KPMG

Daintree Electricity Supply Study

Stakeholder Reference Group – Meeting #2

–

Thursday 12 September 2019

Limitations

This presentation has been prepared at the request of Department of Natural Resources, Mines and Energy (DNRME) in accordance with the terms of KPMG's engagement contract executed 8 May 2019. The services provided under KPMG's engagement contract (the Services) have not been undertaken in accordance with any auditing, review or assurance standards. Any reference to 'audit' and 'review', throughout this presentation, is not intended to convey that the Services have been conducted in accordance with any auditing, review or assurance standards. Further, as KPMG's scope of work does not constitute an audit or review in accordance with any auditing, review or assurance standards, KPMG's work will not necessarily disclose all matters that may be of interest to DNRME or reveal errors and irregularities, if any, in the underlying information.

The responsibility for determining the adequacy or otherwise of our terms of reference is that of DNRME.

In preparing this presentation, KPMG and our subcontractor GHD have had access to information provided by DNRME, and publicly available information. We have relied upon the truth, accuracy and completeness of any information provided or made available to us in connection with the Services without independently verifying it. The publicly available information used in this presentation is current as of the date of this presentation. We do not take any responsibility for updating this information if it becomes out of date.

Any findings or recommendations contained within this presentation are based upon our reasonable professional judgement based on the information that is available from the sources indicated. Should the project elements, external factors and assumptions change then the findings and recommendations contained in this presentation may no longer be appropriate. Accordingly, we do not confirm, underwrite or guarantee that the outcomes referred to in this presentation will be achieved. We assume no obligation to update or otherwise revise this presentation unless requested by DNRME.

We do not make any statement as to whether any forecasts or projections will be achieved, or whether the assumptions and data underlying any such prospective financial information are accurate, complete or reasonable. We will not warrant or guarantee the achievement of any such forecasts or projections. There will usually be differences between forecast or projected and actual results, because events and circumstances frequently do not occur as expected or predicted, and those differences may be material.

Important Notice for Third Parties

This presentation is solely for the purpose set out in Section 1.2 of our final detailed report and for DNRME's information and is not to be used for any other purpose.

If you are a party other than DNRME, KPMG and our subcontractor, GHD:

- owe you no duty (whether in contract or in tort or under statute or otherwise) with respect to or in connection with the attached presentation or any part thereof; and
- will have no liability to you for any loss or damage suffered or costs incurred by you or any other person arising out of or in connection with the provision to you of the attached presentation or any part thereof, however the loss or damage is caused, including, but not limited to, as a result of negligence.

If you are a party other than DNRME and you choose to rely upon the attached presentation or any part thereof, you do so entirely at your own risk. Other than our responsibility to DNRME, neither KPMG nor any member or employee of KPMG or their subcontractor, GHD, undertakes responsibility arising in any way from reliance placed by a third party on this presentation.

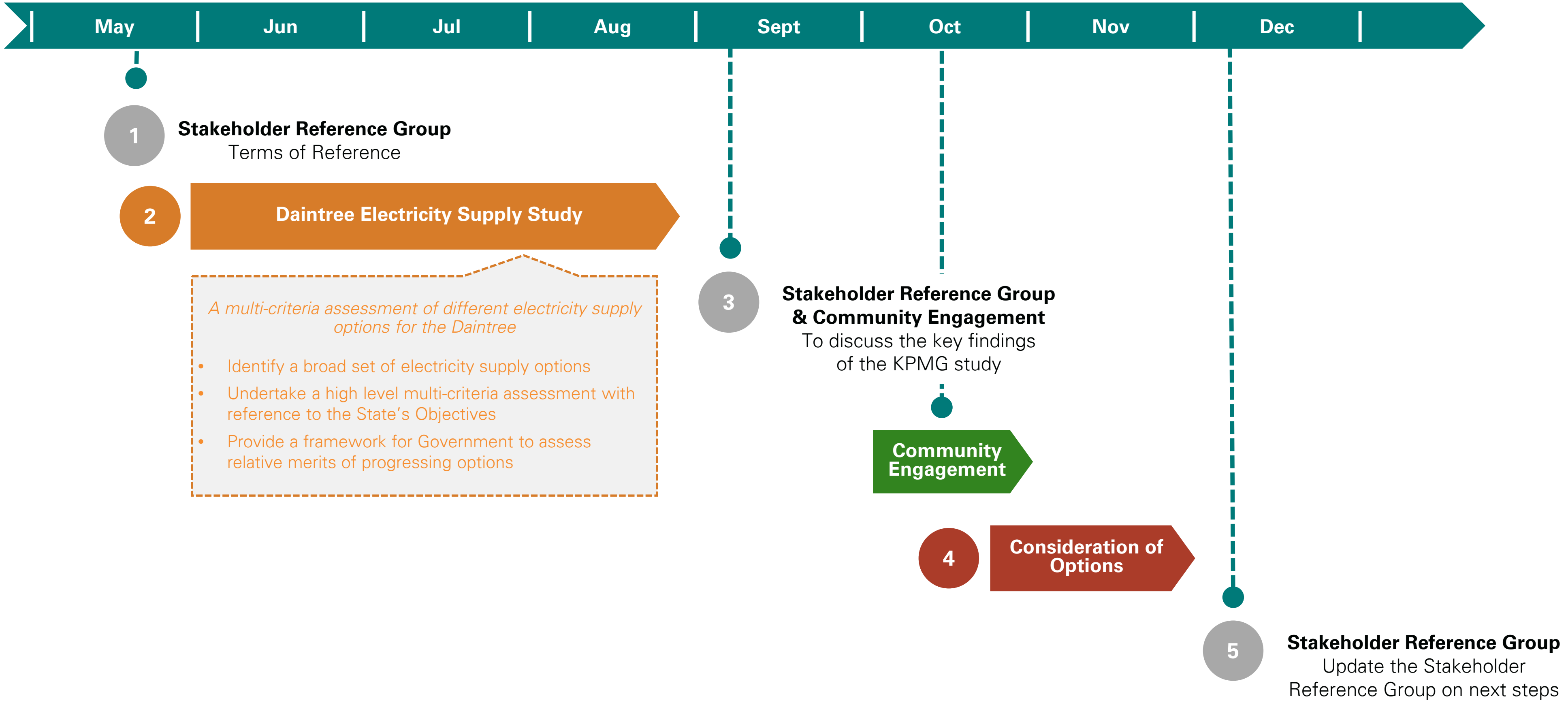
This presentation provides a summary of KPMG's findings during the course of the work undertaken for DNRME under the terms of the engagement contract executed 8 May 2019. The contents of this presentation does not represent our conclusive findings, which will only be contained in our final detailed report. This presentation is provided solely for the benefit of the parties identified in the engagement contract and is not to be copied, quoted or referred to in whole or in part without KPMG's prior written consent.

Agenda

KPMG

Project Overview

Project Timeline



Project Objectives

The Government is seeking to identify electricity supply options for the Daintree that:

- preserve the natural and cultural heritage values in the region
- are fiscally sustainable and/or present a commercial opportunity
- promote affordable electricity supply services and greater cost certainty
- promote improved environmental outcomes, including carbon and pollution reduction
- enhance the standard of living for electricity consumers and enhance associated economic outcomes in the region
- promote innovation and knowledge sharing amongst industry participants
- engage with and inform stakeholders regarding electricity supply in the region

The Project Objectives inform, and map to, the evaluation criteria used to evaluate the options.

Project Team

KPMG and GHD were engaged by DNRME to undertake the Daintree Electricity Supply Study in order to identify, evaluate and provide a framework for Government to assess the relative merits of potential electricity supply option(s) for the Daintree that may be the subject of further development.

PROJECT TEAM		ROLE
SPONSOR	The Department of Natural Resources, Mines and Energy	DNRME is the Department charged with informing the Queensland Government's election commitment. DNRME have engaged KPMG (and its subcontractor GHD) to provide robust, independent analysis that enables Government decision making. DNRME has been responsible for setting the study's: • Purpose • Project Objectives • Evaluation Criteria
ADVISORS	KPMG	KPMG is one of Australia's leading providers of financial and commercial advice on infrastructure projects. KPMG is the lead coordinating advisor on the Daintree Electricity Supply Study, including providing specialist advice on: • Options development • Financial analysis and modelling • Qualitative economic analysis • Commercial strategy
	GHD	GHD is one of the world's leading professional services companies operating in the global markets of water, energy and resources, environment, property and buildings, and transportation. GHD has provided specialist advice on: • Electricity demand and requirements • Infrastructure planning and costings • Operational costings • Regulatory and environmental considerations

Overview of Methodology and Analysis

Current State - Illustrative Customers and Communities

Illustrative customers have been developed to enable the Daintree community to compare the cost of different options with the cost of existing arrangements (the Current State).

