



## **Electrification in Non-Road-Mobile Machineries and the need for dedicated and energy efficient Thermal Management Systems**

## What can you expect from this session

- Very short company introduction – **who we are**
- Electrification in Non-Road-Mobile Machineries – **Whats going on**
- Challenges & Solutions – **efficient Thermal Management**
- The applications – **TMS in different machines**

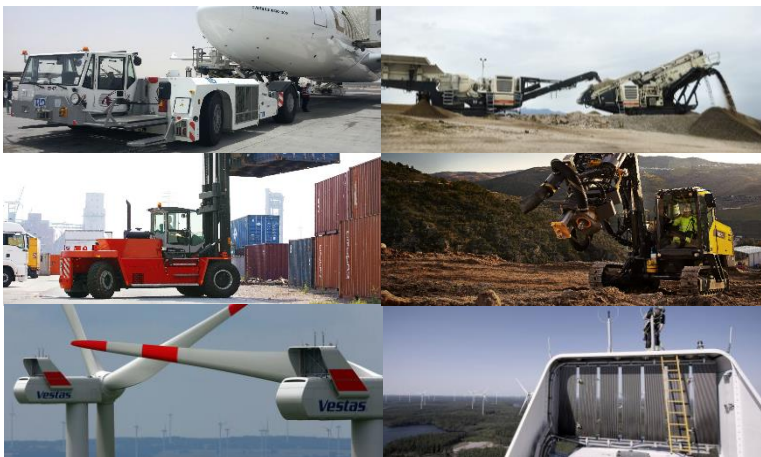
A hand wearing a white nitrile glove is shown in the process of placing small, blue, ring-shaped microfluidic chips onto a transparent, flexible substrate. The substrate has a grid of small, conical protrusions. The chips are arranged in a cluster on the left side of the frame. The background is a blurred laboratory setting.

**We are developing the  
future of cooling-systems**

**based on our intensive  
experience.**

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

- We are focused on Off-Highway machines as well as the wind-industry
- We understand ourself as system supplier:



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

## Who we are:



## We work for...





***„There is a miracle in every  
new beginning.“***

**(Hermann Hesse)**

## Jeff Bezos pledges that Amazon will swiftly combat climate change

Retail giant vows to meet climate goals ahead of schedule

By [Audrey Carlin](#) | [@audreycarlin](#) | Sep 18, 2019, 10:20am EDT

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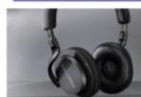


Photo by Paul Mantip/Getty Images for Amazon

Today, Amazon CEO Jeff Bezos announced a massive new commitment to fight climate change called [The Climate Pledge](#). He says Amazon will work to drastically reduce its carbon emissions with the ultimate goal of becoming carbon-neutral by 2040 — all part of an effort to avert some of the most catastrophic effects of climate change.

The pledge's target is 10 years earlier than the most ambitious version of the Paris agreement's climate goals, which currently aims for the world to become carbon-neutral by 2050. Bezos pledged that Amazon would measure and report emissions on a regular basis,

### GOOD DEALS



Beats & Wilson P13 wireless noise-canceling headphones are \$80 off today



Samsung's new Galaxy A51 is a great deal at \$399



Sony's WF-1000XM3 earbuds are under \$200 on Amazon today



Home / Sector / Environment

## Hamburg port operator vows to be carbon neutral by 2040

12 DECEMBER 19th 2019

SAM CHAMBERS

ENVIRONMENT, EUROPE, PORTS AND LOGISTICS

0 COMMENTS

German port and transport logistics company Hamburger Hafen und Logistik (HHLA) has jumped ahead of terminal rivals, vowing this week to become climate neutral by 2040.

The port operator has revealed it has already smashed its environmental targets set for next year. Earlier targets had called for HHLA to reduce CO2 emissions per handled container by at least 30% by 2020, a target it managed to achieve in 2018. Emboldened by this, the Hamburg company has made new ambitious targets, unparalleled in the ports world.

