



Engineered for the Future
CFT – Concept Fire Truck

A3PS ECO-MOBILITY 2019

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 **rosenbauer**



Rosenbauer

Key Figures



153 years of experience

900 mio. EUR turnover

22 locations worldwide

3.600 employees

20% world market share

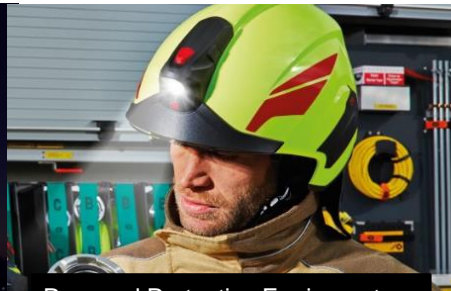
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Each minute a Rosenbauer fire truck starts an emergency response somewhere in the world!

Product Portfolio



ARFF



Personal Protective Equipment



Municipal Fire Trucks (EN)



Technical Equipment

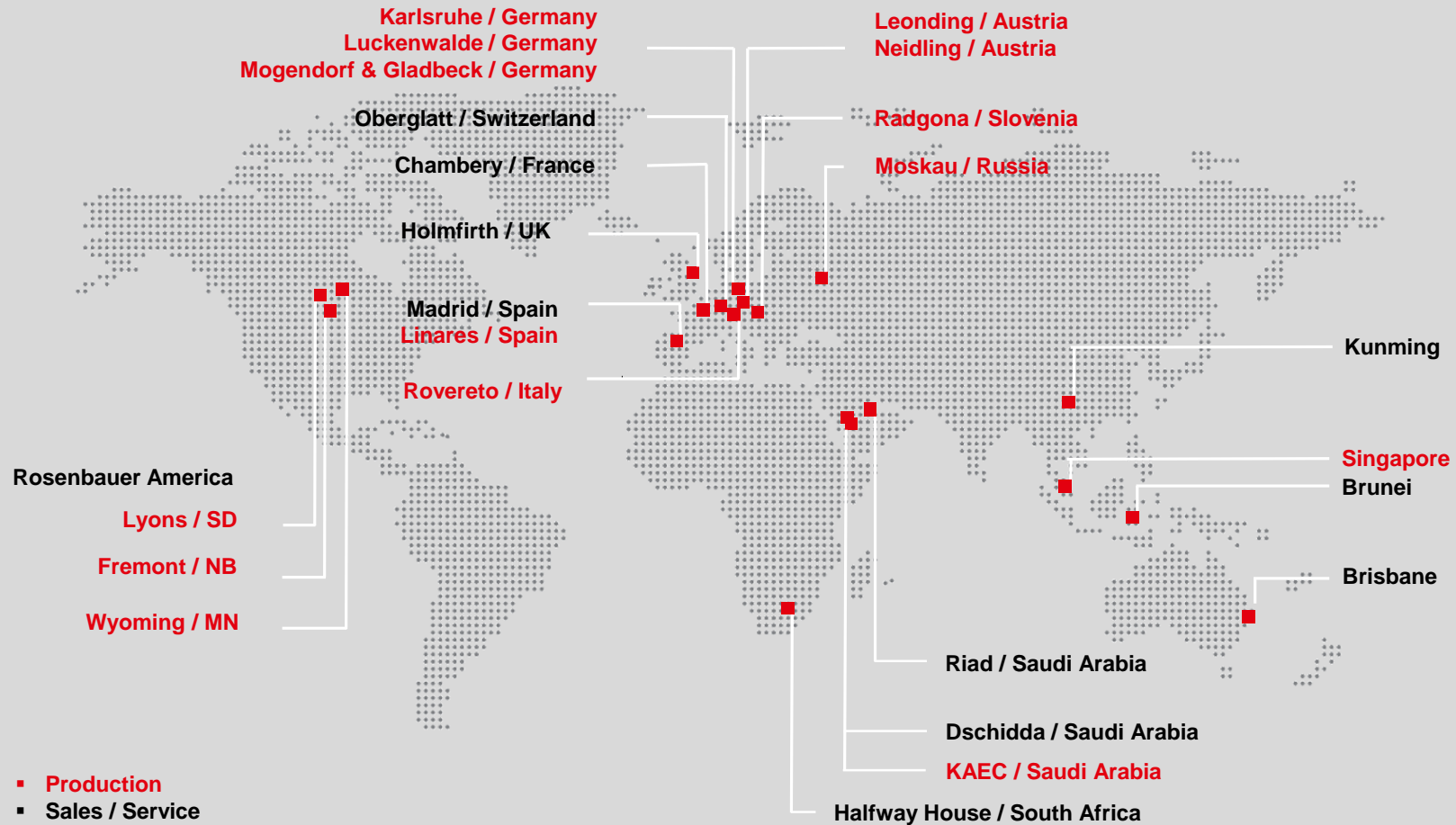


Aerial Ladders and Platforms



US Fire Trucks

Global Footprint





Megatrends

- The firefighting megatrends are based on the megatrends of the German Zukunftsinstitut (<https://www.zukunftsinstitut.de/dossier/megatrends/>). Since 2012 they were continuously developed with international fire fighting experts in so called „Future Dialogues“.
- Currently there are 13 trends as migration was included during 2017. These trends are relevant for the future picture of fire fighting and were the base for the concept study of the firetruck of the future – the CFT.
- You find more explanations for each trend in the Rosenbauer Blog <https://www.rosenbauer.com/blog/en/cat/innovation-en/>

