

# Energy – Communication Lifelines Resilience Assessment

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RESILIENCE  
TO NATURE'S  
CHALLENGES

Kia manawarao  
– Ngā Ākina o  
Te Ao Tūroa

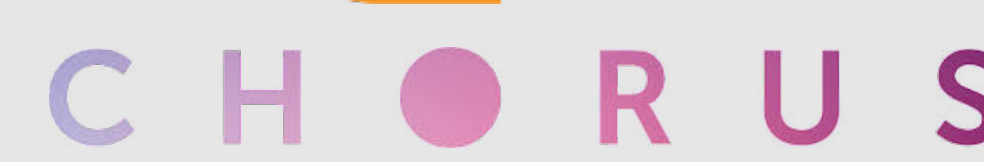
National  
**Science**  
Challenges



**ENGINEERING**  
DEPARTMENT OF ELECTRICAL,  
COMPUTER, AND SOFTWARE ENGINEERING



QuakeCoRE  
NZ Centre for Earthquake Resilience



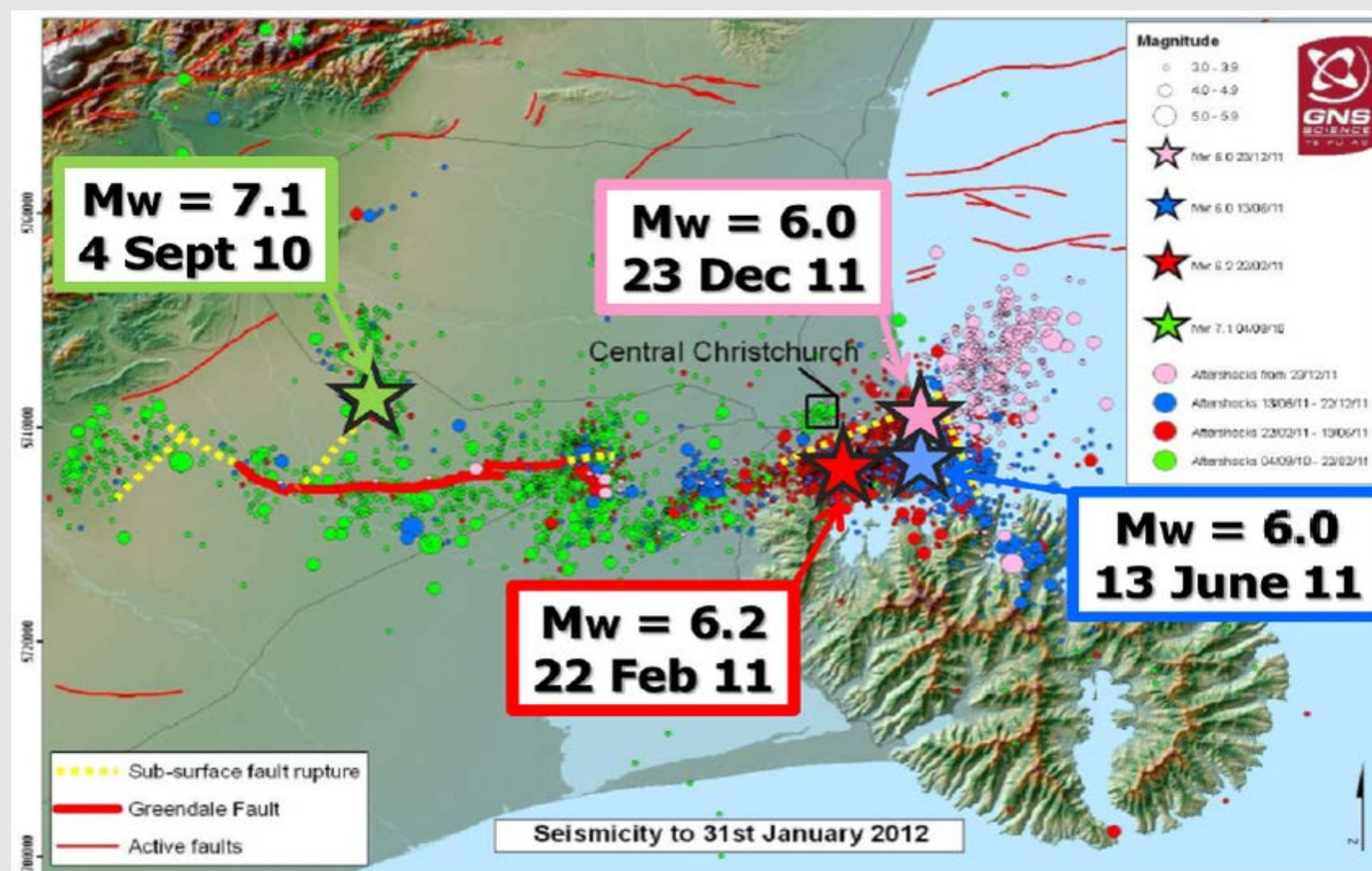
## Power system resilience

### Asset Resilience

*2010-2011 Canterbury  
Earthquake Sequence  
Impact on 11KV  
Underground(UG) Cables*

