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NEW ZEALAND / ENVIRONMENT

Queen St contains highest levels of black carbon in NZ

5:25 pm on 7 November 2018

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Downtown Auckland appears to be serving as a basin for air pollution, including high levels of potentially deadly black carbon.

New research indicates black carbon levels in Auckland's downtown area is three times higher than Canadian cities and twice as high as major North American, European and United Kingdom centres. Photo: 123RF

"…***traffic volumes are declining*** *in the central city, leading scientists to believe the* ***rise in black carbon*** *must be down to other factors –* ***most likely old diesel engines***".

GOLDER

Determining the impact of gross emitting vehicles

6 December 2018

Project Objective

To determine the impact that gross emitting vehicles (GEVs) have on emissions of harmful pollutants and of carbon dioxide from the vehicle fleet.

Stage 1: Method Development – today's presentation.

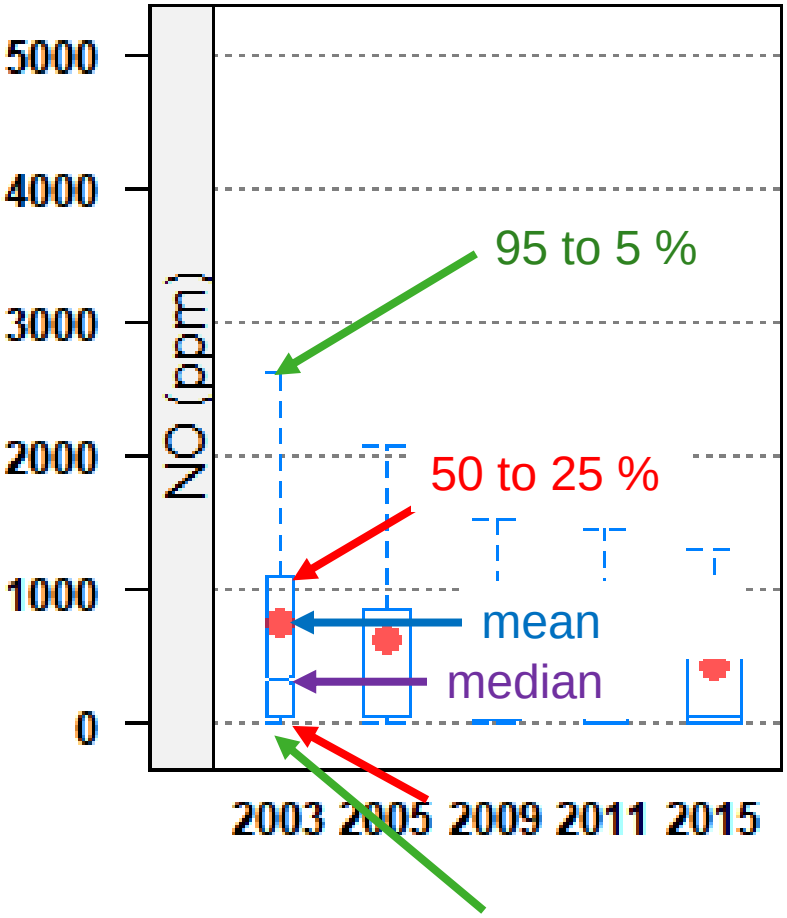
- Harmful pollutants
- CO_2

Hold point meeting: Should we progress to Stage 2?

Stage 2: Assessing the impacts of GEVs.

What is gross emitter?

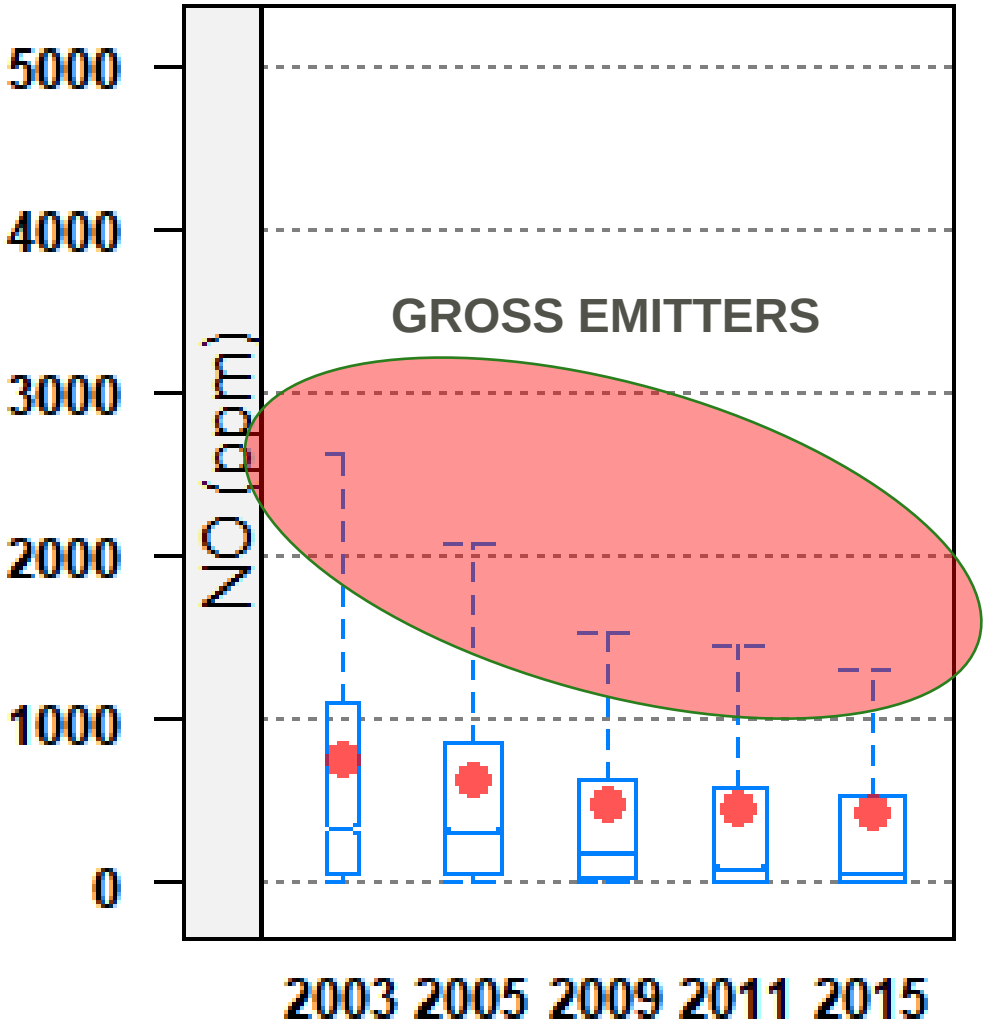
ROADSIDE MEASUREMENTS OF EXHAUST EMISSIONS



The total emissions from the on-road fleet are dominated by a small number of vehicles with very high emissions known as "***gross emitters***".

