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Low Emission Cities Workshop

Best practice measures for increasing the take up of low pollution and carbon vehicles in cities

Wednesday, 18th November 2015, Sheffield

Welcome and opening remarks

Mark Daly, Sustainable Transport & Mobility Officer, Sheffield City Council

mark.daly@sheffield.gov.uk



Building issues

- **Toilets**
 - female just outside
 - Male – turn left out of the room and follow the signs
- **Fire safety**
 - No drill expected
 - The Assembly point for all staff, contractors and visitors is the Peace Gardens in the cobbled area to the rear of the water feature adjacent to St Pauls Parade. (out of the main doors and turn left)
- **Mobile Phones**
 - Put on silent/vibrate mode
- **Social media** – tweet using @TheLowCVP @airawaresheff



Sheffield
City Council





With a population of 551,800 in mid-2011, the City of Sheffield is England's third largest metropolitan authority.

Compared to most other European cities, Sheffield has more public parks and green spaces, more tree cover, and also boasts one third of the city being in the Peak District National Park - the 2nd most visited national park in the world





This unique combination already makes Sheffield the greenest city in Britain.

Sheffield has the highest household spend on outdoor equipment in the country, high participation rates in outdoor recreation and more than 200 outdoor businesses.



Pollution was much easier in the old days –

- See it
- Smell it
- Taste it
- Direct impacts
- Cleaning it up was seen as a vote winner





Pollution today
is more
insidious—
Cant

- See it
- Smell it
- Taste it
- With harder
to see
direct
impacts
- Cleaning it
up is in
some
quarters
seen as too
difficult



Challenges

- Years of neglect for AQ agenda by successive UK Govts
- Govt funding for environment and local authorities slashed
- Ambition on carbon reduction not high enough



Opportunities?

- Global pressure on carbon reduction increasing
- EU fines for air quality breaches
- VW emissions scandal
- Funding available (if limited)
- There is a growing sense that the fossil fuel era is ending



Best practice

Today we will hear:

- a current overview of LEVs and best practice policy measures
- About the widely underused natural gas as a transport fuel as well as experience of its use for buses in Reading
- The fuel “coming in the next 10 years” - hydrogen
- The Ecostars scheme, and
- Birmingham's approach as well as tackling emissions from taxis

EV Inmotion

electric vehicles
inmotion!

Interested? Get in touch

[About the scheme](#) | [Does my business qualify?](#) | [About us](#) | [FAQs](#)

You are here: [Home](#)

Power your South Yorkshire business with a Plug-in Vehicle grant of up to £10,500*

We're looking for 80 businesses** in the South Yorkshire area to join our government-backed scheme to trial the leasing of a Plug-in Vehicle of your choice with a grant of up to £10,500. If eligible, your business will benefit from:

- Plug-in van - £10,500
- Plug-in car - £7,500

This ground-breaking scheme is strictly on a first come, first served basis so [register your interest today](#).

*Maximum subsidy of £10,500 is based on a Plug-in van, benefitting from a government grant. Contract and credit rates are subject to status due to lease agreement. **Scheme only eligible to private and voluntary sector businesses. Excludes public sector organisations and sole traders.



Supporting local businesses by providing subsidised charging and vehicles as well as a network of rapid and fast charge points across South Yorkshire

www.evinmotion.co.uk

Everything you need to know about the scheme

Including how much your business could save compared to running a VW BlueMotion Golf.



[Find out more](#)

Which electric vehicle is right for your business?



[Find out more](#)

Your workplace charger explained

From installation to charging times you'll find all your questions answered here.



[Find out more](#)

Sheffield City Council

- Please stay for lunch and use it to network
- Thanks and enjoy the day
- Mark.daly@sheffield.gov.uk





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Best practice measures for increasing the take up of low pollution and carbon vehicles in cities

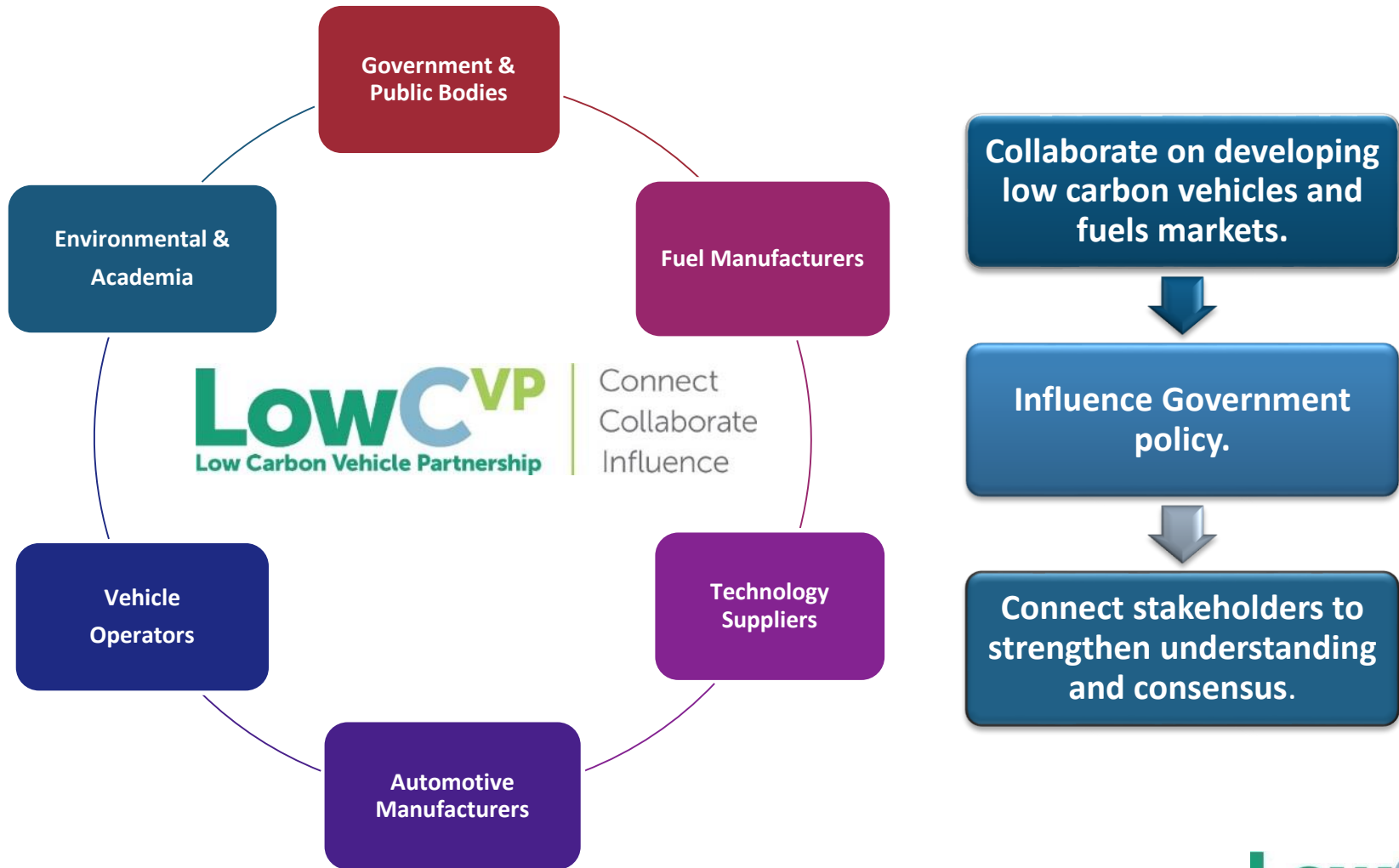
Wednesday, 18th November 2015, Sheffield

Overview of Low Emission Vehicles

Andy Eastlake, Managing Director, Low Carbon Vehicle Partnership



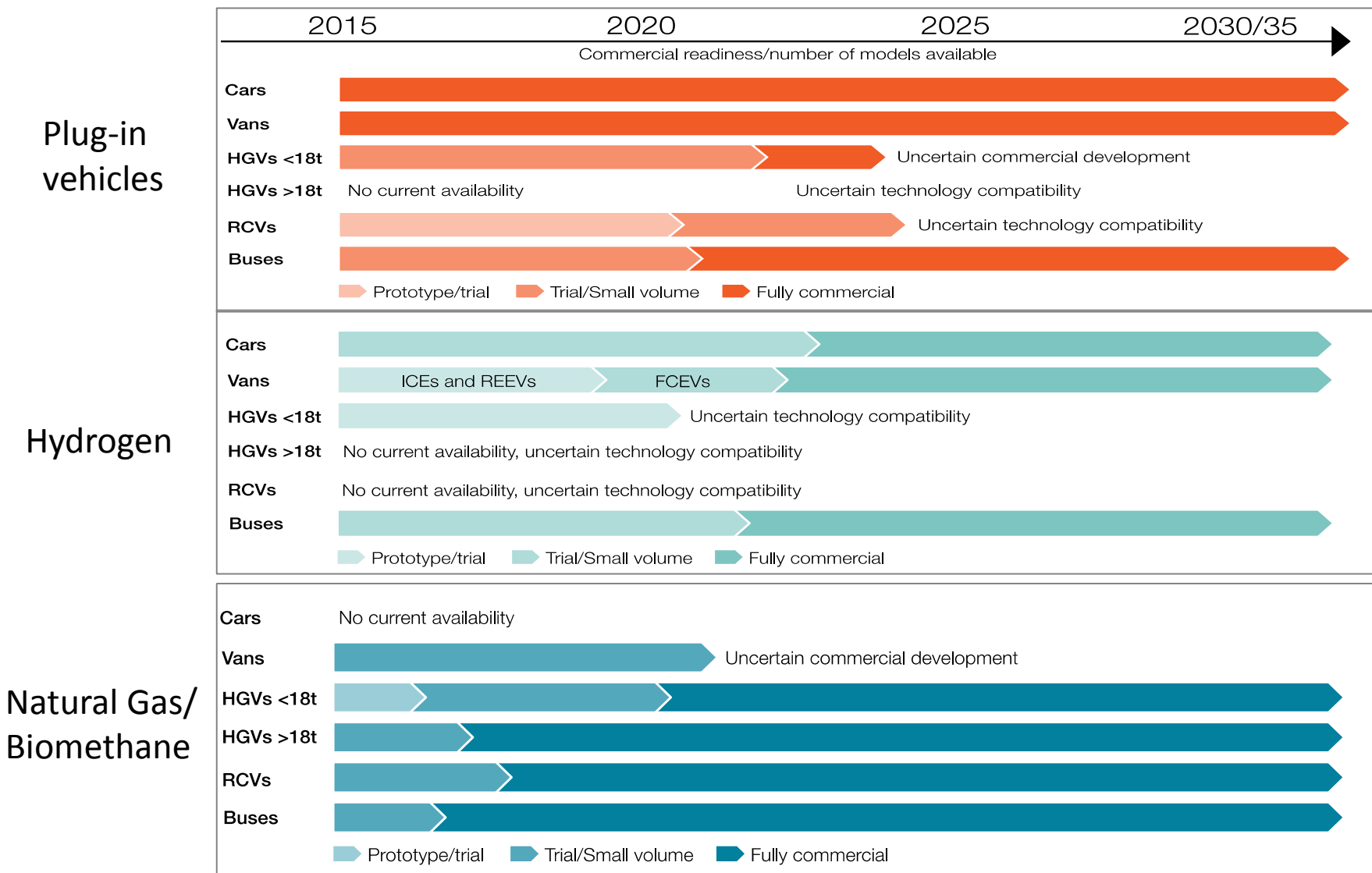
LowCVP is a unique stakeholder organisation, our mission is to accelerate a sustainable shift to low carbon vehicles and fuels



What is a low emission vehicle?

- No official definition but would aim to achieve low to very low air pollution (NO_x,PM) and CO₂ emissions.
- Portfolio of fuel and technology options – no silver bullet!
- **Alternative fuels – natural gas, LPG, hydrogen, sustainable biofuels**
- **Advanced powertrain technologies – battery electric (BEV), plug-in hybrids(PHEV), hydrogen fuel cell(FCEV) - ULEVs**
- **Internal combustion engines which meet latest Euro Standards (Euro 6/VI)**
- **Retrofit technologies – exhaust after treatment, conversions, fuel saving**
- Focus typically on reducing tail-pipe CO₂ emissions but we should consider ‘well-to-wheel’ GHG emissions (fuel production + exhaust).
- There are multiple standards for different vehicle types
 - European Emission Standards for LDV and HDVs
 - EU New Car and Van CO₂ Regulations
 - National standards for funding eligibility: Plug-in car grant <75 CO₂g/km
Low Emission Bus Grant: >15% Well-to-Wheel GHG emission savings compared to a Euro 5 diesel bus and achieve Euro VI engine standard.
- Consistent low emission vehicle definitions and standards recommended

Availability and market projections of a selection of technologies and fuels



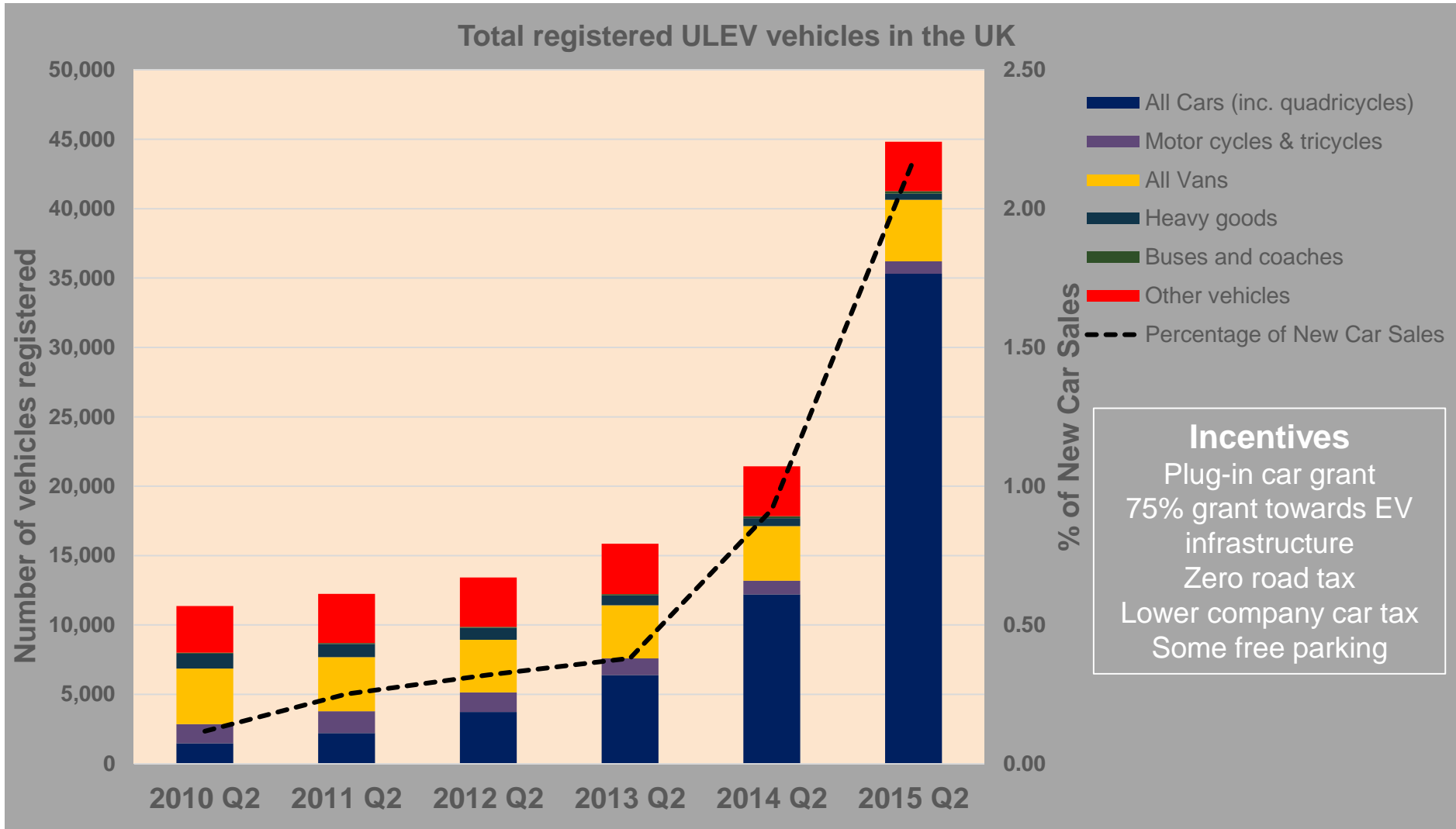
FCEV: Fuel Cell Electric Vehicle **HGV:** Heavy Goods Vehicles **ICE:** Internal Combustion Engine
RCV: Refuse Collection Vehicle **RE-EV:** Range Extended EV

A multitude of barriers preclude the near term uptake of plug-vehicles & alternative fuels

