

Promoting **clean** public transport

## Technical principles of diesel bus to trolleybus conversion

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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 flor 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:

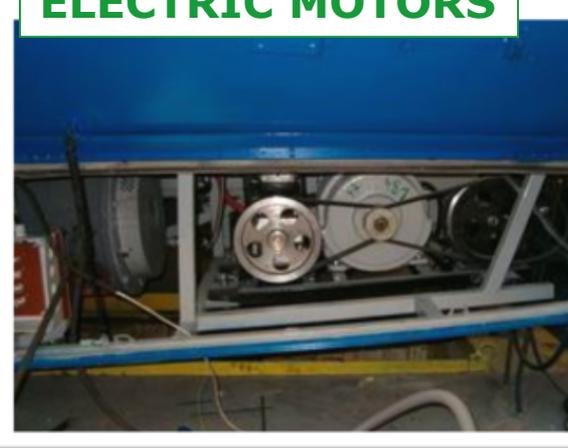
- ▶ Choosing the coachwork and type of the traction drive
- ▶ Analysis of the legal aspects of the conversion – the technical requirements for **the trolleybuses are different than in case of buses**
- ▶ Beside disassembly of the diesel engine and assembly of the electrical installation it was necessary 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

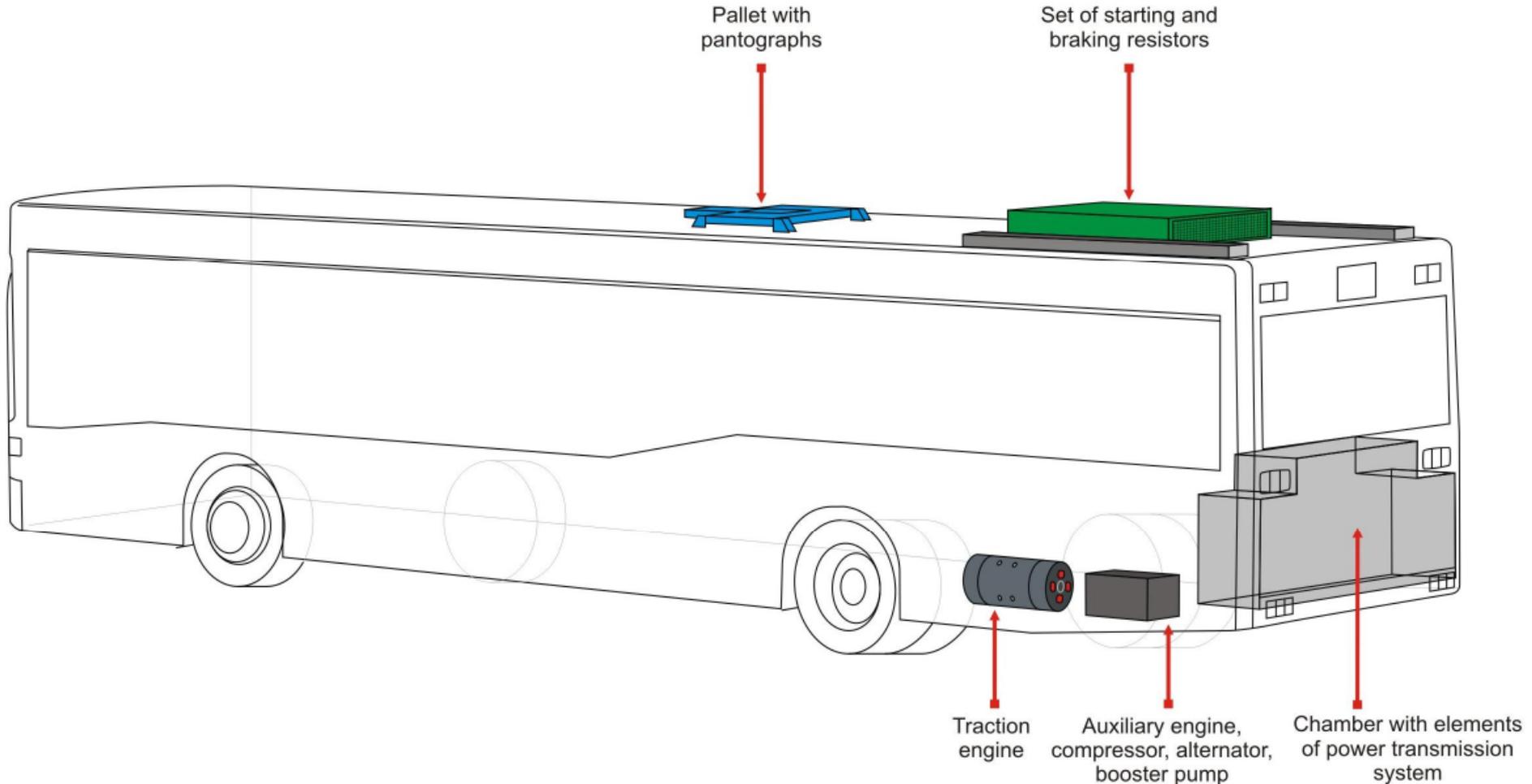
**ASSEMBLING OF  
ELECTRICAL  
EQUIPMENT**



