Real-world fuel use and vehicle emissions

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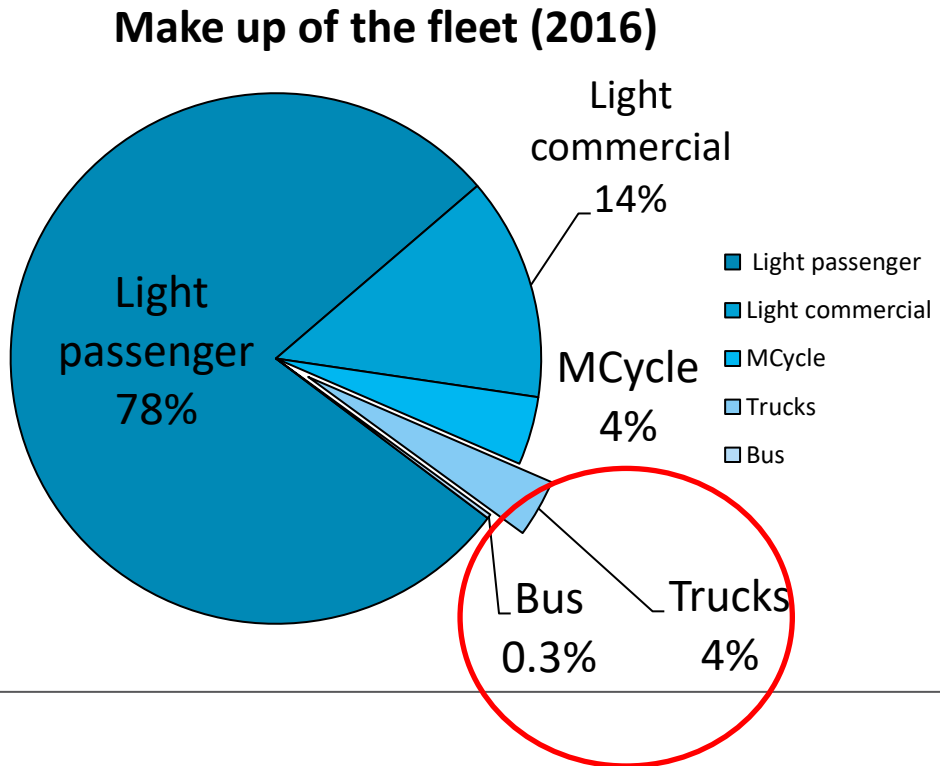
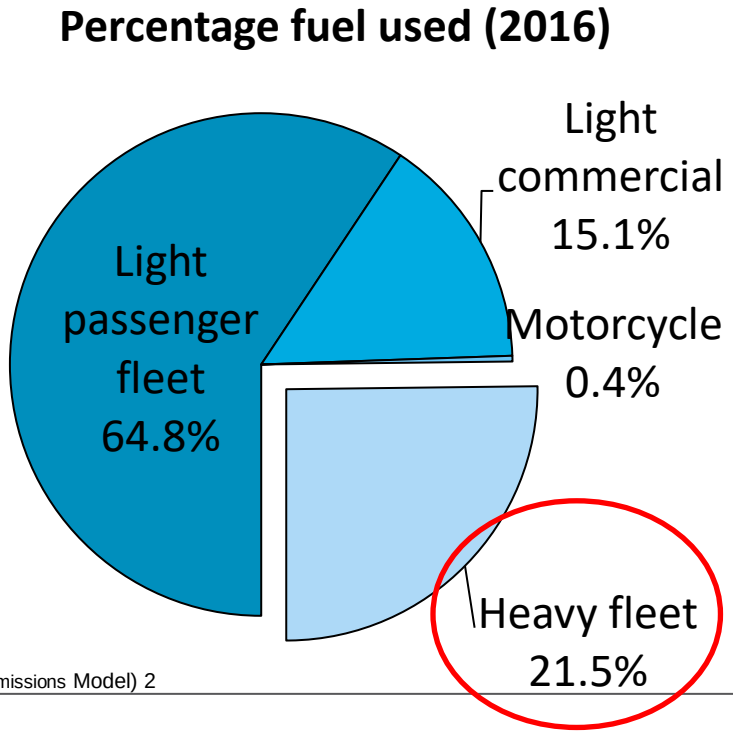
The NZ vehicle fleet

There are around 4 million vehicles on New Zealand roads (not including trailers) and about 92% (3.7 million) are light vehicles (ie cars, 4WDs, vans, utes and light trucks)



The NZ vehicle fleet: where is the fuel used?

- The 4% (~145,000) that are heavy vehicles responsible for ~ 21% of fuel used



Source : VFEM (Vehicle Fleet Emissions Model) 2

Where does the fuel use data come from?

- **Petrol is largely (97%) used in road transport so this data is taken directly from sales**
- **However, around a third of diesel is used off-road**
- **To create the data for that pie-chart we need to use models to work out how much diesel is used and where**
  - We also use these models to predict future energy demands
- **The Ministry of Transport has an ongoing project to refine its models**

Real world fuel use

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Fuel use of in-service vehicles

- **In 2014 MOT obtained several large data sets of on-road fuel use from New Zealand commercial fleets**
- **Data was for both light and heavy vehicles**
- **Data included odometer readings and fuel use based on fuel card data**
- **We then accessed motor vehicle register to get other data such as weight and engine size**
- **We worked with the data providers to ensure no private information was provided to the Ministry**
  - no number plates, ownership details or location data was shared with us

