



Florian Rott

Product Communication &
Launch Management

MAN LION'S CITY E

Agenda



1 Customer Requirements & Vehicle Concept

2 Air conditioning

3 Battery

4 Charging

5 Tools, Services & Consulting



1

CUSTOMER REQUIREMENTS & VEHICLE CONCEPT

Today's requirements in public transportation

Sustainability

- More moving alternatives

Maximum flexibility

- Wide range of possible operation

Reliable Operation

- Reliable, constant range during entire time of use

Maximum compatibility

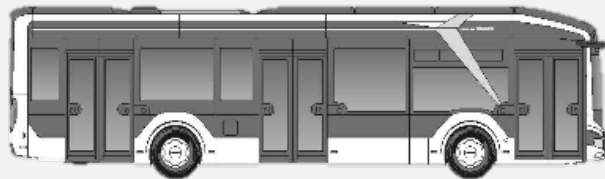
- Standardised connections
- Full integration into portfolio

Holistic partnership

- Professional consulting by MAN Transport Solutions



Portfolio



Lion's City 12 E (12m)

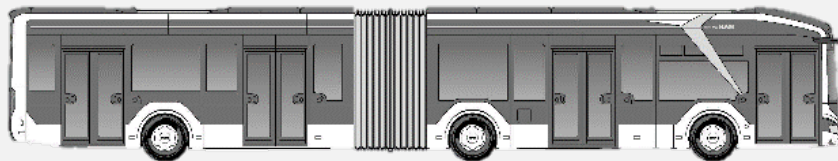
L = 12,2 m | H = 3,32 m
2 doors / 3 doors



480 kWh
6 packs



up to
88 pass.



Lion's City 18 E (18m)

L = 18,1 m | H = 3,32 m
3 doors / 4 doors



640 kWh
8 packs



up to
120 pass.

Technical Data | Drive train

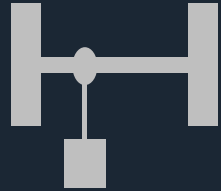
	Lion's City 12 E	Lion's City 18 E
Length	12.2 m	18.1 m
Height	3.32 m	3.32 m
Motor type	Electric MAN central motor	2 electric MAN central motors
Arrangement	Rear axle	Middle and rear axle
Continuous power	160 kW	107 kW/160 kW
Maximum power	240 kW	160 kW/160 kW
Maximum torque	2,100 Nm	1,400 Nm/2,100 Nm
Transmission	Single-stage MAN adapter gearbox	2 single-stage MAN adapter gearboxes



IF GOLD AWARD
2020



Concept decisions – What are the key questions?



TCO & low maintenance

- Maintenance-friendliness
- Maximum integration



Compatibility

- CCS charging standard



Passenger friendly

- Spacious and modern design



Flexibility and reliable range

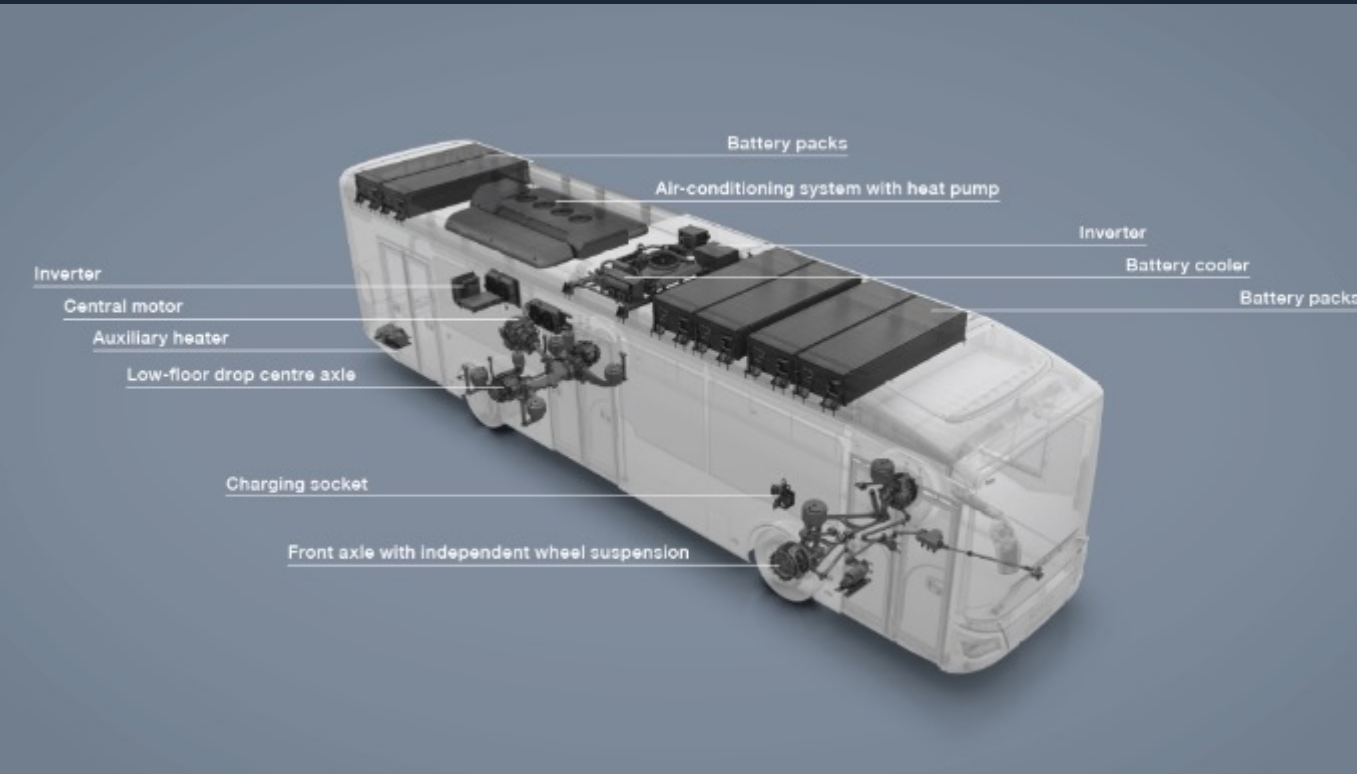
- Depot Charging
- Battery technology



Powerful

- Up to 150 kW charging power
- Quick charging <3h

MAN Solution: Consistent packaging



All high-voltage components on roof and under floor:

- Safe
- Service-friendly
- Easy access
- Future-proof battery concept

Interior



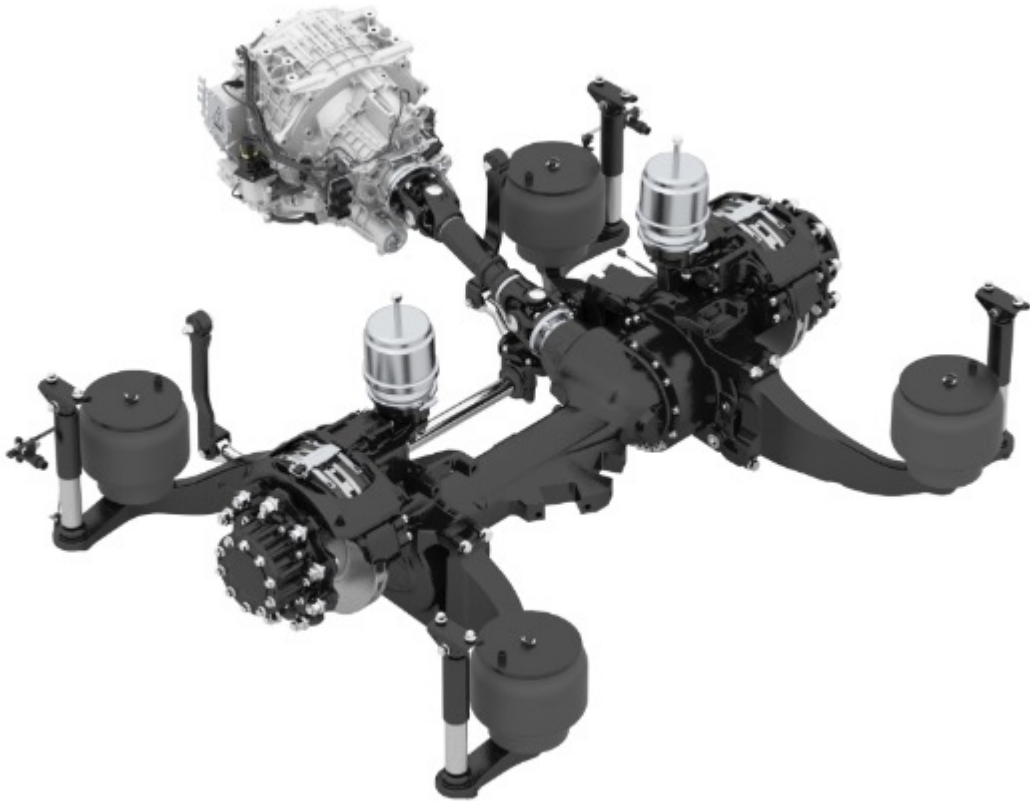
**All high-voltage components
on roof and under floor**

- Safe
- Service-friendly
- Easy access
- Future-proof battery concept

More interior space:

- **No engine tower**
- **4 additional seats**
- **Spacious interior**

Drive concept



All high-voltage components on roof and under floor

- Safe
- Service-friendly
- Easy access
- Future-proof battery concept

More interior space

- No engine tower
- 4 additional seats
- Spacious interior

Central drive

- Maintenance-friendly
- Maximum carry-over parts



„There is very little difference in driving compared to a Diesel bus. This makes it easy to change to electric drive.“

Tamara Drescher
Bus Driver MVG Munich



Driver assistance



**Actively warning
turn assist**



– Look-ahead collision warning



– Pedestrian and bicycle collision warning



– Road sign recognition



– Speed limit display



– Lane departure warning



– Warning cascade (step 1: yellow, step 2: red, step 3: acoustic warning)

Intense Testing Program



Efficiency Run - 550,8 km

0,66 kWh/km, SORT 2/3, TÜV-certified



Important tenders

1	2
3	4

1	2
3	4



18CE



Tender VHH / 17 units

Delivery Nov. - Dez. 2020



Customer field test



Vehicle definition:

ISO 26262, ECE, VDV, ...



Vehicle validation:

Funktion, Geräusche, Klima-Windkanal, Schlechtweg, Dauerlauf

Battery testing (also other components):

