Carbon Footprint of New Zealand Logging Operations

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Carbon Footprint of NZ Logging…

- NZ Harvesting Systems & Mechanisation
- Fuel Use of Harvesting Systems
- Why Carbon Footprint
- Study Design & CO_2e Results
- Reducing our Carbon Footprint

NZ Benchmarking Cost and Productivity (2008 → 2023)

NZ Surveys = 420+ ground-based and 310+ yarder logging crews

Productivity:

Ground-Based – increased from 30 to 36 t/hr

Yarder – increased from 23 to 35 t/hr !!

Logging Rate:

Ground-Based – increased from 15 to US$21/t

Yarder – increased from 21 to 28 US$/t

Crew size:

Ground-based almost 90% mech
- 5.4 machine to 6 people

Yarder – from 4 to 7 machine on average!

Stand details:

Ave tree size down from 2.2 to 1.9 m^3

Ave stand up from 510 to 605 m^3/ha.

Mechanised Ground-Based Operation

Interpine – “Harvest Audit video”

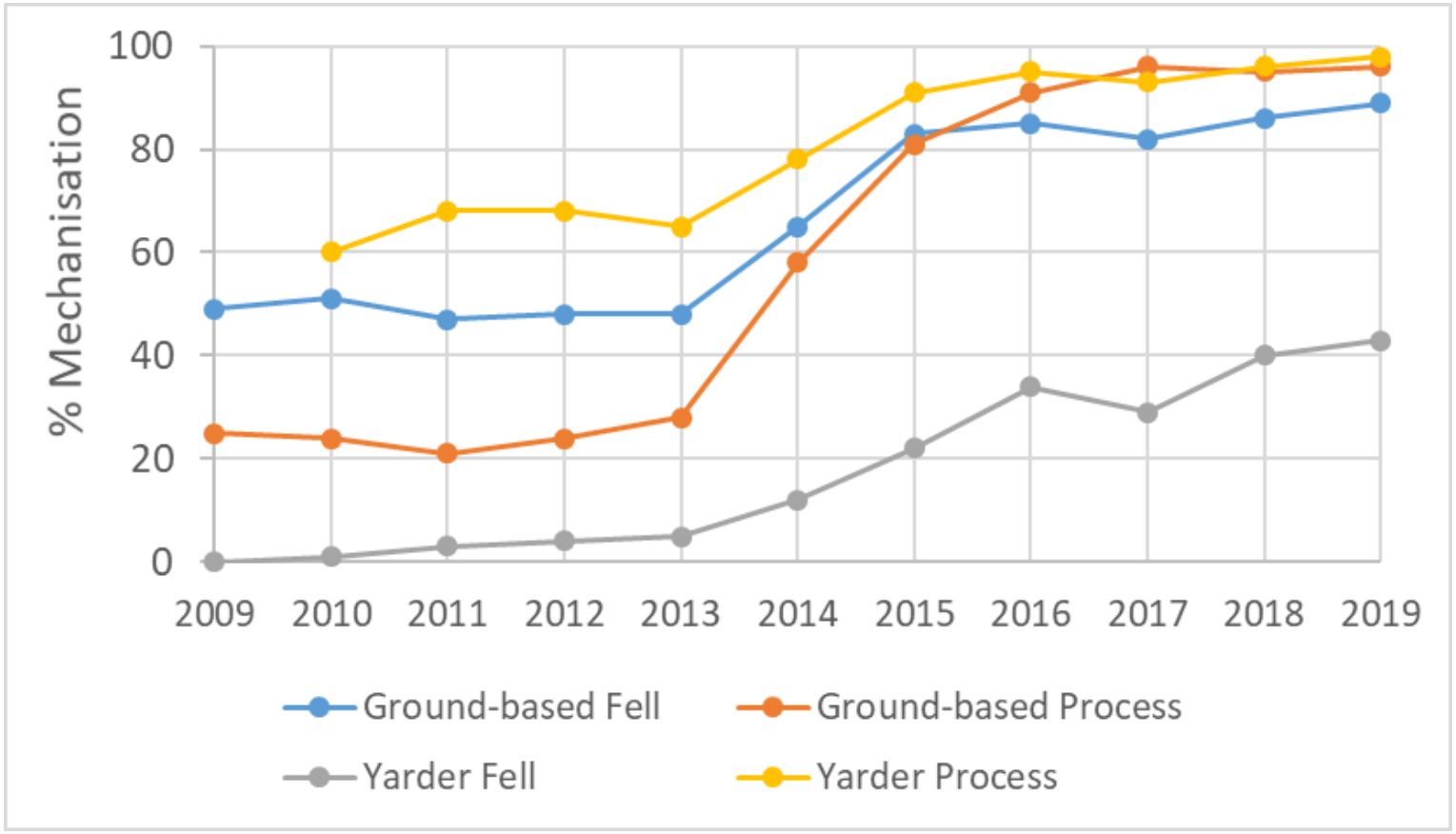
NZ: Winch-Assist

- 220+ working full-time, 470+ made in NZ
- Mainly used for felling pre-bunching

- Now also skidder and forwarder…

Levels of Mechanisation

- 97% of all processing mechanised
  - from < 20% 12 years ago
- 65% of all yarder operations have access to winch-assist



Why study Carbon Footprint of Logging Systems?

1. Plantation forestry is very Carbon positive
   (i.e. we sequester a lot of Carbon)
2. But, highly mechanized harvest system have high energy requirements (i.e. use a lot of fuel!)