Real-world fuel use data

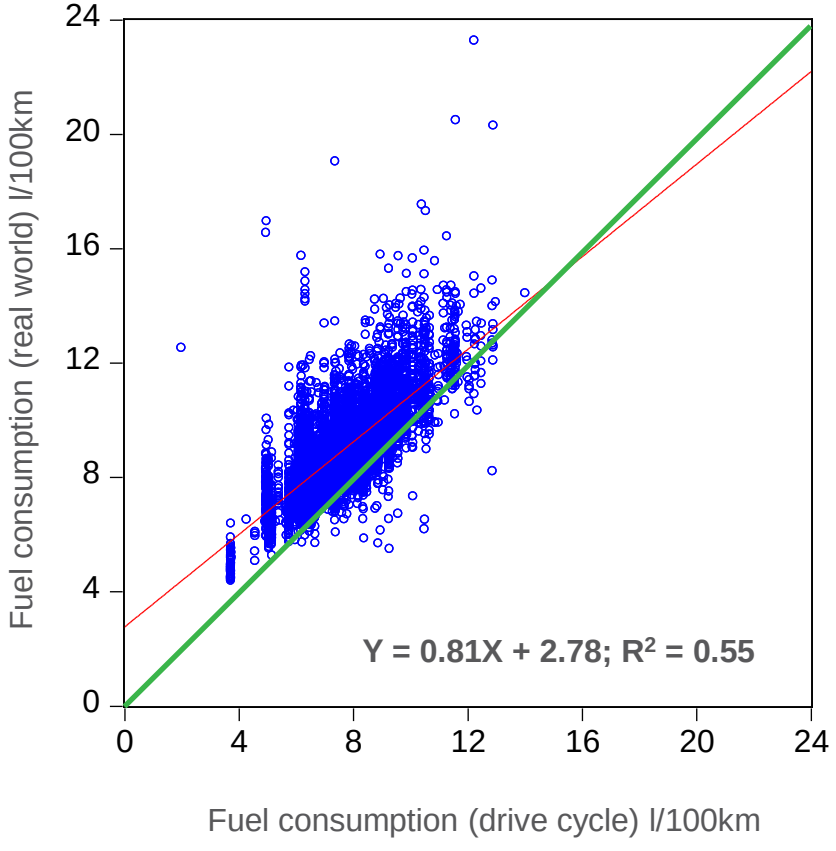
Two data sets with a large number of vehicles monitored (based on fuel card transactions)

	Light petrol	Light diesel	Heavy diesel trucks	Data collection time period
Source A	**6759**	**2511**	71	2013-2014
Source B	131	**662**	**2449**	2011-2014, mainly 2012/13

- They are all corporate vehicles
- These vehicles are fairly new, mostly made in 2010 or later, though heavy vehicle set included more older vehicles

All light petrol vehicles – divergence in FE (%)

- This compares real word fuel use by light vehicles vs manufacturers published figures
- A small number of petrol vehicles are more fuel efficient than would be expected from the type approval numbers
- There is some correlation between real-world and type approval FE values



Fuel use in heavy diesel vehicles

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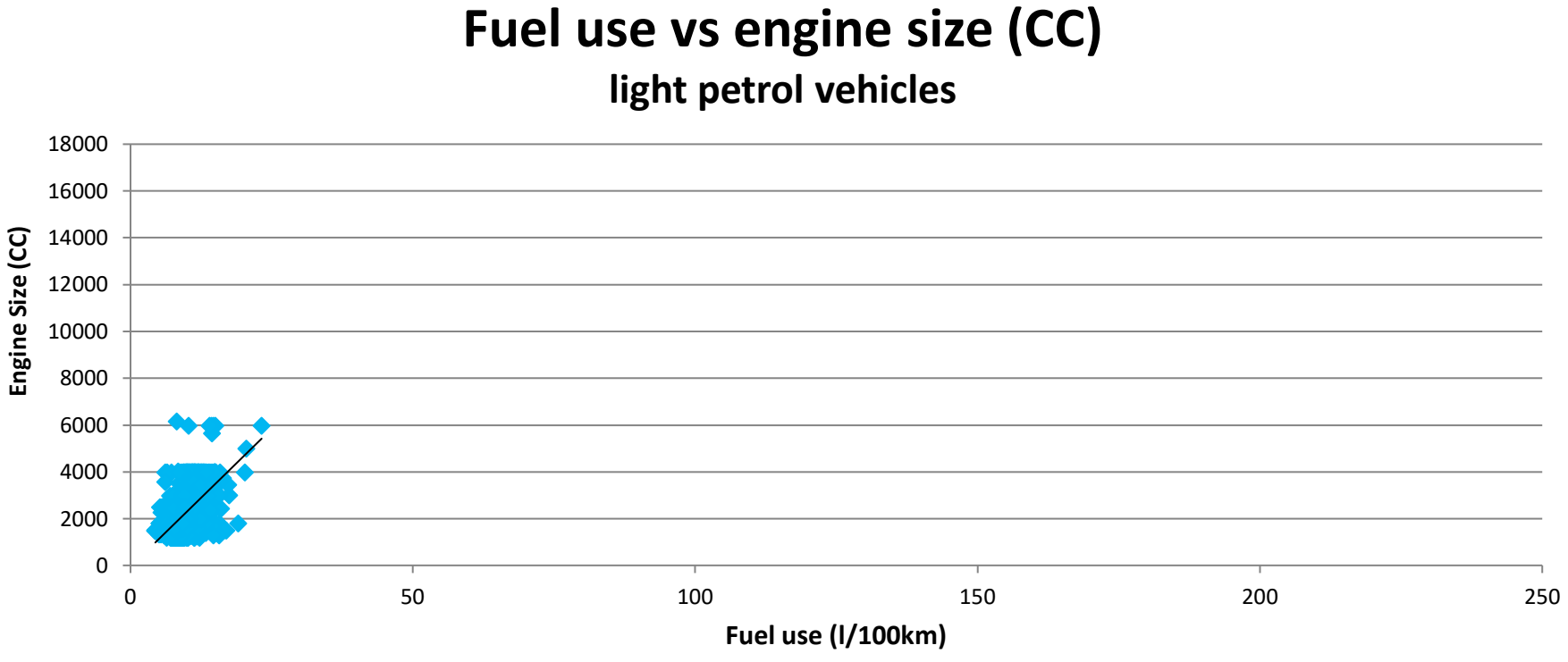
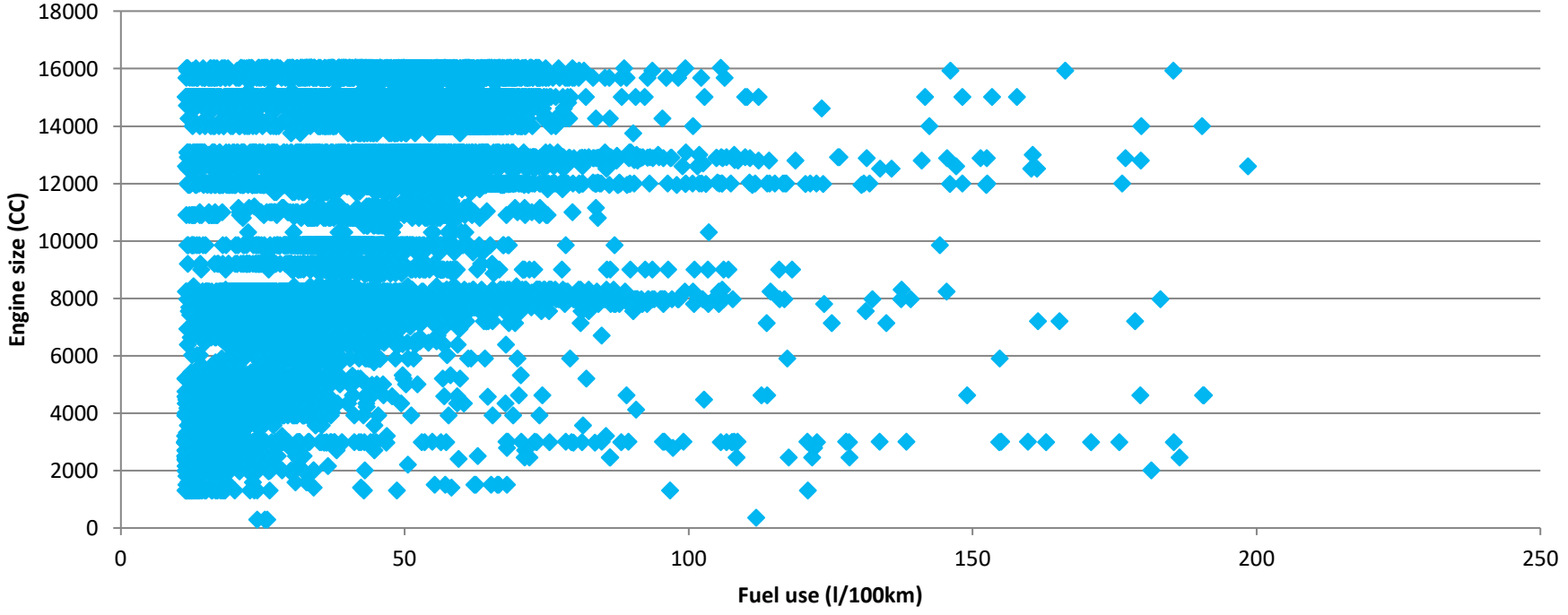
Fuel use vs engine size light vehicles



