Electric freight vehicles – out of niche into mass market

Results of the IA-HEV Task 27 "Electrification of transport logistic vehicles"
3rd Workshop held in Vienna on October 19th, 2016

suggested citation format:

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IA-HEV Task Force 27

Electrification of transport logistic vehicles

2nd Workshop: "Experiences and prospects of electric freight vehicles"

- from city to distributor to transport company, including infrastructure technology -

April 12th, 2016

at Koninklijk Instituut voor de Tropen, Mauritskade 63, 1092AD Amsterdam

09:30 Start of Workshop

09:30 - 09:45 Opening and Task 27 introduction
Stephan Schmid, DLR and scientific delegate to the IA-HEV ExCo

09:50 - 10:00 Why Electric Transport Logistic Vehicles? - Major effects relevant to cities
Hans Quak, Senior Scientist at TNO

10:05 - 10:25 Analysis of (Inter)National Electric Vehicle Projects, Key Factors Underlying Success and Failure
Frank Rieck, Lector Future Mobility

Session 1: City and country perspectives

10:30 - 11:00 Best practice experiences of pioneer cities for electric freight vehicles: Case of Amsterdam
Eric Regterschot, Project manager sustainable Mobility of Amsterdam

11:00 - 11:10 Coffee break

11:10 - 11:40 Need for electric freight vehicles implementation: A common understanding of leading european cities
Jos Streng, Projectmanager of FREVUE in Rotterdam

11:45 - 12:15 Introduction of Korea activities in electric truck
Ock-Taeck Lim, Professor at Ulsan University

12:15 - 13:30 Electric truck demonstration and lunch break

Session 2: Early adopters of electric freight vehicles

13:30 - 14:00 Case of distributor TNT
Edwin Vermeer, Regional Operations Manager Rotterdam

14:05 - 14:35 Case of transport company Transmission
Bert Roozendaal, Transmission

14:35 - 14:55 Coffee break and networking

Session 3: Infrastructure for charging

14:55 - 15:25 eHighway System - Motivation, Current Status and Outlook
Hasso Grünjes, Siemens AG

15:30 - 16:00 Inductive opportunity charging - Status Quo and Outlook
Daniel Dörflinger, IPT Technology

16:00 - 16:10 Coffee break

Session 4: Panel Discussion

16:10 - 17:00 Plan of action for electric freight vehicle market penetration: Out of niche - into the mass market!
Moderation by Eric Beers

17:00 End of Workshop

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HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

IA-HEV

Welcome to IA-HEV Task Force 27 2nd Workshop

Experiences and prospects of electric freight vehicles

from city to distributor to transport company, including infrastructure technology

Enver Doruk Özdemir, Florian Kleiner, Martin Beermann, Bülent Çatay,
Eric Beers, Bob Moran, Ock Taeck Lim, Stephan A. Schmid

Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center
JOANNEUM RESEARCH LIFE
Sabancı Üniversitesi
Office for Low Emission Vehicles
rai vereniging Rijwiel en Automobiel Industrie
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iea Energy Technology Network

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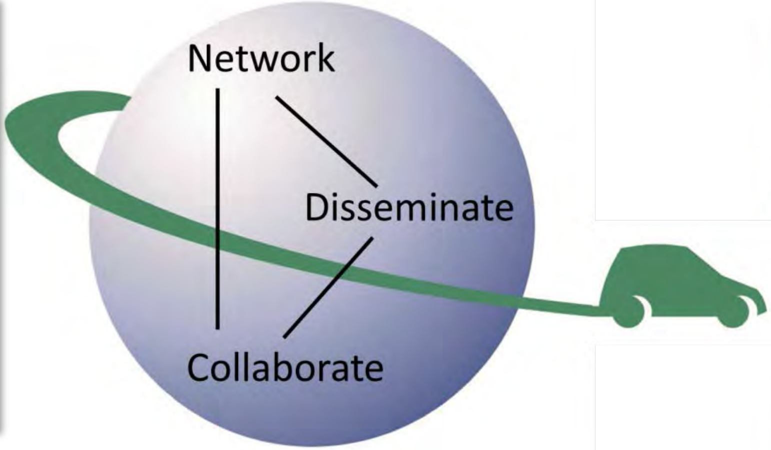
International Energy Agency
Hybrid & Electric Vehicle Implementing Agreement

IA-HEV 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



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Need for alternative vehicles

Ever increasing freight demand

- Worldwide road-freight activity and energy use have almost doubled in the last two decades *[IEA 2012]*

Challenges for Cities

- Worldwide urbanization and online retailing activities are increasing inner city air pollution *[UN 2011]; [RSS 2012]*

§

Expected changes of the regulation framework:

Emission free inner city delivery
CO_2 limits for HDV
...

Development and market introduction of alternative transport logistic vehicles is essential


[1]


[2]


[3]

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Task 27: Electrification of transport logistic vehicles
Objectives & Working Method

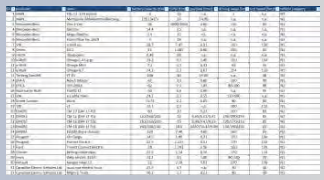
Objectives

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

(2) identify early niche markets and commercialization opportunities

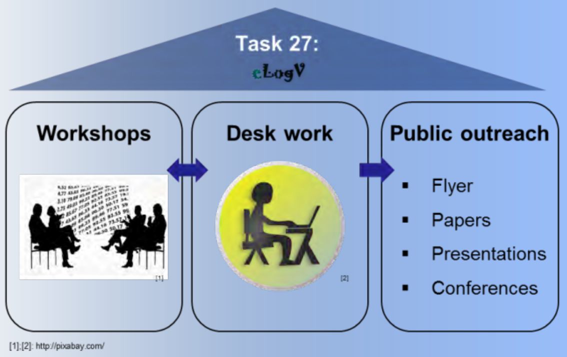
(3) provide policy recommendations for further research and deployment activities

project profiles



vehicle database

Working Method

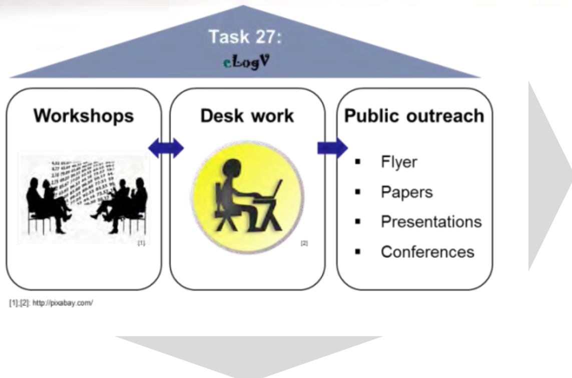


[1],[2]: http://pixabay.com/

Objectives are addressed in three ways:

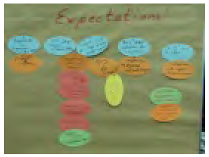
- workshops: to involve stakeholders and collect information
- desk work: to establish the scientific foundations, input for workshops and papers
- public outreach: to raise awareness in the broader community

Task 27 – current Outputs



- **EVS28 (2015) paper:**
  Comparison of country individual Relevant Cost of Ownership per ton-kilometers for light commercial vehicles
- **EEVC (2015) paper:**
  Status and trends for electrified transport logistic vehicles
- **EL-MOTION 2016 conference presentation:**
  International experiences within the IEA HEV Task 27 „Electrification of transport logistic vehicles“

- **1st Workshop held in Germany (2015-03-19)**:
  “Electric transport logistic vehicle technology and its application”
  - Expert presentations regarding battery and fuel cell technology and real world data from electric transport logistic vehicles
  - Workshop session – Hurdles of implementation: Discussions about barriers, drivers, strategies and expectations



- **Project profiles:**
  Key facts of ongoing or terminated demonstration projects from the partner countries
- **Vehicle database:**
  Key facts of electric commercial vehicles available on the market or presented as prototypes. Approx. 90 vehicles are listed up to now.

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JOANNEUM RESEARCH LIFE

IEA INTERNATIONAL ENERGY AGENCY HYBRID & ELECTRIC VEHICLE IMPLEMENTING AGREEMENT

WHY ELECTRIC FREIGHT VEHICLES? MAJOR EFFECTS RELEVANT TO CITIES

Hans Quak, TNO
IA-HEV Task Force 27

12 April Amsterdam

FRevue

VREF'S CENTER OF EXCELLENCE FOR SUSTAINABLE URBAN FREIGHT SYSTEMS

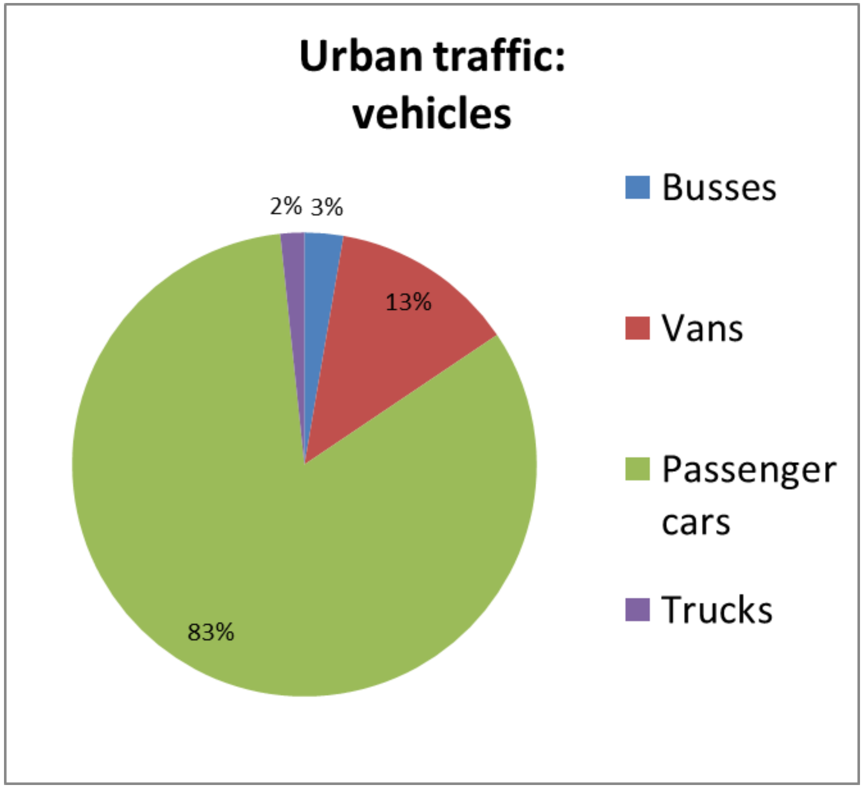
Introduction

Electric freight vehicles – why?

- Air quality is a problem in cities and CO_2 reduction an ambition
  - Ambition European Commission: zero emission urban logistics in 2030
  - Ambition in Green Deal Zero Emission City logistics (GDZES) in the Netherlands
- The logistics industry is a significant driver of economic growth and essential for sustaining the urbanized way of living,
  but is also a heavy contributor to unsustainable impacts, such as:
  - Polluted emissions, nuisance, decrease in traffic safety and accessibility
- The uptake of EFVs in the logistics industry does not go easily
  - Chicken and egg problem?

Commercial vehicles in urban traffic

- Commercial vehicles (vans and trucks) account for about 15% of urban traffic
- Varies slightly between cities (especially ratio trucks – vans)



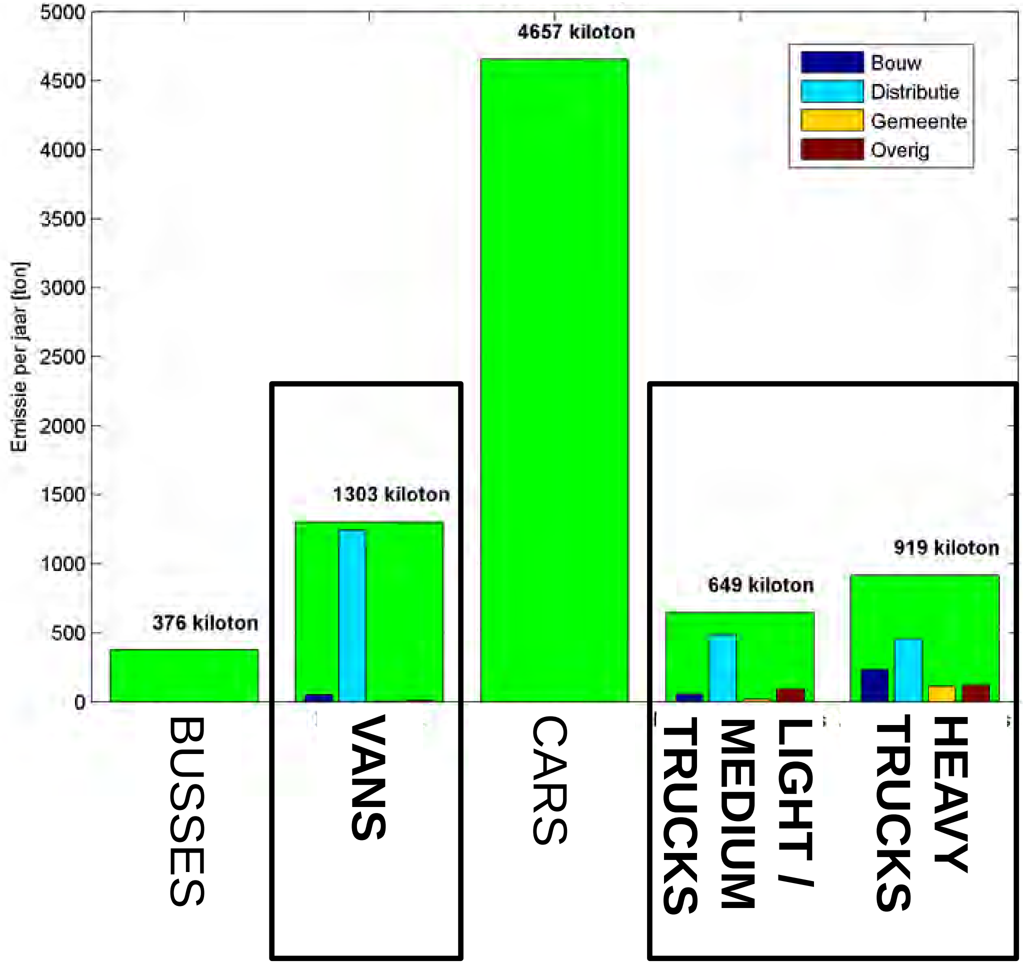
Source: Vehicle fleet scan Amsterdam (TNO, 2014)

What is a vehicle fleet scan and what data are used?

- Cameras registering license plates for one week of vehicles entering city
- Link to data on:
  - Among others: vehicle mass, fuel type, vehicle type and description, Euro-type, chamber of commerce data (including economic sector vehicle owner)

Urban freight transport

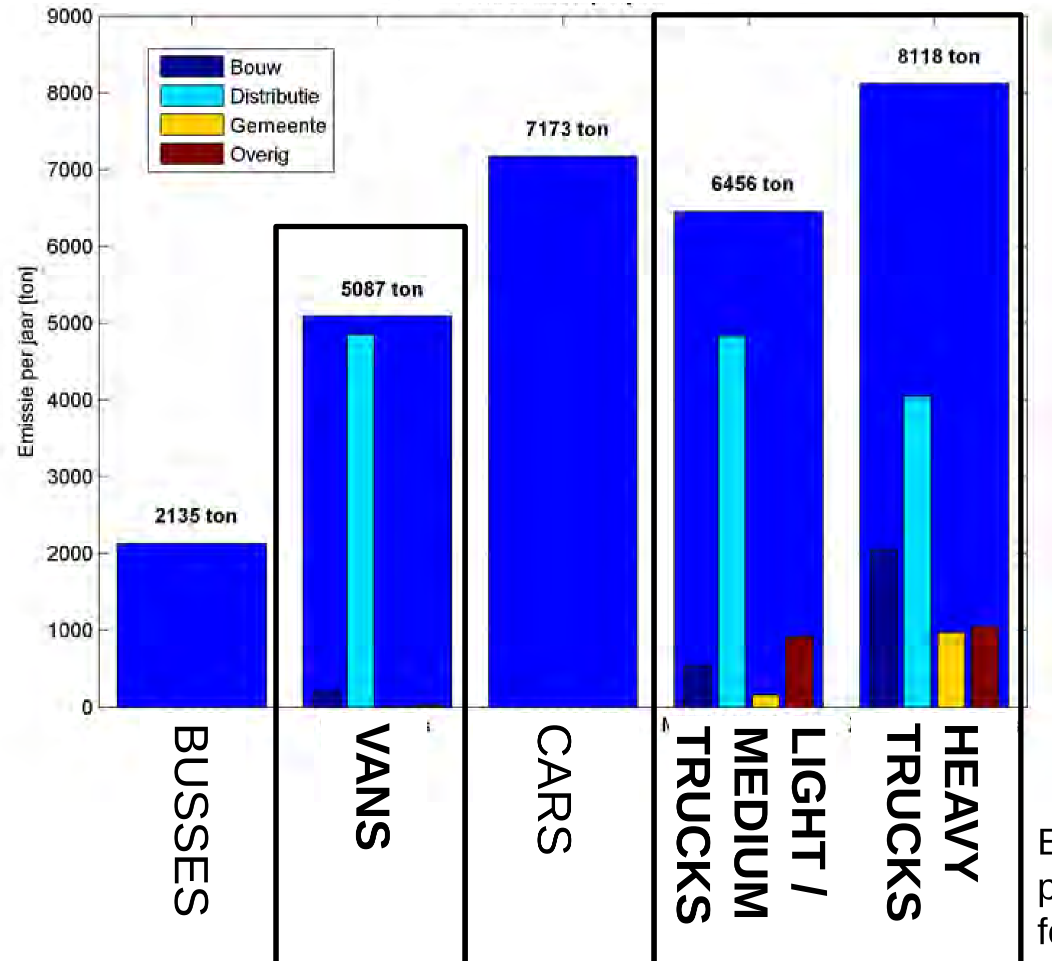
Total CO_2 emissions city traffic in the Netherlands



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

Urban freight transport

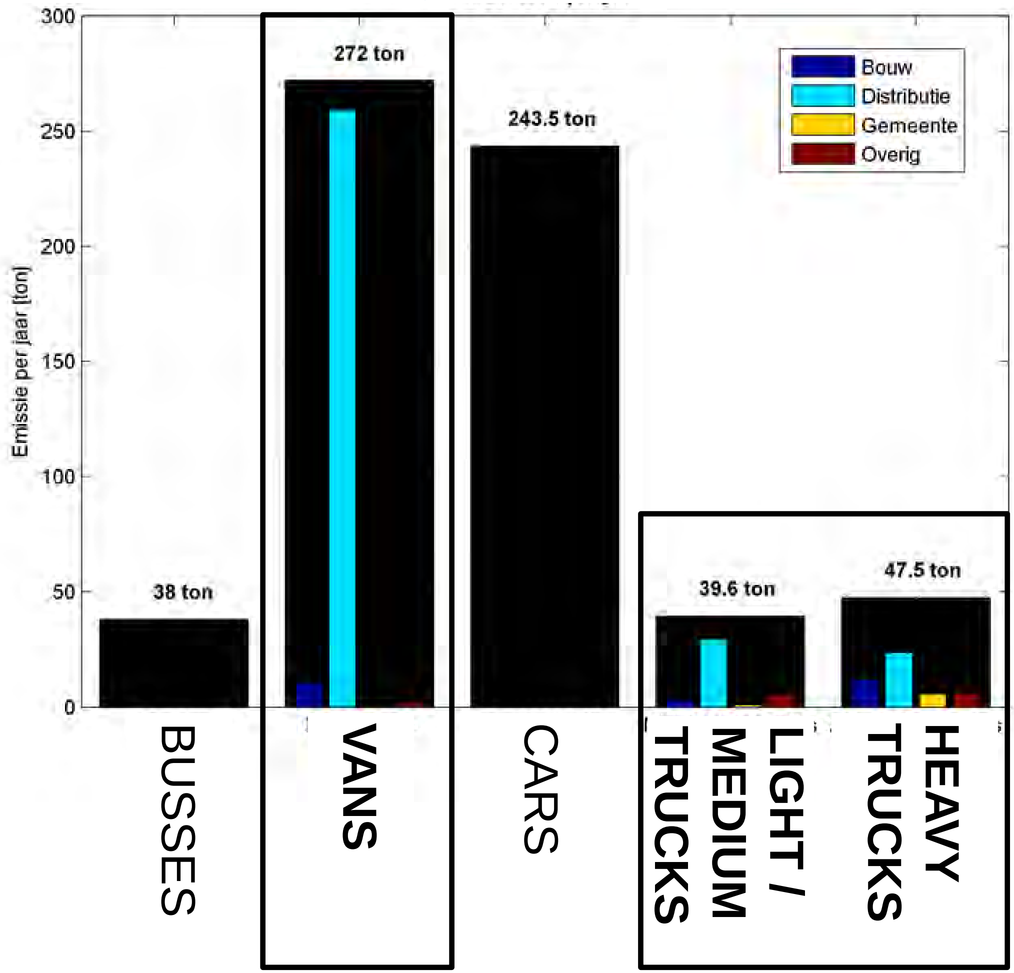
Total NOx emissions city traffic in the Netherlands



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

Urban freight transport

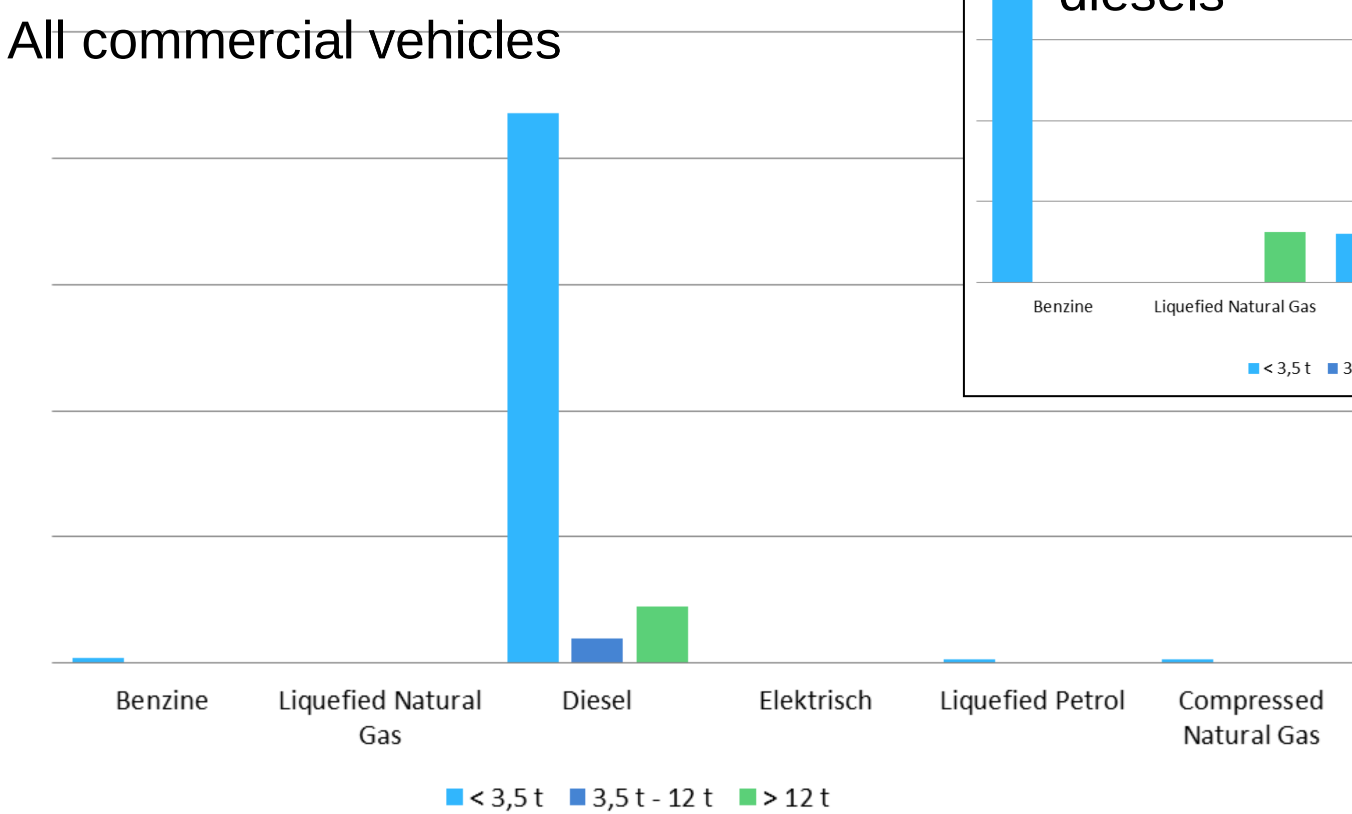
Total PM10 emissions city traffic in the Netherlands

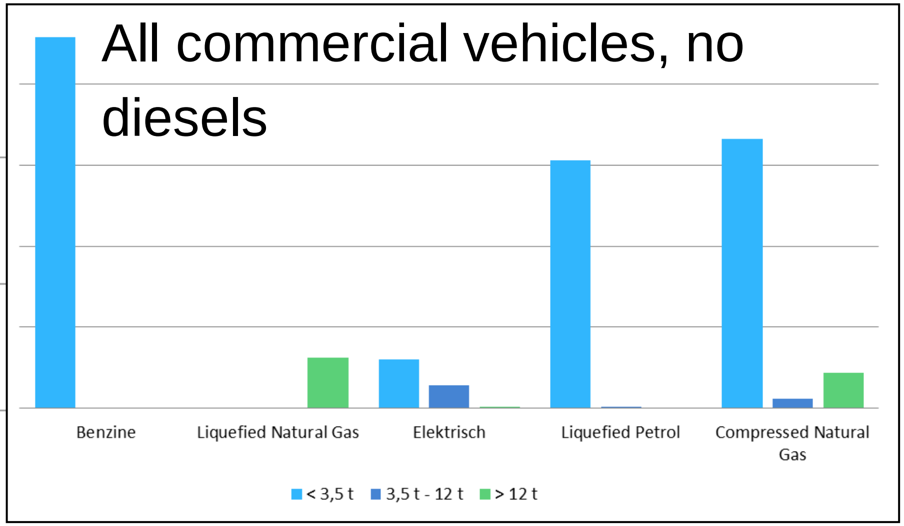


Estimated total emissions per year per vehicle type for all urban traffic in the Netherlands (TNO, 2015)

Commercial vehicles in urban traffic

Fuel type - example





- Diesel drivelines dominate in urban freight transport

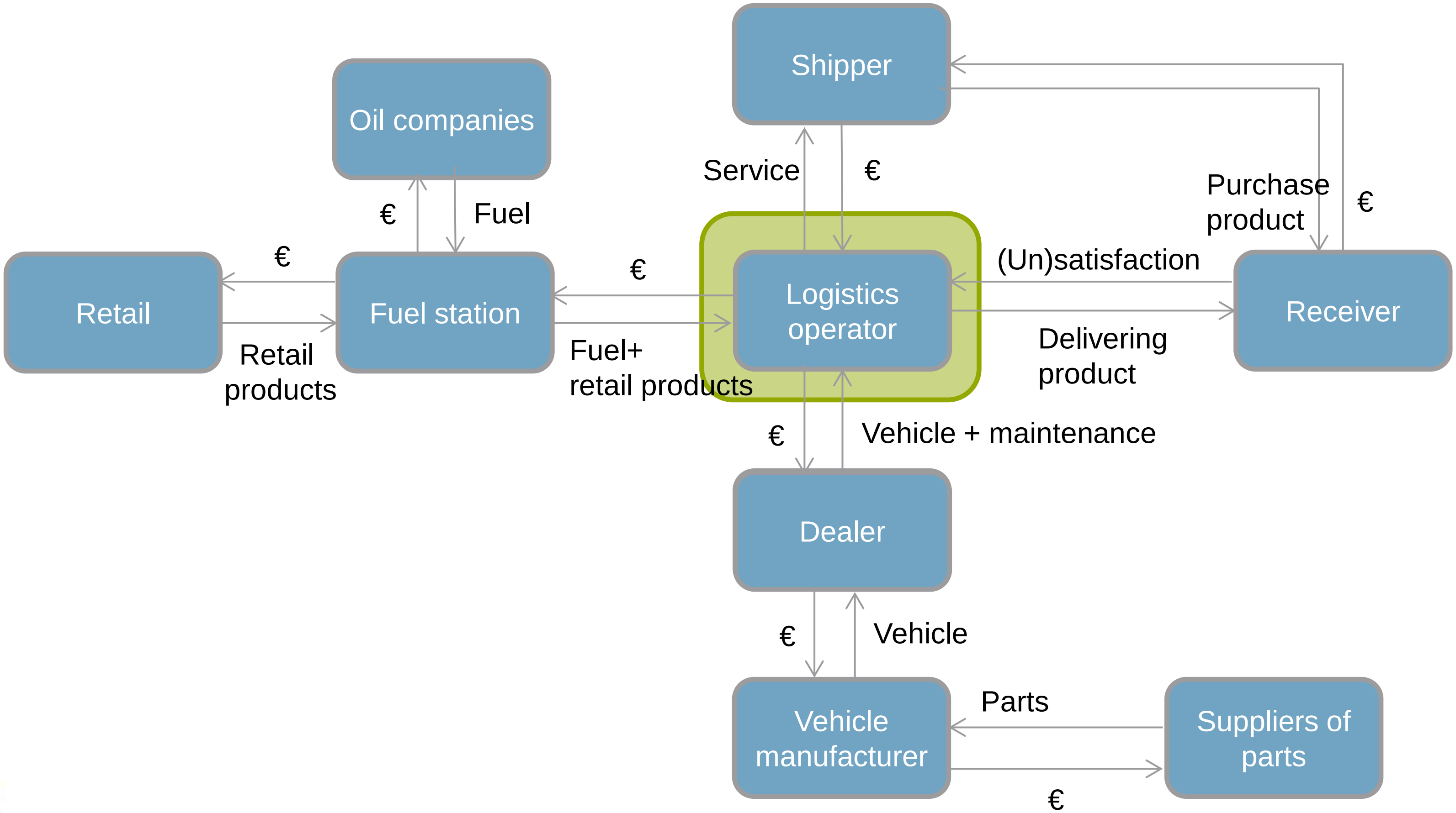
Based on vehicle fleet scan city of Utrecht (TNO, 2015)

CHALLENGE: TOWARDS ELECTRIC VEHICLES IN CITY LOGISTICS

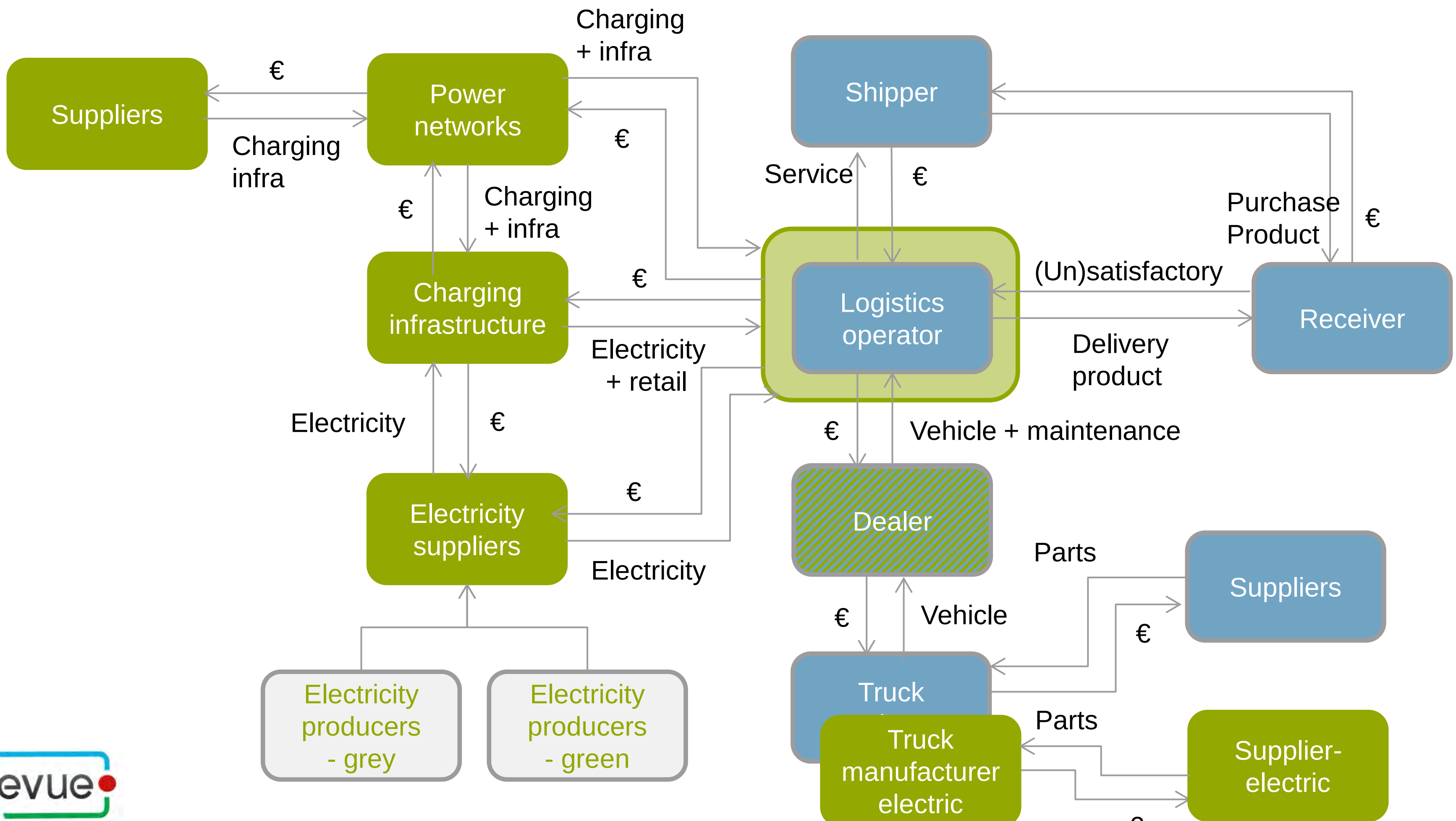
- How to make the transition from diesel dominated urban freight transport to more electrified city logistics?

