The Road to Electrification of Logistics

Results of the IA-HEV Task 27 "Electrification of transport logistic vehicles"
4th Workshop held in Coventry on April 26th, 2017

suggested citation format:

Kleiner, F. and Beermann, M. (Editors), 2017. The Road to Electrification of Logistics. Results of the IA-HEV Task 27 "Electrification of transport logistic vehicles" 4th Workshop held in Coventry on April 26th, 2017

www.ieahev.org

IA-HEV Task 27 eLogV

Electrification of transport logistic vehicles

4th Workshop: The Road to Electrification of Logistics
Time: 09:00– 15:00 GMT, April 26th, 2017
Location: Centre for Mobility and Transport Research
EC1-29 Engineering and Computing Building
Coventry University, Priory Street, Coventry, UK, CV1 5FB

Dear ladies and gentlemen,

The task 27 partners cordially invite you to the workshop *"Experiences and prospects of electric freight vehicles in the UK"* on April 26th, 2017 at the Centre for Mobility and Transport Research of the Coventry University in Coventry.

The Workshop is organized by the Task 27 *"Electrification of transport logistic vehicles"* of the Hybrid and Electric Vehicle Technology Collaboration Program (HEV TCP) within the framework of the International Energy Agency (IEA) (www.ieahev.org/tasks/e-logistics-task-27). Its aim is to summarize and communicate on a global level

- the status and prospects of transport logistic vehicle electrification
- early markets and hurdles of commercialization and
- policy recommendations for deployment and pre-competitive research

for road freight transport vehicles operating in city, urban or regional logistic applications.

Dedicated topics of the Workshop in the United Kingdom are:

- regional stakeholder approach to electrification of transport logistics
- planned and ongoing pilots supporting electrification of transport logistics
- overcoming the technical challenges to electrification of transport logistics

The workshop is targeted at policy makers and stakeholders from entrepreneurs in the transport and logistic sector, vehicle manufacturers, technology suppliers and research around the globe. Participation is free of charge.

The workshop is organized by the Coventry University. **Please register for the workshop by sending your company name and contact details via email to** Dr Huw Davies (ac2616@coventry.ac.uk, +44 2477 659137) **until 19th April 2017**. The number of participants is limited to 30 persons.

Yours faithfully,

Florian Kleiner	Martin Beermann
German Aerospace Center (DLR)	JOANNEUM RESEARCH
Institute of Vehicle Concepts	LIFE – Centre for Climate, Energy and Society
Germany	Austria
Operating Agent	Co-Operating Agent

IA-HEV Task 27 eLogV

Electrification of transport logistic vehicles

IA-HEV Task Force 27

Electrification of transport logistic vehicles

4th Workshop: "The Road to EV Logistics"

April 26th, 2017

Centre for Mobility and Transport Research

Room EC1-21 Faculty of Engineering and Computing

Coventry University, Priory Street, Coventry, UK, CV1 5FB

09:00	**Registration / Start of Workshop**
09:30 - 10:00	Welcome *Professor Andrew Parkes, Centre for Mobility and Transport, Covenrty University*
	Task 27 introduction and previous results *Florian Kleiner, DLR / Martin Beermann, Joanneum Research*
10:00 - 11:00	**Session 1: Regional stakeholder approach to electrification of transport logistics**
	Facts and figures of the United Kingdom *Dr Bob Moran, Deputy Head Office for Low Emission Vehicles*
	EV logistics promotion - case studies from the UK and EU *Tim Anderson, Senior Transport Advice Manager, Energy Saving Trust*
11:00 - 11:30	*Coffee break*
11:30 - 12:30	**Session 2: Planned and ongoing pilots supporting electrification of transport logistics**
	Experience from London in running electric vehicle logistic pilots projects *Tanja Dalle-Muenchmeyer, FREVUE Co-ordinator*
	Electrification of heavy goods vehicles *Harm Weken, FIER Automotive NL*
	Experiences from running Electric Range Extended Vehicles *David Thackray, TEVVA Motors Ltd*
12:30 - 13:45	*Networking Lunch*
13:45 - 14:45	**Session 3: Overcoming the technical challenges to electrification of transport logistics**
	Microcab - Light Electric Fuel Cell Vehicles for Logistics *Professor John Jostins, Centre for Mobility and Transport, Coventry University*
	Technology developments and experiences in the UK *Jonathan Murray, Low Carbon Vehicle Partnership*
14:45 - 15:00	Closure of the day
15:00	**End of Workshop followed by tour of MicroCab**
	Please register interest for MicroCab visit (the MicroCab van will be on display outside EEC building during the day)

For information on MicroCab www.microcab.co.uk

IA-HEV Task 27 eLogV

Electrification of transport logistic vehicles

Participating Nations and Organizations:

DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center	Institute of Vehicle Concepts
JOANNEUM RESEARCH LIFE	LIFE - Centre for Climate, Energy and Society
Office for Low Emission Vehicles	Office for Low Emission Vehicles
Sabancı Universitesi	Sabanci University
울산대학교 UNIVERSITY OF ULSAN	University of Ulsan
rai Rijwiel en Automobiel Industrie	Platform of sustainable transport
Coventry University	Conventry University

IEA Task 27 in the HEV IA is supported by the German Federal Ministry for Economic Affairs and Energy (BMWi), by the Austrian Ministry of Transport, Innovation and Technology (bmvit) and by the Netherlands Enterprise Agency (RVO.nl).

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

bmvit
Austrian Ministry for Transport, Innovation and Technology

Netherlands Enterprise Agency

IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

IA-HEV

Electrification of Transport Logistic Vehicles

presenting author:
Florian Kleiner

Florian Kleiner, Martin Beermann, Bülent Çatay,
Eric Beers, Huw Davies, Ock Taeck Lim

DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center
JOANNEUM RESEARCH LIFE
Sabancı Universitesı
Office for Low Emission Vehicles
Coventry University
rai vereniging Rijwiel en Automobiel Industrie
울산대학교 UNIVERSITY OF ULSAN

www.ieahev.org

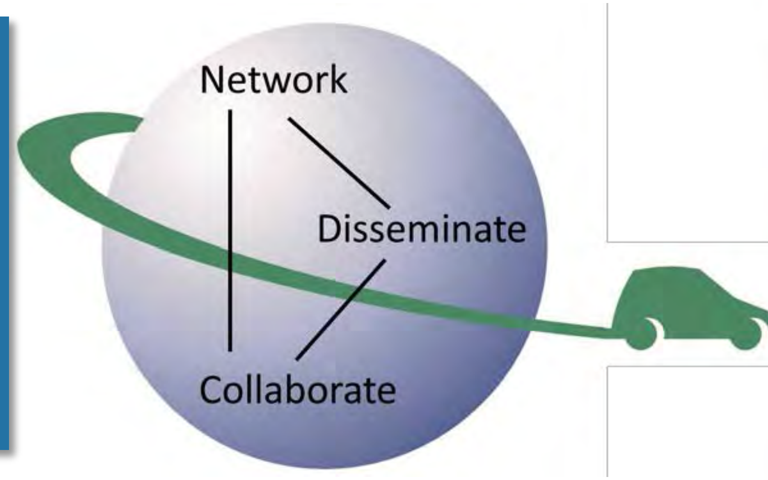
International Energy Agency
Hybrid & Electric Vehicle Technology Collaboration Programme

HEV TCP Mission

- Supply objective information to support decision making
- Facilitate international collaboration in pre-competitive research and demonstration projects
- Foster international exchange of information and experiences

Target audience

- Governmental bodies at national, regional and city levels
- Automotive industry
- Component suppliers
- Utilities



IEA INTERNATIONAL ENERGY AGENCY
HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

Why Task 27 “Electrification of Transport Logistic Vehicles”?

- transport sector heavily depends on fossil fuel
- freight transport activity is predicted to grow
- reduction in GHG emissions is required
- expect changes of the regulation framework

→ the electrification of transport logistic vehicles is essential

lack of information about the status of existing electrified logistic vehicles and possible fields of applications

Task 27 “Electrification of Transport Logistic Vehicles” Objectives & Working Method

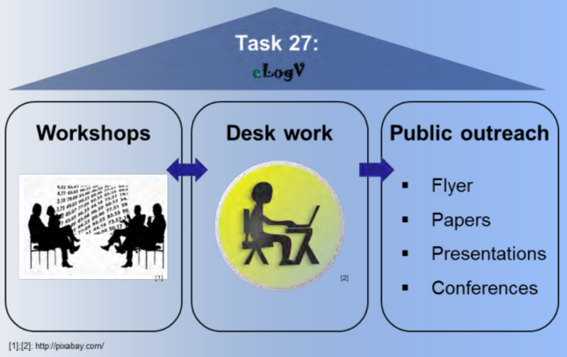
Objectives

(1) summarize the status of vehicle and infrastructure technologies, implementation and hurdles

(2) identify early niche markets and commercialization opportunities

(3) provide policy recommendations for further research and deployment activities

Working Method



Objectives are addressed in three ways:

- workshops: to involve stakeholders and collect information
- desk work: to establish the scientific foundations, input for workshops and papers
- public outreach: to raise awareness in the broader community

IEA INTERNATIONAL ENERGY AGENCY HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

Task 27 Data Basis

Vehicle Database
(includes about 120 electrified transport logistic vehicles: BEV, PHEV, FCEV / N_1, N_2, N_3)

General data:	market, producer, name of vehicle, powertrain technology, type of powertrain, functionality, production status, vehicle category, year, source
Technical data:	engine power, battery type, battery capacity, gross vehicle weight, payload, driving range, top speed

Project Profiles
(info collection of pilot projects)

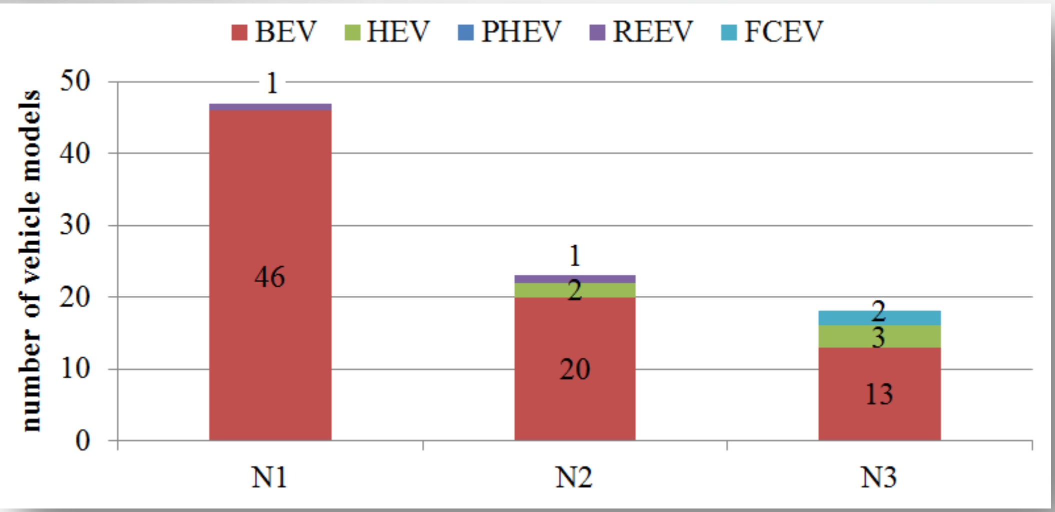
- Short description
- Stakeholder involved
- Actors involved
- Focus areas
- Contact
- Links
- Results

Series of Workshops
- Stuttgart 19.03.2015 ✓
- Amsterdam 12.04.2016 ✓
- Vienna 19.10.2016 ✓
- Coventry 26.04.2017

<u>Topics:</u>
- Electric transport logistic vehicle technology and its application
- Experiences and prospects of electric freight vehicles
- Electric freight vehicles - out of niche into mass market
- The Road to Electrification of Logistics

→ Exchange of experiences with city administrations, battery and fuel cell producers, early adopters, research institutions

Number of Vehicle Models Potentially Available on the Market



either e-converted or close to series production vehicles, no prototypes or technology demonstrator

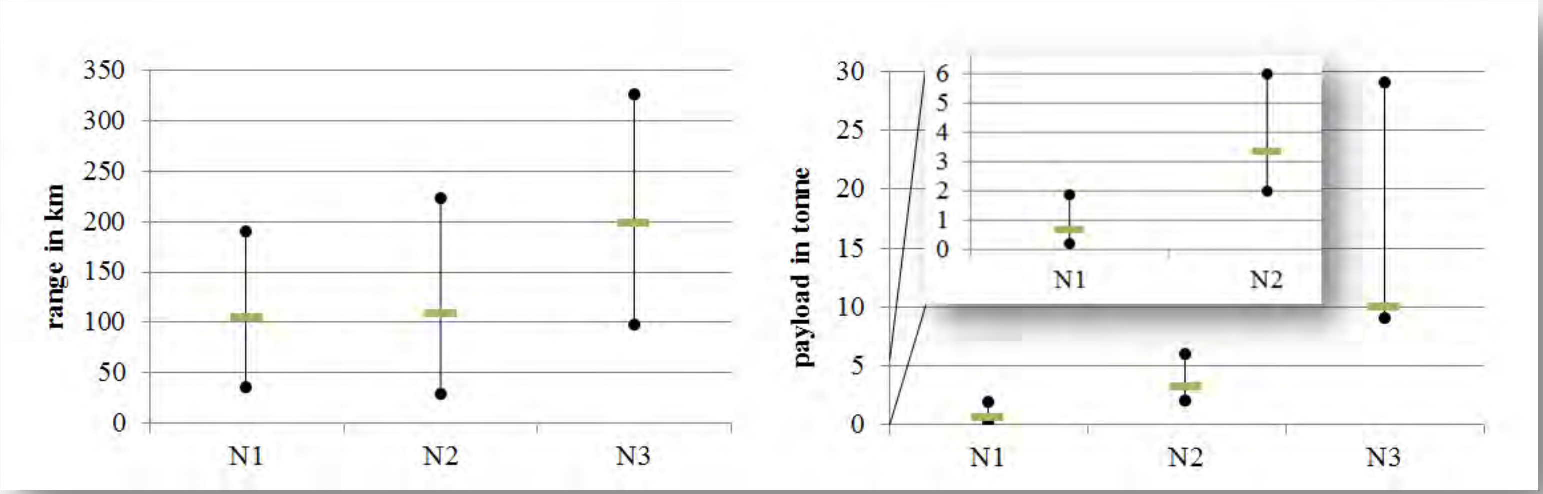
category N according to the European classification scheme:

- N_1: ≤ 3.5t GVW
- N_2: > 3.5t – 12t GVW
- N_3: >12t GVW

- 88 electrified transport logistic vehicles models; >50% in the N_1 vehicle category
- Battery electric vehicles clearly dominate across all vehicle categories
- Not surprisingly, the share of BEV is higher, the smaller the vehicle and battery
- A surprise is the high share of BEV in N_3-class
- Only a few vehicles from OEMs
- The database will be available for download in May 2017
  http://www.ieahev.org/tasks/e-logistics-task-27/

IEA INTERNATIONAL ENERGY AGENCY HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

Performance and Limits of Electrified Transport Logistic Vehicles



- category N_1: on average 106 km range and 700 kg payload
- category N_2: on average 110 km range and 3,400 kg payload
- category N_3: on average 200 km range and 10,100 kg payload

→ current performance limits operation

IEA INTERNATIONAL ENERGY AGENCY HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

based on manufacturer's data; in terms of range total number of vehicles considered is 46 for N_1, 16 for N_2 and 7 for N_3. in terms of payload total number of vehicles considered is 40 for N_1, 14 for N_2 and 7 for N_3

Experiences from Different Countries

- Urban logistic applications are generally seen as early niche markets from the operations point of view
- Vehicle performance varies between specific vehicle types and depends on a number of factors related to operational conditions, technology, infrastructure and cost
- Operability and the business case highly depend on country specific conditions and case of application
- Business cases are hardly provided
- Most experience has been made with battery electric vehicles related to vehicle category N_1 used for parcel and post deliveries → vehicles are well suited and competitiveness is almost given
- More experience is needed in order to identify suitable applications in urban goods distribution for N_2 and N_3 category vehicles

IEA INTERNATIONAL ENERGY AGENCY HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

WS held in Stuttgart (2015-03-19)
“Electric Transport Logistic Vehicle Technology and its Application”

- Contributions on the topics: R&D for Electrified Transport Logistic Vehicles, Possible Fields of Application for Electrified Transport Logistic Vehicles, World Café Discussion about Hurdles of Implementation

Messages (extractions):

- *Automated production for battery systems is achieved* for the capacity of 20 MWh (ca. 200 buses), which can be upscaled
- Automated production for high volume *fuel cell system* manufacturing with an *expected cost reduction of 50% ($/kW)*; offered warranty with a *15,000 operating hours* (>10 years)
- About half of all outages are due to *difficulties with the electric powertrain*
- Economic efficiency is the key to success! → *Electric trucks* are still *NOT profitable*
- The *number of trips that could be electrically operated* with vehicles which are already available is *much higher than estimated*
- There is a need to *transfer the information from desktop to the “real life”*
- *Clear targets and standardised EU wide “zero emission” areas*
- *EV center for all questions and education*
- …

WS held in Amsterdam (2016-04-12)
"Experiences and prospects of electric freight vehicles"

