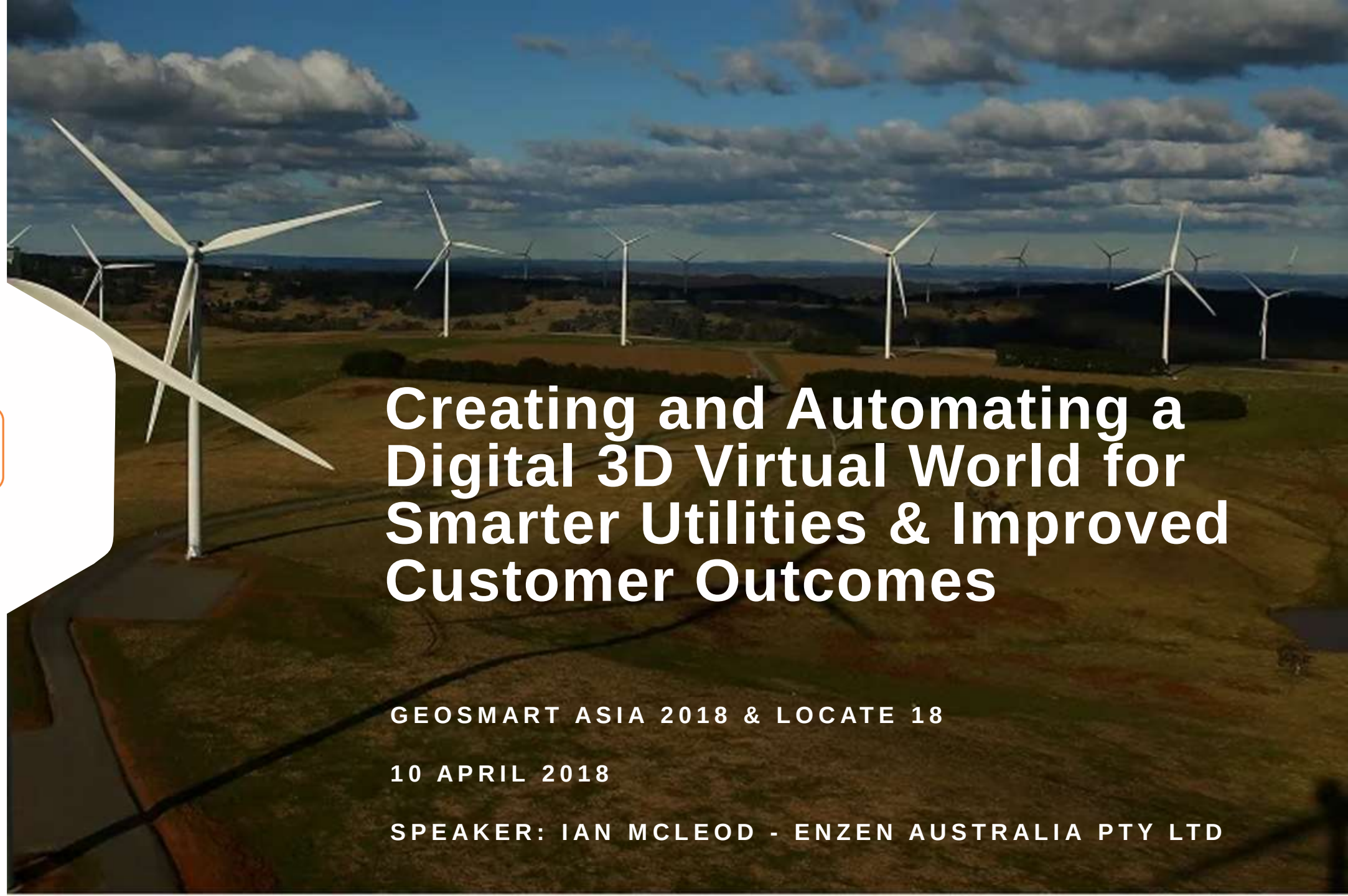


Creating and Automating a Digital 3D Virtual World for Smarter Utilities & Improved Customer Outcomes

