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Energy & Environment

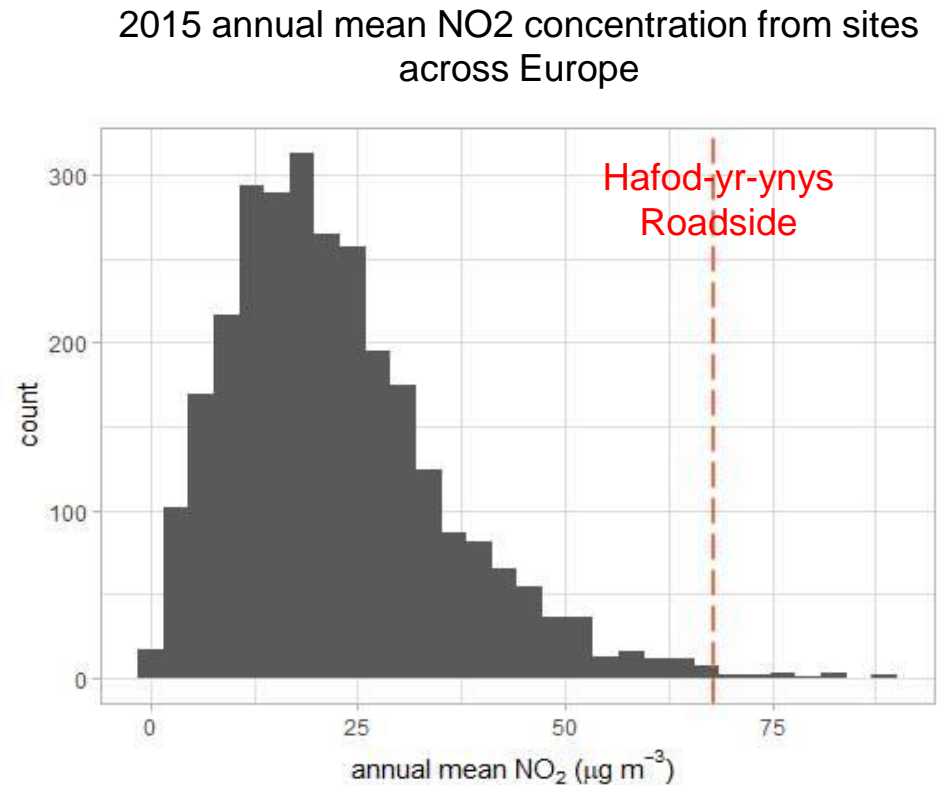
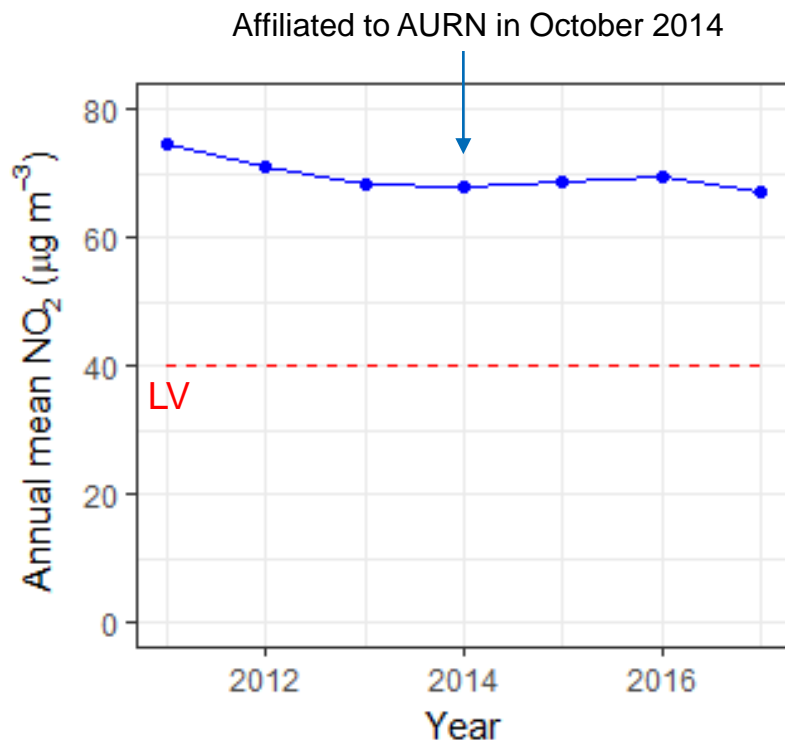
Vehicle Emissions Remote Sensing

