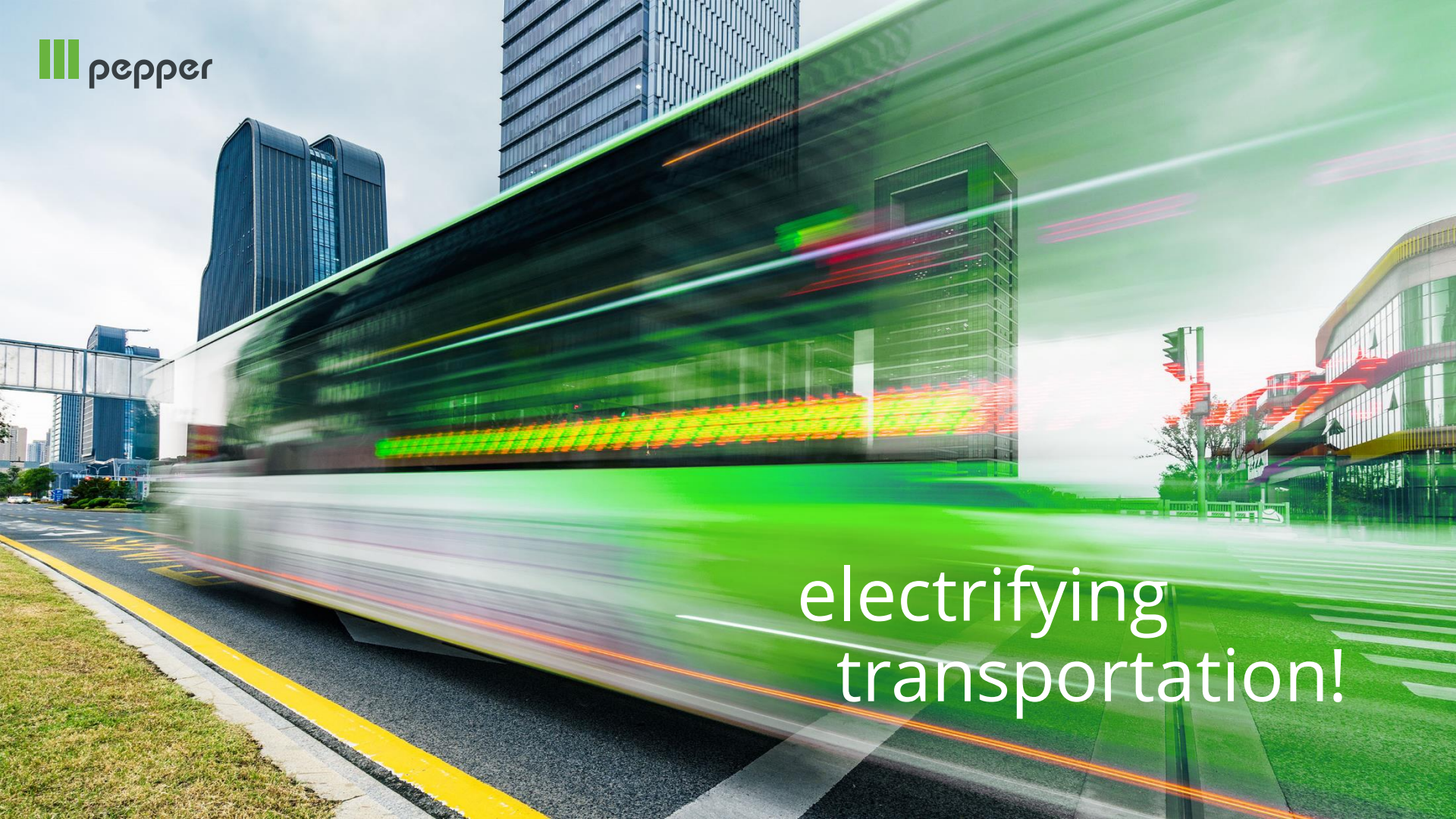

pepper
electrifying
transportation!