### UG Cable Network

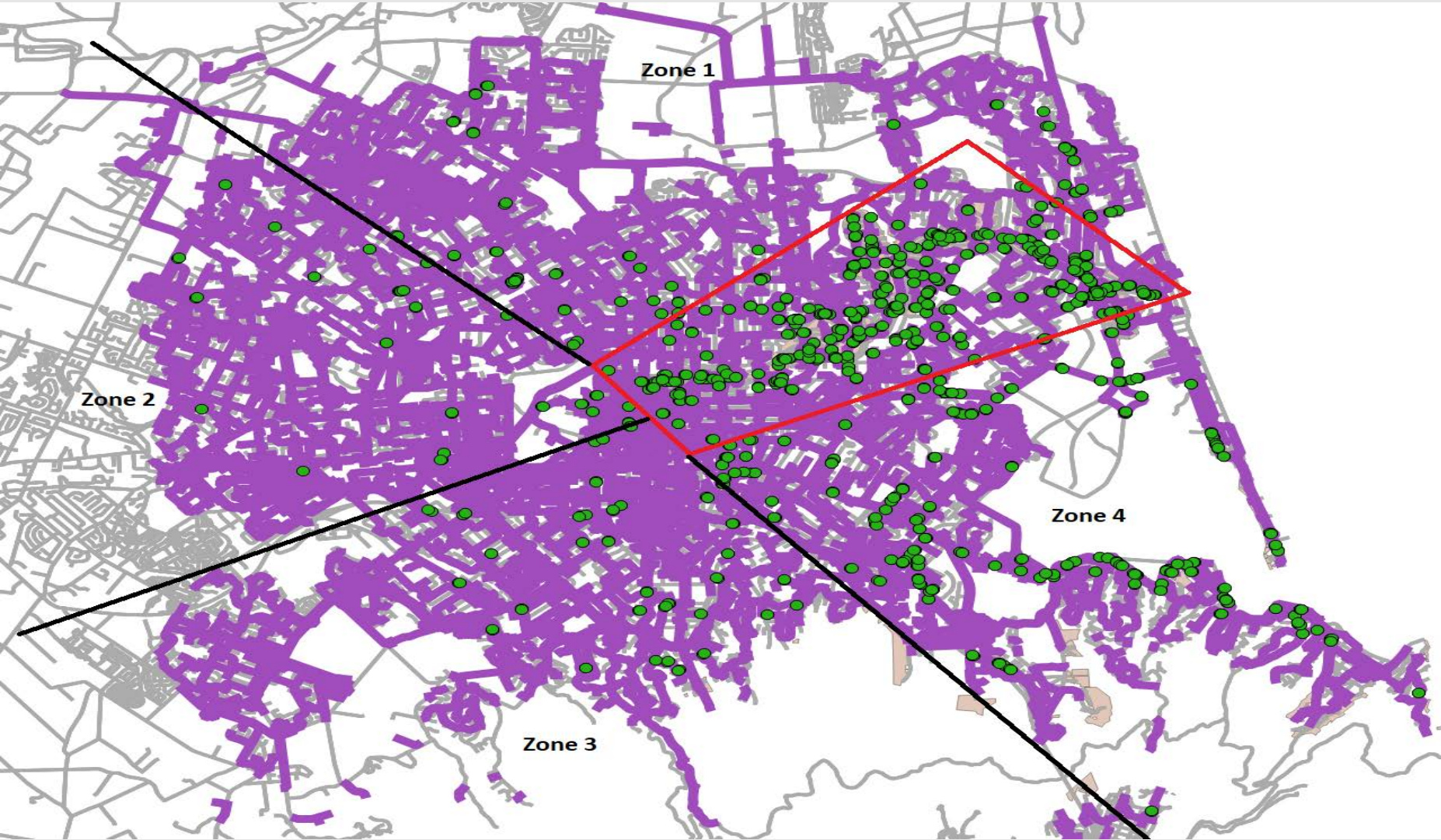
#### Earthquake Impact



**Step 1: Digitising Repair Joints**

**Step 2: Digitising Cables**

#### 11KV UG cables



- Developing fragility curves, by experimentation and modelling, to estimate the earthquake damage impacts for distribution electricity networks.
