



**Mirabou Energy**



# Gulf Savannah Regional Electricity & Energy Supply Proposal

Stage 2 Report Summary

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# Preface

Mirabou Energy is proud to present an Executive Summary of the **Gulf Savannah Regional Electricity and Energy Supply Proposal** (REESP) report.

The REESP represents a critical collaboration between Gulf Savannah Development Inc (GSD), the members of GSD, the Queensland Department of State Development, Infrastructure, Local Government and Planning (DSDILGP), and Mirabou Energy. Mirabou Energy would like to thank our partners and those members of GSD and communities in the GSD region for their time and insights into the important issues for the region in achieving the Queensland and Commonwealth government's net zero emissions targets.

From the initial concept through to the scoping of the REESP with GSD and DSDILGP, Mirabou Energy were excited for this high-level plan that aims to support the GSD region's aspiration to achieve net-zero emissions in electricity and energy in transport by 2050. For GSD, its members, the region's communities and DSDILGP, the REESP represents an actionable plan that provides a guide to decision makers on the choice of assets to achieve emission reduction targets for the region taking into consideration multiple drivers, trends and factors.

The importance of the REESP as an actionable plan became increasingly obvious as GSD's Project Governance Committee identified that:

1. Given the current physical electricity supply in the region, which includes east-coast grid connected regions as well as Isolated Power Systems, there currently is no similar plan for the whole GSD region that sets out how the region should achieve net zero emissions by 2050.
2. People and communities in the GSD region consume more electricity and energy in transport when compared with the Queensland average and the average from south-east Queensland, which is the regulatory reference point for the Queensland Government and Queensland Competition Authority when setting policy instruments such as the Uniform Tariff Policy Community Service Obligation subsidy paid from the government to Ergon Energy.
3. The GSD region already makes a material net positive contribution to Queensland Gross State Product and that renewable energy investments and supporting infrastructure identified in the REESP would increase this net contribution four-fold.
4. The GSD region provides an opportunity as a pilot region to show case how consumers, businesses and government could come together to achieve net zero emissions through industry enablement that will support economic growth, and for First Nation's people in the region, a supporting foundation to 'closing the gap'.

In preparing the REESP, Mirabou Energy acknowledges all community members, leaders, organisations and businesses and their contributions to the analysis and the report. Finally, without DSDILGP vision the REESP would not have been possible – to this end we thank the Queensland Government and the team at DSDILGP for turning the vision into a plan and we hope into action.



# Disclaimer

*The purpose of this Report is to provide the Recipient with general information concerning the engagement of Mirabou Energy (“Mirabou” or “ME”) and its subsidiary with Gulf Savannah Development Inc (GSD) on the Regional Electricity Energy Supply Proposal (“REESP”) for the Gulf Savannah region.*

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*Information contained in this Report has been prepared in good faith by Mirabou Energy and GSD. This Report may include certain estimates, projections, calculations or forward-looking statements and/or opinions with respect to the GSD region in terms of electricity demand and supply, fuel demand and supply, assets, electricity network supply and economic and project development opportunities. Such Estimates are based on assumptions about future events and stakeholders’ actions that may not necessarily take place and are subject to uncertainties, many of which are outside of Mirabou’s and GSD’s control. Mirabou and GSD make no representations or warranties as to the accuracy, reliability or reasonableness of the assumptions on which the Estimates are based. The Recipient should make its own enquiries and investigations regarding the assumptions, uncertainties and contingencies which may affect the future of Australia’s energy markets, the operation of isolated power systems and the Gulf Savannah region.*

*Mirabou takes no responsibility or liability in respect to any reliance placed on this Report by any party.*

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Photo credit: Close-up view of Leichardt Falls, Queensland (Shutterstock)

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# REGIONAL ELECTRICITY AND ENERGY SUPPLY PROPOSAL (REESP)

## Scope Summary

Mirabou Energy is the Gulf Savannah Development Inc (GSD) strategic energy partner. GSD is the business and economic development association for the Gulf of Carpentaria local governments and private businesses in far North West of Queensland, spanning from Etheridge, Croydon, Carpentaria, Burke, Doomadgee and Mornington Island – with a total area of 300,000km<sup>2</sup> or approximately 16% of Queensland.

Mirabou Energy has prepared this Regional Electricity and Energy Supply Proposal (REESP) Report for GSD to identify a clear pathway to achieve renewable energy (RE) and carbon emission reduction targets to 2030, 2032 (Brisbane Olympics), 2040, and 2050 for stationary electricity and energy used in the transportation sector. RE and emission reduction for other segments of the economy, such as land use, were not included.

Mirabou Energy also included economic and industry development opportunities for the GSD region as identified during the REESP project.

The REESP project consisted of two stages. Information on current electricity and energy demand and supply in the GSD region was gathered and summarised in the Stage 1 report. This Stage 2 report provides the analysis and findings of the full scope including:

- Overview and analysis of current demand for stationary electricity and fuels in transport
- Overview and analysis of existing electricity supply systems and supply of fuels to the region
- Market approaches to forecasting and achieving RE and emission reduction targets
- Approach, analysis and findings for the forecast RE assets to achieve targets and reduced emissions in fuel use on transport
- Ensuring that forecast RE assets are fit for purpose to meet future demand from economic and industry development in the region
- Proposed next steps.

The Queensland Government through the Department of State Development, Infrastructure, Local Government and Planning (DSDILGP) Remote Area Board Program provided financial assistance to cover 40% of the REESP project cost with the balance funded by Mirabou Energy.





# GSD Reference Map



Source: Gulf Savannah Development Inc

# Current State

Economic Characteristics

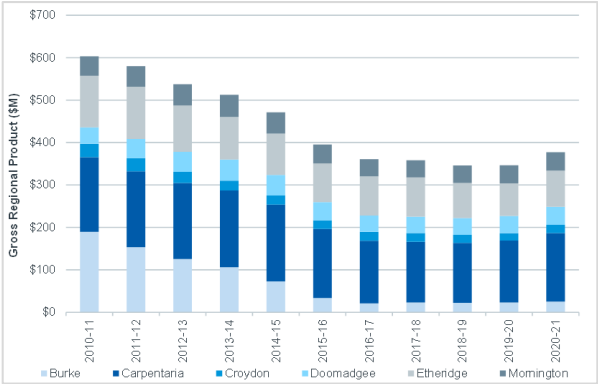
Stationary Electricity Supply and Demand

Fuel Supply

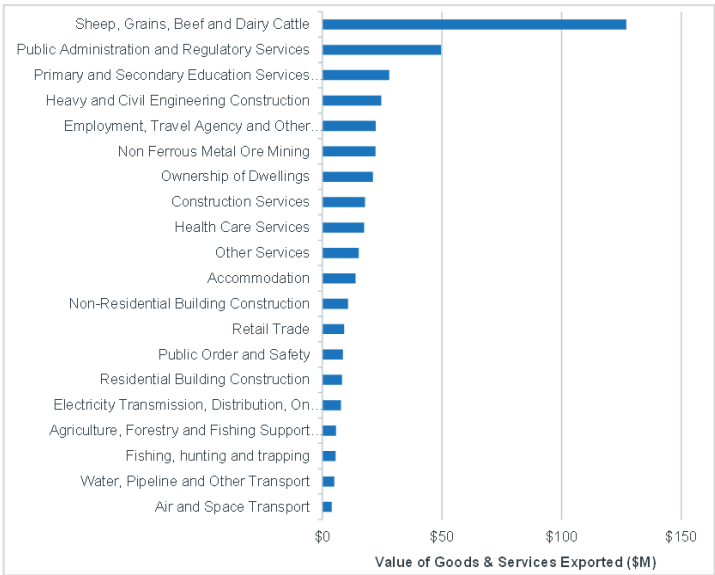
# CURRENT STATE

## GSD Region Economic Characteristics

Gross Regional Product by LGA



Top 20 GSD Region Exports 2018-19



Source: AEC

The GSD region's economy, as measured by Gross Regional Product (GRP), is estimated to be \$377m in FY2020-21. There was a general decline in the region's GRP, however, the trend plateaued between 2016-2020 and reversed in 2020-21. During this period, the region remained to be a net exporter at c\$224m per annum (2018-19).

The region's economy is dominated by cattle farming and agriculture, followed by public administration, education services and engineering construction, with growth in health care and electricity, gas, water and waste services. Recent Far North Queensland Region of Councils (FNQROC) Report on tourism also estimated that the Savannah Way, which links Far North Queensland and the Northern Territory, carried around 640,000 visitors who spend around \$216m per annum in the GSD region.

Likewise, the sectors above represent the main employers in the region with the labour workforce dominated by those with Skill Level 4 (Certificate II, III or at least 1 year of experience) followed by Skill Level 1 (at least a Bachelor degree or 5 years of experience) and Skill Level 3 (Certificate IV).