- Challenges:
  - Solve chicken and egg problem… current market situation
  - Not just replacing vehicles (EFV instead of ICEV), in most cases business case is not feasible:
    - New network and new partners needed for logistics companies
    - High initial costs (vehicle and charging infrastructure), lower operational costs (fuel vs. electricity, policy privileges)
    - Limited range requires other logistics organization
    - (Almost) no extra revenues for more sustainable transport

CURRENT SITUATION (ICE VEHICLES USED FOR CITY LOGISTICS)

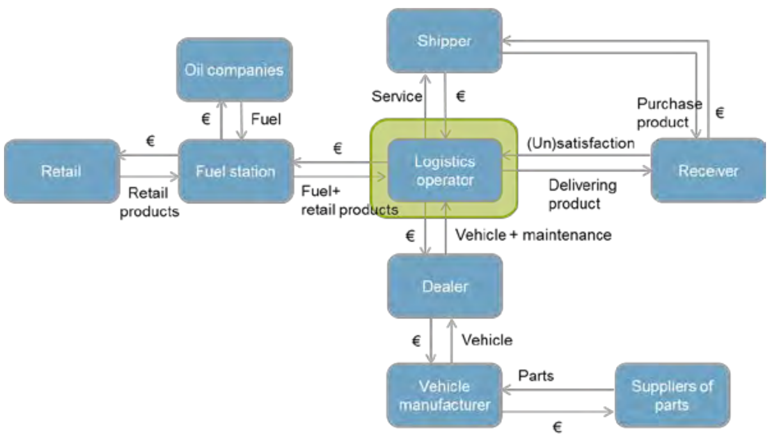


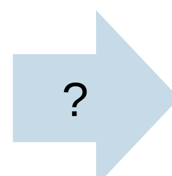
ELECTRIC FREIGHT VEHICLES SITUATION (EFVS USED FOR CITY LOGISTICS)

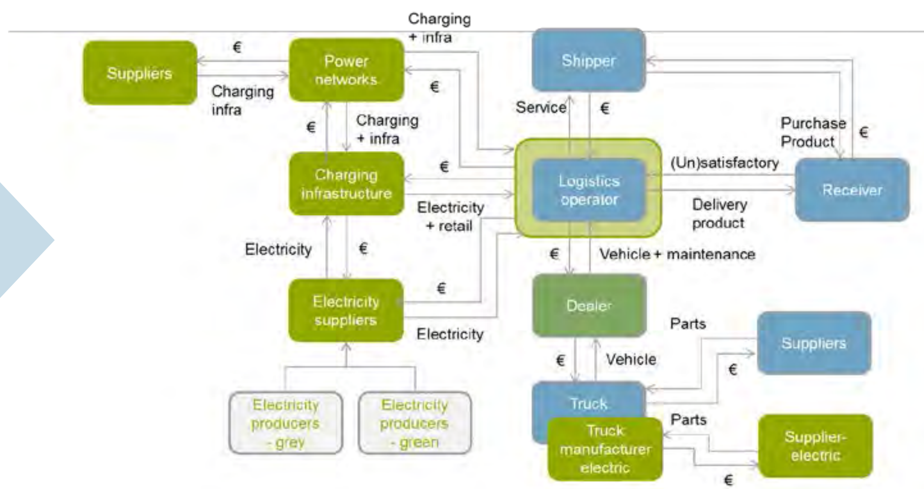


CHALLENGE: TOWARDS ZERO EMISSION CITY LOGISTICS

- **How to make the transition?**







So..

Electric freight vehicles – why:

- City logistics activities have unsustainable effects (both for local air quality and contribution of global emissions): electric vehicles can have a huge positive effect to counteract these effects, while maintaining an efficient urban logistics systems

- Urban deliveries and trips do fit electric vehicle characteristics, but it requires (serious) changes for operators to actually use EFVs

- Yes: there are challenges, but also good examples how to deal with these (as will be presented later today)

THANKS FOR YOUR ATTENTION

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For more information:

- FREVUE Deliverable 1-3 addendum 1 ‘State of the art of the electric freight vehicles implementation in city logistics - Update 2015’ (http://frevue.eu/category/about-us/public-documents/)
- Quak, H.J., N. Nesterova, and T. van Rooijen (2016). Possibilities and barriers for using electric-powered vehicles in city logistics practice, Transportation Research Procedia, Volume 12, 2016, Pages 157–169, Tenth International Conference on City Logistics 17-19 June 2015, Tenerife, Spain

"Experiences and prospects of electric freight vehicles"

Analysis of (Inter)National Electric Vehicle Projects, Key Factors Underlying Success and Failure

Frank Rieck, Professor Future Mobility

April 12th, Amsterdam

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Rijksdienst voor Ondernemend Nederland

dutch-incert DUTCH INNOVATION CENTRE FOR ELECTRIC ROAD TRANSPORT

ANALYSIS OF (INTER)NATIONAL ELECTRIC VEHICLE PROJECTS

KEY FACTORS UNDERLYING SUCCESS AND FAILURE

Assignment: Evaluation Living lab Hybrid and Electric Vehicles
Netherlands Enterprise Agency (August 2014)

Dutch-INCERT, Eindhoven University of Technology and Rotterdam University

AUTHORS: Adrie Spruijt MMC and ir. Frank Rieck
Drs. Ewit Roos and Tobias Platenburg BSc

November 16, 2015

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National & International Pilots

NL:

- **Rotterdam Tests Electric Vehicles**
- **Full Electric Garbage Truck**
- **Elektropool Haaglanden**
- **CityShopper urban delivery service**
- **Urban distribution with Hytrucks**
- **Express delivery / Courier service**

EU:

- **FREVUE (Freight Electric Vehicles in Urban Europe)**
- **DELIVER**

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EV's on the Dutch roads per type

Number per type	31 Dec 2012	31 Dec 2013	31 Dec 2014	31 Jan 2015	31 Aug 2015
Passenger car (FEV)	1.910	4.161	6.825	7.152	8.707
Passenger car (E-REV, PHEV)	4.348	24.512	36.937	38.978	50.926
Commercial Vehicle < 3.500	494	669	1.258	1.267	1.392
Commercial Vehicle > 3.500	23	39	46	46	52
Busses incl hybrid and trolley busses	67	73	80	80	88
Quadricycles (like Renault Twizzy)	469	632	769	774	842
Motor cycle	99	125	196	203	280
Total on the road	**7.410**	**30.211**	**46.111**	**48.500**	**60.490**

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Different categories of Commercial Vehicles

In Europe, the vehicles used for road transport are categorised as follows

Vehicle class	Gross vehicle weight	Field of application
Van (N1)	Below 3.5 t	Service and delivery vehicle
Light truck (N2)	3.5 – 7.5 t	Short haul
Medium truck (N2)	7.5 – 12 t	Medium short haul
Heavy truck (N3)	Above 12 t	Motor tractor in articulated train construction traffic
Road tractor (N3)	Usually up to 40, resp. 44 t	Long distance haul

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City distibution Hytruck

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Spijkstaal garbage truck

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Clean & silent City Movers

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Light Commercial segment

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Light van & Cargo Hopper

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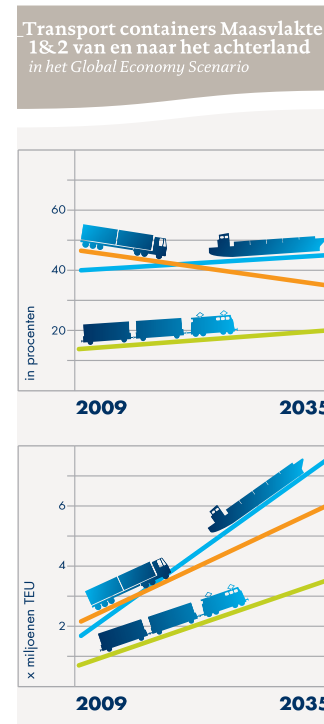
In-harbour container transport: 40% of road trips shorter than 30 km

Afbeelding 11. Overzicht containerterminals Havengebied Rotterdam[11]



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Source: M@R

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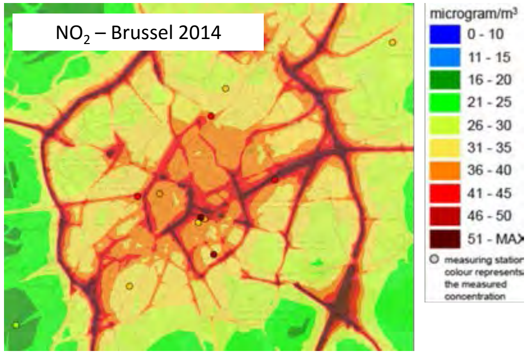
EV’s in Port of Rotterdam

Ref: ECT, APM Terminals, APTS VDL & Terberge

Drivers for Urban e-Mobility

- Today: Air quality / Fine dust



- Today: City & Port Logistics
- Today & Tomorrow: Noise / Quality of live
- Tomorrow: Energy / CO_2

- **Always: €€€€€€€**

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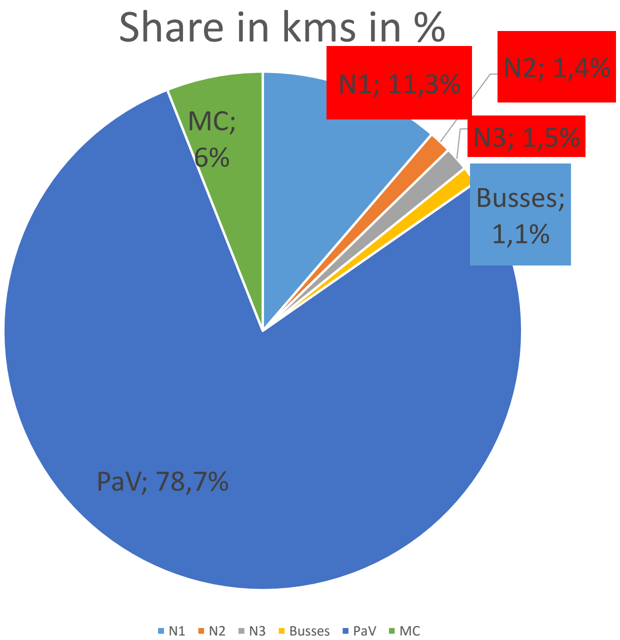
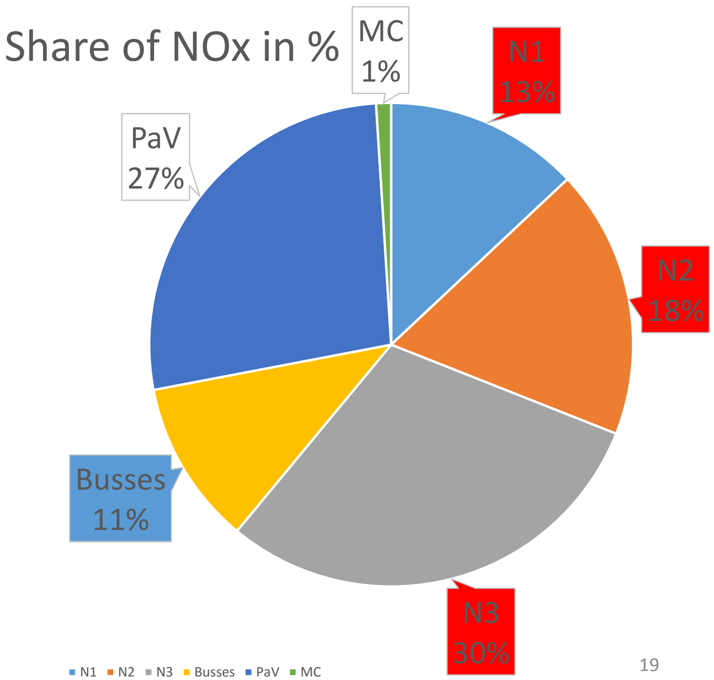
Freight: The 'big three' city polluters

In 2015 72% of the NO_x emissions are caused by 15% of the mileage in Dutch cities – *Source TNO*





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There is no single solution

Systeem	Range	Charge	Cost	Emissions	Human
Battery-Electric system	Fair 300 km ⇑	Bad 3 uur ⇓	Good	Good	RA
Electric with range extender	Good 900 km	Good 10 min.	Fair cost ⇓	Fair	FA
Fuel Cell-Electric system	Good 900 km	Good 10 min.	Bad cost ⇓	Good	NA

‘Horses for Courses’

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Research: eMobility-Lab

- Regenerative energy
- Safety
- Cost
- Service

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Typical losses in the energy chain

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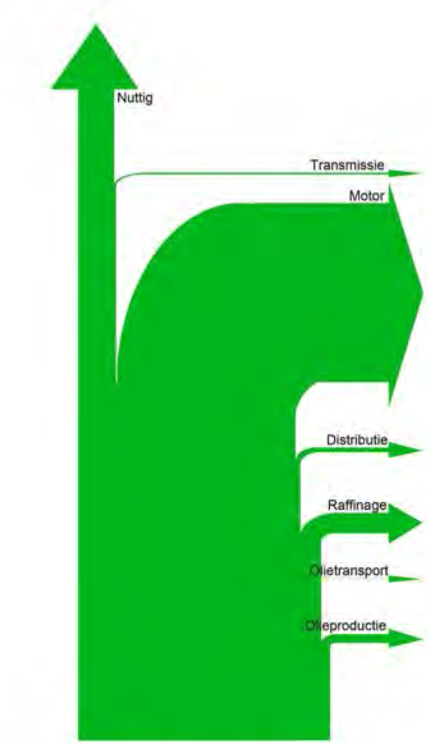
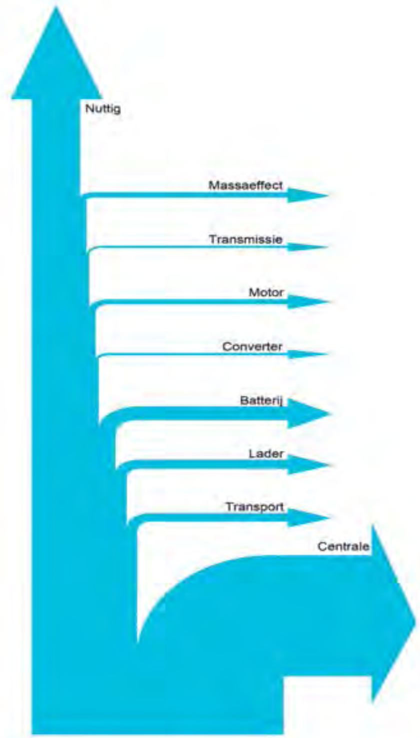
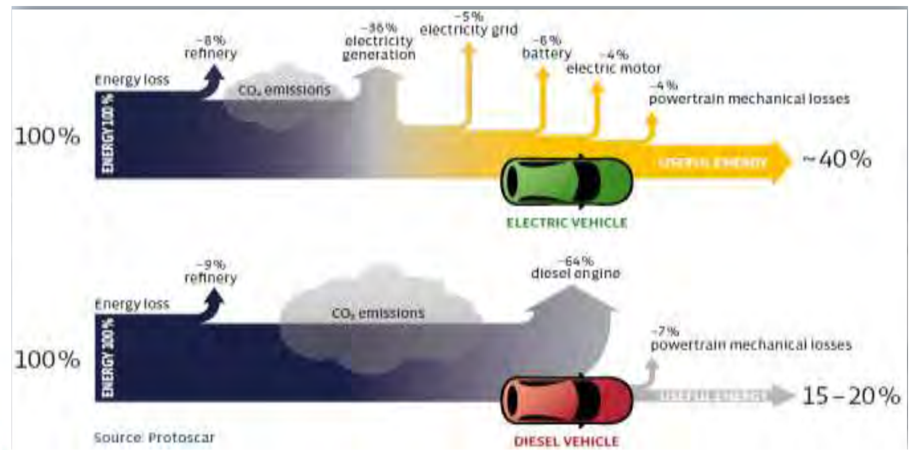


ICE- gemiddelde verliezen



EV- gemiddelde verliezen bij Nederlandse MIX



Regenerative Energy

Stichting Innovatie Alliantie
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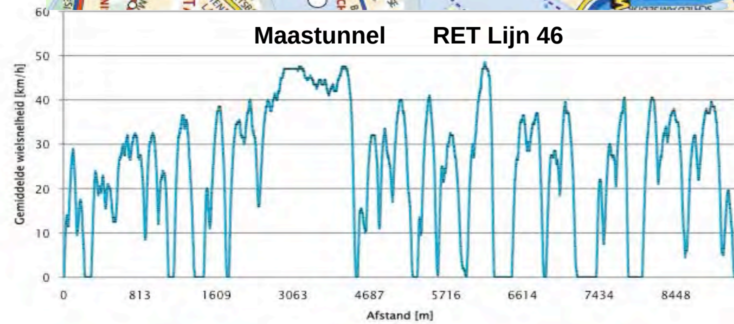
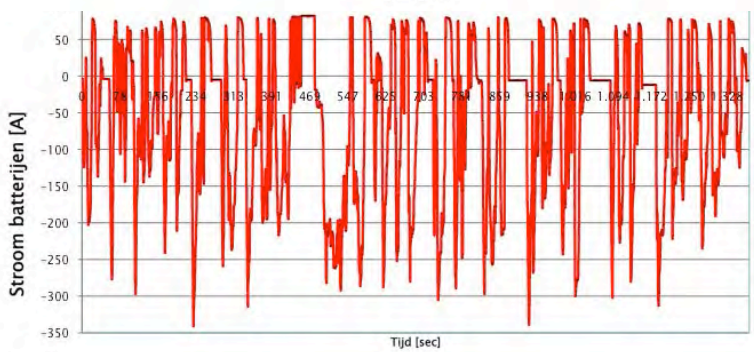
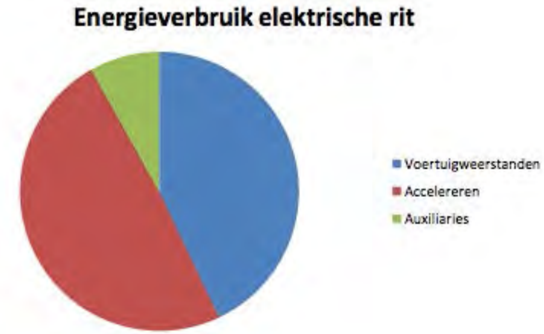
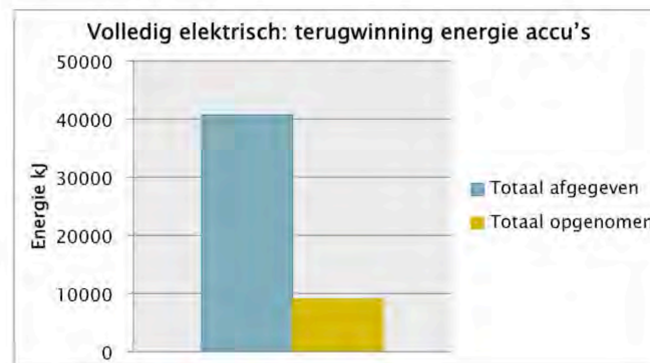






Typical 1.2 kWh per km



33% Recuperation
= 120kW / 1.5C

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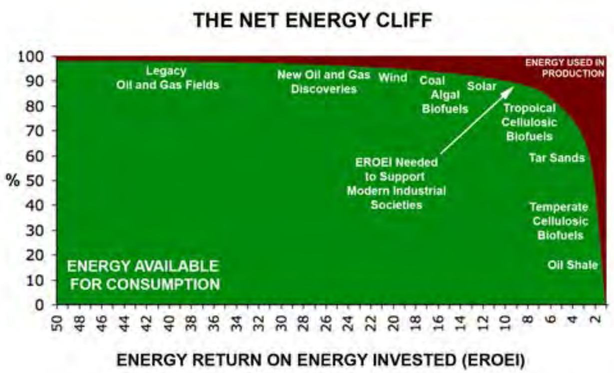
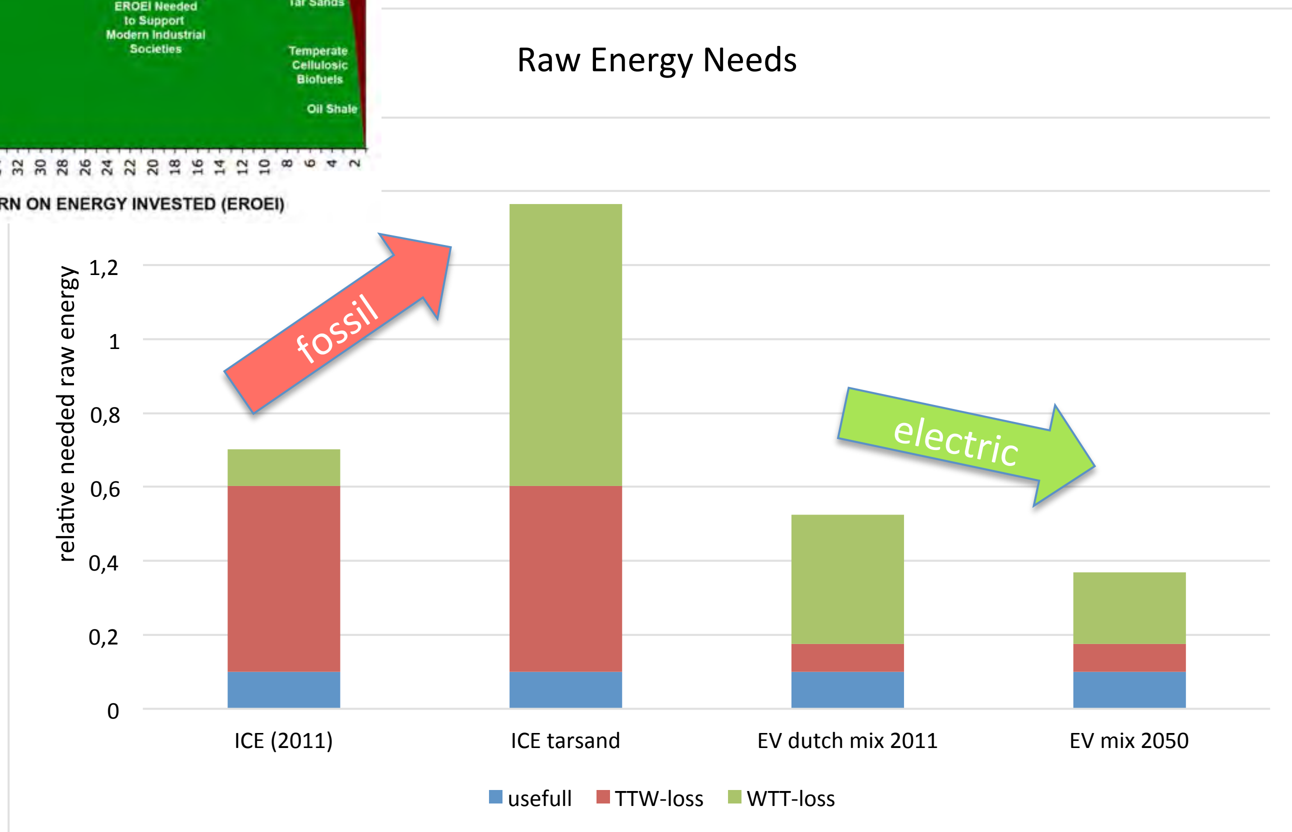
Future proof





Total Cost of Operation

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SPIJKSTAAL
ECOTRUCK

Kosten Binkie functionele eenheid bij batterijpakket**:		Batterij 1		Batterij 2
Levensduur van de betreffende batterij (ongeacht duur functionele eenheid)		4,8		9,6
Aantal jaar dat het batterijpakket wordt gebruikt		4,8		5,2
Afschrijvingskosten	€	99.760,00	€	99.320,00
Onderhoudskosten	€	54.240,00	€	58.760,00
Energiekosten inclusief afschrijving batterijcellen	€	43.440,00	€	26.260,00
Wegenbelasting	€	-	€	-
Verzekering	€	2.491,20	€	2.698,80
Financieringskosten	€	58.572,00	€	70.092,00
CO2-tax	€	-	€	-
Ecokosten	€	-	€	-
Subtotaal niet persooneelskosten	€	*258.503,20*	€	*257.130,80*
Personeelskosten	€	415.008,00	€	449.592,00
Kosten functionele eenheid bij batterijpakket:	€	**673.511,20**	€	**706.722,80**
Schade (kostenverschil in opbouw)	€	12.000,00	€	13.000,00
Totale kosten functionele eenheid bij batterijpakket:	€	**673.511,20**	€	**706.722,80**
Totale kosten functionele eenheid	€	**1.380.234,00**		

Kosten conventionele vuilniswagen functionele eenheid		
Functionele eenheid in jaren		**10**
Afschrijvingskosten	€	186.200,00
Onderhoudskosten	€	190.000,00
Brandstofkosten*	€	76.320,00
Wegenbelasting	€	22.320,00
Verzekering	€	5.190,00
Financieringskosten	€	95.000,00
CO2-tax	€	-
Ecokosten	€	2.625,00
Subtotaal niet persooneelskosten	€	*577.655,00*
Personeelskosten	€	910.000,00
Kosten functionele eenheid	€	**1.487.655,00**
Schade (kostenverschil in opbouw)	€	**100.000,00**
Totale kosten functionele eenheid	€	**1.587.655,00**
Totale kosten functionele eenheid		**1.587.655**

€207.421
Verschil

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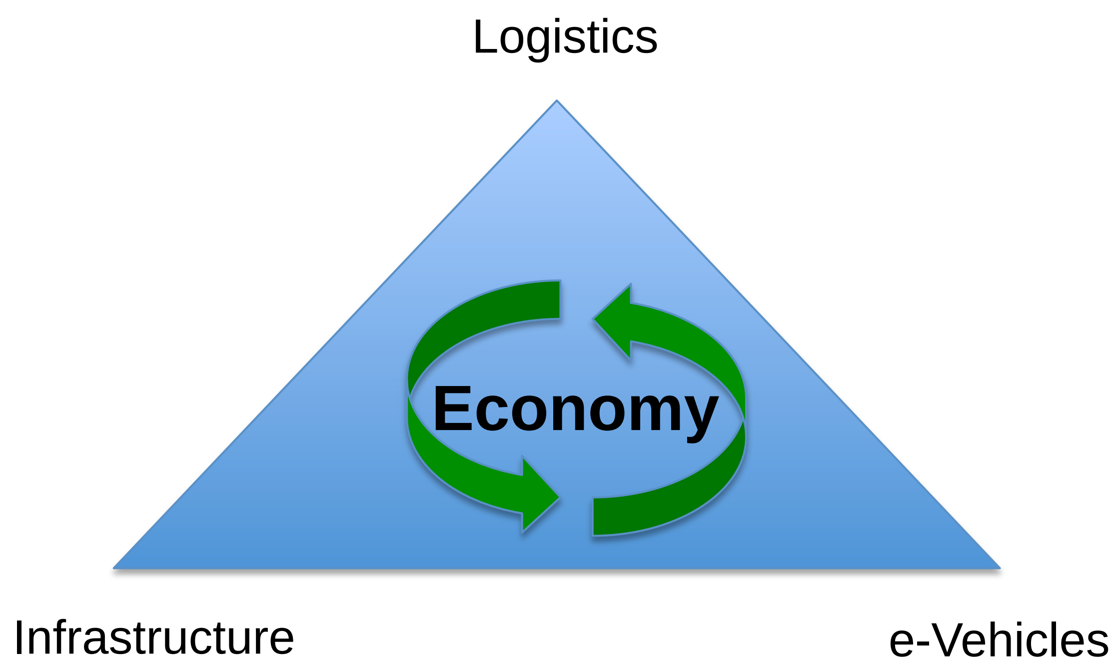
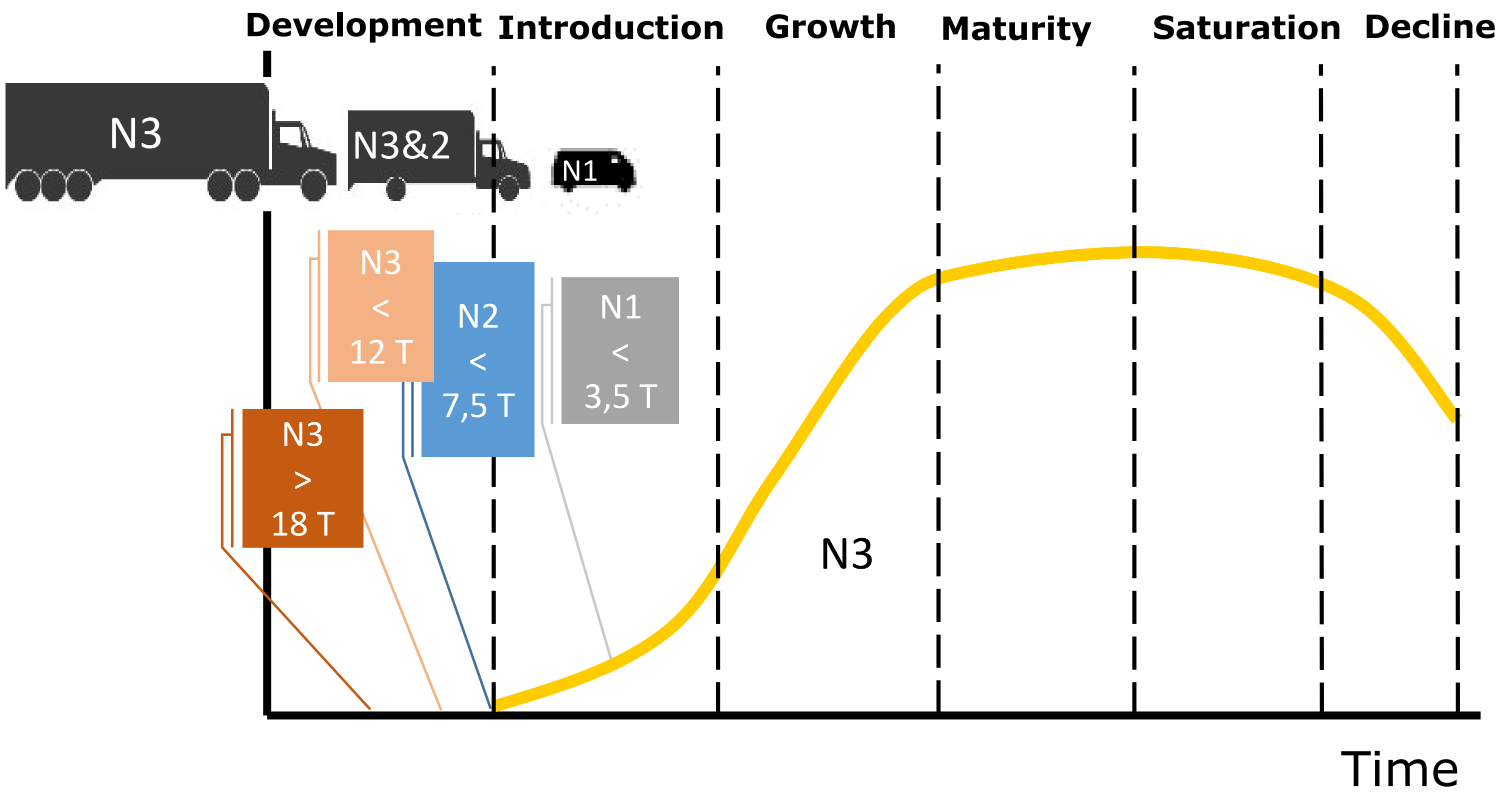
The economic triangle of e-Mobility

