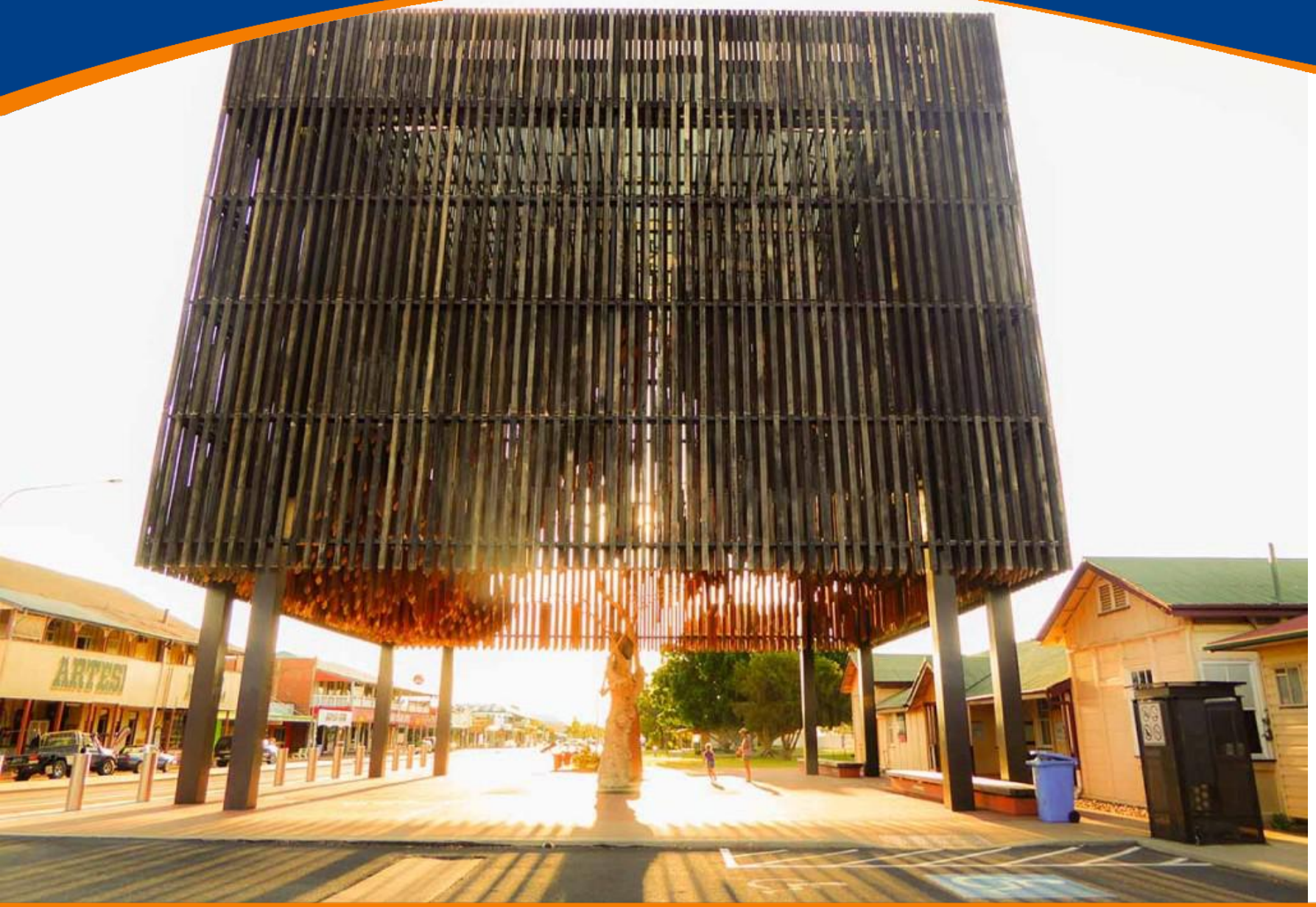



# Barcaldine Remote Community Solar Farm

*30th November 2018*

# Company Structure

**Corporate**
Melbourne

elecnor australia

enerfín grupo elecnor

2016

**204 MW**
**Bulgana Wind Farm**
Victoria

**EPC & OM**
Brisbane

green light elecnor group

2014

**70 MW**
**Moree Solar Farm**
New South Wales

2015

**25 MW**
**Barcaldine Solar Farm**
Queensland

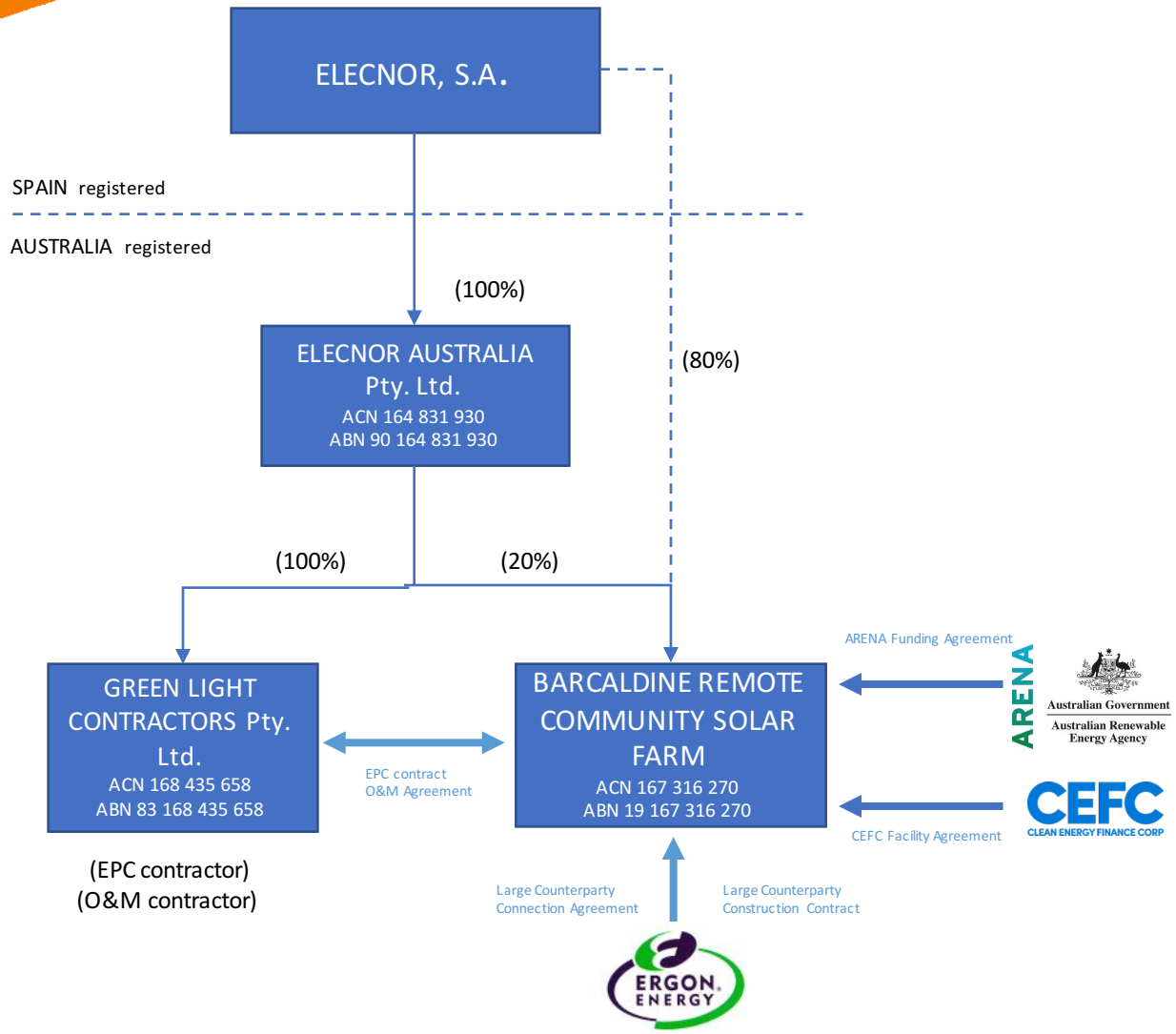
2017

**137 MW**
**Bungala Solar Farm 1**
South Australia