Preliminary results from Measurements on
A472 Hafod Road

Rebecca Rose
WAQF, 12th October 2017

Hafod-yr-ynys Roadside monitoring station

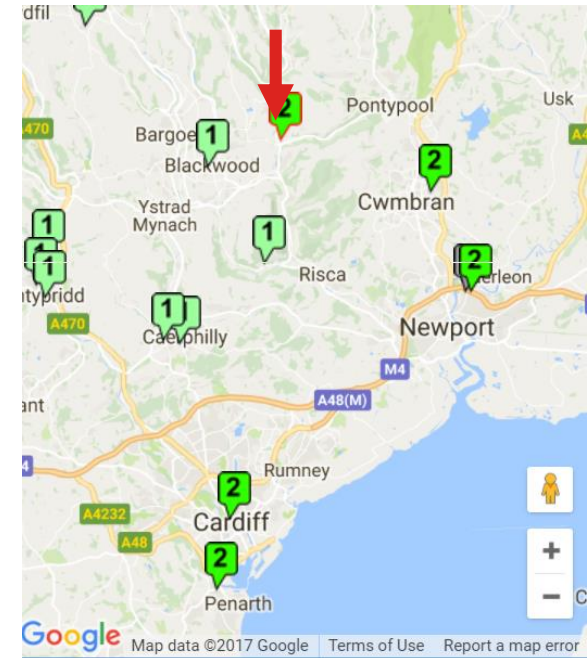
- Annual mean concentration of NO₂ is one of the highest in UK and in the top 0.5% of sites across Europe
- High number of exceedances of the hourly limit value for NO₂ of 200 µg m⁻³
 - 18 allowed exceedances, 126 in 2016 and already 95 in 2017



Hafod-yr-ynys Roadside monitoring station

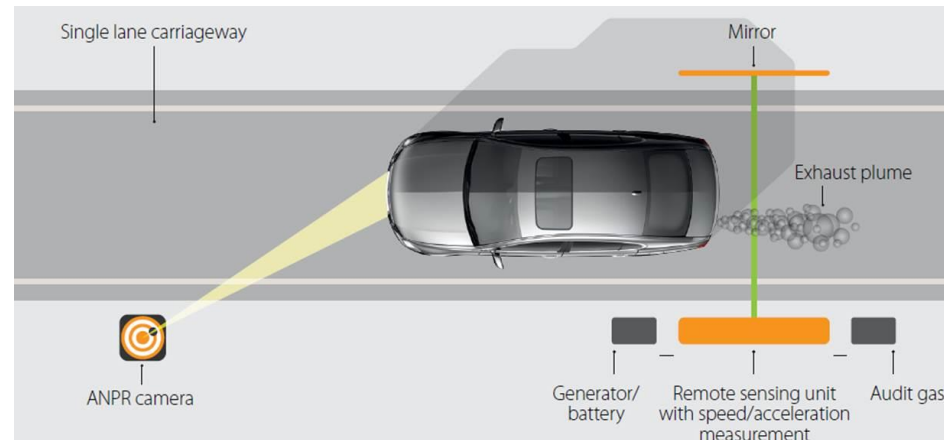
- Monitoring station is located on the roadside of A472 Hafod Road
- Row of houses on one side and wall on the side form a street canyon
- Road has significant gradient so vehicles require additional power to travel up the road
- Congested with a high volume of traffic

Aim to use remote sensing measurements to provide further insight to understand the high levels of pollution recorded at the monitoring study in a one week trial.