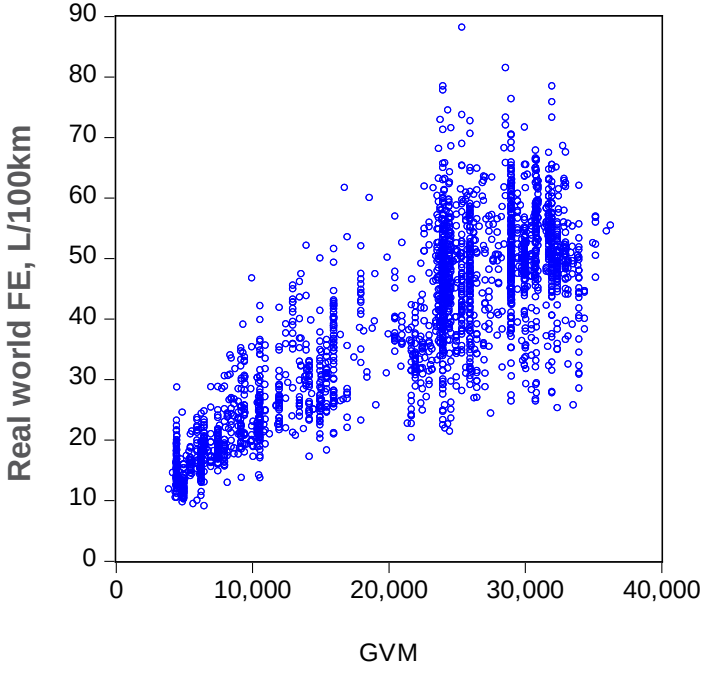
Fuel consumption vs engine size all data

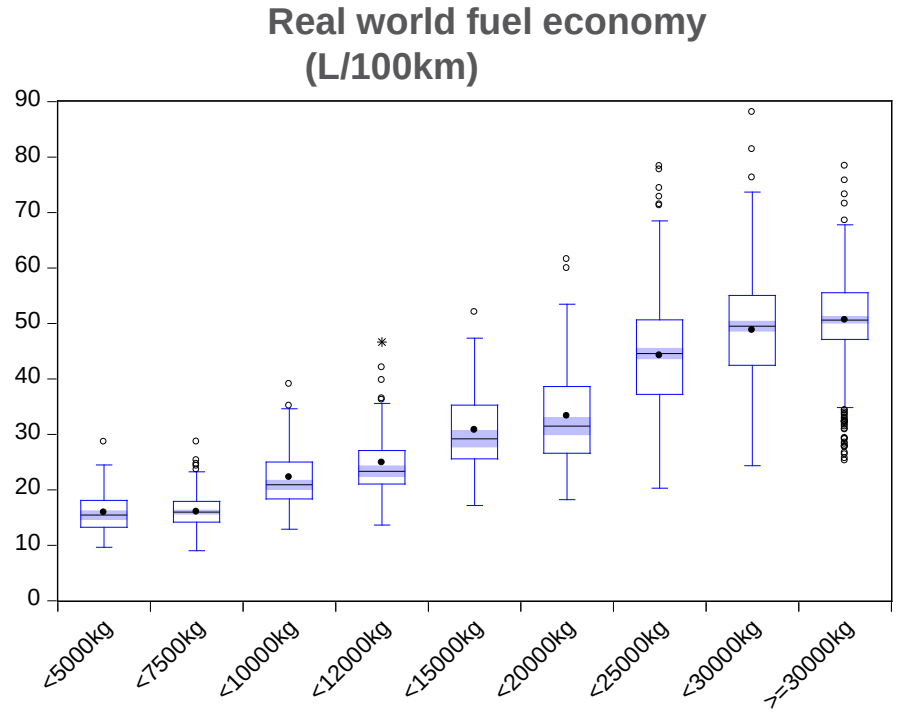
(clipped for overly small and large values for fuel and CC)



You can say a truck uses pretty much any number of litres per 100km that you like!

