

Promoting **clean** public transport

Trolley

Technical principles of diesel bus to trolleybus conversion

Mikołaj Bartłomiejczyk
Marcin Połom

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Content of presentaion



- ▶ 3 case studies of bus to t-bus conversion:
 - ▶ Gdynia
 - ▶ Szeged
 - ▶ Tychy
- ▶ Examples will show:
 - ▶ Determinants of conversion
 - ▶ Technical principles
 - ▶ Realisation of conversion
 - ▶ Results
- ▶ Summary

Bus to trolleybus conversion

- ▶ **Gdynia (Poland)**
- ▶ Szeged (Hungary)
- ▶ Tychy (Poland)

Necessity is the mother of invention

- ▶ Low prices of second hand buses
- 
- ▶ Fast renewal of the bus fleet with the low cost buses
- 
- ▶ Improving the image of bus services

- ▶ High prices of new trolleybuses
- +
- ▶ Small market s-hand vehicles
- +
- ▶ Low lifetime of vehicles
- 
- ▶ Slow renewal of t-bus fleet
- 
- ▶ Bad image of trolleybuses



Solution: **Bus to trolleybus conversion**

The 1st generation of conversion

Assumptions of the projects:

- ▶ Chassis of Mercedes O405N buses -> *well proved construction*
- ▶ Electrical equipment from scrapped trolleybuses -> *not modern, but very cheap solution*
- ▶ Conversion in our workshop, made by our workers -> *cheap labor*



Low floor trolleybus for 50 000 euro



The 1st generation of conversion

The main tasks of conversion:

- ▶ Choosing the coachwork and type of the traction drive
- ▶ Analysis of the legal aspects of the conversion – the technical requirements for **the trolleybuses are different than in case of buses**
- ▶ Beside disassembly of the diesel engine and assembly of the electrical installation it was necessary to adapt the parts of vehicle connected with electric shock security, e.g. the door handles
- ▶ In every case it was necessary to adapt the mechanical construction of the bus vehicle