- Contributions on the topics: Best Practice Experiences of Pioneer Cities, Experiences from Early Adopters of Electric Freight Vehicles, Infrastructure for Charging

Messages (extractions):

- It is essential to give *perspective for action*. Put a dot on the horizon for e.g. environmental and congestion zones
- Initial cost stays high, not enough advantages of privileges to close the financial gap → *Reward frontrunners* e.g. subsidies, parking and loading spaces, time windows for loading-unloading zones, etc. and *build platforms for sharing knowledge*
- Everyone wants you to transport electrically, until you really try…road legislation stays hopelessly behind → *Supportive government policy* is *still of high importance* for the wider uptake of EFVs
- Strong appeal to *develop an integral European vision* on electrical distribution
- A better way to support the mass adoption of the alternatively fueled technology is *to give them a long-term competitive advantage*
- *Adjust driver license B* to a maximum gross vehicle weight of 4,5 tones
- *European cities have to team up* (learn from each other, mass potential in EV demand)
- …

WS held in Vienna (2016-10-19)
"Electric freight vehicles - out of niche into mass market"

- Contributions on the topics: Electric Freight Vehicles as Pillar of Sustainable Logistics, Governmental Perspectives and Implementation Plans for Electric Freight Vehicles, Experiences from Early Adopters of Electric Freight Vehicles

Messages (extractions):

- *Many existing strategies, projects and initiatives which are still not sufficient to reach targets set*
- In order to reach essentially CO_2-free city logistics in major urban centers by 2030 (White Paper) *fleet exchange has to start at 2020 latest* (average exchange of vehicle after 8-10 years)
- *New forms of cooperation is needed* e.g. cross-company, cross-sectoral, multi-institutional
- *After-Sales-Service is not an issue* for e-converter, if you are *prepared in a way, that a local dealer takes on the responsibility*
- The costs of urban city hubs are still too high. Since the utilization of city hubs is limited to only 1-2 hours per day, *"shared hub"-approaches appear to be more useful*
- *Routing according payload is important → deliver heavy goods first*
- *New technology has to be combined with an advanced business model* (fleet integration advisory, on-demand availability/ provision of EV, integrated service & maintenance, training/info material)
- *Allow drivers with class B license to drive E-Vans up to 4.25t GVW*
- …

HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

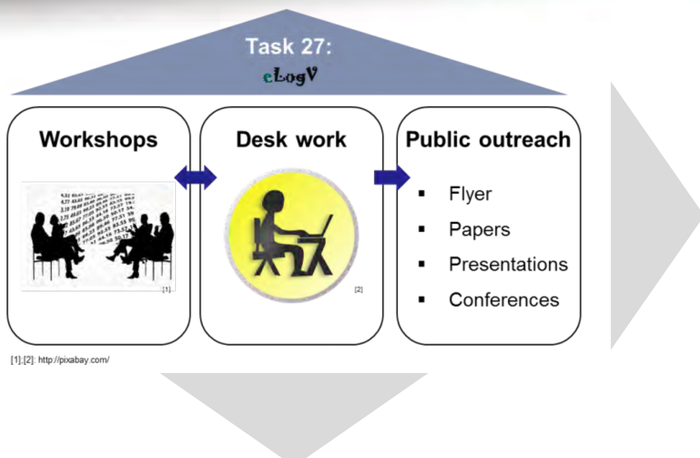
WS held in Coventry (2017-04-26)
"The Road to Electrification of Logistics"

- Contributions on the topics: Regional Stakeholder Approach to Electrification of Transport Logistics, Planned and Ongoing Pilots Supporting Electrification of Transport Logistics, Overcoming the Technical Challenges to Electrification of Transport Logistics

Messages (extractions):

- …

Task 27 Outputs
http://www.ieahev.org/tasks/e-logistics-task-27/



1) **Workshop held in Stuttgart (2015-03-19):**
   "Electric Transport Logistic Vehicle Technology and its Application"
2) **Workshop held in Amsterdam (2016-04-12):**
   "Experiences and prospects of electric freight vehicles"
3) **Workshop held in Vienna (2016-10-19):**
   "Electric freight vehicles - out of niche into mass market"
4) **Workshop held in Coventry (2017-04-26):**
   "The Road to Electrification of Logistics"

Presentations:

1) Electrification of transport logistic vehicles: Techno-economic assessment of battery and fuel cell electric transporter
   EVS28, Korea, May 3-6, 2015
2) Status and trends for electrified transport logistic vehicles
   EEVC, Belgium, 2nd - 4th December 2015
3) International experiences within the IEA HEV Task 27
   „Electrification of transport logistic vehicles"
   EL-MOTION2016, Vienna, 27- 28.01.2016
4) Current status of the electrification of transport logistic vehicles
   EEVC, Geneva, 14th – 16th March 2017

Papers:

1) Electrification of transport logistic vehicles: A techno-economic assessment of battery and fuel cell electric transporter
   EVS28, Korea, May 3-6, 2015
2) Status and trends for electrified transport logistic vehicles
   EEVC, Belgium, 2nd - 4th December 2015
3) Current status of the electrification of transport logistic vehicles - Early niche markets and commercialization opportunities
   EEVC, Geneva, 14th – 16th March 2017

- **Vehicle database:** Key facts of electric commercial vehicles available on the market or presented as prototypes. About 120 vehicles are listed.
- **Project profiles:** Key facts of ongoing or terminated demonstration projects from the partner countries. About 30 project profiles.

Thank you for your Attention

Florian Kleiner
German Aerospace Center
Institute of Vehicle Concepts
Research Group
„Vehicle Systems and Technology Assessment“
Pfaffenwaldring 38-40, 70569 Stuttgart
Tel: +49 (0) 711 6862 8120
florian.kleiner@dlr.de

Tim Anderson

Energy Saving Trust

I-CVUE

INCENTIVES FOR CLEANER VEHICLES IN URBAN EUROPE

Co-funded by the Intelligent Energy Europe Programme of the European Union.

Overview of I-CVUE

Aim:

I-CVUE aimed to reduce CO_2 emissions in urban environments by increasing the number of electric vehicles in large fleets in urban areas

April 2014 - March 2017

Funded by the Intelligent Energy Europe

Co-funded by the Intelligent Energy Europe Programme of the European Union.

I-CVUE

Overview of I-CVUE

Project partners:

10 partner organisations from across Europe, including: UK, The Netherlands, Germany, Norway, Austria, Spain and Belgium

Advisory Board members:

Fleet World	Alex Grant
Lease Europe	Richard Knubben
Leaseplan	Ronald de Haan
RWS	Peter Wilbers
Barcelona LIVE	Angel Lopez

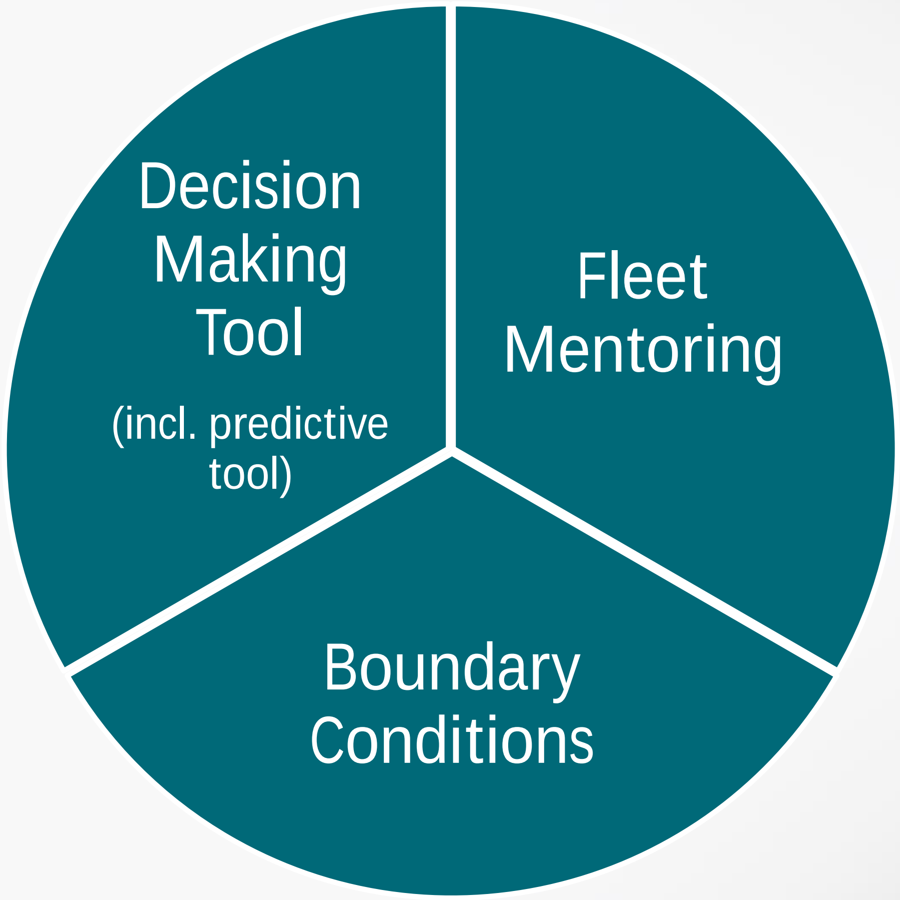
Co-funded by the Intelligent Energy Europe Programme of the European Union.

Main objectives

- Identify business cases for fleets, looking at:
  - whole life cost analysis
  - emission data
  - information on the expected commercial benefit

- Regional authority support framework to set up incentive programs:
  - according to the specific socio-economic conditions of the city, region or country

- Decision Making Tool:
  - for policymakers and fleet operators to evaluate the effectiveness of various incentives

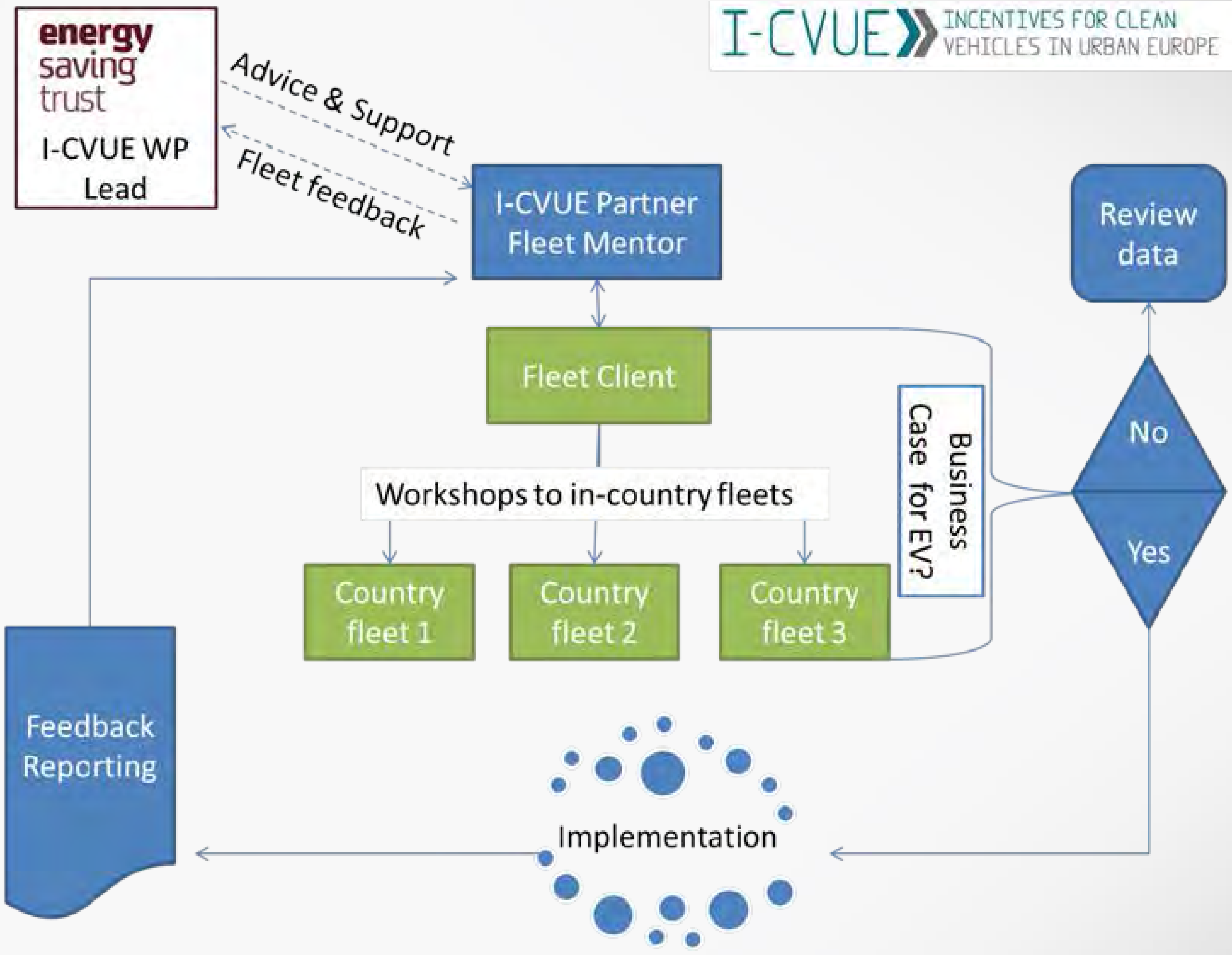


Co-funded by the Intelligent Energy Europe Programme of the European Union.

Mentoring model

5 mentoring partners:

- EST - UK
- RACC - Spain
- FIER – The Netherlands
- AEA – Austria
- IRU – Belgium



The business case

01 Identify the vehicle opportunity

- Vehicle profiles / duty cycles that appear to work
- Vehicles where there is an appropriate alternative

02 Understand the costs & benefits

- Carry out whole life cost analysis vs ICE
- Factor in grants and tax benefits

03 Operational considerations

- How and where to re-charge
- Duty cycle and route optimisation

04 Driver acceptance

- Ensure drivers are educated, informed and enthusiastic!
- Consider specific efficient driver training to improve range

Case studies - **Rijkswaterstaat (RWS)**

- Large fleet mixed van and car fleet.
- After analysis was done, results showed:
  - 30% of fossil fuel powered fleet could be replaced with EVs.
  - the EVs already in the fleet could also be used to a higher potential
  - users were ‘nervous’ of the new technology
- End result:
  - 400 vehicles will be replaced in 2017, of these 25% will be EVs
  - Exploring new ways of providing guidance and training

I-CVUE played a key role in this decision making process

Co-funded by the Intelligent Energy Europe Programme of the European Union.

I-CVUE

Case studies - **Transports Metropolitans de Barcelona (TMB)**

Extremely positive feedback to the mentoring service

- Increased the fleet managers awareness of EVs
- The recommendations given will feed into the future business plan for the fleet

Number of EVs prior to the I-CVUE support	**0**
Number of EVs since to the I-CVUE support	15
Estimated number of EVs/PHEVs by end of 2017	15 additional purchase will take place in 2018
Estimated number of EVs/PHEVs by end of 2020	25

Co-funded by the Intelligent Energy Europe Programme of the European Union.

Case studies - **Manchester Metropolitan University**

Strongly agreed that the mentoring support they received will lead to an increased introduction of Electric Vehicles to the fleet

Number of EVs prior to the I-CVUE support	**0**
Number of EVs since to the I-CVUE support	12
Estimated number of EVs/PHEVs by end of 2017	16
Estimated number of EVs/PHEVs by end of 2020	20

Co-funded by the Intelligent Energy Europe Programme of the European Union.

Achievements

- **50 fleets** have been mentored
- Supported a **wide range of organisations**: public, private, governmental, taxis
- **Increased awareness** of EV use in European cities
- I-CVUE has positively contributed in the decision to purchase **916 new EVs** (final evaluation still being collected)
- Fleet mentoring **business model** developed and refined
- New stakeholder **network** with partners and advisory board

Co-funded by the Intelligent Energy Europe Programme of the European Union.

Conclusions

- Demand is increasing
- There are large opportunities to support fleets
- EV adoption is linked closely to a number of factors including:
    - Total Cost of Ownership
    - Incentives
- Need for variety of EV model – to meet fleet needs – new product arriving all the time
- Driver training is important to ensure a positive experience

Co-funded by the Intelligent Energy Europe Programme of the European Union.

I-CVUE

Lessons learnt and going forward

Lessons learnt

- Circumstances change – governments, policies, costs
- Change within organisations can be slow
- Seek senior buy-in from within the fleet early on
- Take a flexible approach to mentoring

After the lifetime of the project:

- Continue mentoring fleets – partners and wider
- Capacity Building Workshop – exploring wider opportunities
- Mentored fleets to become champions for EVs

Is any ongoing support available?

Fleet support is available in England and Scotland

- DfT and Transport Scotland funded
- Full review of current fleet and opportunities for EVs
- TCO analysis of EVs v ICE vehicles
- Support accessing grants and incentives

- Contact EST for more information.
- www.est.org.uk

energy saving trust

Co-funded by the Intelligent Energy Europe Programme of the European Union.

I-CVUE

Thank you for your attention

Tim Anderson
Energy Saving Trust
Tim.anderson@est.org.uk

Co-funded by the Intelligent Energy Europe Programme of the European Union.

