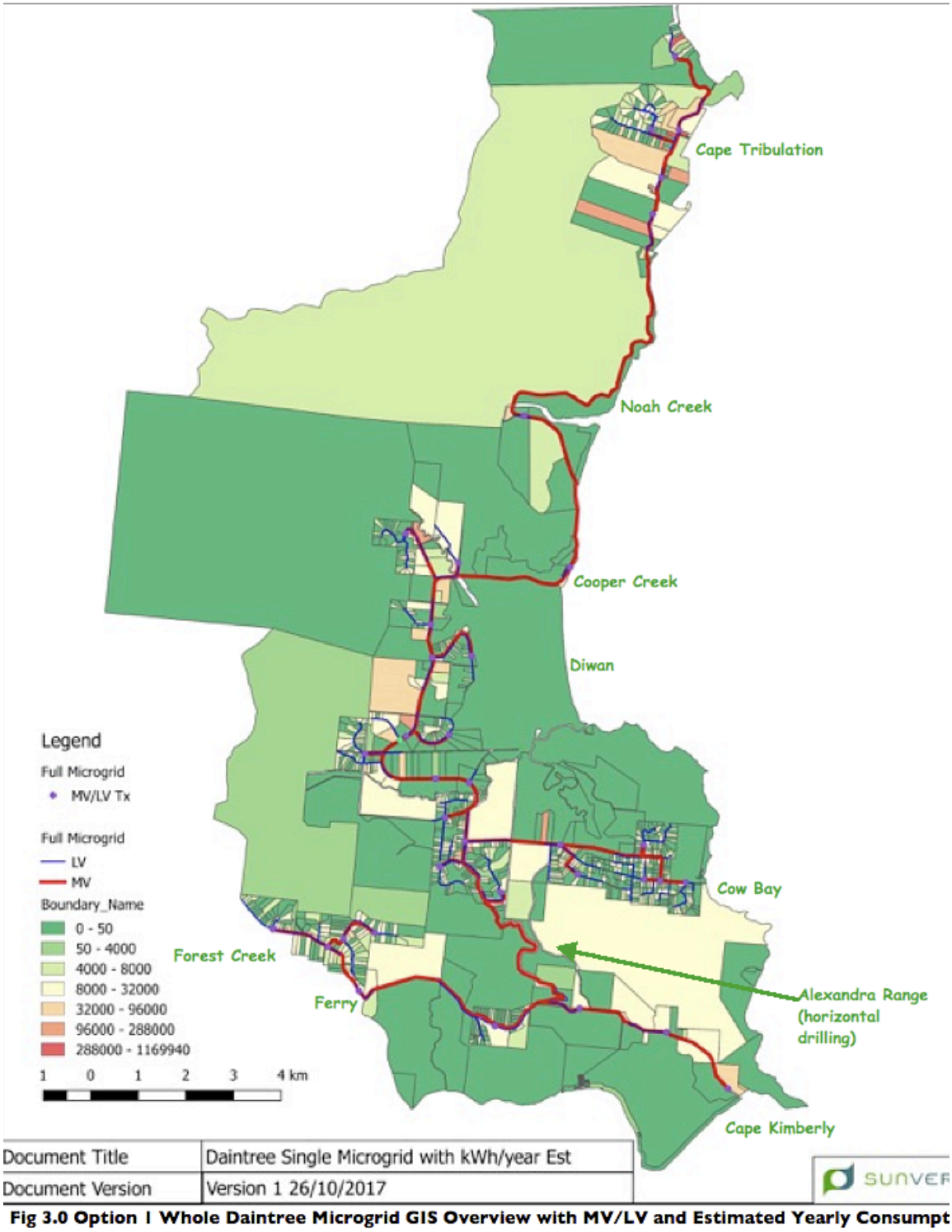


Fig 3.0 Option 1 Whole Daintree Microgrid GIS Overview with MV/LV and Estimated Yearly Consumpt

Map 1 Map of Option 1 from Sunverge – (modified with explanatory labels)

Property connection from road - line costs

Various figures have been given for the connection from the road to the house / business. Connections are at the property owner's expense.

Some (very few) properties are adjacent to the road, most are at 5 - to 100 meters away (or more - see Appendix 1). Connection in the Daintree requires buried cable – and depending on the route taken, and the nature of the land traversed, this can be exceedingly expensive. Swampy areas and creek crossings require specific approaches. These costs add significantly to customer connection costs. General estimate of connection costs to the door are from $500 to $1500 a meter depending on conditions.

Unfortunately, a high percentage of buildings which may wish to be connected, are not wired to modern code – and will require substantial rewiring by a professional electrician before they can be legally connected. This will be a very considerable additional impost which the householder has to bear. They also have to be Council approved dwellings.

Energy conservation is not addressed. Many facilities presently face high fuel costs, but often do not adopt energy conservation measures (which would be a simple matter – key cards) https://www.greenexpressdirect.com/pdf/hotelroomsystememail.pdf.

Hot water: **Option 1** requires that all connected houses / establishments have electrically-heated hot water to function as a "load dump" So what are households supposed to do with the excess hot water? Given that modern evacuated tube solar HWS outperform flat plate collectors, cost about the same and use no energy, this is a ridiculous concept. It also represents a substantial waste of energy from the proposed generation plants.

Use of battery banks at the proposed generating nodes to "iron out" demand shifts would be the appropriate approach, or even, as suggested in **Option 2** – generating hydrogen.

Frequency synchronization – pretty irrelevant for a non-connected system. Modern power inverters can establish 50Hz in seconds.

