



BRINGING IT ALL TOGETHER: REAL TIME CAPACITY MONITORING

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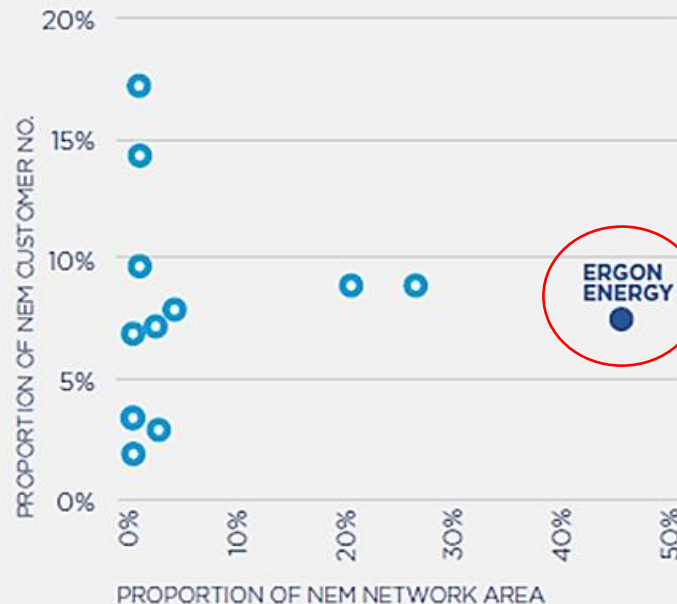
Business context

Introduction to Energy

Merger of Ergon Energy and Energex

- **1.7** million square km (7x United Kingdom)
- **\$24** billion in electricity assets
- **33** remote power stations
- **500+** zone substations
- **3000+** distribution feeders
 - **27,000+** km underground
 - **192,000+** km overhead

HOW ERGON ENERGY COMPARES TO OTHER DISTRIBUTORS



Our service area is by far the largest distribution area in the National Electricity Market (NEM). However, proportionally our customer base is small.

Source: Huegin Ergon Energy Expenditure Benchmarking.



of the Energy Queensland Group



Distribution network challenges

Economics

- Solar and battery affordability becoming a genuine competitor. Downward pressure on network operating costs.

Edge activity

- Large solar farms.
- Highest penetration of residential solar in the world.

Safety

- A power worker is more likely to be killed driving to a job than by electricity.
- Reliance on customers to report lines down and faults.

Real time remote visibility beyond substation

Economics

- ~~Solar and battery affordability becoming a genuine competitor.~~
- ~~Downward pressure on network operating costs.~~

Edge activity

- ~~Large solar farms.~~
- ~~Highest penetration of residential solar in the world.~~

Safety

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- ~~Reliance on customers to report lines down and faults.~~

Real time remote visibility beyond substation

Sensors w/
Communication = Data ≠ Information

We required a platform to:

1. **Capture data** via direct device/system connectivity and wide protocol support.
2. **Produce information** via a self-serve model with off the shelf tools and commoditised extensibility.