RETROFITTING OF COMMERCIAL VEHICLES

WHY RETROFITTING IS ABOUT MORE THAN JUST VEHICLES

ROBERT REISENAUER

CSO PEPPER MOTION GMBH

PEPPER AT A GLANCE

WITH OUR UNIQUE TECHNOLOGY, WE MAKE A VALUABLE CONTRIBUTION TO CLIMATE-FRIENDLY, EMISSION-FREE MOBILITY IN OUR SOCIETY.

140+ EMPLOYEES

Multi-national
team of experts

4 LOCATIONS

Denkendorf near Ingolstadt (HQ)
Garching near Munich
Paderborn
Vienna (Austria)

3 DISTRIBUTORS

France
Italy
Poland

1. DIGITAL OEM

Providing complete solutions:
From electrified commercial vehicles to charging infrastructure and service

ADVANTAGES RETROFIT

SUSTAINABILITY

- Resource-saving
- Second Life
- CO_2 savings

ECONOMY

- Cheaper than buying new
- Lower operating and maintenance costs, lowest TCO
- Term extension

AVAILABILITY

- Fast delivery capability for selected models
- Short development cycles
- Fast implementation

SAFETY

- Standards (e.g. ISO 26262)
- TÜV Certification
- Criteria catalogue of the Federal Ministry for Digital and Transport

HOW TO:
EXAMPLE OF A CUSTOMER USE CASE

ROUTE ANALYSIS - SIMULATION

IDENTIFICATION OF REQUIRED BATTERY CAPACITY FOR THE E-BUS

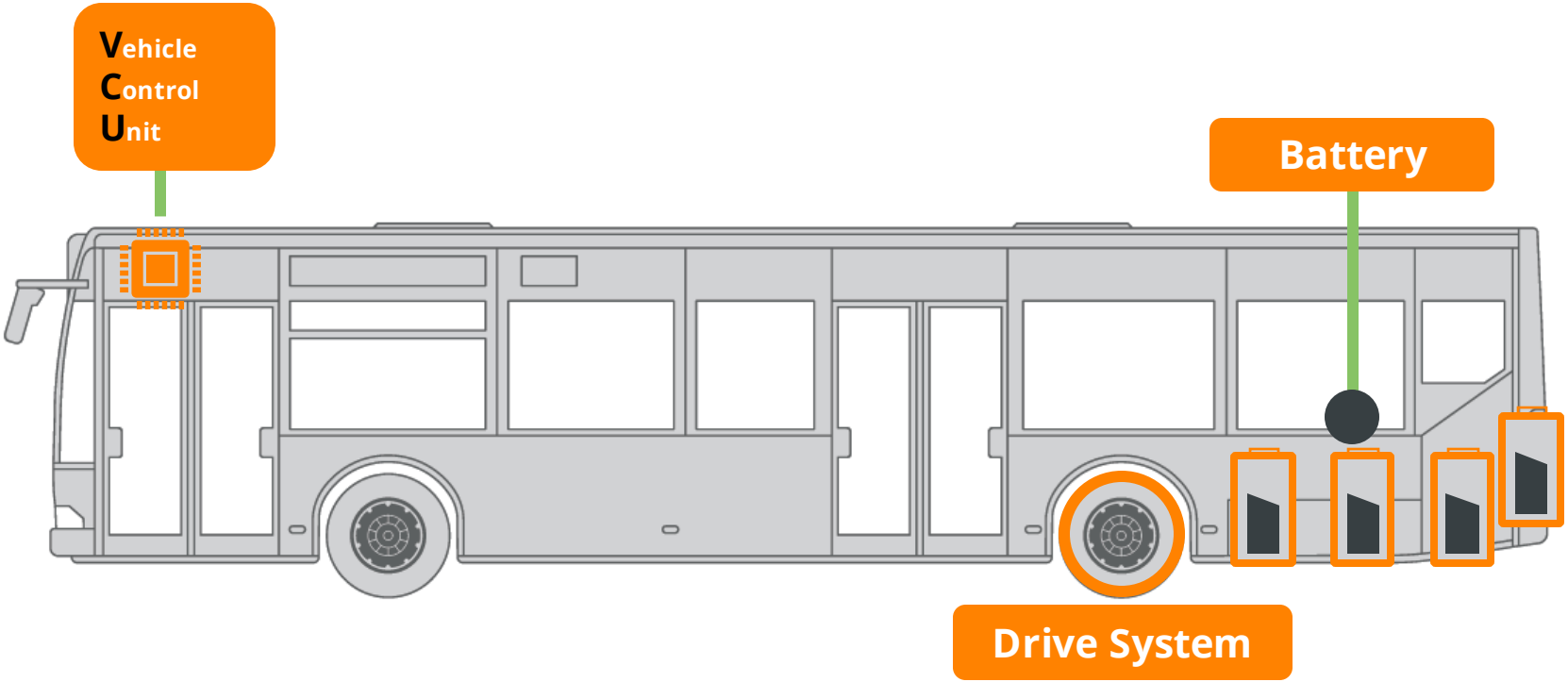
KM TOTAL	ENERGY CONSUMPTION	SOC	AVERAGE ENERGY CONSUMPTION
192.2	213 kWh	~20 %	1.1 kWh/km