ILLUSTRATIVE CUSTOMERS

IC1
Residential or equivalent

A typical residential household (or equivalent) in the Daintree region

IC2
Residential BnB or equivalent

A typical residential household which is also offering a small BnB service (or equivalent) in the Daintree region

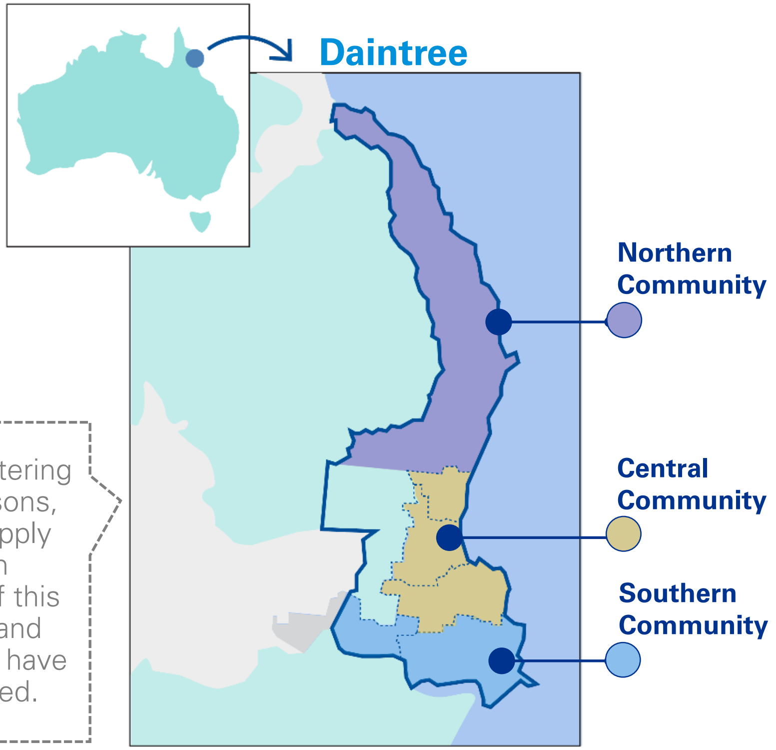
IC3
Commercial shop or equivalent

A typical small sized business/commercial shop that does not offer an accommodation service (or equivalent) in the Daintree region

IC4
Multi-room accommodation or equivalent

A medium sized business/ multi-room accommodation establishment (or equivalent) in the Daintree region

DAINTREE COMMUNITIES



Due to population clustering and geographical reasons, community based supply options have been investigated as part of this study. Region wide and individual SPS options have also been investigated.

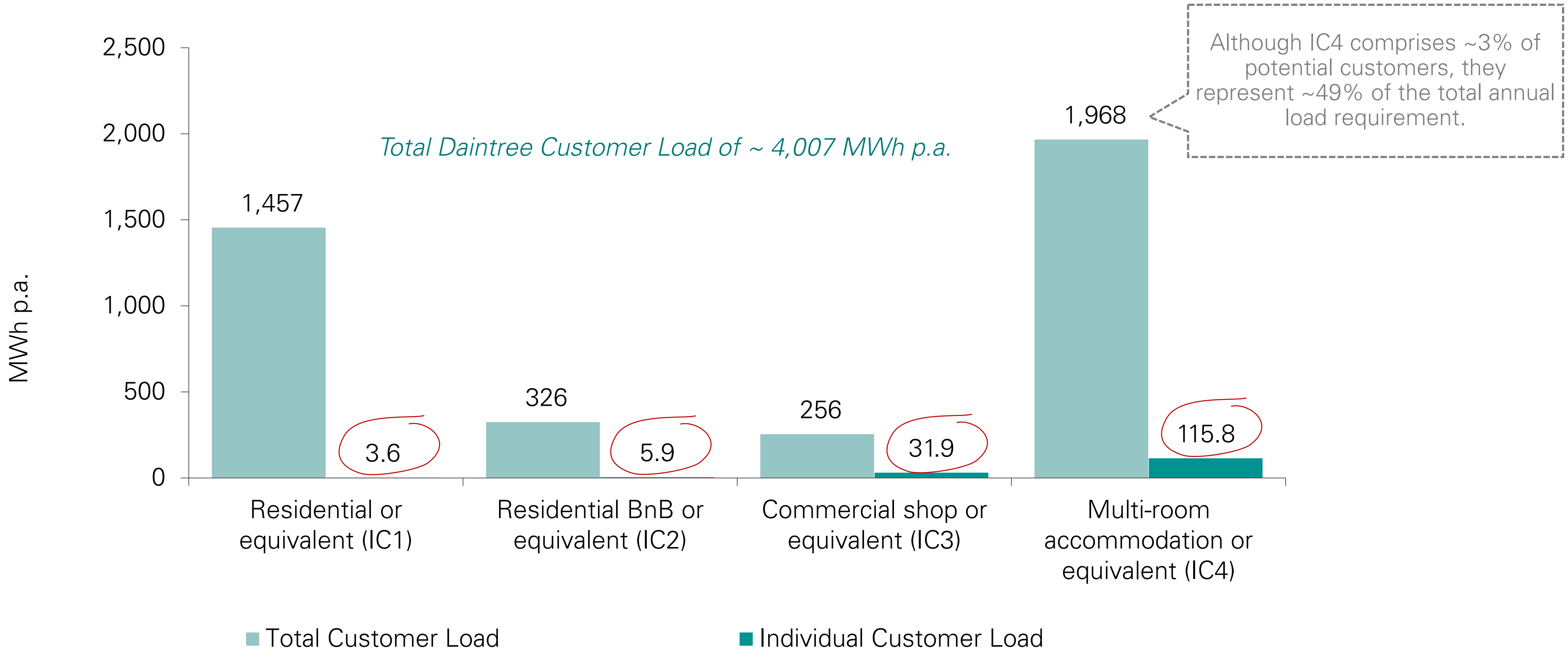
Current State - Estimated Connections (#)

The study is based on an estimated 489 Daintree customers/connections across the 3 communities and 4 Illustrative Customer categories.

TOTAL ESTIMATED DAINTREE CUSTOMERS		CAPE TRIBULATION	THORNTON BEACH	DIWAN	COW BAY	FOREST CREEK	KIMBERLEY		
ILLUSTRATIVE CUSTOMER	**ID#**	**NORTHERN**	**CENTRAL**			**SOUTHERN**		**TOTAL**	**% TOTAL**
Residential or equivalent	IC1	67	10	98	145	66	23	409	84%
Residential BnB or equivalent	IC2	10	4	15	21	3	2	55	11%
Commercial shop or equivalent	IC3	3	1	1	3	-	-	8	2%
Multi-room accommodation or equivalent	IC4	8	-	6	3	-	-	17	3%
Total		**88**	**15**	**120**	**172**	**69**	**25**	**489**	**100%**
Community Total		88			307		94	489	
% Community Total		18%			63%		19%		100%

Current State - Annual Loads

A bottom-up approach has been taken to developing the estimated Illustrative Customer loads and costs.



Current State - Generation Source

Daintree region's total estimated annual electricity load has been assumed to comprise of a combination of solar PV, diesel generation and battery storage.

Back-up generators are assumed to primarily be non-operational for residential Illustrative Customers (IC1 and IC2).

GENERATION SOURCE	IC1	IC2	IC3	IC4	TOTAL (MWH)
	IC TOTAL (MWH)				
Solar PV	619	129	5	48	800
Generator	838	197	237	1,814	3,087
Back-up Generator	-	-	14	106	120
Battery	-	-	-	-	-
Total	**1,457**	**326**	**256**	**1,968**	**4,007**
GENERATION SOURCE	**% IC TOTAL**				**% TOTAL**
Solar PV	42%	40%	2%	2%	20%
Generator	58%	60%	93%	92%	77%
Back-up Generator	-	-	5%	5%	3%
Battery	-	-	-	-	-
Total	**100%**	**100%**	**100%**	**100%**	**100%**

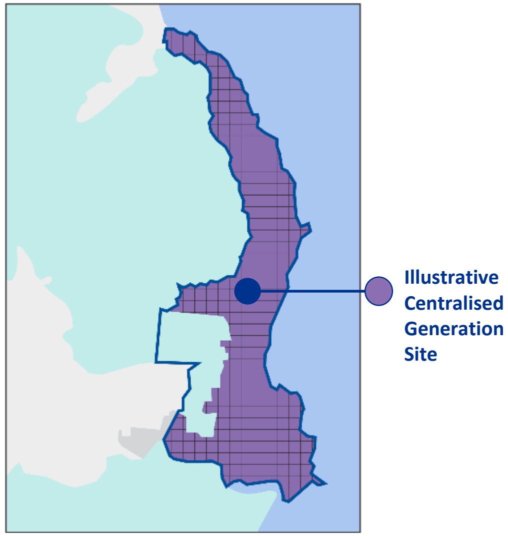
Cooking and water heating has been excluded from the load estimates: Based on the Compass Research of a sample of 100 households and businesses, 99% used gas for cooking and 75% used gas for water heating. As a result, it has been assumed that all Illustrative Customers use gas (LPG) for cooking and water heating purposes. It has also been assumed that gas appliances and hot water systems will not be replaced by electric units under each of the electricity supply options given it is unlikely to make financial sense.

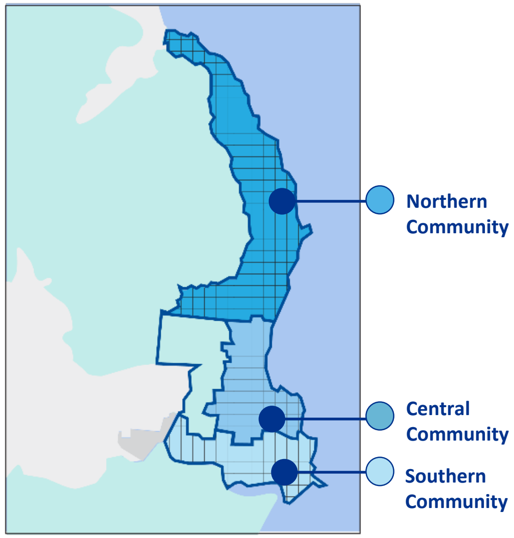
Options

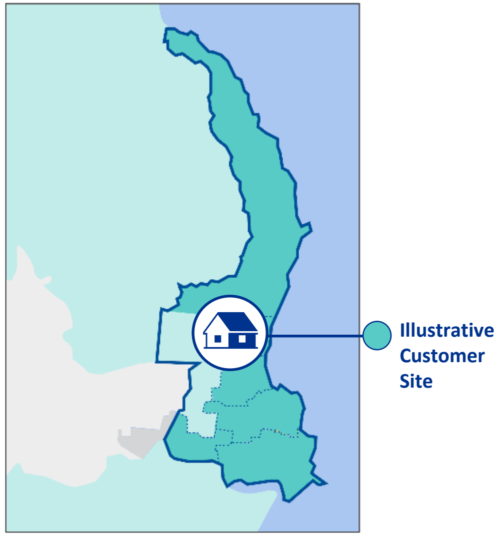
The six options analysed as part of this study, comprising three microgrid based options and three individual SPS based options, include a combination of established (e.g. solar and diesel generators) and emerging technologies (e.g. hydrogen and lithium-ion battery storage).