- Ongoing work to develop the long-time health of underground cables for Asset Health Indicator (AHI) alongside criticality assessment of cable due to earthquake ground shaking.

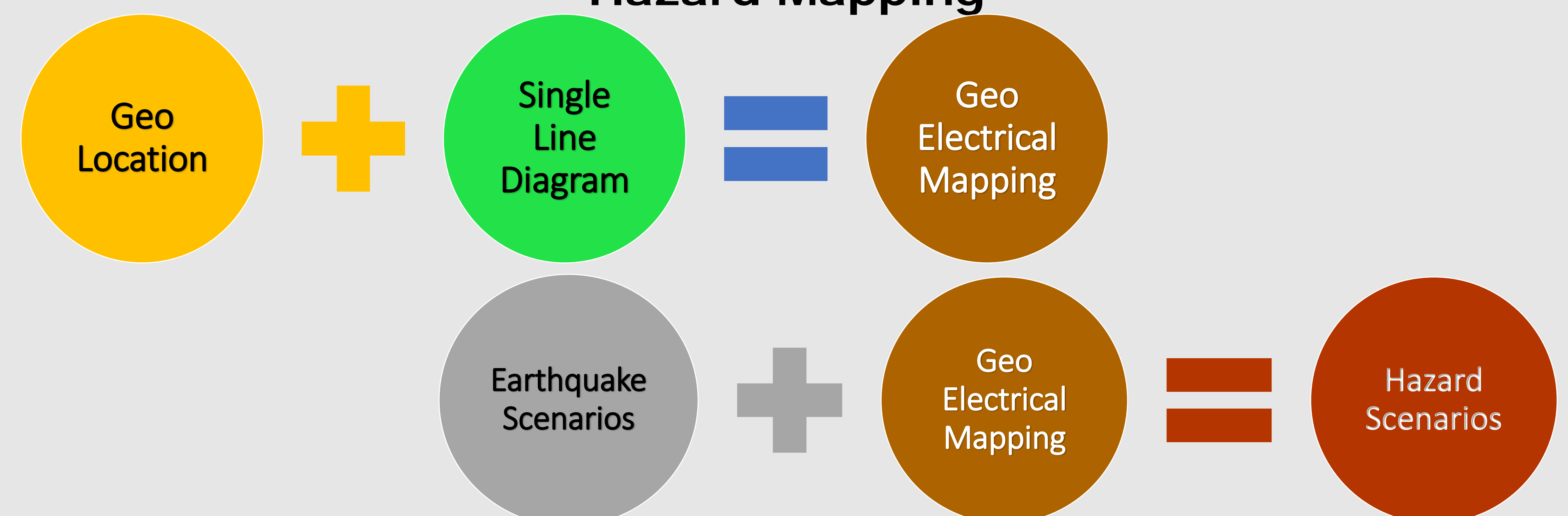
### System Resilience

*NZ Electricity Distribution Network Resilience  
Assessment and Restoration Models following  
Major Natural Disturbance*