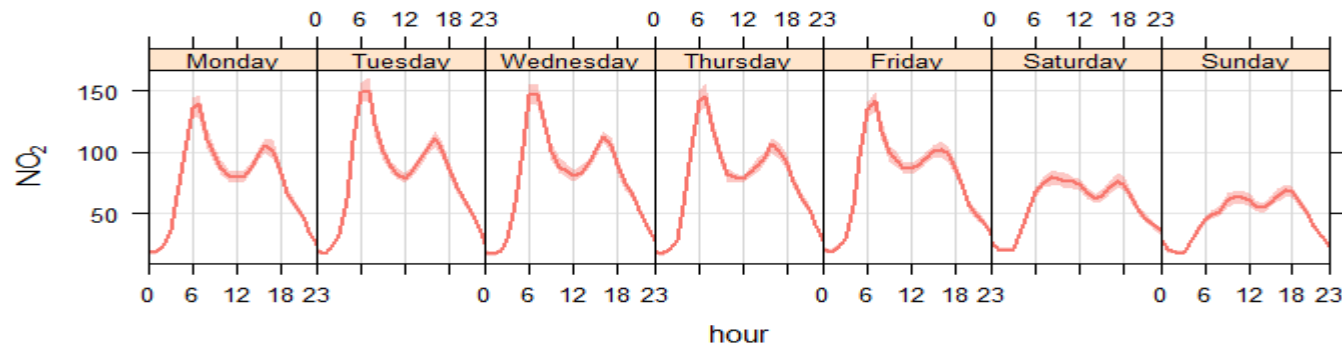
Vehicle Emission Remote Sensing

- We have been trialling remote sensing for 6 months
- The technique:
 - UV/Infrared beam to measure emissions – different gases absorb in different wavelength regions
 - Measure 1000s of vehicles in a day
 - Provide ‘real’ real world emissions data (literally don’t need to touch the vehicle being measured)
 - Measure NO, NO₂ (hence NO_x), CO, HC, PM and NH₃
 - Provides fuel-based emission factors e.g. g NO_x per kg fuel
- Photograph each vehicle to obtain number plate
 - Detailed cross reference with SMMT-derived databases...more than 80 vehicle characteristics, down to the colour of the vehicle!
 - Will soon add MOT mileage data and quantify vehicle degradation effects on emissions systems



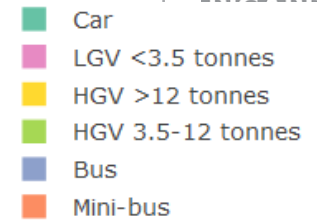
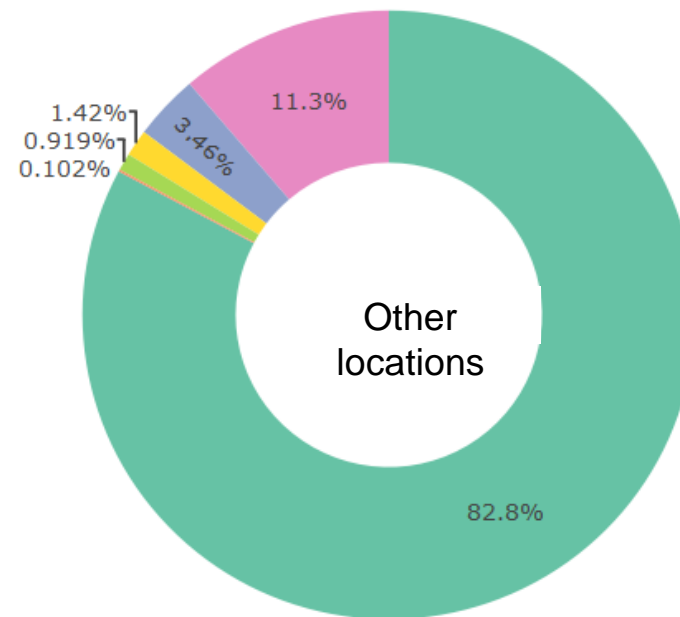
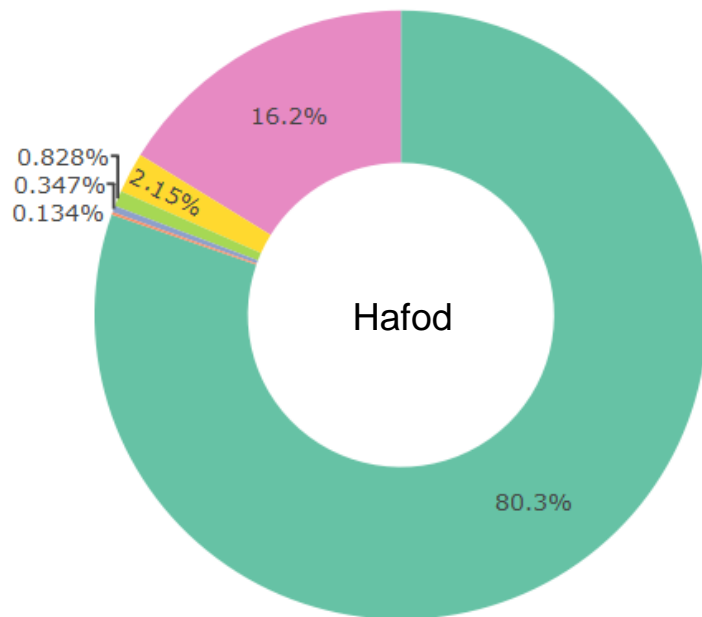
Vehicle emissions remote sensing – Hafod measurements

