

Silent, efficient, eco-friendly:

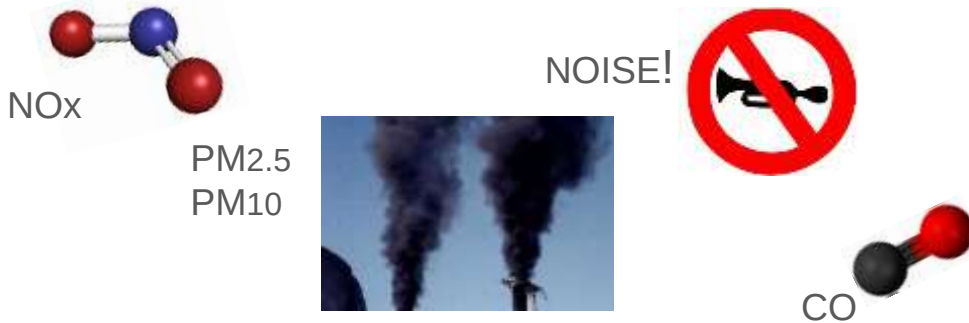
High efficient – gearless - electrical direct drive ZAwheel for electric city busses

Oliver Vahsen, Global Account Manger, ZIEHL-ABEGG Automotive GmbH

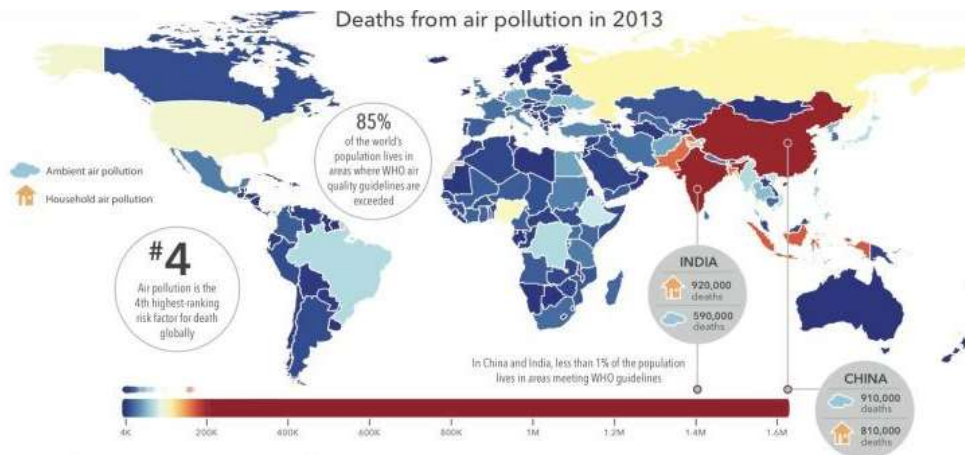


Restricted operation of conventional vehicles will come!

In urban cities people requests improvements



Deaths from air pollution in 2013



Air pollution was responsible for 5.5 million deaths in 2013

London



- Low Emission Zone (LEZ) Greater London
- Congestion charge in London Centre
- 2020 Ultra Low Emission Zone in plan

Paris



- 2015 Low Emission Zone
- 2020 Ban all Diesel vehicles (plan)
- 2025 RATP 80% full electric / 20% CNG

Netherlands



- 2007 First Low Emission Zone in NL
- 2016 Rotterdam Low Emission Zone widen No Diesel < 2001 / Petrol < 1992 allowed!
- 2025 Zero-emission public transport in NL

