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Clean and competitive solutions for all transport modes

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Zero Emission flexible vehicle platform with modular powertrains serving the long-haul Freight Eco System

ZEFES - Deliverable report

D1.2 Defined Use Cases, Target metrics and needs

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Publishable summary

Within the Green Deal, Europe commits itself to be the first CO2 neutral continent by 2050. To achieve this, a first milestone is defined as an overall CO2 reduction target of 55% by 2030. For the road transport sector, the target is set at 30% less CO2 emissions by 2030, following Regulation (EU) 2019/1242. The regulation requires that manufacturers of heavy-duty vehicles (HDV) deliver more efficient vehicles: a reduction of CO2 emissions for the newly produced fleet of 15% in 2025 and 30% in 2030.The use of zero tailpipe emissions vehicles (ZEV) for long distance heavy transport is an important part towards achieving the above targets. Such ZEV vehicles are Battery Electric Vehicles (BEVs) and Fuel Cell Electric Vehicles (FCEVs). Until now, these vehicles have a limited range: this makes it difficult to use them effectively as replacements for vehicles with an internal combustion engine (ICE). In the ZEFES project, OEMs, suppliers, and research partners will work together towards the overall goal of ZEVs for long distance heavy transport, by focussing on efficiency improvements, mass production capabilities and demonstrating the use of the technology in daily operations. This deliverable shows the specifications of the ZEFES use cases and metrics supporting the missions for demonstration of BEV / FCEV vehicles. All use cases demonstrate 9 vehicles operating at maximum GCW up to 64 tons under real time operational conditions comparable to the VECTO long haul and regional-national mission profiles and meeting the requirement of 750km unrefuelled / 400km un-recharged over a period of 15 months, covering 1,000,000 kilometres, representing 30,000hours operational life. The total length of all use cases represents road use of approximately 9000km.

The figure 1 below shows the structure of this deliverable describing the needs & requirements from the viewpoint of the ZEFES OEMs, ZEFES logistics service providers, and ZEFES shippers.

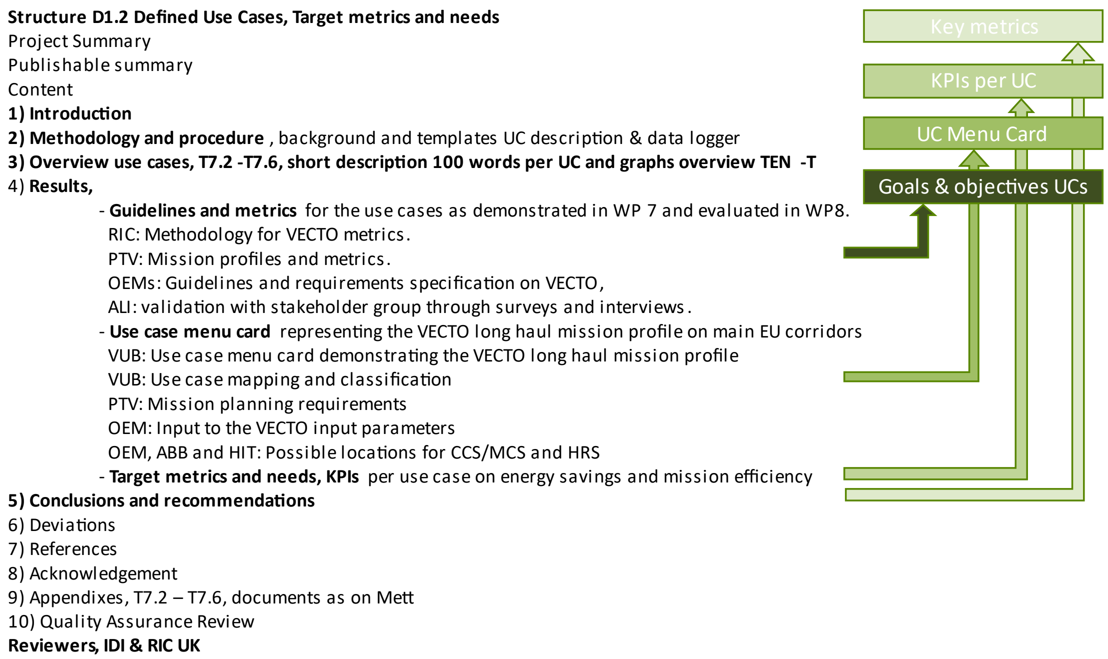

Figure 1 Structure deliverable D1.2

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Abbreviations & Definitions

Abbreviation	Explanation
HDV	Heavy-Duty Vehicle

ZEV	Zero tailpipe Emission Vehicle
BEV	Battery Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
ICE	Internal Combustion Engine
OEM	Original Equipment Manufacturer
VECTO	Vehicle Energy Consumption Calculation Tool
GCW	Gross Combination Weight
ZE-HDV	Zero tailpipe Emission Heavy Duty Vehicle
WPL	Work Package Leader within ZEFES project
BE-HDV	Battery Electric Heavy-Duty Vehicle
FCE-HDV	Fuel Cell Electric Heavy-Duty Vehicle
ISO	Interchangeable container as defined in the ISO-Norm 668
SWAP	Interchangeable container accommodating Euro-pallets for road and rail transport
Reefer	Loading unit to transport temperature-controlled cargo
USP	Unique Selling Proposition (uniqueness of ZEFES use cases)
EMS	European Modular System, HDV carrying standardised loading units for intermodal freight transport
T	Tractor unit
R	Rigid unit
ST	Semi-trailer
TR	Trailer
D	Dolly
e-ST	Electric semi-trailer
e-D	Electric dolly
CCS	Combined Charging System
MCS	Megawatt Charging System
HRS	Hydrogen Refuelling Station
vkm	Vehicle kilometers
tkm	Tonne kilometers
DTP	Digital Twin Platform
DT	Digital Twin
CEDR	Organisation of European national road administrations
i.w.w.	Inland Water Ways
	Abbreviations of ZEFES project partners, see chapter 8 acknowledgement

1 Introduction

The description of the requirements & needs is part of the work to be undertaken by the tasks 1.1 (Powertrain requirements) and task 1.2 (Specify ZEFES use cases and metrics).

The relation D1.2 to other tasks and work packages is shown in the figure 2 **Error! Reference source not found.**below.

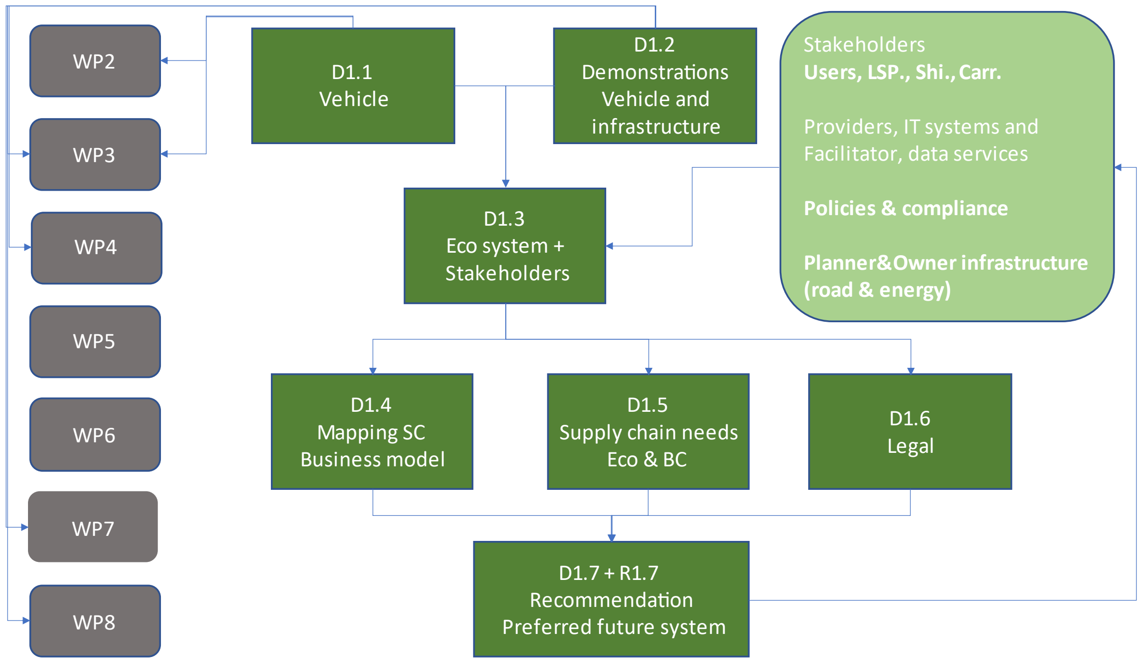


Figure 2 Relation deliverable 1.2 to deliverables WP1 and other WPs

Two subtasks are covered by this deliverable.

ST1.2.1 Define the metrics for the use cases demonstrating HD ZEV in real time logistics missions.

VUB will define the metrics for the single use cases defined as targets and to be addressed in the development process. In line with the VECTO long haul mission profile, the following topics regarding the main commodities and logistics missions, will be addressed for the ZEFES project:

a) the main logistics missions for ZE-HDV along European corridors in a multi modal context,

b) the requirements on infrastructure regarding e-charging and hydrogen fuel supply, parking and resting,

c) the requirements on services to ensure a smooth operation of the use case demonstrations, and

d) the requirement on data being gathered during demonstration.

ST1.2.2 Define use case menu card representing the VECTO long haul mission profile on main EU corridors.

The outcome are guidelines and metrics for the use cases as demonstrated in WP7 and evaluated in WP8.

2 Methods and procedure

2.1 Procedures

As start, the use case numbering is aligned with the WP7 tasks 7.2 – 7.6, as defined in the Grant Agreement.
The table (1) below gives the overview of the planned use cases.

Table 1 Overview use cases

Overview planned use cases /Owner	OEM	Shipper
7.2.1 Demonstration of Volvo FCEV-1 innovations	VOL	OVA
7.2.2 Demonstration of Volvo BEV-1 innovations	VOL	VOL
7.2.3 Demonstration of Volvo BEV-2 innovations	VOL	P&G / PRI
7.2.4 Demonstration of Volvo BEV-3 innovations*	VOL	DPD
7.3.1 Demonstration of Scania BEV-4 and SLI innovations	SCA	SCA
7.3.2 Demonstration of Scania FCEV-2 innovations	SCA	GRU
7.3.3 Demonstration of Scania BEV-4 and FCEV comparison	SCA	PRI
7.3.4 Demonstration of Scania BEV-5-Low Liner innovations	SCA	GSS
7.4.1a Demonstration of Renault BEV-6 and Michelin innovations	REN	MIC
7.4.1b Demonstration of Renault BEV-6 and Michelin innovations	REN	REN
7.4.2 Demonstration of Renault BEV-6 innovations	REN	DPD
7.6.1 Demonstration of Ford FCEV-3 innovations	FRD	EKOL
7.6.2 Demonstration of Ford FCEV-3 innovations	FRD	GBW
7.6.3 Demonstration of Ford FCEV-3 innovations	FRD	P&G

*The demonstration 7.5 is taken over by VOL and renamed 7.2.4, as HYU exited the ZEFES project.

As second step, a template is created to gather all use case needs and requirements as well as vehicle and logistics mission data. For each use case, the template is discussed with the use case owners, the truck OEMs, and the logistics service provider/shipper. Invited to join the discussions were the WPLs of powertrain WP2, infrastructure WP3, BEV vehicles WP5 and FCEV vehicles WP6. This part was ready by end of April to move on to the next steps.

