Bus Carbon Emissions Modelling

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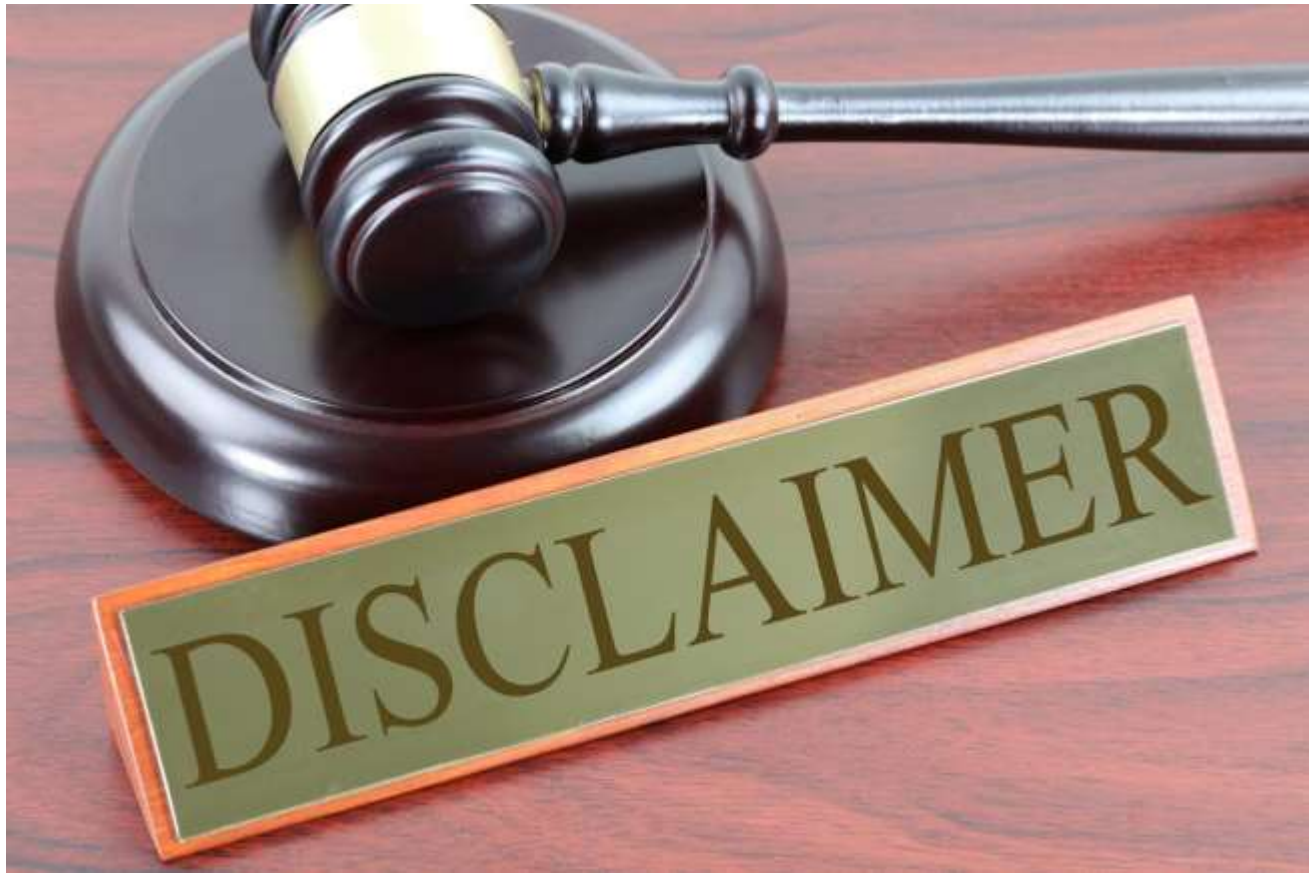
And Victoria University

May 2021

Disclaimer

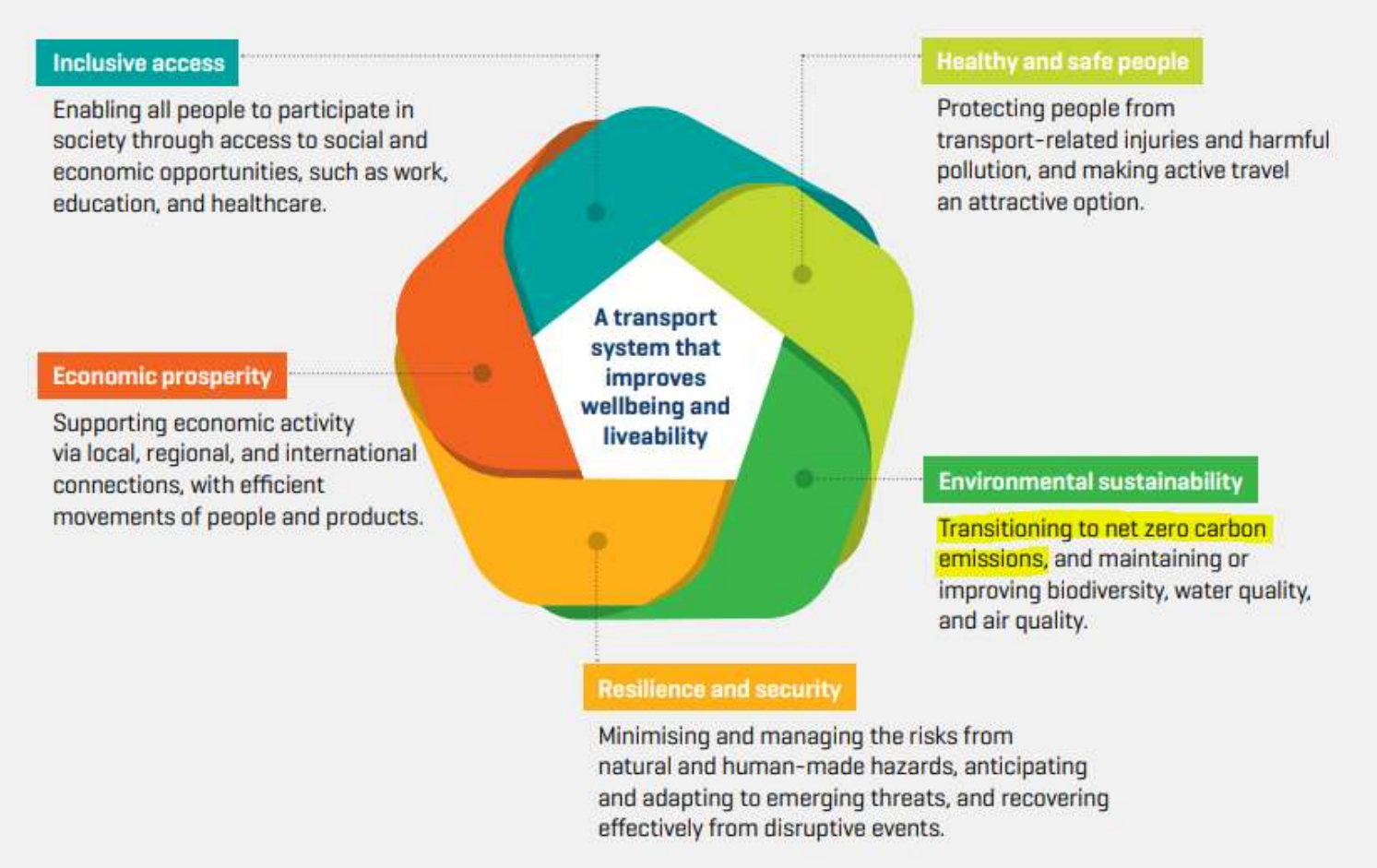


- The material in this presentation predates my arrival at Waka Kotahi
- The work presented is work I have led, however:
  - I am not representing Waka Kotahi
  - I am not representing Greater Wellington Regional Council
  - Any views expressed are entirely my own

What are our targets?

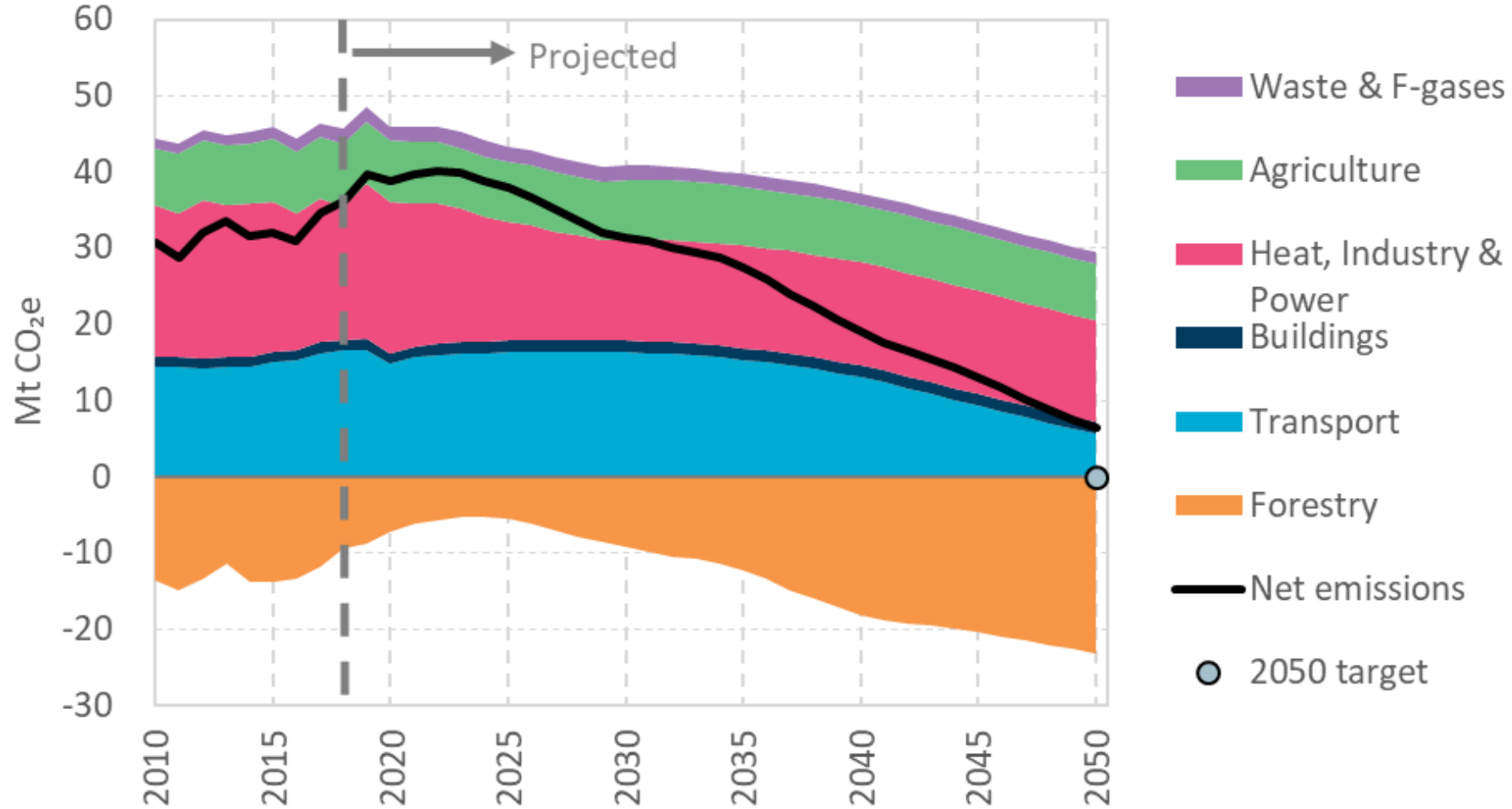
G.P.S Transportation 2021 & Climate Change Response Act 2021