- Measurements made over a 5 day period Monday 11th – Friday 15th September
- Instrument located a few 100 m down the road from Hafod-yr-ynys Roadside monitoring station (due to setup, parking and safety requirements)
- Measurements made between 6 am and 6 pm corresponding to peak traffic flow and highest emissions



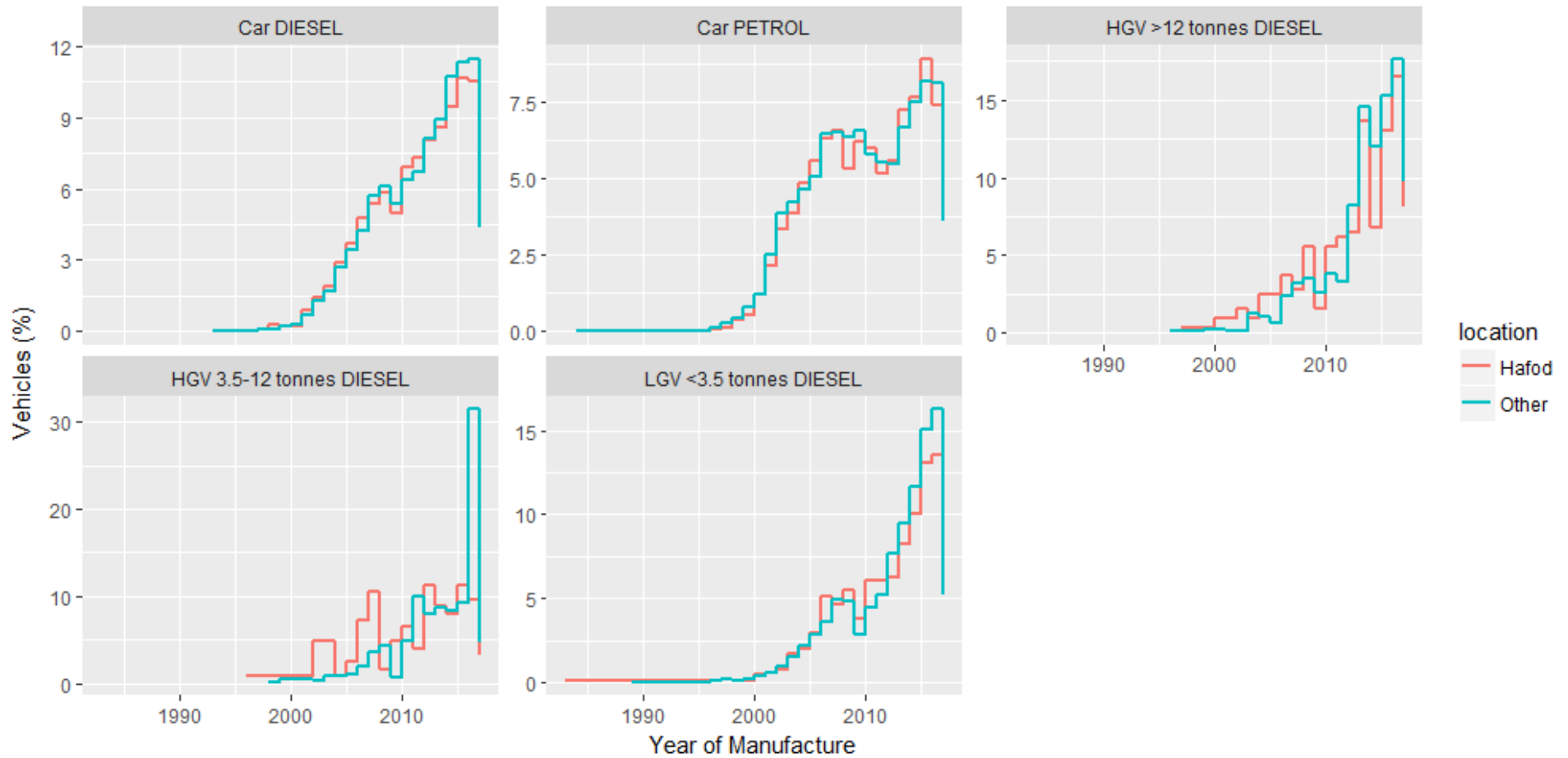
Average NO₂ measurements at Hafod-yr-ynys Roadside by day and time 2014-2017