Cooking. With improved RAPS systems most household cooking can now be done electrically. There are pressure cookers and induction stovetops which are highly efficient, as well as insulated hot water "kettles", bread makers, and microwave ovens with clockwork timers (which are "bomb proof" in the tropics – electronic ones are not). Some gas cooking would be required for baking frying, roasting, barbecuing

Education would appear to be a critical component of addressing the power issue here, as well as the necessity for energy conservation. How this is to be achieved will require a number of approaches – hands-on learning (TAFE style), and perhaps web and video presentations (especially for remote landholders / "weekenders"); attending such a program should be a requisite for all landholders / residents receiving upgraded RAPS systems (Option 5). .

Sunverge Option 2

Three small micro-grids (three microgrids built around load centers)
Forest Creek Road to Cape imberley
Cow Bay to Diwan,
Thornton's BeachCape Tribulation and an extension south to Noah Valle Farm

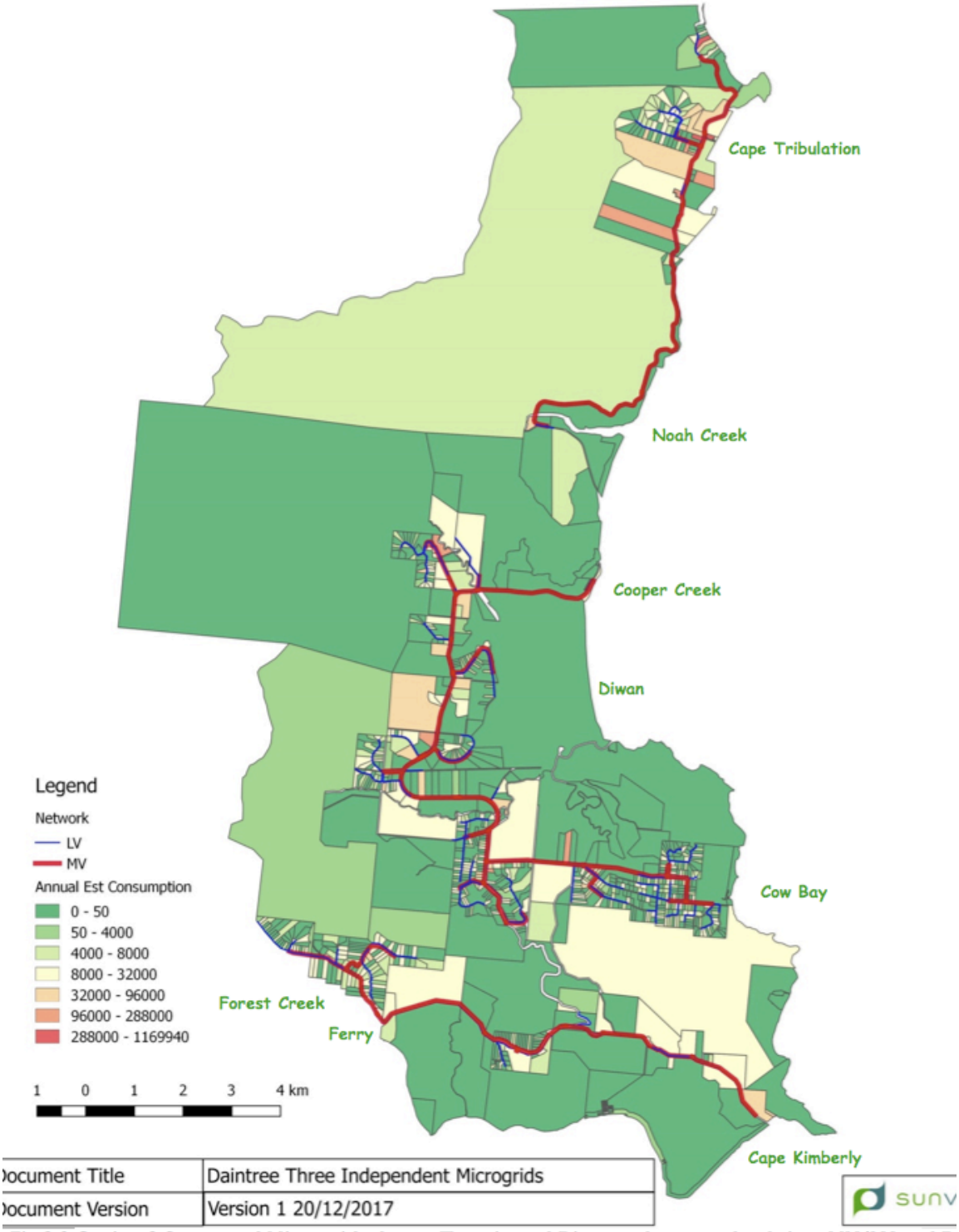


Fig 3.2 Option 2 Separated Microgrids due to Terrain and Distance between load sites MV/LV and P
Annual kWh Consumption

Map 2 Sunverge map forOption 2 (modified with explanatory labels)

Austrop comment on Option 2

This option avoids the possibility of drilling through the Alexandra Range, but would not be able to service the Telstra relay tower on the range.

