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PROFESSIONAL DEVELOPMENT

Annual Power Engineering Exchange (APEX)

Network designing for EV charging stations at park and ride facility.

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The Lines Company

Narnarayandev

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INTRODUCTION

The electrification of transportation has been developed to support energy efficiency and CO_2 reduction. As a result, electric vehicles have become more popular in the current transport system.

Advantages – Quiet, environmentally friendly, less maintenance cost.

Disadvantages – Expensive, longer charging time, less mileage.

TLC working closely with the local council invested in installing 14(7kW) slow EV chargers at National park - park and ride facility.

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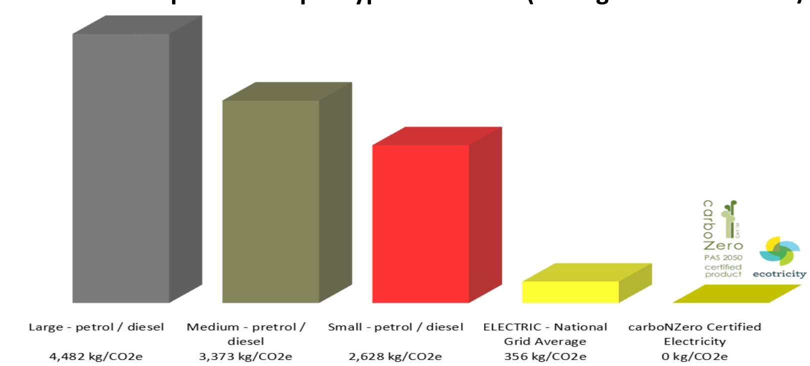
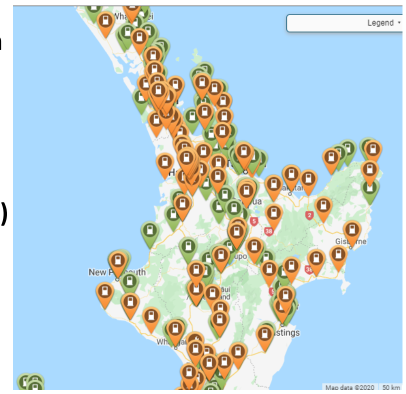
BENEFITS OF ELECTRIC VEHICLES IN NEW ZEALAND

- Less oil imports which will save $2 billion per year and save $370m in health costs per year.
- Reduce CO2 emissions by 6 billion kgs per year and our rivers would receive less oil pollutants.

Fuel Emissions per annum per type of vehicles (average 40km travelled/day)





New Zealand EV charging station Map

MAP : https://driveelectric.org.nz/chargers-map/

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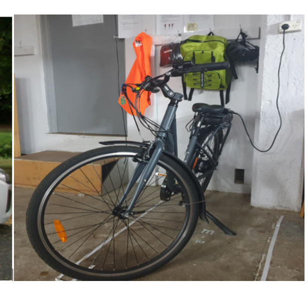
TLC EV INITIATIVES

TLC is supporting the EV program by installing more EV chargers on the Network and investing in a EV fleet;

- EV chargers installed by TLC
  - Te Kuiti New world
  - Otorohanga Town
  - TLC Depots
- EV chargers SITE under construction
  - Ohakune Town
  - Taumarunui Town

- Proposed EV charger installation
  - King street, Te Kuiti
  - 2nd Charger in Otorohanga Town



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ENGINEERING DESIGN

Effects of adding EV charging load to a Network

- High loads of the charging stations results in increased peak load demand, voltage instability, and reduces network security.

Load profiling

- Transformer sizing

	Addition load + existing 100kVA historical Load		
	kVA	11kV A	400V A
EV load	105	5.51	151.55
Kiwi camp load	26	1.36	37.53
Proposed bus chargrer	400	20.99	577.35
Existing transformer size	100	5.25	144.34
	631.00	33.12	910.77

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Power system analysis

- Equipment ratings & spare capacity
  - Identifying all inline equipment to make sure no thermal overloads.
  - Planning for future expansions and considering back feeds .