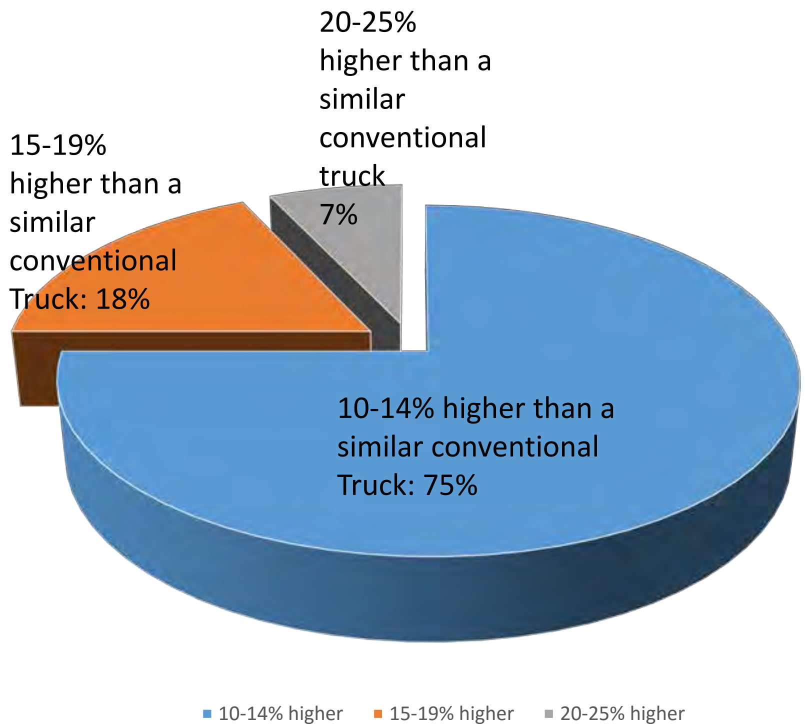


Lack of scale in e-Truck supply



Little Purchase Price Elasticity

Maximum Price Willing to Pay for Hybrid / EV vehicles that are Very/Somewhat Familiar with Diesel Fueled Trucks (N=55) Frost & Sullivan 2011



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From technology focus to TCO viability

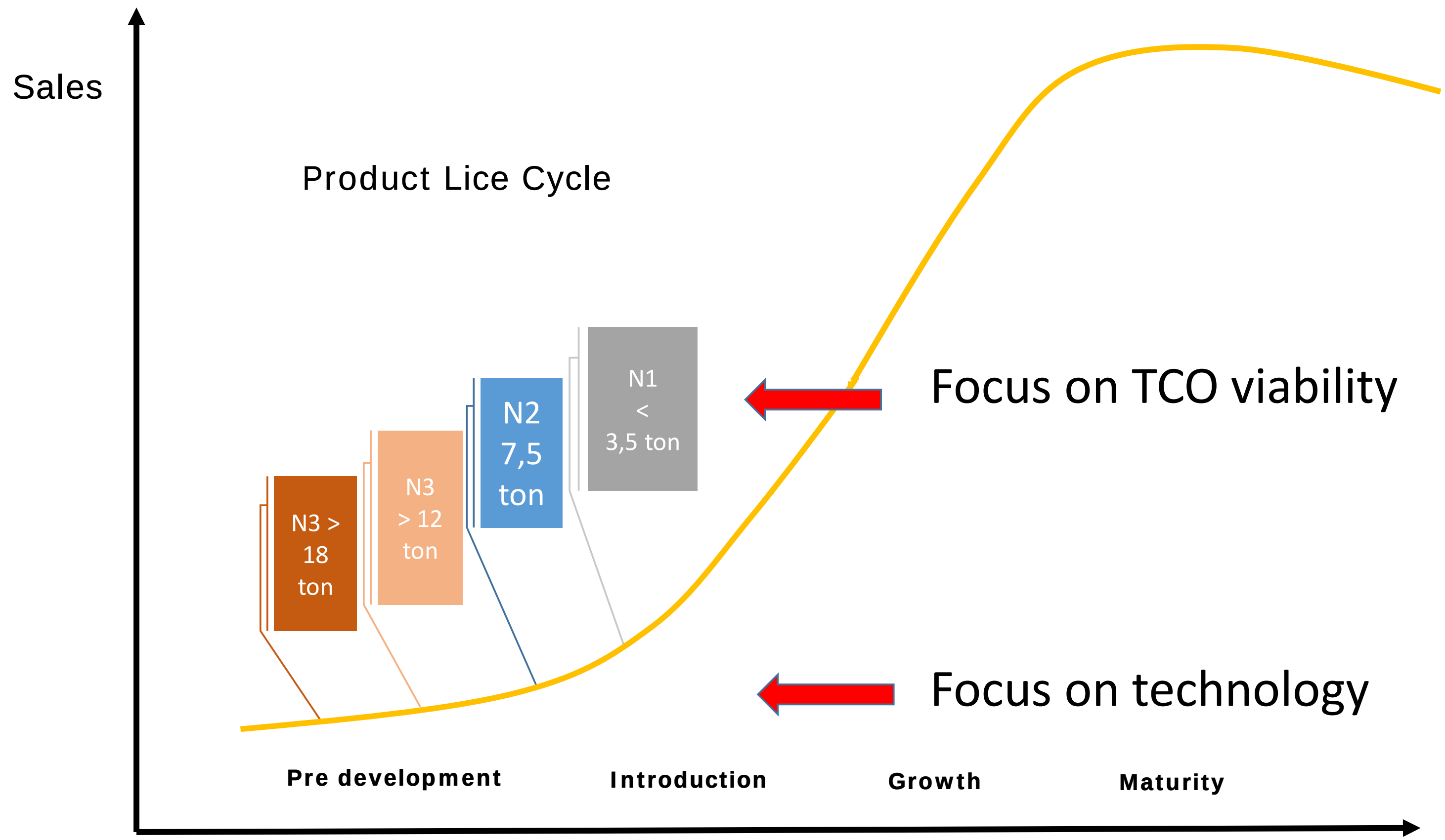

Figure 8.2.4.1 Focus of stimulation per commercial vehicle category

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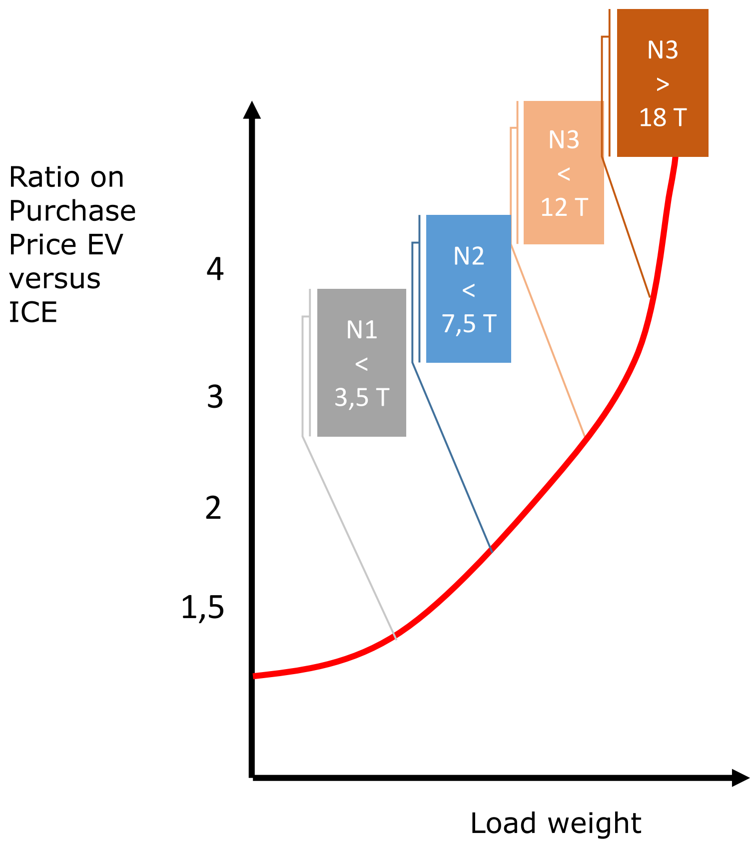
Ratio Purchase Price EV versus ICE



- Category N2 & N3: Converted vehicles
- In commercial vehicles > 3,5 ton the purchase price increases exponentially. From 1,5 to 4
- Higher purchase price cannot be recouped by low maintenance cost and lower energy cost per km
- Especially not in urban areas where driving distances are relatively short.

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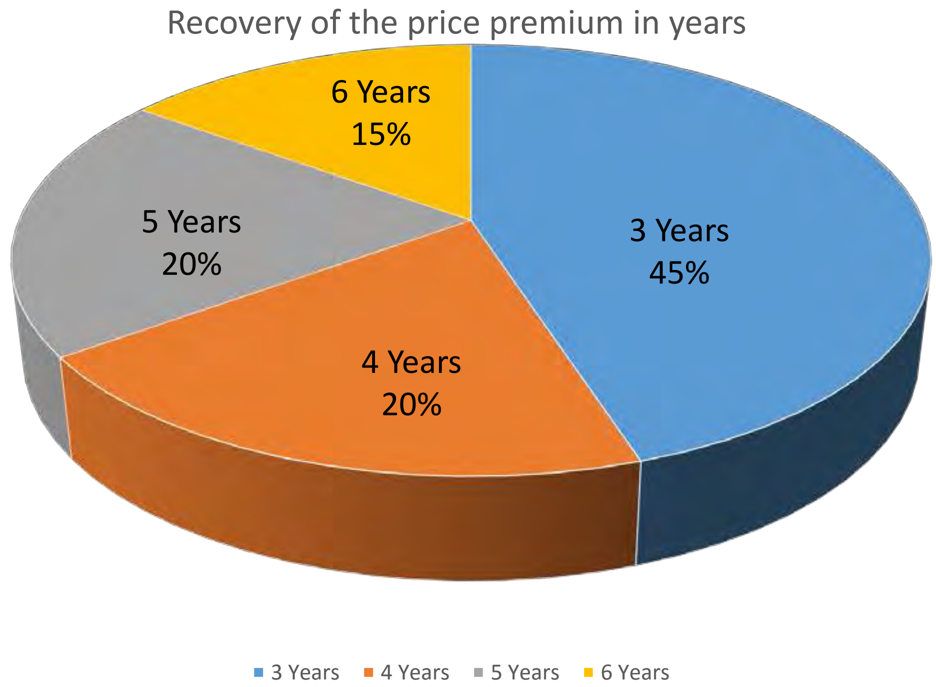
Short Payback Period needed

Hybrid Truck Payback Considerations: Fleet Managers in U.S. Most Comfortable With a Payback Period of 3 Years.

The payback period is another criterion that appears to be important. The majority of fleet managers declare a period of three to four years as the period of amortization in which they expect to recover the purchase price of an EV.



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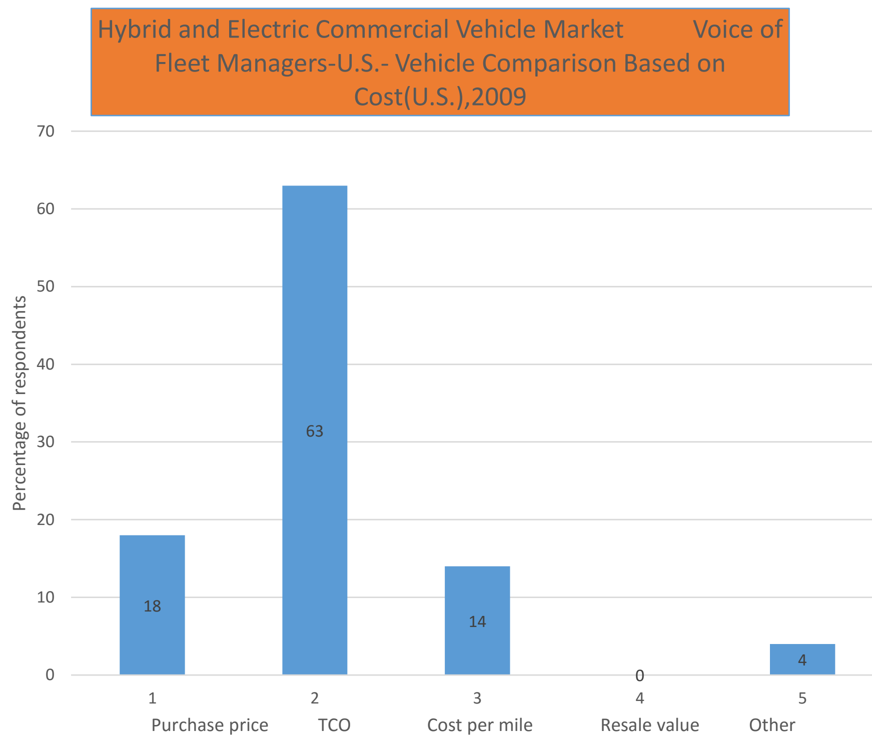
A Viable / positive TCO is the determining factor

- Higher purchase price cannot be recouped by low maintenance cost and lower energy cost per km. *Especially not in urban areas where driving distances are relatively short.*
- Energy density of batteries compares unfavorably to diesel or gasoline; → additional weight → lower payload.
- Specific task design prevents overall deployability
- Higher depreciation
  - Limited deployability
  - Life time batteries



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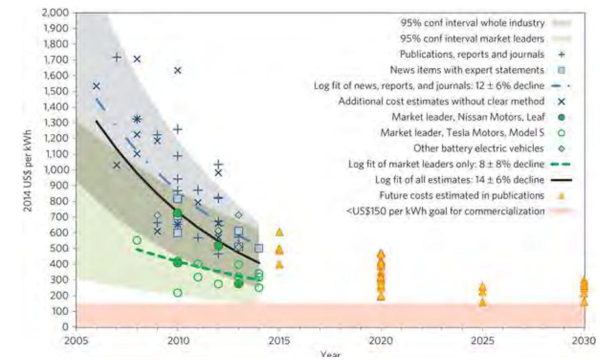
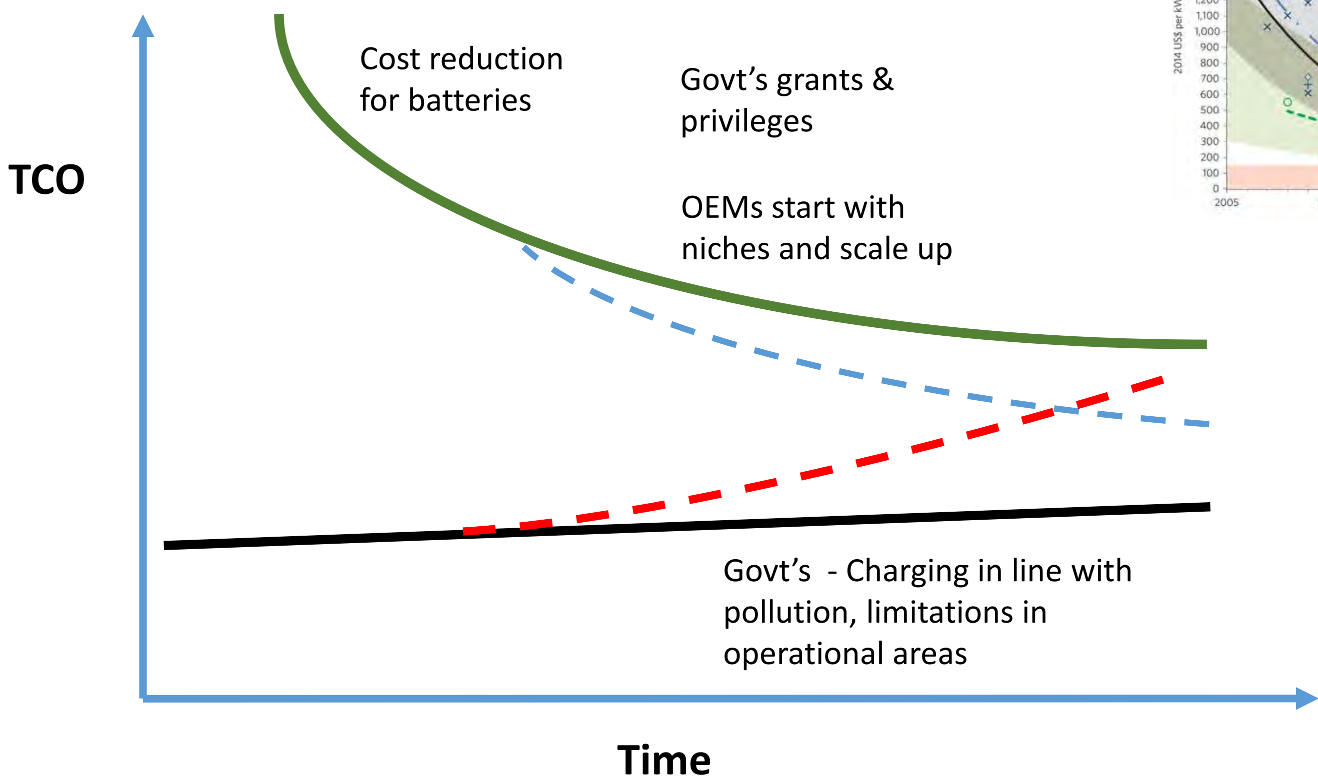
Changing TCO in favour of EV





Are Hybrids and HEV's Old Cows?

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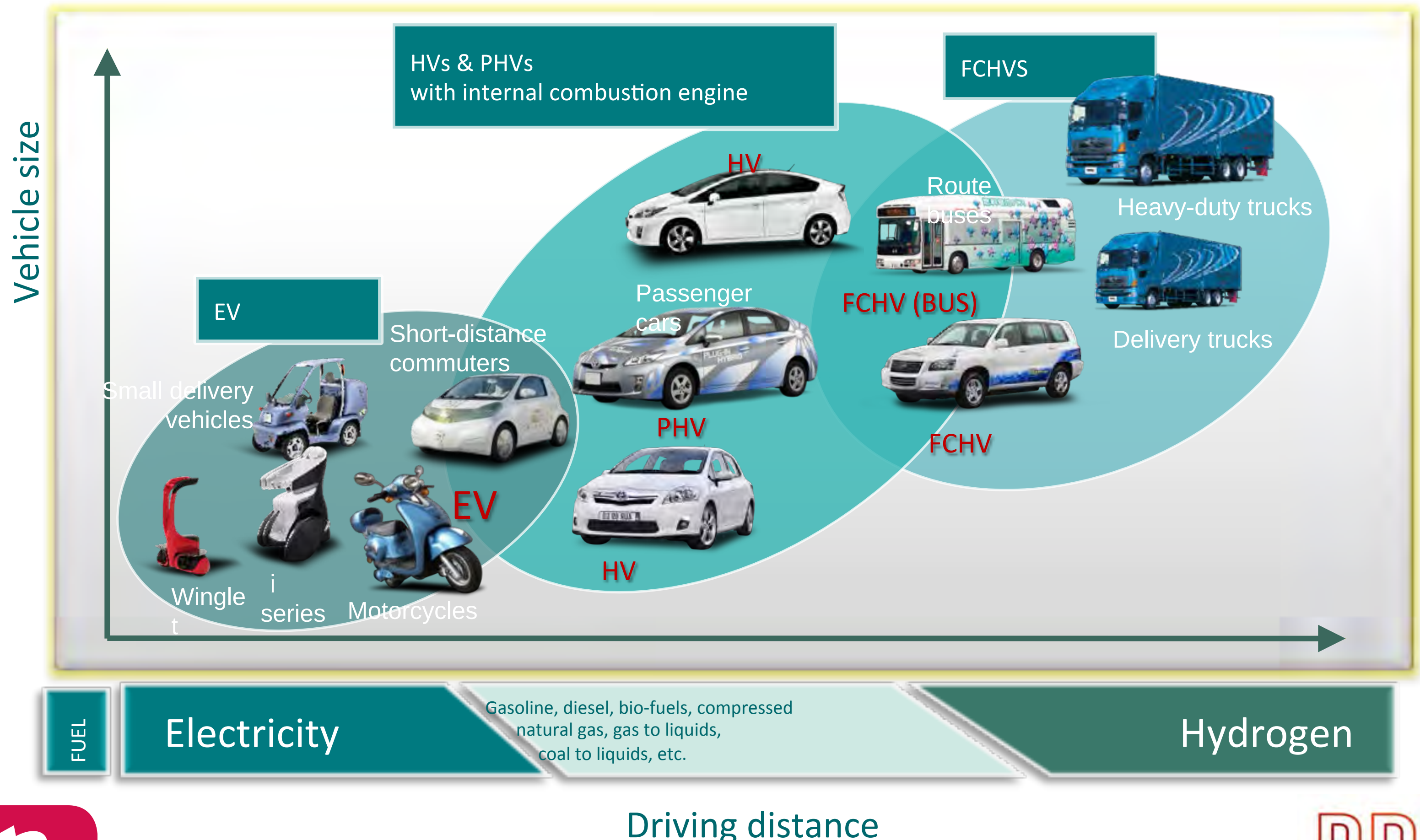
Long-distance: Hybrid & H2?

Innovam 2014: For heavy commercial vehicles aimed at long-distance transport diesel power remains the main driveline until 2025.

Hybrid and Electric MCV, HCV, Transit and Other Bus Market: Electric Commercial Vehicle Suitability, (Americas and EMEA) 2009

GCW / GVW 1* (ton)	Load Capacity (ton)	Typical Application	Pure Electric Attractiveness
3.5	1.5	Urban distribution	✓ ✓ ✓
7.5	4	Urban distribution	✓ ✓
12	7.2	Urban distribution	✓
18	11	Inter Urban distribution	✗
26	17	Long distance	✗✗
40	25	Long distance	✗✗✗

Powertrain map for Future Mobility



(2009 TMC research)

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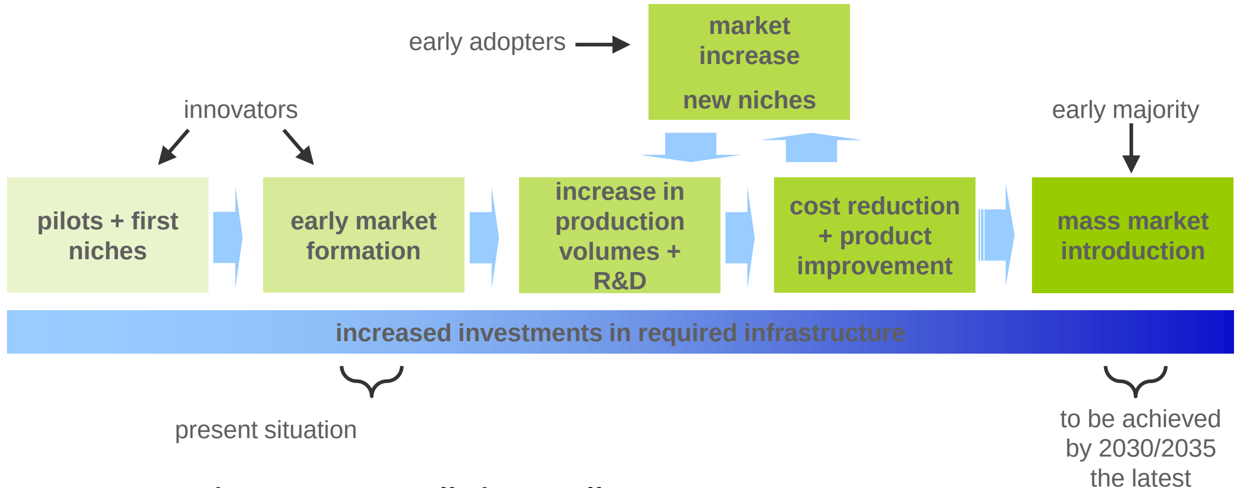
The crucial rol of Pilots

Iterative process is needed to scale up electric transport and to bridge the "valley of death"



- But this is not a "classic" innovation
- There is a complex system change needed: Transition

And this innovation is “need to have” and not “nice to have”

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Differentiated stimulation needed

- N1 Market growth / scale
  - Fiscal arrangements
  - Grants and privileges depending on deployment
  - Purchase N1 for public services like service cars, vans for transport WMO / disability (eg Nissan NV 200).
- N2. Scaling up
  - Guarantees, financial funds
  - Stimulating cooperation and sharing of knowledge
  - Grants and privileges depending on deployment
- N3 Innovation
  - Stimulating innovation by grants
  - Stimulating cooperation and sharing of knowledge
- Apart from this, it is important to differentiate within categories. So movers are easier as segment than heavy trucks that supply supermarkets.

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Key findings for stimulation

- Policy makers should
  - Continue to focus on urban areas for short and medium term
  - **Differentiate supporting policy to PLC stage**
  - **Focus on low hanging fruit / sub segments / Niches → Scale**
  - **Interact more with individual firms to gain industry support rather than industry associations**
  - Continue political effectiveness of employing a "carrot and stick" approach that combines technology-forcing with demand-pull policy.
  - Negotiate preferential treatments of certain technologies over others, if possible
  - **Uniform policy on grants – vertical and horizontal – Harmonize between cities!**
  - **Long term concessions for public transport**

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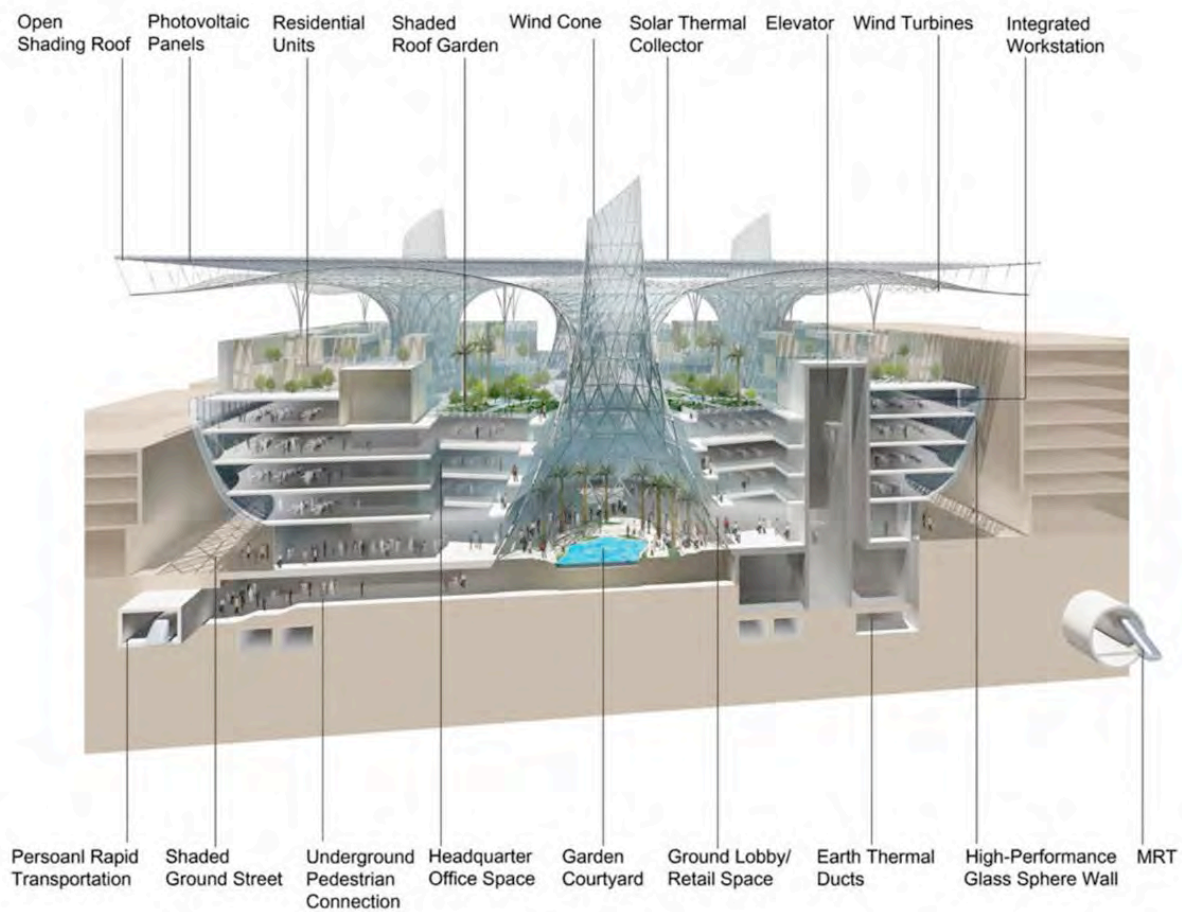
If we could build an new city



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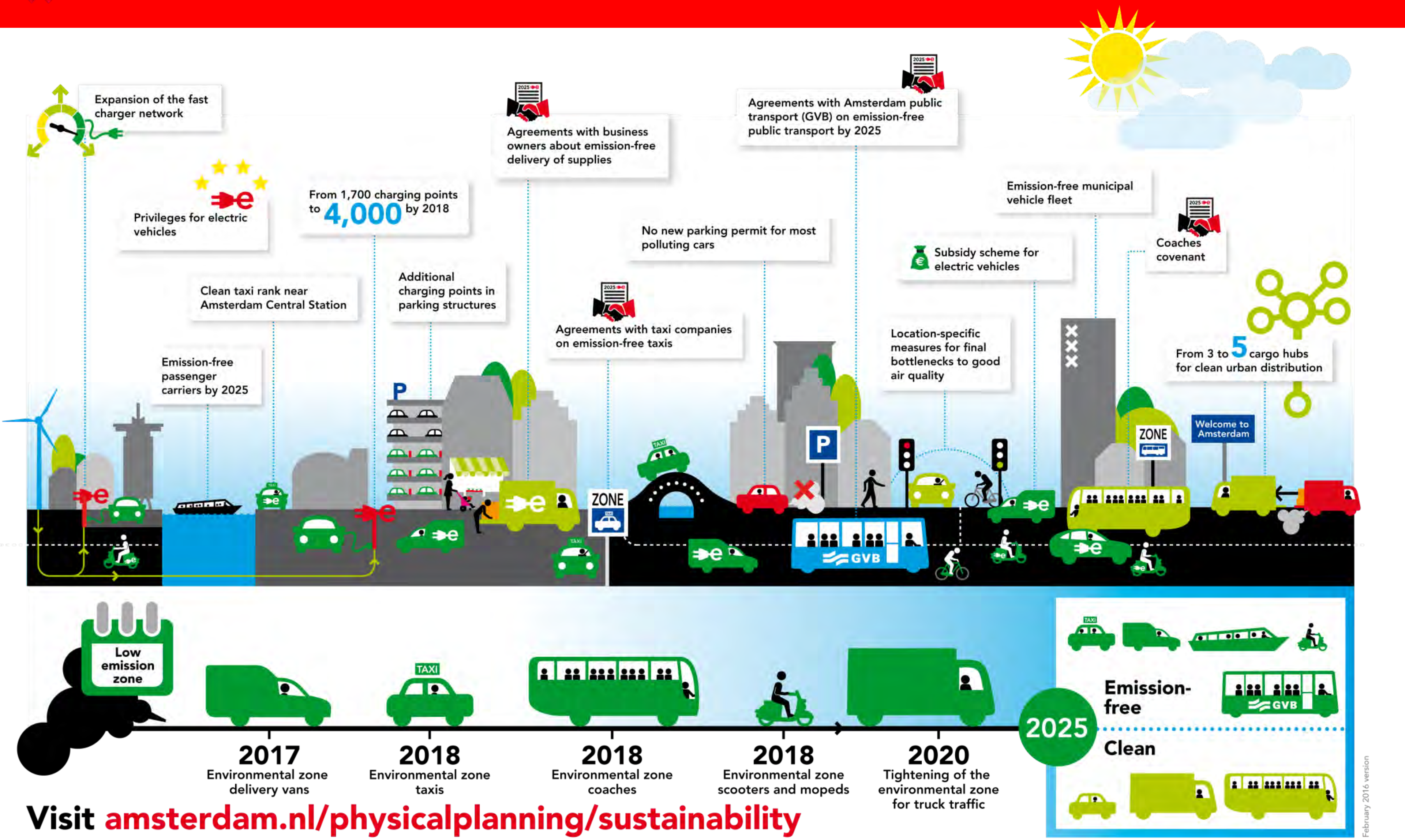
Gemeente Amsterdam

2016: Clean air for Amsterdam

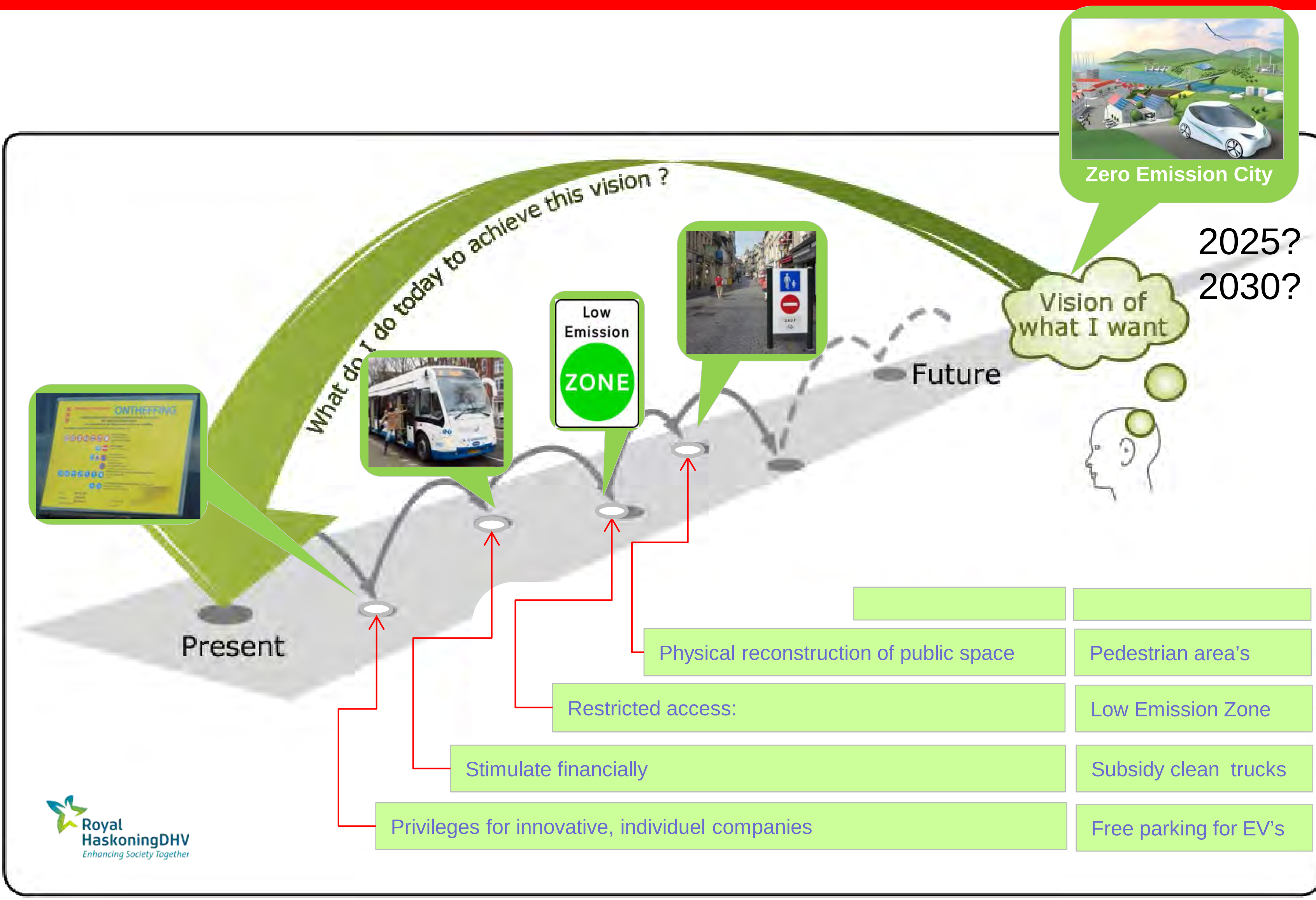


Visit amsterdam.nl/physicalplanning/sustainability

Lessons learned

1. Put a dot on the horizon; give perspective for action !
2. Subsidies for EV trucks
3. LEZ: an infrastructure to secure your ambition
4. Privileges for EV trucks (e.g. parking on sidewalks)
5. Build a platform: Front runners “Sustainable 020”
6. Procurement: practice what you preach!!
7. ..what else?