### Electricity

### Communication

#### Hazard Mapping



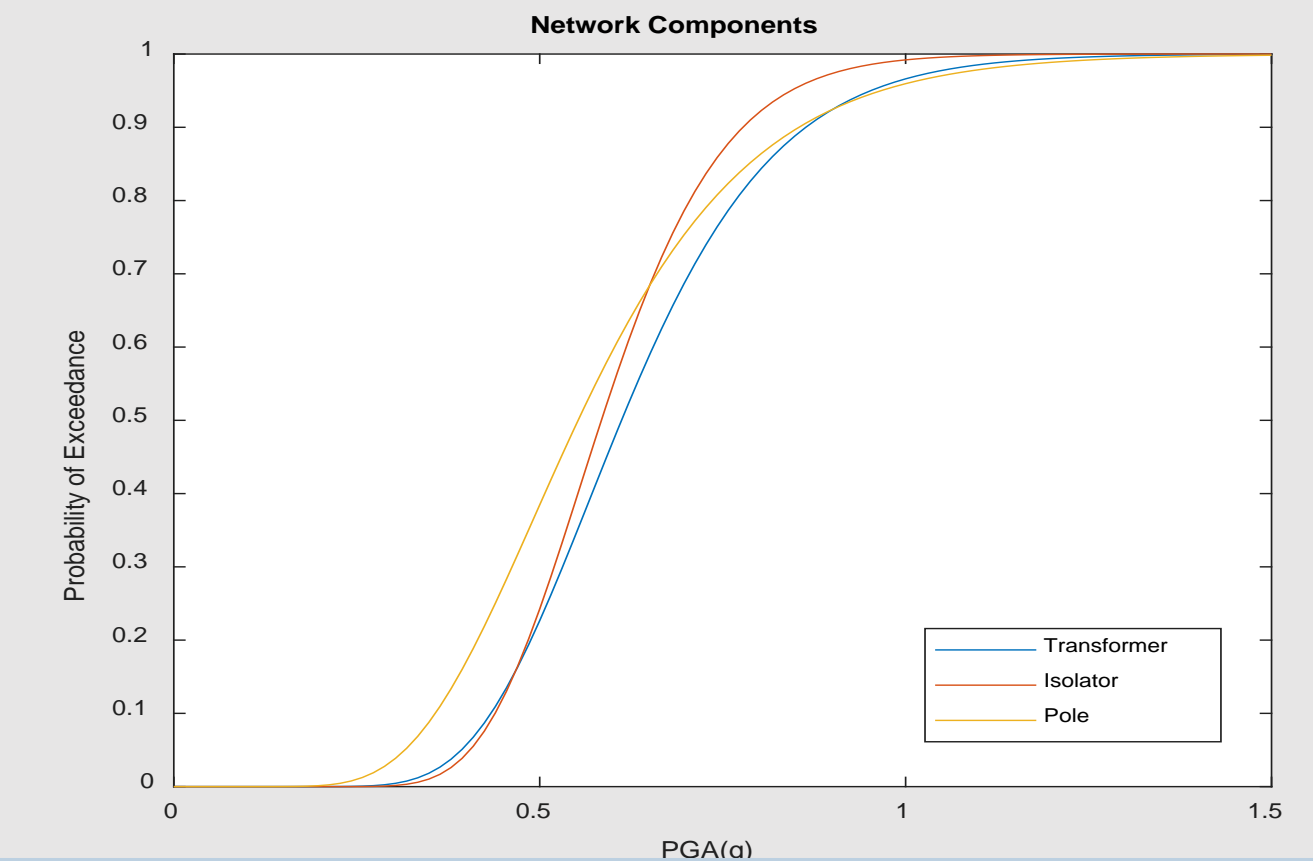
#### Asset Fragility

Component Fragility Assumption

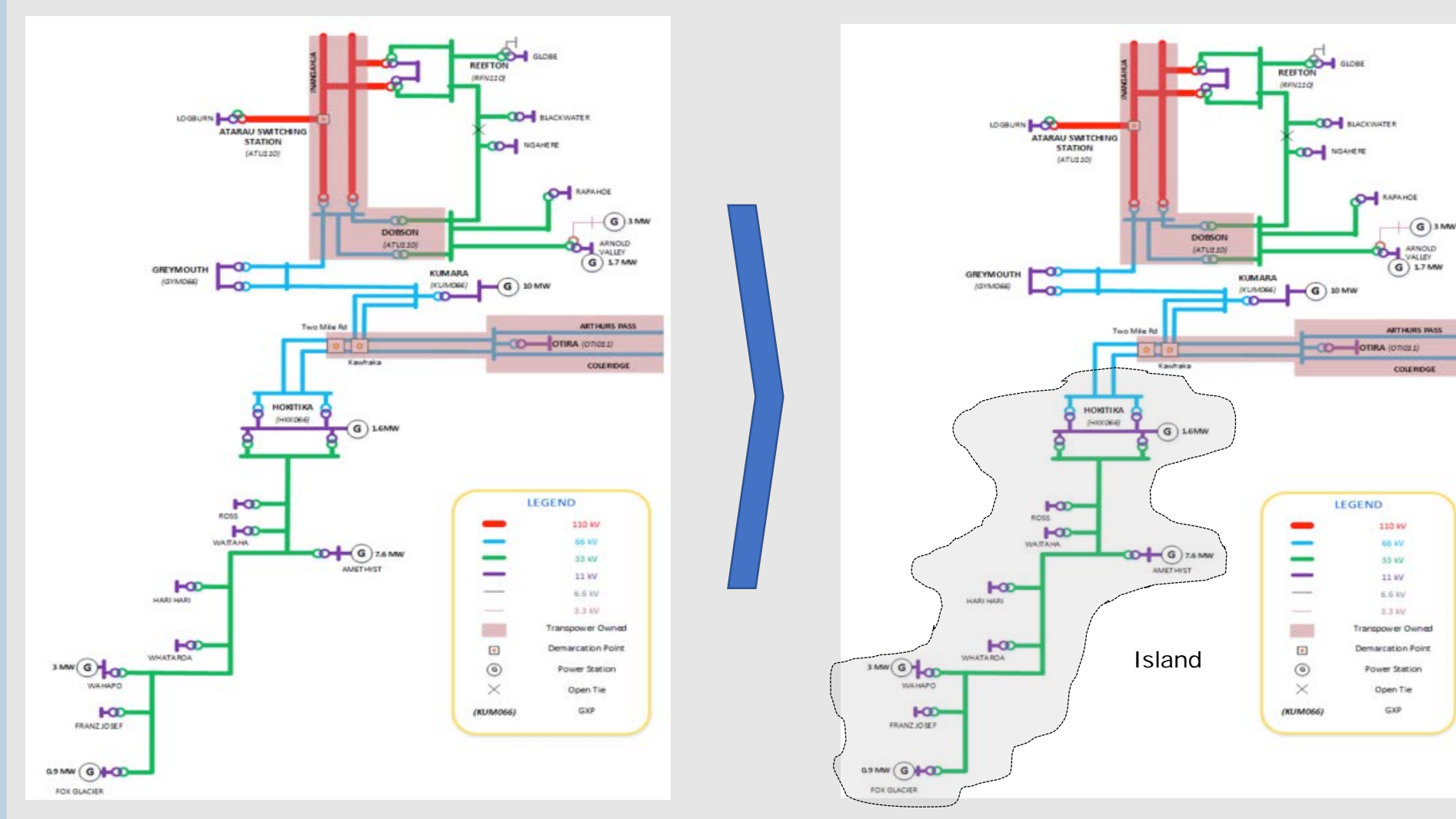
OR

Component Fragility Curves

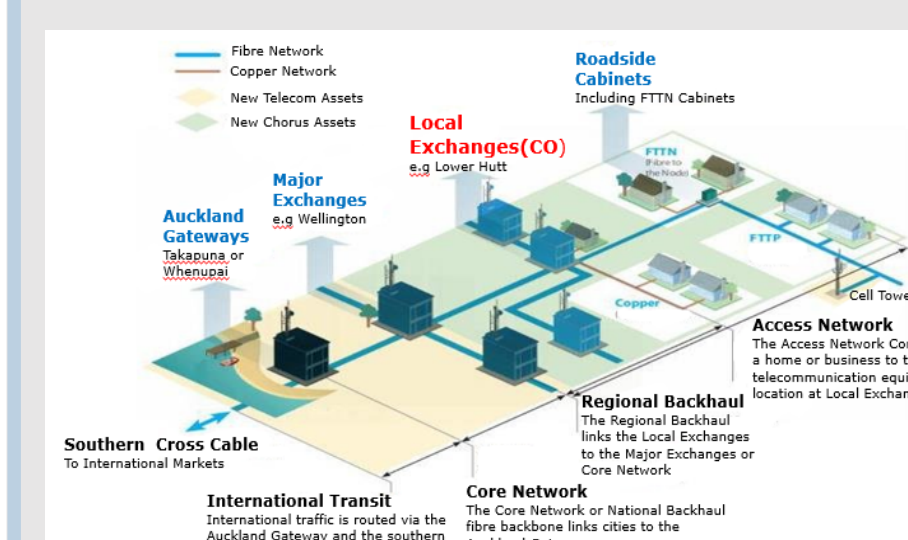
More Scenarios



#### Islanded Scenarios

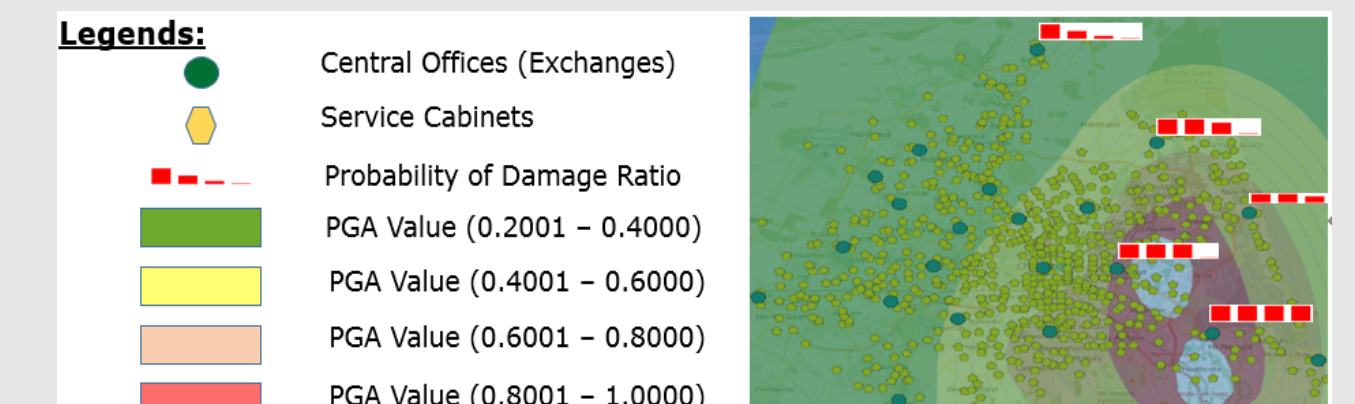


#### Communication Infrastructure and Services



	Domain 1	Domain 2	Domain 3
Preparedness	Matrix A		
Service Delivery	Matrix B	Matrix C	
Recovery			

#### Seismic Risk Quantification



- Combination of geospatial data and electrical data is necessary for restoration, and overall resilience, assessment.