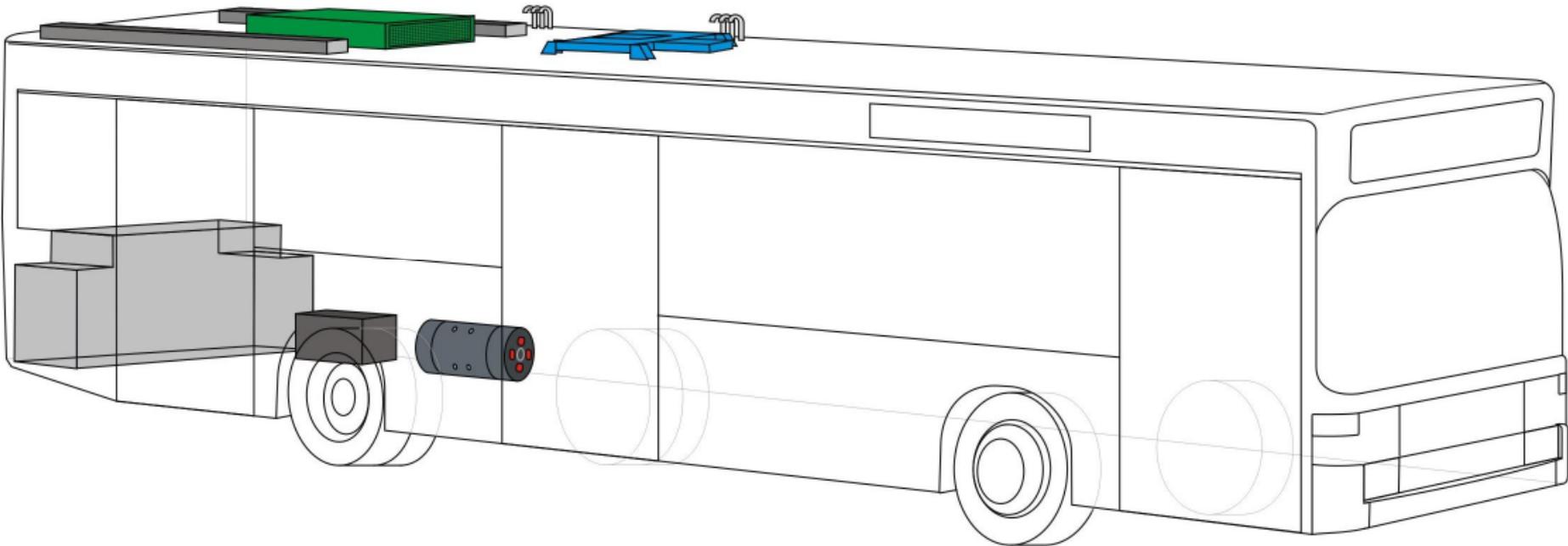
**READY TO GO !**



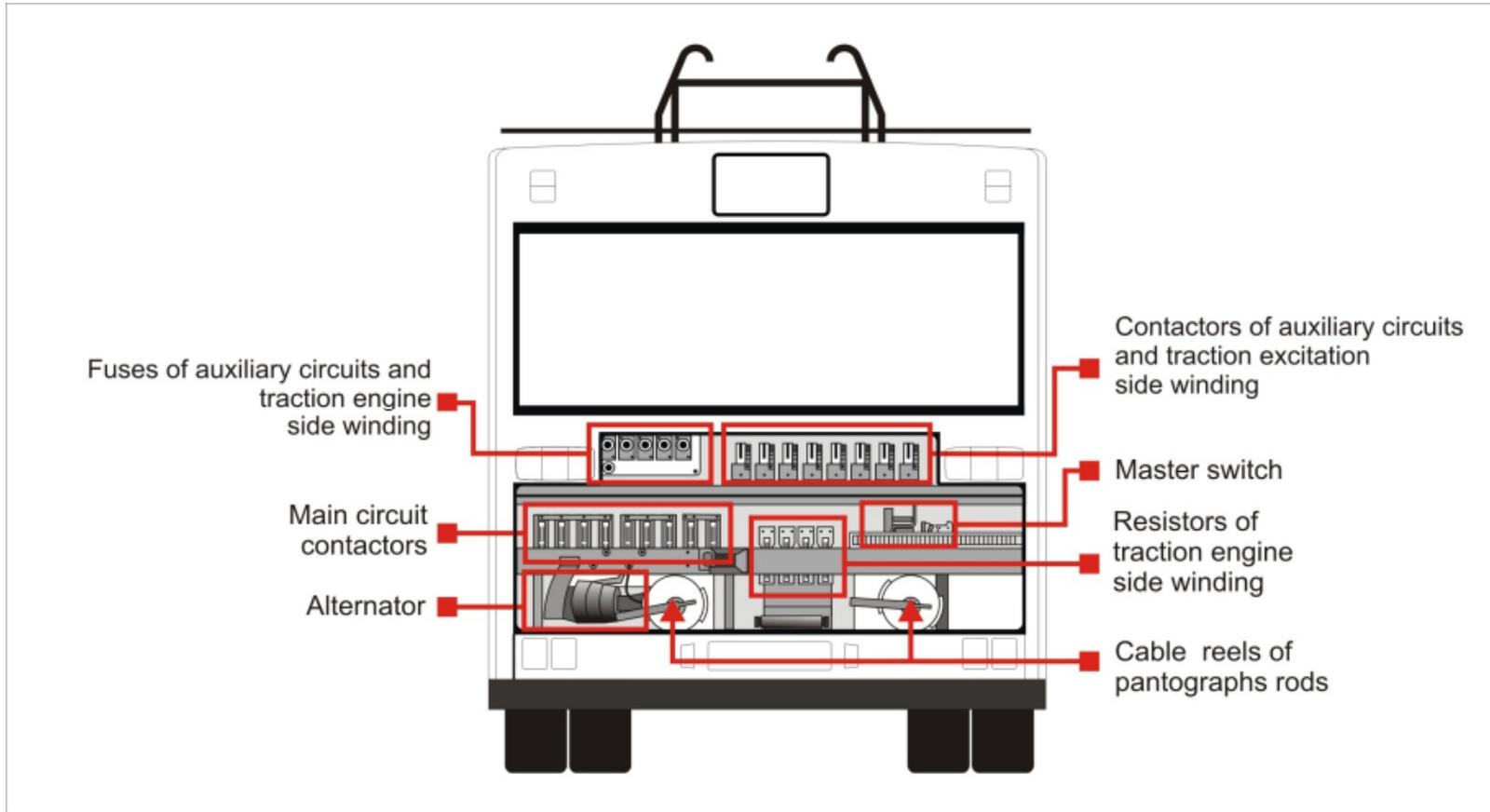
# The 1st generation of conversion



# 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



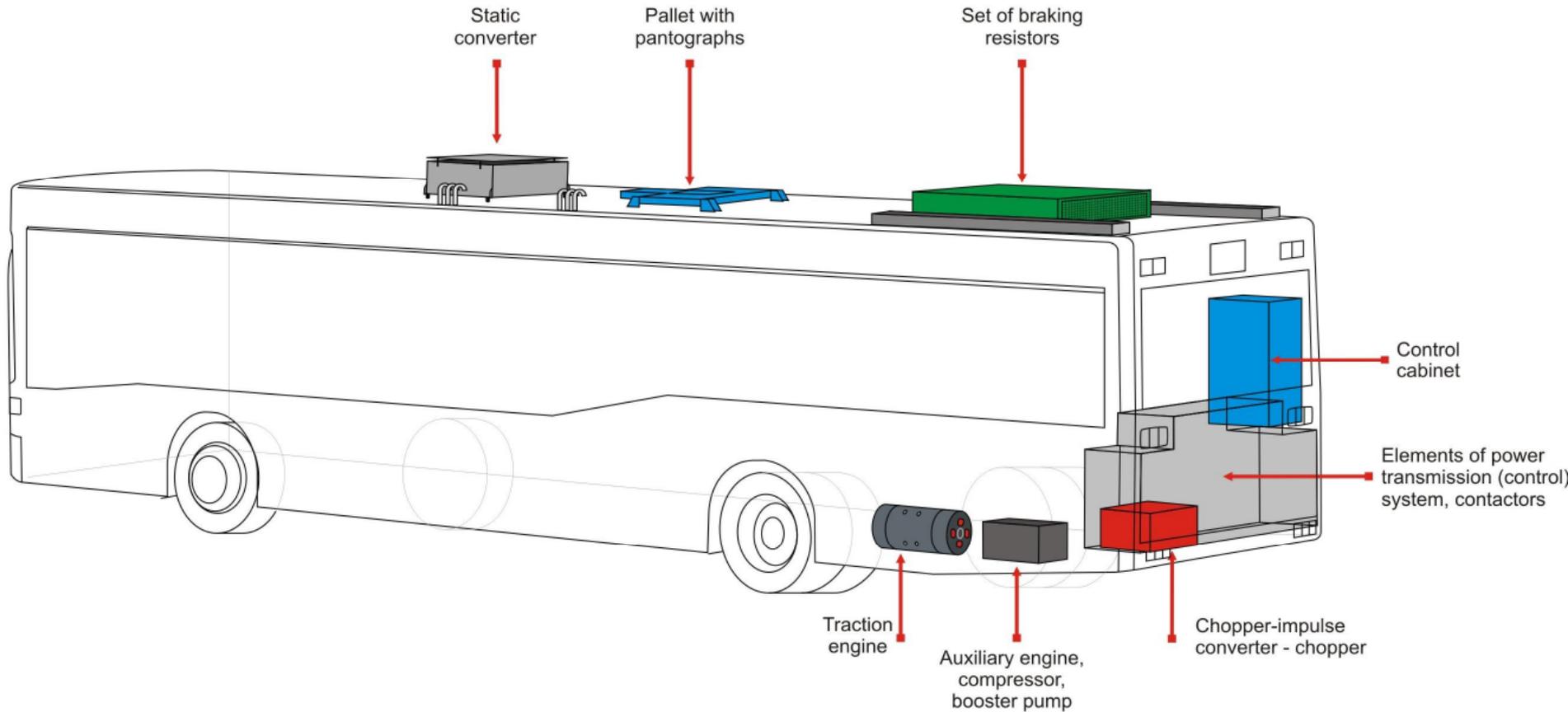
# The 2nd generation of conversion

## Converted Mercedes