As third step, regarding the datalogger, to be installed in each demonstrator, a specific file is created and shared with the OEMs, by the WPLs of Digital Twins WP4 and Evaluation & Impact WP8. This activity is to be combined with the VECTO parameters for analyses by the WP8 evaluation and impact analyses.

As fourth step, the vehicle specifications and energy demand to operate the logistics missions is agreed as input for the mapping of the energy infrastructure.

The next steps focused on the VECTO parameters, the mission planning requirements, and the completion of the missing information to have a first draft ready by end of May.

Evaluation and alignment by PTV and ALI were done during the months of May and June to finalize the deliverable by end of June.
The draft is reviewed by PTV, all OEMs and Shippers (in lead of the demonstrations). The final review of the deliverable is done by IDI and RIC. The table (2) below shows the work plan.

Table 2 Template Use Cases

Working plan D1.2 / Month 2023	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**
Creation templates for UCs and Datalogger	24/01					
Distribution template to UC owners	26/01					
Discussions 7.2.1-7.2.4		21/02	07/03			
Discussions 7.3.1-7.3.4		23/02	08/03			
Discussions 7.4.1-7.4.2			07/03			
Discussions 7.6.1-7.6.3			14/03			
Specification generic figures powertrain			30/03			
Overview UCs first draft				04/04		
Specification energy infrastructure				06/04		
Specification data datalogging & streaming				11/04		
Concept deliverable ready				30/04		
Methodology for VECTO metrics, OEMs parameters						
Mission planning, profiles, and metrics						
Validation with stakeholder group						
Use case menu card, mapping, and classification						
First draft deliverable ready, V02					26/05	
Second draft deliverable ready, V1.1						26/06

2.2 Templates for UC data and vehicle datalogger

The complete templates are attached in the appendix 9.1 (Use case description) and appendix 9.2 (Data logging & streaming). Below the content of the use case description (table 3).

Table 3 Template Use Case Description

Chapter	Description	Pages
1.1	Description task 1.2 and subtasks 1.2.1 and 1.2.2	2
1.2	Description task 7.2 use cases overview	3
x.y	**ST7.x.x Demonstration of xxxxxx innovations**	4
x.y.1	Main logistics missions	4
x.y.2	Requirements on infrastructure regarding hydrogen fuel supply, parking and resting	6
x.y.3	Requirements on services to ensure a smooth operation	7
x.y.4	Requirement on data being gathered during demonstration	temp datalogger
x.y.5	Type approval and road permits (T1.6)	8
x.y.6	Learnings from logistics service providers / shipper / operators	9

Below the content of the data logger description (table 4).

Table 4 Template Data Logging Description

	Description	Pages
1	Description task 1.2 and subtasks 1.2.1 and 1.2.2	2
2	Requirement on data being gathered during demonstration ST1.2.1	3

3 Overview use cases as Task 7.2 – Task 7.6

The paragraphs 3.1 and 3.2 give a visualization of the missions, the vehicle configurations, and the use case descriptions. Each use case is documented in a live document, available on the ZEFES share point METT. These documents will be used in WP7, task 7.1 to further detail the use cases in preparation of the execution of the use cases. See chapter 5.1.

3.1 Missions and vehicle configurations

A careful check is done to ensure appropriate use cases of missions which are mostly road use and where possible to integrate multimodal rail / road transport to also demonstrate the impact on multimodality when implementing ZE-HDV in long-haul cross border logistics missions. The figure 3, see below, shows the shippers and the missions involved in the ZEFES demonstrations, covering temperature-controlled goods, general cargo, consumer goods, parcel distribution, heavy steel products and finally automotive goods.

Figure 3 Overview diversity ZEFES logistics providers and shippers

The OEMs of trucks and trailers in close collaboration with the shippers have developed a proposal for the use of different vehicle concepts to meet the needs and requirements from the shippers.
Six BE-HDV and three FCE-HDV vehicles have been identified in 16 different configurations, using standard semi-trailers, container semi-trailers (for ISO and SWAP bodies), reefer semi-trailers and low-

liner semi-trailers. In addition, several powertrain concepts are planned such as battery packs in the semi-trailer as range extender, a full e-propulsion powertrain in both truck and semi-trailer and an e-propulsion for an emission free reefer operation. The figure 4 shows the overview of the vehicle configurations, the powertrain concept, and the missions.

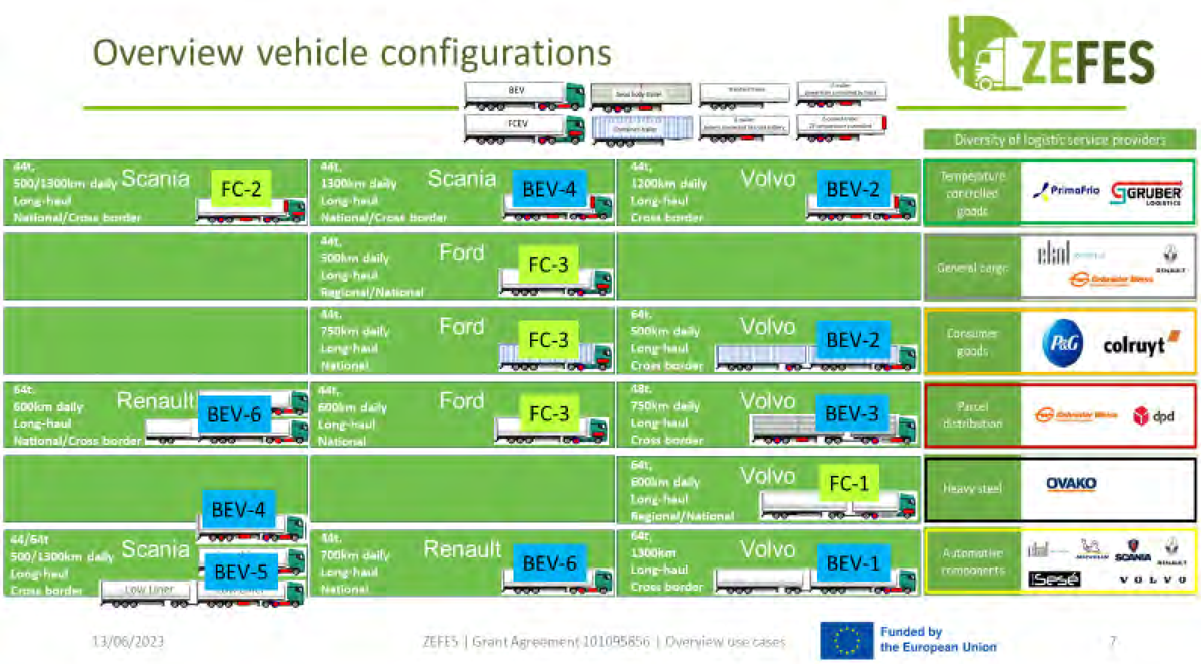


Figure 4 Overview vehicle configurations and missions

3.2 Overview of the use case descriptions

All demonstrations are described in this paragraph. It should be noticed that during the ZEFES project, changes might be necessary due to availability of charging and fuel service stations, road permits for the different vehicle configurations and finally circumstances within the logistics missions which are highly depending on market evolutions being not in control by any ZEFES project partners.

In addition, work progress within the work package 2 (powertrain design), work packages 5 (build of BEV demonstrators) and 6 (build of FCEV demonstrators) may also lead to changes in the final vehicle configuration due to technical or economic feasibility reasons. This makes maximum flexibility and adaptability among the ZEFES partners necessary as is daily practice in the daily logistics. The table 5 and figure 5, show the time plan of the demonstrations, starting month 27 with a duration up to month 39. Paragraphs 3.2.1 – 3.2.4, give a summary of the demonstrations. A glance of the vehicle delivered by the OEM, the shipper, the logistics mission, the vehicle configuration, the cargo type, the duration, the destinations and corridors, the distance, “USP” the uniqueness of the use case.

Table 5 Overview timing use case, see figure 5

Use Case			OEM/Shipper	M27	M28	M29	M30	M31	M32	M33	M34	M35	M36	M37	M38	M39	M40	M41	M42
				Mrz 25	Apr 25	Mai 25	Jun 25	Jul 25	Aug 25	Sep 25	Okt 25	Nov 25	Dez 25	Jan 26	Feb 26	Mrz 26	Apr 26	Mai 26	Jun 26
WP7																			
	T7.2			M27											M38				
		ST7.2.1	VOL/OVA																
		ST7.2.2	VOL/VOL																
		ST7.2.3	VOL/P&G/PRI																
		ST7.2.4	VOL/DPD																
	T7.3																		
		ST7.3.1	SCA/SCA			M29					M34								
		ST7.3.2	SCA/GRU																
		ST7.3.3	SCA/PRI									M35							
		ST7.3.4	SCA/GSS							M33					M38				
	T7.4																		
		´7.4.1	REN/MIC	M27		M29													
		´7.4.2	REN/REN				M30		M32										
		´7.4.3	REN/DPD							M33					M38				
	T7.6																		
		´7.6.1	FRD/EKO				??		M32		M34								
		´7.6.2	FRD/GBW									M35		M37					
		´7.6.3	FRD/P&G												M38				

