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8th International VDI Conference

Powertrain Systems in Mobile Machines 2024

Key topics discussed:

- Think about energy supply and drive technology holistically
- Alternatives with and without combustion engines
- Electric off-road – with batteries or fuel cells
- Solutions for traction and process drives
- New drive systems in various applications
- Experience reports of successful transformation

Conference chairman



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

+ Free entrance to the parallel event
Dritev 2024

+ Empowering ideas through intensive dialogue:
Speakers Corner & Posterexhibition

+ Networking at the joint evening event

+ Exhibition

With experts from:



An event organized by VDI Wissensforum GmbH
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June 12th – 13th, 2024,
 Kongresshaus Baden-Baden, Germany

1st Conference day
Wednesday, June 12th, 2024

08:00 **Registration**

09:00 **Joint welcome of the congress and conference**



Dipl.-Ing. Konstantin Neiß, Director Electric Drive Systems & CoC Electric Drive Units, Mercedes-Benz AG, Stuttgart, Germany



Dipl.-Ing. Thomas Pfund, President Business Unit E-Motors, Schaeffler Automotive Buehl GmbH & Co. KG, Buehl, Germany



Plenary speeches

Moderation: Dipl.-Ing. Konstantin Neiß, Mercedes-Benz AG, Germany

09:20 **CLEPA President – 163 days in office – an interim assessment**

- CLEPA's significant role in the process of shaping more modern and sustainable automotive mobility
- Ensuring that all stakeholders interests are taken into account during this process
- Summary of the first half of 2024
- Outlook on upcoming challenges and potential starting points

Dipl.-Ing. Matthias Zink, President of CLEPA, Belgium & CEO Automotive, Schaeffler AG, Germany Herzogenaurach, Germany



09:45 **Critical success factor of the mobility turnaround: Market-wide interfaces**

- A convincing customer experience is crucial for the success of the mobility transition
- The transportation of the future is purely electric
- It requires a highly complex system from the generation and transportation of renewable energy to simple charging in everyday life and when travelling with digital capabilities and data security

Jürgen Stein, Chief Innovation & New Business Officer, EnBW Energie Baden-Württemberg AG, Karlsruhe



10:10 **Next Steps – electric mobility**

- Technology update of the drivetrain
- Enhancing the customer experience
- Emotionalization

Dr. Karsten Bennewitz, Head of Powertrain and Energy System Development, Volkswagen AG, Wolfsburg



10:35 **Drivetrain technology in agricultural machines – traditionally innovative**

- Development of drivetrain-technology
- Drivetrain challenges in agricultural applications

Dipl.-Ing. Jan-Hendrik Mohr, CEO CLAAS Gruppe, CLAAS KGaA mbH, Harsewinkel, Germany



11:00 **Plenary discussion**
Dialogue with keynote speaker

11:20 Be interactive – meet & greet in the exhibition area and car presentation

11:55 **Opening of**
8th International VDI Conference
Powertrain Systems in Mobile Machines 2024

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



Energy and propulsion systems

Moderation: Prof. Dr. Ludger Frerichs, Germany

12:00 **Use of renewable energies for agricultural machinery**

- Fuel demand of agriculture
- Assessment of alternatives to diesel fuels: Electrification, biofuels, paraffinic fuels
- Options for action for a switch to renewable energies: Financial incentives, technical measures, framework conditions

Dipl.-Geoökol. Henning Eckel, Teamleader energy, emissions and climate protection, Kuratorium für Technik und Bauwesen in der Landwirtschaft e. V. (KTBL), Darmstadt, Germany; Dr. agr. Edgar Remmele, Head of Department for Renewable Fuels and Materials, Technology and Support Centre (TFZ), Straubing, Germany

12:30 **Electrify Africa: A systematic approach to boost mechanization and access to electricity in emerging regions**

- Challenges in emerging regions; demography, electricity and mechanization
- Dedicated electric drivetrain of an e-tractor; exploiting the benefits of electrification
- Combination of power generation, consumption and service model to form an ecosystem

Dipl.-Ing. Holger Lange, Team leader, Dipl.-Ing. (FH) Gregor Dietz Project lead e-tractor, Go.Fair Ecosystem, Group Innovation, Volkswagen AG, Wolfsburg, Germany

13:00 Time for business lunch – meet & greet in the exhibition area and car presentation