Freight Electric Vehicles in Urban Europe

The Road to Electrification of Logistics

IA – HEV Task 27 eLogV

Coventry, 26 April 2017

Tanja Dalle-Muenchmeyer, FREVUE Co-ordinator

Co-financed by the European Commission

Objectives

Demonstrate suitability of electric freight vehicles for urban last-mile deliveries

Underpin future uptake of these vehicles

Provide evidence for policy intervention

Project to be finalised in September 2017

Consortium

City + Policy

Cross River Partnership (Co-ordinator)

City of Amsterdam

City of Lisbon

City of Madrid

City of Milan

City of Oslo

City of Rotterdam

City of Stockholm

Swedish Transport Adm.

EMEL

Transport for London

Co-ordination and Dissemination

Hyer

Polis

Research

Imperial College London

TNO (NL)

SINTEF (NO)

Logistics

ICT Partners

Vehicle Manufacturers

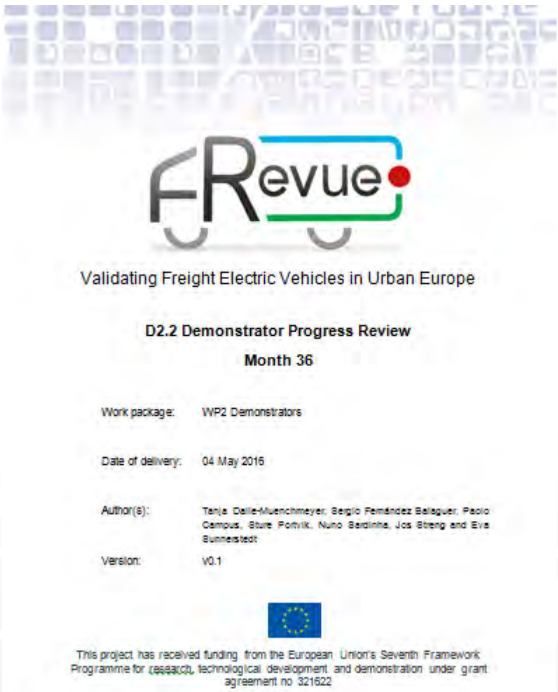
Grid Operators

FREVUE Vehicles

Freigh

Output

- Key reports
  - **Technical** suitability
  - **Economics** of EVs for city logistics
  - Transport and **environmental** impacts
  - **Social** and attitudinal impacts
  - **Policy** and governance
- Guidelines / recommendations


FRevue

Validating Freight Electric Vehicles in Urban Europe

D2.2 Demonstrator Progress Review

Month 36

Work package: WP2 Demonstrators

Date of delivery: 04 May 2016

Author(s): Tanja Dalle-Muenchmeyer, Sergio Fernández Balaguer, Paolo Campus, Sture Portvik, Nuno Sardinha, Jos Streng and Eva Sunnerstedt

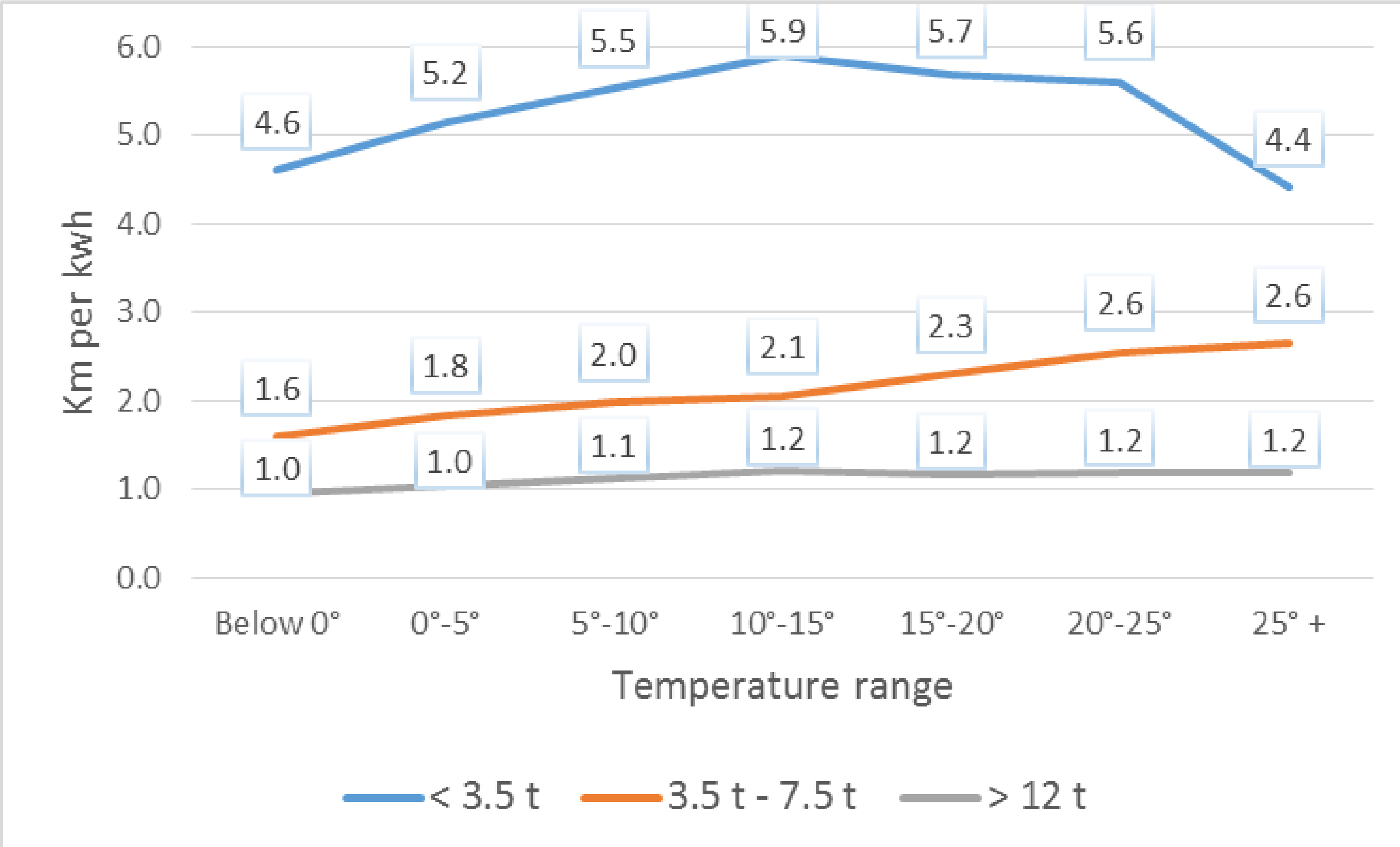
Version: v0.1

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 321622

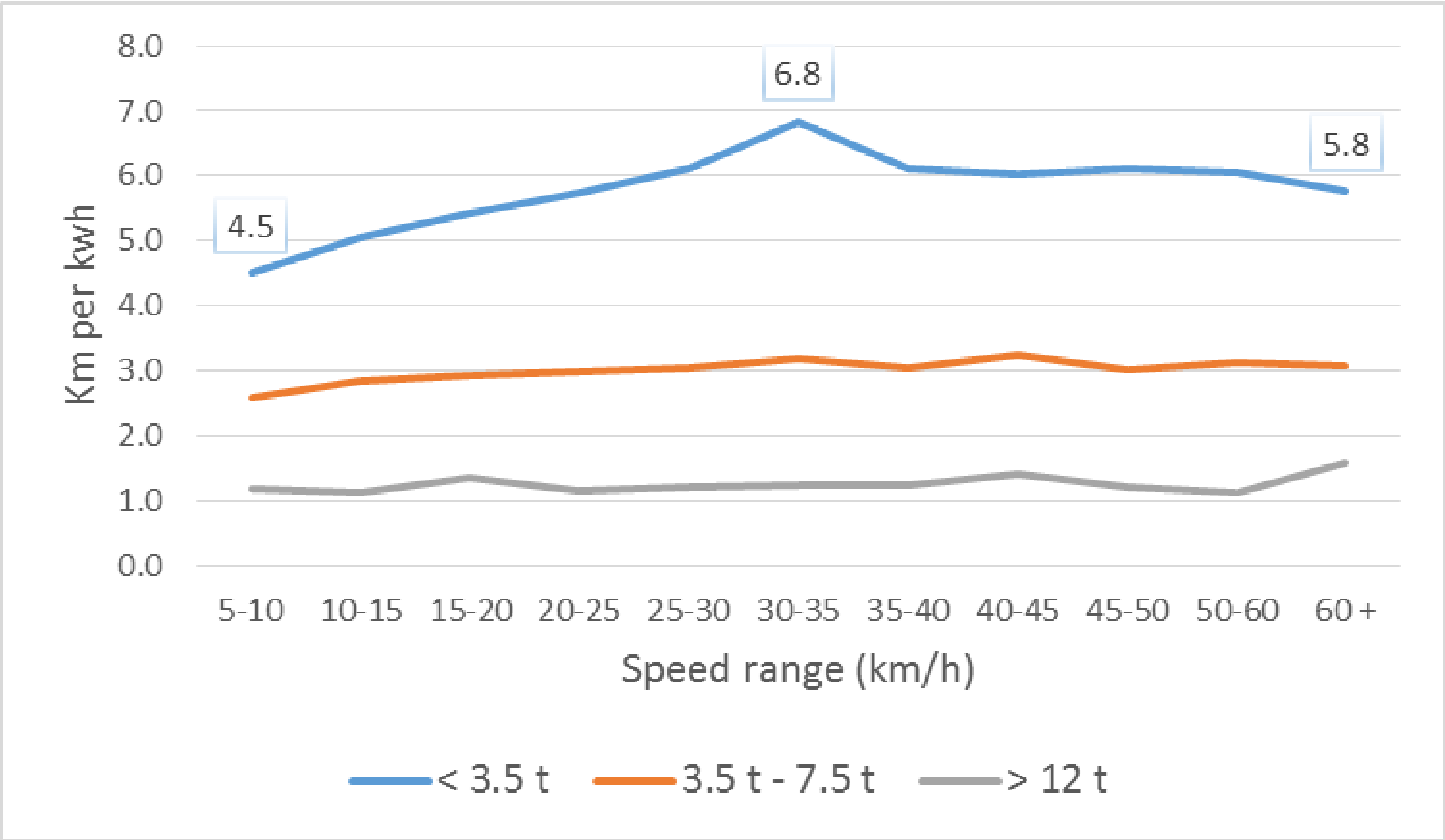
Technical suitability
Data

- Dynamic vehicle data with state-of-charge from 10 operators and 83 vehicles
- Covering 757,000 km – 19 times around the Earth at the equator
- Data collection framework developed as part of the project

Technical suitability
Km per kWh, temperature and weight group

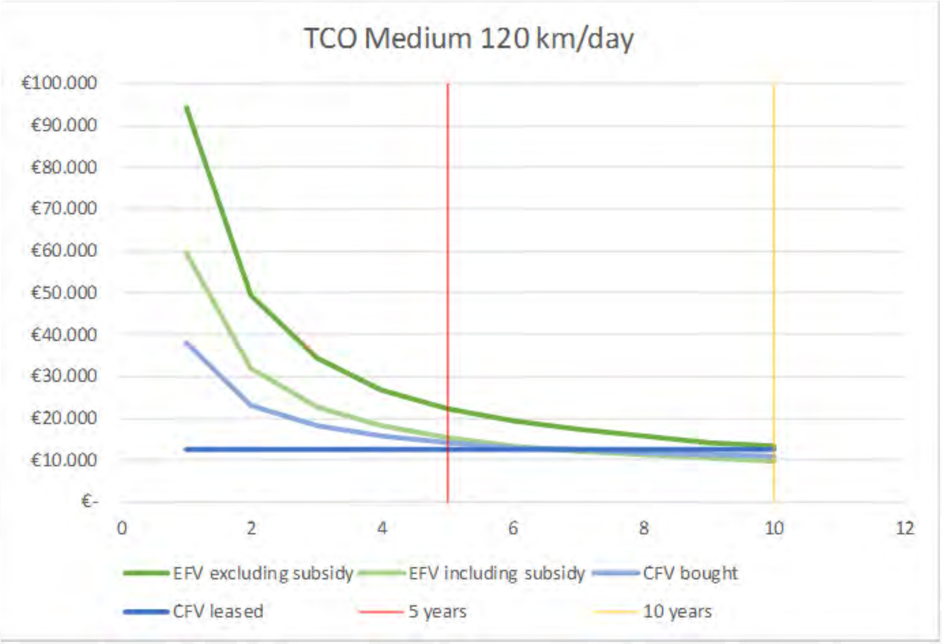


Technical suitability
Km per kWh, average speed



Economics of EVs for City Logistics

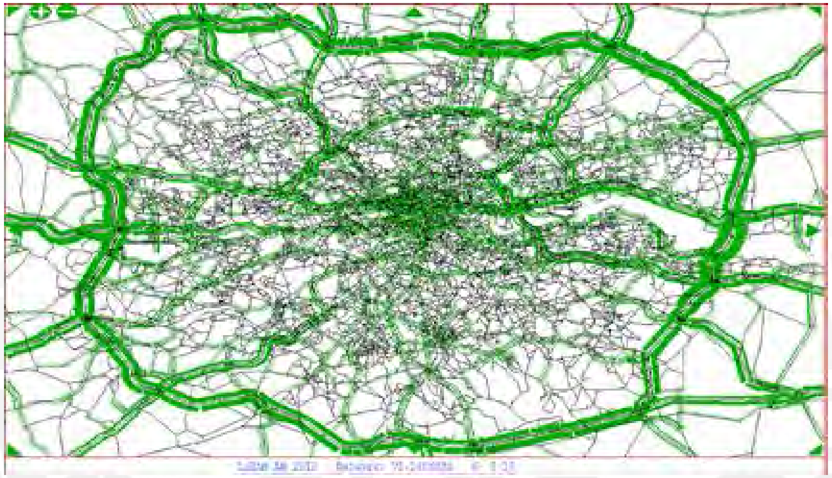
- Work in progress
- Can say that positive business case is achievable for small and medium EFVs
- For large EFVs this remains difficult



Transport and environmental impacts

- Three level analysis:

1. **Direct impacts** from FREVUE project
2. Modelling of **larger uptake**
3. Impact **monetisation**



Direct impacts - Local air pollution

- Strong benefits of NOx and PM savings
- **NOx savings** comparing between EFVs and Euro III/3 ICEVs: equivalent to total road transport NOx emissions in the City of London for three days in 2013
- **PM savings** comparing between EFVs and Euro III/3 ICEVs: equivalent to total road transport PM emissions in the City of London for two days in 2013

Direct impacts - CO_2 emissions

- Carried out both at the local level (direct GHG emissions) and the total environmental load (using Well-to-Wheel analysis)
- WTW emission reduction ranging from 10% to 99%

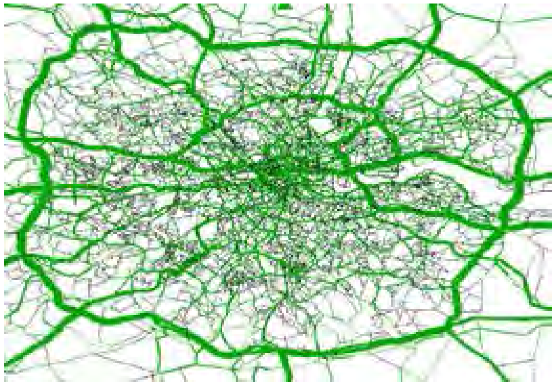
- In total, the FREVUE project has led to:
  - local GHG savings of 385 - 400 tonnes CO2e
  - total environmental GHG savings of 176 - 190 tonnes CO2e, i.e. **approx. 45%**
  - equivalent to total road transport GHG emissions in the City of London for about one day in 2013

Direct impacts - FREVUE London demonstrator

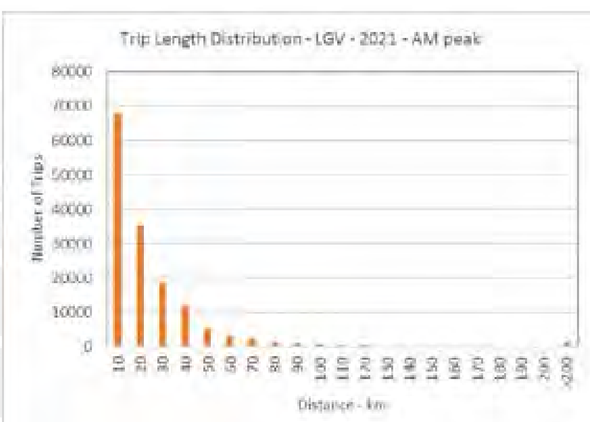
- UPS 7.5t vehicles and Clipper 10t Smith Electric
- Based on Euro IV comparator vehicles:
  - NOx reduction of 437kg
  - PM reduction of 9.4kg
  - Local GHG savings of 93 tonnes CO_2e
  - total environmental GHG savings of 32 tonnes CO2e

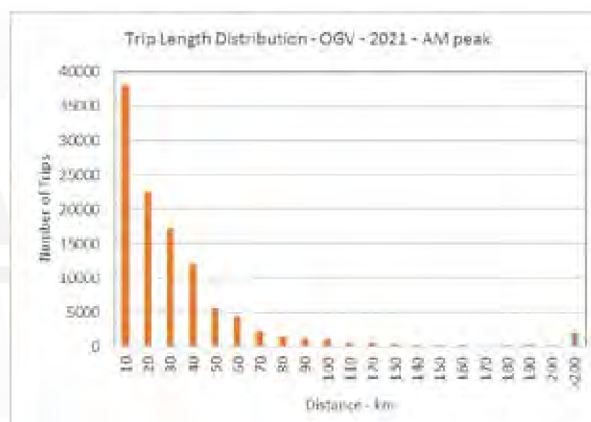
Wider uptake – forecasted LGV/HGV traffic London

Spatial distribution of freight traffic, AM peak, LGV and HGV, 2021



Trip length distribution, AM peak, LGV and HGV, 2021





Wider uptake and monetisation London

- Low penetration level (10%), 2021:
    - NOx reduction of 402Kt
    - PM reduction of 3.8t
    - Local GHG savings of 284Kt CO_2e

- Monetisation, low penetration level, 2021:
    - £881 million savings from NOx reductions
    - £13.5 million from GHG savings

Other preliminary findings

- Vehicle supply
- Local electricity supply constraints
- Maintenance and repair
- Good acceptance

Next steps

- Wider deployment
  - ‘Declaration of Intent’
  - Further funding requirements
- Final event London 21 June 2017
- Innovate UK co-funded Smart Electric Urban Logistics project

Joint Statement of Intent: Electric Urban Logistics

Declaration of intent:

As an organisation active in urban logistics we express our intent to switch to zero emission capable road transport in urban areas using (hybrid) electric trucks. Traditional urban freight transport contributes to air pollution and its associated health risks. As a responsible organisation we want to play our part in addressing this important issue.