Fire Fighting Trendmap 3.0



Relevant Firefighting Trend Clusters

Silver Society / Gender Shift



Safety / Health



Mobility / Neo Ecology



Urbanization



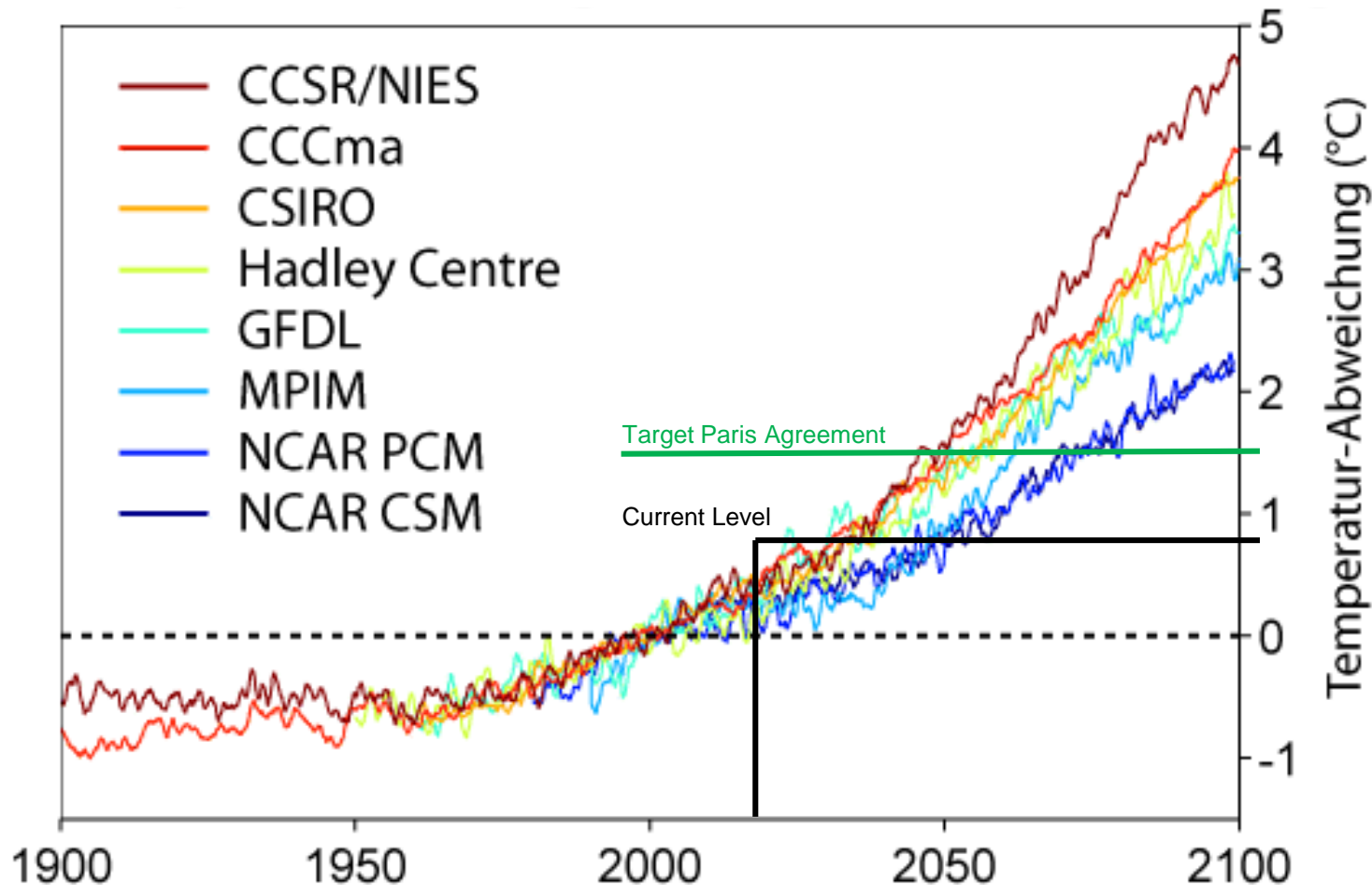
Connectivity



Individualization



Projections for global warming



Climate Change predictions vary between +2 and +5°C (+35 to +41°F). This process is not reversible anymore. The Paris agreement tries to freeze the global warming at a level below +2°C with a target of +1.5°C. Latest results show that the increase in temperature has already reached almost +1°C.

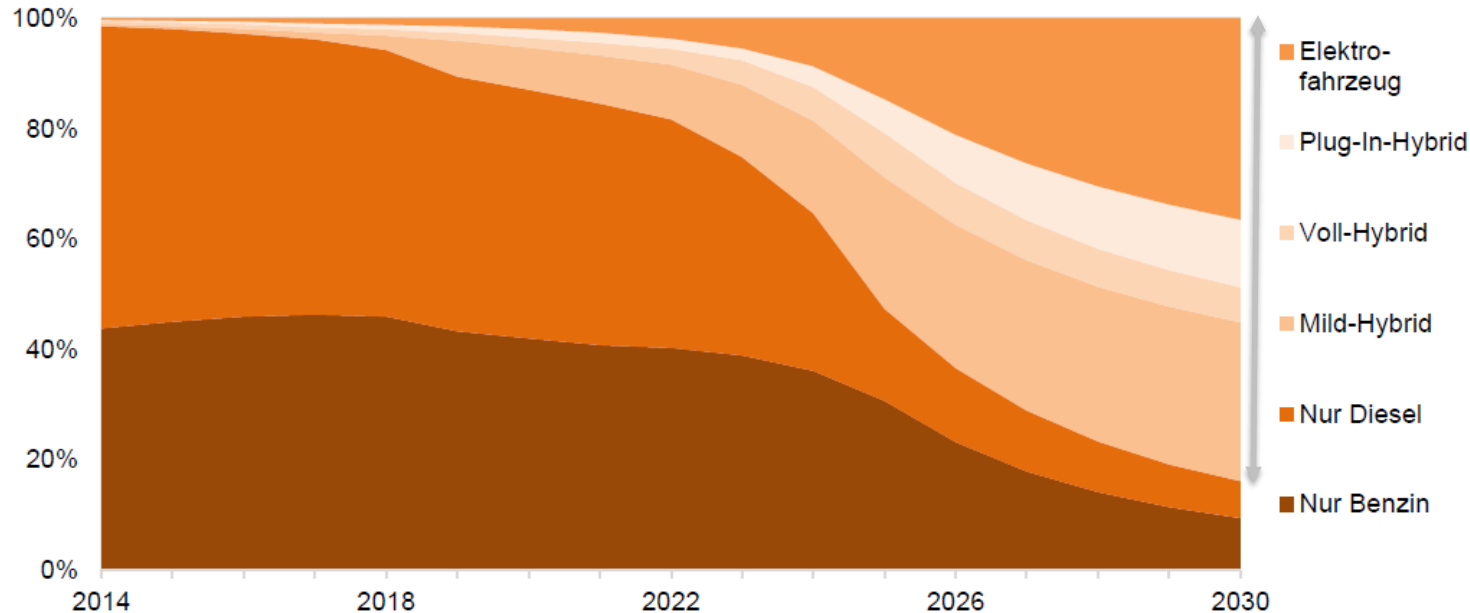
Trend Cluster Mobility/New Ecology

E-Mobility in Europe

Abb. 3 EU: proportion of drive train technologies of newly sold passenger cars and smaller trucks

Abb. 3 EU: Anteil der Antriebstechnologien an den Neuzulassungen von Pkw und leichten Nutzfahrzeugen (detailliert)

2014 – 2030 Europe – development of electric vehicles purchases



Climate Change and the Paris agreement will lead to a strong increase of electrified vehicles. In 2025 the so called tipping point is expected. From this point onwards more vehicles with electrified propulsion systems will be sold than with conventional drive trains.

Quelle: PwC Autofacts Analyse Source: PwC Autofacts

Trend Cluster Mobility/New Ecology

CO₂ - Life-Cycle Emissionen of Electric Vehicles

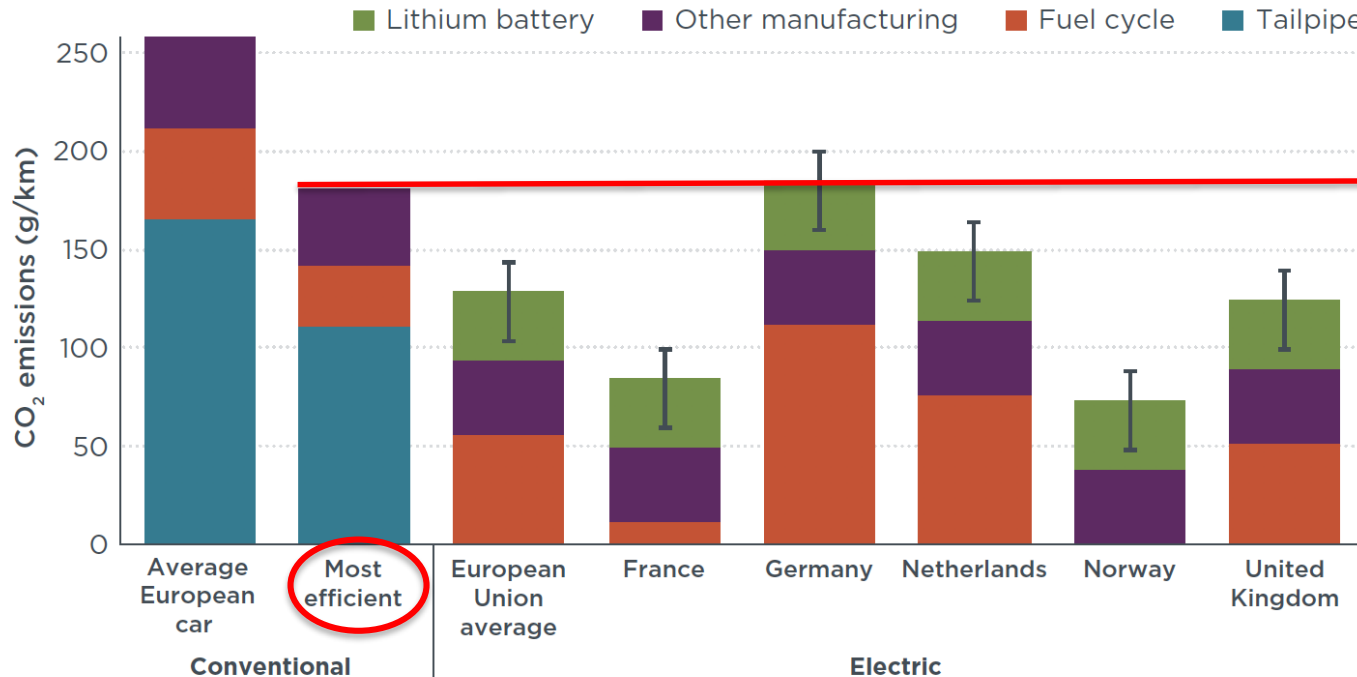


Figure 1. Life-cycle emissions (over 150,000 km) of electric and conventional vehicles in Europe in 2015.

