

Achieving NetZero

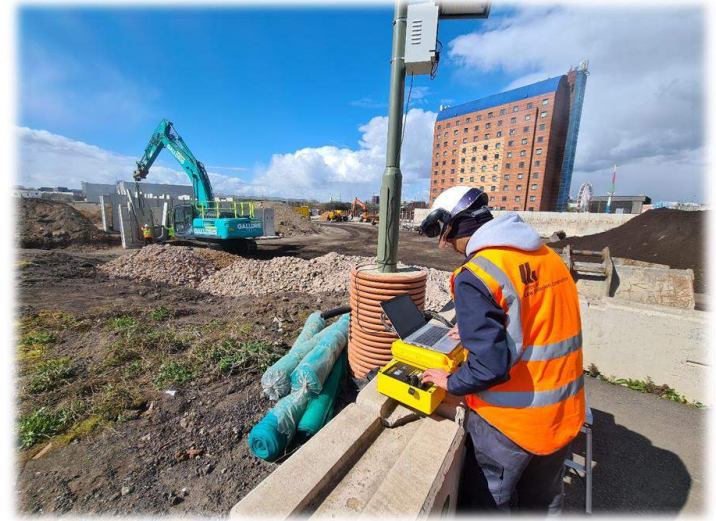
UK strategies for reducing NRMM emissions

28th September 2023

Daniel Marsh, Centre for Low Emission Construction

The Centre for Low Emission Construction

- Raising awareness of air quality impacts from construction and demolition
- Providing high quality scientific research to inform policy development
- Working with manufacturers to develop low emission technologies
- Quantify the health impact of exposure to emissions for the public and people working in the construction sector
- Developing guidance for industry, planners and air quality professionals



Environmental Research Group

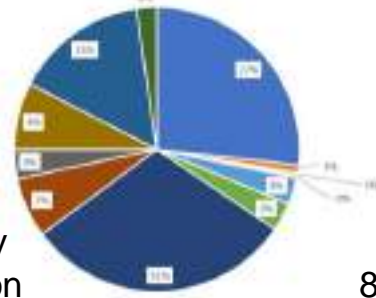
The UK diesel challenge

- The UK government has committed to be carbon 'NetZero' by 2050
- Estimated that there are over 300,000 items of NRMM in use across the UK
- In 2020 the UK construction sector used 2.5 million tonnes of diesel
- Burning diesel has an impact on local air, public health and the environment



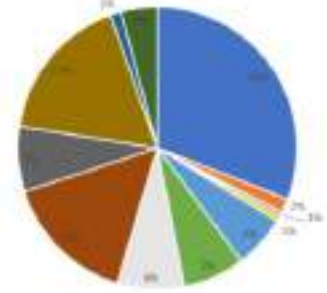
How polluting is the construction industry?

