



KRACHT DOOR SAMENWERKING

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**VDL ETS**





# Facts & figures

VDL Groep per March 31 2017

**92 COMPANIES**



**TURNOVER**  
€ 3,2 BILLION

**PROFIT**  
€ 150 MILLION



SPREAD OVER  
**19 COUNTRIES**



**14.735 EMPLOYEES**

**80% EXPORT**  
TO **106 COUNTRIES**



OPERATING ACTIVITIES  
SPREAD OVER **4 DIVISIONS**

**STRONG** BALANCE SHEET POSITION  
EQUITY RATIO **60%**



**1.265.000 M<sup>2</sup>**  
PRODUCTION SURFACE

# Core values

VDL Groep



International, industrial family-owned company



Controlled growth



Dedicated employees



Highest level of quality



Strength through cooperation



Top-notch craftsmanship



Innovative products and production techniques



# Highlights



**Subcontracting**



**Car assembly**



**Buses & Coaches**



**Finished products**



# Changing focus

Sustainable energy sources & a healthy city



Clean & sustainable energy



Noise reduction



Less pollution



Decrease fossil fuel use



CO<sub>2</sub> reduction



Livable city



# E-Mobility



# Successful transition

The VDL Bus & Coach approach

**TCO + SYSTEM APPROACH**



**OPERATION**



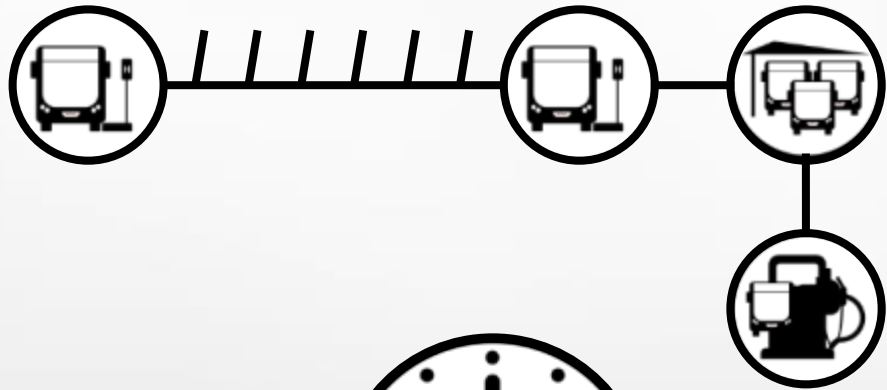
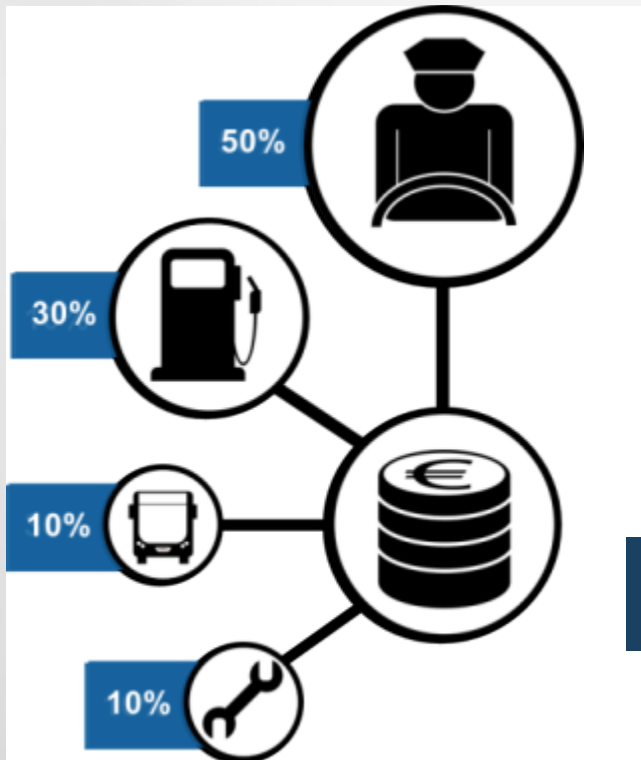
**MODULARITY**



**HEAVY DUTY**

# TCO + System Approach

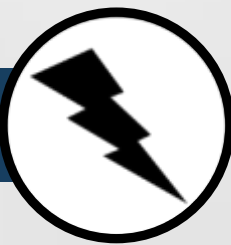
Change DIESEL vehicle by ELECTRIC vehicle?