According to an analysis from ICCT (International Council on Clean Transportation) in Europe an electric vehicle reaches a reduction of CO₂ of about 30% compared to a vehicle with highest efficient combustion engine.

Even in Germany which has a high CO₂ energy mix due to coal power plants an electric vehicle is CO₂ neutral after 3 years compared to vehicle with an average efficient combustion engine.

Source: ICCT (International Council on Clean Transportation)
<https://www.theicct.org/publications/EV-battery-manufacturing-emissions>

C40 Cities



<http://www.c40.org/cities>

C40 Cities – Global Leadership on Climate Change

Steering Committee:

LA, Boston, Mexico City, London, Paris, Milan, Copenhagen, Dubai, Durban, Seoul, Hong Kong

Innovator Cities:

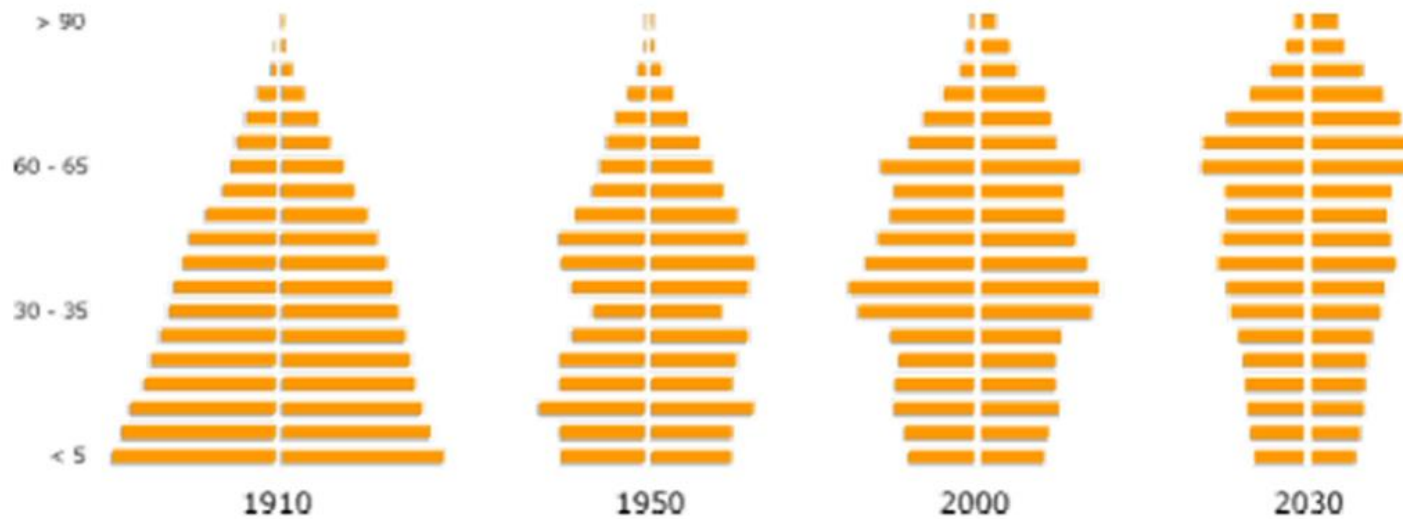
Seattle, Portland, Austin, New Orleans, Quito, Oslo, Stockholm, Amsterdam, Rotterdam, Heidelberg, Basel, Venice, Changwon, Auckland

Observer Cities:

Beijing, Shanghai, Singapore

More and more bigger cities are starting to fight against the CO₂ driven climate change. Modern Cities are powerful economic and political ecosystems being more flexible and faster than countries in realizing climate targets.

Trend cluster Silver Society & Gender Shift



Demographic development will significantly influence the availability of firefighters. Currently big fire brigades have already difficulties to recruit enough young people.

Demographic Development in Germany

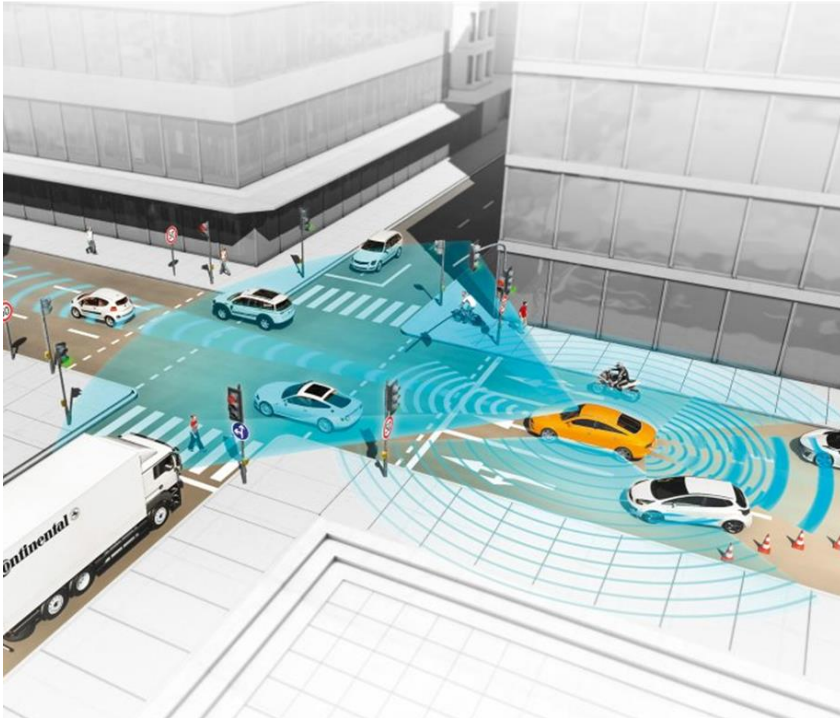
Trend Urbanization



As traffic density will further increase significantly it will be essential for firetrucks to have compact dimensions, high agility and excellent navigation tools!

By 2030 traffic levels will increase by 100%

Trends Mobility and Connectivity



Autonomous Vehicles

V2V (vehicle to vehicle) and V2X (vehicle to other things) communication is constantly increasing. For emergency vehicles it will be essential to participate in a smart way in this communication pattern to be able to influence traffic behaviour.

IOT

Internet of Things is one of the major trends. Since communication technologies have reached new levels as more than 8 bill. things are already connected. This number will more than double during the next two years! Interpretation of information and data security will be decisive for successful applications.





Concept Fire Truck

IAA 2018 - Concepts



New Concepts lead in direction 2030 showing modular systems, hydrogen as energy carrier and autonomous vehicles.

IAA 2018 - Reality



Electrified concepts have arrived in reality already and are state of the art for busses. Pre-series vehicles are tested on the roads of big and modern cities like Hamburg.