- Presence of Distributed Energy Resources (DERs) in the distribution network increases the resilience if they can operate in sustained island mode operation.
- Realistic modelling of the electricity network is required for different studies and depends on the spatial and temporal focus areas of interest following major natural disturbance .
- Sequence of network re-energization is possible with proper coordination amongst the various energy assets: transformers, transmission lines, capacitor banks etc.
- Island detection method is a key important feature to enable transitional islanding and subsequent reconnection to grid.
- Assessment of protection is dependent on the schemes being applied on distribution network during grid connected mode.

- Developed a seismic hazard model (using GIS tool) to quantify the risk to spatially distributed critical communication infrastructure and validate against AF8 West Coast Scenarios.
- Piloted a framework for measuring resilience in communication infrastructure for seismic hazards along with Chorus.
- Developing guidelines for Future Resilient Communication Network Architecture and its interaction and dependencies with electricity lifeline.



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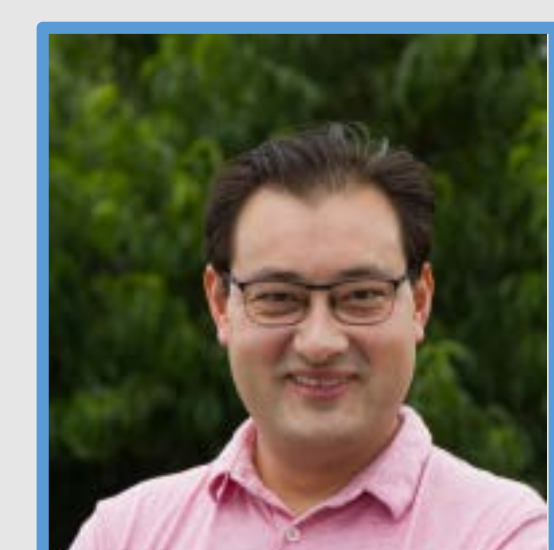
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