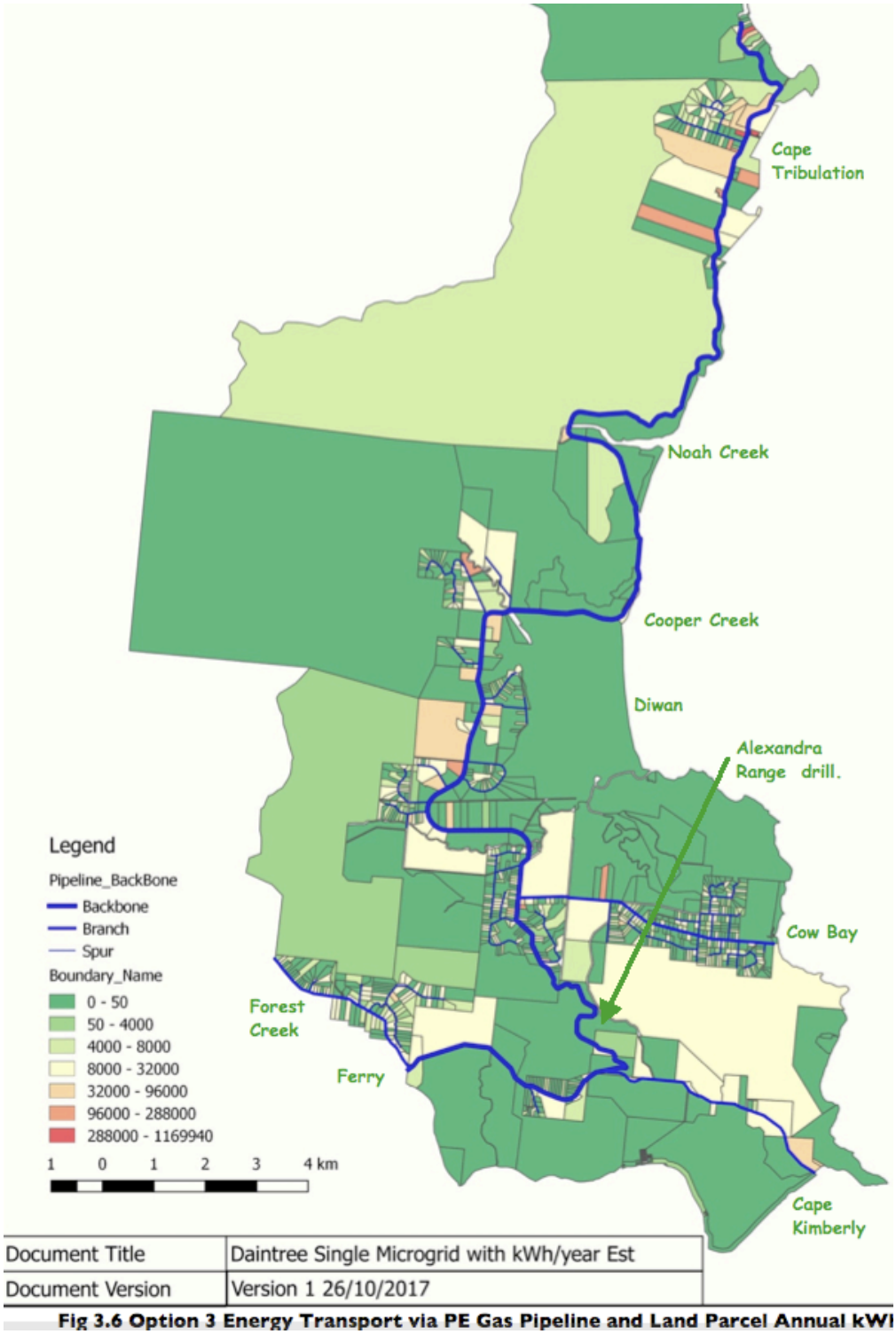
Option 1 suggested the use of extensive solar generation from the Kimberley region (as Cape Tribulation has lower solar potential), as well as load balancing (assuming the existence of "the expected two resorts (at cape Tribulation) which are awaiting grid power". The identity of these proposed resorts are not specified, and Coconut Beach resort (which would have been a major potential consumer) is highly unlikely to re-open). Option 2 would eliminate this.

There is also the assumption of high A/C use, which from the perspective of long-term residents in the area is quite unnecessary, as the presence of the main range tends to result in cool evening conditions (cold air flowing down to the coast). So far, none of the existing Cape Tribulation resorts (Ferntree. PK's and Beach House) have attempted to regulate A/C use by guests (fitting tag switches, for example). Building insulation is poor https://www.greenexpressdirect.com/pdf/hotelroomsystememail.pdf

Having a spur line from Cape Tribulation to service Noah Valley Farms (whose power levels can easily be supplied by solar - or even hydro) does not make economic sense. Noah Beach campground does not require electricity (it is a "cold water" campground).

Sunverge Option 3

80 km underground gas pipeline
30 Km LV (undergrounded) cable
Smaller generators at nodes
More limited supply
Option for Solar To Gas (Hydrogen) or biofuel plant



Map 3 Sunverge map of Option 3 (with added explanatory labels)

Austrop comments on Option 3

The rationale for this option was the "low cost, high reliability and simplicity of installing underground polyethylene gas pipeline networks".
(it would still, presumably, require a directional drill through the Alexandra range).

Solar to hydrogen generation

https://arena.gov.au/assets/2016/05/Assessment-of-the-cost-of-hydrogen-from-PV.pdf
https://en.wikipedia.org/wiki/Hydrogen_storage
https://en.wikipedia.org/wiki/Hydrogen_production
https://en.wikipedia.org/wiki/Fuel_cell
https://www.energy.gov/eere/fuelcells/hydrogen-storage

While hydrogen does offer a form of energy storage (remember that hydrogen is not a fuel – but a form of energy storage) the realities of storing sufficient quantities of electrolytically-generated hydrogen to provide significant power reliability during periods of protracted poor weather are complex and as a result highly problematical. Because of the external energy inputs required – electrolysis (75% efficient) compression and storage (at an estimated 60% efficiency) and fuel cell efficiencies (nominally 50-60%, not including storage infrastructure – then it becomes a very poor alternative to battery storage, even allowing for battery self-discharge. Emerging battery technologies offer better choices

Plus even liquefied H_2 has only one fourth of the energy density of gasoline (and has to be kept at –253 ºC – which entails considerable additional refrigeration energy costs – and insulated storage vessels).

Round-trip efficiency for hydrogen as an energy source is at best 40%.