Excludes LPG used for cooking and water heating under all options.

MICROGRID OPTIONS			INDIVIDUAL OPTIONS		
R1	**R2**	**C1-3**	**I1**	**I2**	**I3**
Microgrid "Optimised"	Hydrogen Microgrid "Green"	Community Microgrids "Optimised"	Lithium-ion Battery Retrofit	Managed Service SPS	Hydrogen Fuel Cell SPS
2,000 kW	2,000 kW	670 kW / 1,260 kW / 180 kW (Total 2,110 kW)	10-60 kW	7-30 kW	6.3-27 kW

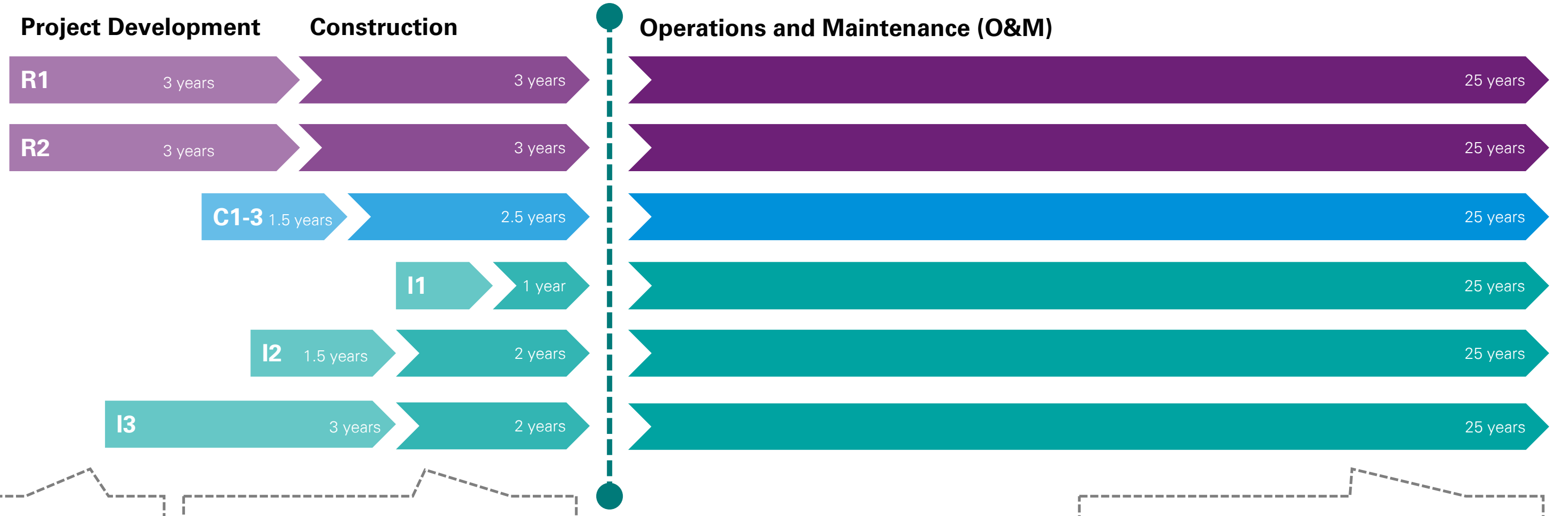






Project Life and Costings

To enable a relative financial assessment of options, all options pivot off the same operations and maintenance start date. Costs that inform the financial assessment include all upfront and ongoing costs.



Project Development timetable based on the anticipated timing of planning and regulatory applications and approvals.

Option R1 and R2 have the longest timing (6 years) due to the need to traverse World Heritage areas between population centres.

To ensure a relative analysis, all options commence on the same operational start date and have a 25 year life to capture replacement and amortisation of upfront costs.

KPMG

Study Limitations

The analysis and conclusions contained within the study are limited in part by a number of factors.

Demographic/customer data: The Daintree community is remote and, as such, there are inherent limitations in the demographic/customer data available.

Detailed information about resident's present energy systems: Information from previous surveys has been used as a guide to the size, configuration and age of energy systems that are presently utilised by Daintree residents. However this information is limited and in some cases changes may have occurred since the survey was performed.

Predictions of uptake rates for new supply options by residents: Uptake rates for new supply options by residents will depend on many factors including cost of energy, cost of connection, age of existing systems, the compatibility of the residences with being connected to the supply system, attitude of residents to the systems that will be available, reliability and security, and availability of support. As such, uptake rates may not match forecast or assumed levels.

Regulatory and approval requirements: The level of regulatory approvals and permitting requirements will be largely dictated by options and site-specific factors that cannot be taken into account at this stage. The level of supporting information required for regulatory approvals and permits, and the assessment timeframe periods for these, vary widely. The regulatory framework for some options, e.g. microgrids, does not currently exist which introduces an additional level of uncertainty for delivery.

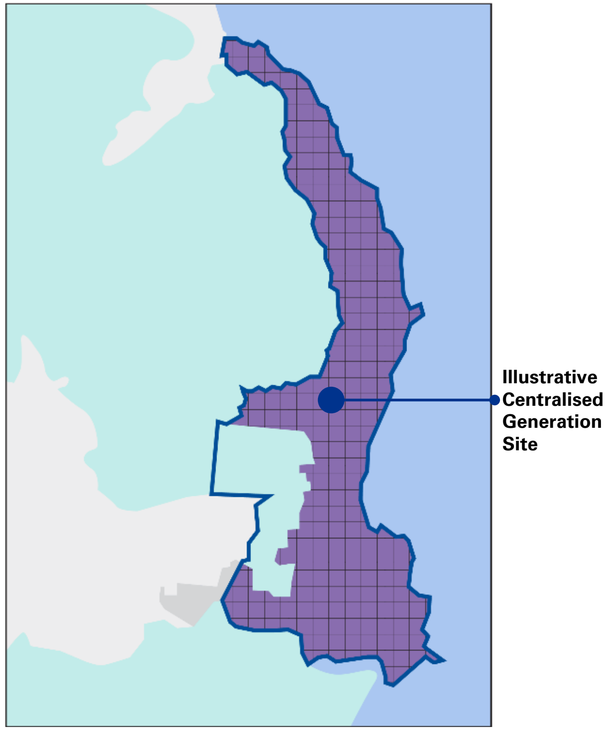
Technical Overview of Options

R1 - Optimised Microgrid

This option involves the construction of an underground electricity microgrid that would service the entire Daintree region. The microgrid would be powered by a centralised generation site that would involve a combination of solar PV and diesel generation paired with lithium-ion battery storage.

This option is based on the most efficient and proven electricity supply technology.

OPTION MAP



OPTION ASSUMPTIONS

TYPE	ITEM	ASSUMPTION
SYSTEM ARCHITECTURE	Solar PV	2,000 kW
	Diesel Generators	3 x 500 kW
	Lithium-ion Battery Storage	3,000 kWh
	System Converter	1,000 kW
	Total Capacity	2,000 kW
OTHER	Cabling (Total HV and LV)	160 km
	Land Requirement	20,000 m^2
	Project Development	3 years
	Construction	3 years
	Operating	25 years
	Carbon Intensity (kgCO2e/kWh supplied)	0.219

OPTION FEATURES

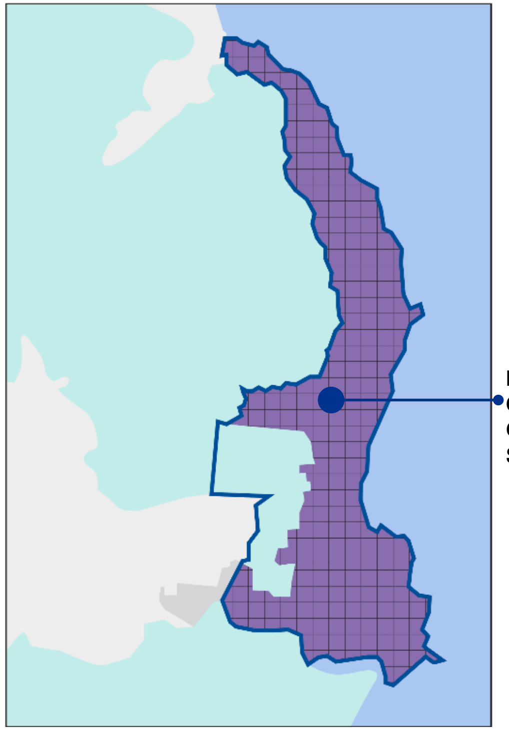
- Solar PV Farm
- Diesel Generators
- Lithium-ion Battery Storage

R2 - Hydrogen Based Microgrid

As per Option R1 however the generation site would contain a large scale solar PV farm whose electricity would be harnessed for the electrolysis of water to produce hydrogen, and to provide energy directly to customers during daylight hours. The hydrogen produced by the electrolysers would be contained within storage and fed into a centralised hydrogen fuelled gas turbine to generate electricity which would be distributed through the underground microgrid network.

This option is designed to be "100% green" however has fossil fuel back-up to ensure reliability and security of supply.

