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7th International VDI Conference

# Powertrain Systems in Mobile Machines 2022

+ Simultaneous translation:  
German – English

## Key topics discussed:

- European regulations in the off-highway sector: emissions, technical rules, examples
- Opportunities for electrified off-road applications
- Hydrogen-based off-road solutions
- Impact of energy sources on powertrain architecture
- Modular and integrated solutions for traction and process drives
- Smart strategies through AI
- Field reports on innovative drive systems

### Conference chairman

Prof. Dr. Ludger Frerichs, Director, Institute of Mobile Machines and Commercial Vehicles (IMN), TU Braunschweig, Germany

+ Free entrance to the parallel event Dritev 2022

+ Networking at the joint evening event

+ Exhibition

## With experts from:



An event organized by VDI Wissensforum GmbH  
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July 06 - 07, 2022,  
 Kongresshaus Baden-Baden

## 1st Conference day Wednesday, July 6th, 2022

07:45 Registration

08:30 Joint welcome of the congress and conference

**Dipl.-Ing. Matthias Zink**, CEO Automotive Technologies, Schaeffler AG, Bühl, Germany

### Plenary speeches

08:45 The electrification of the mobility infrastructure

- What is the demand for charging infrastructure Germany-wide until 2030?
- How can a modern charging network be developed that is based on renewable energies?

**Johannes Pallasch**, National Charging Infrastructure Control Centre, Berlin, Germany

09:10 E-Mobility – the way forward

**Dipl.-Ing. Uwe Wagner**, CTO, Schaeffler Automotive Technologies GmbH & Co. KG, Bühl, Germany

09:35 Energy vectors in future transport – accelerating the revolution in global mobility

- BP energy forecast of global transition to 2050
  - Thermal management for ultra-fast charging
  - Hydrogen adoption for heavy duty transport
- Dr. Rebecca Yates**, VP Advanced Mobility and Industrial Products for Applied Sciences, BP International Limited, Pangbourne, United Kingdom

10:00 The off-highway machine of the future – concepts of alternative drive technologies

- European Green Deal as basis: four pillar approach as holistic approach to increase the efficiency of processes
- Open technology approach: are there alternatives to electrification of machines
- Sustainability of various drive systems: "from cradle to cradle" (material life cycle)

**Dipl.-Ing. Eugen Schobesberger**, Managing Director R&D, Liebherr-EMtec GmbH, Kirchdorf/Iller, Germany

10:25 Be interactive – meet & greet in the exhibition area and car presentation

11:10 Opening of 7th International VDI Conference  
Powertrain Systems in Mobile Machines 2022

**Prof. Dr. Ludger Frerichs**, Director, Institute of Mobile Machines and Commercial Vehicles (IMN), TU Braunschweig, Germany (Conference Chairman)

### Keynote

Moderation: **Prof. Dr. Ludger Frerichs**

11:15 Regulations and measures for limiting emissions from non-road mobile machinery in Europe

- EU-Regulation 2016/1628 und 2017/655 and UNECE Regulation 96; development in the global market
- Technical solutions and certificates for retrofitting
- Control by "In Service Monitoring" and market surveillance

**Dipl.-Ing. Helge Jahn**, Technical Government Inspector in the field of "Air Pollution Abatement and Energy Saving in Transport", Federal Environment Agency, Dessau-Roßlau, Germany



### Use of sustainable energy sources

Moderation: **Dr.-Ing. Hagen Adam**, Strategic program tractors, CLAAS KGaA mbH, Harsewinkel, Germany

11:45 Sustainable powertrains for nonroad mobile machinery

- Need for action towards CO<sub>2</sub> neutral powertrains
- Solutions: a combination of electrification and sustainable fuels
- Application of the different powertrain technologies depending on the range and load profile

**Dr.-Ing. Markus Schwaderlapp**, Senior Vice President Product Development, Andreas Plumpe, M. Sc., Development Engineer Emission & Performance, DEUTZ AG, Cologne, Germany

12:15 Decarbonization strategies for heavy duty harvesting machinery

- Specification analysis for alternative powertrains on harvesting machinery
- Influences of energetical range and power demands
- Technological comparison of different alternative concepts

**Fabian Wohlfahrt, M. Sc.**, Development Engineer, Dipl.-Ing. Stefan Terörde, Head of Advanced Development - Functional Technology, Advanced Development, CLAAS Selbstfahrende Erntemaschinen GmbH, Harsewinkel; Prof. Dr. Ludger Frerichs, Director, Institute of Mobile Machines and Commercial Vehicles, TU Braunschweig, Germany