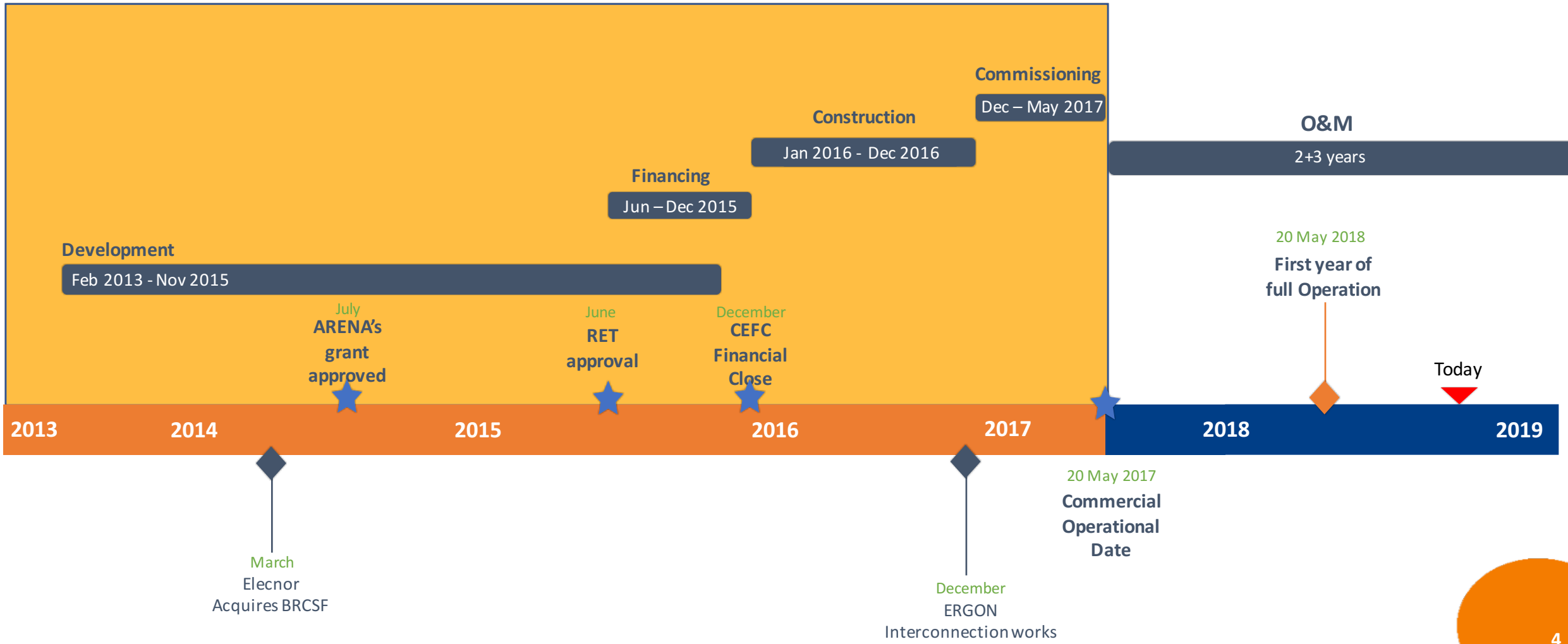
2017

**137 MW**
**Bungala Solar Farm 2**
South Australia

# Project Overview



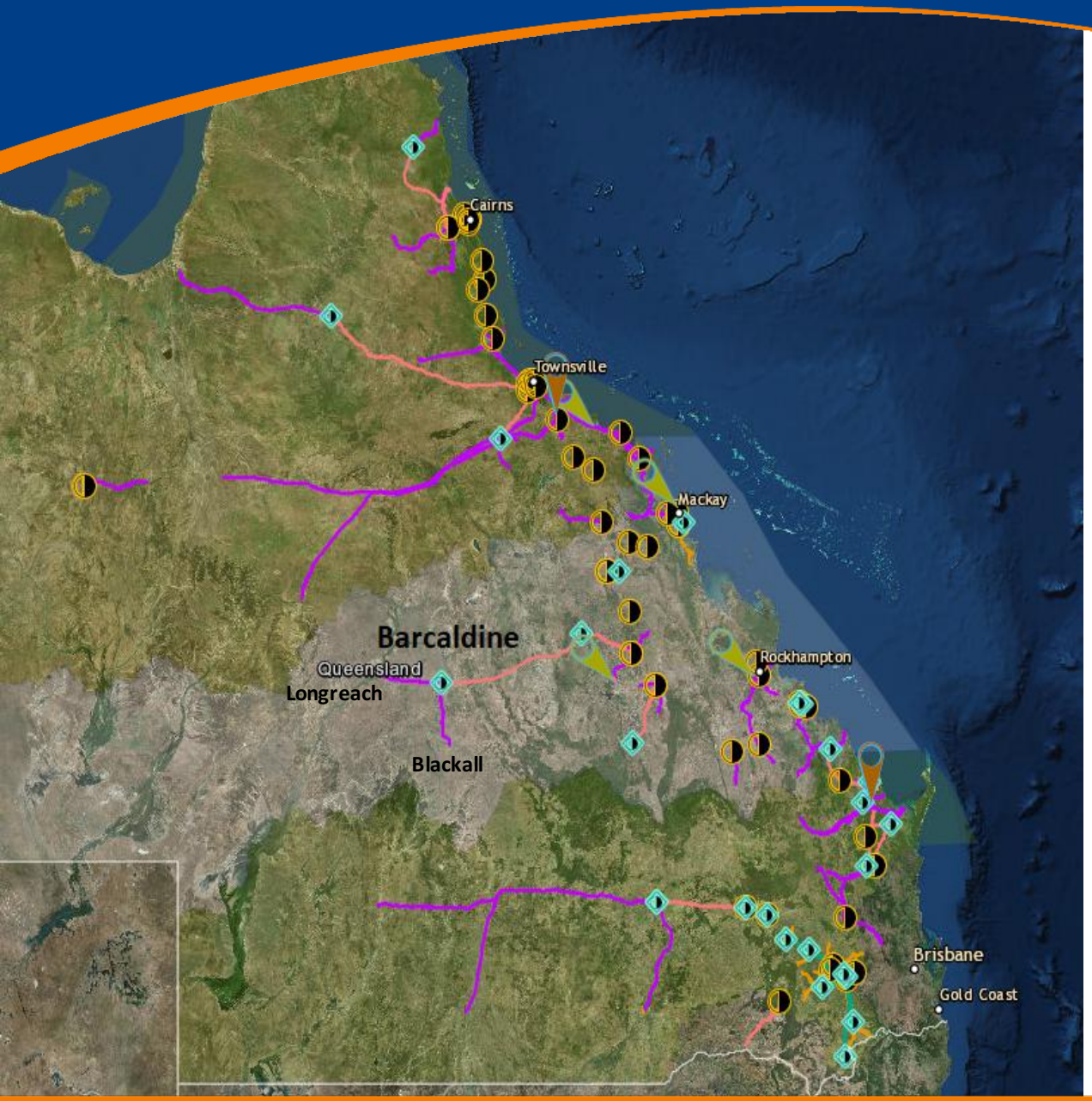

# Timeline

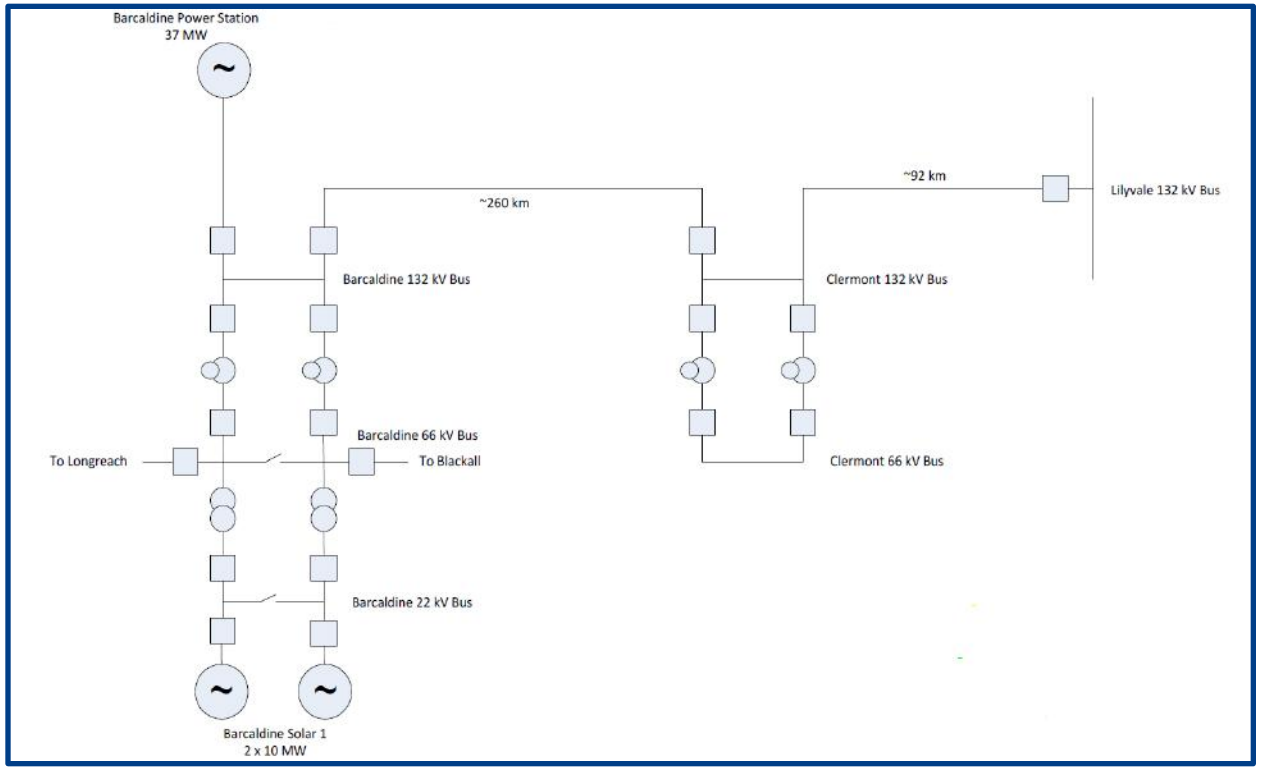

Development
Feb 2013 - Nov 2015
Financing
Jun – Dec 2015
Construction
Jan 2016 - Dec 2016
Commissioning
Dec – May 2017
O&M
2+3 years
July
ARENA's grant approved
June
RET approval
December
CEFC Financial Close
20 May 2018
First year of full Operation
Today
2013
2014
2015
2016
2017
2018
2019
March
Elecnor Acquires BRCSF
December
ERGON Interconnection works
20 May 2017
Commercial Operational Date

# Interconnection
## Main Figures


| Design | |
|---|---|
| Power capacity | 20 MWac/25 MWdc |
| Tracking system | Single axis |
| Power Stations | 10 |
| Inverter Brand | Power Electronics |
| Inverter Model | FS2110CH_420V |
| Interconnection | 2x22 kV – Barcaldine Substation (Ergon Energy) |
| Estimated output | 57,123 MWh/y |