PM10 Emissions by Source Type - LAEI 2019



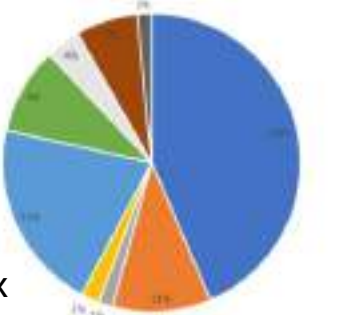
31% PM10 activity
15% Resuspension

PM2.5 Emissions by Source Type - LAEI 2019



8% PM2.5

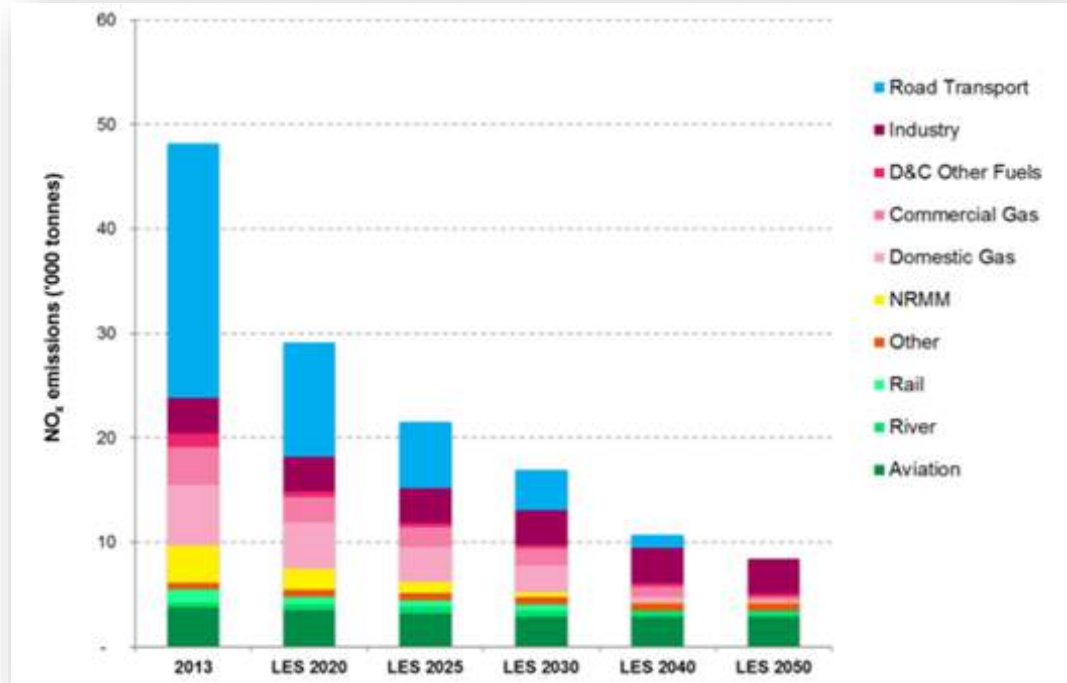
NOx Emissions by Source Type - LAEI 2019



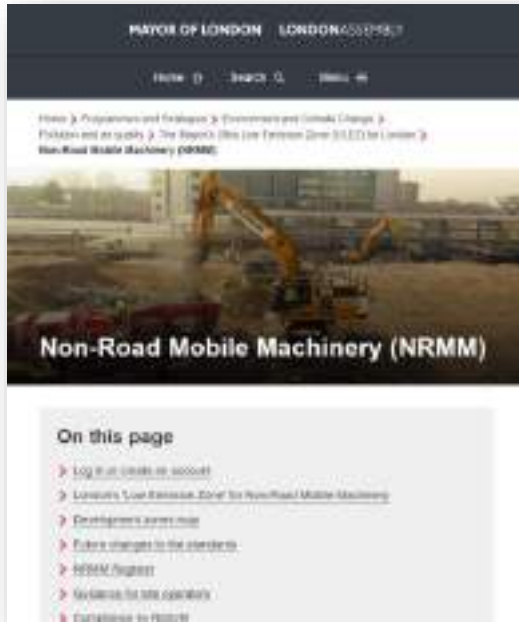
4% NOx

- Road Transport
- Road
- Construction
- Other
- Industrial/Commercial/Power
- International Shipping
- International Air Traffic
- Other
- Domestic Heating
- Sea
- Other

The London Environment Strategy



London's Low Emission Zone for NRMM



- The NRMM Low Emission Zone uses the Mayor and London Borough's planning powers to control emissions from NRMM used on construction sites.
- In a similar way to the [Ultra Low Emission Zone](#) the NRMM Low Emission Zone requires that all engines with a power rating between 37 kW and 560 kW meet an emission standard based on the engine emission "stage"
- **First city in the world** with a NRMM LEZ!

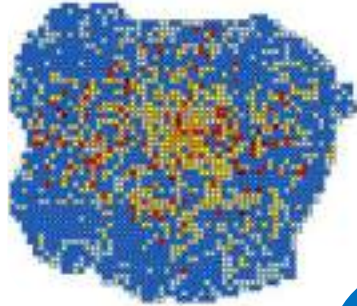
London's Low Emission Zone for NRMM

The current standards are EU stage IV for construction machinery operating in the **Central Activities Zone and Opportunity Areas (including Canary Wharf)** and stage IIIB in the rest of London.

- From 1 January 2025 the standards will be stage IV throughout London
- From 1 of January 2030 the standards will be stage V throughout London
- From 1 of January 2040 only **zero emission** machinery will be allowed.