What is gross emitter?

ROADSIDE MEASUREMENTS OF EXHAUST EMISSIONS



What do we know about GEVs? (1)

- The most polluting 10% vehicles are responsible around 50% of the total emissions.
- The cleanest 50% vehicles are responsible for less than 10% of total emissions.
- The impact of GEVs has been increasing over time.

What do we know about GEVs? (2)

Fuel type:

- Petrol vehicles, 96 % of gross emitters of CO, HC and NO
- Diesel vehicles disproportionate number of particulate GEVs

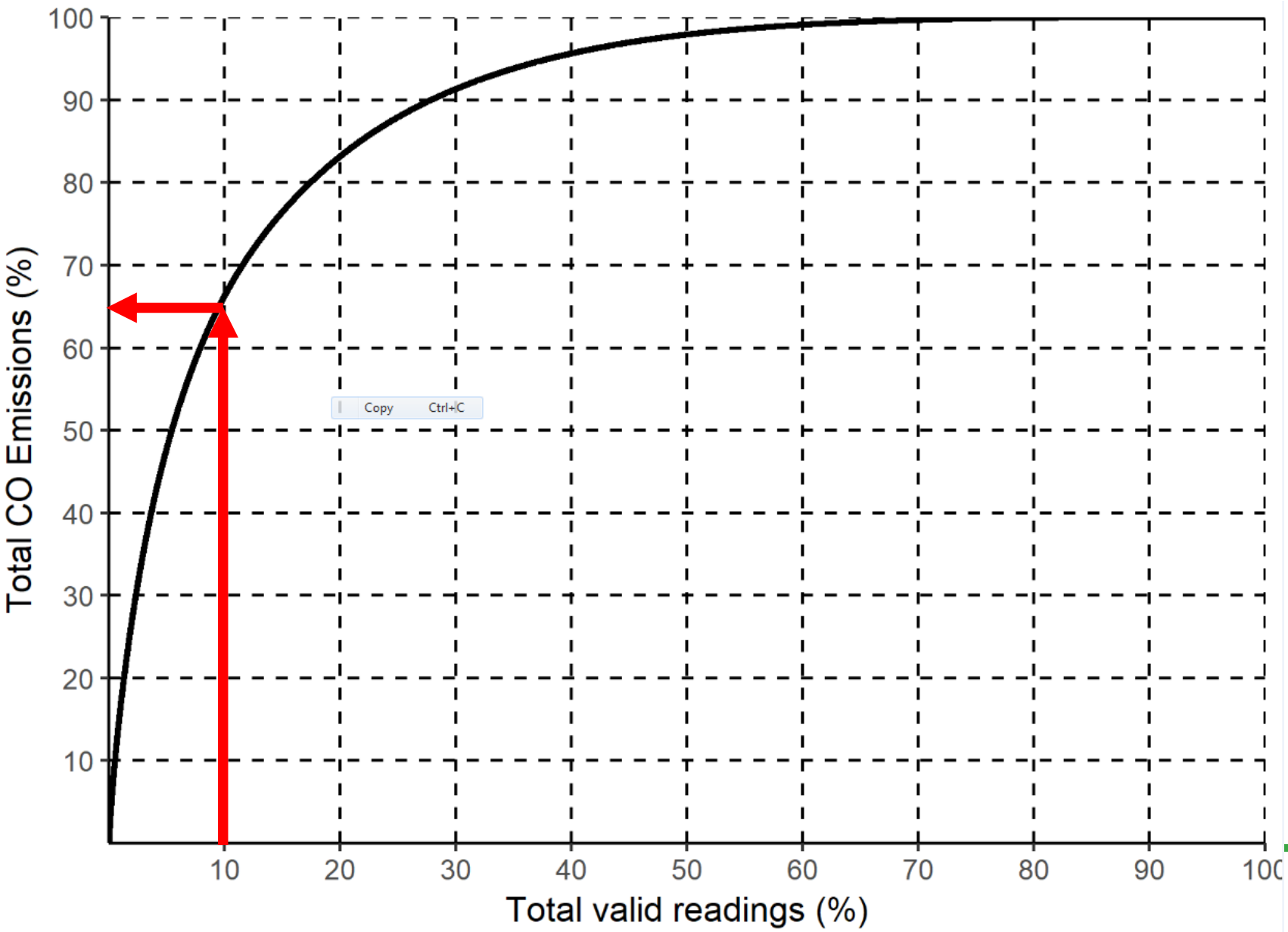
Year of manufacture

- Older vehicles are much more likely to be gross emitters
- A few new vehicles are gross emitters