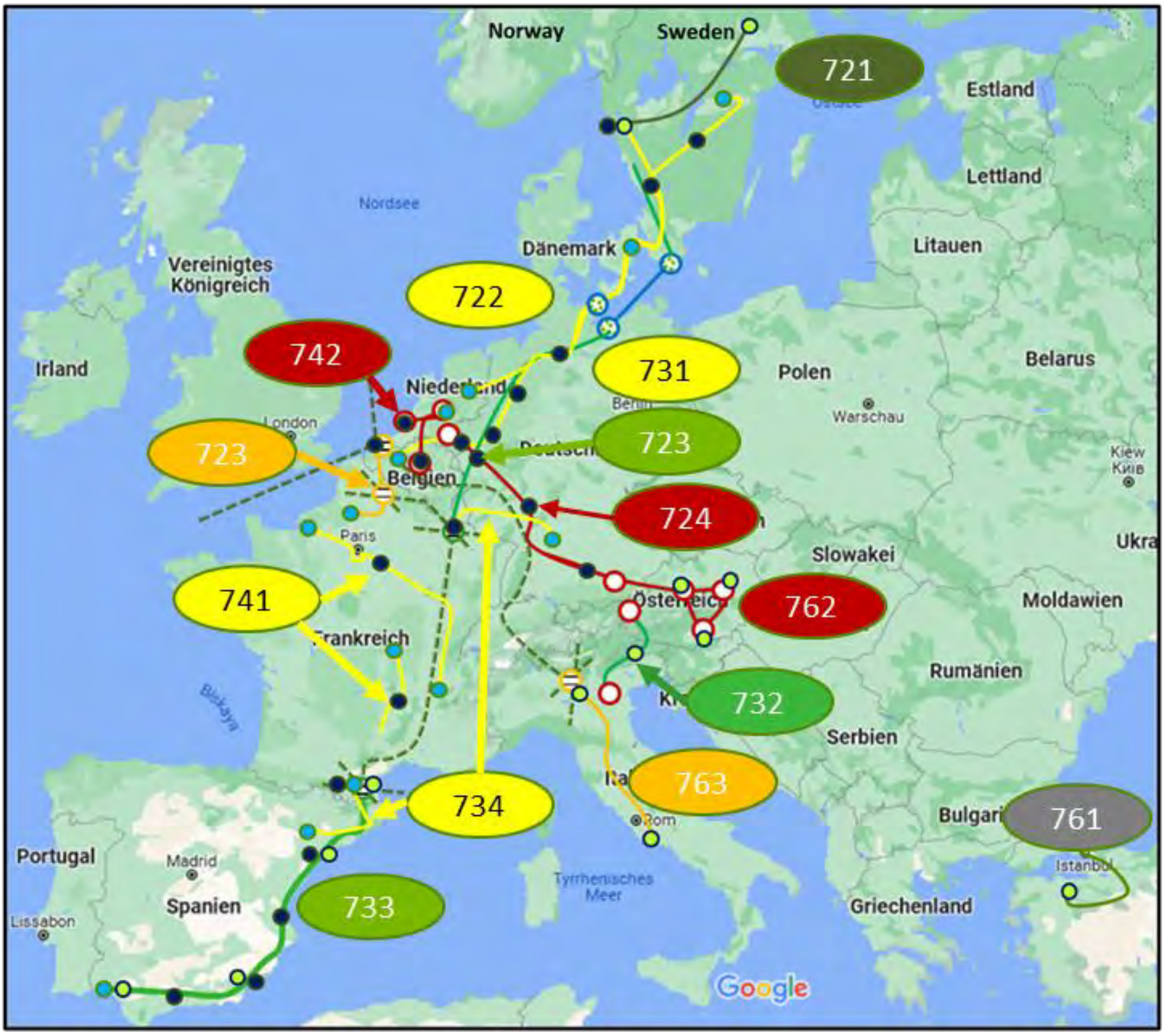


Figure 5 Overview timing use cases, see table 5

3.2.1 T7.2 VOLVO

Figure 6 Overview VOL demonstrators and logistics missions

VOLVO is bringing into the ZEFES project 4 vehicles, 3 tractor units as BE-HDV and 1 rigid unit as FCE-HDV operating in 4 demonstrations.

ST7.2.1 Demonstration of Volvo FCEV innovations

VOL will lead the demonstration, makes the vehicle combination (R+ST 24m @ 64 GCW) available for the logistics provider, will collect and hand over all necessary data for the evaluation.
Stakeholder OVAKO will act as shipper and will contract a carrier to operate the vehicle for 12 months on an existing flow to carry steel scrap from Gothenburg-SE to Hofors-SE and in the opposite direction carry steel collies. The truck is to complete up to five return trips per week resulting in a total distance of ca. 4800 km/week. Several operators are to be chosen to run the vehicle. Decision to be taken by end of 2023. A separate meeting will be set up to get confidence and decide the right operator.
USP, FCE-HDV as a standard Swedish EMS1 configuration @64t GCW in a Long-Haul VECTO profile.

ST7.2.2 Demonstration of Volvo BEV-1 innovations

VOL will lead the demonstration, makes the vehicle combination (T+ST @ 44 GCW) or (T+ST+D+ST @ 64t GCW) available for the Volvo logistics, will collect and hand over all necessary data for the evaluation. VOL will operate the vehicle for 12 months serving the existing automotive parts supply chain between 2 factories, Volvo Gothenborg-SE, and Volvo Gent-BE. The cargo is volume limited.
Stakeholder SLI will operate the ferry connection Puttgarden-DE to Rodby-DK and will analyse the opportunity of charging of the vehicle during ferry operation or at the terminal. The route length is 1250km.
USP, a complete electrified cross border multimodal single driver logistics operation.
Depending on road approval from side country authorities, a decision will be taken between
Plan A is to operate with EMS2 @ 64t GCW or
Plan B is to operate with a T + ST @ 44t GCW.

ST7.2.3 Demonstration of Volvo BEV-2 innovations

VOL will lead the demonstrations, makes the vehicle combination (T+ST @ 44 GCW) available for the shippers, will collect and hand over all necessary data for the evaluation.

VOL BEV-2 innovations part 1

PG will act as shipper and contract a carrier to operate the vehicle for 6 months, as tractor + duo container-trailer (T+ST+e-D+ST @ 64t GCW EMS2), to transport 45ft containers with partly hazardous goods between the P&G factory Amiens-FR via the multimodal terminal Dourges-FR to the multimodal terminal Zeebrugge-BE, a roundtrip of 550km daily. Proposed operation. The vehicle drives (T+ST+D+ST, EMS2) from Amiens to Dourges. At the terminal Dourges, the dolly will decouple from the vehicle. The T+ST will continue to Zeebrugge (cross border). The e-D+ST will operate at terminal and D will be charged. When the T+ST comes back from Zeebrugge, it will continue again as T+ST+e-D+ST, EMS2 back to Amiens.

USP, Operation of a BE-HDV as EMS2 vehicle configuration in a hub-to-hub mission, and a remote e-dolly operation at the terminal Dourges.

VOL BEV-2 innovations part 2

PRI will operate the vehicle for 6 months on an existing route of temperature-controlled goods from the CFL Multimodal Terminal in Dudelange-LU to Lidl Halmstad-SE, taking the ferry from Travermünde-DE to Trelleborg-SE, a 2-driver operation over 1200km. Total weight ca. 44 ton.

SCB will probably supply an e-cooled trailer (e-reefer) having an e-axle, a battery, and an e-cooling for the cargo. UIC/CFL take care of the transport by rail (Le Boulou to Dudelange) and the charging of the trailer batteries during the train operation.

USP, Daily operation of a BEV as tractor / semi-trailer with 2 drivers, 1200km daily.

ST7.2.4 Demonstration of Volvo BEV-3 innovations

VOL will lead the demonstration, makes the vehicle combinations (R+e-D+e-T @ 48 GCW) available for the shipper, will collect and hand over all necessary data for the evaluation.

DPD will act as the shipper and the carrier REBRO will operate the vehicle for 6 months on their daily Rhine-Alpine corridor to transport parcels from Munich area-DE via Neuss area-DE to Eindhoven area-NL v.v., trip length of 675km demonstrating the vehicles capability of 750km.

USP, a ZE-HDV concept for 3 swap bodies and a full electrified-powertrain within each vehicle unit in a cross-border daily operation.

3.2.2 T7.3 SCANIA

Figure 7 Overview Scania demonstrators and logistics missions

Scania is bringing into the ZEFES project 3 vehicles, 1 tractor unit as BEV-HDV, 1 tractor unit as BEV-HDV Low Liner and 1 tractor unit as FCEV-HDV operating in 4 demonstrations.

ST7.3.1 Demonstration of Scania BEV and SLI innovations

SCA will lead the demonstration, makes the vehicle combinations (T+ST @ 44 GCW) available for the Scania logistics, will collect and hand over all necessary data for the evaluation. SCA will operate the BEV vehicle for 6 months on an existing transport flow of automotive components from Sodertalje to Zwolle and back. The return flow to Sodertalje is limited amount of goods. The round trip is forward and return trips are 1325km each. VET/KAE will demonstrate a b/e-trailer operating as range extender. Stakeholder SLI will ensure charging on the ferry Puttgarden-DE / Rodby-DK or in the terminal.
USP, A new e-trailer concept as “range extender”

ST7.3.2 Demonstration of Scania FCEV innovations

SCA will lead the demonstration, makes the vehicle combinations (T+ST @ 44 GCW) available for the shipper, will collect and hand over all necessary data for the evaluation. GRU will run the vehicle for a 6-month-period across the Brenner complying temperature-controlled goods to evaluate the performance of the vehicle into a real-life environment. The demonstration will cover a daily distance of about 340km (680 km round trip) testing hydrogen stations along the Brenner corridor. The drives will be made in the Brenner corridor. Origins and destinations are daily changing, forcing maximum flexibility in the truck operation. The fixed route links are approximately Brixen to the road intersection between the Brenner Corridor (Highway A22) and the Highway A4. The operator has the possibility to choose different destinations on different days to probe the performance of the vehicle.
USP, in partnership with a local customer and supplier of certified green hydrogen, GRU want to build up the first 100% “green transport”, using certified green hydrogen.

ST7.3.3 Demonstration of SCA BEV & FCEV comparison

SCA will lead the demonstrations, will make the 2 vehicle combinations (T+ST @ 44 GCW) available for the shipper, will collect and hand over all necessary data for the evaluation.

PRI will operate both SCA BEV and FCEV vehicles for 6 months on the existing route of temperature-controlled goods from PRI Huelva to the multimodal terminal, Le Boulou France. SCB will probably supply an e-cooled trailer (e-reefer) having an e-axle, a battery, and an e-cooling for the cargo. UIC/CFL will operate the rail transport between Le Boulou-FR and Dudelange-LU and the charging of the batteries on the semi-trailer during rail operation. The destination for the semi-trailer is Halmstad, Sweden. (See also Volvo BEV-2 demonstrator).

IDI will make a back-to-back comparison between the powertrain technologies installed on both vehicles (BEV and FCEV) and a reference ICE vehicle under controlled conditions at the IDI test track and standardized driving routes used in the previous EU project AEROFLEX. It will allow to make a direct comparison under the same environmental conditions to confirm actual results versus defined targets and generating relevant data to be compared with previous and future projects and tested technologies.

IDI also captures the issues during the refuelling events, especially SoC <100% and fail initial starts.

USP, a direct comparison of both BEV- and FCEV-HDVs under identical conditions in a roundtrip of 1300km (2 driver operation).

ST 7.3.4 Demonstration of Scania BEV-Low Liner innovations

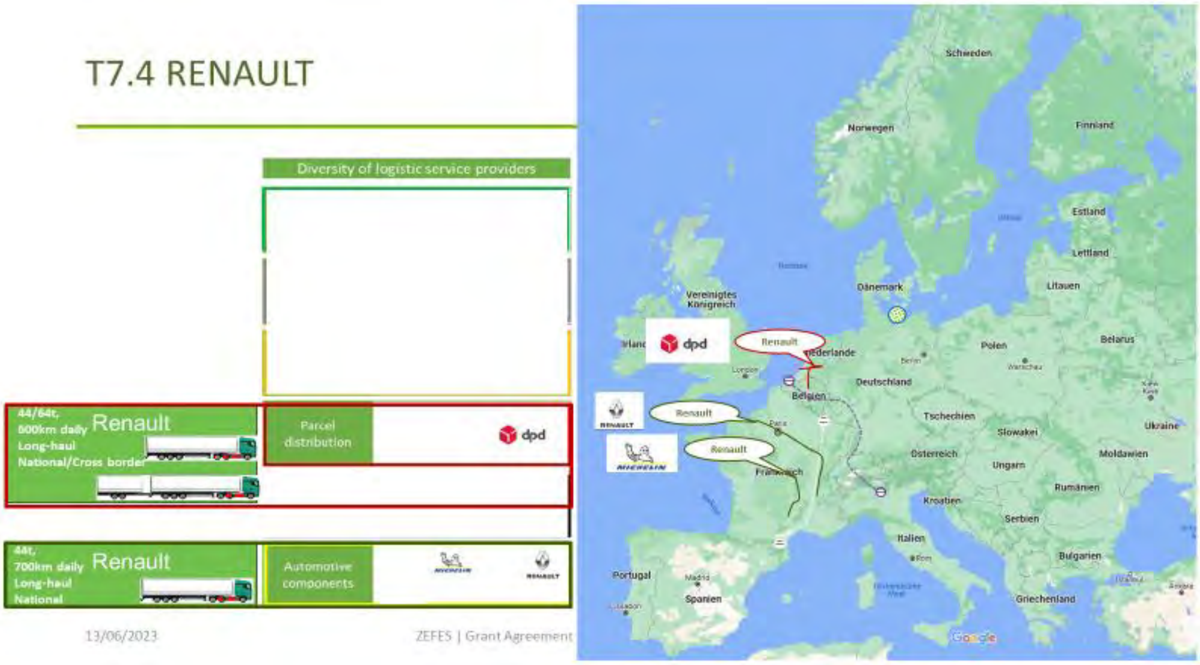
SCA will lead the demonstration, makes the vehicle combination (T+ST @44 GCW) available for the shipper, will collect and hand over all necessary data for the evaluation. GSS will operate the vehicle for 3 months in Germany on an existing transport flow of automotive goods between KCC-Heilbronn-DE to Dudelange-LU, a round trip of 600km. GSS will operate the vehicle for 3 months in Spain on this existing transport flow of automotive goods from Le Boulou-FR to SEAT Martorell-ES as EMS2 configuration, a tractor and duo semi-trailer combination, (T+ST+D+ST @ 64t GCW), a round trip of 550km.