- 20% of NZ GHG is from transport
  - 90% of that is road transport
- Paris Accord:
  - Reduce GHG to 30% below 2005
- Climate Change Response Act:
  - Be net zero carbon by 2050
  - Zero Emissions Vehicles (2025)



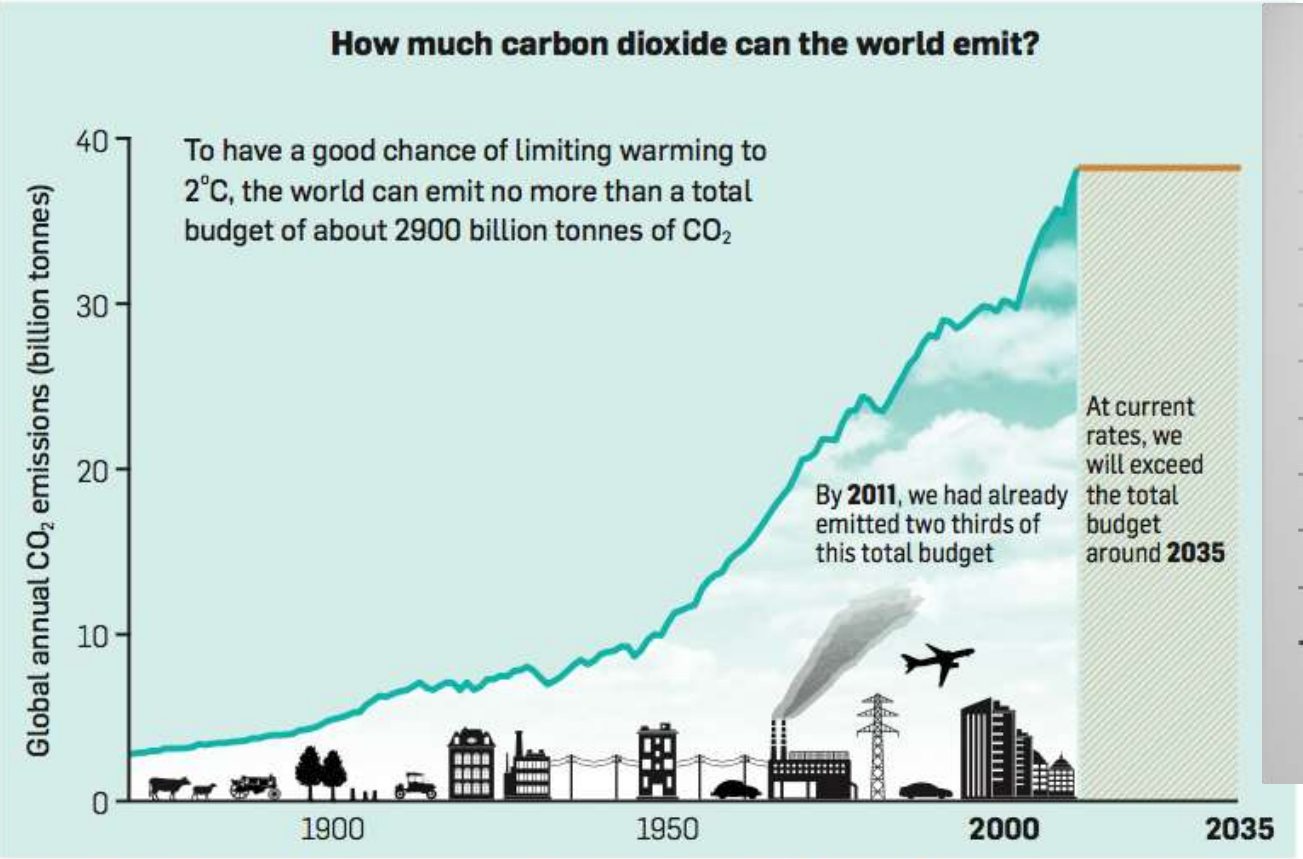
Transportation is a key intervention focus area

