

ECS Simulation Conference 2023

Electrification of a Bugatti 35T - as a tool to develop our modular YMER TMS

Josef Graubmann – Director BU TMS / Managing Director

Agenda

1. About YMER
2. YMER TMS® in a nutshell
3. Electrification of a Bugatti 35T
 - Motivation and Targets
 - The “original” car
 - Technical Concept and Set-Up
 - TMS and Development Ideas



About YMER

We are developing the future of cooling systems based on our intensive experience



Our Company

We have an international footprint and are proud of our trustful and long-term customer relationships



Founded 2005,
privately owned



40 mn. €
turnover
in 2022



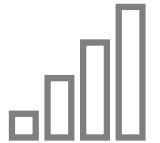
Start of the YMER
TMS® business
unit in 2018



Development in
Sweden,
Germany, USA
and France



Production in
Sweden, China,
USA



Over one million
produced
cooling systems

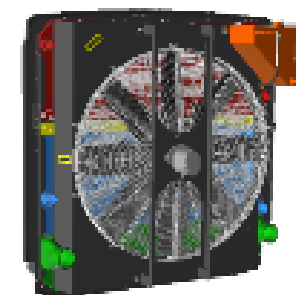
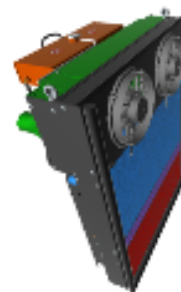
Best Class Cooling Systems

Our market know-how and our long-lasting experience enables us to develop best in class cooling systems for our customers

Purley focused on Off-Highway machines



We understand ourself as a system supplier



We work for...



E-machine customers with YMER TMS® in Development or in Series Production





YMER TMS in
a nutshell

Our Thermal Management
Systems are ensuring highly
efficient electrical machines



**Ymer
Technology**

The Ymer TMS®



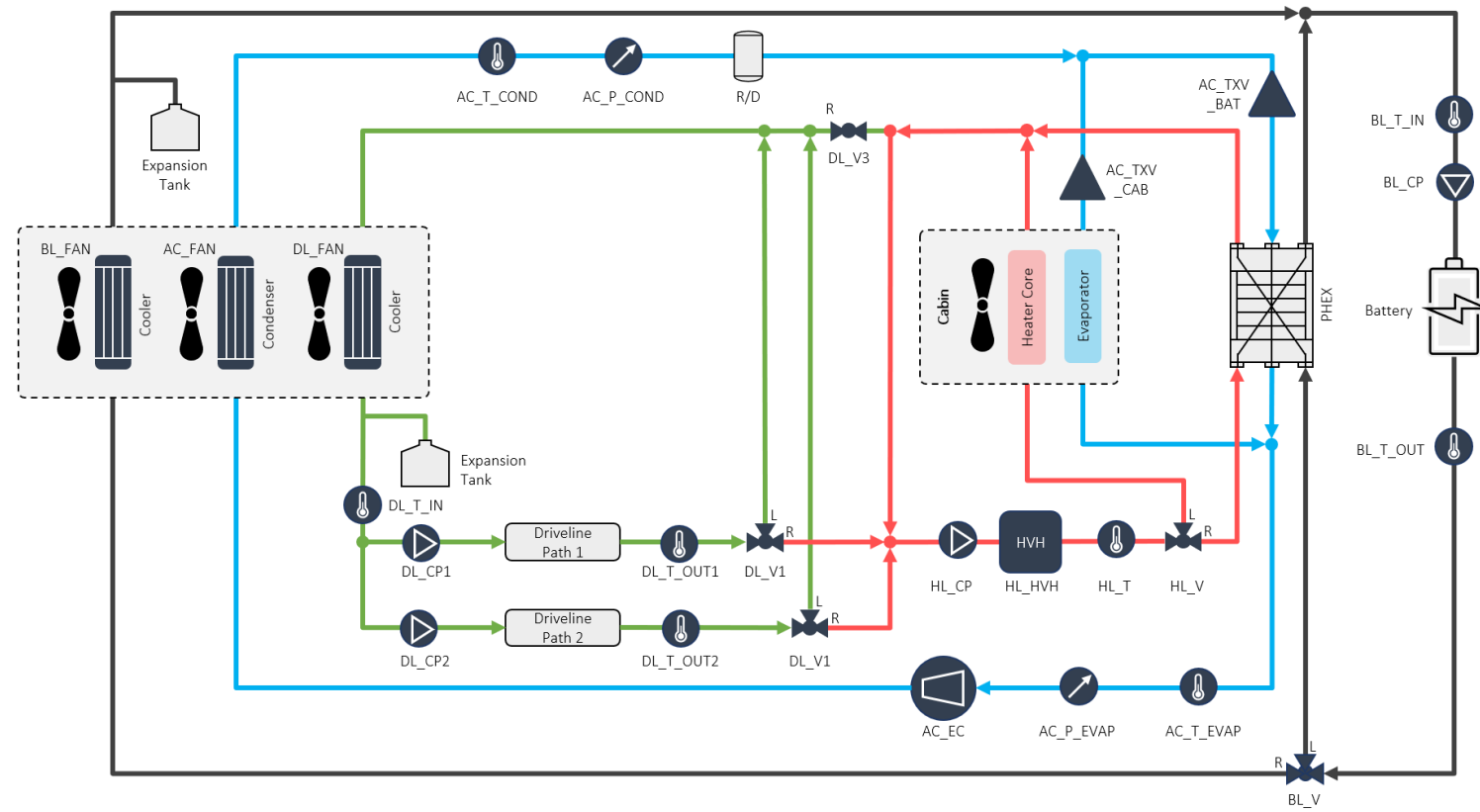
- Comprehensive system for electric vehicles and machines
- Highly flexible and a modular approach
- Autonomous control with intelligent ECU works in tandem with heater, compressor, pumps and coolers
- Focus on smooth operation, energy saving and high efficiency

Fully integrated Stand Alone System

The YMER TMS® focusses on component and energy efficiency.