Data Set 1						
At Normal Configration at peak load - Fed of National Park feeder						
	Equipment rating		Existing maximum load		Spare Capacity left after new laod	
In line equipment/conductors	Rated A	Rated kVA	A	kVA	A	KVA
Substation	157	3000	87.50	1667.10	69.50	1324.15
CB6767	630	12003	63.70	1213.65	566.30	10789.46
Protection OC element	150	2858	63.70	1213.65	86.30	1644.24
Mink 2.67km	210	4001	63.70	1213.65	146.30	2787.39
EV Site						

Data Set 2						
With EV peak load - Fed of National Park feeder						
	Equipment rating		Estimated maximum load		Spare Capacity left after new laod	
In line equipment/conductors	Rated A	Rated kVA	A	kVA	A	KVA
Substation	157	3000	115.37	2198.09	41.63	793.16
CB6767	630	12003	91.50	1743.31	538.50	10259.80
Protection OC element	150	2858	91.50	1743.31	58.50	1114.57
Mink 2.67km	210	4001	91.50	1743.31	118.50	2257.73
35mm2 AL 3C HV to TX	111	2114	33.00	628.73	78.00	1486.10
New transformer (750kVA) LV	1083	750	909.00	629.77	173.56	120.25
New cable to meter box (240mm2 AL) t	345	239	181.20	125.54	163.80	113.48
New cable to EV carager controld box (1	291	202	148.00	102.54	143.00	99.07

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- **Load flow and voltage profiles at 11kV**
  - The main challenge of adding EV chargers to an existing Network can rise the peak loads suddenly and lower the Voltage on the LV Circuit.
  - Installing a new dedicated transformer for the EV charger site the one LV circuit is dedicated for the EV load hence does cancels out the low voltage issue at peak times.

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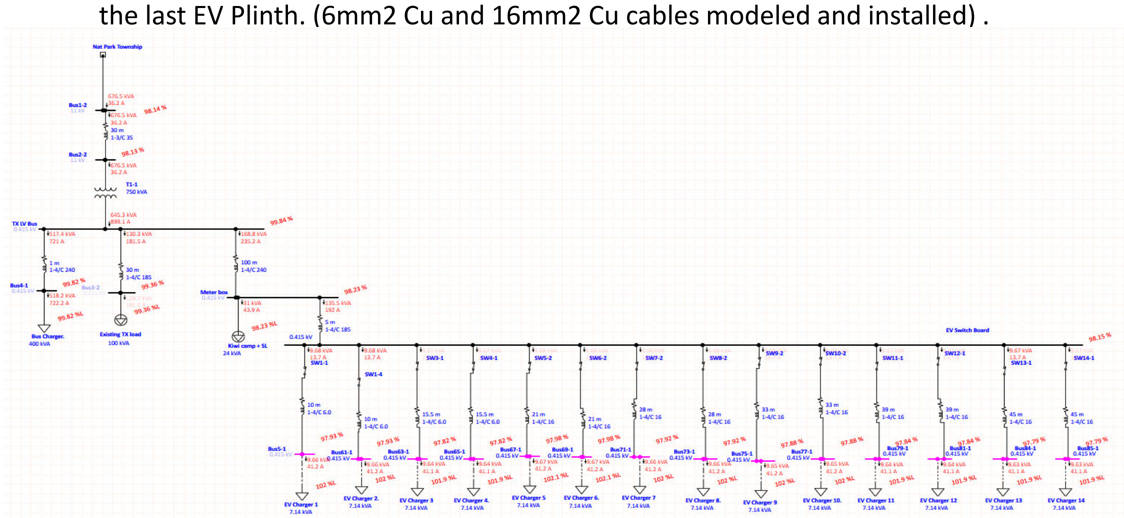
- **Load flow and voltage profiles at low voltage**
  - The lowest voltage at peak EV load at Low voltage is suspected to be 0.98pu at the last EV Plinth. (6mm2 Cu and 16mm2 Cu cables modeled and installed) .