Latest News (2019)



Mack Garbage Truck based on Volvo Components



Full electric Freightliner eCascadia



Hyundai FC Truck

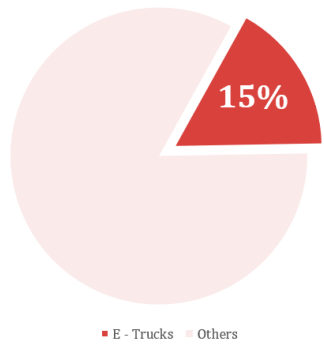


Toyota and Kenworth with FC Technology

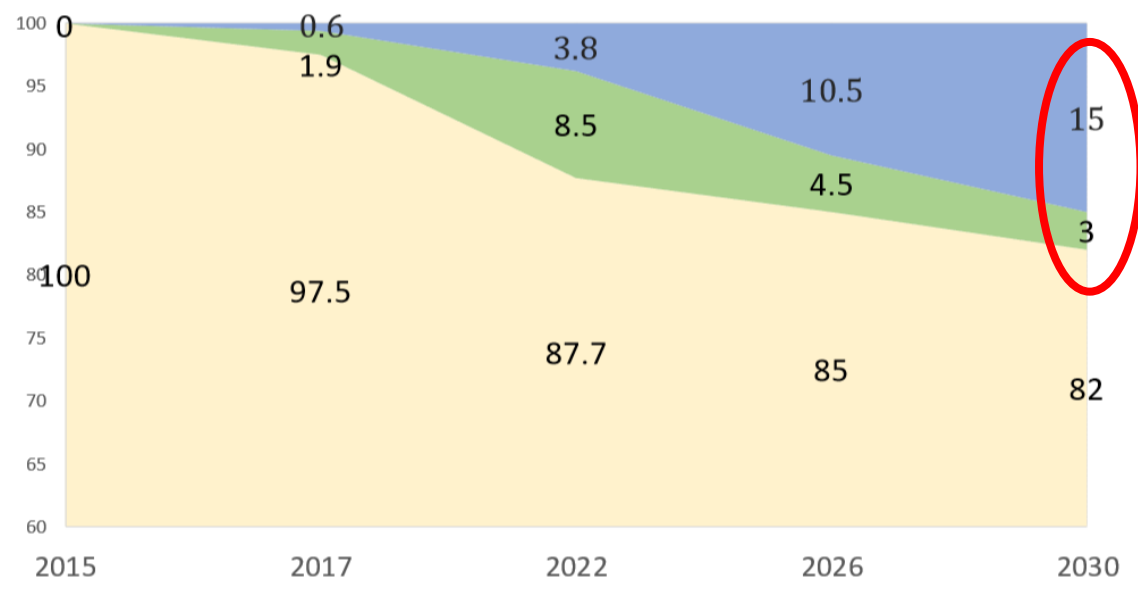
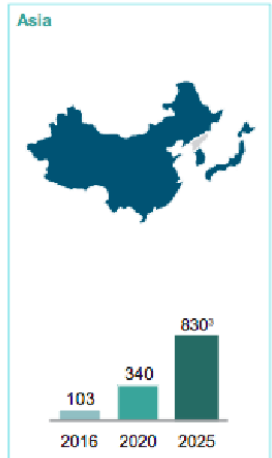
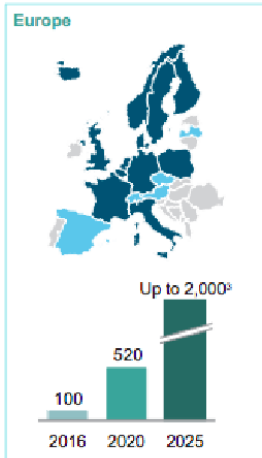
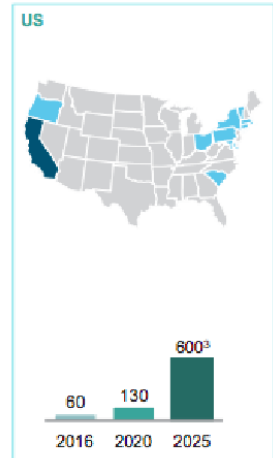
Trucks – Future Trend

- E-Truck sales ≈15% until 2030
- LDTs ≈25-35% of the sales across Europe and China

Global Truck Sales 2030



Source: McKinsey, 2017
LDT = Light Duty Truck



Source: JKU 2018

ICE Natural Gas HEV/BEV

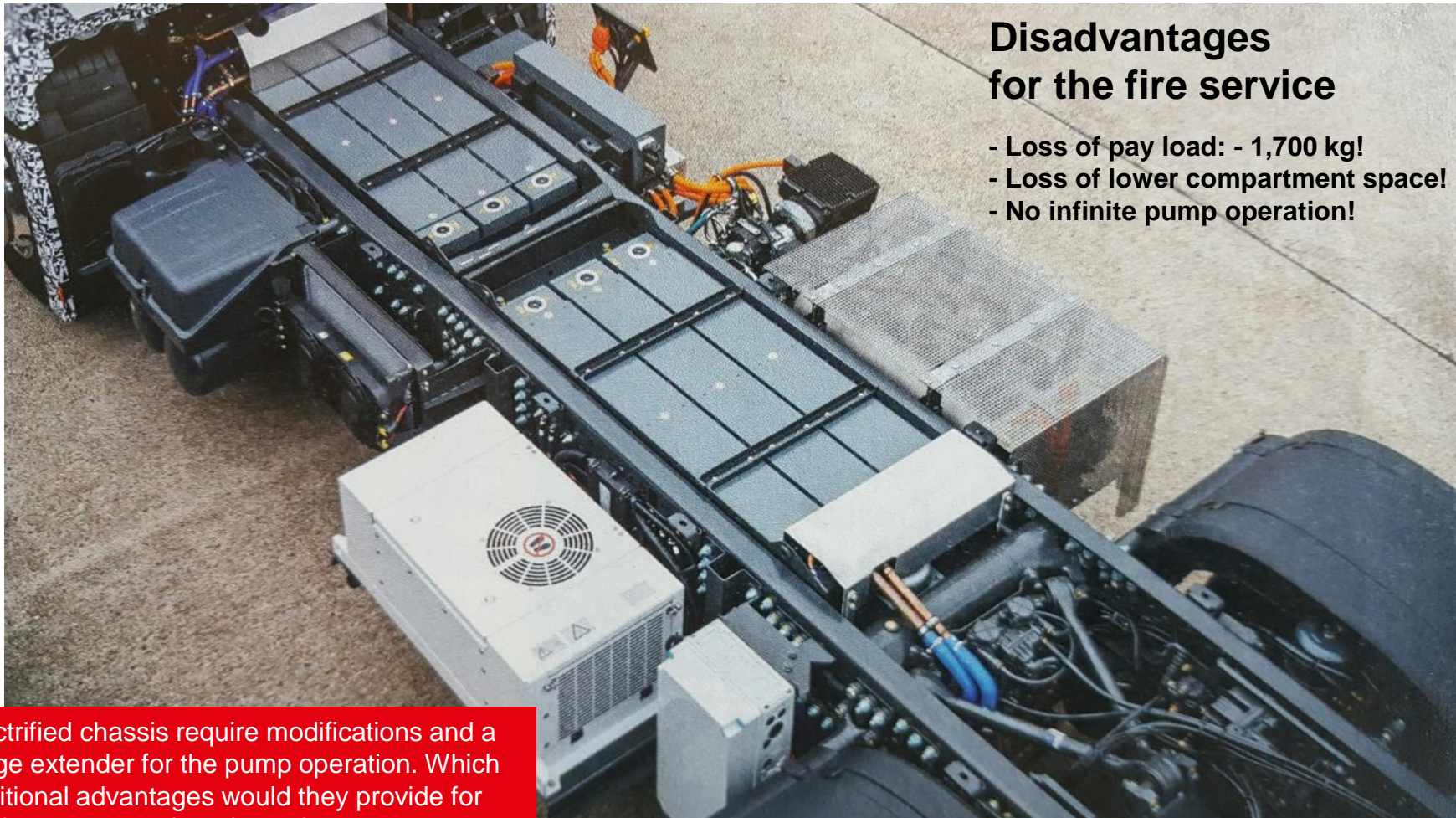
Investment in H2 Infrastructure until 2025

(No. of filling stations)
Source: Hydrogen Council 2017

JKU Study Projection for Trucks > 7t

Additionally, there is a strong believe, that for longer distances and heavier vehicles **Hydrogen** will be the future concept (starting from 2025)

Disadvantages for Fire Trucks



Disadvantages for the fire service

- Loss of pay load: - 1,700 kg!
- Loss of lower compartment space!
- No infinite pump operation!