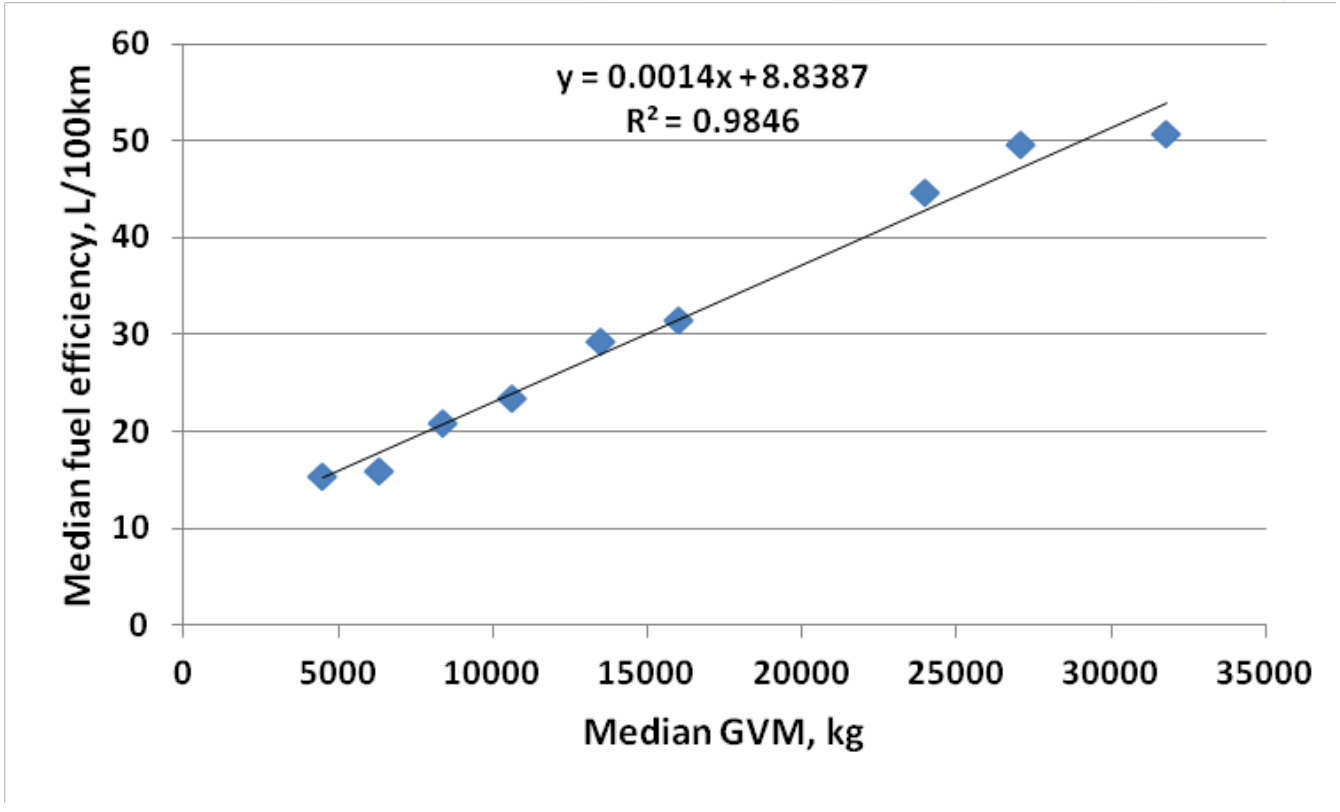
Good linear relationship with GVM





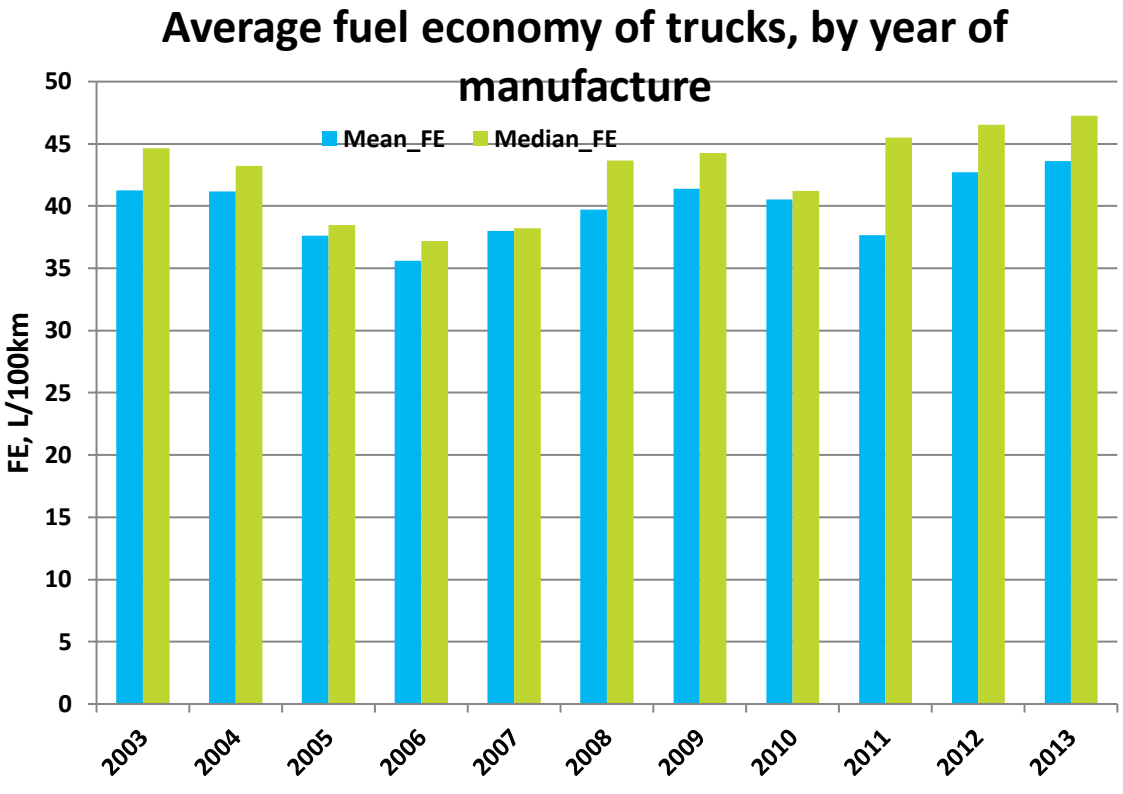
- Fuel use was distributed in a wide range, but the trend of increasing fuel use with GVM is clear