1. Put a dot on the horizon; give perspective for action !



2. Give subsidies for EV trucks

NOT: the polluter earns BUT: reward frontrunners

And: € for trucks is far more cost efficient than for passenger cars

3. LEZ: an infrastructure to secure your ambition

4. Privileges for EV Trucks

5. Build a platform: Front runners “Sustainable 020”

inder gibt es ... ppt[1].gif

SLIM EN SCHOON

HOME KOPLOPERS CASES MEER INFO OVER

KOPLOPERS

Hieronder staat een overzicht van de koplopers. Dit zijn bedrijven die voorop lopen in de transitie naar slimmer en schoner vervoer door Amsterdam.
Alle koplopers krijgen een eigen profiel op de site. De koplopers met een link hebben al een profiel op de site.

LIDL	TECHNISCHE UNIE	BUBBLEPOST
TRANSMISSION/CARGOHOPPER	MARQT	REDERIJ KEES
020 STADSDISTRIBUTIE	LITE/DARK	VKV NISSAN
MOKUM MARITEAM	CAR2GO	DEUDEKOM
VROEGOP WINDIG	DE BUURTBOER	BLOM BV
DE KWEKER	INTERSAFE	WAGENPLAN
VAN KEULEN BOUWMATERIALEN	TAXI ELECTRIC	JUIZZ
AAD DE WIT VERHUIZINGEN	PEETERS VERVOERCENTRALE	ORANGEGAS
DHL EXPRESS	SLIGRO	TESLA
POSTNL STADSLOGISTIEK	HEINEKEN	PETER APPEL TRANSPORT
MISTER GREEN	ETS TAXI	FOODLOGICA
LOGISTIEKE HUB AMSTERDAM	BLUE BOAT COMPANY	LEEN MENKEN
PANTAR	ELECTROCAR BV	GUNTERS EN MEIJSER
DRUKKERIJ de BIJ	XP KOERIERS	CONNEXXION
SHELL GTL FUEL	APOLLO	AMSTERDAM ARENA

TRANSMISSION – CARGOHOPPER

5 oktober 2015

Met Cargohopper Amsterdam verstuurt de Amsterdamse binnenstadondernemer al zijn goederen en pallets zo schoon als de techniek het momenteel toelaat.

Lees verder

Zoeken

BLIK OP DE STAD

KALENDER

13 april 2016
AVERE E-mobility Conference Amsterdam - Elektrisch rijden: wat zijn de ervaringen?

13 april 2016
Week van de logistiek - Dinalog congres Stadslogistiek

12 april 2016
Experiences and prospects of electric freight vehicles

Meer evenementen

TAGS

aanbesteding gemeente · aanbieder · alternatieve brandstof · bouwlogistiek

6. Procurement: practice what you preach

Good suggestions, contact and more info:

Erik Regterschot
e.regterschot@amsterdam.nl
0031 6 5201 8693

FRevue

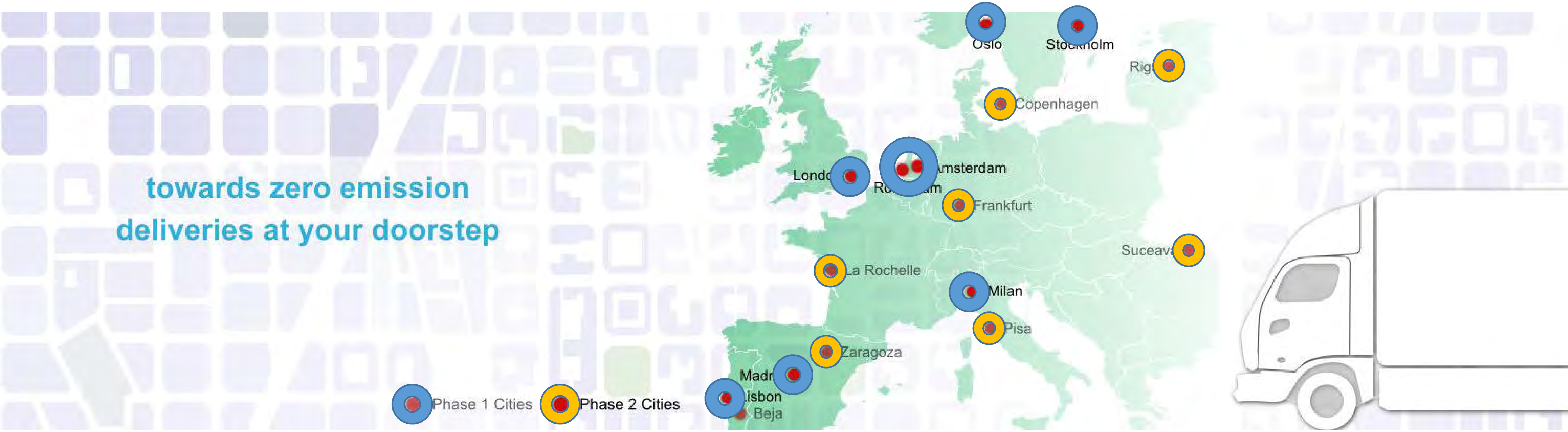
Promoting electric freight

from the urban authority perspective

IA-HEV wg27

Jos Streng, City of Rotterdam

Which cities participate in FREVUE?



What is FREVUE about?

- Demonstrators (=participating organisations) procure and deploy a number of fully electric freight vehicles.
- Local authorities support the deployment by coordinating it and some apply or develop a set of privileges (parking, bus lane use, widening of time windows).
- The vehicles are monitored technically (covering a range of climatic conditions and goods types: Oslo to Madrid, food to construction goods)
- The companies monitor the impact of EV use on their business
- The research team analyses further environmental, systemic transport and social impacts and extrapolates the results to system level
- In the end, it is about which step to take next to speed up zero emission urban delivery OR: It is about showing that the current generation of vehicles is suitable for last-mile urban deliveries and what steps are necessary to increase take-up

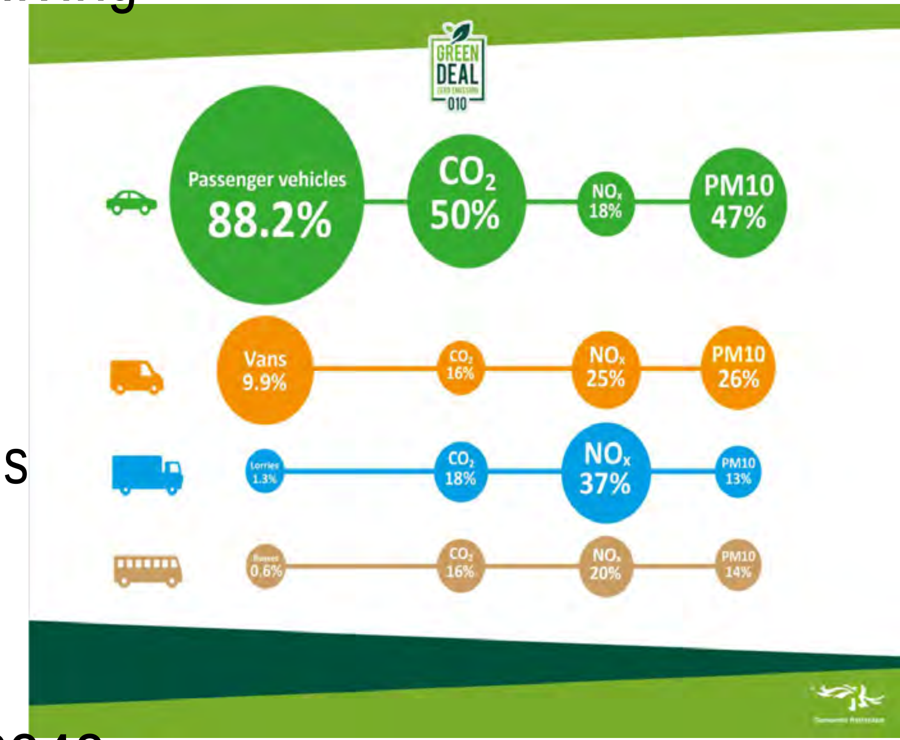
Reasons for cities to participate

They all want:

- more pleasant and healthy conditions for working and living
- accessibility of city centers
- to contribute to the mitigation of climate change[CO_2]

Freight traffic (including vans):

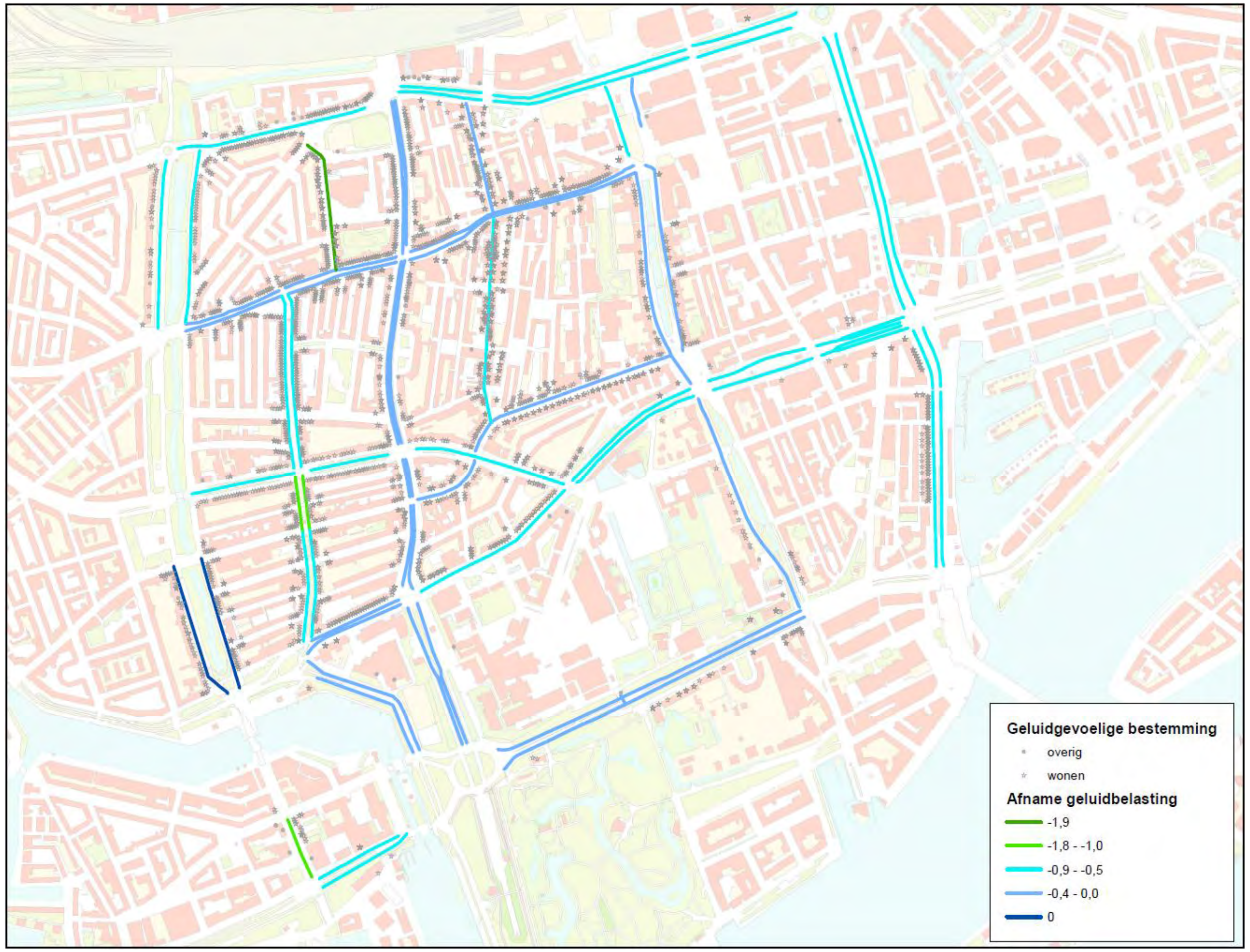
- only 10% of all urban traffic
- responsible for a much larger fraction of local emissions (noise and air pollution)

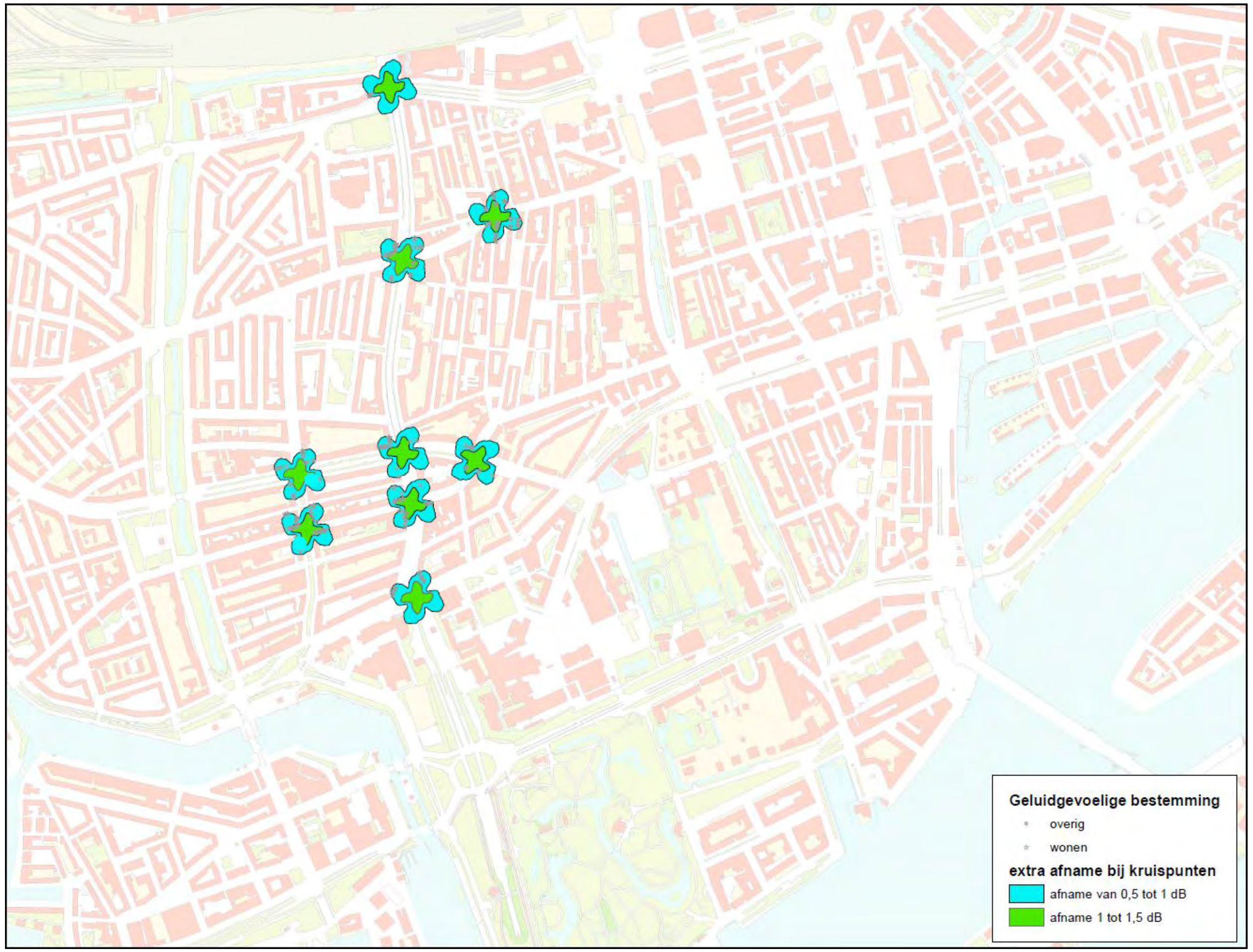


The EU's rationale for the project:

- a White Paper with a ZE target for urban transport by 2040

Noise reduction potential for Rotterdam when all freight vehicles converted to FEV





What do we implement [what is in our toolkit]

- Local covenants, such as Green Deal Zero Emission Urban Logistics
- Environmental zones and congestion zones
- Privileges [less limited use of zones and time windows for loading-unloading zones, bus lane]
- Procurement policy for our own vehicle fleet [to minimize our direct footprint – only small vans on the market]
- Procurement policy for delivered goods and services [to minimize our indirect footprint]

How to implement

- setting the example
  - investigate the footprint of our own delivery
  - including internal delivery from central storage location
- teaming up with frontrunning companies to speed up the process
- experiment with privileges for FEV [no emission = no regulations]
- look at the whole logistics chain to mobilise the demand for ZE delivery
  - less frequent, more planned ordering makes other logistic concepts possible [ZE last mile and last minute]
  - potential for consolidation of the flow of goods to a group of receivers *[Seven Square Endeavour - Schouwburgplein]*

The dilemma:
quote from intermediate FREVUE report

(http://frevue.eu/wp-content/uploads/2015/12/FREVUE-D1.3-State-of-the-Art-add1.pdf)

- Supportive government policy is still of high importance for the wider uptake of EFVs.
- Initially financial subsidies were largely used.
- Nowadays there is an understanding that non-monetary incentives are also very important, as financial ones are not sustainable in a longer term.
- A better way to support the mass adoption of the alternatively fuelled technology is to give them a long-term competitive advantage.
- However, even frontrunner companies stress that they cannot compete without a means to bridge the financial gap in the business case for FEV.
- Let alone smaller companies with less ambition [OR incentives/reason to act] and/or financial means

Why do EU cities have to team up?

- The more, the merrier
- Creating mass in potential FEV demand [should be sufficiently specific, i.e separate plans for trailers]
- Learning from each other [though you don't actually need a project for that]
- Counterbalance for competitiveness [city marketing stresses the uniqueness of cities]
- Show that solutions are valid in different climate and policy environements

- Local diversity (within and between countries) in tax regimes and legal regulations
- Difference in economic interest

Discussion points

- *In an era where interest rates are very low [and thus in principle large sums of money are unemployed], Europe could put this money to work.*
- *Quick charging for FEVs is not really addressed in IA-HEV task 20 [completed], limited to passenger cars and free public access. If fast charging is to help business models for FEV, it should be provided at stopover locations, with guaranteed access and very high power. This is quite different from the case described in the task 20 report.*
- *Batteries are a technical common denominator in buses, FEV and passenger cars, and they dominate vehicle prices.*
- *How do we keep the playing field level? First hour investors in expensive E-trucks [to be written off in 10 years] fear to be beaten five years from now by competitors who can buy the same vehicle at half the price.*

IA-HEV Task Force 27

Electrification of transport logistic vehicles

eLogV

2nd Workshop: Experiences and prospects of electric freight vehicles

Time: 09:30 – 17:00 CET, April 12th, 2016

Location: Koninklijk Instituut voor de Tropen, Mauritskade 63, 1092AD Amsterdam

Introduction of Korea activities in electric truck

System Integration Technology Development of Small Commercial EV

Ocktaeck LIM

(Univeristy of Ulsan, South Korea)

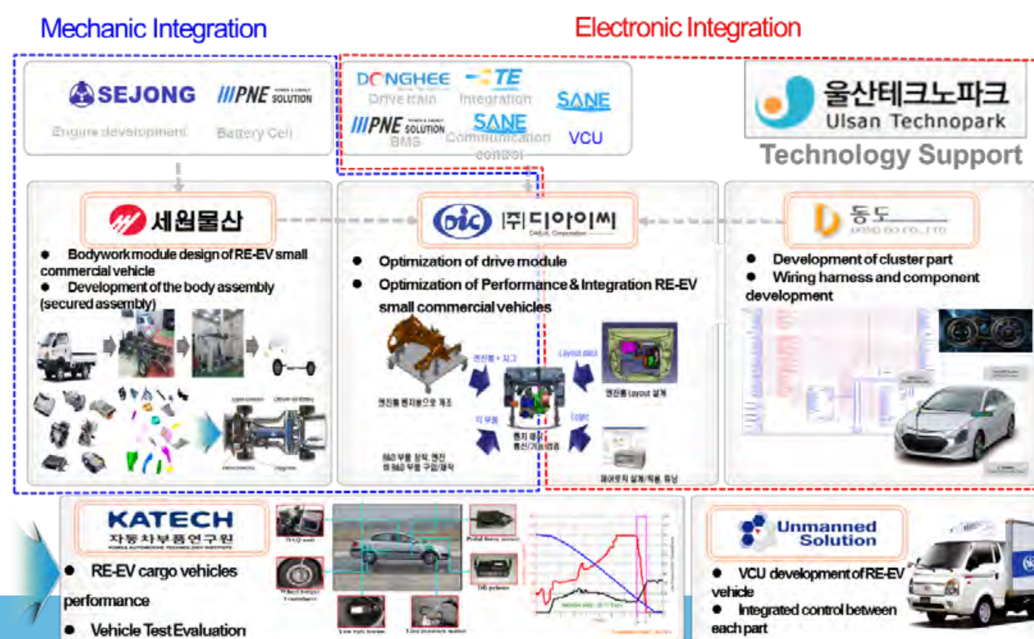
Development situation of Domestic Electric Truck

Design				
Max. Power	26 kW	40 kW	100 kW	100 kW
Max. Toque	108 Nm	162 Nm	318 Nm	320 Nm
Max. Speed	95km/h	100 km/h	130 km/h	130 km/h
Per-Charge Range	67.5 km	100 km	110 km	120 km
Battery capacity	17.8 kW (Lithium-Ion)	32 kWh (Lithium-Ion)	35 kWh (Lithium-Ion)	30 kWh (Lithium-Ion)
Weight on Board	500 kg	1,000 kg	1,000 kg	1,000 kg
Development form	EV conversion	EV conversion	EV conversion	EV conversion
Progress of Development	On sale	Prototype	Prototype	Prototype

Overview of Development

Project Title	Development of small commercial-grade components in RE-EV System Integration Technology
Final Development Goals	Development of small commercial logistics vehicles RE-EV
Key of developments	➢ Development, Design and Optimization Lay-out of dedicated commercial vehicle parts RE-EV -Drive modules, body modules, battery modules, high-voltage / low-voltage wiring harness, cluster ➢ Reliability of the RE-EV commercial vehicle control modules and performance of Integration components ➢ RE-EV commercial vehicle production and performance evaluation

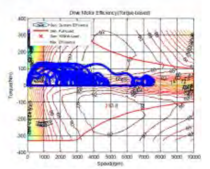
Evaluation Items	Unit	Development Goal
Top speed	km/hr	120
Mileage (EV mode)	Km	100
Mileage (combined mode)	Km	400
Charging time 20KW grade (slow)	Hr	7
Acceleration (0-> 100Km / Hr)	sec	15
Start of prototype vehicle	-	-
Duration Reducers	km	200.000



Vehicle production progress information

▶ Analysis of proposed vehicle spec.& performance

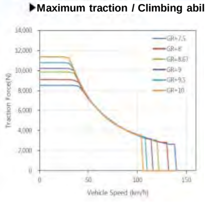
Driving Fuel consumption analysis



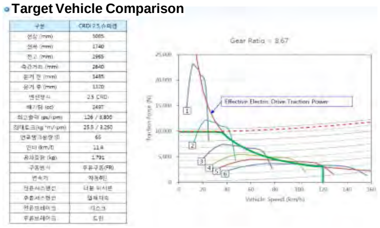
(a) 구동모터 작동점 분석
회생제동 無, HVW, FE = 4.38 km/kWh

Power performance #1

▶Maximum traction / Climbing ability

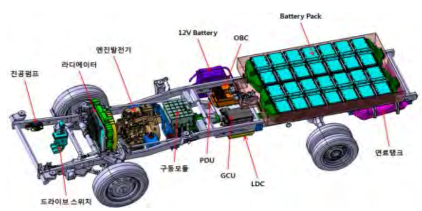


Target Vehicle Comparison



- Vehicle spec. analysis
- Transmissions Spec. analysis
- Vehicle Hard Point 3D measurement
- Vehicle&parts instrumentation
- Acceleration performance
- Top speed, climbing ability standard gear ratio selection
- Driving Fuel Consumption analysis

▶ Package Design Review and LAYOUT



- RE-EV vehicles Layout & Parts Design
- FLOOR PANEL
- Motor / inverter, reducer
- Engine & generator
- Battery & BMS
- GCU, ECU, OBC, LDC, PDU
- Fuel system, an exhaust system development
- APS, Drive SW
- Water pumps, vacuum pumps

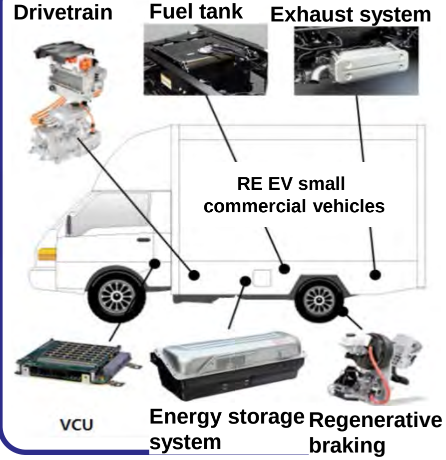
▶ Vehicle production

Developments mounting bracket

Integrations

- Component modules CALIBRATION
- Mounting Brackets Development
- Vehicle remodeling
- Vehicle Assembly
- Vehicle Test

▶ Parts Design



- Reducer devpmt. (trucks only)
- VCU devpmt.
- Battery & BMS devpmt.
- Fuel, exhaust system devpmt.
- Power Distribution devpmt.
- APS, Drive Switch Selection
- Cluster devpmt.
- Wire/Harness devpmt.
- Cooling, vacuum Line devpmt.
- LDC,OBC devpmt.

* devpmt → development

Vehicle production core technology development

Small cargo system technology development

▶ **Devpmnt. of small cargo vehicle system tech.**

- Utilize the parts developed relying on the passenger vehicles base.
- Development of system optimization for the best performance by implementing important parts for 1ton truck.

Small cargo driveline control logic development

▶ **Vehicle driveline control logic development**

- Development of motor tuning and reducer of driving force control for the vehicle driving in simulation utilizing the motor maximum efficiency and good driving pattern.

Harness Development for small freighters

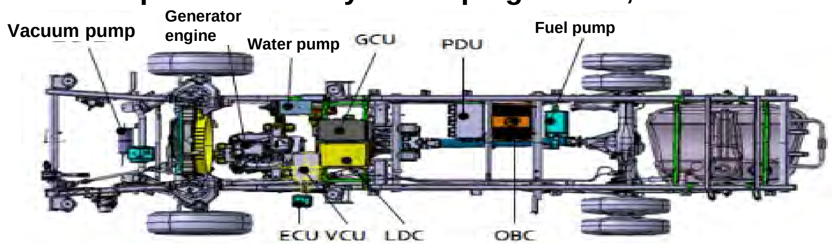
▶ **Devpmnt. of small cargo vehicle wiring harness**

- Complete the harness design part for high/low-voltage
- Complete the development of wiring harness including unique cluster and power distribution of design vehicle.

