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Annual Power Engineering Exchange (APEX)

The Challenge and Opportunity for Distribution Companies in Process Heat Electrification

Case Study: Open Country Dairy 13MW Electrode Boiler

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EEA.CO.NZ



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Agenda



- About PowerNet
- Process heat
- Electrode Boiler
- Challenges and opportunities of process heat electrification
 - Potential process heat electrification site
- Case Study : Open Country Dairy 13 MW Boiler Project
 - Network planning
 - Project challenges
- Key learning
- Question & Answer



In 2019-2020, we managed

- Approx. 72,000 customers
- \$ 629M in electricity distribution assets (Regulatory Value)
- 74 zone substations
- Over 14,000 km lines and cables
- 160,000 poles
- 16,000 transformers

Key industries within the network:

- Farming
- Dairy and meat processing
- Coal and gold mining
- Forestry
- Timber processing
- Tourism



What is Process Heat?



Steam, hot water or hot gases used in industrial processing, manufacturing and space heating.

- Accounted 35% of NZ energy consumption (200 PJ)
- 55% fueled by coal and natural gas
- 28% GHE – Second largest source in the energy sector



[1] <https://www.mbie.govt.nz/dmsdocument/152-process-heat-current-state-fact-sheet-pdf>

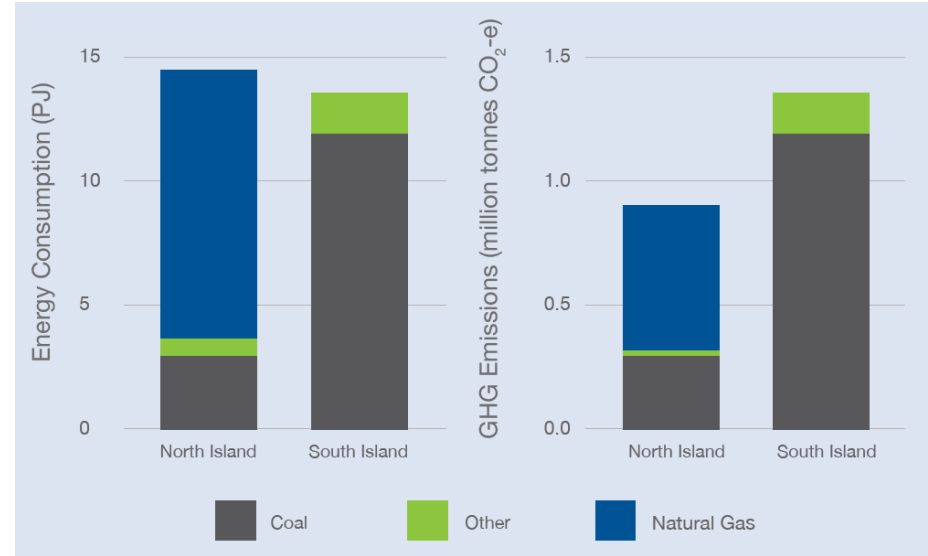
[2] <https://www.mfe.govt.nz/publications/climate-change/new-zealands-2020-emissions-target/new-zealands-2020-emissions-target>



Why Electrode Boiler?

Coal is traditionally the preferred fuel in the South Island due to its availability and low cost. It has a higher carbon emission than gas.

- Electrode boiler is energy efficient in creating on-demand process at scale ($\approx 99\%$)
- Heating from cold in less than 5 minutes or from standby in about 1 minute



Fuel demand and GHG emission in the dairy manufacturing sector, 2016 – North/South Island [1]

[1] <https://www.mbie.govt.nz/dmsdocument/151-dairy-manufacturing-fact-sheet-pdf>



Process Heat Temperature Requirements



| Category | Temperature requirement | Uses | Example |
|----------|-------------------------|--------------------------------|--|
| Low | Less than 100°C | Water heating Space heating | Sanitisation of equipment in the food processing sector |
| Medium | Between 100 to 300°C | Industrial processes | Drying wood products, Drying food products, e.g. milk powder |
| High | Greater than 300°C | Industrial processes | Oil refining, Melting metals, Chemical manufacturing |

- $\approx 200^{\circ}\text{C}$ for drying milk powder

[1] <https://www.mbie.govt.nz/dmsdocument/152-process-heat-current-state-fact-sheet-pdf>