# Fringe-Of-Grid




*Barcaldine Solar Farm connection point*

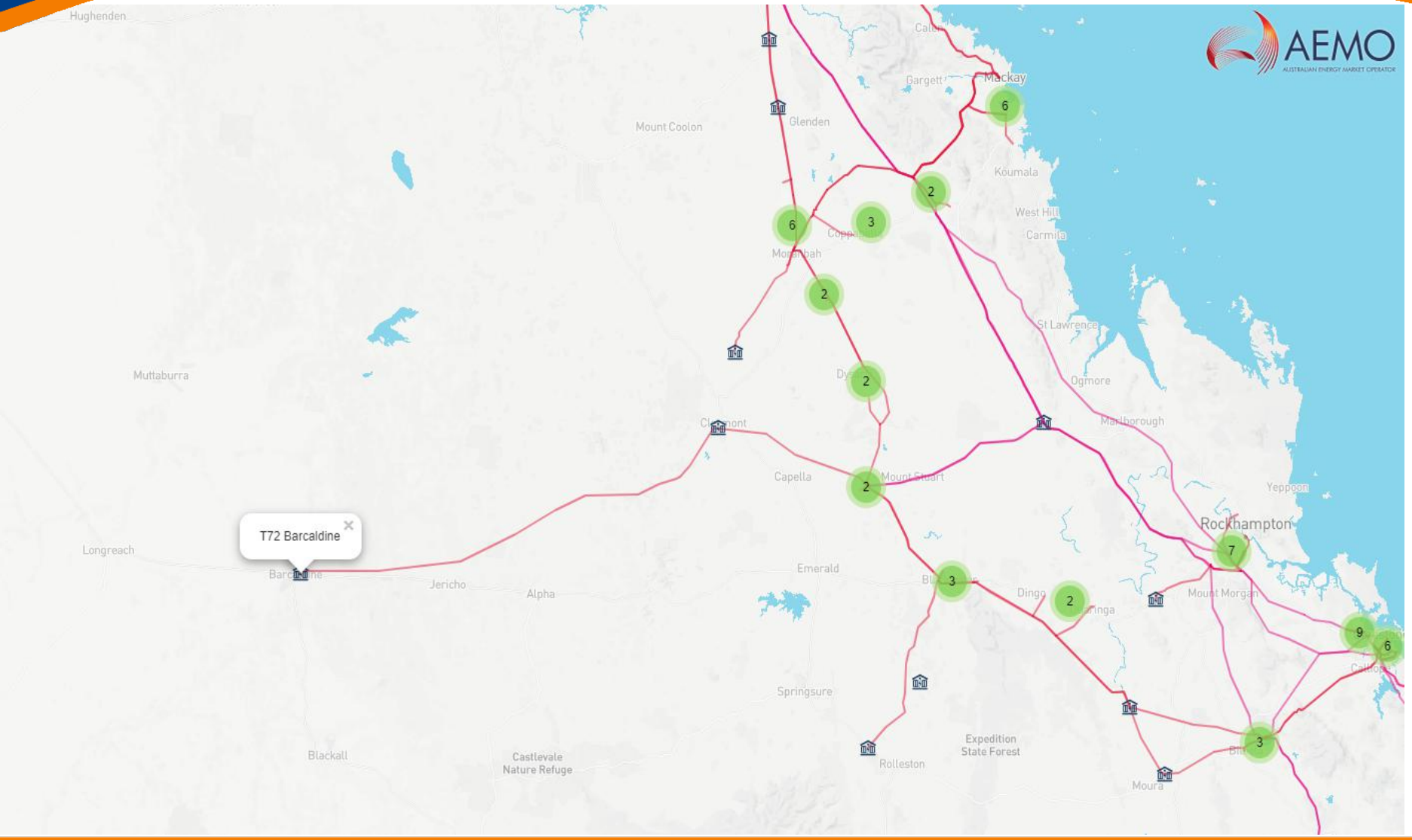
# ARENA: Network Impact Analysis

| Objectives | Status |
|---|---|
| Tracking systems on remote grids | In progress – conclusions after 24 months of full operation |
| Local and downstream power supply | Addressed for the first year of full operation |
| Upstream reverse flow | Addressed for the first year of full operation |
| Island operation | No islanding events have occurred since connection |
| Integration with Gas Plant | Lack of GT operation during the operating period |
| Reactive Power Injection | Addressed for the first year of full operation |

6 Separate Interval Reports:

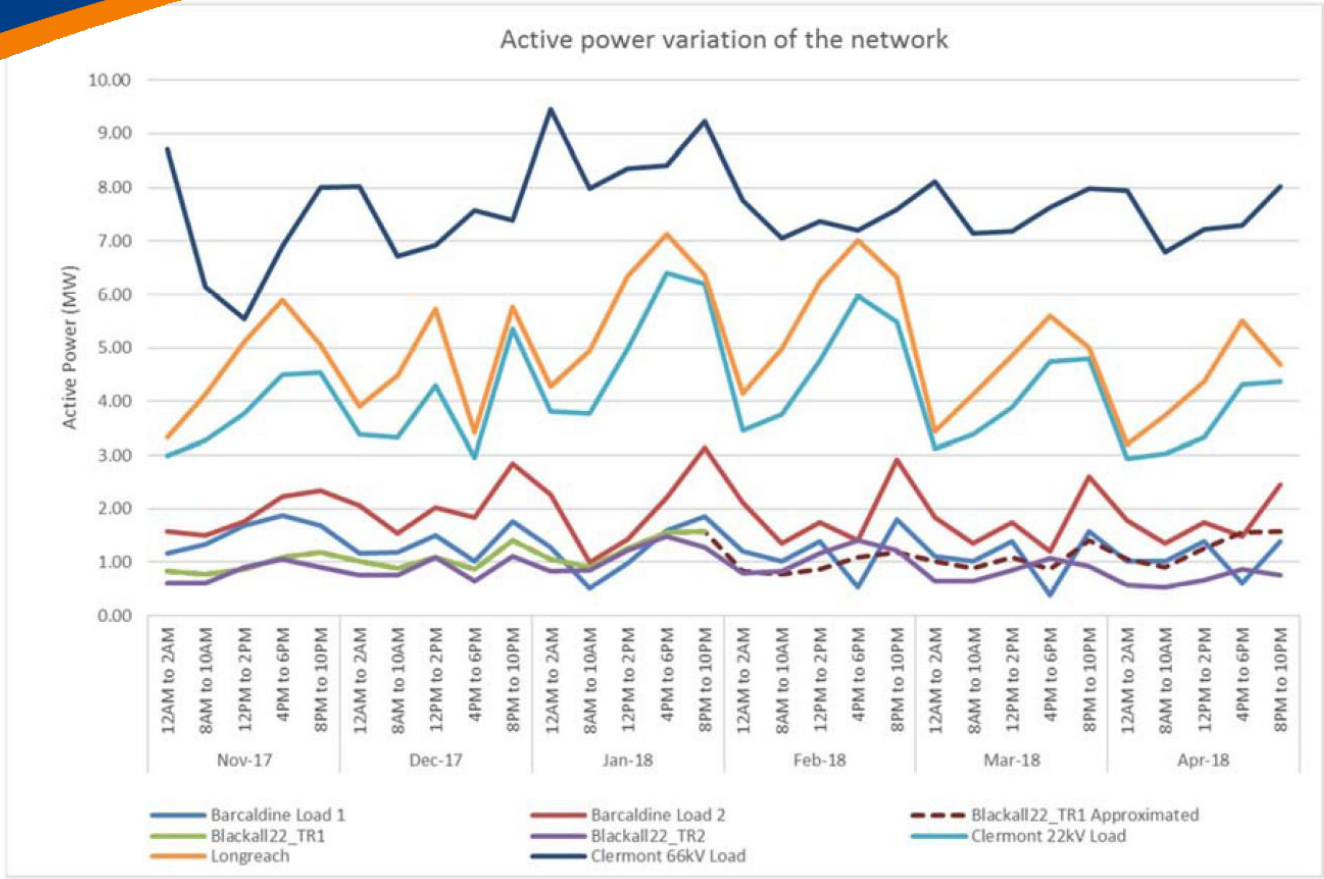
- Pre commissioning;
- Commissioning;
- 6-months after COD (Dec 2017);
- **12 months after COD (June 2018);**
- 18 months after COD (Jan 2019);
- 24 months after COD (June 2019);