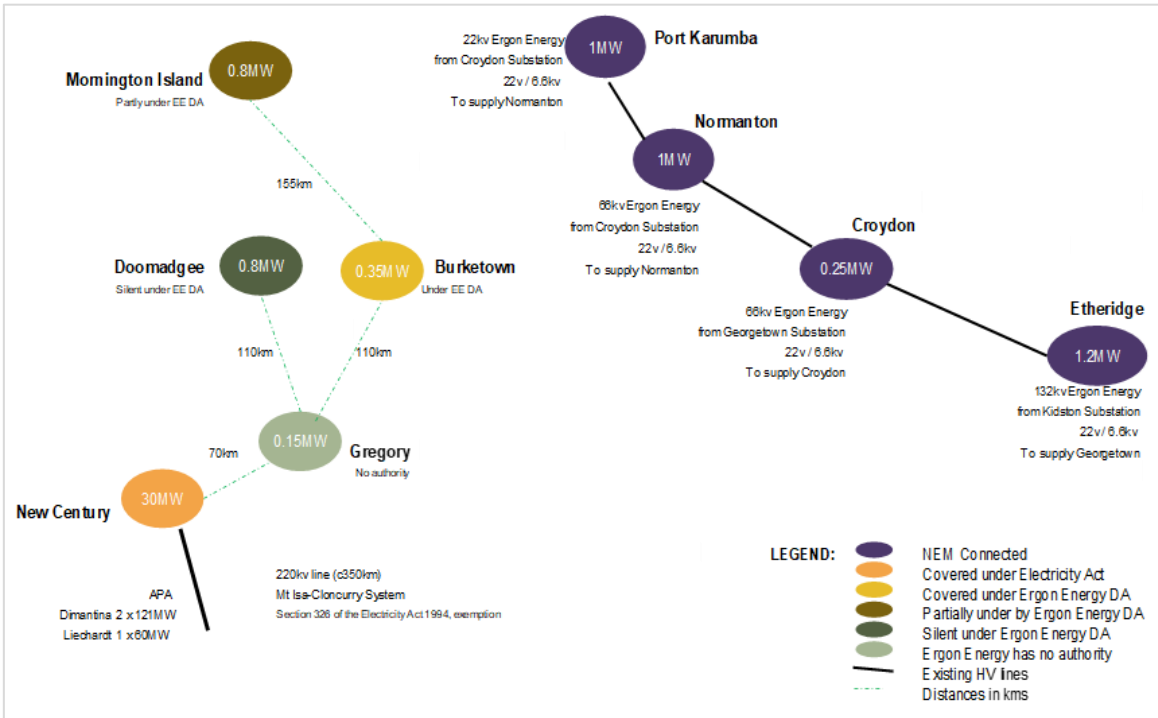
For the region to continue its upward trajectory observed in FY2020-21, foundation infrastructure projects, such as roads, ports, water and electricity are needed to further unlock the region's potential economic and industry development opportunities including those identified in both Australia's and Queensland's Critical Mineral Strategies.



## CURRENT STATE

# GSD Region Stationary Electricity Supply System

GSD Supply Region



In addition to the Ergon operated electricity supply systems, there are also a number of privately owned and operated Stand-Alone Power Systems (SAPS). There was no publicly available information on the extent of SAPS within the region.

The GSD region electricity supply system notable for its three separate electricity supply models:

### NEM Connected in eastern GSD region

Etheridge, Croydon and Carpentaria is connected via Kidston, 132kv, 66kv, 22kv to Karumba as operated by Ergon Energy Network. Ergon Energy Retail is the only retailer available for residential and small business customers (<100 MWh). Large Business customers (>100 MWh) can choose another Retailer but cannot revert back once transferred.

### Isolated Power Systems in western GSD region

Burke, Doomadgee and Mornington Island, N-2/3 diesel (Doomadgee has community solar c550kw), 22kv, 415v systems. Ergon Energy Retailer is the sole supplier.

### New Century Mine in western GSD region

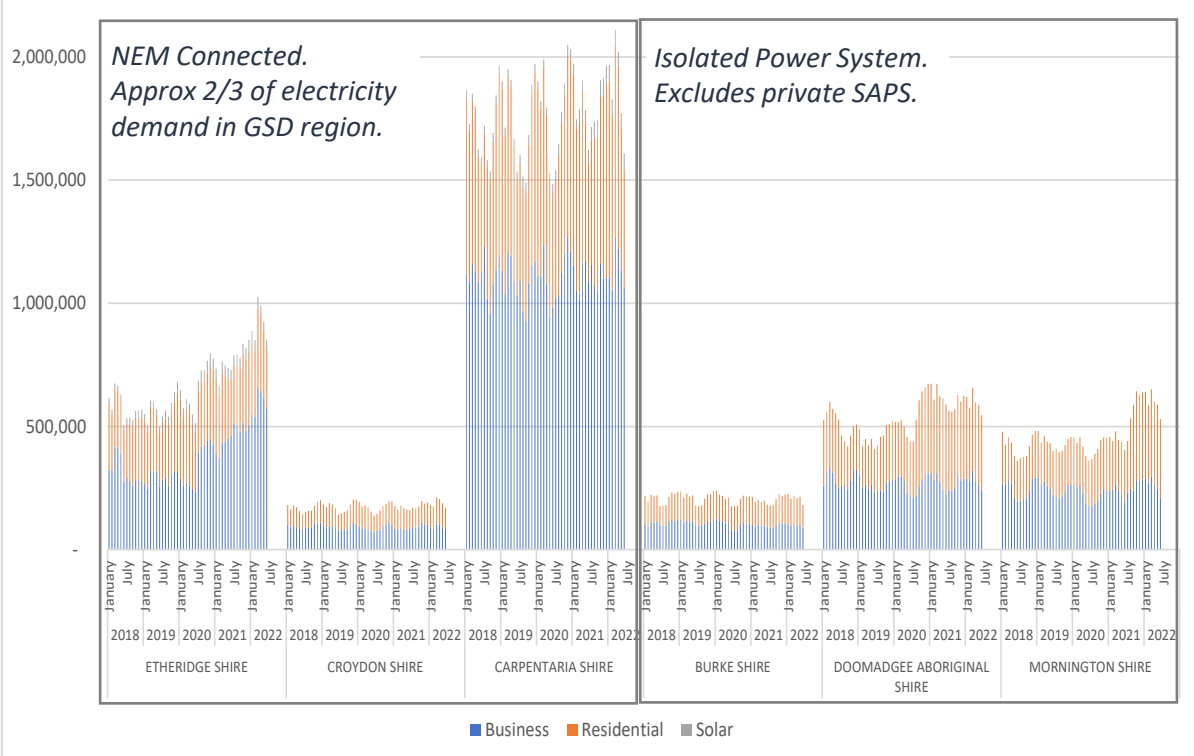
Connected to North-West system 220kv. Ergon Energy operates grid and APA generates electricity. Ergon Energy Retail is the only retailer available for residential and small business customers. Large Business customers can choose another Retail but cannot revert back.

Queensland Government pays Ergon Energy a Community Service Obligation (CSO) subsidy for the difference between its 'true costs' in providing electricity to the communities and the standard contract prices for residential only. Business tariffs are meant to be at full cost recovery. (Source: Queensland Competition Authority)

# CURRENT STATE

## Stationary Electricity Demand and Growth Rates

Electricity Consumption for Residential and Business by LGAs (FY2018–22)



In the NEM connected region, during FY2018-22, businesses consumed more electricity than residential (60:40) whilst in the isolated region, residential consumed slightly more than businesses (55:45). This excludes private SAPS.

Compounding year-on-year growth rate of electricity consumptions across GSD region over 5 years (FY18-FY22)

	Residential	Business	Total
<b>NEM Connected System</b>	<b>2.94%</b>	<b>3.14%</b>	<b>3.55%</b>
Etheridge	3.92%	13.29%	10.06%
Croydon	5.14%	0.88%	2.83%
Carpentaria	2.28%	-0.28%	1.15%
<b>Isolated Power System</b>	<b>7.93%</b>	<b>0.28%</b>	<b>4.11%</b>
Burke	1.14%	-2.38%	-0.61%
Doomadgee	4.98%	-0.13%	2.49%
Mornington	14.59%	1.85%	8.02%
<b>GSD Region</b>	<b>4.91%</b>	<b>2.35%</b>	<b>3.73%</b>

Electricity consumption in the GSD region had been growing year-on-year at a rate of more than 3%, mainly driven by residential and housing upgrades/new housing.

Increase in business electricity consumption was largely due to projects in Etheridge. For the remaining LGAs, business electricity consumption grew at a low level or was contracting which might be related to the lack of growth in the region’s economy as well as the adoption of SAPS. In turn, constraint in electricity supply in isolated power systems has also imposed limitation on business growth.



CURRENT STATE

Case Study: High Residential Electricity Consumption

Historic GSD LGA’s Residential Average Household Electricity Consumption (kWh)

LGAs	Residential					Trend
	FY18	FY19	FY20	FY21	FY22	
Etheridge	8,250	8,340	9,391	9,201	9,467	
Croydon	8,283	8,874	9,705	9,585	10,305	
Carpentaria	9,198	9,208	9,435	9,823	10,302	
Burke	12,078	12,180	12,178	12,352	13,027	
Doomadgee	10,596	7,500	9,057	12,837	11,517	
Mornington Island	8,068	7,330	7,525	8,241	12,787	
Average	9,184	8,644	9,228	10,072	10,886	

Source: Direct from Ergon Energy, Publicly Available Ergon Energy, Pers Comms Burke Shire Councillor for Gregory and Bidunggu

Compared to the average electricity consumption in South-East Queensland and Regional Queensland, residential electricity consumption in the GSD region is almost double (c5,500 kWh vs c5,600 kWh vs c11,000 kWh). Higher electricity consumption means a higher electricity bill.

Possible explanations for the higher electricity consumption includes:

- greater use of air conditioning in the GSD region when compared to the rest of Queensland
- less energy efficient practices
- more refrigeration and cooling appliances (mainly for food storage) for remote and regional living
- lower penetration of rooftop solar PV particularly in the isolated power systems areas, and
- more concentration of the number of people in a house resulting in greater demand at each residential household.