Process Heat Electrification Challenges



- Remoteness of site and connection size
 - Low customer density in Southland (≈ 4 customers / km)
- Complexity in network planning
 - Estimating of possible investment needed in network planning
- Long planning, consenting and construction times
- Customer connect directly from transmission network as they expand

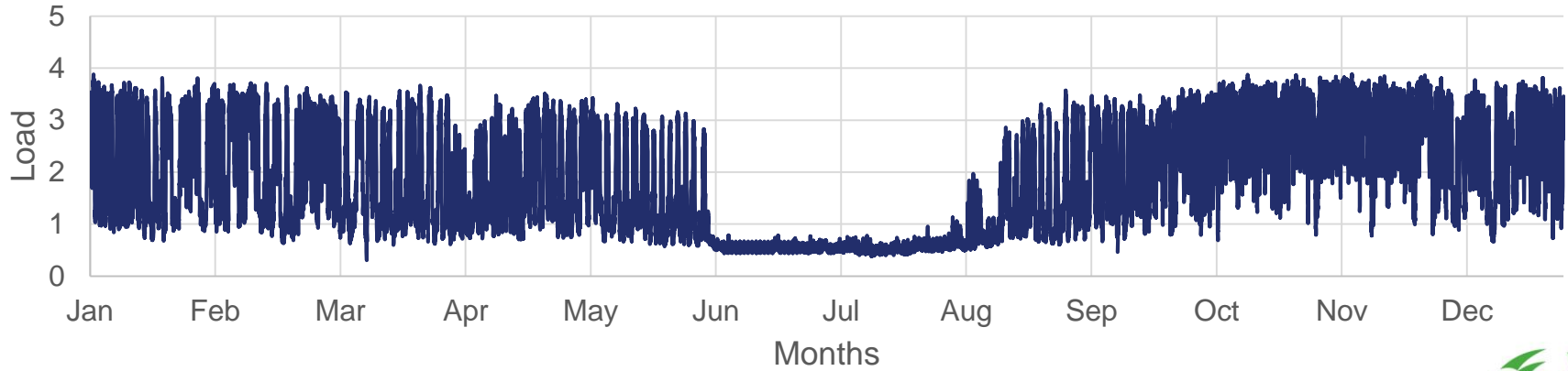


Process Heat Electrification Opportunities



- Seasonal energy demand from the meat and dairy sectors
- Increase network utilisation

Dairy factory electricity demand

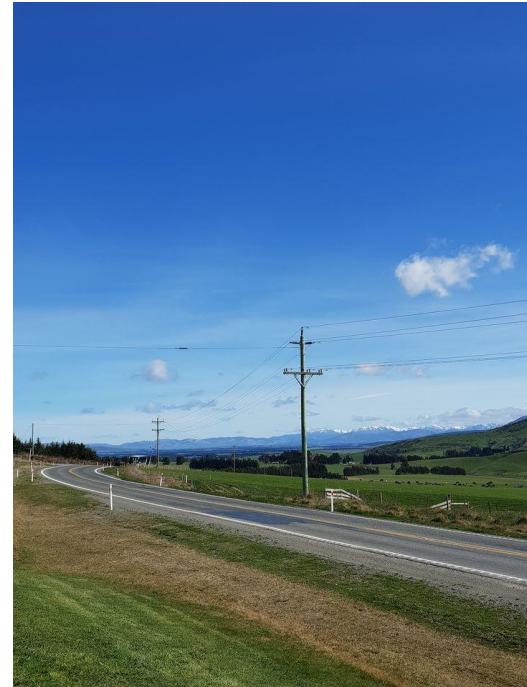
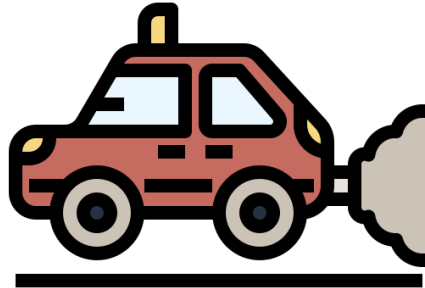
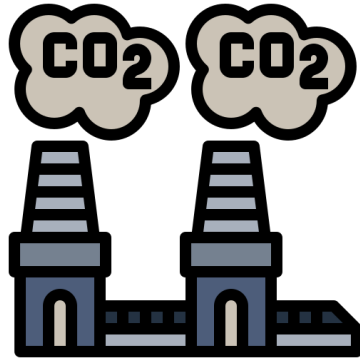