Small cargo layout design

▶ **RE-EV layout design for small cargo vehicle**

- Utilize the each key part from this project
- Perform the optimization of chassis module and drivetrain through the distribution of gravity center and package design for 1 ton truck.
- The second year is scheduled to perform the test vehicle performance by developing brakes,

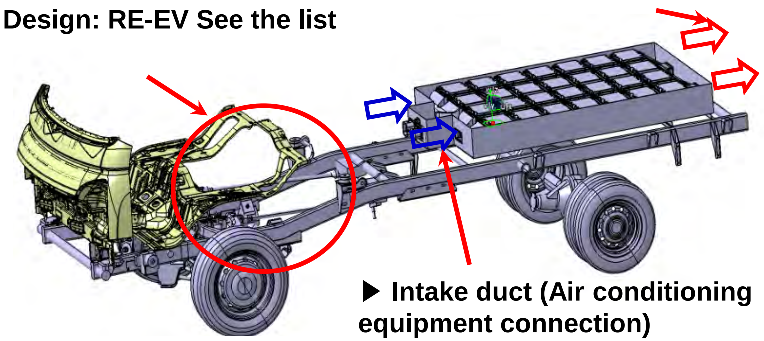


RE-EV Development of energy storage systems for commercial vehicles

▶ **Mounting parts Lay-Out Location**

Design: RE-EV See the list

▶ **Exhaust duct / fan**



▶ **Intake duct (Air conditioning equipment connection)**

※ Battery System Specification

Item	Specification	Remark
Cell Type	Li-ion Polymer	
Number of Cells	324 EA	3P-108S
Nominal Voltage	399.6V	3.0~4.2V /Cell
Rate Capacity	90A	30Ah*3P
Total Energy	35.96KWh	
Operating Temp.	-20~60℃	

※ Battery System Test : Quality Certificate

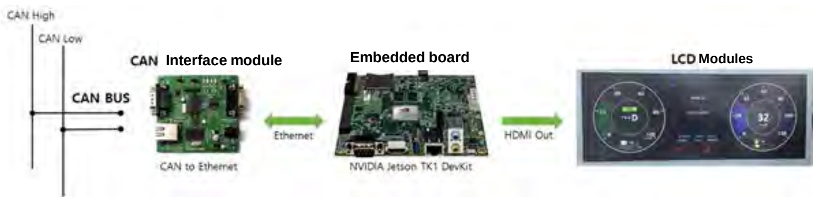
Test	Check	Remark
Voltage accuracy	Cell BMS voltage comparison	Lower than ±1%
Current Accuracy	Cel BMS Compare current	Lower than ±1%
Temperature accuracy	BMS Temperature and internal temperature comparison	Lower than ±2℃
Supply Operation	After power + 12V, + 5V Measure	12V ±0.5V , 5V ±0.5V
Current consumption	Input power supply operating current consumption measurement	Below 500mA
CAN Communication	DATA Transmission / receipt	Normal operation
PRA Control Function	Relay ON/OFF Control whether	Normal operation

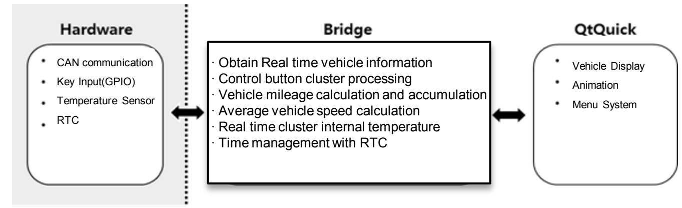
※ BMS Specifications

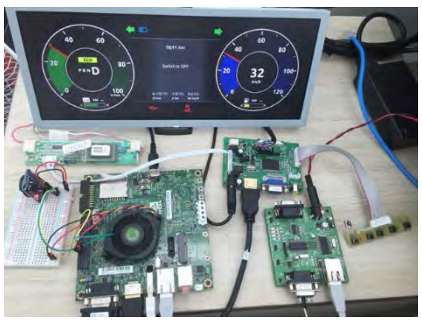
Item		Specification	Accuracy
Control voltage input range		9~16V	
Current consumption (Master BMS)		500mA	
Dark Current		1mA	
Voltage	Cell	0~5V	±1.0%
	Pack	250~500V	±1..0%
Current	Pack	-500~200A	±1%
Temp.	Cell	-50~100℃	±2℃
SOC Calculation		0~100%	±7%

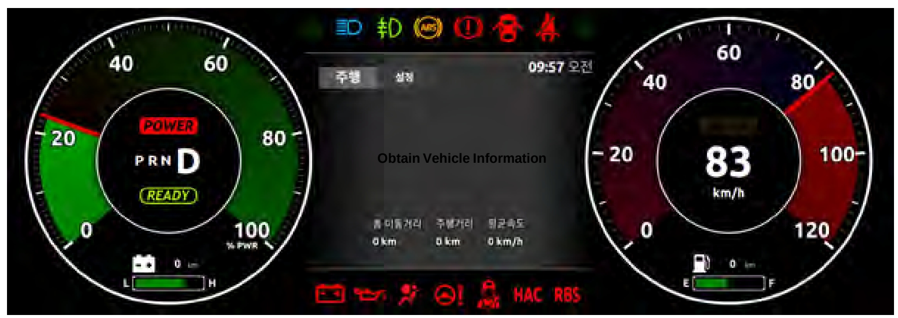
RE-EV Digital cluster & virtual engine development

▶ Cluster Configuration System and Software

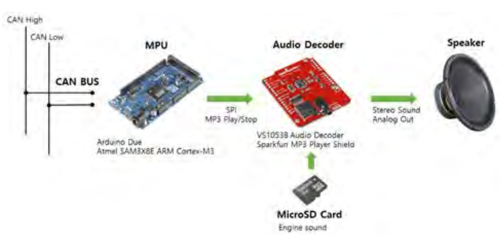


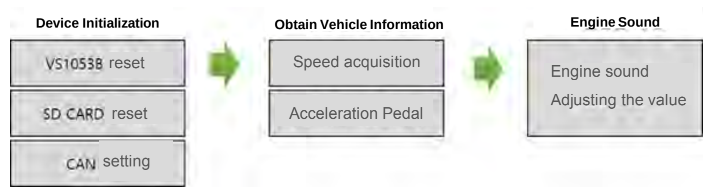




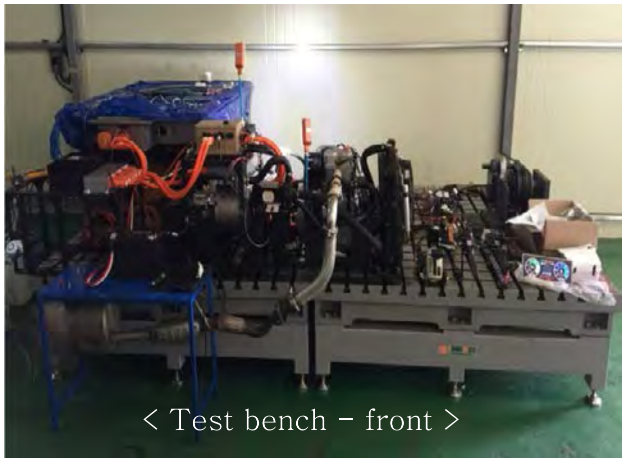


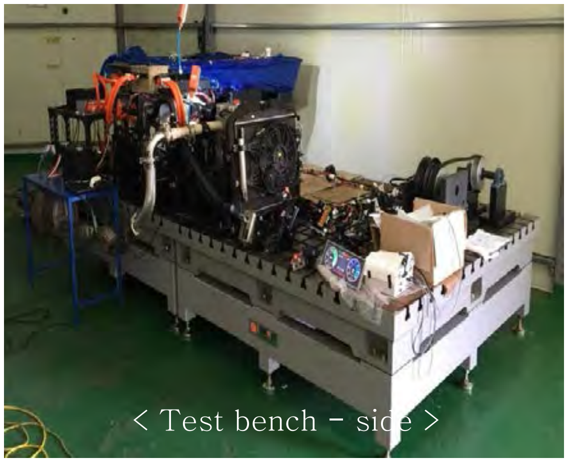
▶ Virtual engine sound system and software configuration

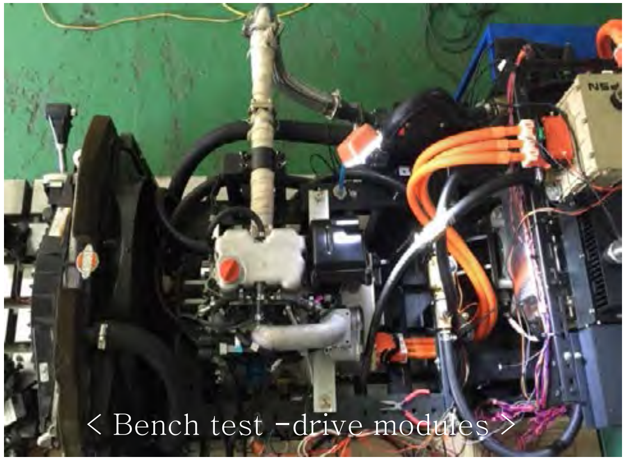


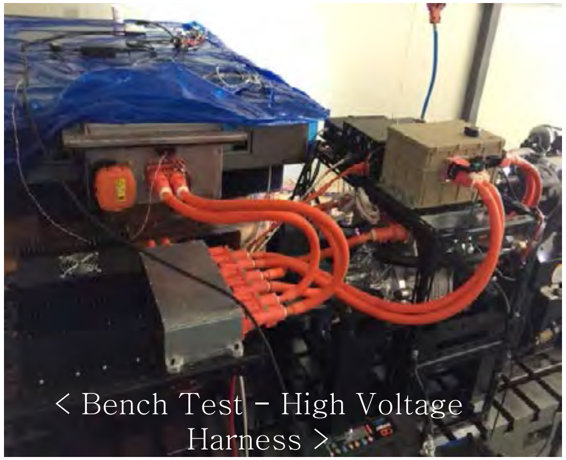


RE-EV Test benches for commercial vehicles


< Test bench – front >


< Test bench – side >


< Bench test –drive modules >


< Bench Test – High Voltage Harness >

❑ Testbench Contents

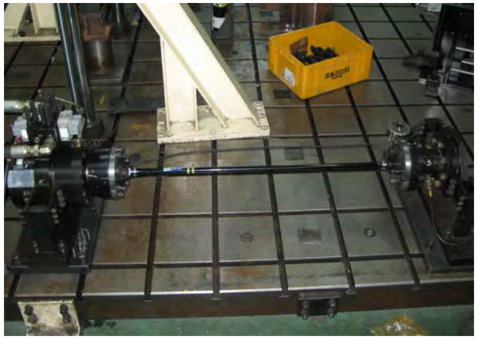
- CAN communication and motor cluster, check the drive switch


< Motor drive check >

< Clusters and low-voltage control test >

Target vehicle specifications and analytical instrumentation

< Vehicles Hard Point 3D measurement >

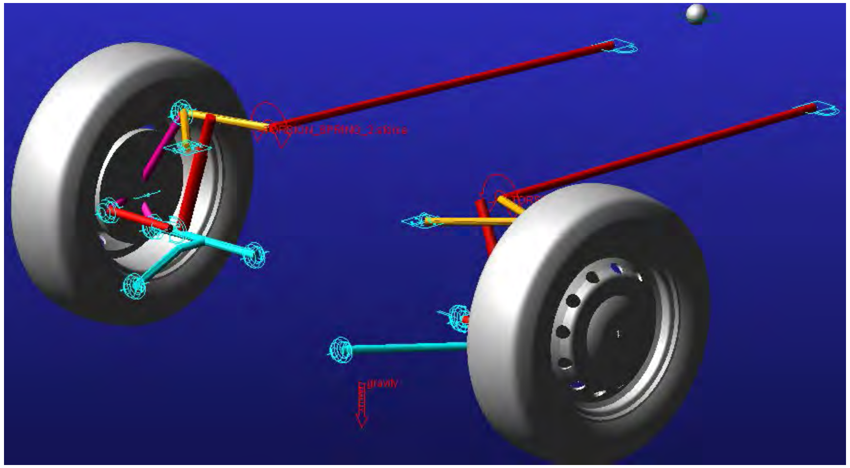


< Spring stiffness measurements front / rear >

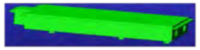
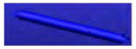
< The damper characteristics test front/ rear >

RE-EV Development of integrated vehicle models

Suspension System Modeling



The main components Integration

Product Name	Image	Weight (kg)
Frame, water pump, vacuum pump, number of drives tea, vacuum auxiliary tank, cooling valves, flow harness		597.5+5.6+1.7+1.55+0.85+2.8+4
Cabin		241.5
Engine Generator		107
Motor, Reducer, GCU, ECU, LDC		65.6+22.8+7.5+8.8
Battery, OBC		302.3+10.45
Fuel Tank		15+0.7*70 L
Propeller shaft		6.5
Total		1450.45

RE-EV fleet vehicles modeling school

1. External shape 3D scan of commercial vehicle

2. Cabin (TOP), charger, engine parts extraction and 3D Scan

Air Conditioning System

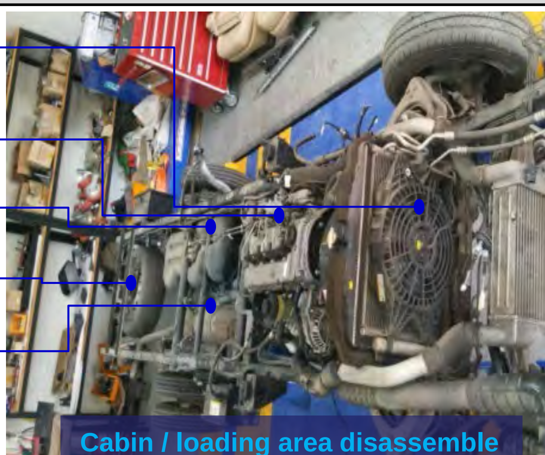
Engine / Transmission

Fuel Tank

Spare tire

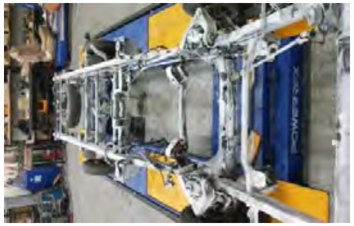
Exhaust System

Battery

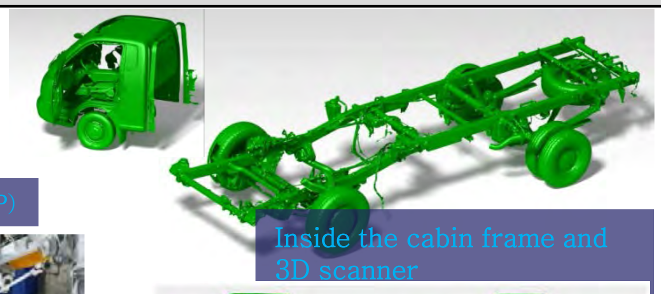


Cabin / loading area disassemble

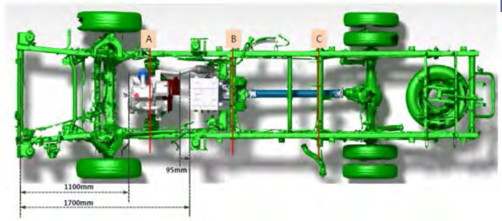
Cabin (TOP)



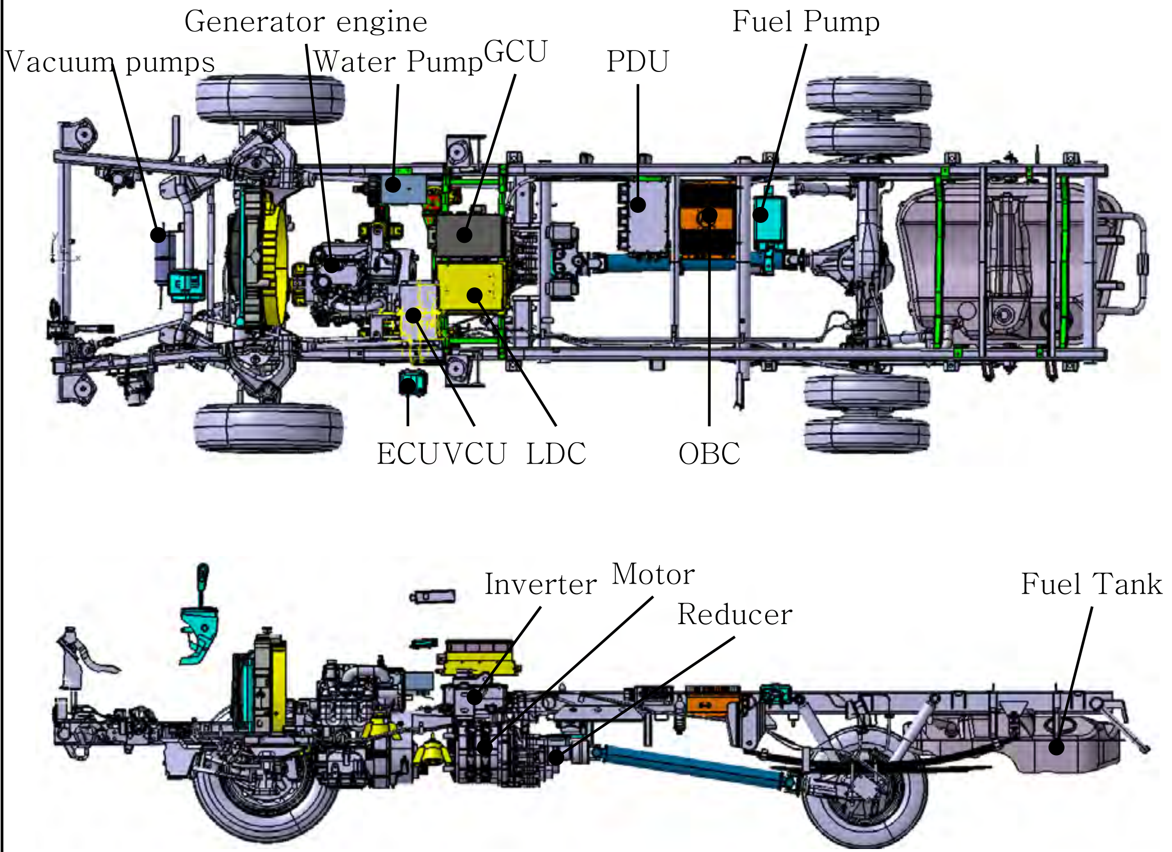
Engine parts disassembly

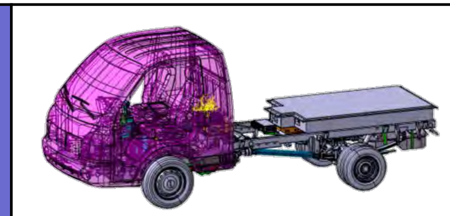
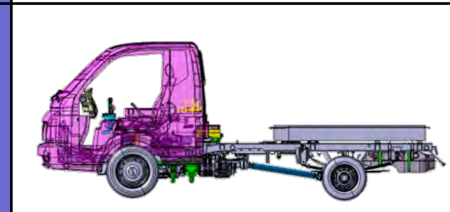
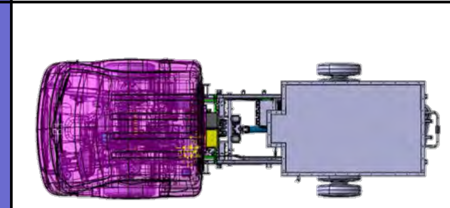
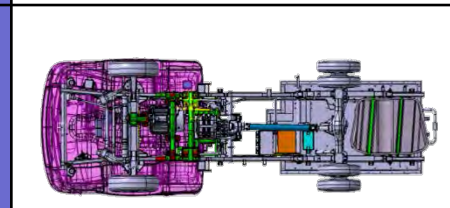


Inside the cabin frame and 3D scanner



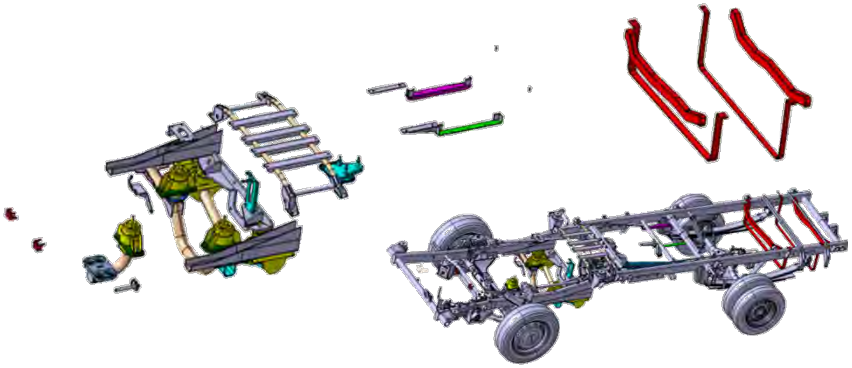
3. RE-EV LAYOUT commercial design

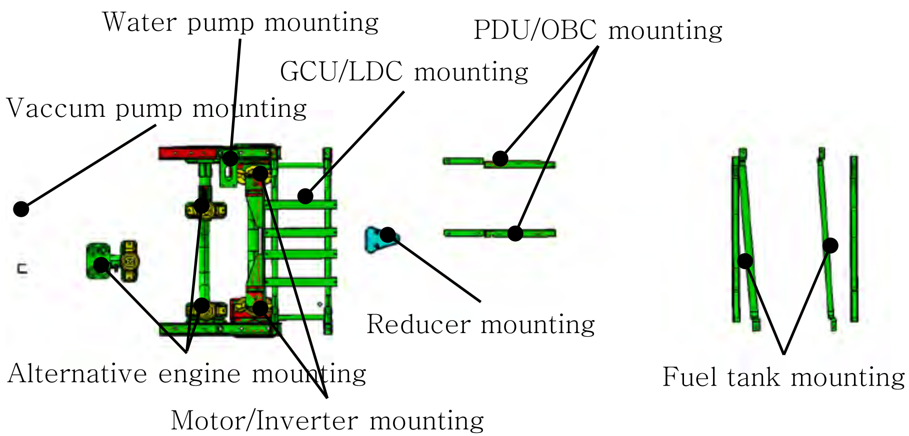


ISO View	
Side View	
Top View	
Bottom View	

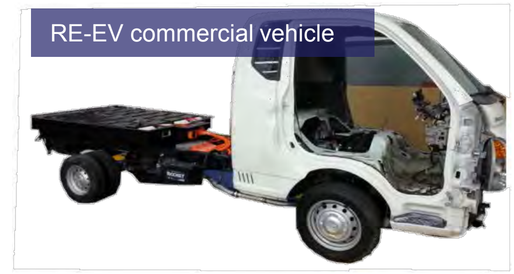
4. Development of mounting RE-EV module component structure design & mounting assembly component

▶ LAY-OUT of parts for RE-EV commercial vehicles

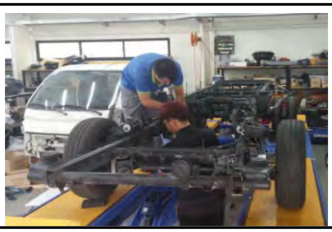
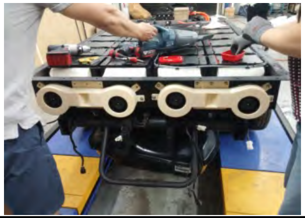




5. RE-EV module parts assembly



▶ Details assembled into

1. RE-EV parts assembly	2. Propeller shft	3. Motor/Inverter & Reducer	4. Battery pack
			
5. Battery cooling duct	6. Painting battery case	7. Cavin	8. Fuel tank
			

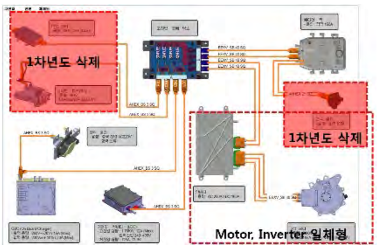
RE-EV integrated vehicle manufacturing

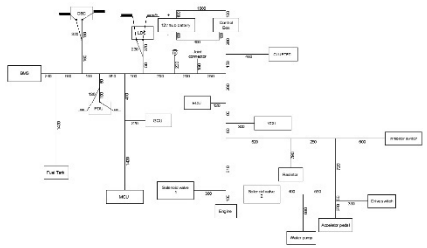
▶ Details assembled status

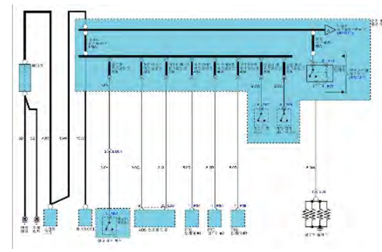
9. PDU	10. Engine generator	11. Vacuum pumps	12. GCU
			
13.LDC	14. OBC	15. Engine, motor vibration dampers	16. Vacuum deck
			
17. Water pump	18. Solenoid vavle	19. Exhaust system remodeling	20. Radiator
			

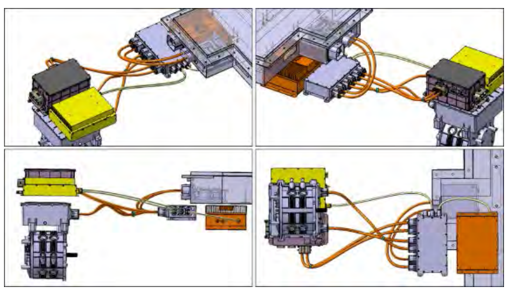
6. RE-EV commercial car high/low voltage harness production

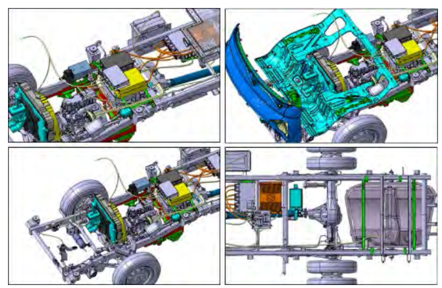
▶ RE-EV commercial car high/low voltage power system and electric circuit, LAY-OUT design



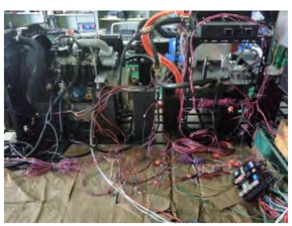








▶ RE-EV commercial car harness production and connected with actual car

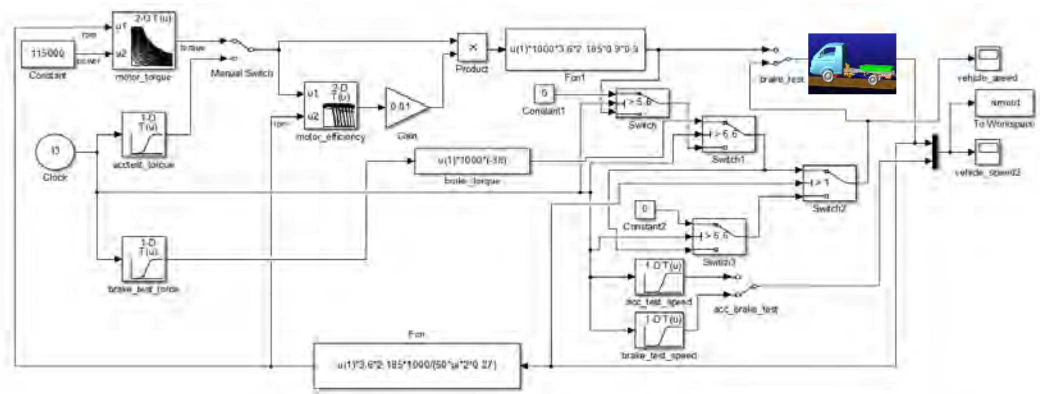


RE-EV integrated vehicle manufacturing

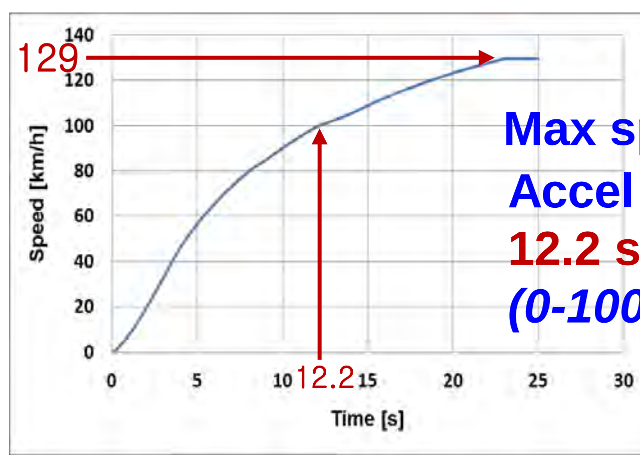
Max speed & acceleration performance

Classification	RE-EV Vehicle
Motor capacity	110 kW
Motor max speed	10,000 rpm
Motor max torque	330 $N \cdot m$
Battery	90Ah, 399.6V, 36kWh
Engine generator	Gasoline, 2 cylinder, 1.2L
Reduction gear ratio	2.185
Final Drive	3.6
Rear wheel tire radius	0.27 m
Setting Weight	1558 kg (empty vehicle weight) +183kg (man, measuring equipment)
Front axle/Back axle	1048 kg/693 kg
reducer & Final Drive efficiency	90%, 90%
air & rolling resistance coefficient,	0.4,0.01
Fuel tank volume	70L

< RE-EV Vehicle Analysis Conditions>



< ADAMS & Simulink modeling >



Max speed : 129 km/h

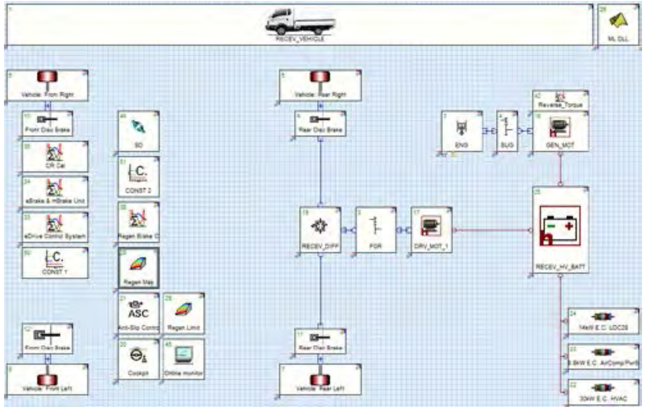
Accel performance : 12.2 s *(0-100km/h)*

< RE-EV Analysis Results>

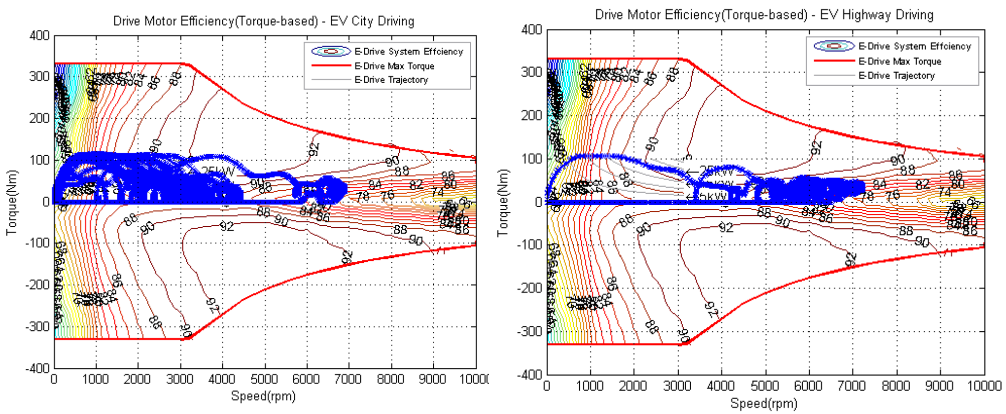
MILEAGE (EV & composite mode)

Classification	Settings	Application
Initial SOC	100%	O
EV Final SOC	10%	O
EV DoD	90%	O
HEV Control SOC	20%~22%	O
HEV DoD	79%	O

< Analysis conditions of RE-EV Vehicle Mileage >



< AVL Cruise modeling >



< RE-EV Analysis Results>

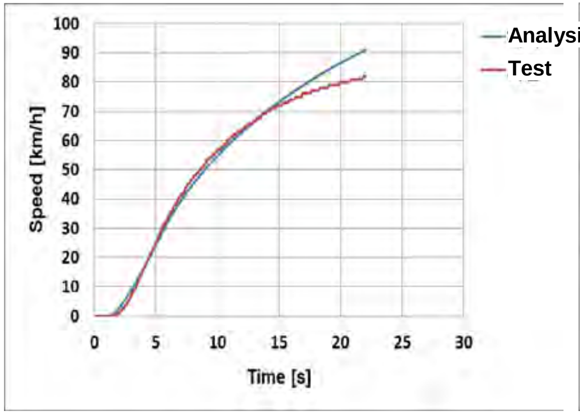
작동모드	구분		5사이클		복합연비 & AER	
			보정전	보정후	보정전	보정후
PHEV (RE-EV)	CD 연비 (km/kWh)	도심	4.755	3.329	4.257	2.980
		고속	3.773	2.641		
	CS 연비 (km/L)	도심	14.512	11.168	13.382	9.932
		고속	12.218	8.749		
	AER (km)	도심	146.893	102.825	136.000	95.200
		고속	122.687	85.881		
EV	연비 (km/kWh)	도심	4.886	3.420	4.500	3.150
		고속	4.103	2.872		
	AER (km)	도심	163.761	114.633	151.793	106.255
		고속	137.165	96.016		

MILEAGE at EV mode = 106 km

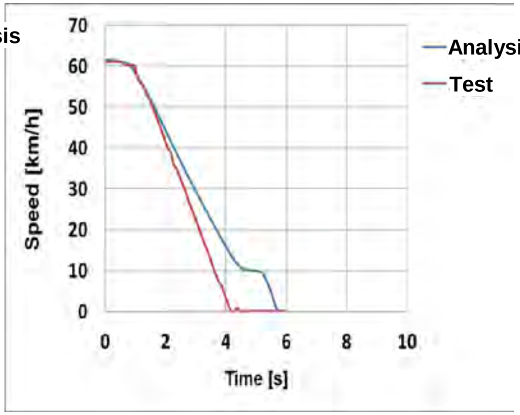
MILEAGE at Composite mode = 799 km

(106km+9.9km/L*70L)

Vehicle longitudinal acceleration correlation



<Acceleration Test>



<Deceleration Test>

<Correlation test vehicle settings>

Test mode	Target variable	Correlation vehicle(%) The coefficient of determination R^2
Acceleration Test	Vehicle Speed (TPS 50%)	98.6
Deceleration Test	Vehicle Speed (-0.5g)	88.4

$$R^2 = \frac{\sum (\hat{y}_i - \bar{y})^2}{\sum (y_i - \bar{y})^2} = 1 - \frac{\sum e_i^2}{\sum (y_i - \bar{y})^2} = 1 - \frac{SSE}{SST}$$

Conclusions

1. Korea has developed EV logistic trucks successfully

- Development, Design and Optimization Lay-out of dedicated commercial vehicle parts RE-EV
  -Drive modules, body modules, battery modules, high-voltage / low-voltage wiring harness, cluster
- Reliability of the RE-EV commercial vehicle control modules and performance of Integration components was develped
- RE-EV commercial vehicle production and performance evaluation was finished

Thank you very much

Ocktaeck LIM

otlim@ulsan.ac.kr

FREVUE

Freight electric vehicles

TNT – Edwin Vermeer

12th of April 2016

TNT
THE PEOPLE NETWORK

Content

- The motivation of TNT to participate in the Frevue project
- Our experience so far
- The benefits for TNT
- What are or were the barriers we faced in using EV's
- What stopped us to make the next step
- What is needed in order to take the next step and ultimately, deliver energy neutral.
- Which support or privileges are needed from authorities or partners to make this interesting for TNT

FREVUE linked to our Corporate Responsibility and Strategy

Our Corporate Responsibility commitments

- Constant focus in improving our performance on Health & Safety and Environment (HSE).
- Invest in healthy and safe working conditions for our people
- Reduce our consumption of energy and natural resources, and decrease our emissions.

Outlook strategy

Focus on profitable growth

1. Move More by Road
2. Drive sales from four priority industries
3. Serve more SMEs even better
4. Increase profitability Domestics

Invest in performance

5. Realise the Perfect Transaction
6. Increase efficiency and productivity
7. Establish superior revenue management
8. Prioritise Health & Safety practices

Organise to win

9. Create focused and accountable units
10. Strengthen leadership culture

Environmental initiatives focus on reducing our CO2 emissions

OUR OPERATIONS

*Improve CO_2 footprint of our operational activities**

OUR CUSTOMERS

Provide insight and support on CO_2 emissions to our customers

OUR PEOPLE

Engage, train employees and subcontractors on Environment

Performance Management

Performance Management

CO_2 emissions are managed and reported transparently

- Replacement by more efficient aircraft
- Eco driving training
- Replacement by more fuel efficient vehicles
- Energy efficiency improvement in warehouses

* Including subcontracted activities,

Electric vehicles track record

UK: 2006 introduced a 7.5 tonne electric vehicle into our delivery fleet at our Barking depot.