VEHICLE ANALYSIS

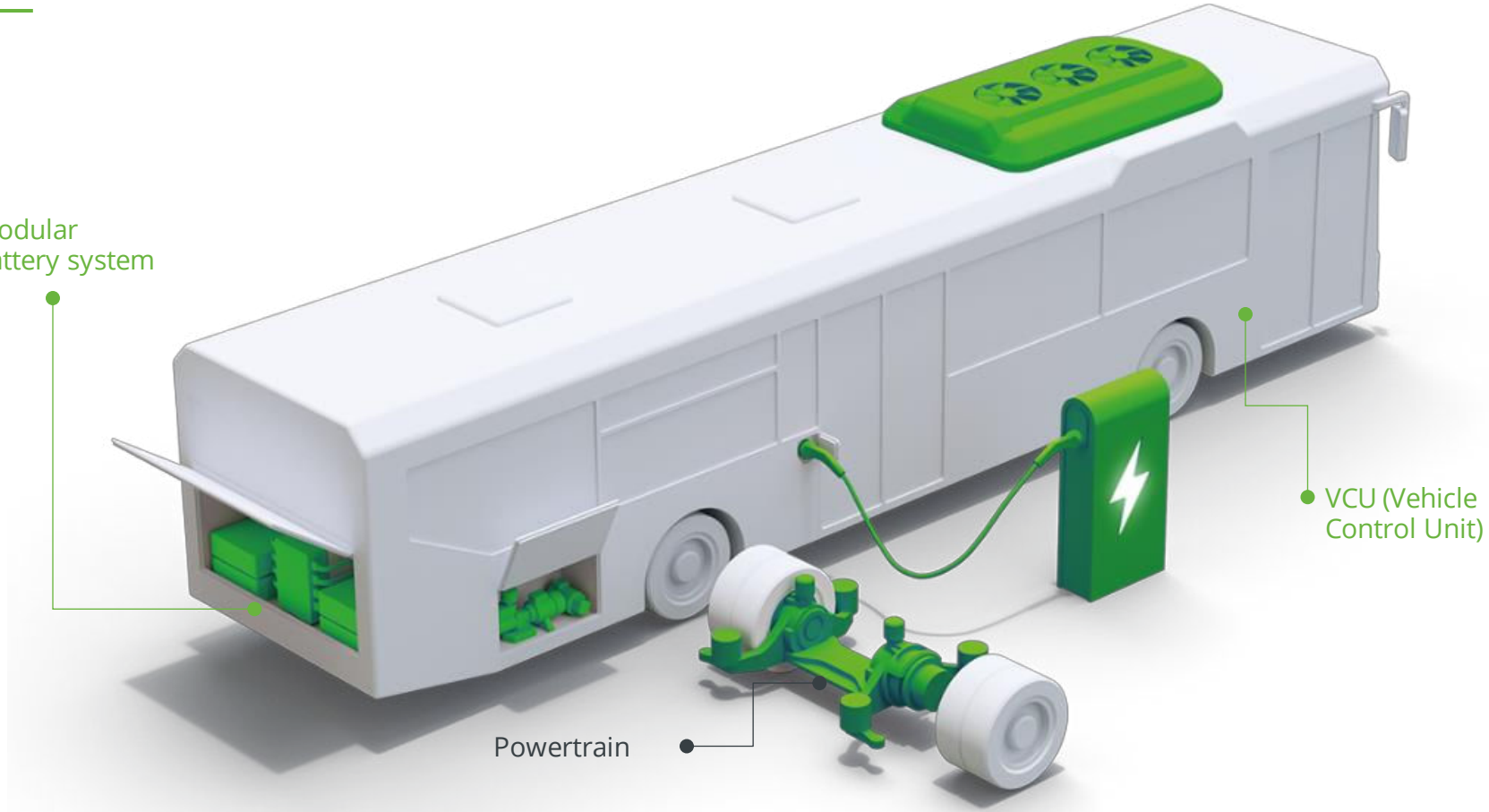
WHICH INFORMATION DO WE NEED BEFORE THE RETROFIT