Electrified chassis require modifications and a range extender for the pump operation. Which additional advantages would they provide for the fire brigades of the future?

CFT – Concept Fire Truck

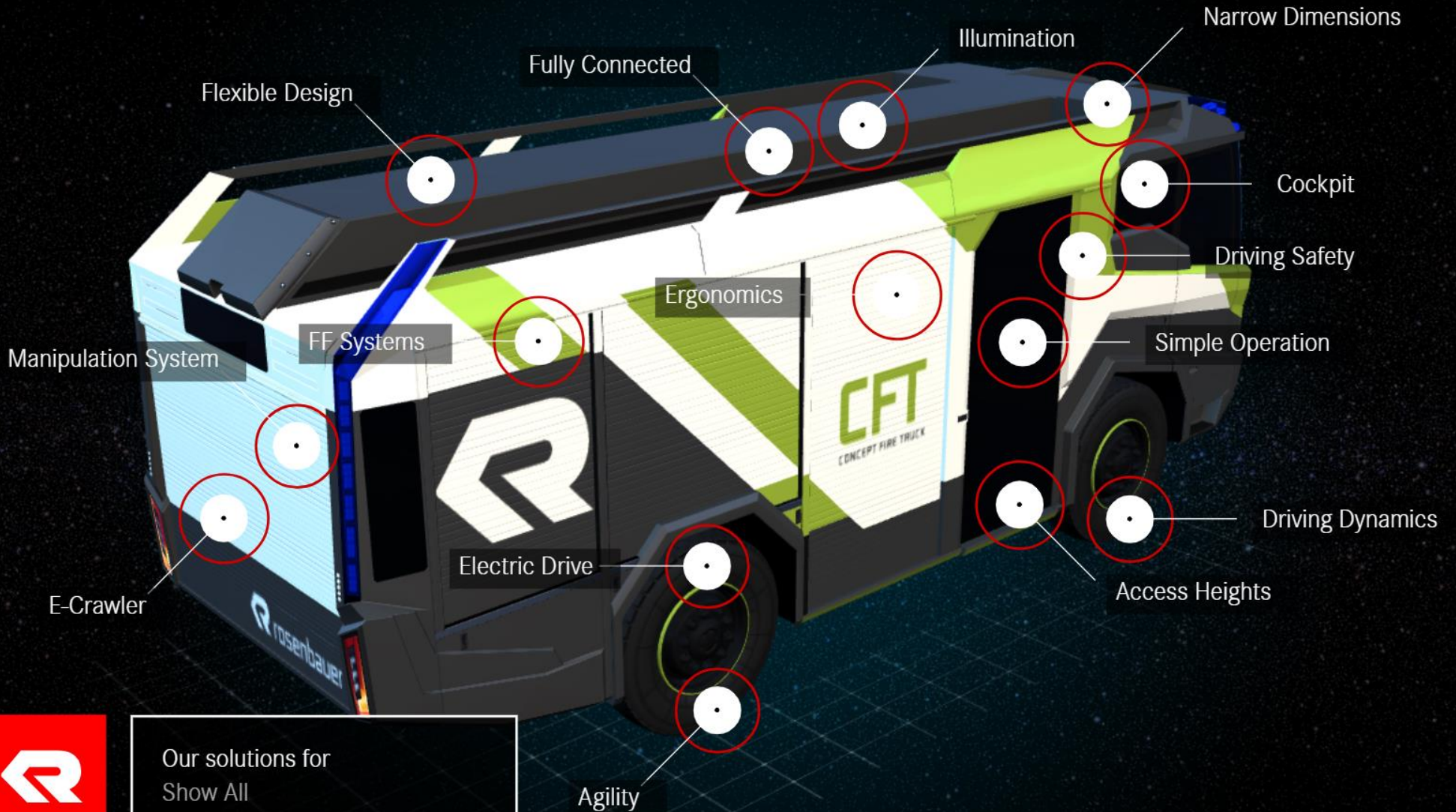


- Mobility
- Individualization
- Silver Society
- Gender Shift
- Connectivity
- Health
- Safety
- New Ecology
- Knowledge Culture
- Globalization
- Urbanization
- New Work
- Migration

- Outstanding Ergonomics
- Higher loading volume
- Agility & driving performance
- Improved communication
- Highest vehicle safety
- Environmental friendly

Only the implementation of electric drives enabled the development of **a vehicle architecture without any compromises** considering all future requirements of fire brigades by providing functional excellence, outstanding ergonomics and highest safety levels.