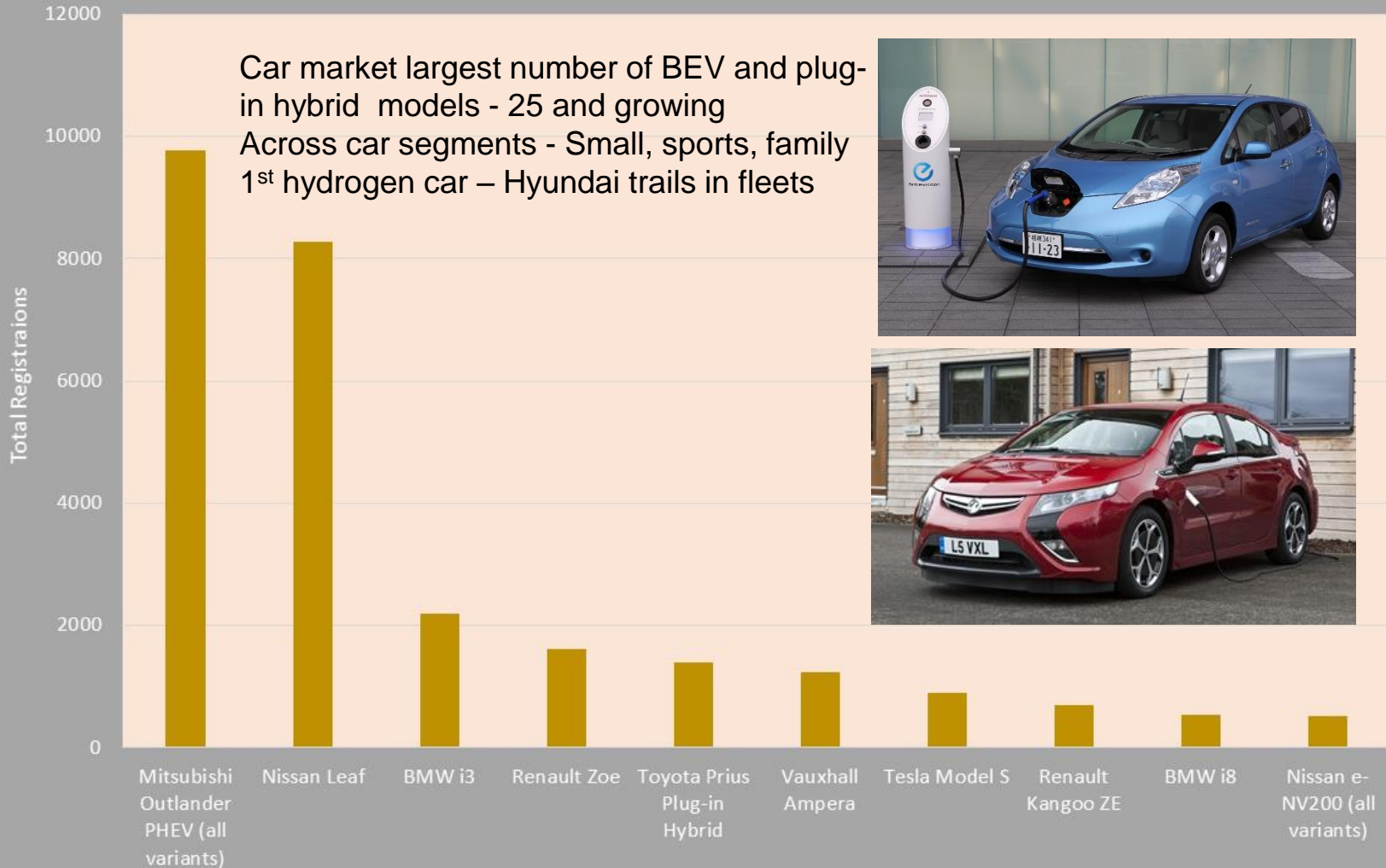
	Fleet Operators	Public
Electric /Plug-in hybrids	<ul style="list-style-type: none"> Higher capital cost Uncertainty in total cost ownership Battery life/replacement cost Payload penalty for vans Range limitation Resale value Lack of availability for low emissions vans with higher payloads Lack of information about financial benefits and suitability of different technologies Lack of data on real world performance 	<ul style="list-style-type: none"> Higher purchase cost Battery life Range anxiety Lack of public refuelling Recharge time Performance/reliability
Natural gas/biomethane and dual fuel	<ul style="list-style-type: none"> Lack of refuelling stations Uncertainty in performance/reliability especially dual fuel Supply of biomethane Cost of infrastructure for small operators/LAs 	

National and local policy can facilitate reducing these barriers and stimulate demand for low emission vehicles.

Plug-in car market has increased rapidly since 2014, incentives played a key role



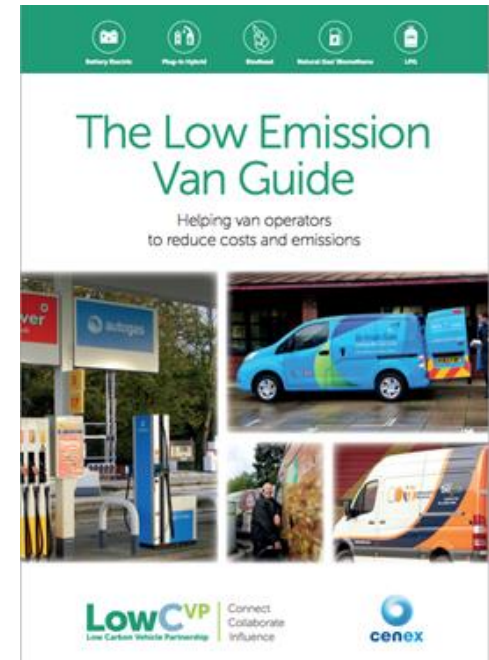
Top ten plug-in car models purchased 2015



The low emission van market is in its very early stages of development

- 99% of UK vans are diesel, <1% new van sales are plug-in/alternative fuels
 - Plug-in vans limited availability, mainly small van segment
Models - 9 BEV, 1 REEV, 1 hydrogen ICE
 - Larger vans – LPG, natural gas/biomethane, sustainable biodiesel (B20)
 - LowCVP Low Emission Van Guide – outlines low emission fuels and technologies, business case, incentives, infrastructure, environmental and operational merits.
- More information LowCVP Low Emission Van Hub:

<http://www.lowcvp.org.uk/lev.htm>



Renault Kangoo (BEV)



Mitsubishi Outlander (REEV)



Autogas Conversion (LPG)

Low emission taxis market is focused on plug-in technology but opportunities exist for alternative fuels

- Plug-in black taxis (BEV & REEV) recently entered the market, very low volume
- Black taxis conversions are possible - LPG and natural gas/biomethane. Birmingham City Council LPG black taxi conversion project (Clean Vehicle Technology Fund) – lower cost option
- Petrol hybrids been very popular with city mini-cab firms; opportunities with PHEV



Mercedes Benz Vito Taxi

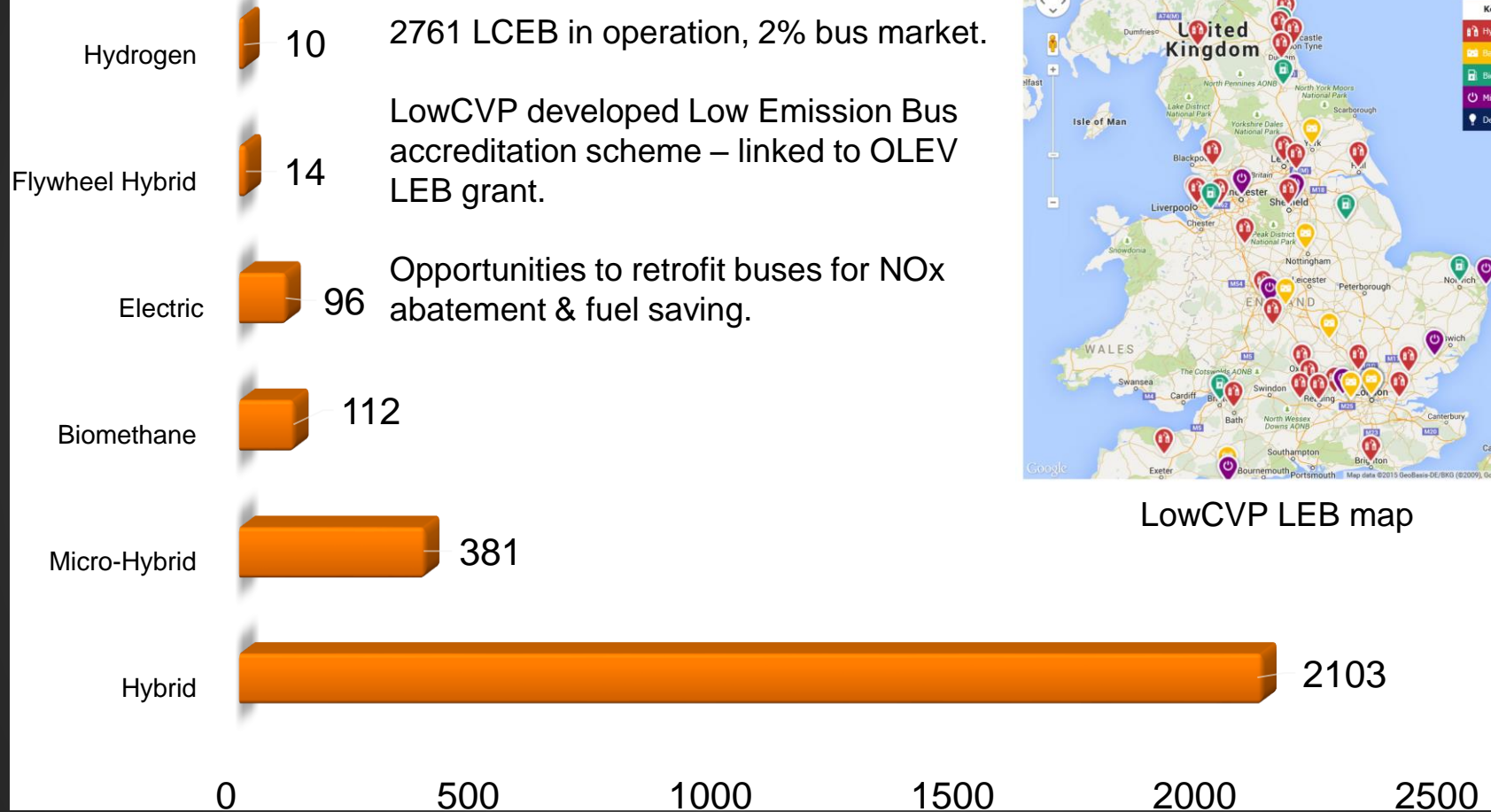


Fraser Nash Metrocab



Nissan e-NV200

The low emission bus market has experienced strong growth over the past three years, variety of technologies in use



2761 LCEB in operation, 2% bus market.

LowCVP developed Low Emission Bus accreditation scheme – linked to OLEV LEB grant.

Opportunities to retrofit buses for NOx abatement & fuel saving.



LowCVP LEB map

OEMs – ADL, Volvo, Scania, MAN, Optare, BYD

Exemplar low emission bus fleets



Transport for London

- Largest hybrid bus fleet >1700
- Biodiesel B20 (used cooking oil) >30 buses
- 17 battery electric buses, 1st double decker
- 3 plug-in hybrid bus with inductive charging
- 8 hydrogen fuel cell buses
- Bus retrofit programme – Selective Catalytic Reduction Technology, >90% NOx reduction

Reading Buses

- 34 gas buses run on biomethane (more from Reading later!)

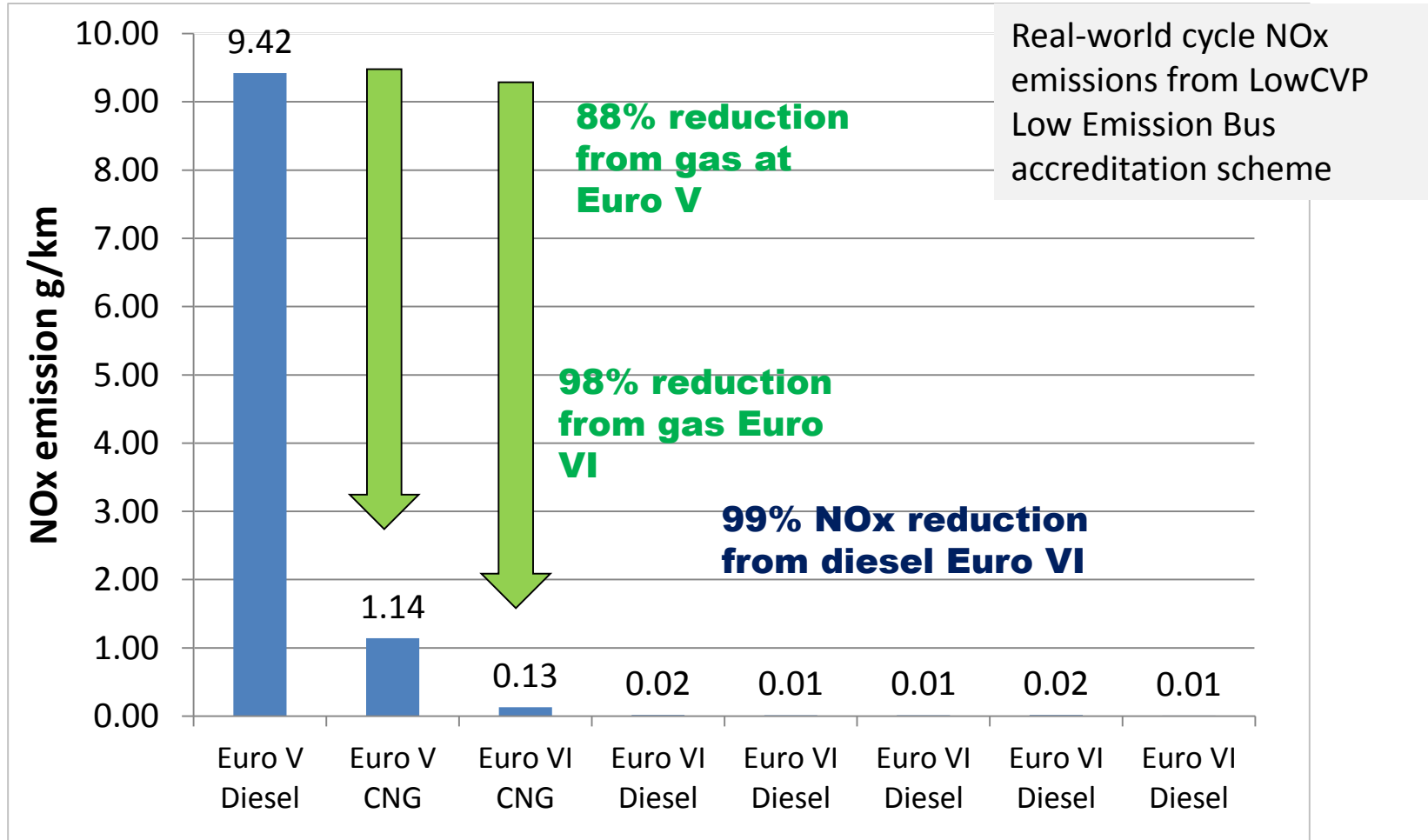


Nottingham City Council

- 45 battery electric buses
- Exploring conversion of diesel to electric
- Developing fast & standard charging



Independent vehicle emission testing shows very good NOx emissions performance of Euro VI buses



NOx emissions can be lower than the Euro VI car limits (0.08g/km)

Low emission truck market is in its very early stages, fuel and technology options dependant on vehicle duty cycle

- City duty cycles - hybrid, battery electric, and natural/gas biomethane (dedicated CNG/LNG trucks), sustainable biodiesel (used cooking oil)
OEMs – Scania, Volvo, Mercedes Benz, DAF, Iveco
- Long haul/motorway duty cycles – natural gas/biomethane dedicated and dual fuel (LNG/CNG), sustainable biodiesel
- Very low numbers of hybrid and BEV trucks, natural gas and dual fuel trucks – circa 500 in use
- Opportunities for retrofitting fuel saving technology
LowCVP Low Carbon Truck Accreditation Scheme
- Availability of sustainable liquid and gaseous biofuels is a key challenge and ensuring WTW GHG emissions are lower than diesel.
(DfT - Low Carbon Truck Trial <http://www.gasvehiclehub.org/>)



DAF Hybrid Truck



Mercedes Benz CNG Truck

THANK YOU FOR LISTENING

Andy Eastlake – andy.eastlake@lowcvp.org.uk

Join us Connect | Collaborate | Influence
<http://www.lowcvp.org.uk/>

Low Emission Van Hub
<http://www.lowcvp.org.uk/lev.htm>

Low Emission Buses
<http://www.lowcvp.org.uk/initiatives/leb/Home.htm>



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Best Practice Policy Measures for the Uptake of LEVs

Dan Hayes, Project Support, Low Carbon Vehicle Partnership

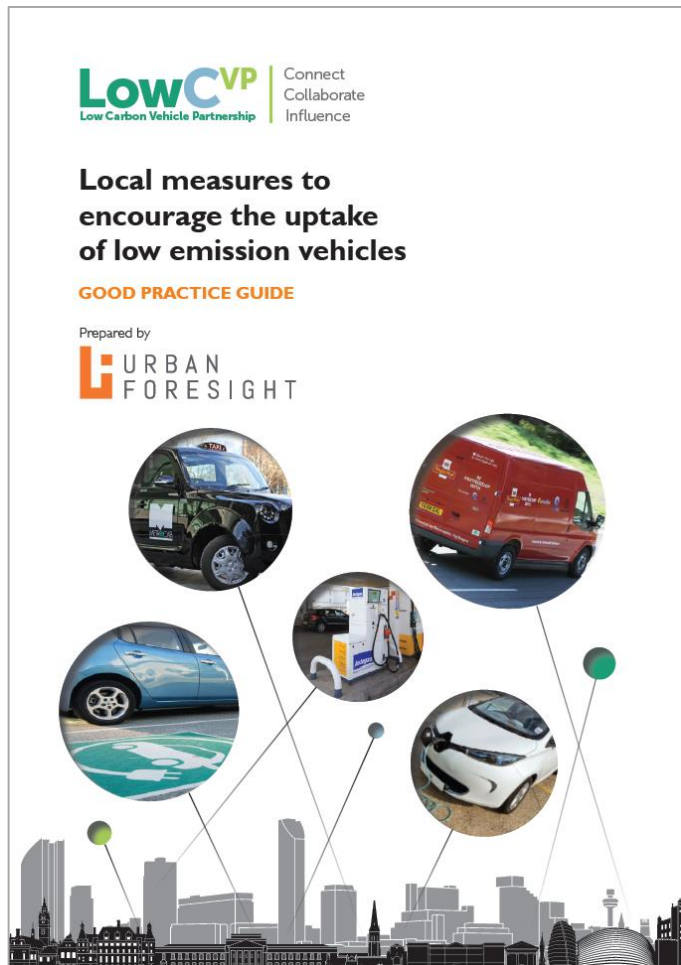


Contents

- Introduction to Good Practice Guide
- What is a Low Emission Vehicle?
- Topics and Measures
- The 5P's :
 1. Planning
 2. Procurement
 3. Provision of Infrastructure
 4. Parking
 5. Promotion
- Implementation Mechanism
- Conclusions



Good Practice Guide for Local Authorities



Aim: To assist local authorities in introducing a broad range of policy measures and initiatives to stimulate the take up of low emission vehicles by private, business and fleet operators.