Manipulation, Function, Climate tests, shaker, EMV, etc

Summer testing in Spain, Italy

Driving, Charging, functionality, climate,
Extreme endurance tests

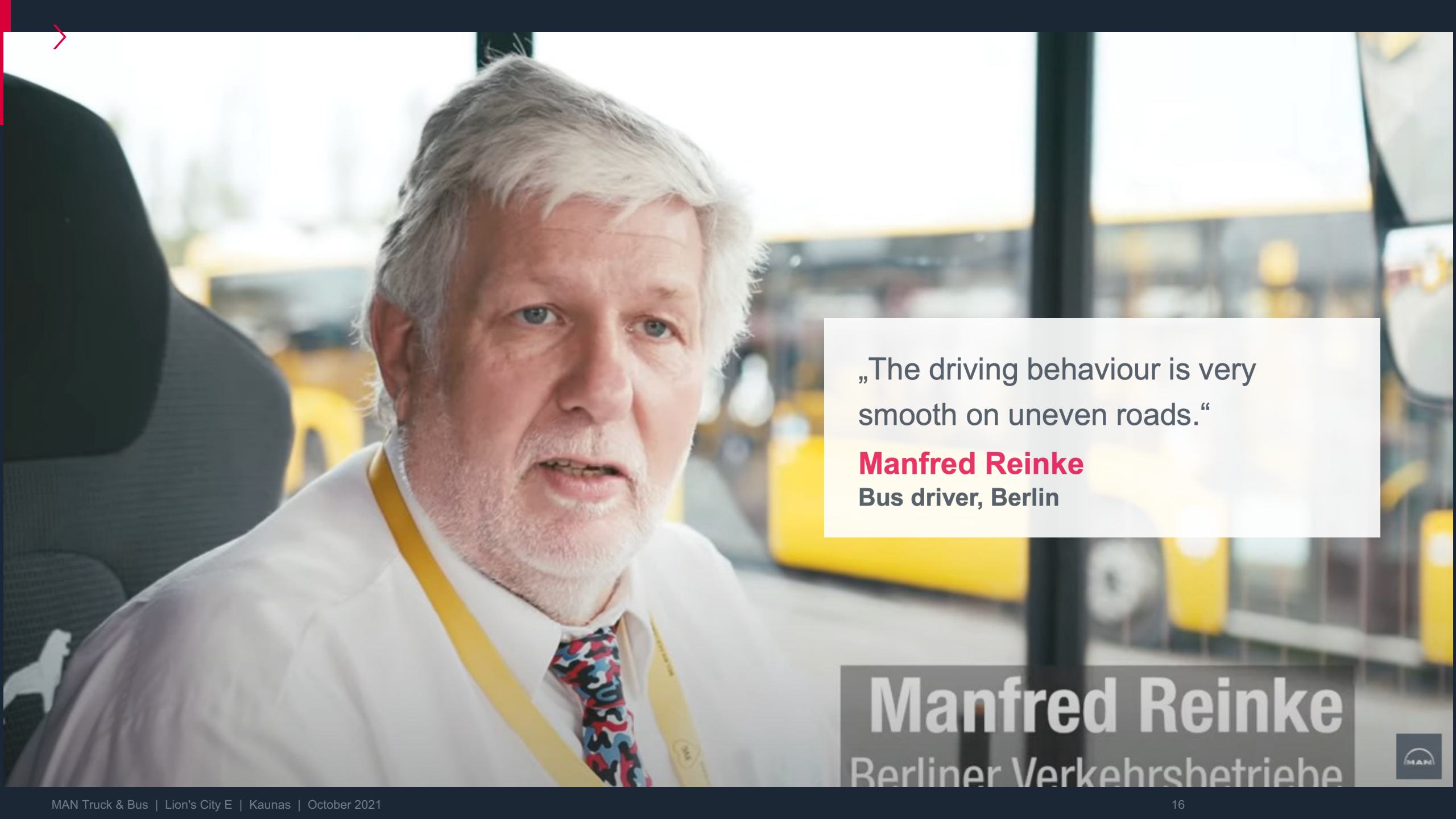


Winter testin in Sweden

Driving, Charging, functionality, climate,
Extreme endurance tests



Customer phase



„The driving behaviour is very smooth on uneven roads.“

Manfred Reinke
Bus driver, Berlin

Manfred Reinke
Berliner Verkehrsbetriebe



2

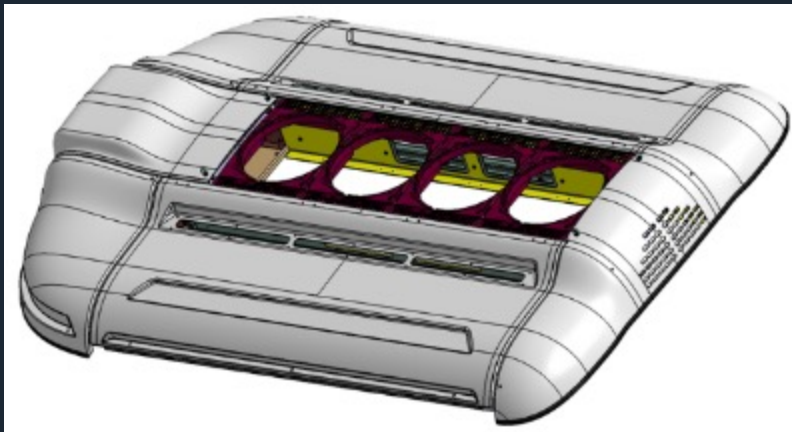
AIR CONDITIONING

Heating, ventilation and air conditioning

- Electrical heat pump on the roof (heating & cooling, 1)
- CO₂ air conditioning available Q2/2022