Functional Excellence



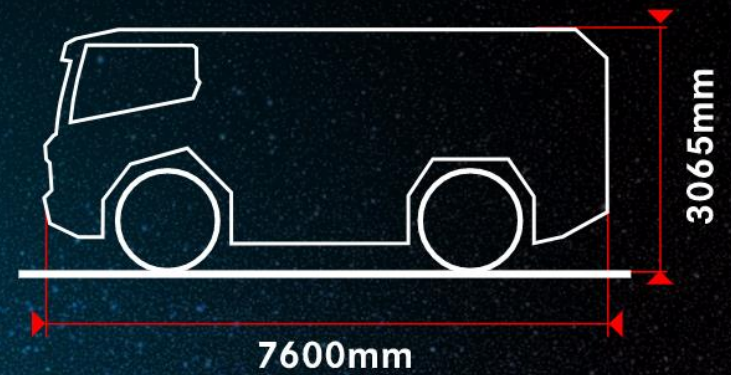
Our solutions for
Show All



Kompakte Abmessungen



Narrow dimensions

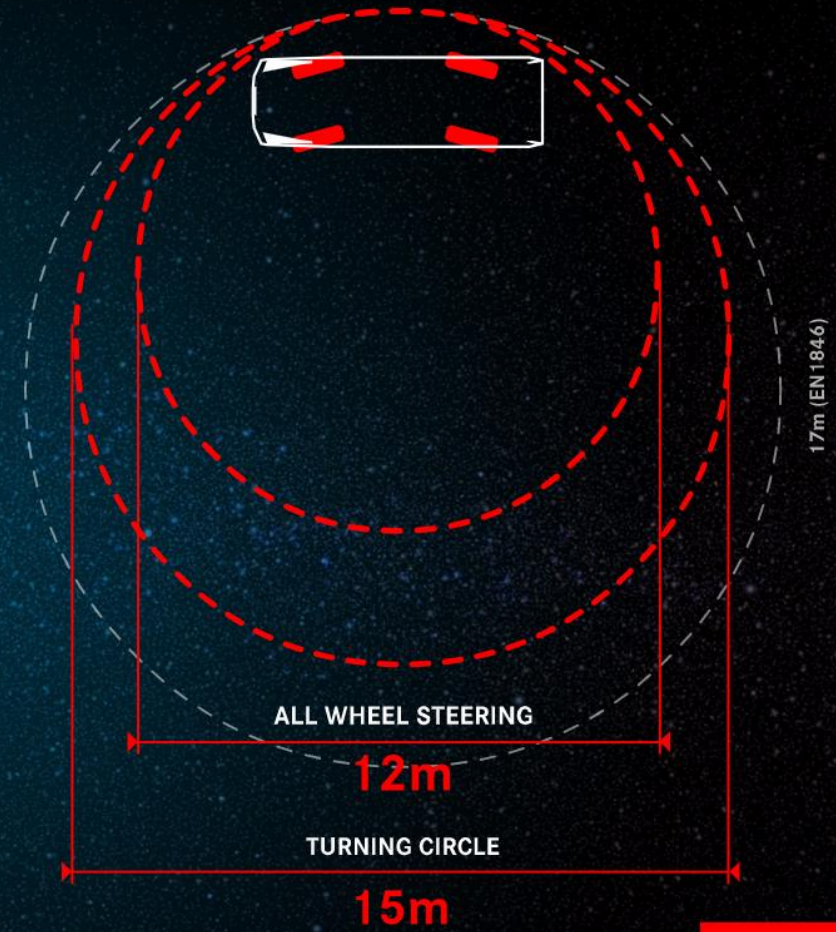


NARROW SLIDING DOORS
150mm



Agility

- Small turning circle
- All wheel steering
- Crab steering

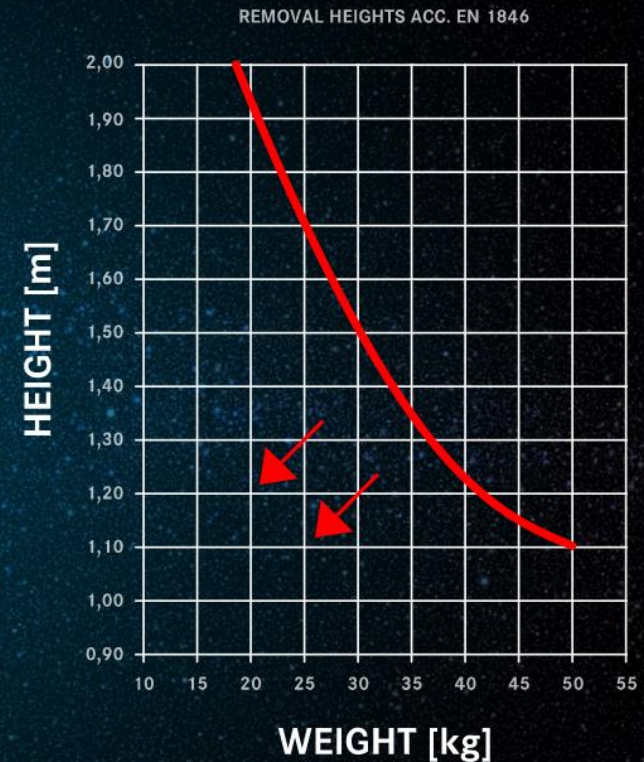


- Kleiner Wendekreis
- Allradantrieb
- Hundegang



Outstanding Ergonomics

- Expected development of removal heights
- All equipment can be reached from the ground
- First attack equipment in the crew cab



- Erwarte Entwicklung der Entnahmehöhen
- Jedes Equipment wird vom Boden aus erreicht
- Erstangriffs-Equipment in der Mannschaftskabine



Optimum Ergonomics



Manipulation System

- Lifting platform at the rear end of the CFT
- Containers with heavy tools to be transported to the place of action
- Easy manipulation system for roof equipment (roof ladder and roof box)



LIFTING CAPACITY

up to 2t

- Hebeplattform im Heck des CFT
- Kontainer mit schwerem Equipment können leicht zum Einsatzort transportiert werden
- Einfaches Manipulations-System für das Dach-Equipment (Leiter und Dachbox)



Manipulation System



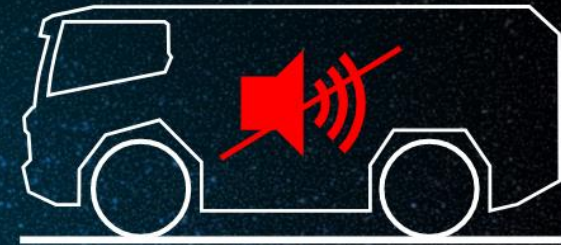
Simple Operation

- Intuitive Touch Screens
- Focus on main functions
- One Button Operation
- Driver Control Panel
- Commander Control Panel
- Main Control Panel serves as Crew Info Screen
- Individual configuration



Electric Drive

- 350 kW/475 hp electrical power ▪
- 30 min electrical operation ▪
- Range Extender for infinite operation ▪
- Zero/low Emissions ▪
- Reduced Noise levels ▪



- 350 kW/475 PS elektrische Leistung ▪
- 30 min elektrische Operation ▪
- Range-Extender für den Endlosbetrieb ▪
- Zero/Low-Emission ▪
- Reduzierte Lärmemissionen ▪

Technology Partnership with Volvo Penta



**VOLVO
PENTA**

- Li-Ion Batteries [60 kWh]
- Electric Motors [180 kW Peak]
- Inverters
- High Voltage Distribution
- E-PTO Options 40, 70 & 110 kW
- System Engineered according to ISO26262
- Same components as used in Volvo Trucks and Busses

Technology Partnership with BMW

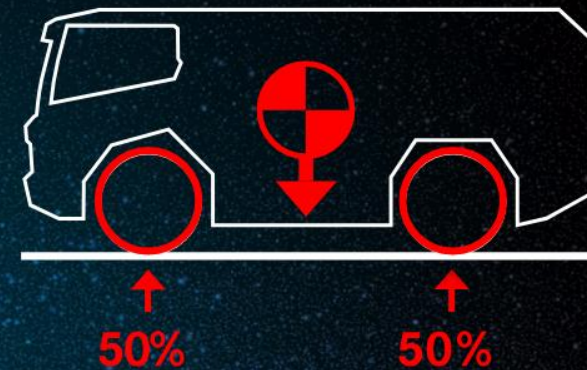


- Range Extender Application
- BMW B57 6 Cylinder Diesel Engine
- 200 kW, 600 Nm



High Driving Dynamics

- High acceleration
- 4 wheel drive
- Low center of gravity
- Optimum load distribution

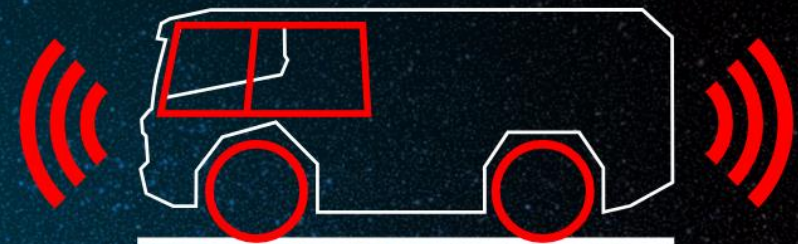


- Hohe Beschleunigung
- Allradantrieb
- Niedriger Schwerpunkt
- Optimale Gewichtsverteilung



Driving Safety

- Safety cell
- Electronic mirror system
- Rear cameras
- ESP in 4x4 drive mode
- Rollover protection
- Driver warning device
- Force feedback system in driver seat