Methodology:

Desk-based research – survey 60 LAs and 15 interviews to identify LEV related policies and good practice and key challenges

Contents:

- National Policy Framework
- What is a Low Emission Vehicle?
- Local Policy Measures
- Best Practice UK and Internationally
- Implementation, Challenges and Outlook

Collaboration: Transport for London, Committee on Climate Change, York City Council, SMMT, LowCVP, Transport Scotland, Ecolane Transport Consultancy

Good Practice Guide for Local Authorities

LIGHT DUTY VEHICLES & INFRASTRUCTURE



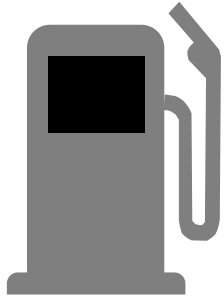
NEXT 10 YEARS



NATIONAL FRAMEWORKS



ALL TECHNOLOGY/ FUEL OPTIONS



Efficient ICE Hydrogen
Battery Electric CNG
Plug-in Hybrid Bio-methane
Hybrid LPG

LOCAL & REGIONAL GOVERNMENT



Unitary
County
District
Boroughs

Transport Council tax collection
Planning Air quality
Licensing Energy
Education Climate change
Housing Economic development
Public health Procurement



**PUBLIC-PRIVATE
PARTNERSHIPS**

EUROPEAN CASE STUDIES



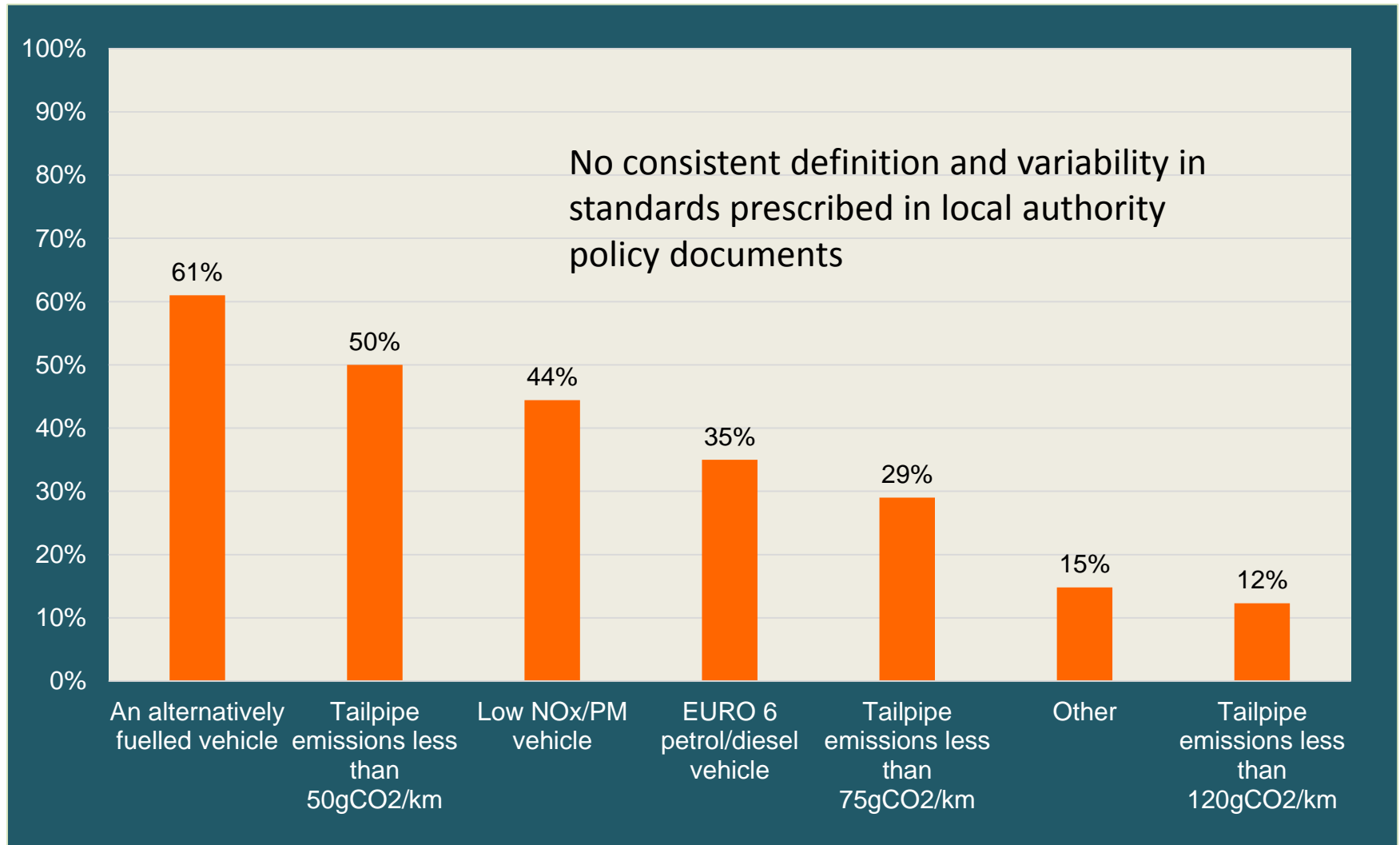
Good Practice Guide for Local Authorities

Survey information collected from:

- Personal Interviews:
 - 15 Local Authorities
 - 3 Public-Private Partnerships
 - 4 NGOs
 - 3 EU Organisations
- Online survey:
 - 68 Local Authorities,
 - 3 Passenger Transport Executives
 - 3 Local Organisations



Survey: Definition of Low Emission Vehicle



Low Emission Vehicle – Definition

- Definitions often follow Euro Standards or CO₂ emissions thresholds. (OLEV's Plug-in car grants defines ULEV as 75g CO₂/km or less).
- LEVs are not just alternative fuels and plug-ins; efficient ICEs of Euro 6 standards can contribute to reducing average air quality.
 - **Air Quality: Euro 6 for passenger cars, Euro 6c for LDVs and Euro VI for HDVs.**
 - **Consideration for older vehicles: average age of vehicle is 7 years.**
- A consistent and coherent framework of standards should be adopted across local authority policy areas; avoids confusion for consumers.
- Targets and standards for LEVs are not **static** – these require regular periodic review and updating in local policy to encourage ambition and ensure continued introduction of cleaner vehicles.

12 Topic Areas Covering 52 measures

P

PARKING



INFRASTRUCTURE
PROVISION



PLANNING

C

ROAD ACCESS AND
CHARGING



TAXIS & PRIVATE
HIRE VEHICLES



INTEGRATION WITH
WIDER TRANSPORT



CAR CLUBS



PROCUREMENT



ECONOMIC
DEVELOPMENT
& TOURISM



PILOTS & TRIALS



EDUCATION &
PROMOTION

£

FINANCIAL
MEASURES

Key for Local Authorities: The 5 P's...

Identified 5 key policy areas that will have that greatest impact on low emission vehicle uptake:

1. Planning

2. Procurement

3. Provision of Infrastructure

4. Parking

5. Promotion (Education and Communication)



Topic 1 - Planning



Specify a minimum requirement for provision of LEV parking spaces and EV/alternative fuel infrastructure in planning conditions for new developments.

Specify creation of 'low emissions zones' through planning conditions.

Specify the need for ULEV 'readiness' in building codes e.g. require sockets in new and renovated buildings.

Electric vehicle charge point installation designated as a permitted development right.

Planning obligations (section 106/section 75), community infrastructure levy and highway contributions for LEV infrastructure and car clubs.

Use Local Development Orders to secure land for LEV infrastructure.

Topic 1 - Planning



Good Practice Case Studies

- **Royal Borough of Greenwich:** Introduction of a 'low emission zone' in major developments setting a minimum Euro standard for commercial vehicles.
- **Barcelona:** Requires 2% of new off-street parking construction must be equipped with EV charging posts.
- **York City Council:** New community stadium secured funding for EV charging for e bikes and cars.
- **Swindon Borough Council:** Use of local development order to speed construction of low carbon infrastructure – hydrogen and EV.
- **Vancouver:** New residential constructions require electrical circuit for home EV charging.
- **Camden Council:** Specifying EV car clubs in new developments and setting residents parking controls based on tail-pipe CO2 emissions.

Topic 2 - Procurement



Setting LEV Procurement Standards for Council's own fleet

Setting LEV procurement standards for out sourced public services
e.g. logistics services, refuse collection, street cleaning, private hire firms, car clubs.

Employees that are entitled to subsidised leases are encouraged to select LEVs

New public-private partnerships to provide resources and expertise to reduce operating costs and emissions in fleets – new business models

Good Practice Case Studies

- **Dundee:** ULEV procurement policy for LDV, total of 62 EV in fleet, largest in UK
- **Camden:** Green Fleet Procurement Policy for their own fleet and contractors,
Stockholm: Lead a joint procurement effort, 335 partners purchasing 1,250 vehicles/ year
- **Transport for London:** EV and infrastructure procurement frameworks and targets for their own fleet (Ultra-Low Emission Vehicle Delivery Plan)

Topic 3 – Infrastructure Provision



Electric vehicle drivers have access to recharging infrastructure at reduced cost or free. Can apply to alternative fuels.

Infrastructure network is developed for ULEVs at key locations (standard/fast charging)

Grants or loans to local businesses to support installation of recharging infrastructure

Council depot or LA owned land to offer 3rd party access for refuelling/charging for local LEV fleets

Examples of Good Practice

- **Bristol and Source West:** Network of electric vehicle charging points
- **London Borough of Camden:** EV fast charging, LPG & biomethane refuelling at depot.
- **London Borough of Hackney:** Rapid on-street charging infrastructure
- **Birmingham City Council:** Strategic Infrastructure Planning

Topic 4 - Parking



LEVs permitted to use public parking facilities free or at a reduced cost.

LEV-only car parking spaces that do not include charge points.

Cost of parking permits reduced or waived for LEV owners.

Priority for parking permit applications given to LEV cars.

Allocating parking for sole use by LEV car clubs.

Good Practice Examples

- **Sheffield Council:** Green Parking Permits for EV, hybrid and LPG vehicles.
- **Kirklees Council:** Annual parking season ticket for free or discounted for LEV.
- **London Borough of Westminster :** Free parking for EVs and discount non-council CP
- **York City Council:** Emissions based residential parking charges
- **Oslo:** EV only car parks
- **Amsterdam:** Reduced waiting times for parking permits for EV drivers

Topic 5 – Promotion



Advisory services - Providing tools and information on the use of LEVs
e.g. Council website, leaflets

‘One-stop shop’/promotion office to access more information, advice, guidance, permits and access cards for infrastructure.

Measures to share/access information internally and externally to a local authority – ‘stakeholder’ groups e.g. local fleets, businesses, neighbouring LAs

LEV demonstration events - offering ‘try and drive’ experiences for local businesses and the public. Partnership with OEMs and local media.

Awareness campaigns events to promote the benefits of LEVs

Good Practice Examples

- **Scottish Borders Council:** EV road show.
- **Camden Council:** Free electric vehicle trials for businesses, created electric car guide video, LEV event hosted by local celebrity.
- **Sweden:** EV car rally to increase media attention.
- **Rotterdam:** Electric Vehicle Centre, test drive EVs and related information.

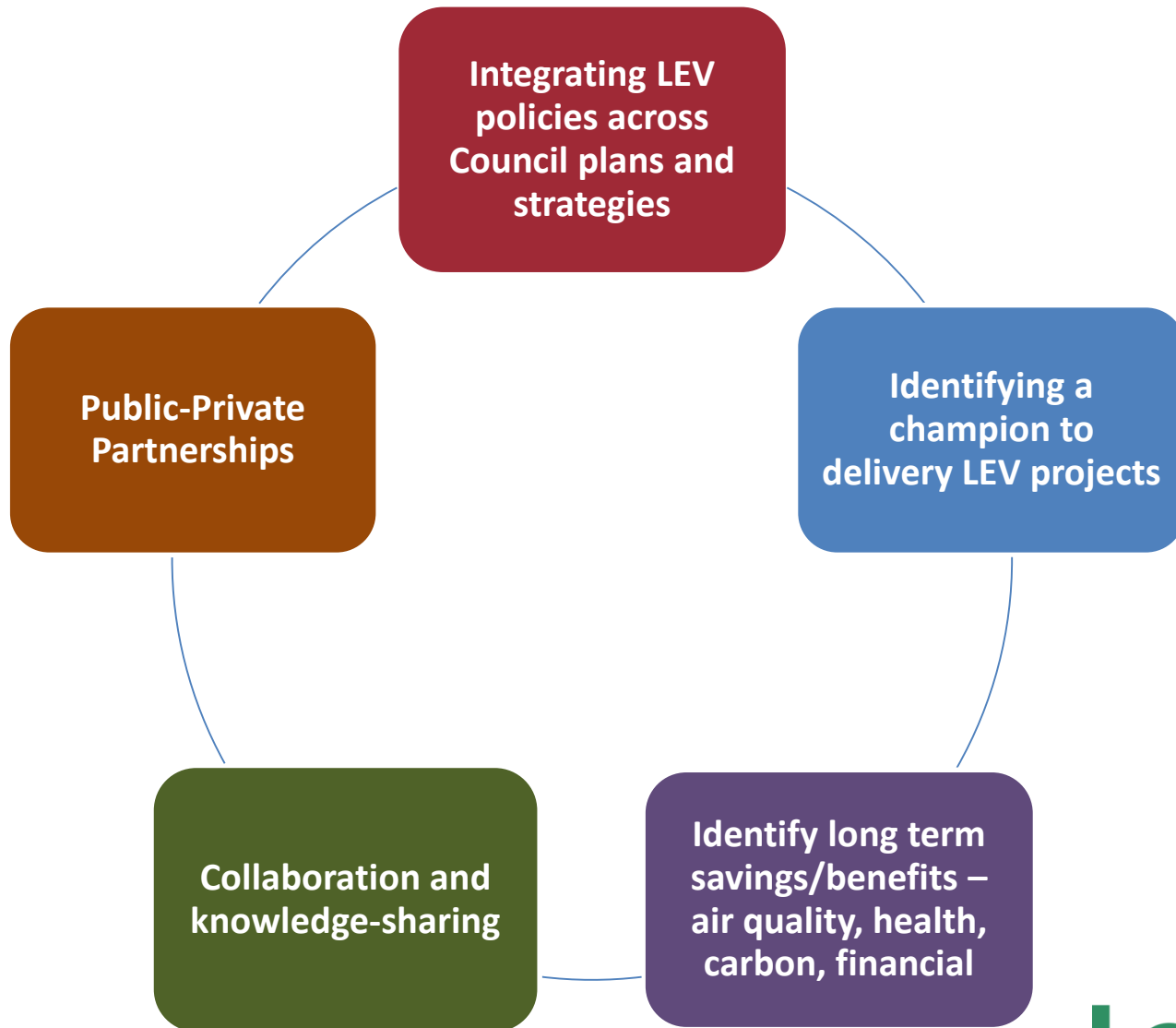
Matrix of policy areas and relevant departments

		Department															
		Building Control	Customer Services	Communication	Economic Development	Education Services	Environment and Regulatory Services	Finance	Fleet Management	Legal	Licensing	Parking Enforcement	Planning	Procurement	Transport Policy	Roads, Highways, and Pavements	Tourism
Policy	Planning												Lead		Lead		
	Procurement								Lead					Lead			
	Infrastructure Provision	Supporting			Supporting		Supporting		Supporting			Lead	Lead		Lead	Lead	
	Education and Promotion		Supporting	Lead		Supporting	Lead		Supporting						Lead		Supporting
	Road Access and Charging						Supporting					Lead	Supporting		Lead	Lead	
	Parking							Supporting				Lead	Supporting		Lead	Supporting	
	Car Clubs							Supporting				Lead	Supporting		Lead	Supporting	
	Taxis & Private Hire Vehicles						Supporting				Lead				Supporting		
	Integration with the Wider Transport Network											Supporting	Lead		Lead	Supporting	
	Pilots & Trials				Supporting		Supporting		Lead						Lead		
	Financial Measures				Supporting			Lead		Supporting							
	Links to Economic Development & Tourism		Supporting	Supporting	Lead								Lead		Supporting		Lead

Assessment of impact/ease of implementation of measures in the guide

		EASE OF IMPLEMENTATION		
		Less Challenging	Moderate	Challenging
IMPACT	High	<ul style="list-style-type: none"> » Discounted parking for LEVs » Discounted residential parking permits for LEVs » Reduced fees for taxi and private hire licenses » Business support » Educational and promotional activities » Information exchange 	<ul style="list-style-type: none"> » Discounted road charges or tolls for bridges/tunnels » Flexible taxi licensing caps » Taxi emission standards » Discounted and integrated travel » Freight consolidation centres » LEV-based car clubs » Local authority trials of new technologies and business models » Facilitating local demonstration projects and trials 	<ul style="list-style-type: none"> » Access to bus lanes » Access to high occupancy vehicle lanes » Links to economic development and regeneration
	Medium			

Implementation Mechanisms



Concluding Messages

- Local measures can make LEVs more convenient, cost effective and desirable.
- Wide range of policies measures that can have a big impact : **The 5 P's!**
- Range of technologies and fuels will help you reduce CO₂ and improve AQ.