As an organisation active in urban logistics we agree that:

- The ambition to reach zero emission urban freight logistics is achievable
- At present, electric (including fuel cell) drivetrains are the only ones that do not produce tailpipe emissions
- There is only a very limited number of (hybrid) electric trucks on the market for which a business case can be made

As individual organisations active in urban logistics we cannot on our own create the conditions to make this business case feasible. Therefore we call and count on other parties to contribute:

- Local authorities: Coherent privileges for zero emission capable trucks, e.g. priority loading
- Regional, national and/or European authorities: Financial support to procure and deploy (hybrid) electric trucks to stimulate the market
- Government to implement a concession on payload regulations for vehicles where an electric drivetrain contributes to taking gross vehicle weight over 3.5 tonnes
- Producers-OEMs: development and production of (hybrid) electric trucks that meet the requirements of urban logistics operators

Name of organisation:

Name of contact person:

Permission to publish your organisation's name:

Date:

What is the approximate number of commercial vehicles in your organisation's fleet that you could replace with zero emission capable alternatives:

Number of trucks between 3.5t and 7.5t:

Number of trucks over 7.5t

Additional comments:

For further information please contact:

Tanja Dalle-Muenchmeyer
FREVUE Coordinator
Cross River Partnership

tanjadallemuenchmeyer@crossriverpartnership.org

www.frevue.eu

Heavy duty electric truck deployment in Europe

Workshop, Road to Electrification of Logistics
Task27 IEA-HEV

26th of April 2017

Harm Weken
Managing Partner

FIER Automotive & Mobility

Harm Weken: Managing Partner of FIER Automotive

- Chairman of the board, Foundation Limburg Electric
- Member of the Council of Advisors:
  - Drive Oregon, US
  - EU Center for Sustainable Mobility, FH Aachen, D
- Ambassador for EVU, Electric Vehicle Union
- Board director of EASN, platform for automotive clusters and regions (2007-2015)

FIER Automotive & Mobility

- Business development for Dutch e-mobility sector:
  - Missions to EU countries, China, India, US etc
  - 3-year program on German market
- Business planning and funding applications: smart- and e-mobility test labs, Automotive Campus Helmond (follow-up campus co-development)
- Clean vehicle fleet projects for governments
- Realisation and expansion of corporate / private e-car sharing programs together with Foundation Limburg Electric
- Strategic planning and mapping of future-proof charging infrastructure
- International benchmark and technology / supplier search for electric bus consortium
- Business development and grant applications for electric trucks (incl. PHEV & hydrogen) for distribution, garbage and container transport
- Boardmemberships / advisory rolls: Drive Oregon, EU Center for Sustanable mobility FH Aachen, Electric Vehicle Union, EASN

Electric Mobility: European projects

I-CVUE

- EV fleet monitoring and analysis
- Transferability of Best Practice
- Market-Potential supported by Predictive Tools

FRevue

- Support the uptake of electric freight vehicles in eight of Europe's largest cities
- Demonstrating and evaluating innovative urban logistics solutions
- New concepts and business models

e-GLM

- 10 full electric trucks (45t) with network of fast charging points in a cross border project (Germany – Netherlands) for
- Innovative logistic concepts for regional container distribution

ENEVATE

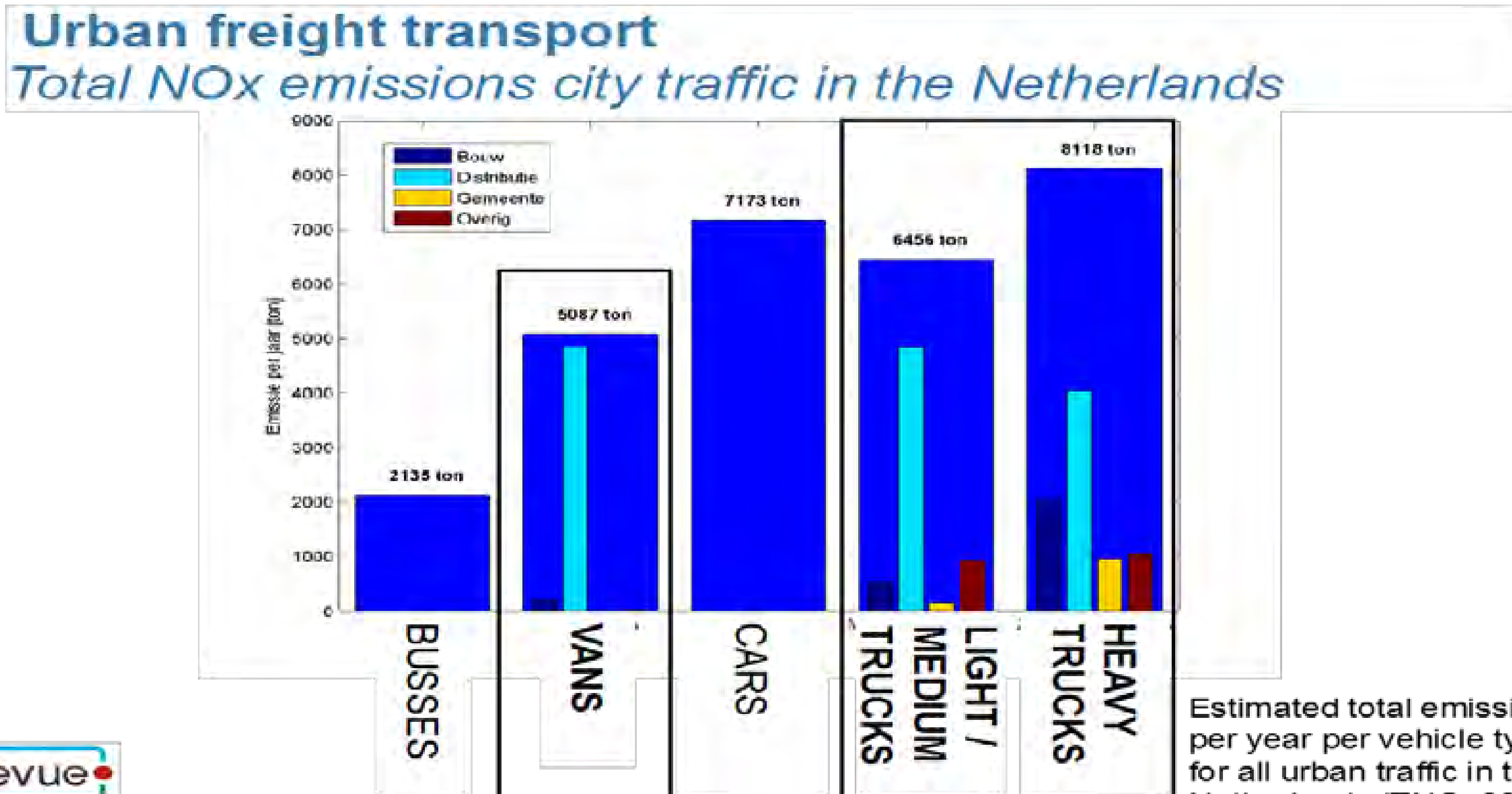
European Network of Electric Vehicles and Transferring Expertise

- Electric Vehicle Supply Chain Development
- Strategic implementation & infrastructure roll-out plan
- Market drivers and mobility concepts
- E-car sharing pilot project

BATTERI

- Intermodal, smart technologies & Alternative Fuels
- Policy & Behaviour
- Pilots

3 big polluters



Estimated total emissions per year per vehicle type for all urban traffic in the Netherlands (TNO, 2015)

Electric mobility, future or past

Automotive & Mobility

.... the future is now

Electric Mobility Projects Heavy Duty

Amsterdam elektrisch

- Support companies for application electric trucks (30+)
- Technical, economical and finance support
- ICOVA, Hoogwout, Lidl, etc.

FREVUE

- Support the uptake of electric freight vehicles in eight of Europe’s largest cities **(Milan, Rotterdam, London)**
- Demonstrating and evaluating innovative urban logistics solutions
- New concepts and business models

eGLM electric Green Last Mile

- 2014: Feasibility study and preparation for FULL electric truck e Green Last Mile Netherlands - Germany
- 9 fully electric trucks (45t) with network of fast charging points in a cross border project (Germany – Netherlands) for
- Innovative logistical concepts for regional container distribution

Others to be Announced...

Amsterdam electric truck support

Automotive & Mobility

Amsterdam elektrisch

Peeters Vervoerscentrale
- Inner-city distribution
- Goal of full electric fleet in 5 years
- Electric DAF
- GVW 12.000 kg
- 120 kWh Lithium Ion
- 150 km NEDC

Albert Heijn
- Delivering of online ordered grocery's
- Electric VW Crafter
- GVW 3.500 kg
- 80 kWh Lithium-Ion
- 150 km NEDC

ICOVA
- Garbage collectors for the inner-city
- Electric FIAT Ducato
- GVW 6.900 kg
- 80 kWh Lithium-Ion
- 150 km NEDC

LIDL, VsdV
- Distribution from DC to multiple supermarkets
- Electric MAN TGM
- GVW 17.990 kg
- 200 kWh Lithium-Ion battery
- 225 km NEDC

Hoogwout Berging
- Road service and towing
- Electric IVECO
- GVW 8.000 kg
- 160 kWh Lithium-Ion
- 160 km NEDC

Freight Electric Vehicles in Urban Europe

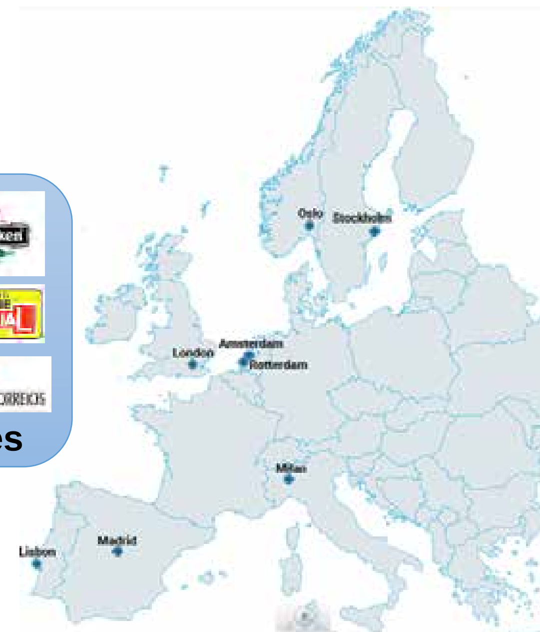
AER Automotive & Mobility

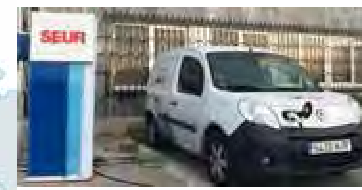
FRevue

TNT, UPS, Heineken, bring, Leche Pascual, ARUP, SEUR, CTT Correios

Logistics companies

2013 - 2017





Co-financed by the
European Commission

Automotive & Mobility

Challenges experienced in FREVUE eTrucks > 12ton

Economic feasibility

Ø High purchase costs

Ø Negative TCO à -€30.000 and -€75.000 in 8 - 10 years

Ø Decisions made for marketing reasons / pilots

Vehicle supply

Ø Technical possible but not many suppliers / mainly conversions

Risks / uncertainties e-Trucks:

Ø Residual value / second life

Ø Repair and maintenance

Ø Reliability, lifecycle of battery and second use of battery

à **TCO e-Truck needs: more operational years and more kilometres**

Co-financed by the European Commission

eGLM electric Green Last Mile

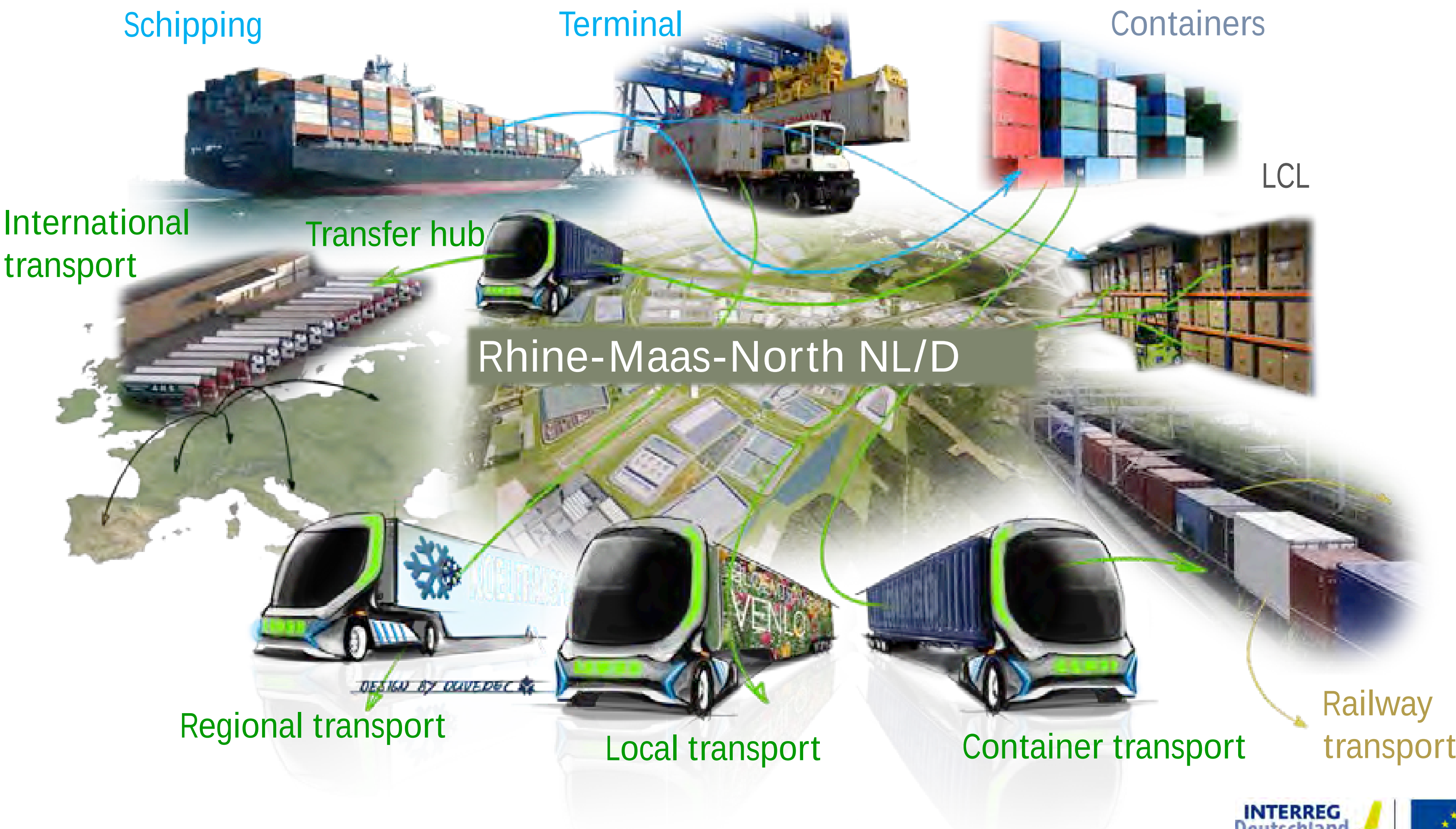
eGLM legacy by the end of 2020

3,5 years experience:
- 9 full electric container trucks (40ton)
- 2 mln electric kilometres
- Efficient fast charging on smart charging locations – open for public (other e-trucks, busses e.g.)
- Innovative logistic concept for truck sharing, increased mileage per day and increased capacity utilisation

è 5 companies, ready and well positioned for a future in sustainable transport, ahead of competition!

Contribution in CO2 reduction of 1.900 ton as well as other hazardous emissions. As a modest first start!