12:45 Alternative fuels for vehicles in off-road sector

- E-Fuels: hydrogen, synthetic fuels, ammonia, methanol and fischer-tropsch
- Well to wheel efficiency for different alternative fuels
- Opportunities of renewable fuels in non-road mobile machinery

**Dipl.-Ing. (FH) Peter Guenter**, Development Engineer, Predevelopment, Liebherr Machines Bulle SA, Bulle, Switzerland

13:15 Time for business lunch – meet & greet in the exhibition area and car presentation



### Hydrogen based powertrains as one possible solution

Moderation: **Dr.-Ing. Christof Lamparski**, Vice President Development and Sales Gearbox Technology, Bosch Rexroth AG, Dortmund, Germany

14:15 Optimization of powertrain layout to maximize benefits of an H2 internal combustion engine

- Possible applications for hydrogen internal combustion engines
- Key challenges for hydrogen internal combustion engines development
- System optimization process for hydrogen internal combustion engines

**Dr.-Ing. Lukas Virnich**, Product Manager, Commercial Hydrogen Engines, FEV Europe GmbH, Aachen, Germany

14:45 A hydrogen-electric operated tractor system

- System design of hydrogen fueled experimental vehicle Fendt HELIOS (Hydrogen Electric Operated System)
- Challenges in the agricultural sector with hydrogen infrastructure
- Process simulation of tractor operation to determine hydrogen consumption

**Dipl.-Ing. (FH) Wolfgang Breu**, Project Lead HELIOS, Research & Advanced Engineering, AGCO GmbH, Marktobendorf, **Lukas Reuter, M. Sc.**, Research Assistant, Institute of Mobile Machines and Commercial Vehicles, TU Braunschweig, Germany

**15:15 Fuel cell: energy source for electrical powertrains**

- Market driver and chances of fuel cells in the automotive segments and transfer for mobile power train
- H2 infrastructure – segment requirements e.g. passenger cars, trucks
- Fuel cell system, BoP (Balance of Plant) components, technical requirements, application, challenges and how to bring it on the road

**Dipl.-Ing. Achim Wach**, Project Director Powertrain Solutions, Fuel Cell Sales, Robert Bosch GmbH, Stuttgart, Germany

**15:45 Be interactive** – meet & greet in the exhibition area and car presentation

**Battery electric powertrain systems**

**Moderation: Philipp Suhm, M. Sc.**, Head of Development, Drive System Technology, Liebherr-Components Biberach GmbH, Biberach an der Riss, Germany

**16:30 Agricultural machinery – perspectives for battery electric powertrains?**

- Perspectives for future powertrains and energy carriers: non-fossil future, Ag machinery needs, alternative energy carriers
- Electric powertrains – boundaries and opportunities: machine categorization, powertrain architectures, performance perspectives
- From machines to ecosystems – the broader view: application segments, local zero emission systems, infrastructure and ecosystem

**Dr.-Ing. Joachim Sobotzik**, Engineering Manager, EVE – Electric Vehicle Ecosystems, John Deere GmbH & Co. KG, Mannheim, Germany; Hillary Leach, B.S. Economics USNA, MBA UMICH, Business Development Manager EVE, Derek Muller, B.S. Agricultural Economics UNL, Utility Tractor Product Lead, EVE, Deere & Company, Moline, IL, USA

**17:00 Approach for determining future areas of application for battery-electric wheeled and telescopic loaders**

- Basic conditions influencing the development of wheeled- and telescopic loaders
- System comparison of internal combustion engine machines to battery electric machines
- Categorization of machine classes considering future drive systems

**Andreas Meyer, M. Sc.**, Team Leader Drivetrain & Powertrain, Dipl.-Ing. Michael Kurz, Manager System Technology, Dipl.-Ing. (BA) Florian Madlener, System Engineer E-Mobility, Kramer Werke GmbH, Pfullendorf, Germany

**17:30 Solutions for a needs-based range optimization of battery-electric vehicle platforms**

- Combustion engines as system enhancement
- Battery technologies: second Life, NMC, LFP
- Hydrogen as energy medium in combustion engines and fuel cells

**Dr.-Ing. Thomas Wooten**, Development Engineer Vehicle, Dr.-Ing. Stephan Hammes, Skill Team Leader Vehicle Development – Off-Road, Sascha Bild, Design Engineer Distributed Systems, AVL Tractor Engineering Germany GmbH, Neuss, Germany

**18:00 End of the 1st conference day****18:30 Get-together at the 'Kurhaus Baden-Baden'**

Look forward to an enjoyable evening. Make new contacts and meet colleagues from your industry in an informal atmosphere.