1. Capture data

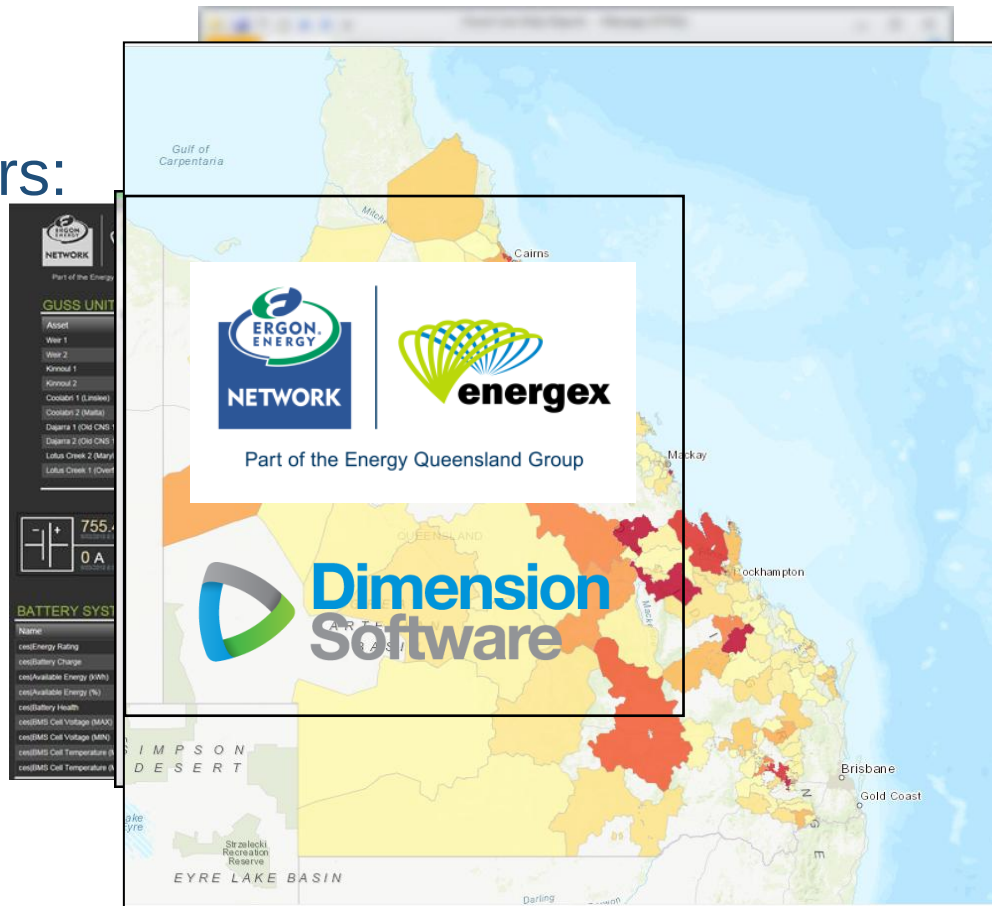
PI interfaces used in last two years:

- **Modbus** Meters, inverters, statcoms, temperature sensors
- **DNP3** Voltage regulators
- **OPC DA** ICCP adaptor
- **SNMP** Comms equipment battery chargers, modems
- **HTTP** Internal and external web APIs
- **RDBMS** SQL server data capture
- **CSV** Battery management log files, weather

2. Produce information

PI tools used in last two years:

- PI Vision
- PI Notifications
- PI Analysis Services
- PI Web API
- PI Integrator for ESRI
- PI AFSDK



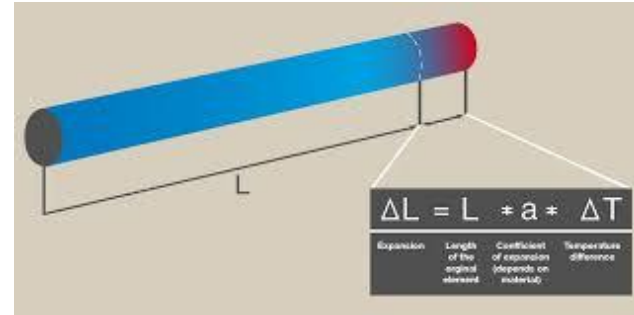
Conductor Ratings

Conductor Ratings:

What are they and why do we need them?

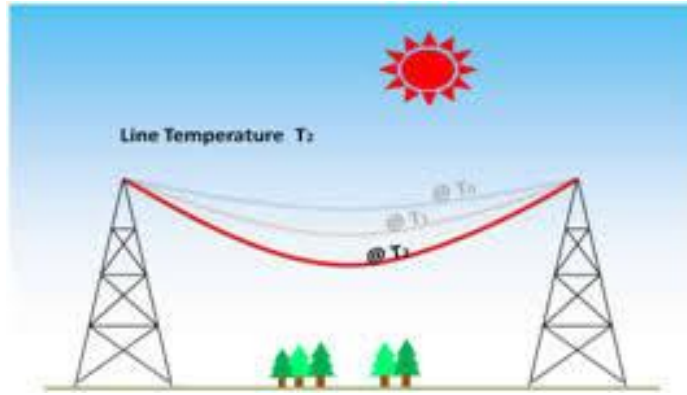


- As current increases, heat increases.
- As heat increases, length increases.