CO2 reduction – Air quality improvements – Lower noise



Lower costs, stronger competitive strength

INTERREG Deutschland Nederland
Europäische Union Europese Unie
www.deutschland-nederland.eu

eGLM Project partners

CTV Multimodal Container Transport

Köppen

KUIJKEN LOGISTICS GROUP KLG EUROPE BORDERLESS LOGISTICS. SINCE 1918.

SAMSKIP

MEULENBERG

FIER Automotive & Mobility

LIOF

provincie limburg

INTERREG Deutschland Nederland

Europäische Union Europese Unie

www.deutschland-nederland.eu

Nordrhein-Westfalen

INTERREG Deutschland Nederland
Europäische Union Europese Unie
www.deutschland-nederland.eu

Conceptual designs

40t tractor **Flexibility** **Sharing**

Charging Infrastructure

AC slow charging via a plug

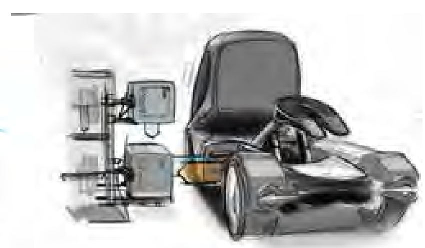
DC fast charging via a plug

Induction charging

Overhead charging (pantograph)

Battery 'swap'

Conductive plate'

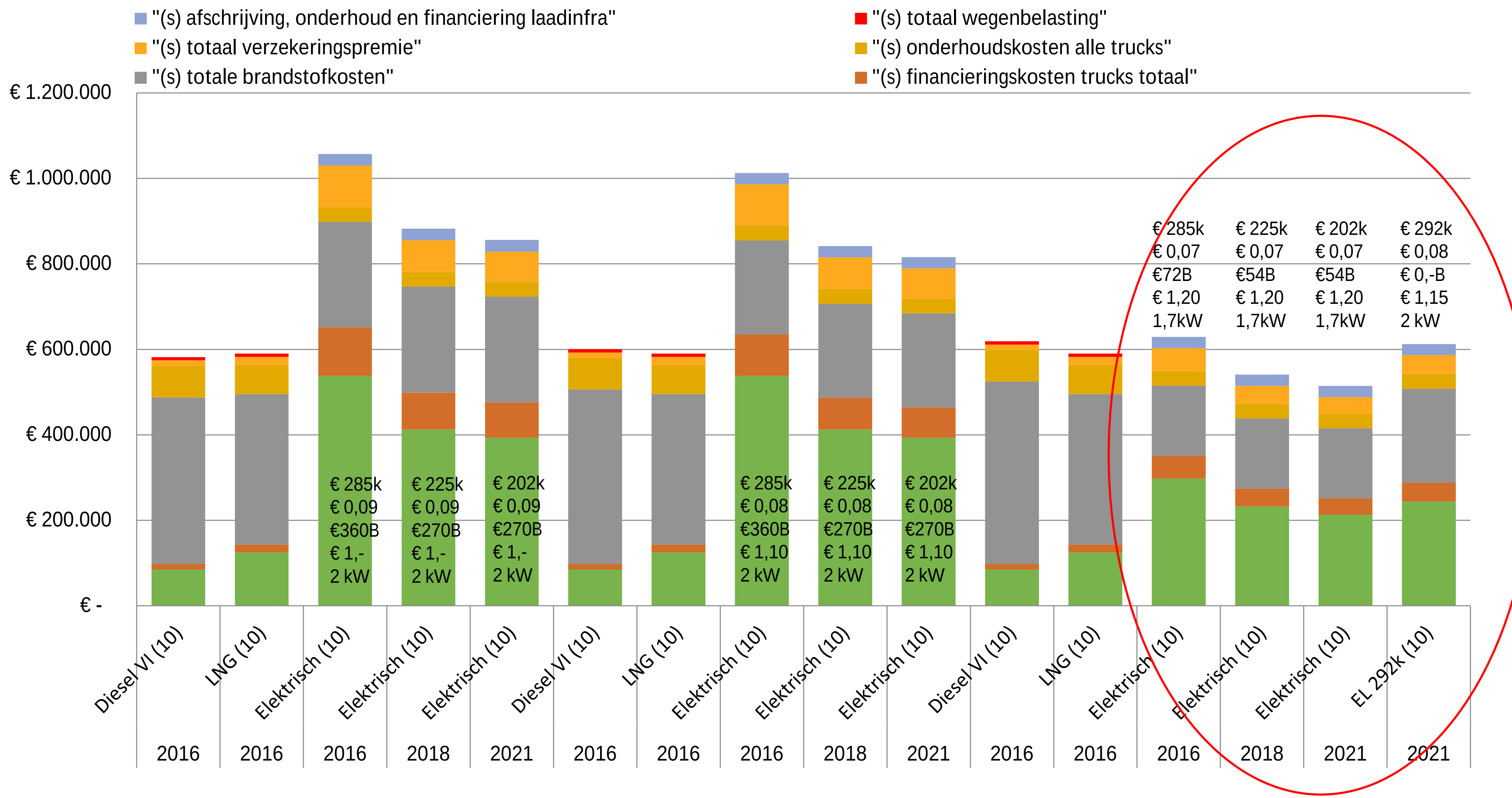


Feasibility study eGLM

- Technical feasibility of trucks
- Technical feasibility of fast charging
- Logistic & organizational, operational feasibility
- Financial-economic feasibility

Analyses | Financial feasibility

De Groene Cockpit



Summarising, Why eGLM

- Reduce CO2 emissions, NOx and particle's and noise pollution from transport
- Create broad cooperation in region for transport innovation and increased competitiveness
- Kick-start the market for electric trucks and create urgency at OEM's. Realise (first step towards) critical mass
- Transport companies get a head start in testing and applying electric trucks as well as new logistics models for increased capacity utilisation
- Increase the economic and environmental sustainability of logistics sector in the region

Overall conclusions on deployment of Heavy Duty EV

Already many e-trucks / pilots on the road in Europe

Ø Positive feedback from companies and drivers

Ø Decisions made for marketing reasons / pilots

Economic not feasible yet	Technical feasible	Risks / uncertainties:

Ø High investment è negative TCO
Ø Low daily distance ç conservative planning & long slow charging
Ø Improved economics
    Ø In right application
    Ø Adapted logistic models
    Ø Fast(er) & opportunity charging
	• Trucks available however still conversions
	• Range is in many applications not an issue
	• Fast charging solutions available, not yet standardized
	• Reliability needs improvement
		Ø Residual value & second life of e-trucks
		Ø Repair and maintenance
		Ø Reliability, lifecycle of battery and 2nd use of battery
		Ø Technology innovation: Increased range, lower investments, improved reliability
		Ø Traditional “one-truck-fits-all approach”

TEVVA MOTORS

Zero Emissions Where it Matters

Technology – Outline and Key Advantages

Cloud-based software monitors vehicle and controls use of range extender to ensure zero emissions where most needed

On-board charging system means any 3-phase power socket can be used

Small engine or fuel cell (range extender) drives on-board generator to recharge the batteries

Wheels driven only by electric motor

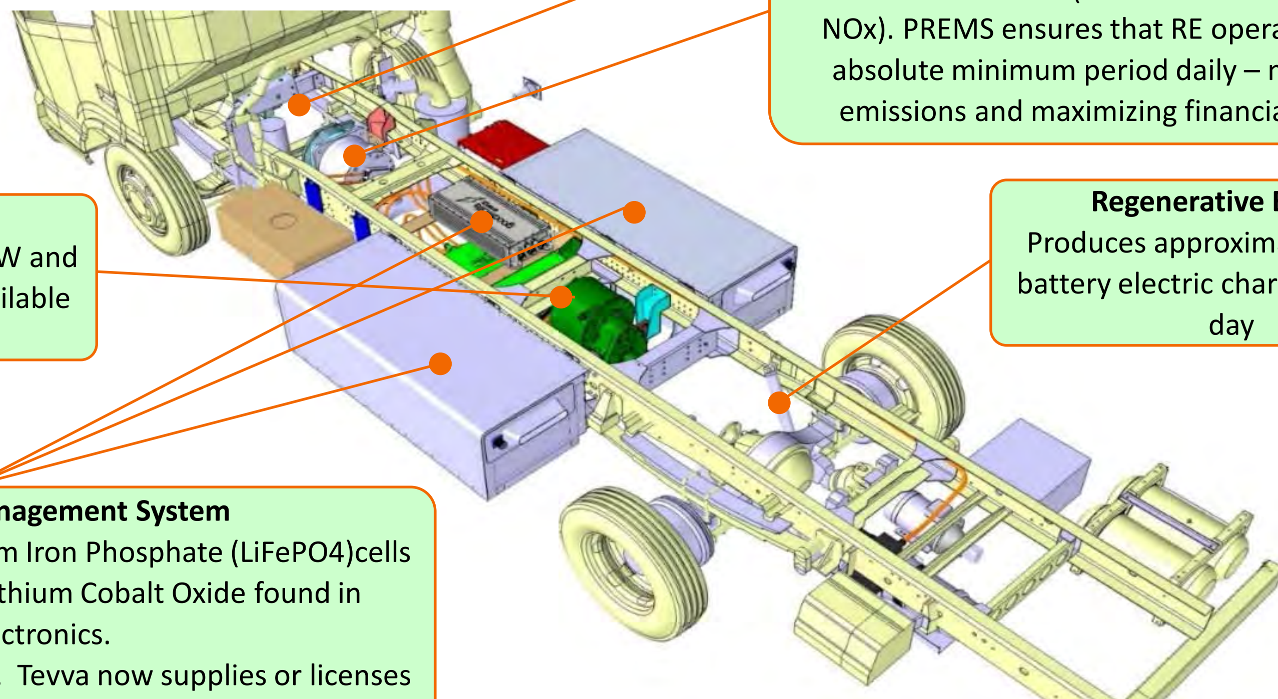
Batteries charge primarily from the mains

BENEFITS: Unlimited range; minimised emissions with zero emissions where most needed; lower operating and lifetime costs

Tevva Tecnology Detail and Schematic

Cloud-based software
Tevva patented Predictive Range Extender Management System (PREMS)

Range Extender/Generator
Current range extender uses standard car engine driving generator only. RE operates at constant RPM maximizing efficiency and removing 100% of 'transient' emissions (which are the main cause of NOx). PREMS ensures that RE operates for the absolute minimum period daily – minimizing emissions and maximizing financial savings.



Motor/Generator
Currently fitted motor rated at 150kW and 2000Nm torque. 200kW option available 'off the shelf'

Regenerative Braking
Produces approximately 30% of battery electric charge used each day

Battery/ Battery Management System
Battery comprised of multiple Lithium Iron Phosphate (LiFePO4)cells – safer and more durable than Lithium Cobalt Oxide found in consumer electronics.
BMS is Tevva proprietary technology. Tevva now supplies or licenses technology to McLaren, NextEV and motorsport

Fleet Trial at UPS

UPS P80 truck retrofitted by Tevva Motors and delivered to UPS UK in October 2015

Truck has successfully covered 11,238 km on road in 9 months

Operational period extended by 6 months – UPS needed capacity and Tevva prototype proved robust

Truck has successfully completed operations under optimal and non-optimal battery SOC

Feedback has been very positive

Truck was be used as a daily fleet vehicle from October 2015 to January 2017

Purchase order received for a further 15 Vehicles to be delivered December 2017 – January 2018

RETROFIT PROTOTYPE

TEVVA MOTORS

37 Updates Made During Trail Period Bringing Significant Performance Uplift

Software Level	Distance travelled (km)	Fuel Used (l)	Fuel Cost (£)	Electricity charged (kWh)	Electricity cost (£)	Cost per kilometre (£)
Base Vario	4,950	1,040	873	0	0	£0.18
Initial	7,457	880	739	1,974	196	£0.13
Final performance	3,781	208	149	1,408	141	£0.08
12/7/2016 Performance	111.8	3.13	2.63	55.8	5.58	£0.07

Next Moves

Broadening the application

- Higher weights
- Integration of ancillary loads

New Technologies

- High Density Switched Reluctance Motor
- ZE Range Extender

Source: Transport for London, Ultra Low Emission Zone Supplementary information, October 2014

Next Moves

HDRSM
Q4 2017 – Q1 2018

7.5 & 14 tonne GVW
Temperature Controlled Body
Q4 2017 – Q1 2018

Software

Autumn 2017

- Leeds City Council
- Integration of PREMS into Smart City traffic systems

Specific Markets

US West Coast

Madrid

Heathrow

Adoption Barriers

Few and Manageable

- Residuals
- Initial outlay (smaller fleets)
- Perceived technical risk (larger fleets)
  - Status of OEM warranty
- Uncertainty re. whether R&M savings will be achieved
- Uncertainty re. future fuel costs

Solutions

- Full R&M Contract hire option
- Lifetime drivetrain and battery warranty

Market Evolution

Frenetic

- December 2016 - Paris, Madrid, Athens and Mexico City annoce full diesel bans from 2025
- December 2016 Announcement of 1st ever joint public procurement in US – SFO, LA, Portland & Seattle -24,000 EVs
- Feb 2017 above expanded to include 26 cities – 114,000 EVs
- Jan 2017 Oslo begins temporary diesel ban
- Feb 2017 Stuttgart announces ban of older diesel cars from City
- Feb 2017 Sadiq Khan announce London T Charge from the Autumn and pulls forward London ULEZ date
- April 2017 Govt of India announces aim to achieve 100% of all vehicles nationwide as EVs by 2030

TEVVA MOTORS

Thank You

T27 workshop
Microcab project

Coventry University
26 April 2017

John Jostins
Managing Director, Microcab Industries Ltd.
Prof. Sustainable Transport Design, Coventry University

Working in partnership with Coventry University

Microcab background

SME, founded 2004
- The UK’s innovative fuel cell vehicle maker.
- 14 years of pioneering fuel cell vehicle design

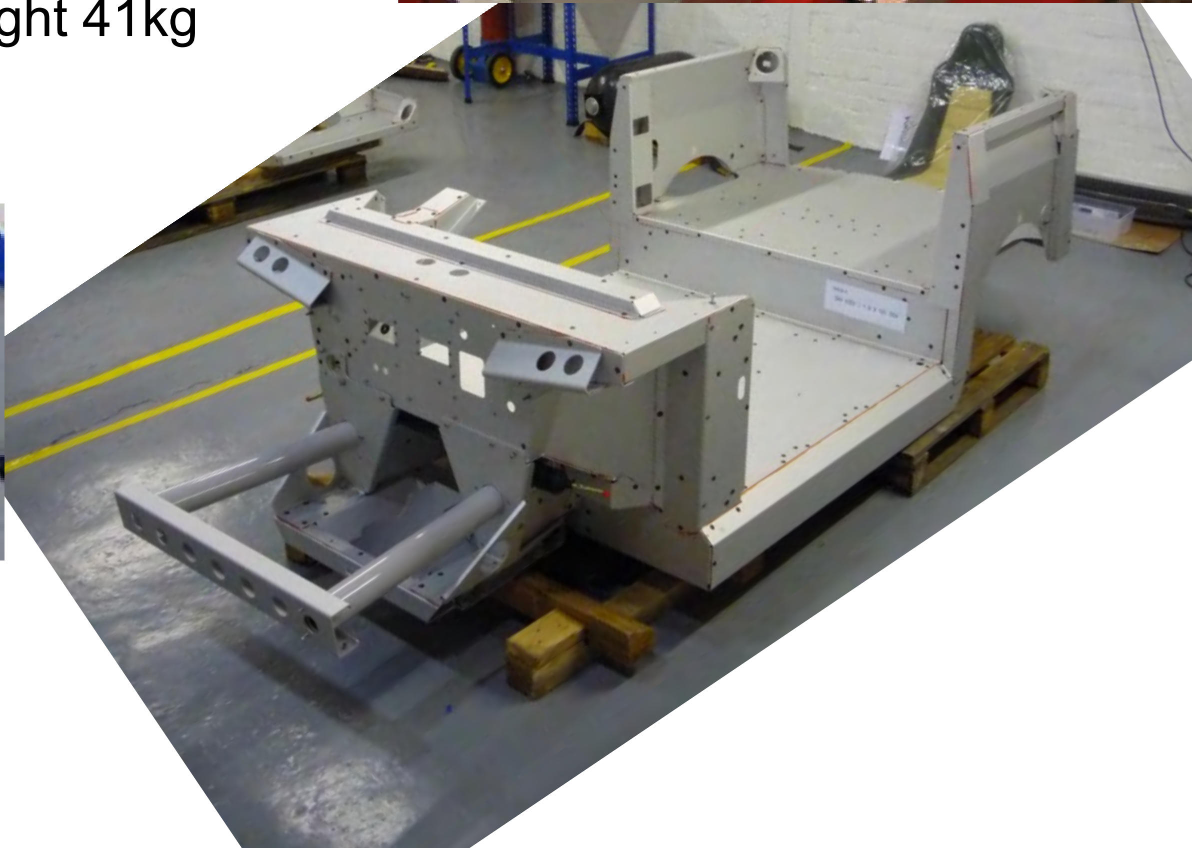
Mission statement
- Developing sustainable, integrated solutions for the New Mobility and Circular Economy

Recent growth:
- Commercial order for vehicles
- Extensive portfolio of grant funded programs
- Job creation – 3 new employees in last 12 months

H2EV platform

Chassis, built by Lotus
Bonded aluminium, laser cut flat sheet

- Hydrogen cylinder weight 41kg
- Chassis weight 80kg



MICRO CAB

H2EV powertrain

1.8kg H2 storage, 350bar
1 kg H2 = 33.3KWh

3-5kW fuel cell & DC/DC converter

4kWh lithium battery

Twin 72v DC motors,
13kW each
Single speed
Belt drive to front wheels

Twin motor controllers
Top speed 88kph

MICRO CAB

Van variant development – Royal Mail

H4 Mk2 ***2008***

- 2007 started work with Royal Mail
- Interested in zero emissions
- Very large fleet
- Looking at potential of Hydrogen power
- FC and ICE
- Plan to generate hydrogen at delivery depots
- Adopted a Microcab in van variant
- Used for mail delivery at University of Birmingham
- Royal Mail now privatised

H2EV platform – light van

- 2009 H2EV design started
- Used Royal Mail light van spec.