3 key messages to take away:

- 1. Collaboration** – Internal & External
- 2. Communication** – Shout it from the rooftops!
- 3. Consistency** – Gives Certainty for Everyone.

Local measures to encourage the uptake of low emission vehicles

GOOD PRACTICE GUIDE

Prepared by

URBAN
F**O**RESIGHT



<http://bit.ly/1evy5mT>

The Low Emission Van Guide



Van Cost & Carbon Calculator



Find out about Low Emission Vans



Battery



Plug-In Hybrid



Biodiesel



Natural Gas / Biomethane



Liquefied Petroleum Gas



Hydrogen

<http://www.lowcvp.org.uk/lev.htm>

Your Whole Life Cost and Well-to-Wheels Carbon Savings
Compared to a Diesel Small Van

Electric Small Van ? <i>Saving:</i> £11,135 and 13.4 Tonnes CO₂	Your selections Urban / Inner-City: 70% Rural / B-Road: 30% Motorway / A-Road: 0% Driving Style: Normal Annual Mileage: 20000 miles Years Ownership: 5 years Diesel: £1.11 (p/litre) Electricity: £0.10 (p/kWh)
Electric Battery Lease Small Van ? <i>Saving:</i> £7,147 and 13.4 Tonnes CO₂	
CNG Small Van ? <i>Saving:</i> £1,763 and 1.2 Tonnes CO₂	

THANK YOU FOR LISTENING

ANY QUESTIONS?

daniel.hayes@lowcvp.org.uk

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The ECO Stars Scheme

Ann Beddoes, ECO Stars Scheme Manager, Barnsley MBC

Morag White, ECO Stars Deputy Programme Manager, TTR Ltd

A red, rounded rectangular stamp-style logo with a white border. The text 'ECO Stars Fleet Recognition Scheme' is written in white, sans-serif font inside the stamp.

ECO Stars Fleet
Recognition Scheme



Odd one out...



Background

- Air Quality is increasingly a significant issue within the UK
- UK Cities are failing to meet Air Quality targets
- Air Quality impacts health resulting in social and economic consequences
- Transport is a significant contributor to poor air quality



How it Works

- Member vehicles and operating practices are assessed
- To recognise levels of environmental and energy saving performance
- A star rating is applied

Fleet Composition



Fuel Management



Driver Skills Development



**Vehicle Specification
& Preventative Maintenance**



IT Support Systems



**Performance Monitoring
& Targeting**



**ECO Stars Fleet
Recognition Scheme**



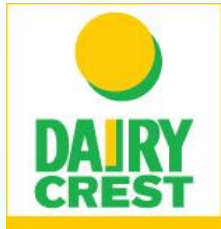
ASDA



JGIP
JG PEARS

First Existing Members

NOBLE
FOODS



RELIANCE

Potter
Logis

Samworth Brothers
DISTRIBUTION



Keeping the Future in Shape



Alliance
TRANSPORT



TOCKWITH
TRAINING

Sainsbury's



MALCOLM
GROUP



Scottish Environment
Protection Agency



Clipper

UNISERVE
perfect
service solutions

ALcontrol
Laboratories

wilkinson

Nestlé



Bidvest
3663

REACT
TRANSPORT SERVICES LTD



brakes



Revive
Property Solutions

ECO Stars Fleet
Recognition Scheme

expert logistics

Sheffield Teaching Hospitals
NHS Foundation Trust

Borchard Lines Ltd



culina AMBIENT

w.culina.co.uk

GREGGS

Grant Westfield





ECO Stars



Has telematics AND uses them in their vehicles?

Has someone who is appointed to manage fuel within the business on a day to day basis

Has reduced their fuel (like for like) in the last year?

Has a procurement policy that includes MPG as a determiner?

Has looked at alternative fuels?



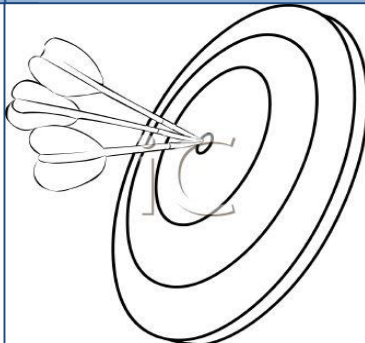
Has driver performance based on fuel measures?

Does fuel benchmarking?

Has fuel targets as part of their KPI's?

Has an idling policy?

Can give an example of fuel best practice?



ECO Stars Bingo

- Feedback
 - What was easy to find?
 - What was less easy?
 - Any observations?



Thank You

Any Questions

Contact

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morag.white@ttr-ltd.com

www.ecostars-uk.com



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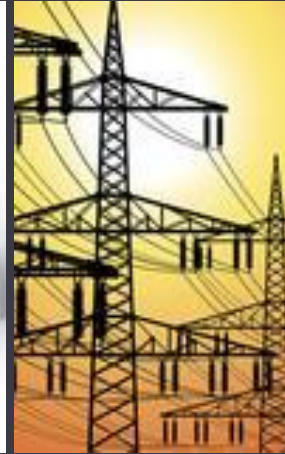
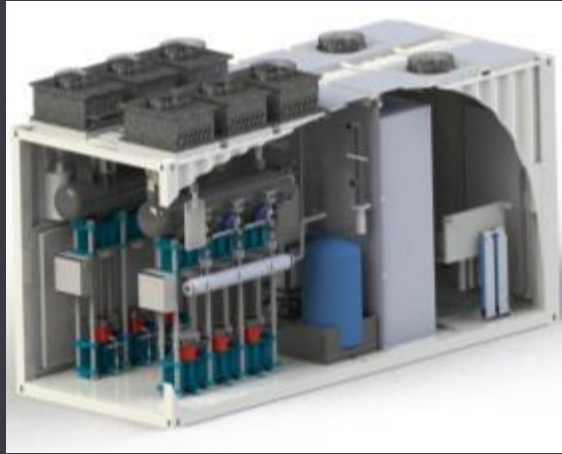
INTRODUCING HYDROGEN VEHICLES & INFRASTRUCTURE IN THE UK

Charles Purkess,
Business Development Manager
ITM Power plc
chp@itm-power.com



INTRODUCING H2 VEHICLES & INFRASTRUCTURE

LOW EMISSION CITIES WORKSHOP - SHEFFIELD



INTRODUCING H2 VEHICLES & INFRASTRUCTURE

LOW EMISSION CITIES WORKSHOP - SHEFFIELD

Contents

- Introduction
- Why hydrogen ?
- Hydrogen Infrastructure
- Cars
- Van fleets
- Buses – Public Transport
- “The Road to Sustainability”



ITM POWER PLC

DESIGN AND MANUFACTURE ENERGY STORAGE & CLEAN FUEL SYSTEMS

ITM Power | History

- First AIM listed fuel cell & hydrogen company
- 2004 IPO | £10m | ITM.L
- 2006 Secondary | £30m
- 2012 -14 Expansion | £17m
- 2015 JCB £4.9m Strategic Investment
- Two facilities in Sheffield | 70 staff
- Manufacturing business model



WHY HYDROGEN FUEL?



ENERGY STORAGE | CLEAN FUEL





UK H₂ Mobility

Development of a national HRS plan

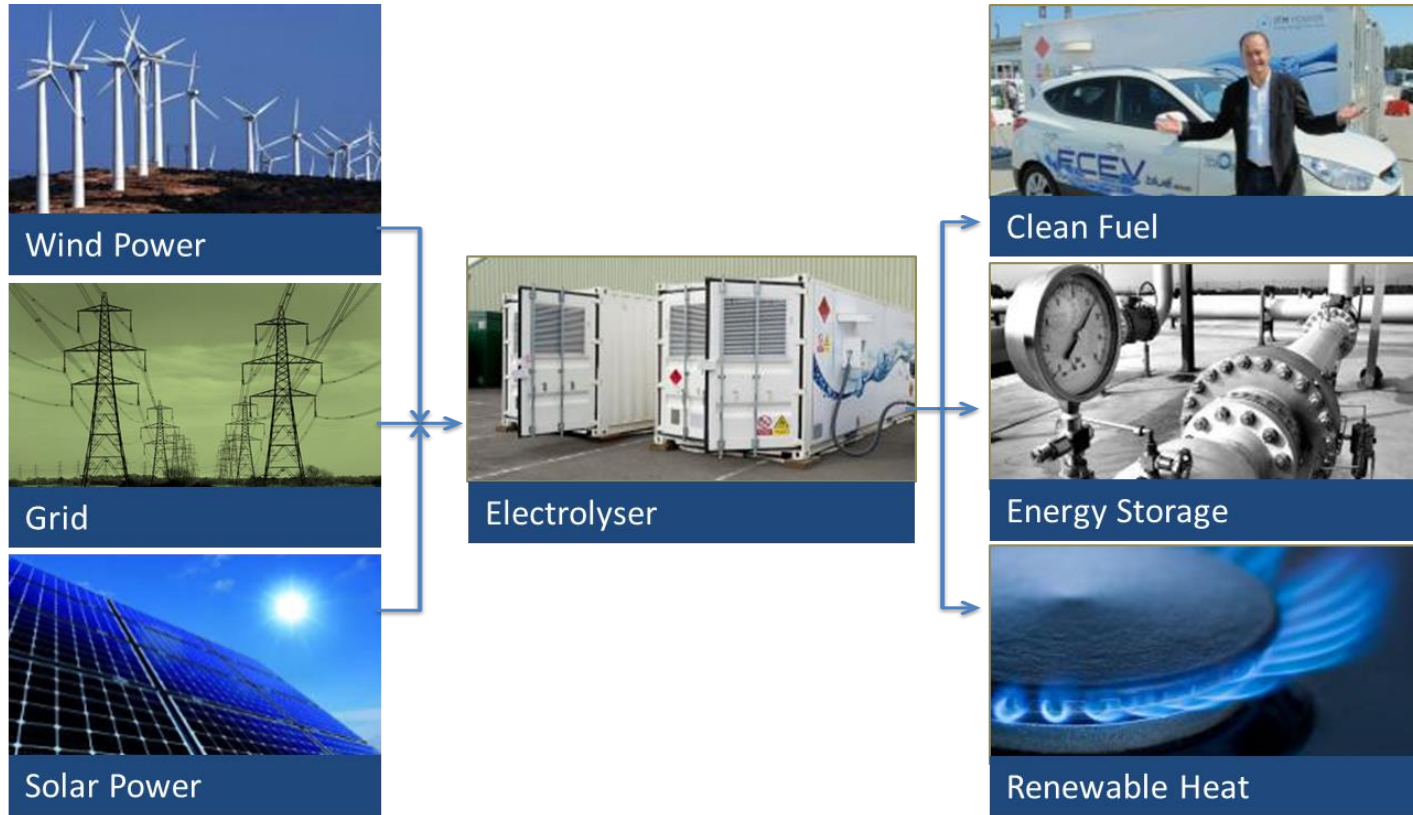
- Full report published April 25th 2013
- Phase 2 underway
- An initial roll out of 65 refuelling stations of 80kg/day each
- 50% electrolysis



 Air Liquide	 ITM Power	 BOC
 Johnson Matthey	 Toyota	 Nissan
 Daimler	 Vauxhall	 Hyundai
 SSE	 Intelligent Energy	 Dept for Business Innovation & Skills
 Dept of Energy & Climate Change	 Morrisons	 Sainsbury's

CLEAN FUEL | ENERGY STORAGE | RENEWABLE HEAT

PEME Convert surplus renewable electricity into chemical energy (green hydrogen)



RAPID RESPONSE INTEGRATION
HYDROGEN ENERGY SYSTEMS

MARKET OFFERING

Rapid Response | High Pressure | High Efficiency | MW scale

- Rapid response: less than 2s; for primary grid balancing
- High pressure: up to 80bar; for direct injection
- High efficiency: 75% measured by third parties in the field
- MW scale: 1MW modules available today
- Compliant: EU, USA and Asia



MARKET OFFERING
HYDROGEN ENERGY SYSTEMS

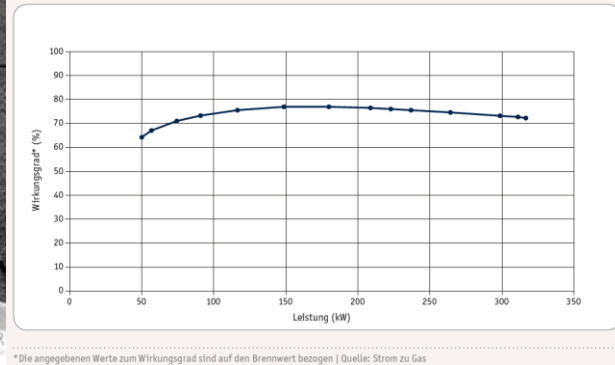


ITM Power's HGas System brings together rapid response and self-pressurising PEM electrolysis into a fully integrated package which injects hydrogen into the gas distribution network at the Mainova Aktiengesellschaftsite, Frankfurt, utilising pre-existing compliant gas mixing and grid injection infrastructure. The plant has undergone an extensive acceptance, compliance and commissioning phase before going live in December 2013. The sale was the result of a competitive tender, based on price and performance, and was commissioned ahead of schedule. Capable of addressing MW scale Power-to-Gas applications, and accommodates fluctuating power profiles while generating hydrogen at pressures suitable for either direct injection into natural gas networks or via methanation processes without additional compression.



Wirkungsgrad bei unterschiedlicher Auslastung der Strom zu Gas-Anlage

Zahlen + Fakten



POWER-TO-GAS
ENERGY STORAGE | CLEAN FUEL



RWE

ITM Power's HGas System was delivered to RWE within 10 weeks of receiving the order, which was won as part of a competitive tender. The system is a second generation ITM Power PEM electrolyser system using a higher current density, permitting higher hydrogen output per stack. The system efficiency is also increased by simplification of the balance of plant.