trolleybus with DC chopper propulsion system (2008)

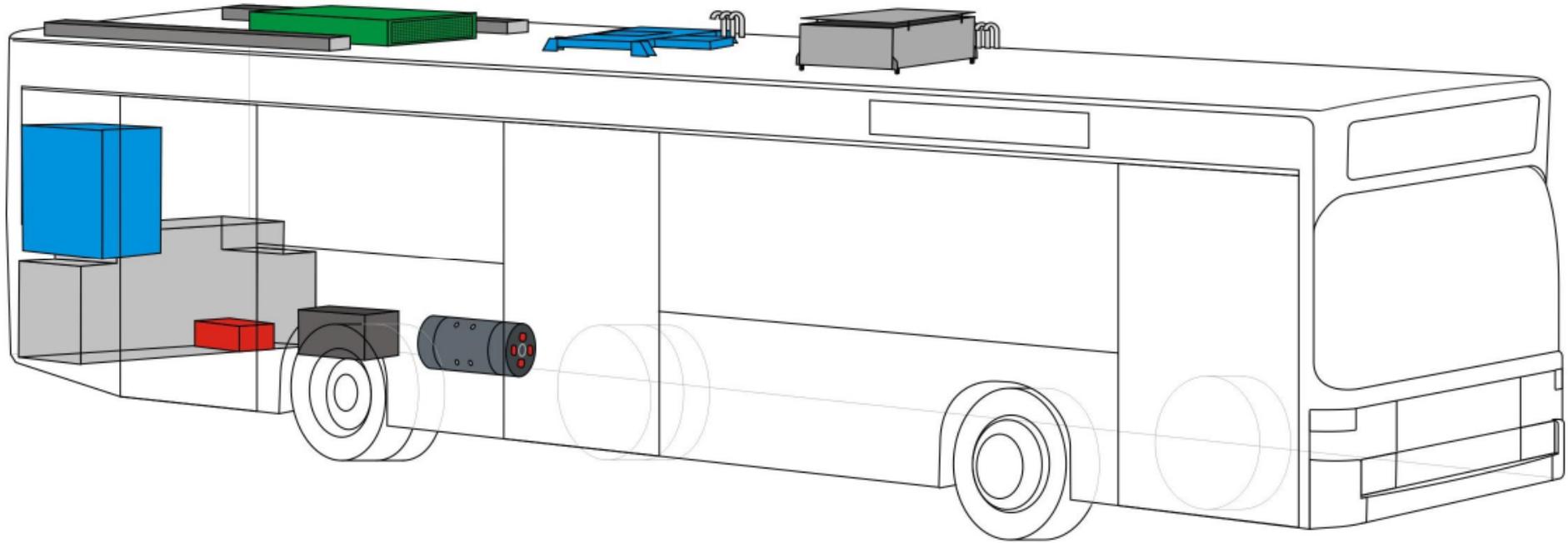
- ▶ DC traction motor from old vehicles
- ▶ New DC converter – chopper in place of rheostatic control system
- ▶ New DC/DC converter for auxiliary engines
- ▶ Two level of 600 V equipment isolation