Non-Network Opportunities

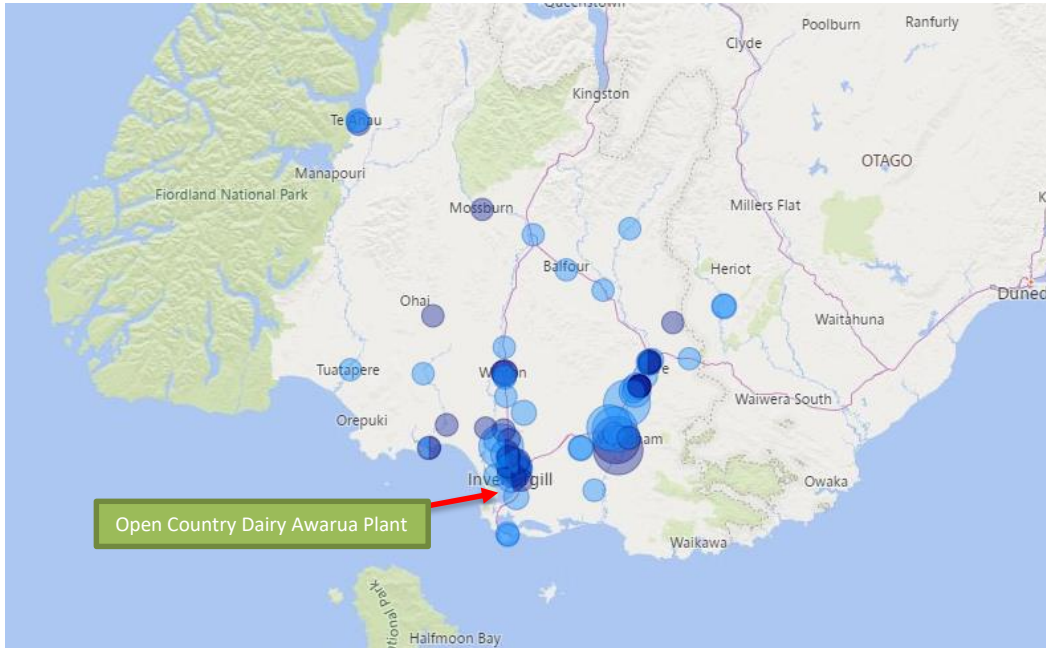


Environmental and social benefits

- Improve air quality
- Health and Safety
- Transport (Reduce transporting fuel and waste)



Potential Process Heat Electrification Site



Age

- <20Yrs
- >20Yrs

- Boiler useful lifespan: 20 to 40 years

≈ 65 MW Dairy Industry

≈ 25 MW Meat Processing

[1] <https://www.mbie.govt.nz/dmsdocument/152-process-heat-current-state-fact-sheet-pdf>

[2] <https://greatsouth.nz>



Case Study: Open Country Dairy (OCD)



Awarua Plant Expansion:

- Capable in producing higher-value whole milk powder, skim milk powder and anhydrous milk fat
- Increase plant production capacity by 50%
- 13 MW electrode boiler
 - Strong environmental focus
 - Willing to adopt new technologies