Angela Titzrath, chairwoman of HHLA's executive board, commented in a release: "The people of Hamburg can rely on HHLA. We are well aware of our responsibility to protect the climate and that is why we are implementing specific measures for efficient and more sustainable container handling and environmentally friendly transport chains."

At the 29<sup>th</sup> ACI Europe Annual Congress and General Assembly in Cyprus, the airport trade body unveiled a resolution formally committing the European airport industry to become net zero for carbon emissions under its control by 2050, at the latest.

With this commitment, Europe's airports are responding to the climate emergency – and acting upon the latest scientific evidence presented by the Intergovernmental Panel on Climate Change (IPCC) Special Report on Global Warming of 1.5°Celsius. This commitment comes alongside a call for the entire aviation sector to develop a joint ambition and initial roadmap towards a net zero carbon emissions air transport system. This is needed to supplement the significant efforts already being made by the aviation sector under International Civil Aviation Organization's (ICAO) Basket of Measures, including Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

The pledge is further backed up so far by 194 airports run by 40 airport operators across 24 European countries – with each of them individually committing to the same objective. This marks a step change in the climate action of the airport industry. Based on Europe's airports current traffic volumes (2.34 billion passengers welcomed in 2018) and estimated carbon footprint, this net zero commitment will eliminate a total of 3.46 million tons of annual CO2 emissions as of 2050.

"Europe's airports have already started delivering."

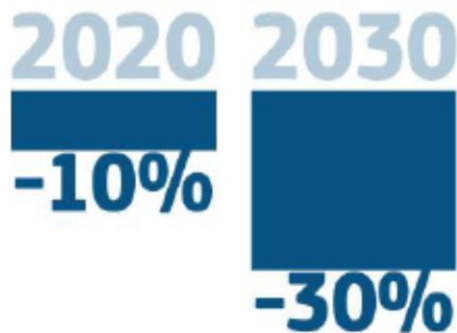
Dr Michael Kerkloh, president of ACI Europe and CEO of NetZero2050, has been leading climate action with annual reductions and have actually become carbon neutral, supported by the Accreditation. However, today's commitment brings a NetZero2050 commitment, the airport industry is aligning ambitions of the vast majority of EU countries."



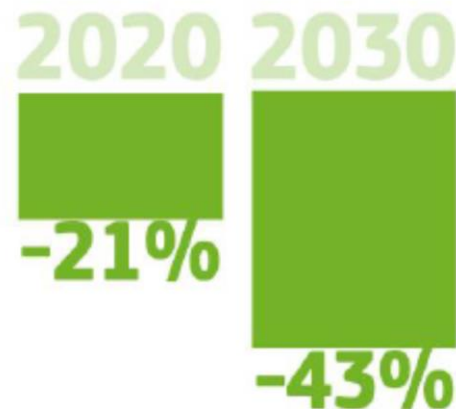
# Electrification in the Non-Road-Mobile Machinery Industry has several drivers

## Influencing factors

- Paris agreement and massive CO<sub>2</sub> reduction  
Governmental funding and pressure
- EU-Roadmap for Electrification of transport system<sup>1</sup>:
  - Up to 5 % electric machines / road transport in 2020
  - 50 – 60 % of new sales in 2030 must be electric machines / road transport
  - In 2050 100 % must be CO<sub>2</sub>-free.