3. Harvest operations contribute 45%-60% of emissions for production of a domestic log

Carbon Footprint of Logging Systems – study goals

1. Develop a pragmatic method to measure and report their carbon footprint equivalent (CO_2e).
2. Establish CO_2e for harvesting crews in NZ

   (ground-based, swing yarder, tower yarder).
3. Investigate and present current and future methods to mitigate GHG emissions for harvest crews.

Method – Contractor & Company Survey

Harvest systems in study – contractor asked to report fuel use and production:

- 30 ground-based crews (average 4.8 Machines)
- 12 tower yarder (average 7.4 Machines)
- 13 swing yarder (average 8.1 Machines)

Also asked for reasons to report and ideas for reducing fuel.

Mechanised Yarder Operations

Method – develop protocol

- Set scope = 1, 'direct GHG emissions and removals'.
  - approx. 90% is diesel used, further 7% for oils

Total footprint is…

- Diesel = Diesel use (l) x diesel factor (of 2.69 $kgCO_2e/l$) =
- +Oil = Diesel use (l) x 7% x oil factor (of 2.96 $kgCO_2e/l$)
- *+ petrol if any…*

= Total Estimated Carbon Footprint (tCO2e/year)

divided by annual production

= Carbon per unit ($kgCO_2e$ / m3)

- *Note: Well to tank? = Diesel use x factor 0.63*

Results

Fuel use (l/m3) is

going up fast!

2000 – 2.5 l/m^3 approx.

2016 – 3.0 l/m^3 for GB and 3.2 l/m^3 for yarder

(Paul Oyier and Visser 2017)