The 1st generation of conversion

MECHANICAL WORKS



ELECTRIC MOTORS



12/2004

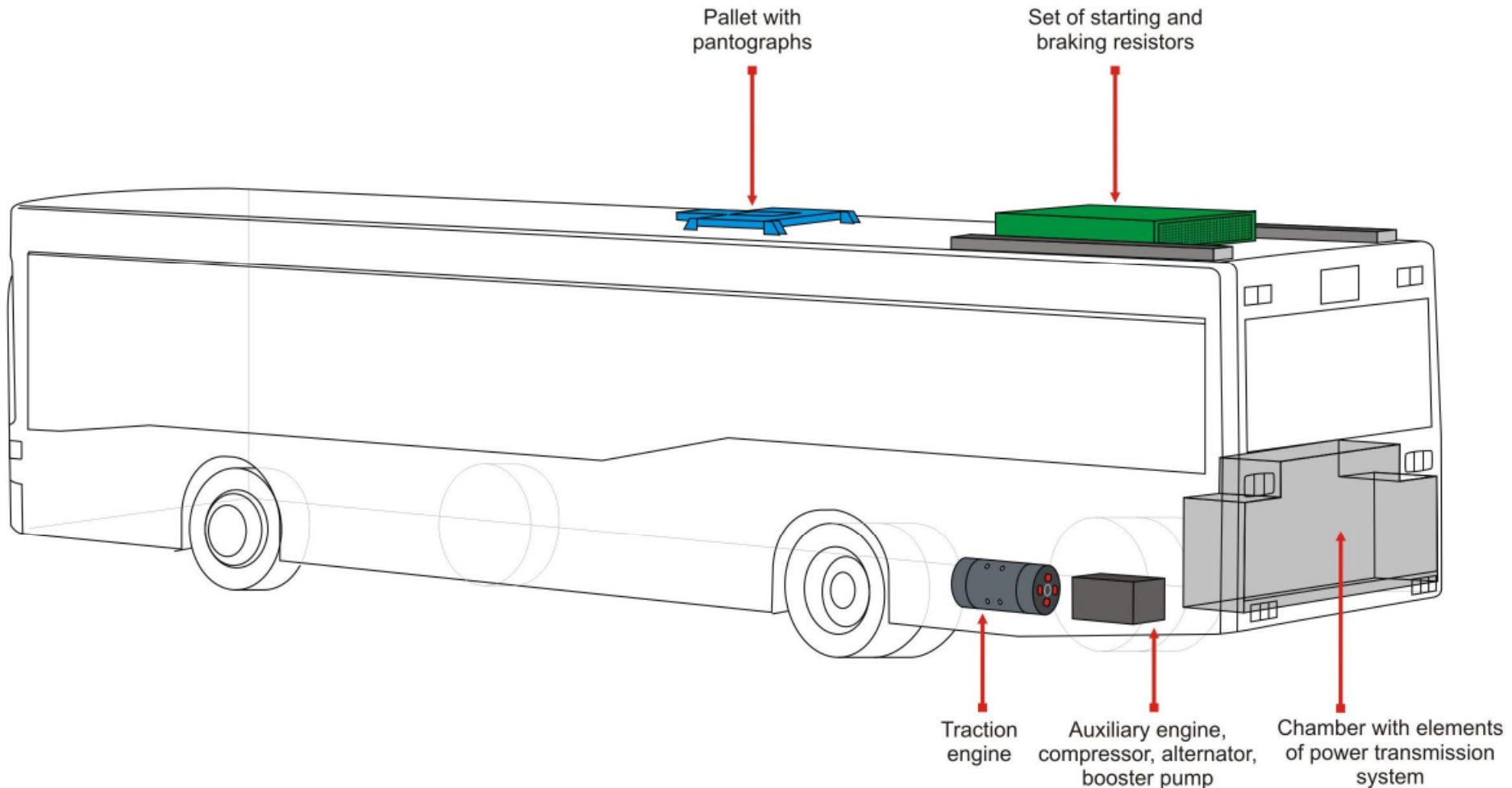
**ASSEMBLING OF
ELECTRICAL
EQUIPMENT**



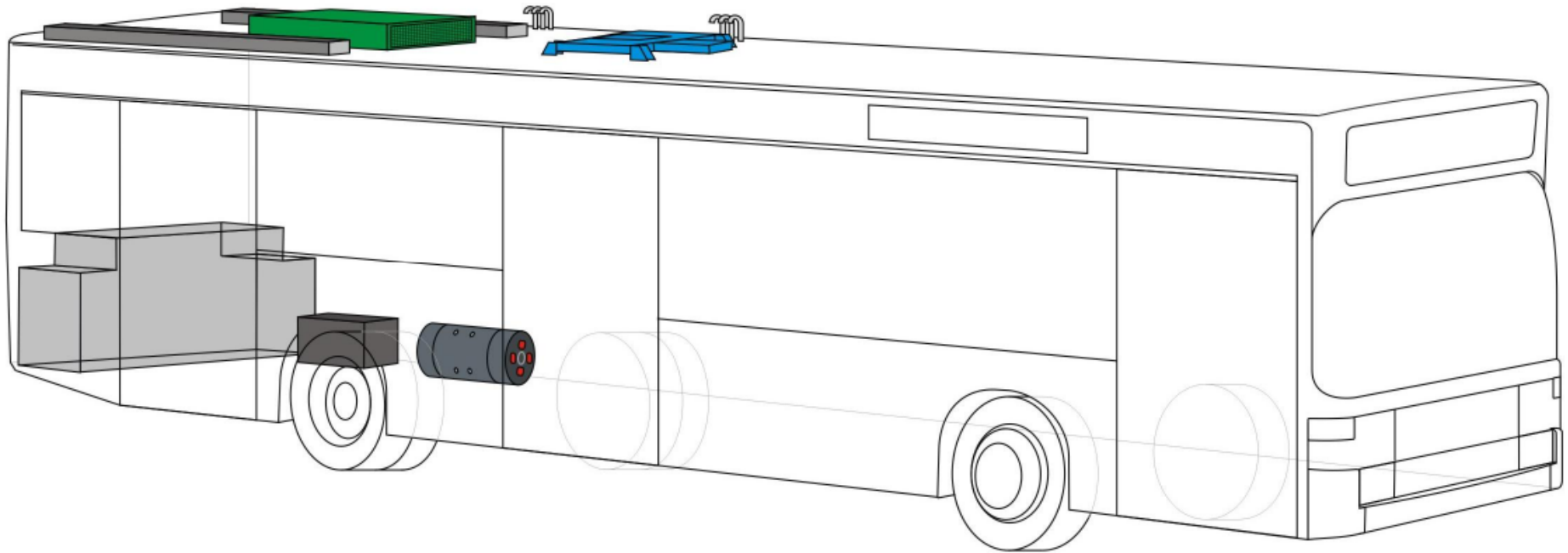
READY TO GO !



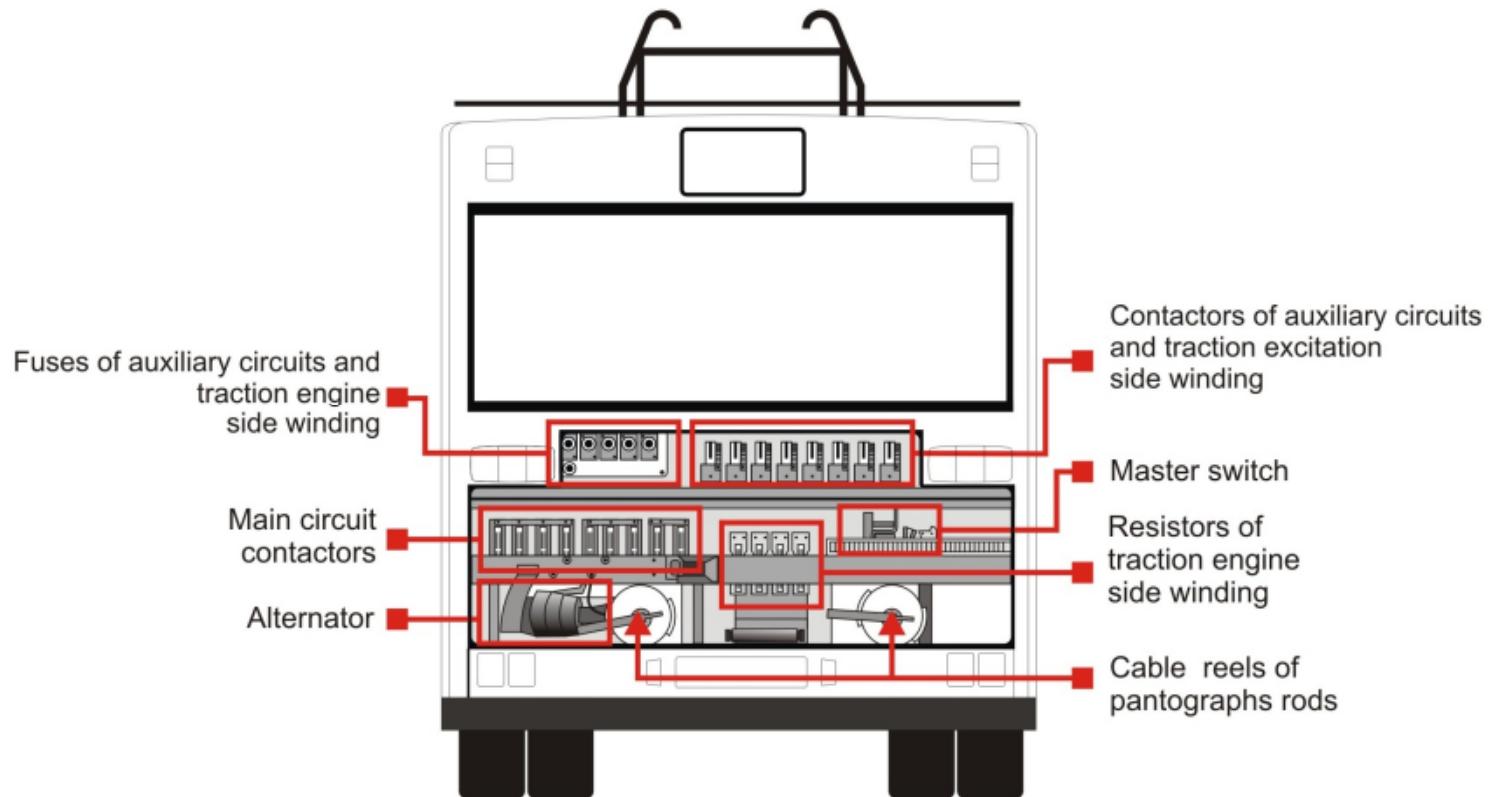
The 1st generation of conversion



The 1st generation of conversion



The 1st generation of conversion



Our innovations in old equipment

- ▶ New control system of rheostatic propulsion, e.g. ABS + ASR system
- ▶ Roof cable collectors unified with Trollino
- ▶ Current collector with lamp
- ▶ New heating devices