Improved approach to NRMM inventory



Real World
Emission
Factors

Fleet
Composition
and Location

Activity Data

- Engine test bed emissions factors
- PEMS measurements
- NRMM register
- Supplier data
- Hire company data
- Compliance visits
- Engine Telematics
- Supplier data
- Direct measurements



Emissions from the construction sector in the United Kingdom

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A greater but less developed approach to calculating the NRMM inventory for the construction sector in London

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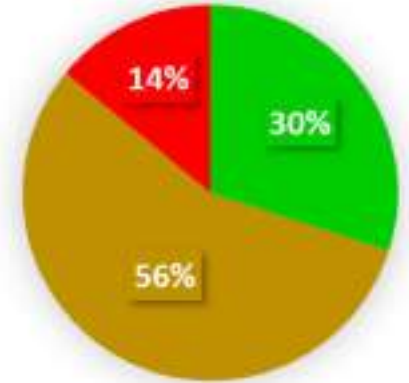
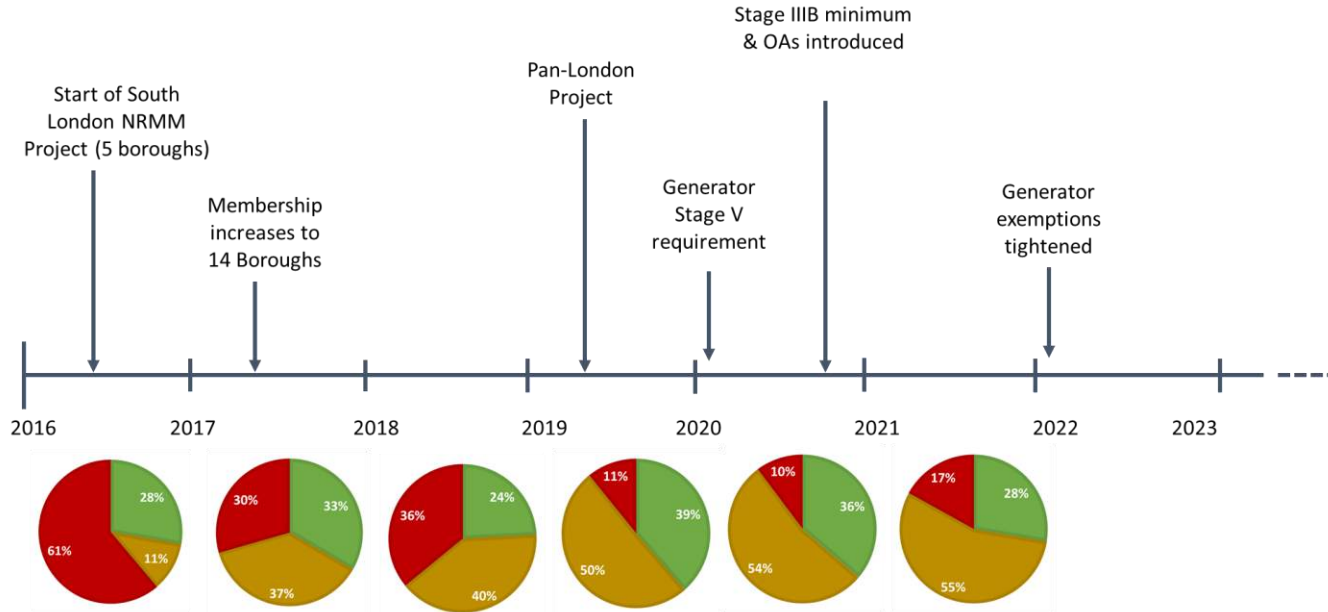
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Improved compliance due to NRMM policy



National NRMM regulation



*“Local authorities are **encouraged** to promote the use of cleaner non-road mobile machinery as part of construction and environment management plans for development they grant planning permission for and consider incentivising cleaner construction equipment through tendering processes where there is clear evidence of air quality issues”*