The stakeholder UIC/CFL will operate the rail connection Dudelange-LU to Le Boulou-FR 1000km and the charging of the vehicle at the rail terminal Le Boulou.

USP, BE-HDV low liner concept in a tight scheme of time slots at factory and rail terminals.

3.2.3 T7.4 RENAULT

Figure 8 Overview Renault demonstrator and logistics missions



Renault is bringing into the ZEFES project 1 vehicle, a tractor unit as BE-HDV, operating in 3 demonstrations.

ST7.4.1 Demonstration of Renault BEV and Michelin Tire innovations

REN will lead the demonstrations, makes the vehicle combinations (T+ST @ 44t GCW) available for the shipper, will collect and hand over all necessary data for the evaluation.

MIC will start to operate the vehicle for 3 to 6 months on an existing plant-to-plant MIC flow, a 500km daily shuttle of semi-finished products on hilly national roads (Blanzy (71)– Blavozy (43)). Starting point address: Michelin, ZI de la Fiolle, Rue de la Fiole, 71450 Blanzy. End point address: MFP Michelin, Avenue René Descartes, ZI Blavozy, 43700 Blavozy. MIC evaluates the impact of electrification on tires performances (wear, Rolling Resistance) for a drive prototype tire (315/70R22.5 XM901 - market maturity 2027) with improved wear resistance vs rolling resistance compromise in comparison to current market tyres, reference 315/70R22.5 XMD. The assessment of electrification impact on tyre wear performance will be made thanks to the comparison between field placement in France of the XM901 prototype on 1 BEV Renault Trucks (6x2) and 1 ICE Renault Trucks vehicle (4x2), taking into account the eventual usage severity gaps by monitoring these field placements by telematic boxes.

REN will continue to operate the vehicle for 3-6 months on an existing RENAULT TRUCKS logistic flow, delivering cabs (Blainville sur Orne – 14) to assembly plant warehouse (Bourg en Bresse – 01), a daily distance of 700 km mainly on French highways. Starting point address: Renault Trucks, ZI Caen, 63 Rue du Canal, 14550 Blainville-sur-Orne. End point address: Renault Trucks Livraison, Rue Paul Berliet, 01250 Bourg-en-Bresse. Pending on logistic operation, goods are going through warehouse closed to each plant before sequenced deliveries.

USP, New tires for ZE-HDV vehicles demonstrated in a real logistics operation for 6 months.

ST7.4.2 Demonstration of Renault BEV innovations

REN will lead the demonstrations, makes the vehicle combinations (T+ST @ 44 GCW) available for the shipper, will collect and hand over all necessary data for the evaluation.

DPD will act as shipper and contract a carrier to operate the vehicle for 6 months in 2 different configurations as tractor and semi-trailer (T+ST @ 44t GCW) and as tractor and EMS1 (T+ST+TR @ 54t GCW) on an existing parcel logistic flow:

• Pick up round Veenendaal-NL as Tractor + semi-trailer (T+ST @ 44t GCW)

• Std routing: Veenendaal-NL Brussels-BE area back to Veenendaal-NL (T+ST @ 44t GCW)

• Std routing: Veenendaal-NL to Rotterdam-NL area back to Veenendaal-NL, as EMS1 (T+ST+T @ 60t GCW)

The daily distance is 575+100 km, a combination of highway and express roads.

USP, one vehicle in 2 configurations in a traditional full round trip cross border logistics parcel route, equipped with the new designed Michelin tires for ZE-HDV. Charging aligned with drive / rest time schedule and critical time slots at depots.

3.2.4 T7.6 FORD

Figure 9 Overview Ford demonstrator and logistics missions

Ford is bringing into the ZEFES project 1 vehicle, a tractor unit as FCE-HDV, in 3 demonstrations.

ST7.6.1 Demonstration of FRD FCEV innovations

Stakeholder EKOL Logistics will operate the vehicle, on a regional-national long-haul profile, between Ford Kocaeli Plant and Istanbul Pendik Ports, daily 3 round trips ca. 500km for 2-3 months transporting vehicle production parts used in the Ford Otosan plant. OPET will deliver a mobile HRS station to ensure a smooth operation.

USP, FCEV vehicle operating in a non-EU country.

ST7.6.2 Demonstration of FRD FCEV innovations

FRD will lead the demonstrations, makes the vehicle combinations (T+ST @ 44 GCW) available for the shipper, will collect and hand over all necessary data for the evaluation.

GBW will act as shipper and contract carriers to operate the vehicle in a logistics network on a daily regional-national long-haul profile for general cargo and parcel distribution between Vienna and Graz and in the area surrounding Vienna, daily ca. 600km for 3 Months.

USP, FCEV vehicle operating in a regional / national long-haul VECTO mission profile.

ST7.6.3 Demonstration of FRD FCEV innovations

FRD will lead the demonstrations, makes the vehicle combinations (T+ST @ 44 GCW) available for the shipper, will collect and hand over all necessary data for the evaluation.

PG will act as shipper and a contract carrier will operate the vehicle, as tractor + 45ft container-trailer in a national flow long-haul profile of partly dangerous goods on mountainous terrain and with the use of tunnels, daily ca. 660km for 3 months. The 45ft containers arrived or go to the terminal Zeebrugge by rail, see also ST7.2.3 PG.

USP, FCE-HDV vehicle operating in a hilly national long-haul VECTO mission profile.

4 Needs and Requirements

4.1 Introduction

Having described the uses case to operate the demonstrators in real time logistics missions, the needs and requirements of vehicle, infrastructure and services are gathered as input for the developments and assessments to be performed within the ZEFES project.
The objectives of the demonstrations are.
Demonstration of missions on cross-border, TEN-T corridors, fulfilling the requirements for range (750km after refilling and 400km after charging within 45min) and payload (>90% compared to current ICE trucks), and comparing the deploy-ability of BEVs and FCEVs for different mission profiles.
Demonstration of an interoperable Megawatt Charging System (MCS) and the location deployment strategy for hydrogen refuelling stations (HRS) to accommodate and make ZE HD transport possible along several corridors.
Data collection of the demonstrations and CCS/MCS/HRS, used for smooth operations and comparisons, and to make it clear to logistic companies that it is possible to use these ZEVs. Next to that, the data is used to make better configurations of vehicles.
Demonstration how the ZE-HDV can be used, in terms of energy use, payload, cooling of refrigerated goods, etc.

To structure the needs and requirements in line with the objectives, the following paragraphs will cover, 4.2 Guidelines and metrics; 4.3 Use case menu card; 4.4 Digital environment and data logger.

4.2 Guidelines and metrics

4.2.1 Vehicle platforms and vehicle configurations

Trucks transport united loading units to serve multimodal transport of goods on regional, national, cross border and intercontinental routes. The OEMs are currently using platforms to produce ICE trucks to cover their portfolio at a market accepted volume/price level. Future ZE-HDV need to comply with the existing platforms to meet the requirements for transporting the united loading units and achieve a market acceptable volume/price level. The ZEFES OEMs, FRD-REN/VOL-SCA, will therefore use their vehicle platform to integrate the build of BEV and FCEV trucks in all tractor and rigid variants covering the future portfolio.
The figure 10 demonstrates a simplified structure of a vehicle platform existing out of component groups to maximize volume and reduce cost levels.

Component groups							
engines	gearbox	axles	cabs	chassis	systems	electric	air

Figure 10 simplified vehicle platform

Based on these platforms, the ZE-HDV will be developed and built according to the specification agreed between the OEM and shippers / carriers. As shown in the figure 11 below, all vehicles meet the requirements for the transport of unified loading units as used in today´s long-haul transport.

Battery Electric Vehicle		
OEM	Type	Configuration demonstrators
VOL	BEV 1	
VOL	BEV 2	
VOL	BEV 3	
SCA	BEV 4	
SCA	BEV 5	Low Liner / Low Liner / Low Liner
REN	BEV 6	

Fuel Cell Electric Vehicle		
OEM	Type	Configuration demonstrators
VOL	FCEV 1	
SCA	FCEV 2	
FRD	FCEV 3	

Figure 11 Overview demonstrators 6 BEVs and 3 FCEVs

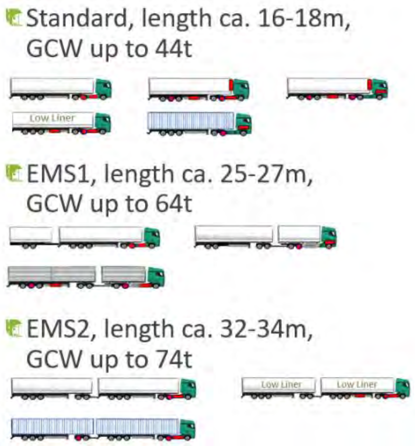


Figure 12 Overview vehicle configurations

All categories of vehicle configurations within the VECTO scheme, group 5 / 9-10 are present, enabling the ZEFES project to demonstrate the correct use of ZE-HDV, see figure 12 and paragraph 4.2.4.

The use of EMS vehicle configurations is becoming increasingly relevant to counter the growth of freight transport, to optimize the rail/road freight transport, to reduce the number of vkm due to fewer vehicles, to reduce the cost of transport per tkm. These cost savings can be used to accelerate the transition into ZE Fleets in the long-haul freight transport.

4.2.2 Installed energy capacity on the prime movers

As input for the ZEFES project developments regarding powertrains and energy infrastructure desk research was undertaken to define the installed usable energy capacity for the demonstrations. This because in the long-haul transport sector the energy use per kilometre highly depends on topography, climate conditions, traffic density, vehicle weight & dimensions. A study “Energy Distribution Diagram Used for Cost-Effective Battery Sizing of Electric Trucks”, authors Johannes Karlsson and Anders Grauers, both Electrical Engineering Systems & Control at Chalmers was found appropriate to define the basics of the powertrain energy capacity of the demonstrators. The figure 13 below gives a short overview of the basics of the study.