Powertrain transformation

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

14:30 **Infinitely variable transmission development using electric drive system**

- Explanation of the electric drive system & technologies: Electric motors and power electronics.
- Transmission design overview and integration into tractor hydraulic and cooling systems.
- Control of transmission & vehicle

Roger Burjes, B. Sc., Chief Technology Engineer, Drivetrain, John Deere Product Engineering Center, Deere & Company, Waterloo, Jake Pence, B. Sc., M. Sc., Production & Precision Ag Electrification Manager, Clayton Janasek, B. Sc., John Deere Electric Powertrain Controls Lead, Deere & Company, Moline, USA

15:00 **Introduction of alternative drives in tractors of different performance classes**

- Trends and challenges of future zero emission off-road vehicles: Installation space, weight and tank infrastructure
- Electrification and introduction of alternative drives in different performance classes: Methane-, battery-electric-, hydrogen- & Diesel-hybrid-powertrain
- Implemented examples like NH Methan Power, NH T4 electric, Steyr FCTRAC, Steyr Hybrid CVT

Dr. techn. Jürgen Karner, Technischer Projektleiter, Advanced Technology & Innovation, Christian Mayer, M. Sc., Tractor Product Engineer BEV, CNH Industrial Österreich GmbH, St. Valentin, Austria; Stefano Fiorati, Ph.D, Director Tractor Innovation, Zero Emission & Advanced Drivetrain, CNH Industrial Italia spa, Modena, Italy

15:30 **Construction equipment drivesystems: Focus on hydrogen**

- Overview of different drivetrains: Range, emissions, infrastructure
- Operational capability of hydrogen on construction sites: quantity of energy and safety aspects
- Solutions: fuel cells, hydrogen engines and refueling

Stefan Peters, M. Sc., Programm Manager Technology, Liebherr-EMtec GmbH, Kirchdorf/Iller, Germany



16:00 Be interactive – meet & greet in the exhibition area and car presentation



Implementation of hydrogen fuel cell systems

Moderation: Dipl.-Ing. Kai Brandhofe, Vice President SF System Technology, CLAAS Selbstfahrende Erntemaschinen GmbH, Harsewinkel, Germany

- 16:45 High-power fuel cells for heavy-duty hydrogen mobility**
- Fuel cell electric vs. battery electric: when does each make sense?
 - Manufacturing high-power density fuel cell systems
 - Future prospects: Hydrogen eco-systems
- Prof. Dr. Christian Mohrdieck**, Chief Technology Officer, Technology, Hyzon, Bolingbrook, USA

- 17:15 Excavator with fuel cell electric powertrain – challenges of the conversion**
- Setup of a CO₂-free commercial vehicle powertrain by usage of a fuel cell in a conventional powertrain topology
 - Impact of fuel cell and battery size on the operating strategy
 - Compliance with the specifics of currently available fuel cell solutions in the market

Dipl.-Ing. (FH) Dieter Farthofer, Lead Engineer Off-Road Powertrain System, Commercial Vehicle Powertrain Systems, DI (FH) Wolfgang Gruber, M. Sc., Manager Commercial Vehicle Powertrain Systems, DI Johannes Pell, System Simulation Engineer CV, AVL List GmbH, Steyr, Austria

- 17:45 From system model to operational environment: Testing H₂-hybrid drives for mobile machinery**

- Consistent, development-accompanying testing of H₂-FC drives: Component specification, operating strategy, operating
- Virtual testing of individual subsystems and the entire system based on an interdisciplinary system model: Component specification, operating behavior, lifetime, economic performance
- Testing of FC drivetrain with regard to functional performance and operating behavior on a test bench and on a reference construction site

Jan de Vreeden, M. Sc., Research Assistant, Christian Habermehl, M. Sc., Group Lead Off-Highway, Systems Engineering – Modelling and Simulation, Univ.-Prof. Dr.-Ing. Georg Jacobs, Head, Institute for Machine Elements and Systems Engineering, RWTH Aachen University, Germany

- 18:15 Safety and functional safety in the conception of hydrogen tank systems**

- The role of hydrogen in the energy transition for the mobility sector
- Challenges in the design of an H₂ tank system: Safe storage, controlled release of H₂ and support for the refueling process
- Safety concept for H₂ tank systems from a structural, technical and organizational perspective