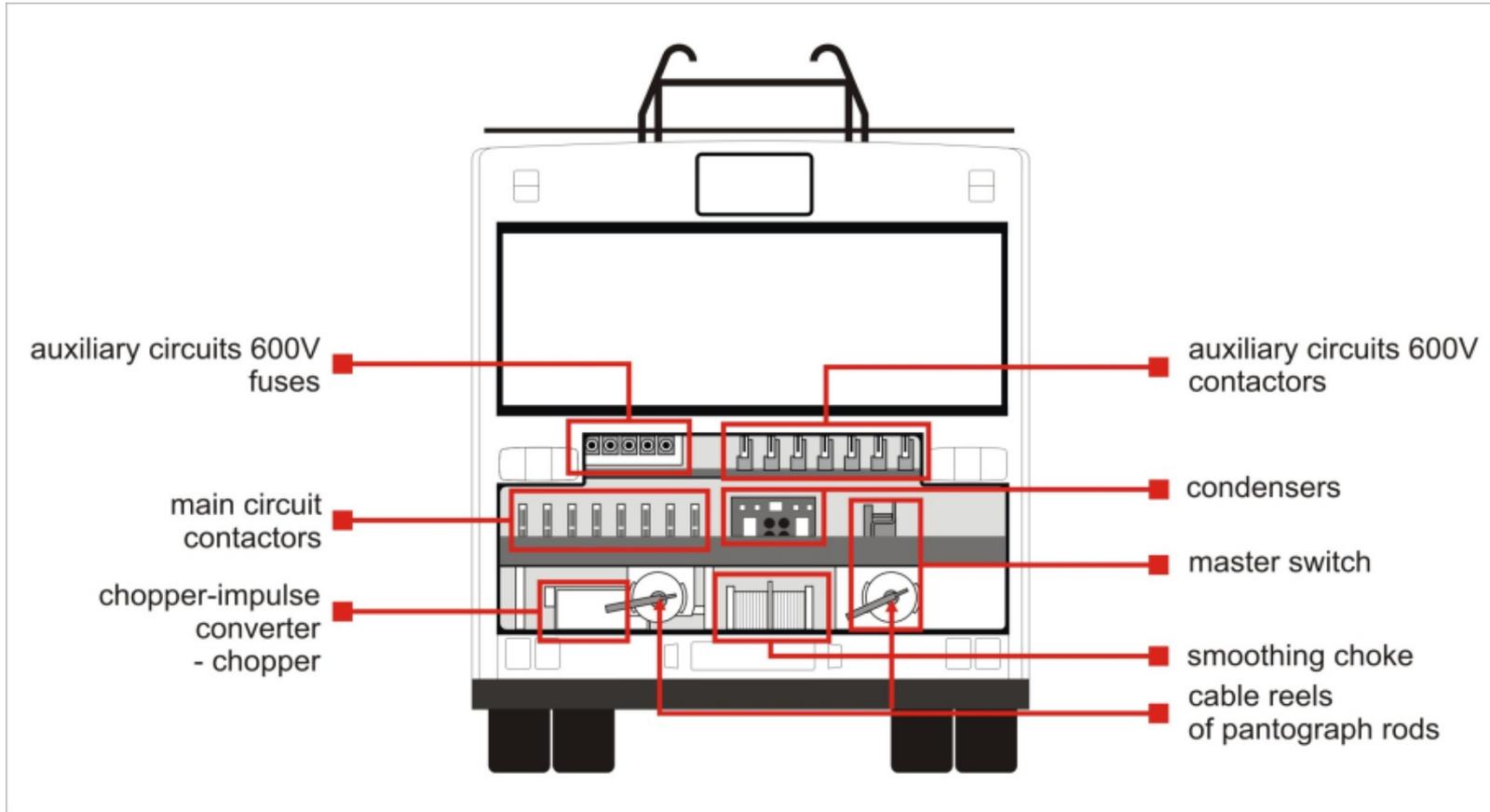
# The 2nd generation of conversion



# The 2nd generation of conversion

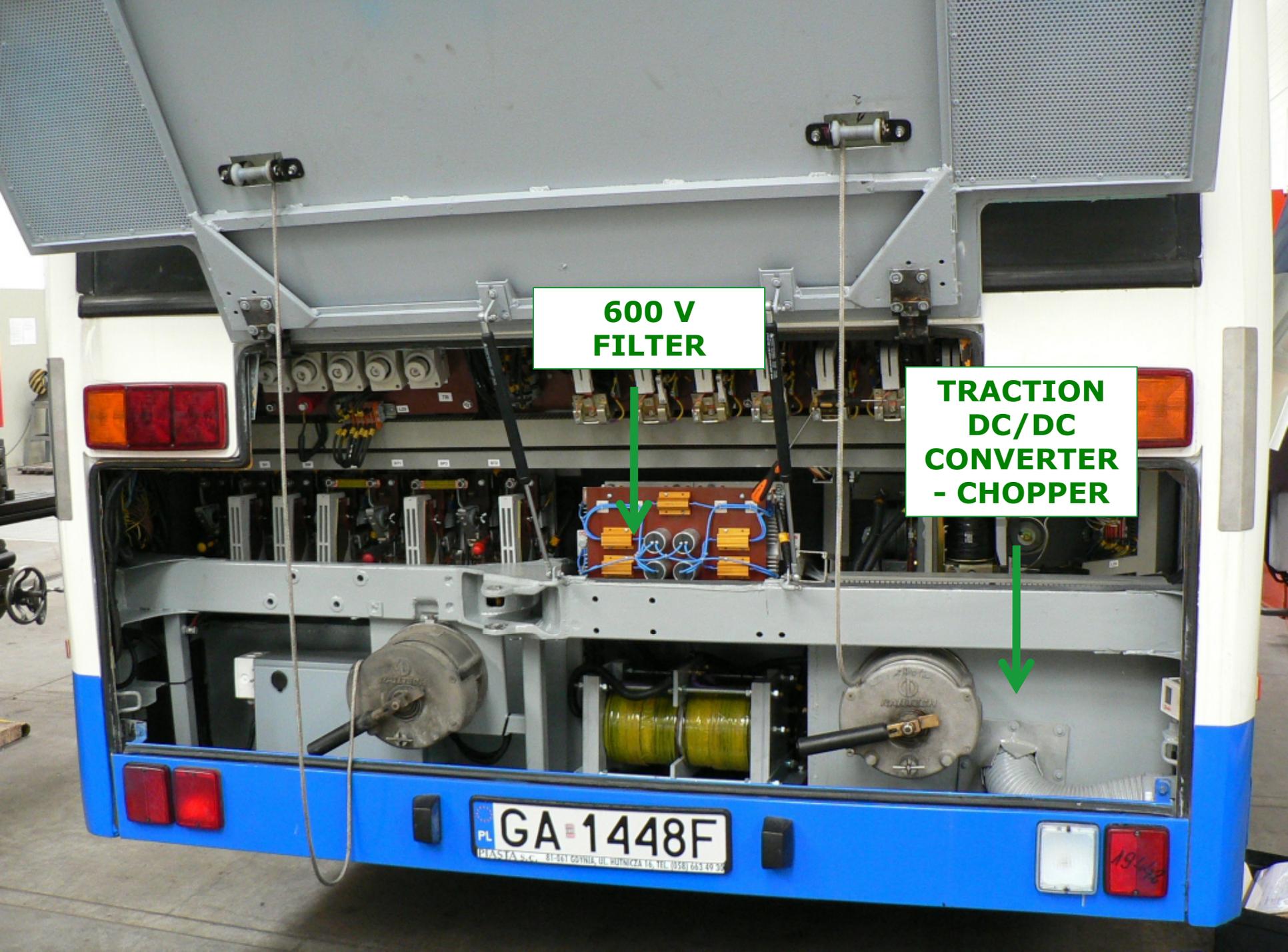


# The 2nd generation of conversion

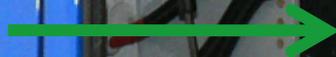


**600 V  
FILTER**

**TRACTION  
DC/DC  
CONVERTER  
- CHOPPER**



**TRACTION  
MOTOR**