Previous Deferred Decisions require Ambitions Targets

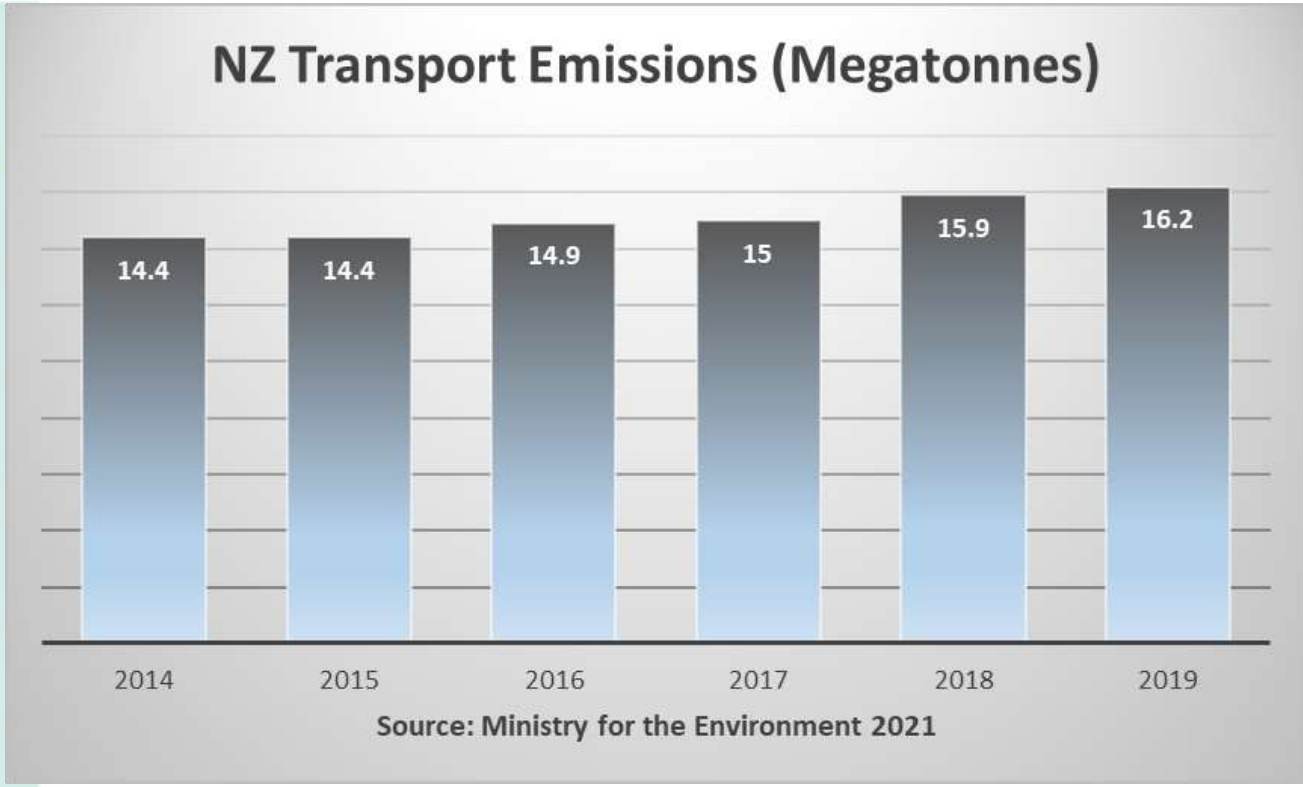


Emissions are Trending Upwards

FIGURE 1

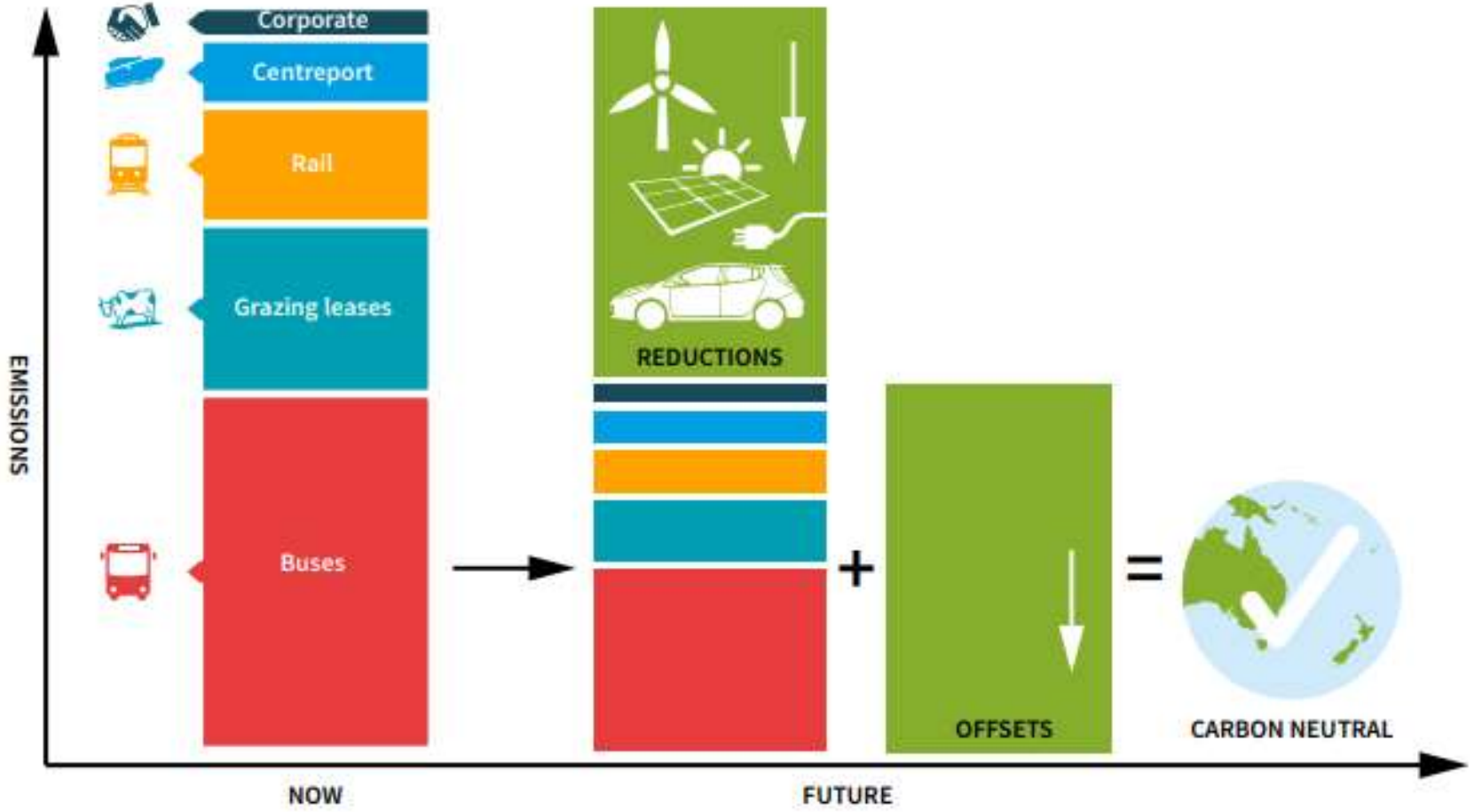


Source: Information is sourced from the IPCC's Fifth Assessment Report, Working Group 1 (emissions data, Figure 6.8; carbon budget, SPM E.8)



We’re beginning to understand the problem

But can we quantify viable solutions?



Public Transport Carbon Modelling - Timeline

- 2017 Collaboration with Victoria University for new decision support tools
- 2018 – improved bus loading/trip data became available
- 2019 – Emissions Impossible provided formulae for bus emissions
- 2019/20 VUW developed tools to calculate emissions for each bus trip
- 2020/21 Carbon Footprint & Decarbonisation Scenarios
- 2021 Auckland Pilot Study

Ingredients (a.k.a. Data)

Bus Data / Fleet Lists:

- Bus Tare Weight
- Bus Euro Class

Trip data:

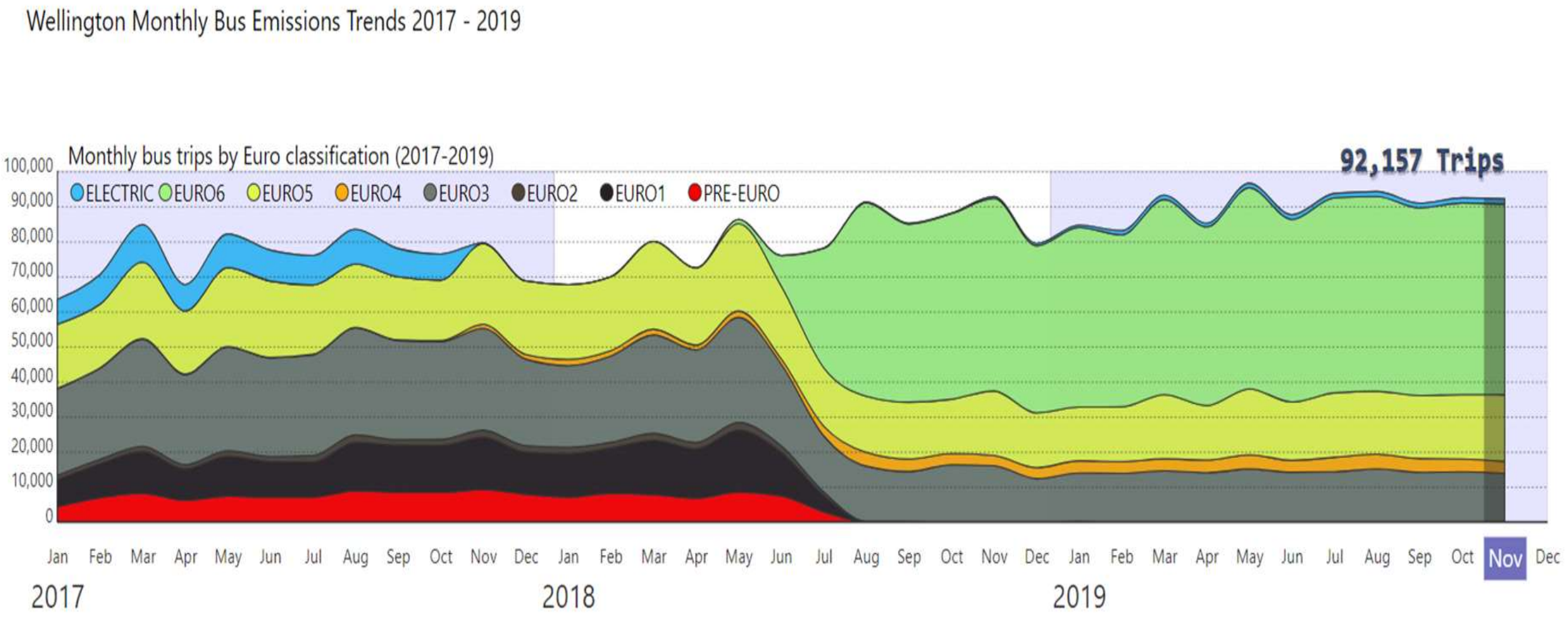
- Bus ID
- Trip distance
- Average speed
- Bus loading/mass
- Cancellations

Bus Fleet Emissions 2017 - 2019

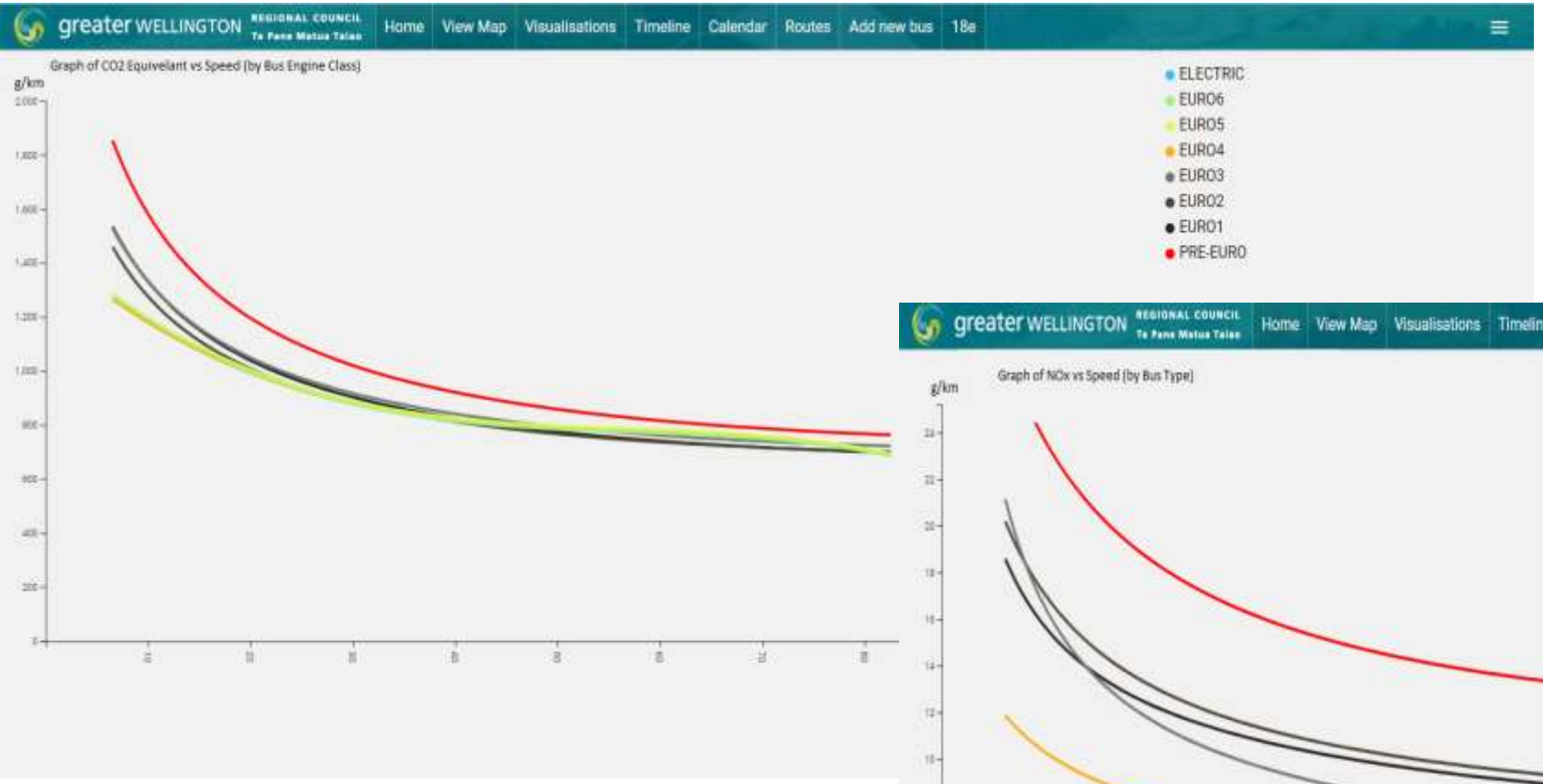
- 2,900,000 recorded bus trips
- Emissions calculated for each bus trip