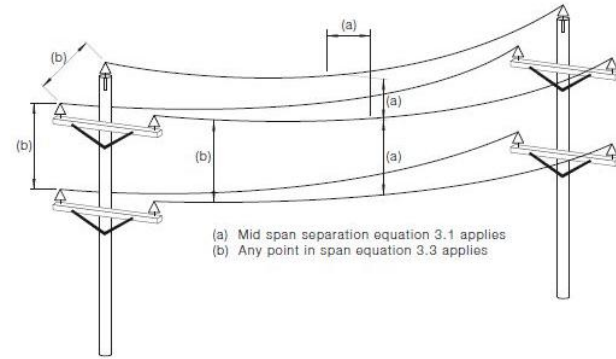


Conductor Ratings: Impacts of heat

1. Increase in length = sag



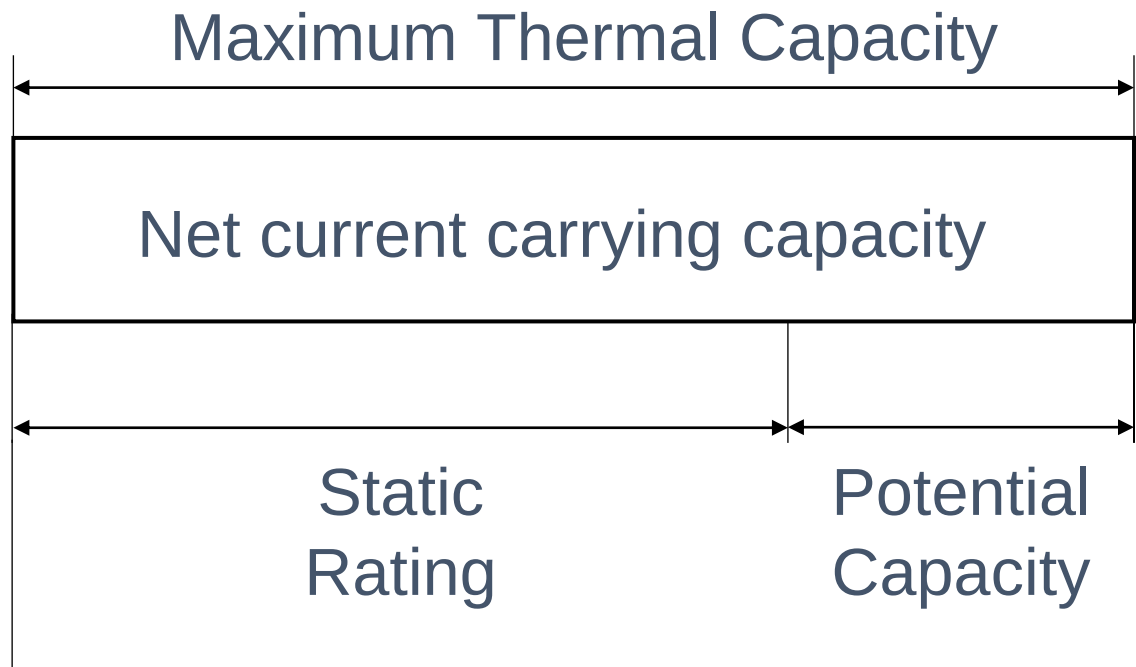
Ground clearances



Inter circuit clearances

2. Annealing (permanent damage or deformation)

Conductor Ratings: External influences



Heat gain

- High ambient temp
- Solar irradiance

Heat loss

- Low ambient temp
- Wind

Dynamic Ratings in PI

Asset Framework Hierarchy (Radial Network)



