



# E-troFit

sustainable solution  
empowering e-mobility

**The future of E-mobility and Urban Planning in Egypt**  
EV Developments in the context of Sustainable Cities



## Mother company in-tech at a glance

### Who we are

**Solution provider for digitalization  
in mobility and industry.**



Automotive



Smart Mobility



Smart Factory



Electrified



**Germany:** Munich/Garching, Ingolstadt, Leipzig, Wolfsburg, Brunswick, Renningen, Weissach-Flacht, Kirchheim-Nabern, Friedrichshafen

**USA:** Greenville (SC), Woodcliff Lake (NJ), New Jersey (NJ)

**Mexico:** San Luis Potosí

**China:** Shenyang, Beijing

**Europe:** Vienna (Austria), Nottingham (UK), Warwick (UK), Braşov (Romania), Prague (Czech Republic)



**1500** Staff members



**17+** Project locations



**8** Countries



**108 Mio.€** Revenue  
(2018)

in-tech is a **German-based engineering company focusing on electronics and software**.  
Within just a few years, **in-tech has developed into a successful mid-sized company with offices and project locations worldwide**

Being an **expert in validation and testing of automotive components, sub-systems and full-systems**, **e-troFit buys this service from in-tech** and benefits greatly for the product development

It is always possible for e-troFit to obtain **additional R&D and administration services to enable scalability**

## in-tech Group

The parent company offers access to a large expert pool in the automotive sector and sales cooperation worldwide

## Root

**Political pressure for zero-emission traffic creates a high demand for electric utility vehicles.**

**Emission problems especially in metropolitan regions:**

- ✔ Nitrogen oxides (NO<sub>x</sub>) values often exceeded
- ✔ Diesel driving bans in inner cities

**EU sets Clean Vehicles Directive:**

- ✔ Complete decarbonization of road transport by 2050
- ✔ Forces operators to electrify their fleets

**-15%**  
emissions  
by 2025

**-30%**  
emissions  
by 2030

**-100%**  
emissions  
by 2050



## Cause

**OEMs cannot meet market demand.**

**Low quantities available:** Only a few hundred electric buses available per year

**Long delivery times:** Current delivery times are at least 18 months

**High costs:** New electric commercial vehicles are expensive

“ Not enough electric buses for clean air in NRW cities ”

“ Switch to e-buses in Osnabrück is delayed ”

“ Ordered e-bus for Trier does not come after all ”

“ Evobus experienced troubled quarter – Fire stops production ”

## Consequence



## Gap of Electrification

Vehicle **operators** face driving bans or penalties if they cannot buy new electric vehicles or electrify existing ones.

Vehicle **manufacturers** lose their market position if they cannot offer new, reasonably priced electric vehicles.

## Gap of Electrification

The CV market is challenged by high demand for electrification and low supply

## Facts about the global urban bus market

According to the International Association of Public Transport (UITP), **buses are the most widely-used form of public transport worldwide** – with a **63% share**, it was a higher sum of all other modes (metro, tram and suburban rail) combined in **2015**

**Buses are a primary target for reducing emissions in cities.**

In some cities, buses account for 2% of vehicles in inner city traffic, while causing up to 30% of emissions.



**Urban electric buses** constitute the **fastest-growing part of the EV market** with a **CAGR of more than 100% since 2013**

Sources: ACEA; UITP; McKinsey; European Commission

## Global demand of electric urban buses

Status Quo



All over the world there are about 385.000 electric buses, which means **13% of the global bus fleet**.

Forecast 2040



The demand for electric buses rises rapidly: Until 2040 **80% of all global urban buses** are estimated to be electrified, which means 2,34 millions electric buses worldwide.