- ~15,000 vehicle measurements, adding to a database of ~80,000 vehicle measurements from locations across the UK
- Results are presented providing an insight into the fleet and vehicle emissions at this location, comparison is made to measurements at other UK locations
- All results presented are provisional and subject to change



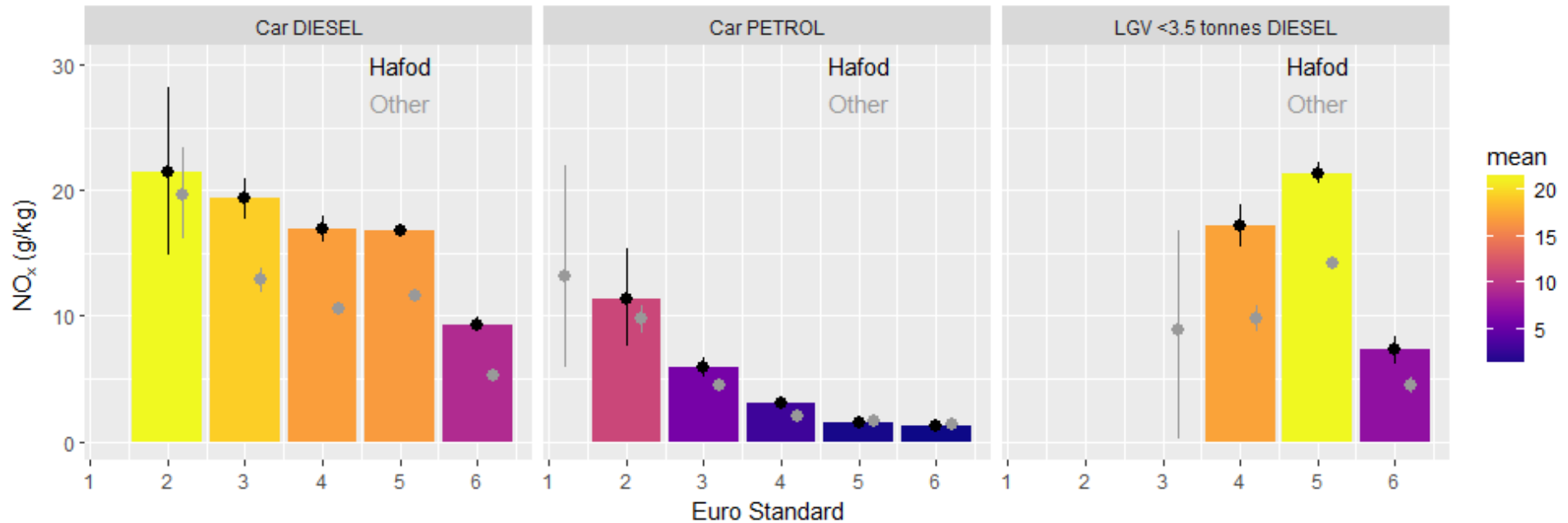
- Photographs of vehicle number plates matched to vehicles properties provides fleet info
- Fleet is dominated by cars (close to 50:50 diesel/petrol split)
- Higher proportion of vehicles are LGVs and HGVs at Hafod than at other locations
- Smaller proportion of buses
- Note that a small proportion of number plates are not captured by camera and this may impact on the fleet mix