Batteries at worst are 80%.

Biofuel

This was suggested as an additional fuel source in addition to hydrogen.

As becomes very evident from https://en.wikipedia.org/wiki/Category:Biofuels
Biofuels are a very broad category, and other than those deriving from the very limited locally available agricultural waste (which would be better used as compost, or used in individual residential cooking biogas generators), the Daintree coast is unlikely to be a biofuel producer at anything like the amounts that would be needed.

Sunverge Option 4

Using existing generation to provide power to local properties.

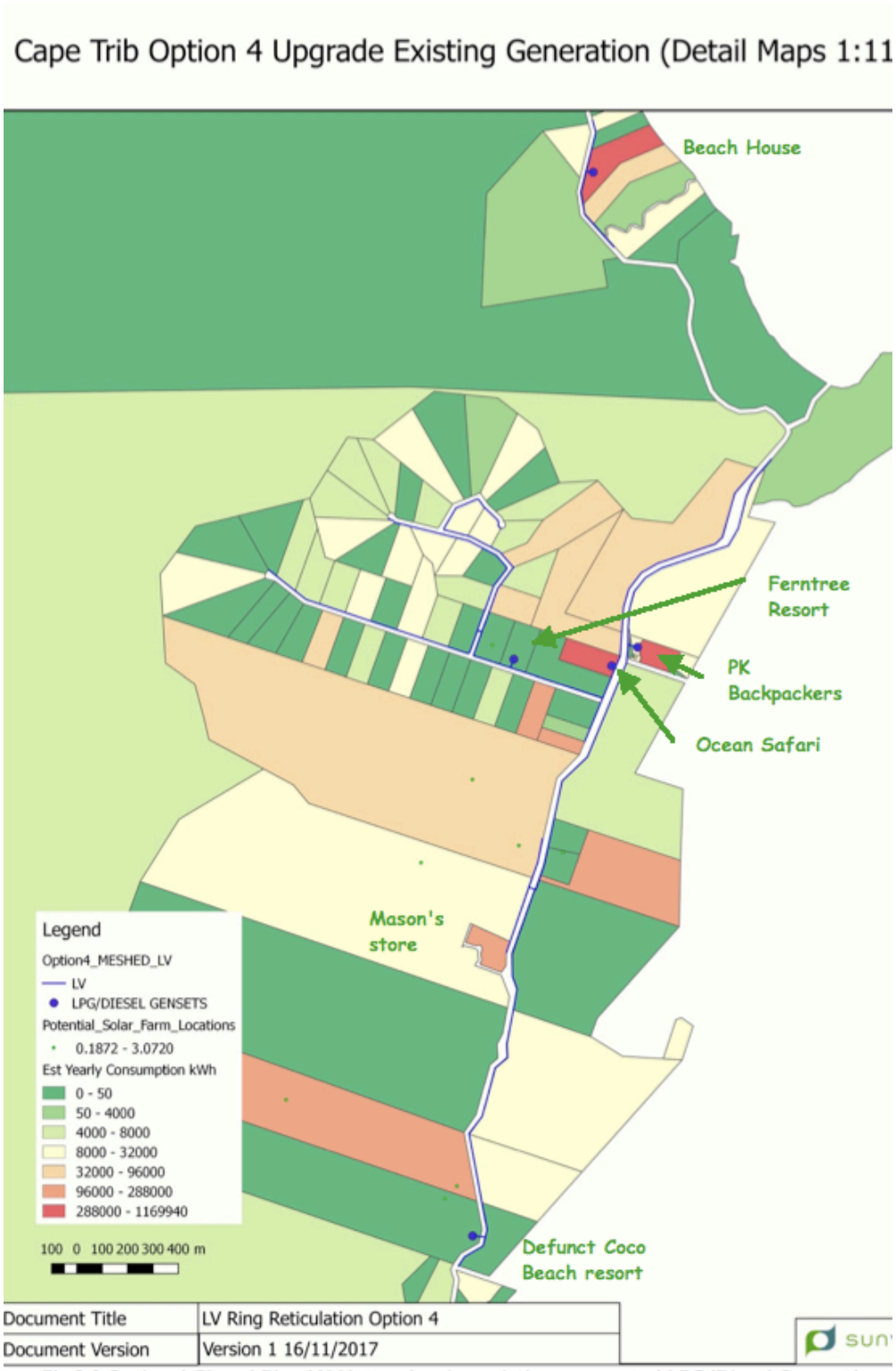


Fig 3.8 Option 4 Closed Ring LV Network using existing augmented LPG/Diesel Generation a Tribulation

Map 4 Sunverge map for Option 4 (with added explanatory labels)

Austrop comments on Option 4

This option addresses Cape Tribulation alone – as the Study suggests that "Cape Tribulation has nearly 50% of the anticipated load, but only 15% of the expected customers" The study assumes that there is no access to solar at Cape Tribulation – which is incorrect.

The Study's associated maps indicate a poor level of assessment of energy resources and potential demands in this area. Coconut Beach Resort (now abandoned) is shown as a potential generating node!

Sunverge Option 5

Upgrade of individual hybrid supply options.

Austrop Comments on Option 5 and suggested variations

This is the logical (and lowest cost, and least environmentally-challenging) solution to the issue of providing grid-equivalent power to the area. However even with current technological improvements, it will still require a shift in resident's expectations of power availability.

It would also signal that this region is one of the most aware in Australia of energy constraints and living "within your energy footprint"

The Study proposes as a "Recommended solution for Residential properties (small B&B excluded)….."

15 KVA diesel generator
6KW PV array (24 x 250W panels)
DC coupled Battery System 12-14 KWH (at 30% depth of discharge at 24V = 12 x 2000Ah batteries., at 48V 24 x 1000AH).