**NON ETS**  
INCLUDING ROAD TRANSPORT, HOUSING, AGRICULTURE etc.



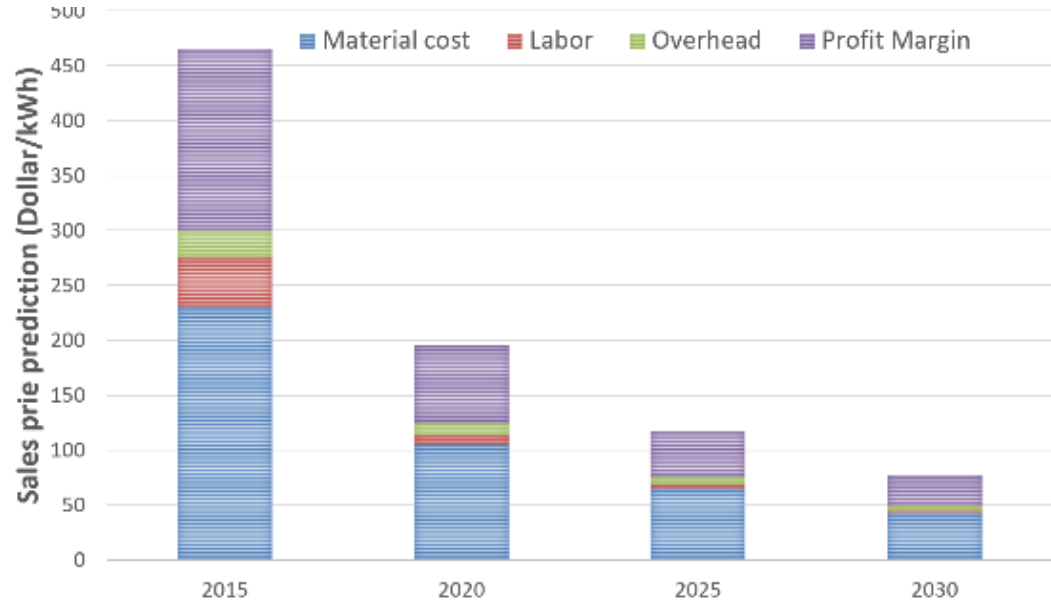
**ETS**  
INCLUDING POWER/ENERGY SECTOR & INDUSTRY



# Electrification in the Non-Road-Mobile Machinery Industry has several drivers

## Supporting Factors

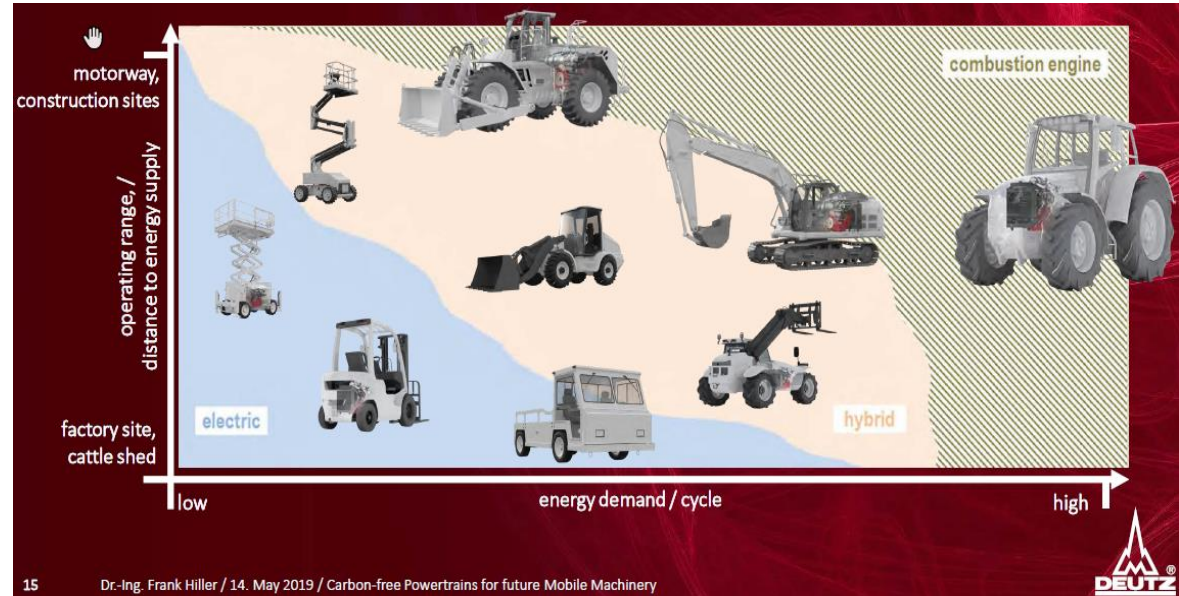
- Increasing availability of high power High-Voltage componentry (> 600 V DC)
- Decreasing of battery costs and increasing supplier market
- **Overall decreasing TCO of electric machines and increasing TCO of fuel operated machines (e.g. CO<sup>2</sup> Tax)**



# Machines with clear used cycles working in defined work areas will be electrified initially

## Electrification path

- Access to charging is key enabler for electrification
- Material handling, airport and mining machines are the early adopters
- Next step will be smaller & medium-sized construction machines.




