

EECA Electrical Network Capacity Review

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Regional Assessment

- Why?
 - Net Zero Carbon goals
 - Can the grid and distribution networks cope with the extra load?
 - EDBs and Transpower look at capacity individually, no view of the whole system
 - Lack of information available to industrial energy consumers – cost and capacity
- Who could the information help?
 - Private energy consumers – food, material processing
 - Public energy consumers – DHBs, universities, councils

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Scope of Engagement

- Develop a system wide, regional view of the capacity and constraints of the electrical network within New Zealand
- Provide a view of the load characteristics of individual electrical substations
- Consider a number of Load Conversion Opportunities and specify possible infrastructure upgrade requirements and costs associated with connecting

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Data Processing

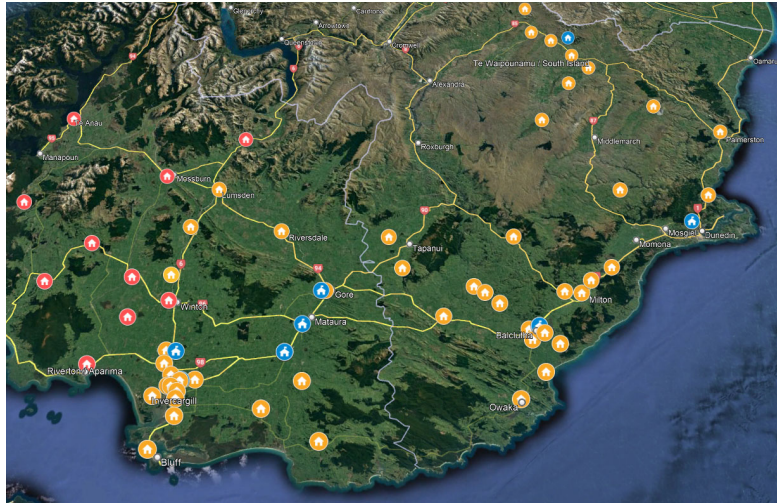
- Data from Transpower, EDBs can be in different formats
- Generally measured or averaged at 30-minute intervals
- For example, the PowerNet area:
 - 76 Zone Subs and 9 GXPs with different numbers of feeders
 - 17520 trading periods in a year
 - = a lot of data!
- Need to visualise data to make it useful

Timestamp	Feeder 1	Feeder 2	Feeder 3	Feeder 4	Feeder 5
2020-01-0100:00:00	52.45	17.22	3.74	17.00	50.77
2020-01-0103:30:00	48.51	16.00	8.74	15.74	45.46
2020-01-0107:00:00	45.67	17.67	6.33	15.07	39.58
2020-01-0110:30:00	42.43	16.33	6.53	14.81	38.12
2020-01-0114:00:00	40.88	15.88	6.55	12.07	36.22
2020-01-0117:30:00	40.52	15.39	6.26	12.86	36.07
2020-01-0121:00:00	40.12	14.67	6.33	12.14	34.41
2020-01-0124:30:00	39.62	13.67	6.00	12.33	32.86
2020-01-0128:00:00	39.07	13.46	5.33	12.81	33.26
2020-01-0131:30:00	40.04	14.80	5.74	11.07	32.00
2020-01-0105:00:00	39.29	13.76	5.33	11.78	31.41
2020-01-0108:30:00	40.12	32.25	6.52	15.78	32.33
2020-01-0112:00:00	45.04	42.35	8.67	16.67	32.33
2020-01-0115:30:00	44.00	48.45	11.19	18.52	32.33
2020-01-0119:00:00	45.59	50.97	9.93	18.52	32.52
2020-01-0122:30:00	51.97	55.19	11.78	19.33	31.68
2020-01-0126:00:00	51.00	55.41	10.22	21.26	34.45
2020-01-0129:30:00	53.26	50.77	11.26	20.81	35.37
2020-01-0133:00:00	55.10	47.28	12.21	23.04	39.68
2020-01-0136:30:00	53.67	41.53	13.33	21.11	42.02
2020-01-0140:00:00	60.79	35.41	12.12	23.56	46.14
2020-01-0143:30:00	64.12	35.11	13.12	22.44	51.12
2020-01-0147:00:00	66.35	30.19	12.54	21.11	51.46
2020-01-0150:30:00	66.35	26.54	12.33	23.47	56.49
2020-01-0154:00:00	67.23	24.88	12.56	25.54	63.31
2020-01-0157:30:00	68.44	24.23	12.44	26.35	64.86
2020-01-0201:00:00	66.76	24.85	11.21	23.09	63.11
2020-01-0204:30:00	64.44	21.33	10.33	23.65	63.00
2020-01-0208:00:00	64.91	23.24	10.56	23.12	62.89
2020-01-0211:30:00	64.58	31.94	11.00	23.56	60.65
2020-01-0215:00:00	67.19	41.73	13.35	24.79	56.39
2020-01-0218:30:00	63.63	48.94	13.67	27.03	56.48
2020-01-0222:00:00	61.47	52.58	13.67	27.89	54.98
2020-01-0225:30:00	63.23	53.09	12.77	29.00	56.67
2020-01-0229:00:00	64.68	51.54	13.33	29.67	58.33
2020-01-0302:30:00	63.63	43.29	12.87	29.78	62.37
2020-01-0306:00:00	69.42	36.39	11.42	31.68	69.31
2020-01-0309:30:00	66.06	31.03	12.33	31.22	67.14
2020-01-0313:00:00	67.69	28.00	12.14	28.56	68.33