Defra AQS – April 2023

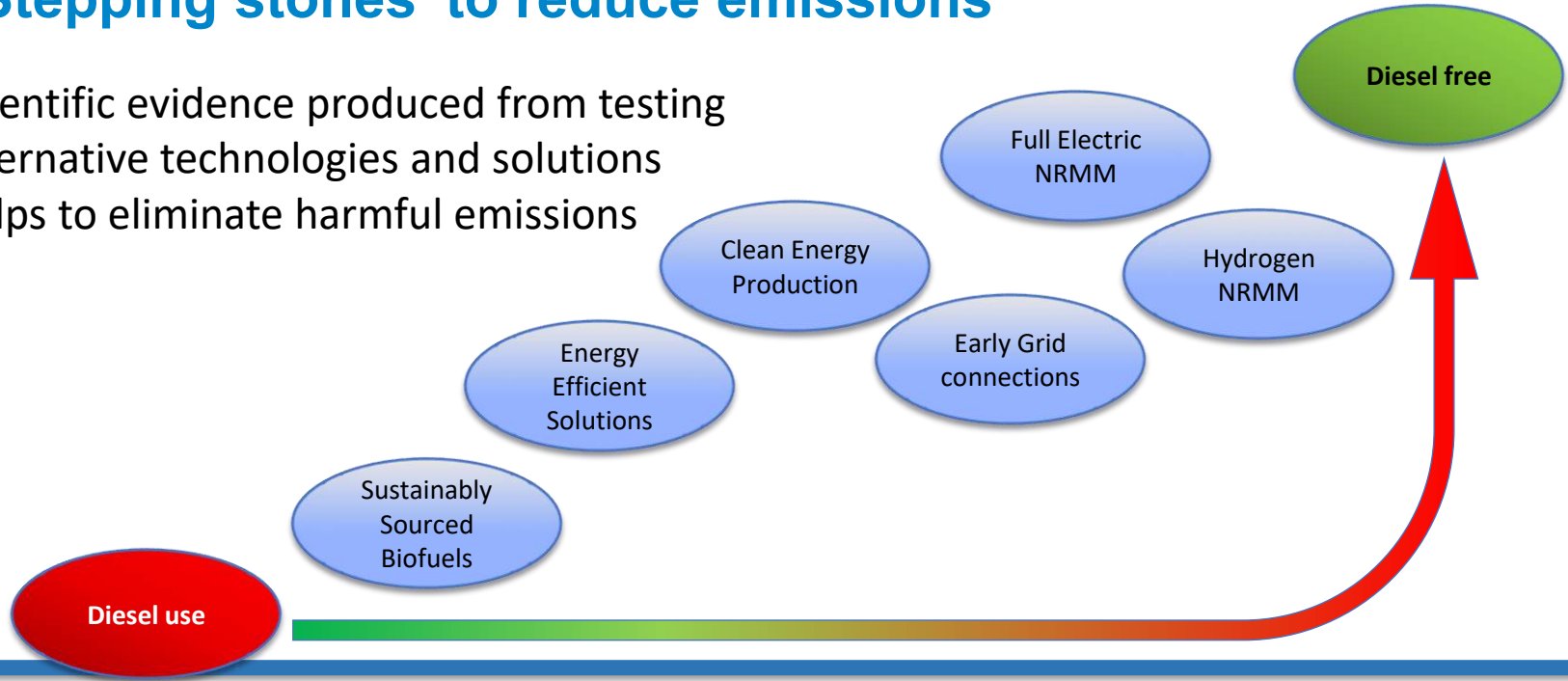
Diesel-free construction



- **High Speed 2** achieved the first diesel-free site in May 2022, now have ten similar sites
- Committed all sites diesel-free by 2029
- The **Construction Leadership Council's** CO2nstruct Zero campaign, has set a target to cut diesel used in construction by 78% by 2035

'Stepping stones' to reduce emissions

Scientific evidence produced from testing alternative technologies and solutions helps to eliminate harmful emissions



Improving efficiency: Behavioural change

- Understanding engine telematics
- Anti-idling & operator training
- Using AI and machine learning



AIR QUALITY

HS2 Anti Idling Video

VIDEO

★★★★★

In this video you will find out about why idling is an issue
HS2 have done to reduce vehicle idling.