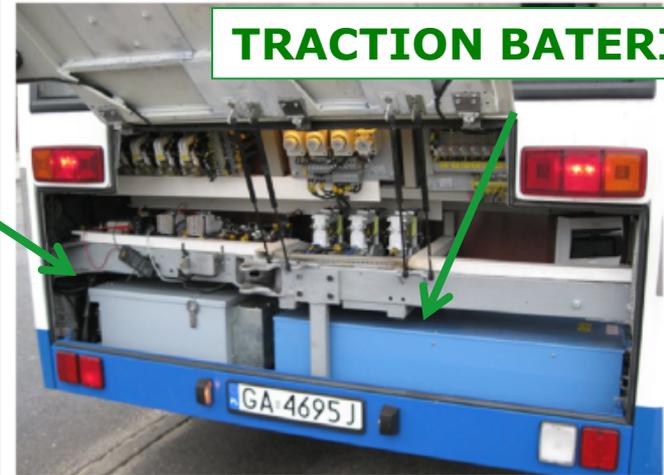
# The 3rd generation of conversion

## 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

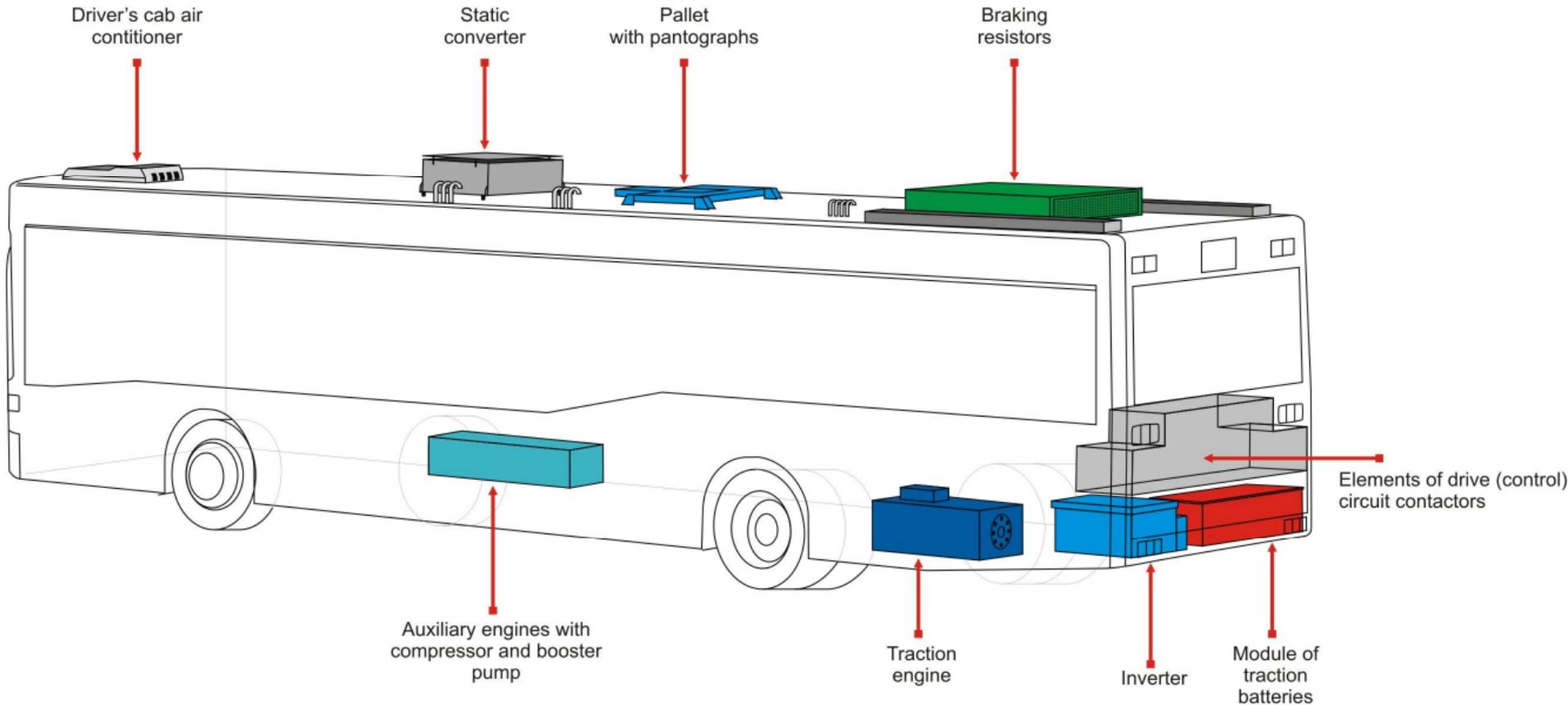


**TRACTION  
INVERTER**

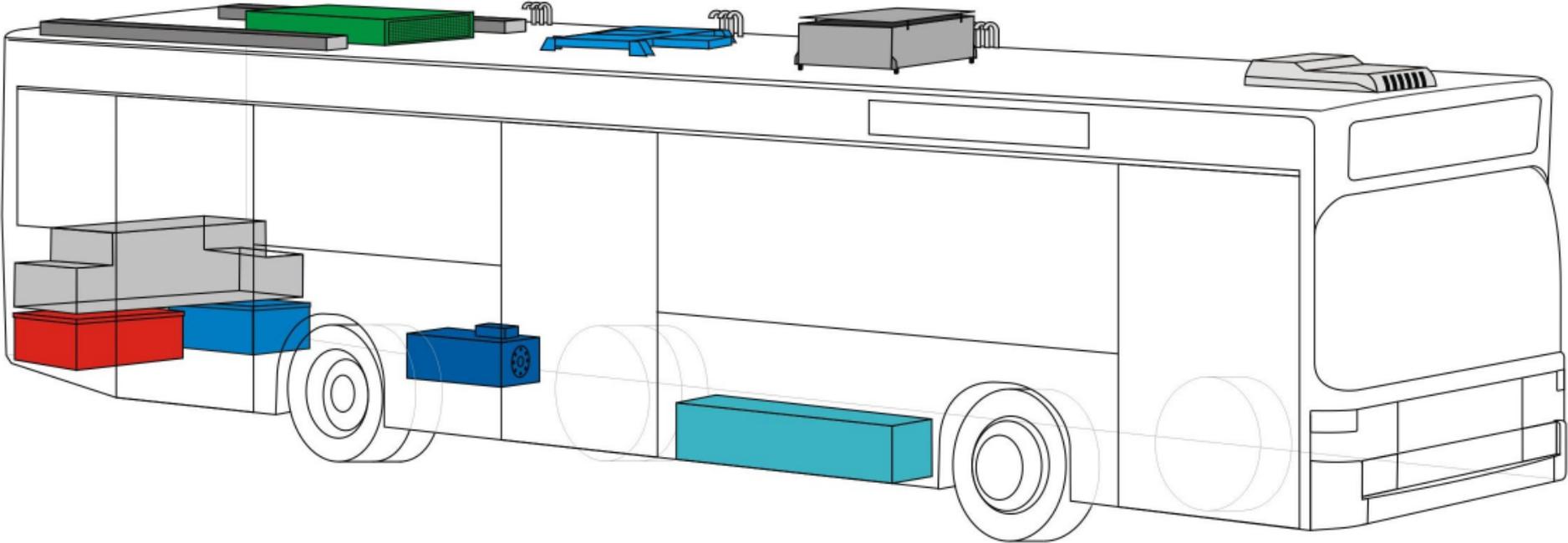


**TRACTION BATERIES**

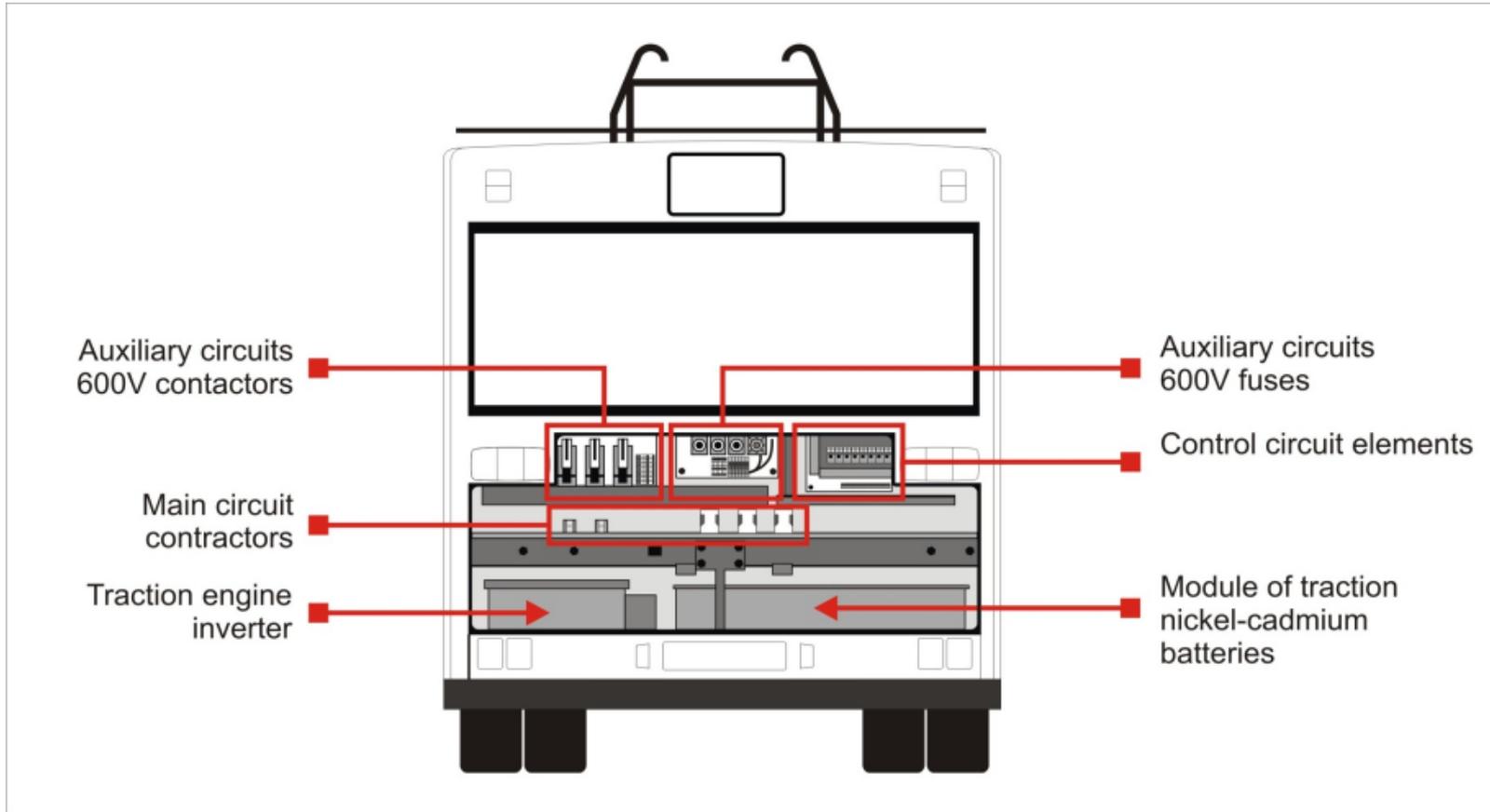