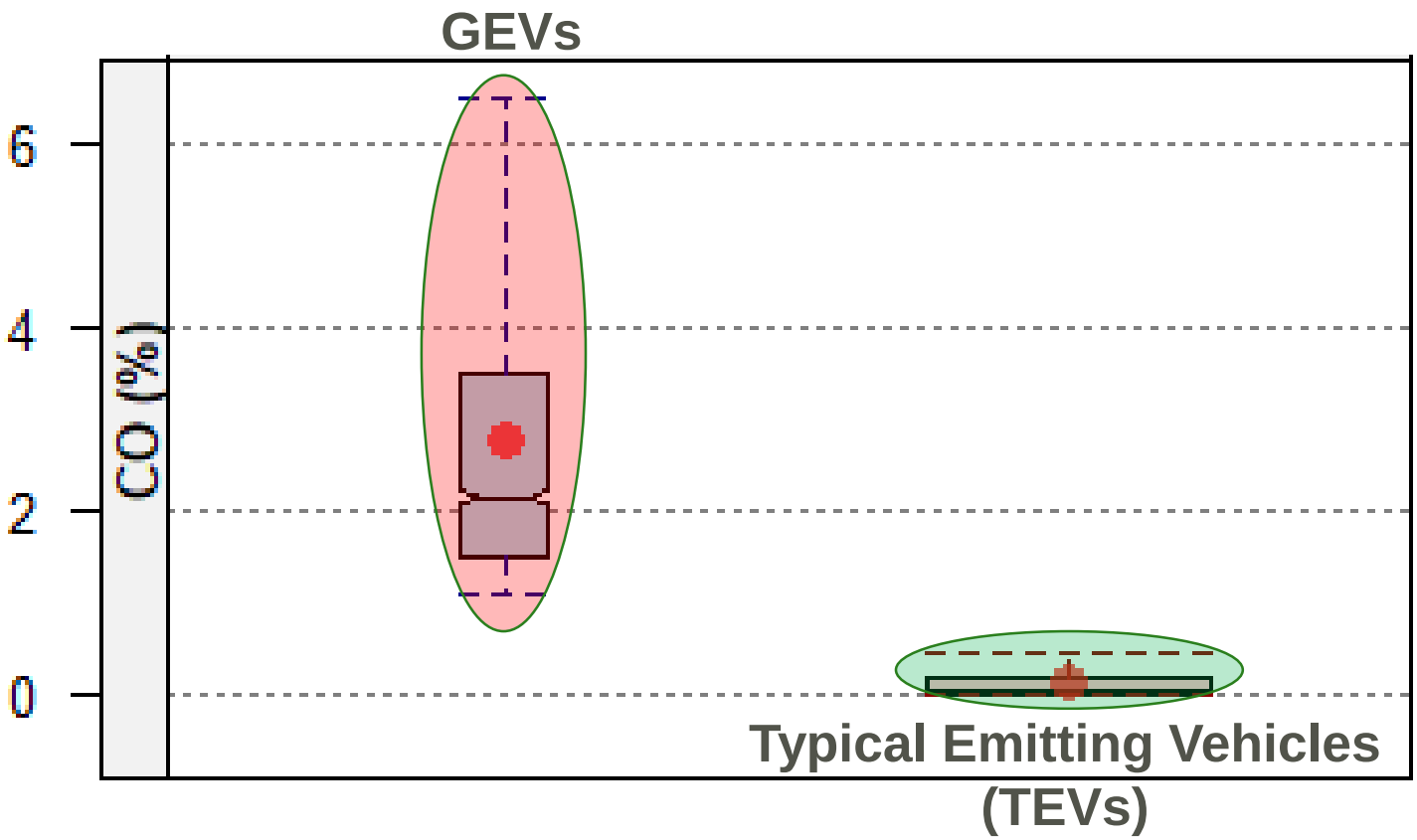
Mileage. High km:

- Petrol vehicles have significantly higher emissions than low km vehicles
- Diesel vehicles have slightly higher emissions of HC, NO and PM than low km vehicles

