

Traktoren – Möglichkeiten und Herausforderungen alternativer Antriebssysteme und Schnittstellen

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JOHN DEERE

NOTHING RUNS LIKE A DEERE

Content

Tractors and Implements

- Electric Drives on Tractors and Implements
- Traction Optimization on System Level

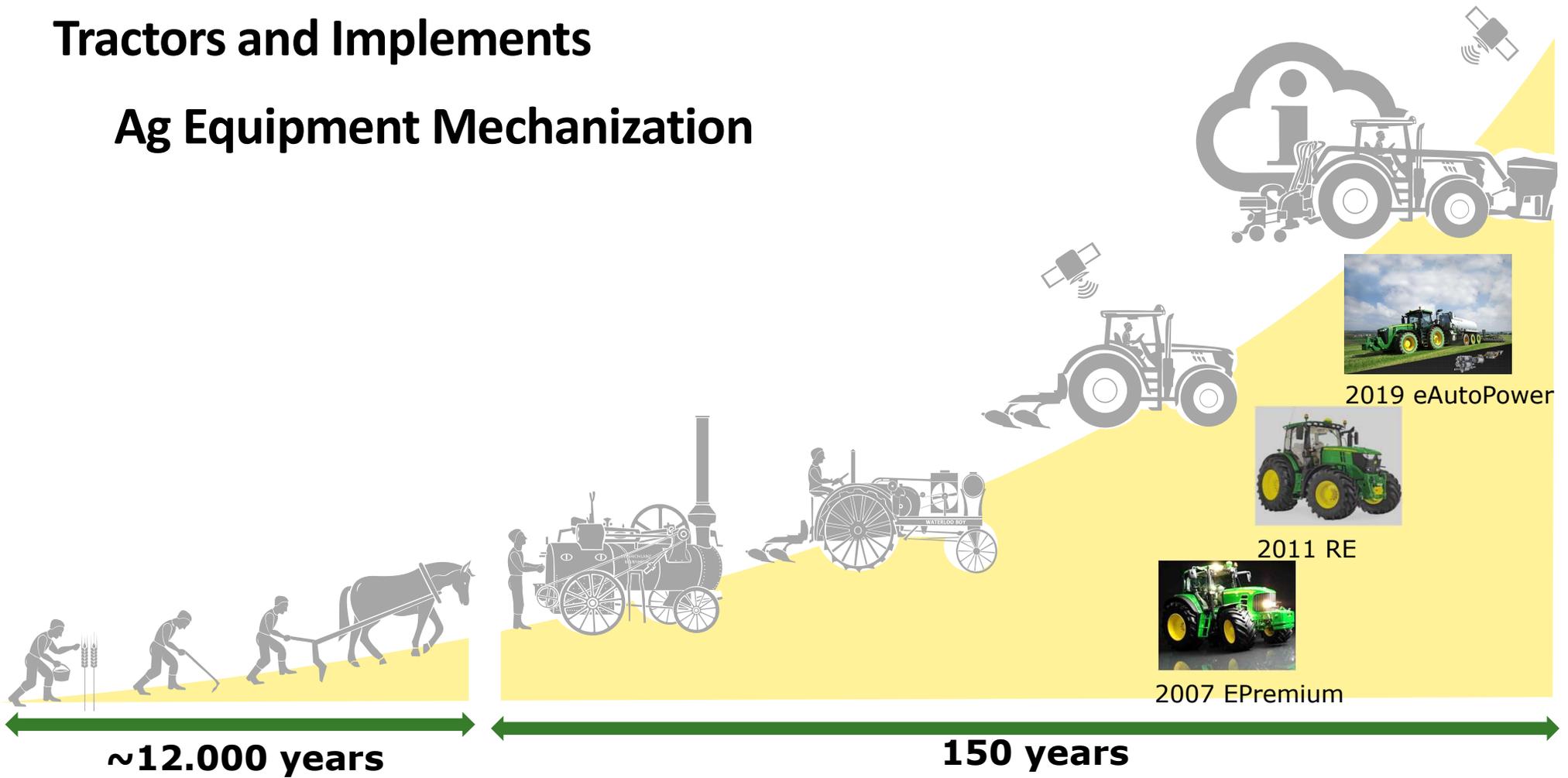
Future Powertrains

- Sideways Glance: Trucks & Commercial Vehicles
- Electric Drivetrain Flexibility