# The 3rd generation of conversion



# The 3rd generation of conversion



# The 3rd generation of conversion



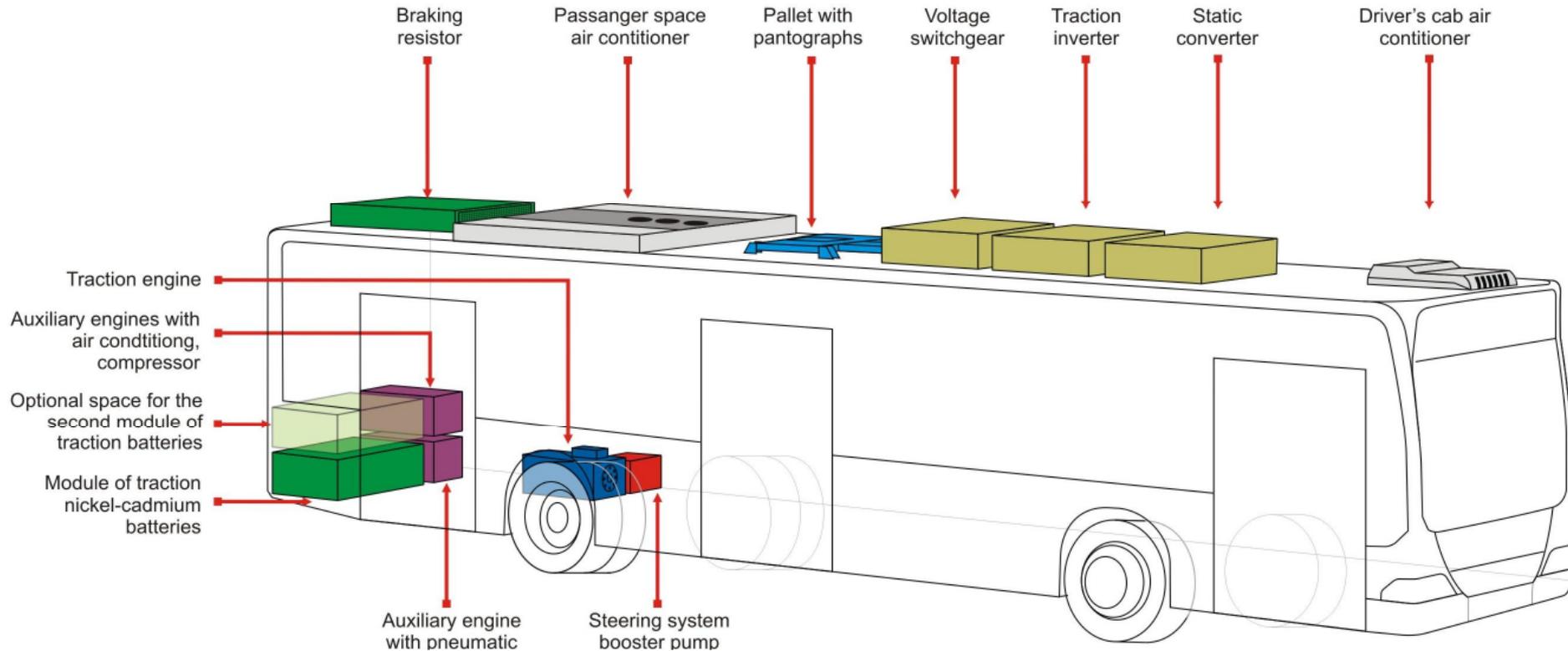
# The 4th generation of conversion

## Mercedes Citaro O530

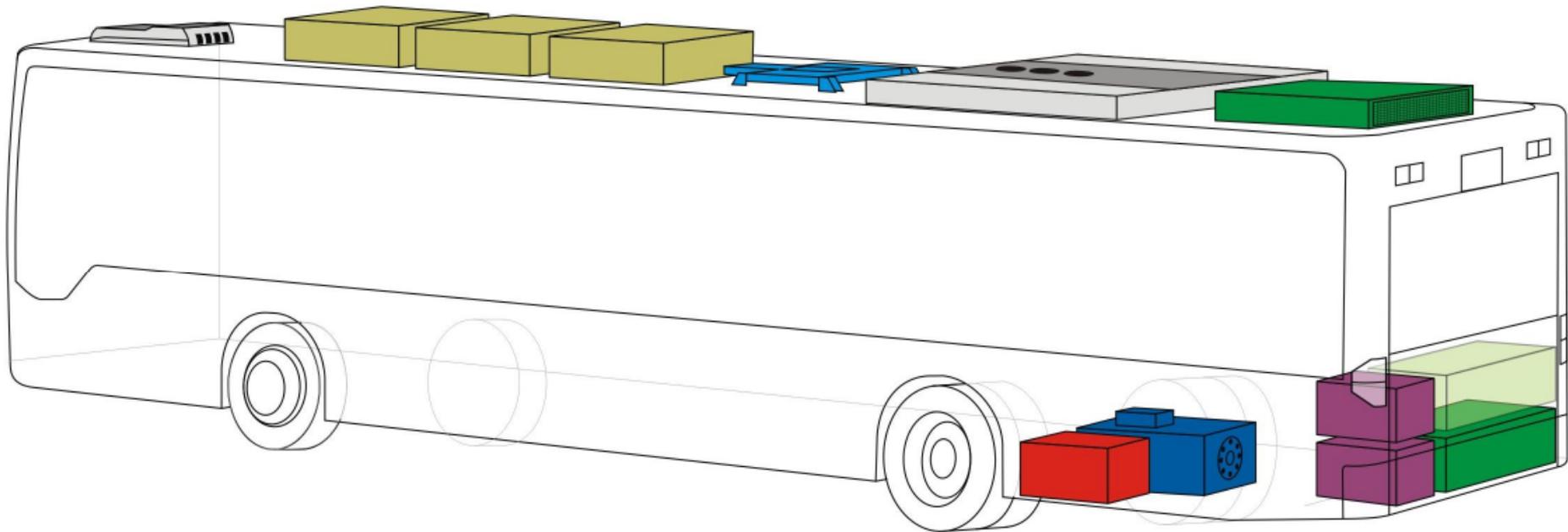
- ▶ Electrical equipment is the same like in the 3th generation vehicles
- ▶ But, much more modern chassi with complete air condition