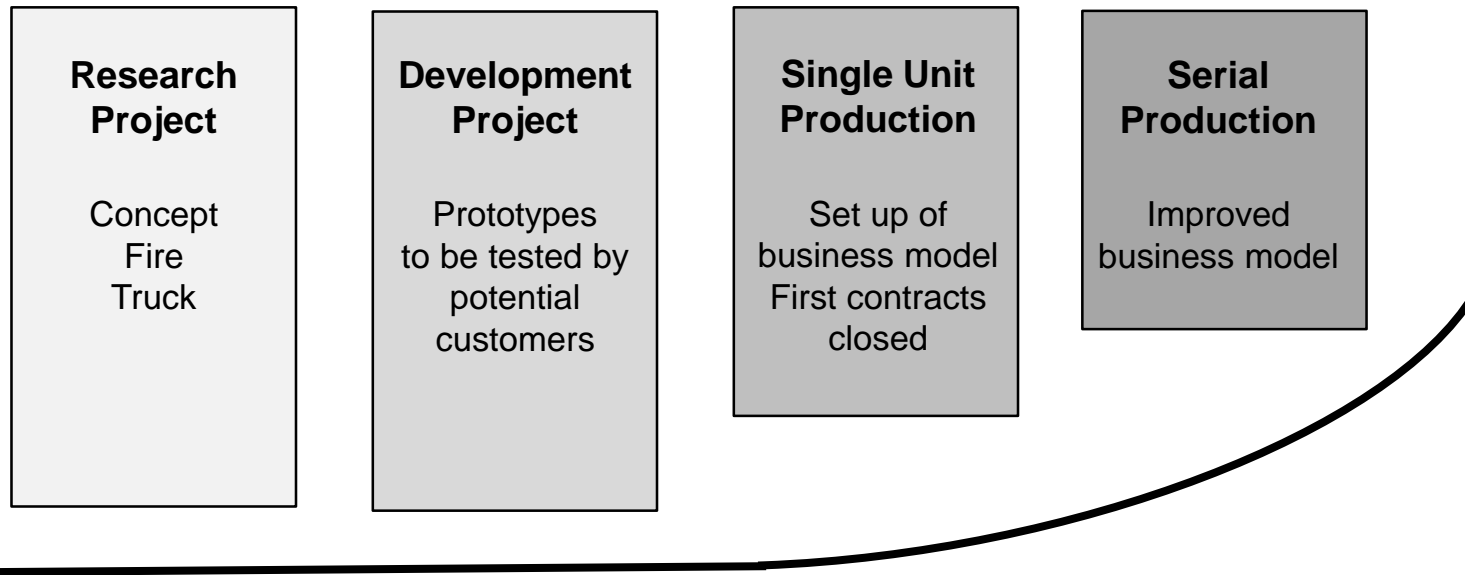
Blind spot detection
Object identification/recognition
Less covered visual field

- Sicherheitszelle
- Spiegeleratzsystem
- Rückfahrkameras
- ESP im Allradmodus
- Rollover Protection
- Driver Warning Device
- Force Feedback System im Fahrersitz



Development Process

Innovation & Development Approach



- 1. Early Involvement of Stake Holders
 - 2. Open Innovation with Model Regions
 - 3. Internal Start Up → **RED**
 - 4. Agile Product Development

1. Early Involvement of Stake Holders

- Future Dialogs with Experts
- Firefighting Trendmap
- Internal Innovation Workshops
- Core team with focus on the initial Concept creation

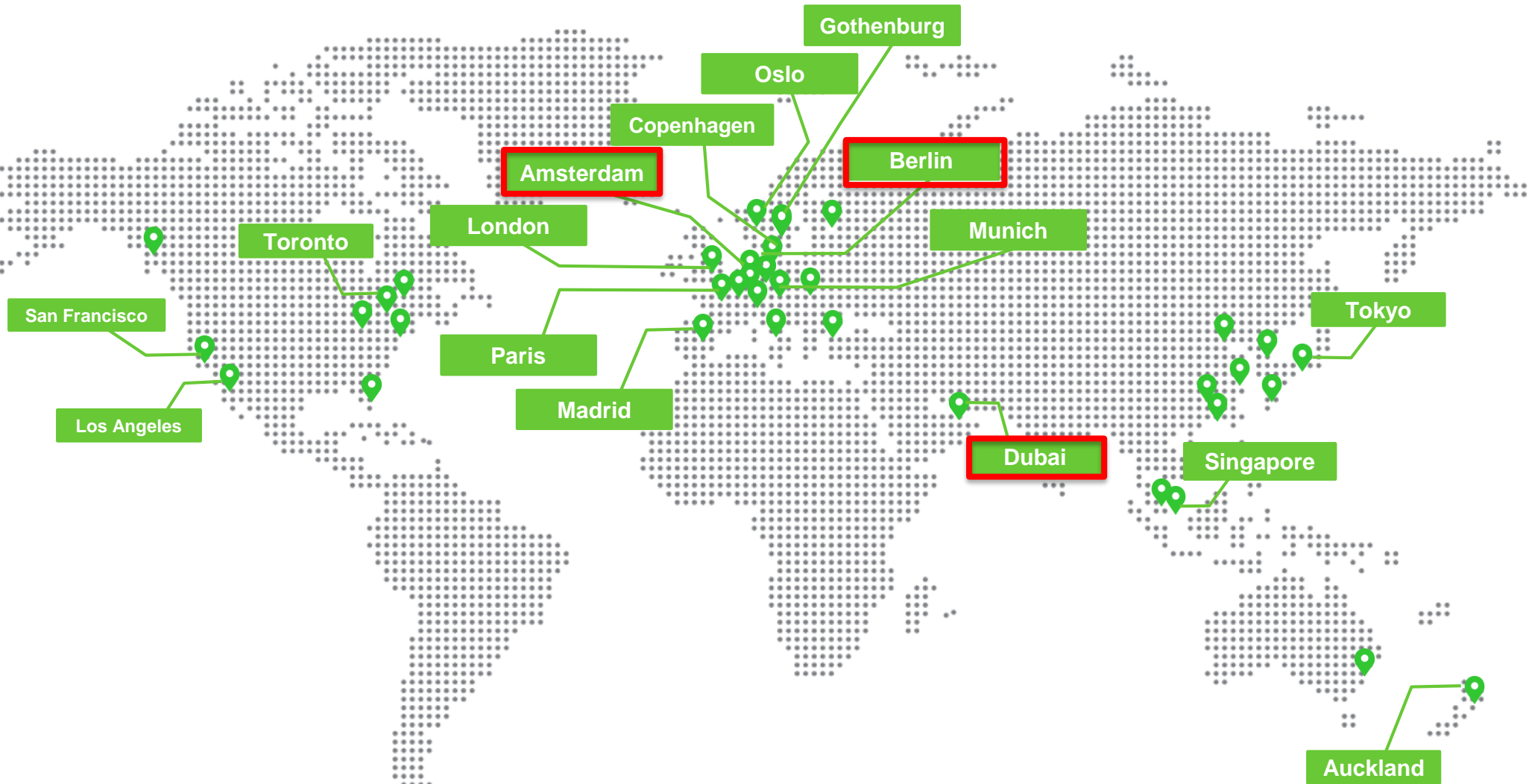


2. Open Innovation with Model regions



- Selection of Model Regions – CFT Affinity Index
- Exclusive Demonstrations and Feedback Sessions
- Innovation Partnerships
- CFT Platform to exchange learnings in all Aspects

World cities with a high CFT affinity



CFT Demo Tours



Innovation Partnership with Berliner Feuerwehr, 15.10.2018



The aim is to implement the 1st pre-series truck and start testing in Berlin in autumn 2020.

The implementation and testing phase will be accomplished by end of 2021.