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GXP and Zone Substation Locations

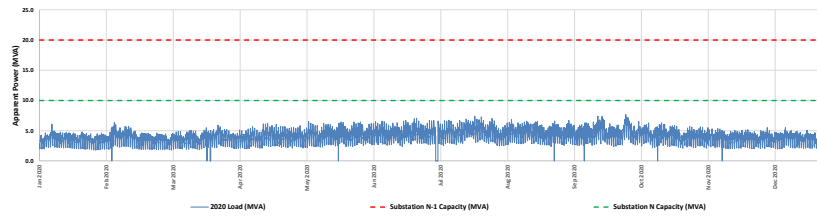


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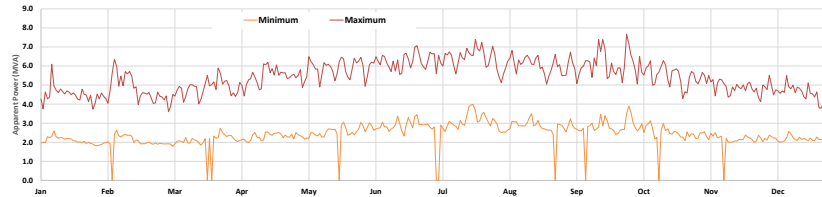


Example Electrical Load Characteristics

Example Zone Substation (2020 year) - Half hourly loading



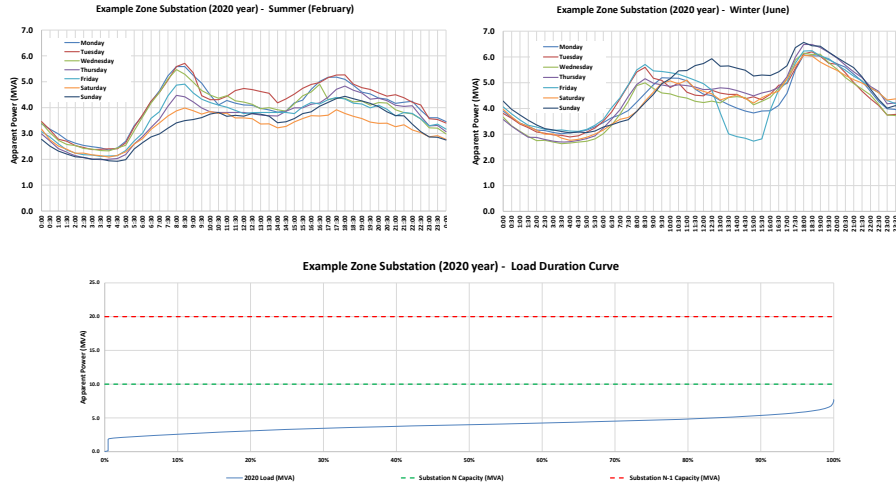
Example Zone Substation (2020 year) - Daily Maximum/Minimum



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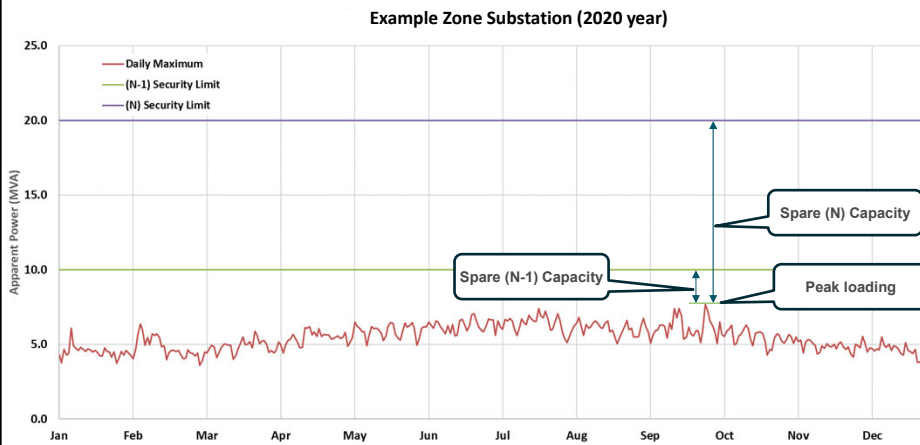
Example Electrical Load Characteristics