Battery?



Charging?



Time schedule?



Range?



Emissions?



Climate system?





# TCO + System approach

- Energy(supply)
- Energy storage
- Charging infrastructure
- Monitoring and Maintenance of Charging infrastructure
- Building blocks for electrical vehicles
- Battery assembly / Battery pack development
- Hydrogen technology
- Simulation software
- Connectivity solutions
- Autonomous driving



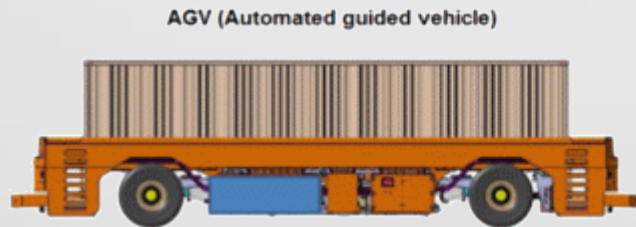




# Modularity

Flexibility through modular design

- Modular system – for all heavy duty applications
- Configuration depending on intended usage
  - Small battery – fast charging
  - Big battery – fast charging
  - Range extender possibilities
- Re-use of building blocks where possible

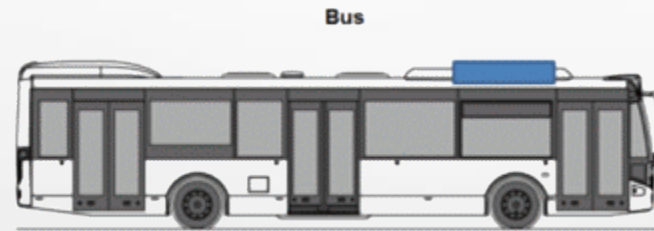
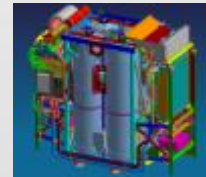


AGV (Automated guided vehicle)



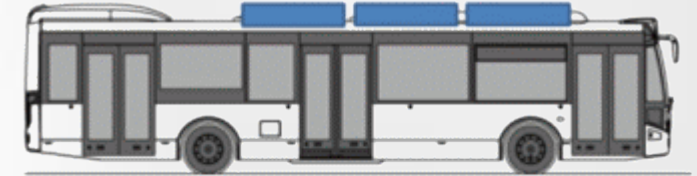
Distribution truck

Modular H2 range extender



Bus

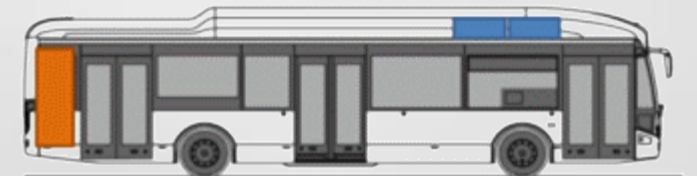
PLUG-IN



FAST CHARGING



RANGE EXTENDER / HYBRID



# Heavy Duty Bus:

Connexion (Transdev), concession AML

Fast charge pantograph

169 kWh battery system



Siemens driveline

Combo 2 Slow charging plug

100 Units

Delivery Q4/2017



# Heavy Duty Truck:

- Truck based on a standard DAF CF FT4x2 40 tons
  - Integration VDL B&C E-Driveline.
    - A-Brand drivers compartment
    - Top quality chassis / wheel suspension
    - Worldwide dealer network service parts
    - Close cooperation VDL – Truck OEM DAF
1. GVW 27-40 ton
  2. Power 210 kW
  3. Torque 2.000 Nm
  4. Battery capacity 85-170 kWh
  5. Battery charging 3C