SUPPLY CHAIN SUSTAINABILITY
SCHOL

HS2

Anti-Idling Toolkit

In collaboration with partners across the construction industry, this anti-idling toolkit is aimed to remind site teams on the importance of anti-idling.

keltbray **LYNCH** **mace** **DRAGADOS** Imperial College London
Centre for Low Emission Construction

Alternative fuel studies

- Trials to test the potential air quality benefits of alternative fuels to cut the use of diesel and introduce low-carbon solutions
- Results show limited air quality benefit compared to diesel; there could be a potential carbon reduction through the **sustainable sourcing**
- Alternative fuels are not as effective as using cleaner machinery, or retrofitting existing plant





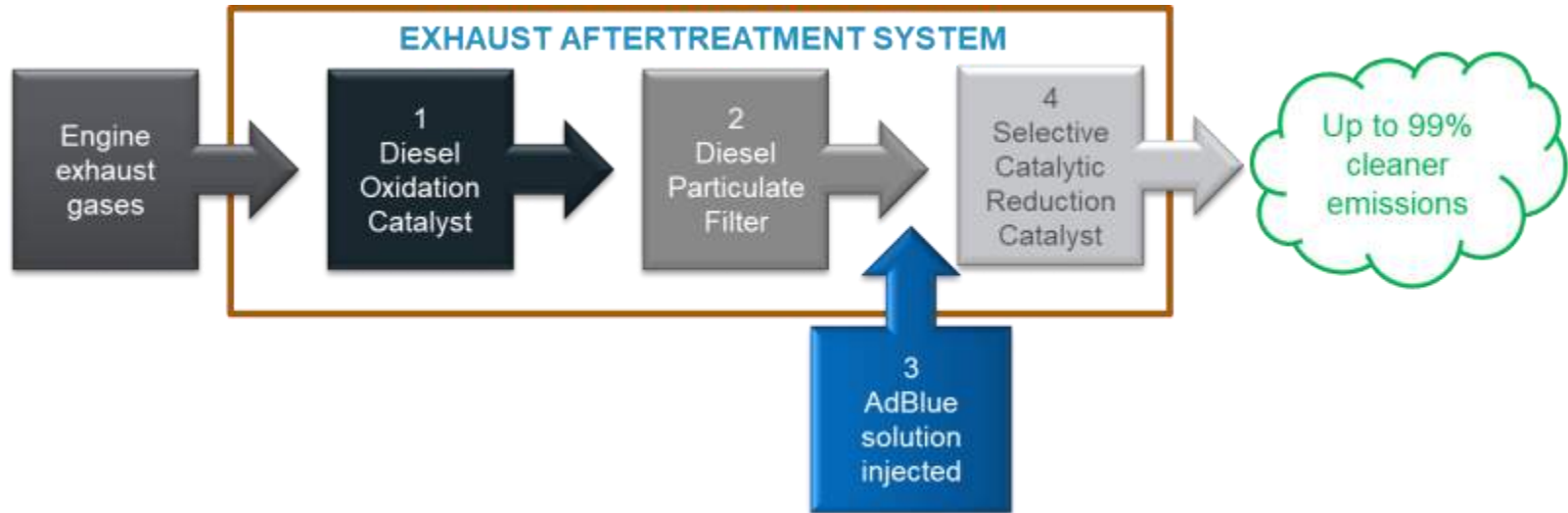
Retrofit technology

- Successful pilot of world's first retrofit on large construction equipment will have massive impact across the HS2 project, saving millions of pounds
- Certified by the Energy Saving Trust
- The trial on older vehicles showed emissions reduced below Stage V NRMM standards, leading to better air quality on construction sites
- Allows for industry-wide roll-out that will bring benefits for the environment, communities and the workforce



energy
saving
trust

Exhaust After-Treatment System (EATs)







The original stage IIIB after-exhaust engine components mounted externally to allow for pre and post-retrofit field testing