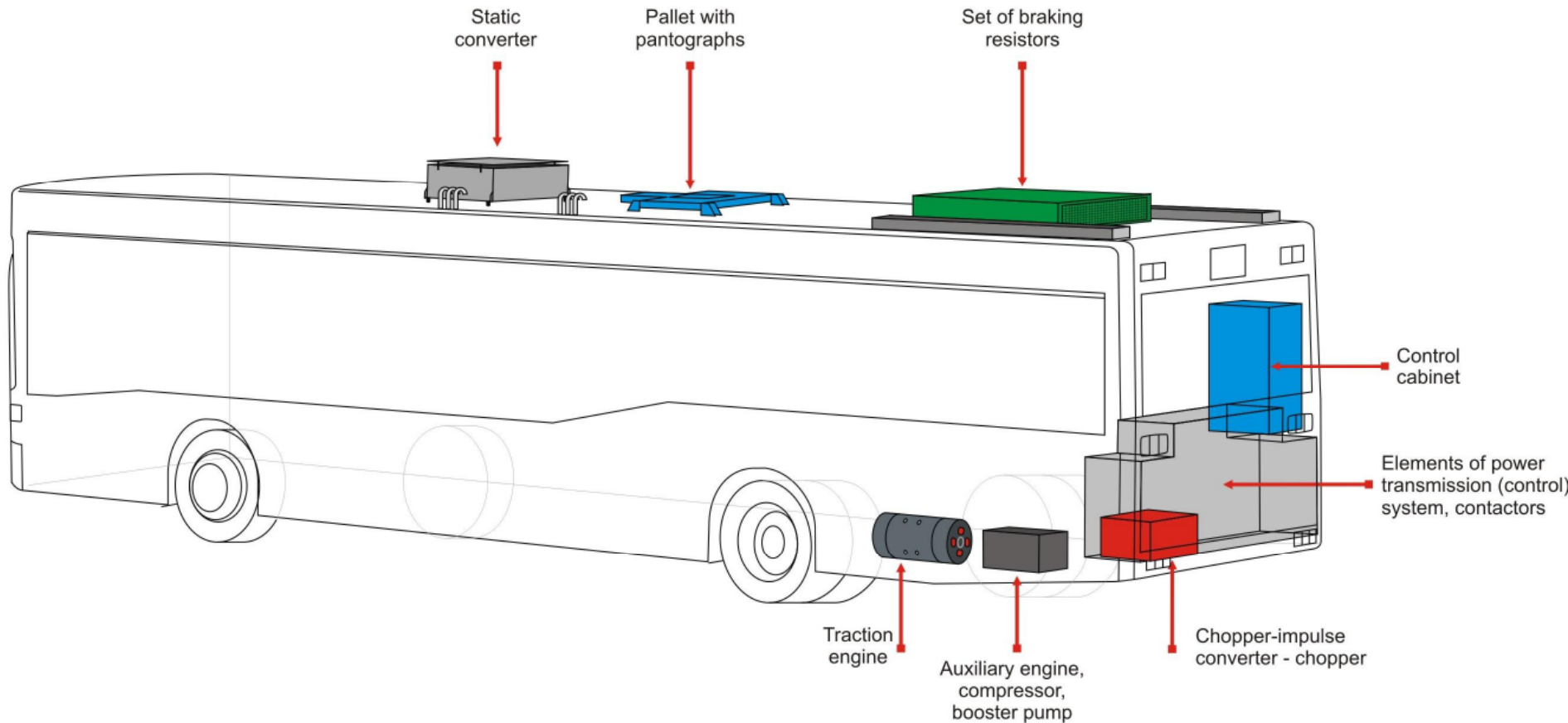
The 2nd generation of conversion

Converted Mercedes trolleybus with DC chopper propulsion system (2008)

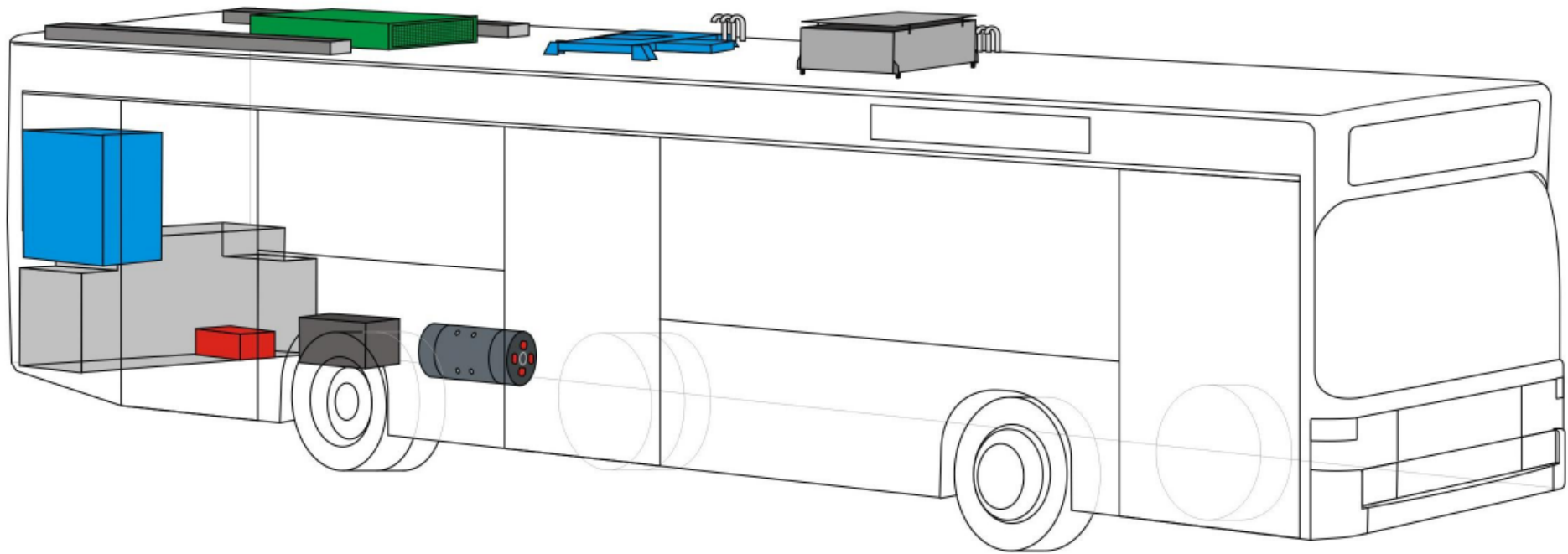
- ▶ DC traction motor from old vehicles
- ▶ New DC converter – chopper in place of rheostatic control system
- ▶ New DC/DC converter for auxiliary engines
- ▶ Two level of 600 V equipment isolation



