



# Ultra Low Emission Trucks

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# What is a Ultra Low Emission Truck?

Electric?

Certainly - But for whom?

Hybrid?

Probably - Depending on application

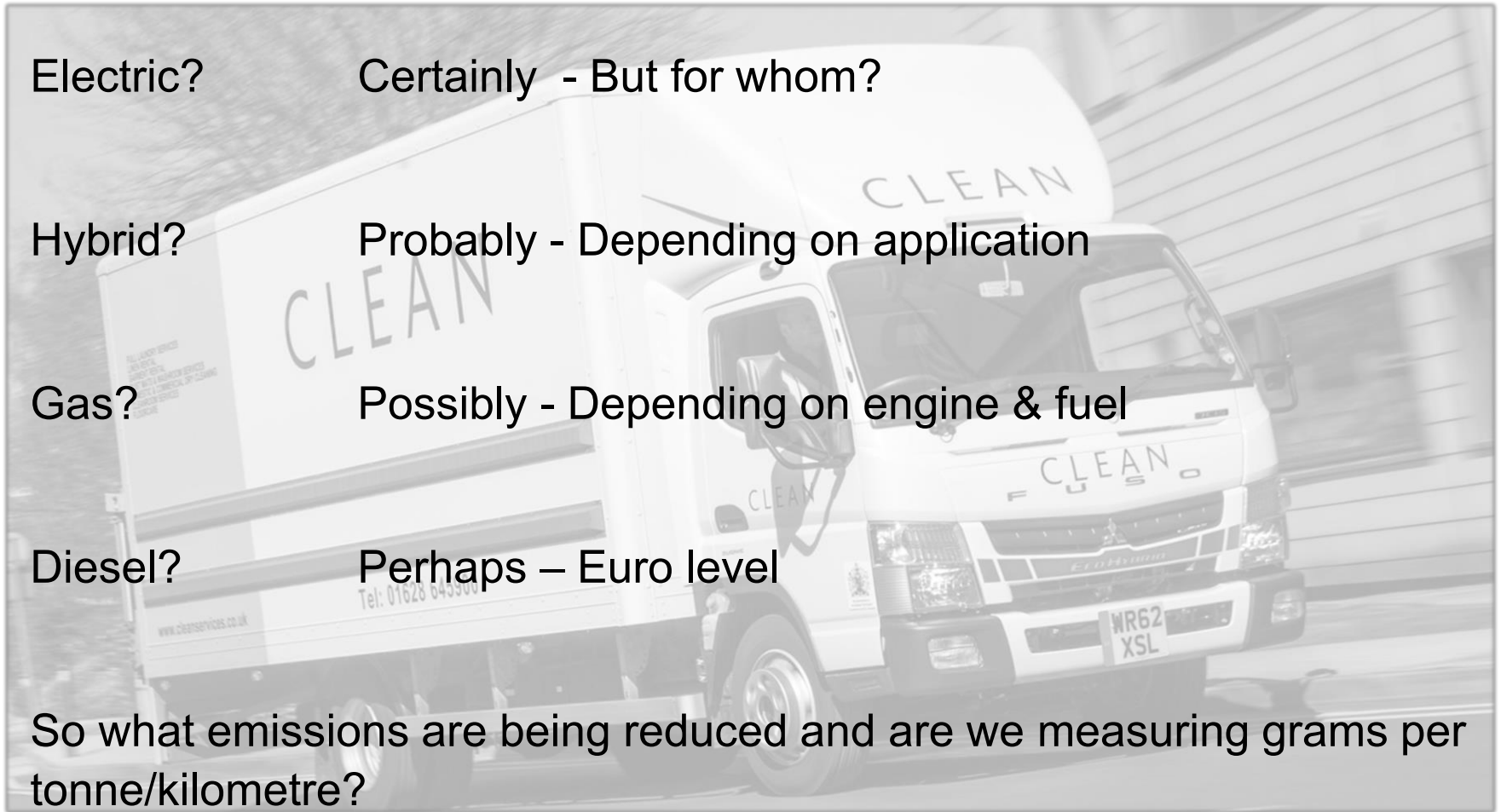
Gas?

Possibly - Depending on engine & fuel

Diesel?

Perhaps – Euro level

So what emissions are being reduced and are we measuring grams per tonne/kilometre?





# Why do we need Ultra Low Emission Trucks?

Carbon emissions must be reduced by:

**20% by 2020 and by 80% by 2050**

In the UK transport is responsible for 26% of Carbon emissions

To reduce this we must reduce the carbon intensity of fuel.

And

Reduce grams of CO<sub>2</sub> per tonne/kilometre



# Why do we need Ultra Low Emission Trucks?

Air quality must be improved because:

## Infraction proceedings by EU

**European Commission (Commission) has sent the UK a 'Letter of formal notice' for breaching nitrogen dioxide (NO<sub>2</sub>) limit values in 16 of 43 zones.**

London has the highest levels of NO<sub>2</sub> of any capital city in Europe.

The UK has the highest proportion of zones breaching legal limits.