- Electrical heaters in the interior (2)
- Auxiliary heater with alternative fuels (3)

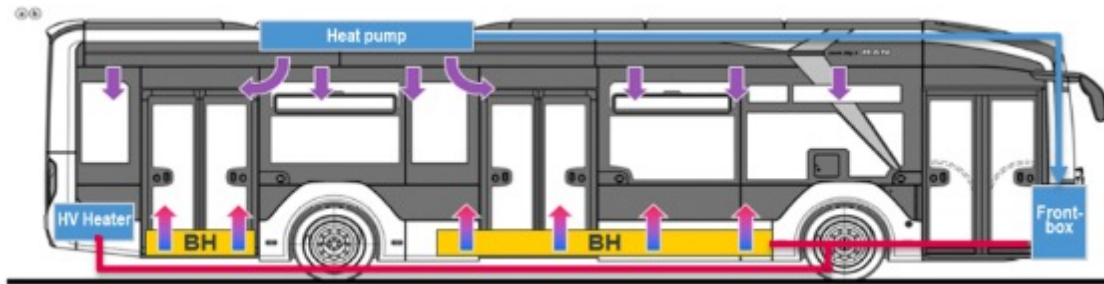


CO₂ air conditioning



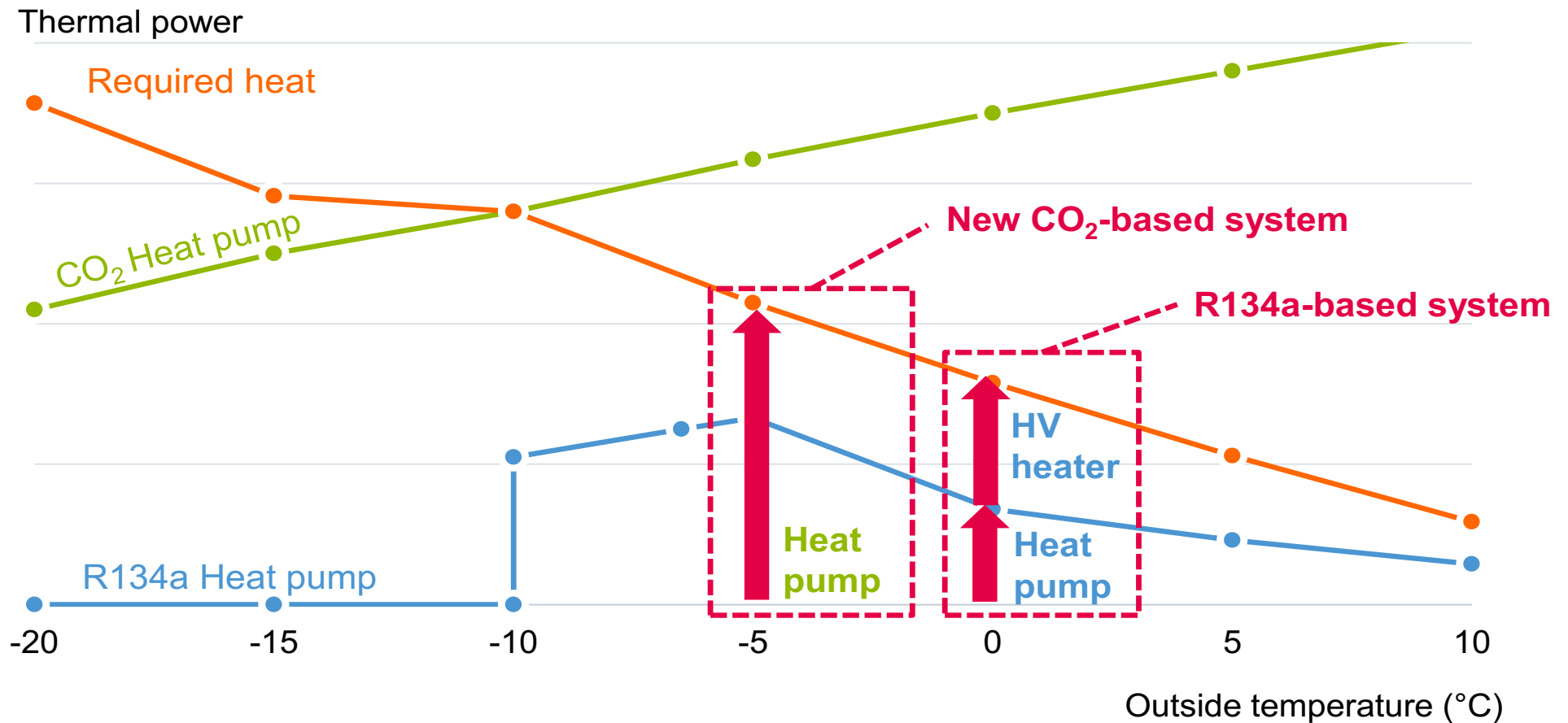
- Dimensions: 2,900/2,100/415 mm (L/W/H)
- Weight: ca. 365 kg
- Amount of coolant: ca. 3,8 kg
- Heating and cooling power: ca. 35 kW
- Max. operation temperatures: ca. -20 °C to ca. 50°C
- Reduction of power at ca. 40 °C
- CO₂ pressure: 10-120 bar
Safety shut-off at 135 bar
Blow-off valve at 150 bar (100 bar when compressor off)
- Cooling circuit maintenance free
(Annual oil and noise check + check of safety systems)
- High voltage operation / 24 V control
- No diagnostics with MANCats