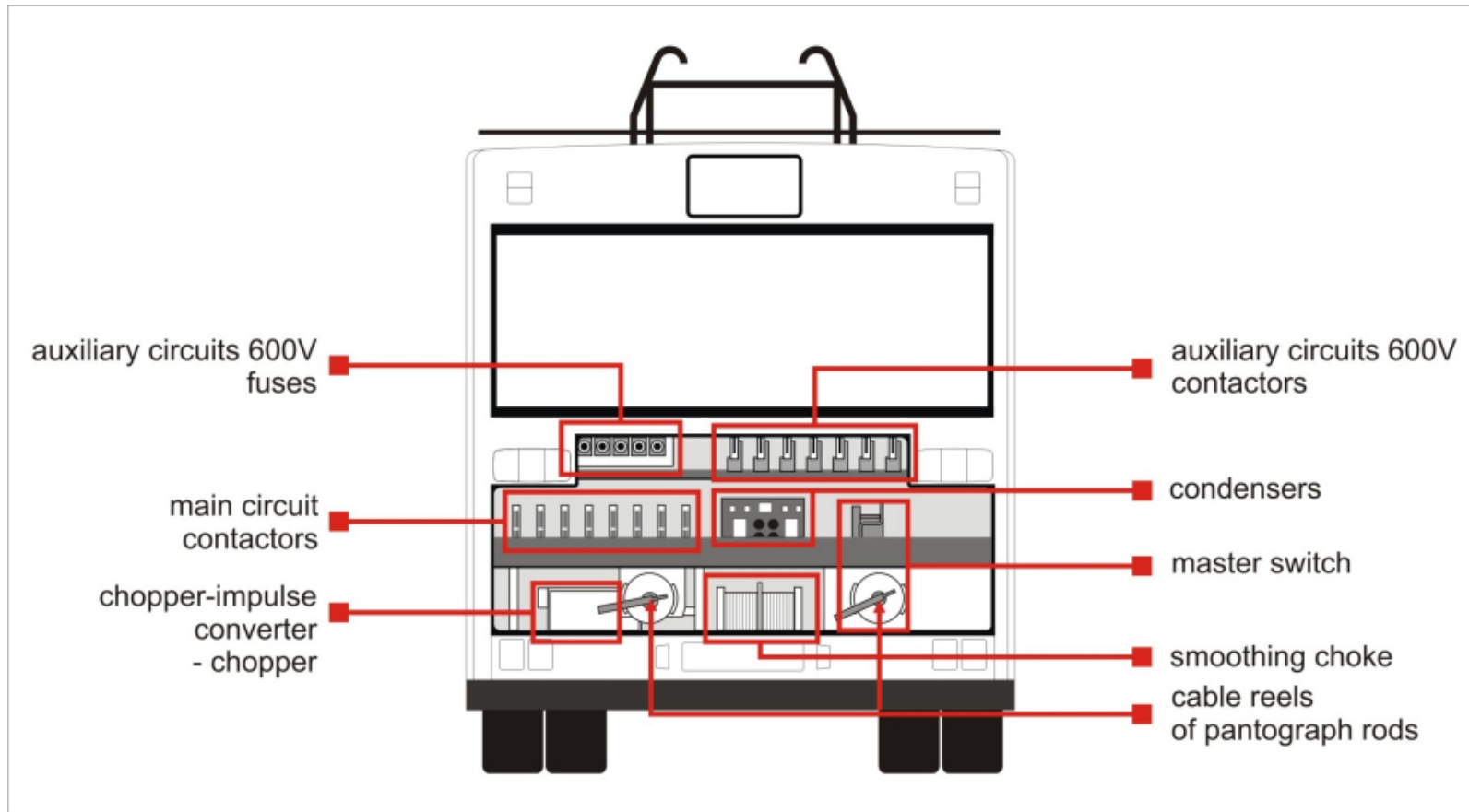
The 2nd generation of conversion



The 2nd generation of conversion



The 2nd generation of conversion

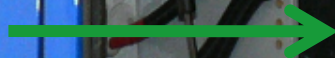


**600 V
FILTER**

**TRACTION
DC/DC
CONVERTER
- CHOPPER**

PL GA 1448F
IRIASA s.c. 81-647 GOYNIA, UL. HUTNICZA 16, TEL. (0581) 663 49 30

**TRACTION
MOTOR**



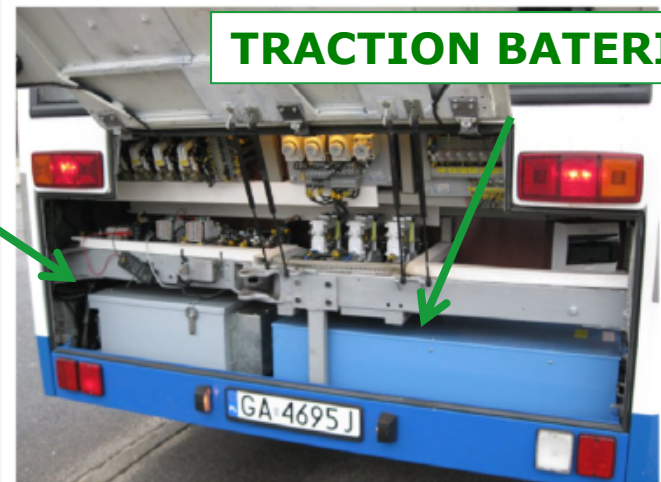
The 3rd generation of conversion

Challenge – modern vehicle for a reasonable price

- ▶ Chassis still from MB405N buses
- ▶ New AC propulsion system with 3 f traction motor
- ▶ Traction batteries
- ▶ Air condition for driver
- ▶ New designed converter for auxiliary drives