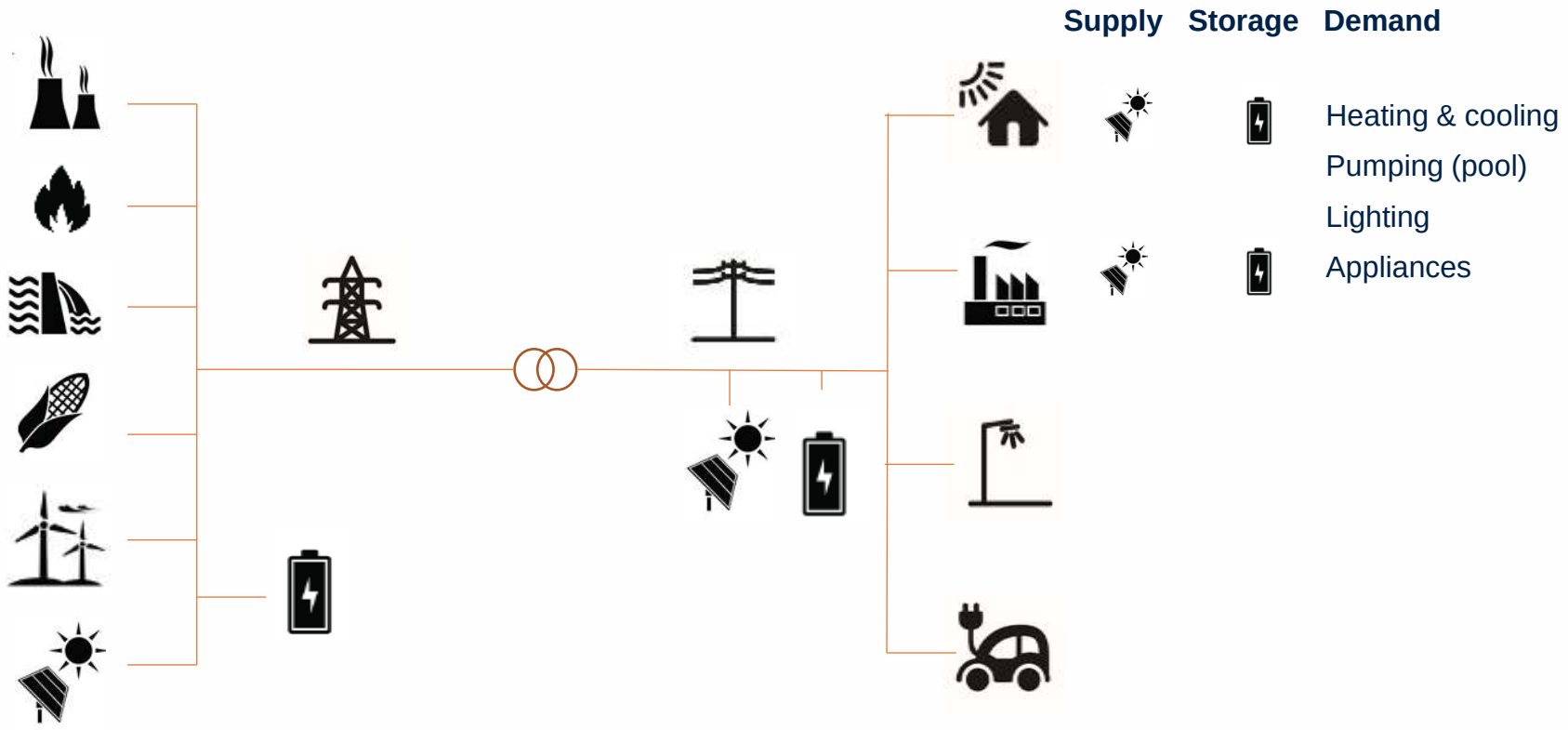
GEOSMART ASIA 2018 & LOCATE 18

10 APRIL 2018

SPEAKER: IAN MCLEOD - ENZEN AUSTRALIA PTY LTD

Utilities Becoming Customer Centric

What Knowledge Do We Need & Why?



- 47GW
- 337 registered generators

- 780,000 km of power lines
- ? Trees

- 9.6m Customers
- ? Streetlights
- Electric Transport

- 1.8m Solar Rooftops
- ?m Appliances

Spatially Connected

The National Electricity Market stretches from Cooktown in the tropical north to Tasmania in the south and across to South Australia

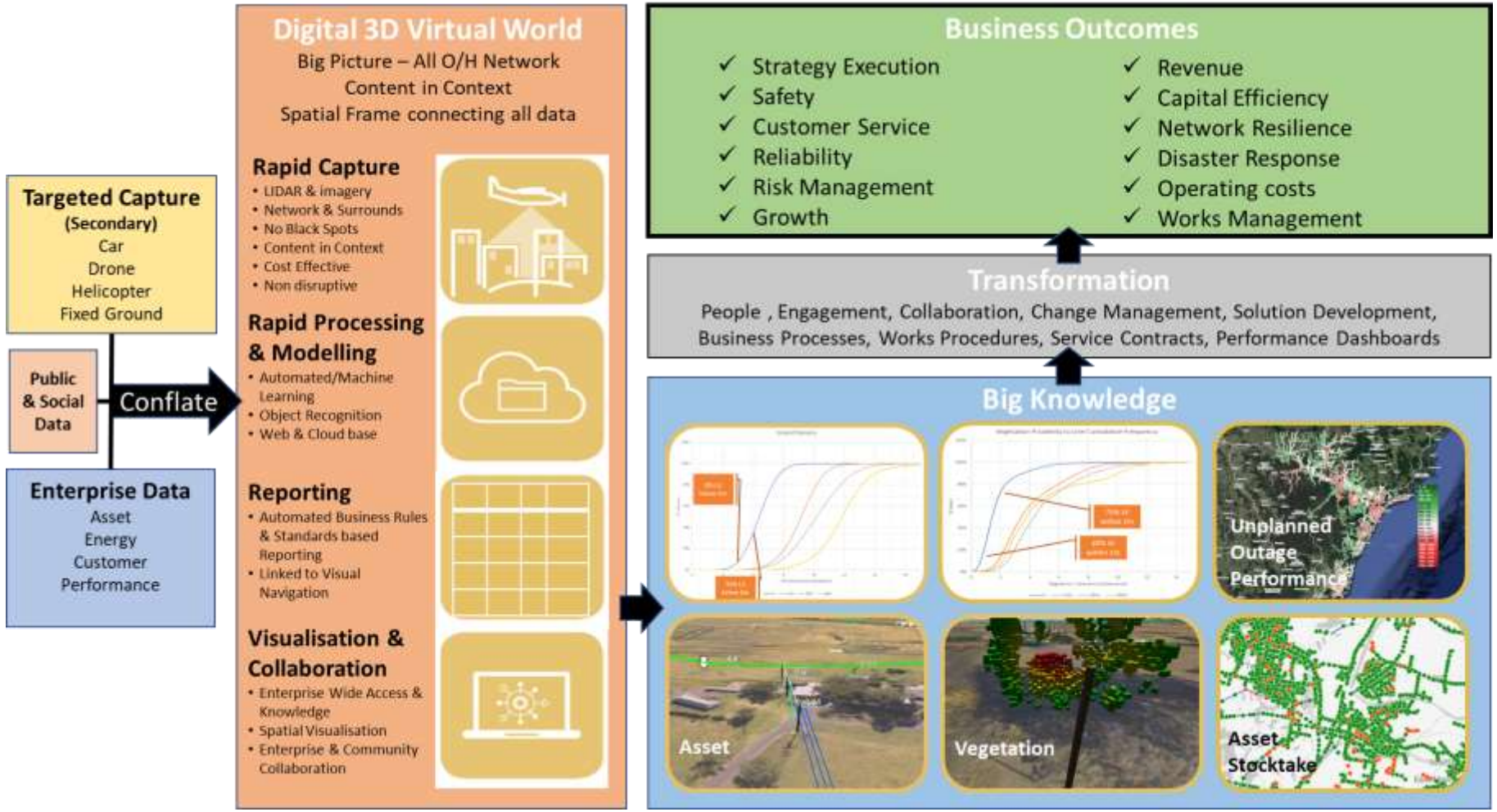
Connected, But, Capital & Resources Are Not Efficiently Deployed

- Energy Networks Australia's "Electricity Networks Transformation Roadmap" is a good example of why greater intelligence on "where" is needed
- More intelligence on the network is needed to enable the Distribution System Operator role

Transforming Big Knowledge to Business Performance

Attributes

- Fast Capture
- Fast Processing
- Full Network
- Spatial Data Frame
- Data Conflation
- 3D Visualisation
- Process Automation
- Machine Learning
- Scalable
- Web base collaboration
- Advanced Analytics
- Business Transformation