- Substation XYZ
 - Feeder 01
 - Section 01
 - Section 02
 - ...
 - Section N



Roll up of
worst case

Weather Data



REST API



Co-ordinates



Conditions

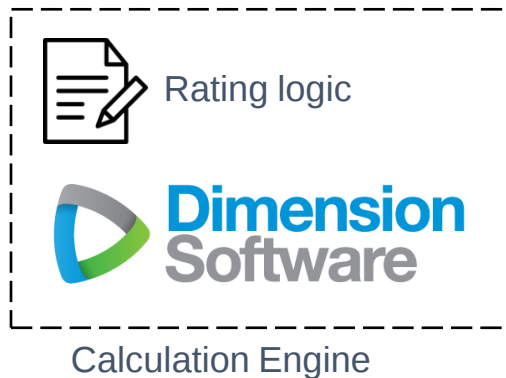


Category: 00 - Weather Station Data			
+		Closest Weather Station	Oakey Ap
		Corrected Wind Angle	15.1824244861698 °
		Distance	3.9 km
+		Measured Ambient Temperature	16.2999992370605 °C
+		Measured Wind Bearing	98 °
+		Measured Wind Speed	8.33333396911621 m/s



PI Asset
Framework

Calculation Engine



Variables

Ratings

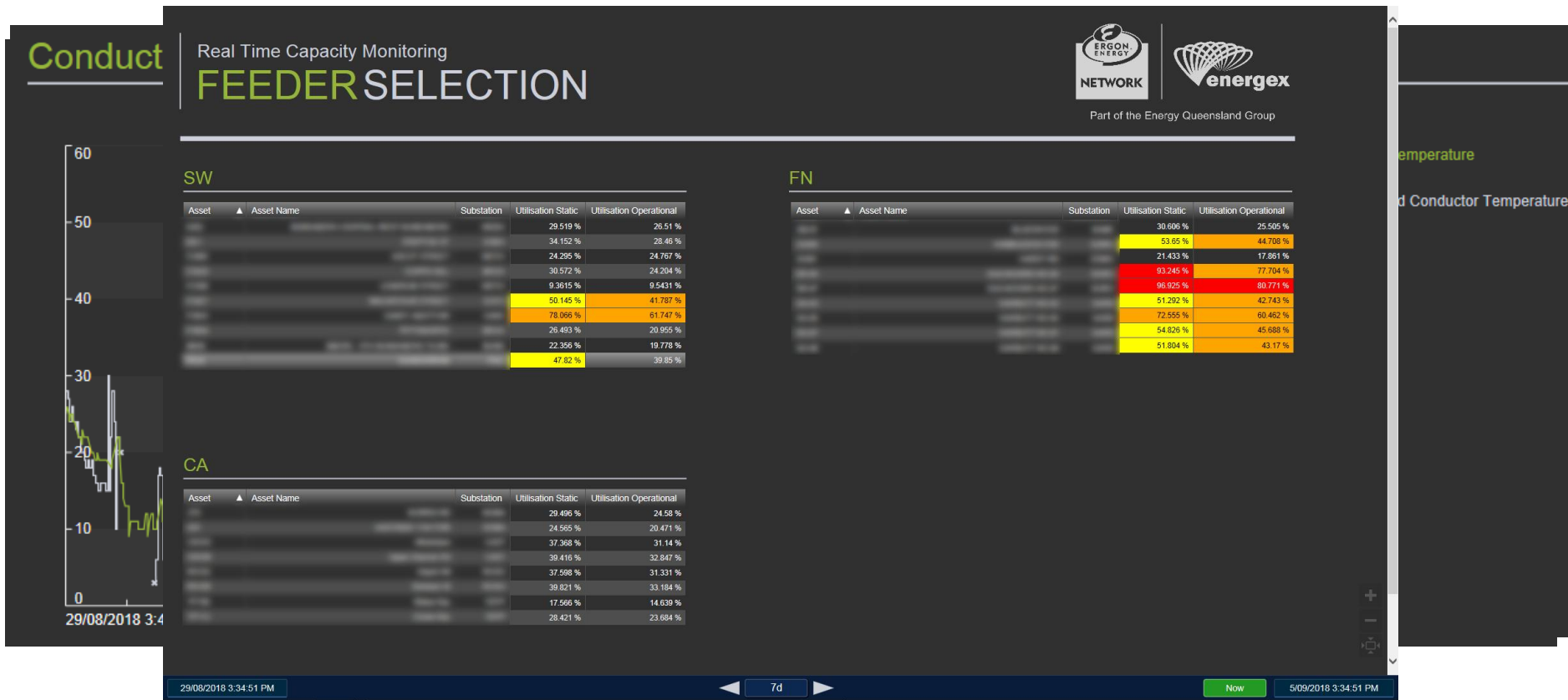


AFSDK

Category: 00 - Weather Station Data		
✓	Closest Weather Station	Oakey Ap
✓	Corrected Wind Angle	46.1824244861698 °
✓	Distance	3.9 km
✓	Measured Ambient Temperature	18.7999992370605 °C
✓	Measured Wind Bearing	67 °
✓	Measured Wind Speed	7.22222280502319 m/s
Category: 000 - Conductor Attributes		
✓	Absolute Maximum Operating Temperature	140 °C
✓	Altitude	500 m
✓	Climate Zone	Central Tablelands - Southern
✓	Conductor Alpha	0.00403
✓	Conductor Construction	MOO
✓	Conductor DC Resistance	0.232
✓	Conductor DIA	14.25 mm
✓	Conductor Emissivity	0.5
✓	Conductor Geography	
✓	Conductor Ground Cover	Grass, Crops
✓	Conductor MAG Effect	1
✓	Conductor Name	Moon
✓	Conductor Skin Effect	1.005
✓	Conductor Surface	Rural Weathered
✓	Ground Reflectivity	0.2
✓	Maximum Design Temperature	75 °C
✓	Solar Absorption	0.5

Category: 0000000 - Results		
✓	Limit Status	No wind condition
✓	Operational Rating	429.492452761413 A
✓	Rating Dynamic	849.014158005982 A
✓	Rating Dynamic Maximum	480.572981585439 A
✓	Rating Limit	429.492452761413 A
✓	Rating Realtime	621.767246691448 A
✓	Rating SCADA Existing	339.711837075947 A
✓	Rating Static	388.662244823263 A
✓	Rating Static Maximum	429.492452761413 A
✓	Realtime Rating Rollup	621.767246691448 A

Bringing it all together: PI Vision