Good linear relationship with GVM



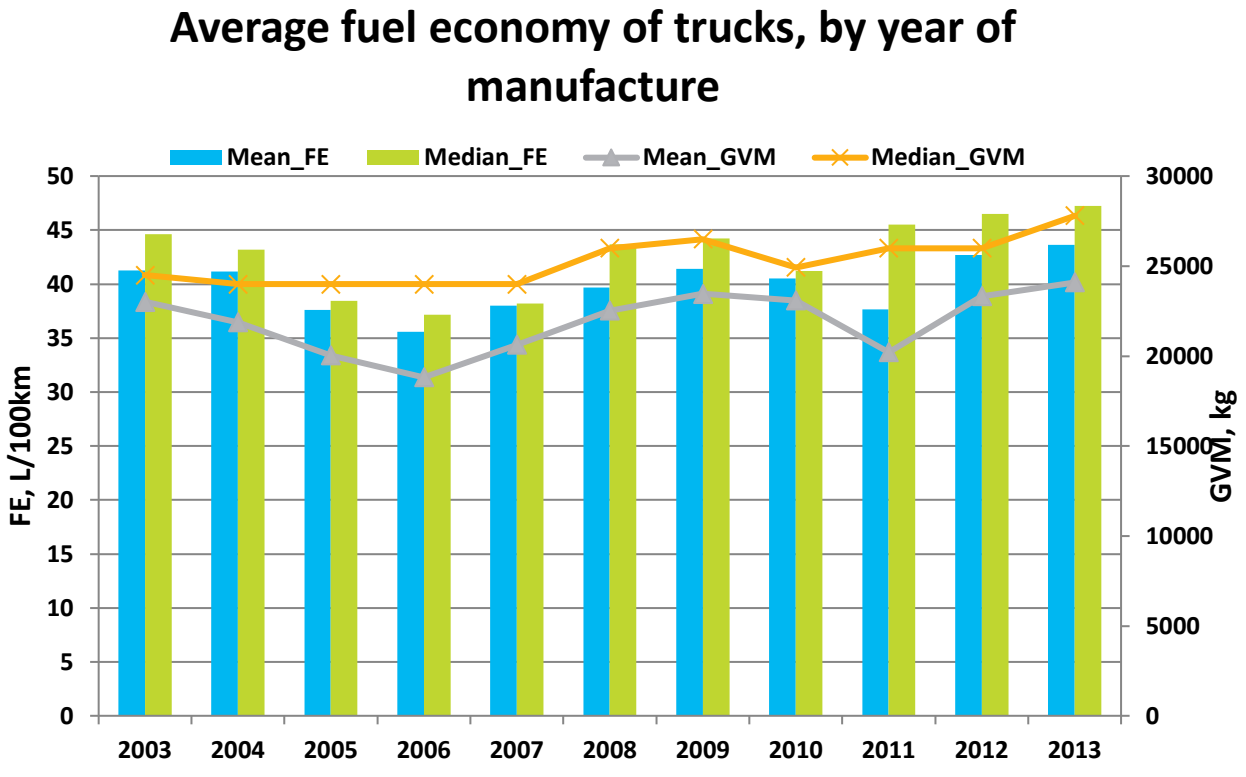
- Exception at the top end

Real world FE (L/100km) *vs.* YOM is not improving



Fuel economy (FE) does not change with YOM for heavy diesel trucks

Real world FE (L/100km) *vs.* YOM is not improving



The biggest reason for variation in fuel economy appears to have been changes in GVM

Air quality and heavy diesel vehicles

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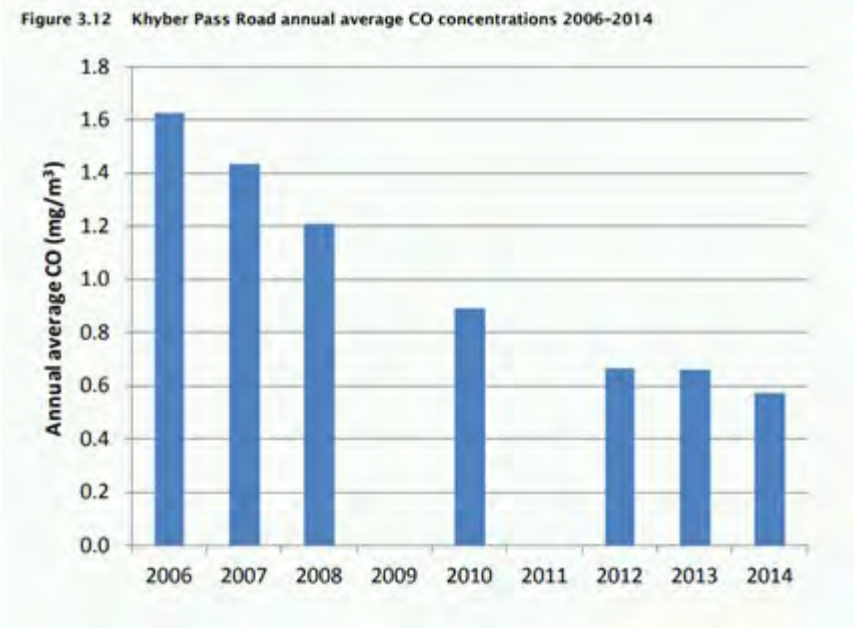
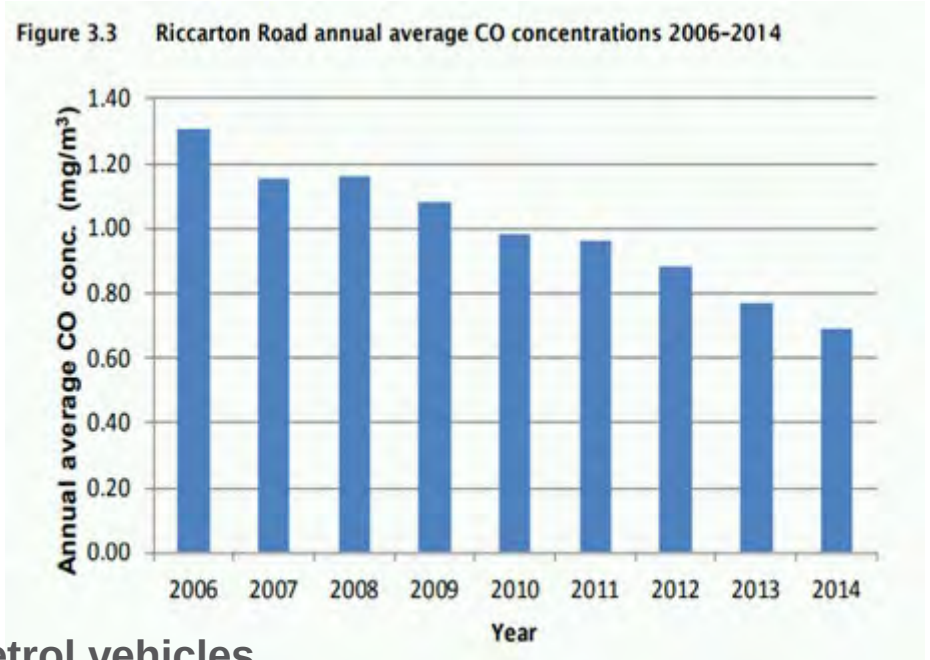
2007 Vehicle Exhaust Emissions Rule