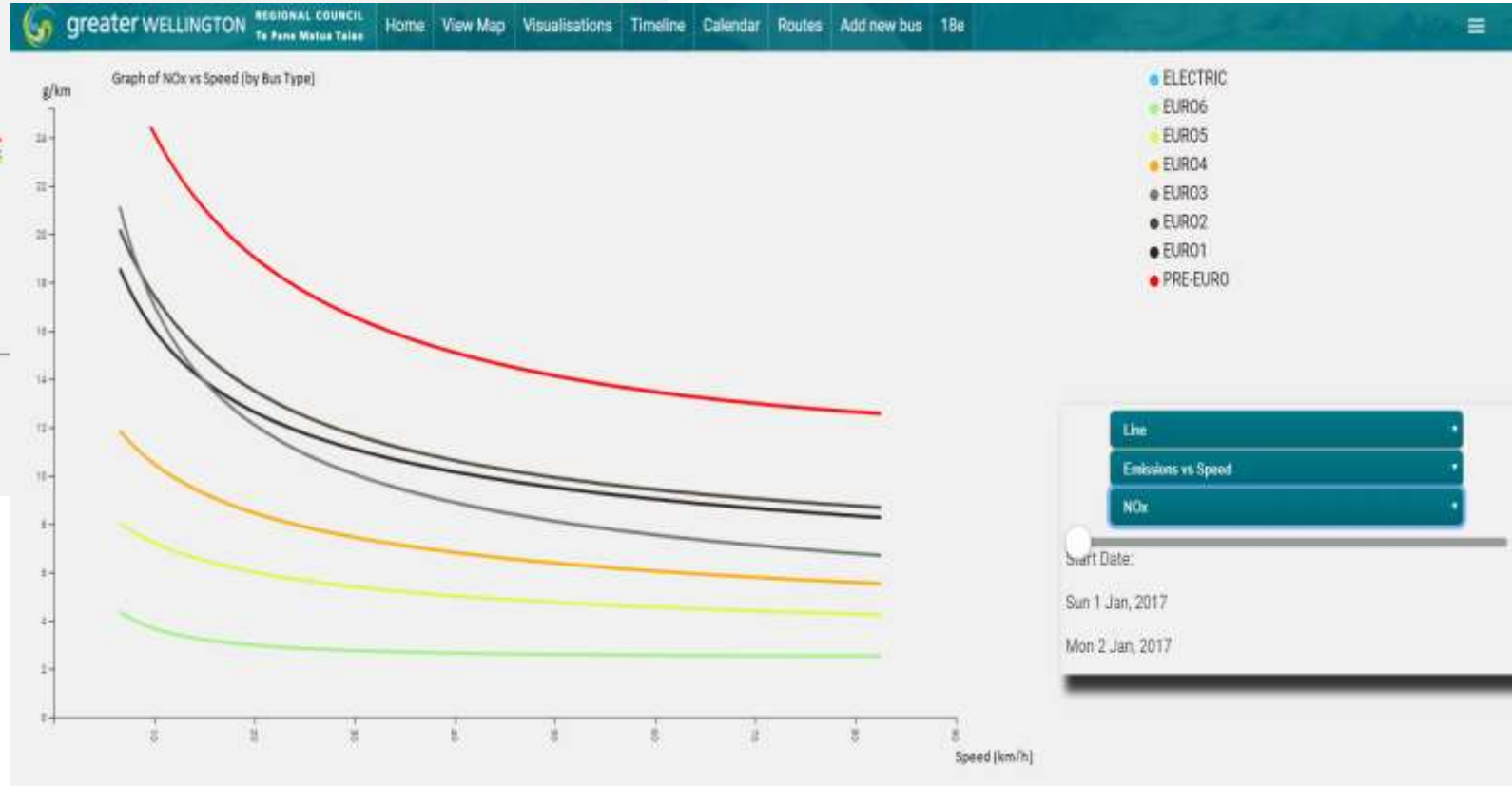
route	Trip id	vehicle	type	distance	time	speed	FC	CO2	NOx	CO	HC	PM	Pax km	offset
50	1200	65	PRE-EURO	7.8	1500	19	7.064	18.819	0.197	0.111	0.068	0.018	138.415	29.239
50	1206	19	EURO1	7.8	1500	19	3.090	8.250	0.081	0.021	0.007	0.004	138.415	29.239
50	1204	19	EURO1	7.8	1500	19	3.090	8.250	0.081	0.021	0.007	0.004	138.415	29.239
50	1202	65	PRE-EURO	7.8	1500	19	7.064	18.815	0.197	0.111	0.068	0.018	138.415	29.239
50	1210	125	EURO3	7.8	1500	19	3.566	9.482	0.094	0.025	0.005	0.002	138.415	29.239
50	1208	19	EURO1	7.8	1500	19	3.090	8.250	0.081	0.021	0.007	0.004	138.415	29.239
50	1214	125	EURO3	7.8	1500	19	3.566	9.482	0.094	0.025	0.005	0.002	138.415	29.239
52	1312	165	EURO5	19.792	2820	25	8.305	22.204	0.081	0.028	0.002	0.001	138.415	29.239
52	1315	172	EURO5	19.462	3000	23	8.994	24.026	0.088	0.031	0.002	0.001	138.415	29.239
52	1316	144	PRE-EURO	19.792	2880	25	8.847	23.705	0.324	0.107	0.038	0.015	138.415	29.239
52	1303	165	EURO5	19.462	3000	23	8.479	22.660	0.083	0.029	0.002	0.001	138.415	29.239