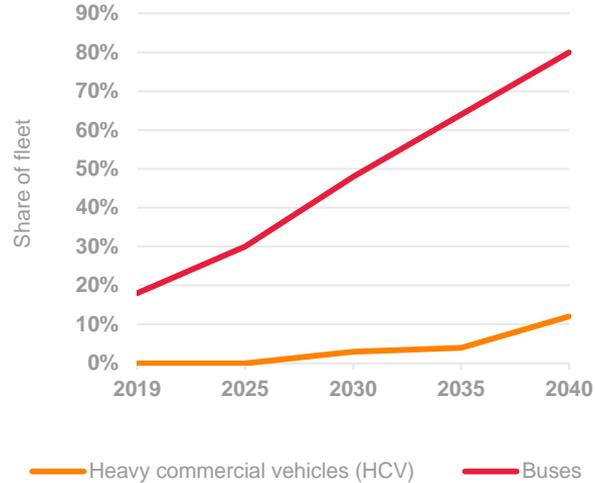
Sources: ZeEUS; Bloomberg New Energy Finance

## Urban Bus Market in Detail

Especially urban buses are in the focus of the electrification discussion

## Rate of electrification for different vehicle types

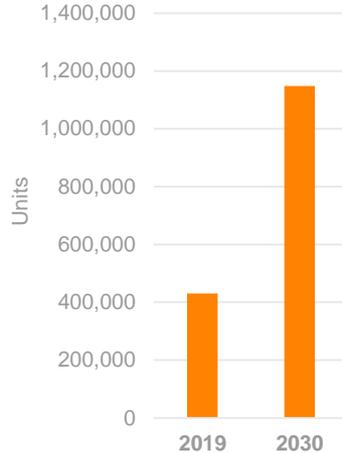
### EV share of global vehicle fleet by segment



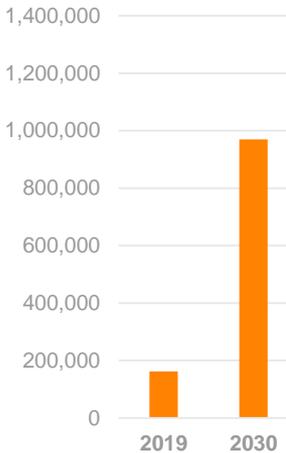
Source: BloombergNEF. Note: Commercial vehicle adoption figures include the main markets of China, Europe and the U.S.