Exhaust emissions from passenger cars (including private hire vehicles) of NO<sub>2</sub> and dangerous airborne particles (PM<sub>2.5</sub>) are expected to rise from 39% and 49% of transport exhaust emissions respectively in 2010 to a staggering 47% and 54% respectively in 2015



## Why do we need Ultra Low Emission Trucks?

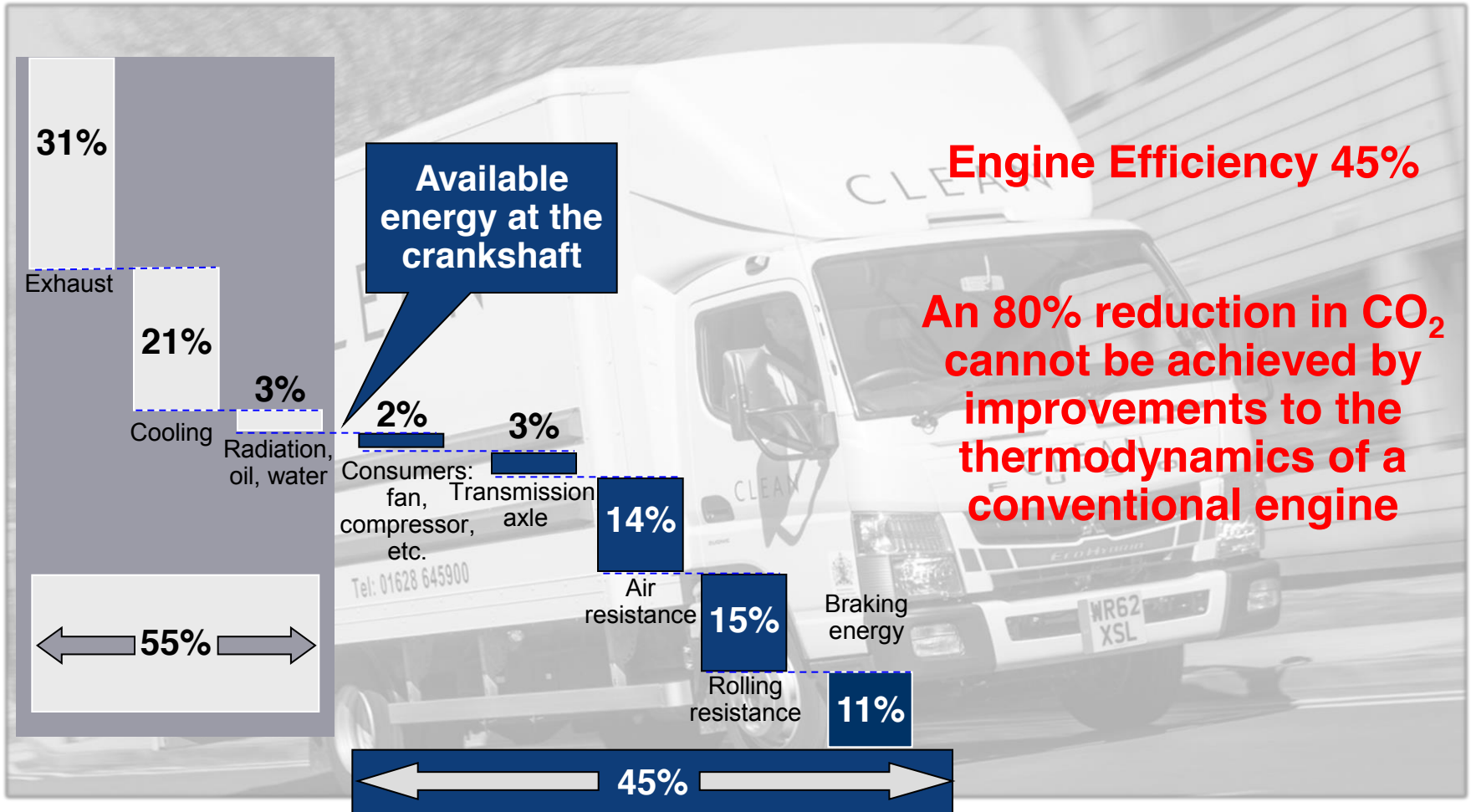
**World Health Organisation says studies have found adverse health effects at concentrations that were at or below the current EU limit values. Leading scientists say there is evidence for a long-term effect of NO<sub>2</sub> on natural mortality as high as that of PM<sub>2.5</sub>**

**The Mayor of London, Boris Johnson, estimates UK faces fines of £300m per annum for London alone if compliance is not achieved**

Cities affected outside London include Birmingham, Glasgow, Kingston upon Hull, Leeds, Manchester and Southampton and so-called 'zones' such as Eastern, East and West Midlands, North East, North West and Merseyside, South East, Teesside, The Potteries and Yorkshire.



# Use of Diesel and engine efficiency

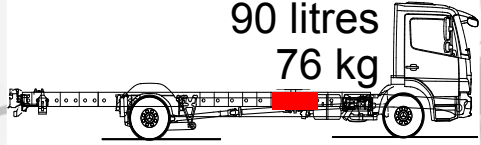
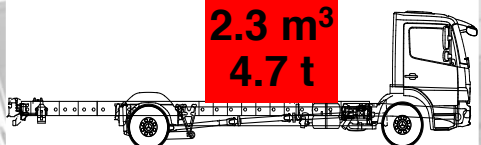

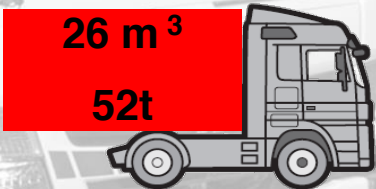
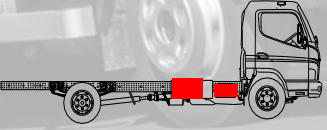


Source: Mercedes-Benz-Trucks - Actros 1844 LS; 40 t EURO 5, G211-12KL/14.93-1.0, HL6 Axle i=2.846, Route: Stuttgart-Hamburg-Stuttgart 1.517 km, Average speed v=83.2 km/h



# Why not purely electric for all vehicles?

Battery technology is not sufficiently advanced to drive long distance trucks under electric power alone!