# Political Pressure, TCO-advantages are the driver – access to electrical infrastructure and “electric friendly” use-cycles the enabler.

Main drivers
<ul style="list-style-type: none"> <li>▪ Availability and accessability of electrical power</li> <li>▪ Duty cycles suitable for electric machines</li> <li>▪ Political and society pressure on operator of machines</li> <li>▪ Availability of funding and support</li> <li>▪ Total cost of ownership advantages of electric machines.</li> </ul>

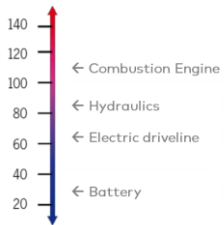
Affected Market Segments			
Criteria	Airport	Material Hand.	Construction
Availability of Power	●	◐	◑
Accessibility of Power	●	●	◑
Duty Cycles of Machines	◐	●	◐
Political Pressure	●	◐	●
Environmental Pressure	◐	◑	●
Society Pressure	◐	◐	●
Availability of funding	●	◐	◐
Image for end-users	●	◐	◑
Noise Reduction	⌚	◑	●
Need to be able to win projects	●	●	◐
Lower TCO	◑	●	●

***„Challenges are what make life interesting and overcoming them is what make life meaningful.“***

A 3D illustration of a person in a dark suit carrying a ladder on a dark, curved path. The path is set against a light blue background with a large, dark, curved structure that resembles a doorway or a tunnel. The person is walking away from the viewer, carrying the ladder horizontally. The overall scene is rendered in a clean, modern style with soft shadows.