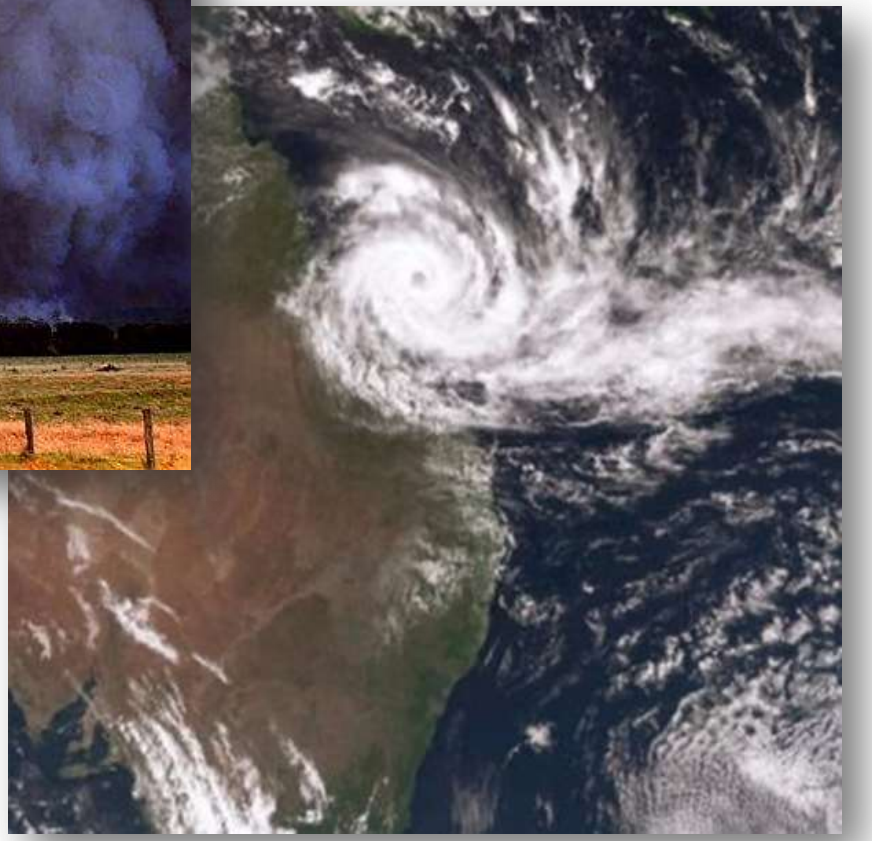


Disasters: The Moments that Define Us

Dunalley, Tasmania

Black Saturday, Victoria

Yasi, Queensland



Physical Vulnerabilities: Consequence

2017 US Hurricanes – Up to $400B Cost

Hurricane Maria

Disaster

Hurricane Maria is regarded as the worst natural disaster on record in Dominica and is potentially the costliest Caribbean hurricane on record as a result of causing catastrophic damage and a major humanitarian crisis in Puerto Rico. Wikipedia

Highest wind speed: 280 km/h

Date: 16 September 2017 – 3 October 2017

Direct fatalities: 66

Category: Category 5 Hurricane (SSHWS)

Lowest pressure: 908 mbar (hPa); 26.81 inHg

Affected areas: Puerto Rico, Dominican Republic, France, MORE

Total fatalities: 97 direct, 32 indirect (as of November 13), 583 reported (unofficial)

Hurricane Irma

Catastrophe

Hurricane Irma was an extremely powerful and catastrophic Cape Verde-type hurricane, the strongest observed in the Atlantic since Wilma in 2005 in terms of maximum sustained winds. Wikipedia

Total fatalities: 134

Highest wind speed: 295 km/h

Date: 30 August 2017 – 16 September 2017

Total fatalities: 134 total (as of October 10)

Affected areas: Florida, Cuba, Puerto Rico, Bahamas, MORE

Category: Category 5 Hurricane (SSHWS), Category 4 Hurricane (SSHWS), Category 1 Hurricane (SSHWS)

Hurricane Harvey

2017 tropical cyclone

Hurricane Harvey was the costliest tropical cyclone on record, inflicting nearly $200 billion in damage, primarily from widespread flooding in the Houston metropolitan area, breaking the previous record set by Hurricane Katrina. Wikipedia

Total fatalities: 77

Dates: 17 Aug. 2017 – 3 Sep. 2017

Date: 17 August 2017 – 3 September 2017

Fatalities: 82

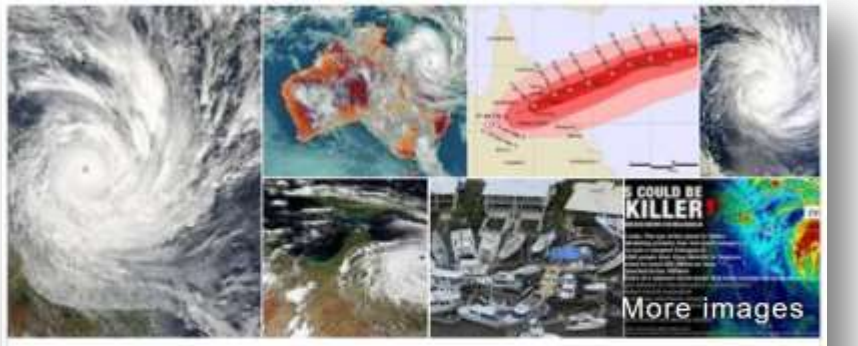
Category: Category 3 Hurricane (SSHWS), Tropical Depression (NHC/CPHC)

Affected areas: Texas, Louisiana, Belize, Nicaragua, Honduras, MORE

Did you know: Harvey is the costliest Atlantic hurricane ($198.6 billion in damage). wikipedia.org

Physical Vulnerabilities: Consequence Australia

- Ash Wednesday Fatalities – 75
- Black Saturday Fatalities – 173



Cyclone Yasi

2011 tropical cyclone

Severe Tropical Cyclone Yasi was a very powerful and destructive tropical cyclone that made landfall in northern Queensland, Australia on 3 February 2011, causing major damage to affected areas. Wikipedia

Total fatalities: 1

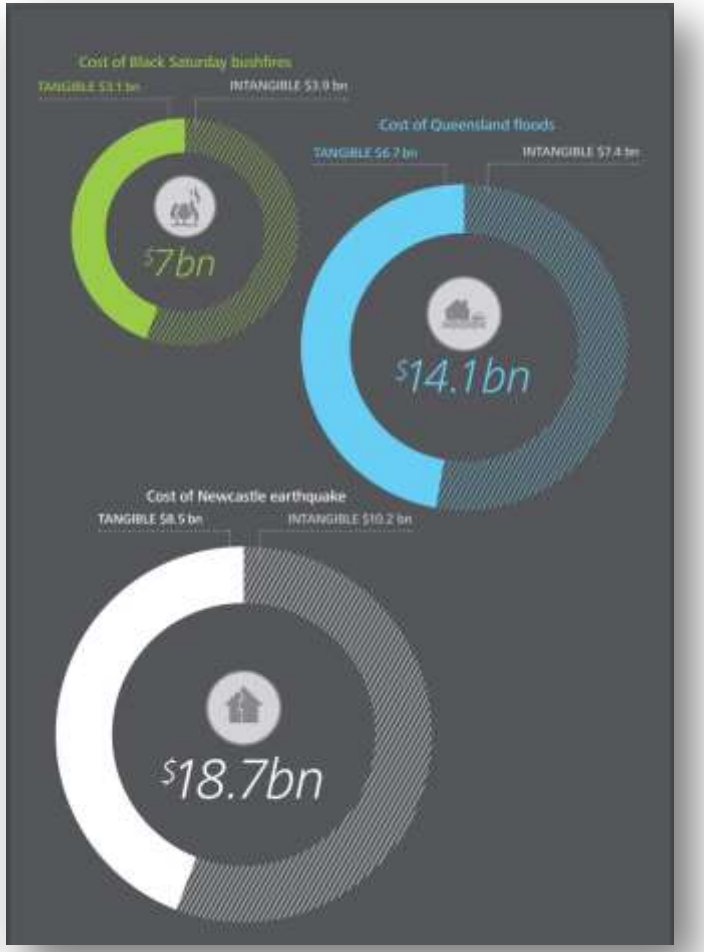
Date: 26 January 2011 – 6 February 2011

Damage: $3.6 billion (2011 USD)