Heating circuits



- For maximum reliability, utilisation of the CO₂ system concentrates on the compact air-conditioning unit on the roof – components such as the front box or convectors are supplied via heat exchangers, using water as the medium.
- For cooling, the frontbox is connected to the heatpump and for heating it is attached to the high voltage heater elements.

Wider temperature range of CO₂ heat pump





3

BATTERY



„The range fits to our routes perfectly.“

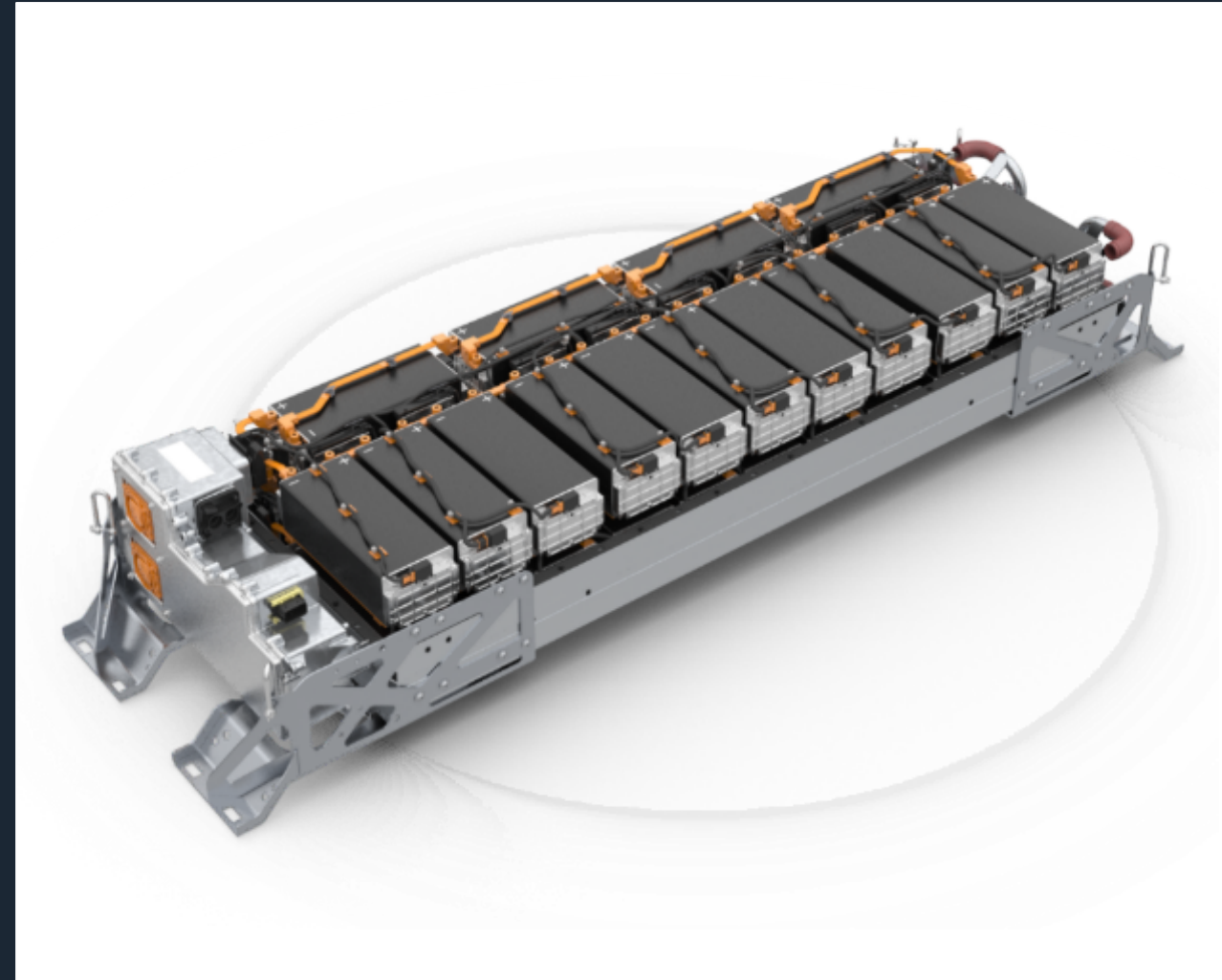
Sven Frener

CEO, Pellworm public transport

Future-proof battery concept

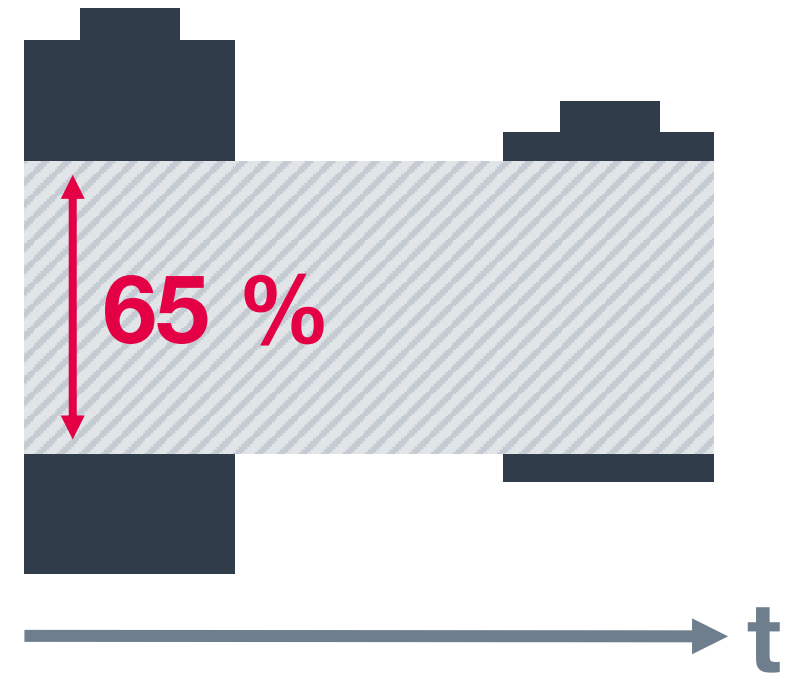
- **Future-proof and practical battery technology**
Lithium ion technologie (NMC)
- **Optimized performance and reliability**
Specifically designed for commercial vehicles using synergies and validation within the group
- **Capacity**
6 packs with 480 kWh (solo)
8 packs with 640 kWh (articulated)
- **Range**
up to 350 km*

* SORT 2, perfect conditions



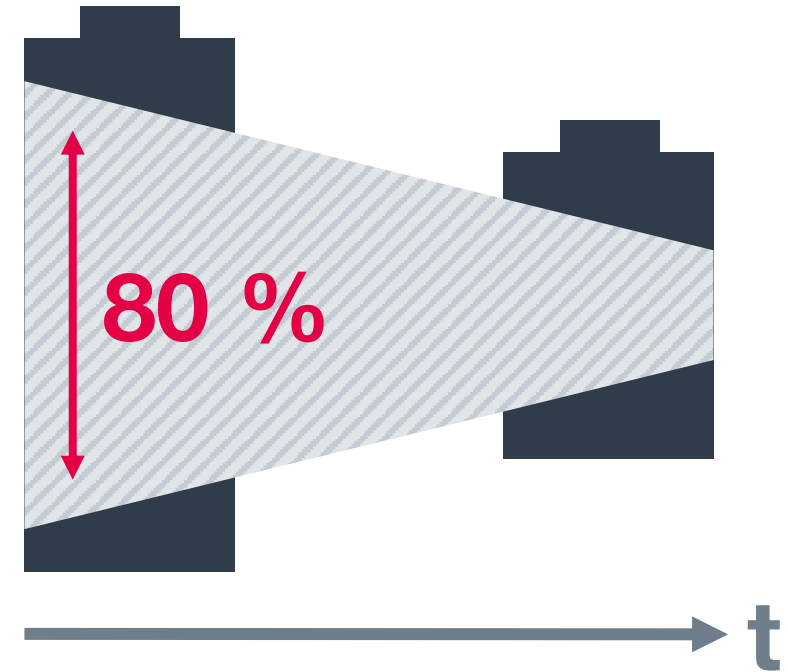
The "Reliable Range" usage strategy

- The "Reliable Range" battery usage strategy is ideal for customers who require a constantly reliable range throughout the entire service life of their buses.
- With a restricted charging hub it provides sufficient reserves to guarantee an equally long range of up to 270 km under favourable conditions over the entire service life.
- Battery usage up to 10 years



The "Maximum Range" usage strategy

- In addition, the "Maximum Range" strategy enables MAN to respond flexibly to customer requests. An extended charging window enables more energy to be drawn per charge in order to increase the daily range.
- This provides greater flexibility in use when required. With the "Maximum Range" strategy, the achievable range with one charge is thus up to 350 km.*
- Battery usage up to 10 years