- Vehicle Identification Number: For example “Mercedes WEB629083*****“
- Vehicle functionality: Any defects or problems?
- Available space for batteries and electrification KIT
- Vehicle condition of chassis and body

VEHICLE CONCEPT



VEHICLE CONCEPT



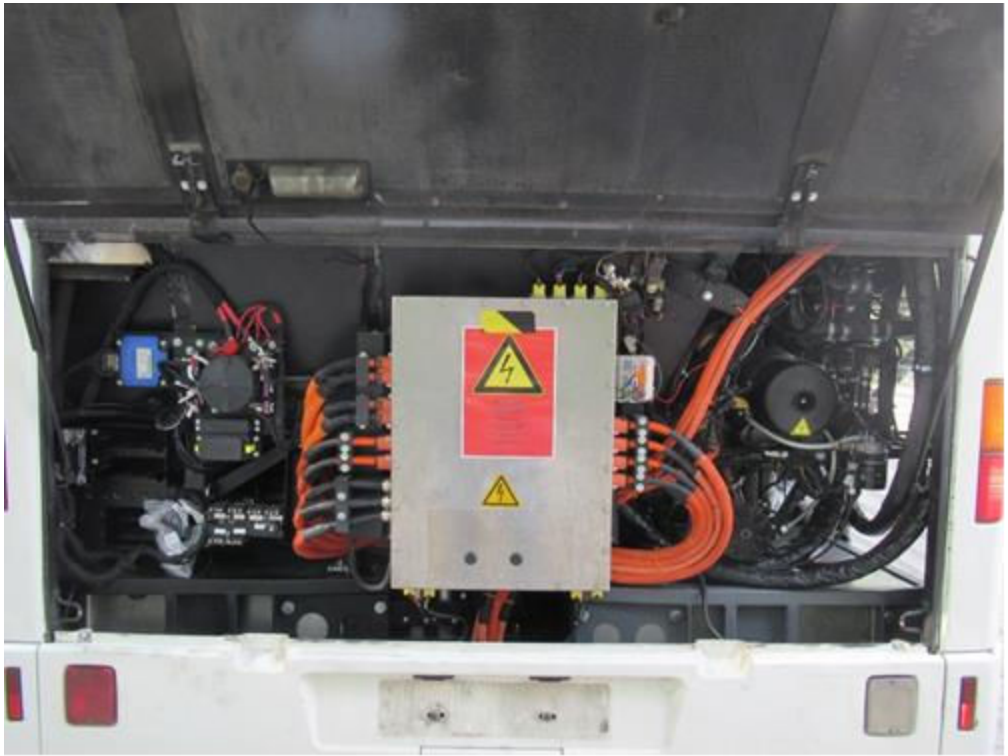
Graphics: exemplary overview

THE RETROFIT PROCESS: RE-DIESEL

THE RETROFIT PROCESS: ELECTRIFICATION

THE RETROFIT PROCESS

THE RETROFIT PROCESS



THE RETROFIT PROCESS

TECH. DATA ABOUT THE ETROFIT KIT CITY BUS

POWERTRAIN	
VCU pepper	▪ Interface between etrofit kit and vehicle ▪ Developed according to ISO 26262
Rear axle	▪ Electric driven drop center axle ZF AxTrax-AVE 130 ▪ 2 near-wheel asynchronous motors ▪ water-cooled
Torque [Nm]	2 x 485 = 970
After final translation [Nm]	2 x 11.000 = 22.000
Rated power [kW]	2 x 80 = 160
Peak power [kW]	2 x 125 = 250
Recuperation [kW]	Up to 250