- In 2007 the Government signed the Land transport Rule Vehicle Exhaust Emissions
- This was the first comprehensive requirement for all vehicles entering the fleet to meet recognised vehicle emissions standards
- So have they worked and what is next?

Good news: Emissions standards are working!



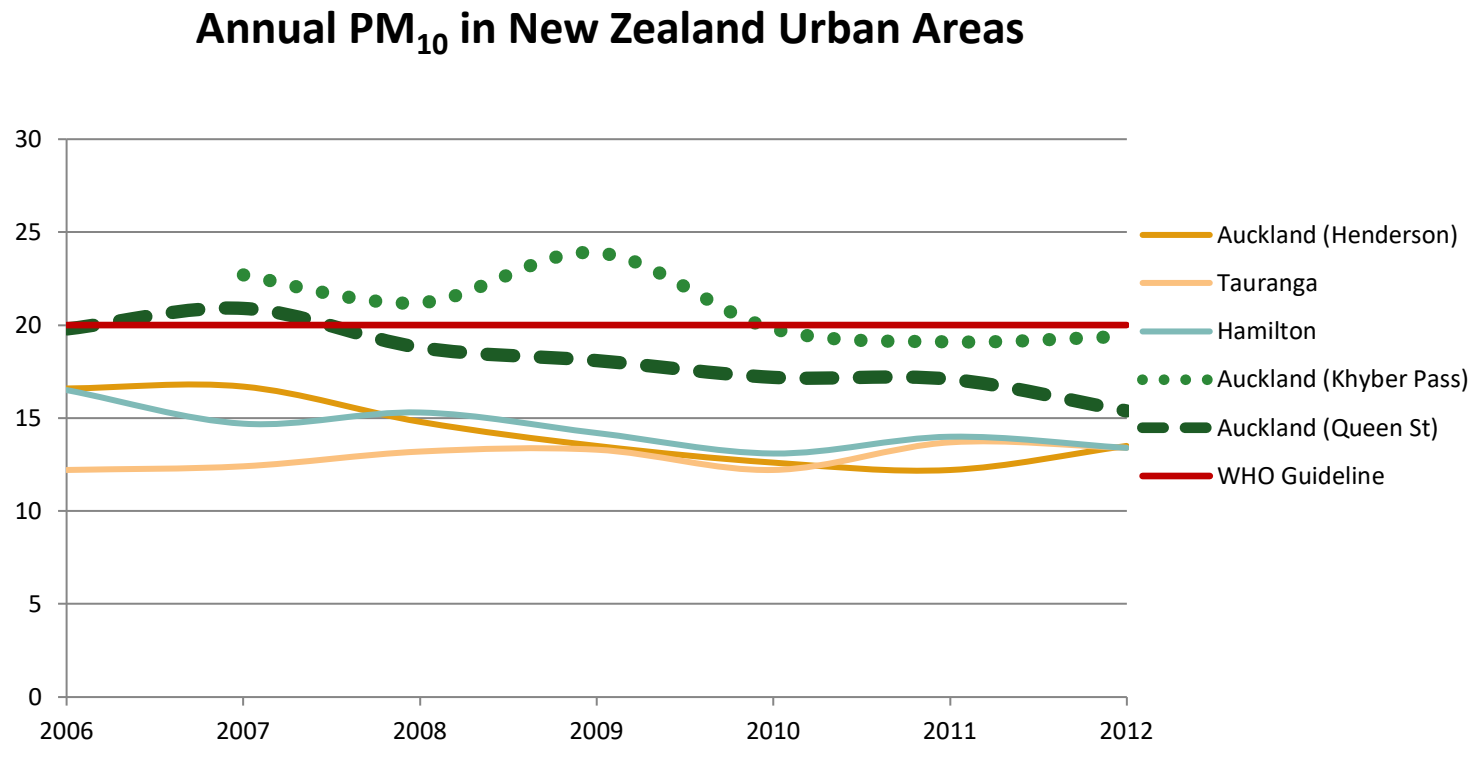


The real world data is good news – for petrol vehicles

Data from Auckland Council sensors shows CO emissions from vehicles are declining at the roadside