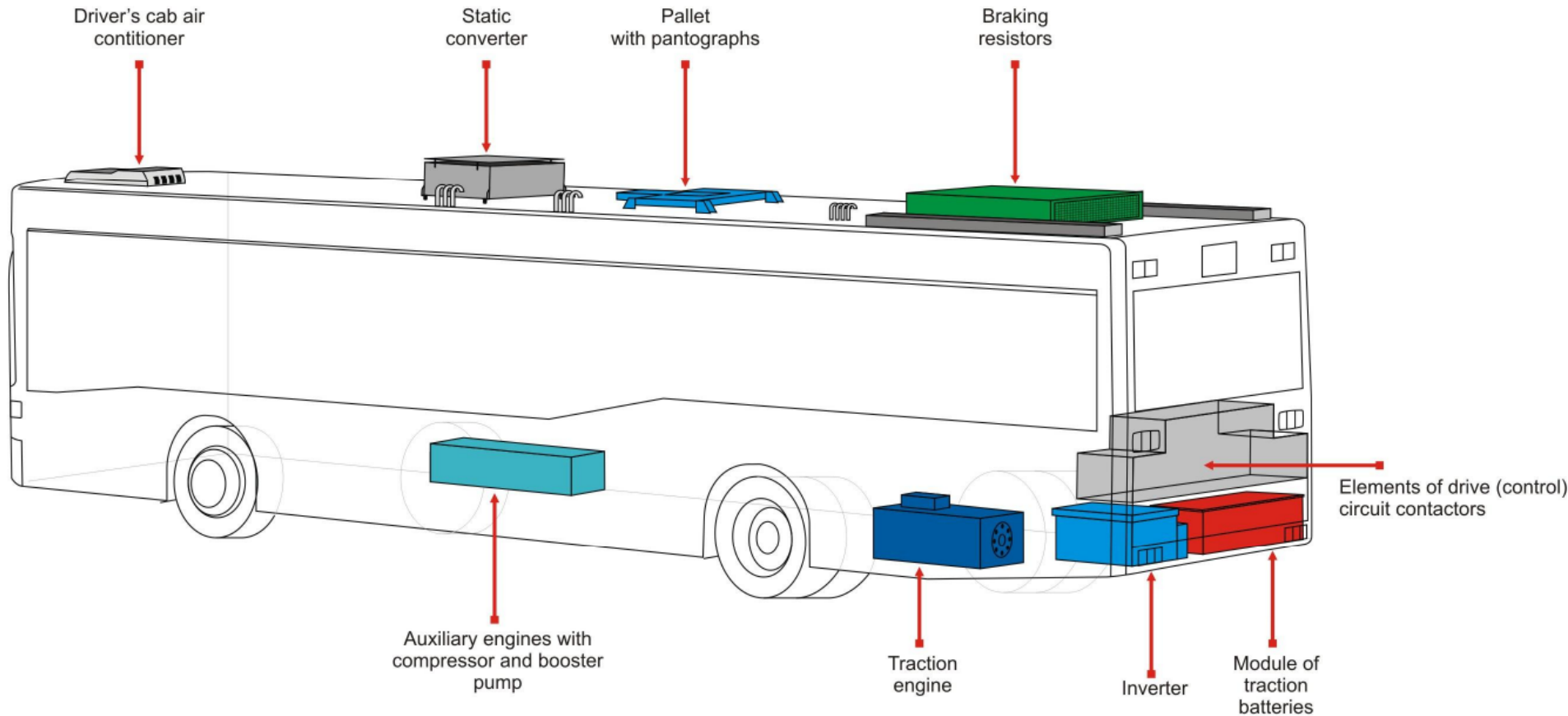


**TRACTION
INVERTER**

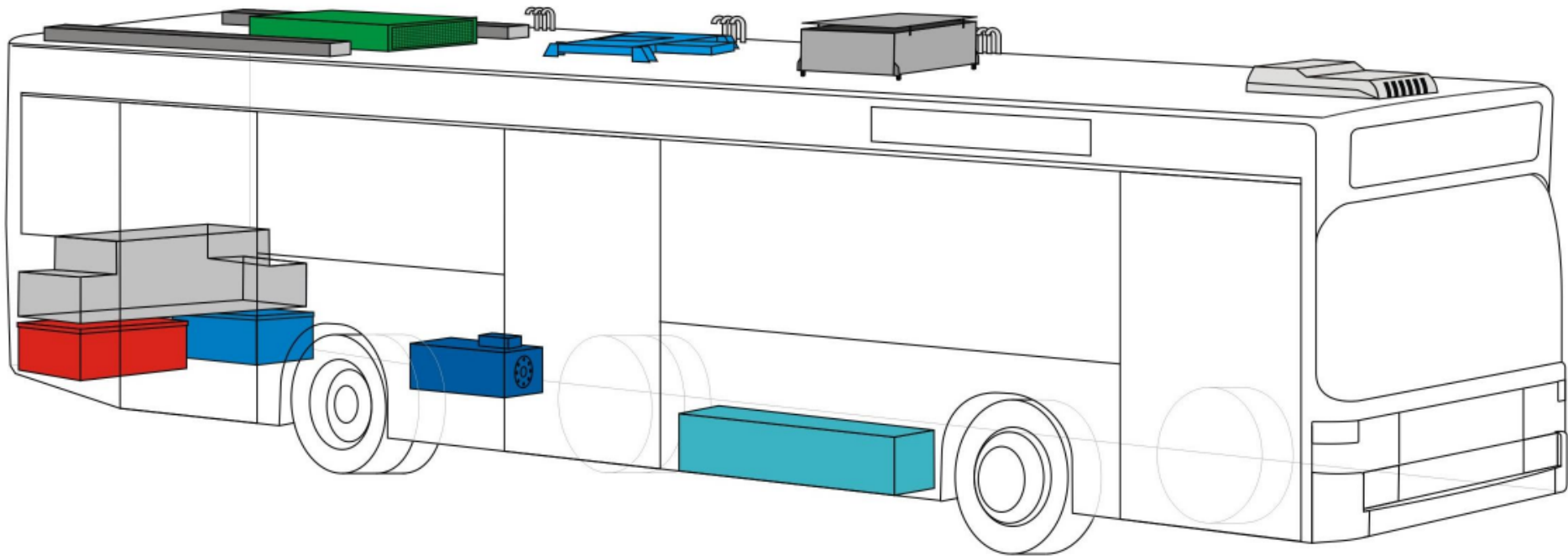


TRACTION BATERIES

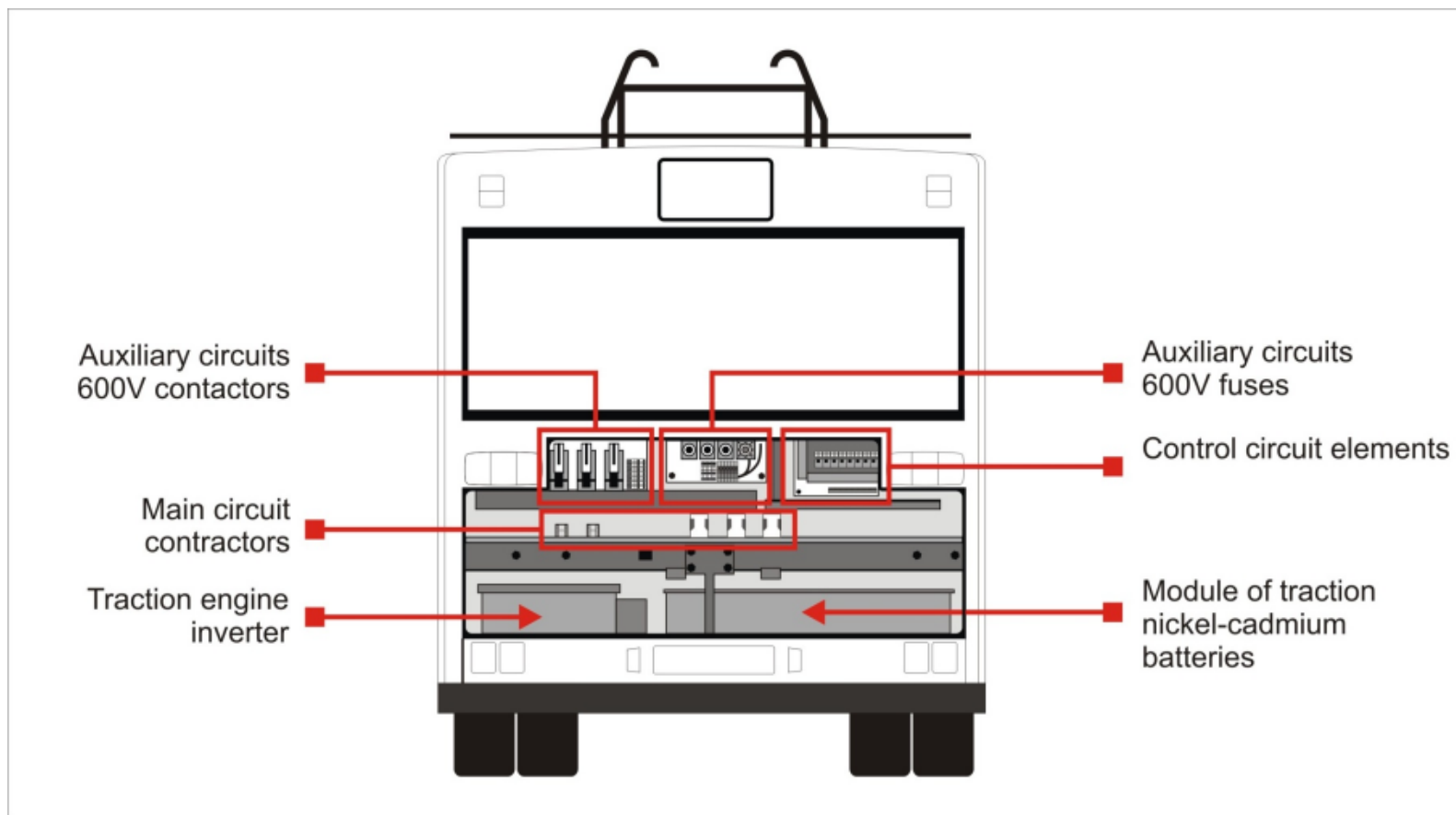
The 3rd generation of conversion



The 3rd generation of conversion



The 3rd generation of conversion