BATTERY	
Technology	NMC (nickel-manganese-cobalt)
Cooling	Water glycol (active battery cooling)
Usable battery capacity (8 units) [kWh]	240 (other configuration possible)
Charging power [kW]	Up to 150
Charging type	Type 2 CCS, DC charge
Range [km]	Up to 250
System voltage [V]	650

AIR CONDITIONING	
Type	Air conditioning/ Heat pump
Electric auxiliary heater [kW]	2 x 7 = 14
Hybrid auxiliary heater [kW]	23
Cooling capacity [kW]	25

WEIGHT	
Gross vehicle weight [kg]	18.000
Curb weight [kg]	12.300

COSTS FOR THE ELECTRIFICATION (GERMANY)

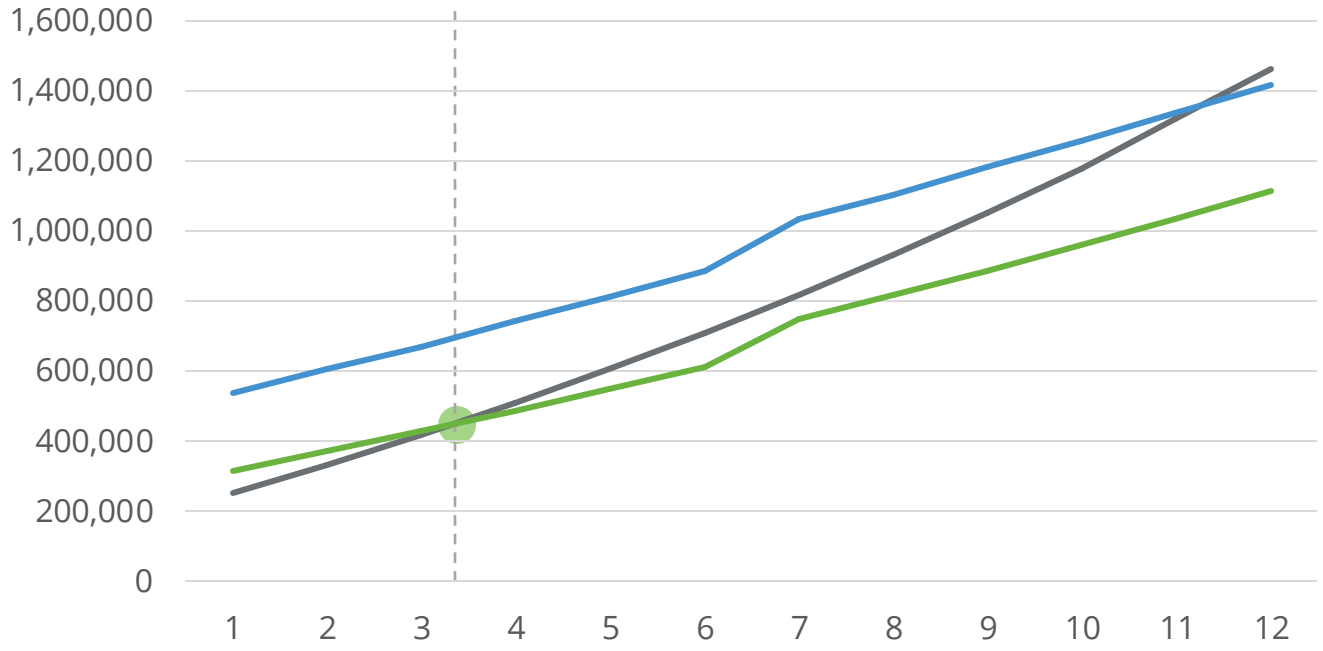
DESCRIPTION	UNIT PRICE IN EUR (NET)
Electrification KIT ▪ Powertrain ▪ Battery ▪ Air conditioning/heat pump ▪ Inverter ▪ Driver display ▪ Other auxiliary components	250.000
Electrification of the vehicle ▪ Integration of electrification KIT ▪ Validation of the vehicle ▪ Homologation	30.000
Refurbishment and modernization	10.000