2022 - 3.7 l/m^3 for GB and 4.7 l/m^3 for yarder

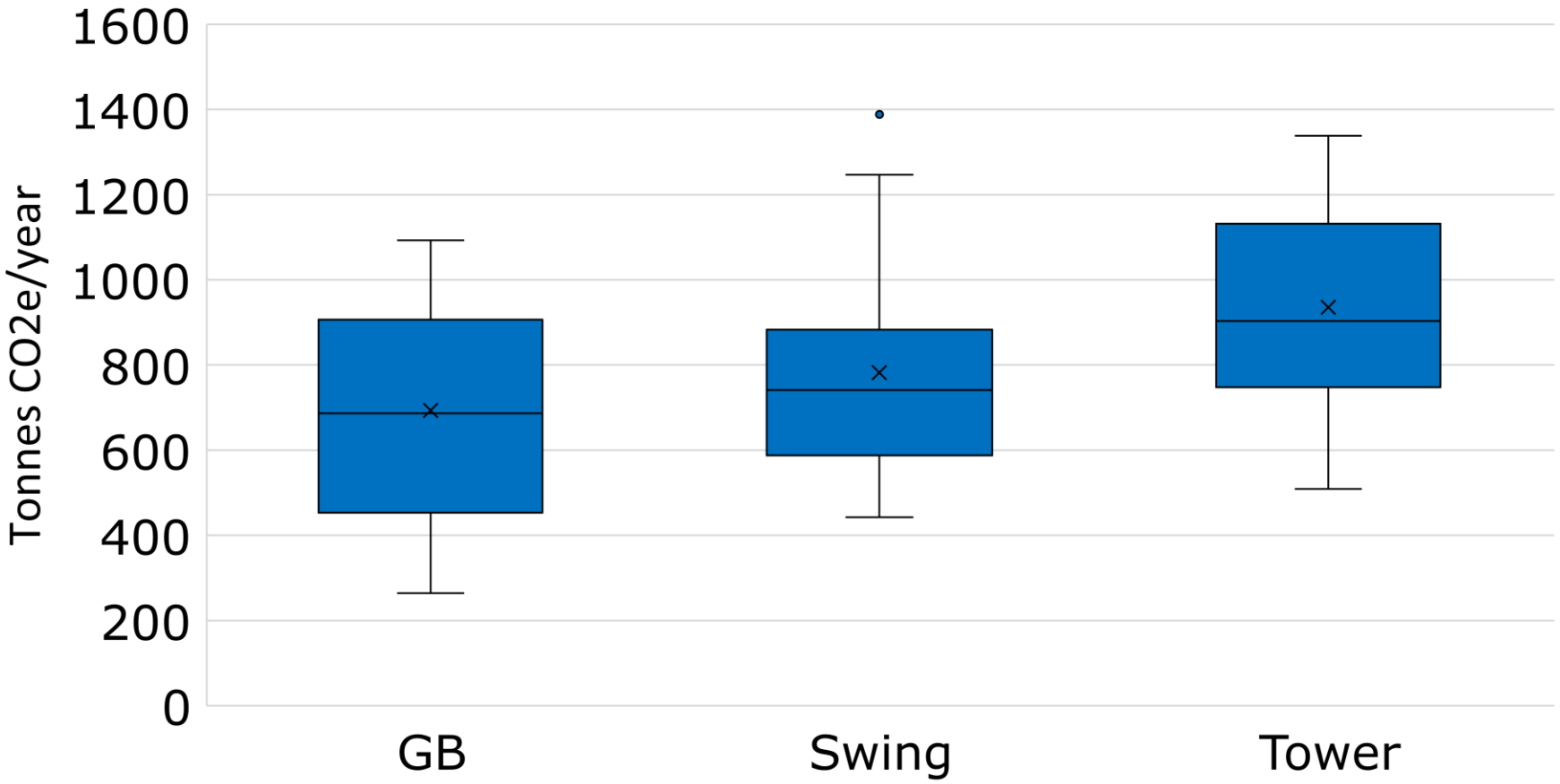
In Europe – modern yarder systems @ 1.6 – 1.8 l/m^3