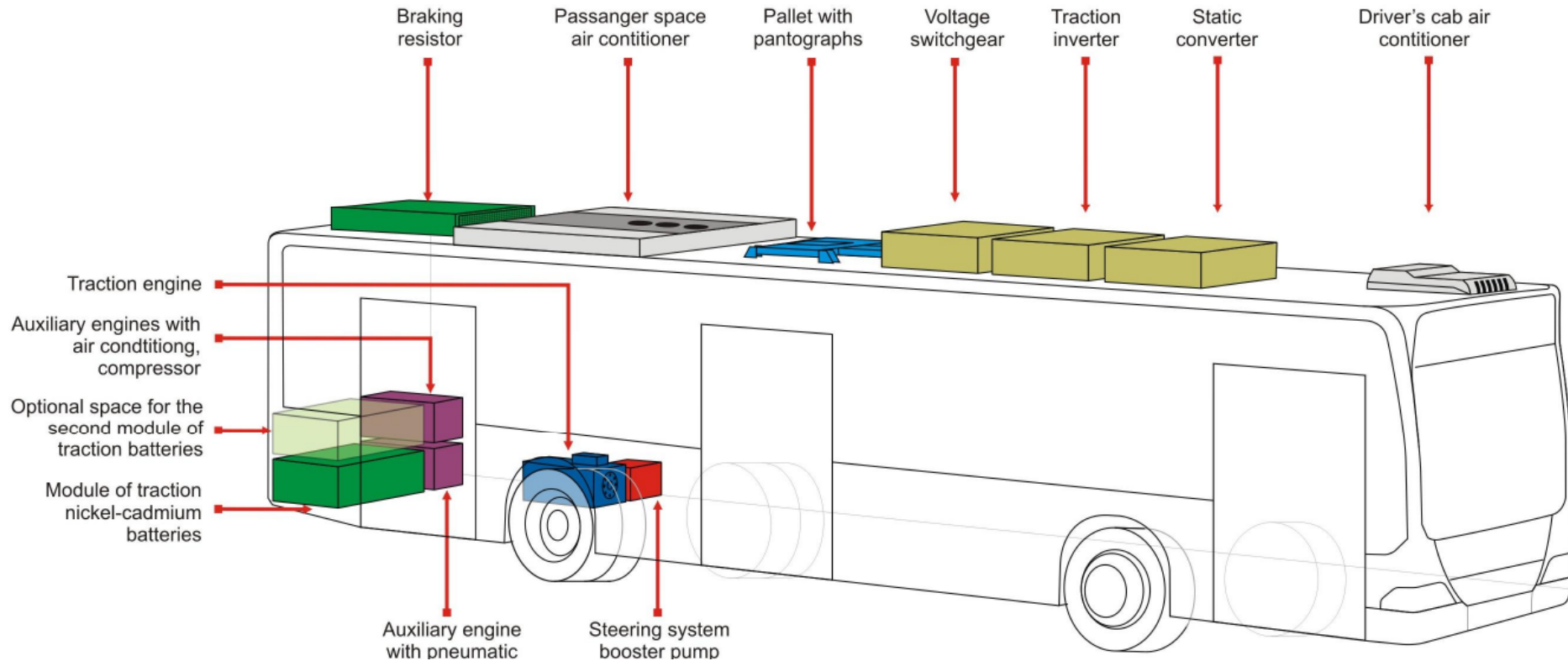
The 4th generation of conversion

Mercedes Citaro O530

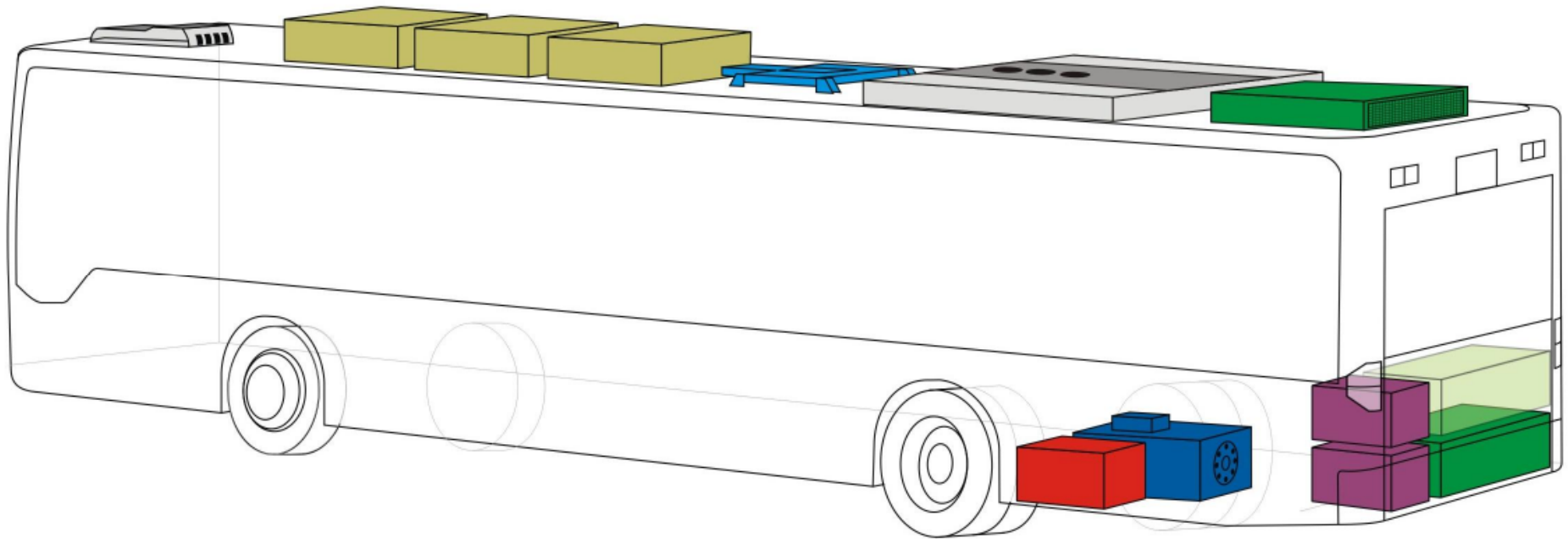
- ▶ Electrical equipment is the same like in the 3th generation vehicles
- ▶ But, much more modern chassi with complete air condition