Duy Cuong Nguyen, M. Sc. Applied Physics, Systems Engineer H₂-Systeme, Data Driven Software and Sensors, ITK Engineering GmbH, Rülzheim, Germany

- 18:45 End of the 1st conference day**

ab 18:45 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, June 13th, 2024



Electric drive concepts

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

- 08:30 Electrification of the drivetrain of an all-wheel-drive municipal equipment carrier**

- General requirements in municipal use: Multifunctionality, multi-shift operation, instant availability
- Transfer concept from diesel to electric drive: Diesel like performance and usability, electrification of a Diesel-Platform, no Range Extender
- Experience report on technical implementation and outlook: Pro/Cons off-the-shelf components, challenges in thermal management, dos and don'ts

Dipl.-Ing. Malte Braunschweig, Manager, Dipl.-Ing. Christoph Hornig, Project Manager, Product Line Municipal Equipment, Hako GmbH, Bad Oldesloe, Germany

- 09:00 Evolution of transmission technology for electric off-highway machines**

- Innovation drivers for transmissions: Efficiency, performance, sustainability
- Modular approach to electric transmission range
- Advanced transmission architectures and controls

Joachim Van Dingenen, M. Sc., Lead engineer technology development, Giacomo Faggiani, M. Sc., Senior engineer systems and processes, Lorenzo Serrao, Ph.D., Lead engineer electrification, Dana Inc., Off-Highway Drive and Motion Systems, Bruges, Belgium and Rovereto, Italy

- 09:30 Local zero emission solution for mobile compact cranes**

- Motivation for local zero emissions and challenges in implementation
- Architecture of the electric drive system: Passive rectification, power architecture, thermal management
- Smart dual utilisation of installed components for mains supply or generator operation in driving mode

Thomas Speh, M. Eng., Head of Construction Machinery Systems, Dipl.-Ing. (DH) Martin Paal, Head, Mobile Switchgear & Systems, Liebherr-Electronics and Drives GmbH, Lindau, Germany

- 10:00 Electrification concepts in the field of tension of the operational business: A practical example**

- Basic electrification concepts – from minimally invasive to fully electric: Diesel emulation, fully electrical vehicle concept, advantages and disadvantages
- Drivers – which concept is the best? Energy efficiency vs. system costs, one-off costs, after-sales
- Realisation of a minimally invasive drivetrain with auxiliary drive for a heavy commercial vehicle: Realisation concept, motivational reasons, operational aspects

Dr.-Ing. Michael Philipp Schmitt, CEO, DINTEC GmbH, Kaufbeuren, Germany



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



Implementation of electric drivetrain systems

Moderation: Philipp Suhm, M. Sc., Head of Mobile Switchgear & Systems, Liebherr-Electronics and Drives GmbH, Biberach (Riß), Germany

11:15 Electrical machines for mobile machinery – application-specific requirements, design, and layout

- General requirements (environment: e.g. temperature, shock and vibration; system: e.g. voltage and current limits, interfaces) and application-specific requirements (e.g. speed ranges, torques, overload capacity)
- Challenges of mechanical design to fulfill all requirements with full variant flexibility and test scopes necessary for qualification
- Electromagnetic design and optimization: the degrees of freedom and trade-offs

Dr.-Ing. Thomas Finken, Product Owner Electrical Machine, Development Electrical Machine, Bosch Rexroth AG, Lohr am Main, Germany

11:45 Improved synergies: how to achieve the perfect match between battery, thermal management and drive train

- From analysis to dimensioning: consideration of charging infrastructure- and intervals relative to the battery parameters
- Influence of environmental and machine parameters to the thermal management
- Specification of best matching drive train solution: possible system architectures and how they affect the system efficiency and hence usage of battery system

Dipl.-Ing. (FH) Stefan Eichler, Sr. Manager, Editron Sales EMEA, Danfoss Editron Oy, Offenbach, **Christian Kiemer, M. Eng.**, Manager Application Engineering & E-mobility, Customized & Lifecycle Solutions Webasto Thermo & Comfort SE, Gilching, Germany

12:15 Immersion cooling battery technology with focus on safety and lifetime

- Modular battery architecture for maximal flexibility
- Thermal propagation prevention for highest safety standards
- Longer battery life by operating all cells at the optimal temperature range