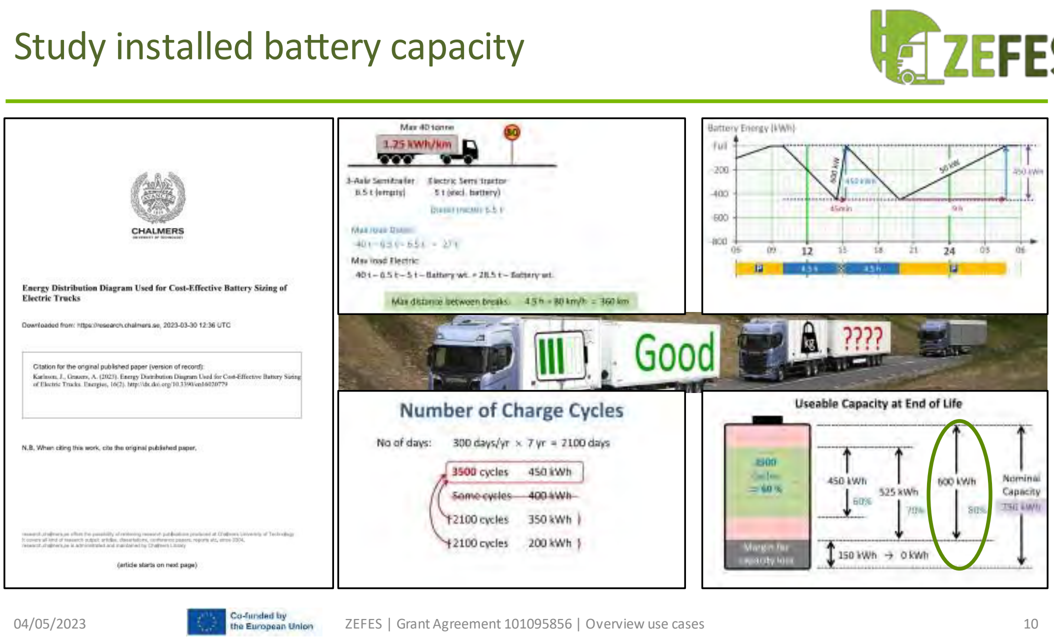


Figure 13 Study installed battery capacity in ZE-HDV @ 44t GCW

Agreed between the OEMs is to install on the demonstrators a usable energy capacity of 600kWh for the BE-HDV and 56kg hydrogen for the FCE-HDV. Expected cost and availability of components, curb weight of the vehicles and ability for platform usage have been looked at. See figure 14 below.

During the ZEFES project developments, the installed energy capacity might be redefined to meet targets of at least 80% recharge, to add 400km range within 45 min. using fast-charging concepts and achieving a range of more than 750 km for the truck-trailer combination.

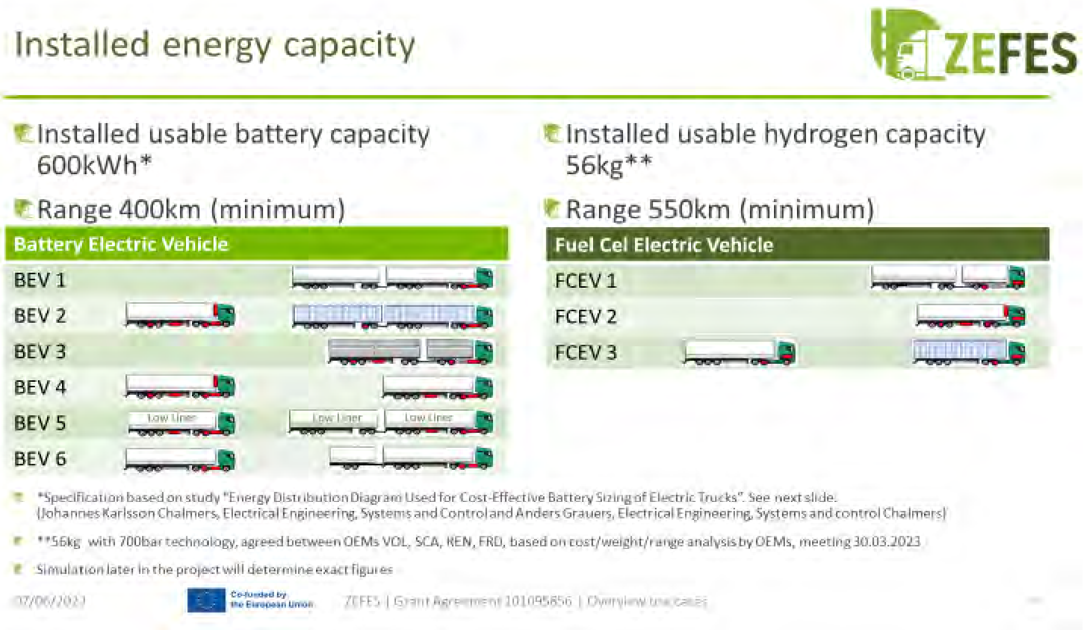


Figure 14 Overview installed energy storage in ZEFES demonstrators

4.2.3 Trailer concepts to be analysed and chosen

As seen, different trailer concepts will be used.

The standard semi-trailer, equipped with 3 axles and a length of 13,6m. Ready for intermodal transport on rail, road, and i.w.w.

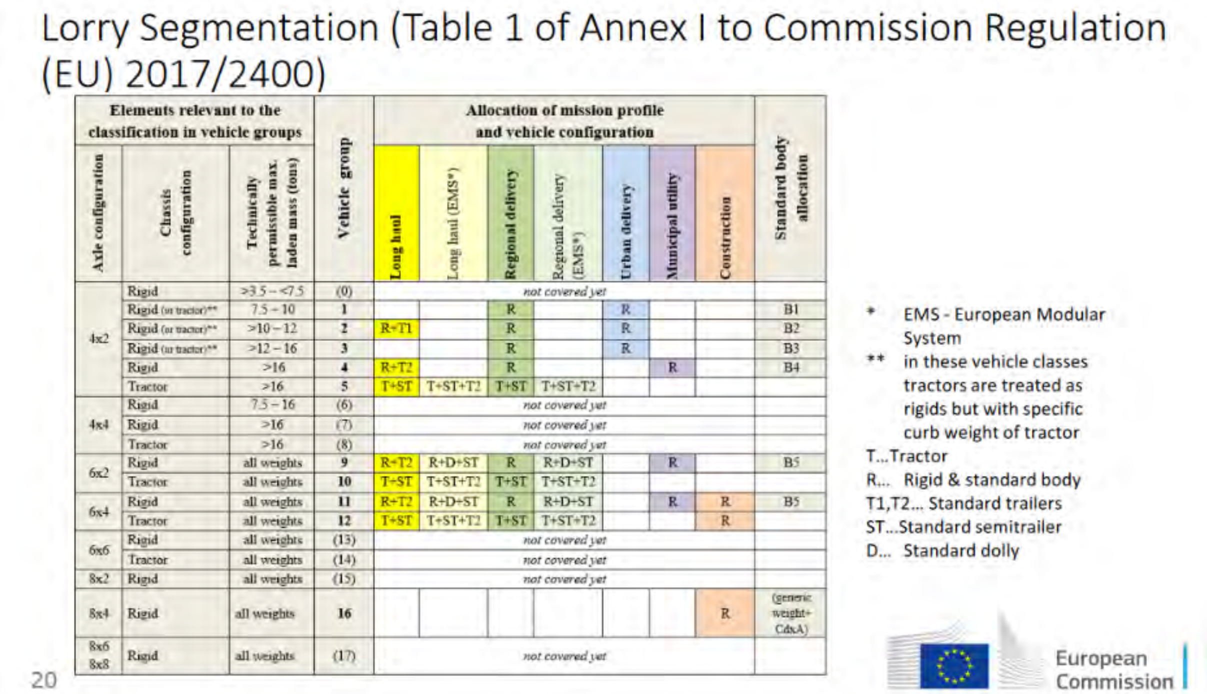
The container semi-trailer for the transport of ISO 45ft container interchangeable for intermodal / intercontinental transport.

The German Long Trailer for the transport of 7,45m swap bodies ready for intermodal rail-road transport and the typical hub to hub German corridors. New trailer concepts equipped with propulsions like a battery as range extender, an e-axle and battery to operate a cooling unit (reefer), and a full e-propulsion integrated in the powertrain of the prime mover. See_figure 15. Analyses within the WP2, led by FHG, will finally determine the choice of the different trailer propulsion concepts, their use in the different use cases, and the development of a European e-trailer concept usable for the main European corridors and countries.

Figure 15 Overview trailer concepts

4.2.4 VECTO capabilities for BEV, FCEV and EMS

VECTO is used to determine the CO2 emissions and fuel consumption of fuel powered HDV's over specific, prescribed cycles. Equivalently, such a tool will be needed to assess the energy consumption of a battery electric or hydrogen fuel cell truck. As a part of the ZEFES project, a review of the current capabilities of VECTO with respect to BEV and FCEV was undertaken to identify the gaps in the tool, to make VECTO usable for electrical energy and hydrogen consumption calculations for EV and fuel cell powered trucks.
The document in appendix 9.3, describes the needs and activities within ZEFES to comply with the VECTO Tool and the new VECTO models for the ZE-HDV and e-trailers.



Lorry Segmentation (Table 1 of Annex I to Commission Regulation (EU) 2017/2400)

Elements relevant to the classification in vehicle groups			Vehicle group	Allocation of mission profile and vehicle configuration							Standard body allocation
Axle configuration	Chassis configuration	Technically permissible max. laden mass (tons)		Long haul	Long haul (EMS*)	Regional delivery	Regional delivery (EMS*)	Urban delivery	Municipal utility	Construction	
4x2	Rigid	>3.5 – <7.5	(0)	not covered yet							
	Rigid (or tractor)**	7.5 – 10	1			R		R			B1
	Rigid (or tractor)**	>10 – 12	2	R+T1		R		R			B2
	Rigid (or tractor)**	>12 – 16	3			R		R			B3
	Rigid	>16	4	R+T2		R			R		B4
	Tractor	>16	5	T+ST	T+ST+T2	T+ST	T+ST+T2				
4x4	Rigid	7.5 – 16	(6)	not covered yet							
	Rigid	>16	(7)	not covered yet							
	Tractor	>16	(8)	not covered yet							
6x2	Rigid	all weights	9	R+T2	R+D+ST	R	R+D+ST		R		B5
	Tractor	all weights	10	T+ST	T+ST+T2	T+ST	T+ST+T2				
6x4	Rigid	all weights	11	R+T2	R+D+ST	R	R+D+ST		R	R	B5
	Tractor	all weights	12	T+ST	T+ST+T2	T+ST	T+ST+T2			R	
6x6	Rigid	all weights	(13)	not covered yet							
	Tractor	all weights	(14)	not covered yet							
8x2	Rigid	all weights	(15)	not covered yet							
8x4	Rigid	all weights	16							R	(generic weight+CdxA)
8x6 8x8	Rigid	all weights	(17)	not covered yet							

* EMS - European Modular System
** in these vehicle classes tractors are treated as rigids but with specific curb weight of tractor
T...Tractor
R... Rigid & standard body
T1,T2... Standard trailers
ST...Standard semitrailer
D... Standard dolly

Figure 16 Overview vehicle segmentation VECTO Tool

ZEFES will focus on the vehicle groups 5/ 9-10 and 11-12 for the long-haul and regional profiles with standard, EMS1, and EMS2 vehicles configurations. See figure 16.