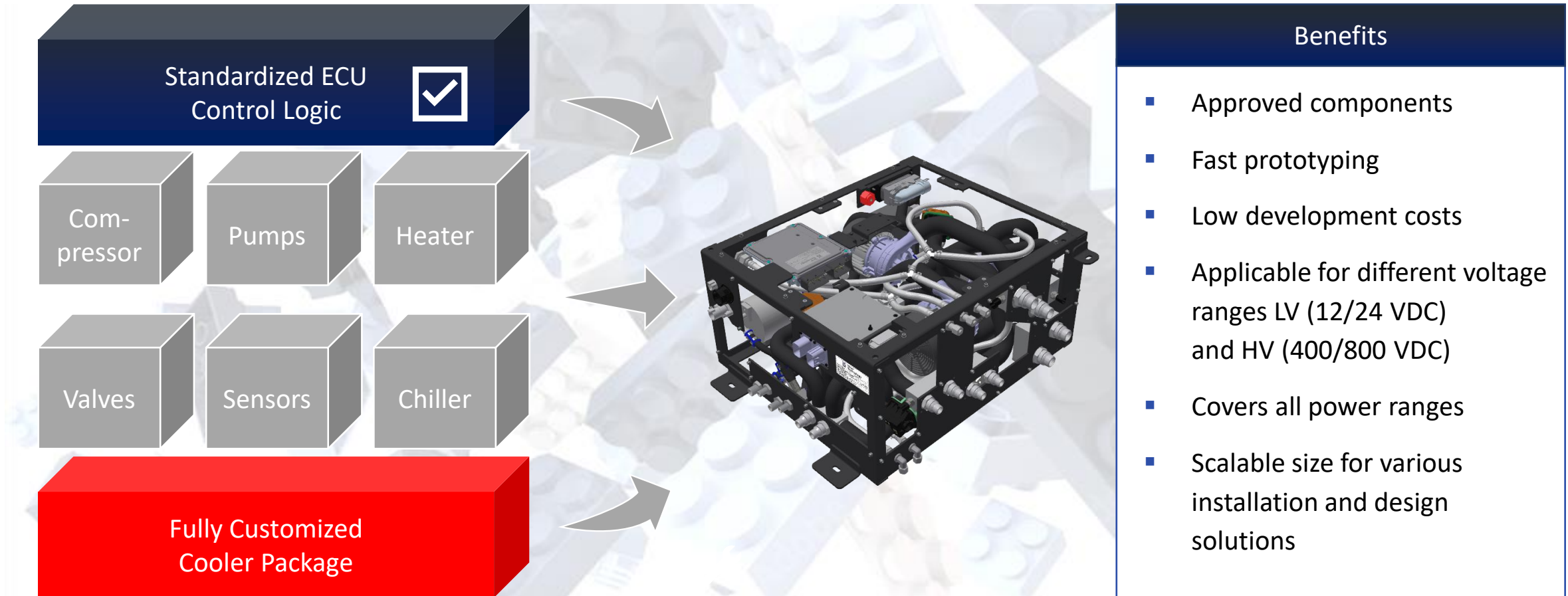
Functions Overview

- Battery and cabin management
- Residual heat & passive cooling to increase efficiency
- Reduced amount of components
- Pre-conditioning fully integrated
- Independent control logic
- “Plug and Play” ready



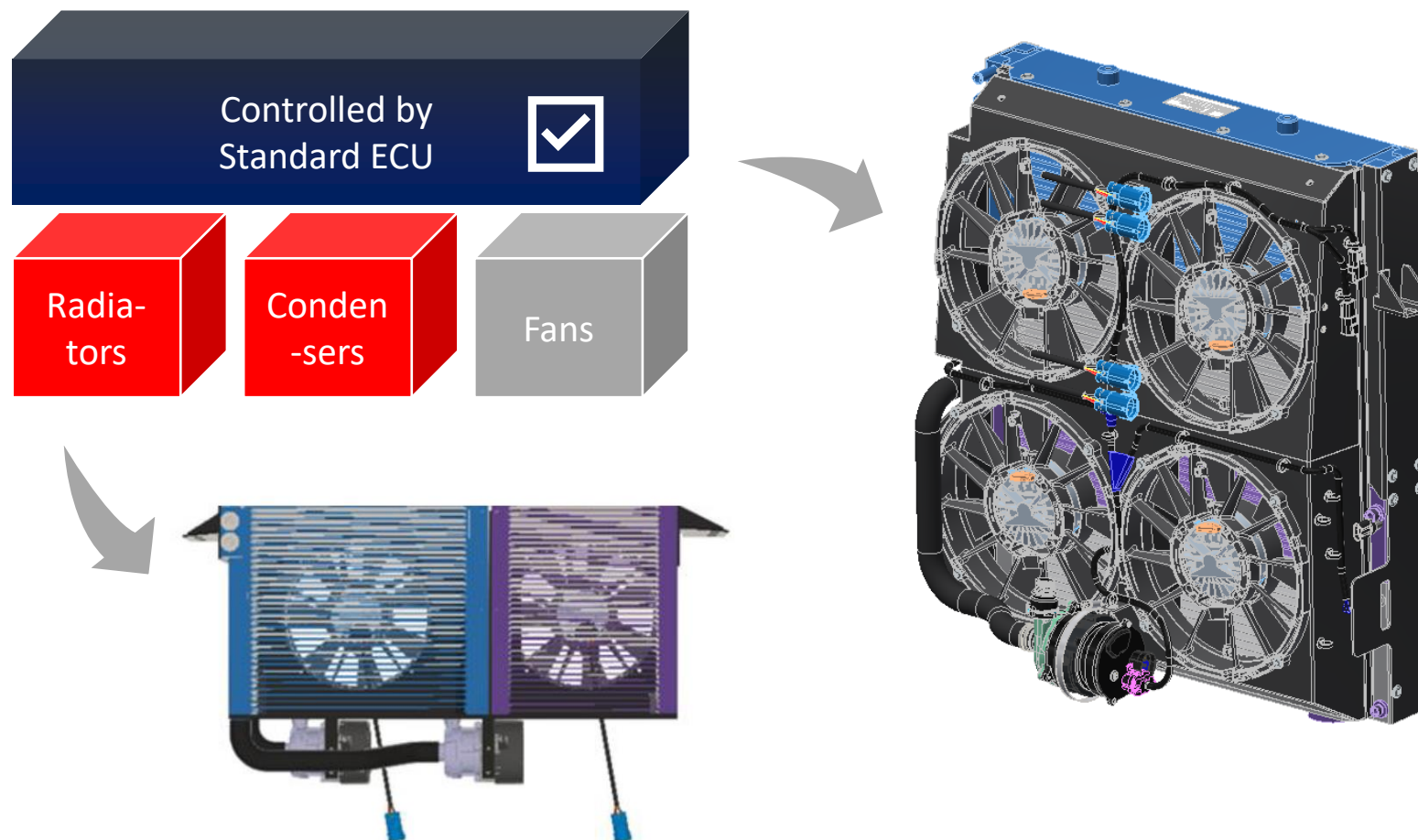
1st step: YMER TMS[®] as fully modular system

Ymer TMS offers high flexibility and customization based on a modular platform



Fully customized Cooler Pack

Part of the YMER TMS® is a 100 % customized cooler pack

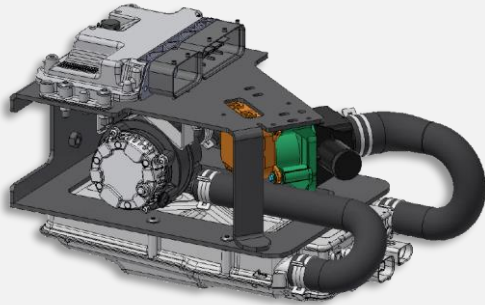


Needed Fans

- PMW or CAN controlled
- Different sized and power ratings
- Preferably high Δp resistance / capabilities
- IP6K9K – installed outside
- Lifetime > 15.000 hours