Results

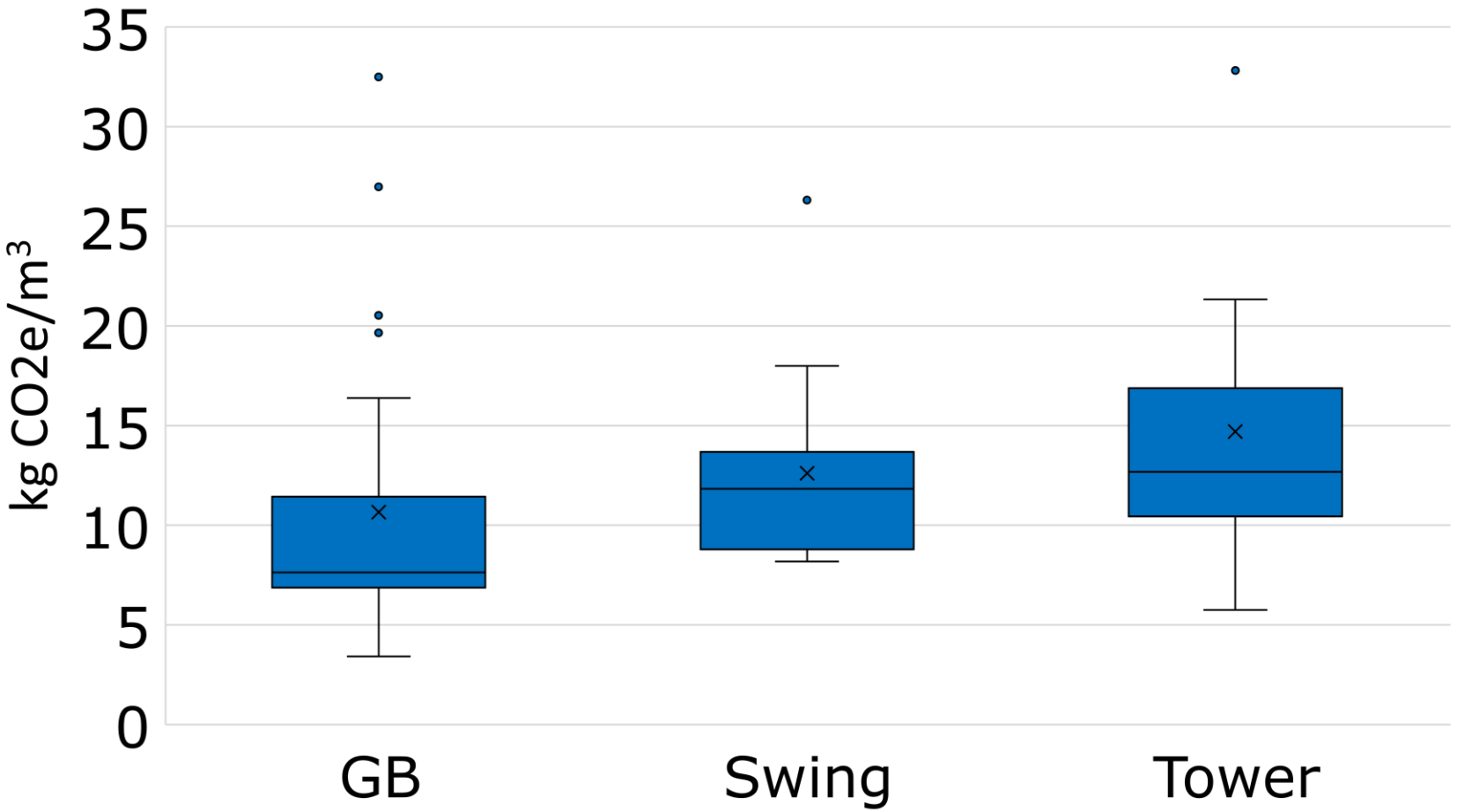
Average NZ logging crew produces approx. 70,000 m3 and uses 260,000 litres of diesel per year!

	Mean t CO_2e/annum	Mean (Kg CO_2e/m^3)
Ground Based (n = 30)	690	10.7
Swing Yarder (n = 13)	780	12.6
Tower Yarder (n = 12)	940	14.7