Gross Emitters in the 2015 RSD data set – CO



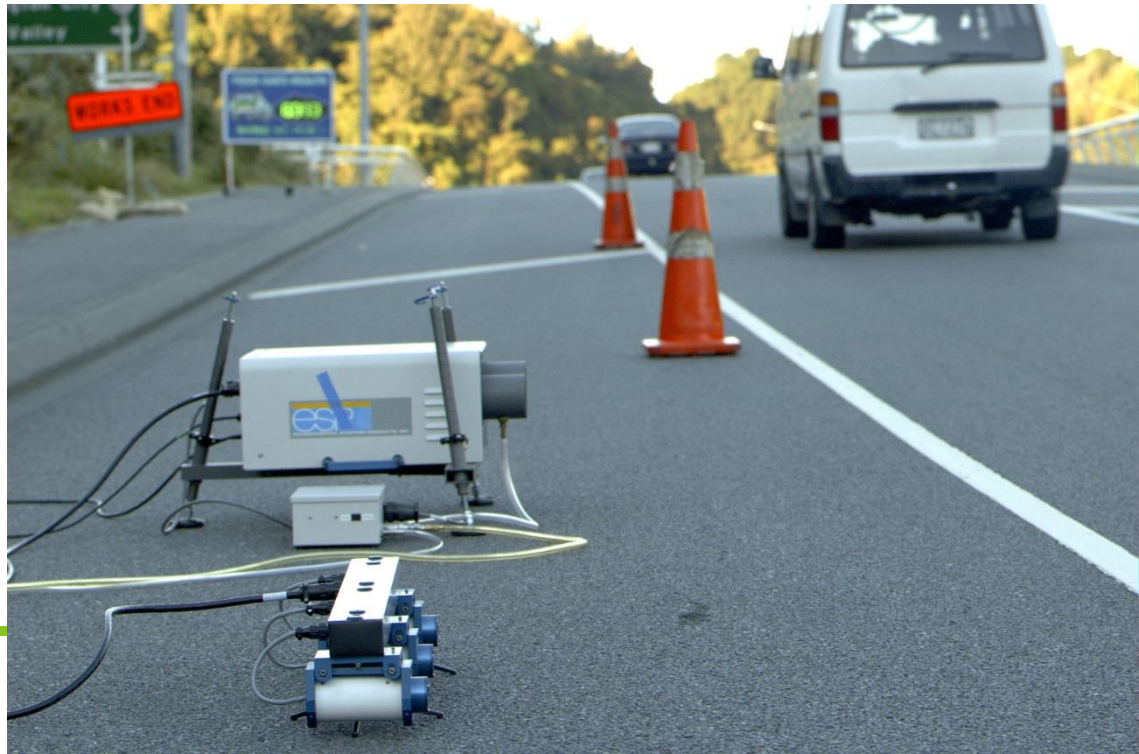
GEVs in the 2015 RSD data set – CO



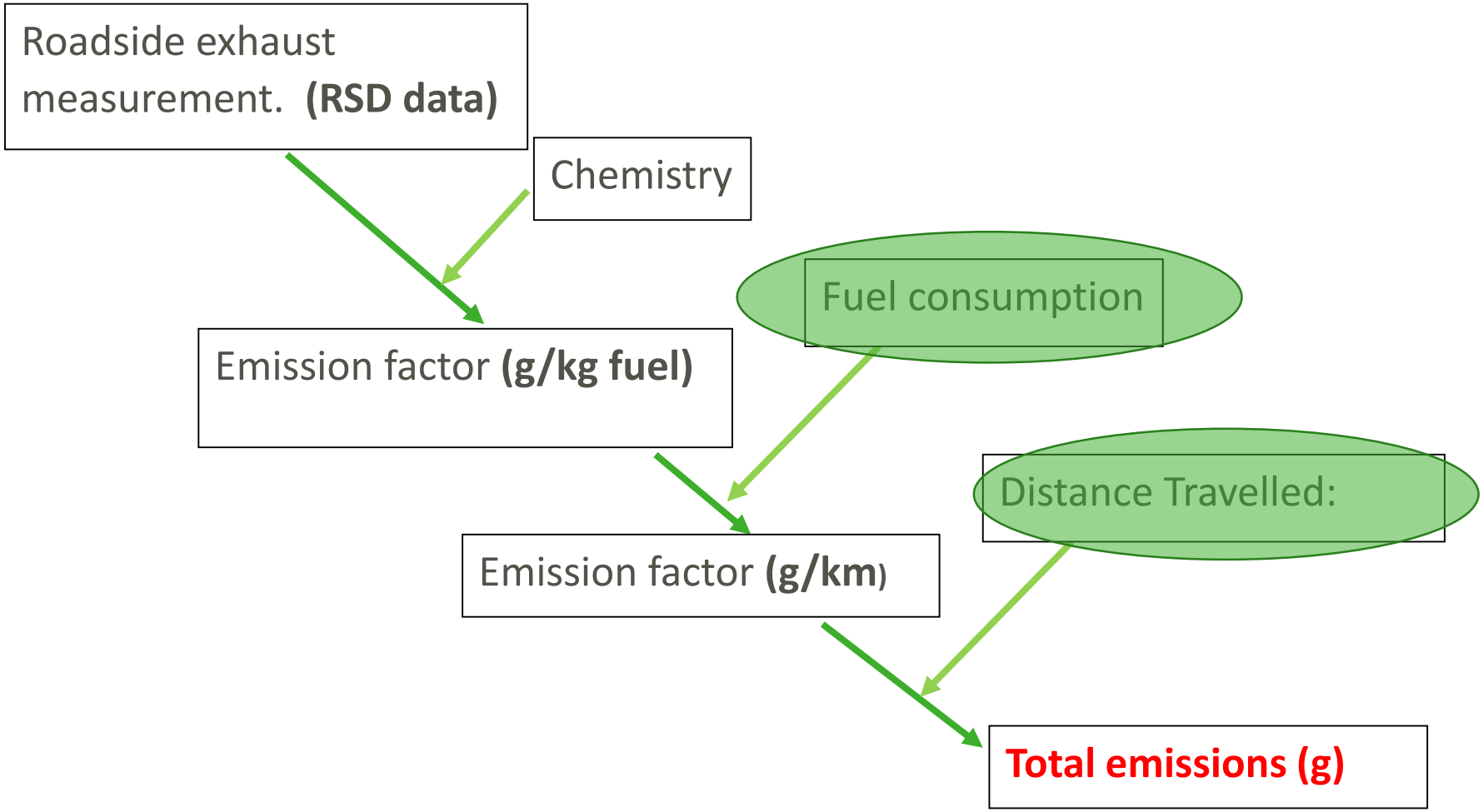
Key Questions for Stage 1 of this Study

Can we use the RSD data to calculate the:

- **Impact of emissions from GEVs?**
- **Benefit of replacing GEVs with Typical Emitting Vehicles (TEVs)**
  - **Part 1 – Harmful emissions**
  - **Part 2 – CO_2 emissions**



Method Part 1: Calculating Emissions of Harmful Pollutants using RSD and other data.



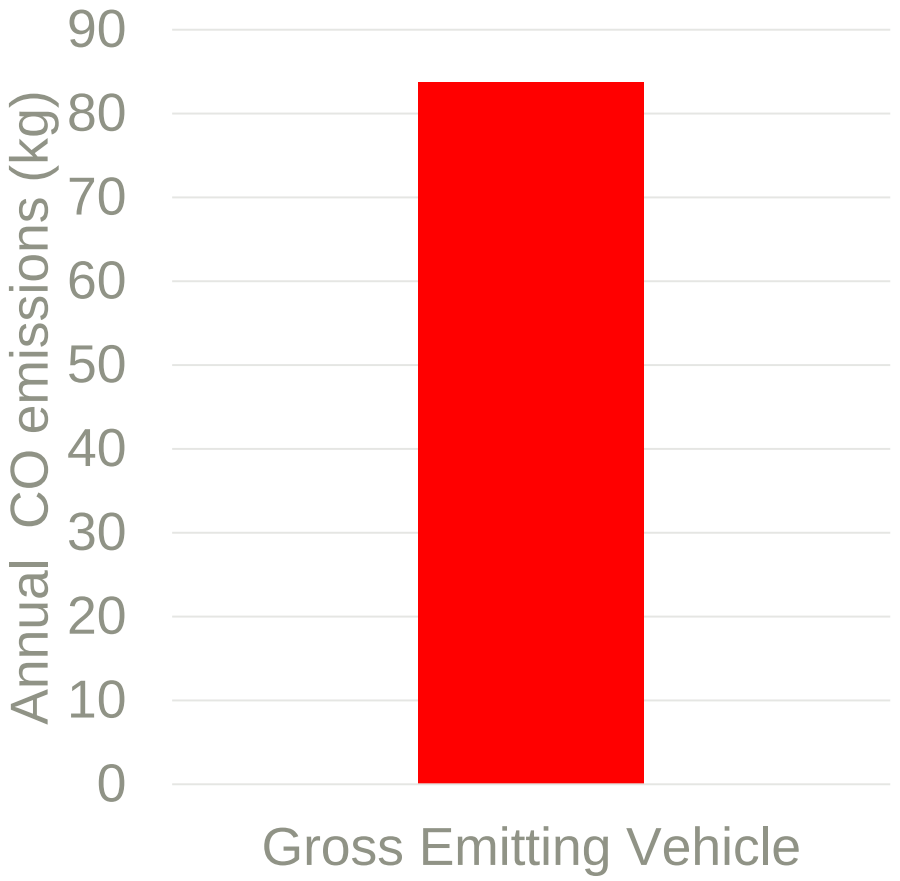
Stage 1: Method Development – Proof of Concept.