- Payload:
- 1 cubic metre
- 250kg

- Plug Fuel Cell
- Range 240 – 280km

MICRO:CAB

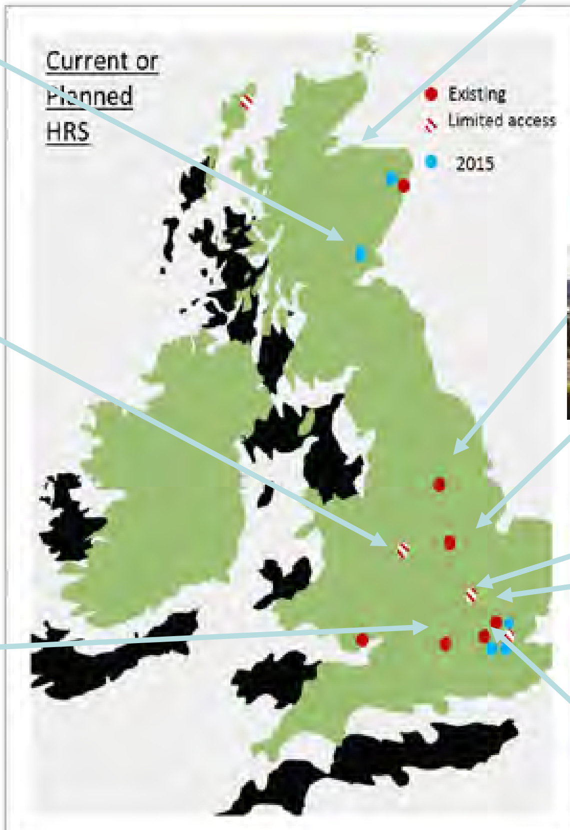
SWARM trials: FCH-JU
New **hydrogen station**

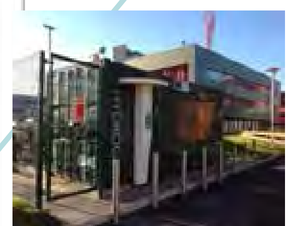
Brussels

- Air Liquide, first HRS in Belgium
- Opened Zavantem, 2016
- M-cab V4 delivered University Libre
- Testing and data collection
- Operating in Brussels

Hydrogen refuelling UK

MICRO CAB





Hydrogen refuelling

- Possibilities for on site generation
- Water electrolysis
- Move to decentralised energy
- Supports the energy storage agenda
- Generate hydrogen with surplus renewable energy
- Very low carbon possiblities

- Pics: ITM Power HRS, Sheffield with wind turbine

MICRO CAB

Conclusions

- Delivery vehicles operate in large numbers – diesel
- Internet shopping increases demand for deliveries
- Air Quality dominates still
- HFCs offer benefits of zero emissions and very low carbon
- Hydrogen gives quick fill and long range
- Infrastructure is expanding – buses lead the way

Thanks to all staff at Microcab and Coventry University.

https://www.youtube.com/watch?v=0ykWf3R8xZ4

LowCVP
Low Carbon Vehicle Partnership
Connect
Collaborate
Influence

Technology developments and experiences in the UK

26 April 2017




Jonathan Murray

Policy & Operations Director

Low Carbon Vehicle Partnership

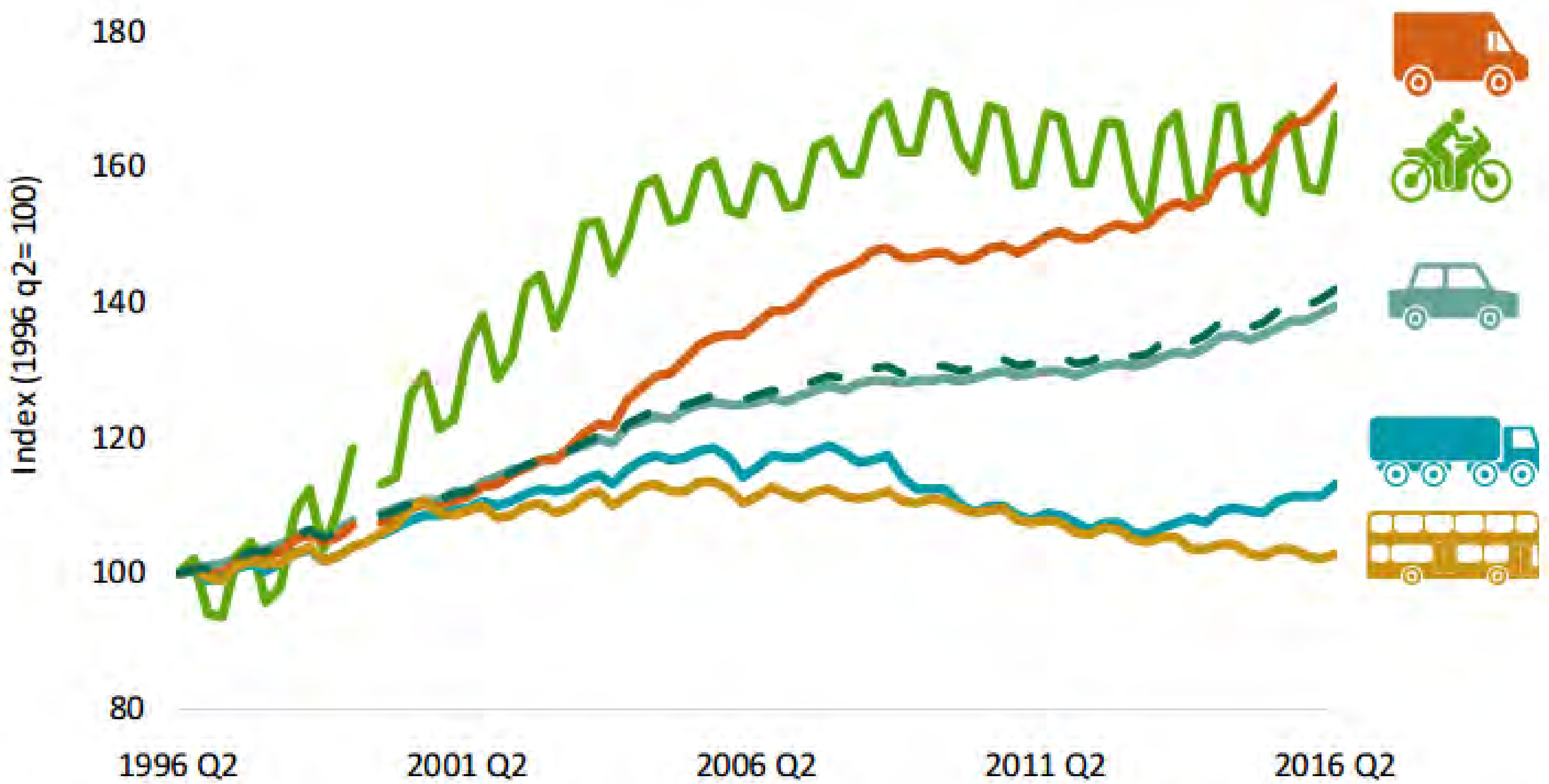
Connect
Collaborate
Influence

Public Private Partnership

"To accelerate a sustainable shift to low carbon vehicles and fuels in the UK and thereby stimulate opportunities for UK businesses”.

Commercial goods vehicles: The next big (low) carbon opportunity?

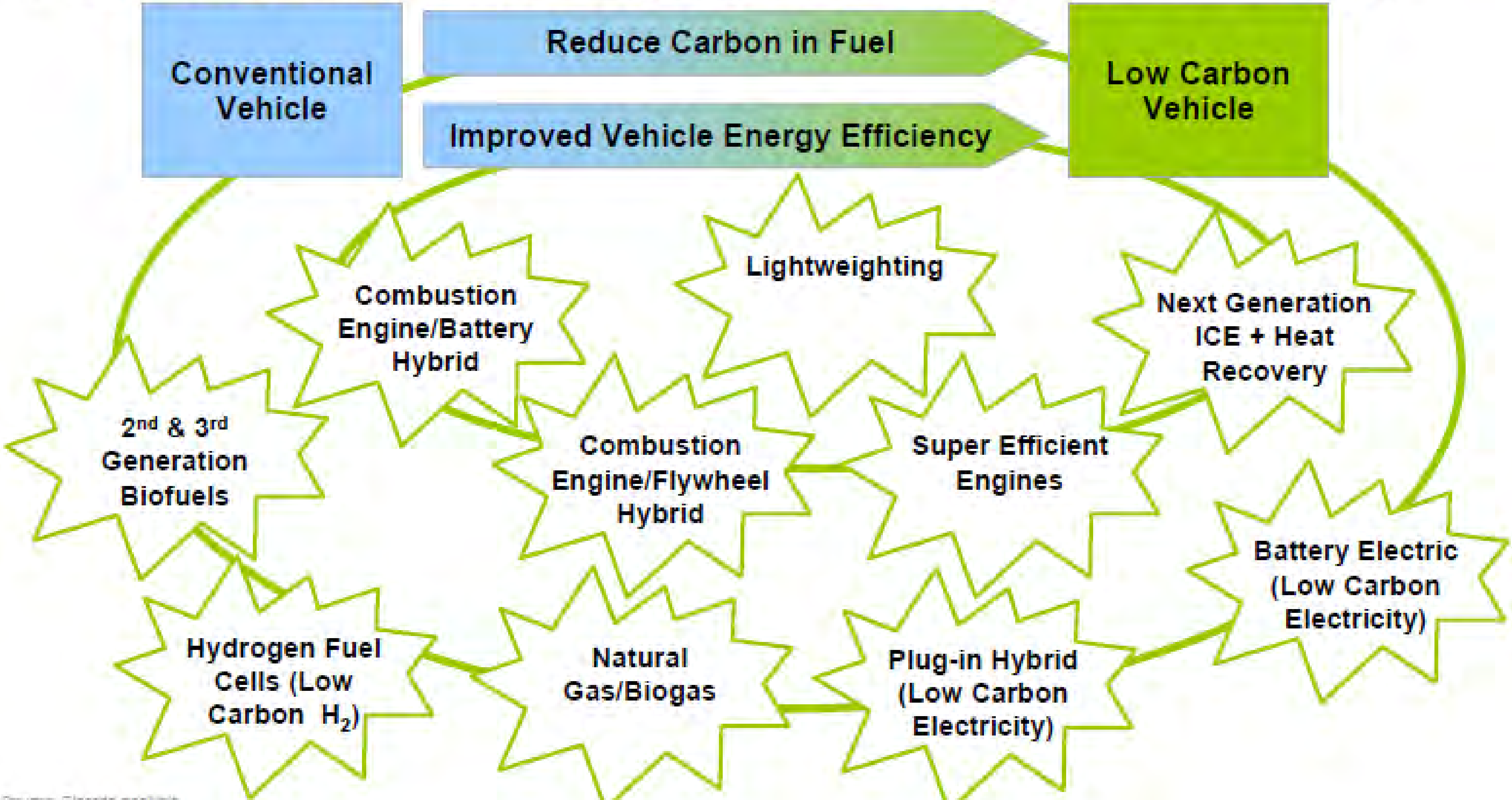
Figure 5: Licensed vehicles by type, GB: Q2 1996 - Q2 2016



Dotted line = All Vehicles

There are many technical options to reducing vehicle CO_2 and improving air quality. All have challenges and are suitable to different applications. We are likely to need all of them.

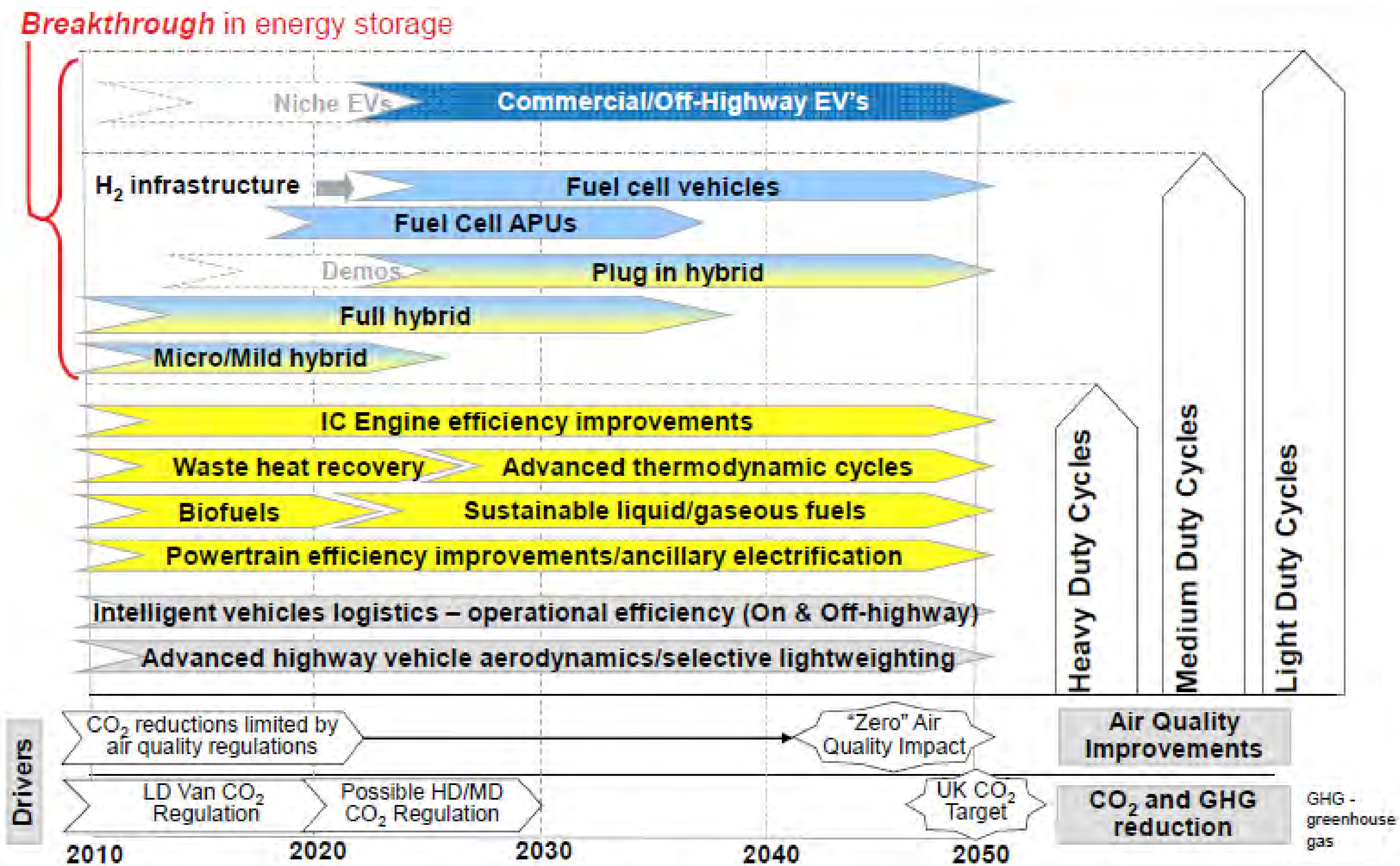
- Low carbon vehicles achieved through improved efficiency and/or low carbon fuels:



Source: Ricardo analysis

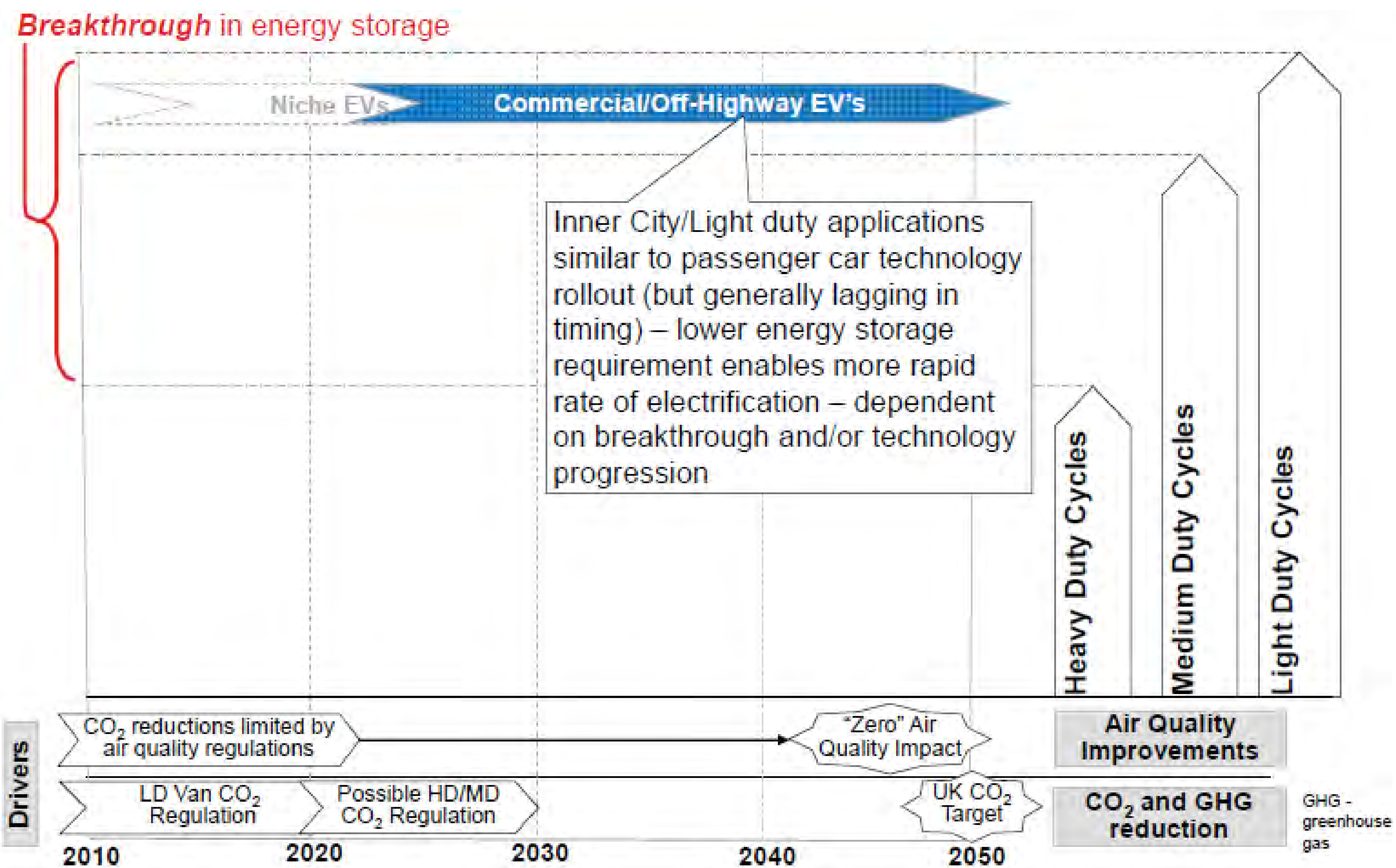
A number of technology roadmaps have been developed for CVs. The Automotive Council UK's provides the UK consensus view driving investment.

LowCVP
Low Carbon Vehicle Partnership



automotive council UK

Battery electric vehicles are seen as being limited to duty cycles with lower range and GVW.

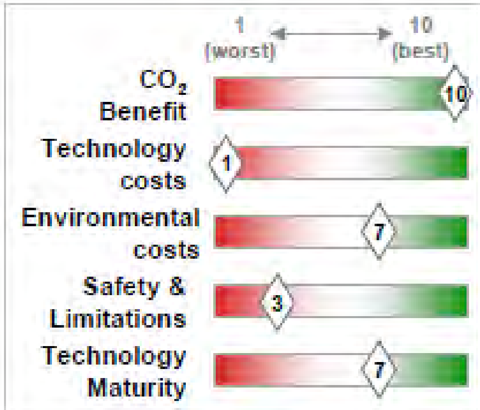


Electric commercial vehicles are available up to 12t GVW and benefit from lower taxes and running costs

Electric Vehicles

- **Concept:** Vehicle which is driven by a battery powered electric motor
- **Base Functioning:** Vehicle is driven by an electric motor powered by batteries which are charged from mains electricity. The vehicle has no other power source other than the battery
- **CO_2 Benefit:** Tailpipe CO_2 emissions are 0g/km and overall emissions are estimated to be 40% lower than conventional diesel, but this is dependent on fuel source used to generate electricity
- **Costs:** Smiths Newton electric 7.5t vehicle (very similar to medium duty benchmark) is between £78,387 and £80,886
- **Environmental Benefit:** Electric vehicles have societal benefits in that they reduce road noise

Powertrain



Safety and Limitations

- Less stressful driving
- Lower mainteneance and servicing requirements
- Lower vehicle payload than comparable diesel vehicle
- Limited to GVW of 12t
- Low residual vehicle values
- Operation limited to central depot based fleets
- Reduction in road noise needs to be handled carefully to ensure no adverse effects for vulnerable road users

Technology Applicability

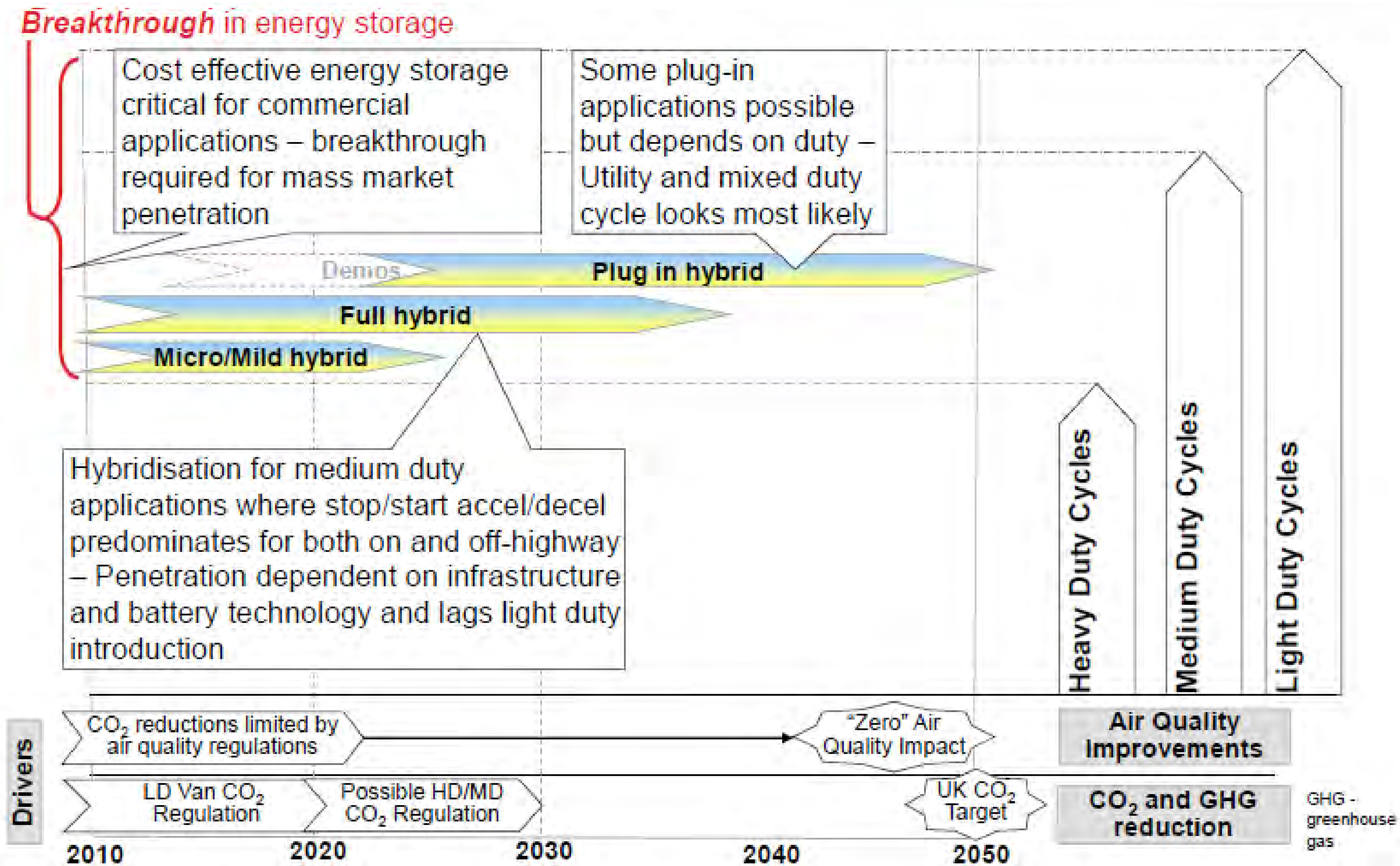
- Limited to vehicles up to 12t
- Best suited to vehicles operating from a single depot and with daily mileage of <100miles
- Greatest benefit for urban applications where exemption from congestion charge and low emission and noise operation is beneficial

Visualisation

Picture: Smith Newton from sev-us.com

Source: Smiths Electric Vehicles; The Benefits of Operating an Electric Vehicle in an Urban Environment, Freight Best Practice, April 2009 – Full sources available on detail slides in the attached annex

Greater opportunities for electrification of the drive train are anticipated through hybrid and range extender technologies.



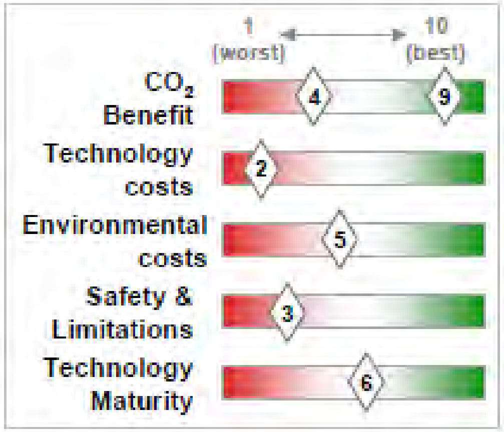
Hybrid and range extended vehicles offer high CO2 reductions in urban applications but are expensive and require maintenance training

Low Carbon Vehicle Partnership

Hybrid Powertrains – Full Hybrid

- **Concept:** A powertrain which can use more than one fuel source to provide energy to propel the vehicle
- **Base Functioning:** Typically implemented as hybrid electric vehicles where electrical energy is stored in batteries which can be used to drive an electric motor to power the vehicle or supplement engine power
- **CO_2 Benefit:** Ranges significantly dependent upon vehicle operation but averages 20% for medium (urban) and 7% for heavy duty (long haul) applications
- **Costs:** Significant technology on cost of additional hybrid components. Some environmental impact in terms of battery manufacture and disposal

Powertrain



Safety and Limitations

- ✓ Lower brake wear due to use of regenerative braking – leads to lower maintenance costs
- ✓ Makes use of existing fuel infrastructure
- ✓ Vehicles have better acceleration
- ⊖ Some vehicles have a reduction in payload
- ⊖ Engine stop/start unsuitable for some applications
- ⊖ Requires training of maintenance staff to safely work with high voltage systems

Technology Applicability

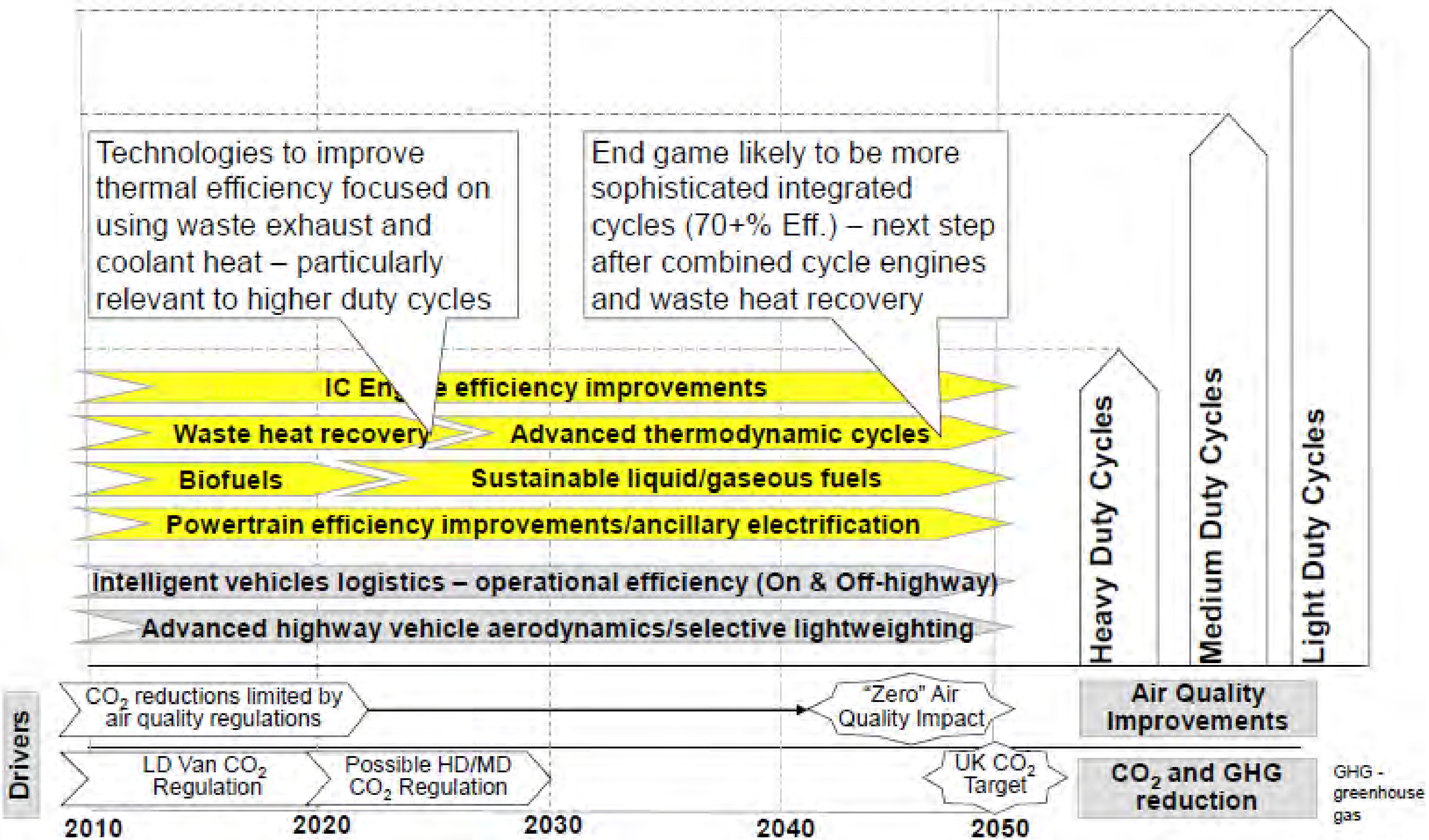
- Greatest CO_2 reduction potential for vehicles operating over an urban duty cycle
- CO_2 savings still possible for long haul applications but business case requires more consideration

Visualisation

Picture: DAF LF Hybrid

Source: OEM corporate websites and press releases – Full sources available on detail slides in the attached annex

There are also opportunities for electrification in delivering efficiency gains in ICEs and electrification of ancillaries.