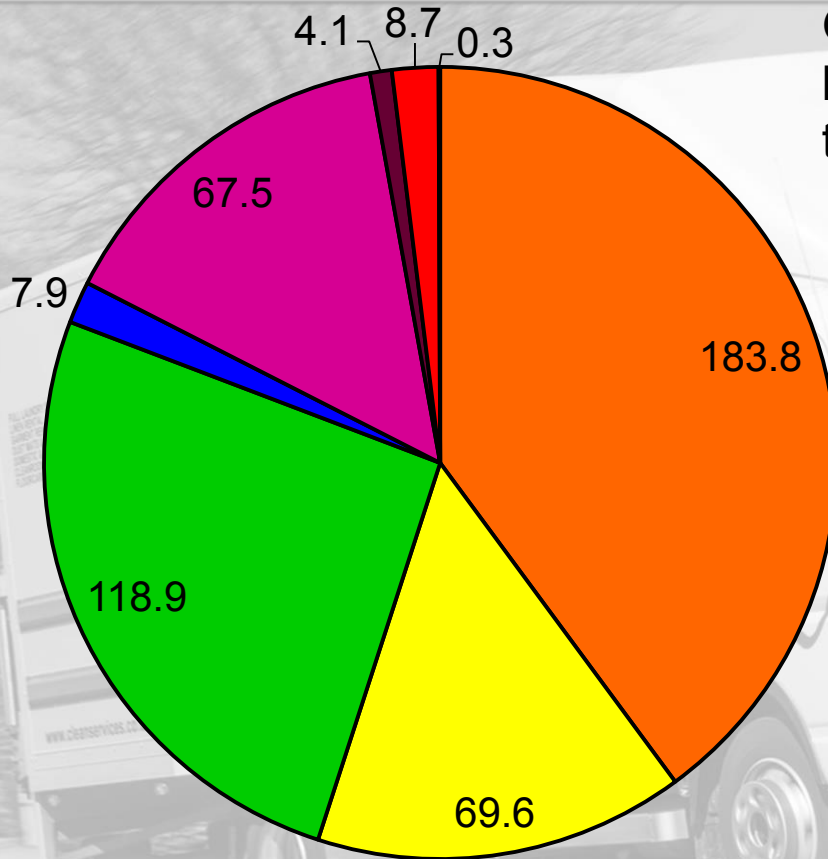
Range	Diesel	100% electric with Li-Ion battery
500 km 7.5-tonne distribution operations	 <p>90 litres 76 kg</p>	 <p>2.3 m<sup>3</sup> 4.7 t</p>
3000 km 44-tonne long distance operations	 <p>990 litres 836 kg</p>	 <p>26 m<sup>3</sup> 52t</p>
500 km 7.5-tonne distribution operations	<b>Eco Hybrid with Li-Ion battery</b> 	
	<b>Diesel</b> 72 litres / 61kg <b>Li-ion Battery</b> 80 kg	

Calculation: consumption: 20 l/100 km /33 l/100 km, efficiency: diesel engine = 40%, electric motor = 80%, energy content: diesel = 11.8 kWh/kg, Li-Ion battery = 0.19 kWh/kg, weight: diesel = 0.845 kg/l, Li-Ion battery = 2 kg/l



## Greenhouse Gas Emissions

Greenhouse gas emissions weighted by global warming potential (million tonnes carbon dioxide equivalent)