- Data inputs are typical values, not specific to any one vehicle.
- Results are indicative.
- Full analysis will use vehicle specific data for many vehicles.
- The results will be aggregated to provide emissions for the monitored fleet.

Prelim Result – 1. Annual Impact of a Gross Emitting Vehicle

Data inputs.

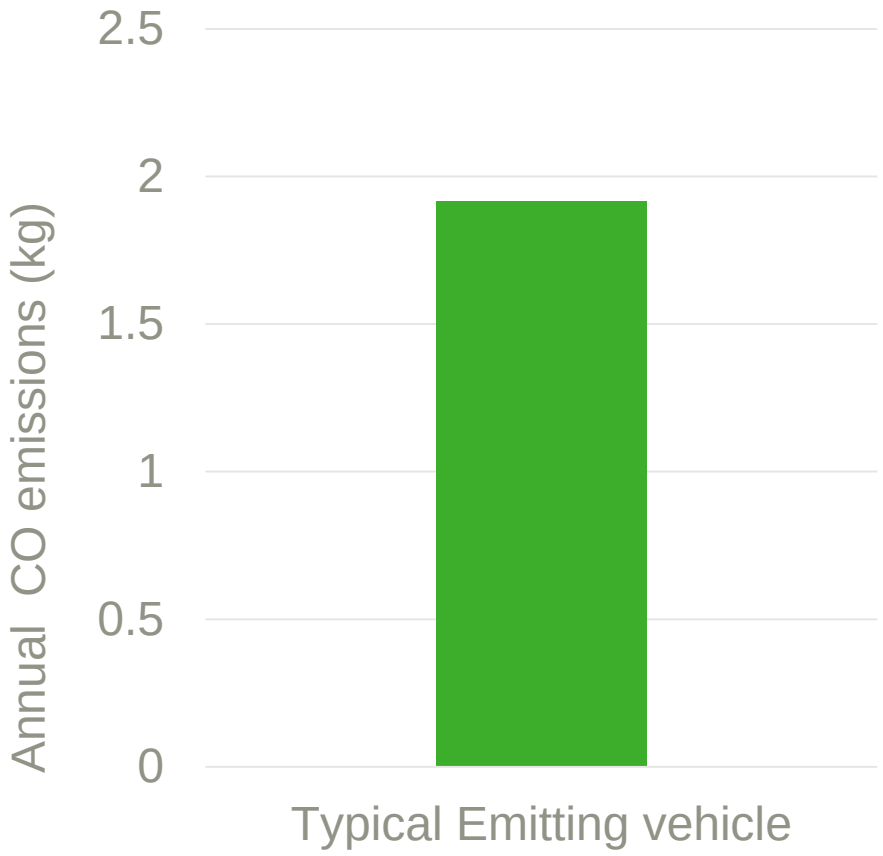
- CO = 2 % (RSD)
- CO emission factor = 17 g/km.
- 5,000 km year (MVR 2018-2015)



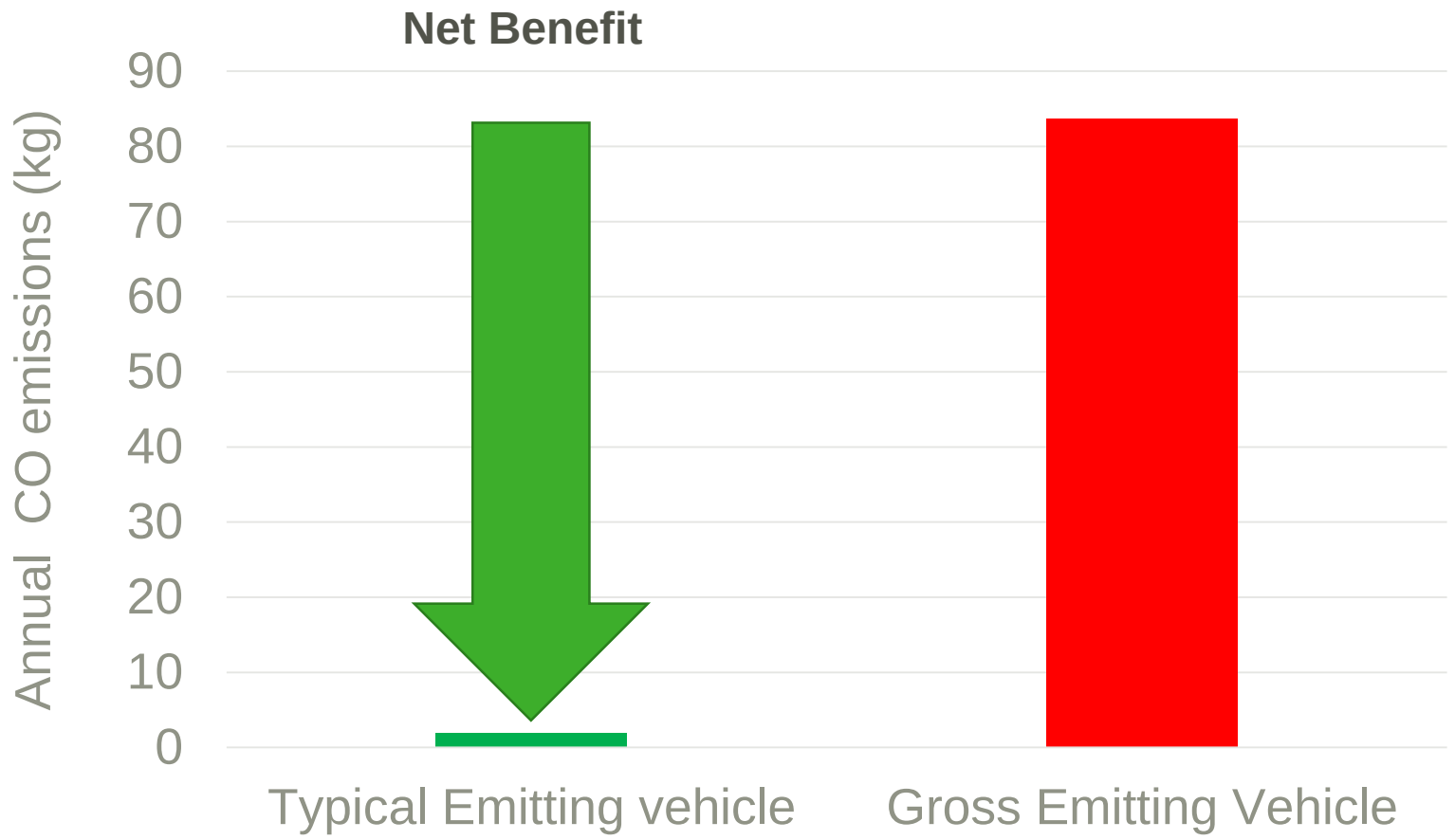
Prelim Result – 2. Annual CO emissions of a Typical Emitting Vehicle