OPTION MAP



Illustrative Centralised Generation Site

OPTION ASSUMPTIONS

TYPE	ITEM	ASSUMPTION
SYSTEM ARCHITECTURE	Solar PV	7,000 kW
	Electrolyser	5 x 1,250kW
	Hydrogen Storage	1,530kg (3 days)
	Lithium-ion Battery Storage	333 kWh
	System Converter	1,000 kW
	Hydrogen Gas Turbine	1,000 kW
	Diesel Generator	2,000 kW
	Total Capacity	2,000 kW
OTHER	Cabling (Total HV and LV)	160 km
	Land Requirement	70,000 m^2
	Project Development	3 years
	Construction	3 years
	Operating	25 years
	Carbon Intensity (kgCO2e/kWh supplied)	0

OPTION FEATURES

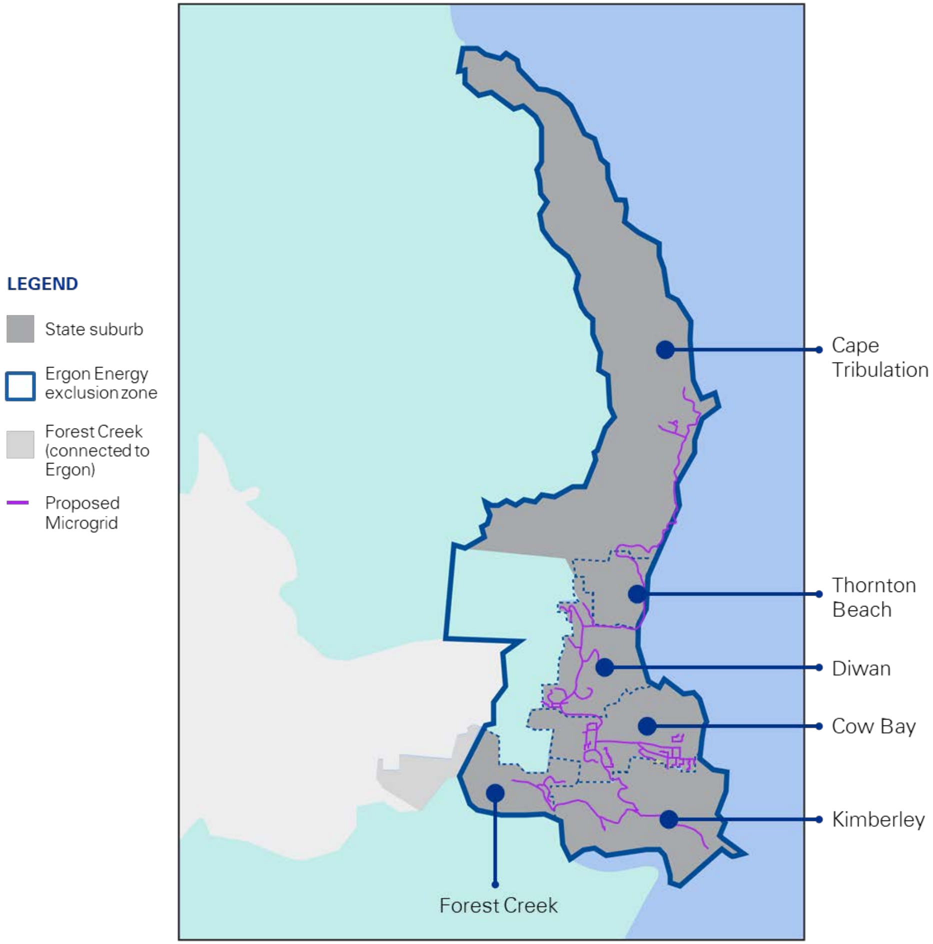
- Solar PV Farm
- Hydrogen Fuelled Turbine
- Electrolyser
- Hydrogen Storage
- Lithium-ion Battery Storage
- Diesel Generators

R1 and R2 - Proposed Microgrid

The central generation facility will connect to a high voltage underground network to distribute electricity to the population centres where it will be transformed to low voltage as required

Customers’ energy usage will be metered at their point of supply

The microgrid follows the existing road network to minimise any additional impact on the environment

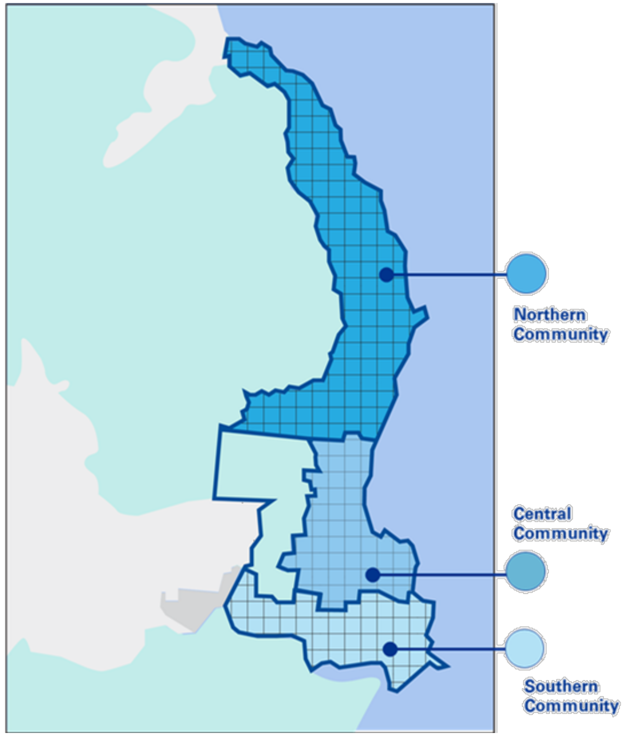


C1-3 - Community Microgrids

This option involves construction of three underground electricity microgrids that would service the northern, central and southern communities of the Daintree. The microgrids would be powered by three individual centralised generation sites that would involve a combination of solar and diesel generation paired with lithium-ion battery storage.

These options are based on the most efficient and proven electricity supply technology.

OPTION MAP



OPTION ASSUMPTIONS

TYPE	ITEM	ASSUMPTION BY COMMUNITY		
		NORTHERN	CENTRAL	SOUTHERN
SYSTEM ARCHITECTURE	Solar PV	800 kW	1,000 kW	100 kW
	Diesel Generators	3 x 135 kW	3 x 230 kW	3 x 40 kW
	Lithium-ion Battery Storage	1,000 kWh	2,500 kWh	300 kWh
	System Converter	400 kW	800 kW	100 kW
	Total Capacity	670 kW	1,260 kW	180 kW
OTHER	Cabling	30 km	40 km	60 km
	Land Requirement	10,000 m^2	10,000 m^2	5,000 m^2
	Project Development	1.5 years	1.5 years	1.5 years
	Construction	2.5 years	2.5 years	2.5 years
	Operating	25 years	25 years	25 years
	Carbon Intensity (kgCO2e/kWh supplied)	0.178	0.150	0.442

OPTION FEATURES

Solar PV Farm

Diesel Generators

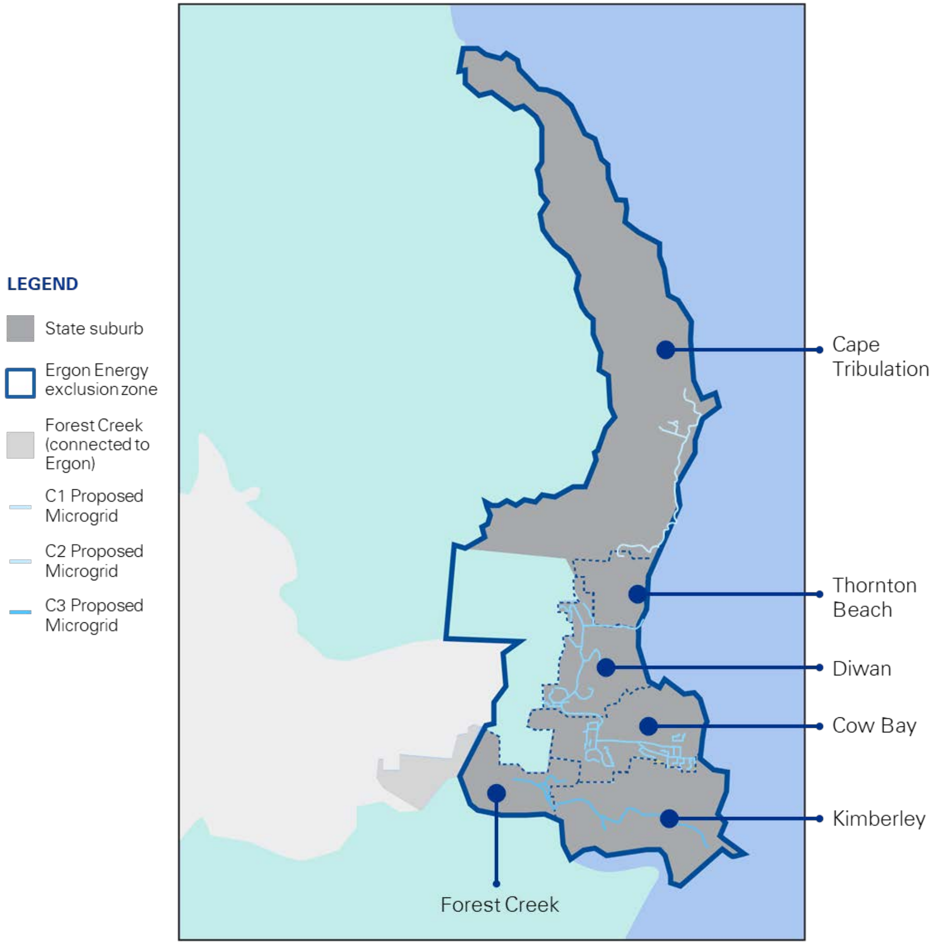
Lithium-ion Battery Storage

C1-3 - Proposed Microgrids

Central generation facilities will connect to a high voltage underground network to distribute electricity to the population centres where it will be transformed to low voltage as required

Customers' energy usage will be metered at their point of supply

The map to the right is similar to Option R1 and R2 and follows the existing road network, but excludes connections between population centres