Within ZEFES new technologies will be developed to achieve ranges up to 450km for BE-HDV and up to 750km for FCE-HDV. The current VECTO Tool need to be adapted with new modules to incorporate these new technologies.
In addition, new trailer concepts will be developed including propulsion systems, either ataurique or integrated in the propulsion system of the prime mover. Also, for these new technologies, new VECTO Modules need to be developed, incorporating the amendment of ISO 11992-2 which will include e-trailer control for integration of the e-Trailer in the endurance brake management of the truck and allows acceleration support control by the towing vehicle.
This will be also valid for the e-dolly, output form the AEROFLEX project, used in 2 demonstrations (VOL/P&G and VOL/DPD). The VECTO Module for trailers needs to be compatible for e-dollies as well.

VUB will lead this task based on the developments out of previous projects, e.g., LONGRUN see figure 17. For more information regarding the LCA/VECTO Tool see, https://h2020-longrun.eu/.

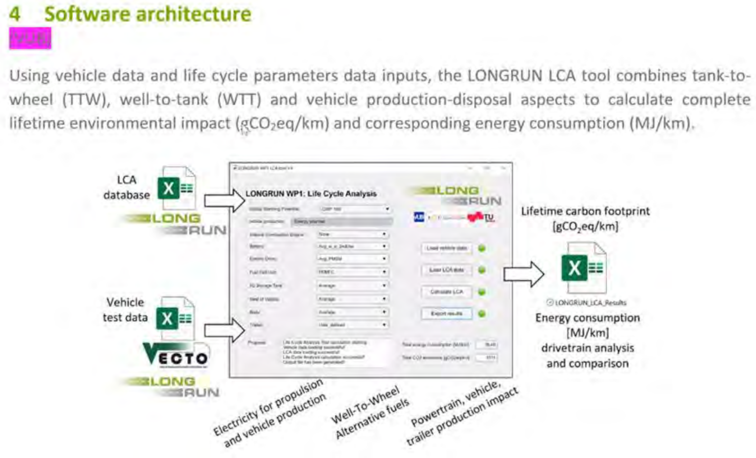


Figure 17 Schematic view architecture LONGRUN LCA Tool

4.2.5 Corridors, energy infrastructure (charging and fuelling)

The figure 18 below, shows the ZEFES corridors and TEN-T corridors. Major corridors will be used, the north – south from Sweden into Spain, the west-east from France-Benelux into Germany-Austria-Italy.

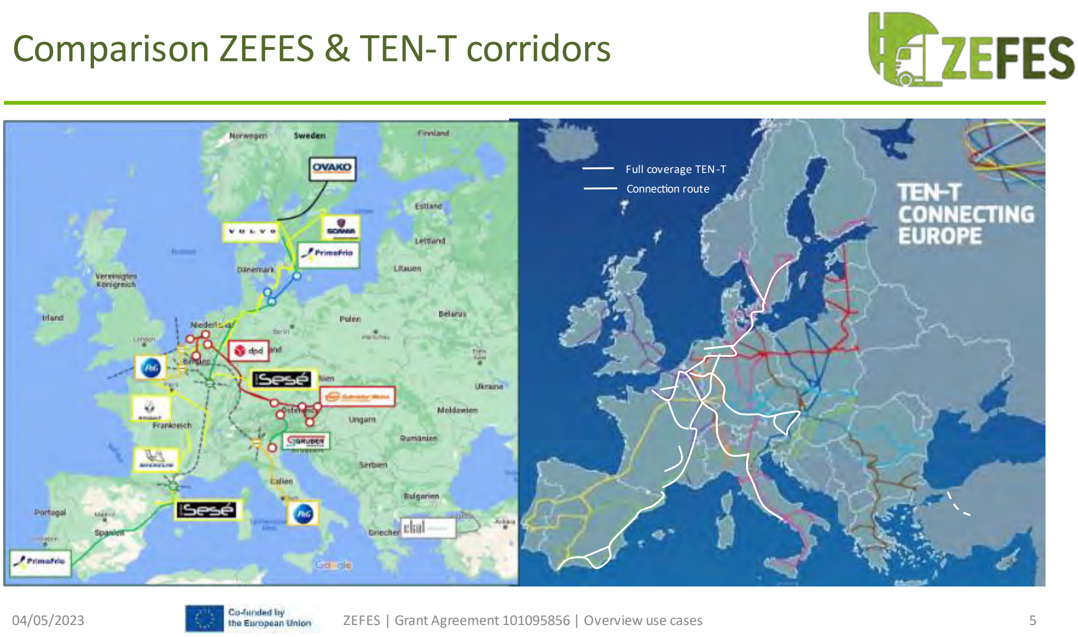


Figure 18 Comparison ZEFES & TEN-T corridors

Further 2 corridors are multimodal, using the rail connection Dudelange (LU) – Le Boulou (FR) transporting trailers across France, and using the rail connection Zeebrugge (BE) – Milano (IT) transporting ISO containers through Belgium, Germany, Switzerland, and Italy.

Most important is the energy infrastructure along the corridors to serve the ZE-HDV demonstrators. The figure 19 shows the current chosen locations for the charging points (CCS / MCS) and fuelling stations (HRS). The challenge will be to have all points in place by M27 to ensure a smooth operation of the ZE-HDV. Depending on the progress of implementing the charging and HRS points, it might be necessary to adapt the routings or as worst scenario adapt / replace the use case.
Based on the energy storage capacity on the ZEFES vehicles of 600kWh, a range of 400km under normal conditions at 44t GCW is theoretical possible, see paragraph 4.1.2. For EMS1 (up to 64t GCW) and EMS2 (up to 74t GCW) vehicle configurations the ranges will be limited to approximately 240 – 275km. Additional energy storage in the trailer will extend the range up to 640km for std 44t GCW vehicles and up to 400km for EMS1 and EMS2 vehicle configurations.
All demonstrations have a daily distance over 450km, single or roundtrip, and some cover a distance up to 1.300km.
Based on the topography, the climate conditions, the drive & rest schedules, and the time slots to be kept meeting the logistics conditions at final destinations, an overview is created of the charging and HRS points needed along the corridors for the different demonstrations. Indicated are the points to be covered by the ZEFES project and points expected to be available by Q2-2025 being part of national or regional initiatives. Out of the ZEFES project objectives, the project is not expected to deliver the required number of CCS/MCS and HRS stations. Enroute charging locations expected must be a minimum of 8 CCS, 12 MCS, and 8 HRS. Ideally is to have a 100% coverage 13 CCS, 21 MCS, 13 HRS stations. <u>This is a preliminary overview and will change during the coming period up to Month 24 as we are depending on external organizations and authorities responsible for permits, invest, works, availability of equipment.</u>

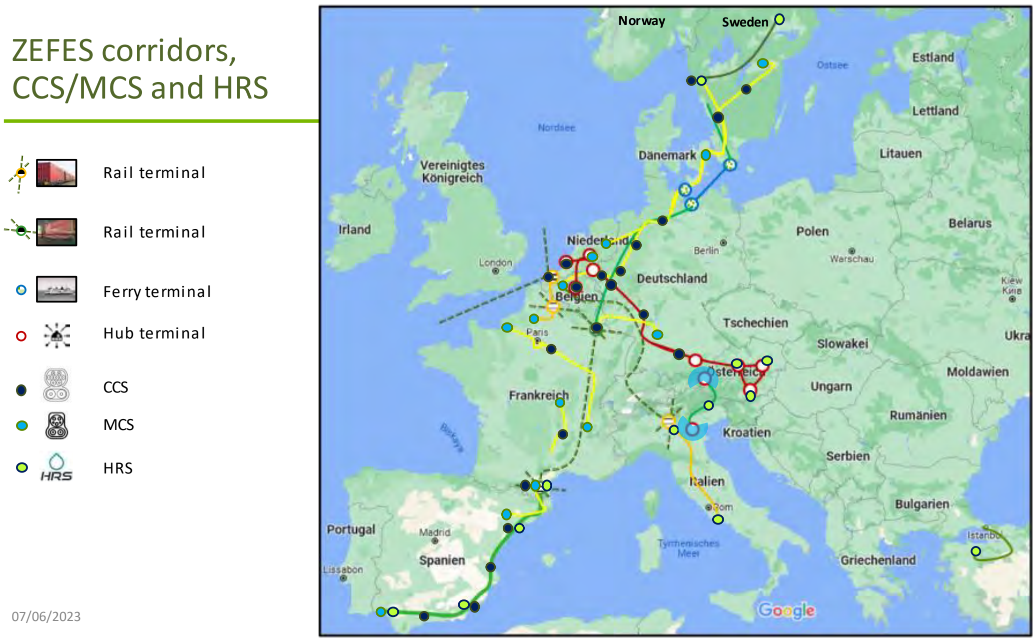


Figure 19 ZEFES corridors and charging & filling locations

The appendix 9.4 gives a detailed overview of all locations. “This will be a living document: all locations need to be checked on the availability of grid connections, usability of charging & filling stations, and expected future business viability, as invest is high and investors to implement these stations can only be found if a business case beyond the ZEFES project is proven.”

4.2.6 Vehicle Type Approval and Road Permits

All demonstrators need a full road approval as they will operate in real time logistics missions. For most vehicle configurations specific authorizations outside the standard type-approval process are needed. The Type Approval process is in hands of the OEMs and the Trailer manufacturers.

The same counts for the use of the demonstrators along the chosen corridors, the road permits. They need to be handled between the shippers/carriers/OEMs and the local / national / cross border road authorities. Special attention is needed for the cross-border corridors. IDIADA will set up a Corridor Working Group in closed collaboration with CEDR to support the process of type approvals and road permits, task 1.6.

4.3 Use case menu card

At this stage of the ZEFES project the use case menu card, see table 6 below, is defined by the choice of prime mover, (semi)-trailers in the desired vehicle configurations. During the ZEFES project, development challenges and decisions by authorities might need a change of the final vehicle configurations or even a change in use case. The Task 7.1, use case menu card, running between months 10 and 24 will deliver the final overview including all planning data.

Table 6 Preliminary use case menu card

	Vehicle – Task (UC)	7.2.1	7.2.2	7.2.3	7.2.4	7.3.1	7.3.2	7.3.3	7.3.4	7.4.1	7.4.2	7.6.1	7.6.2	7.6.3
Tractor	BEV		X	X		X		X		X	X			
	L-L BEV								X					
	FCEV						X	X				X	X	X
Rigid	BEV				X									
	FCEV	X												
Trailers											X			
	Swedish trailer	X												
	Standard trailer		2X			X				X	X	X	X	
	Container trailer			2X										X
	Swap body trailer				X									
	Low Liner								2X					
			X	X	X				X					
Propulsion trailers	E-trailer battery connected to truck battery					X?								
	E-cooled-trailer temperature controlled			X			X?	X?						
	E-trailer powertrain controlled by truck				X	X?								
				X	X									

4.4 Digital environment and data logging / streaming

Within the logistic sector the sender and receiver of goods and services have contractual agreements. Delivery quantity, delivery quality, delivery time and delivery cost are key parameters. For the carriers, those who perform the transport of goods must ensure the delivery of goods within these parameters. In addition, they need to ensure that the probability of delivery on time is given. This implies the choice of the right transport mode, the right timing of the transport within the right transport cost. Planning and adaptation due to daily changes of all kinds ask for intelligent digital support. The figure 20 shows a simplified supply chain of goods between sender and receiver.