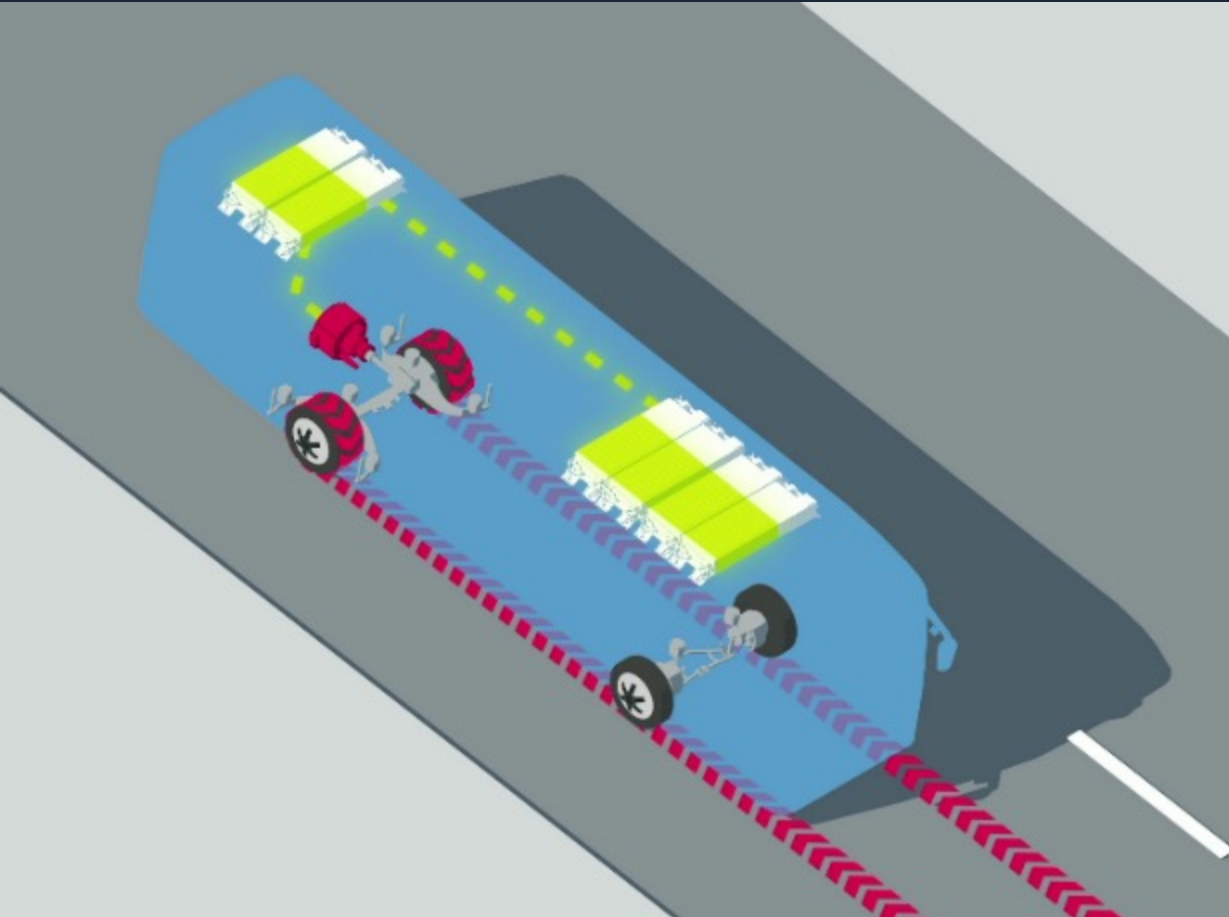
* SORT2, optimale Bedingungen

MAN Efficiency Run

- 550 km in 24 hours
- No Charging
- Real MVG Munich route
- Average load
- Certified by TÜV Süd



Influencing factors on autonomy



- High amount of recuperation power reduces influence of **driver** and **topography**
- MAN ProfiDrive driver coaching improves driving efficiency
- Climate conditions and comfort requirements can reduce range by up to 50 %



„We had some few cold days in February but we didn't notice a huge impact on the battery state of charge.“

Mario Provez
Hansea Belgium

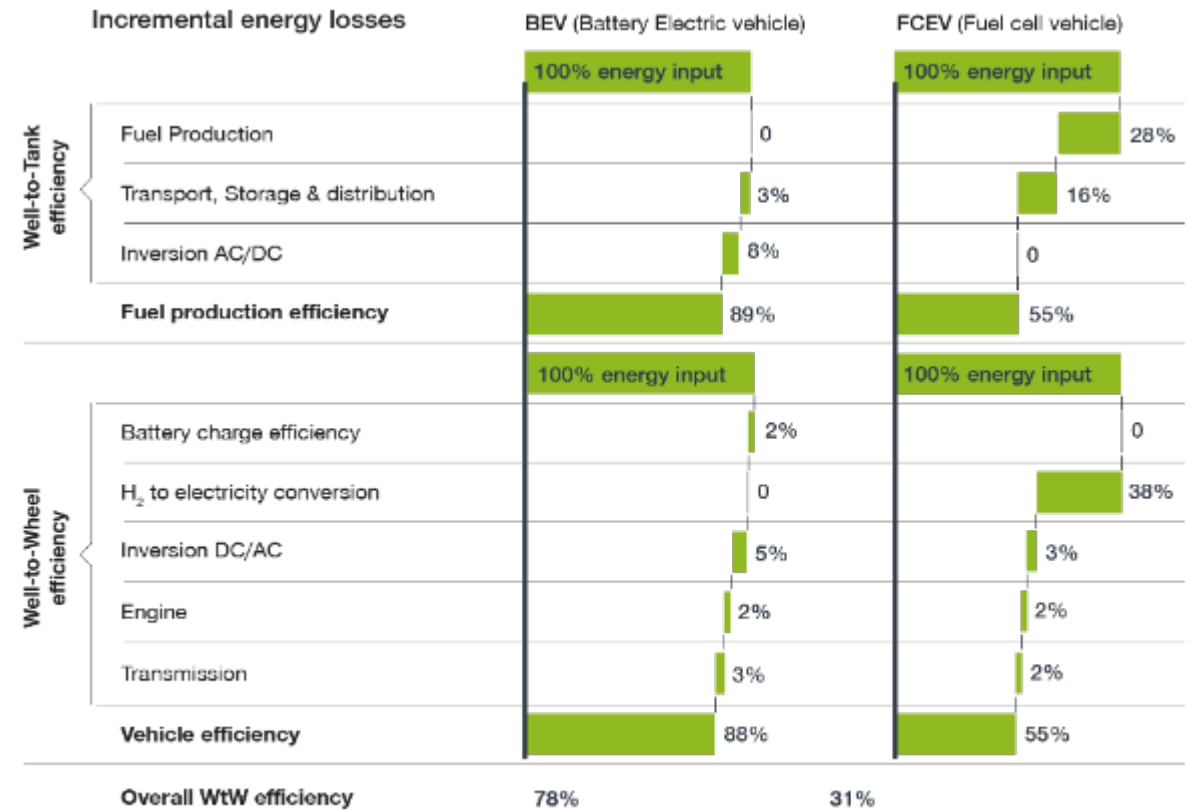


BEV with better TCO compared to hydrogen

Energy efficiency

- Very low conversion losses
- This offers significant advantages in producing and providing electrical energy
- 1 km powered by a battery requires less than half of the energy required for 1 km powered by hydrogen
- Battery electric drives have the lowest TCO due to battery price development and efficiency

Batteries remain the most efficient energy storage systems



Source: Bloomberg New Energy Finance, ICCT, Argon National Lab, CCS Institute

Battery validation

Test Levels:



Test Cases:

- E.g. Penetration, Crash, etc.
- Bus rollover R66
- E.g. Over-charge, Over-temperature
- Life time
- Environmental validation



Total Cells tested @MAN all test levels & cases (generic):

A-Sample	B-Sample	C-Sample	Total Cells
5.400	26.450	70.980	102.830

Future development of battery technology



- **Rapid battery innovation** makes BEV the TCO-optimal solution
- **Range of 450+ km** possible mid-term
- Possibility to charge with more than 150 kW and with pantograph