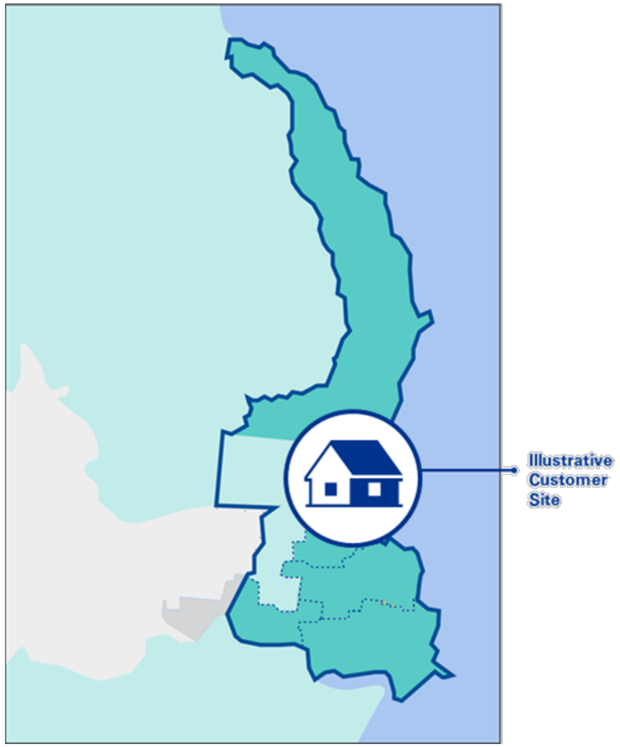


I1 - SPS Battery Retrofit

This option involves installation of individual lithium-ion batteries at customers' dwellings that would be an addition to their current SPSs. This option is intended to improve the efficiency of customers' current solutions. This option currently only applies to IC1 and IC2 as it is assumed that IC3 and IC4 do not have battery storage, however in reality, Option I1 does not preclude these customers from accessing the option.

This option is an incremental enhancement to existing SPSs.

OPTION MAP



OPTION ASSUMPTIONS

TYPE	ITEM	ASSUMPTION			
		IC1	IC2	IC3	IC4
SYSTEM ARCHITECTURE	Existing: Solar PV	3.2 kW	5 kW	1 kW	5 kW
	Existing: Diesel Generators	5 kW	7.5 kW	2x10 kW	2x30 kW
	New: Lithium-ion Battery Storage	16 kWh	31 kWh	0 kWh	0 kWh
	Existing: System Converter	5 kW	5 kW	5 kW	5 kW
	Total Capacity	10 kW	12.5 kW	20 kW	60 kW
OTHER	Enclosure	×	×	×	×
	Land Requirement	n/a (existing premises)			
	Project Development	1 years			
	Construction	1 years			
	Operating	25 years			
	Carbon Intensity (kgCO2e/kWh supplied)	0.567	0.530	0.925	0.883

OPTION FEATURES

Existing: Solar PV

Existing: Diesel Generator

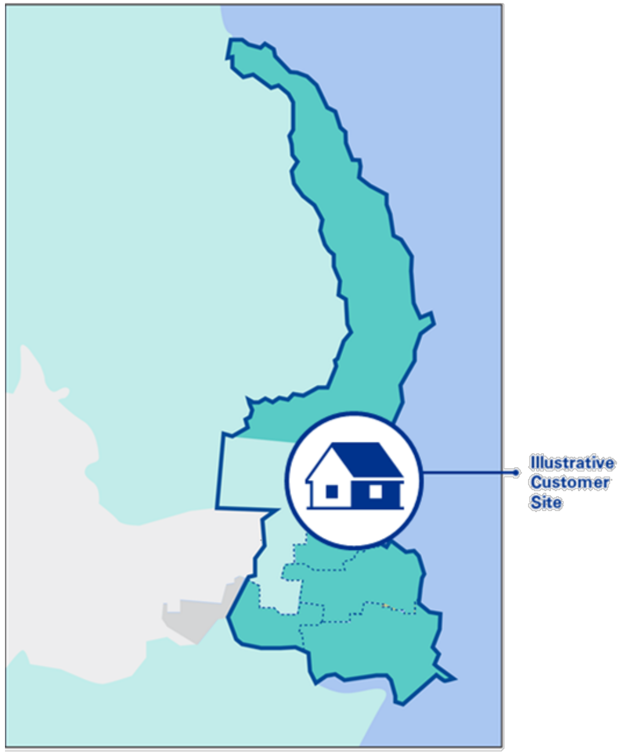
New: Lithium-ion Battery Storage

I2 - Standardised SPS

This option involves the development of standardised SPSs that are managed and maintained by a central organisation/authority. Customers would pay a standard charge for services and electricity. Each SPS would involve a level of solar PV and diesel generation paired with lithium-ion battery storage.

This option will improve reliability and security, and smooth costs, through a managed service provider.

OPTION MAP



OPTION ASSUMPTIONS

TYPE	ITEM	ASSUMPTION			
		IC1	IC2	IC3	IC4
SYSTEM ARCHITECTURE	Solar PV	2.5 kW	5 kW	5 kW	10 kW
	Generators (diesel)	1x7 kW	1x10 kW	1x15 kW	1x30 kW
	Battery Storage (lithium-ion)	25 kWh	40 kWh	225 kWh	750 kWh
	System Converter	2.5 kW	5 kW	50 kW	50 kW
	Total Capacity	7 kW	10 kW	15 kW	30 kW
OTHER	Enclosure	✓	✓	✓	✓
	Land Requirement	50 m^2 (existing premises)			
	Project Development	1.5 years			
	Construction	2 years			
	Operating	25 years			
	Carbon Intensity (kgCO2e/kWh supplied)	0.630	0.564	0.856	0.853

OPTION FEATURES

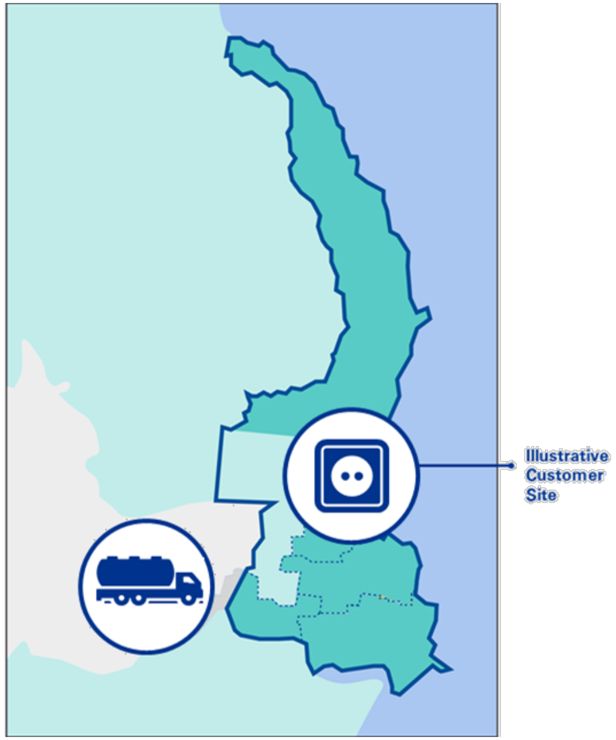
- **SPS Enclosure**
- **Solar PV**
- **Lithium-ion Battery Storage**
- **Diesel Generator**

I3 - Hydrogen SPS

This option involves individual hydrogen fuel cells at customers' dwellings that would replace their current SPSs. Three options to source green or brown hydrogen fuel have been explored through the study given supply at the residential level is not established in Australia.

This option may be an example of the right long term solution for the Daintree as the hydrogen sector and technology continues to develop and mature over coming years.

OPTION MAP



OPTION ASSUMPTIONS

TYPE	ITEM	ASSUMPTION			
SYSTEM ARCHITECTURE	Hydrogen Fuel Cell – unit size per customer	IC1	IC2	IC3	IC4
		6.3 kW	9.0 kW	13.5 kW	27.0 kW
	Hydrogen Fuel	Option I3.1: 1.25 MW electrolyser in Cairns			
		Option I3.2: 10 MW electrolyser in Townsville			
		Option I3.3: Brown hydrogen from Newcastle			
	Hydrogen Transportation	Transportation of compressed hydrogen via truck			
OTHER	Enclosure	×			
	Land Requirement	25 m^2 (existing premises)			
	Project Development	3 years			
	Construction	2 years			
	Operating	25 years			
	Carbon Intensity (kgCO2e/kWh supplied)	0 kgCO2e/kWh supplied^			

^ Fuel cell power generation; fuel carbon footprint depends on source

OPTION FEATURES

SPS Generation & Storage

- Hydrogen Fuel Cell
- Hydrogen Storage

Hydrogen Supply Options

GREEN

- Solar PV
- Electrolyser
- Grid Electricity
- Hydrogen Storage & Compression

OR

BROWN

- Brown Hydrogen Industrial Supplier

KPMG

Evaluation of Options

Evaluation Criteria

The evaluation criteria used for the evaluation of the options was developed with reference to the Government's Project Objectives. The Current State was also assessed to inform a baseline to compare options.

NO	CRITERION	DESCRIPTION
1	Natural and Cultural Heritage	The ability of the option to preserve the natural and cultural heritage values in the region and limit cumulative/indirect impacts on these values into the future.
2	Financial	The estimated levelised cost of the option and the ability of the option to provide cost certainty for consumers.
3	Environmental	The ability of the option to reduce carbon emissions and pollution.
4	Reliability and Security of Supply	The ability of the option to provide ongoing reliability of supply (capacity to meet peak demand) and security of supply (operating within the range of acceptable limits and ability to withstand faults) that will meet or exceed the status quo.
5	Economic	The ability of the option to deliver incremental economic benefits to the region.
6	Learning and Innovation	The ability of the option to provide a level of innovation to support Queensland's transition to a low carbon economy, including facilitating skills development for new technology.
7	Technical and Commercial Implementation Risk	The certainty of the option in terms of technical implementation risk (delivering the upgraded services in the anticipated timeframes and managing disruption and integration risk) and commercial implementation risk (the complexity, flexibility and certainty of the commercial framework).