## Forecast: Global fleet of electric buses and heavy commercial vehicles

### Electric buses worldwide



### Electric trucks (HCV) worldwide

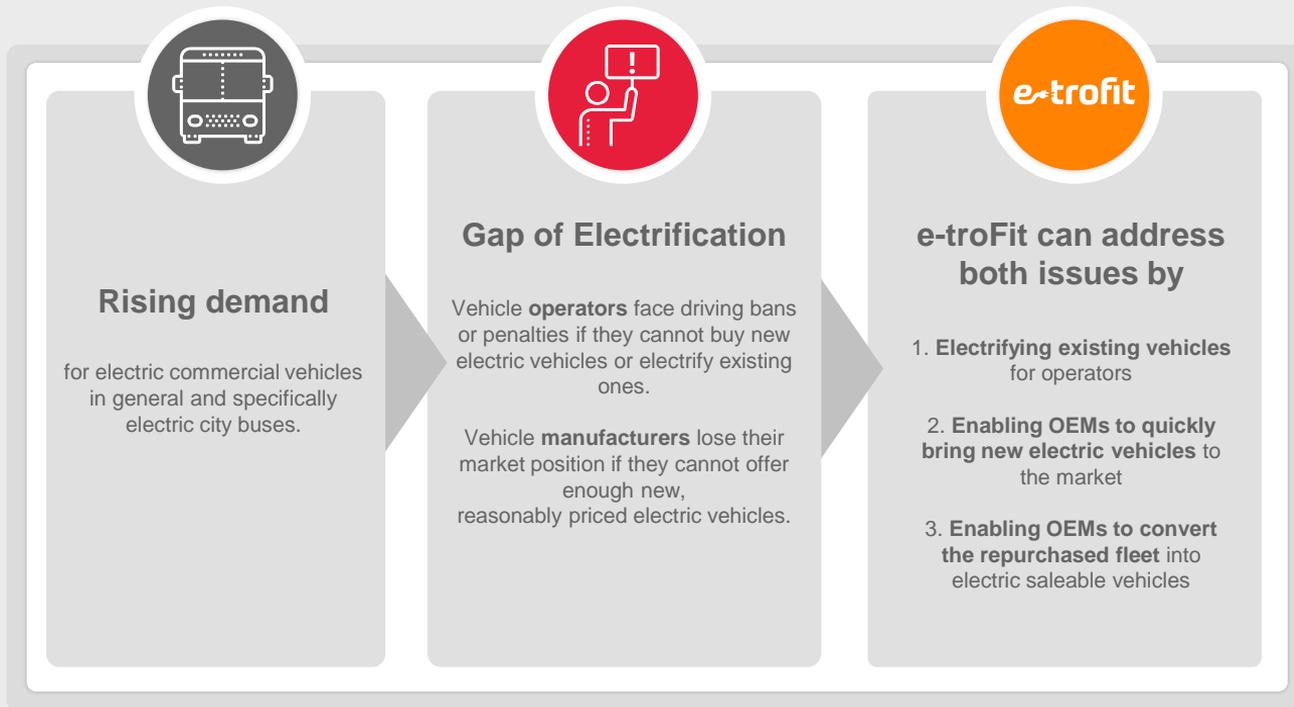


Source: e-trofit analysis with data from BloombergNEF, OICA, ACEA, KBA, Focus

In terms of total volume, the HCV market is the much larger market than the bus market. Electrification of buses is already well underway today with almost 50% EV share of the global fleet in 2030. Electrification of trucks is set to accelerate in the late 2020s with almost 5% EV share of the global fleet in 2030. Based on market know-how, we estimate that German bus manufacturers can only produce low three-digit volumes in 2020. Therefore, the strategy is to focus on the bus market first.

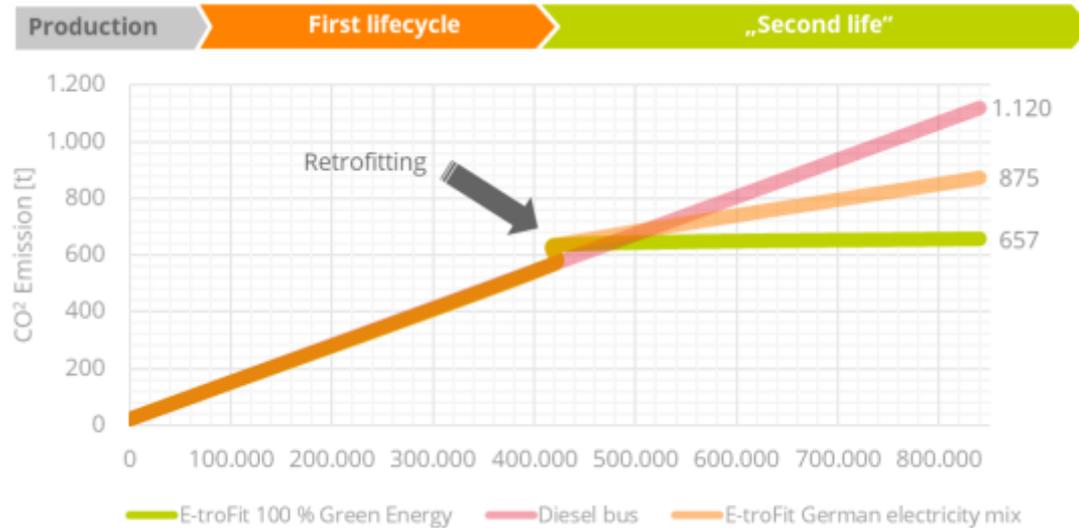
## Market Dynamics

The electrification of CVs is therefore a fast-growing and sustainable market



## e-troFit

e-troFit as a solution for the demand-and-supply dilemma in the CV market

CO<sub>2</sub> lifecycle comparison

Retrofitting makes a diesel bus a clearly **climate-friendly vehicle**

This is particularly noticeable when operating the e-troFit bus with 100% green energy

This results in a **CO<sub>2</sub> saving of almost 75% over the lifetime compared to a diesel bus.**

Even when operating the e-troFit bus with the **current German electricity mix, CO<sub>2</sub> savings of almost 35% are achieved**

The usage of the **bus battery in stationary operation** means that the e-troFit **can continue to be used even after the "second life" phase**, making it even more environmentally friendly

kg CO <sub>2</sub> / km	
0,053	Green energy
0,572	German electricity mix
1,309	Diesel

## CO<sub>2</sub> Emission of the e-troFit

The e-troFit has a lower CO<sub>2</sub> emission than a diesel bus over the whole lifecycle

e-troFit consists of an **electric axle or electric central motor**, **scalable battery system including battery management system (BMS)** and **battery cooling**, **various auxiliary units**, **air conditioning system** and the **Vehicle Control Unit (VCU)**.