Average number of people per household/dwelling

NEM Connected	
Etheridge	2.78
Croydon	3.36
Carpentaria	3.21
Average	3.11
Isolated Power System	
Burke	3.55
Doomadgee	5.04
Mornington Island	4.53
Average	4.57
GSD average	3.68
Queensland average	2.50

Source: ABS, 2021 Census All persons QuickStats



## CURRENT STATE

# Stationary Electricity Average Bills

Average Residential Bill for GSD (QCA and Mirabou Analysis)

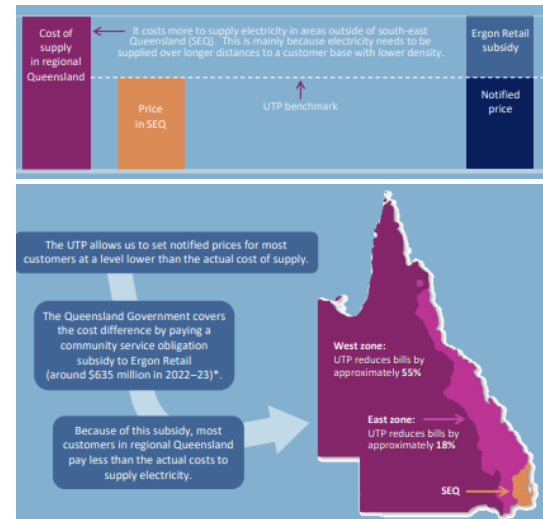
Tariff 11	FY22 (kWh)	QCA 22-23 Tariff 11 Forecast Residential Bill	% of Median income (incl non-disposable)
Etheridge	9,467	\$ 4,071	5.43%
Croydon	10,305	\$ 4,431	4.40%
Carpentaria	10,302	\$ 4,430	4.99%
Burke	13,027	\$ 5,602	5.07%
Doomadgee	11,517	\$ 4,952	10.80%
Mornington Island	12,787	\$ 5,498	16.95%
GSD Average	<b>10,886</b>	<b>\$ 4,681</b>	<b>7.41%</b>
Queensland	<b>4,436</b>	<b>\$ 1,496</b>	<b>1.42%</b>

Customers in the GSD region pay electricity prices set by the Queensland Competition Authority (QCA) as per the Qld govt Uniform Tariff Policy (UTP) which means wherever possible, customers of the same category should pay the same rate for their electricity.

For residential customers, the QCA uses South-East Queensland median consumption to set the price which is half of the consumption in GSD region. The higher electricity consumption in the GSD region results in a higher electricity bill. Compared to the Queensland average, the share of electricity cost as a percentage of median household income is estimated to be at least three times more (1.42% vs 7.41%) – and for Mornington Island, it is estimated to be 10 times more (1.42% vs 16.95%).

Average Small and Large Business Bill for GSD

Tariff 44-46	FY22 (kWh)	QCA 22-23 Tariff 44 Forecast Business Bill
Etheridge	35,373	\$ 15,210
Croydon	22,916	\$ 9,854
Carpentaria	50,094	\$ 21,540
Burke	27,000	\$ 11,610
Doomadgee	72,567	\$ 31,204
Mornington Island	<b>62,396</b>	<b>\$ 26,830</b>
GSD Average	<b>44,701</b>	<b>\$ 19,221</b>



The total operating Ergon Retail subsidy to achieve the UTP is \$635m in financial year 2022-23 and \$66.6m for 33 Isolated Power Systems, equates to approximately \$2m per Isolated Power System or between \$6,000 and \$8,000 per person in Isolated Power Systems.

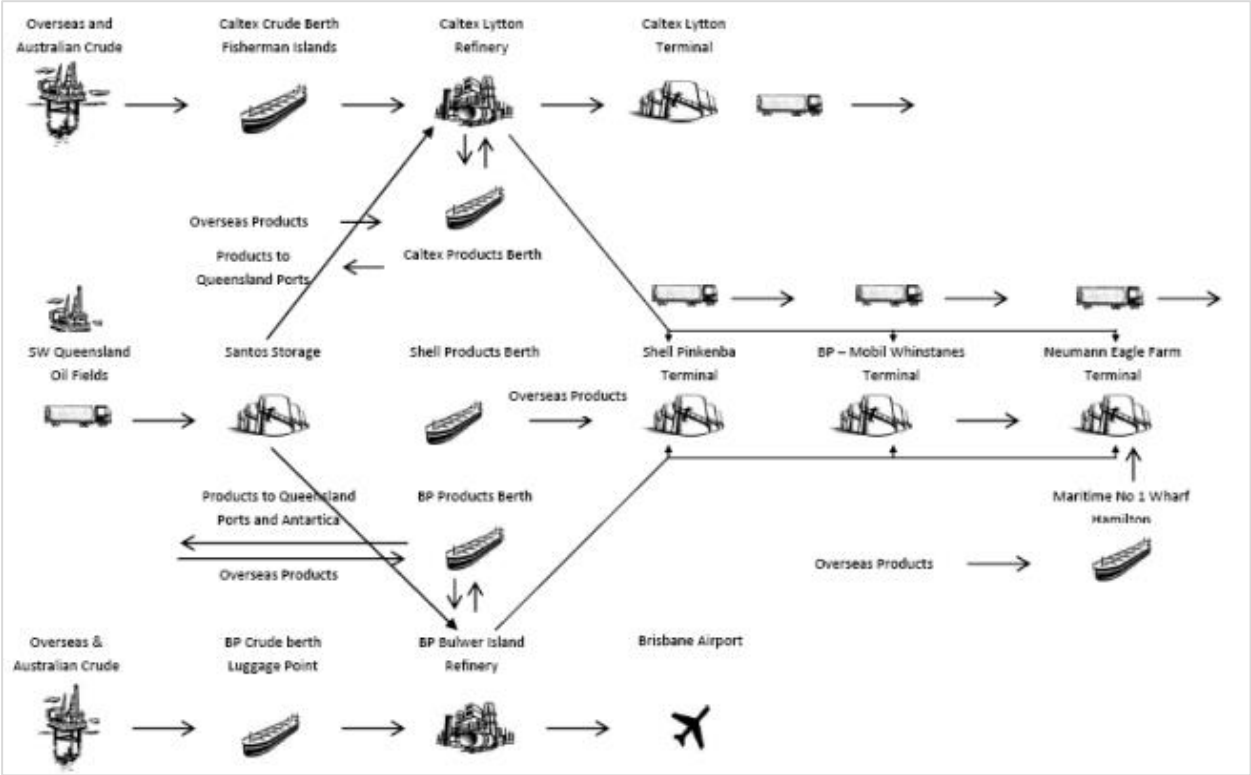
QCA 2023-24 – Price Information Book  
UTP and Standard Contract Prices



# CURRENT STATE

## GSD Region Fuel Supply

Being a remote region, GSD relies heavily on fuel being available for both electricity generation and transportation. Figure below illustrates the fuel supply chain from Brisbane, noting that BP closed its Bulwer Island refinery in 2015 and the AMPOL Lytton refinery remained open as part of FY2020-21 Commonwealth Government funding to ensure fuel security. Emissions related to the transportation of fuel to the GSD region has been included in the current analysis by examining how renewable fuels could be imported and or produced in the GSD region.



Source: ACIL Tasman 2010



For the GSD region, fuel products are likely sourced from Townsville (1m tonnes of petroleum imports FY2021) and Cairns storage terminals (0.5m tonnes of petroleum imports FY2021), as well as Karumba during flood periods and other Queensland terminals including the Brisbane AMPOL Lytton refinery.

Fuel supply to Gulf Savannah Region (2022)

LGA	Fuel type	Tonnes	Litres	Co2 tonne
Etheridge	Petrol	27,000	31,860,000	15,930
	Diesel	83,576	98,619,680	49,310
Croydon	Petrol	13,400	15,812,000	7,906
	Diesel	5,032	5,937,760	2,969
Carpentaria	Petrol	6,751	7,966,180	3,983
	Diesel	2,236	2,638,480	1,319
Burke	Diesel	73,300	86,494,000	43,247
TOTAL		211,295	249,328,100	124,664

Source: CSIRO TraNSIT 2023

# Renewable Energy and Emission Targets

Opportunities in the Transportation Sector  
Options for the GSD Region

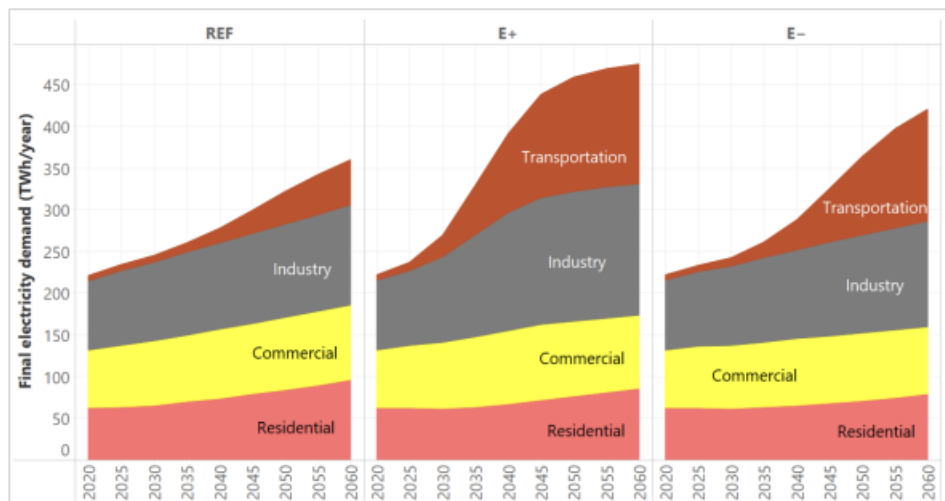
# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – FUEL Opportunities in the Transportation Sector

CO<sub>2</sub> emissions in the transport sector make up around 30% of Australia's CO<sub>2</sub> emissions. Achieving CO<sub>2</sub> emission reduction in the sector is assumed to occur from electrification of transport for domestic passenger and urban freight movements, with long haul transport emissions being resolved by potentially hydrogen and economic electrification of long-haul freight. Emissions in aviation fuels and maritime fuels is seen as being a far more difficult challenge to tackle (range of sources including AEMO (2022), ISP 2022).