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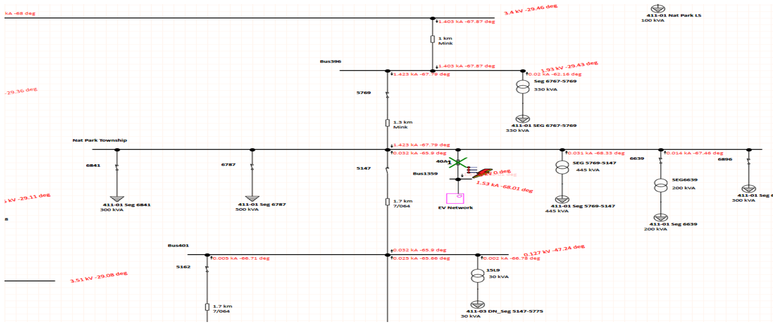
- **Protection**
  Power system protection is key to reliability, and it is important to capture all the upstream and down stream protection equipment to make sure all new fuses/CBs coordinate with the existing protection system.

LV Protection
- Check for high fault levels that can damage LV equipment.
- Highest recorded Isc was 5kA.



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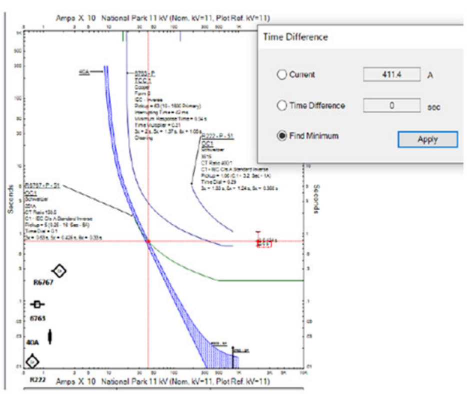
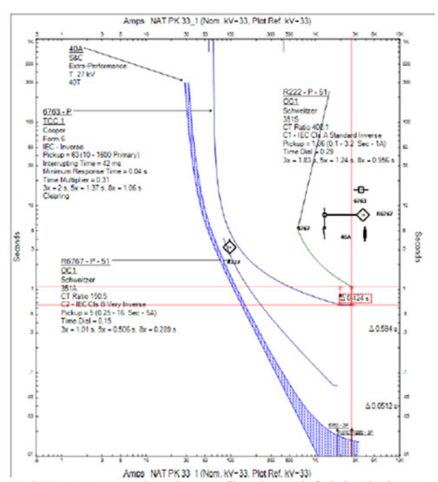
High Voltage Protection

- Fuses sizing & Protection coordination



Existing Settings Plus 40A fuse at TX and

- The minimum fault time clearing gap between CB6767 and the 40T fuse is 0s at system fault of 0.4114 KA on fuse bus – need to update CB6767 settings to achieve at least 0.3s at all fault levels



No Changes on CB6763 at 33kV so the curve will not change. The fault time clearing gap between CB6763 and CB222 will remain as it is.

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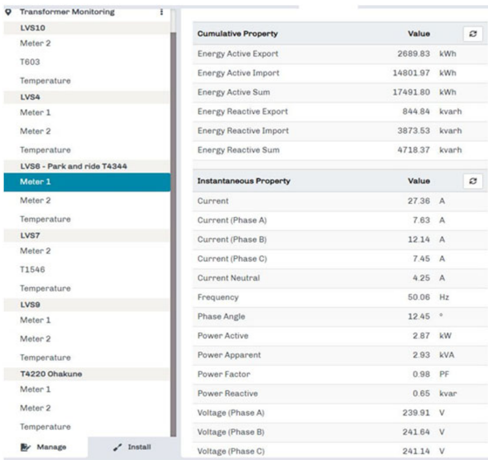
GOOD MEASURE UNIT

Being a 750kVA unit it had plenty space to install a permeant data logger that can continuously log – Current, Voltage, HZ, Phase angle, Power.



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CONCLUSION

- Electrical Vehicles have proven to reduce carbon emission in New Zealand and the world.
- Electric Vehicles can help NZ save $2.4 billion a year spent on oil and health system.
- For a 40km a day journey, gasoline vehicle's average CO_2 emission is recorded to be 3494 kg.
- Electrical vehicles come with new challenges for the distribution companies and it will be wise to consider this when designing new systems.

REFERENCES

- https://ecotricity.co.nz/electricvehicles/#evemissions
- https://driveelectric.org.nz/chargers-map/

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