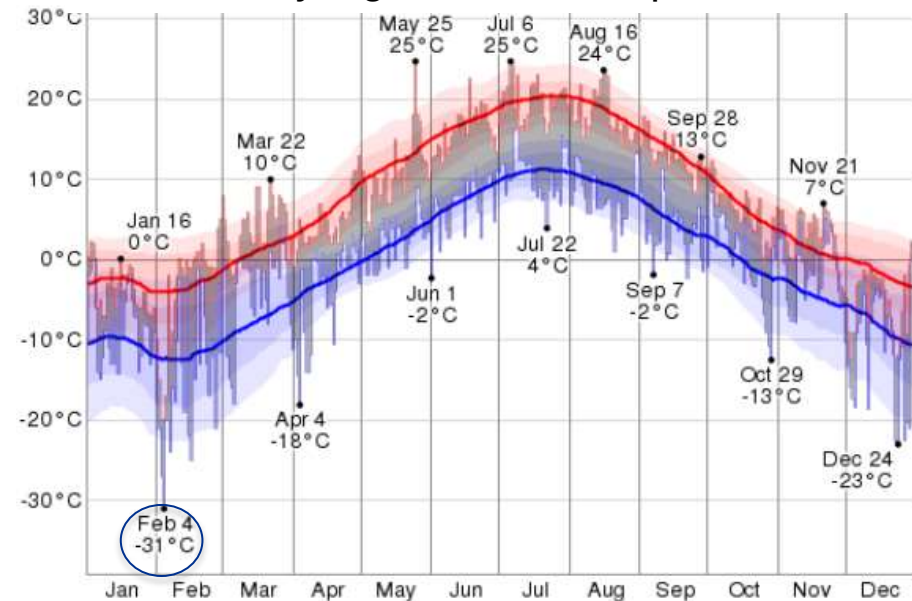
ZAwheel: References cities / operators

Country	 Netherland		 Sweden		
City	Rotterdam		Umea		
Operator			Nobina		
Project	NEMS E-BUSZ				
Manufacturer	VDL - Bus & Coach		Hybricon Bus System AB		
Vehicle	12m City buses - VDL Citea Retrofit Battery modul: Valance 106 kWh Range Extender: VM Motori with 70 kW		12m + 18m city buses Battery module: 40 kWh	12m Airport shuttle bus Volvo 7700 Retrofit Battery module: Altairnano 106 kWh	
Amount	2		8	1	
Charging system	Over night charging		Fast charging via pantograph		
Country	 Germany			 Germany	
City	Hohenlohe		Münster		
Operator	 NVH				
Project	LaGa 2016		ZeEUS		
Manufacturer	ebe Europa - Ekova Electric a.s.		VDL - Bus & Coach		
Vehicle	12m City bus - Electro buses		12m City bus - Electro buses		
Amount	4		5		
Charging system	Over night charging		Fast charging via robotorarm		

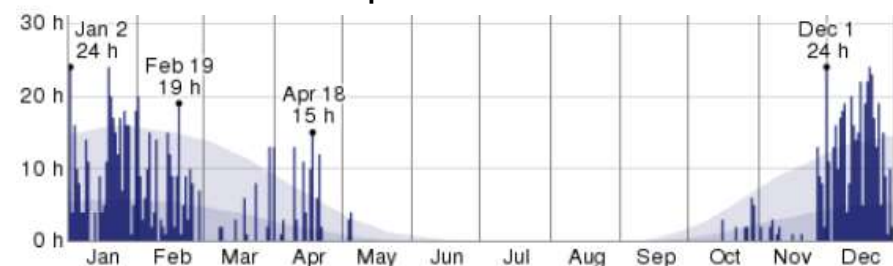
A glance to the polar circle: Umeå (Sweden)



Umeå: Daily high and low temperature 2012



Umeå: Snow report 2012



<https://weatherspark.com/history/28943/2012/Umea-Vasterbotten-Sweden>

Umeå line 80: **ZA**wheel operation under arctic conditions

Map airport shuttle line 80



Operator in Umeå: Ultra <http://www.tabussen.nu/ultra/>

Bus in operation: 2x 12m electric city bus

Operation: 7 days a week

Daily operation: 20h / 450km/d

Airport – city shuttle (~45min / 20km)

Morning / evening pupil shuttle (2h each tour)

Charging: Ultrafast Charging® 650kW between 180 – 300 sec



Umeå line 9: **ZA**wheel operation under artic conditions

Map City line 9



Operation:

7 days a week

Daily operation:

20h / 450km/d

City shuttle

~50min / 20km

... passing a lot of sleeping police mens

Buses in operation: 1 + 5x 12m / 1x 18m electric city bus

1st complete line converted

Charging:

Ultrafast Charging® 650kW between 180 – 300 sec

1x battery booster – designed for residential area

1x standard



Umeå: **ZA**wheel operation under arctic conditions



City / Country: Umeå (S)
 Application: 12 / 18 m city bus
 Vehicle manuf.: Hybricon
 Bus Type: Electric bus (EV)
 Number of Veh. 8 + 1
 Equipment: full-electric bus
 fast charging

Project description

- City Bus for Umeå – line 9
- Airport – city shuttle for Umeå – line 80
- Pupils shuttle