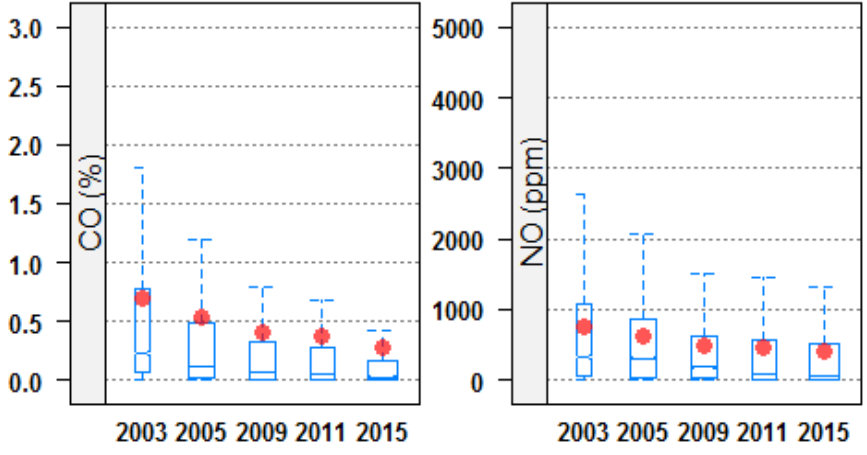
http://www.nzta.govt.nz/assets/resources/research/reports/596/596.pdf

Particulate matter (PM10) is also falling



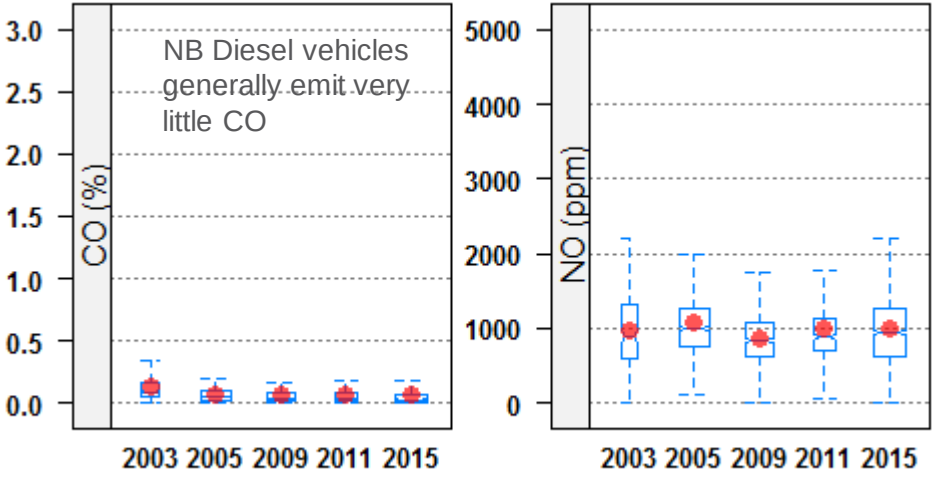
What is happening at a vehicle level?

- To find out what is happening at an individual vehicle level we use remote sensing which measures pollutants in exhausts of vehicles as they drive past measuring device
- Many tens of thousands of vehicles have been measured in series of research trials since 2003
- Heavy vehicles are hard to measure due to vertical exhausts!
- Good news is that per-vehicle levels of harmful emissions from light petrol vehicles are declining steadily, primarily as a result of introduction of standards



Results from 2015 remote sensing trials

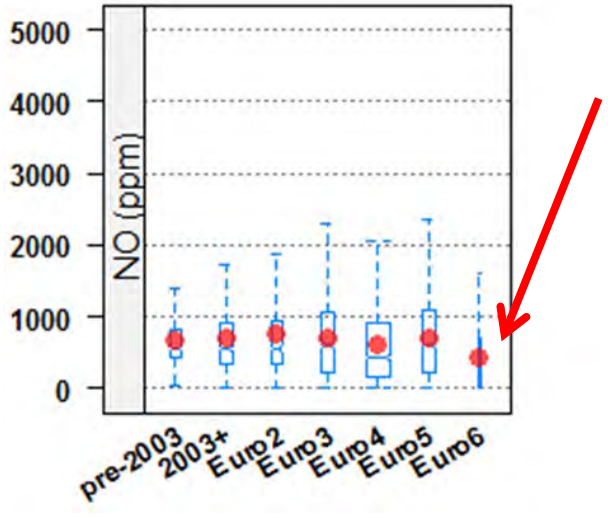
- **2015 data shows emissions are not falling from heavy diesel vehicles as expected**
- **Basically the standards have not delivered the reduction in emissions in the real world that the models predict**
- **Some of the older vehicle standards are actually cleaner in the real world than newer ones**



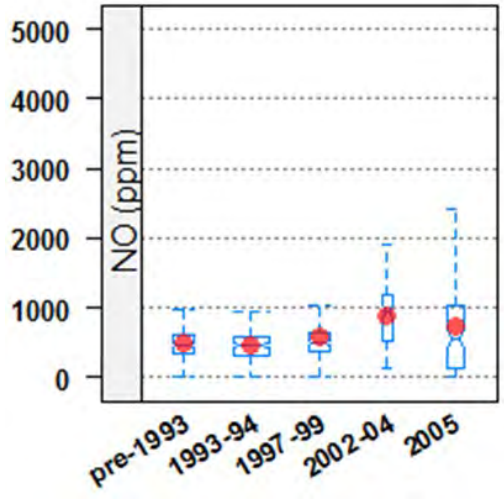
Results from 2015 remote sensing trials (Cont)

- **Not enough data to analyse effect of new standards for heavy vehicles**
- **What is interesting is that for light diesel vehicles surveyed in 2015, Euro 6 is working!**