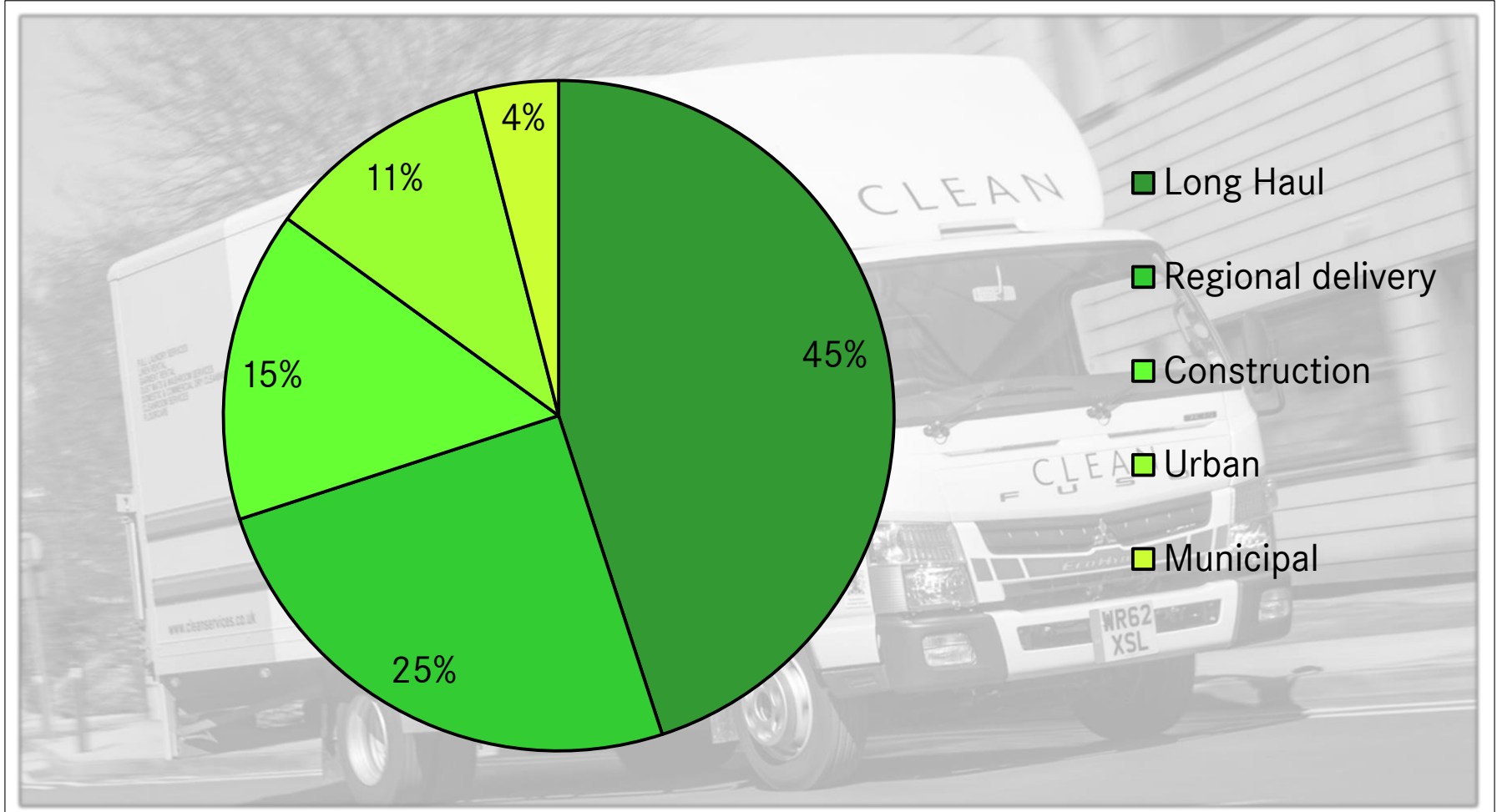
- 39% Energy supply
- 15% Business
- 26% Transport
- 2% Public
- 15% Residential
- 1% Agriculture
- 2% Industrial process
- 0.3% Waste Management

<http://www.decc.gov.uk/assets/decc/11/stats/climate-change/4818-2011-provisional-data-tables.xls>





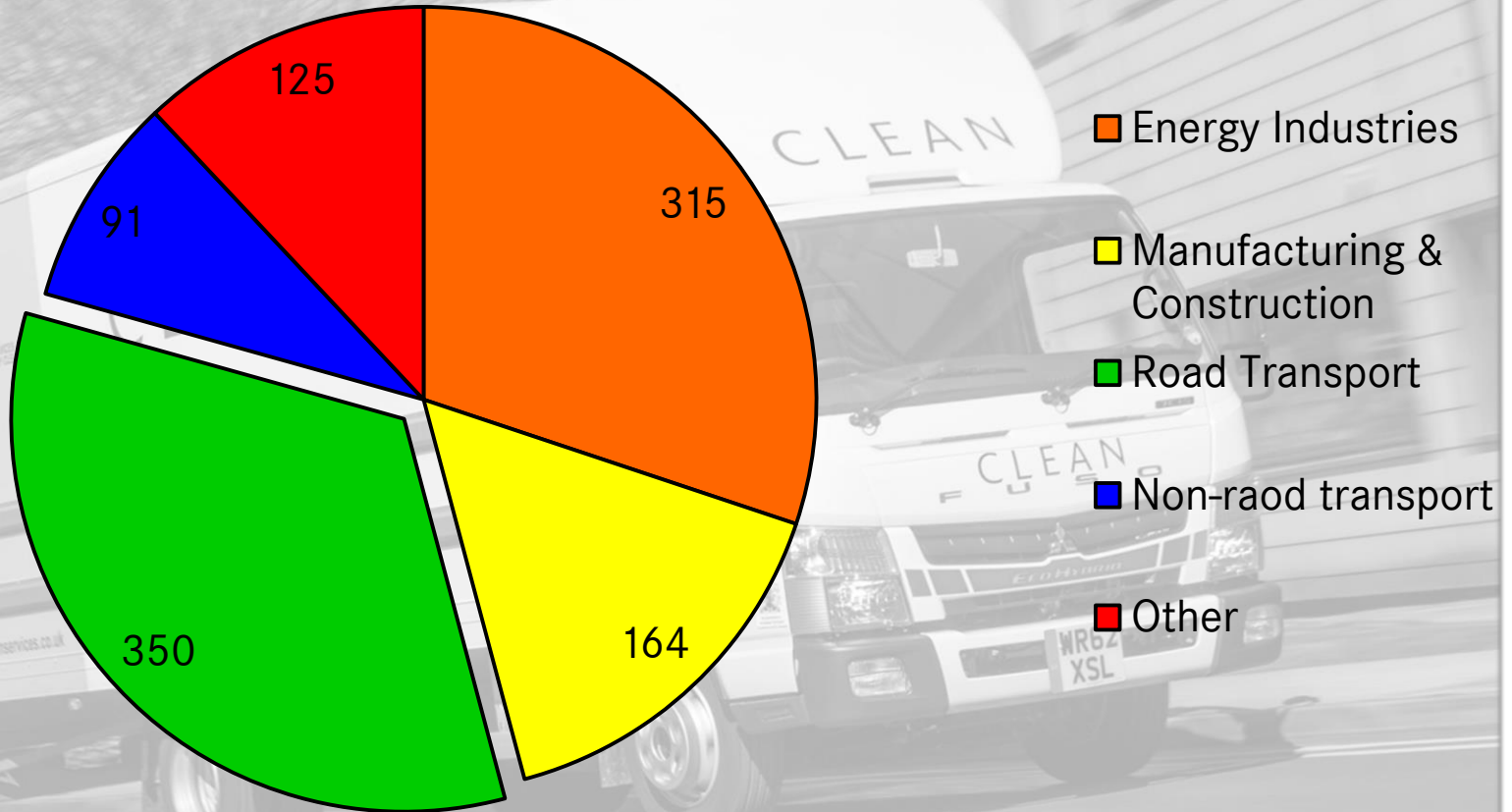
## Ranking of Truck Duty Cycles by CO<sub>2</sub> Emissions Share