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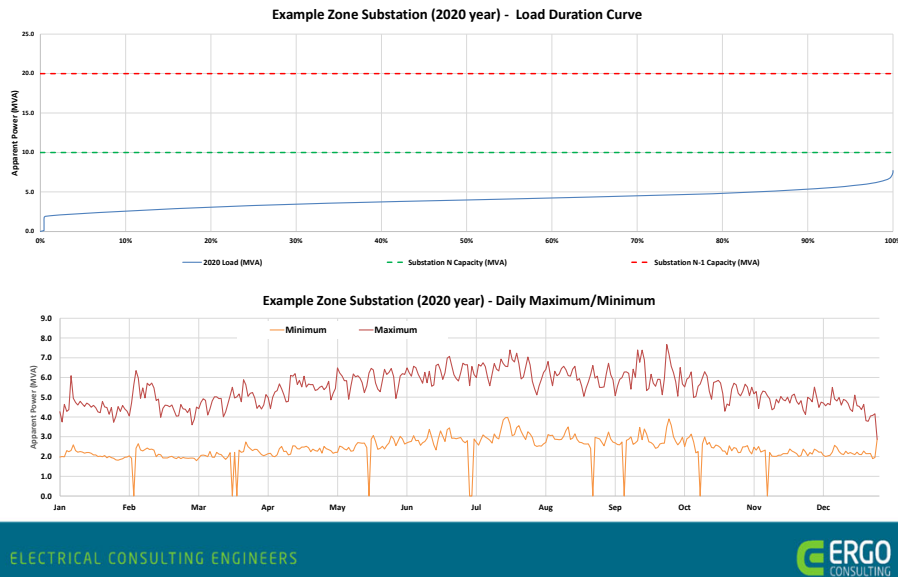
(N) and (N-1) Security



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Why so many graphs?



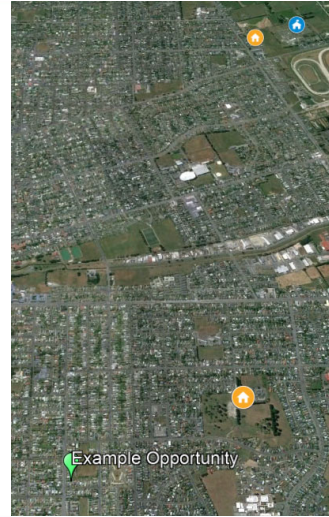
Load Conversion Opportunities (LCO)

- EECA provided a list of “Opportunities”
- Considered the existing network capacity at:
 - Transmission
 - Sub-transmission
 - Distribution
- Where upgrades were required, used a building block approach to scoping and costing connection options
- Purpose was to provide a high-level view of likely implications and costs

Example Opportunity

- Opportunity - 6MVA, approx. 2.5km from the nearest zone substation
 - Incoming 220kV transmission circuits have significant spare capacity
 - Local GXP has ≈30MVA (N-1) spare capacity
 - 33kV sub-transmission circuits appeared to have sufficient capacity
 - Local Zone Substation has ≈2MVA (N-1) spare capacity on the 10MVA Transformers
 - Unlikely the existing 11kV network could supply the load
- Likely network upgrades and cost estimate

Network Asset	Equipment	Number and Capital Cost (\$M)	
Distribution	Medium supply transformer (ZSS)	2.00	\$2.00
Distribution	11kV circuit breaker bay	1.00	\$0.10
Distribution	Single underground 11kV cable	2.50	\$1.00
TOTAL			\$3.10



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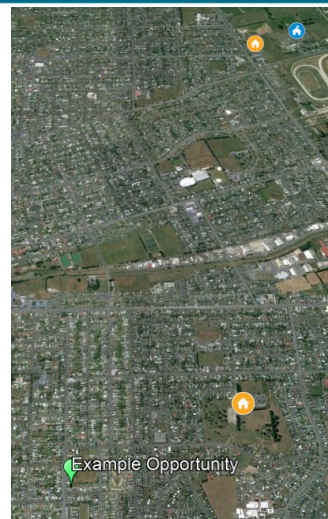
Example Opportunity

- What about if the customer would accept load shedding?
- Filling in the gaps instead of adding on top...

Network Asset	Equipment	Number and Capital Cost (\$M)	
Distribution	Protection Changes (TOPS)	1.00	\$0.20
Distribution	11kV circuit breaker bay	1.00	\$0.10
Distribution	Single underground 11kV cable	2.50	\$1.00
TOTAL			\$1.30

A saving of ~\$1.8m

- What if opportunities shared upgrade costs?



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Next Steps

Undertake detailed Power-flow studies, requiring further input information:

- Daily and seasonal load profiles for LCO's (MW/MVA)
 - Network and LCO security requirements
 - Transmission and Distribution network models
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- Develop more detailed engineering concepts and optioneering

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