# There are several challenges within Thermal Management of Electric Machines

## Temperature & Flow control



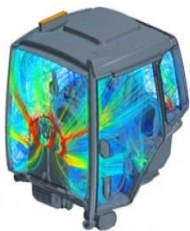
## Battery Conditioning



## Control & Sensing



## Cabin Comfort

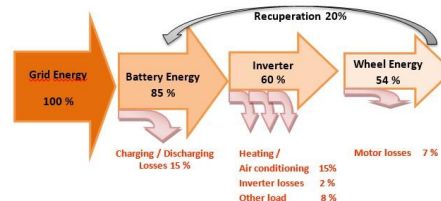


## No standards existing

on driveline components



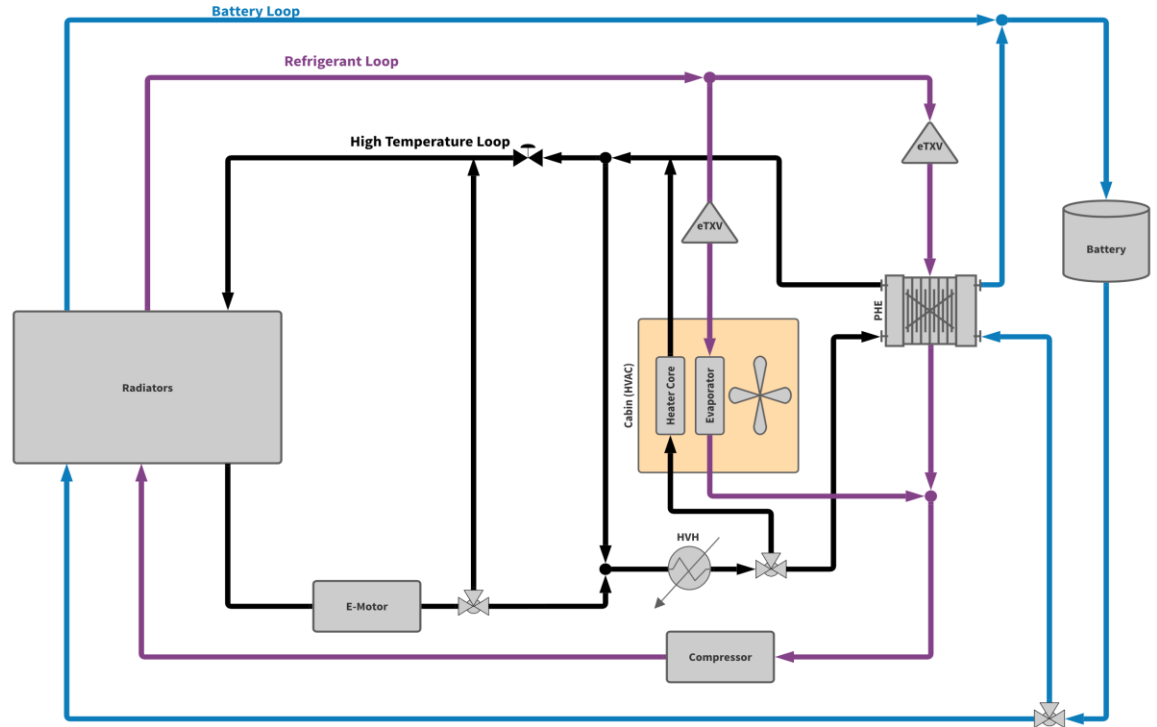
## Energy consumption



# Fully integrated and stand alone system with focus on component and energy efficiency

## TMS-System-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



# Low development costs and fast in customization based on a modular platform

**Standardized ECU + Control Logic**

**Pumps**

12 V and 24 V

Pressure drop

Flow

Pump large  
Pump medium  
Pump small  
Pump Power

**Compressor**

400 V and 750 V

Cooling Power

Voltage

Compressor 400 V DC \_power  
Compressor 750 V DC \_power  
Compressor 400 V DC \_eco  
Compressor 750 V DC \_eco

**Sensors**

**Valves**

12 V and 24 V

Pressure drop

Flow

Valve Power  
Valve large  
Valve medium  
Valve small

**Heaters**

400 V and 750 V




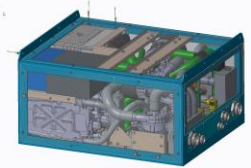
Heating Power

Voltage

Heater 400 V DC \_power  
Heater 750 V DC \_power  
Heater 400 V DC \_eco  
Heater 750 V DC \_eco

**Chiller**

**Fully Customized Cooler Package**



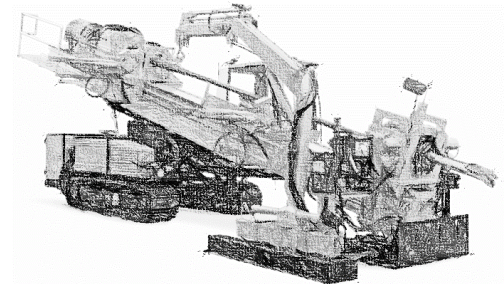
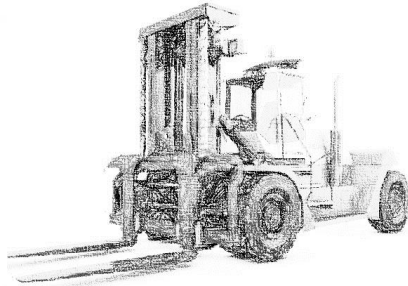
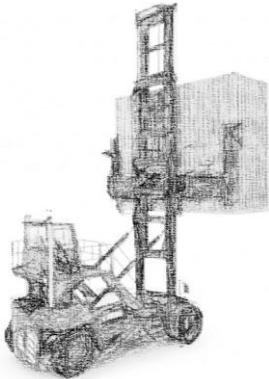
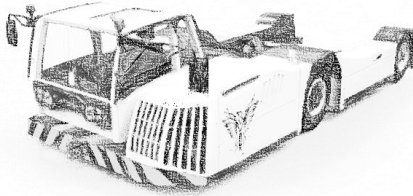
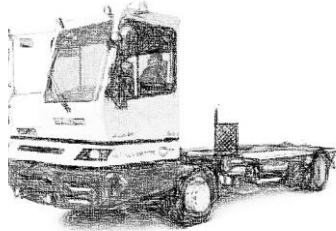
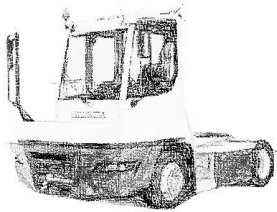
**We have accepted the challenge...**