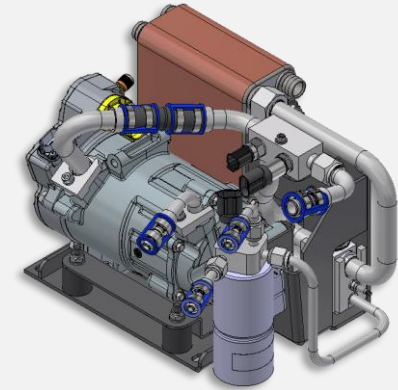
2nd step: YMER TMS[®] Standard Modules

Heating Module



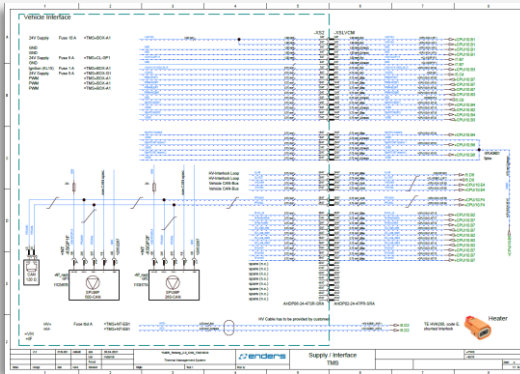
- HV heater
- Coolant pump
- 3-2-way valve

- Compressor
- Receiver drier
- Plate heat exchanger



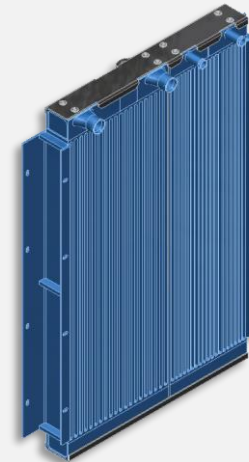
Cooling Module

Electronics



- One ECU
- Standard wiring harness & connections

- Matrix portfolio
- Standard setup
- Adjustable in dimensions

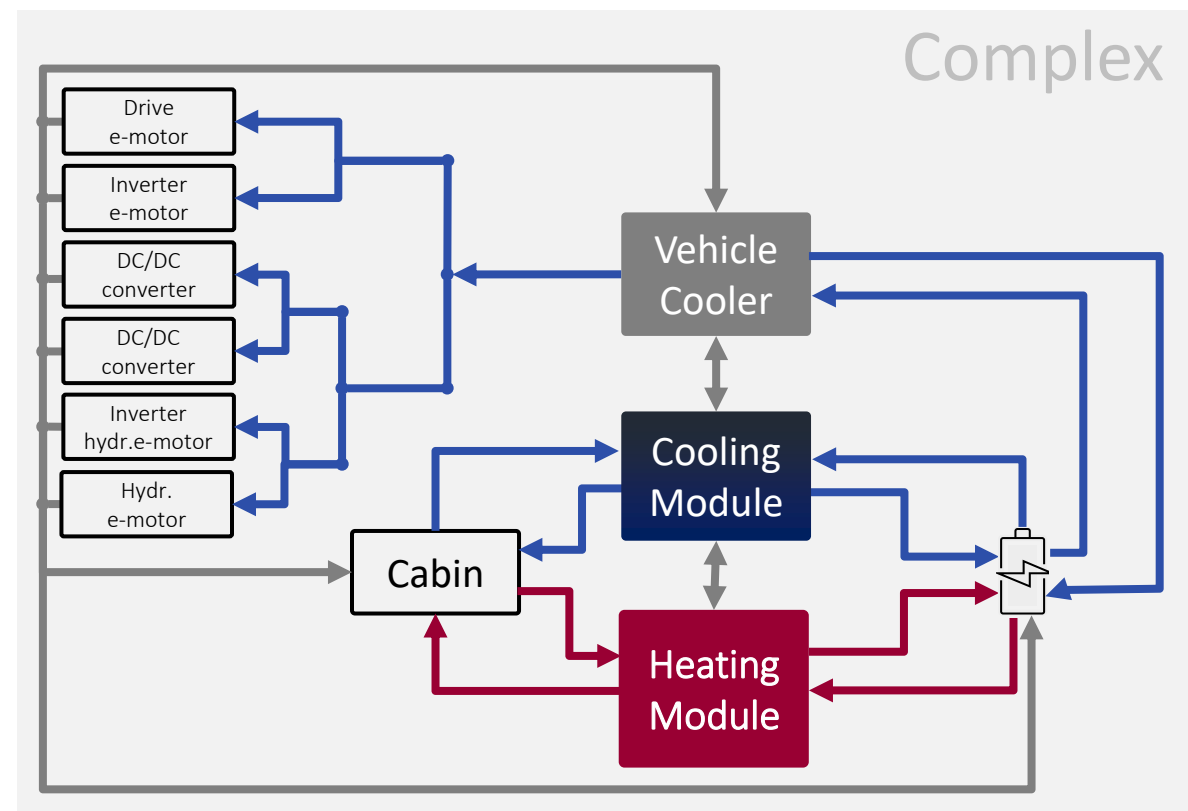
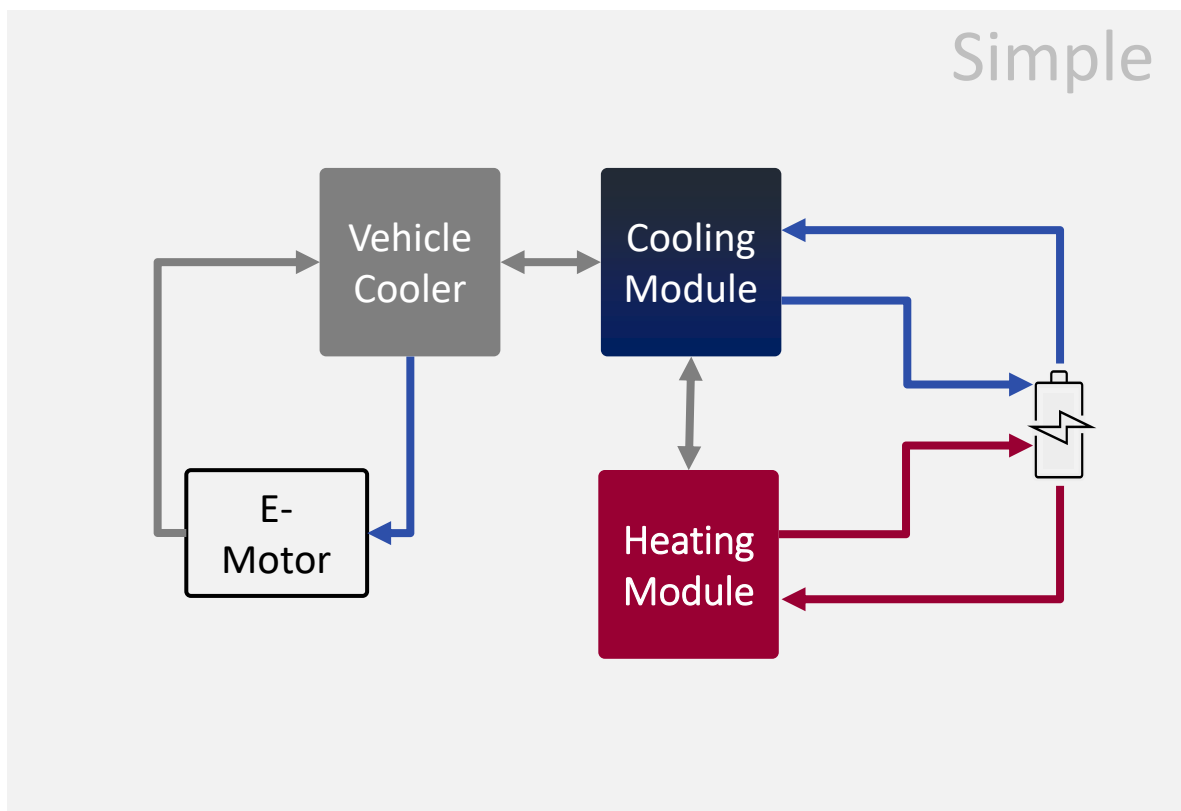