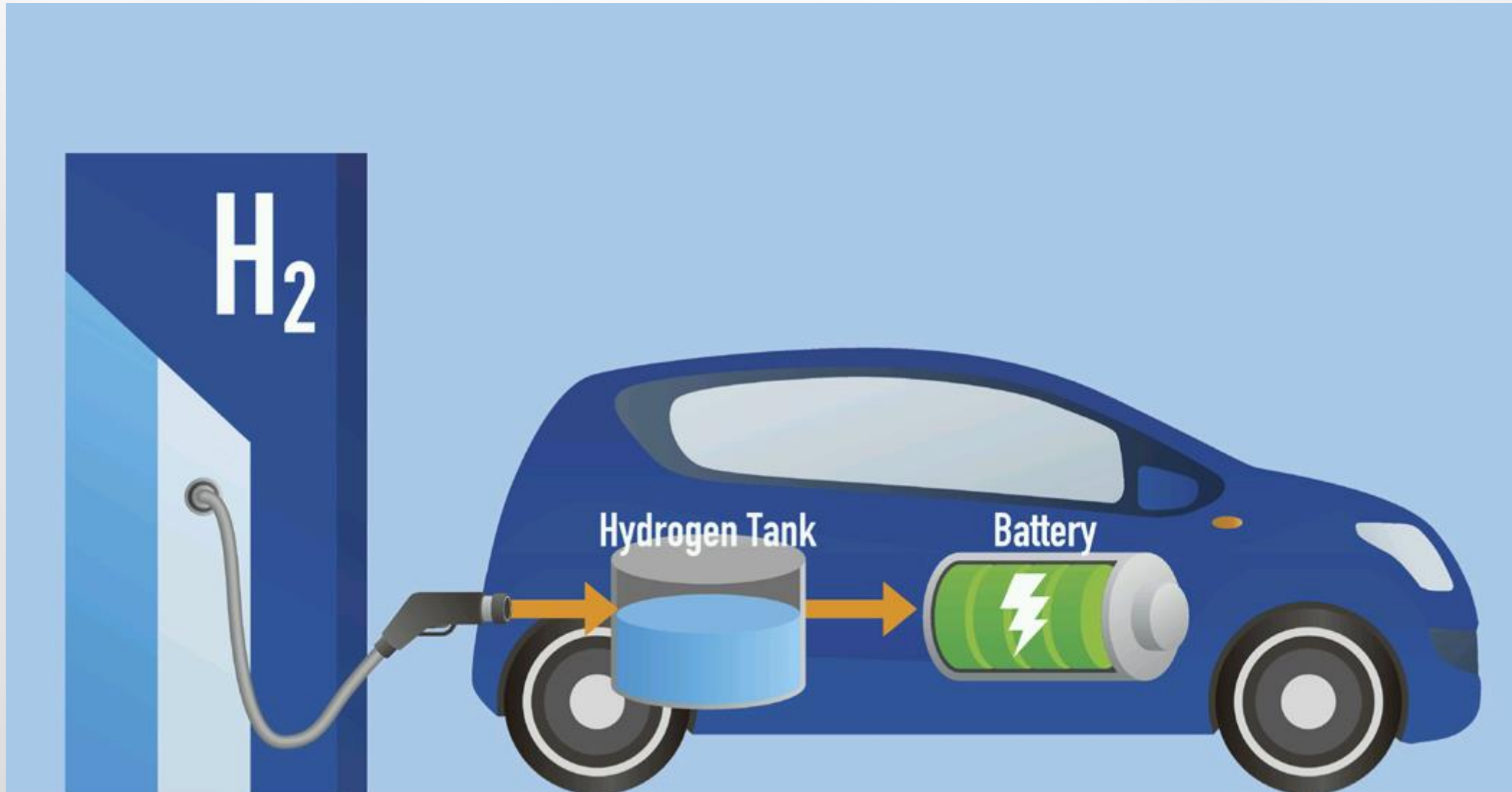
# Heavy Duty AGV:

- AGV from 90-125tons
- Integration VDL B&C E-Driveline.
  - 52ft containers
  - Close cooperation VDL – Götting