POWER-TO-GAS
ENERGY STORAGE | CLEAN FUEL

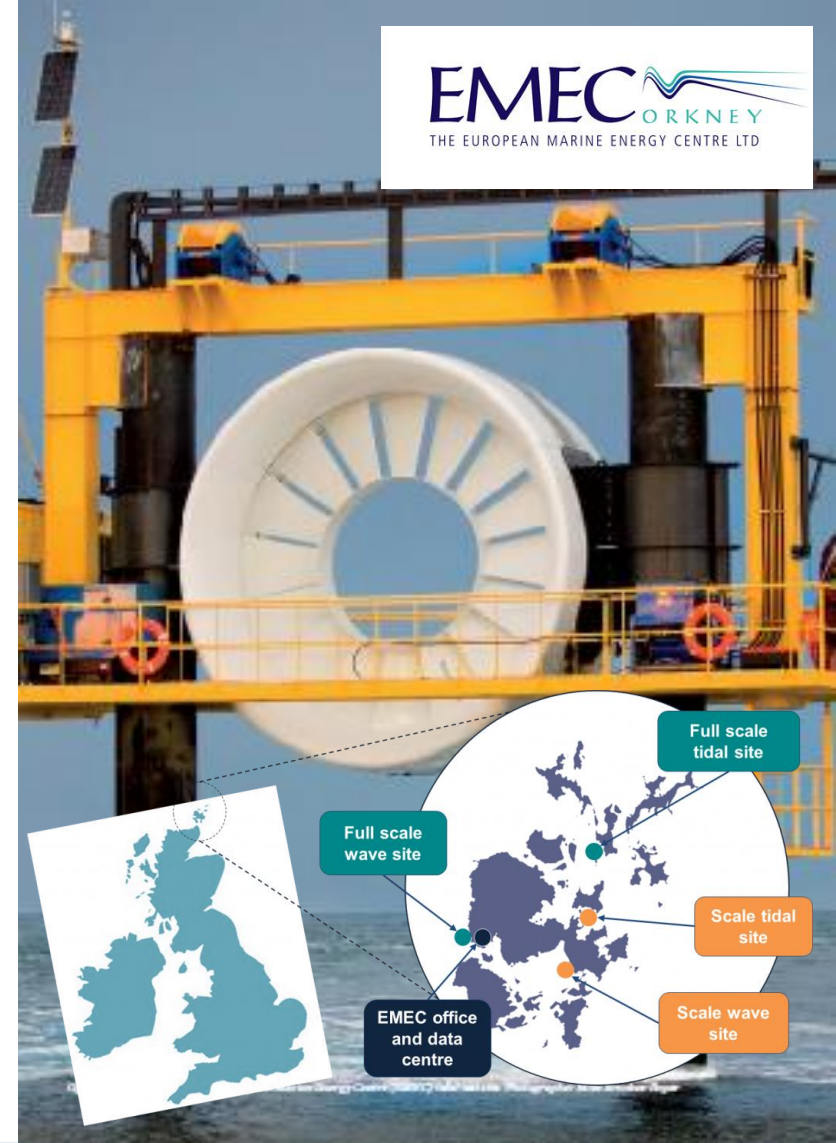


ISLAND HYDROGEN

EMEC | Orkney

- £1.8m sale
- Competitive tender
- 0.5MW electrolyser + storage
- Complete hydrogen energy system
- Eliminate island grid constraints for tidal testing site
- Largest system to date
- Many follow on projects

EMEC ORKNEY
THE EUROPEAN MARINE ENERGY CENTRE LTD



ENERGY STORAGE | CLEAN FUEL

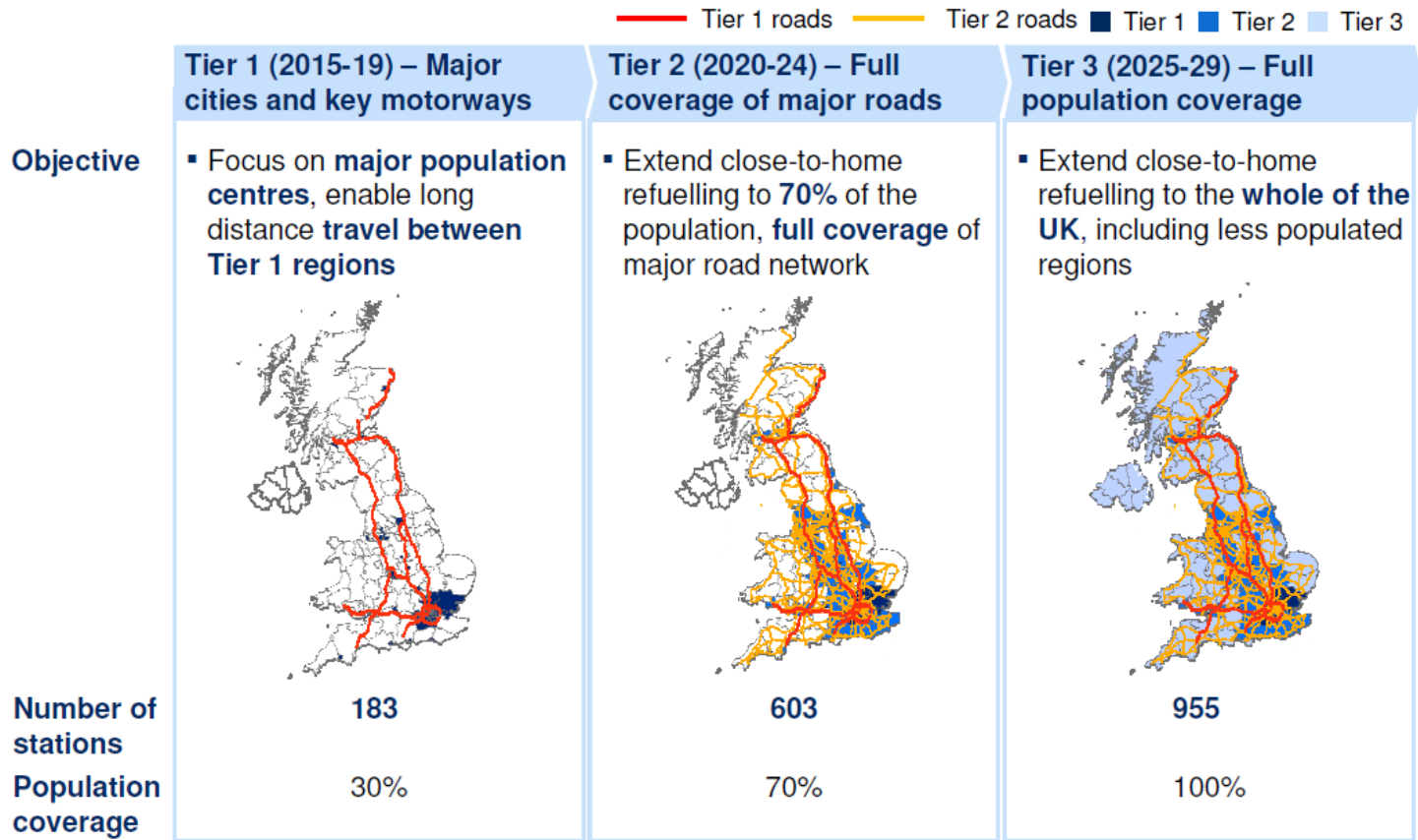
ENERGY STORAGE | CLEAN FUEL

ITM POWER
Energy Storage | Clean Fuel

CLEAN FUEL



1 The proposed HRS network provides full coverage of major UK roads by 2025, reaching 955 stations by 2030



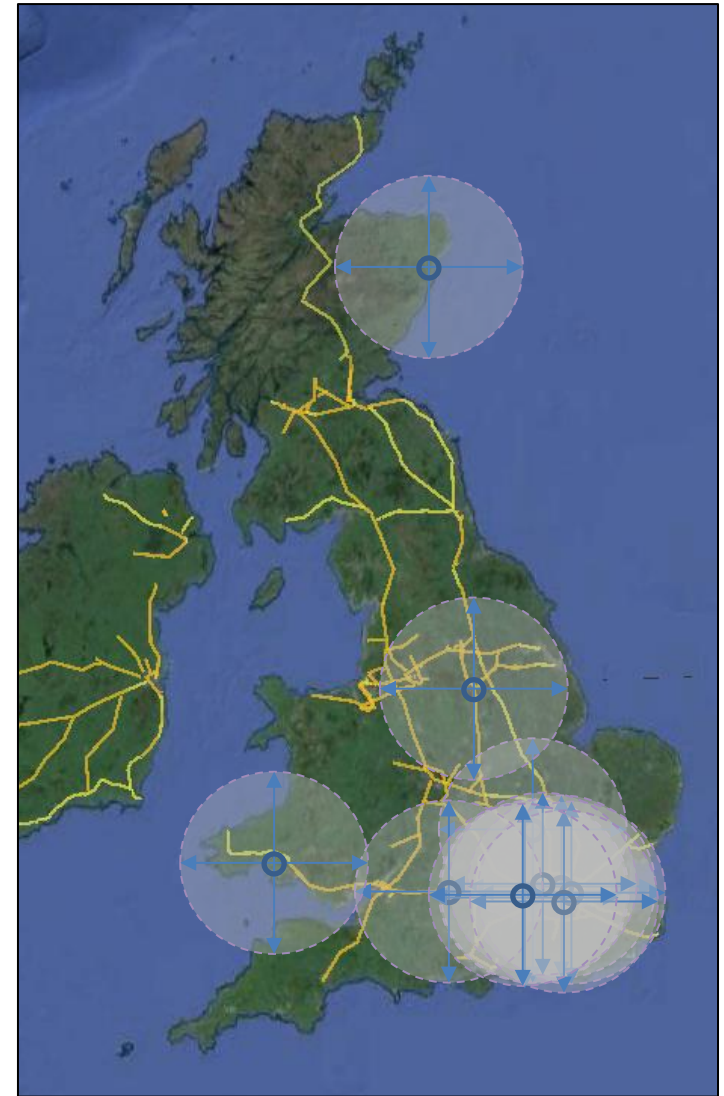
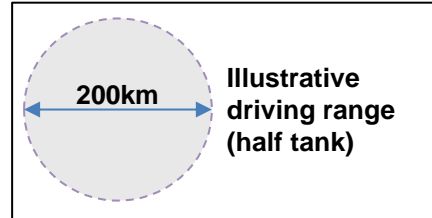
SOURCE: UK H₂Mobility



McKinsey & Company | 10

Existing and Funded UK HRS

HRS Provider	Location
Air Products	Hendon, London
Air Products	Temple Mills Bus station, London (buses only)
Air Products	Hatton Cross, Heathrow
Baglan Energy Centre	Port Talbot
BOC	Swindon, Honda manufacturing centre
BOC	Aberdeen
ITM Power	M1, Sheffield
ITM Power	Teddington, London (under construction)
ITM Power	Rainham, London (planned)
ITM Power	London (planned)
ITM Power	South East (planned) Shell
ITM Power	South East (planned) Shell



Demonstration scale refuelling equipment also exists in (not shown):

- Coventry
- Birmingham
- Nottingham
- Loughborough
- Millbrook
- Isle of Wight

M1 WIND HRS

Launched September 2015

- Located on the Advanced Manufacturing Park
- M1 Junc. 33 Rotherham
- H2 Production 80kg/day
- Upgraded to 350 & 700 bar spring 2016
- 24/7 swipe card access



REFERENCE PLANT



HyFive is an EU funded project which will see hydrogen stations being deployed to European cities as well as 100 fuel cell vehicles from 5 OEM's. ITM Power was awarded three stations, all of which will be 80kg/day refuelling at 700bar. These stations will be deployed in London in Q3 2015.



UK H₂ Mobility



HYFIVE - VEHICLE REFUELLING
ENERGY STORAGE | CLEAN FUEL





FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING



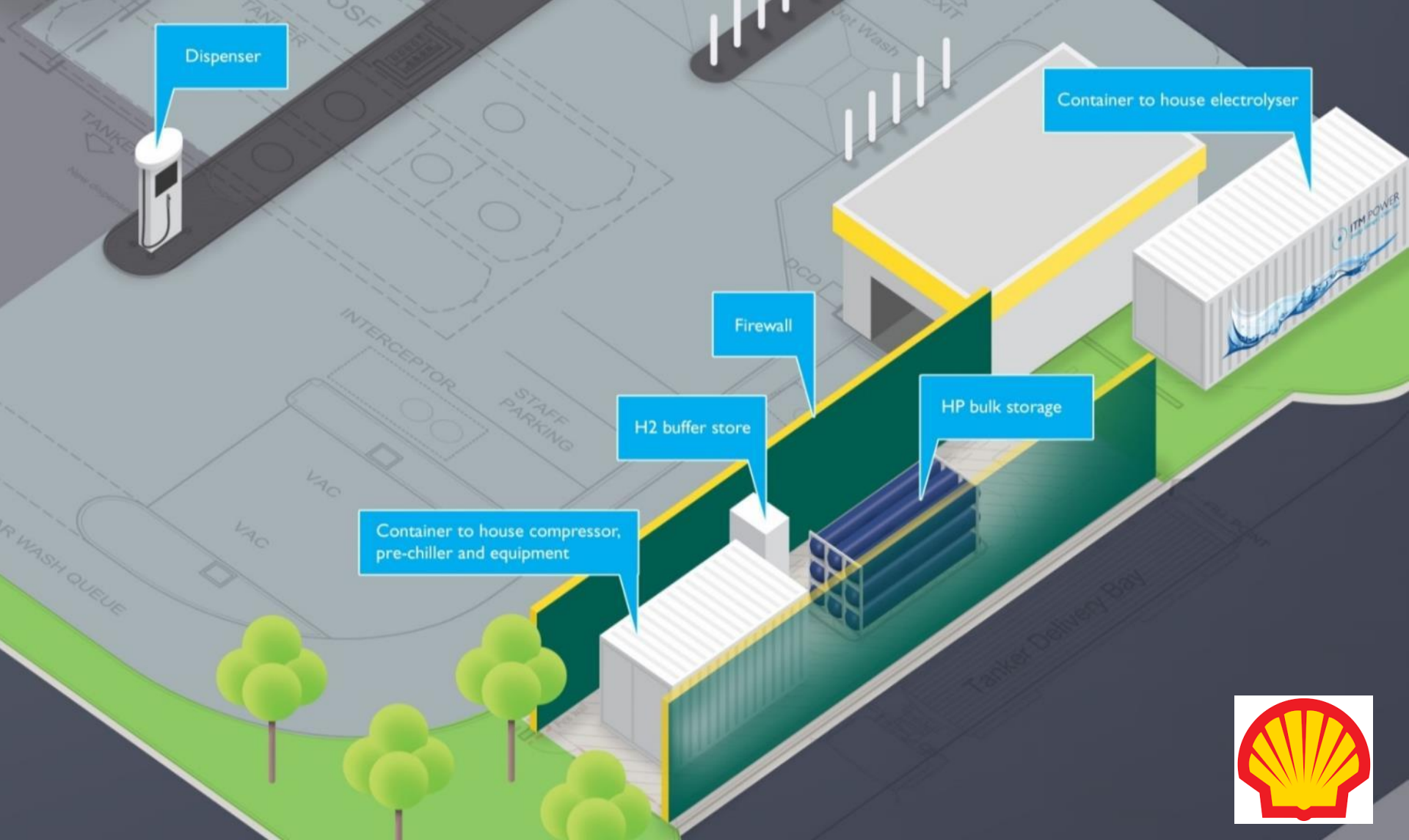
Hydrogen
Mobility Europe



These activities have received funding from the European Union's Horizon 2020 Programme through the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) under grant agreement number 671438.

H2ME - VEHICLE REFUELLING
ENERGY STORAGE | CLEAN FUEL





ON-SITE HYDROGEN PRODUCTION ENERGY STORAGE | CLEAN FUEL

REGULATIONS, CODES & STANDARDS

A leading role in shaping hydrogen deployment

- Secretary of BCGA Technical Steering Committee 9
- Secretary and UK Expert to ISO Technical Committee 197
- UK Expert to ISO working groups...
- ...for electrolysers, dispensers & H2 quality
- Next Chair of BSI PVE/3/8



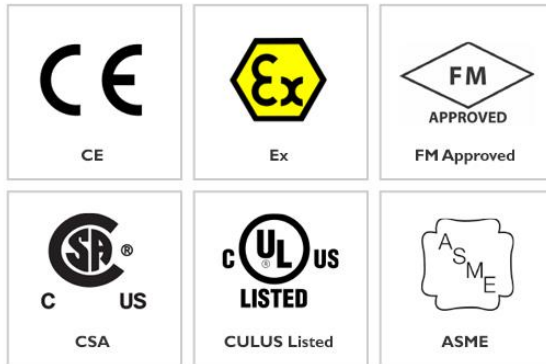
Code of Practice 41: H₂ Fuelling Stations
Design & Construction
Maintenance & Operation



ISO 19880-1: H₂ Fuelling Stations
ISO 22734: Electrolyser
ISO 14687: H₂ Quality



BSI PVE/3/8: H₂ Systems Standardisation
Production & Storage
Transport, Measurement & Use



COMPLIANCE
HYDROGEN ENERGY SYSTEMS

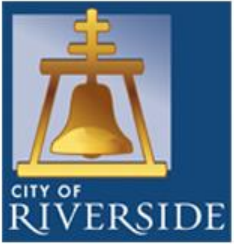


ITM Power will supply an advanced 100kg/day refuelling station with ability to dispense at both 350 and 700 bar. The station will provide hydrogen for Hyundai's Tucson Fuel Cell fleet and fork lifts. Funded under the Californian CEC programme 2013.