Standard Cooler

- ▶ Lower development time
- ▶ Lower development costs
- ▶ Higher quality
- ▶ Scalability and thereby lower costs for components

Simple to Complex Solutions

Realization of simple to complex system layouts. Standard modules in combination with individual components lead to highly flexible customer solutions



Modular approach to meet all requirements



12 VDC to
850 VDC



-30° up to
+50°C



No cabin to Full-
Auto HVAC



30 kWh to
650 kWh



Refrigerant &
Liquid Cooled
Batteries

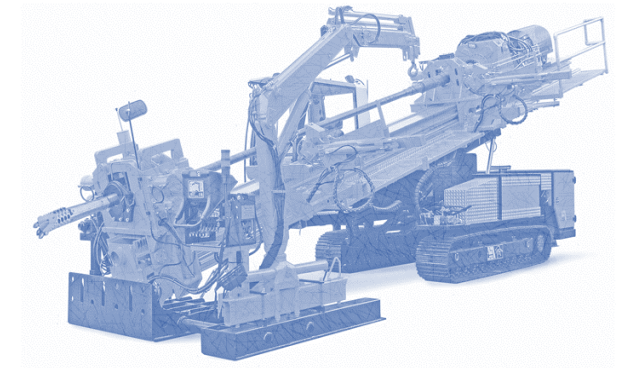
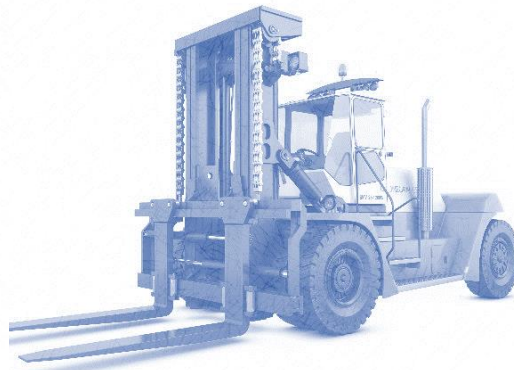


From simple
to complex
drivetrains



Ymer TMS® Applications

Today our YMER TMS® Systems are applied and operating at several different machines and applications.





Electrification of a Bugatti 35T

E-Mobility **fits in every
frame.** Even in very old and
very small ones.



Motivation and Targets

Motivation

- Motto "Electromobility fits into every framework"
- World's first electrified Bugatti Type 35T
- Emission-free driving in a vehicle that is almost 100 years old
- **Increased efficiency of all components through active control of the operating temperatures**
- Contact to university and attract new talents
- Build R&D cooperation with university

Targets

- Integrate electric drivetrain with battery as well as fuel cell powered
- Keep car in original shape to be able to "switch back"
- Keep identical driving performance as the original car and same weight
- Road license
- **Fun!!!!**

The “original” car

Facts & Figures

- Bugatti Type 35T built in 1926
- Curb weight: 750kg
- Permitted additional weight FA: 250kg
- Allowed additional weight RA: 125kg
- Top speed 177 km/h
- Power 110 hp



Challenges and Tasks

- Packaging – no drawing and models are existing
- Cw-Value unknown
- Definition of needed battery capacity and fuel cell performance to achieve 200 + 100 km range
- Selection (and availability) of components
- Electrical and mechanical integration

YMER Solutions

- 3d-model created via 3d-Scanning
- Cw-Value calculated and simulated using shadow measurement
- Intensive study of different voltage levels (pros and cons) and different motor as well as battery types and manufactures
- E-Motor: 80kW peak power 45 kg - Ø 254 x 265mm
- With 48V system voltage range no contact protection measures required
- Battery Capacity: 22 kWh + 5 kW Fuel Cell as Range Extender

Technical Concept and Set-Up

Battery: CATL 16S

Akkumulatortyp	Akasol Typ3P	CATL 16S	MG-RS Series	Scio Brick
Anzahl benötigter Module	3	2	3	8
Energieinhalt (kWh)	19,8	22	22,2	20
Punkte	1	3	4	2
Kapazität (Ah)	450	376	432	400
Punkte	4	1	3	2
Maximale Entladerate (A)	567	1400	1260	1120
Punkte	1	4	3	2
Kühlmedium	Wasser	Wasser	Wasser	Luft
Punkte	4	4	4	0
Abmaße (Länge x Breite x Höhe) (mm)	590x446x399	643x372x228	593x355x960	397x220x776
Punkte	2	4	1	3
Gewicht (kg)	156	103,4	210	124
Punkte	2	4	1	3
Preis (€)	3700	2800	8000	2000
Punkte	2	3	1	4
Gesamtpunktzahl	16	23	17	16

OBC and BMS

- Performance: 3,3 kW



Hydrogen Tank: HES Energy

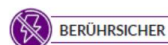
- Speichervolumen: 2700 L
- Speicherdruck: 300 bar