## Sources of NOx in the UK

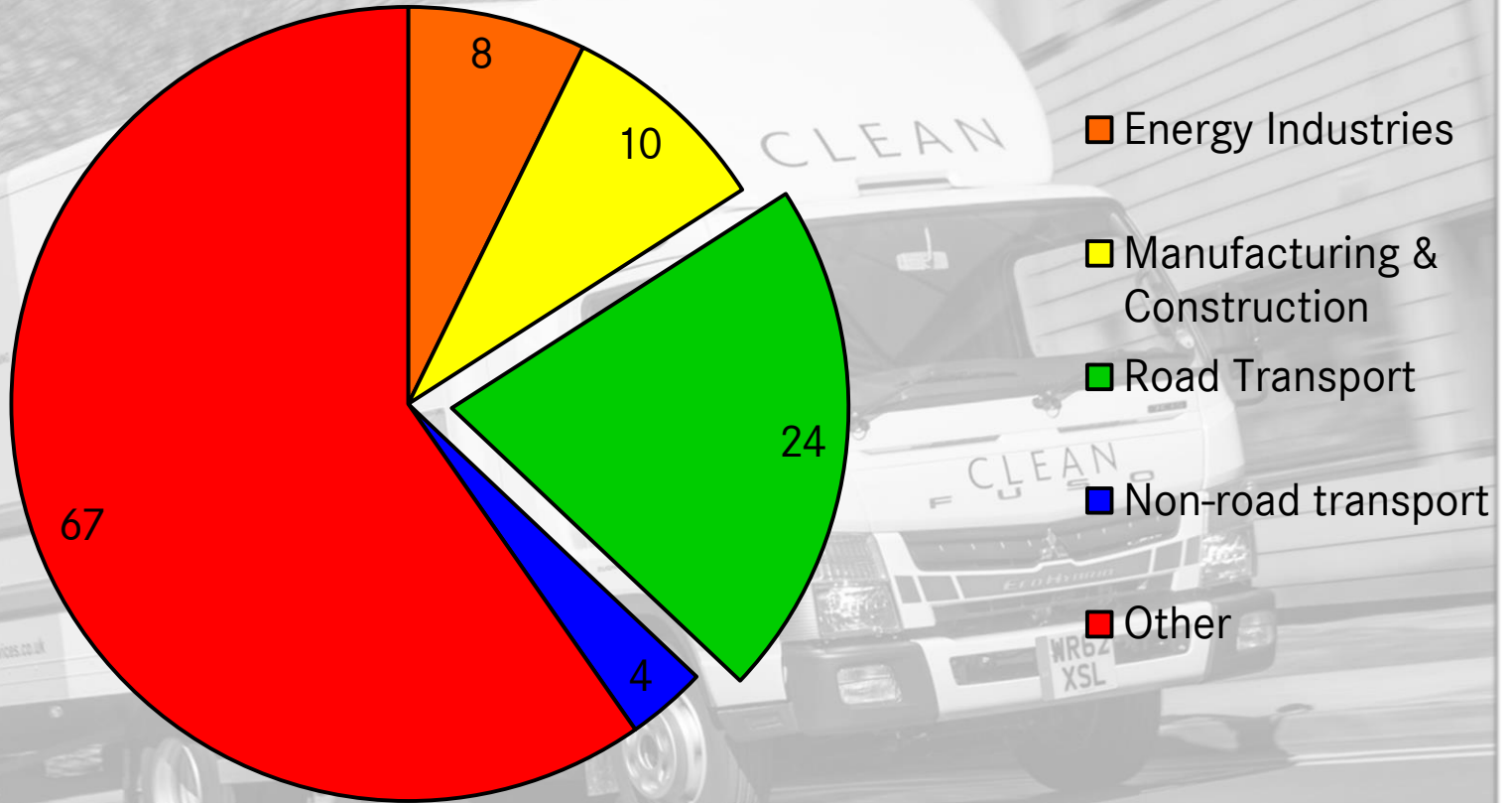
NOx emissions Thousand tonnes





## Sources of PM<sub>10</sub> in the UK

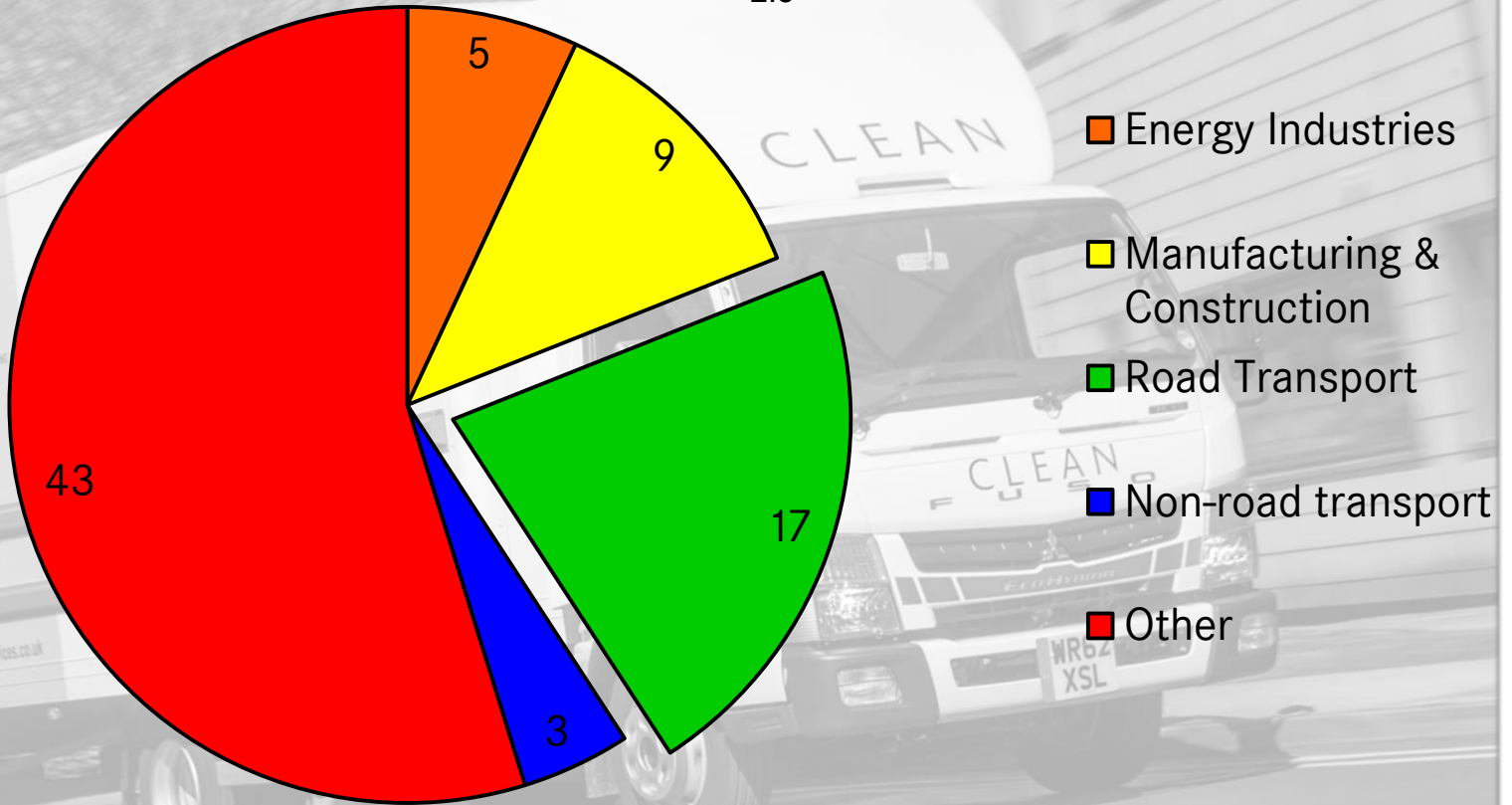
PM<sub>10</sub> emissions Thousand tonnes





## Sources of PM<sub>2.5</sub> in the UK

PM<sub>2.5</sub> emissions Thousand tonnes





# Key Technologies to reduce Emissions

Technology	Urban Delivery	Regional Delivery	Long Haul	Municipal	Construction
Dual Fuel		✓	✓		✓
Dedicated gas	✓	✓	✓	✓	✓
Hybrid & Batt. Electric	✓			✓	
Stop/Start	✓	(✓)	(✓)	✓	✓
Aerodynamics		✓	✓		✓
LRR Tyres	✓	✓	✓	✓	✓
BioMethane	✓	✓	✓	✓	✓

Opportunities to overcome barriers for uptake of low emission technologies appropriate to each commercial vehicle duty cycle - AEA