2008 introduced a further 50 vehicles (3.5 and 7.5t)

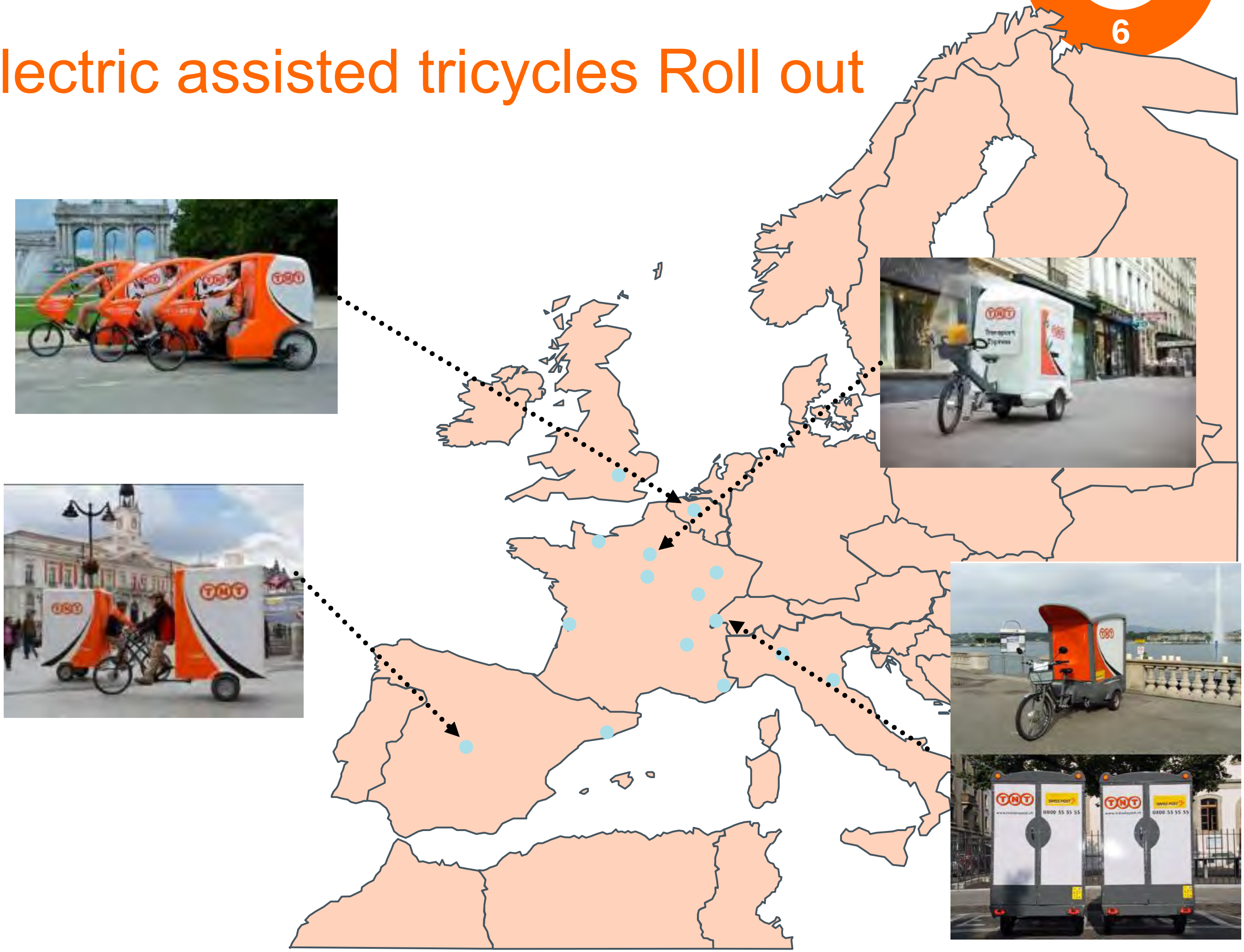
SMITH

2012 commenced delivery of 20 replacement 7.5 tonne "new generation" electric trucks

Other EV trials in Europe and in ROW led to further roll out phase but still at limited scale and with various providers / OEMs

TNT

Electric assisted tricycles Roll out



FR-EVUE Amsterdam & Rotterdam

Tests cases description

- All Electric Parcel distribution centres

Objectives

- Prove that urban freight deliveries can use 100% electric mode
- Deploy a total of 24 large EVs (from 3,5 t vans to 18 t trucks) in Amsterdam and Rotterdam exploring exemptions for time-windows, parking and weight regulations and more flexible permission for night-deliveries
- ICT solutions and intelligent charging systems.
- Establish reliability and technical feasibility of large electric trucks in beverage distribution
- Get a comprehensive cost overview (including usage of charging stations - on depot and in the city)

TNT involvement

- 9 vehicles / 2 NL depots (Schiphol Rijk , Dordrecht)
- Operational set up: Replacement of PUD vans and truck by Electric vehicles on inner city routes

Benefits for TNT to invest in EV’s?

- Improve our operational efficiency and get privileges through collaboration with city authorities (eg Rotterdam / Amsterdam)
- Save fuel therefore costs
- Reduce CO2 and tailpipe emissions, noise and congestion in cities
- Gain experience and skills with motivated drivers
- Public exposure
- Customer acquisition / competitive
- edge

“Takes the stress out of driving”

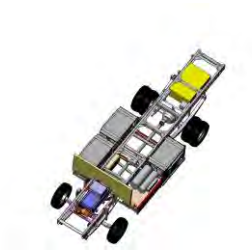
“Vehicle is excellent for city centre driving”

“Less gear changes, less tired at end of day”

“Our customers think a zero emission vehicle is excellent”

“People stop and watch me – they are amazed how quiet the vehicle is”

Main challenges



- Technology reliability
- Daily range – less flexible
- Duty Cycle / Charging
- Driver acceptability / Driver training
- Fitting of telematics to monitor vehicle performance remotely
- Suitable charging infrastructure in place
- Positive business case to invest for Electric Vehicles

Deliver via Electric vehicles!

THE PEOPLE NETWORK

Starting of the transplantation….

Work in progress…

Second "life"

The new hart

Project at risk

✓Technical issues put the EV project at risk

✓Negative impact on motivation drivers

✓Productivity and quality impact by late arrivals

Next steps to move forward

- More production of EV’s makes it attractive to invest in this type of vehicles
- No clarity of rest value makes it less interesting for lease companies to step in
- Infrastructure structure for power supplies is insufficient
- Facilities for charging stations on TNT locations are limited
- Cost price for charging stations are to high
- Local privileges by using bus / tram lane or private parking area to be more efficiënt
- Adjust driverlicense B, to max weight of 4,5 T (due to net weight of the EV)

Thank you!

THE PEOPLE NETWORK

zero-emissie voor **binnensteden**

cargohopper
stadsdistributie

Electrical city distribution: a ‘quick and easy’ solution?

Bert Roozendaal 12 April 2016

Town councils struggle with their air quality

- Emission of fine dust and NO_x are often too high
- Traffic jams and road safety
- Quality of life

- Pressure groups are ‘flexing their muscles’
- Increasing volumes of small e-commerce deliveries
- How can a distributor take its responsibility?

Our solution: The Cargohopper concept

- Cargohopper is a zero-emission last mile system since 2008
- Our aim: more volume with less trucks in the inner city
- Hub at the border of the environmental zone
- Are we a game changer after eight years of try and error?

That's iffy, If no one moves, nothing happens...

- Municipalities are aiming at more electrical transport in inner cities
- Their problem is: how?
    - Councils do not transport
    - The market has little financial room to manoeuvre
    - And…Who benefits from it?

50 kilometres, daily 5 days a week

- Cargohopper operates in Amsterdam and Enschede

- 5 self developed vehicles do up to 70 drops a day covering 50km,
- 1.100.000 kg annually

- Beloved in the city: Cargohopper is Amsterdam!

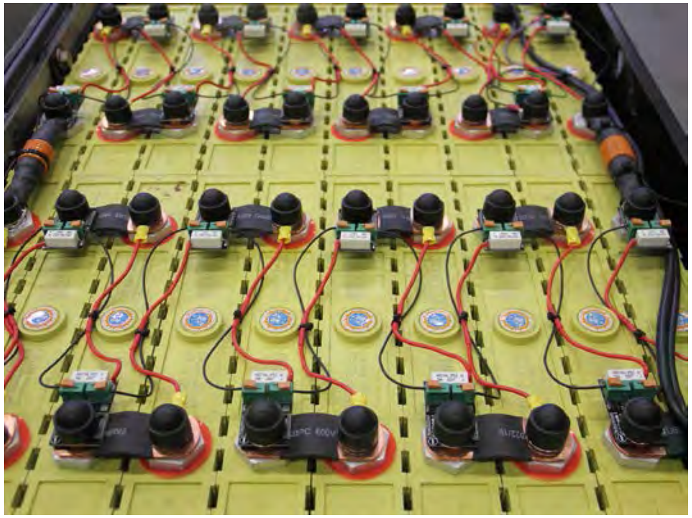
- We have a perfect solution to distribute copier paper, but..

- We haul construction materials

We are an advanced living lab

- We are growing but…
- Business case could be better
- Initial cost stays high, not enough advantages of privileges to close the financial gap
- We get some some support from the cities
- But no major breakthrough so far

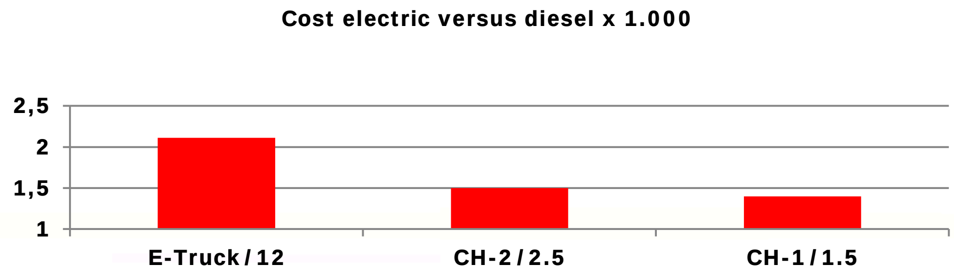
It is all about regulations and batteries

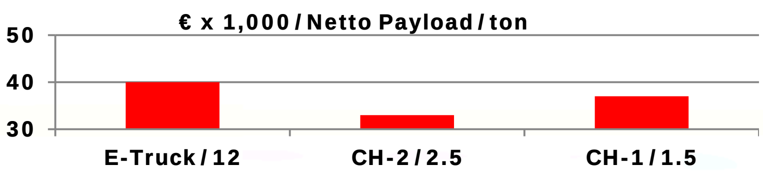


- Everyone wants you to transport electrically, until you really try… roadlegalisation stays hoplessly behind
- We struggled with our batteries
- Forget about solar
- But our 3th generation Cargohopper is a really reliable and practical product

Cargohopper has the highest payload per Euro

- **2.8 ton payload on 6.3 ton TTM is better than a 7,5 ton diesel truck**
- **We have the most cost efficient solution but…**
- **Industry does not develop distribution EV's**





It is not the operational costs

- Only small maintenance twice a year
- Most problems are small mishap
- ‘fuel costs’ eu. 0,05 vs eu. 0,17 / km with diesel
- Lower speed and good training prevents accidents
- No charging problems, just some wear and tear on cables and connectors
- But that is not enough to neutralize the initial costs.

What will the future bring us?

- Cargohopper will continue but cannot expend with the rules momentarily in place

- In the end it is the community that benefits. So if fast progress is wanted, that depends on how fast cities create adequate conditions

- Strong appeal to develop an integral European vision on electrical distribution.

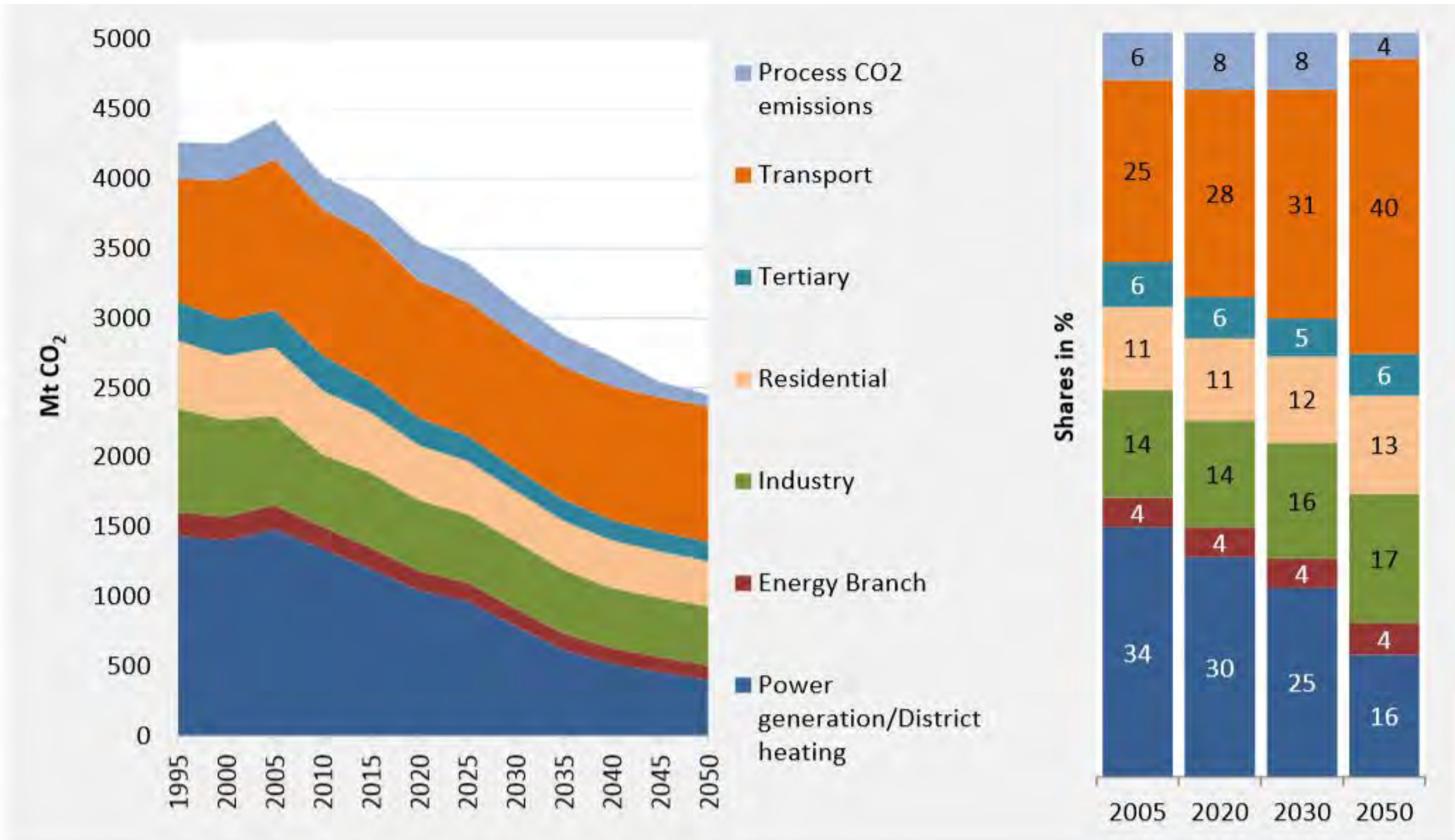
SIEMENS
Ingenuity for life

eHighway
electrified heavy-duty road transport

Hasso Grünjes

Transport will increasingly be the biggest challenge for decarbonization

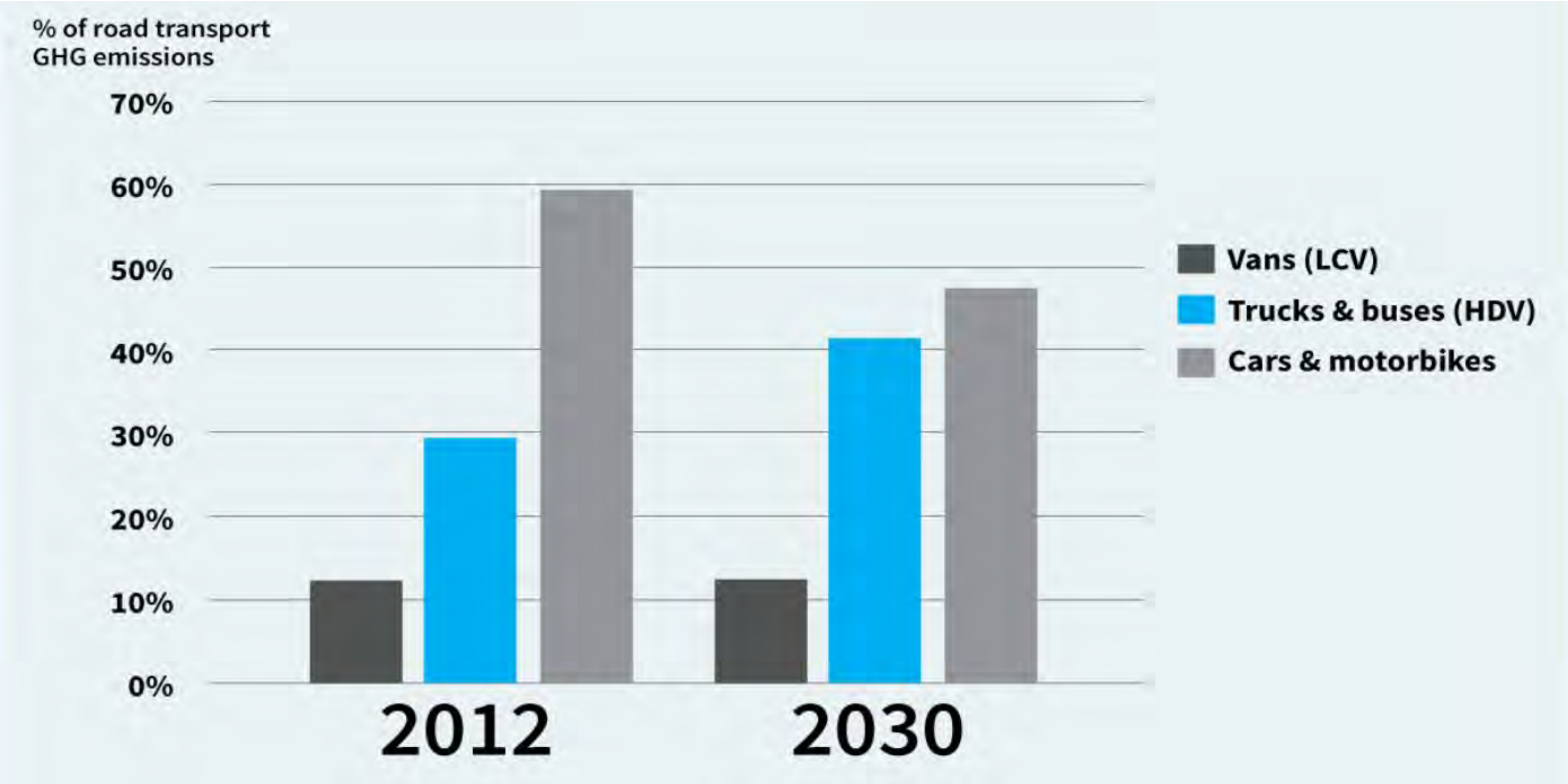
SIEMENS



Source: European Commission reference scenario for 2050 (2013)

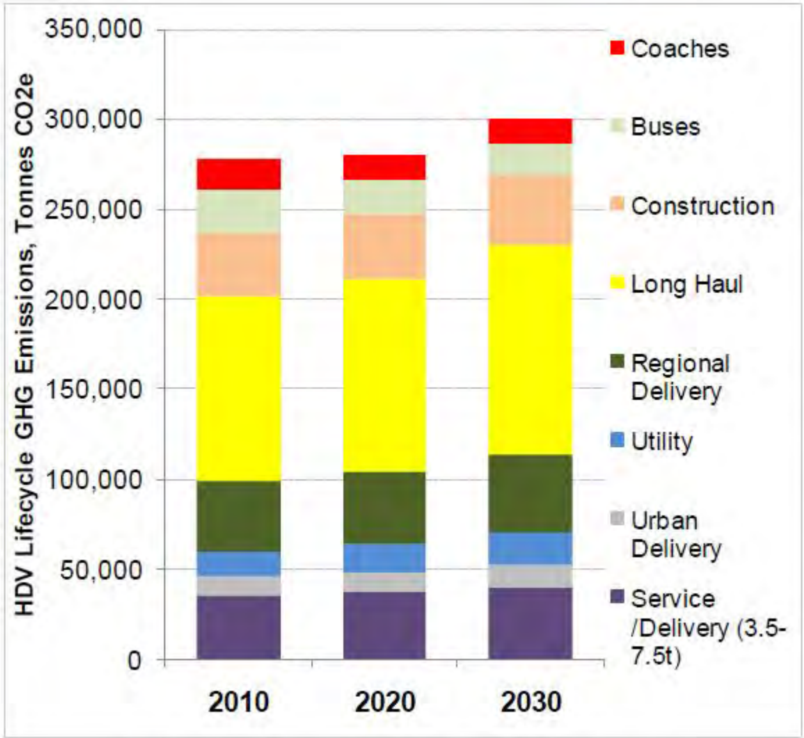
Freight emissions will replace passenger traffic as main source of CO_2 already by 2030

SIEMENS



Source: Transport & Environment – Briefing: Too big to ignore – truck CO2 emissions in 2030 (2015)

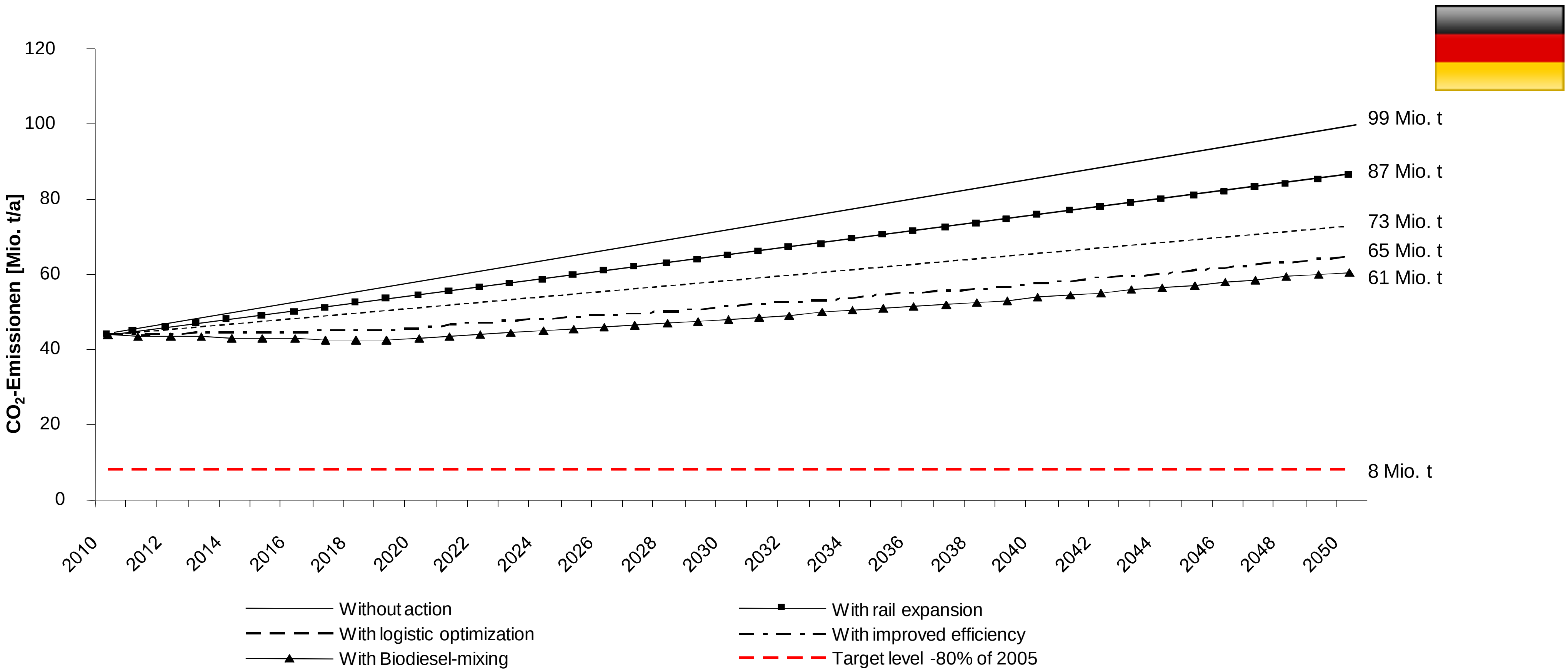
Long haul is by far the biggest segment of HDV in terms of fuel consumption and GHG-emissions



Lifecycle GHG Emissions

Source: Reduction and Testing of Greenhouse Gas (GHG) Emissions from Heavy Duty Vehicles – Lot 1: Strategy
Final Report to the European Commission – DG Climate Action
Ref: DG ENV. 070307/2009/548572/SER/C3

Measures to reduce road freight CO_2 emissions



Source: German Ministry of Environment (BMU), March 2013

Alternative concepts

Investigated concepts comprise external power supply and on-board storage systems

On-board storage

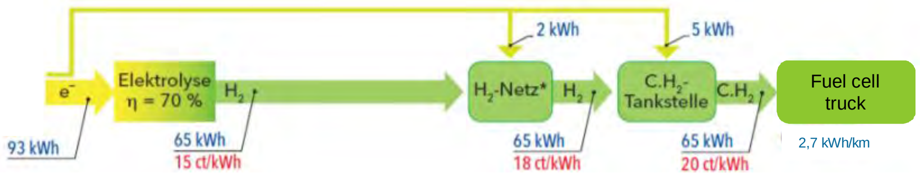
- **Alternative fuel**
- **Electricity**
  - Battery
  - Capacitors
  - Fuel cell

External power supply

- **Contactless**
  - Inductive power supply
  - Linear s. motor concepts
- **Conductive**
  - Ground based contact line
  - Overhead contact line

Zero-emission trucks are possible with renewable energy, but efficiency varies greatly

SIEMENS

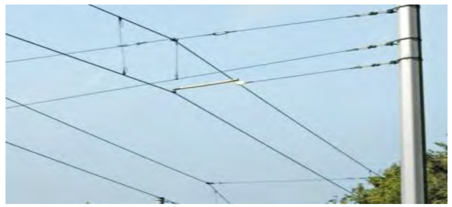
Pathway	Range Cost per km	Efficiency WTW	Example vehicle
Battery 	48 km 20 ct/km	62 %	
Hydrogen 	24 km 55 ct/km	29 %	
Power-to-Gas 	17 km 70 ct/km	20 %	

Source: German Ministry of Environment

Alternative concepts

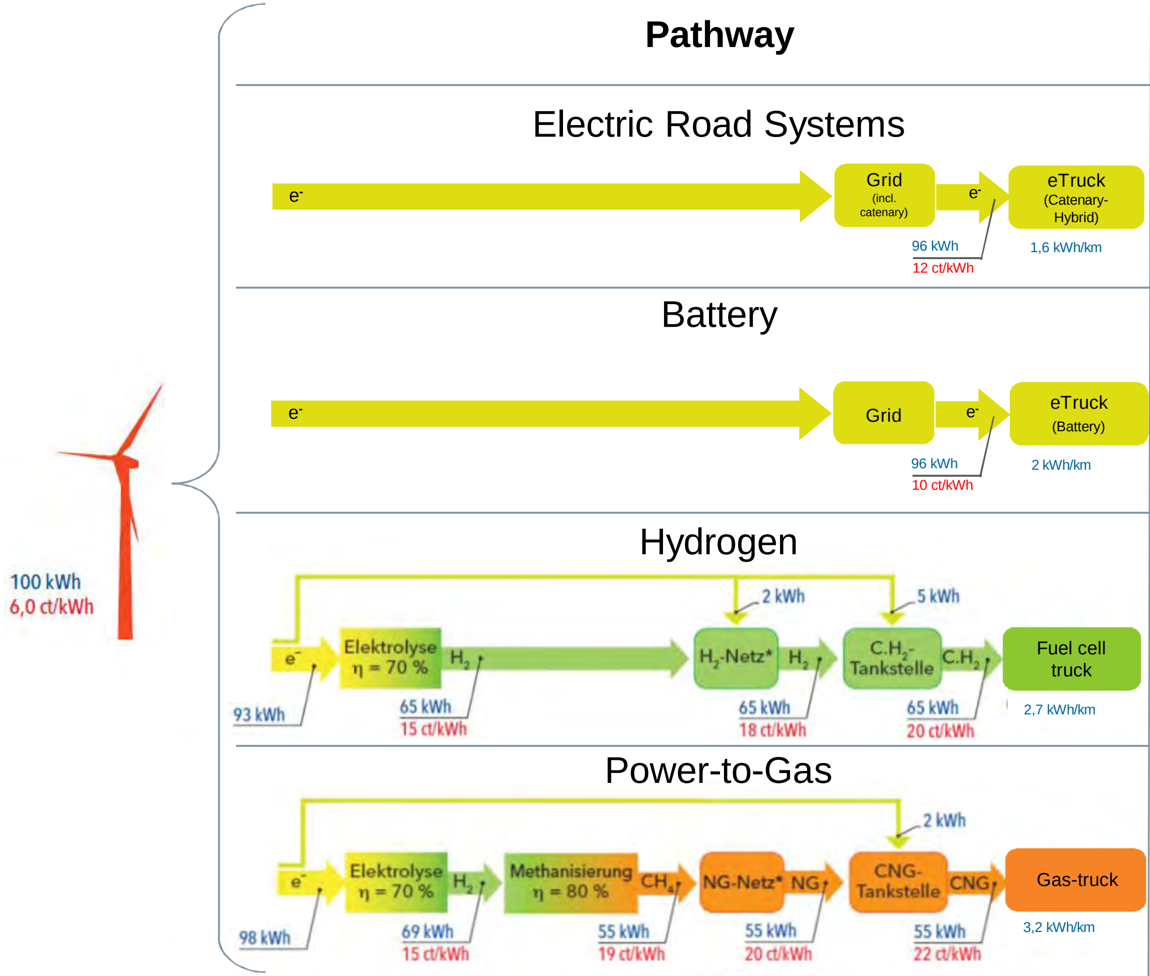
Investigated concepts comprise external power supply and on-board storage systems

- **On-board storage**
  - **Alternative fuel**
  - **Electricity**
    - Battery
    - Capacitors
    - Fuel cell
- **External power supply**
  - **Contactless**
    - Inductive power supply
    - Linear s. motor concepts
  - **Conductive**
    - Ground based contact line
    - Overhead contact line



Zero-emission trucks are possible with renewable energy, but efficiency varies greatly

SIEMENS



* inklusive Speicher

Pathway	Range / Cost per km	Efficiency WTW	Example vehicle
Electric Road Systems	60 km 19 ct/km	77 %	
Battery	48 km 20 ct/km	62 %	
Hydrogen	24 km 55 ct/km	29 %	
Power-to-Gas	17 km 70 ct/km	20 %	

Source: German Ministry of Environment

Akerman / MO TI EH

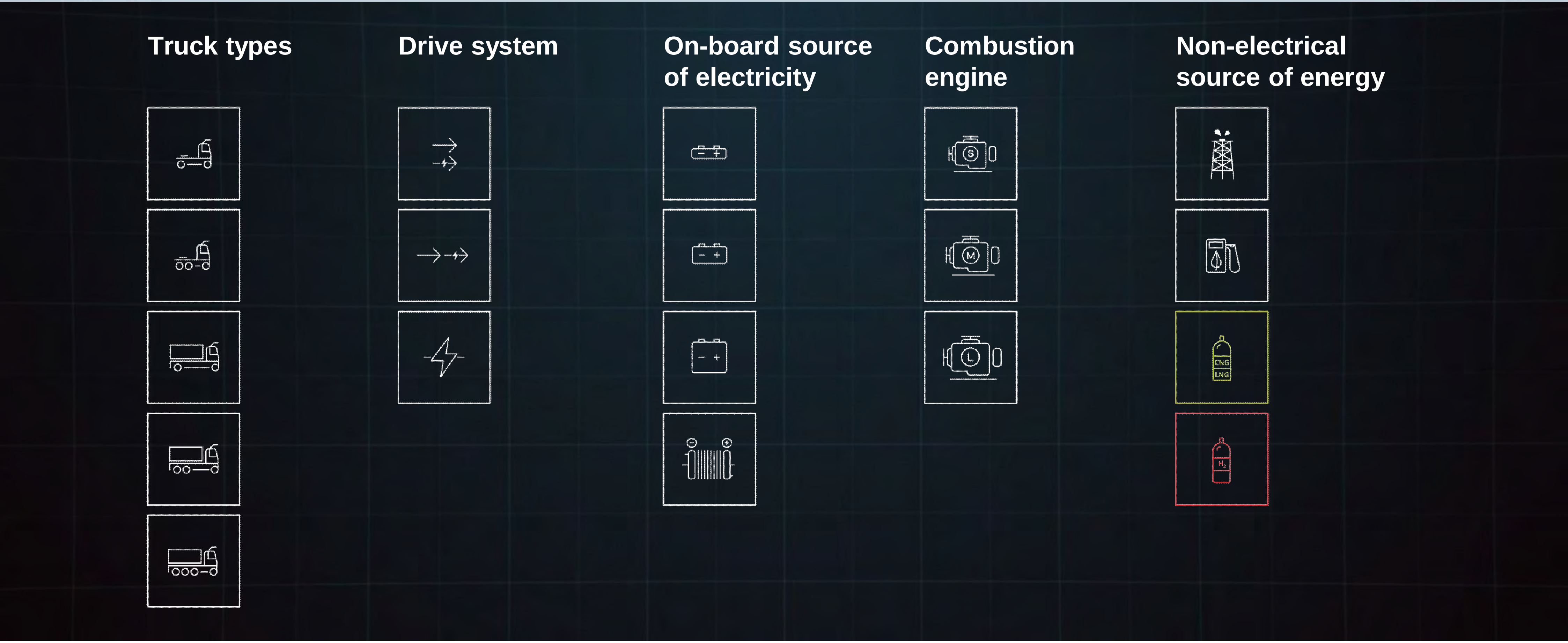
What an Electric Road System could look like