Time period:

Starting 06 / 2013

Wheel hub motor:

SM530.60AL-30

Technical Data:

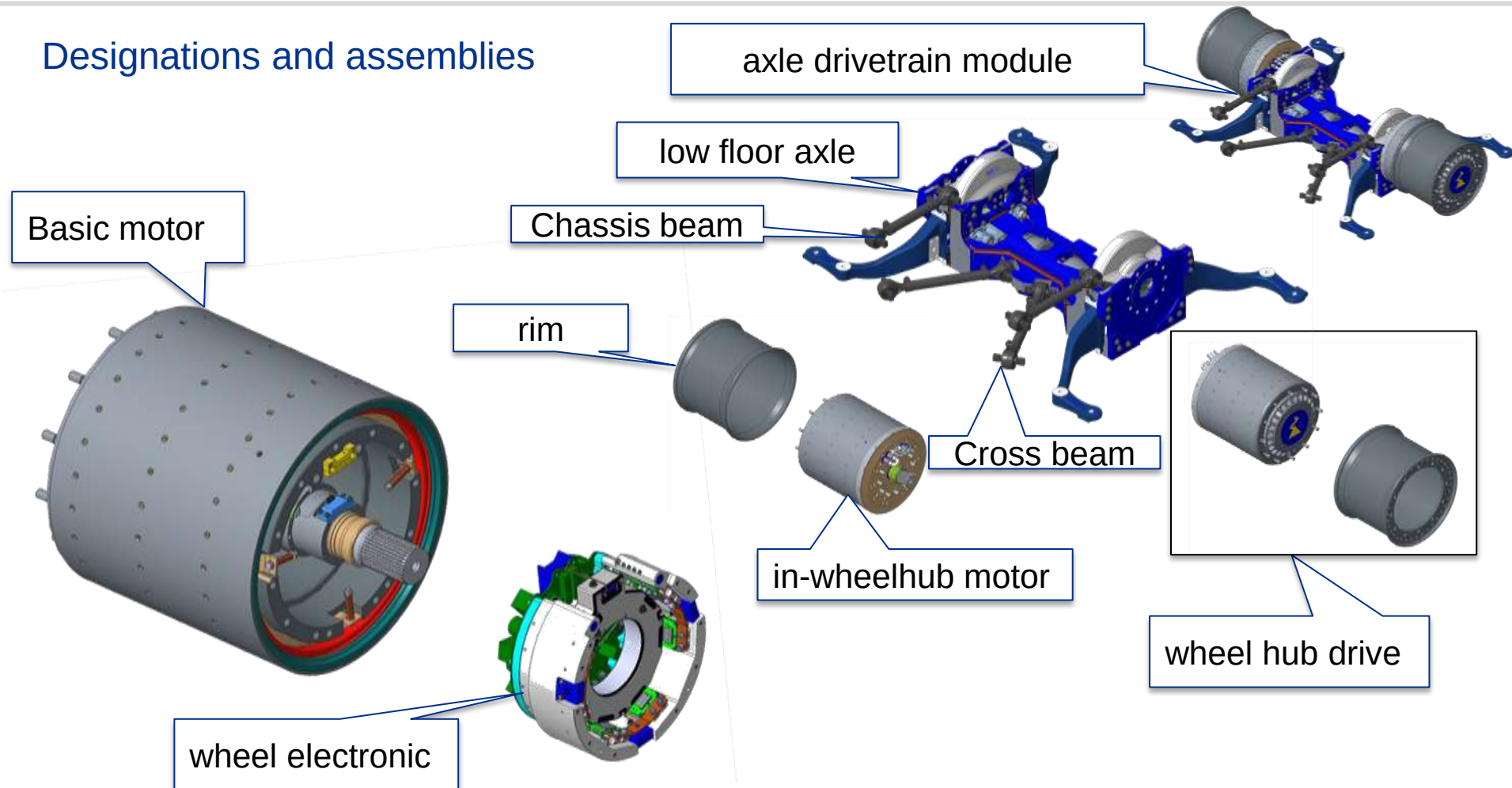
- e-drive: **ZA**wheel - 2. Generation
- Arctic climate adaptation: < – 20°C usage
 - Extra isolation of floor and side walls
 - Usage of battery and motor heat
 - Electric heating
 - Heat pump
 - Bio Diesel; EURO 6 Range extender
- 40 / 80kWh Battery package: Altairnano
- Option: Range extender EURO 6