## Why Natural Gas?

Lower emissions than petrol or diesel –

The lowest Hydrocarbon fuel available

Available now

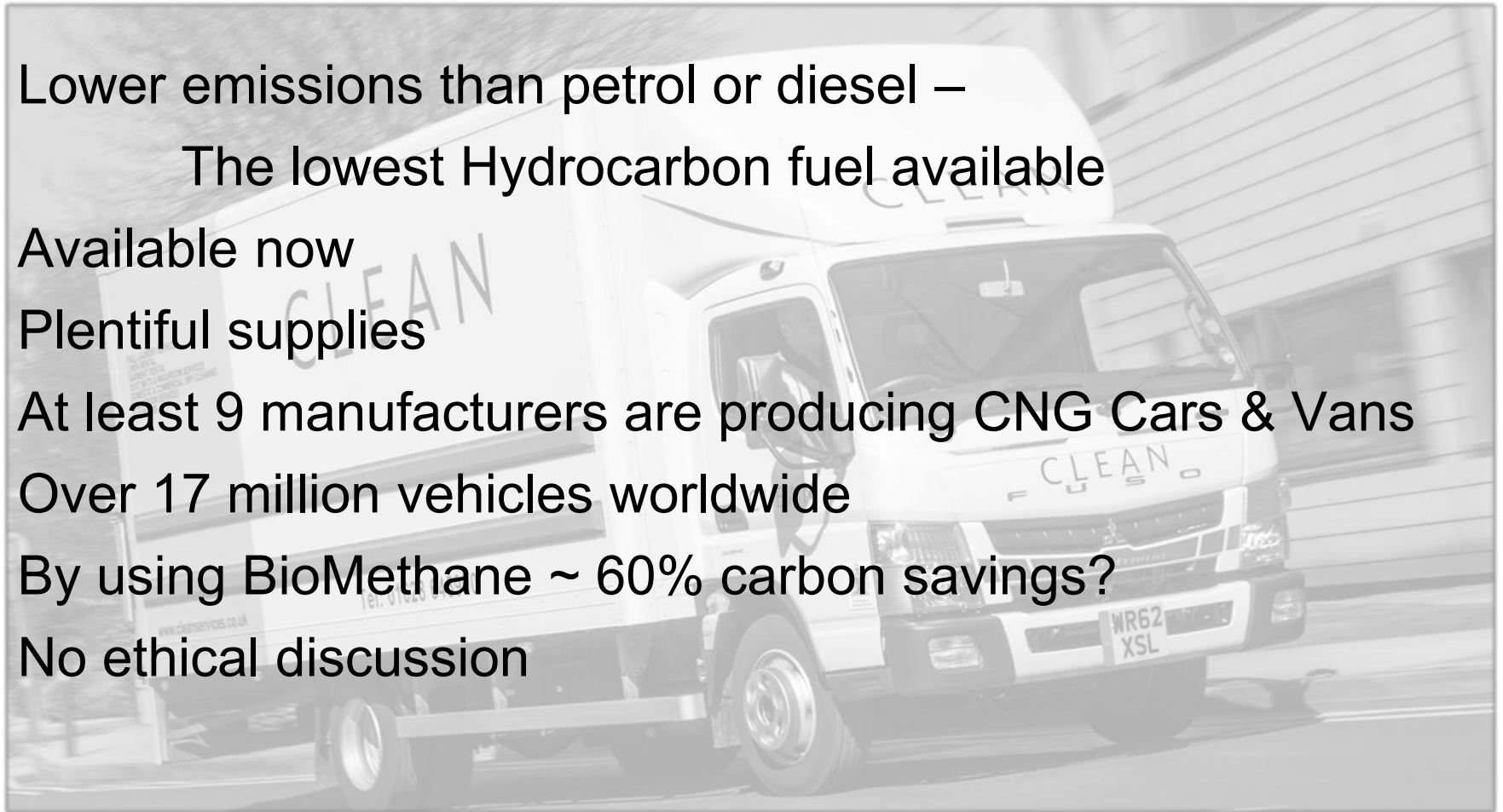
Plentiful supplies

At least 9 manufacturers are producing CNG Cars & Vans

Over 17 million vehicles worldwide

By using BioMethane ~ 60% carbon savings?

No ethical discussion





# Why not Natural Gas?

Limited Refuelling Infrastructure

Additional cost of vehicles

Loss of Payload





## Why Electric?

Zero tail pipe emissions

Available now

Quiet operation – Night time deliveries







## Why not Electric?

Difficulty with recharging quickly and large numbers

Additional Cost

Additional Weight

Limited Availability

Limited Range especially in adverse weather





## Why Hybrid?

Up to 20% fuel saving

Cost effective

Minimal Weight Penalty

Availability

No Range issues if vehicle needs to be used for a different route





# Why Not Hybrid?

You tell me!