# E Mobility and H<sub>2</sub> Range-Extender



# Why Hydrogen as Range-Extender (**SWOT**)?

## Strength:

- Zero emission
- Long Range and Easy to extend (0.8-0.9kg/kWh)
- Short refuelling time
- Independent of Energy-Grid
- Supply:
  - Power to Gas
  - Waste H<sub>2</sub>

## Weakness:

- H<sub>2</sub> only as Energy-Carrier
- H<sub>2</sub> not available in nature
  - Needs energy to produce
- Need of other tank-infrastructure (incl. safety measures)





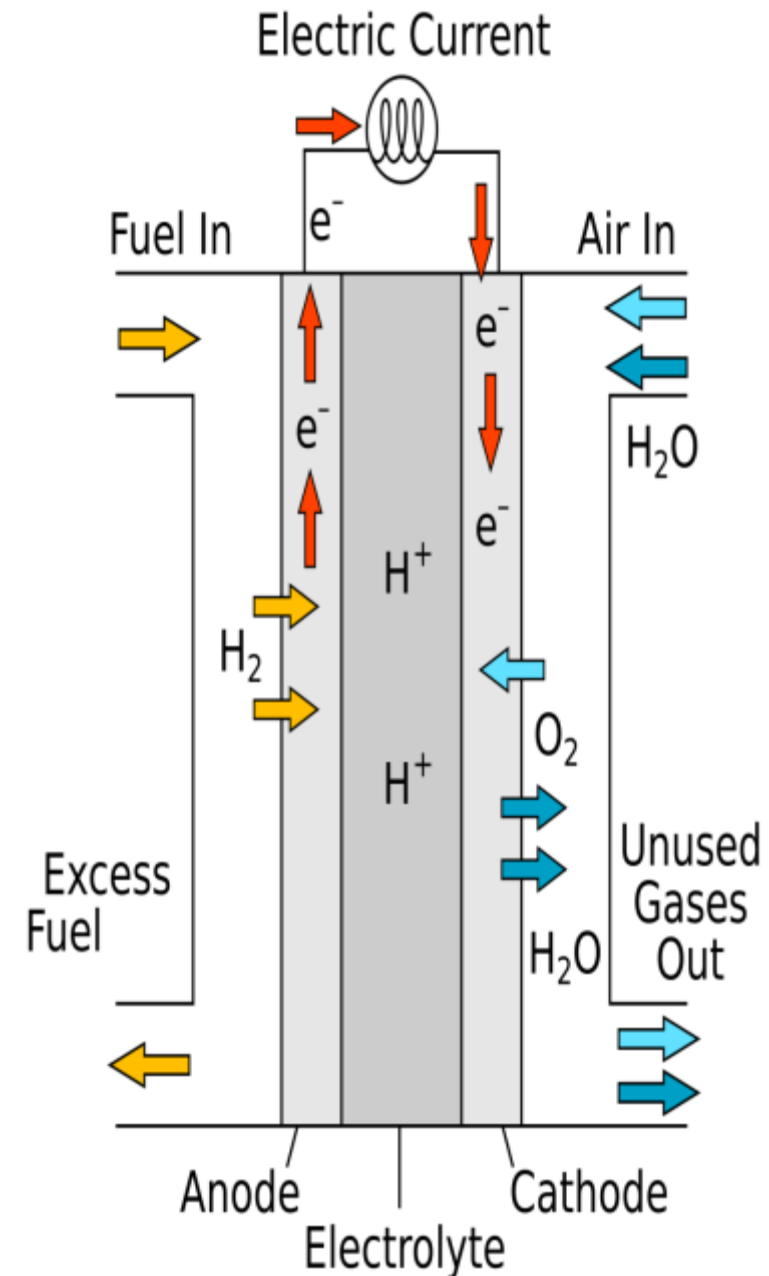
# Why Hydrogen as Range-Extender (SWOT)?