Highest gust: Gusts: 285 km/h (180 mph)

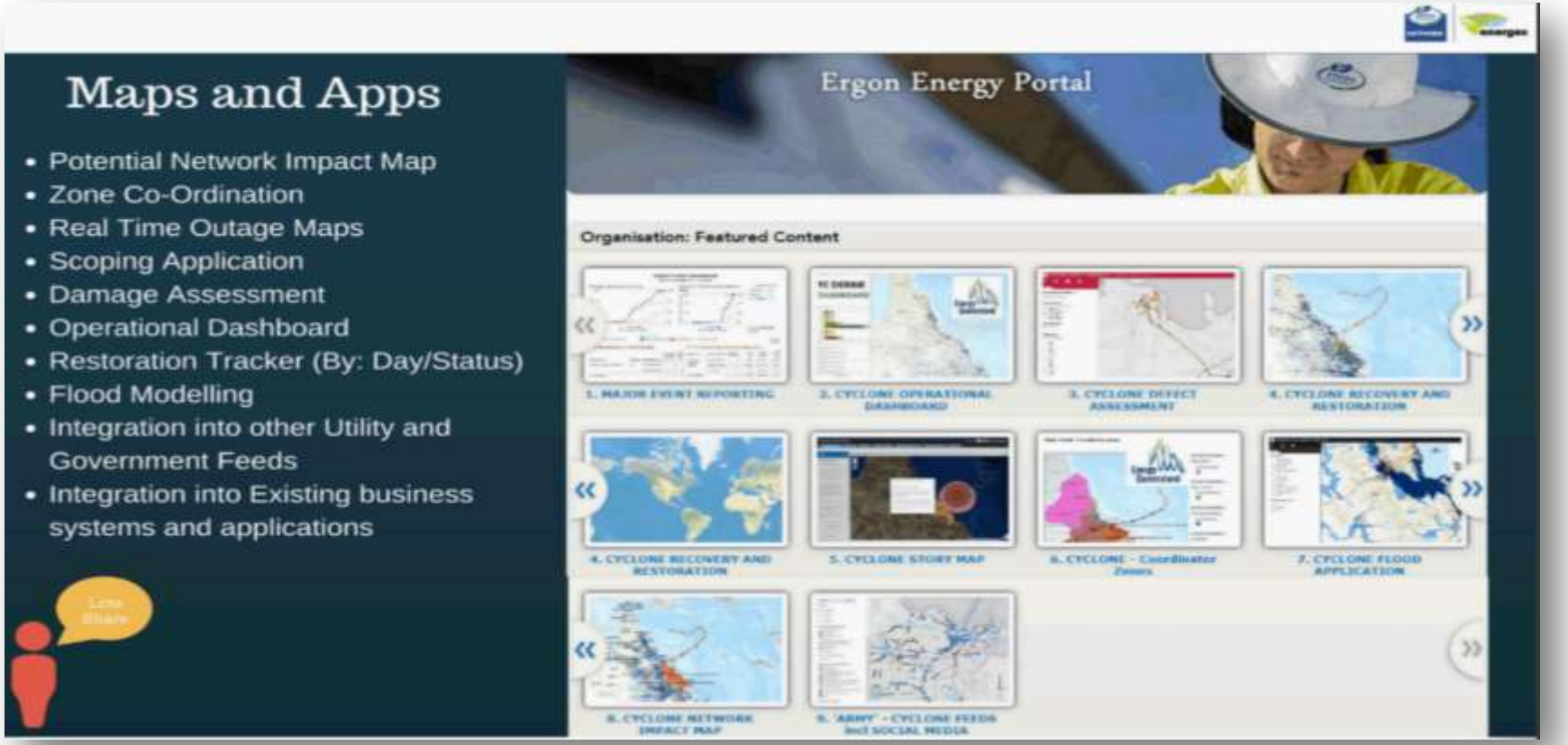
Affected areas: Queensland, Papua New Guinea, Vanuatu, Solomon Islands, New South Wales, Northern Territory

Category: Category 4 Hurricane (SSHWS), Category 5 Severe Tropical Cyclone (BOM)



Improving Grid Resilience & Response:
Technology & Data Conflation

Data conflation, visualisation and analytics improves resilience planning and disaster response