# Impacted Network




- The **downstream** 66/22 kV network to Alpha, Barcaldine, Longreach and Blackall;
- The 66 kV and 22 kV buses at Barcaldine Bulk Supply Substation (BBSS);
- The **upstream** 132 kV network through Clermont to Lilyvale.

# Impacted Network




Impacts of BSF to the network vary throughout the year.
Losses increase during summer months due to high demand in loads

Barcaldine is supplied via Powerlink's 275/132kV Lilyvale BSS.

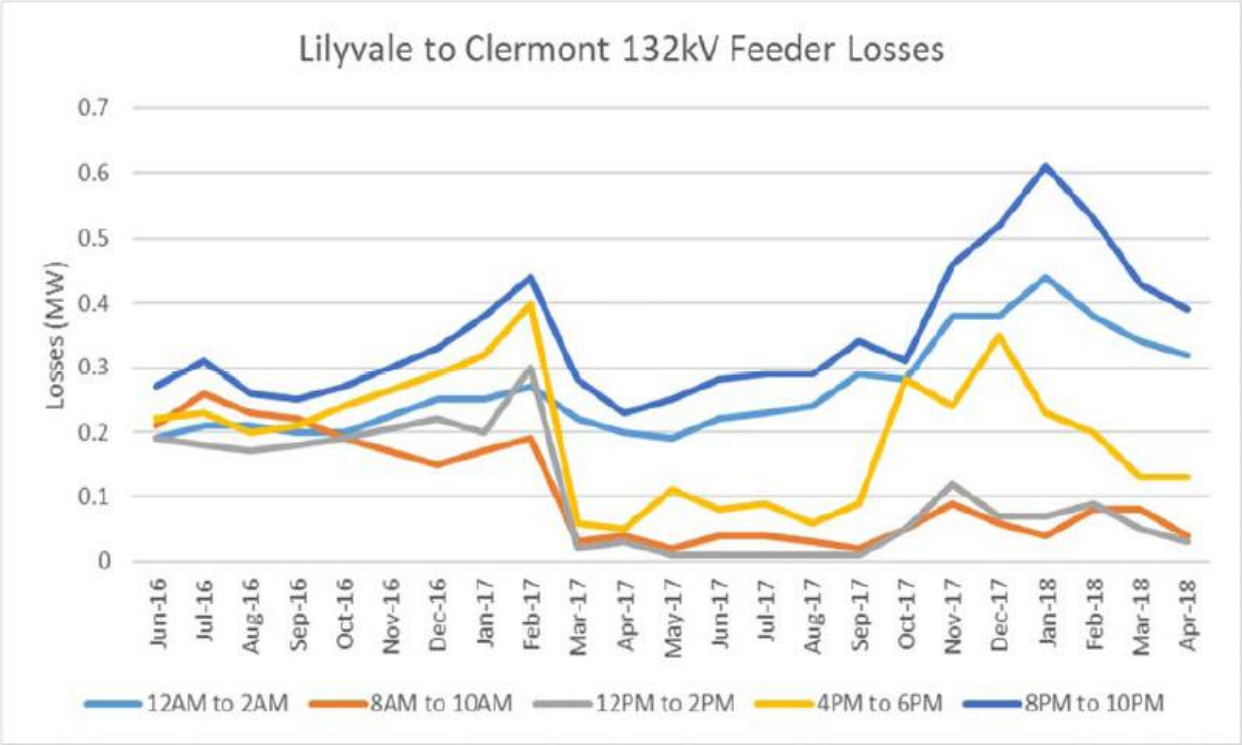
Ergon takes a 132kV supply from LBSS, which then runs cross country to Clermont BSS and onto Barcaldine BSS (approx. 350km).

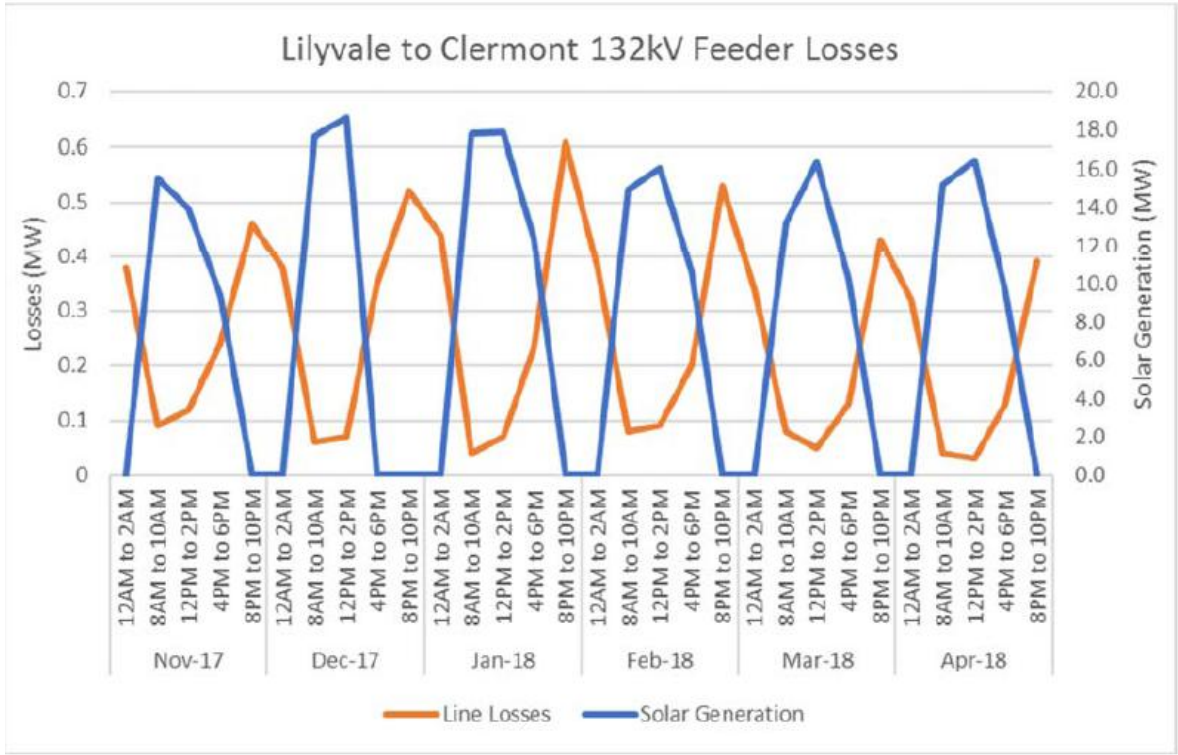
At BBSS the 132kV is transformed down to 66kV and further to 22kV. 66kV lines runs West to Longreach and South to Blackall.