Data inputs

- CO = 0.023 % (RSD)
- CO emission factor = 0.2 g/km.
- 10,000 km year (MVR 2018-2015)



Prelim Result – 3. Net Benefit of replacing a GEV with a TEV.



Key Questions for Stage 2: Auckland 2015 monitored Fleet

- How long do GEVs remain in the fleet? – Registration still current?
- How far have GEVs travelled since 2015?
- What is the impact of replacing GEVs with TEVs within the 2015 monitored fleet?

Key Questions for Stage 2: National Fleet

- **How many GEVs are there <u>likely</u> to be in the national fleet?**
- **Is there a regional variation in the occurrence of GEVs?**
- **What is the national/regional benefit of replacing GEVs?**
- **What percentage of GEVs should/could be replaced?**

Method Part 2: Calculating GEV Emissions of CO_2 using RSD and other data.

RSD measures the ratios of:

- CO/CO_2
- HC/CO_2
- NO/CO_2

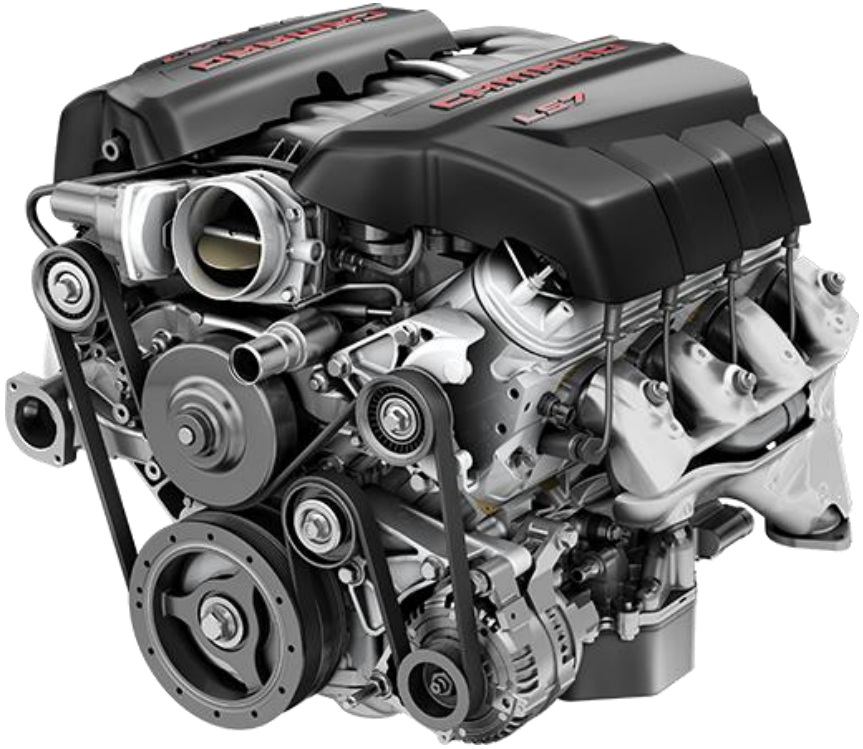
No data direct on CO_2 emissions.

Challenge!