The Changing Bus Fleet



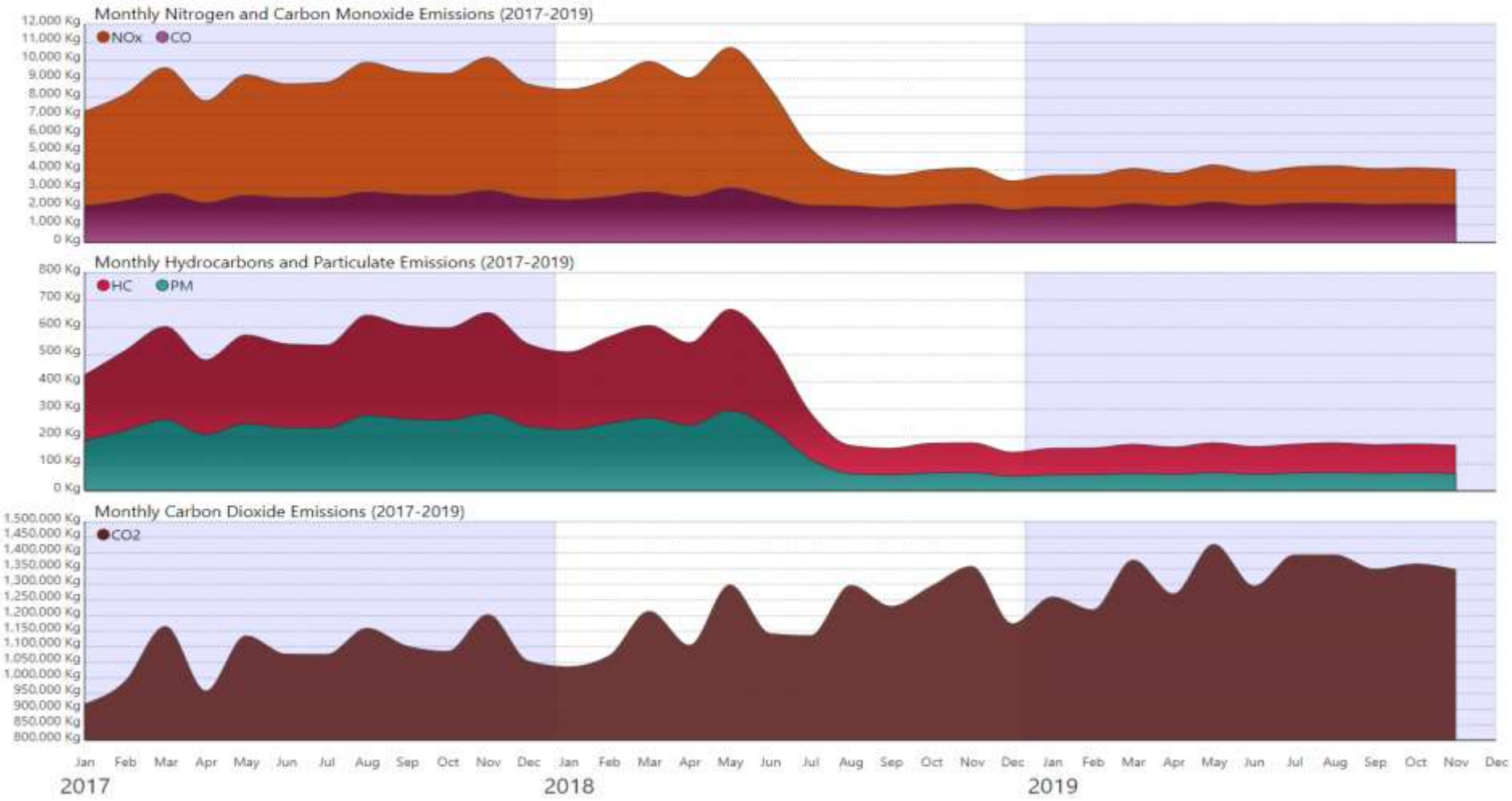
Emissions vs Speed



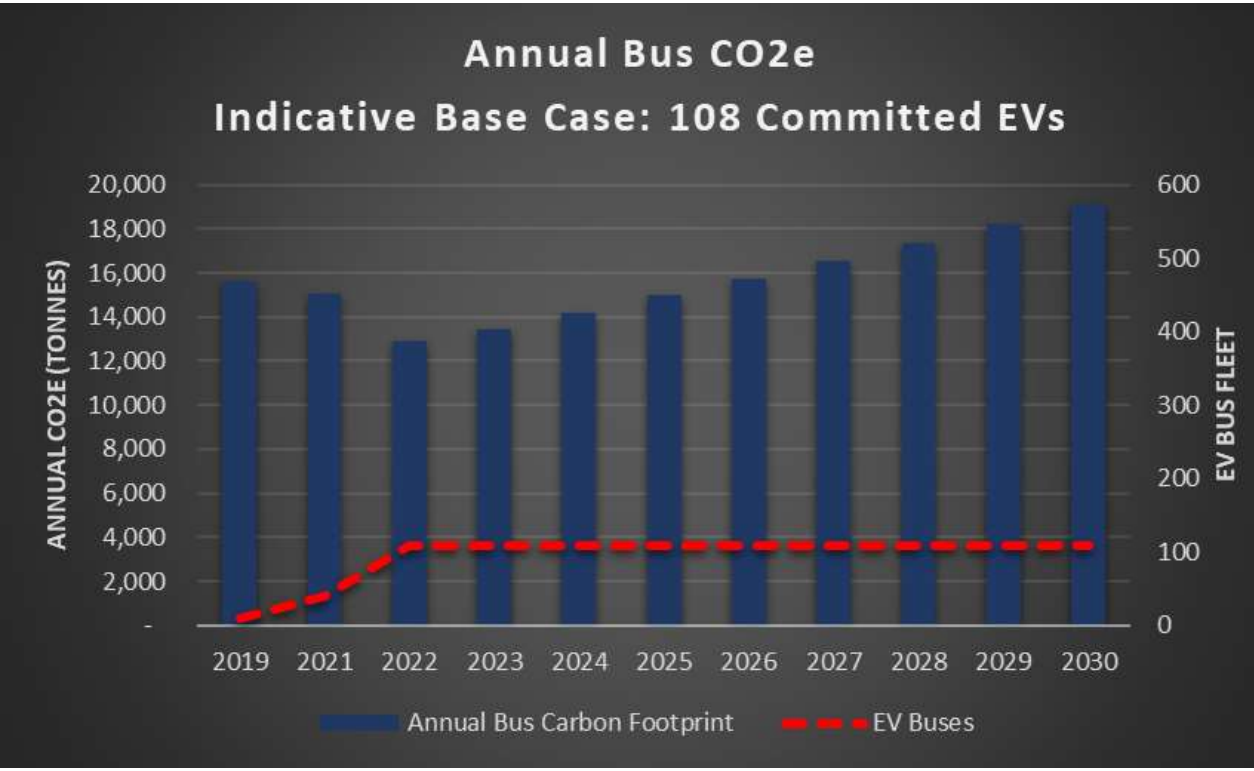


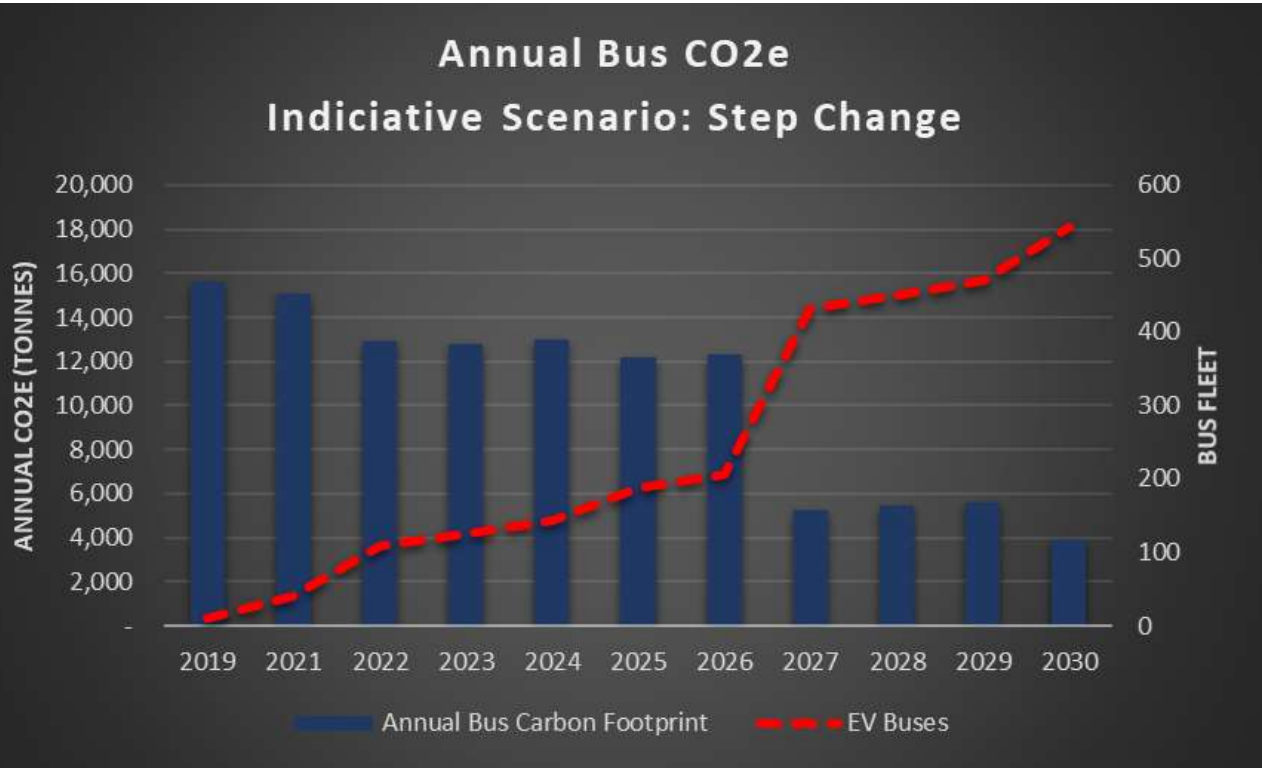
Changing Emissions Trends 2017-2019

How Wellington tackled it's non-GHGs

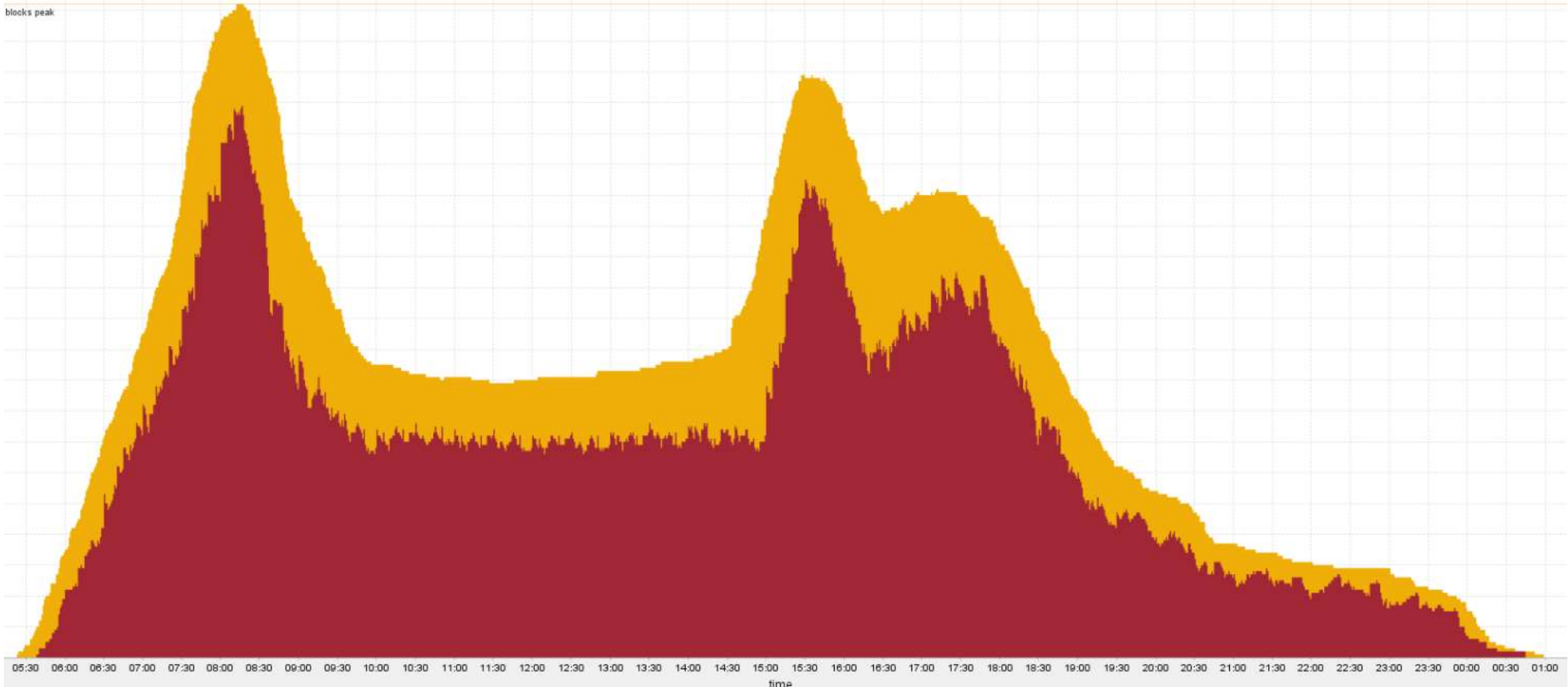


On-going investment required

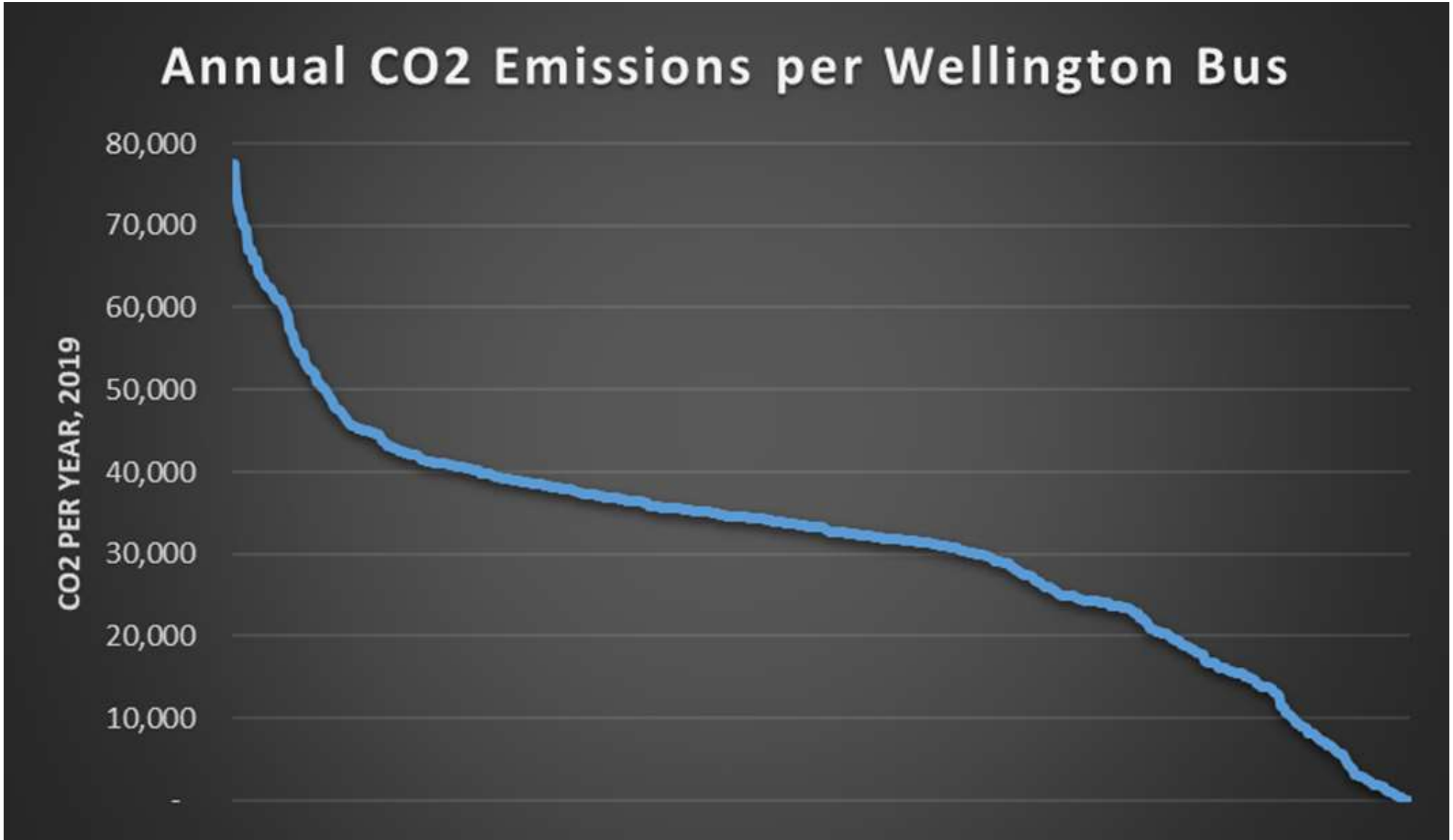




A ‘peaky’ problem