How it could work

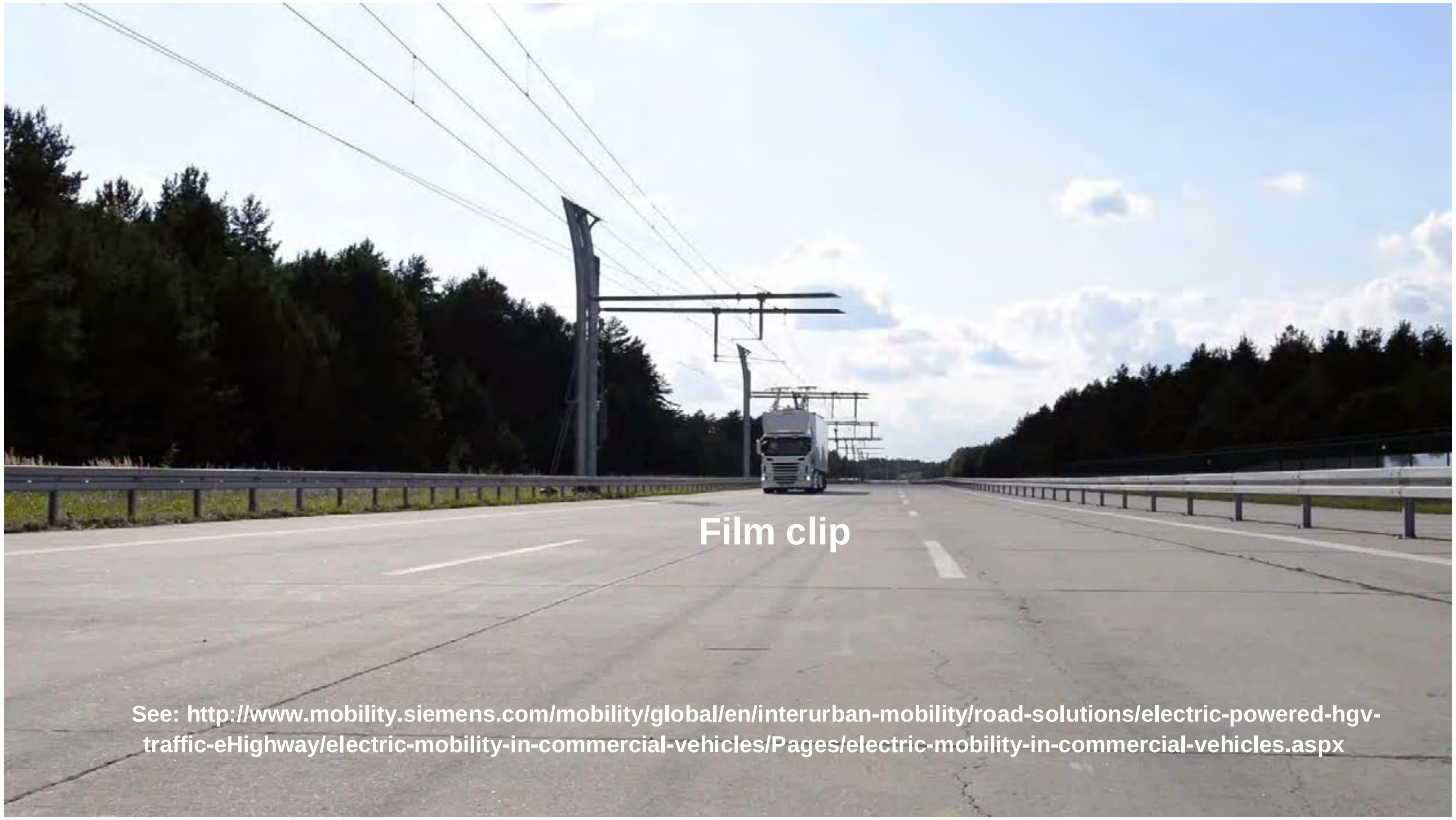
Film clip

The overhead contact line hybrid can be configured to suit very different applications

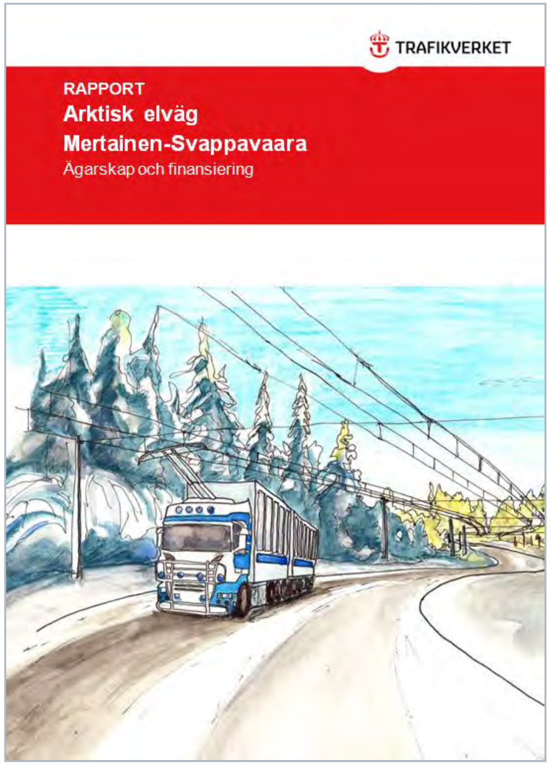
SIEMENS



But is it realistic?

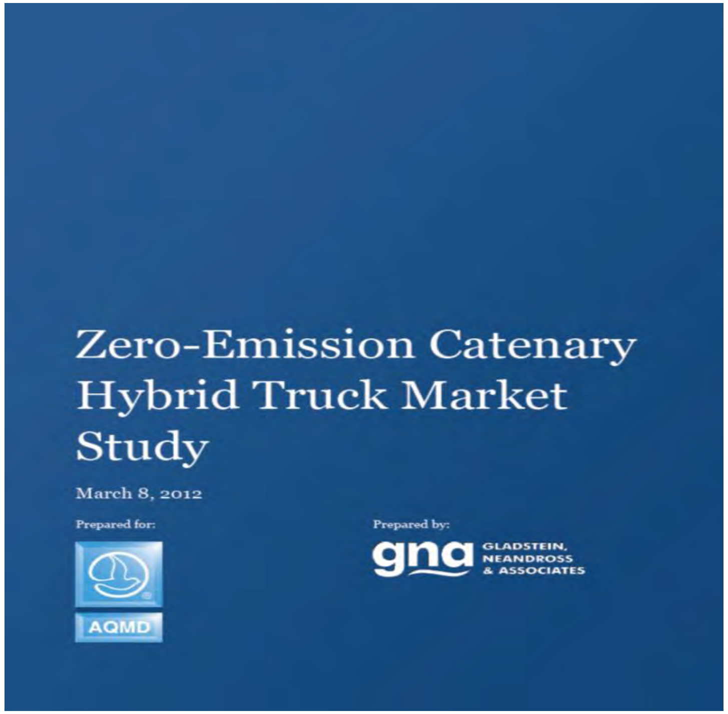


Public road demonstration in Sweden



Source: Vägverket Konsult

Public road demonstration in the U.S.



Electrification is especially attractive on highly frequented routes

SIEMENS

eHighway application fields

near term		long term

Shuttle transport

Mine transport

Long-haul traffic

The development path of road electrification is likely to echo that of rail electrification a century ago

Infrastructure built on the heavily trafficked roads can address significant part of heavy duty emissions

SIEMENS

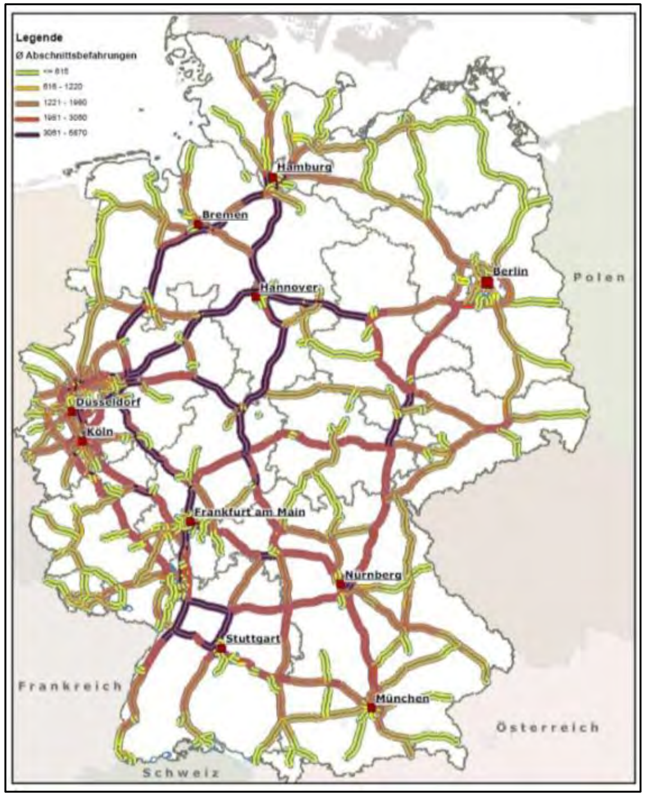
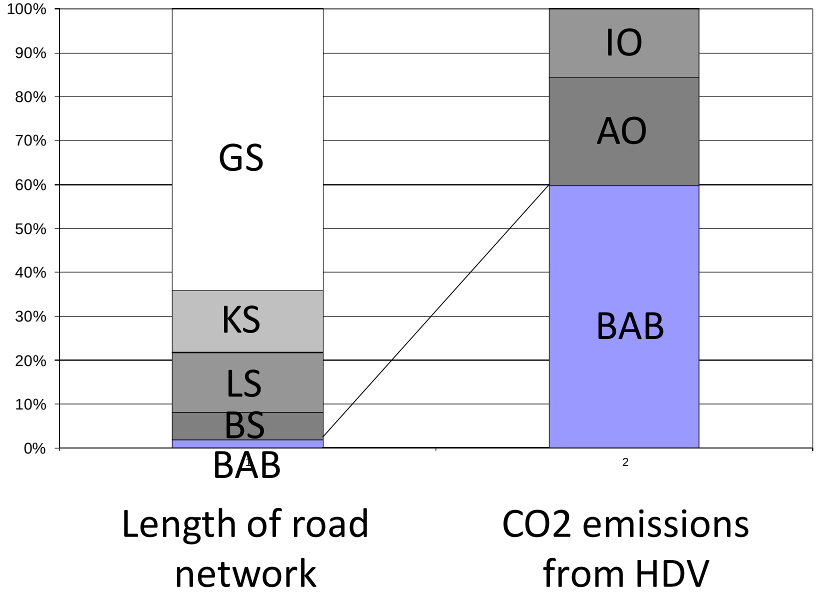


Image: HDV density on BAB-Network



IO = Innerorts
AO = Außerorts
BAB = Bundesautobahn

Source: TREMOD 2012

BAB = Bundesautobahnen (12.594 km)
BS = Bundesstraßen (40.400 km)
LS = Landesstraßen (86.600 km)
KS = Kreisstraßen (91.600 km)
GS = Gemeindestraßen (>420.000 km)

Source: Verkehr in Zahlen 2012

- 60 % of the HDV emissions occur on 2 % of the road network (BAB = 12,394 km)
- The most intensely used 3,966 km handle 60% of all ton-km on the BAB

Thank you for your attention

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Mobility
Technology & Innovation
eHighway

Erlangen

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www.siemens.com/mobility/ehighway


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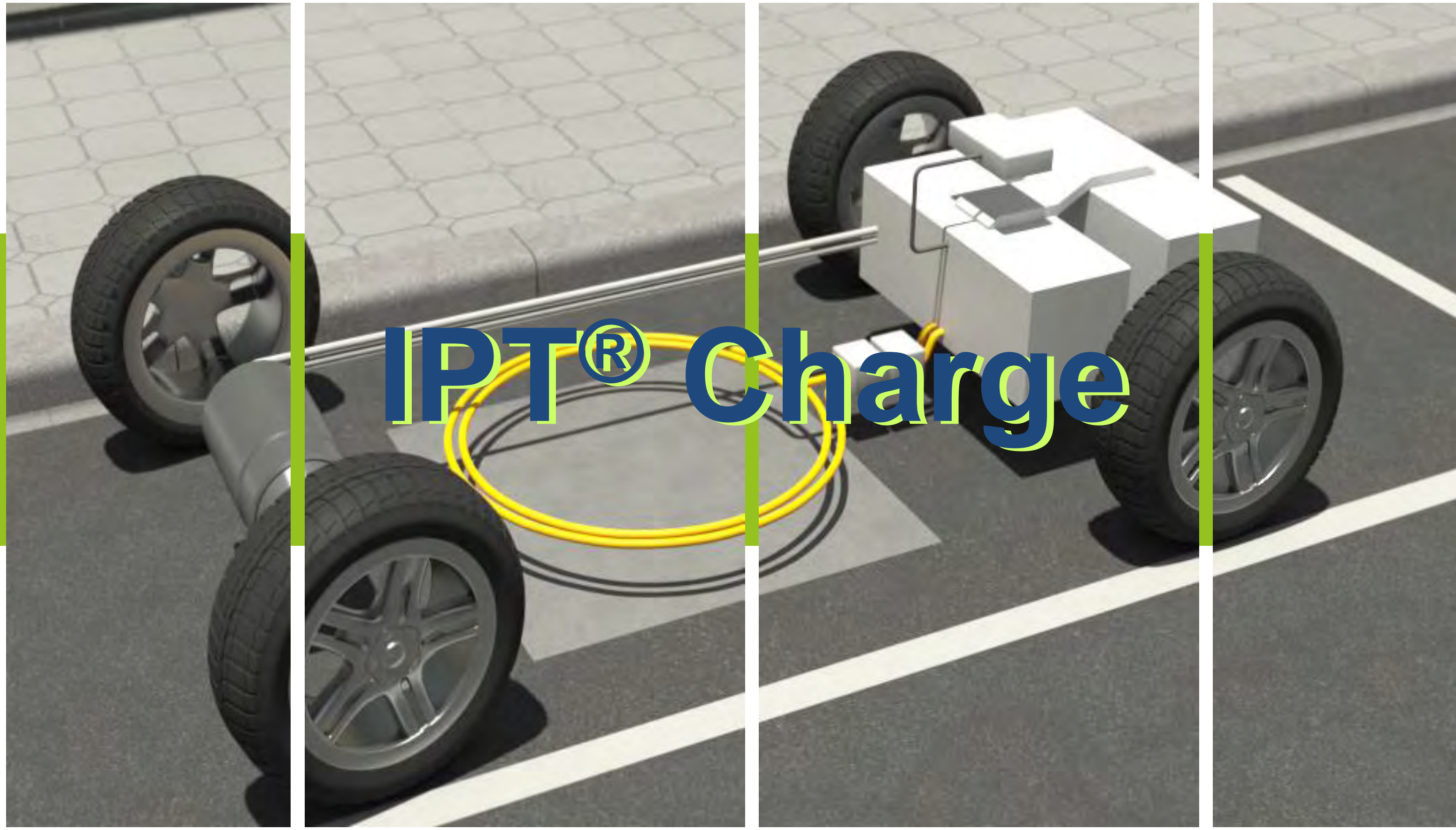
Ingenuity for life
eHighway
Elektrisch in die Zukunft

Presentation TASK 27, Amsterdam 12th April 2016



IPT® Charge

History

… never heard …

Technology

We design, build and deliver comprehensive power transfer solutions for the needs of our markets.
We are a professional partner for our customers.

Innovative Power Transfer for a World of Movement

Typical applications served

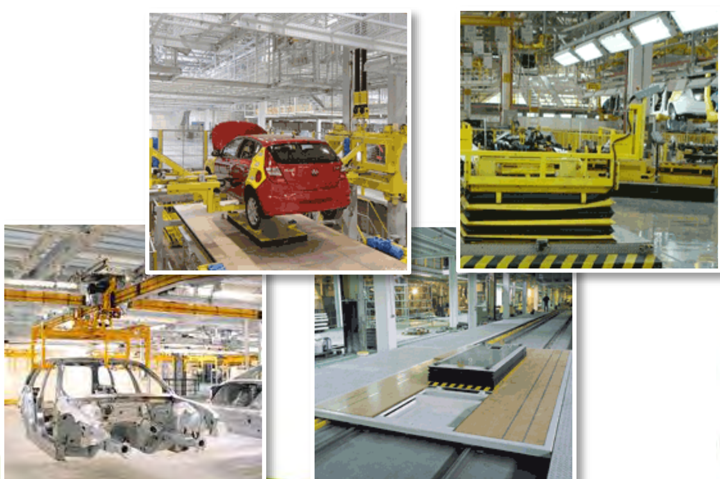
Continuous Power Transfer

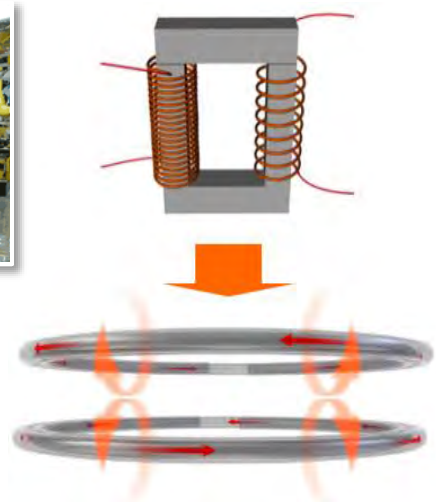
i.e.
Production Line Electrification
in the Car Industry, Plane Manufacturing, ..

Baggage and Parcel Transport and Sorting
in Airports, Distribution Centers, …

Discontinuous Power Transfer

i.e.
Buses in Public Transport
Microbuses to Double Deckers





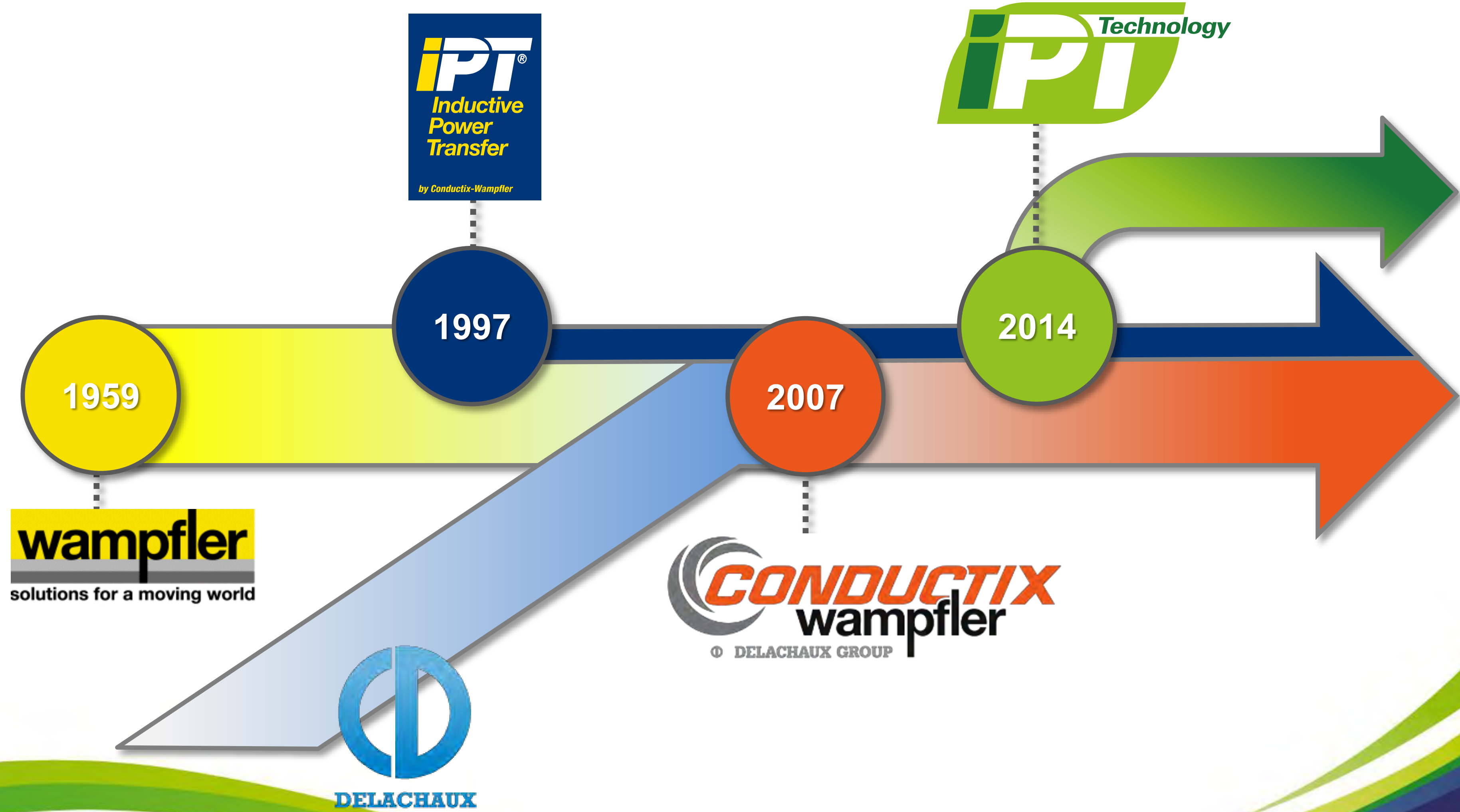
Experiences

More than a Decade of Experience – on the Road and off the Road

IPT® Charge – Turin and beyond!

Rotorua, Genoa, Luzern, Japan, Utrecht, Chattanooga UTC, s‘Hertogenbosch, Milton Keynes, London, Bristol ...

History



IPT®
Inductive Power Transfer
by Conductix-Wampfler
IPT Technology
1959
1997
2007
2014
wampfler
solutions for a moving world
CONDUCTIX wampfler
DELACHAUX GROUP
DELACHAUX

Markets

2014

Core Competences

Design

Production

Implementation

Services

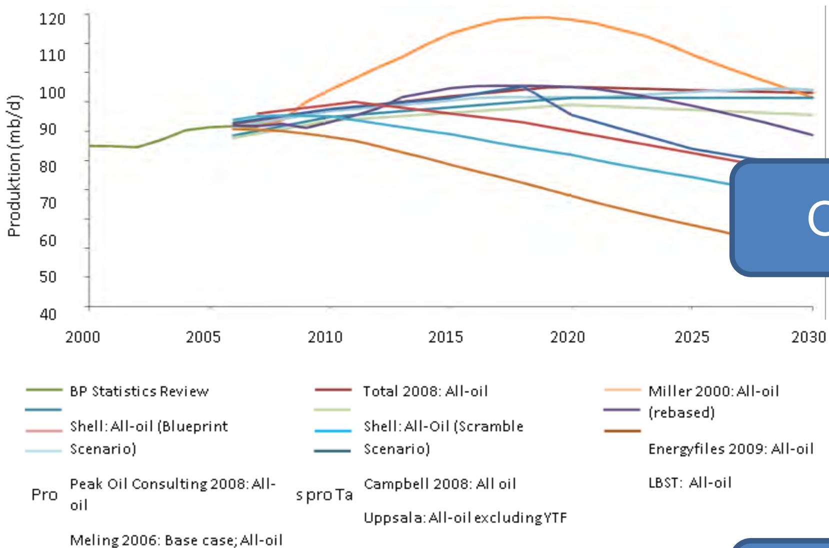
Research

Customizing

System Engineering

Monitoring

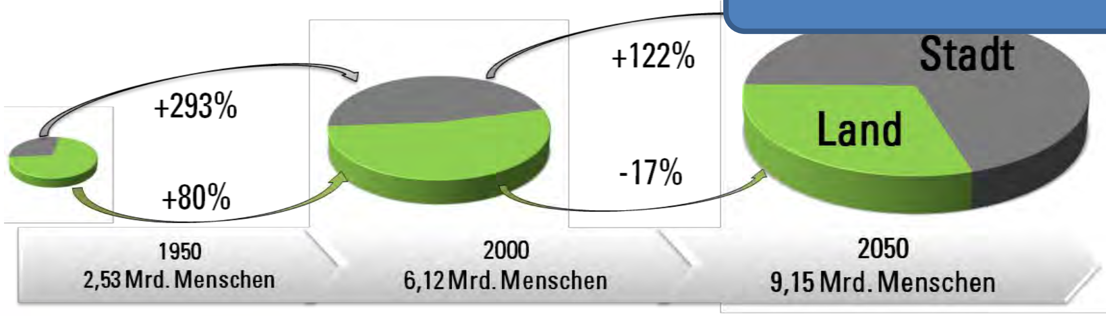
Electrification Mega-Trend … and Need



Quelle: Sorrell, S.: Peaking Forecasts In: https://workspace.imperial.ac.uk/earthscienceandenginee PublicSeminarsOnEnergy/Peak%20oil%20by%20Sorrell.pdf, zugegriffen am 21.10.2011.

Oil Resources

Urbanization



Source:
World Urbanization Prospects The 2009 Review, hrsg. v. United Nations-Department of Economic and Social Affairs, New York 2010, S. 29.

More Sustainability

- Conscious Use of Energy
- Efficient Use of Energy
- Low Emission Use of Energy
- No Noise

clean, quiet, efficient Transportation

Commercial Vehicles in Cities

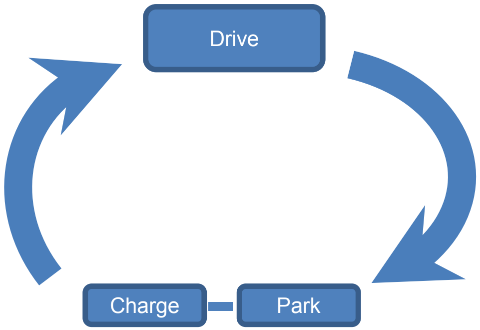
- Vehicles of Municipality
- Garbage Trucks
- Street Cleaning
- Rescue Services
- Police
- Social Services
- Taxis
- Rental Cars
- Car-Sharing
- Driving Schools
- Shuttle Services
- Food Services, „Pizza Delivery“
- Construction Works
- Mail Services
- Couriers
- Parcel Services
- Shipping Companies
- Service Vehicles
- Contractors
- Distribution (Supermarkets, etc.)
- Intercompany Traffic
- …..

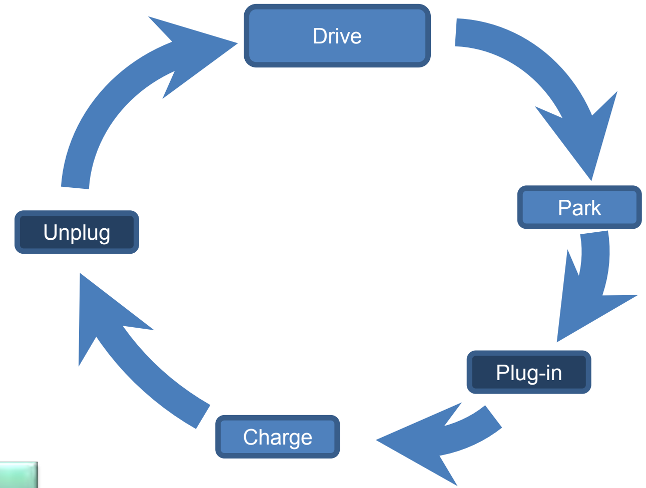
Inhomogeneity in Use of Vehicles !

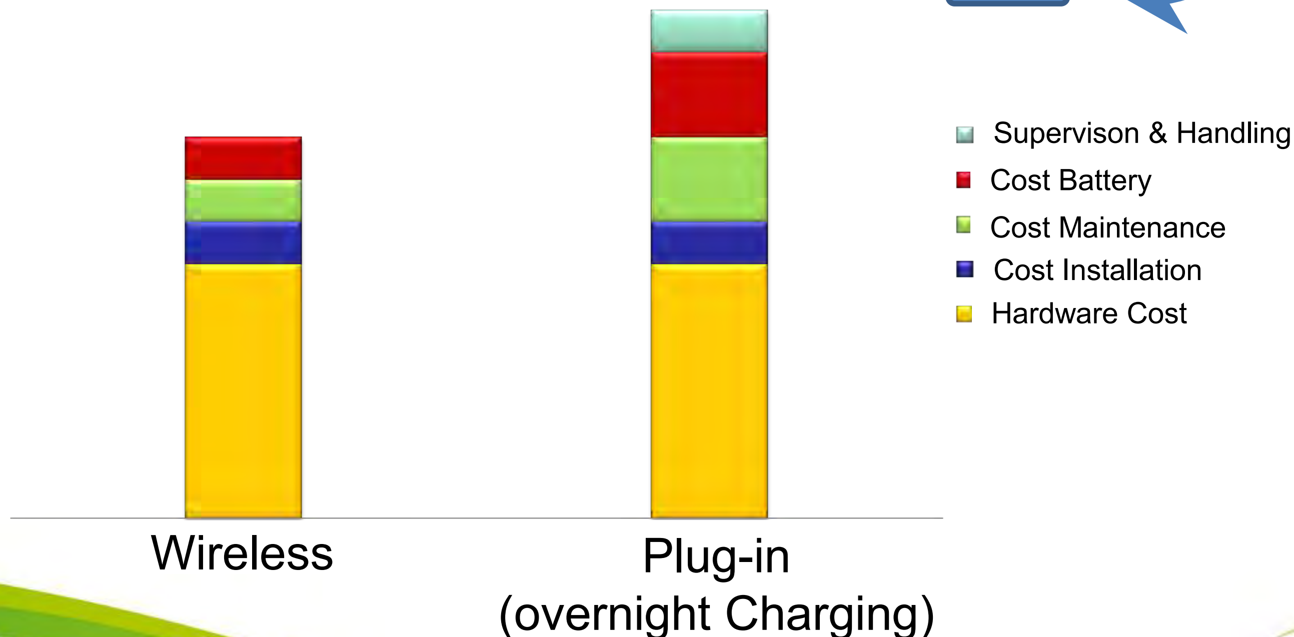
Clustering homogeneous Groups!

Fast Implementation Strategy !