Fleet age

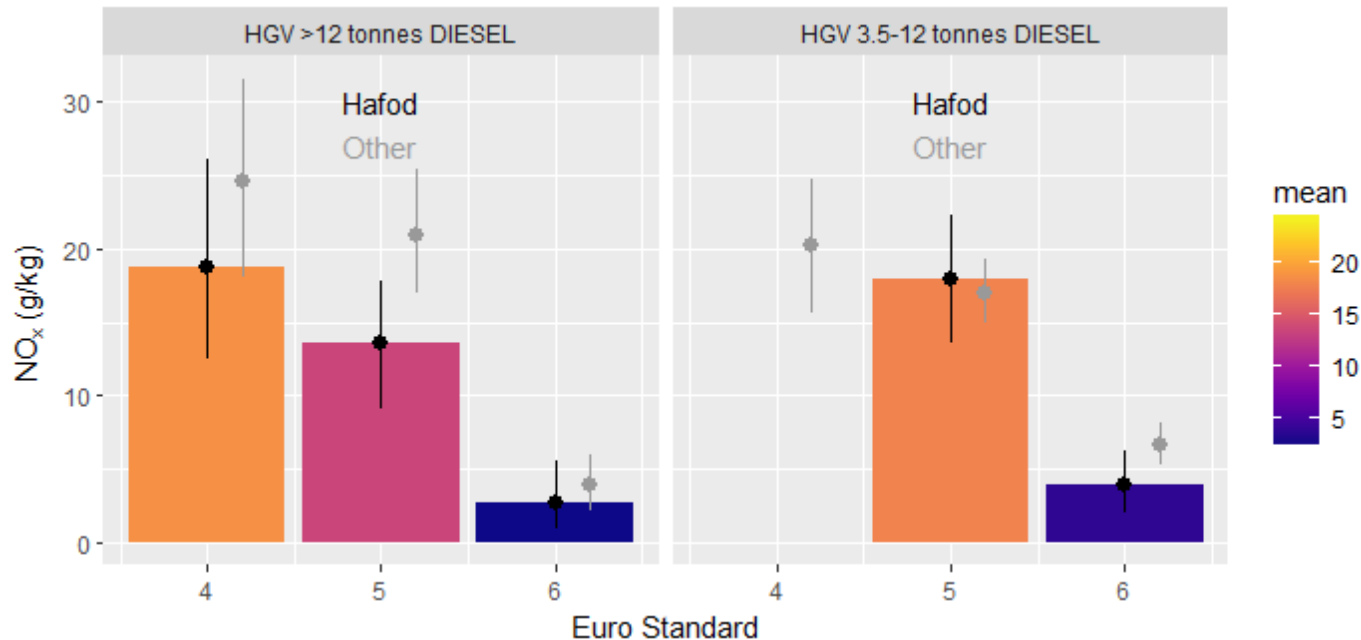


- Generally the fleet age distribution is similar to that recorded at other locations
- Higher proportion of older HGVs and LGVs in Hafod