ON-SITE HYDROGEN PRODUCTION
ENERGY STORAGE | CLEAN FUEL





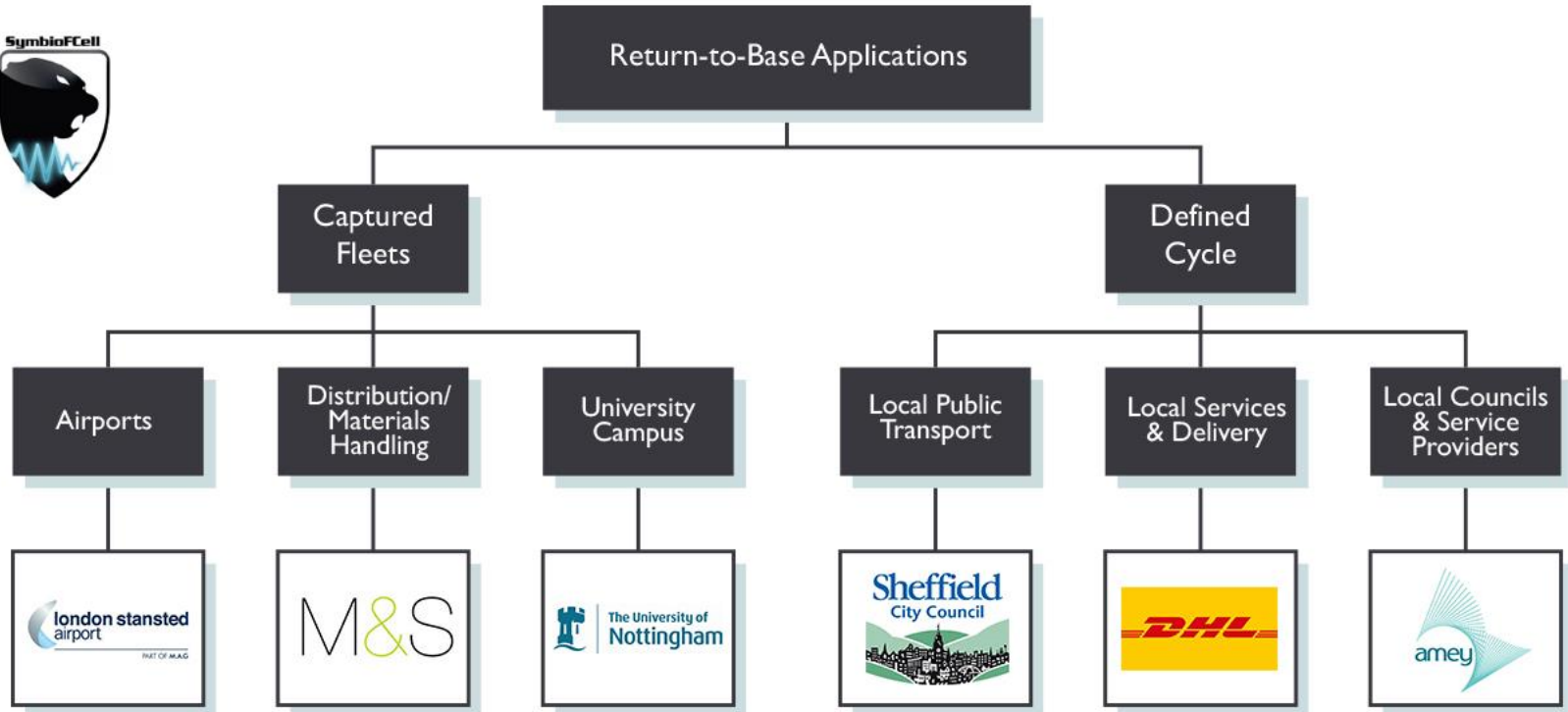
ITM Power is to supply this 100kg per day station which will be located in Riverside, California. The station will be 33% Renewable and Expandable. The site is already offering existing alternative fuels so it is exciting to be adding hydrogen to the offering. The station will be operational in October 2015.



ON-SITE HYDROGEN PRODUCTION
ENERGY STORAGE | CLEAN FUEL



LOCAL CLEAN FUEL: THE EXPERIENCE



ON-SITE FUEL PRODUCTION
ENERGY STORAGE | CLEAN FUEL

HYKANGOO 5KW RANGE EXTENDER VAN



FC RANGE EXTENDER VAN
HYDROGEN ENERGY SYSTEMS

A number of bus projects are underway across Europe



CHIC Buses – Over 50 buses

Aargau



5 EvoBus buses

Bolzano



5 EvoBus buses

London



8 Wrightbus buses

Milano



2 EvoBus buses

Oslo



5 Van Hool buses

Cologne



2 APTS buses

Hamburg



2 Van Hool buses



4 EvoBus buses

Whistler



20 NewFlyer buses

3 dedicated Van Hool projects are planned, of which two (**High V. Lo City** and **HyTransit**) have already deployed vehicles. Total of >40 buses involved.

Aberdeen



10 Van Hool buses

San Remo



5 Van Hool buses

Antwerp



5 Van Hool buses

FCEV BUS COMMERCIALISATION STRATEGY

Published September 2015

Coalition of stakeholders

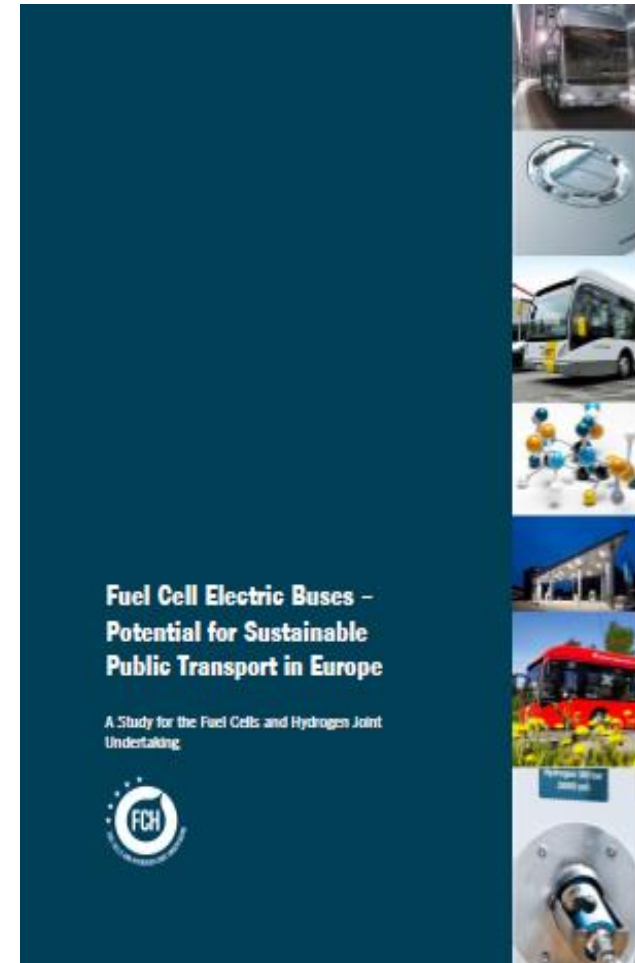
- Bus Operators
- Infrastructure OEMs and hydrogen suppliers
- Municipalities
- Bus OEM & Technologies

Summary of Benefits

- Political – the need to reduce urban emissions
- Operational – most flexible zero emission technology option
- Environment – clean emissions
- Economic – Reduce external costs



FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING



SUSTAINABLE PUBLIC TRANSPORT
HYDROGEN ENERGY SYSTEMS



A SUSTAINABLE FUTURE- TODAY

Fuel Cell Cars

- Rapid 3-5 min refuelling
- 400 mile range
- Full power on-demand
- No disruption to normal routine - business or social
- Facilitates rapid adoption

PEM Electrolyser - Green hydrogen

- On-site production – no need for fuel deliveries
- High purity – made from water – “Fuel cell friendly”
- Utilises surplus RES for carbon free fuel
- Compliant, low footprint - forecourt integration
- Key enabling technology for infrastructure roll-out

Meets multiple policy goals - clean air and GHG targets

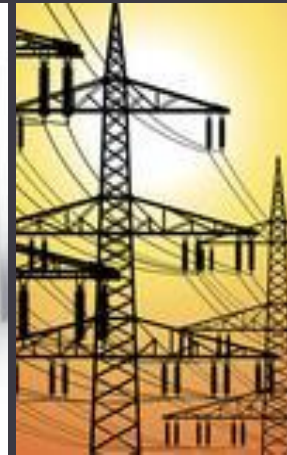
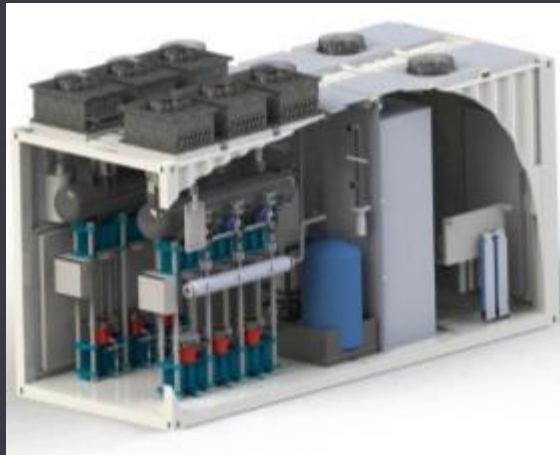


“THE ROAD TO SUSTAINABILITY”

HYDROGEN ENERGY SYSTEMS

INTRODUCING H2 VEHICLES & INFRASTRUCTURE

LOW EMISSION CITIES WORKSHOP - SHEFFIELD





Connect
Collaborate
Influence



Low Emission Cities Workshop

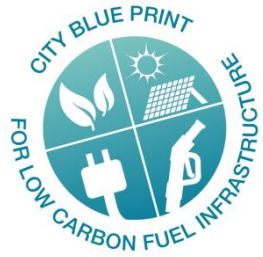
Best practice measures for increasing the take up of low pollution and carbon vehicles in cities

Wednesday, 18th November 2015, Sheffield

Low Emission Vehicle Strategy & LPG Taxi Programme

Sylvia Broadley, Green Fleet Change Manager, Birmingham CC



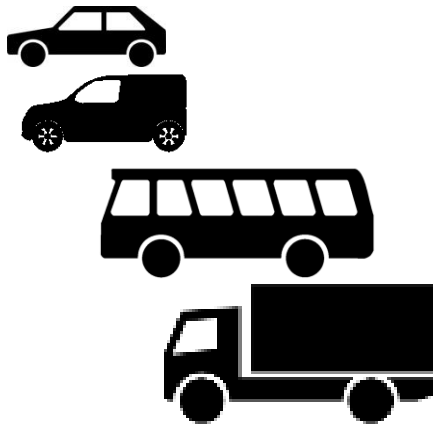


Context

Birmingham Green Commission is targeting 60% CO₂ reduction from 1990 levels by 2027 .

- Birmingham Green Commission & Carbon Road Map
- Air quality a priority for the city- DEFRA 2020

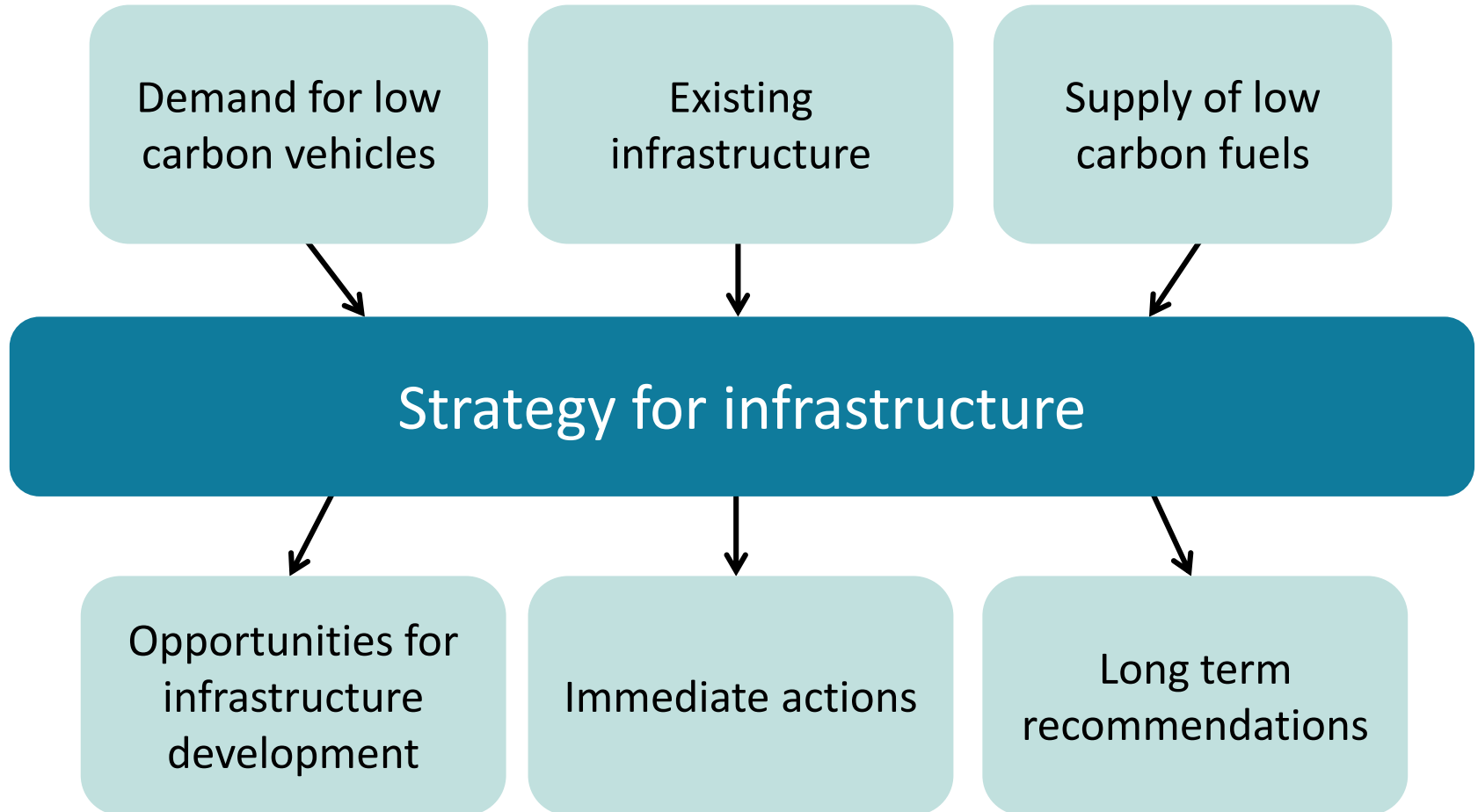
Road transport is a major contributor to greenhouse gas emissions and air pollution – BCC Fleet approx 944 vehicles.

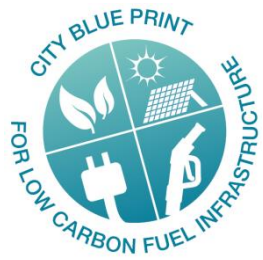


- Lack of infrastructure is a key barrier to deployment of alternative vehicles which can achieve emissions savings and air quality improvements.
- Recent Blueprint strategy identified savings of over 260,000 tonnes of CO₂ by 2035



Birmingham Blueprint sets out a refuelling infrastructure strategy

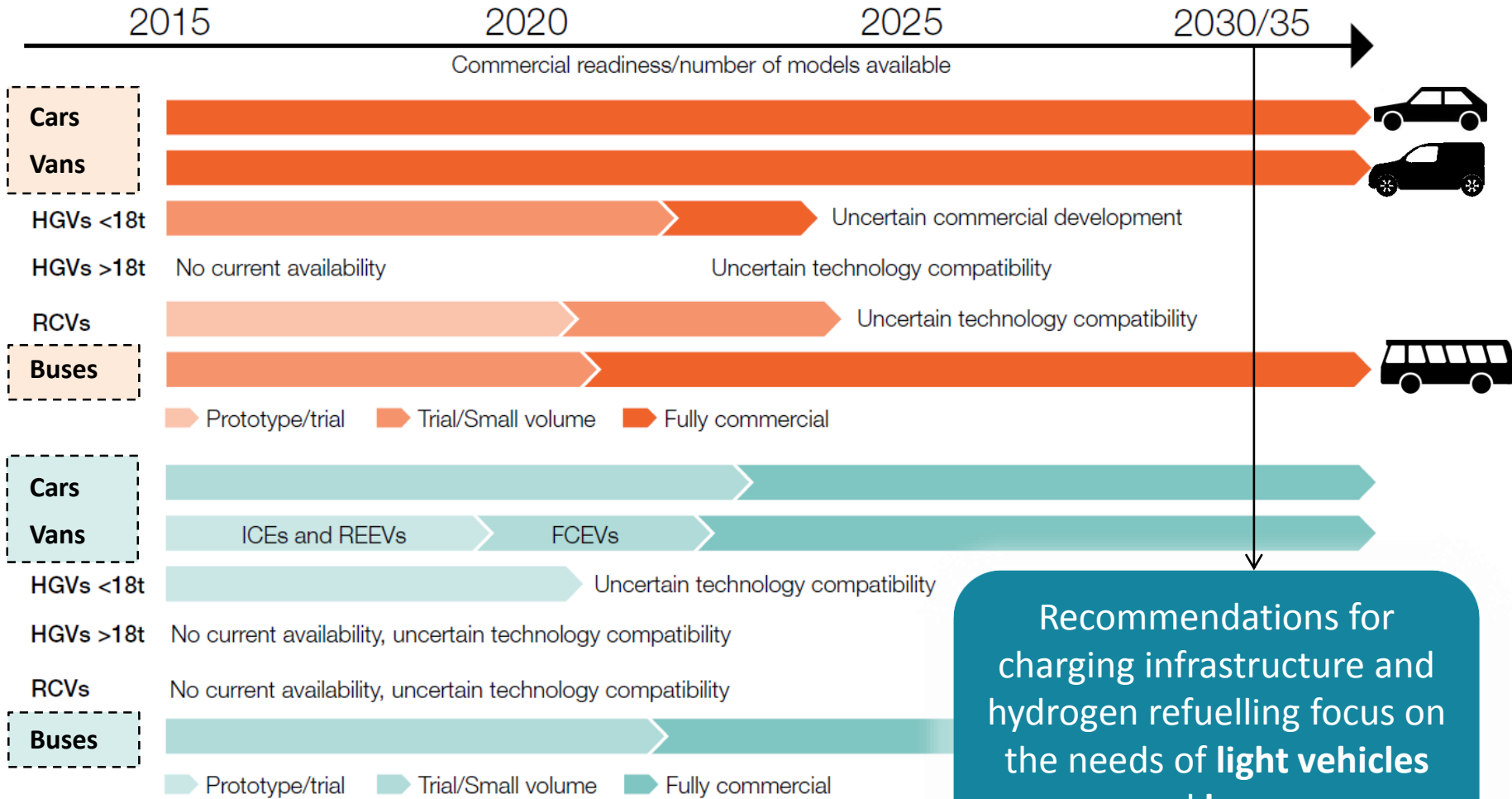




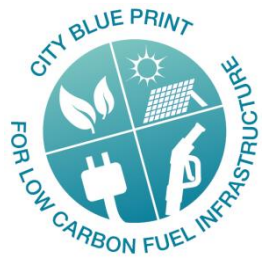
Fuels and vehicle types in the scope of the Blueprint