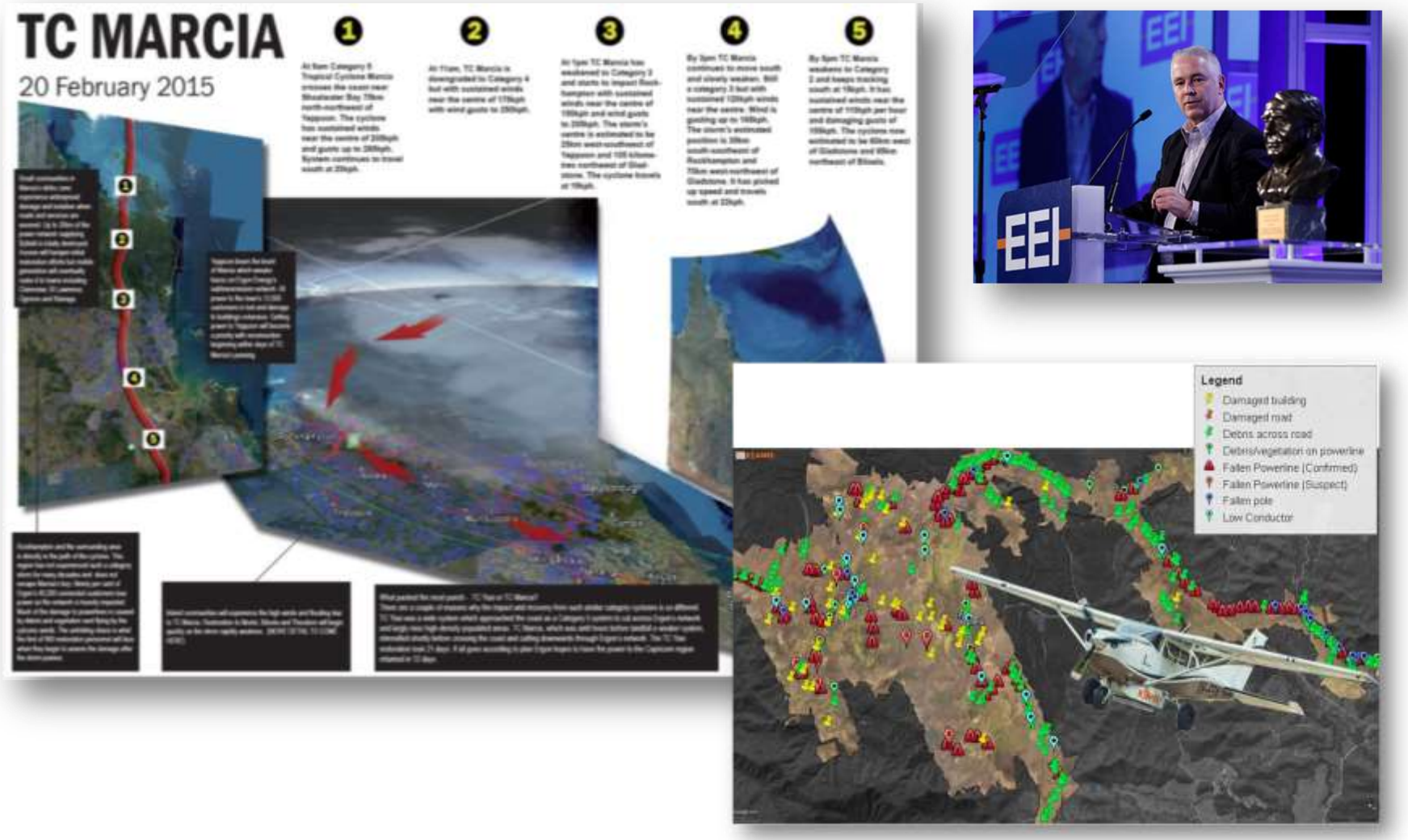
Improving Grid Resilience: Modelling & Technology

- Adaptation through understanding risk (modelling) & executing good design
- Scenario analysis
- Identify changes for asset renewal
- Reduce disaster impact
- Smart, Embedded & Micro Grids – Intelligent switches
- Distributed Energy Resources – Solar, diesel

Improving Response: Spatial

Visualisation & analytics

- A digital response replaces labour intensive high risk ground based defect identification
- Rapid aerial damage capture & processing (24 hours)
- Automated spatial digital intelligence
- Enables rapid response, logistics and restoration planning



Improving Response: Resource Planning & Field Force Automation

- Visualisation to improve deployment of field crews to priority areas
- Field Force Automation to improve work allocation and closure, workforce productivity and data management Improved

Note: Field crews replacing low voltage poles and wires to loads that no longer exist

60,000 response personnel deployed to Irma – were that many needed?

Often ***the same problem is re-instated*** – non fire resilient wood poles

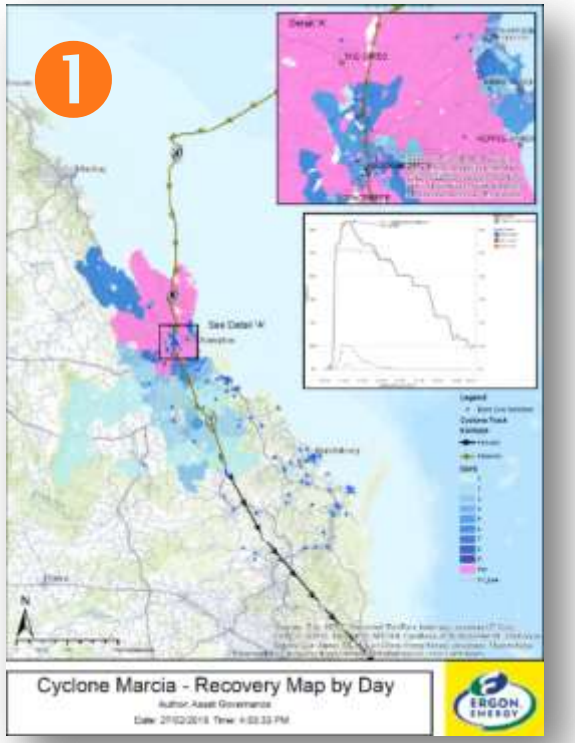
Improving Response: Communication & Social Media

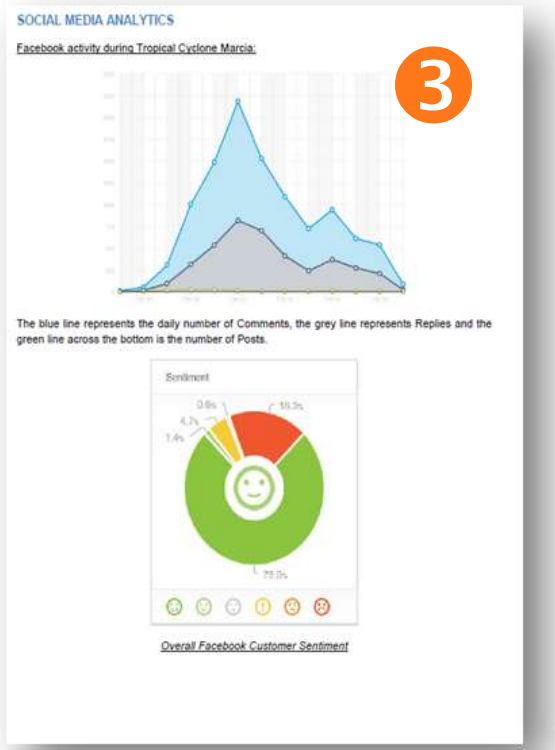
Cyclone Marcia (Central Queensland):

1. Target restoration dates for areas published on the web site
2. Website hits peaked when plans were published
3. Social media monitored to improve response. Social media sentiment favourable and overall response results in improved brand and reputation

Observation

Customers further north who had experienced a number of cyclones helped set reasonable expectations for customers in Central Queensland hit by Marcia. The last Cyclone to hit the area was in 1976