NO_x emission – light vehicles



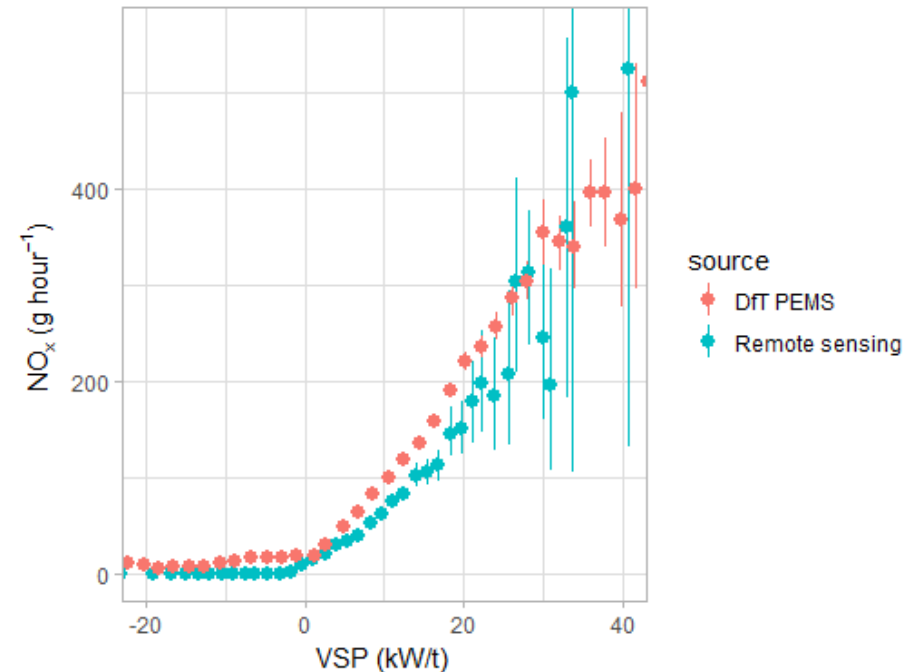
- Measured NO_x emissions in g NO_x per kg fuel
- Results presented by Euro standard and require > 10 vehicle/euro standard category
- Little change in NO_x emissions up to Euro 5, significant signs of improvement for Euro 6
- Evidence that diesel vehicles have **higher** NO_x emissions per kg fuel at Hafod location than at other locations measured e.g ~40% higher for Euro 6 diesel cars



- Measured NO_x emissions in g NO_x per kg fuel
- Results presented by Euro standard and require > 10 vehicle/euro standard category
- NO_x emissions for Euro 6 vehicles are significantly lower than for earlier Euro standards
- Evidence of **similar** NO_x emissions per kg fuel at Hafod location compared to other locations measured

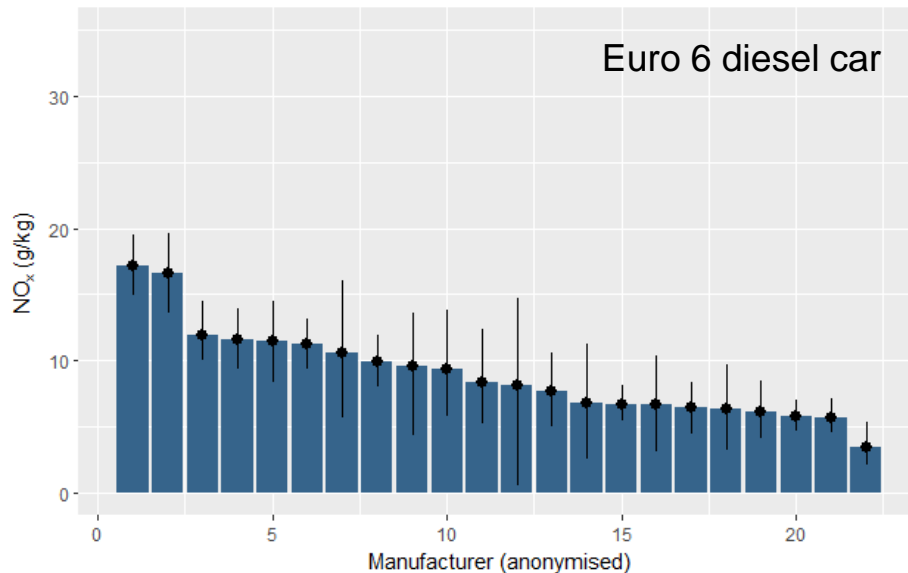
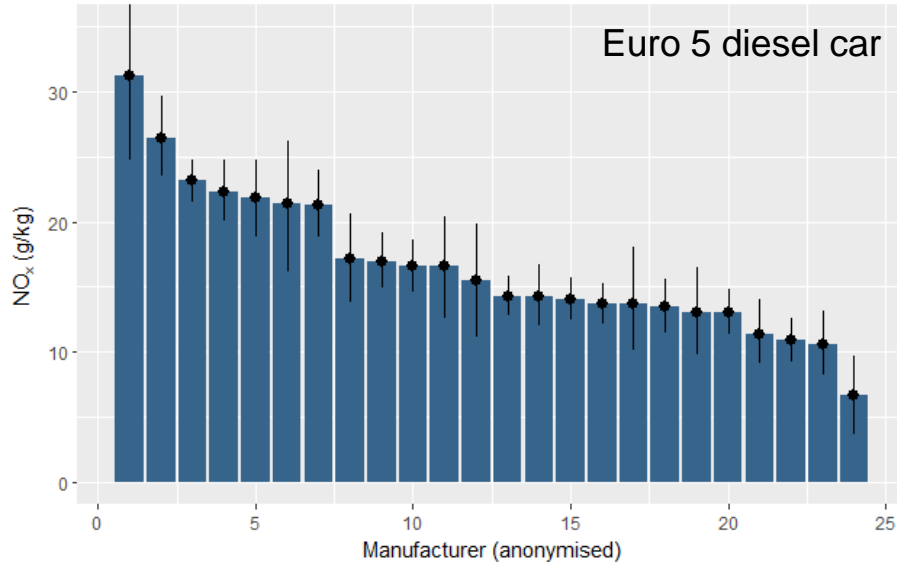
Link with emission factors and inventories