Market availability for plug-in electric and hydrogen vehicles



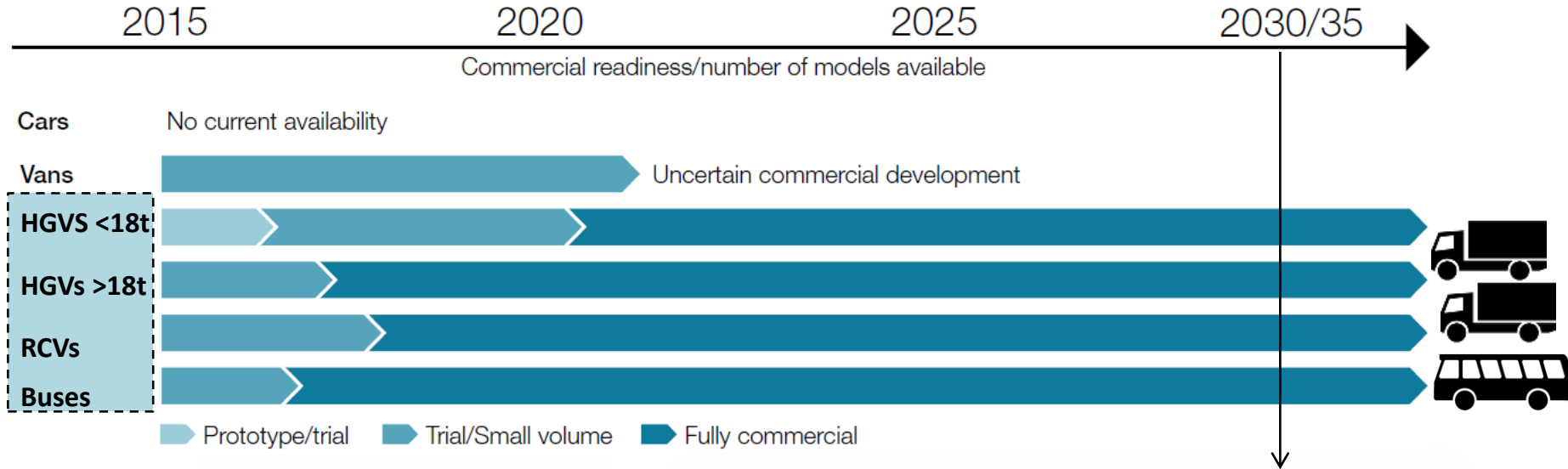
Recommendations for charging infrastructure and hydrogen refuelling focus on the needs of light vehicles and buses



Fuels and vehicle types in the scope of the Blueprint



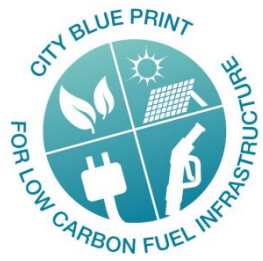
Market availability for natural gas vehicles



Liquid air is another fuel considered in the report, with the first applications involving refrigeration for heavy goods vehicles

Recommendations for gas refuelling infrastructure refuelling focus mainly on the needs of **heavy vehicles** and **buses**

LPG is also included in the scope of the report; recommendations focus on the needs of light vehicles



Refuelling for Depot based vehicles



- Heavy vehicles such as buses and trucks (and some light vehicle fleets) typically refuel in dedicated, in-depot refuelling facilities
- In the absence of in-depot infrastructure for depot-based fleets, strategically placed public or shared facilities in Birmingham could support vehicle uptake

For depot based **electric vehicles** (buses and light vehicles) in-depot charging facilities are a definitive requirement

For depot-based **hydrogen** vehicles, in-depot refuelling is preferred in the long term; **shared refuelling in strategic locations** could be feasible in the short term

Depot based **gas vehicles** (buses and trucks) could also use shared facilities in the short term

All vehicles using **liquid air** for refrigeration are likely to be depot based – trials will involve in-depot refuelling



Make up of BCC Fleet

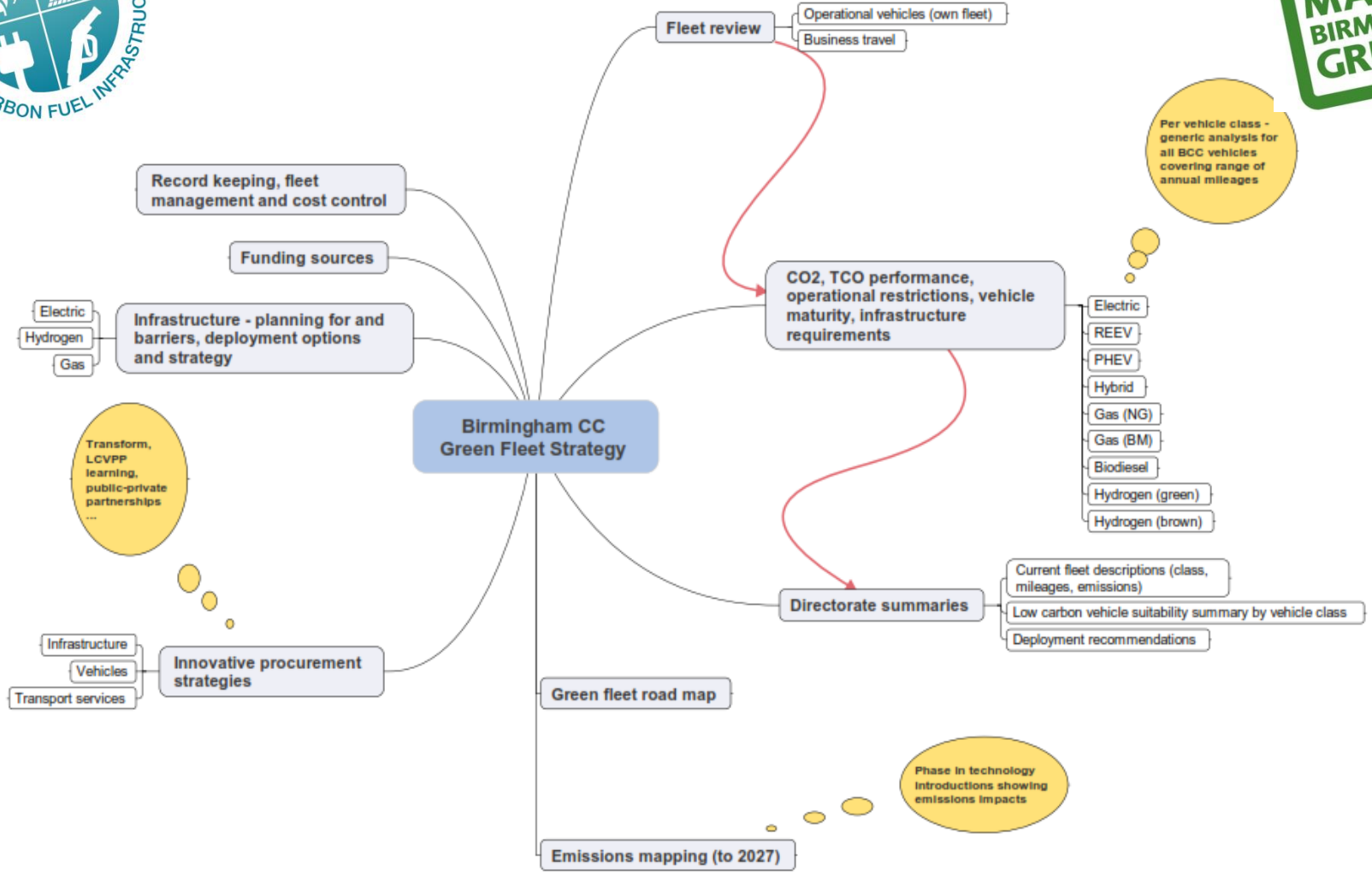
Directorate	Car	Minibus	Plant	RCV	Sweeper	Truck	Van	Grand Total
Adult & Communities	16	3				3	76	98
Development	8					3	15	26
Education	3					1	57	61
Fleet & Waste Management	68		2	147	106	57	162	542
Housing	2						83	85
Local Services	17					1	54	72
Transportation	4						2	6
Unknown	10					5	39	54
Grand Total	128	3	2	147	106	70	488	944

Key issues

- Annual Mileage
- Where Located
- Carbon reduction through downsizing, fuel monitoring, telematics , use of Car clubs etc..
- Demand is not met through supply- infrastructure & OEMS seeing business case.



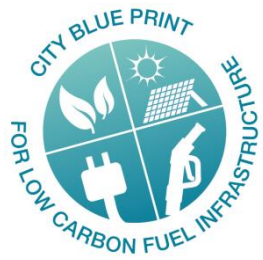
Green Fleet Strategy Project scope



Transform, LCVPP learning, public-private partnerships ...

Phase in technology introductions showing emissions impacts

Per vehicle class - generic analysis for all BCC vehicles covering range of annual mileages



Strategy for public infrastructure – gas vehicles



Opportunities for public gas stations on trunk routes near Birmingham

- Preferred areas for public gas stations to enable gas vehicle use on routes in and via Birmingham
- Zones with gas network connection opportunities for CNG stations



A38/M6



M42/M6



M5/M42



Hams Hall Distribution Centre

Relevant vehicle types:



Mapping potential vehicle uptake & emissions savings by 2035



- Realisation of these emissions savings will depend on the availability of low carbon electricity, hydrogen and gas

	Potential fleet uptake (average across fleets)	WTW GHG savings (tonnes CO _{2e} /year)	Percentage WTW savings for Birmingham road transport emissions ¹
Plug-in vehicles	20% (Taxis, vans, private cars, buses and small trucks)	190,000 tonnes (based on 100% renewable electricity)	12%
Hydrogen vehicles	3% (Taxis, vans, private cars and busers)	48,000 (based on carbon neutral electrolysis)	3%
Gas vehicles	7% (Buses, heavy goods vehicles, Refuse collection vehicles)	26,000 tonnes (based on injected biomethane)	2%
Liquid air refrigerated vehicles	45% (Refrigerated heavy goods vehicles)	Dependent on applications / duty cycles	Dependent on applications / duty cycles

1 - Compared to a baseline case without low carbon vehicles



Requirements for successful implementation of Green Fleets



- Encourage and contribute to uptake of low carbon vehicles
- Use planning guidance to deliver strategy recommendations for infrastructure
 - Work closely with private fleets on demonstration and deployment activities for low carbon vehicles
 - Make land available for infrastructure providers
- Streamline planning processes for renewable fuel production and infrastructure
- Include low carbon fuels for transport into the development of energy system strategies



Strategic Actions required



- Launch of Green fleet strategy for Council fleet & LA strategic engagement re Buses, Taxis, HGVs, LGVs, coaches & cars.
- Public/private sector and University collaboration to align energy system strategies – from waste strategies to bio-methane injected into the grid , hydrogen production and electric for heat & power.
- Low/zero carbon re-fuelling infrastructure alignment with ‘Birmingham Connected’ Transport Policy – key focus on Green Travel Districts , enabling take up of new modes & models of integrated green transport.
- Strategic focus on funding sources getting right mix of capital & revenue - LEP, H2020, OLEV, DFT.



BCC Developments

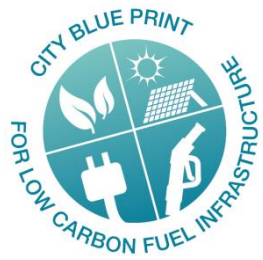


- Specific projects include:
 - Plug in EVs - OLEV LA /Taxi/Demonstrators
 - Hydrogen – H2020 NBF & bus/van project
 - Gas - infrastructure development (LEP funding approved for 4 feasibility studies)- opens up options for CNG Refuse vehicles
 - Hybrid – MSP mini buses-TRANSFORM
- Working with the private sector will be key
- Blueprint will be used to inform projects



Birmingham LPG Taxi Project





OLEV-Clean Vehicle Technology Fund

- 80 Hackney Carriage LTI TX1 & 2 -Euro 2 & 3 (9-15 years old) diesel vehicles.
- Voucher scheme- £6,150 with VAT paid by owner.
- Selection Criteria – location of Air Quality hotspots - Broad St, New St Station and Navigation St.
- New Vauxhall engine/LPG - status of the vehicle ie well-maintained, 5 years + life- no longer issues about engine or radiator related defects & original engine.
- Millbrook certification at Euro 6 (passenger & light commercial)- impact for Taxi Licensing.
- Monitoring of Emissions- LowCVP.
- Conditions of grant & Feedback.
- LPG infrastructure development – alignment with Electric ‘Taxi Only’ scheme.



Connect
Collaborate
Influence



Low Emission Cities Workshop

Best practice measures for increasing the take up of low pollution and carbon vehicles in cities