**2nd Conference day**  
Thursday, July 7th, 2022**Challenges on the electric drive system**

**Moderation: Dipl.-Ing. (FH) Marco Reinards**, Engineering Manager Tractor Drivetrain & Hydraulics, John Deere GmbH & Co. KG, Mannheim, Germany

**08:30 Driving the electric transformation: the evolution of off-highway powertrain**

- Electrification impact on component and system development in off-highway
- Challenges and requirements of emerging e-Drive and e-Motion technologies, including system optimization, energy management, component design
- System and component development that meets duty cycle requirements and performance expectations: a case study

**Lorenzo Serrao, PhD**, Lead Engineer, Off-Highway Electrification – Dana Mechatronics Technology Center, Rovereto, Italy

**09:00 A new platform approach for the electrification of mobile machines**

- Requirements of motors and inverters
- Developing a holistic machine solution approach: electrics, hydraulics and mechanical transmissions
- Realized performance during machine operation: cycle times and efficiency

**Dr.-Ing. Steffen Mutschler**, Global Sales and Product Management Electrification Mobile Machinery, Bosch Rexroth AG, Ulm, Germany

**09:30 Future electrified drivetrain for off-highway in the 60-80 kW power range**

- High expectations on drivetrain performance in vehicles above the compact equipment segment
- Diversity of applications in this power range necessitates flexibility and adaptability
- Proposed electric central drive combines new and proven modular assemblies

**Robert Morrison, BSME**, Supervisor Engineering Working Machines Systems R&D CVT Transmissions, Dipl.-Ing. (FH) Juergen Legner, Senior Manager Industrial Technology, System Architecture & Product Allocation, ZF Friedrichshafen AG, Germany

**10:00 Integration and modularization approaches for fuel cell solutions in commercial vehicles**

- Powertrain requirements for different use case scenarios
- System design for a cross-platform vehicle application with different vehicle weights
- Enhancement of the modularization approaches by battery and pantograph powertrain configurations

**Mario Kehrer, M. Sc.**, Chief Engineer Fuel Cell Technology & Electrification Engineering, Sebastian Biegler, M. Sc., Research Associate Fuel Cell Technology, PEM RWTH Aachen University, Germany

**10:30 Be interactive** – meet & greet in the exhibition area and car presentation



## Challenges on the electric drive system

**Moderation:** Dr.-Ing. Ettore Cosoli, Dana Incorporated, Maumee, USA

### 11:15 Electric wheel loader – system-approach enables improved vehicle performance

- 14-tons wheel loader converted to a battery-electric vehicle with electric traction, work function and power management
- Optimized sub-system design considering system architectures, component selection and software function
- Vehicle performance comparing the traditional vs. electric wheel loader

**Dipl.-Ing. (FH) Agricultural Machinery Engineering Stefan Eichler**, Senior Sales Development Manager, Danfoss Power Solutions GmbH & Co. OHG, Offenbach, Germany; Cameron Guernsey, M. Sc. Engineering Management, B. Sc. Physics and Mathematics, Product Manager, Electrification, Danfoss Power Solutions US, Longmont, USA



## Working function solutions

### 11:45 Electrification of linear positioning and working functions in mobile machines

- Methodology and approach to the development of electric drive solutions
- Application examples: actuating cylinder on a sweeper, oscillating drive of a cutter bar
- Presentation of results of field testing

**Michaela Pußack, M. Sc.**, Research Assistant, Prof. Dr. Ludger Frerichs, Director, Institute of Mobile Machines and Commercial Vehicles (IMN), TU Braunschweig, Germany

### 12:15 When will electrified and sensor-controlled drive system modules be available in agricultural technology?

- Advantages and disadvantages of modularized drive systems
- Potential for process efficiency of variable function drives and active traction support by implements
- Implementation example in the tractor-implement system taking the example of "Kronos"

**Dipl.-Ing. Tim Bögel**, Research Assistant, Prof. Dr.-Ing. habil. Thomas Herlitzius, Chair of Agricultural Systems and Technology, Institute Director, Institute of Natural Materials Technology, Faculty of Mechanical Science and Engineering, TU Dresden, Germany

### 12:45 Time for Business Lunch – meet & greet in the exhibition area and car presentation



## Potentials of smart technologies

**Moderation:** Dr.-Ing. Florian Mulzer, Transmission Specialist, AGCO GmbH, Marktoberdorf, Germany

### 14:15 eCVT for tractors: ExperienterReport about potentials and challenges

- Differences between hydraulic and electric continuously variable transmissions concerning design, actuation and characteristics of the system
- Test results about efficient power transfer and electric power take off capability for implements or electrified auxiliaries
- Test bench experiences about performance of driving and dynamic during vehicle acceleration