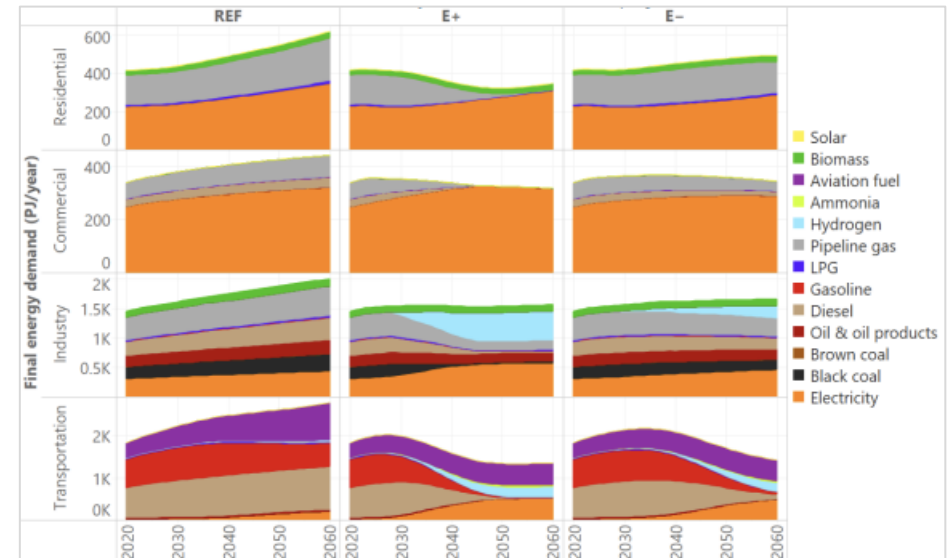
Net Zero Australia (NZAu) 2023 study projected an increase electricity demand due to electrification efforts across various sectors including in transportation:

- Forecast domestic final energy demand by sector, note the bottom graphs highlighting the transition in the transportation sector from oil and diesel to electrification and hydrogen, and
- Forecast increase in transportation electricity as the basis for achieving emissions reductions.

Projected growth in domestic final electricity by sector (TWh/year)\*



Domestic final energy demand by sector (PJ/Year)\*



\* Refer to the NZAu report for an explanation of the scenarios REF, E+ and E-.

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – FUEL

## Options for the GSD Region

To achieve the renewable energy and CO<sub>2</sub> emission targets, the GSD region requires an approach to reduce fuel consumed within the region.

### **Electrification of local transport**

In the immediate period (now to 2030), Electric Vehicles (EVs) are likely to have more impact for short distances within the communities rather than for travelling across the region. Over the planning horizon, low emissions energy in transport is likely to be resolved by EVs and potentially hydrogen or similar for long distances.

### **Importing renewable fuels from Singapore, Malaysia, USA and Europe**

Procuring renewable fuels in the current import supply chain is an option as well as building out renewable fuel import supply chain through Port Karumba as an economic development opportunity. Renewable fuel generally sells at 20-30% premium to current fuel prices however it provides an immediate reduction in CO<sub>2</sub> emission of up to 65%.

### **In region renewable fuel production facilities**

Sorghum, which is currently produced in the region, is a source of renewable petrol, diesel and Sustainable Aviation Fuels (SAF). Plastic waste to renewable diesel, petrol and SAF (central hub at Port Karumba or Port Karumba with regional centres to provide greater resilience) is also an option noting that further study will be required to determine their feasibility.

### **Combination of the above options**



# Renewable Energy and Emission Targets

Forecasting Approaches in the Electricity Sector  
Opportunities in the Electricity Supply System

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

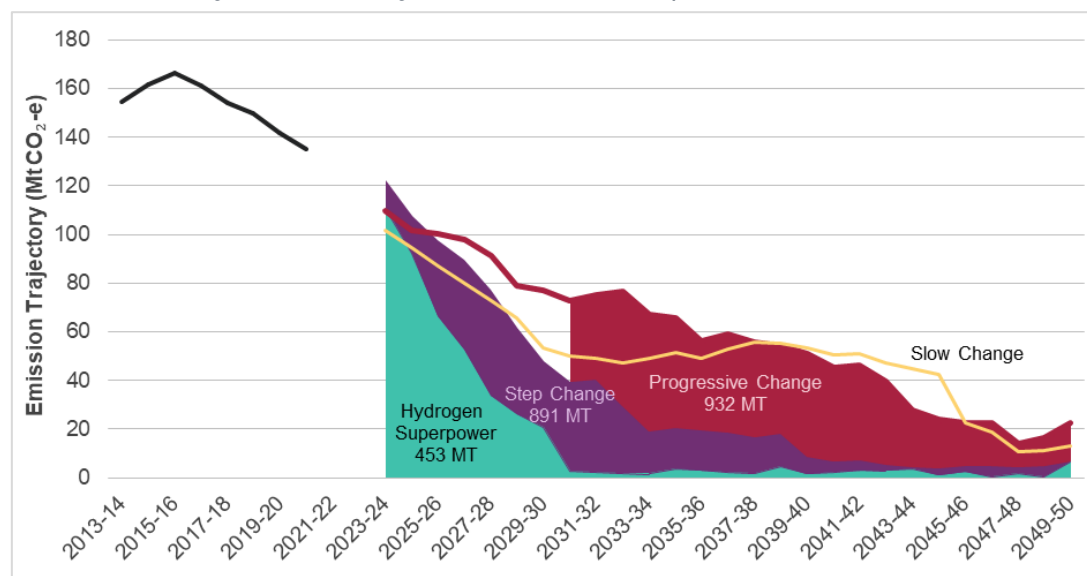
## AEMO Integrated System Plan for the NEM

As the manager and operator of the electricity and gas systems across Australia, the Australia Energy Market Operator (AEMO) produces an Integrated System Plan (ISP) for the National Electricity Market (NEM) every two years. The ISP provides a roadmap to support Australia's energy transition towards net zero. It determines the CO<sub>2</sub> budgets under the scenarios and the required generation capacity investments to 2050 to achieve the targets.

In its 2022 ISP, AEMO has adopted the Step Change scenario as the preferred pathway to achieving the emission reduction targets. As shown below, close to 170MW of RE assets (which is nearly four times of the current dispatchable capacity) and 56GW of energy storage will be required by 2050, in addition to other dispatchable generation such as hydro and peaking gas and liquids.

AEMO ISP 2022 Scenarios

NEM Carbon Budgets and resulting emissions reduction trajectories

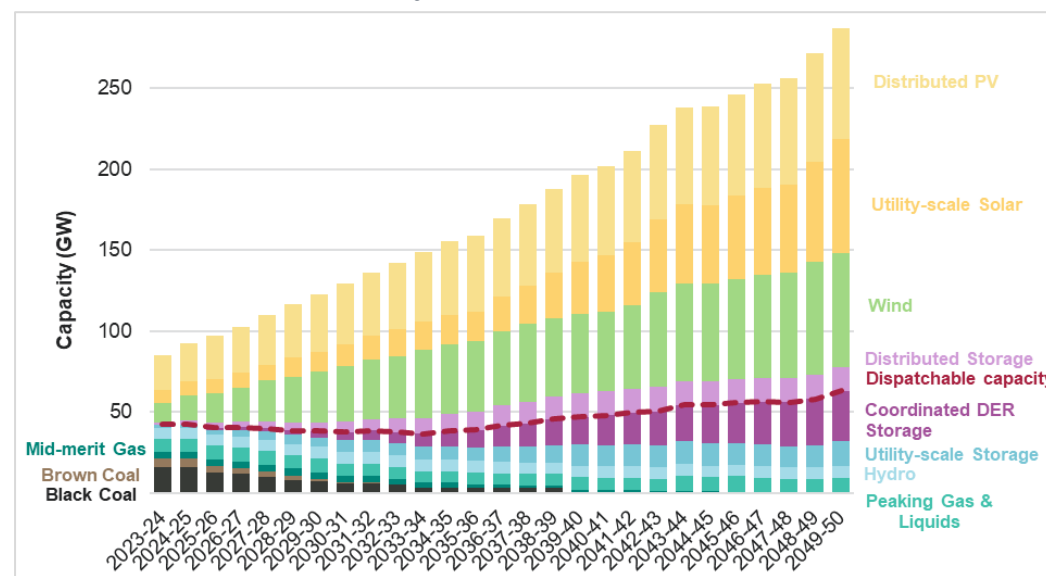


Source: AEMO, 2022, ISP 2022.



AEMO ISP 2022 – Step Change Scenario

Modelled Outcomes to Achieve targets



# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

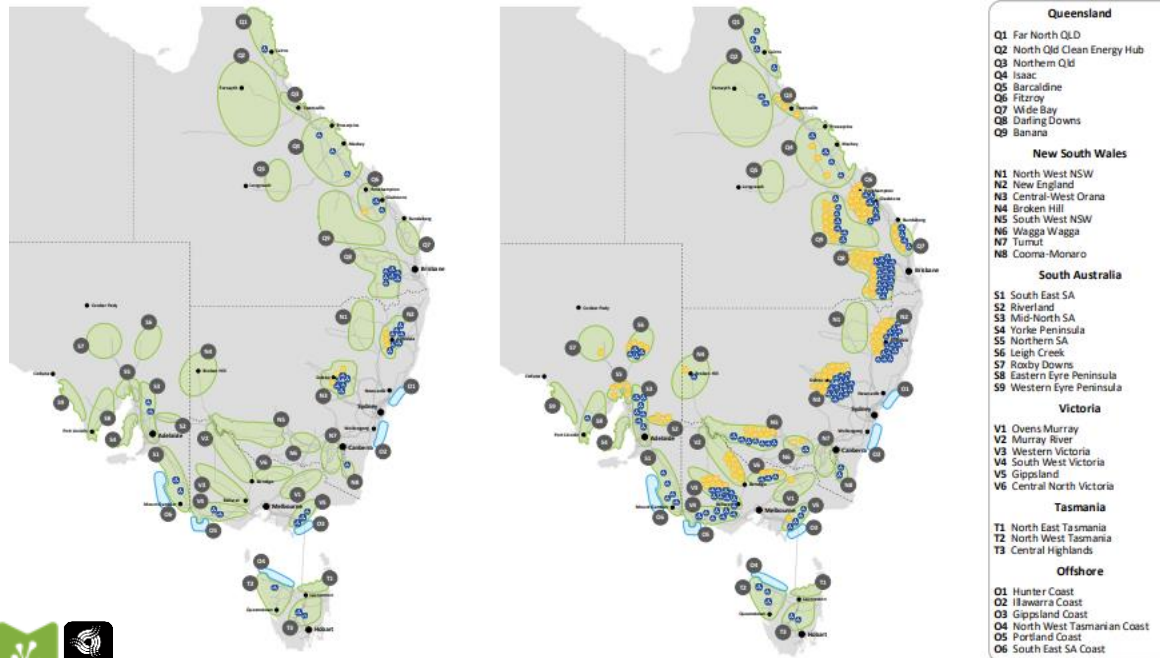
## AEMO ISP: Renewable Energy Zones and Network