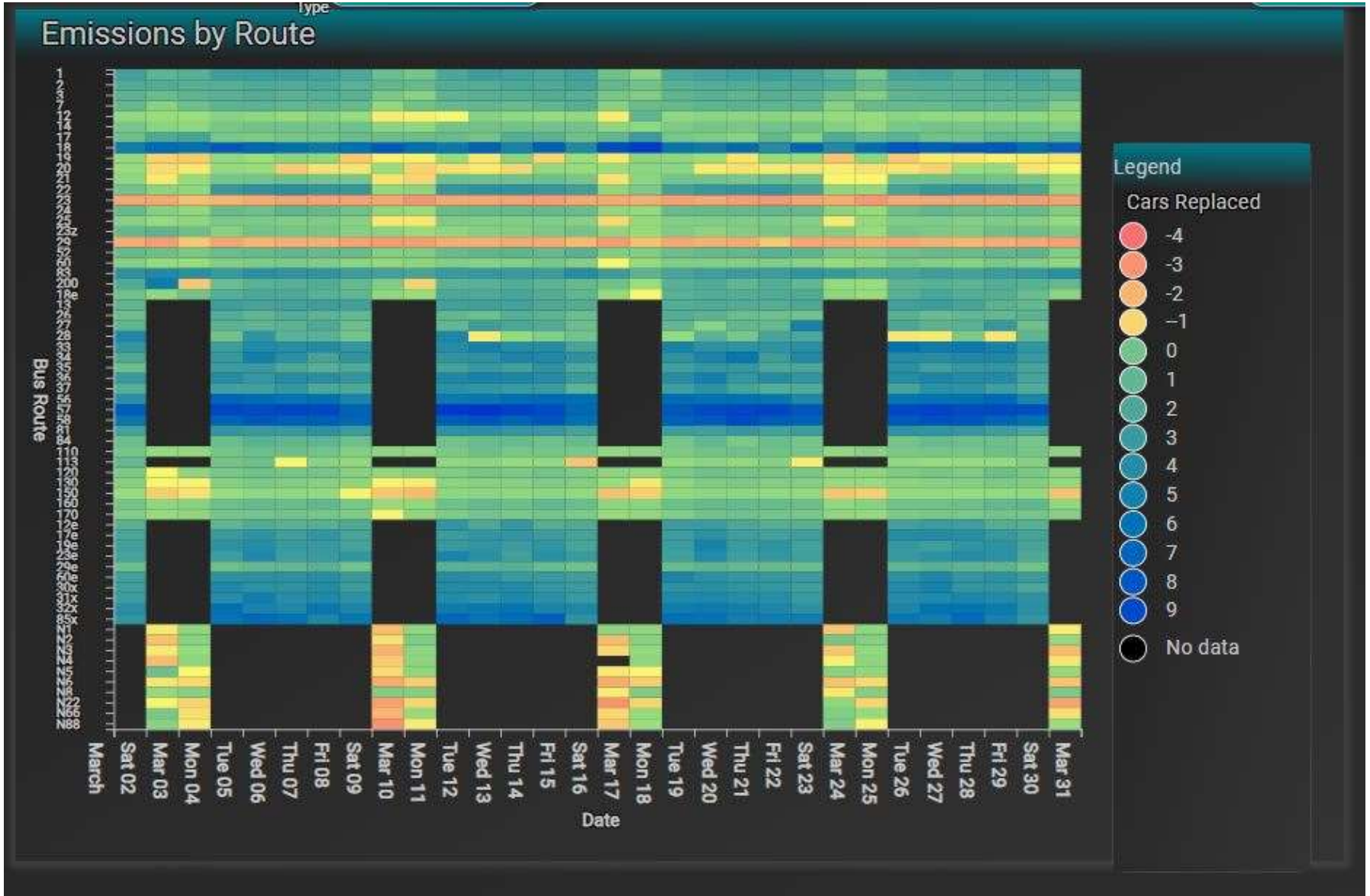
Buses produce a wide range of emissions values



Range Anxiety

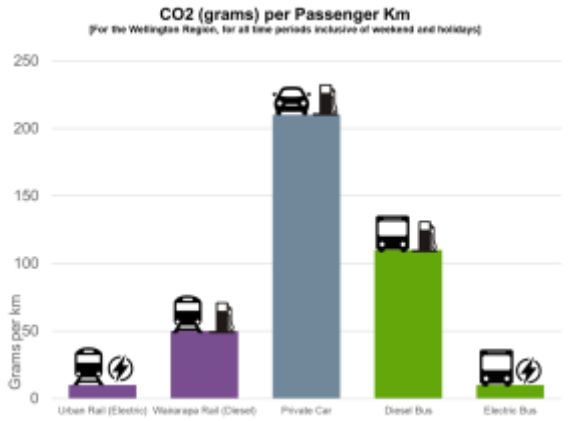
- Perception: Operating Range is a limitation
- Reality: this limitation is trivial
  - ✓Buses can charge overnight
  - ✓<1% of bus activities exceed realistic battery range
  - ✓ Only minor operational changes required