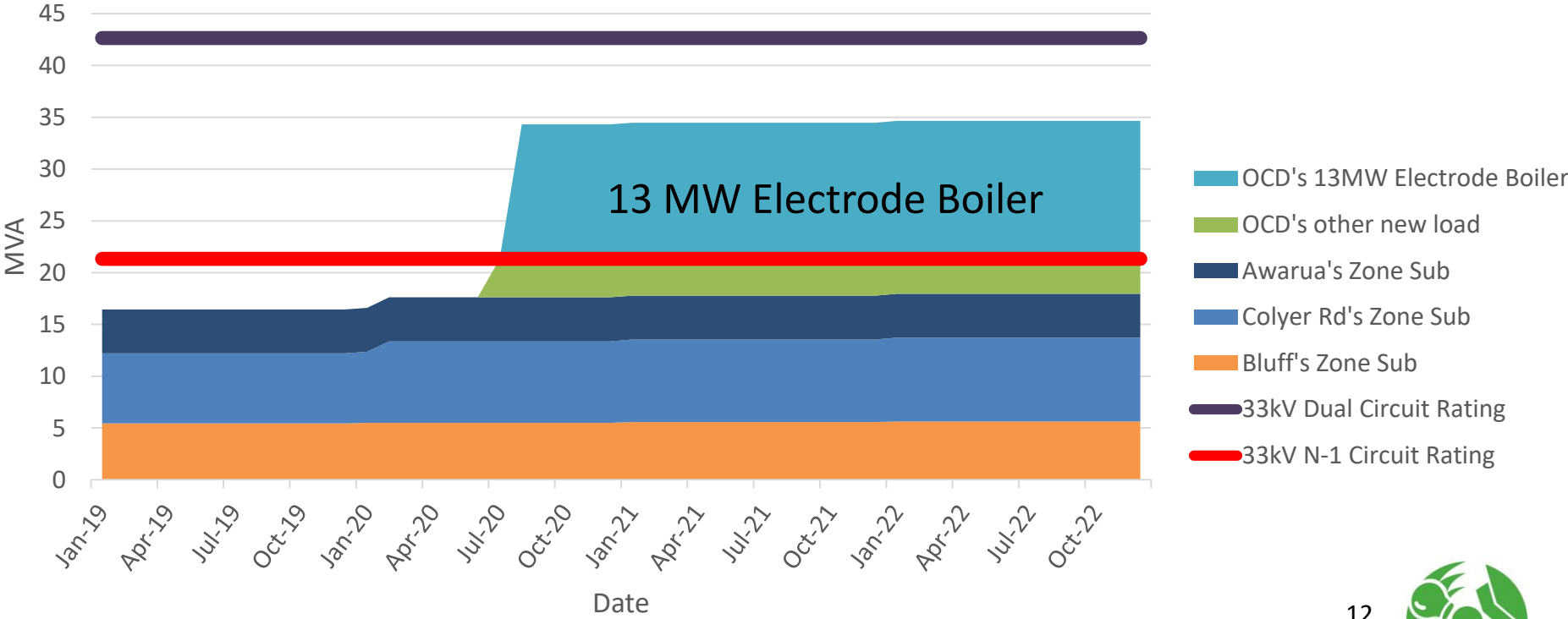


[1] <https://www.opencountry.co.nz/our-products/>

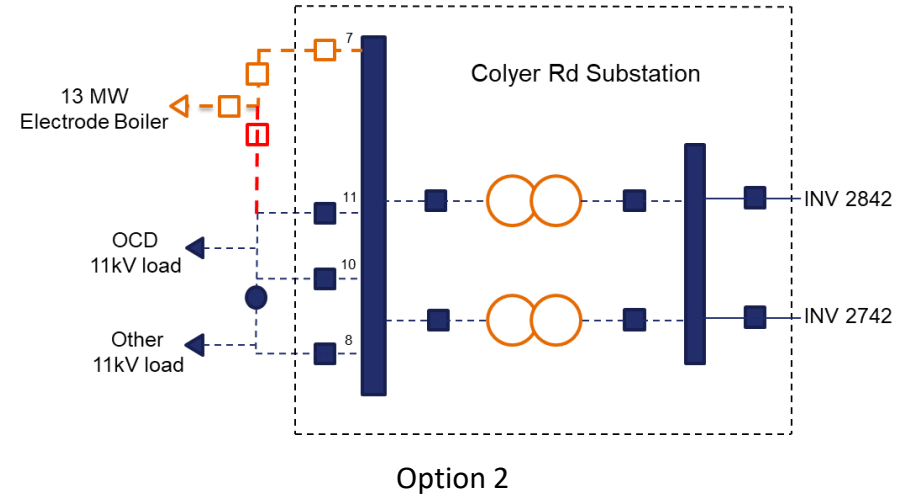
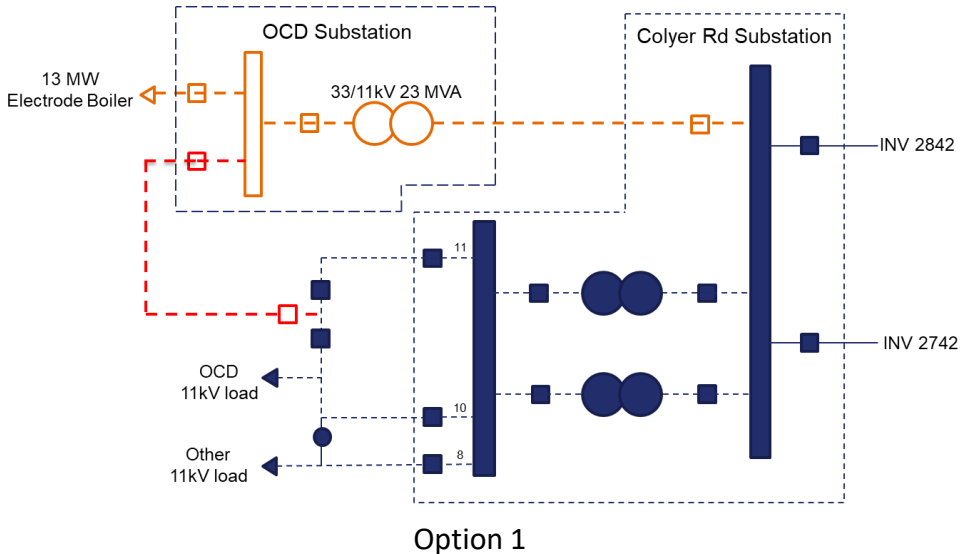
[2] <https://www.waterfordpress.co.nz/business/open-country-dairy/>