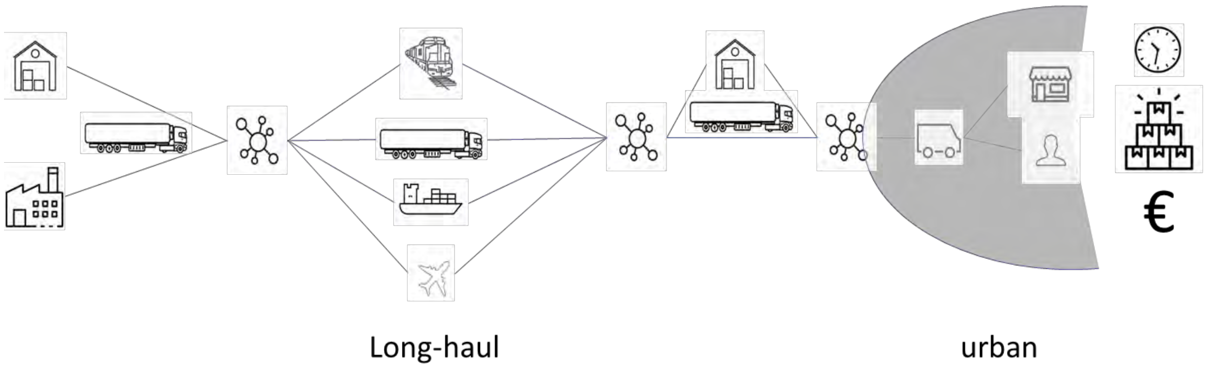


Figure 20 Schematic view supply chain

Today a wide variety of digital services is available, all connected through clouds, modems, devices, etc. by defined protocols and interfaces. Most HDVs are equipped with a data device sending and receiving data for a smooth logistics operation. The data refer to routing information, traffic information, missions' profiles, and vehicle performance as defined by the FMS standards. Implementation of ZE-HDV into current fleets force the carriers to handle additional information as the ZE-technologies and energy infrastructure require additional data. Available energy on board of the ZEV (electric and or hydrogen), availability of charging and filling service stations, reservation of parking, road use allowances, weather conditions, all being additional key parameters to ensure smooth operation of ZE-HDVs.

The above clearly explains the need for data logging / streaming within the ZEFES project. Data to perform the developments (WP2 powertrain design, WP3 CCS/MCS/HRS, WP4 tools to perform missions, e.g., road permits & type approvals, diagnostics and predictive maintenance, routing, parking, and navigation, WP5 build & commissioning of BEV demonstrators, and WP6 build and commissioning of FCEV demonstrators), to execute the demonstrations (WP7) and to perform the evaluations and assessments (WP8). The data specification, signals and formats need to be defined by the relevant WPs.

An agreement is needed to share vehicle specific data between specified ZEFES project partners as these data are sensible and should not be available for other partners than agreed. The validation of the missions and the performances of the vehicles will be done by TNO (WP8) in close alignment with the relevant OEMs (truck and/or trailer). The evaluation and assessment will be done using the ZEFES Digital Twin Platform (DTP), developed within WP4, led by RIC. To ensure a proper data exchange and compliancy with the GDPR regulation Data Protection Directive 95/46/EC, an independent appointed

ICT team within TNO (not part of WP8) will act as facilitator for collecting data and making data available for the specified partners.
The first challenge is to align the specific needed data for the ZEFES project, and the daily needed data as described above. Secondly, if not already planned by the OEM's, the need of a specific data logger needs to be discussed and agreed with the OEMs or alternative solutions can be agreed. The third challenge is to create an interface between the ZEFES DTP and the different clouds to ensure a smooth operation of the logistic missions and the ability to validate and to assess the impact of ZE-HDVs compared to the todays ICE-HDVs.
The figure 21, below, shows a possible concept of data exchange within the ZEFES project. The data logging collecting ZEFES specific data, and a commonly used Data Device sending and receiving data to & from clouds. The clouds representing the digital service providers, "Provider", the "User" representing the logistics service providers, the shippers, and carriers, the "Policies & Rules" representing governmental compliances with type approval & road permits, the "Planners & Owners" representing the infrastructure, e.g., modes, energy, parking, hubs & terminals, etc.
The "TNO cloud" to handle ZEFES data, GDPR compliance and agreed between ZEFES project partners and connected with the different clouds collecting and exchanging operational real-time data. The box "WP4" represents the ZEFES Digital Twin Platform (DTP), incorporating all DTs (Digital Twins) to be used by the ZEFES project partners during the ZEFES project.

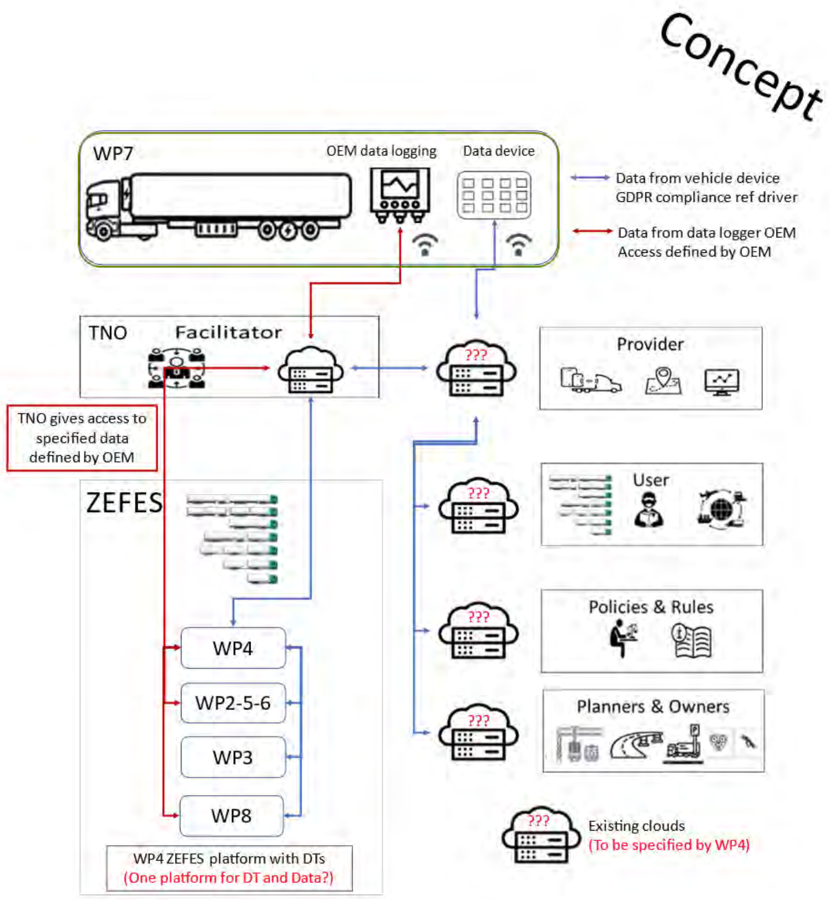


Figure 21 Concept data streams and data logger

The ZEFES DTP must be an open platform accessible through an Application Programming Interface (API), exposed on the Internet, by any ZEFES project-partnered (in the market available) cloud / platform as these are in use by the logistic sector. This will enable its use by operators who want to analyse the implementation of ZE-HDV within their fleets. For ambitions beyond the ZEFES project TNO can provide an (open-sourced) implementation of the platform such that partners may host the platform on their own infrastructure. This, in turn, enables operators to keep making analyses like the situation during the ZEFES project. Of course, the ZEFES DTP beyond the ZEFES project will not keep collecting and processing data from data loggers in ZEVs.

Most concerns are expressed by the shippers and carriers regarding the availability of DTs for reservation and payment of parking, fuelling, and charging to perform optimal planning in line with the drive and rest schedules and agreed arrival times at the destinations. See figure 22 below.

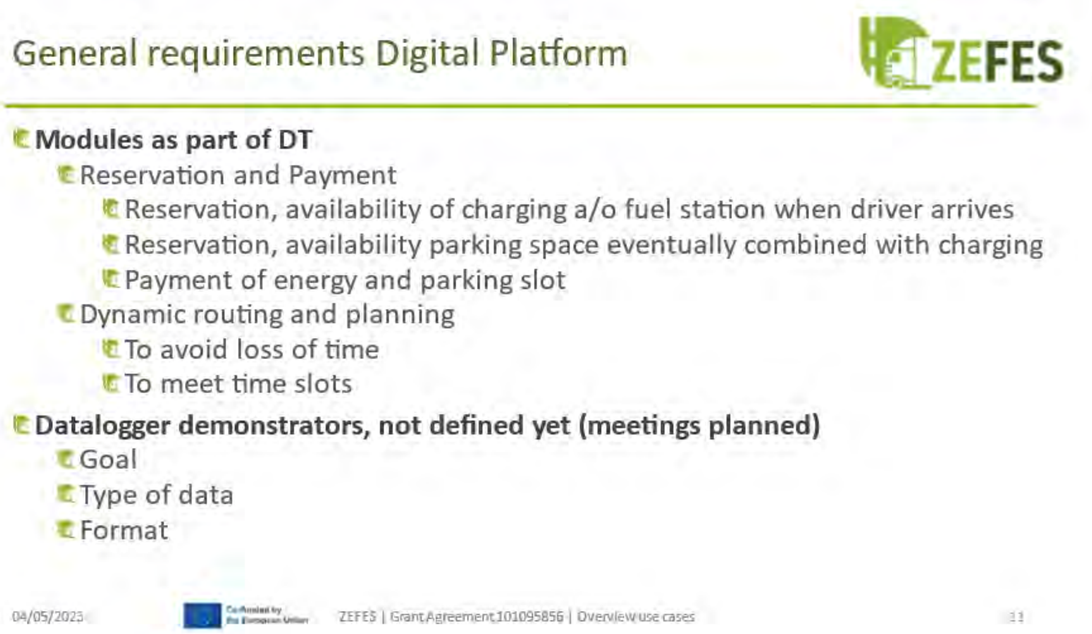


Figure 22 Main concerns ZEFES OEMs and ZEFES Shippers

TNO will provide a DTP that is able to collect data from other parties through the DTP API. TNO will ensure that the data is stored securely, and that (computational) models can access the data, restricted by access rights set by data owning parties. The models are not designed and constructed by TNO, but they can be hosted in the DTP (environment with computational and storage resources, and workflow functionality for enabling interconnected Digital Twins).

The DTP will not include the development of models, visualizations, and digital twins. It will enable users to run these systems and connect them to create the tools envisioned by the ZEFES project. TNO will, of course, assist in implementing the tools consisting of various models, visualizations, and digital twins on the Digital Twin Platform.

4.5 Target metrics and KPIs

Target metrics

As described in the introduction of chapter 4, four main key metrics are defined.

1) **Demonstration of missions on cross-border and** TEN-T corridors, fulfilling the requirements for range and payload and comparing the deploy-ability of BEVs and FCEVs for different mission profiles.
2) **Demonstration of an interoperable Megawatt Charging System (MCS)** and the location deployment strategy for hydrogen refuelling stations (HRS)
3) **Data collection of the demonstrations**,
   a. used for comparisons and
   b. to make it clear to logistic companies that it is possible to use these ZEVs.
   c. to make better configurations of vehicles.
4) **Demonstration how the ZE-HDV can be used,** in terms of energy use, payload, cooling of refrigerated goods, etc.