Formal, fixed weightings have not been applied to the Evaluation Criteria. Rather, evaluation criteria have been individually assessed and scored, and then KPMG and GHD have reached an informed, consensus view of the overall score and relative merits of each option against the evaluation criteria as a guide to DNRME for its further consideration of the options.

1. Natural and Cultural Heritage

KEY ANALYSIS

- Planning and Regulatory
- Risk

The ability of the option to preserve the natural and cultural heritage values in the region and limit cumulative/indirect impacts on these values into the future.

NO	R1	R2	C1-3	I1	I2	I3
1	Low/Medium	Low/Medium	Medium	High	High	High

CURRENT STATE
High

REGIONAL MICROGRIDS R1-R2

- **Options R1 and R2** presents some risks to the natural and cultural heritage values of the region.
- Likely to encourage development which is considered to have the greatest impact.
- Likely to see increased pressure (e.g. cars, buses) on existing infrastructure, facilities and local resources in the region (e.g. roads, bridges, beaches, public facilities, National Park visitor areas etc.).

COMMUNITY MICROGRIDS C1-3

- Assessed as relatively better in comparison to **Options R1 and R2** given construction is not required in the sensitive Wet Tropics World Heritage Area between population centres.

SPS BASED SOLUTIONS I1-I3 ✓

- **SPS Options** are not regarded as encouraging or accelerating development (which is considered to have the most significant source of impacts on natural and cultural heritage).
- Impacts are primarily site and property specific and can be managed through normal Douglas Shire Council building codes, planning requirements, local laws and regulations.

2. Financial

Refer next slide for annual levelised cost outcomes

KEY ANALYSIS

- Financial
- Risk

The estimated levelised cost of the option and the ability of the option to provide cost certainty for consumers.

NO	R1	R2	C1-3	I1	I2	I3
2	Low/Medium	Low	Low/Medium	Medium	Medium	Low/Medium

CURRENT STATE
Medium

REGIONAL MICROGRIDS R1-R2

- **Options R1 and R2** have the highest levelised cost, and for a typical household (IC1), these solutions represent a significantly higher cost than current supply arrangements, costing around $11,000 to $14,000 more on an annual basis.
- The options present a medium/high cost certainty risk due to potential construction cost overruns and uncertain ongoing operational management costs.

COMMUNITY MICROGRIDS C1-3

- **Option C1-3** has the third highest levelised cost and is significantly higher cost than current supply arrangements.
- The option has a lower cost certainty risk than **Options R1 and R2** due to not having to install underground cabling in the sensitive WTWHAs between the population centres.

SPS BASED SOLUTIONS I1-I3

- **Option I1** has the lowest levelised cost, and is $700 to $1,500 per annum higher than the Current State for IC1 and IC2 (IC3 and IC4 are not applicable for this option). ✓
- **Option I2** has a levelised cost that is materially lower than the microgrid options, but is still materially higher than **Option I1**. The solution can be externally managed and provide a greater level of consistency and standardisation relative to Current State. ✓
- **Option I3** has a levelised cost that is materially lower than the microgrid options, but is still materially higher than the Current State and represents a medium/high cost certainty risk due to the emerging nature of the technology.

Levelised Cost Analysis

The levelised cost is used to assess and compare the alternative options, and takes into account all upfront and ongoing costs through a unitised "levelised" cost. It can be thought of as the average annual cost of all costs over the life of the project.

Annual levelised costs are weighted by assumed load

ILLUSTRATIVE CUSTOMER	IC1	IC2	IC3	IC4
ASSUMED LOAD (KWH P.A.)	3,561	5,934	31,945	115,790
Total Weighted Levelised Cost ($ p.a.)				
Current State	**2,064**	**3,321**	**11,290**	**38,787**
Option R1	12,983	21,633	116,453	422,109
Option R2	16,166	26,937	145,007	525,608
Option C1-3	16,717	19,135	74,157	278,075
Option C1	10,133	16,884	90,891	329,454
Option C2	7,148	11,911	64,117	232,405
Option C3	48,875	81,436	-	-
Option I1	2,728	4,799	-	-
Option I2	5,832	8,053	34,418	100,907
Option I3.1 ("Green Hydrogen" from Cairns)	7,372	10,781	21,774	53,690
Option I3.2 ("Green Hydrogen" from Townsville)	7,415	10,852	22,154	55,065
Option I3.3 ("Brown Hydrogen" from Newcastle)	7,933	11,716	26,806	71,928

Upfront costs of the Current State have been assumed to be sunk costs.

KPMG

3. Environmental

KEY ANALYSIS

- Environmental

The ability of the option to reduce carbon emissions and pollution.

NO	R1	R2	C1-3	I1	I2	I3
3	Medium	High	Medium/High	Low/Medium	Low/Medium	High

CURRENT STATE
Low

MICROGRIDS

R1 | C1-3

- **Microgrid options** are generally more efficient than individual SPSs because the diversity that exists between multiple customer loads reduces the overall total peak demand.
- There will be improved ability to control any spills at a central generation facility.
- Noise of generation can be managed by placing the facility away from population as much as possible and providing good noise insulation in the generation housing.

HYDROGEN BASED OPTIONS

R2 | I3

- **Hydrogen based options** are designed to provide supply to the Daintree with minimal carbon emissions.
- **Option R2** hydrogen fuel will be "green hydrogen" as it is produced from solar PV.
- **Option I3** hydrogen fuel also has the potential to be carbon free through the use of "green hydrogen".

SPS BASED SOLUTIONS I1-I2

- The environmental outcomes will largely remain unchanged from existing levels under **Options I1 and I2** however there may be incremental environmental improvements.

4. Reliability and Security of Supply

KEY ANALYSIS

- Technical
- Risk

The ability of the option to provide ongoing reliability of supply (capacity to meet peak demand) and security of supply (operating within the range of acceptable limits and ability to withstand faults) that will meet or exceed the status quo.

NO	R1	R2	C1-3	I1	I2	I3
4	Medium/High	Medium/High	Medium/High	Medium	High	Medium/High

CURRENT STATE
Medium

ALL OPTIONS

- **All Options** will result in an improvement in reliability and security of supply compared with the Current State apart from **Option I1** which is an incremental enhancement.
- **Option I2** will provide a very high level of reliability and security as each customer will have a separate energy system to provide supply. Any failure will impact only one customer whereas a failure in a microgrid will likely impact a group of customers.

5. Economic

KEY ANALYSIS

- Economic

The ability of the option to deliver incremental economic benefits to the region.

NO	R1	R2	C1-3	I1	I2	I3
5	Low/Medium	Low/Medium	Low/Medium	Low	Low	Low

CURRENT STATE
Low

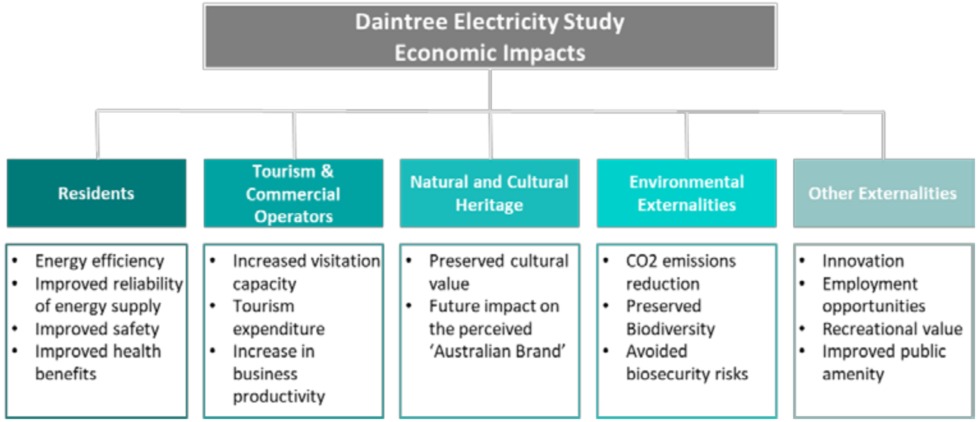
MICROGRIDS
R1, R2, C1-3

- There is no anticipated material incremental net economic benefit for **microgrid options**, however they may result in a marginal benefit to tourism and commercial operators.

SPS BASED SOLUTIONS
I1-I3

- **SPS options** are not anticipated to provide an incremental net economic benefit for tourism and commercial operators.

The following impact groups have been identified as part of the economic assessment, and are considered to have the potential to experience an economic change as a result of the Project.



The evaluation of the Economics criterion has been undertaken with an emphasis on the impact an option has on tourism and commercial operators, noting that all the other impacts are considered through other dedicated criteria.

6. Learning and Innovation

KEY ANALYSIS

- Technical
- Planning and Regulatory

The ability of the option to provide a level of innovation to support Queensland's transition to a low carbon economy, including facilitating skills development for new technology.

NO	R1	R2	C1-3	I1	I2	I3
6	Medium	Medium/High	Medium	Low	Low/Medium	High

CURRENT STATE
Low

MICROGRIDS
R1, R2, C1-3

- **Options R1 and R2** provide an opportunity to develop a microgrid that could provide substantial industry learnings.
- A microgrid of this type would be used as a case study, including in relation to the AEMC's Priority 2 review of SPSs, specifically Category 2 systems.
- **Option R2** scores slightly higher due to the deployment of hydrogen electrolysis technology.

SPS BASED SOLUTIONS
I1-I3

- **Option I1** provides limited learning and innovation opportunities given the technology is widely used and similar schemes have already been put in place in Queensland.
- **Option I2** would be used as a case study in relation to the AEMC's Priority 2 review of SPSs, specifically Category 3 systems.
- **Option I3** uptake of cutting edge technology in a unique location would be one of the first of its kind in the world and a first for Australia.