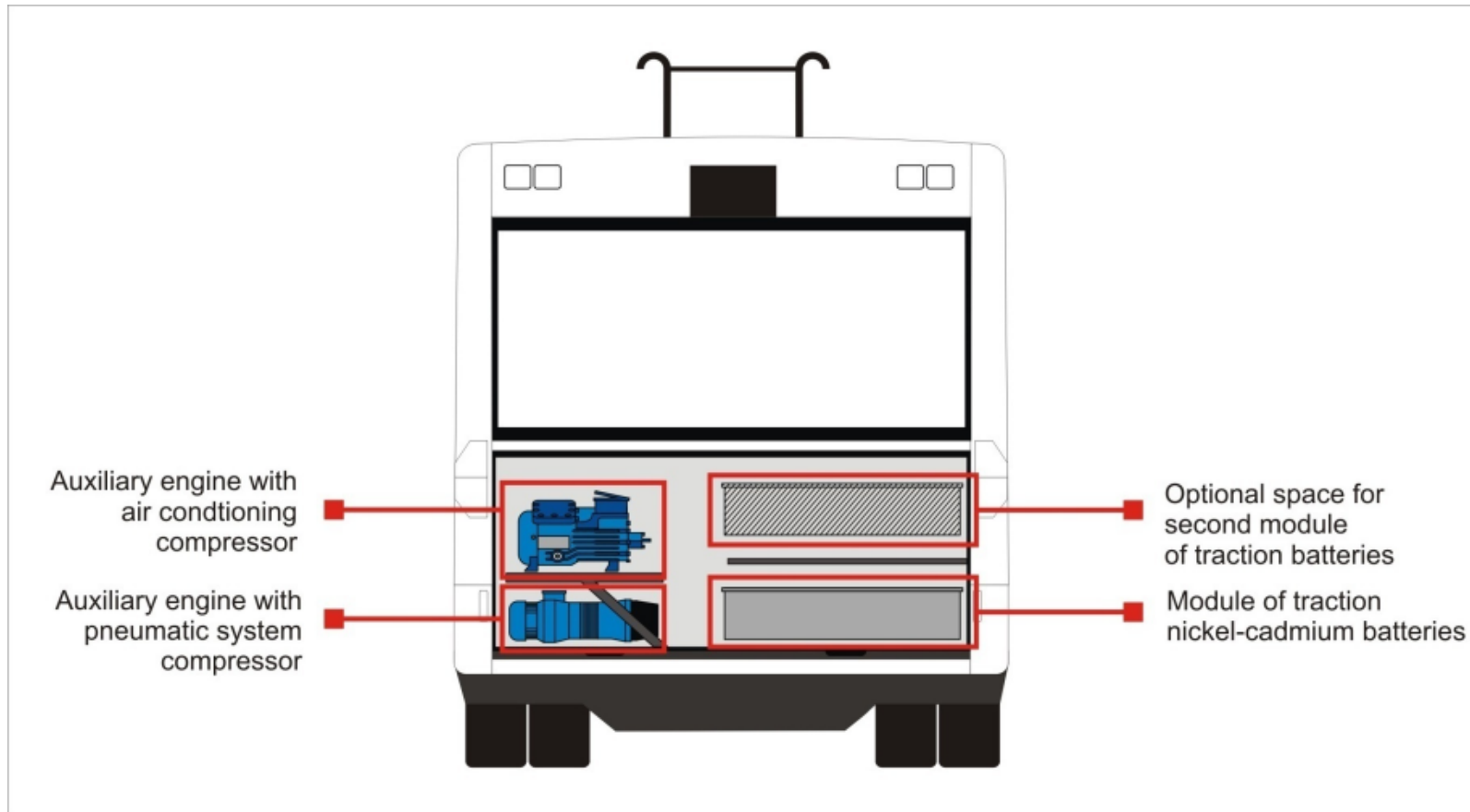
The 4th generation of conversion



The 4th generation of conversion



The 4th generation of conversion



Impressions from conversion work



Bus to trolleybus conversion

- ▶ Gdynia (Poland)
- ▶ **Szeged (Hungary)**
- ▶ Tychy (Poland)

Bus to t-bus conversion in Szeged

- ▶ The first conversion in 2004 – Volvo B7 bus
- ▶ In 2007 first Mercedes O530 conversion:
 - ▶ AC propulsion system
 - ▶ Re-arrangements of the interior
- ▶ 7 bus -> t-bus conversion until 2010
- ▶ Using Li-Ph. traction batteries is planned for the future