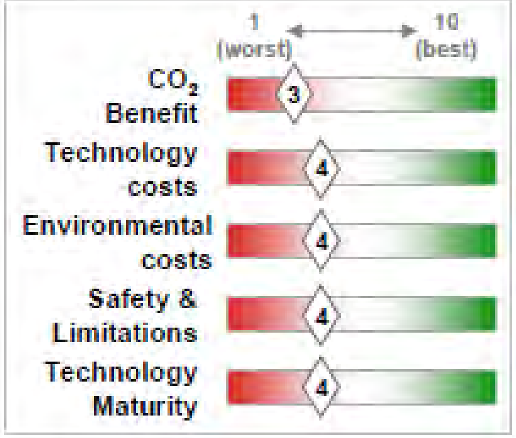


Waste heat recovery can provide moderate CO2 benefits – electrical turbocompounding

Waste recovery systems – electrical turbocompound

- **Concept:** Exhaust gas energy recovery
- **Base Functioning:** Exhaust turbine in combination with an electric generator / motor to recover exhaust energy
  - Recovered energy can be stored or used by other electrical devices
  - Motor during transients to accelerate
- **CO_2 Benefit:** Fuel economy benefit of 10 % achieveable at maximum power point[1]. Real world benefit closer to 3% depending on duty cycle. ETC perhaps best suited to off-highway applications like ploghing tractor which runs a long time at max power
- **Costs:** Increasing costs for turbocompound system

Powertrain



Safety and Limitations

- ✓ Moderate potential in reduction of fuel consumption and CO_2 emissions
- ✓ Primary for new engine designs
- ⊖ Added complexity for energy storage, control
- ⊖ Increased costs generator turbine, energy storage, crank mounted motor
- ⊖ High voltage system

Technology Applicability

- Electric turbocompounding systems for medium and heavy duty application in developement phase
- Fuel / CO_2 benefits confirmed

Visualisation

Picture: John Deere- Bowman Power turbogenerator
Source: http://www1.eere.energy.gov DEER 2006

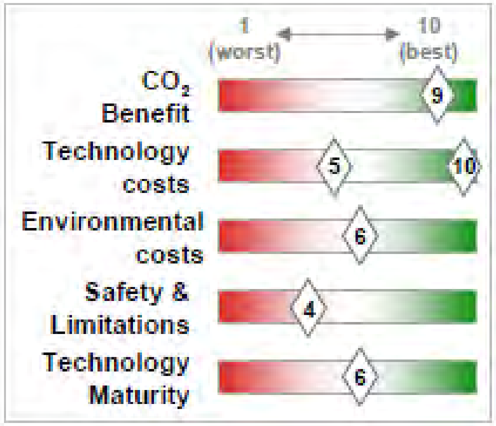
Source: Ricardo Research, Ricardo Evaluation; 1) http://www1.eere.energy.gov: Electric turbocomponding; John Deere: DEER 2006 – Full sources available on detail slides in the attached annex

Refuse trucks are being developed that use electric motors to drive hydraulic lifting and compacting mechanisms

Electric/ Alternative Fuel Bodies

- **Concept:** Replacement of existing power sources for vehicle bodies which use diesel for power
- **Base Functioning:** Electrification or use of an alternative power source, e.g. nitrogen to drive systems requiring power instead of diesel
- **CO_2 Benefit:** Varies between 10% and 20% depending on the body power system being replaced
- **Costs:** Up to 15% vehicle on cost, but some systems are lower cost

Vehicle



Safety and Limitations

- No limitations on vehicle usage
- Electric and nitrogen systems offer quieter and smoother operation
- Electric and nitrogen systems have low operating and maintenance costs
- Nitrogen system, unlike mechanical – will not 'top freeze'
- Safety of nitrogen system

Technology Applicability

- Suited to applications where electrical motors have sufficient torque to drive load
- For use in hybrid vehicle applications where hybrid battery can be used to power trailer

Visualisation

Picture: Volvo Hybrid Refuse Truck (gizmag)

Source: Ricardo Research, Ricardo Evaluation; http://www.gizmag.com/worlds-first-hybrid-refuse-truck-volvo-sweden/9131/ – Full sources available on detail slides in the attached annex

VECTO – HDV CO2 tool

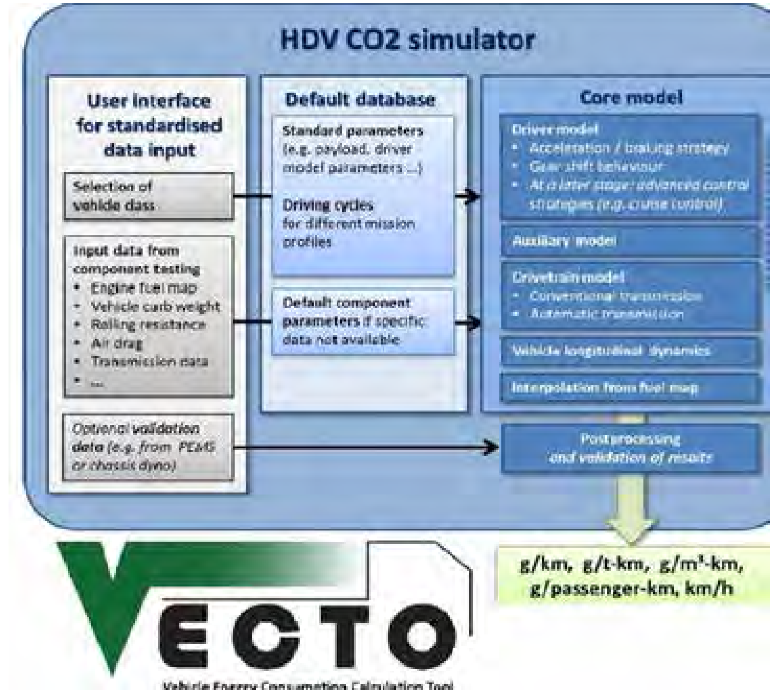
The EC has developed a computer simulation tool, VECTO, to measure CO2 emissions from new HDVs.

The EC will use VECTO to propose legislation which would require CO2 emissions from new HDVs to be certified, reported and monitored.

Vecto has three purposes

1. OEM – robust and objective tool to assess vehicles
2. Legislator – to assess emissions and develop measures to improve CO2 from HDV
3. Member states – to implement additional measures for more energy eff vehicles

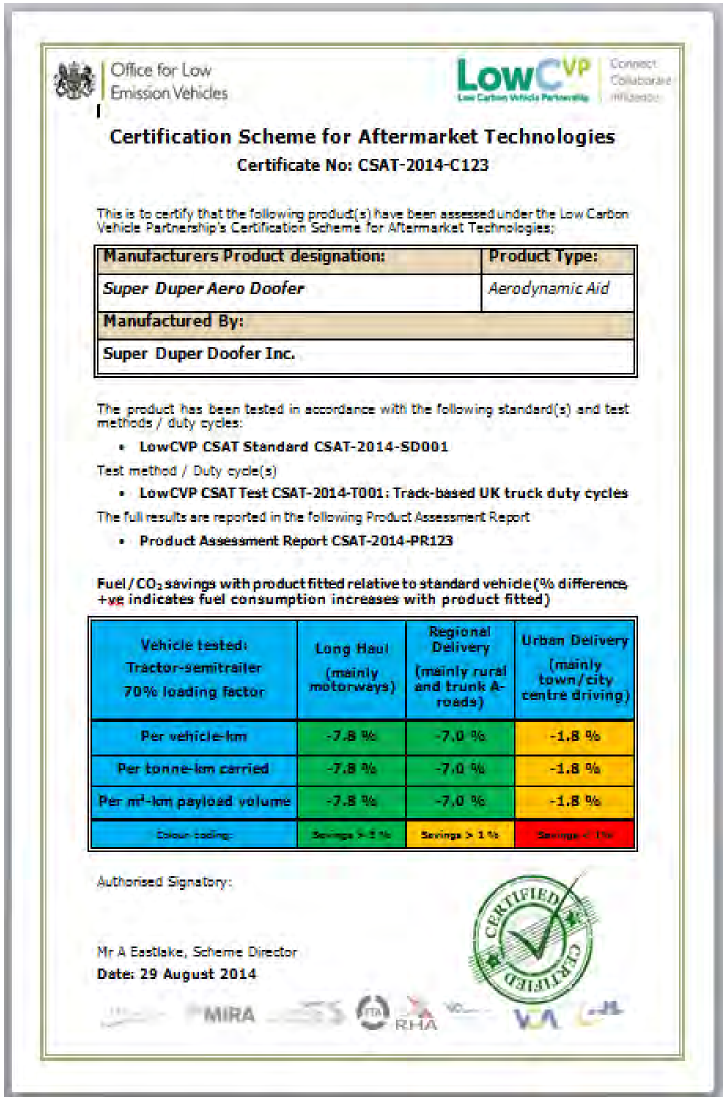
Likely to be simulation approach (VECTO) for certification, but conformity and post validation see vehicle testing benefits



LowCVP Initiative – Accreditation scheme for low carbon technologies

Carbon saving technologies face a major hurdle to penetrate the market.

- Operators are highly sceptical of technology manufacturer performance claims
- There is no widely accepted process to test technology and validate claims
- Vehicles are used for a range of operations (driving cycles) and testing for every situation is prohibitive.



Office for Low Emission Vehicles

Certification Scheme for Aftermarket Technologies

Certificate No: CSAT-2014-C123

This is to certify that the following product(s) have been assessed under the Low Carbon Vehicle Partnership's Certification Scheme for Aftermarket Technologies:

Manufacturers Product designation:	Product Type:
Super Duper Aero Doofer	*Aerodynamic Aid*
Manufactured By:	
Super Duper Doofer Inc.	

The product has been tested in accordance with the following standard(s) and test methods / duty cycles:

- **LowCVP CSAT Standard CSAT-2014-SD001**

Test method / Duty cycle(s)

- **LowCVP CSAT Test CSAT-2014-T001: Track-based UK truck duty cycles**

The full results are reported in the following Product Assessment Report

- **Product Assessment Report CSAT-2014-PR123**

Fuel / CO_2 savings with product fitted relative to standard vehicle (% difference, +ve indicates fuel consumption increases with product fitted)

Vehicle tested: Tractor-semitrailer 70% loading factor	Long Haul (mainly motorways)	Regional Delivery (mainly rural and trunk A-roads)	Urban Delivery (mainly town/city centre driving)
Per vehicle-km	-7.8 %	-7.0 %	-1.8 %
Per tonne-km carried	-7.8 %	-7.0 %	-1.8 %
Per m^3-km payload volume	-7.8 %	-7.0 %	-1.8 %
Colour coding:	Savings > 5 %	Savings > 1 %	Savings < 1%

Authorised Signatory:

Mr A Eastlake, Scheme Director

Date: 29 August 2014

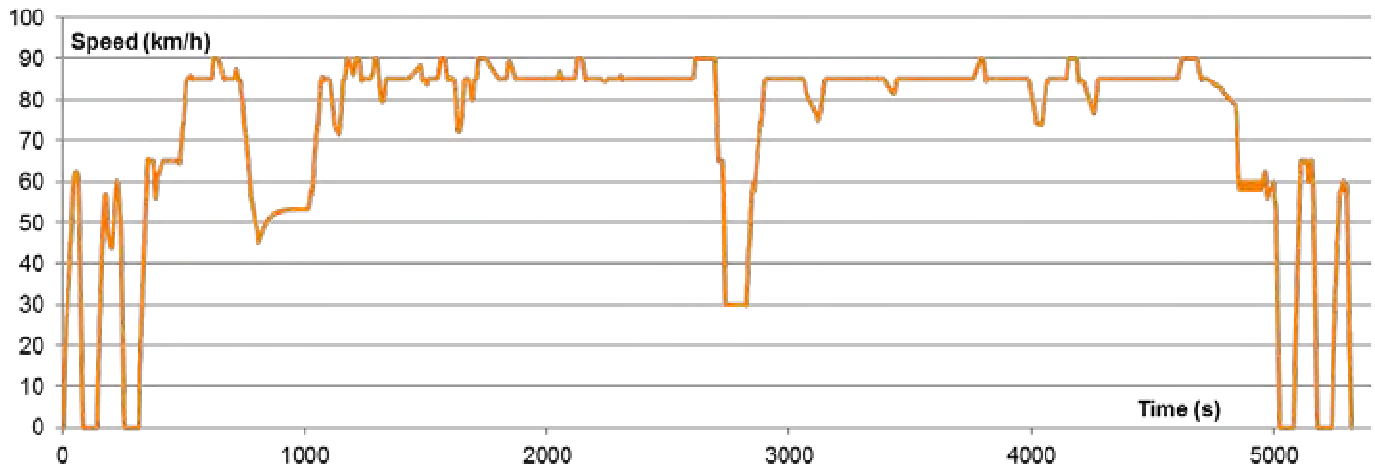
LowCVP Certification Scheme for Aftermarket Technologies

The scheme will help to build the market for low carbon HDVs

Evidence	•Operators get reliable, trustworthy and relevant information on likely effectiveness for their duty cycles •Suppliers can demonstrate realistic savings, independently evaluated
Recognition	•Suppliers gain marketing opportunities, able to distinguish themselves from the snake oil salesmen •Innovative and genuinely effective products encouraged •Certificate issued for products that meet the mark
Incentives	•Win-win for suppliers and operators via increased sales and fuel savings •Government can properly target support mechanisms towards genuinely effective products

What are the schemes objectives?

- The Scheme will be designed, managed and run for the benefit of UK operators – collaboration and co-operation with them are key guiding principles. Credibility is paramount.
- The Scheme will support UK Government policy and the achievement of CO_2, air quality and energy security targets
- The Scheme will add value to the development of a market for low carbon HGVs by addressing one of the key existing market failures – operators don't have a 'go-to' source of reliable information about technologies that might be useful to them and are reluctant to believe everything a supplier tells them



Millions of charge points (mostly residential) will be needed to support widespread EV deployment, with uncertainty over charging technologies

electricity

Infrastructure roadmap

Charging infra-structure network			2015	2020	2025	2030	2050
Public network	Total sites		*Many sites but variable offer*	Visible and accessible network to all drivers: c. 500	Full national coverage: c.1,100	*c. 10 charge points per site*: c.2,200	*Dependant on BEV/ PHEV split and charging rates*
	Cost			£20-40m	£130-230m	£300-530m	
	Technology		Rollout of primarily conductive rapid (40+kW) charging points in short term. Future type and rates will depend on technology developments				
Residential	Cars/vans		3-7 kW off-street or shared on-street	300-370k	Solutions to provide certainty of access to homes w/o off-street parking	4-7 million	10-15 million
Depot / workplaces	Cars/vans		3/7/22 kW	8-10k		100-200k	400 -550k
	Buses and HGVs		>40 kW CP (plug and wireless) installed with concurrent trials of alternative power delivery systems		Potential rollout of alternative power delivery systems e.g. dynamic charging on highways, battery swap or overhead cables	4-5k	20-25k
Investment in electricity networks (transmission & distribution) – cumulative from 2015			EV related DSR commercial arrangements formalised		Introduce smart systems alongside conventional network upgrades	Up to c. £20bn for transmission and £30-45bn for distribution*	

*To handle decarbonisation of the grid and uptake of EVs, heat pumps and distributed generation such as PV panels

Legend

Cost

Total CPs

Technical

Plug-in electric vehicles stock

Thousand vehicles

Projections are based on policy-led uptake scenarios presented on page 25

Data supported quantification of infrastructure requirements

	2020	2025	2030	2050
Cars	300	1,500-2,500	4,000-8,000	20,000-25,000
Vans	60	250-400	700-1,300	3,400-4,000
HDVs	<5	10	20	130

Dashed lines represent high uncertainty

Major milestone /enabler

Cost estimates are cumulative costs from 2015

CP = Charge point

Solutions to facilitate overnight charging will be required across residential areas and depots

Depots / workplaces and fleets

- Fleet operators of HDVs are likely to be faced with high local network reinforcement costs (already observed) –an investment in assets not own by the fleet operator: an unfamiliar risk and procedure

Recommendations

- Local gov. : facilitate the interface between DNOs and fleet operators and prediction of 'demand cluster' for optimised investment; socialise early adopter case studies to share lessons learnt
- Central gov. and regulator: align EV uptake ambition with network reinforcement needs to allow/encourage 'top-down' strategy (upfront investment in advance of need)
- R&D bodies: support trial of new technologies (e.g. inductive, ultra fast conductive, 'automatic plug-in' etc.) that would be more practical for fleets than current technologies

Mitigating the impact of electric vehicles on the network will require new technologies and new commercial arrangements

Impact on electricity network

- Without management of the charging time, **EVs will require large investment in new distribution infrastructure (substations, cables) and possibly new generation / interconnection capacity.** The Smart Grid Forum estimate that 'smart' technical and commercial solutions could **save in the order of £15bn** on distribution network reinforcement costs by 2050
- **DNOs will need information on EV location and uptake to plan investment** and smart solutions rollout accurately
- Research is needed to **understand relative impact of different charge point** deployments (3kW, 7kW or more)
- Although less studied **benefits to the grid could also be available**: as flexible loads, recharging EVs could provide important grid balancing services to maintain grid frequency, to manage supply and reduce renewable curtailment

Recommendations

- Central Gov. & regulators: support DNOs to access geographically disaggregated EV uptake data;
- Installers and DNOs: improve platform for compiling charge point installation notifications (as stipulated by IEC)
- Regulators, electricity suppliers and DNOs: develop new commercial arrangements and tariffs required for the uptake of smart charging solutions and for customer engagement [Ofgem's Low Carbon Fund already supports these activities]
- On-going trial programs:disseminate findings on local network management solutions to DNOs and related stakeholders
- R&D bodies & DNOs: Investigate network related topics: charging/demand management technologies, Vehicle-2-Grid, impact on battery life, co-locating energy storage devices with rapid charge points to alleviate strain on weak grid

In summary

- Increasing numbers of CVs, particularly LCVs, increasing source of GHG and impact on air quality.
- Range of technologies which are capable of reducing GHG and improving air quality.
- Electrification of powertrain focused on light and medium duty applications, opportunities for electrification of ancillaries and energy recovery.
- Accreditation scheme for vehicles and components can provide marketing opportunity for manufacturers, confidence for fleet operators and metric for Govt to set incentives against.
- Electrification of CVs will increase pressure on electricity distribution network and need for reinforcement or demand side management.
- Electric vehicles offer opportunities for demand levelling and V2G.
- To make most of electrification of vehicles will require a level of information flow between vehicles, recharging infrastructure and networks which is unprecedented.

Thank you!

Jonathan Murray
Low Carbon Vehicle Partnership
www.lowcvp.org.uk

Links to key studies on LowCVP website

- Market background study
- Technology Roadmap
- Technology Testing study
- Technology accreditation
- HGV Simulation tool
- LowCVP report on recommendations to accelerate the market for Low Carbon HGVs
- Auto Council Commercial and Off-highway Technology Roadmap
- Opportunities for low emission HGVs Report
- Infrastructure Roadmap Final Report
- Infrastructure Roadmap - Electricity
- Infrastructure Roadmap – Hydrogen
- Accreditation Scheme for Aftermarket Technologies - Sample Certificate (Updated 29.06.16)
- Development of test cycles and measurement protocols for a low carbon truck technology accreditation scheme. (Updated 29.06.16)
- Test Procedure for Measuring Fuel Economy and Emissions of Trucks Equipped with Aftermarket Devices. (Updated 29.06.16)

Low Carbon Emission Bus market