4

CHARGING

Standardised charging technology

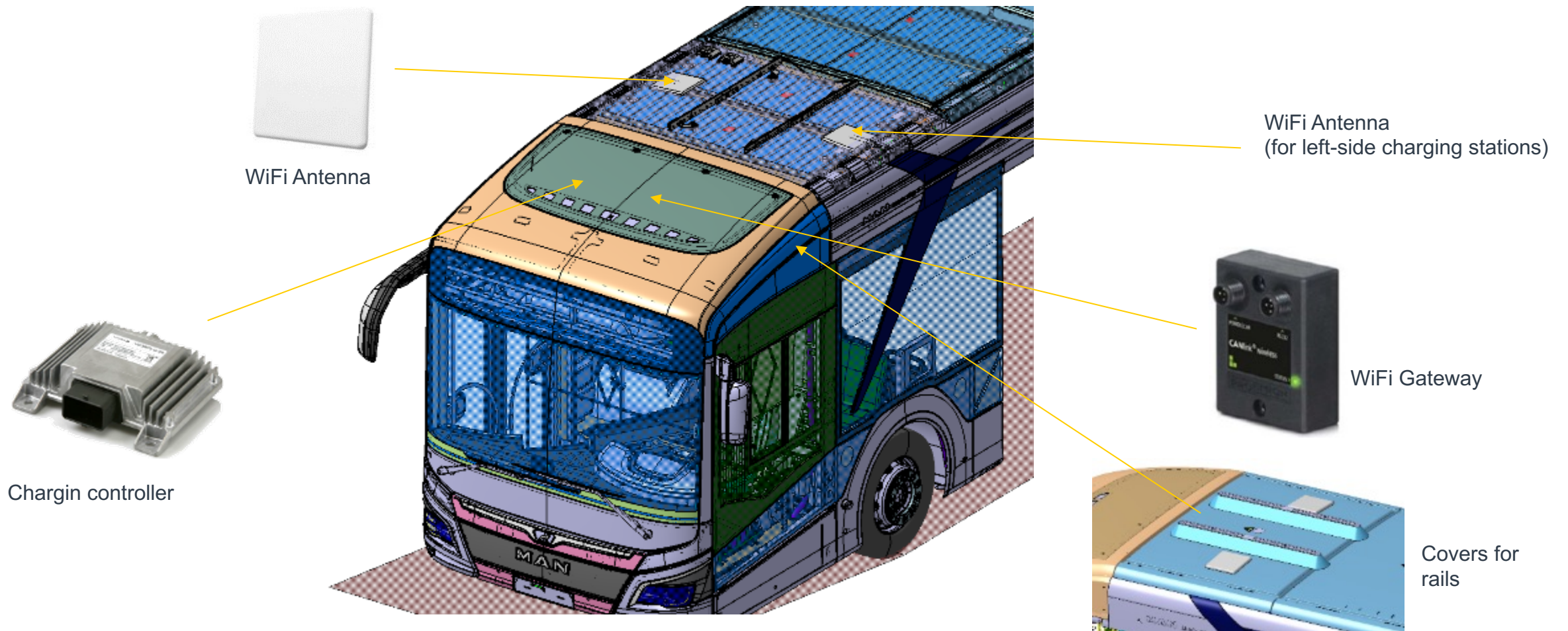


Maximum compatibility and future-proof investment

- 5 possible positions of the CCS plug allows optimal depot layout
- CCS plug and communication standardised
- Rails for top-down pantograph charging available



Component packing without compromise on battery capacity



Charging infrastructure



Matching charging infrastructure



Wide range of options



Cooperation between headquarter, NSC and charging infrastructure partner



Customer benefit

- MAN can now offer the most perfectly matching charging infrastructure

Product Highlights

- Innovative technology
- Highly flexible, customer-specific solutions
- Industry's highest efficiency rate of up to 97%
- Multi-outlet:
possibility to charge two connected vehicles alternately with full power on both outlets
- Preventive maintenance
Execution of scheduled maintenance as specified in the maintenance manual tuned in with traffic planning to maximize uptime
- Unplanned maintenance
On-call repair in case errors occur which need immediate action in order to maximize uptime
- Back Office System
Connectivity-based services for remote maintenance and diagnostics for stable operation



Customer benefit

- Depending on customer demands and location the appropriate partner can be selected

A thick red line starts from the top left corner, extends diagonally down to the right, then turns 90 degrees and extends vertically down to the bottom left corner.

5

TOOLS, SERVICES & CONSULTING

MAN DigitalServices



MAN DigitalServices | Charging planning with eManager

- Select between immediate and timer charging
- Optionally precondition your vehicle while charging to save energy on route
- Charging status
- State of charge in % & range
- Vehicle status (ready to drive, not ready)

The screenshot displays the MAN eManager interface, which is divided into a main dashboard and a detailed 'Charging Details' sidebar.

Main Dashboard:

- Summary Cards:** At the top, there are two cards. The first card shows '1 Unknown' and '1 Failure' status. The second card shows '1 Charged' and '2 Charging' status.
- Vehicle List Table:** Below the summary cards is a table listing vehicles and their current status.

Vehicle	Charging Status	State of Charge	Remaining Capacity
MAN Lion's City E 01	Unknown		400 kWh
MAN Lion's City E 05	Failure		400 kWh
MAN Lion's City E 03	Connected	28%	76 km
MAN Lion's City E 08	Charging via vehicle charging button	85%	230 km 408 kWh
MAN Lion's City E 04	Charging until 10:30	78%	210 km 374 kWh
MAN Lion's City E 06	Charged	100%	270 km 480 kWh
MAN Lion's City E 02	Disconnected at 03/03 18:33	8%	21 km 38 kWh
MAN Lion's City E 07	Disconnected at 05:55	55%	149 km
MAN Lion's City E 09	Disconnected at 06:47	78%	210 km 374 kWh
MAN Lion's City E 10	Disconnected at 07:30	84%	227 km 403 kWh

Charging Details Sidebar:

- Vehicle Information:** MAN Lion's City E 3, VIN: WWA12C9274749172, Last updated: 04/03/2021 09:44.
- Charging Status:** Connected. State of Charge: 31%. Remaining Capacity: 76 km.
- Charging Options:**
 - Immediate charging:** Start charging immediately when vehicle is connected.
 - Timer charging:** Set a charging by timer for vehicle. Includes a calendar view for selecting days and departure times.
 - Days: MO, TU, WE, TH, FR, SA, SU. TH and SA are selected.
 - Departure Time: 13:30 (selected) and 05:30.
 - Next departure times: TU 04/03/2021 13:30 (Accepted), SA 25/03/2021 05:30 (Not sent yet).
 - Ready to drive time: 30 minutes.
- Climate control:** Enabled (toggle switch).
- Charge to:** 75% (dropdown menu).
- Premium features:** A section at the bottom with 'Cancel' and 'Save' buttons.