- Results presented are in units g NO_x per kg fuel
- Emission factors for inventories use units g per km
- Work is underway to convert remote sensing outputs to emission factors in g/km
- Fuel use depends on vehicle specific power (VSP):
 - Function of **road gradient** (among other things)
- For Hafod Road, the slope is $\sim 6\%$, therefore power demand of vehicle and fuel use will be high
- Therefore expect emission factors in g/km to be **higher** at Hafod than at other locations we have measured with lower gradients



[Plot provided by D. Carslaw, based on previous Remote sensing measurements in London and PEMS measurements by DfT]

Emissions by manufacturer



- With higher numbers of measurements we can delve further into the data to extract more detailed information e.g. split by manufacturer.
- NO_x emissions from vehicles made by different manufacturers vary by up to factor of 4
- The best Euro 5 vehicles are better than the worst Euro 6 vehicles
- 95% confidence intervals for Euro 6 diesel cars indicate less confidence in emissions by manufacturer compared to Euro 5 vehicles because a lower proportion of the fleet is Euro 6

Summary and conclusions

- Undertook a one week study to measure real world vehicle emissions on A472 Hafod Road
- ~15,000 measurements recorded, adding to a database of ~80,000 vehicle measurements from locations across the UK
- Reductions in emissions of NO_x for Euro 6 vehicles compared to previous Euro standards are significant
- For light vehicles emissions at Hafod will be high for two reasons:
 - Evidence that emissions of NO_x (in g NO_x per kg fuel) from light vehicles are higher at Hafod than at other locations across the UK
 - Significant road gradient means that vehicle emission factors in g/km will be high compared to roads with little gradient (work to quantify this is underway)
- For heavy duty vehicles the road gradient means that vehicle emission factors in g/km will be high compared to roads with little gradient
- High emission factors, high traffic volumes and street canyon effects will all contribute to high concentrations of NO₂

- Development of g/km emission factors for detailed vehicle categories that could be used for sensitivity analysis of current inventory emissions factors (NO_x, NO₂ etc.)
- Using data in more innovative ways
 - Combine local fleet data (e.g. ANPR survey data) with real world emission factors from remote sensing in local models
- Linking MOT mileage data to give an understanding of deterioration effects – is current technology going to continue to work in the future?
- Increasing sample size of newest Euro 6 diesel vehicles (RDE)
- Working with OPUS and ICCT to take 100,000 measurements in London (plus measurements in Paris and Berlin)

And for more information...



... on emerging evidence from our measurements, see our vehicle emissions monitoring blog:

<https://ee.ricardo.com/transport/vehicle-emissions-monitoring>

The screenshot shows the Ricardo Energy & Environment website. At the top left is the Ricardo logo. The navigation menu includes: About us, Market sectors, Services, Investors, News and media, Contact us, Careers, eStore, and a search icon. Below the navigation is the 'Energy & Environment' header with a 'Login/Register' button. A secondary menu lists: Air quality, Climate change, Energy, Environment, Transport (highlighted with a green underline), Waste, Water, Sustainable business, and Downloads. The main content area features a large image of a car wheel and a road with the text 'Vehicle emissions monitoring'. Below the image is a breadcrumb trail: Home page / Transport / Vehicle emissions monitoring.

Helping you to understand real-world driving emissions and the environmental impacts

Related news



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