The primary assumptions underpinning AEMO ISP in reaching RE and net zero emissions targets are:

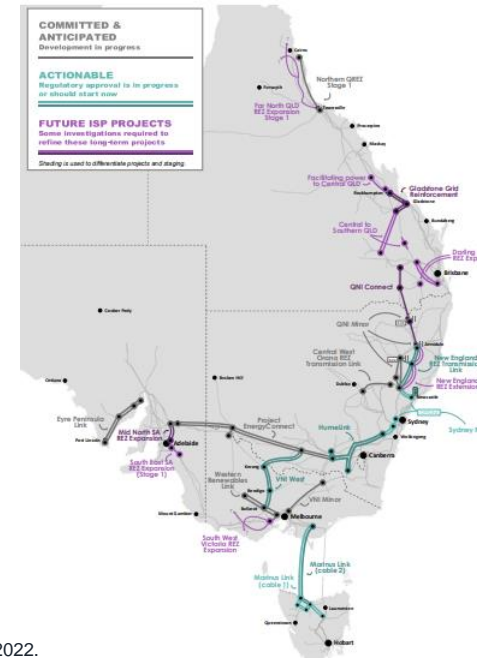
- Renewable Energy Zones (REZ) maximise Variable Renewable Energy (VRE) generation
- interconnect these REZs with load to ensure a diversity in meeting electricity demand and achieving the targets.

As shown in the diagrams below, part of Etheridge Shire is captured within North Queensland Clean Energy Hub REZ with potential for both large scale solar and wind farms identified.

*AEMO NEM Step Change – ISP 2022 Modelled Outcomes to Achieve targets:  
Map of REZ development in Step Change, 2029-30 (left) and 2049-50 (right)*



*AEMO NEM Step Change – ISP 2022 Modelled Outcomes to Achieve targets:  
Map of electricity network investments in the optimal development pathway*



Source: AEMO, 2022, ISP 2022.

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## Approaches to forecasting and modelling

### AEMO ISP

AEMO's ISP approach to determining the best way to achieving RE and emission reduction targets includes:

- Deterministic assumption of achieving RE and emission reduction targets as per the policy settings by forecasting VRE arrival 'just in time' to meet targets
- That the systems adequacy, reliability and quality requirements are met by having sufficient storage, electricity transmission system, and dispatchable generation to support additional forecast VRE capacity, and
- That taken together, these assets are able to meet future demand including the increase in electricity demand from electrification of the Australian economy.

### GSD REESP

With regards to the REESP, Mirabou and GSD, supported by our partners, conducted the long-term modelling exercise by adopting the following:

- Deterministic model to achieve straight line reductions in emissions
- Use of AEMO's Input and Assumptions Book for ISP 2022 as an input
- For Isolated Power Systems, use of RE assets and Battery Energy Storage Systems (BESS) to achieve targets
- For NEM connected communities, adoption of AEMO's ISP assumptions
- Evaluation of transmission electricity capacity requirements for the NEM connected communities
- Consideration of an interconnected transmission network option for the current Isolated Power Systems to support the achievement of RE targets as well improving reliability, security and resiliency
- Identification of current economic growth opportunities and industries and the identification of new economic growth and industries which complement the achievement of RE and emission reduction targets
- Use of commercial in confidence performance and capex cost data for alternative low emission power generation technologies of:
  - Small Modular Reactors (SMRs), fission reactors – 3MW to 10MW
  - Modular on-site hydrogen fuel gensets – 1 MW to 50 MW.



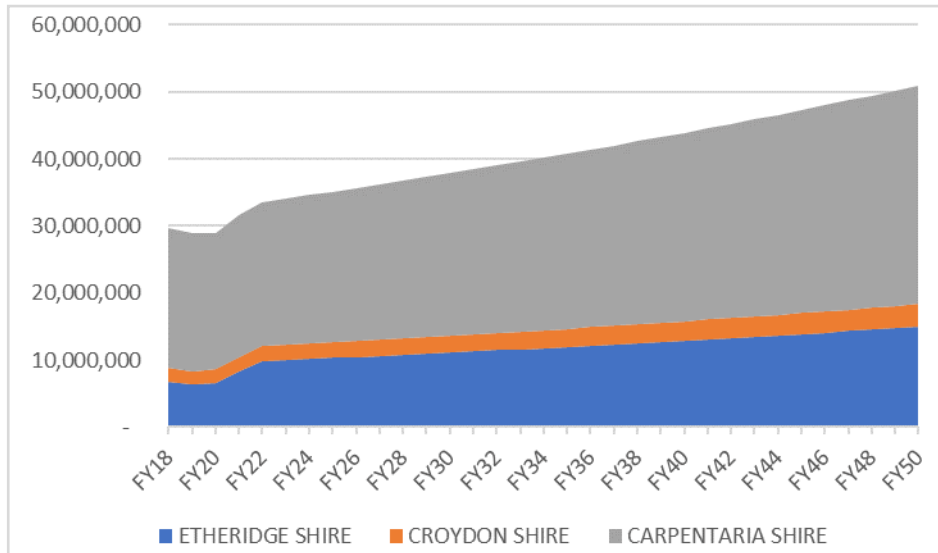
# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Eastern GSD, NEM Connected

### Eastern GSD – BASE CASE Scenario

For the base case scenario, a straight-line approach was adopted to forecast demand with 1.5% per annum growth rate assumed. By FY50, demand for the eastern region of GSD is forecasted to be 70% more than current.

Forecast Electricity Demand to FY2050 at Base Case Growth (kWh)



Source: Direct from Ergon Energy, Publicly Available Ergon Energy, Personal Communications with New Century Mines, Personal Communications Burke Shire Councillor for Gregory and Bidunggu



The following RE assets are expected to be deployed in the GSD eastern region and support the region to meet RE targets:

- Kidston Pumped Hydro Energy Storage (PHES) Project nameplate capacity of 250MW (maxp) with 8 hours of storage (i.e 2,000MWh) under construction and is expected to be in operations by September 2024
- Kidston Wind Farm 258MWac in feasibility assessment and is likely to be in operation by 2027-28
- Kidston Solar Farm Stage 2 270MWac in feasibility with no timing yet
- Iberdrola's Forsayth Wind Farm 75MWac with no timing yet.

Forecast Electricity Demand GSD NEM Connection LGAs, RE Supply and Emission Reductions

GSD LGA	FY2023	FY2030	FY2032	FY2036	FY2050
Electricity Demand (MWh)					
Etheridge	10,019	11,119	11,455	12,158	14,976
Croydon	2,247	2,494	2,569	2,727	3,359
Carpentaria	21,833	24,231	24,963	26,495	32,635
RE Supply (MWh)					
Etheridge	2,404	6,671	8,019	9,726	14,676
Croydon	539	1,496	1,798	2,181	3,292
Carpentaria	5,240	14,538	17,474	21,196	31,983
CO2 Emissions					
Etheridge	7,614	4,448	3,437	1,945	180
Croydon	1,708	998	771	436	40
Carpentaria	16,593	9,692	7,489	4,239	392

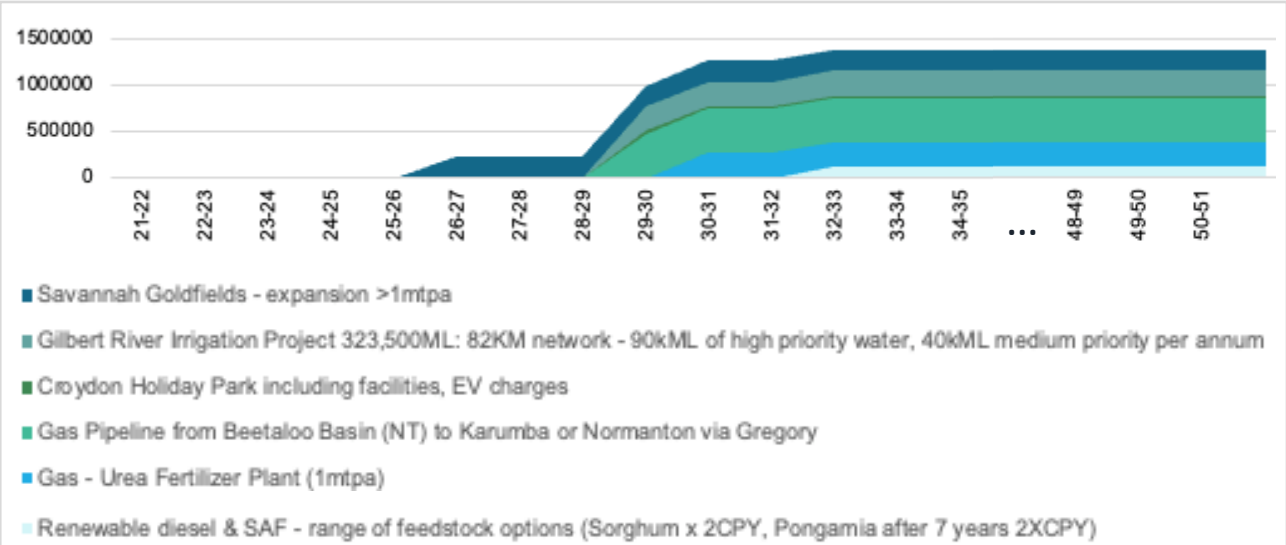
# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Eastern GSD, NEM Connected

### Eastern GSD – GROWTH Scenario

Potential economic development opportunities identified for the GSD eastern region and their likely impact on electricity demand is shown below. Information about these opportunities were provided by the proponents who also noted that without public investments in critical infrastructure such as roads, ports and also water storage, the GSD Region’s development opportunities would be limited. Details of these opportunities are provided in Appendix D of the REESP full report.