MAN DigitalServices | ServiceCare



INCREASED PLANNING QUALITY

Everything the customer needs to know to run the vehicles in a most efficient way !



MAXIMIZATION OF UPTIME

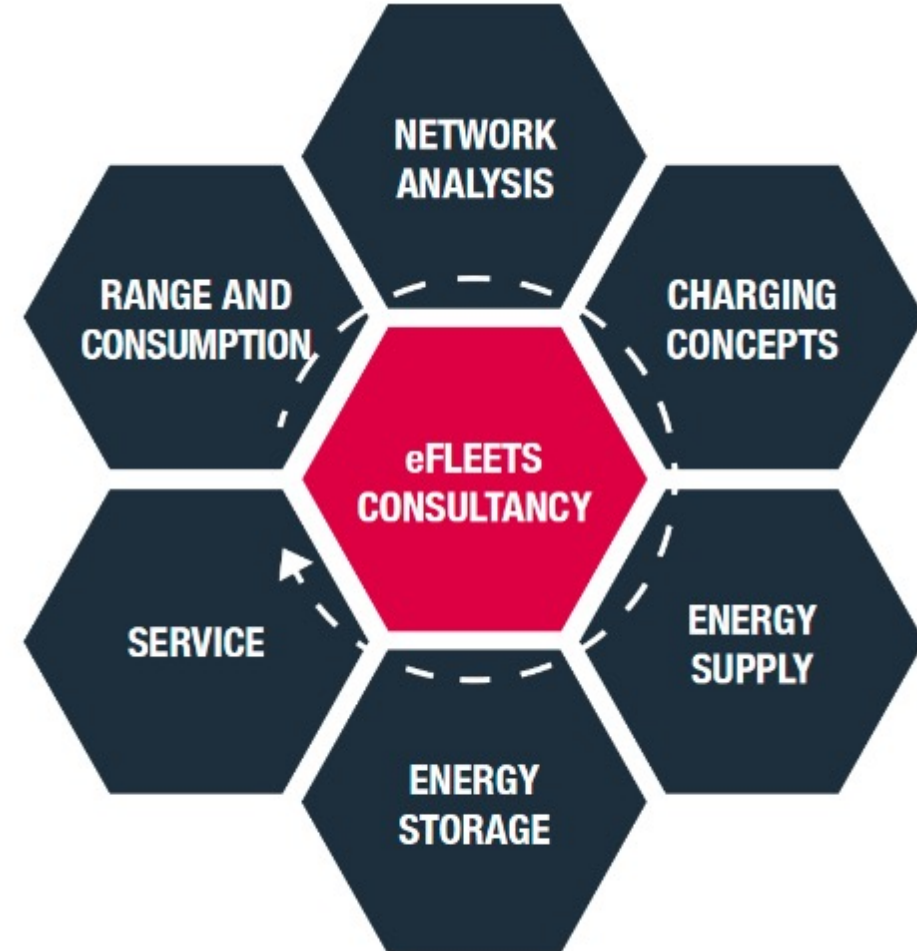
Keep the vehicle on the road and avoid unpredictable downtimes !



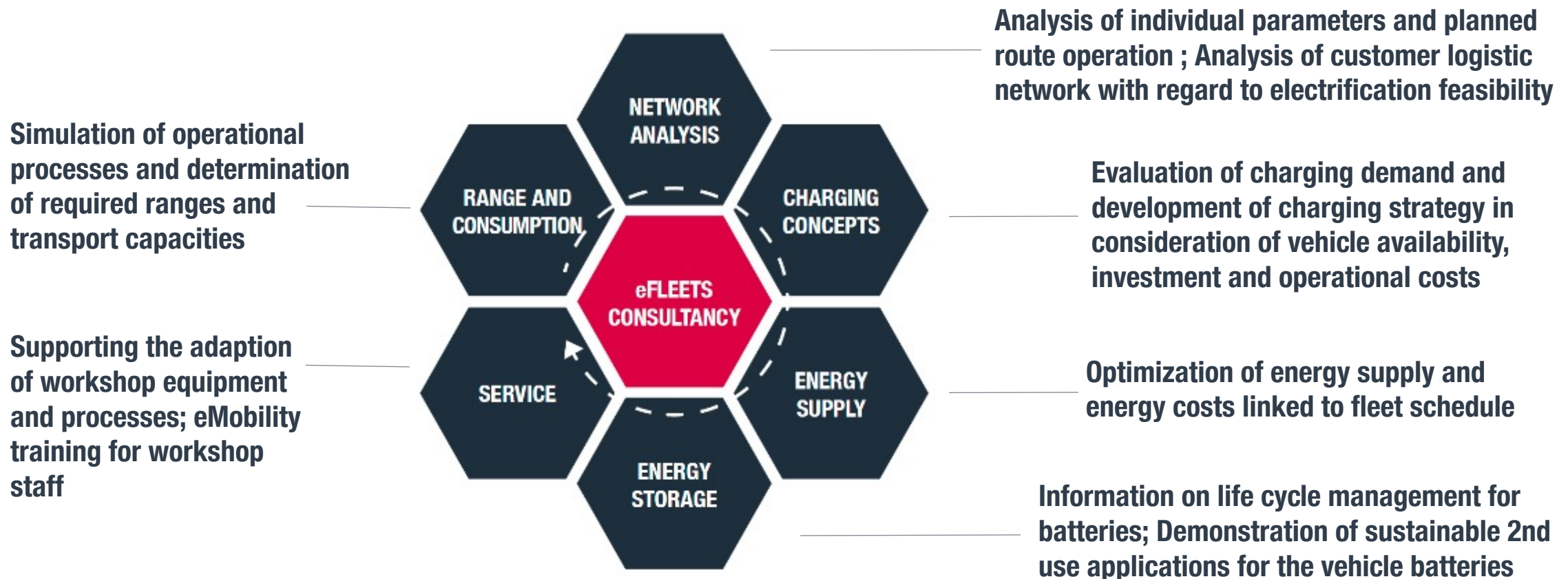
MINIMIZATION OF DOWNTIMES AND TCO

Minimization of profit losses !

Tailor-made solutions of MAN Transport Solutions



Tailor-made solutions of MAN Transport Solutions



CREATE YOUR MAN LION'S CITY WITH THE MAN BUS DESIGNER

<https://busdesigner.bus.man.eu/>



THE FUTURE STARTS **NOW**.
MAN IS YOUR **PARTNER**.