7. Technical and Commercial Implementation Risk

KEY ANALYSIS

- Technical
- Planning and Regulatory
- Risk

The certainty of the option in terms of technical implementation risk (delivering the upgraded services in the anticipated timeframes and managing disruption and integration risk) and commercial implementation risk (the complexity, flexibility and certainty of the commercial framework).

NO	R1	R2	C1-3	I1	I2	I3	CURRENT STATE
7	**Low**	**Low**	**Low/Medium**	**High**	**Medium/High**	**Low/Medium**	**High**

REGIONAL MICROGRIDS R1-R2

- **Options R1 and R2** are high risk due to:
  - High demand and counterparty risk of the customer base
  - Complex and high level of regulatory and approval requirements
  - Complexity of delivering a microgrid network in the Wet Tropics World Heritage Area
  - Risk of establishing a service connection to the customer.
- **Option R1** generation technology risk is low.
- **Option R2** has greater generation technology risk due to new hydrogen technology, however this option assumes full diesel generator redundancy.

COMMUNITY MICROGRIDS C1-3

- Compared with **Options R1 and R2**, risk is reduced to Medium/High as this option does not have to traverse more difficult terrain and sensitive Wet Tropics World Heritage Area between population centres (i.e. planning and regulatory, and delivery risk is slightly reduced).
- All other risks as per **Option R1**.

SPS BASED SOLUTIONS I1-I3

- **Option I1** – Low risk due to being an incremental enhancement to existing arrangements and successful frameworks exist for options such as this that can be utilised by Government. ✓
- **Option I2** - Based on established technology however demand and counterparty risk may impact the bankability of this option for an operator without Government support.
- **Option I3** – Residential fuel cell technology and the Australian hydrogen market is still in its infancy, and the regulatory framework is uncertain and likely to be complex.

Assessment Summary

The table below provides a summary of the criterion and overall rating for each option.

NO	CRITERION	R1	R2	C1-3	I1	I2	I3	CURRENT STATE
1	Natural and Cultural Heritage	Low/Medium	Low/Medium	Medium	High	High	High	High
2	Financial	Low/Medium	Low	Low/Medium	Medium	Medium	Low/Medium	Medium
3	Environmental	Medium	High	Medium/High	Low/Medium	Low/Medium	High	Low
4	Reliability and Security of Supply	Medium/High	Medium/High	Medium/High	Medium	High	Medium/High	Medium
5	Economic	Low/Medium	Low/Medium	Low/Medium	Low	Low	Low	Low
6	Learning and Innovation	Medium	Medium/High	Medium	Low	Low/Medium	High	Low
7	Technical and Commercial Implementation Risk	Low	Low	Low/Medium	High	Medium/High	Low/Medium	High
	Assessment Summary	Low	Low	Low/Medium	Medium/High	Medium	Medium/High	Medium

Conclusions

Conclusions

At this time, no one option satisfies all of the Government's objectives for the Daintree region. However, the evaluation suggests that some of the options have a relatively higher degree of alignment with the Government's objectives, and that these could be further considered and developed.

MICROGRID BASED SOLUTIONS DO NOT APPEAR TO BE THE RIGHT LONG TERM SOLUTION FOR THE DAINTREE

- A microgrid would supply residents with a **reliable and secure energy network**, however it presents **numerous technical and commercial risks** and is likely to be financially unviable without significant upfront and ongoing Government support.
- The microgrid options annually cost between **$11,000 and $15,000 more per residential customer** or, conversely, a **subsidy of between $70 million and $150 million** would be required to preserve customers' current electricity costs.
- A microgrid **presents varying levels of risk to the natural and cultural heritage values of the region,** requires a high level of regulatory approvals and design work and is expected to comprise a six year development and construction timetable.

SPS BASED SOLUTIONS ALLOW FOR INCREMENTAL STAGED ENHANCEMENT AND REPLACEMENT OVER TIME

- Relative to a microgrid, **SPS based solutions better preserve the existing natural and cultural heritage values** of the Daintree.
- However, there are **limited short term solutions to materially improve existing arrangements**, but opportunities could exist for incremental enhancements (e.g. battery upgrade program) while other potential long term solutions are investigated and potentially relevant technologies mature (e.g. hydrogen based SPS, displacing diesel).
- The SPS based solutions annually cost between **$700 and $6,000 more per residential customer** than current supply arrangements.

A3 Handout

Daintree Electricity Supply Study

CURRENT STATE

Illustrative customers have been developed to enable the Daintree community to compare the cost of options to the Current State

IC1 Residential or equivalent
A typical residential household (or equivalent) in the Daintree region

IC2 Residential BnB or equivalent
A typical residential household which is also offering a small BnB service (or equivalent) in the Daintree region

IC3 Commercial shop or equivalent
A typical small sized business/commercial shop that does not offer an accommodation service (or equivalent) in the Daintree region

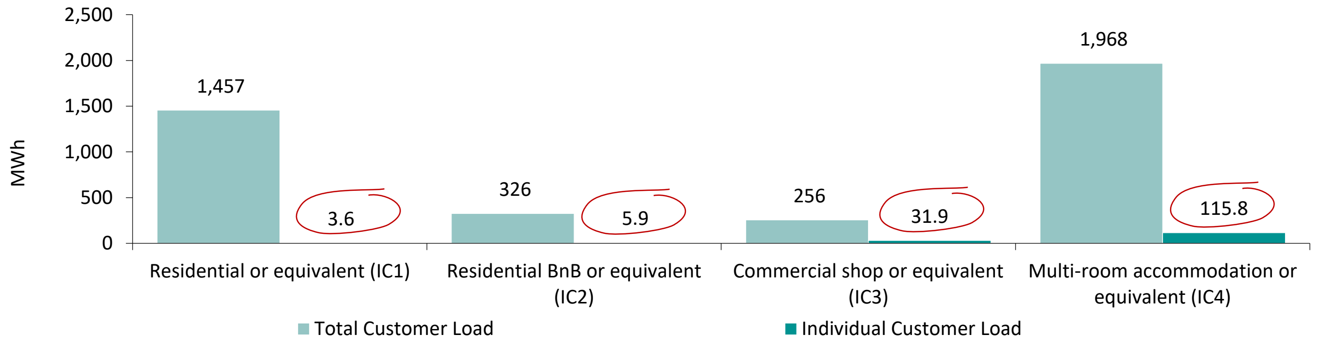
IC4 Multi-room accommodation or equivalent
A medium sized business/multi-room accommodation establishment (or equivalent) in the Daintree region

DAINTREE CUSTOMERS – ESTIMATED CONNECTIONS (#)

TOTAL ESTIMATED DAINTREE CUSTOMERS		CAPE TRIBULATION	THORNTON BEACH	DIWAN	COW BAY	FOREST CREEK	KIMBERLEY		
ILLUSTRATIVE CUSTOMER	ID#	NORTHERN	CENTRAL			SOUTHERN		TOTAL	% TOTAL
Residential^	IC1	67	10	98	145	66	23	409	84%
Residential BnB^	IC2	10	4	15	21	3	2	55	11%
Commercial shop^	IC3	3	1	1	3	-	-	8	2%
Multi-room accommodation^	IC4	8	-	6	3	-	-	17	3%
Total		**88**	**15**	**120**	**172**	**69**	**25**	**489**	**100%**
Community Total		88			307		94	489	
% Community Total		18%			63%		19%		100%

^Or equivalent

DAINTREE CUSTOMERS – ANNUAL LOADS (MWH)

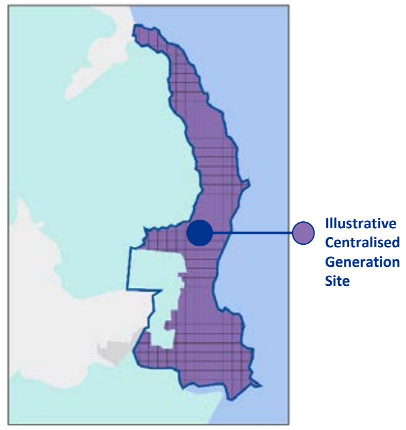


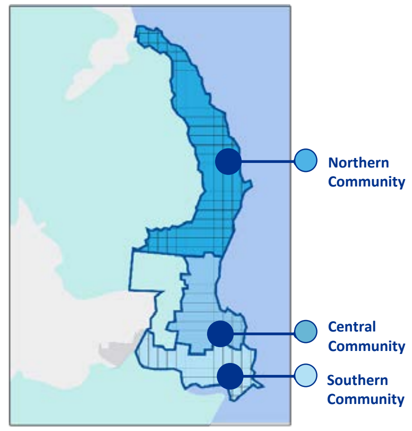
ILLUSTRATIVE CUSTOMER	NORTHERN COMMUNITY	CENTRAL COMMUNITY	SOUTHERN COMMUNITY	TOTAL REGION	TOTAL
	MWH				%
IC1	239	901	317	1,457	36%
IC2	59	237	30	326	8%
IC3	96	160	-	256	6%
IC4	926	1,042	-	1,968	49%
Total	**1,320**	**2,340**	**347**	**4,007**	**100%**
% Total	**33%**	**58%**	**9%**	**100%**	

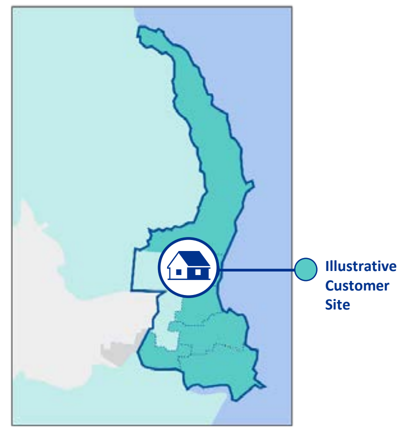
OPTIONS

The six options analysed as part of this study, comprising three microgrid based options and three individual SPS based options, include a combination of established (e.g. solar and diesel generators) and emerging technologies (e.g. hydrogen and lithium-ion battery storage)