The Study acknowledges that there would be lower (or non-existent) regulation costs associated with this option (a highly critical issue for uptake)..

This would entail:-

1) No connection costs (in many cases, connection costs to the property owner under the other options, would be far greater than the costs of major upgrade of their RAPS systems).
2) There would be no requirement to have all house wiring upgraded to current standards (although the fitting of RCD's (residual current devices) should be mandatory for all installations operating at 240VAC). These are not expensive and provide a major safety factor.

Also, the massive infrastructure costs (Options 1, 2 and 3), disruption (horizontal drilling) are avoided, as well as connection and undergrounding costs.

Not mentioned in the Sunverge proposal are continuing staffing costs, as the 3 proposed nodal systems will require 24Hr presence of operators and maintenance (plus accommodation etc.) for each node.

The proposed use of 15KVA generators is totally unnecessary (but in the past it was ”traditional”) A“top line” 2 or 5 KW gasoline powered inverter-generator (Yamaha, Honda) will supply the needs of the majority of households, and will be far more efficient. Many of these generators now have remote start/stop capabilities.

Commercial installations currently run 100KVA generator systems- some have smaller generators for night demand. Better energy management (coupled with renewables) should considerably reduce this.

(note – KVA – Kilovolts/Amps - https://www.powerelectrics.com/blog/posts/2015/07/30/the-difference-between-kw-and-kva)– power available depends on the nature of the load – resistive (heaters) or reactive (such as motors, A/C)

Critical to a stand-alone RAPS system is the expected peak power that the householder / business requires, compared with the average power. (Activities like welding require high peak power, for short times, but actually require very little total power,) so it would be necessary to either run a separate generator to supply this power need, or, better, have an inverter that can handle the power surges. Modern household inverters can easily supply 4-5 KW short-term loads.

As a rule of thumb, especially with PV panels at their current low price, it would be far better to oversize the array than the batteries. Failure to recharge batteries (whether lead-acid or lithium) results in early failure.

It is now standard practice to use MPPTs (Maximum Power Point Trackers) between the panels and the battery. MPPTs greatly increase the efficiency of the solar array – especially in overcast weather (by as much as 30%) – and they regulate battery charging as well. MPPTs allow series connection of solar panels, resulting in high PV voltage but low current – so smaller gauge wiring can be used, with less power losses over distance.

It is better to have a separate charger. The primary inverter should operate all the time, so there are fewer issues with switching from inverter to generator or solar should charging be required. Plus – standard petrol/diesel alternator power output is not ‘clean’ – and is responsible for failures of electronic systems. (http://www.livingindaintree.org.au /Power)

While it is becoming more common for the inverter and charger (and even MPPTs) to be integrated into one unit, for areas remote from service facilities, failure of one component results in total system failure (which can take weeks to rectify), whereas having each component separate permits temporary ”swap” repairs should a component fail, with little loss of function, and permits a range of substitutions to maintain functioning.

A problem with solar RAPS is the need to keep the solar panels clean. Cleaning solar panels is easy to do on flat roofs and ground-based arrays – very difficult for steep roofs. There is the potential for a locally based panel cleaning service here.

A major issue with power systems for businesses: their feeling of being "locked-in" to their energy requirements for specific appliances like "display" drinks cabinets. If they are installed inside, additional A/C is required to remove waste heat but if they are installed outside, there is far less of a problem. Cool-rooms usually have the refrigeration units outside.

The Study maintains that this approach (Option 5) is not favourable as it is:

- *inequitable because of the diversity of solar irradiance within the area.*
- *costly to maintain on an ongoing basis*
- *unable to achieve significant renewable potential due to lack of diversity.*

"inequitable due to solar irradiance potential diversity"

This is a strange rationale - while there definitely is diversity in solar access across the Daintree Lowlands, much of this can be addressed in system design and sizing, and some vegetation pruning or removal. One of the failures of the 1995 installations, was that they were a "one size fits all" program. We have advanced in solar RAPS design considerably since then. Certainly there will be inequities, but there are also large differences between the wants / needs of residents which need to be addressed.

"costly to maintain on an ongoing basis"

Maintenance issues can be readily addressed by:

1) using standardised equipment, so that it becomes economical to hold spares locally for rapid repairs. Coupled with this would be the training and employment (and support) of a number of local residents, to enable rapid response to RAPS issues. Most modern equipment is well-made, but may require pre-installation tropic proofing (and screening) to secure longevity in this environment.

2) Ensuring that equipment and system installations are designed to be protected against vermin and fungal attack and are installed in areas which allow easy access for preventive maintenance. From past experience, most system failures have been caused by these issues.

3) Having easy-to-access and read monitors of system parameters – such as Trimetric Amp Hour meters. (http://www.bogartengineering.com/products/trimetrics.html)

4) Having a (free) program of householder education on RAPS systems, basic maintenance and the limitations of RAPS systems.

"unable to achieve significant renewable potential due to lack of diversity".

We are unsure what this means.

Summary

Sunverge Recommendations and responses:

Recommendation 1

Key stakeholders to support a staged approach to building a reliable low-impact underground microgrid which is initially serviced by a mixture of traditional gas generation and Solar PV and leverages regional skills for real world operation.

Comment

1) "Key Stakeholders" are not identified in the report, unless they are considered to be the people involved with Sunverge's initial study.
2) Compared with Option 5, which can be rolled out almost immediately with minimal disruption to the environment, at relatively little cost, Sunverge's Option 1 is a major and disruptive scheme, which will also signal that development can proceed in this important World Heritage environment.