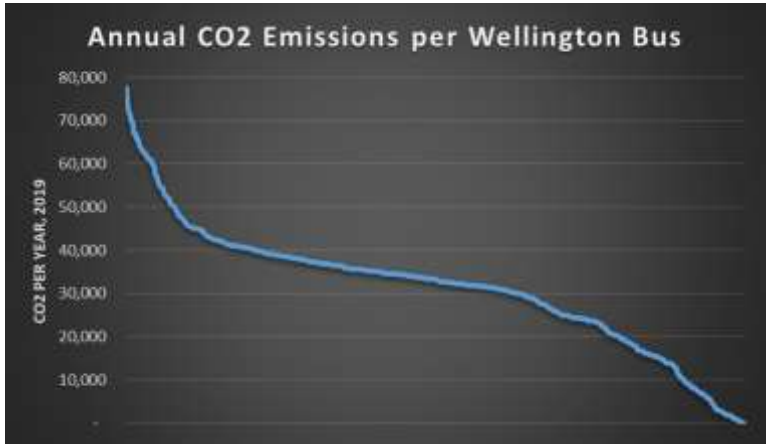
We can calculate emissions/Carbon Offset by Route



Consistency is King

- New Zealand needs a Nationally Consistent method for calculating Public Transport Carbon Emissions
- To inform a common understanding of issues and interventions





CO2 by mode of travel

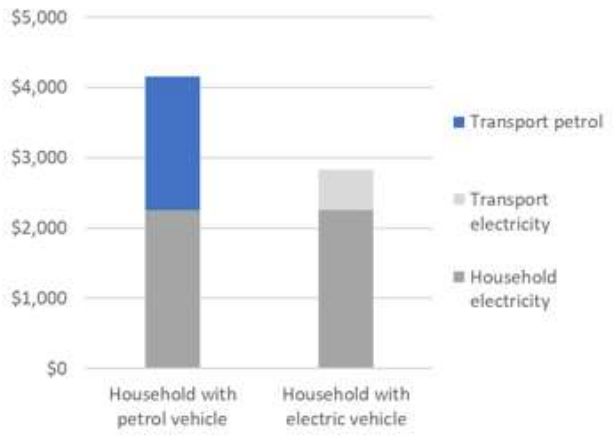
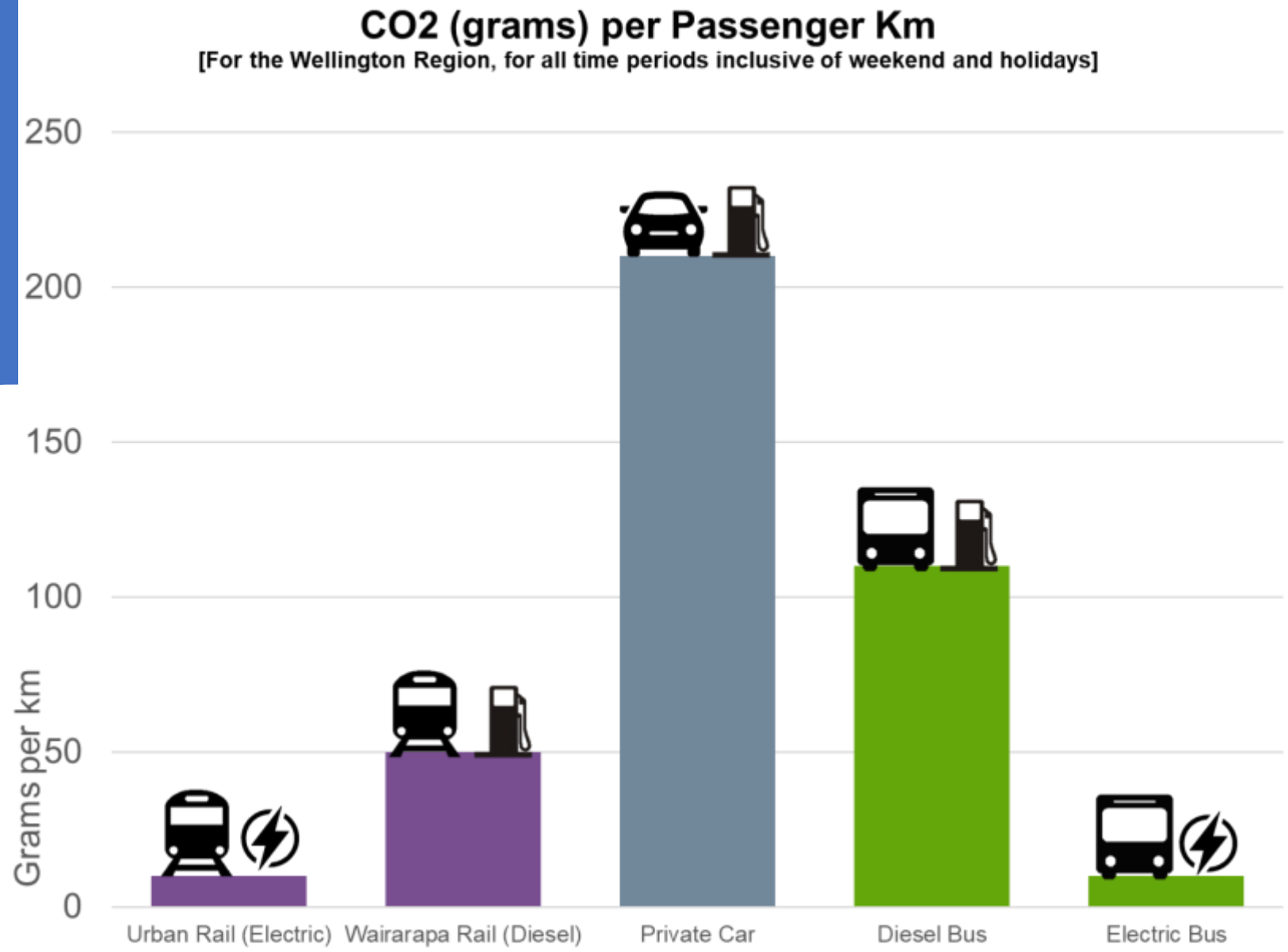


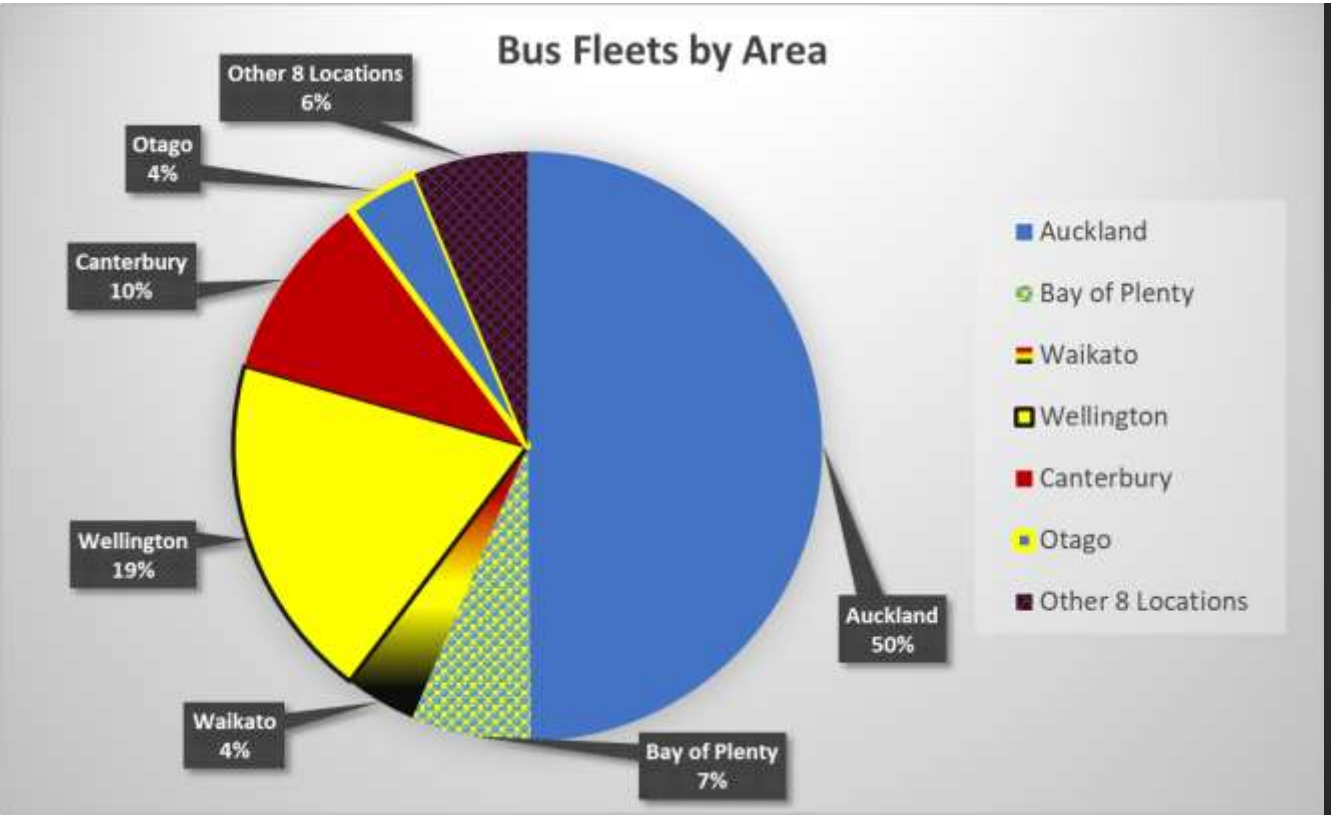
Figure 5.2: Total household energy cost in 2035 for a single car household.