## Threats:

- H<sub>2</sub> price is too high
- Fuel Cell and System Components price is too high or Lifetime is too short
- No H<sub>2</sub> fuelling stations

## Opportunity's:

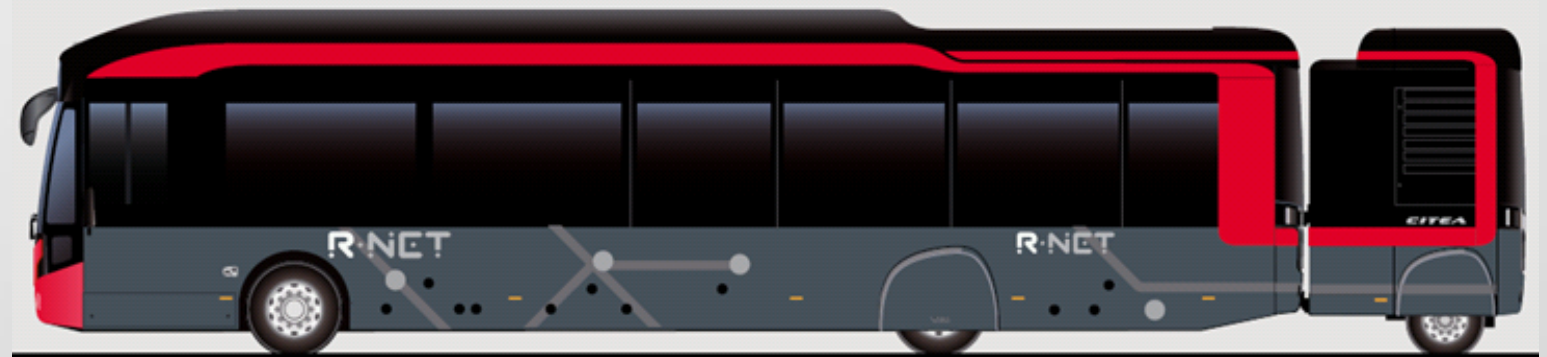
- All 3 points are solvable
  - Price 1kg H<sub>2</sub> in industrial market is 1,90Euro/kg (100bar)  
Project H<sub>2</sub>SHARE: Mobile "Waste H<sub>2</sub>" fuelling station
  - Fuel Cell price can drop easily to <100-200Euro/kW  
See Toyota/BMW, Hyundai  
Project Giantleap: Life extension "cheap" Fuel-Cell
- Mobile H<sub>2</sub> Fuel-Stations  
Project H<sub>2</sub> share and Teamfast



# Intended use Range Extender Unit!

Intended use in:

- Regional and Intercity Public Transport
- Delivery and Disposal trucks
- Transporting Mobile H<sub>2</sub> Fuelling station
- Generator sets (Stand-Alone Unit)