Forecast Incremental Electricity Demand to FY2050 with economic growth – NEM Connected (kWh)



The additional economic opportunities identified, if realised, will not only increase demand, but it will also require further investments in feeders and substations to ensure that renewable electricity being generated in the Kidston area is able to meet the demand in a reliable and secure way as per the current electricity network connection to the NEM.

High level Estimates of investments in NEM Connected Feeders and Substations to 2050

Feeder	Location	Aproximate Kilometres	kVA	Budget Estimate(\$M)	
3NOR	Croydon to Normanton	160	2X132	\$	266
3CRO	Croydon to Georgetown	150	2 X 132	\$	249
7216	Georgetown to Kidston	160	1X132	\$	226
4KID	Kidston to Ross	NA	NA		NA
LV	Karumba to Normanton	70	66	\$	79
Total				\$	821

132KV Line 7216 will add to existing 132KV line. Assumed all lines need replacing which needs to be assessed re their capacity.

Substation	Year	Size	Budget (\$M)	
			Low	High
Normanton	2028	132/66/22	\$ 300.00	\$ 350.00
Croydon	2028	132/22	\$ 50.00	\$ 75.00
Georgetown	2024	132/22	\$ 75.00	\$ 100.00
Kidston	2035	132/22	\$ -	\$ -
Total			\$ 425.00	\$ 525.00

Note all costs based on comparative figures used by AEMO for their planning.  
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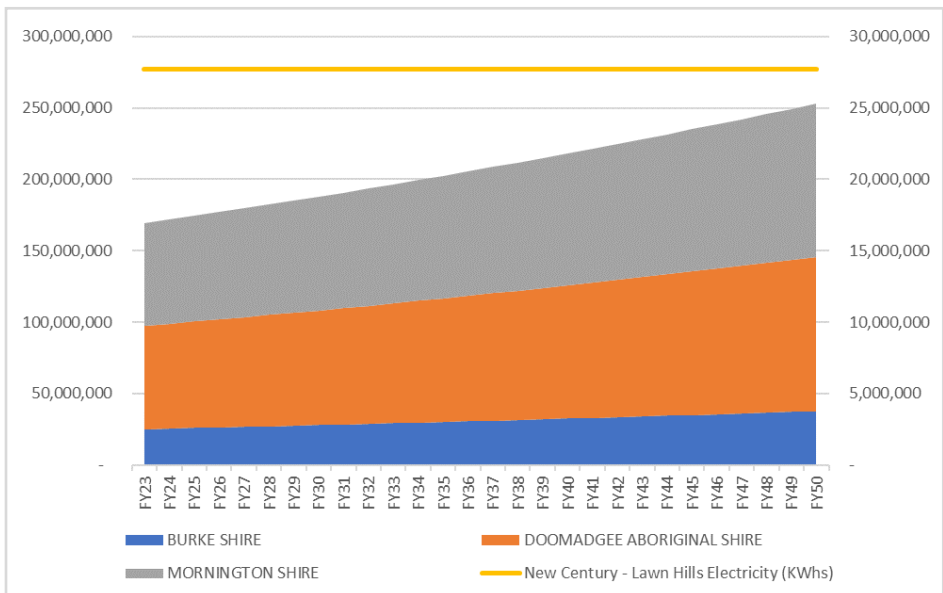
# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Western GSD, Isolated and North-West system

### Western GSD – BASE CASE Scenario

Similar to the NEM connected eastern region, for the base case scenario, a straight-line approach was adopted to forecast demand with 1.5% per annum growth rate assumed. By FY50, demand for the western region of GSD is also forecast to be 70% more than current.

Forecast Electricity Demand to FY2050 at Base Case Growth (kWh)



To achieve the region’s RE target, a combination of solar and Battery Energy Storage Systems (BESS) are to be deployed in the GSD western region’s isolated systems.

Details of the Solar/BESS combination is provided overleaf.

Forecast Electricity Demand GSD Isolated LGAs, RE Supply and Emission Reductions

GSD LGA	FY2023	FY2030	FY2032	FY2036	FY2050
Electricity Demand (MWh)					
Burke Shire	2,522	2,800	2,884	3,061	3,771
Doomadgee	7,236	8,031	8,274	8,781	10,817
Mornington Island	7,175	7,963	8,203	8,707	10,725
New Century – Lawn Hill	277,172	277,172	277,172	277,172	277,172
RE Supply (MWh)					
Burke Shire	-	1,680	2,019	2,449	3,695
Doomadgee	946	4,819	5,792	7,025	10,600
Mornington Island	-	4,778	5,742	6,965	10,510
New Century – Lawn Hill	3,504	166,303	194,020	221,738	271,629
CO <sub>2</sub> Emissions					
Burke Shire	1,703	756	584	413	51
Doomadgee	4,884	2,168	1,675	1,185	146
Mornington Island	4,843	2,150	1,661	1,175	145
New Century – Lawn Hill	218,934	88,695	66,521	44,348	4,435



Source: Ergon Energy, Publicly Available Ergon Energy, Personal Communications with New Century Mines, Personal Communications Burke Shire Councillor for Gregory and Bidunggu

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Western GSD, Isolated and North-West system

### Western GSD – BASE CASE Scenario

GSD LGA	FY2023	FY2030	FY2032	FY2036	FY2050*	Total
<b>AEMO Capex Assumptions (\$/KW)</b>						<i>Average</i>
Solar	1,305	999	925	875	662	953
BESS 8 hour	2,829	2,124	1,726	1,485	1,145	1,862
Regional Solar	1,958	1,499	1,388	1,313	993	1,430
Regional BESS 8 hour	4,244	3,186	2,589	2,228	1,718	2,793
<b>Burke Shire (\$'000)</b>						
Solar		2,248	-	159	2,429	4,837
BESS		4,779	-	271	4,202	9,251
<b>Sub-Total</b>		<b>7,027</b>	<b>-</b>	<b>430</b>	<b>6,631</b>	<b>14,088</b>
<b>Doomadgee (\$'000)</b>						
Solar	1,226	4,306	694	1,313	6,102	12,414
BESS	2,658	9,155	1,295	2,228	10,553	23,231
<b>Sub-Total</b>	<b>3,884</b>	<b>13,462</b>	<b>1,988</b>	<b>3,540</b>	<b>16,655</b>	<b>35,645</b>
<b>Mornington Island (\$'000)</b>						
Solar		5,245	694	1,313	5,462	12,713
BESS		11,151	1,295	2,228	9,446	24,119
<b>Sub-Total</b>		<b>16,396</b>	<b>1,988</b>	<b>3,540</b>	<b>14,908</b>	<b>36,832</b>
<b>TOTAL (excluding New Century)</b>	<b>3,884</b>	<b>36,884</b>	<b>3,977</b>	<b>7,510</b>	<b>38,194</b>	<b>86,565</b>
<b>New Century – Lawn Hill (\$'000)</b>						
Solar	4,541	161,522	25,463	24,087	144,444	355,516
BESS	9,845	343,417	47,512	81,757	249,831	722,517
<b>Sub-Total</b>	<b>14,386</b>	<b>504,939</b>	<b>72,974</b>	<b>105,844</b>	<b>394,275</b>	<b>1,078,033</b>
<b>TOTAL</b>	<b>18,270</b>	<b>541,823</b>	<b>76,951</b>	<b>113,354</b>	<b>432,469</b>	<b>1,164,597</b>

NB – New Century is included for study purposes and reflects estimates for a stand-alone power system supply new Century achieving RE and net zero emissions targets. Ergon Energy and APA as the network operator and the power generation supplier are the relevant commercial stakeholders.

\* Replacement of 2030 assets in 2050



# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

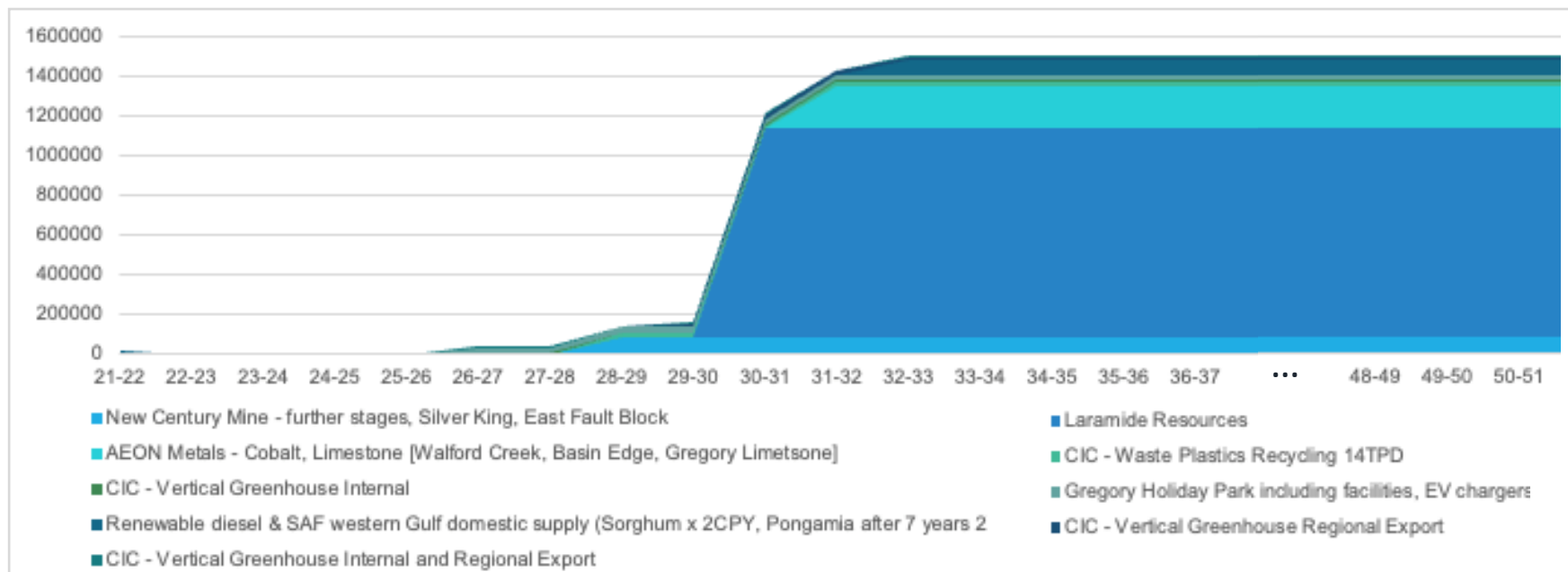
## REESP: Western GSD, Isolated and North-West system