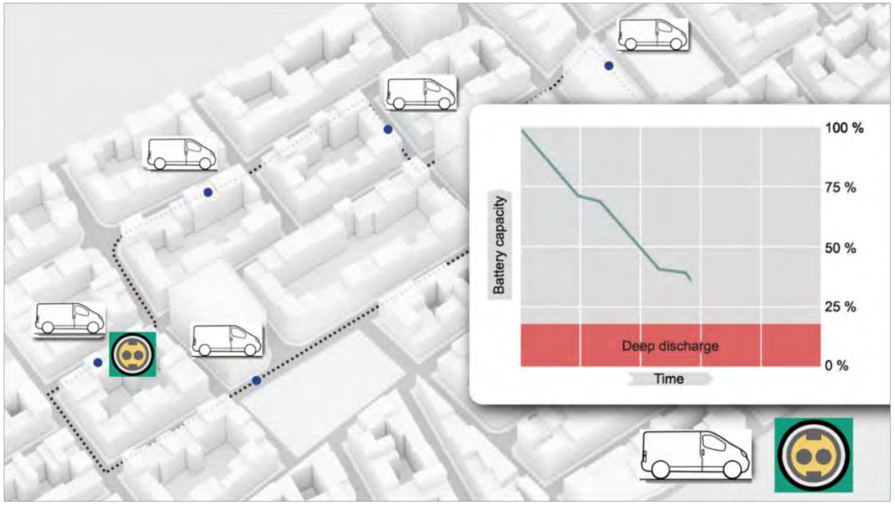
Plug-in vs Wireless



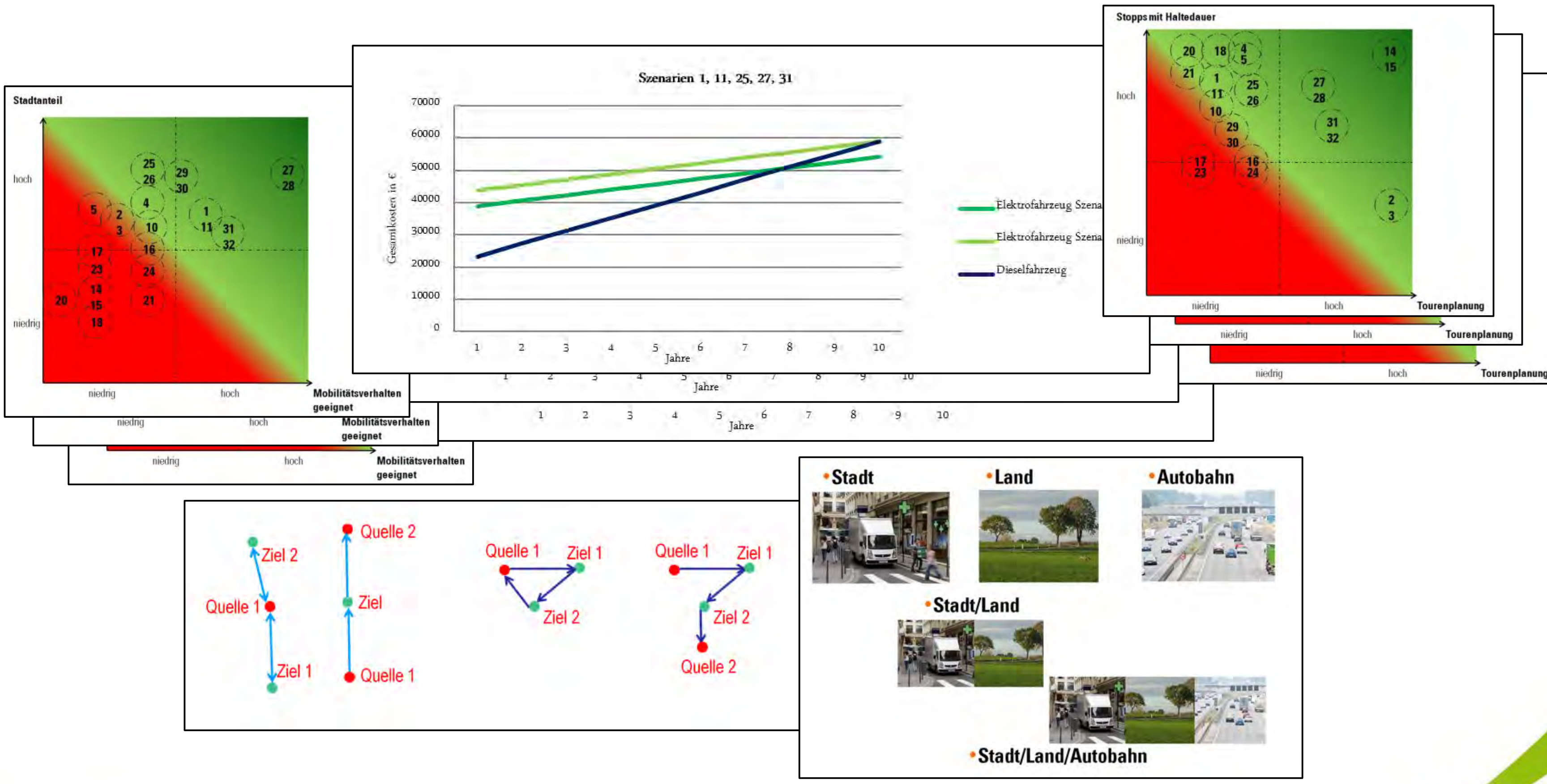




Plug-in vs. Wireless

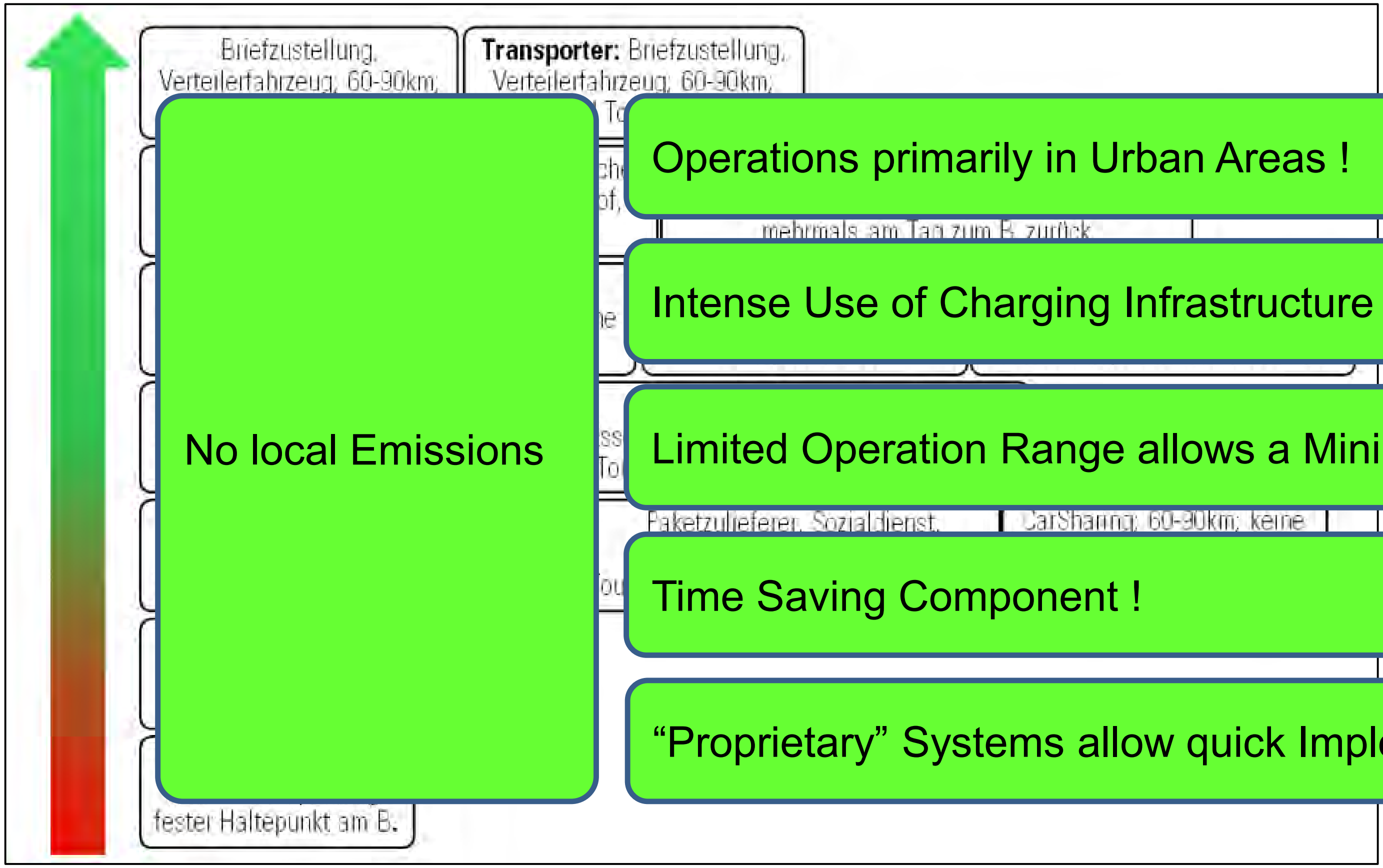


Clustering



Stadtanteil
hoch
niedrig
niedrig
hoch
Mobilitätsverhalten geeignet
Szenarien 1, 11, 25, 27, 31
Gesamtkosten in €
70000
60000
50000
40000
30000
20000
10000
0
1 2 3 4 5 6 7 8 9 10
Jahre
Elektrofahrzeug Szena
Elektrofahrzeug Szena
Dieselfahrzeug
Stopps mit Haltedauer
hoch
niedrig
niedrig
hoch
Tourenplanung
Ziel 2
Quelle 1
Ziel 1
Quelle 2
Ziel
Quelle 1
Quelle 1
Ziel 1
Ziel 2
Quelle 1
Ziel 1
Ziel 2
Quelle 2
Stadt
Land
Autobahn
Stadt/Land
Stadt/Land/Autobahn

Fast Implementation Track



No local Emissions

Operations primarily in Urban Areas !

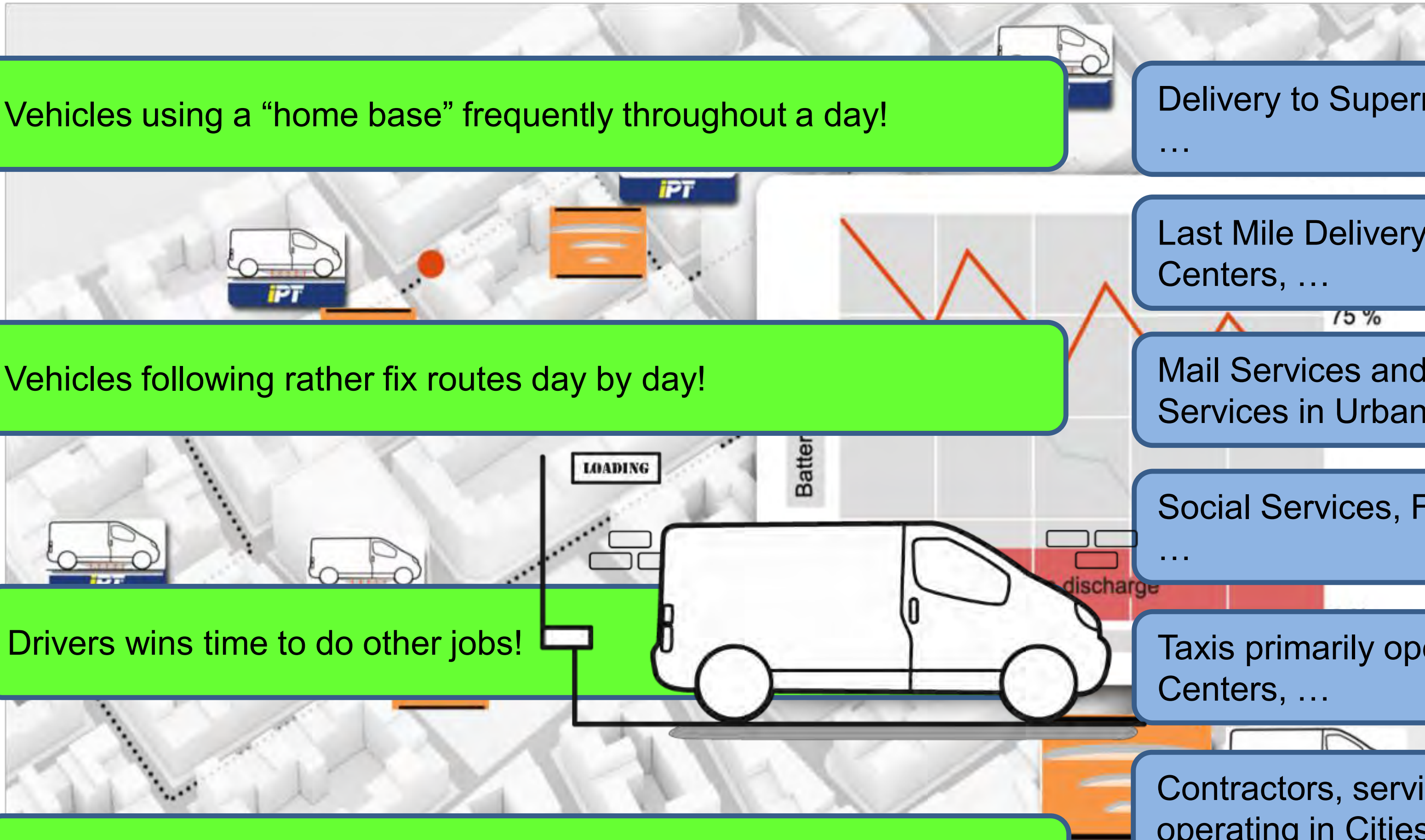
Intense Use of Charging Infrastructure !

Limited Operation Range allows a Minimum of Batteries !

Time Saving Component !

“Proprietary” Systems allow quick Implementation !

Fast Implementation Track



Vehicles using a “home base” frequently throughout a day!

Vehicles following rather fix routes day by day!

Drivers wins time to do other jobs!

No waiting for the Implementation of a public charging infrastructure!

Delivery to Supermarkets, Malls, …

Last Mile Delivery into City Centers, …

Mail Services and Parcel Services in Urban Areas

Social Services, Food Delivery, …

Taxis primarily operating in City Centers, …

Contractors, services primarily operating in Cities, ..

…
..

Fast Implementation Track

Opportunity Charging with IPT®

Potential Restrictions of Electrification

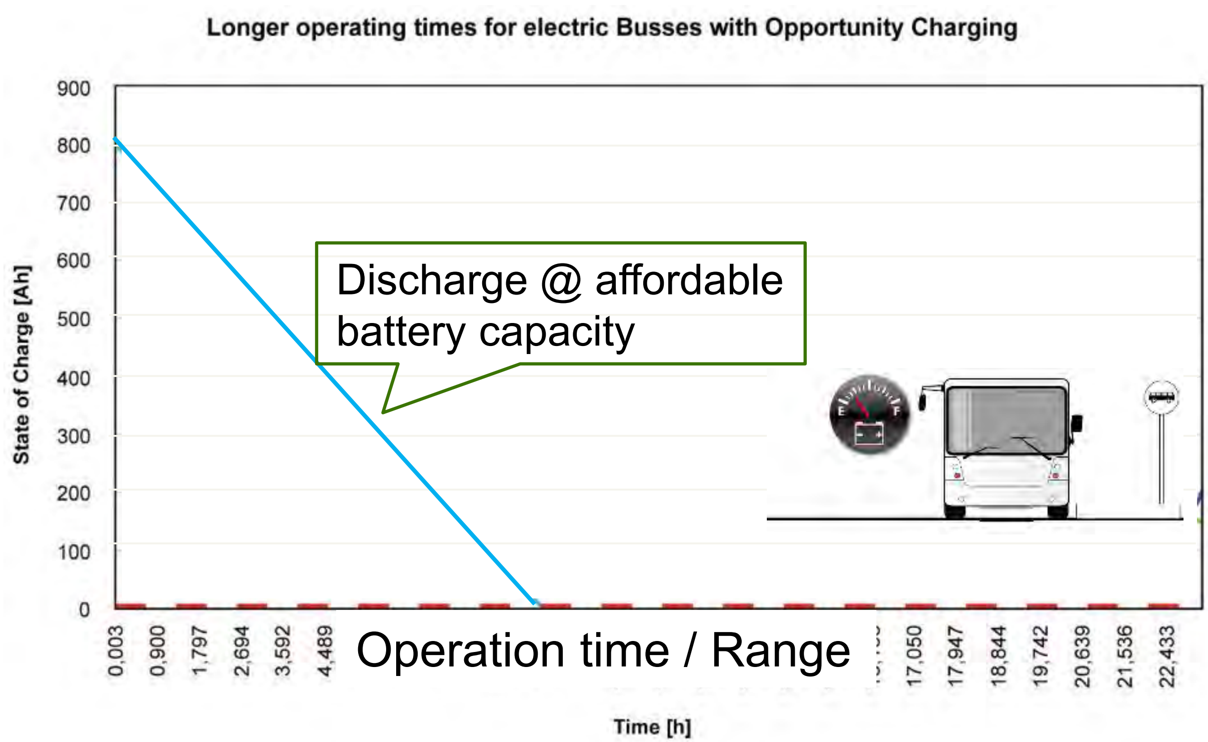
Range?
Investment?
Restrictions?

Image Electric Buses:

- More efficient

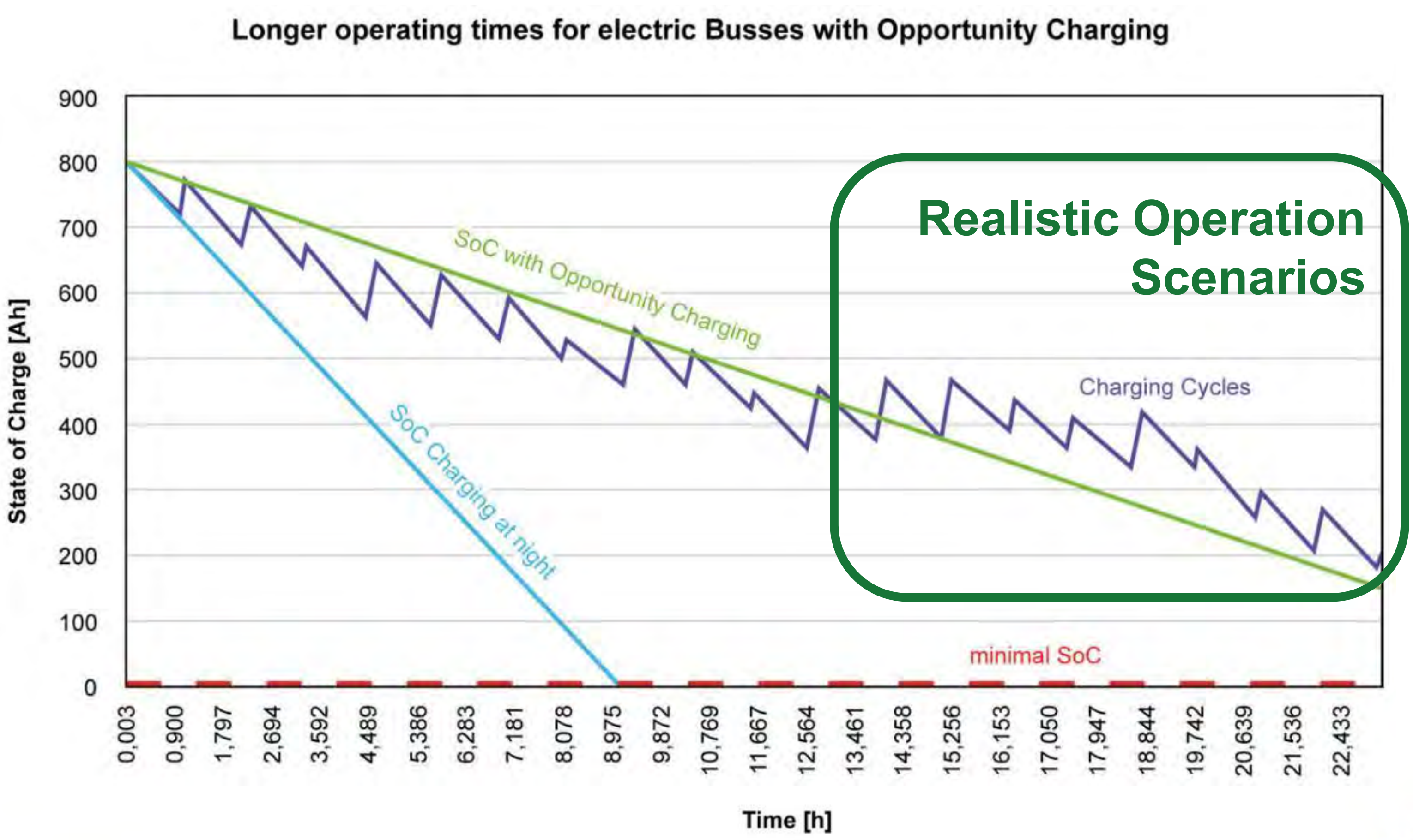
but …

- Not enough range
- To expensive
- Not practicable



Opportunity Charging with IPT®

Need for Opportunity Charging



Opportunity Charging with IPT®

Trend E-Mobility

Clean
Quite
Safe operation
Protection of resources

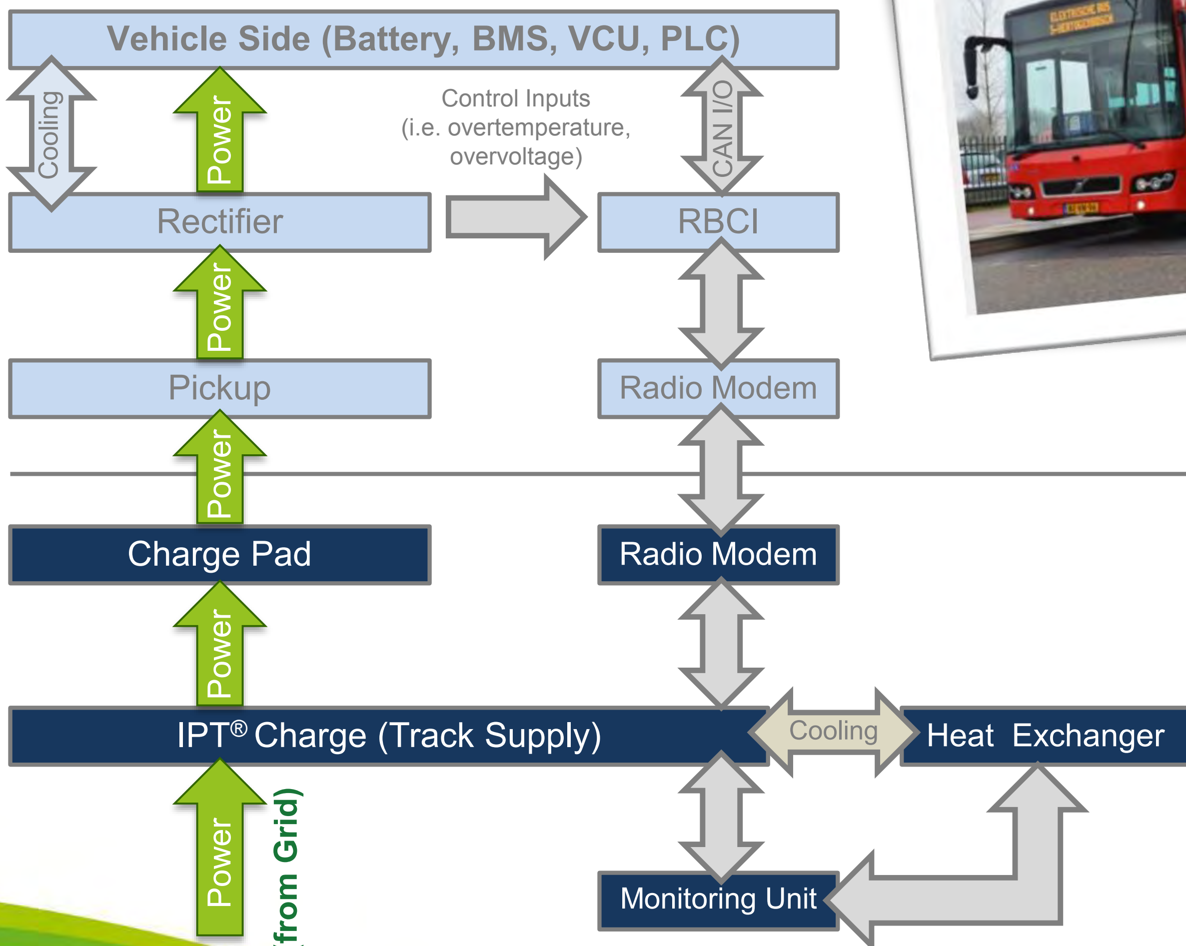
Electric Drive Systems

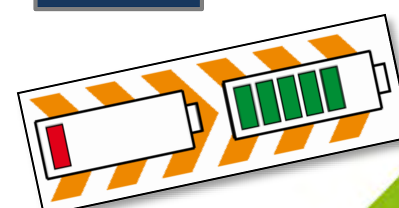
Ecologic & Economic Win-Win with IPT® Charge

No plugs, less batteries
No emission fees
No worries, efficient
Cost competitive

Opportunity Charging with IPT®

System Overview





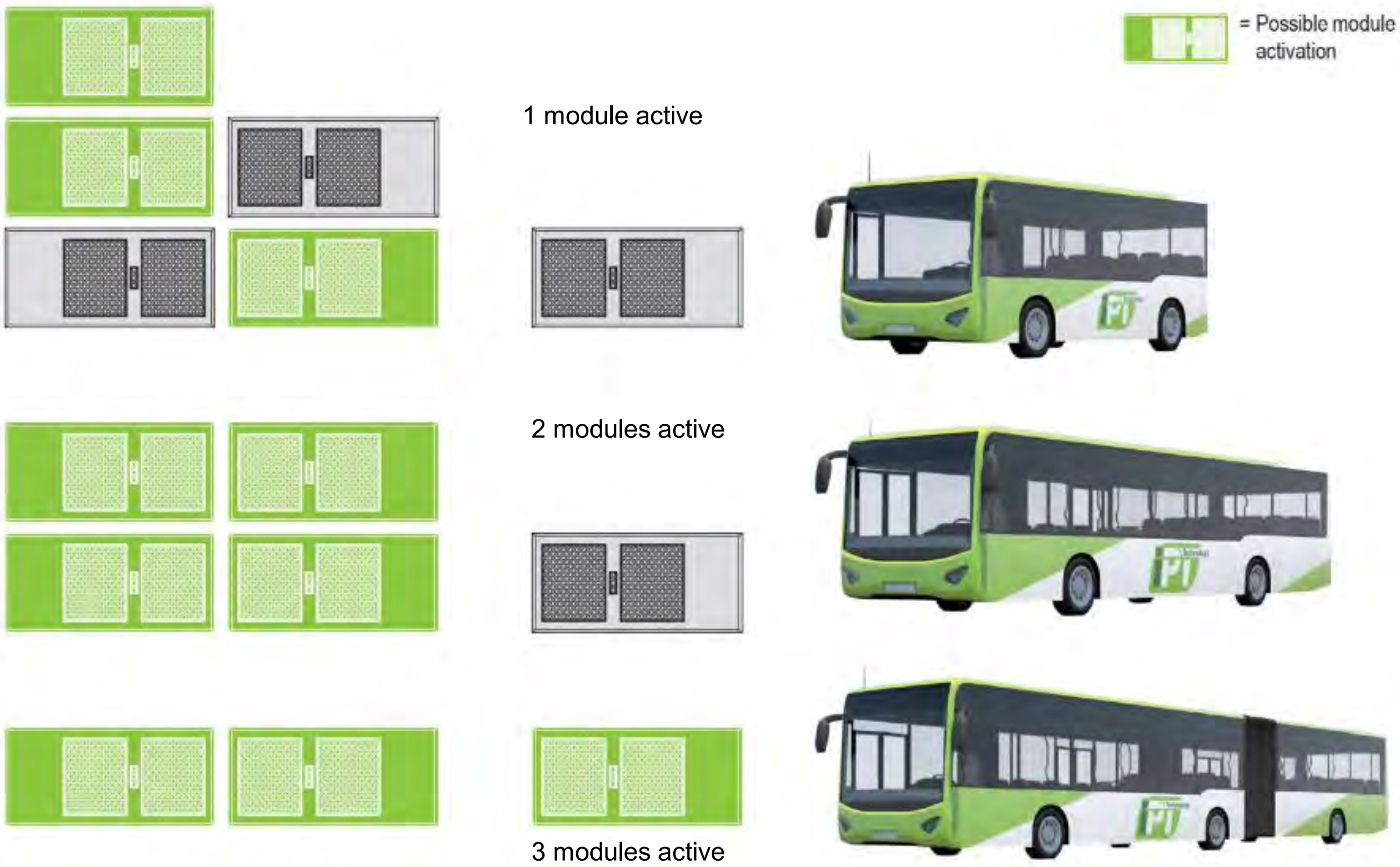
Opportunity Charging with IPT®

Optimized Infrastructure
For Dense City Traffic & Commuter Routes

Projectimpressions „London“

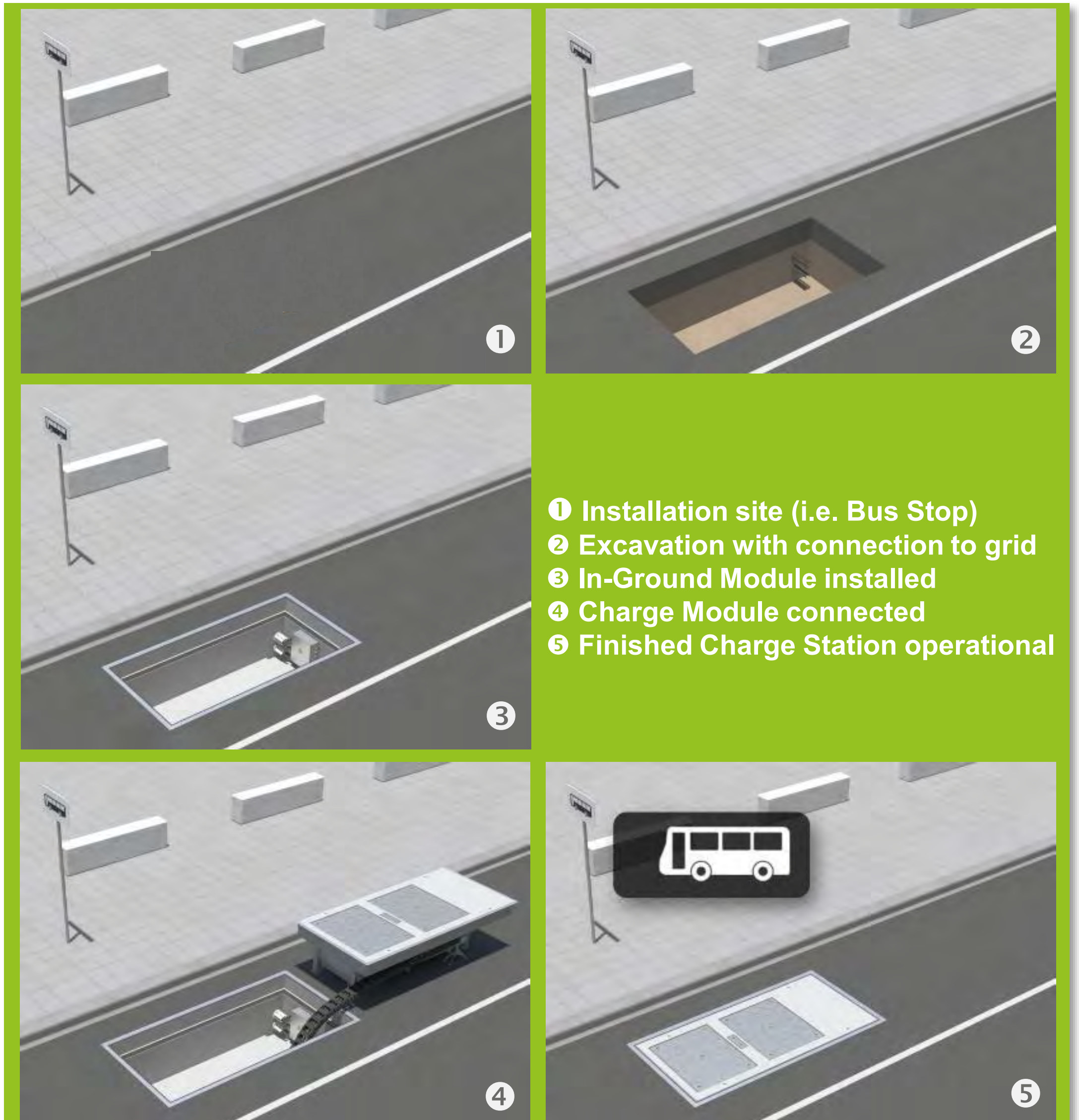
Opportunity Charging with IPT®

Modular Setup IPT® Charge

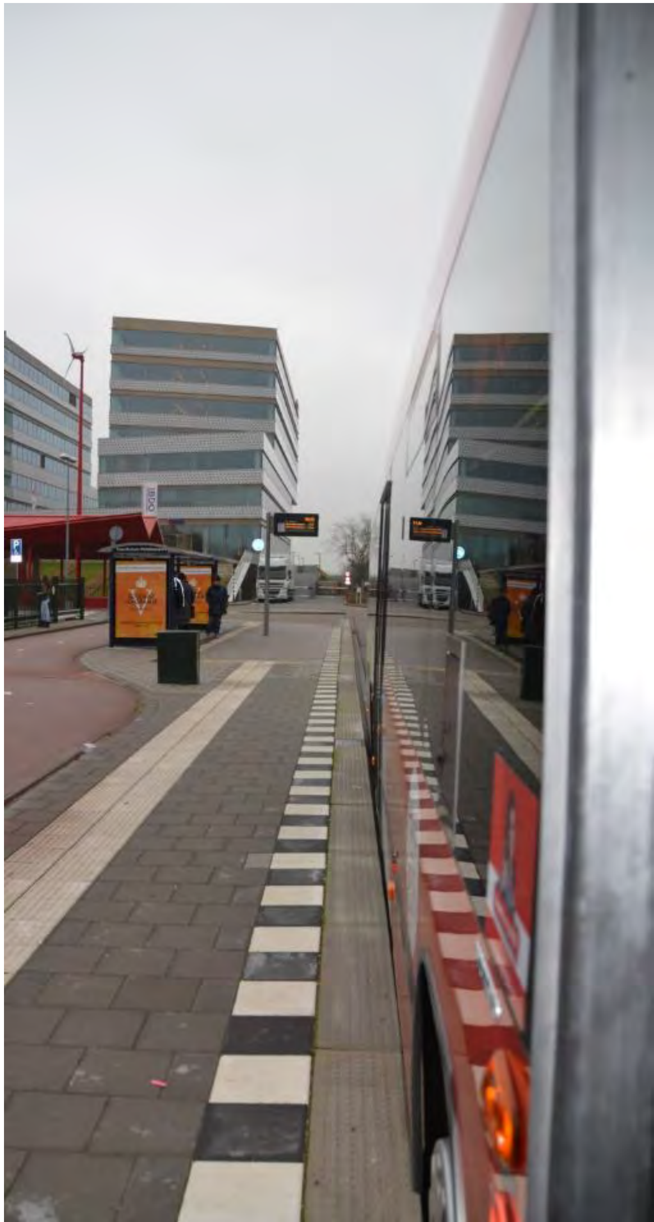


Opportunity Charging with IPT®

Installation



❶ Installation site (i.e. Bus Stop)
❷ Excavation with connection to grid
❸ In-Ground Module installed
❹ Charge Module connected
❺ Finished Charge Station operational



Opportunity Charging with IPT®

More than a Decade of Experience – on the Road and off the Road

IPT® Charge - not just Turin!

Rotorua, Genoa, Luzern, Japan, Utrecht, Chattanooga UTC, s'Hertogenbosch, Milton Keynes, London, Bristol ...

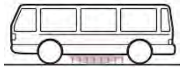
Outlook

3 kW (6 kW)

22 kW

„50 kW“

100 kW



200 kW

300 kW


IPT Technology
Innovative Power Transfer
for a World of Movement
www.ipt-technology.com