Motor/Inverter: Sicad V50



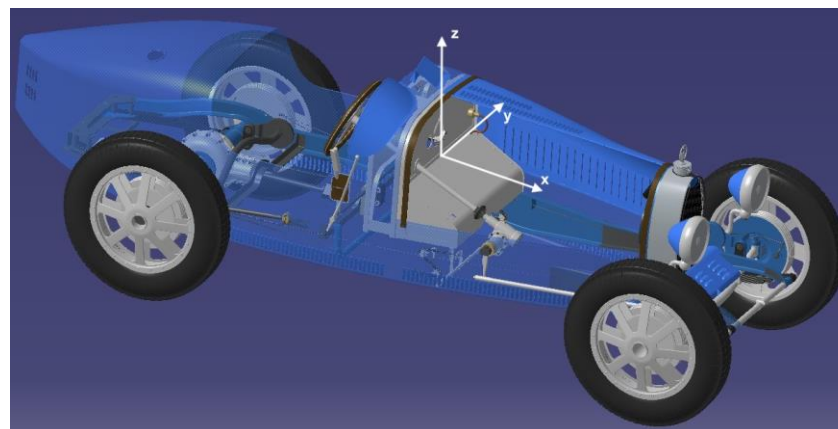
ISCAD V50



48 V Hochleistungsantrieb
mit integriertem Controller

Spezifikationen* ISCAD V50

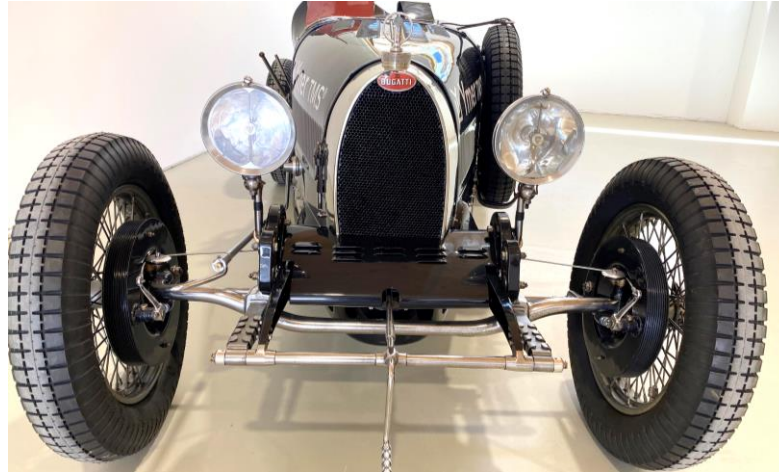
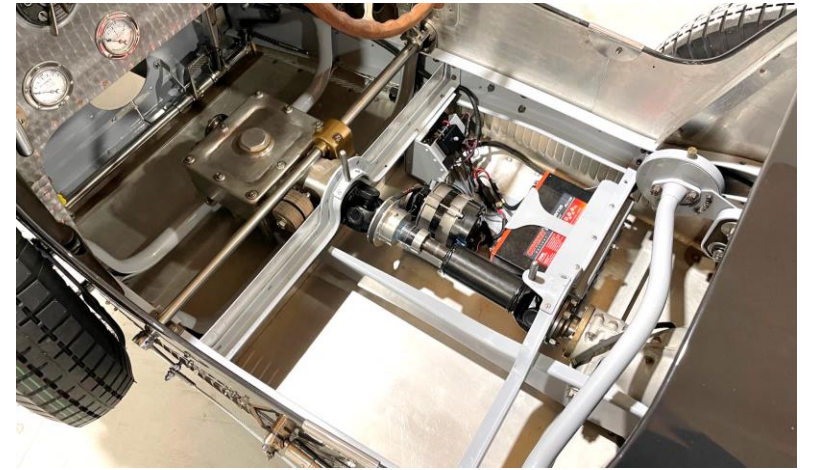
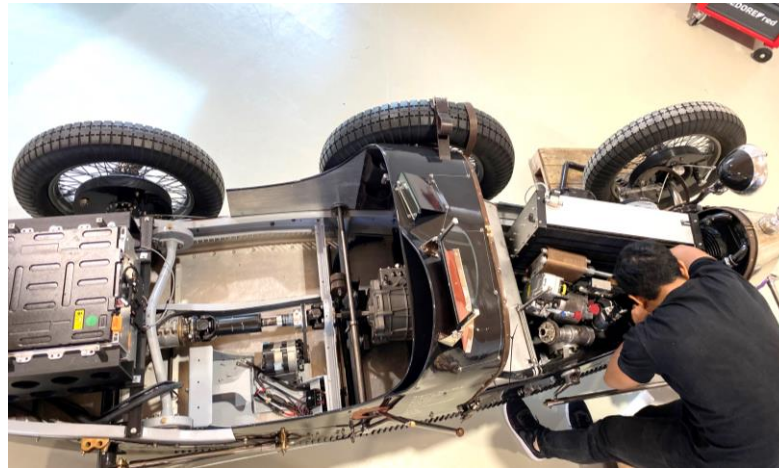
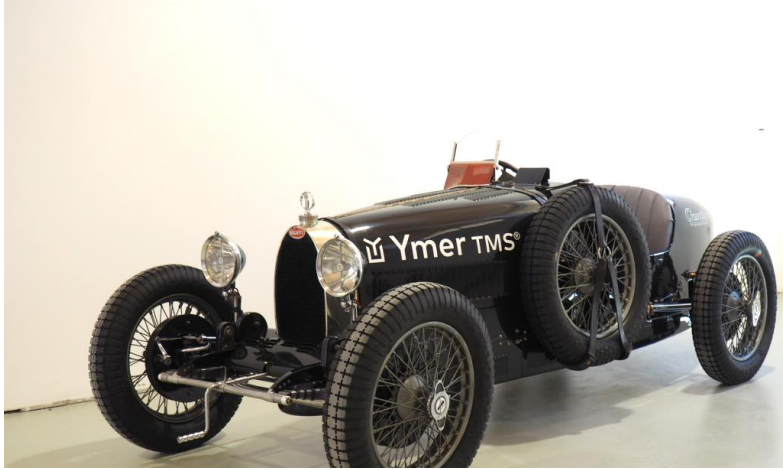
Mechanische Spitzenleistung	80 kW
Mechanische Nennleistung	50 kW



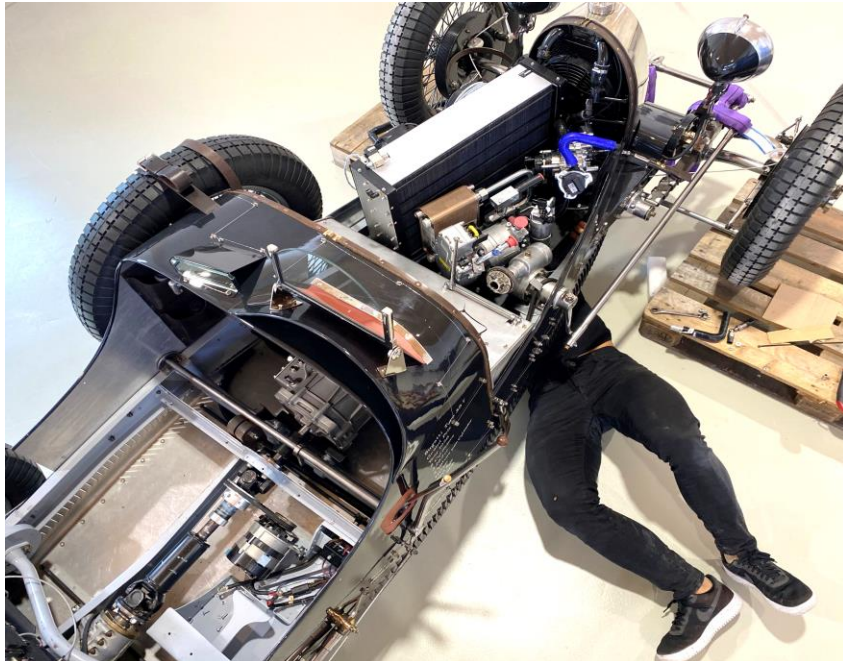
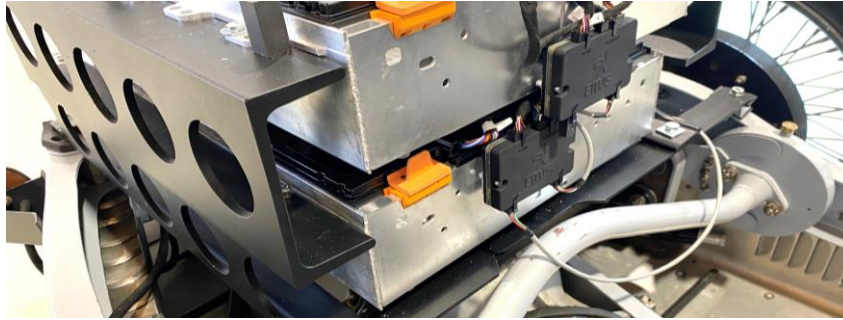
Fuel-Cell: Horizon 5kW