Sub-transmission Demand Forecast



What were the Options?



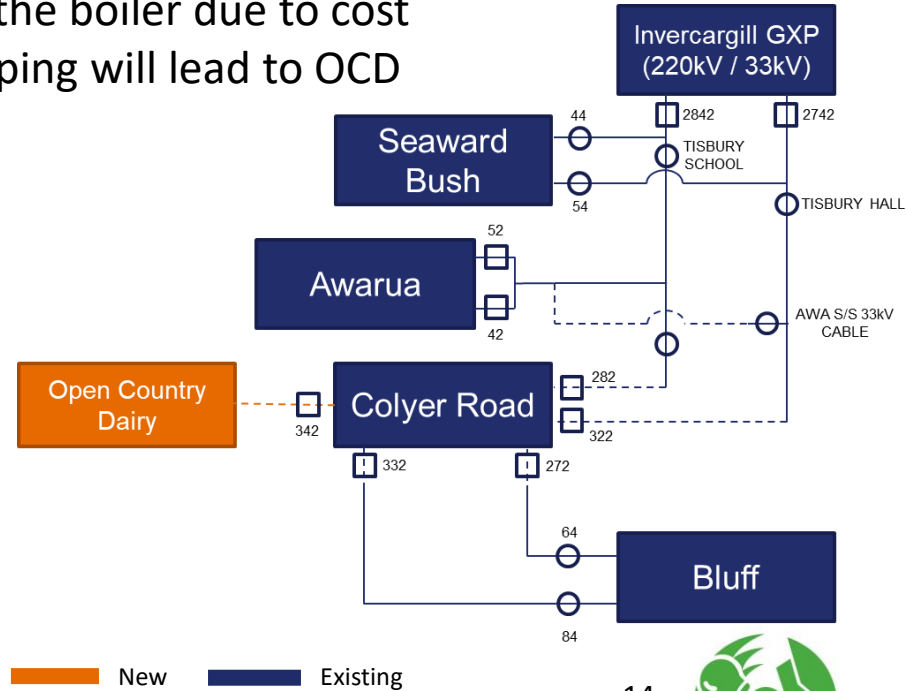
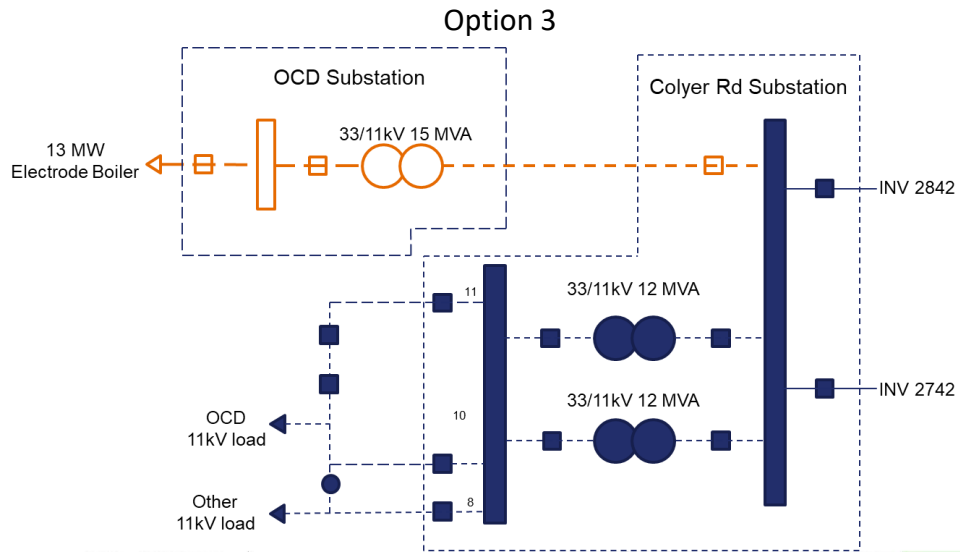
- 11kV N-1 options

New / Upgrade
 Existing
 Inter-connection



How we Delivered 13MW ?