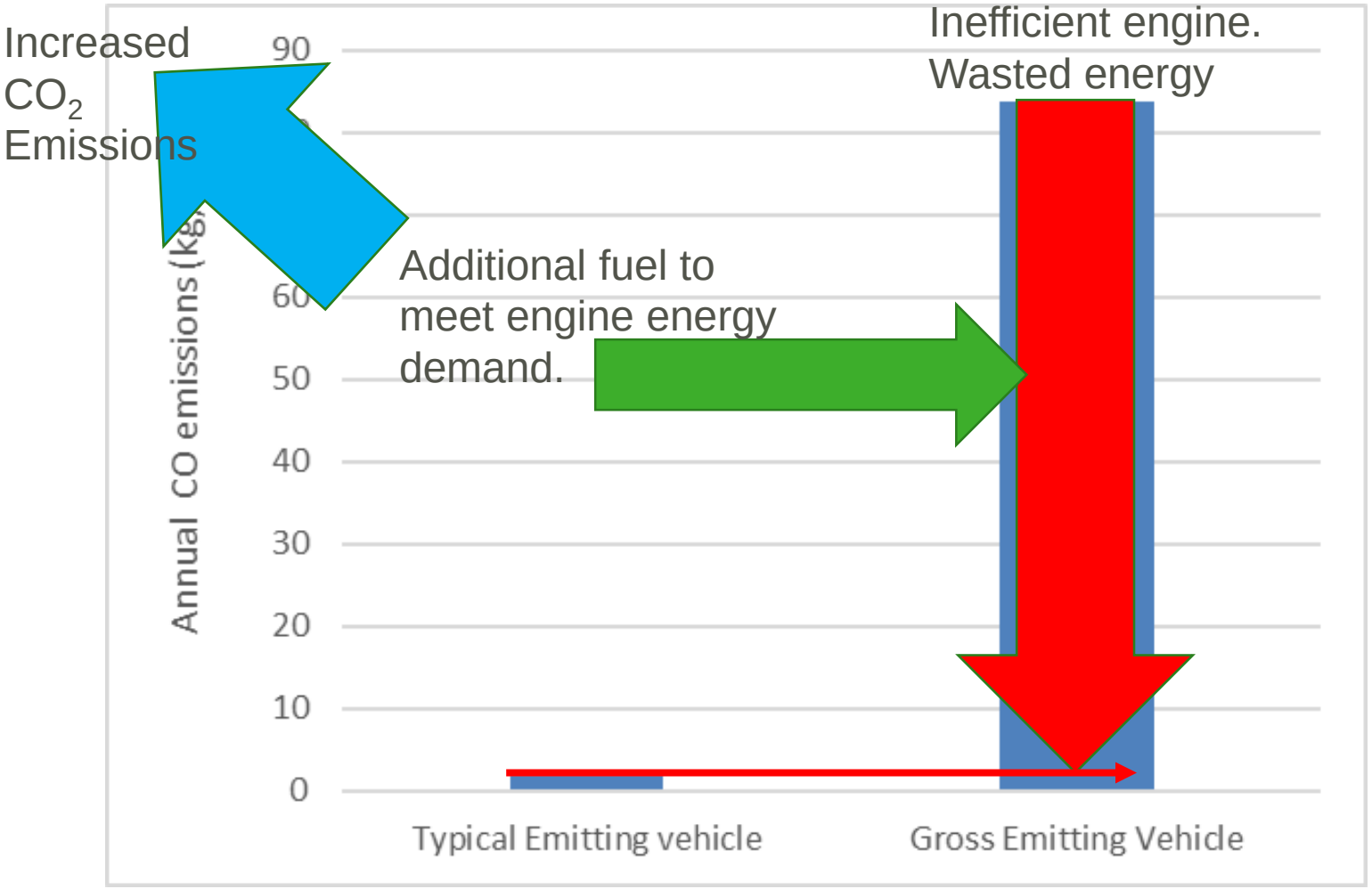
<u>Utilise the RSD data to estimate the impact of GEVs on CO_2 emissions.</u>

General approach

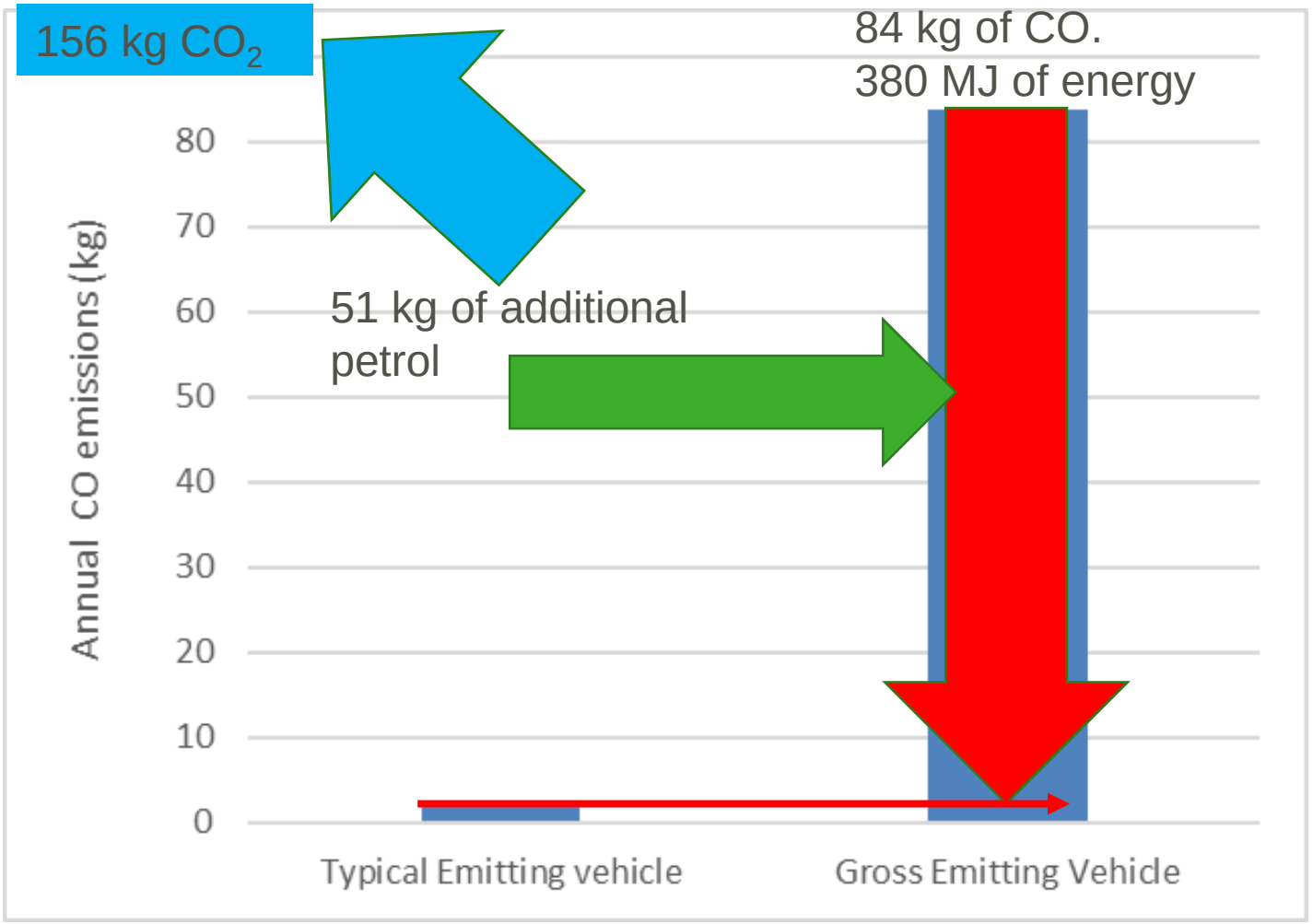
- CO and HC emissions are useful indicators of engine efficiency.
- Use CO and HC emissions to estimate the amount of additional fuel used by gross emitters.
- Calculate increase in CO_2 emissions from additional fuel use.