Wednesday, 18th November 2015, Sheffield

Going Green – biomethane bus fleet

John Bickerton, Chief Engineer, Reading Buses





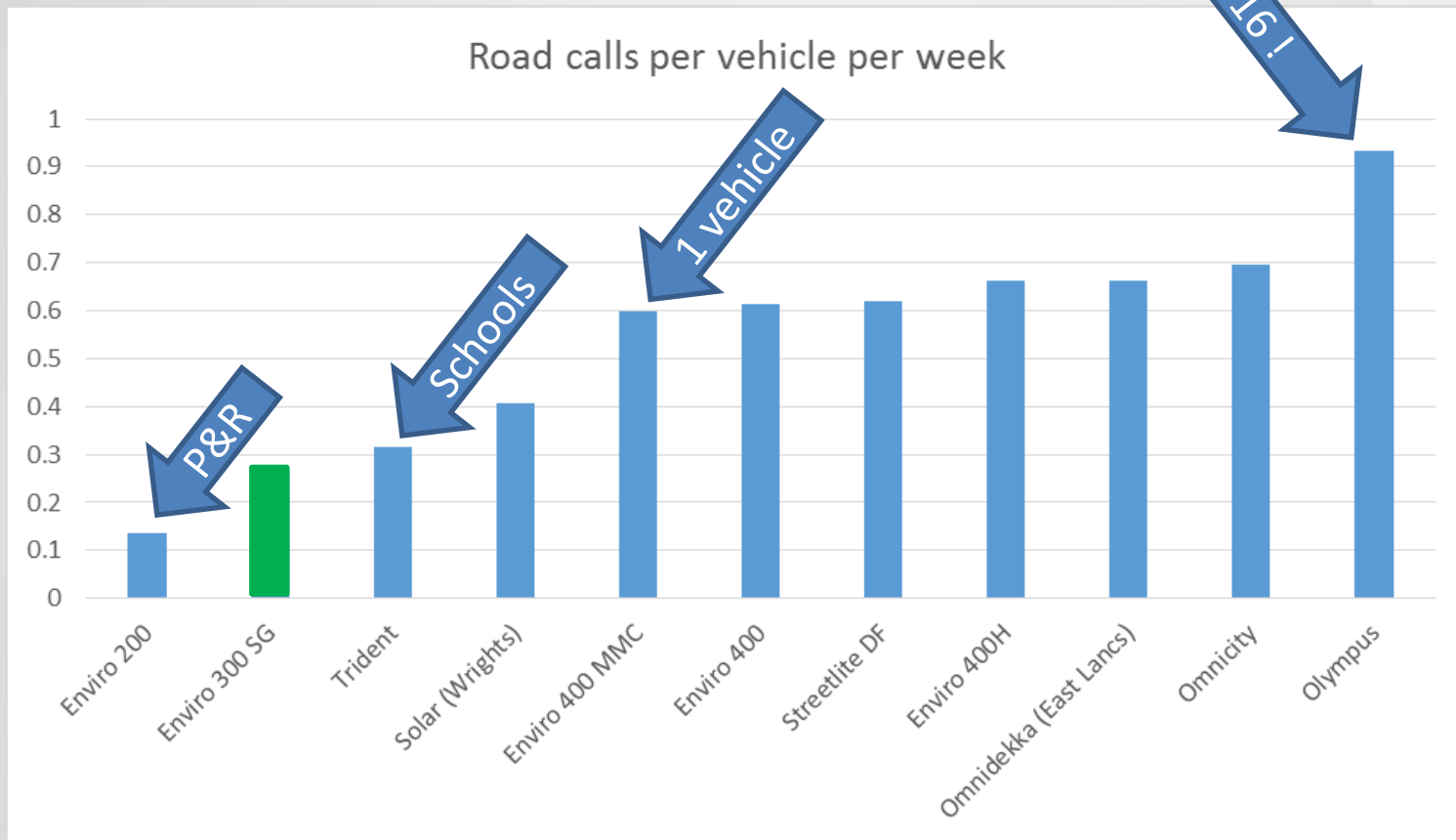
Readingbuses

Operating costs

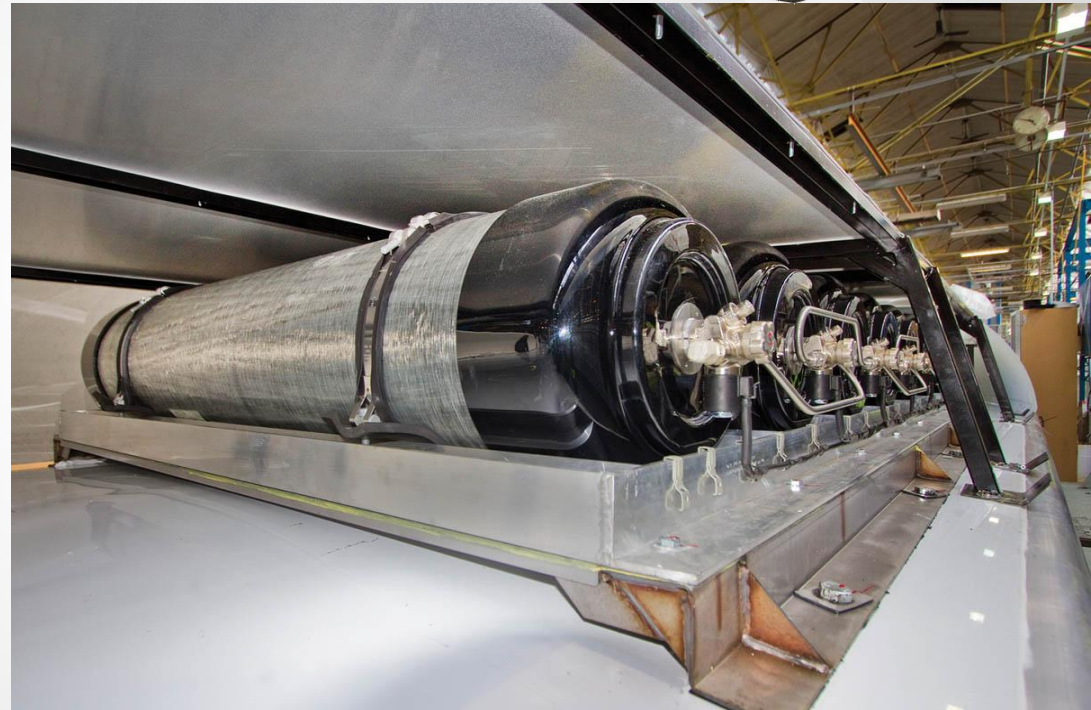
Vehicle	Pence per mile	Avg miles between breakdowns (normalised)	Servicing interval
CNG single deck	13	220	8 wks
Diesel single deck	26	144	8 wks
Diesel double deck	28 - 32	100 - 132	8 wks



Reliability

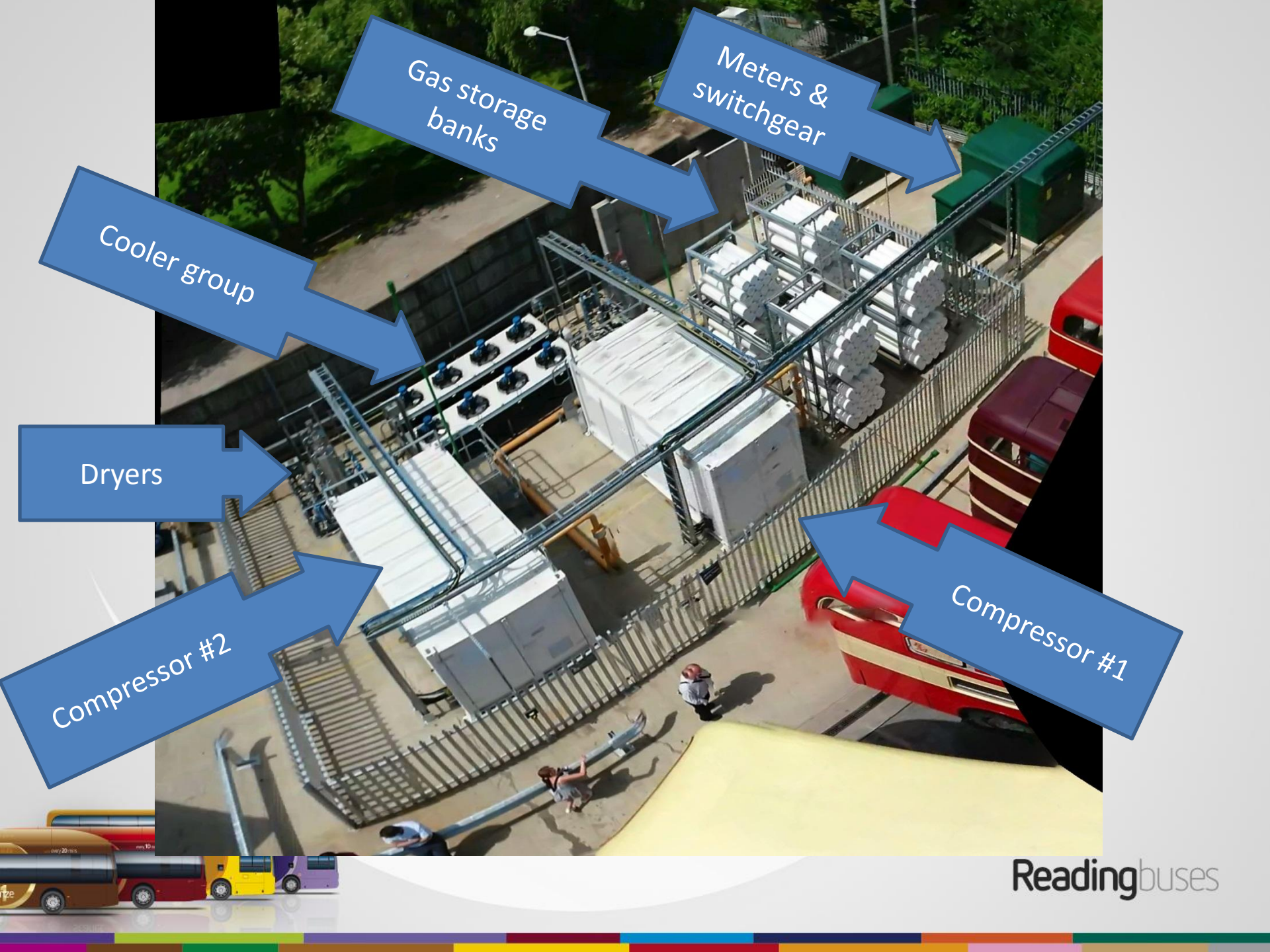


Vehicles



Facilities





Gas storage banks

Meters & switchgear

Cooler group

Dryers

Compressor #2

Compressor #1

Fuel



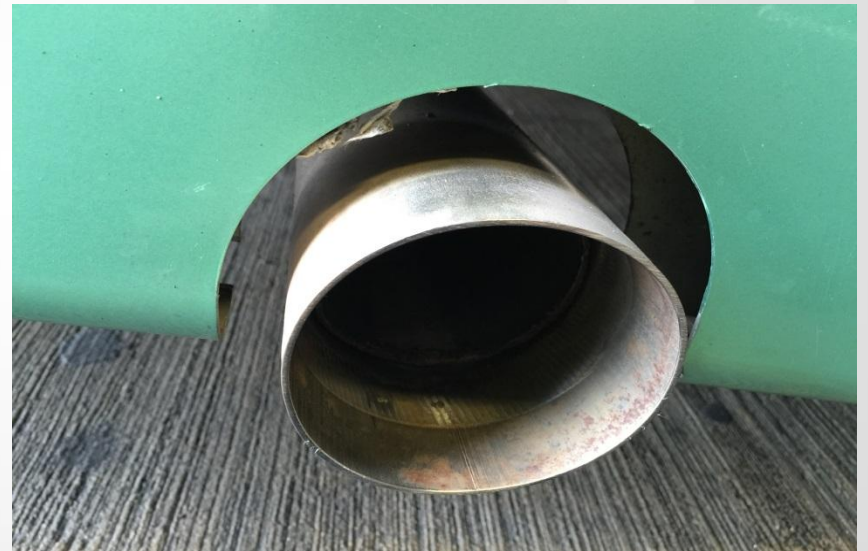
Complexity



Complexity



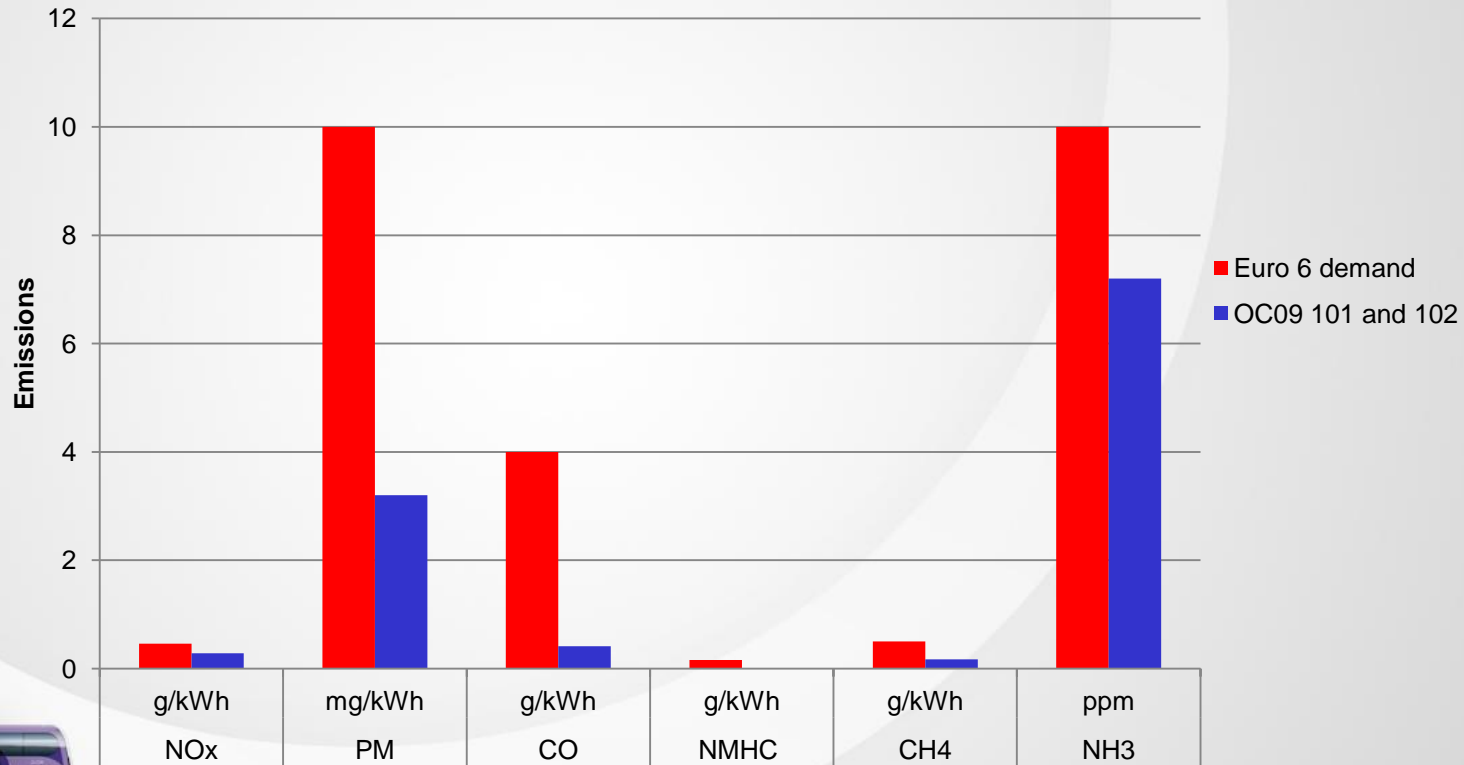
Maintenance



Air quality

Emissions OC9 101/102; Euro 6 gas 280hp and 340hp

Emissions	NO _x	PM	CO	NMHC	CH ₄	NH ₃
	<i>g/kWh</i>	<i>mg/kWh</i>	<i>g/kWh</i>	<i>g/kWh</i>	<i>g/kWh</i>	<i>ppm</i>
Euro 6 demand	0,46	10	4	0,16	0,5	10
OC9 101 and 102	0,28	3,2	0,41	0,01	0,17	7,2
% of limit	61	32	10	6	34	72





BusHound - 80.7mph

19th May 2015, Millbrook
#projectvroom



Readingbuses

the fastest bus in the world how we did it

80.78 MPH
TOP SPEED

carbon neutral bio-methane
compressed natural gas from cows,
supplied by Gas Bus Alliance

driver's safety frame
by Readingbuses
engineering team

body integrity and technical
support from Alexander Dennis

racing seat from
TEK seating
and USSC

Scania K270 gas engine
with ECU modification
and technical
support from Scania UK

live telematics and
remote monitoring
by Mix Telematics

brand new, fully x-rayed, XZE2
tyres and technical support
supplied by Michelin

test & record setting venue
Millbrook Proving Ground

cow print livery
by Best Impressions
fitted by Numbercraft

risk consultancy and
independent timing from
Malcolm Pittwood and
the UK Timing Association

promotion and professional
development from IMechE,
CILT and RouteONE



Readingbuses

Lots of this...



PRIDE OF READING
Nominate the town's
unsung heroes >

getreading

READING K1
Latest ev
Children

Most read What's on - News - Reading FC Rugby History Business Traffic & Travel In Your...

Bus & Coach Buyer

Latest News Election outcome

routeone

HybriDrive Series System
The route to ZEV www.hybridrive.com

Username or Email Password Login Forgot? Not R

859 Shares

Enter your e-mail for our

Bus Hound Reading

Posted by David Cole on Mon 20th April 2015 - 16:17PM 10 Comments



Raising the profile of gas buses

After choosing them for the Greenwave network in 2013, Reading Buses has a successful fleet of 34 biomethane gas powered Scania buses with ADL Enviro

In 2014 the company added a state of the art gas filling station to its depot, being progressed to grow the fleet with the UK's first biomethane gas dual Euro6 standard. The biomethane gas is produced remotely from farm waste into the national gas grid, the whole process being essentially carbon neutral

Despite this successful reference project, the profile of gas power for buses, exceptions, remains low across the UK. Reading Buses and its partners have

News

Please note: no cows were harmed in this world record attempt

A Scania single-decker operated by Reading Buses of Berkshire is set to lay claim this month to one of the most driving around the Millbrook track the driver will even issue a "high-speed ticket", though there will be no passengers on the 34 Alexander Dennis-bodied Scania in the Reading Buses fleet running on biomethane compressed natural gas (CNG) (named in British) (aiming for plus land-year) has strands to and Bickerton serious

the concept of cow poo power may sound novel, it is growing in popularity each day. For me this project is about challenging the perceptions of bus travel, demonstrating the credibility of bio-methane and promoting science, technology and innovation in our industry." The gas used to power the Reading bus is described as "nearly carbon-neutral". The fuel is supplied by Gas Alliance Group and comes from an anaerobic digester fed with vegetable and animal waste

HOME INDUSTRY NEWS JOBS VEHICLES PEOPLE LEGAL

BusHound aims to set world record for a gas bus

BY MEL HOLLEY ON APRIL 22, 2015 TECHNOLOGY



BusHound aims to set world record for a gas bus

BY MEL HOLLEY ON APRIL 22, 2015 TECHNOLOGY

Reading Buses has laid down a marker as it revealed its aim to set a world speed record for a 'standard' gas-powered single-decker bus.

Launching the project at Brooklands Museum, Surrey – home of the famous banked circuit used for motor-racing in the 1930 – the municipal operator is not only aiming to enter the record books, but also significantly raise the profile of bio-gas as a sustainable fuel.

As a result, the project – dubbed BusHound, in homage to the British Bloodhound project which aims to push the 763mph land speed record to 1,000mph next year – has the backing of 14 sponsors: Scania, Michelin, USSC, Ticketer, Millbrook, ZF, Mix Telematics, Nimbus, Gas Alliance Group, Alexander Dennis, TEK Seating, Brooklands Museum, routeone magazine and the Institution of Mechanical Engineers. Also, during the attempt, the driver will



to spread about the if bio-gas as nable truck fuel and to like bus ore e to the especially nger public. ling Buses first UK r to order eam crea Scania in Vehicle 31," says the il has proven reliable and ion. While (hence the delicate "cow poo" reference). John Bickerton dismisses any suggestion that an attempt on a land-speed record of any kind is hardly the sort of activity in which a responsible bus fleet engineer ought to be engaged. He spells out the BusHound project's clear objectives: "to take a vehicle to Millbrook and return safely; promote Reading Buses as a fast, safe and carbon-neutral operator, and an employer of choice; promote our sponsors and particularly gas as a fuel; bring together the Reading team to show ourselves and others that we can lead the industry; and achieve a speed record." □

Capturing the imagination



CNG helps us go green!

- Can be carbon neutral, lower cost-per-mile, simpler vehicles
- Tailpipe emissions on par with range-extended hybrids
- Reliable in operation - better than diesel
- Real alternative to electric vehicles, today
- Needs on-site equipment (amortised capital)
- More to come! Double deck OLEV bid submitted Oct 2015.



Reading buses



FA57 BUS

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Questions?