ZAaxle: Axle Drive Modul



ZAwheel: Layout – drivetrain module

Designations and assemblies



ZAwheel: Overview wheel hub motor



Main features

Power:	173 kW peak / 113 kW nom.
Torque:	3200 Nm nom. 5900 Nm peak
Voltage:	400 V – 700 V
Current:	max. 500 A
Electronic:	integrated power electronic
Cooling:	Water (Motor & Electronic)
Brake:	Support for disk-brake at rear axle via E-maschine (incl. Recuperation)
Efficiency:	up to 92%
Tire size:	SuperSingle 455/45R22.5
Rim size:	22,5" x 15"
Sensors:	Temperature (for Motor and Electronics), Speed

Wheel hub motor:

Application:	City Bus EV full electrical HEV serial Hybrid
Solobus:	Rear Axle
Artic.-bus:	Mid-, Rear Axle
Propulsion:	Gearless Singlewheel Direct Drive

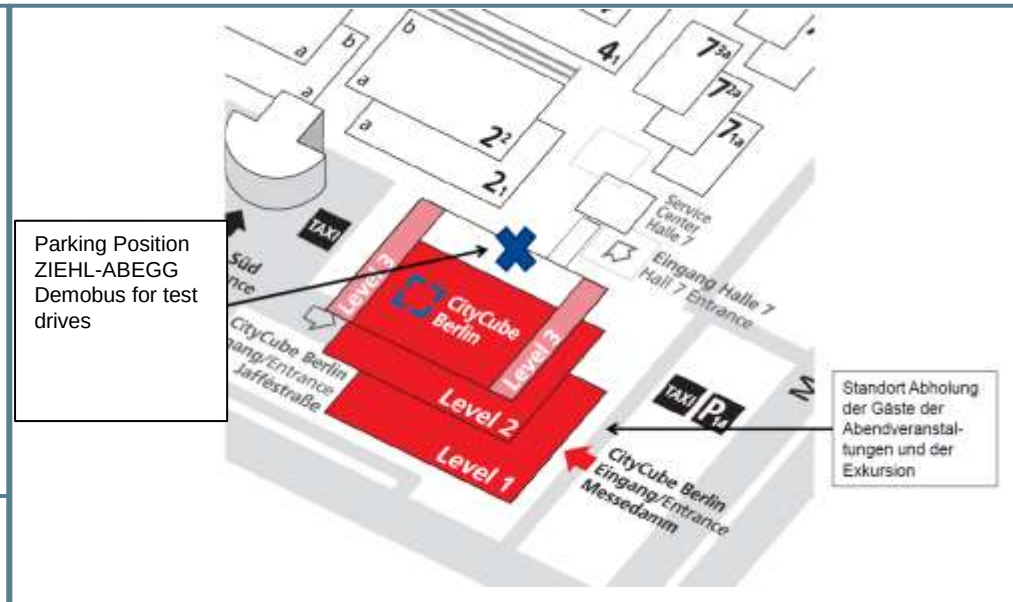
Summary & Outview

1. Several European cities have done the decision for emission-free public transport. Implementation phase about 2020 - 2025. (No turn back ...)
2. The transmission of the fleet from Diesel into E-buses will start 2017 / 18.
3. The transmission of the fleet will be done with new and retrofitted vehicles
4. Hybrid technology for city busses will be only a bridge technology
5. Umeå & **ZA**wheel :
 - **ZA**wheel operates under worst environmental conditions reliable
 - Vehicle availability > 95%
 - Low maintenance efforts for the drive-train **ZA**wheel
 - Lowest energy consumption of the drive-train **ZA**wheel
 - Extrem positive feedback about low noise + air pollution from inhabitants
 - Electrification will be continued in Umeå

Welcome to a test drive with **ZA**wheel!



Application: Full elektrischer bus
 Manufacturer: VDL Bus & Coach
 Vehicle type: Retrofit
 City Solobus
 12 m / 2.55m / 3.30m
 Seats 29 + 2
 Standings 37
 Charging: On-Board 400V / 63A



ZIEHL-ABEGG on the Metropolis Solution:
 City Cube
 Hall B
 Stand B34



Thank you and see you again at ZIEHL-ABEGG