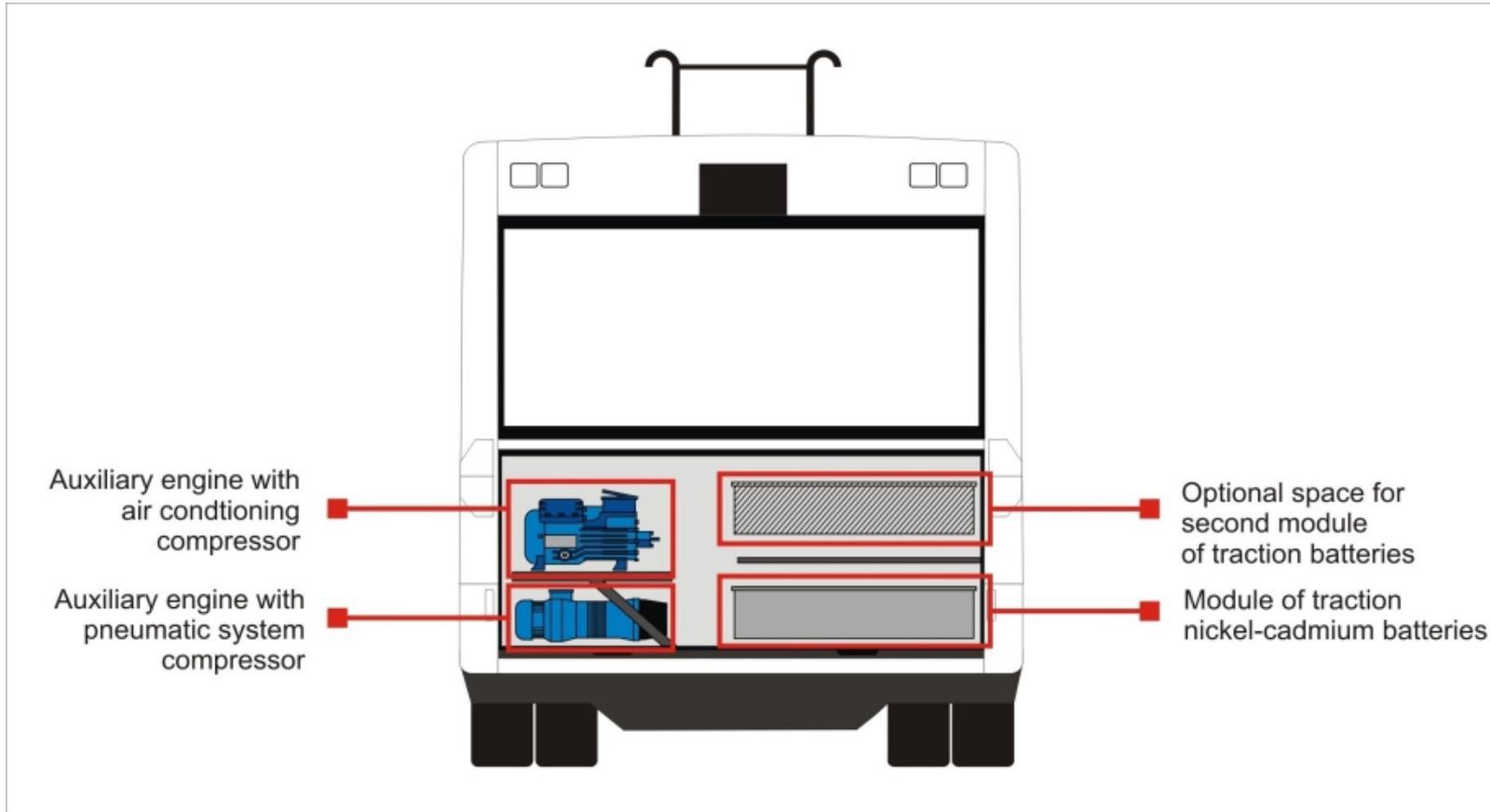
# The 4th generation of conversion



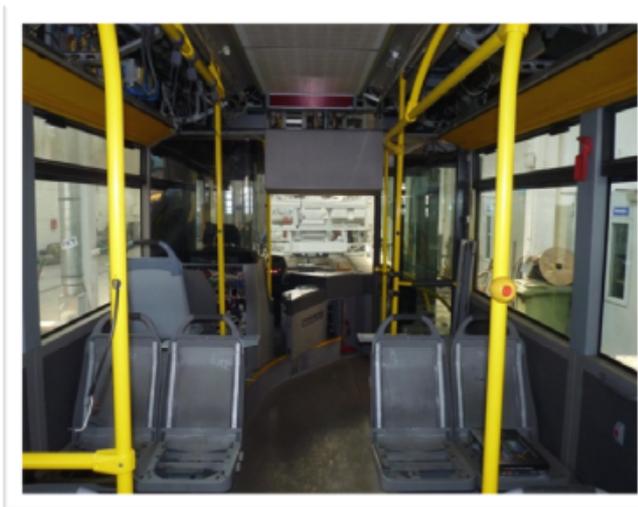
# The 4th generation of conversion



# 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



# Impressions from conversion work

## REMOVING OF DIESEL ENGINE



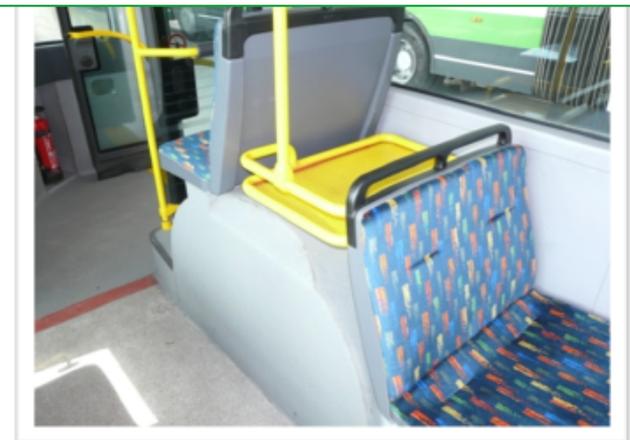
## TRACTION MOTOR BOX



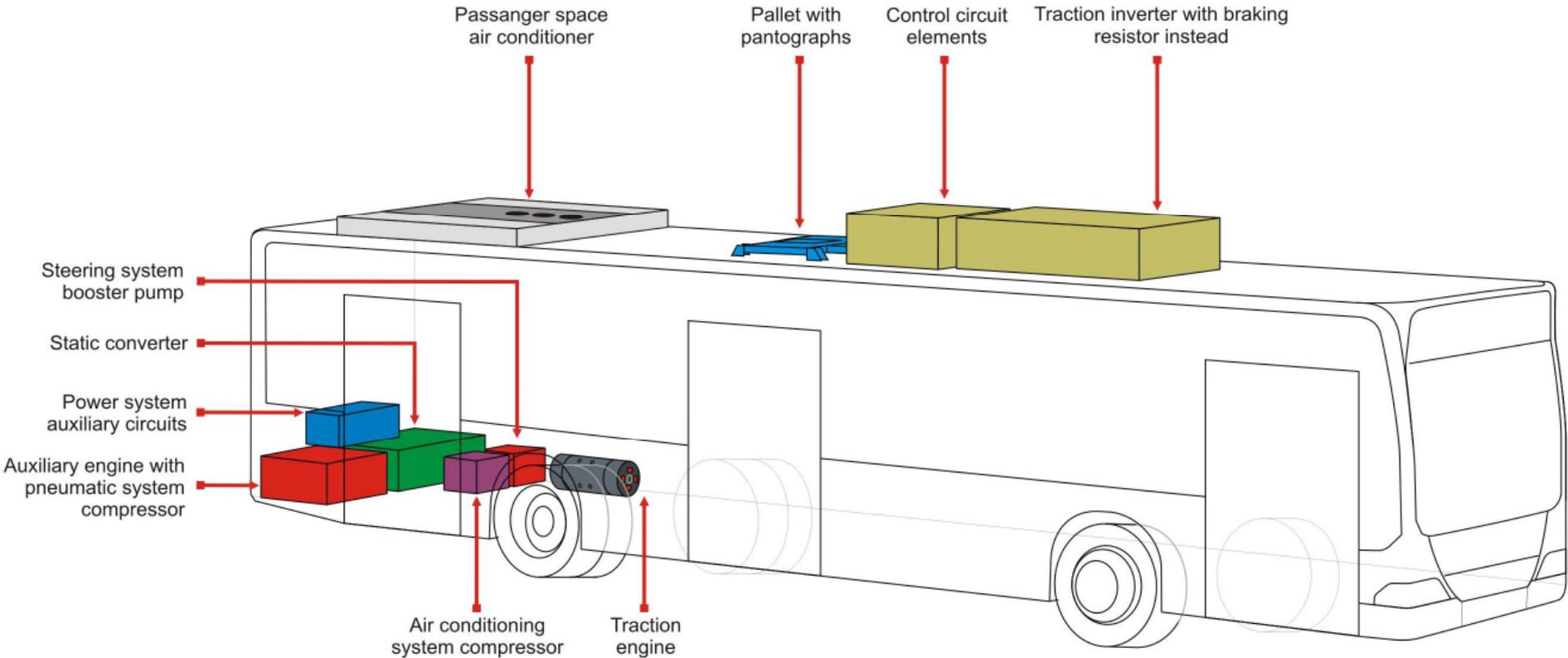
## REBUILDING „TOWER DRIVE”



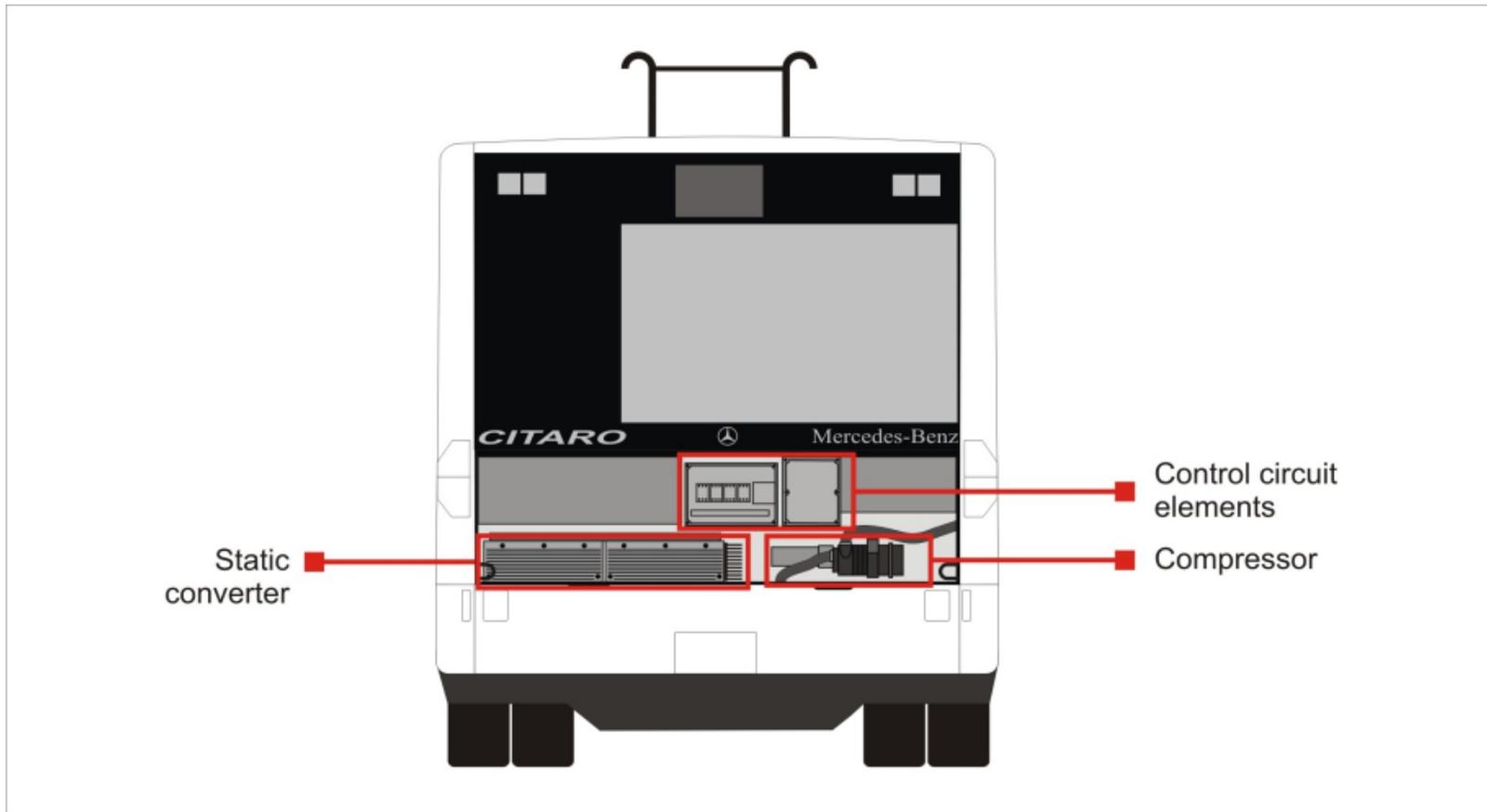
## ELIMINATION OF FUEL TANK



# Bus to t-bus conversion in Szeged



# Bus to t-bus conversion in Szeged



# Bus to trolleybus conversion

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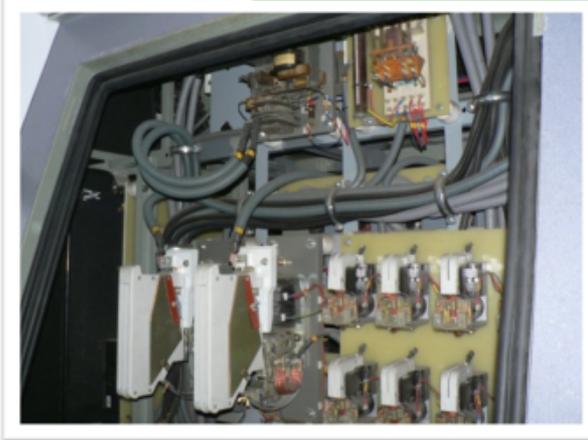
# Bus to t-bus conversion in Tychy

- ▶ Reasons for conversion approach:
  - ▶ High cost of the new vehicles
  - ▶ High maintenance / 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



# 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!