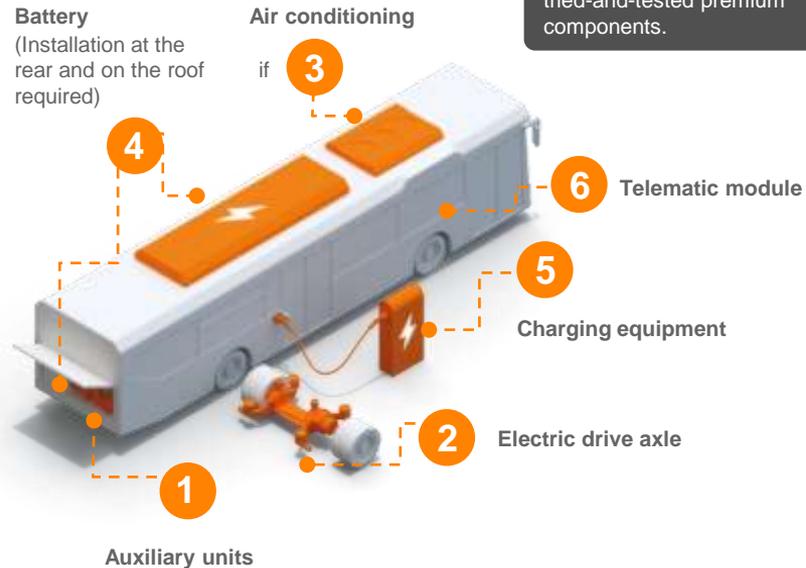
As the **central IP** of e-troFit, the **in-house developed VCU** connects all vehicle components, resulting in a perfectly balanced system which applies to **functional safety ISO 26262**.

**On-board charging unit** is used from e-troFit's sister company smart charging GmbH, which is a market leader for communication modules in DC charging Stations in Europe (80% Market share).

The e-troFit Kit already allows **fast charging** (up to 150 kW) by plug today while **high power charging solution (HPC)** via pantograph will be developed in 2020.

**Easily adaptable charging strategy** due to multiple cells chemicals without adjustment on the battery pack itself. The construction and development of battery packs is made for multiple battery cell chemicals (for example: NMC, LTO, LFP).

Every e-troFit Kit contains a **Telematic module** from Openmatics (a ZF company) enabling **Over the air updates (OTA)**, **Predictive maintenance**, **Full battery surveillance** (State of Health, State of Charge) and **Connectivity to the customers' in-house fleet management**



## Technical Approach: Example Urban Buses

The e-troFit combines own intellectual property (IP) with premium components

## Partnership with ZF

ZF believes in the product e-troFit and sees a strong market demand for it

ZF is:

- ✔ a strong and reliable brand
- ✔ an expert in helping to scale and industrialize products globally
- ✔ a market leader on power train for busses

ZF is a service partner, sales partner and preferred (not exclusive) supplier for e-troFit

Through this partnership, e-troFit has access to ZF's global end customer sales network, workshop and supplier network in 120 locations in 40 countries and 650 service partners



## e-troFit and ZF Friedrichshafen

The world's 3rd largest automotive supplier is e-troFit's strategic partner

## e-troFit stands for sustainable mobility

e-troFit GmbH is certified according to ISO DIN 9001 and works according to the highest quality standards.

e-troFit® was awarded the **German Mobility Prize 2018**. The Federal Ministry of Transport honors groundbreaking best practice projects for sustainability in transport.



Furthermore the e-troFit® concept was awarded with the **International busplaner Sustainability Award 2019** in the category Service and Parts by the trade journal busplaner.





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**Thank you!**