**1 YEAR**

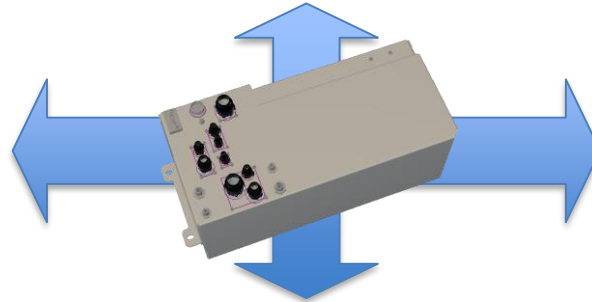
A close-up photograph of a hand holding a white sign with the text '1 YEAR' written in large, bold, black capital letters. The sign is tilted slightly to the right. The background is dark and out of focus.



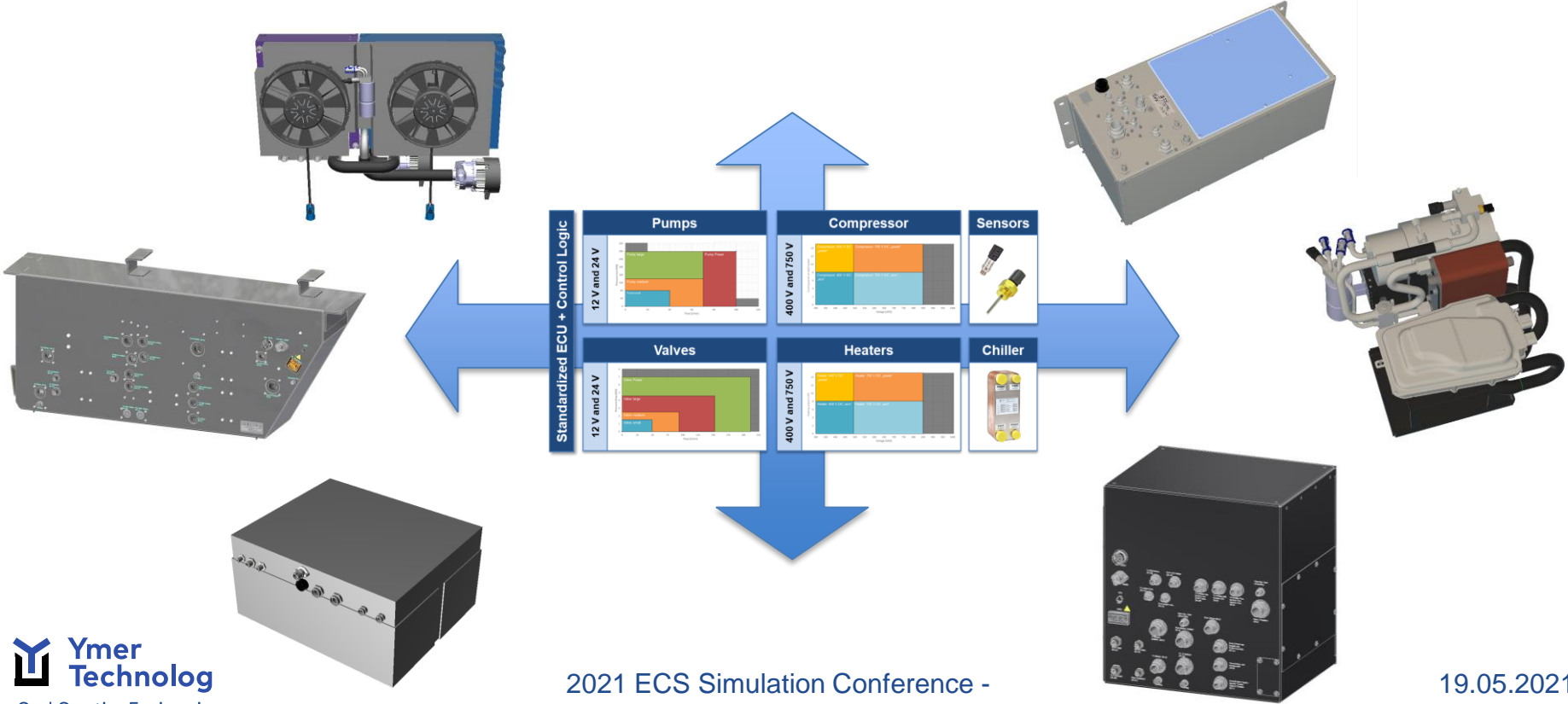
# Today our TMS-Systems are applied and operating at several different machines and applications