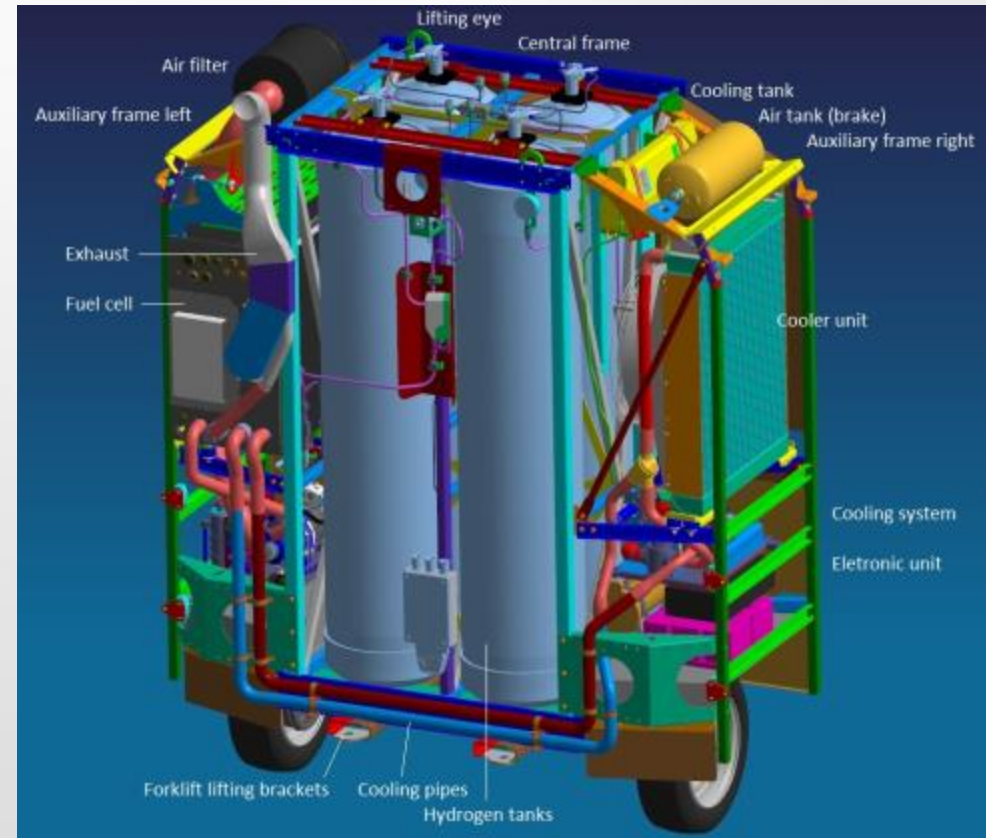
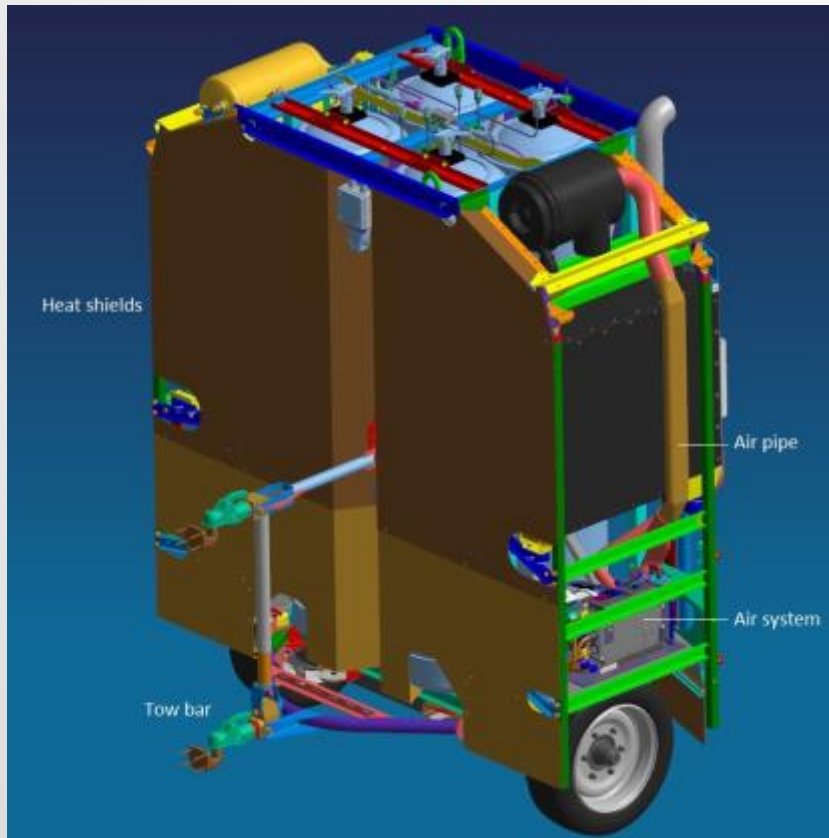




# Range Extender Status!

Status:

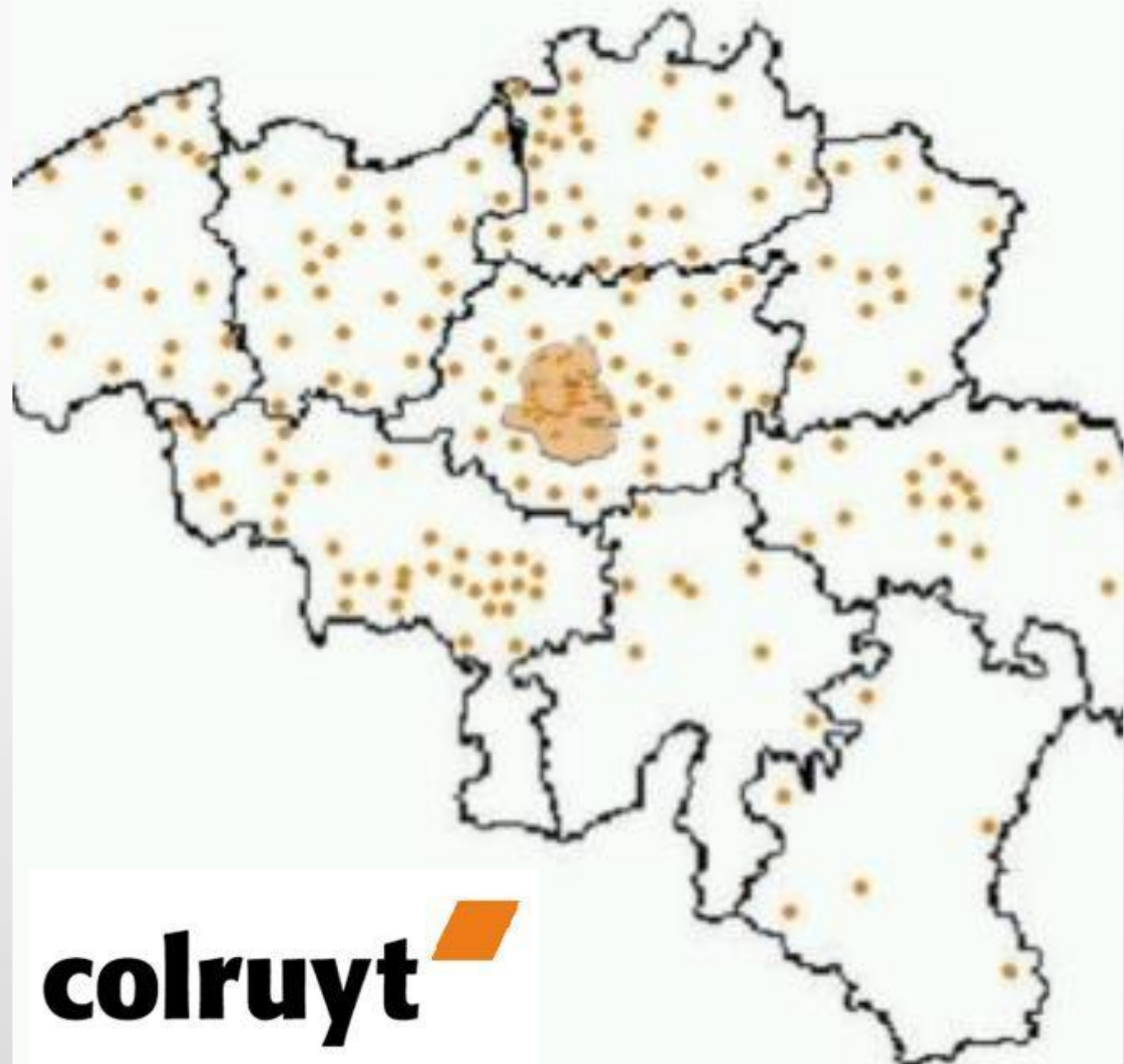
- First parts delivered to VDL Bus Chassis (including tanks)
- First proto ready for testing