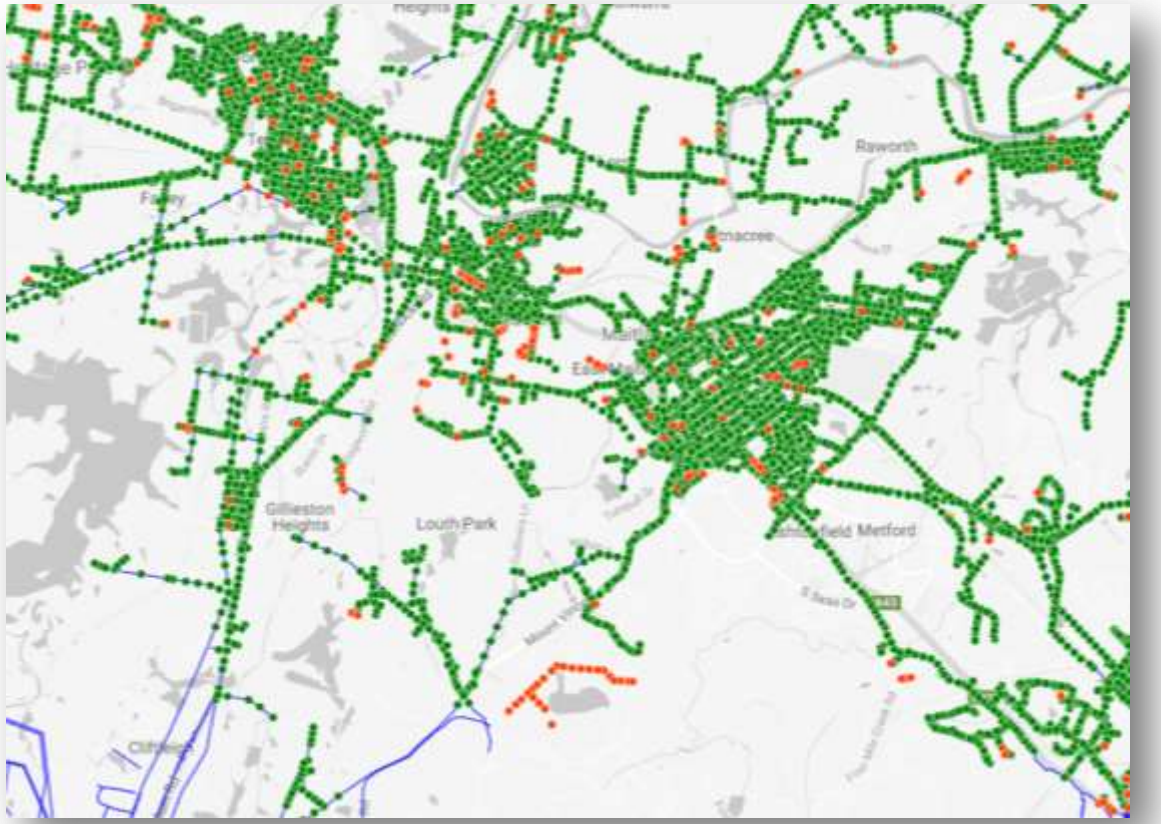


Asset Analytics: Safety 1.5M High Voltage Clearance from Building

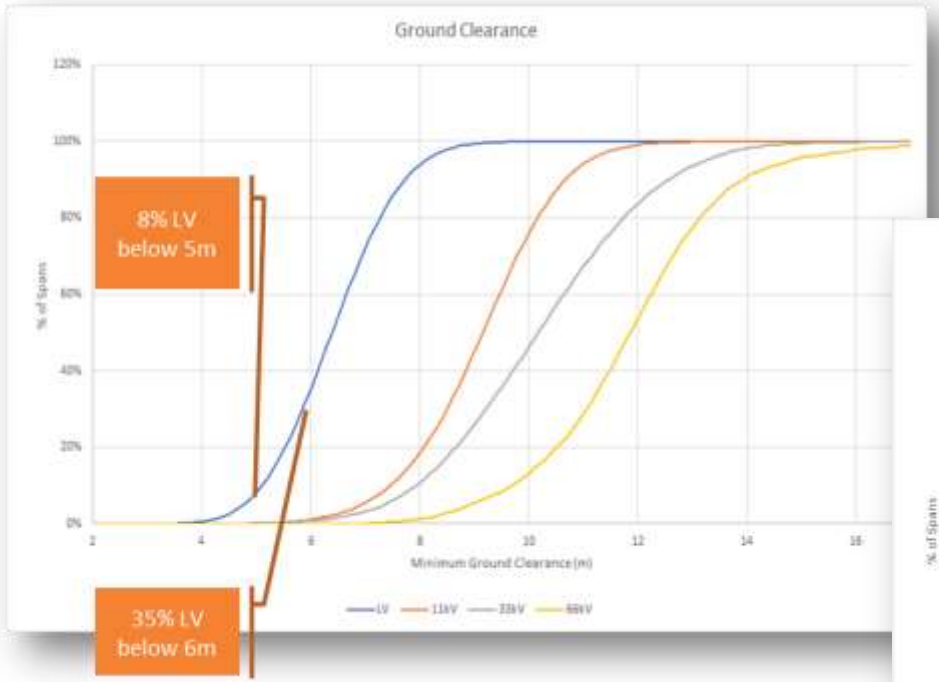
22KV live 1M off ground

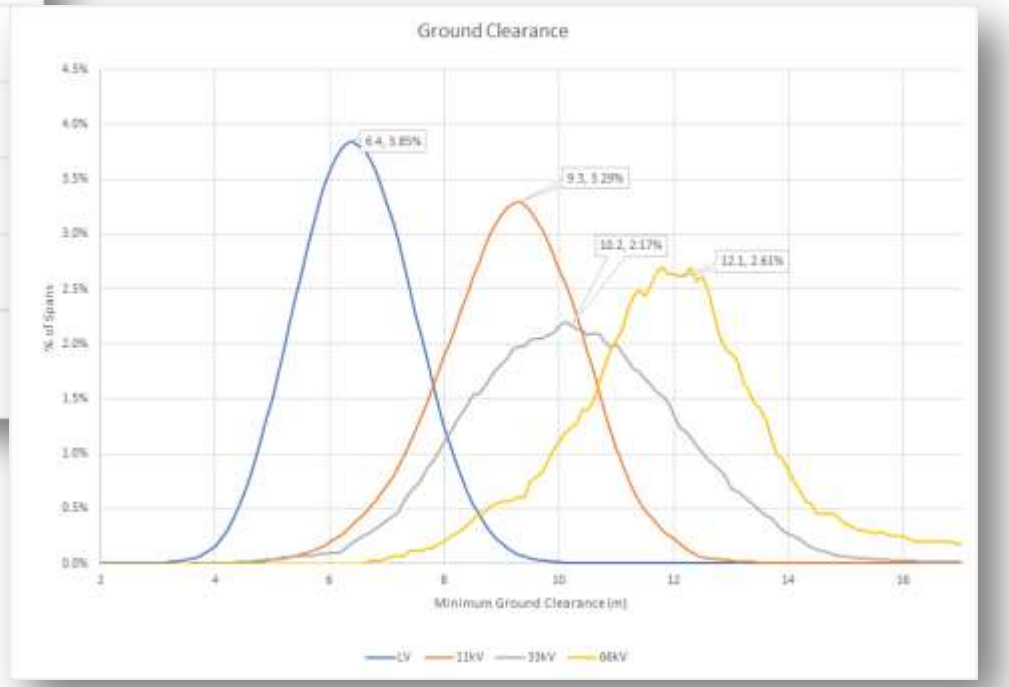
Asset Analytics: Asset Stocktake

- In Australia Benchmarking is being used by the regulator as a key input in determining performance & revenue
- It is therefore critical to have an accurate stocktake of assets
- The red dots indicate poles that were not in the utilities asset records (some may be private poles).