The 22kV network from BBSS feeds the towns of Barcaldine, Alpha and Jericho.

*Note: During the first six months of 2018, Longreach Solar Farm has also come into operation on the same section of the Energy Queensland network.*

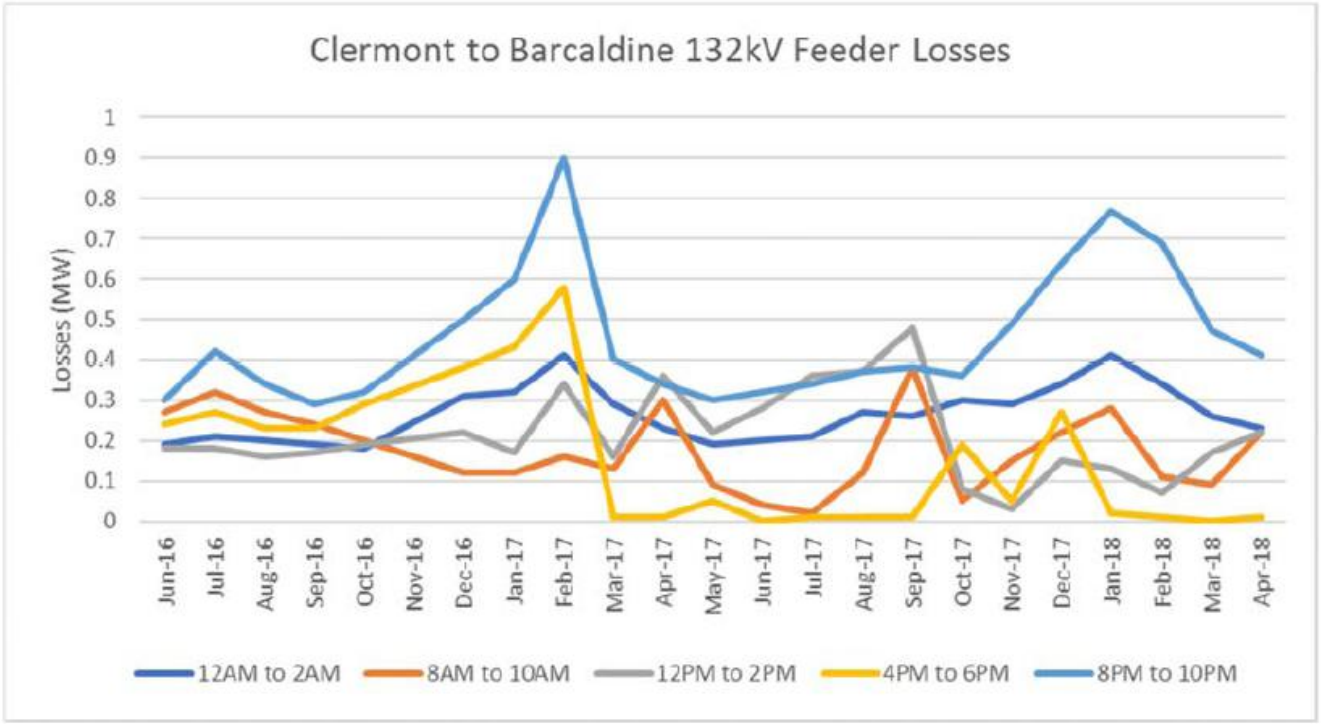
# Main Results
## Resistive Losses

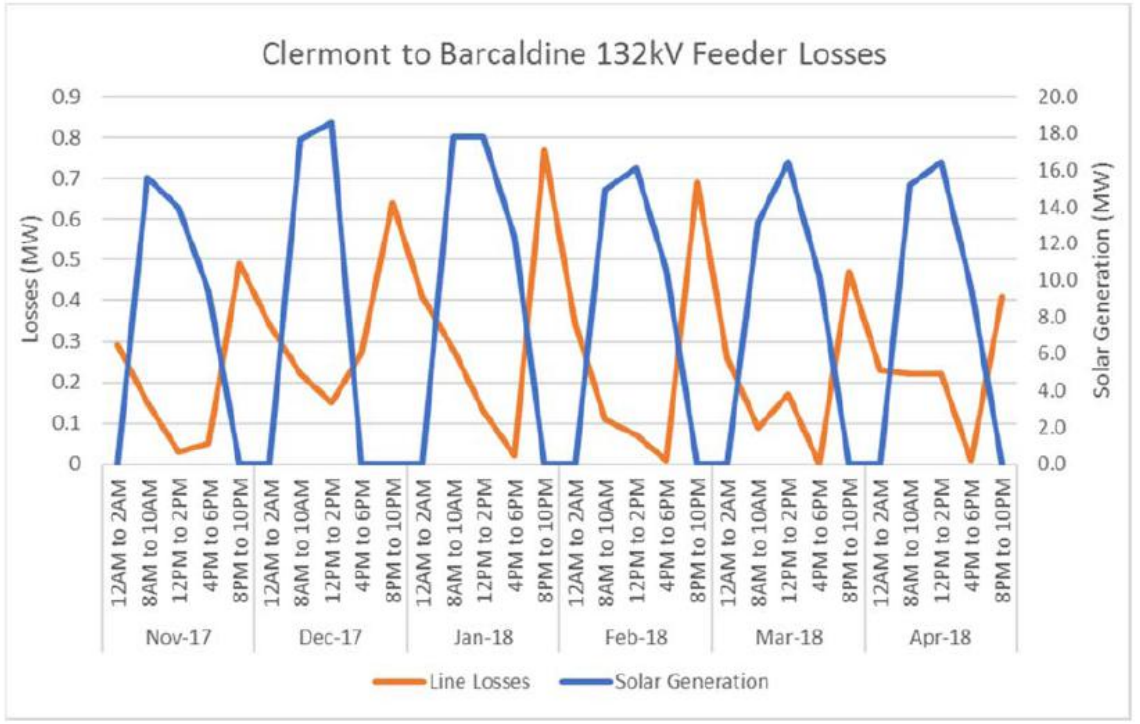



The power flow along the Lilyvale-Clermont feeder was reduced when BSF is generating. When BSF generates at its full capacity, a small reverse power flow can be observed. Therefore the losses of this feeder are reduced with BSF generation.