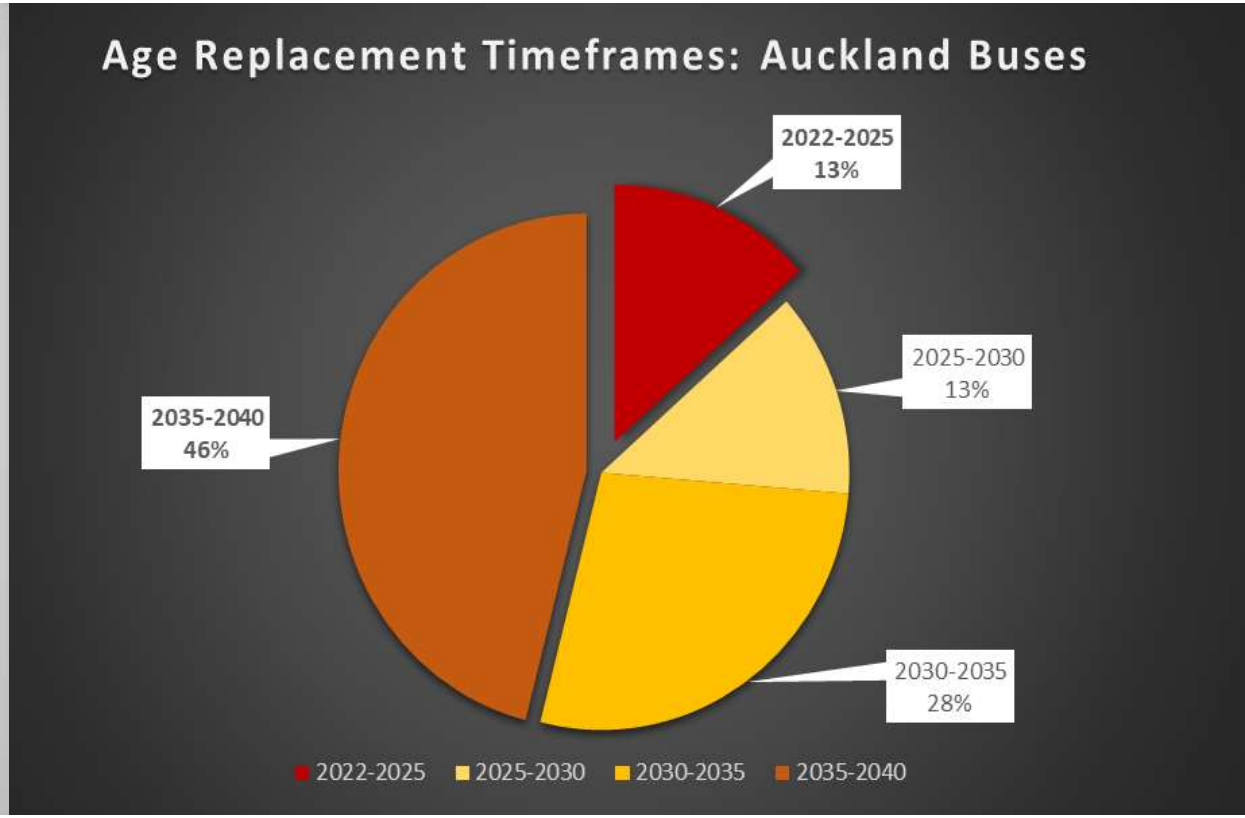
Source: Commission analysis.



The Scale of The Challenge

See also: Darek Koper's Poster Presentation 2:30pm session Tuesday





Questions?

P.S This isn't very likely

→ → →

Residual Carbon - NZ Electricity Grid 2020 - 2050

Climate Change Commission Jan 2021

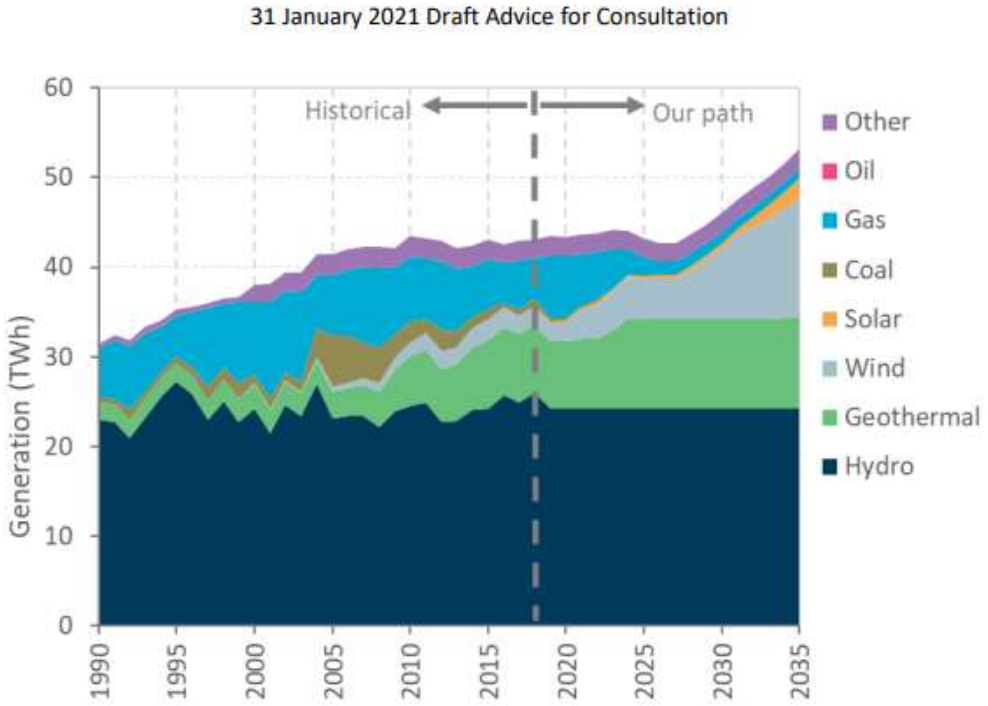


Figure 3.13: Electricity generation by fuel in our path.

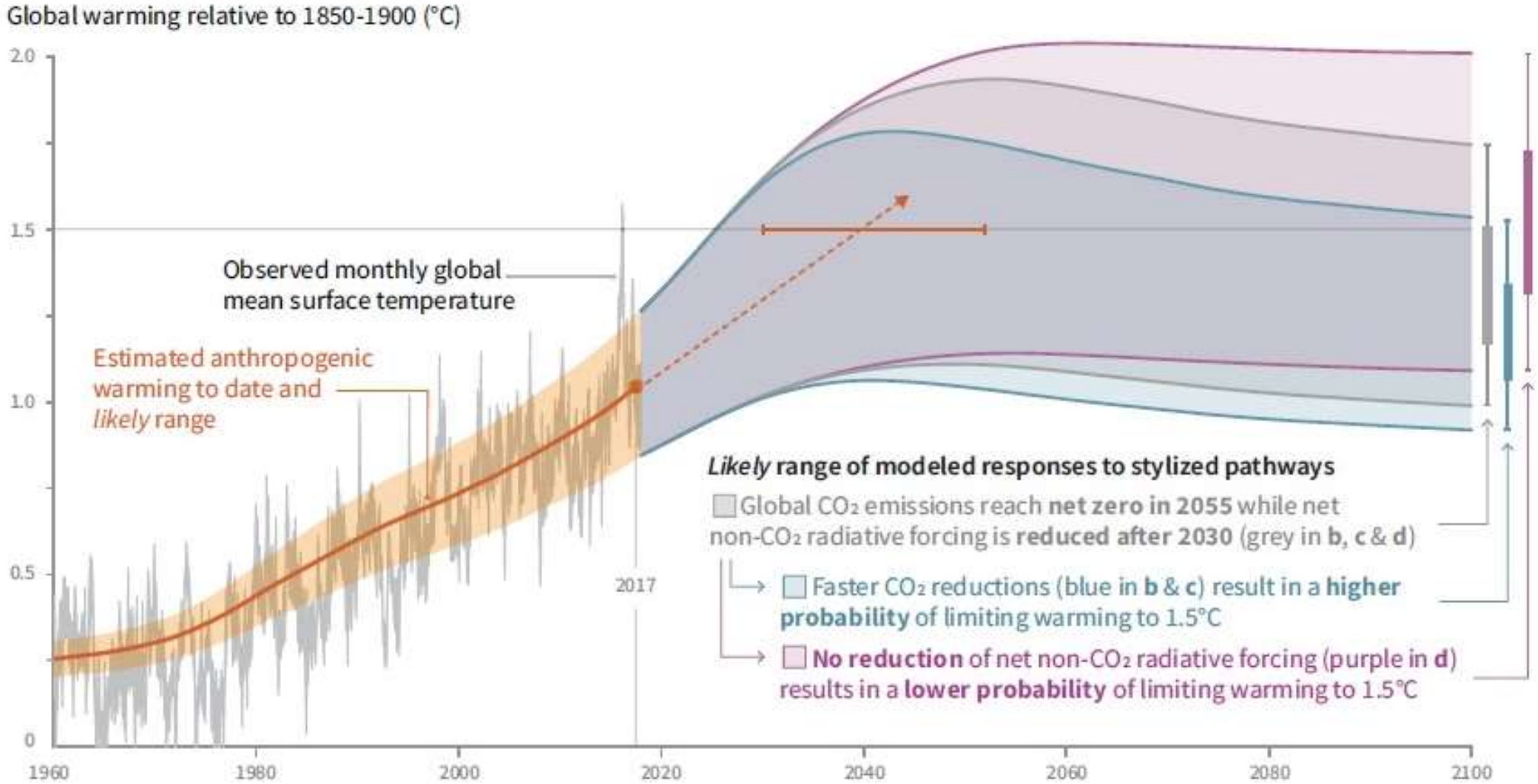
Source: Commission analysis.

Figure 3.14: Annual increase (positive) or decrease (negative) in electricity generation compared to the previous year.

Source: Commission analysis.

Global Temperatures are Trending Upwards

Climate Change Commission 2021



How does NZ Compare?