Recommendation 2

Key stakeholders to support, subsequent to the provision of reliable, low-impact microgrid power, exploring options to increase the renewable generation of the system to approximately 80% through:

First understanding the detailed load characteristics of the whole system based on analysis of installed system (traditional) generation for a period of up to one year, then (based on actual system load data and detailed site investigation);

Implementing a plan to reliably increase renewable penetration and deploy innovative technologies including large scale, long-term storage (e.g. solar to gas).

Comment

1 "Key Stakeholders" are not identified .. unless they are considered to be the people involved with Sunverge's initial study
2 While increasing renewable component to 80% is a worthy aspiration, Option 5 will achieve that far more quickly and with less impact and far less cost. It will also (we hope) increase the sense of community responsibility for the area.
3 "analysis of installed system (traditional) generation" – which is primarily fossil fuelled (and with almost no attempts at load minimization by the users) gives an exceedingly biased (expanded) account of anticipated energy usage.
4 "implementing a plan to reliably increase renewable penetration and deploy innovative technologies including large scale, long-term storage (e.g. solar to gas)". As discussed earlier in this response, while such technologies (such as hydrogen) are "sexy" they are far less practical (or efficient) than battery storage, whether lead acid (AGM) or lithium or flowcell.

Recommendation 3

Key stakeholders to support establishing a mechanism to allow customers to benefit from sharing their excess solar production (similar to a Feed-in-Tariff scheme).

Comment:

While sharing might be a great idea – the infrastructure required (interconnects and their cost) negates any practical advantages. Removal of legal restrictions on sharing / selling power (as well as water) across boundaries could assist for locally- organised neighbour webs.

With **Option 5** – most users (commercial and household) would quickly develop ideas for using excess power (electric vehicles for example).

Recommendation 4

Key stakeholders to support implementing residential and business tariffs with a fixed and variable component similar to those offered to grid connected customers in regional Queensland.

Comment:

Not relevant for Option 5 Those on **well-designed**, **installed and maintained** "stand alone" RAPS will have low external costs.

Recommendation 5

Key stakeholders to explore options to encourage a public private partnership arrangement to the development of the microgrid solution.

Comment: Not relevant –

Recommendation 6
*Key stakeholders to support and agree on the key principles for engineering solutions, tariff structures, subsidies and schemes, ownership, regulation and governance***.**

Comment: Not relevant –

Recommendation 7

Agree on funding for the development of a next stage detailed microgrid pre-construction study with capable project proponent including detailed survey data, detailed engineering cost studies, pre-approvals and detailed project plan for Option 1. It is noted that the Queensland Government has made a commitment to provide $ 1M of funding for a study for renewable solutions for the Daintree and it is recommended that these funds be considered for the support of the pre-construction study for Option 1.

Comment:

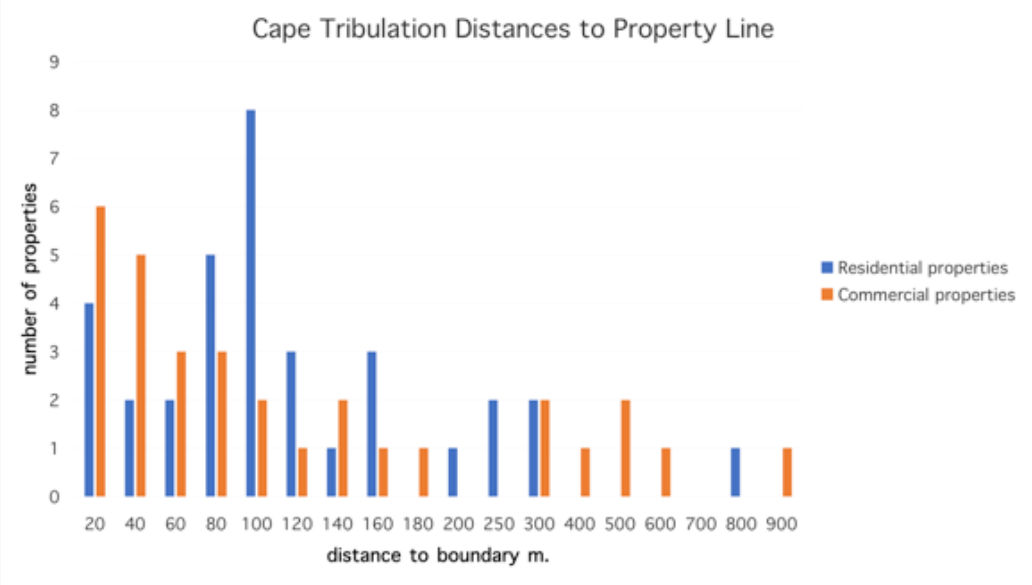
At an estimated average price of $55,000 per household (estimated costs for a 6KW solar array system. www.solarpoweraustralia.com.au), including B&B's (which are not that much different to residential houses, and which can have better regulation of energy use than backpackers or resorts)

Total costs for upgrading 308 properties with currently installed Solar RAPS would be approximately $20 million assuming an average $55,000 upgrade. Most recent properties will not require this level of expenditure, so this amount should also comfortably accommodate major upgrades to current non-solar commercial establishments. Businesses such as the Daintree Tea Farm (a major energy user for drying) could be encouraged to examine higher-efficiency processing technology.