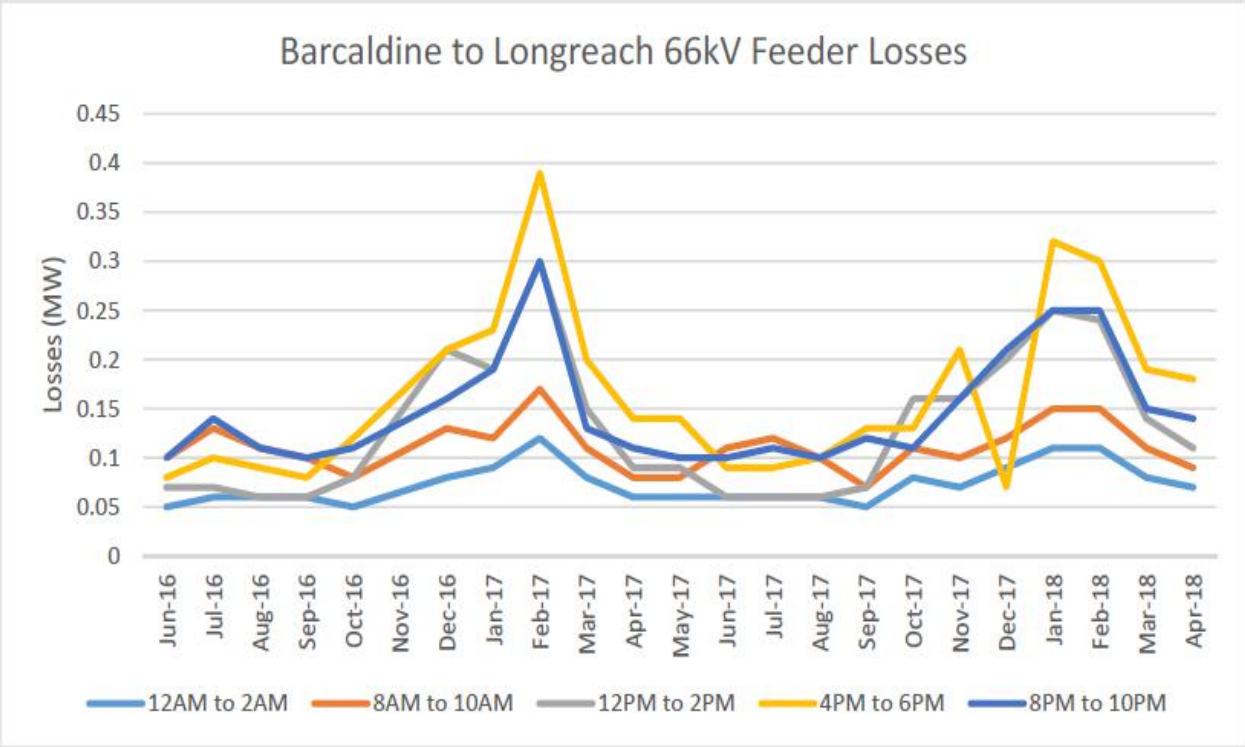
# Main Results
## Resistive Losses

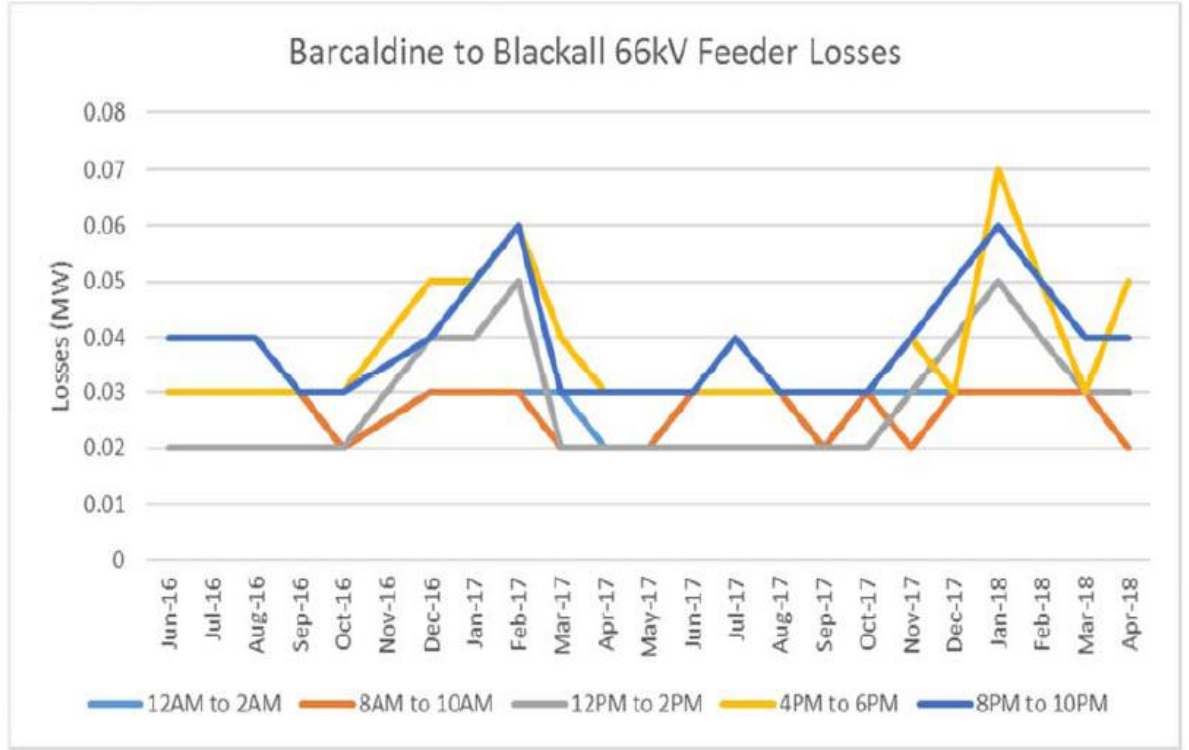



Losses in the Clermont-Barcaldine feeder have decreased since the connection of the BSF in the 4-6 pm time period (intermediate level of generation). This may be due to the amount of generation being approximately equal to local loads at this time.