Impresions from conversion work

REMOVING OF DIESEL ENGINE



TRACTION MOTOR BOX



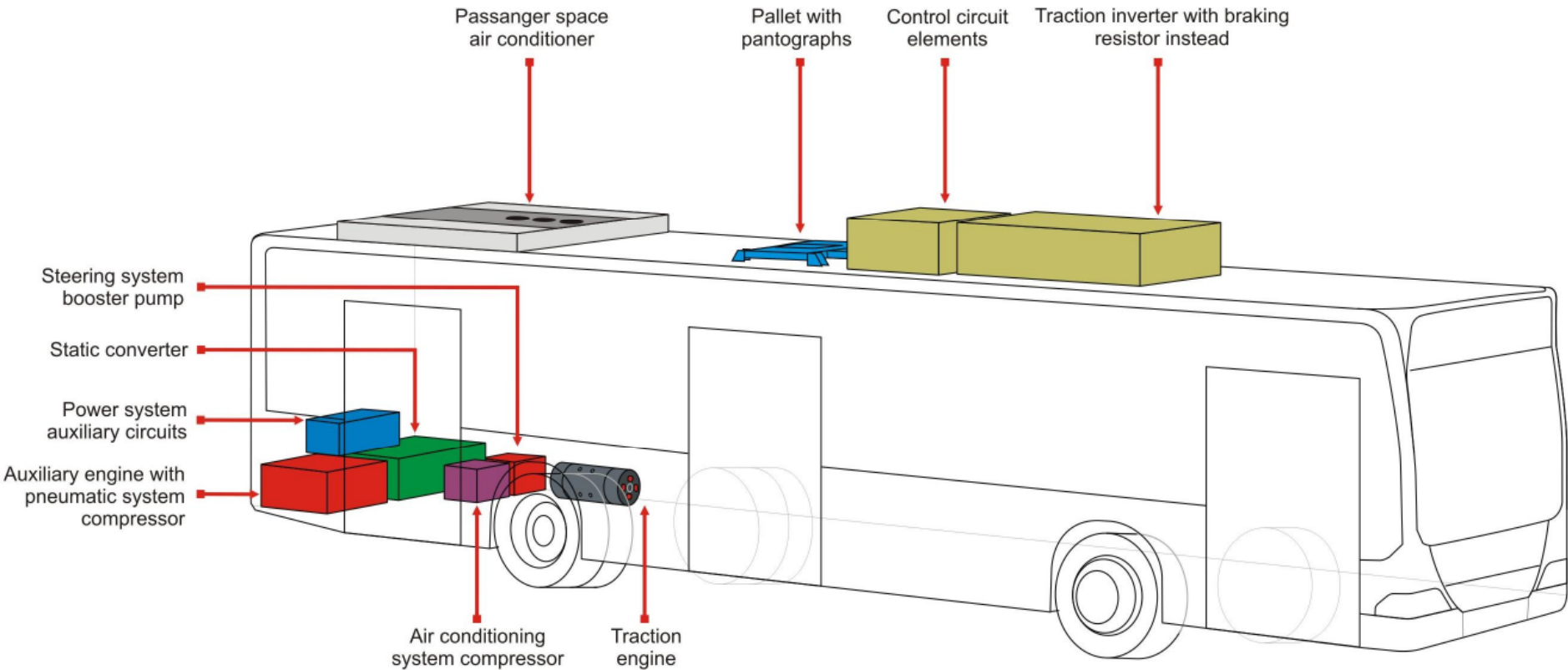
REBUILDING „TOWER DRIVE“



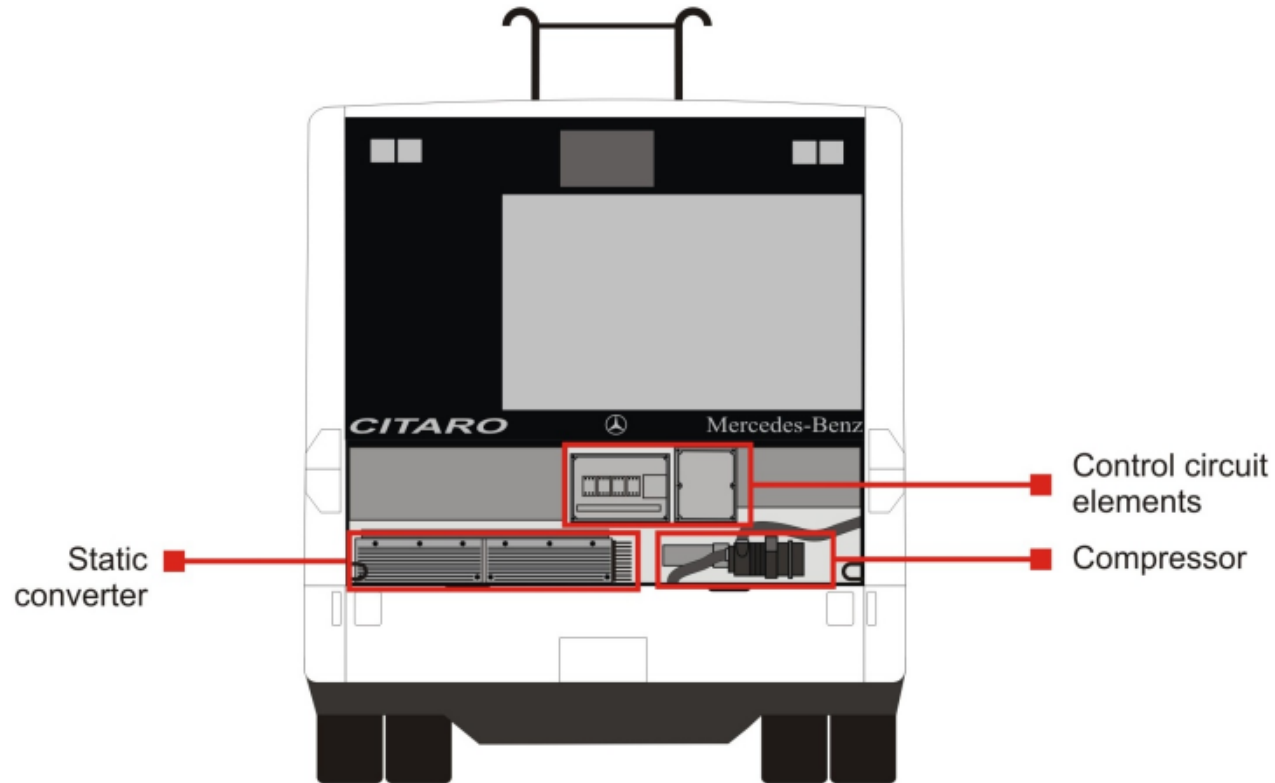
ELIMINATION OF FUEL TANK



Bus to t-bus conversion in Szeged



Bus to t-bus conversion in Szeged



Bus to trolleybus conversion

- ▶ Gdynia (Poland)
- ▶ Szeged (Hungary)
- ▶ **Tychy (Poland)**

Bus to t-bus conversion in Tychy

- ▶ Reasons for conversion approach:
 - ▶ Hight cost of the new vehicles
 - ▶ Hight maintance / service cost of the new vehicles
- ▶ In 2006 the first conversion:
 - ▶ New Solaris Trollino chassis
 - ▶ DC Motor + rheostatic control system
 - ▶ DC static auxiliary supply converter
- ▶ 3 vehicles converted in 2006 - 2007



Leipzig, October 2012

Impressions from conversion work

DC 600 V CONNECTORS IN „ENGINE TOWER“



AIR COMPRESOR AND OIL PUMP



ADAPTATION OF DESK BOARD



Failure frequency – groups of trolleybuses

<i>Groups of trolleybuses</i>	<i>Number of vehicles</i>	<i>Number of failures per 1000 km</i>
<i>Jelcz</i>	20	1,01
<i>Mercedes of 1st generation</i>	23	0,62
<i>Mercedes of 3th generation</i>	5	0,76
<i>Solaris / IEL</i>	16	0,57
<i>Solaris / Cegelec</i>	4	1,11
<i>Solaris / Medcom</i>	21	0,21
<i>Average</i>	90	0,56

Advantages & Disadvantages

Advantages

- ▶ Low floor t-bus at a bargain price
- ▶ Low cost of conversion in case of 10 years body and used electric equipment
- ▶ Easy conversion in case of 2nd generation low floor vehicles

Disadvantages

- ▶ Reduced lifetime of converted vehicle (old body)
- ▶ Diversed bus bodies – complicated conversion
- ▶ Complicated conversion in case of 3rd generation vehicles
- ▶ Complicated rules of vehicles registration in many countries
- ▶ High cost in case of new body or new electric equipment

Conclusion: Reasonable solution in case of using second hand bus bodies and old equipment



Thank you for your attention!