Limited Range of Vehicles Available





# Estimated duty cycle CO2 saving - Long Haul

Technology / fuel	Estimated duty cycle WTW CO <sub>2</sub> e saving*	Payback range***
Dual fuel	16 % (CNG) 9-12 % (LNG)**	2-4 years
	<b>42 % (BioMethane)</b>	
Dedicated natural gas	5-16 % (CNG) 11 % worse to 8 % better (LNG)**	1-3 years
	<b>61-65 % (BioMethane)</b>	
Aerodynamic improvements	6-9 %	3-12 months
Predictive cruise control	1-2 %	1-2 months
Reduced ancillary loads	1-2 %	1-3 months
Stop / Start and idle shut-off	1%	2-3 years

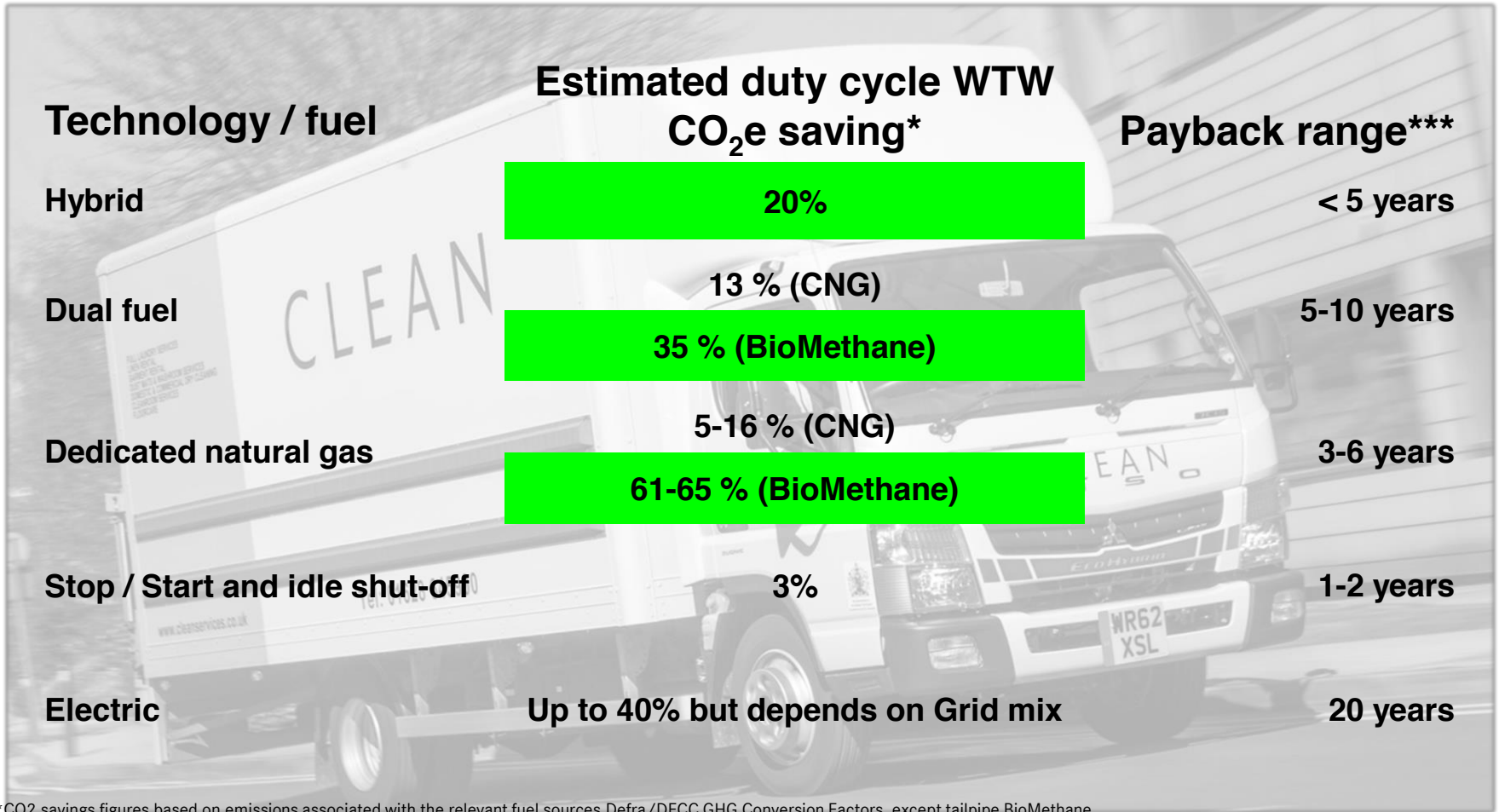
\*CO2 savings figures based on emissions associated with the relevant fuel sources [Defra/DECC GHG Conversion Factors](#), except tailpipe BioMethane.

\*\*LNG figures presented as a range. Lower saving is based on standard Defra/DECC figures. Upper saving based on CNG liquefied to LNG in the UK.

\*\*\*Based on current technology marginal capital costs. Fuel cost savings and low-high mileage sensitivities



# Estimated duty cycle CO2 saving - Urban Delivery



\*CO2 savings figures based on emissions associated with the relevant fuel sources [Defra/DECC GHG Conversion Factors](#), except tailpipe BioMethane.

\*\*LNG figures presented as a range. Lower saving is based on standard Defra/DECC figures. Upper saving based on CNG liquefied to LNG in the UK.

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# Opportunities

Determine ULEV and ULEZ Criteria

Euro VI, Hybrid and/or Electric?

Encourage early adopters with reduction in Congestion Charge

Reduction for Diesel Euro VI Removal for Hybrid & Electric

This could be easily controlled via ANPR as used in Congestion Charge already

Thank you..... Questions?