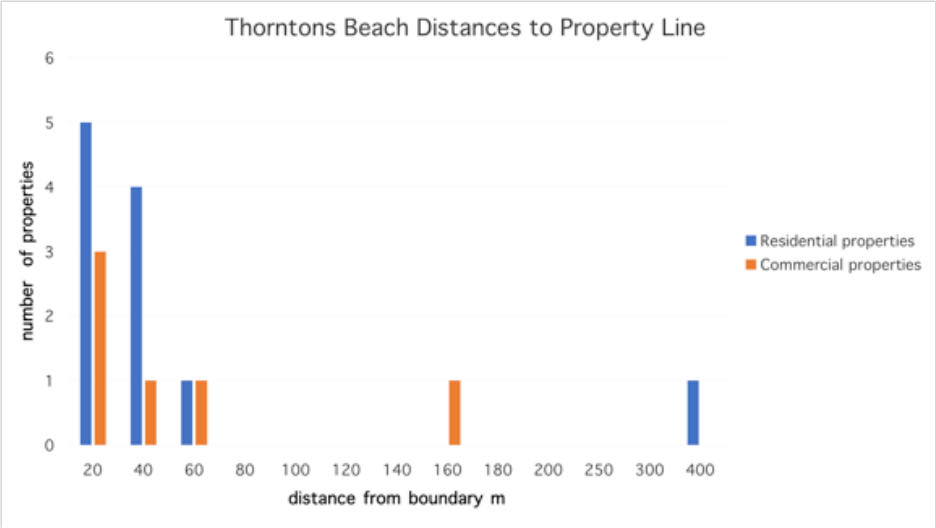
Appendix 1

<u>Distribution of installed RAPS, and property categories for the Daintree Lowlands</u>

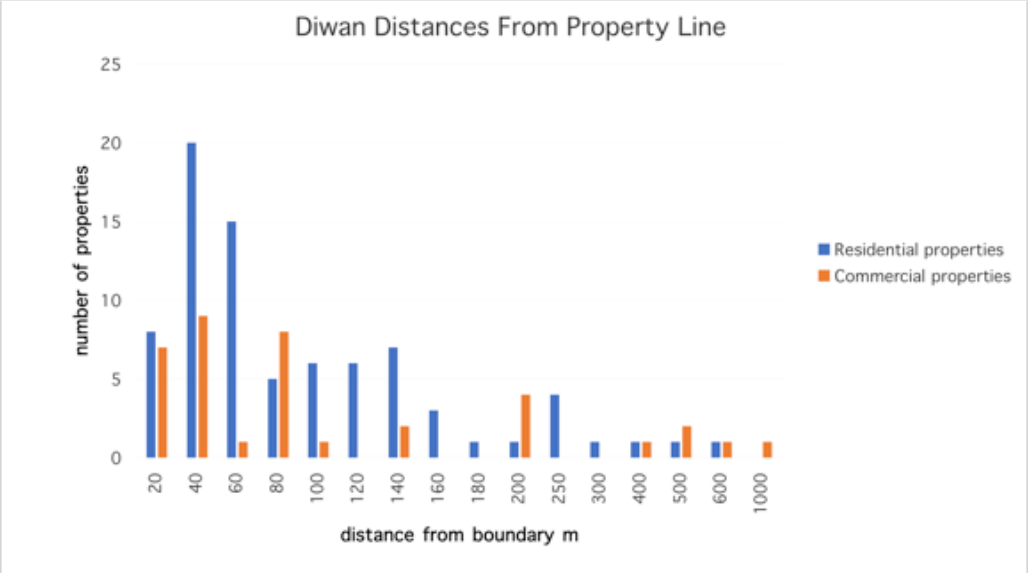
The graphs plot property distances from roads. X-axis - distance from property boundary in meters, Y-axis - number of properties in each category.



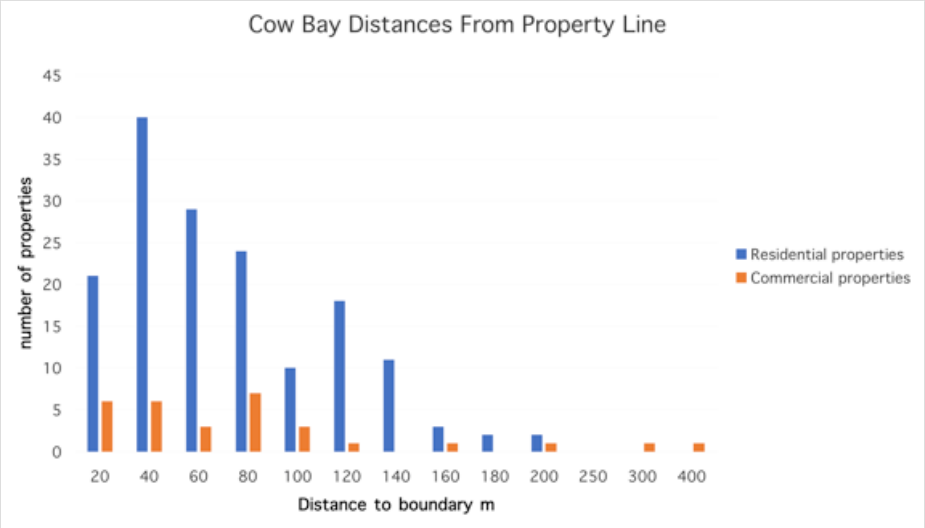
Map 5 Distribution of properties and RAPS systems in Cape Tribulation (Austrop).