NZ New light diesel vehicles



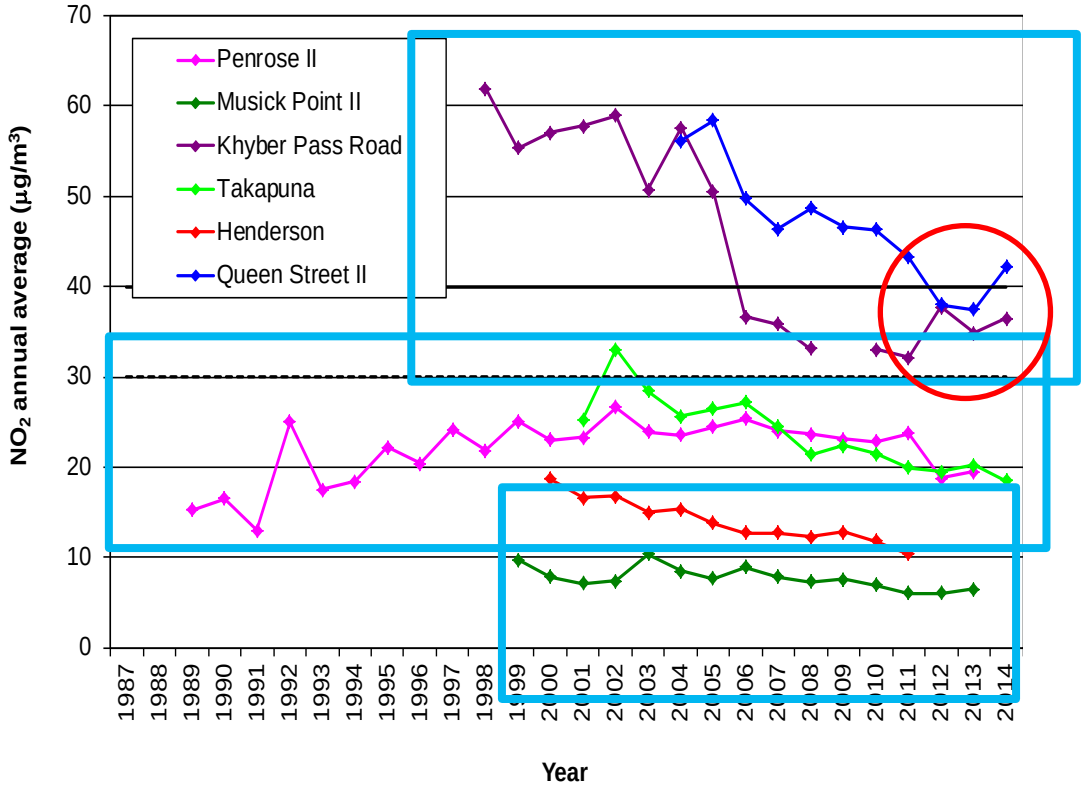
Japanese used light diesel vehicles



In this data Japan 05 emissions are roughly the same as Euro 5

We can see effects of NOx on busy roads

- But more complicated for diesel emissions
- This chart shows data from air quality monitoring equipment in Auckland for nitrogen dioxide (NO_2)
- Background sites are stable or declining
- Suburban sites are also falling
- BUT
  levels at heavily trafficked roadsides are increasing again after falling for a period



Emission standards – adoption of Euro 6/VI

- **Currently the 2007 Vehicle Exhaust Emissions Rule requires the following minimum standards:**

New heavy diesel vehicles	**ADR 80/03; Euro V; Japan 09; or US 2007**
Used heavy diesel vehicles	**ADR 80/02; Euro IV; Japan 05; or US 2004**

- **There is currently no official timeline for updating the minimum standards in New Zealand to Euro 6/VI in New Zealand**
- **There are no technical impediments to the import and use of Euro 6/VI (or equivalents from Japan and US) vehicles.**
  - Our fuel standards already meet Euro 6/VI requirements
- **We are waiting for Australia to set out its plan for adoption of further Euro standards as most manufacturers see New Zealand as a branch market of Australia**

Why are NOx emissions not falling

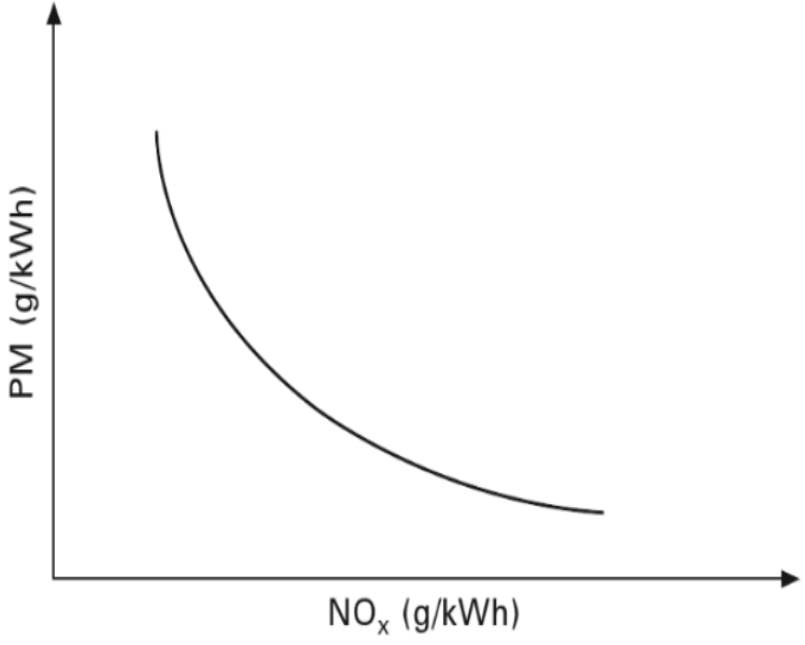
All diesel engine manufacturers have to make a trade off

- the higher the temperature, the lower the particulates
- The lower the particulates the higher the fuel efficiency (least fuel use) and higher the power of the engine

BUT

- the higher the temperature the higher the NOx

This is known as the diesel dilemma



Why are NOx emissions not falling (Cont)

- Most manufacturers have opted to burn fuel as efficiently as possible and then treat exhaust gases in the exhaust stream to reduce NOx
- Most technologies that treat the exhaust stream to comply with Euro 5 (and above) require purchase and ongoing use of diesel emissions fluid (AdBlue)
- This adds costs, both to the manufacturer and the owner
- Software may also reduce power output from the engine by preventing heavy acceleration to avoid producing Nox, which may not be desired by the driver

Defeat device vs tampering

- **In New Zealand we have been discussing tampering with vehicle exhaust emissions equipment**
- **Tampering is done by the owner after the vehicle enters service**
- **A ‘defeat device’ is one installed by the manufacturer to ‘defeat’ the certification tests.**
  - ***a ‘defeat device’ is what Volkswagen was accused of installing in its vehicle.***
- **There is no definition of tampering in NZ law. EU legislation defines tampering:**
  - *Tampering means inactivation, adjustment or modification of the vehicle emissions control or propulsion system, including any software or other logical control elements of those systems, that has the effect, whether intended or not, of worsening the emissions performance of the vehicle;*

Tampering

- Tampering, especially by bypassing AdBlue (urea) systems, is clearly against the intent of the law, but is not explicitly illegal
- The Ministry is considering the potential size/scale of tampering and what we could to do about it
- All jurisdictions face the same problems and we cannot find any clear examples of other jurisdictions that have policies to reduce tampering

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