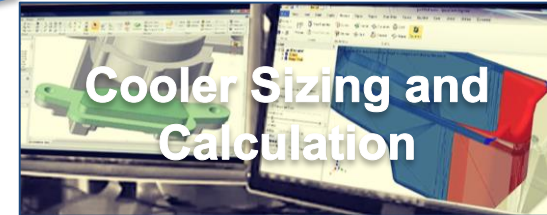
# Our modular approach realizes all different applications



# Each TMS-System is fully customized to the individual machine



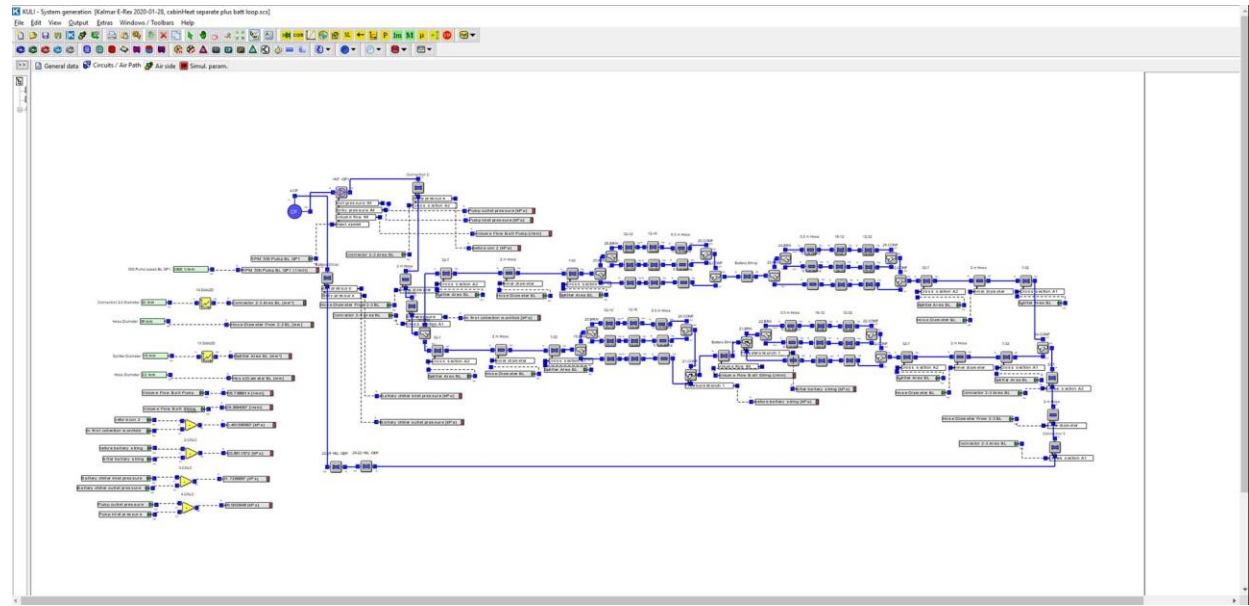
# Thermal Management is much More than just a Product



# Thermal Management is much More than just a Product



- ### Use of Kuli today
- Hose Routing inside the machine can be a challenge
  - Influence of hose-routing in pressure drop and pump power needed
  - Kuli-Model available to simulate and optimize hose-routing





... and looking forward to work  
also with you!

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