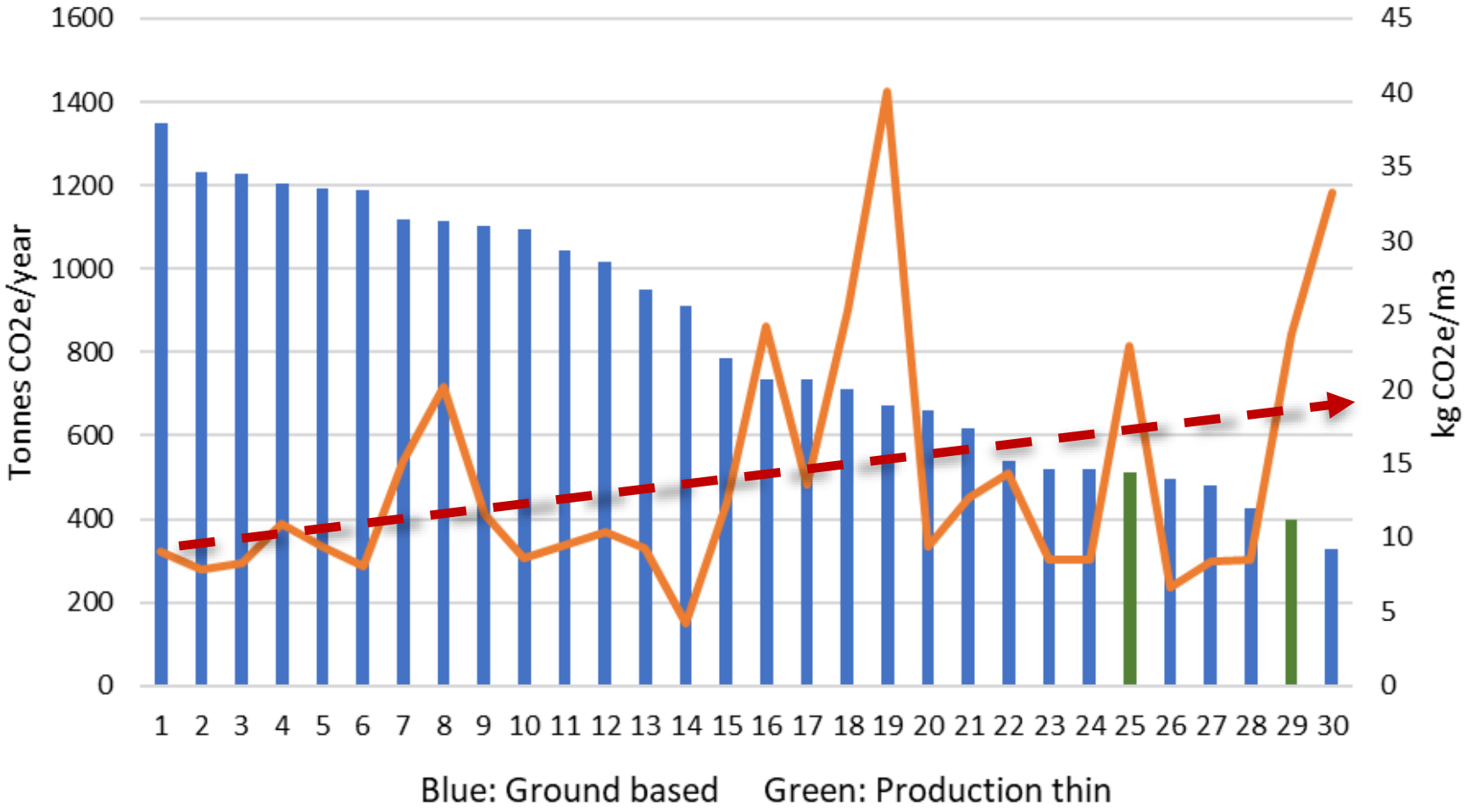
t CO_2e/year by crew



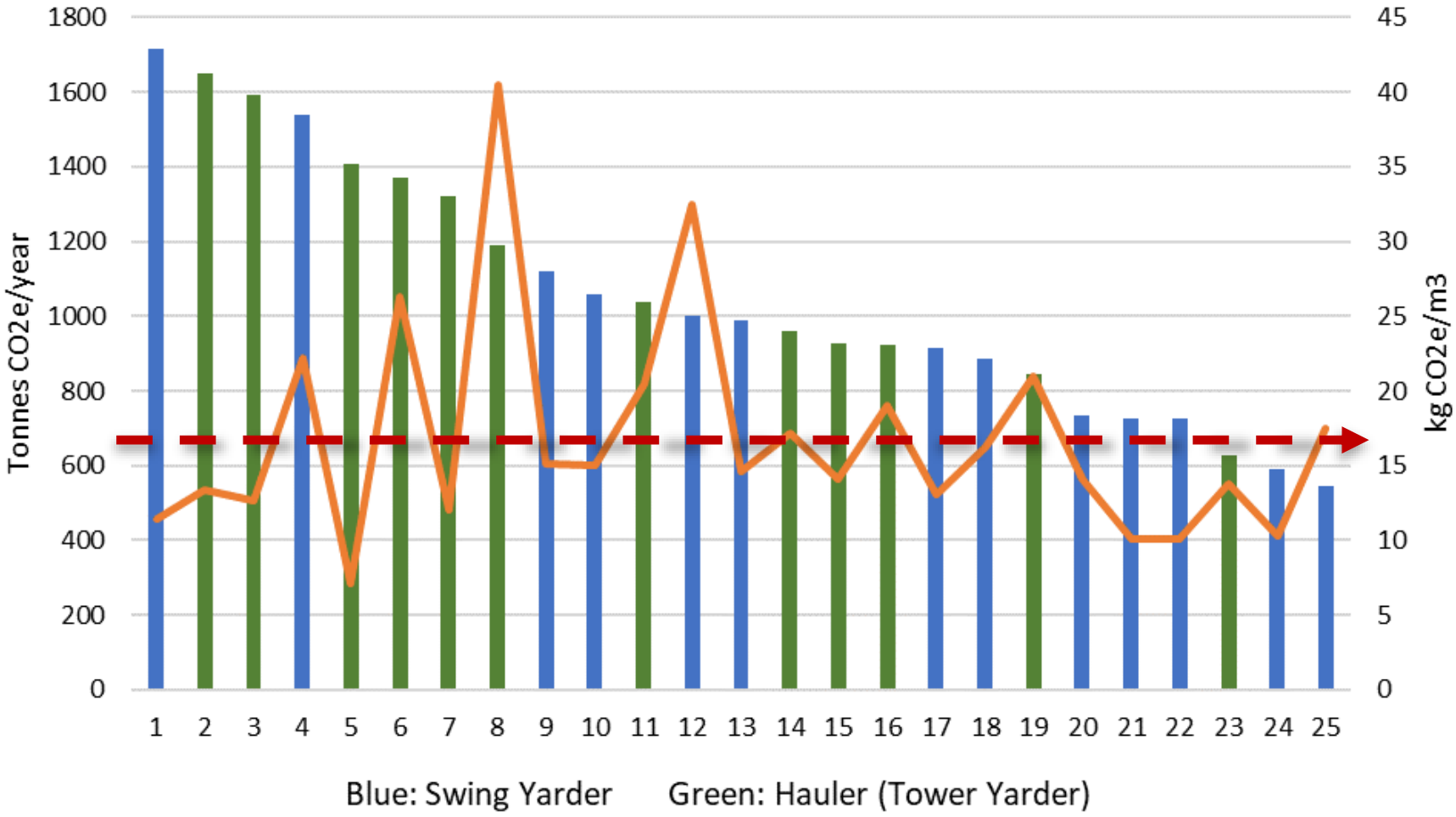
kg CO_2e/m^3 by crew



Ground-based – Link between total and per m^3 CO_2e?



Yarder
– Link between total and per m^3 CO_2e?



Opportunities to reduce fuel use?

Near Term:

- Opportunity for biomass → fuel - studied but currently not realistic in NZ
- Bio-fuels → High life cycle cost – high global feedstock demand & transport first
- Bio-oils / lubricants: suited to forestry applications – low uptake as expensive per L cost?

  6% less cost than traditional oils (M & R Visser, 2016)
- Simplification of harvest system design?

Longer Term

- Integration of more electric-hybrid machines (i.e. Logset 12H GTE - 7-30% fuel reduction
- Several companies investing in Hydrogen infrastructure
- Pilot and design phase hydrogen and electric forestry specific machinery underway

Where are we at?

Pros

- Good ‘social licence’ – ethical desire to improve & contribute to society goals
- Better financing opportunities
- Help focus on reducing costs
- Some larger forestry companies report their carbon footprint, include harvesting based on fuel estimates

Cons

- No pressure on harvest crews to report – “brings unnecessary attention?”
- Time taken, cost of reporting
- Easy to ‘adjust’ fuel use values – drive to be lowest / best

Summary

- *Methodology developed for simplified carbon footprint of Logging Operations*
- *Averages established of 10.7 (Ground Based), 12.6 (Swing Yarder), 14.7 (Tower Yarder) kg CO_2e per m^3 harvested*
- *High level of variation – suggests logging crews need to review fuel use*
- *Reducing footprint?; short term biofuels and oils, long term electric and hydrogen*