TOTAL COST OF OWNERSHIP (TCO) COMPARED

LIFE CYCLE 12 YRS

New Diesel Bus	pepper Bus	New E-Bus
1.464.000 €	1.113.000 €	1.417.000 €
2,03 €/km	**1,55 €/km**	**1,97 €/km**

- ANNUAL MILEAGE [KM] 60.000
- ELECTRICITY PRICE [€/KWH] 0,34
- DIESEL PRICE [€/LITER] 2
- AD BLUE PRICE [€/LITER] 0,7
- ANNUAL PRICE INCREASE [FACTOR] 1,02
- CONSUMPTION DIESEL TRUCK [LITER/KM] 0,27
- CONSUMPTION E-TRUCK [KWH/KM] 1,50



CO_2 EMISSIONS

CONTRIBUTION TO SUSTAINABILITY WITH PEPPER VEHICLES

60.000 KM/YEAR

SAVINGS PER BUS:
1,15 KG CO2/KM

Cumulative CO_2 emissions [ton CO_2-eq/year]					
Year		Current German power mix		100% green power	
	New Diesel Bus	pepper Bus	New E-bus	Green pepper Bus	New green eBus
Production	100,8	88,1	136,7	88,1	136,7
1	170,1	119,1	167,8	96,9	145,5
2	240,8	150,6	199,3	105,7	154,4
3	312,8	182,6	231,3	114,6	163,2
4	386,2	215,1	263,7	123,4	172,1
5	461,0	248,1	296,7	132,4	181,0
6	537,3	281,6	330,2	141,3	190,0
7	615,0	315,6	364,2	150,3	199,0
8	694,2	350,1	398,8	159,3	208,0
9	775,0	385,2	433,9	168,4	217,0
10	857,4	420,9	469,5	177,5	226,1
11	941,3	457,1	505,8	186,6	235,2
12	1.026,9	493,9	542,6	195,7	244,4
EoL	12,5	12,7	12,7	12,7	12,7
Total emissions [kg CO_2-eq/km]	**1,44**	**0,70**	**0,77**	**0,29**	**0,36**

IMPRESSIONEN

ROADSHOWS FRANCE & ITALY

HOW TO:
CREATING LOCAL IMPACT GLOBALLY

LOCAL VALUE

WITH LOCAL PARTNERS LOCAL VALUE IS BEING CREATED.

INFRASTRUCTURE

JOBS

FUNDING

LOCAL PARTNERS

Sales

Production

Service

INFRASTRUCTURE

Production workshops

Charging stations / network

Service points

REQUIREMENTS

FOR SUCCESFUL LOCAL RETROFITTING/REPOWERING

PRODUCTION

- Identify and qualify local production facilities

TRAININGS

- Local staff needs to be trained for production & service (incl. HV-trainings)

VEHICLES

- Evaluation of vehicles for possible rertofitting

SERVICE

- Identify and qualify local workshops and service teams

PEPPER BUS & TRUCK

PEPPER BUS


100% electric!
pepper
electrifying
transportation!