Bringing it all together: ESRI ArcGIS



Bringing it all together: ESRI ArcGIS



Real Time Capacity Monitoring: The Best Bits

- Switching it on.
- Uncovering errors in asset data sets.
- Entirely templated, including tag creation.
- Self service visualisation (Vision and ArcGIS).
- Calculation Engine
 - Highly available across two data centres
 - Scalable to entire network
 - Supports backfilling

Real Time Capacity Monitoring: The Future

- Tuning of logic (in progress)
- Results published to Control Rooms (in progress)
- Forecast ratings (in progress)
- Combining with Underground Cable Rating system (in progress via PI Web API)
- Transition to off-the-shelf AF analyses only
- Tighter integration with PI Vision and ArcGIS displays
- Application to other assets and constraint types

Energy Queensland

REAL TIME CAPACITY MONITORING



CHALLENGE

Distribution network not designed for large reverse power flows at edge.

- Reducing capital budgets for network capacity upgrades, need to improve existing asset utilization.
- Commercial pressure to allow solar connections.

SOLUTION

Deploy real time dynamic ratings to improve on conservative static capacity estimates.

- Deployed to 30 constrained feeders but scalable to entire network.
- PI Asset Framework and AFSDK central to solution.

RESULTS

Demonstrated potential asset utilization improvements of +20% for comparatively low cost.

- Breaks down complex data streams into usable information for wider engineering audience.
- Already produced 12 months of data for further analysis and refinement.



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Questions?

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the **microphone**

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name & company



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