- OCD picked option 3
- Agreed by OCD no N-1 contingency supply to the boiler due to cost
- Overload condition at INV GXP or breaker tripping will lead to OCD boiler disconnected from the network



Project Challenges



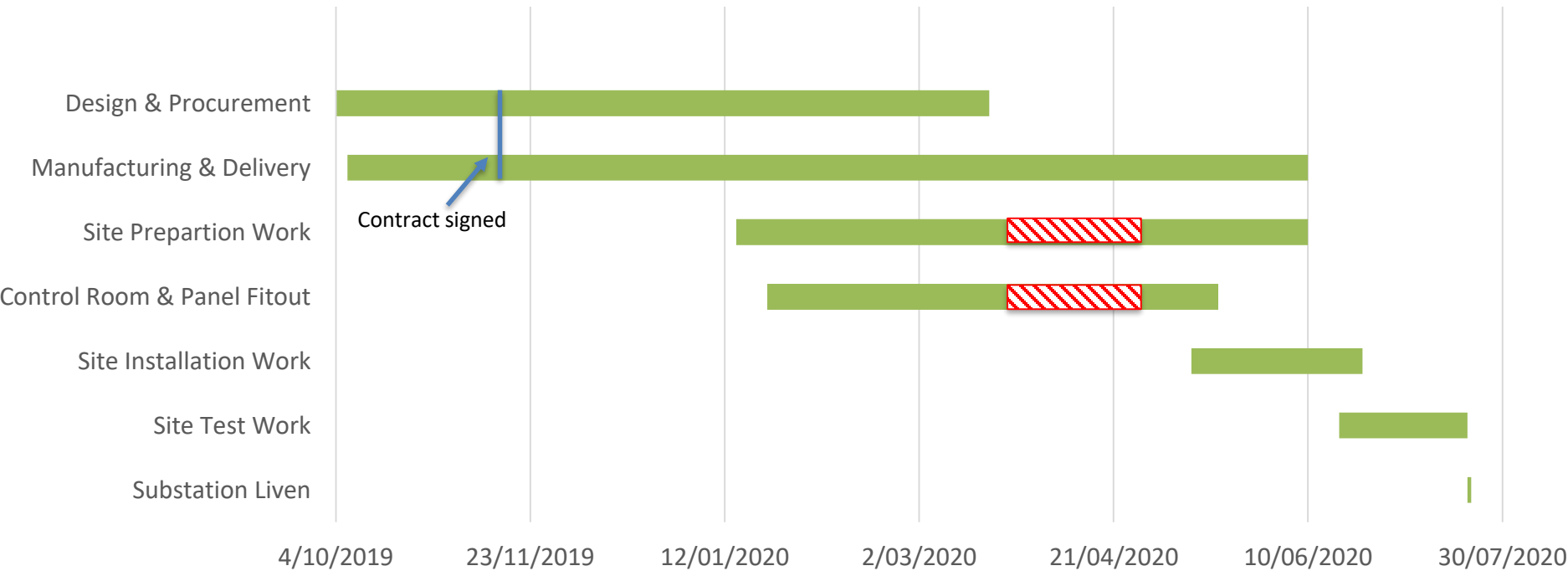
- Short time frame (8 months)
- COVID-19
- Transformer's factory acceptance test (FAT) and delivery delays

How target was achieved?

- Transformer FAT completed remotely
- Contractors willing to put additional hours
- Special task force team led by project managers



Project Gantt Chart



On site construction time: 31 weeks

 COVID-19 Alert Level 4



Key Learnings

- Plan ahead and build a future proof network
- Network maintenance needs to be timed and managed with customers in order to minimize impacts to both parties
- Early communication and alignment with stakeholders is key
- Understanding customer's requirements
 - Willing to compromise on reliability (no N-1)



Thank You



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