# H<sub>2</sub> Projects: Waterstofregio 2.0

Timing: 01-03-2016 tot 01-03-2019

- Distributie rond Brussel
- Halle





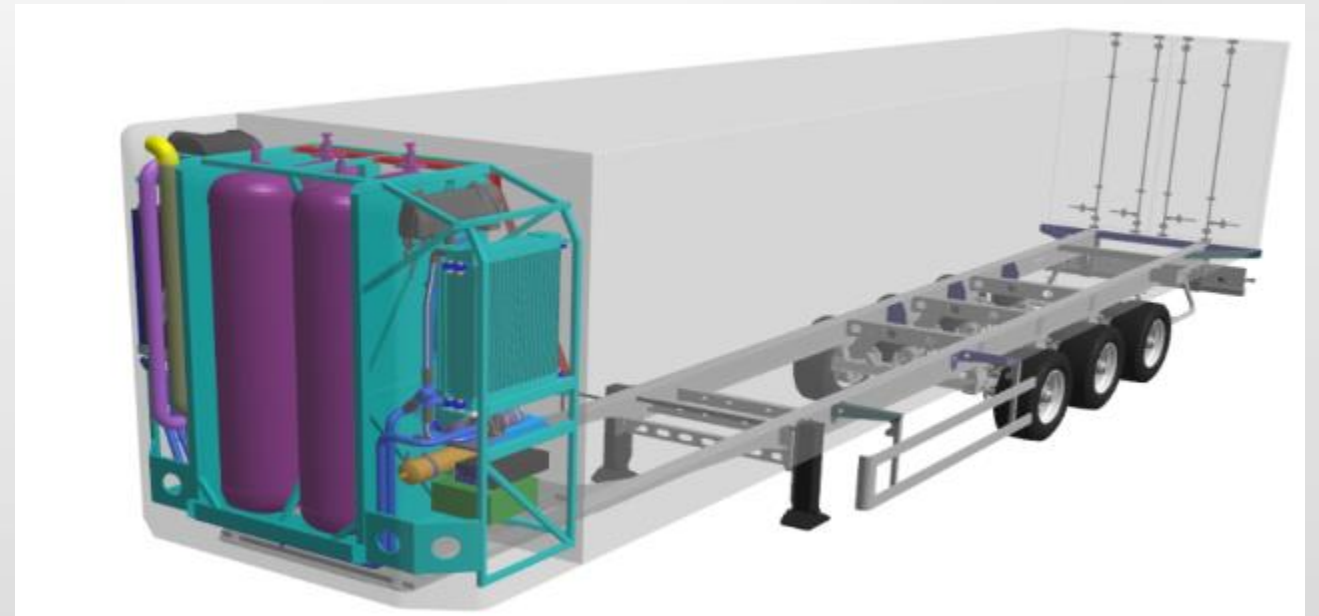
# Waterstofregio 2.0 (44ton 4x2 Tractor plus Trailer)

Range extender in Trailer:

- Charging power 88 kW
- Volume 30kg H2
- Range 350 km

Targeting the 3 major H2 topics:

- FC costs
- Reliability FC technologie.
- Highway and Long-Range capabilities



# H<sub>2</sub> projects: H2Share

Timeschedule:

- Eindhoven NL
- Stuttgart DE
- Brussel BE
- Rotterdam NL
- Rochefort FR
- Breda NL





# H2Share (27ton Rigid)

Range extender:

- Charging power 88 kW
- Volume 30kg H<sub>2</sub>
- Range 400 km

Mobile H<sub>2</sub> Fuel-Station (350 bar):

- 2\*20ft container
- 1 container storage (...kg waste/blue H<sub>2</sub>)
- 1 container Fuel station (buffer+compressor)

Targeting the 4 major H<sub>2</sub> topics:

- FC costs
- Reliability FC technologie
- H<sub>2</sub> costs
- H<sub>2</sub> availability



# Conclusion H<sub>2</sub>!

H<sub>2</sub> mobility in Heavy Transport for:

- Long Ranges
- Short refuelling time
- When no charging opportunities

But only with:

- Standardisation of vehicle fleet. All vehicle(s) must be suitable for H<sub>2</sub> RE
- And extra Range Extenders

(For example: 60 the same vehicles and 15 RE)

Then:

- Price will be almost comparable with Diesel and Electric vehicles
- There will be enough refuelling stations

Thus:

- The Range Extender is the fastest way to get H<sub>2</sub> feasible for transportation



# Questions?





Hydrogen Range Extender

**THANKS FOR YOUR ATTENTION**