etrofit
PEPPER

CONTACT

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CSO

robert.reisenauer@
peppermotion.com

PROJECT SCHEDULE

Analysis & Consulting

1

- Vehicle suitability
- Individual use case

Conception

2

- Vehicle specifications
- Dimensioning charging infrastructure
- Finance plan

Conversion

3

- Refurbishment & upgrades
- Electrification
- Commissioning

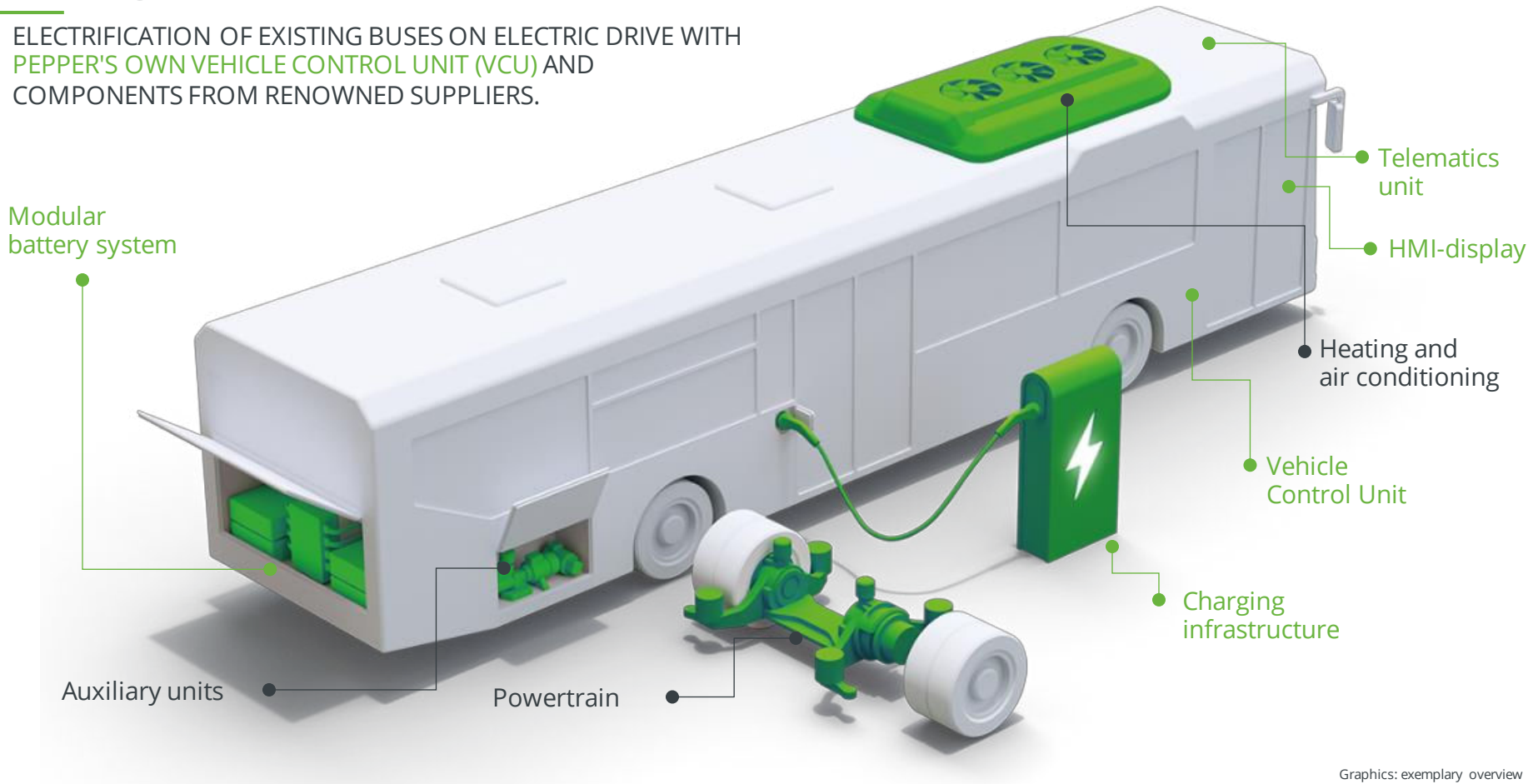
Operation

4

- Service & maintenance
- Staff training
- Innovative hard- & software updates

ETROFIT KIT

ELECTRIFICATION OF EXISTING BUSES ON ELECTRIC DRIVE WITH PEPPER'S OWN VEHICLE CONTROL UNIT (VCU) AND COMPONENTS FROM RENOWNED SUPPLIERS.



Graphics: exemplary overview

REQUIREMENTS & AVAILABLE MODELS

DUE TO THEIR LONG SERVICE LIFE, COMMERCIAL VEHICLES ARE IDEALLY SUITED FOR ELECTRIFICATION.

VEHICLE SUITABILITY

- Basically, any existing city bus or coach can be electrified
- Focus on the most common models in Europe
- Individual inspection of each vehicle (technical equipment, condition)

AVAILABLE & PLANNED VEHICLE MODELS

- MB Citaro C1
- MB Citaro C2
- IVECO Crossway
- MAN A21

Further vehicle models on request