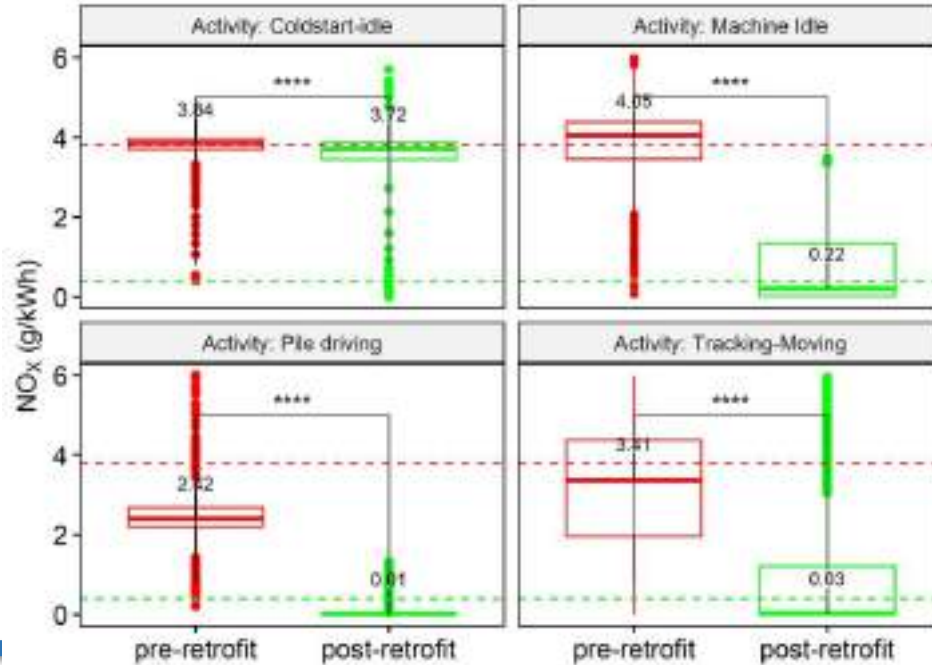
Telematic activity data is also logged directly from the engine



Portable emission measurement system (PEMS) for CO, CO₂, NO, NO₂, HC, PN

Exhaust mass flow (EMF) measurement to allow for concentrations to be converted to g/kWh for direct comparison with EU Emission standards

NRMM Retrofit results



Flywheel energy storage systems

- Technology adopted from Formula 1 used to capture energy from an engine that is normally wasted and stored in a high-speed flywheel
- Smaller generators are used more efficiently



PUNCH | Flybrid



Smart energy management systems

- Actively manages energy demand
- Intelligently switches off non-essential assets when energy demand spikes
- Down-sizing generators reduces hire and fuel costs whilst reducing emissions



AVAILABLE NOW

Clean Air Gas Engines (CAGE)

- CAGE generator currently using LPG
- Recognisable ICE technology
- System integrated into an Advanté Hybrid welfare cabins during covid
- UK DESNZ Red Diesel Replacement project to trial rDME and H₂
- Delivers 95% reduction vs stage V diesel



Hydrogen dual-fuel

- Retrofitting existing on-road fleet to run on diesel and H₂
- Transferable technology for NRMM
- First dual fuel H₂ piling rigs being trialled on HS2
- Requires national H₂ infrastructure



AVAILABLE NOW

Hydrogen fuel cell

- Demonstrating safe use of H₂ on construction sites
- Developing safe fuel handling and storage protocols
- Zero harmful exhaust emissions



The importance of science-based evidence

“The results from these trials highlight how important it is that we continue to independently test and evaluate existing and emerging low emission fuels and technologies to produce scientific evidence to inform and encourage the uptake of low emission approaches across the wider construction industry.

This research will support accelerated decarbonisation programmes to meet stringent carbon targets by 2050, whilst still delivering local air quality benefits.”

Other alternatives?

Hybrid battery



Solar and renewables

Fully electric NRMM

- Battery technology already exists for small to medium NRMM
- Larger machines still likely to be hydrogen or hybrid
- Requires better site energy efficiency measures
- Clean off-grid power generation essential as numbers of electric machines increase
- Early planning for site electrification



Hydrogen NRMM



- Hydrogen has potential to decarbonise sectors, such as construction
- Zero tail-pipe emissions
- Low-carbon hydrogen could meet 10% of global energy needs under the International Energy Agency's Net Zero by 2050 scenario
- Demand forecast to double by 2030
- Clear and consistent policy on use, and infrastructure development still required from UK Government



Any More Questions?

CLEC.UK