**Dipl.-Ing. Raphael Himmelsbach**, Manager Drivetrain Concepts & Electrification, Advanced Engineering Industrial Systems, Elisabeth Nachbaur, B. Eng., Testing CVT Transmission and electric Drives, Testing and Function- Development, Dipl.-Ing. Johannes Ziegler, Manager development agricultural machinery transmission, ZF Friedrichshafen AG, Germany

### 14:45 Potentials and implementation of neural networks on simple series control units for off-highway machines

- Machine Learning based approach for applying complex behaviors or controllers to current control devices
- Design of neural networks for real-time execution on simple control devices
- Introduction of a methodical approach and its implementation on an example

**Dipl.-Ing. Markus Birk**, Development Engineer Advanced Engineering, Application Specific Perception & AI, **Dipl.-Ing. Steffen Biel**, Development Engineer Advanced Engineering, Application Specific Perception & AI, ZF Friedrichshafen AG, Germany

### 15:15 Resource-efficient dimensioning, usage and maintenance of machine components through AI-based virtual sensors

- Health and usage monitoring through the intelligent combination of standardly available machine data
- Failure prediction and predictive maintenance with machine learning
- Usage-oriented and load-compliant design with regard to cost, weight, ecological footprint and maintenance

**Prof. Dr.-Ing. Stephan Rinderknecht**, Head of the Institute for Mechatronic Systems in Mechanical Engineering, TU Darmstadt; Dr.-Ing. Stéphane Foulard, Managing Director, Dr.-Ing. Rafael Fietzek, Managing Director, COMPREDICT GmbH, Darmstadt, Germany

### 15:45 Closing remarks

### 16:00 End of 7th International VDI Conference Powertrain Systems in Mobile Machines 2022



## Joint plenary session



### 16:00 Awarding of the best presentation for junior engineers

### 16:15 Common closing remarks



### 16:30 End of the 22nd International VDI congress Dritev



## Questions, to be answered at the conference:

1. What role do hydrogen drives play in mobile machines and why?
2. Where do battery electric drives make sense and where do they come up against system limits?
3. What are the challenges of electric drives in off-road applications?
4. What potential do conventional systems offer?
5. What opportunities do digital approaches offer in the field of mobile machinery and in relation to the drive system?
6. How are the framework conditions changing: legal regulations, technologies, infrastructure?

## Advisory board



1st row from left to right:

**Dr.-Ing. Hagen Adam**, Strategic program tractors, CLAAS KGaA mbH, Harsewinkel, Germany

**Dr.-Ing. Ettore Cosoli**, Vice President, Global Heavy Vehicle Engineering, Dana Incorporated, Maumee, USA

**Prof. Dr. Ludger Frerichs**, Director, Institute of Mobile Machines and Commercial Vehicles (IMN), TU Braunschweig, Germany (Conference Chairman)

**Dipl.-Ing. (FH) Tilo Huber**, Vice President Product Line Construction Machinery Systems, ZF Friedrichshafen AG, Passau, Germany

2nd row from left to right:

**Dr.-Ing. Christof Lamparski**, Vice President Development and Sales Gearbox Technology, Bosch Rexroth AG, Dortmund, Germany

**Dr.-Ing. Florian Mulzer**, Transmission Specialist, AGCO GmbH, Marktobendorf, Germany

**Dipl.-Ing. (FH) Marco Reinards**, MBA, Engineering Manager Tractor Drivetrain & Hydraulics, John Deere GmbH & Co. KG, Mannheim, Germany

**Philipp Suhm, M. Sc.**, Head of Development, Drive System Technology, Liebherr-Components Biberach GmbH, Biberach an der Riss, Germany

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## Parallel conference

July 06 – 07, 2022, Baden-Baden, Germany

### International VDI Congress Dritev 2022

#### Main topics:

- Design of electric drives
- Intelligent all-wheel drive
- Thermal management of e-machines
- Sustainability and life cycle analysis in development
- Vehicle development with computational fluid dynamics
- Efficiency of electric drives
- Electrified city of Rüsselsheim: Development of an urban charging infrastructure for electric mobility

#### Chairman:

**Dipl.-Ing. Matthias Zink**, CEO Automotive, Schaeffler AG, Bühl, Germany

#### With experts from:

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#### Further details and the final program can be found here:

[www.vdiconference.com/dritev](http://www.vdiconference.com/dritev)

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## VDI workshops

Tuesday, July 5th, 2022

These one-day seminars – held on the day before the conference – must be booked separately and are only offered in the German language.

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