Technical Concept and Set-Up

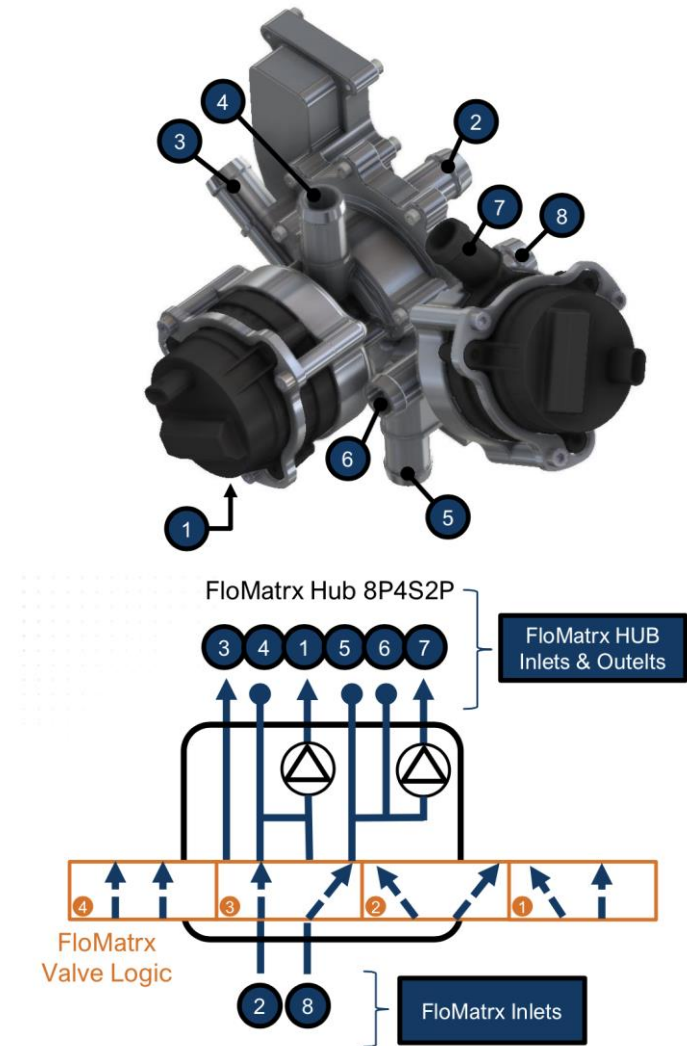


Technical Concept and Set-Up

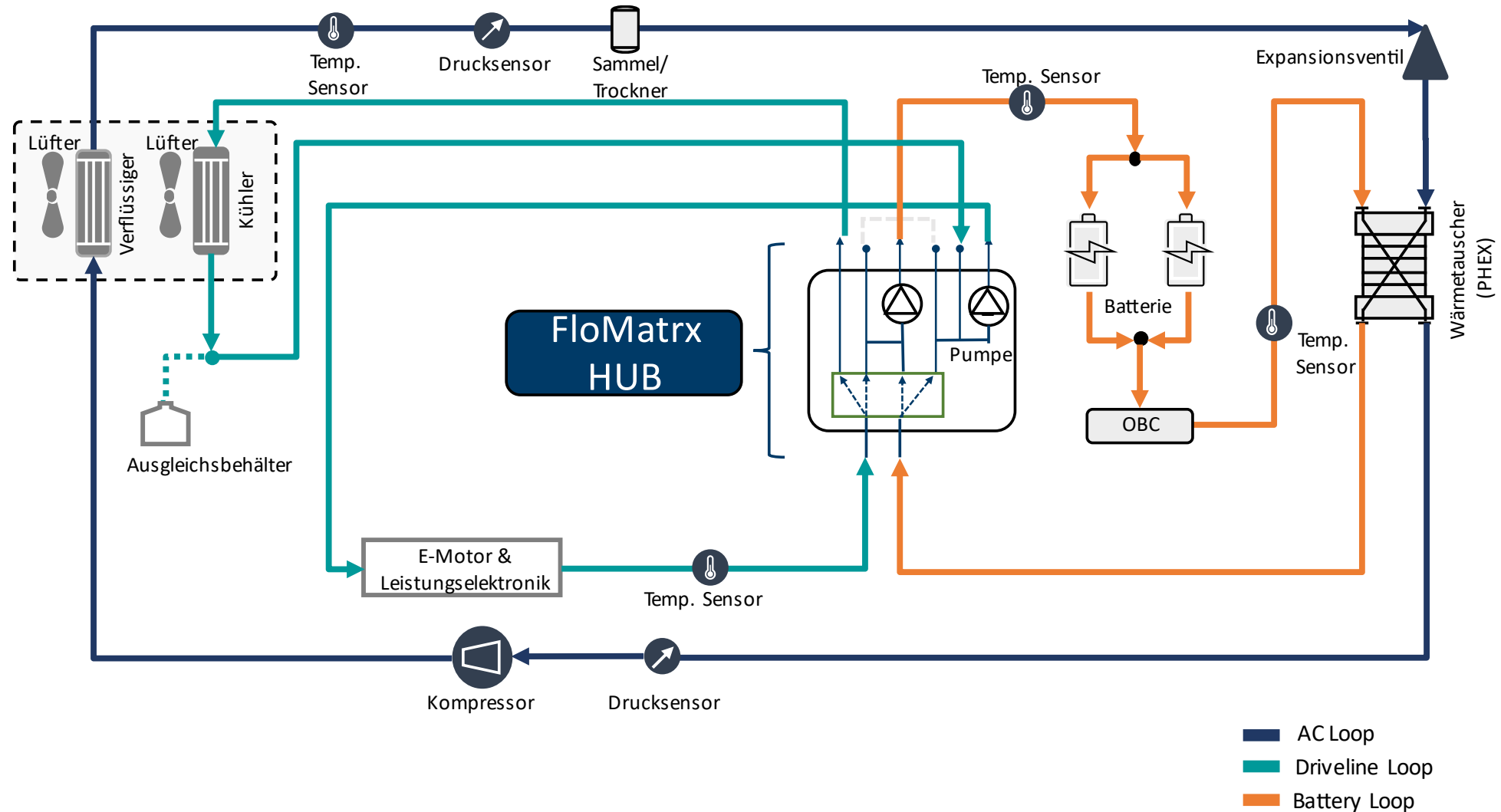


Main ideas and functions

- Ymer TMS to increase the efficiency of all components
- Innovative pump-valve-unit with 3 flow scenarios to intelligently manage thermal flows and demands
- Liquid cooling and heating (waste heat recovery) of the whole system
- Maintaining optimal operation temperature of the motor at +45 °C and the battery at +25 °C
- 48 V electric compressor with 5 kW cooling performance filled with refrigerant R134a