Asset Analytics: Conductor Clearance Curves – The Bell & S

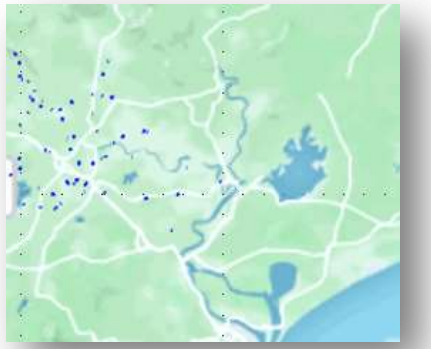




Key Attribute

Every wire is measured at 100mm intervals along the line.

Asset Analytics: Conductor Clearance – Data Slicing for Targeted Risk & Strategy

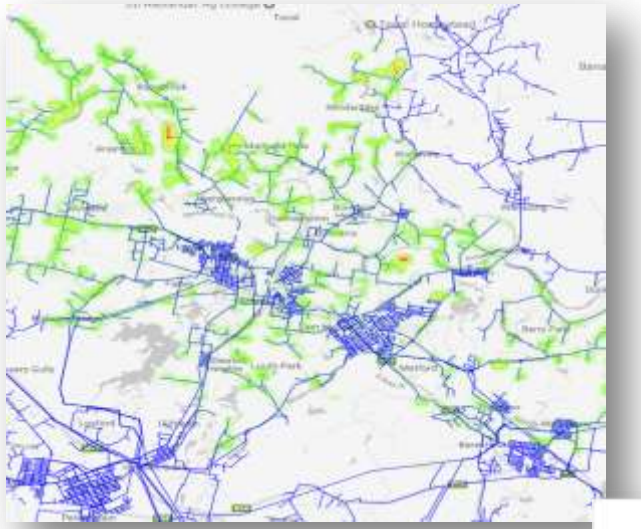


Blue Dots = Low Clearance

Rural
- Agriculture risk
- Land use overlays
  - Irrigation
  - spraying

Urban
- Building risk
- Rubbish removal

Asset Analytics: Pole Location



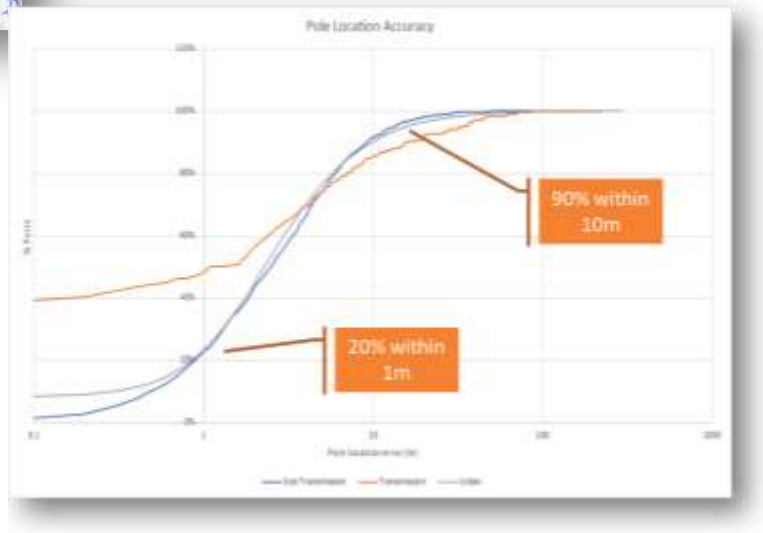
What utilities say:

Locations of poles are accurate

What is usually the truth:

They're not

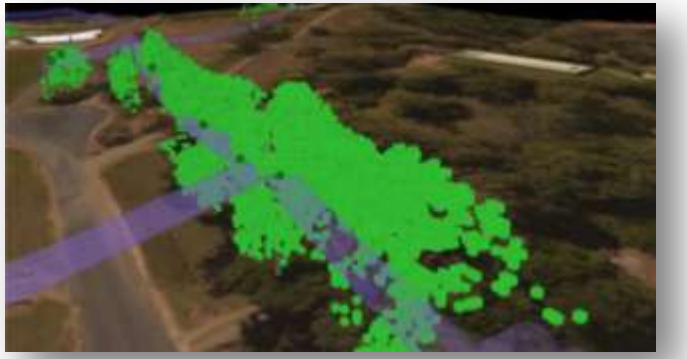
This heat map depicts the locations of the poles with potentially inaccurate locations

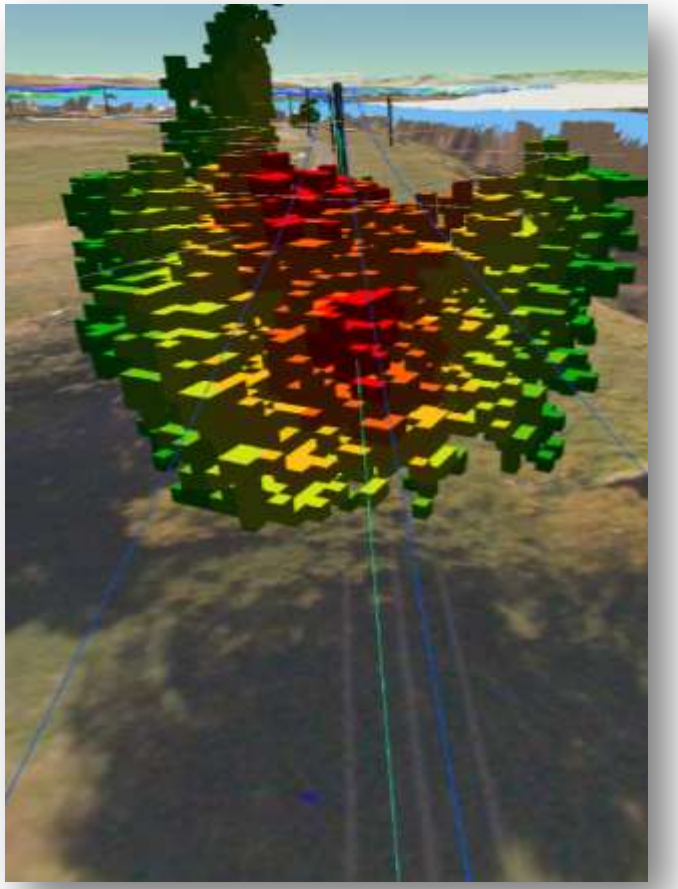


Errors in location can impact:

- property access information
- Assessment of physical loading of a pole (automated or manual)
- Risks related to pole loadings
- Conductor ground clearances from increased DER

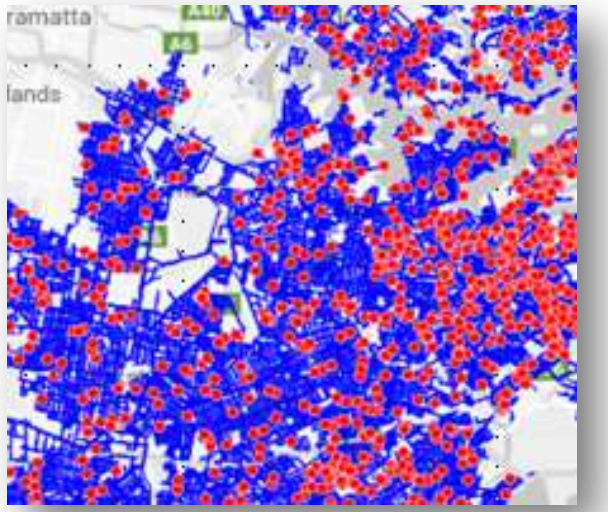
Vegetation Analytics: Vegetation Encroachment





Vegetation Analytics: Bow Wave Peak

Urban



Customer Complaints

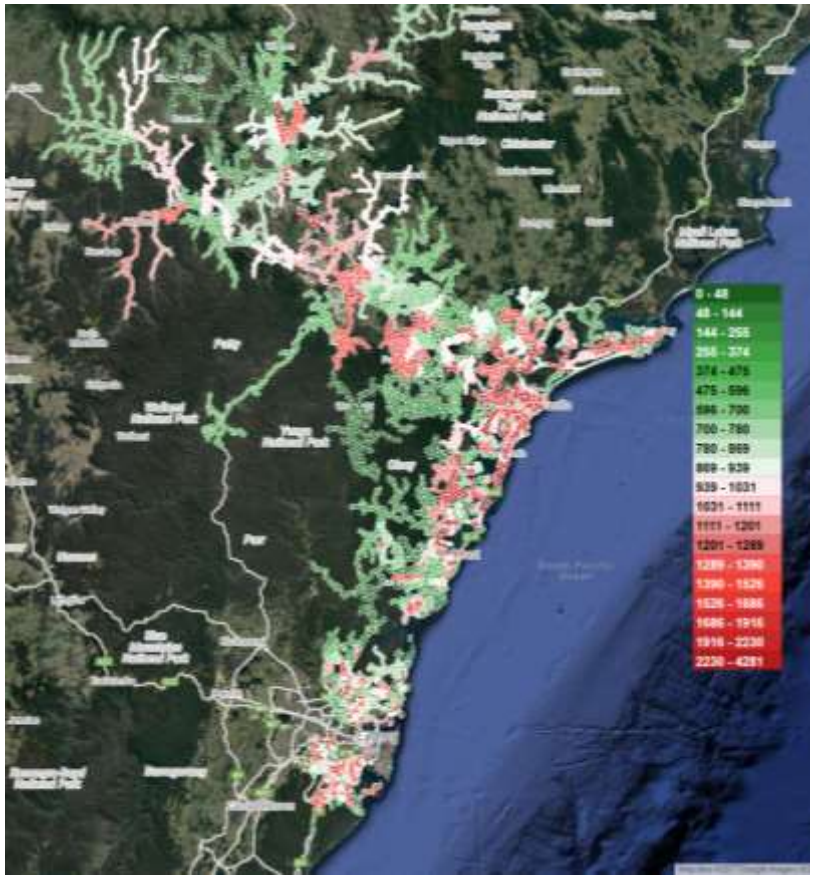
Rural

Vegetation Clearance

Location	A1	A2	A3	A4	C1	C2	C3	C4	C5	C6	C7	OH	TOTAL
Region 1	20	88	181	401	705	1134	1491	2105	1616	1232	866	4	9843
Region 2	0	27	210	330	1234	938	626	620	407	181	74	0	4647
Region 3	10	87	599	1444	5653	4688	2169	1372	398	135	37	0	16592
Region 4	12	124	396	638	1951	1430	650	455	207	87	20	5	5975

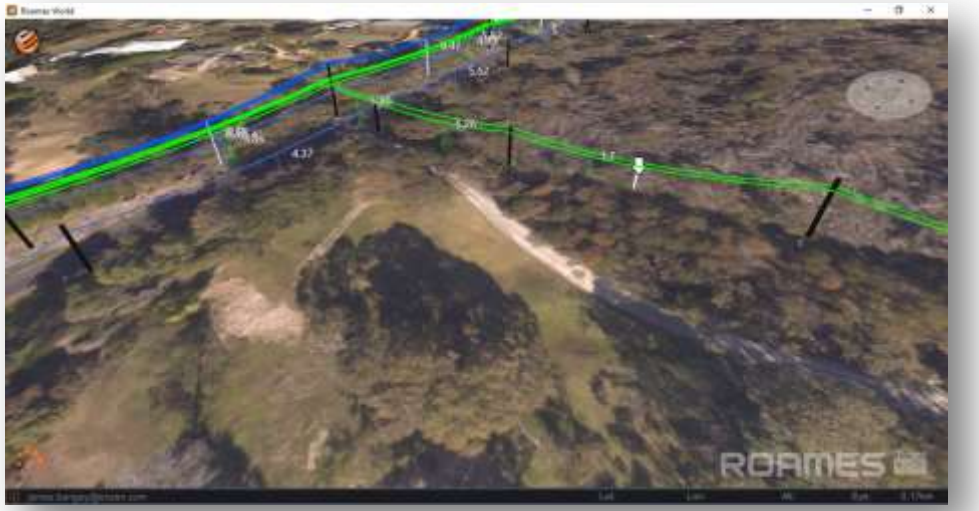
Reliability Incentive – Performance & Risk Analytics

- Revenue and service opportunity
- Data conflation
  - Customers
  - Vegetation
  - Asset condition
  - Performance history
- Risk rank entire network



Economic Analytics: Ensuring Best Low Cost Solution

- Work is often done in silos
- By conflating and making visible vegetation, asset attribute, asset condition, clearances, risk, augmentation, customer extension and other data, the best financial and risk decision can be made

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