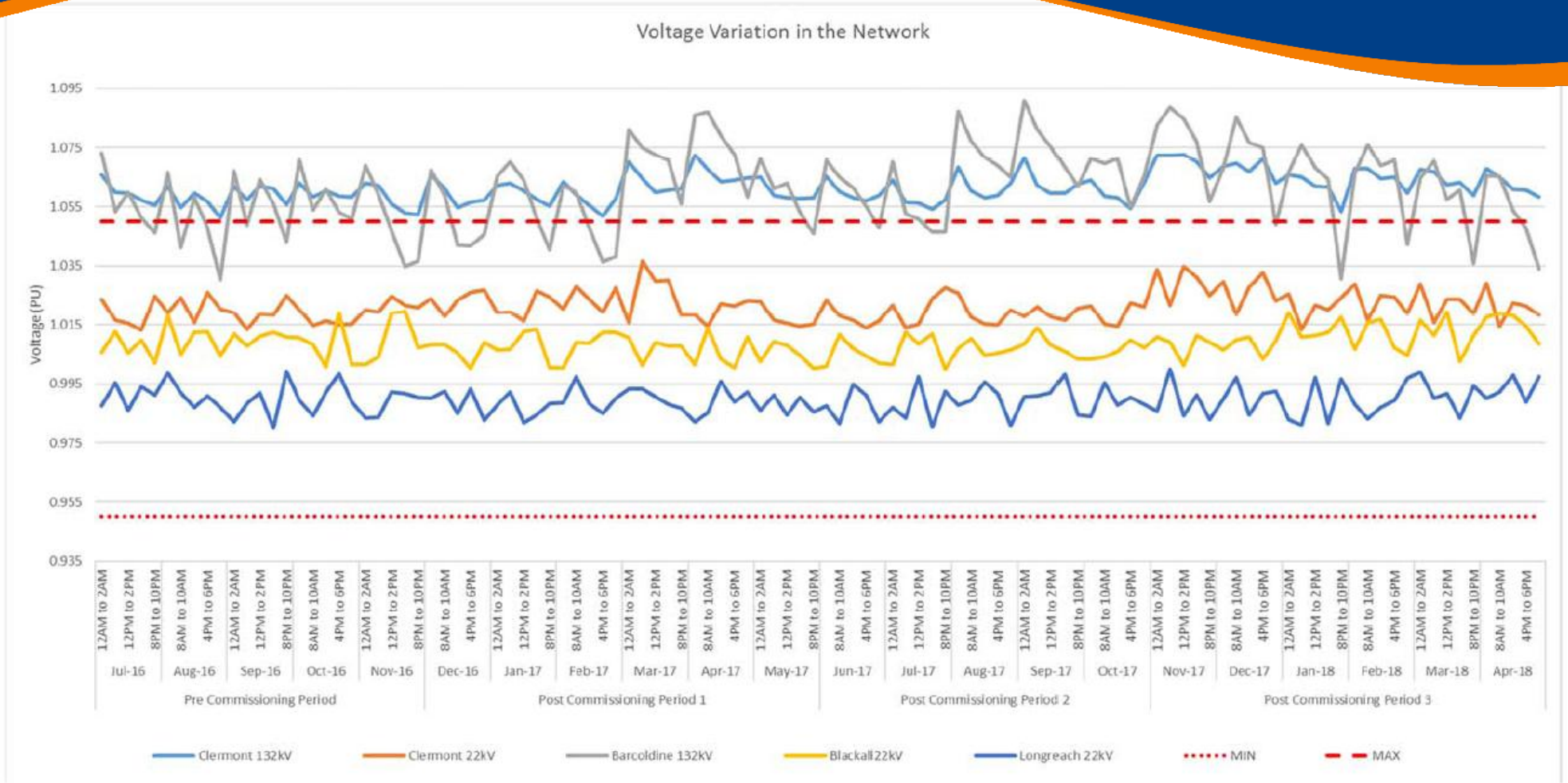
# Main Results
## Resistive Losses




Downstream feeders show insignificant changes in the losses between pre-commissioning and post-commissioning of BSF

# Main Results
## Voltage Variation




No noticeable change in voltage levels were identified during operation of the solar farm compared to previous periods.

# Other Considerations

- During the monitored period, BSF has absorbed reactive power from the network (reactor effect). Most of the time it has absorbed reactive power at its full capacity
- The inverters of BSF can provide reactive power during night time. This supports the electrical system by regulating the system voltage at any time throughout the day. This is, in effect, demonstrable Network Support.
- Preliminary Analysis shows that voltages on the Lilyvale to Barcaldine 132 kV could be reduced with operation of BSF.
- There is an overall reduction in system losses between Lilyvale and Clermont when BSF is exporting energy.
- The level of reduction of losses between Clermont and Barcaldine are dependent on the network load and also the magnitude of generation from BSF. Sometimes losses are increased with the maximum generation coincident with low load periods due to reverse power flow on this portion of the network.

## 1) Reduced System Losses

During the full period of operation, a sustained reduction of reactive and resistive losses has been demonstrated as a result of Barcaldine Solar Farm generation interactive with the upstream network. As well, when generation and load at Barcaldine Substation were similar, loss reductions were observed.

## 2) No Substantive Grid Detriment From Reverse Flow

It has been noticed during the first year of full operation, that since the loads of the downstream network and the Barcaldine SS are lower than the total solar generation, a reverse power flow can be observed during full solar generation, with no obvious sign of Network distress.

## 3) Voltage Support

Modelling shows that BSF is providing support for system voltages at Barcaldine SS in both directions, providing the ability to both increase and decrease system voltage to respond to upstream and downstream events.

## 4) Potential to Reduce Upstream System Voltages

It was identified that the voltage levels of the downstream network, prior to solar farm operation, were highly varying. This variation was at its worst during summer months. This network voltage variation indicates suboptimal network voltage controls in the very remote Blackall and Longreach substations that have been significantly improved by the inverter presence at Barcaldine, rather than previous reliance on voltage control from Lilyvale.

## 1) Localised Losses Not Extensively Impacted by Oversizing

The analysis indicates that in remote grids where generation is significantly larger than the load, additional losses will be incurred on that remote area of the grid, however upstream benefits throughout the NEM to the source of generation will be experienced that are likely to outweigh the additional losses on the remote feeder.

As expected, no difference of losses can be observed in the downstream network during the solar generation in the first of operation, regardless of seasonality.

# THANK YOU

**Elecnor Group**

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