Concept for calculating CO_2 emissions



Impact of CO gross emitter on CO_2 Emissions



Benefit of replacing CO GEVs for CO_2 Emissions

1995 Toyota Corolla

Gross emitter

231 CO_2/km

2005 Toyota Corolla

Typical emitter

200 CO_2/km

Net reduction 31 g CO_2/km or 16 %.

Limitations and Logistics – CO_2 gross emitters

- HC and CO emissions are easily controlled by catalytic converters
  - Some engine inefficacy will not be detected by the RSD.
- Assessing the combined impact of CO and HC emissions.
- Possibly use a top down approach.

Conclusions: Stage 1 Method Development

Harmful pollutants and CO_2 Emissions -

- **RSD and supporting information can be used to calculate real world:**
  - Emissions from GEVs
  - Benefit of removing GEVs from the vehicle fleet

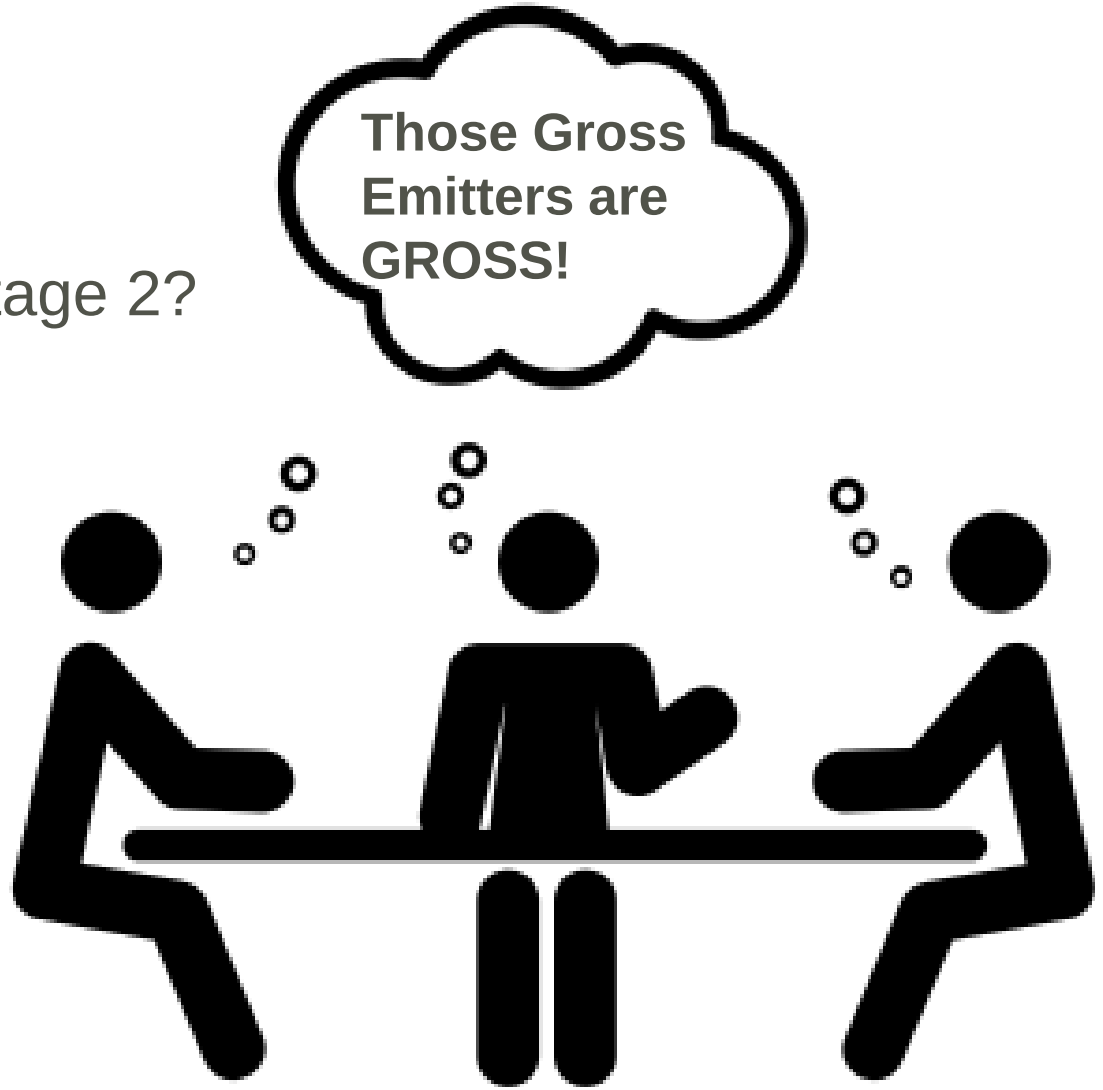
Preliminary Results show the potential benefits of replacing GEVs with TEVs are:

- **Very large reductions of emissions of CO**
- **Non-trivial reduction of emissions of CO_2**

Next step in the project:

Hold point meeting -

Progress to Stage 2?



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Thank you!
Questions?