DI (FH) Helmut Kastler, Head of Development, Dr.-Ing. Norbert Heublein, Senior Thermal Management Engineer, Kreisel Electric GmbH, Rainbach, Austria

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



Electric drives in different application

Moderation: Dipl.-Ing. Stefan Prebeck, Head of R&D Off-Highway Systems, ZF Friedrichshafen AG, Passau, Germany

14:15 Electrified powertrain for a medium size wheel loader

- Electric central drive with integrated ePTO
- Industrial meets Automotive: SiC Inverter and Hairpin E-machine from the commercial vehicle segment – motivation and effects of performance
- Functional system integration of components with modular approach and reuse

Dipl.-Ing. (FH) Rico Glöckner, Technical Project lead, System-Engineer, Electric Systems, ZF Friedrichshafen AG, Passau, Germany

14:45 Sustainable powertrains for special foundation equipment

- Hybrid powertrains as a combination of conventional diesel and electric drives
- Electro-hydraulic and direct-electric drive systems with plugged-in or autonomous energy supply
- Perspectives for hydrogen-based energy sources

Dr.-Ing. Hans-Philipp Otto, Director Central Development & Design, BAUER Maschinen GmbH, Schrobenhausen, Germany

15:15 'An electrification journey' – Developing and fine-tuning a system platform for electric off-highway machines

- Technologies and drive components developed for the system platform: electric motors and inverters, efficient gearbox, Li-Ion battery
- Introduction to the machine architecture wherein the system platform is implemented: component integration, thermal behavior and cooling concepts, drive control software
- An experience report: Application, fine-tuning and validation of realized machines

Dipl.-Ing. (BA) Florian Madlener, System technology engineer e-mobility, drive technology, Dipl.-Ing. Michael Kurz, Head of Systems Engineering, Andreas Meyer, M. Sc., Team Leader Drive Technology, Kramer-Werke GmbH, Pfullendorf, Germany; **Luca De Pascali, Ph.D.**, Mechatronics Engineer, Dana Inc., Off-Highway Drive and Motion Systems, Rovereto, Italy

15:45 Closing remarks by Prof. Dr. Ludger Frerichs (conference chairman)

15:50 End of 8th International VDI Conference Powertrain Systems in Mobile Machines 2024

Joint plenary session

Moderation: Dipl.-Ing. Thomas Pfund, President Business Unit E-Motors, Schaeffler Automotive Buehl GmbH & Co. KG, Buehl, Germany



16:00 Awarding of the best presentation for junior engineers

16:05 Common closing remarks

16:15 End of the International VDI congress Dritev 2024

Advisory board



1st row from left to right:

Dipl.-Ing. Kai Brandhofe, Vice President SF System Technology, CLAAS Selbstfahrende Erntemaschinen GmbH, Harsewinkel, Germany

Dr.-Ing. Ettore Cosoli, Vice President, Global Heavy Vehicle Engineering, Off-Highway and Commercial Vehicle Drive and Motion Systems, Dana Incorporated, Maumee, USA

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

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

2nd row from left to right

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

Dipl.-Ing. Stefan Prebeck, Head of R&D Off-Highway Systems, ZF Friedrichshafen AG, Passau, 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 Mobile Switchgear & Systems, Liebherr-Electronics and Drives GmbH, Biberach (Riß), Germany

Questions, to be answered at the conference:

1. What are the challenges of electric drivetrain systems and possible solutions?
2. What is the status of fuel cell systems for heavy-duty machinery?
3. How are electric drivetrains implemented and what do they look like in various heavy-duty applications?
4. What are challenges related to infrastructure for mobile machines: Energy supply, tank design and mobile source?
5. How do we get the energy to the application?

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Main Topics:

- Design and architecture of vehicle drive systems
- Thermal management, operating behavior, acoustics
- E-machine and power electronics
- Methods and simulation
- Gearbox and fluids
- CO₂ neutrality and sustainability

Conference chairman:

Dipl.-Ing. Konstantin Neiß, Director Electric Drive Systems & CoC Electric Drive Units, Mercedes-Benz AG, Stuttgart, Germany

Vice Chair

Dipl.-Ing. Thomas Pfund, President Business Unit E-Motors, Schaeffler Automotive Buehl GmbH & Co. KG, Buehl, Germany

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Development of energy-efficient, high-performance, and environmentally friendly propulsion solutions for the heavy-duty sector.

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