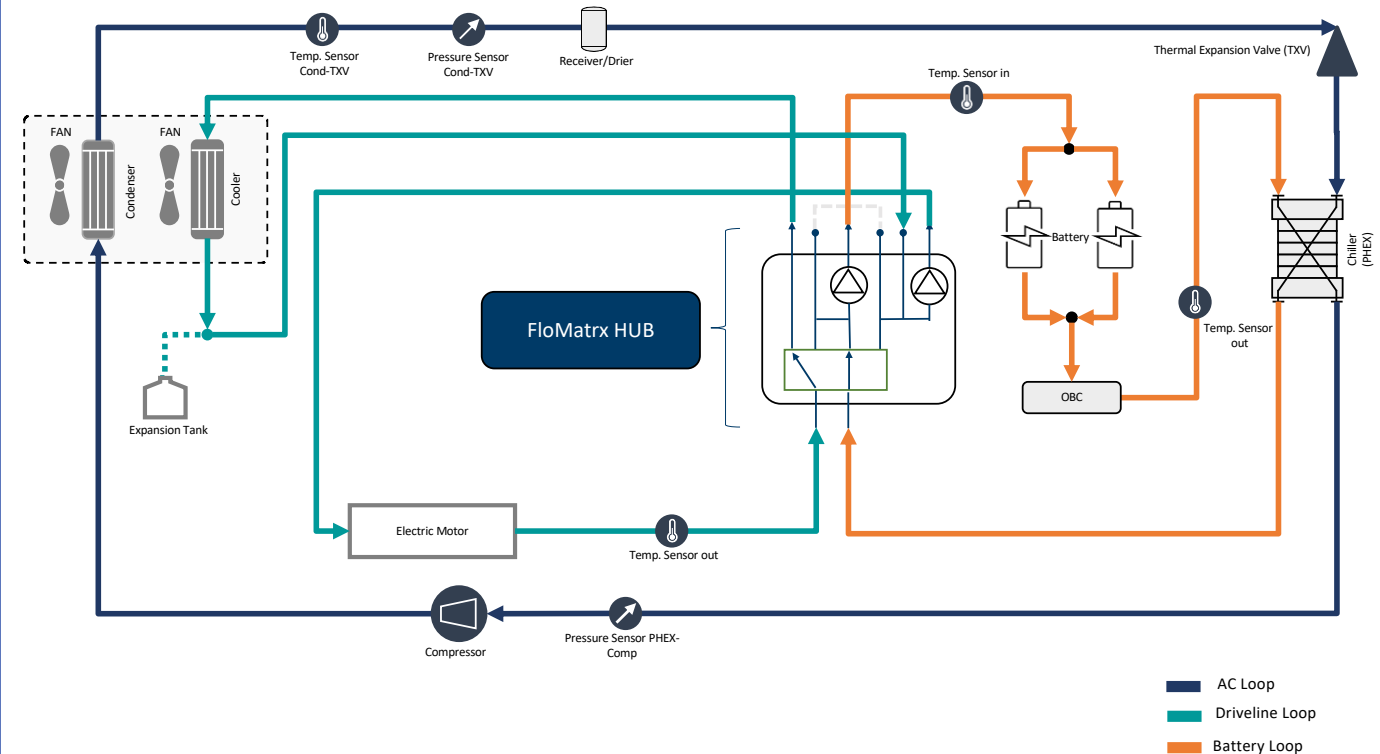
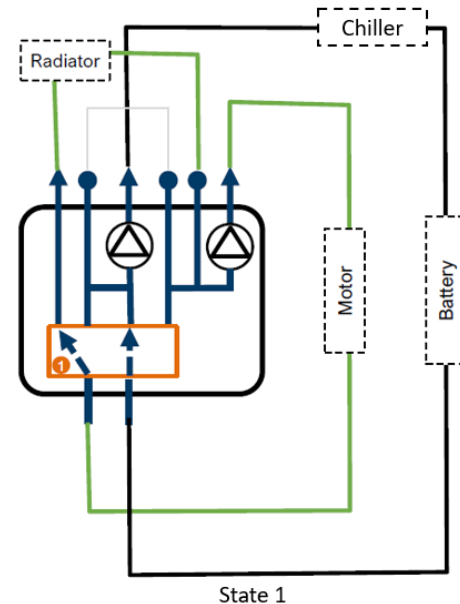


YMER TMS[®] and Development Ideas



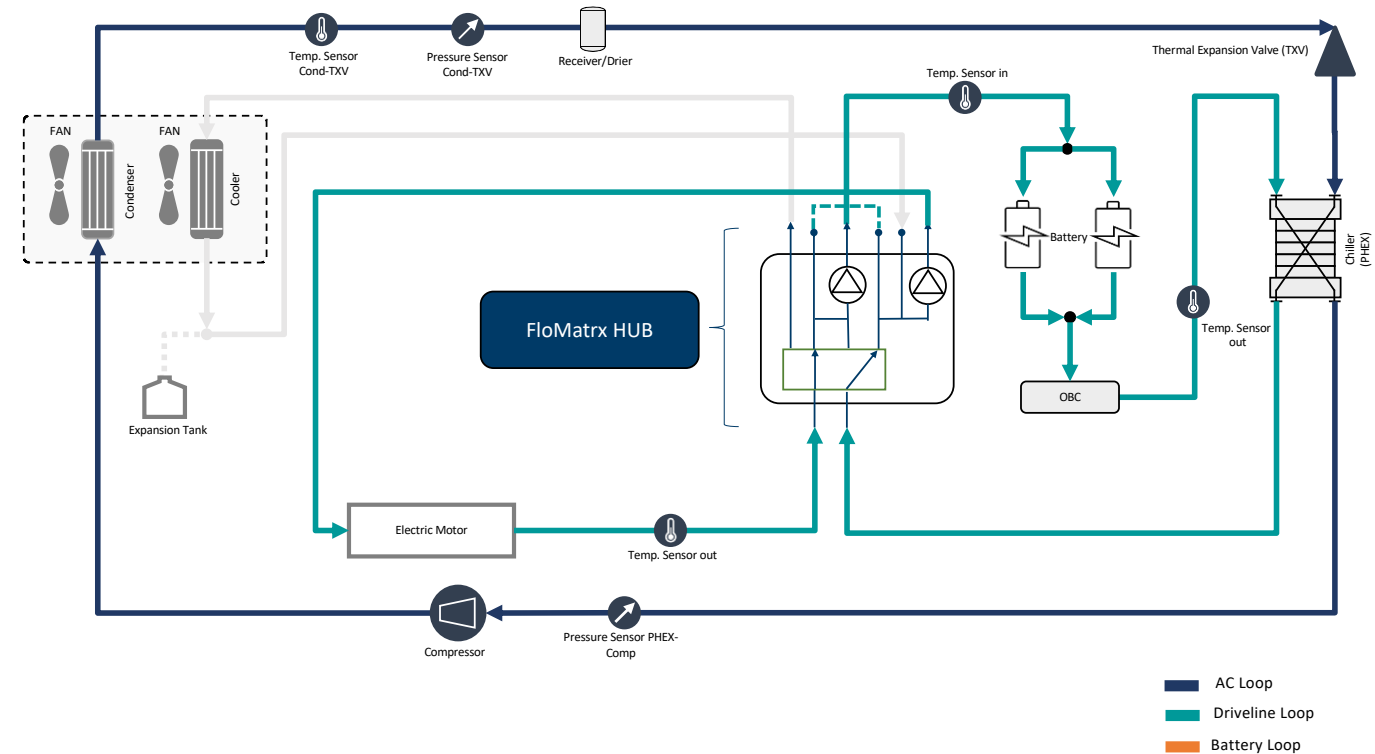
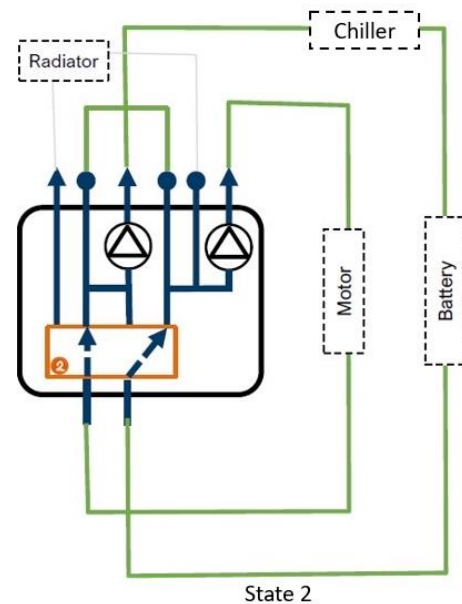
YMER TMS® - Layout State 1