Representative Photo

Top 5 Firefighting Trends

1. **Health**
2. **Security**
3. **New Ecology**
4. **Mobility**
5. **Urbanization**

Top 5 Functions of the CFT

1. **Driving Safety**
2. **Agility (small turning circles)**
3. **One Button Operation**
4. **Ergonomic and flexible Design**
5. **Driving Performance**

Life Cycle Costs – Value Creation



Direct Value Potentials

based on electric drive and vehicle architecture

- **Less service costs**
- **Less fuel/energy costs**
- **Higher payload and volume**
→ optimized fleet
- **One responsibility**
→ less risks and less administration

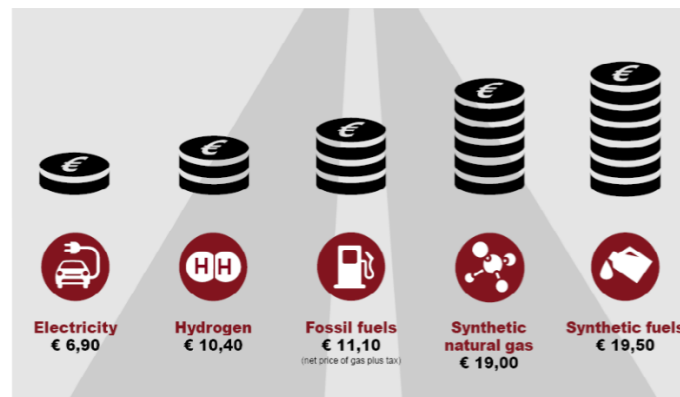


Indirect Value Potentials

Based on ergonomics and functional excellence

- **Less injuries and sickness**
- **Highly efficient crews**
- **Longer service time**
→ less training costs
- **Best and latest technology**
→ efficiency and highly motivated crew

Fuel costs comparison of different powertrains for a distance of 100 km in a mid-range vehicle



Source: PWC 2019

3. RED – an internal Startup

Rosenbauer **E**-Technology **D**evelopment GmbH

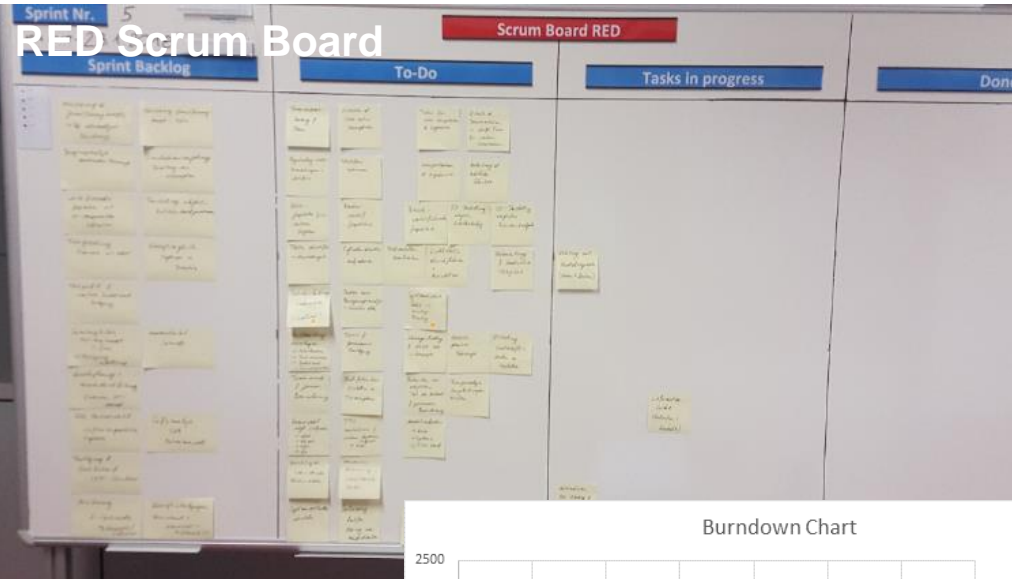
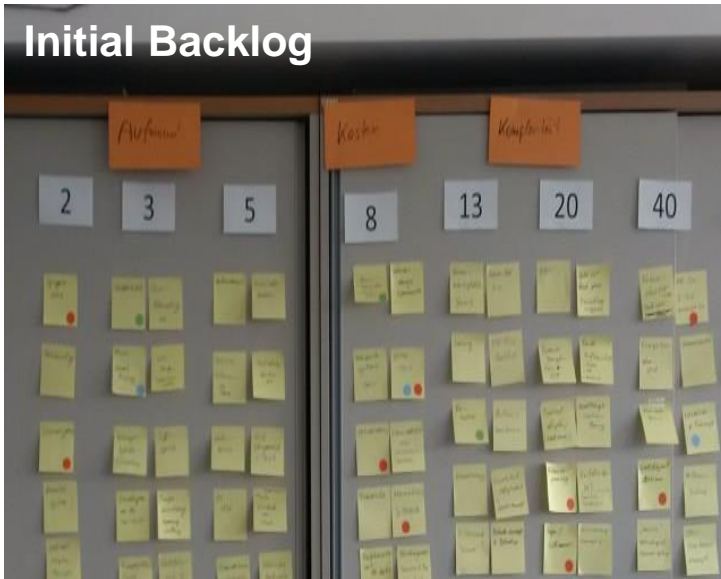
- Independence of slow corporate structures and processes
- Easy options to foster partnerships (e.g. JVs with Start Ups)
- Implementation of agile methodes
- Reduction of risks for the group
- Direct felt responsibility
- Higher transparency



Never go hunting alone!

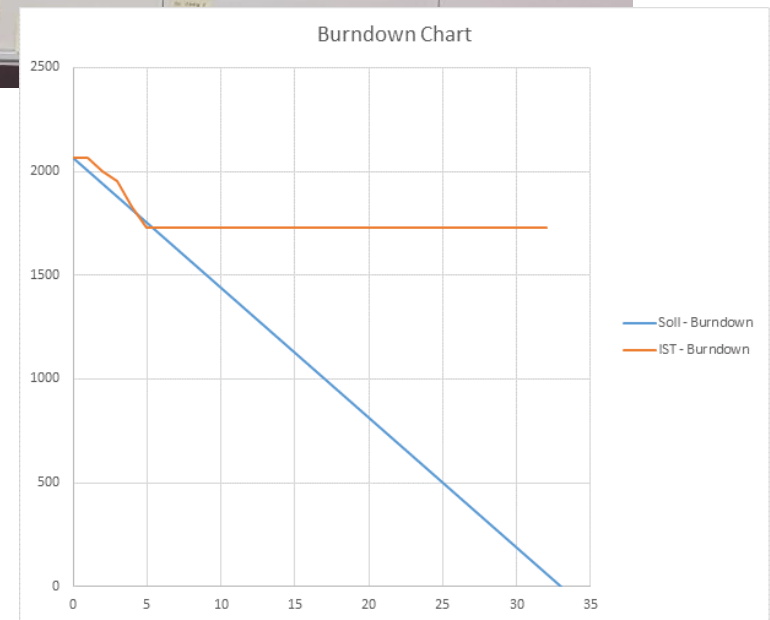
4. Agile Product Development

Initial Backlog



RED Scrum Process

- 3 CSMs – Michael, Edmund, Josef
- Product Owner(s) – Split roles Michael/Edmund
- Scrum Master – Josef
- Dev Team – Josef, Ronald, Stefan, Gregor, Simon, (+ Edmund)
- Agile Backlog planning (= Refinement)
- 4 weeks sprints (70 storypoints/sprint)
- 3-4 hrs Sprint Review
- (0,5 hrs Retrospective)
- 2 hrs Sprint Planning
- 20 min daily Scrum



CFT – a concept study for the near future!



We did not just use an existing chassis and develop the body around it...

... we developed an innovative emergency vehicle, answering the functional demands of tomorrow's emergency task forces.

A concept study for the near future!

CFT – a concept study for the near future!



You find further information about the CFT and the model regions on the Rosenbauer Website:

<https://innovation.rosenbauer.com/de/concept-fire-truck/>

in the Rosenbauer Blog:

<https://www.rosenbauer.com/blog/de/cat/innovation/cft-de/>

and on YouTube:

<https://www.youtube.com/user/RosenbauerGroup>

<https://www.youtube.com/watch?v=It7rByg6FBc&list=PL2961725DEB84BA7C&index=1>

Thank You!

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Responsible for the Future.