MICROGRID OPTIONS			INDIVIDUAL OPTIONS		
R1	R2	C1-3	I1	I2	I3
Microgrid "Optimised"	Hydrogen Microgrid "Green"	Community Microgrids "Optimised"	Lithium-ion Battery Retrofit	Managed Service SPS	Hydrogen Fuel Cell SPS
2,000 kW	2,000 kW	670 kW / 1,260 kW / 180 kW (Total 2,110 kW)	10-60 kW	7-30 kW	6.3-27 kW







	#	DESCRIPTION*	GRID**	SOLAR PV	DIESEL GENERATOR	HYDROGEN GAS TURBINE	LITHIUM-ION BATTERY	HYDROGEN FUEL CELL	ELECTROLYSER	HYDROGEN STORAGE
REGIONAL		CENTRALISED GENERATION & STORAGE								
	R1	A single microgrid connecting all customers. Centralised generation and storage based on the most efficient and proven electricity supply technology.	✓							
	R2	A single microgrid as per Option R1 but using hydrogen fuel generation to move away from fossil fuel generation.^	✓							
COMMUNITY		CENTRALISED GENERATION & STORAGE								
	C1-3	C1 – A single microgrid connecting all customers in the Northern community of the Daintree. Centralised generation and storage based on most efficient supply.	✓							
		C2 – A single microgrid connecting all customers in the Central community of the Daintree. Centralised generation and storage based on most efficient supply.	✓							
		C3 – A single microgrid connecting all customers in the Southern area of the Daintree. Centralised generation and storage based on most efficient supply.	✓							
INDIVIDUAL		SPS GENERATION & STORAGE								
	I1	Fit lithium-ion batteries to customer's existing installations to improve efficiencies and reduce environmental impacts.		^^	^^					
	I2	Provision of standardised power systems to customers that are managed and maintained centrally. Customers pay standard charge for services.								
	I3	Installation of individual hydrogen fuel cells at customer's dwellings that replace their current SPS.								

**Excludes LPG used for cooking and water heating under all options. ** If compatible existing customers could connect their systems to the microgrid.*
^ A diesel generator has been included to act as a backup should a failure in the hydrogen production or generation system occur. ^^Existing SPS component.

Daintree Electricity Supply Study

EVALUATION CRITERIA

The evaluation criteria used for the evaluation of options was developed with reference to the Government's Project Objectives.

1. Natural and Cultural Heritage
2. Financial
3. Environmental
4. Reliability and Security of Supply
5. Economic
6. Learning and Innovation
7. Technical and Commercial Implementation Risk

PLANNING AND REGULATORY ANALYSIS (1, 6, 7)

The study area encompasses multiple tenures where development is subject to a wide variety of regulatory aspects. The various suburbs in the study area are separated by significant areas of conservation reserves, with the majority of this being the Wet Tropics World Heritage Area which includes the Daintree National Park.

Timing of planning and regulatory approvals will depend on the option progressed.
Options R1 and R2 are likely impact assessable for EPBC and WTMA permits.
Option C1-3 will be dependent on level of supporting information requirements and level of assessment required, which may be up to 18 months.
Options I1 to I3 are subject to local government planning laws and building codes (where applicable).

LEGEND	
Red	Long timeframe for assessments and requires high level of supporting information/studies, e.g. EIS level of assessment
Orange	Complex integrated assessment for Development Applications with multiple agencies and specialised requirements
Yellow	State assessment timeframes. May require some specialised studies e.g. Protected Flora Surveys and Clearing Permits
Green	No regulatory permits required, may require Council development and building approvals and/or referral to WTMA for conditions on Development Application (DA)

PLANNING/ REGULATORY REQUIREMENT	STAKEHOLDER ENTITY	STATE / FEDERAL / LOCAL	EST. TIMING OF APPLICATION & APPROVAL	OPTION R1	OPTION R2	OPTION C1-3	OPTION I1	OPTION I2	OPTION I3
Environment Protection and Biodiversity Conservation Act 1999 Referral	Department of the Environment and Energy (DEE)	Federal	12 to 36 months	Red	Red	Yellow	Green	Green	Green
Wet Tropics Management Plan 1998 permit	Wet Tropics Management Authority (WTMA)	State/Federal	Concurrent with EPBC Referral	Red	Red	Green	Green	Green	Green
Fisheries Act 1994	Department of Agriculture and Fisheries (DAF)	State	6 to 18 months Concurrent with DA	Yellow	Yellow	Yellow	Green	Green	Yellow
Vegetation Management Act 1999	Department of Natural Resources, Mines and Energy (DNRME)	State	6 to 18 months Concurrent with DA	Yellow	Yellow	Yellow	Green	Green	Yellow
Nature Conservation Act 1992	Department of Environment and Science (DES)	State	12 to 18 weeks	Yellow	Yellow	Yellow	Green	Green	Yellow
Nature Conservation Act 1992	Department of Environment and Science (DES) and Queensland Parks and Wildlife Service (QPWS)	State	18 to 36 months	Red	Red	Green	Green	Green	Green
Planning Act 2016	Department of State Development, Manufacturing, Infrastructure and Planning	State	9 to 18 months Up to 36 months if WTWHA and EPBC requirements to be integrated.	Red	Red	Orange	Green	Green	Yellow
Land Act 1994	Department of Natural Resources, Mines and Energy (DNRME)	State	6 to 12 months Concurrent with DA	Yellow	Yellow	Yellow	Green	Green	Yellow
Douglas Shire Council *Planning Scheme, Local Planning Laws and Regulations*	Douglas Shire Council	Local government	6 to 12 months	Green	Green	Green	Green	Green	Green
Electricity Act 1994	Department of Natural Resources, Mines and Energy (DNRME)	State	6 to 12 months	Yellow	Yellow	Yellow	Green	Green	Green
Total Anticipated Timing			Up to 3 years	Up to 3 years		Up to 18 months	Up to 12 months		

A range of further State assessment approvals would be triggered for microgrid options under the *Planning Act 2016* Development Application

FINANCIAL ANALYSIS (2)

The levelised cost is used to assess and compare the alternative options, and takes into account all upfront and ongoing costs through a unitised "levelised" cost. It can be thought of as the average annual cost of all costs over the life of the project. **All options are higher cost than the Current State.**

ILLUSTRATIVE CUSTOMER	IC1	IC2	IC3	IC4
ASSUMED LOAD (KWH P.A.)	3,561	5,934	31,945	115,790
Total Weighted Levelised Cost ($ p.a.)				
Current State	2,064	3,321	11,290	38,787
Option R1	12,983	21,633	116,453	422,109
Option R2	16,166	26,937	145,007	525,608
Option C1-3	16,717	19,135	74,157	278,075
Option C1	10,133	16,884	90,891	329,454
Option C2	7,148	11,911	64,117	232,405
Option C3	48,875	81,436	-	-
Option I1	2,728	4,799	-	-
Option I2	5,832	8,053	34,418	100,907
Option I3.1 ("Green Hydrogen" for Cairns)	7,372	10,781	21,774	53,690
Option I3.2 ("Green Hydrogen" for Townsville)	7,415	10,852	22,154	55,065
Option I3.3 ("Brown Hydrogen" from Newcastle)	7,933	11,716	26,806	71,928

The annual levelised cost of the regional microgrid options R1 and R2 broadly ranges between $13,000 and $16,000 per annum, which is significantly higher than the Current State

RISK ANALYSIS (1, 2, 4, 7)

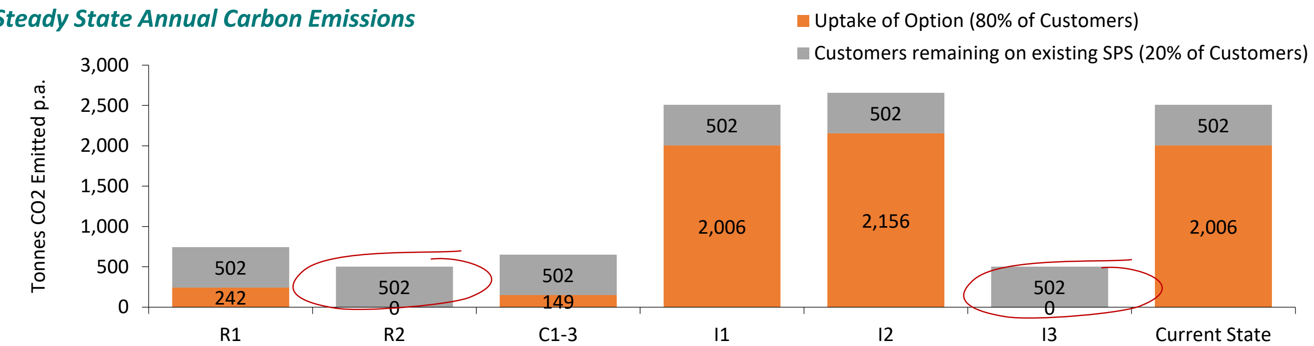
Key risks were identified and assessed and partly informed the overall assessment against the corresponding criteria.

AGGREGATED RISK ASSESSMENT	R1 (Microgrid options)	R2 (Microgrid options)	C1-3 (Microgrid options)	I1 (Individual options)	I2 (Individual options)	I3 (Individual options)
Natural and Cultural Heritage	Medium - High	Medium - High	Medium - High	Low	Low	Low
Financial	Medium - High	High	Medium	Medium	Low - Medium	Medium - High
Reliability and Security of Supply	Low - Medium	Low - Medium	Low - Medium	Medium	Medium	Medium
Technical and Commercial Implementation	High	High	Medium High	Low	Low - Medium	Medium - High

ENVIRONMENTAL ANALYSIS (3)

Microgrid options are generally more efficient than individual SPSs due to the diversity of customer loads. Options with hydrogen do not produce carbon emissions however the customers that are assumed to remain on their existing SPS will produce carbon emissions at existing levels.

Steady State Annual Carbon Emissions



kpmg.com.au