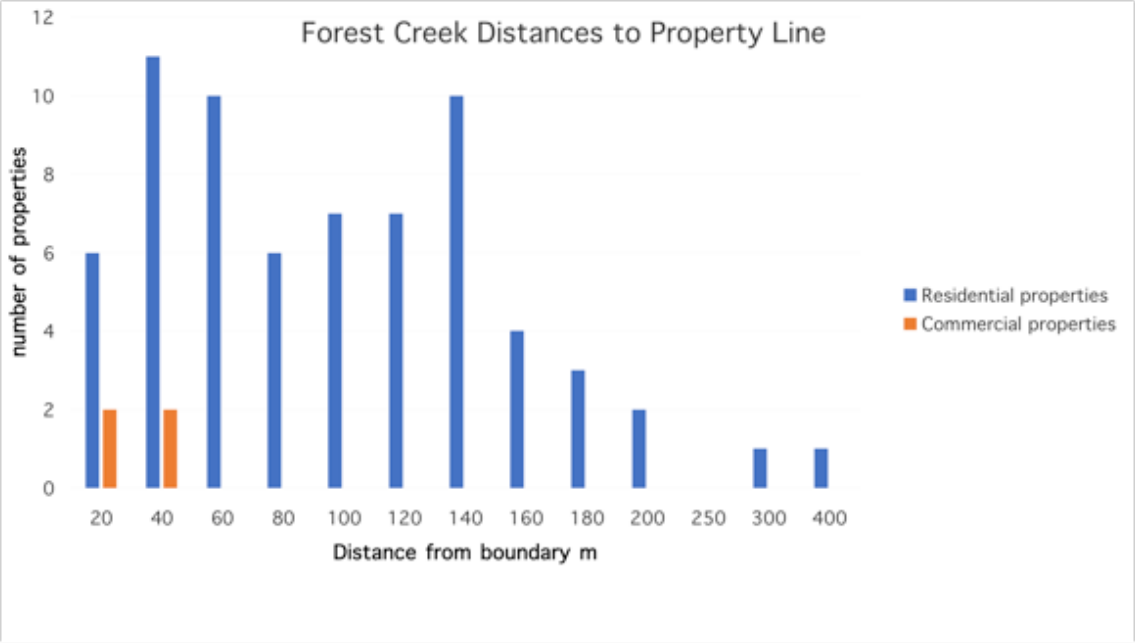
Map 6 Distribution of properties and RAPS systems in Thornton Beach (Austrop).



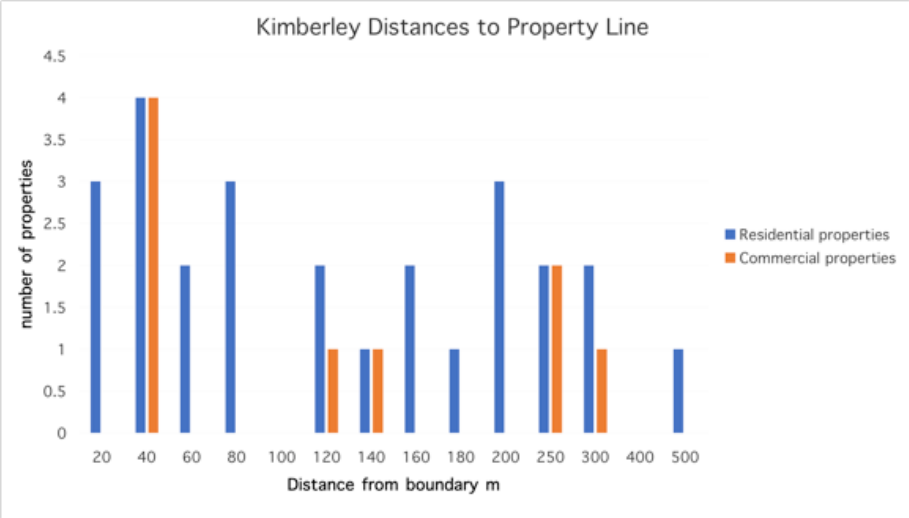
Map 7 Distribution of properties and RAPS systems in Diwan (Austrop).



Map 8 Distribution of properties and RAPS systems in Cow Bay (Austrop).



Map 9 Distribution of properties and RAPS systems in Forest Creek (Austrop).



Map 10 Distribution of properties and RAPS systems in Cape Kimberley (Austrop).

Table 1

	Average distances from the road to properties	Modal distances
Forest Creek	100	50
Cape Kimberly	140	100
Cow Bay	72	50
Diwan	116	50
Thornton Beach	60	30
Cape Tribulation	150	100

Because of the considerable range of distances – these figures are at best an approximation. However, they indicate clearly the additional costs that will be involved for the majority of those wishing to connect to a supply "along the road" – not including building upgrades to become legally compliant.

References.

1 https://www.rainforestrescue.org.au
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3 https://douglas.qld.gov.au/download/Part-1-About-the-Planning-Scheme_2.pdf
4 http://www.cairns.qld.gov.au/__data/assets/pdf_file/0004/18526/23jul08_specialbudget_cl9.pdf
5 https://qldglobe.information.qld.gov.au/
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9 https://onestepoffthegrid.com.au/off-grid-vs-network-connected-queensland-community-divided/

Sunverge report "Powering Daintree" appears unavailable for download.

We've all heard of Kilowatt (kW): it's what we learnt at school.Iit's how our electrical items at home are rated and it's the unit we see on our electricity bill. It's probably not until you need a generator that kVA even enters the equation.

So what's the difference between kW and kVA? And, more importantly, how do you convert between the two?

kVA: apparent power

kVA is a measure of apparent power: it tells you the total amount of power in use in a system. In a 100% efficient system kW = kVA. However electrical systems are never 100% efficient and therefore not all of the systems apparent power is being used for useful work output.

kW: actual power

kW is the amount of power that is converted into a useful output. kW is therefore known as actual power or working power.

Power Factor: a measure of electrical efficiency

You can convert between kVA and kW if you know the efficiency of the electrical system. Electrical efficiency is expressed as a power factor between 0 and 1: the closer the power factor is to 1, the more efficiently the kVA is being converted into useful kW. Generators have a power factor of 0.8.

The formula for converting kVA into kW is:

Apparent power (kVA) x power factor (pf) = actual power (kW)

e.g. 100 kVA x 0.8 = 80 kW

The formula for converting kW into kVA is:

Actual power (kW) / power factor (pf) = apparent power (kVA)

e.g. 100 kW / 0.8 = 125 kVA

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