### Western GSD – GROWTH Scenario

Potential economic development opportunities identified for the GSD western region and their likely impact on electricity demand is shown below. It is assumed that available RE asset would be built to align with the straight-line increase in RE electricity produced to meet the target:

- the RE asset combination is solar and BESS (approx. 8 hours)
- the RE assets are built to follow the step changes required to achieve the RE and emission targets and base case growth
- use of AEMO \$/kW assumptions for capex increased by 50% to reflect remoteness of GSD region
- by 2050 there is a capital replacement cycle (or before).

*Forecast Incremental Electricity Demand to FY2050 with economic growth – Isolated system (kWh)*



# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Western GSD, Isolated and North-West system

### Western GSD – GROWTH Scenario

The forecast additional demand shall be met with RE and low emissions power generation assets.

The following growth assumptions were adopted in the analysis for the period of up to 2032:

- The vertical greenhouse and renewable diesel / petrol from sorghum (or other suitable crop / feedstock) is operational by financial year 2030 and 2032, respectively for Burke Shire
- Export vertical greenhouse by financial year 2030 for Doomadgee
- GSD supply vertical greenhouse by financial year 2030 for Mornington Island
- New Century Silver King expansion by financial year 2032.

GSD LGA	FY2023	FY2030	FY2032	FY2036	FY2050	Total
<b>AEMO Capex Assumptions (\$/KW)</b>						<i>Average</i>
Solar	1,305	999	925	875	662	953
BESS 8 hour	2,829	2,124	1,726	1,485	1,145	1,862
Regional Solar	1,958	1,499	1,388	1,313	993	1,430
Regional BESS 8 hour	4,244	3,186	2,589	2,228	1,718	2,793
<b>Burke Shire (\$'000) - new demand</b>						
Solar		10,489.50	48,562.50	-	41,706.00	100,758.0
BESS		22,302.00	90,615.00	-	72,135.00	185,052.0
<b>Sub-Total</b>		<b>32,791.50</b>	<b>139,177.50</b>	-	<b>113,841.00</b>	<b>285,810.0</b>
<b>Doomadgee (\$'000) - new demand</b>						
Solar		19,480.50	-	-	12,909.00	32,389.5
BESS		41,418.00	-	-	22,327.50	63,745.5
<b>Sub-Total</b>		<b>60,898.50</b>	-	-	<b>35,236.50</b>	<b>96,135.0</b>
<b>Mornington Island (\$'000) - new demand</b>						
Solar		10,489.50	-	-	6,951.00	17,440.5
BESS		22,302.00	-	-	12,022.50	34,324.5
<b>Sub-Total</b>		<b>32,791.50</b>	-	-	<b>18,973.50</b>	<b>51,765.0</b>
<b>TOTAL (excluding New Century)</b>						
		<b>126,482</b>	<b>139,178</b>	-	<b>168,051</b>	<b>433,710</b>
<b>New Century – Lawn Hill (\$'000) - new demand</b>						
Solar		-	120,712.50	-	-	120,712.5
BESS		-	225,243.00	-	-	225,243.0
<b>Sub-Total</b>		-	<b>345,955.50</b>	-	-	<b>345,955.5</b>
<b>TOTAL</b>						
		<b>126,482</b>	<b>485,133</b>	-	<b>168,051</b>	<b>779,666</b>



## REESP: Western GSD, Isolated and North-West system

### Western GSD – GROWTH Scenario

The GSD region has several prospective industry, project and economic development opportunities to 2050 amounting to between 50MW and up to 300MW of future additional demand.

For illustrative purposes, examples of the typical new economic projects and required electricity demand modelled are:

- Laramide Resources – new mine at Westmoreland estimated to require peak demand of 120MW and minimum demand of 60MW, and
- AEON Metals – Cobalt and Limestone mine estimated to require electricity demand of 30MW.

If it is assumed that these operations would need to be supplied directly, regardless of interconnection with current supply systems, and with a system of N – 1 dominated by RE assets, BESS and limited diesel back up.

Adopting AEMO assumptions, the capital investment required is estimated to be:

- 2029 for AEON Metals total of \$398m:
  - Solar PV 125MW, \$190m
  - BESS at 8 hours, \$182m
  - Gas Turbine (GT) as back-up at 15MW, \$26m
- 2030 for Uranium at Westmoreland total of \$994m :
  - Solar PV 360MW, \$540m
  - BESS at 8 hours, \$364m
  - Gas Turbine (GT) as back-up at 60MW, \$90m.

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Western GSD, Isolated and North-West system

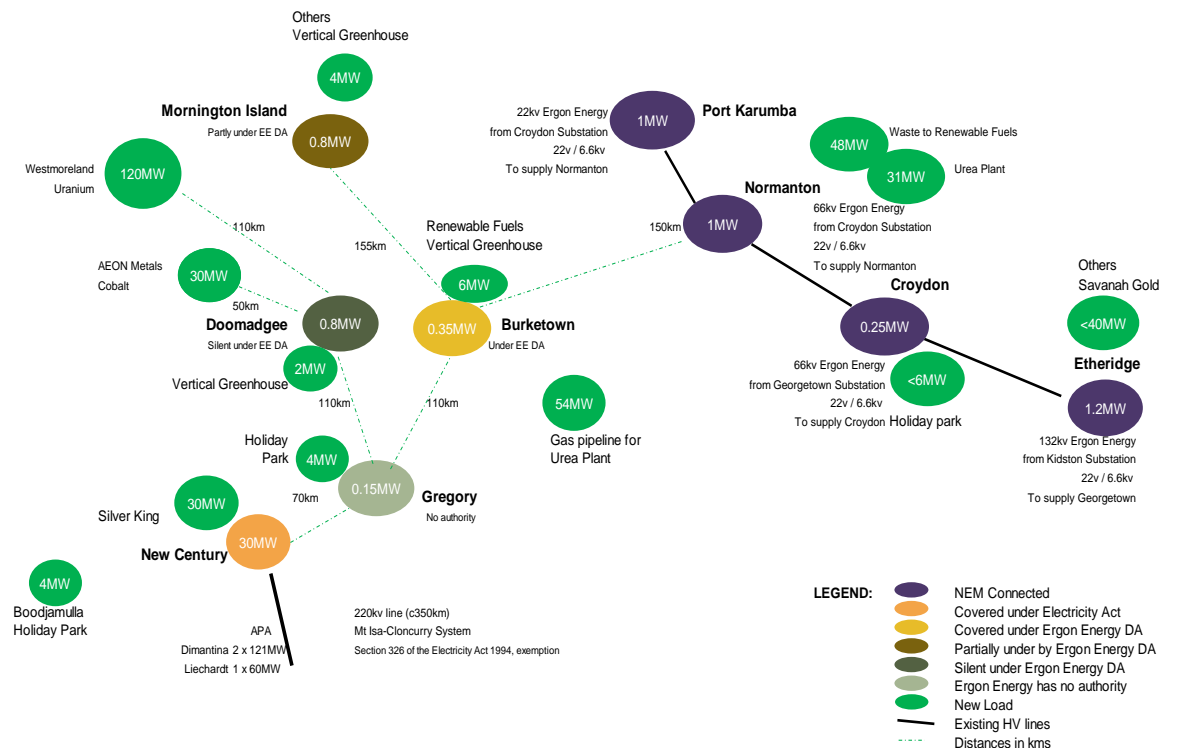
### Western GSD – INTERCONNECTED WESTERN REGION

In a scenario where electricity system in the western GSD region is interconnected, supplied from a central power generation location such as Gregory-Bidunggu to meet current and future demand as well as the RE and emissions targets, the overall estimates of capital investment costs were:

- Gas GT interconnected gas pipeline option: minimum \$1,041m - \$1,215m
- Current available RE assets, solar and BESS and common electricity interconnected transmission networks: minimum \$8,337m - \$8,511m
- On-site hydrogen power generation system and common electricity interconnected transmission networks: minimum \$743m - \$917m
- S/MMR and common electricity interconnected transmission networks: minimum \$4,124m - \$4,298m.

Adopting REESP assumptions and utilising our assumed power generation capacities in the power generation technologies planned for Gregory-Bidunggu, the operating fuel costs were estimated to be:

- Gas GT interconnected option: up to \$308m per annum
- Current available RE assets, solar and BESS and common electricity interconnected transmission networks: nil
- Hydrogen power generation system and common electricity interconnected transmission networks: approximately \$264m per annum
- S/MMR and common electricity interconnected transmission networks: approximately \$8m per annum.



# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Summary of Options (1..5)

GSD Region / LGA / Centres / Energy System	Power Generation Systems*	Electricity Network*	Total Estimated Capex*
<b>Eastern GSD Region</b> Etheridge, Croydon, Carpentaria Stationary Electricity Supply	<b>Base case / Growth</b> NEM provided Kidston Energy Hub c615MWs in RE assets	<b>Base case</b> Nil  <b>Growth</b> Between \$1.2 - \$1.4 bn in feeders/substations	\$1.2 - \$1.4 bn Network investments
<b>Western GSD Region</b> Burke, Doomadgee, Mornington Island + Gregory-Bidunggu Isolated Electricity Supply	<b>Base case</b> Solar + BESS: \$47m - \$65m (includes Gregory-Bidunggu network)  <b>Growth</b> \$262m - \$434m excludes Gregory-Bidunggu	<b>Base case</b> Nil  <b>Growth</b> Nil	\$47m - \$434m no network investment  (plus replacement 20 years in)
<b>Western GSD Region</b> New Century Lawn Hill – NW System	<b>Base case</b> Solar + BESS: approx. \$505m  <b>Growth</b> \$350m	<b>Base case</b> Nil  <b>Growth</b> Nil	\$505m + \$350m  (plus replacement 20 years in)

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Summary of Options (2..5)

GSD Region / LGA / Centres / Energy System	Power Generation Systems*	Electricity Network*	Total Estimated Capex*
<b>All GSD Region Remote centres</b> New project – industrial demand supplied on stand-alone basis	<b>30MW New Demand (Flat)</b> Solar PV 125MW \$145m BESS at 8 hours \$130m GT as back-up at 15MW <u>\$ 26m</u> <b>Total \$301m</b> <i>(Capital recovery \$170/MWh)</i>	<b>Base case</b> Nil  <b>Growth</b> Nil	Capital costs  \$791m
	<b>120MW New Demand (Peak)</b> Solar PV 250MW \$290m BESS at 8 hours \$110m GT as back-up at 60MW <u>\$ 90m</u> <b>Total \$490m</b> <i>(Capital recovery \$170/MWh)</i>  <i>Variable costs inc Fuel \$130/MWh</i>		



# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Summary of Options (3..5)

GSD Region / LGA / Centres / Energy System	Power Generation Systems*	Electricity Network*	Total Estimated Capex*
<b>Western GSD Region</b> Burke, Doomadgee, Mornington Island + Gregory-Bidunggu + New Century  <b>Interconnected System</b> using Gregory-Bidunggu as power generation hub	<b>Base</b> <b>Total capital investment \$126m - \$406m</b> RE power plant \$47m  Capex            \$47m Solar F           10MW BESS              10MW:8-12hrs	<b>Base case</b> Stage 1 interconnection Gregory-New Century(70km) \$35m    \$ 53m Gregory-Burketown (110km) \$44m    \$ 83m <b>Total</b> <b>\$79m    \$136m</b>	Total capital investment \$205m - \$542m

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY

## REESP: Summary of Options (4..5)

GSD Region / LGA / Centres / Energy System	Power Generation Systems*	Electricity Network*	Total Estimated Capex*
<b>Western GSD Region</b> Burke, Doomadgee, Mornington Island + Gregory-Bidunggu + New Century  <b>Interconnected System</b> using Gregory-Bidunggu as power generation hub	<b>Base plus Growth</b> <b>Total capital investment \$406m - \$7.8bn</b>  <b>Gas GT Option</b> Pipeline for supply \$ 460m GTs 220MW \$ 334m <b>Total \$ 794m</b> (Annual Fuel Costs) \$ 308m  <b>On-site hydrogen</b> Onsite fuel assets \$ 100m Turbine/gensets 220MW \$ 396m <b>Total \$ 496m</b> (Annual Fuel Costs) \$ 264m  <b>S/MMRs</b> S/MMRs (260MW) \$ 2,800m (Annual Fuel Costs) \$ 8m  <b>RE Assets All Region</b> Solar 1,800MW \$ 2,160m BESS 8 hours \$ 5,600m GT 60MW \$ 90m <b>Total \$7,850m</b>	<b>Base case</b> Stage 1 interconnection Gregory-NCM (70km) \$ 35m \$ 53m Gregory-Bktn (110km) \$ 44m \$ 83m <b>Total \$ 79m \$136m</b>  <b>Growth case</b> Min Max Route 66kV 132kv Gregory-Doomadgee (110km) \$ 44m \$83m Burketn-Normanton (150km) \$ 60m - Doomadgee-Walford (50km) \$ 20m - Doomadgee-WestML (110km) \$ 44m - <b>Total \$168m \$207m</b> <i>(Growth electricity network investments are excluded from the total estimate)</i> Substations in all locations \$100m - \$120m.  <b>Total investment \$268m - \$327m</b>	Power generation Total capital investment \$406m - \$7.8bn  Network \$268m - \$327m

# ACHIEVING RENEWABLE ENERGY AND EMISSION TARGETS – ELECTRICITY & FUEL

## REESP: Summary of Options (5..5)

GSD Region / LGA / Centres / Energy System	Power Generation Systems*	Electricity Network*	Total Estimated Capex*
<b>All GSD Region</b> Complete electrification of fuels consumed in GSD region (260M litres diesel and petrol)  Requires Interconnected System of GSD	<b>Base and growth</b> Large scale solar (415MW) \$495m BESS (160MW:8 hours) \$413m  Would require interconnection investments as per previous page.  EV charging infrastructure investment of \$40m - \$65m.	<b>Eastern GSD Region</b> Between \$1.2 - \$1.4 bn investment in feeder/substations  <b>Western GSD Region</b> <b>Base case</b> Stage 1 interconnection Gregory-New Century(70km) \$35m \$ 53m Gregory-Burketown (110km) \$44m \$ 83m <b>Total</b> <b>\$79m \$136m</b>  <b>Growth case</b> Route Min Max Gregory-Doomadgee (110km) \$ 44m \$83m Burketn-Normanton (150km) \$ 60m - Doomadgee-Walford (50km) \$ 20m - Doomadgee-WestML (110km) \$ 44m - <b>Total</b> <b>\$168m \$207m</b> (Growth electricity network investments are excluded from total estimate) Substations in all locations \$100m - \$120m.  <b>Total investment \$268m - \$327m</b>	Power generation Total capital investment \$406m - \$7.8bn  Network <b>Eastern GSD</b> \$1.2bn - \$1.4bn  <b>Western GSD</b> \$347m - \$463m
* Any figures provided is estimates only based on information available at the time of the analysis			

# Least Regret Recommendations

Stationary Electricity

Current Fuel to Net Zero

## Least regrets recommendation: Stationary Electricity

The proposed least regrets pathway for RE assets to achieve the RE and net zero emissions targets taking into consideration future economic growth including possible new projects should incorporate:

### Eastern GSD Region

For the eastern GSD region of Etheridge, Croydon and Carpentaria:

1. Ergon Energy and PowerLink, where required, undertaking a review of the current feeders and substations to determine:
  - a. Ability of current electricity power system to meet RE and net zero emissions targets
  - b. The likelihood of the forecast 615MW of RE assets being commissioned and operating 'on-time', largely in the Etheridge LGA near the Kidston substation given these RE assets form the basis for achieving RE and emission reduction targets in stationary electricity supply
2. Between 2030 and 2050 where economic growth and new projects emerge, an additional >200MW in electricity demand is forecast. This would require investment in the feeders and substations in the eastern GSD region of between \$1.2bn and \$1.4bn. It is suggested that Ergon Energy, as part of its review, considers the required investments in its network, on a least regrets basis, to meet these future demands.

### Western GSD Region

For the western region of Burke, Doomadgee and Mornington Island:

1. For the Isolated Power Systems of Burketown, Doomadgee and Mornington Island, at least \$47m to build solar and battery storage and up to \$270m where new projects occur within these LGAs under the current non-connected electricity system model; and/or
2. Establishment of Gregory-Bidunggu centre as RE power generation hub requiring between \$88m and \$149m including interconnection between Gregory, Burketown, Doomadgee and New Century Mine between 2024 and 2028 and then:
  - a. A single 20MW Gas GT at Gregory-Bidunggu supplied by road transport (approx. \$250m) and
  - b. The on-site hydrogen power generation system of 120MW (approx. \$280m), and
  - c. From early 2030s building of S/MMR or equivalent at 50MW of capacity (approx. \$600m)

The above is expected to provide the building block of essential electricity services to the communities with focused industry outcomes, supplemented with proactively pursuing the development of producing renewable fuels for the region (target 2030).

## Least regrets recommendation: Current Fuel to Net Zero

### ALL GSD Region

The proposed least regrets approach for the stationary electricity system for the GSD region (as outlined above) would increase the electricity supply of the region and make a substantive contribution to address the CO<sub>2</sub> currently being generated from diesel and petrol being consumed in the GSD region, which is largely from transport uses and private electricity generation. However, to achieve net zero emissions in the current 250M litres of diesel and petrol consumption of the region further investments in RE assets would be required (including power renewable options for refining facilities and / or to completely electrify this energy source with RE assets).

In addition to the least regrets RE investments outlined above, to achieve net zero emissions in fuels consumed in the region, the following additional investments should be considered:

- Subject to further work on appropriate sizing of feeders and substations a further investment between \$250m to \$400m that would interconnect the existing electricity supply systems in the GSD region (connecting east and west) which would support the net zero emissions target in fuels and stationary electricity
- Where the additional economic development emerges, as forecast in both regions, then a further investment of 200MW in large scale solar and battery capacity of 100MW (at 8 hours) in storage would be required estimated to be a further \$500m in capital investment, and
- There would need to be supporting investments made in EV charging infrastructure and co-located battery energy storage facilities including: up to \$20m for EV public charging stations; and between \$20m and \$45m for electricity supply solution to support – noting that the effectiveness of any full electrification of transport solution would be greatly enhanced by: having data on the amount of fuels being used for private electricity generation and making these investments after there has been capital investments made to improve GSD's road network (circa \$3 bn).





**Mirabou Energy**



# Thank you



0438 668 680



E-mail:  
[info@mirabou.energy](mailto:info@mirabou.energy)



Web:  
[mirabou.energy](http://mirabou.energy)