To measure the results of the performance of the demonstrators used for the logistics missions, several KPIs need to be defined. These should reflect the needs and requirements as described in the previous paragraphs. To visualize the KPIs a table, see table 7, is created showing the relation of the KPIs, the vehicle configuration & technology, and the logistics missions. The target-values need to be aligned by the OEMs, the shippers, and the research to enable a proper validation and assessment.

Table 7 Overview ZEFES logistic & shippers KPIs

	KPIs, comparison BE-, FCE-, and ICE-HDV long-haul vehicles			7.2.1		7.2.	7.4.2	7.6.1		7.6.2		7.6.3	
	KPI description	Value	Target	ICE	FCE	ICE	BEV	ICE	FCE	ICE	FCE	ICE	FCE
Logistics	Duration of trip	hr:min	Same as ref. vehicle (ICE)										
	Duration (un)loading	hr:min	Same as ref. vehicle (ICE)										
	Delivered quantity during trip	ton / m3	Same as ref. vehicle (ICE)										
	Delivery cost of trip	€	Same as ref. vehicle (ICE)										
	Number and duration of stops and stop type (fueling / charging / resting / maintenance / (un)loading/other)	n, hr:min	Same as ref. vehicle (ICE)										
Vehicle	Range @ 40t GCW on VECTO long-haul profile	km	750km										
	Charging during parking 45min	kWh/min	400km @ 40t GCW on VECTO long-haul profile										
	Payload	ton	Min 90% as ref vehicle (ICE)										
	Load factor	%	% of available m3 or ton										
	Repair and maintenance (€)	€/km and €/tkm	% ref vehicle (ICE)										
Powertrain	CO_2 credits VECTO Vehicle Group												
	Energy use per km	kWh/km	Achieve range of 750km respectively 400km										
	Energy use per weight cargo	kWh/tkm – kWh/ton	% ref vehicle (ICE)										
	Tires usage drive axle wear and driven kilometres	µg/km - km	% ref vehicle (ICE)										
	Number of drive axles and axle weight during operation	n – t/n	% ref vehicle (ICE)										

5 Conclusions and recommendations

5.1 Conclusions

The use case menu card has still a preliminary status as too many circumstances, caused by internal and external events / dependencies, will occur during the coming period up to Q2 2025, the start of the real time demonstrations.

Within Task 7.1, the sub task will work on the detailing based on this document D1.2.
The start will be M10 and the finalization of all activities of ST7.1.1 – ST7.1.6 will be M24, the start of the demonstrations. The full detailed plan of all demonstrations will be the guideline for the execution of all demonstrations and handed over to WP8 enabling the start of the evaluation and assessment of the incoming data collected during the demonstration.
ST7.1.1 Detailed plan of the demonstration phase covering all demonstrators and the missions.
ST7.1.2 Preparation and preparatory activities for infrastructure permits and vehicle road allowances.
ST7.1.3 Preparation of charging and fuelling infrastructure and back office.
ST7.1.4 Use case set up, network planning and orchestration.
ST7.1.5 Training and instructions for the driver, the operators, and the mechanics.
ST7.1.6 Installation and testing of data loggers in demonstrator vehicles (when necessary).
ST7.1.7 Coordination of the demonstration of vehicle innovations and fast charging concepts.

The reporting of the status within WP7, Task 7.1 will be done by a traffic light progress. The table below shows the setup and the status. As mentioned above, the status is preliminary for all use cases and by that all traffic lights are red.

Table 8 Overview status report use cases Task 7.1

Task 7.1 STx.x.x		Topic	7.2.1	7.2.2	7.2.3	7.2.4	7.3.1	7.3.2	7.3.3	7.3.4	7.4.1	7.4.2	7.6.1	7.6.2	7.6.3
7.1.1		Detailed plan	●	●	●	●	●	●	●	●	●	●	●	●	●
7.1.2		Type approval & Permits	●	●	●	●	●	●	●	●	●	●	●	●	●
7.1.3		Charging & Fuelling	●	●	●	●	●	●	●	●	●	●	●	●	●
7.1.4		Orchestration	●	●	●	●	●	●	●	●	●	●	●	●	●
7.1.5		Training & instructions	●	●	●	●	●	●	●	●	●	●	●	●	●
7.1.6		Installation data logger	●	●	●	●	●	●	●	●	●	●	●	●	●
7.1.7		Coordination execution	●	●	●	●	●	●	●	●	●	●	●	●	●

Internal dependencies (use case related)
Carriers as contract partners of the shippers operating the demonstrators. To be covered under WP7, subtask 7.1.1
Development of the e-trailer concept strategy. Decided is a task force led by VET, and partners KAE, SCA, VOL, ZF to follow up a feasible e-trailer strategy, WP5 task 5.3.
Charging of e-reefers on the rail wagon. The partners CFL and UIC, under supervision HIT, WP3, need to work out a solution.
Concept of the ZEFES Digital Twin Platform. The DTP must be an open platform to be user-friendly beyond the ZEFES project.

Agreement of vehicle-data exchange between OEMs and ZEFES partners, e.g., IDI, RIC, PTV. Lead RIC, WP4; to agree with all relevant partners what and how data will be made available.

External dependencies (use case related)

Market situation 2025 / 2026 with regard the planned logistics real time use cases
Vehicle Type Approval and Road Permits for the demonstrators.
Coverage of charging (CCS/MCS) and fuelling (HRS) along the ZEFES corridors

5.2 Recommendations

As recommendations the success of the ZEFES project would benefit from setting up an extended stakeholder´s engagement in which ZEFES project partners and stakeholders work together to counter the internal and external events / dependencies.

Engagement Shippers and carriers

As the shipper cannot guarantee or confirm yet the details of the logistics tasks, due to internal purchase process and market dynamics, a fallback scenario must be developed to enable a switch of and or an adaptation of use cases. (WP7, Task 7.1)

Engagement Energy Infrastructure

Out of the ZEFES project objectives, the ZEFES project will never deliver the required number of MCS and HRS stations. Enroute charging locations expected must be a minimum of 8 CCS, 12 MCS, and 8 HRS.

Ideally to have a 100% coverage 13 CCS, 21 MCS, 13 HRS stations. Call to action is necessary, *"invest in charging (CCS/MCS) and fuelling (HRS) is needed now, as from 2025 - 2030 over 150.000 ZE-HDVs and over 1.000.000 units by 2040 will be running on European corridors!"*

Therefore, an initiative is already started to form a working group on searching for investors along the ZEFES corridors. As getting permits and funds for this kind of investments takes time, this working group should get the highest support within the ZEFES project. (WP3)

Engagement road authorities and policy makers

The initiative is undertaken to set up a ZEFES Corridor Working Group. In close collaboration with CEDR and using the GRVA Geneva Working Group, a group of road and vehicle authorities willing to share their expertise and support in achieving the necessary type approvals and road permits. The challenges will be to use the stakeholders' networks to express the need for ZE-HDVs on European corridors, regional-national-cross border in a multimodal context. (WP1, Task 1.6)

Engagement digital service providers

A close collaboration with shipper, carriers and digital service providers is needed to optimize the usability of the digital twin platform beyond the ZEFES project. (WP4)

In addition, it will be necessary to include,

- stakeholders representing digital logistics services as they all use their platforms and can support the determinations of the interfaces, protocols and needed data from a logistics point of view,
- stakeholders representing authorities regarding road access policies and rules,
- stakeholders representing energy infrastructure and service stations regarding parking fuelling, etc.

6 Risks and interconnections

6.1 Risks/problems encountered

As stated in chapter 5.2 Recommendations, the risks are known and mainly depending on the willingness of external organizations and authorities. The set up of the different working groups is a way to act within the timeline of the ZEFES project duration by creating fall back scenarios. See also WP10, task 10.3 Risk Management.

Some use cases might not be demonstrated because we might not be able to supplement the budget for chargers from ZEFES with sufficient chargers from other sources, similar for hydrogen refuelling and finally the availability of the required road permits.

6.2 Interconnections with other deliverables

A close alignment with Task1,1 and the WPs 3, 4, 7 and 8 has resulted in addressing topics already at an early stage in the ZEFES project.

7 Deviations from Annex 1

As stated in chapter 2.1 Procedures, VOL has taken over the tasks and demonstration from HYU as they left the project. An amendment has been submitted to report all details.
In addition, as stated in chapter 5.1 Conclusions, the trailer strategy regarding the powertrain concept might be deviating from the annex 1. This strategy will be further discussed and decided within the WP2 Powertrain optimization.

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ZEFES Project partners:

#	Partner short name	Partner Full Name
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2	FRD	FORD OTOMOTIV SANAYI ANONIM SIRKETI
4	KAE	KASSBOHRER FAHRZEUGWERKE GMBH
5	REN	RENAULT TRUCKS SAS
6	SCA	SCANIA CV AB
7	VET	VAN ECK TRAILERS BV
8	VOL	VOLVO TECHNOLOGY AB
9	ABB	ABB E-MOBILITY BV
9.1	ABP	ABB E-MOBILITY SPOLKA Z OGRANICZONAODPOWIEDZIALNOSCIA
10	AVL	AVL LIST GMBH
11	CM	SOCIEDAD ESPANOLA DE CARBUROS METALICOS SA
11.1	APG	AIR PRODUCTS GMBH
12	HEPL	HITACHI ENERGY POLAND SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA
13	MIC	MANUFACTURE FRANCAISE DES PNEUMATIQUES MICHELIN
14	POW	PLASTIC OMNIUM NEW ENERGIES WELS GMBH
15	RIC-CZ	RICARDO PRAGUE S.R.O.
15.1	RIC-DE	RICARDO GMBH
16	UNR	UNIRESEARCH BV
17	ZF	ZF CV SYSTEMS HANNOVER GMBH
18	ALI	ALLIANCE FOR LOGISTICS INNOVATION THROUGH COLLABORATION IN EUROPE
19	DPD	DPD (NEDERLAND) B.V.
20	COL	ETABLISSEMENTEN FRANZ COLRUYT NV
21	GRU	GRUBER LOGISTICS S.P.A.
22	GBW	GEBRUEDER WEISS GESELLSCHAFT M.B.H.
23	PG	PROCTER & GAMBLE SERVICES COMPANY NV
23.1	PGP	PROCTER AND GAMBLE POLSKA SPOLKA Z OGRANICZONA ODPOWIEDZIALNOSCIA
23.2	PGA	PROCTER & GAMBLE AMIENS
24	PRI	PRIMAFRIO CORPORACION, S.A.
25	PTV	PTV PLANUNG TRANSPORT VERKEHR GmbH
26	Fraunhofer	FRAUNHOFER GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG EV
27	HAN	STICHTING HOGESCHOOL VAN ARNHEM ENNIJMEGEN HAN

28	IDI	IDIADA AUTOMOTIVE TECHNOLOGY SA
29	TNO	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO
30	UIC	UNION INTERNATIONALE DES CHEMINS DE FER
31	CFL	CFL MULTIMODAL S.A.
32	GSS	Grupo Logistico Sese
33	HIT	Hitachi ABB Power Grids Ltd.
34	IRU	UNION INTERNATIONALE DES TRANSPORTS ROUTIERS (IRU)
35	RIC-UK	RICARDO CONSULTING ENGINEERS LIMITED

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