- **Engine and battery circuits are separate, the cooler is connected to the drive circuit**
- Battery circuit is independent -> coolant can flow in the circuit, or battery can be cooled via chiller
- Motor circuit can be cooled via the radiator



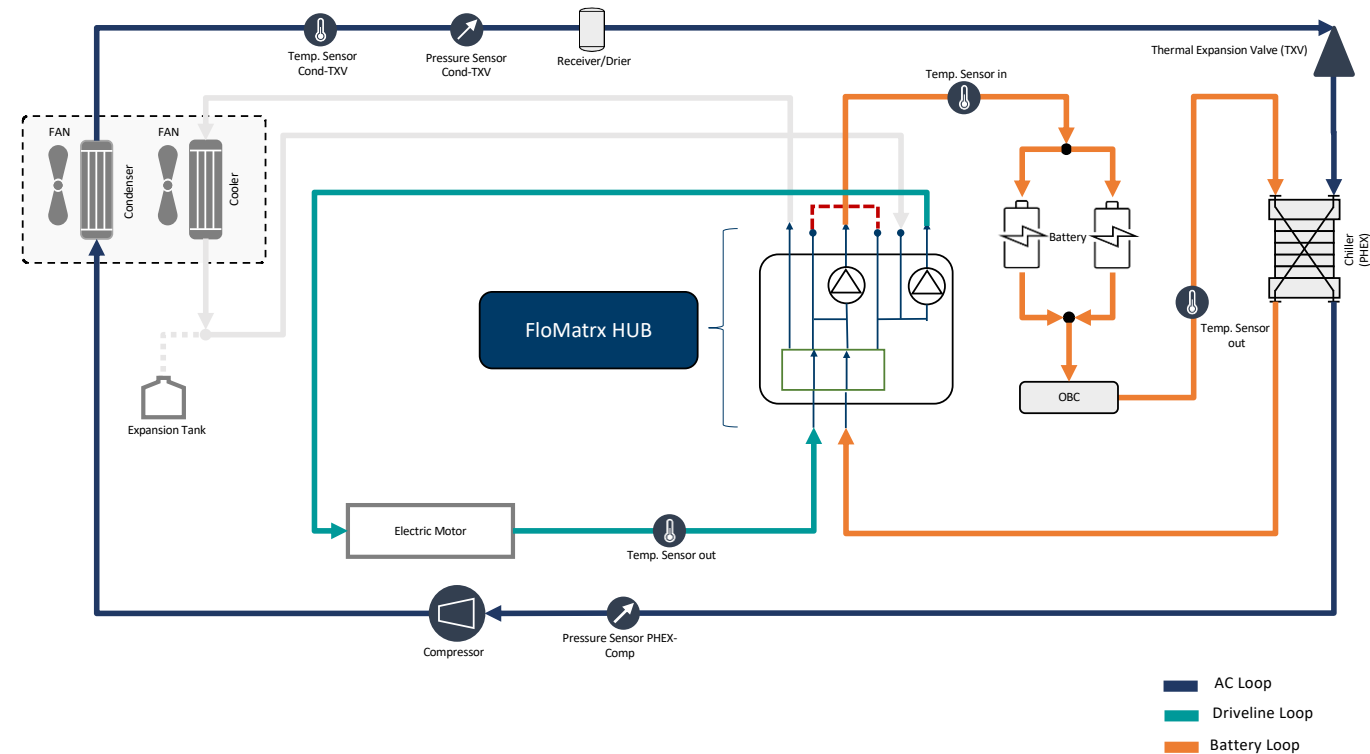
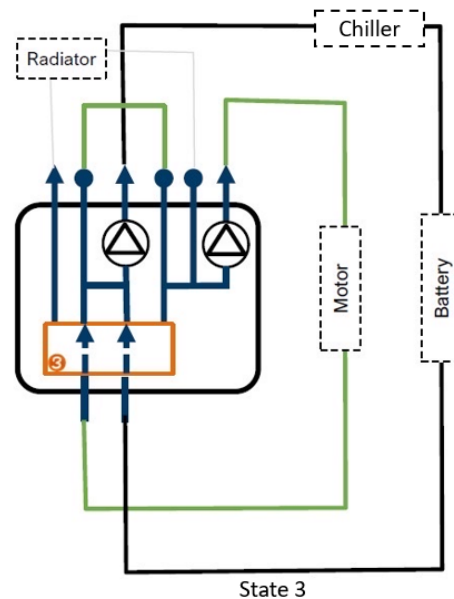
YMER TMS[®] - Layout State 2

- **Motor and battery circuit are connected**
- mixture of coolants; e.g. use of heat from the drive motor to heat up the battery
- Motor and battery cooling via a heat exchanger



YMER TMS[®] - Layout State 3

- **Motor and battery circuit are separate:**
- Engine and/or battery coolant circuit separate from each other; e.g. battery cooling via heat exchanger; or warm up



... we need another student with electricity in his blood to do:

- Application Software
- Driving Software

... and finally bring the electric car on the road with us!



Ymer Technology GmbH

Georg-Gröbl-Straße 1a
86911 Diessen am Ammersee
Germany

Mobile: +49.172.244 480

Mail: Josef.Graubmann@ymer.com

Web: www.ymer.com



**Ymer
Technology**

... and looking forward
to work also **with You!**