Perspectives and Take Aways

Tractors and Implements

Ag Equipment Mechanization

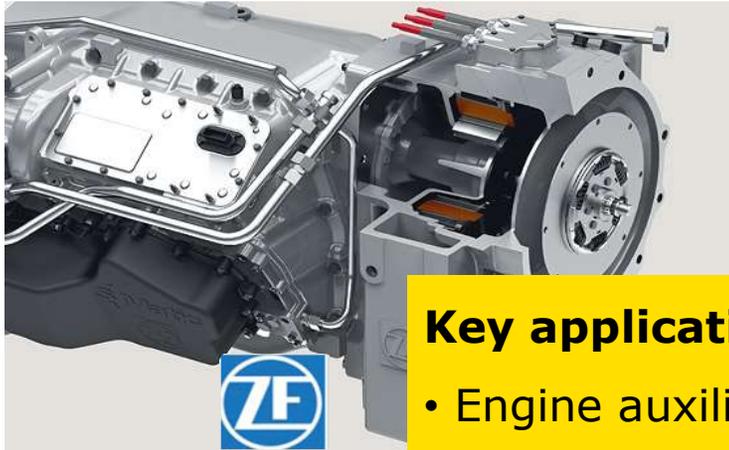


Electrification: key support to effective solutions

- Alternative Vehicle Concepts
 - Automation
 - Tractor and Implements
 - Automated Field Operation
 - **Electrification**
 - **Electric Auxiliary & Traction Drive Concepts**
 - **Electric Power Take Off for Implements**
 - Sensorics
 - Integration with Production Systems
 - Tractor – Cloud Connect
 - Farming 4.0
 - Vehicle and System Autonomy (Swarm Technology)
- It is all about controllability and power distribution**



Electric Drives: On-board & Off-board



Key applications:

- Engine auxiliaries
- Attachments / Implements
- Traction Drives

- Energy Storage:



Sources:
KvernelandRauch,
Amazonen Werke,
ZF



Tractor Power for Attachments & Implements

Advantages:

- Improved Controllability
 - Dynamics
 - Robustness
- Efficient Power Distribution
 - Power Losses
 - Packaging
- Reduced Footprint
 - Leakage Free
 - Optimized Sizing
 - Compatibility to New Power Sources

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Building Blocks of the Revolution



Row-Unit



High Performance Meter



Trench-Delivery System



Electric Motors



All electric drive planter with a 56 volt system



Improved Monitoring

John Deere Exact Emerge

JD Epremium
Fendt X-Fendt
JD 6215 RE
JD Centurion w/ Fiegl Power DriveElect
Fendt e100
JD 1RE
JD/Joskin eAutoPower & e8WD
...
Monarch tractors
...

Power for Attachments & Implements

Challenges:

- Widely Applicable and Available Interfaces
 - Expectations vs. Needs
 - Power Levels
 - Control Features
 - No. of Individual Interfaces
 - Scaling
 - Machine Sizes
 - Upgradeability
- Collaboration and Intellectual Property
- Functional Safety

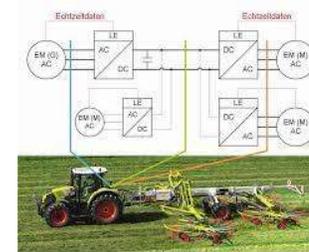
Power for Attachments & Implements

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 - Upgradeability
- Collaboration and Intellectual Property



Large and diverse group of players engaged
Typical development-cycles and -culture: slow to intermediate
Very few applications at start
Steep learning curve
Costs coming with technology introduction



Quellen:
emobilserver.de
aef-online.org
Landtechnik-online.eu

Achievements: Alignment and Standardization

Alignment and Standardization

AEF Guidelines

High Voltage Interface: Power and Information

ISO 16230

High Voltage Safety on Ag Machinery

ISO 23316

High Voltage Interface

ISO 23285

Intermediate Voltage Safety on Ag Machinery

Achievements: Standardized High Voltage Training

„Fachkundiger für Hochvoltsysteme in der Land- und Baumaschinentechnik“

- Basic qualification training (mandatory and brand-independant)
- Product specific training (by machine type)

Content:

H.A.G. initiated w/ communication via VDMA from 2010

- Crafts Association (BG) HV Qualification Training
- DGUV HV Training

Delivery Support:

- IHK (e.g. @Claas)
- HWK (e.g. @John Deere)

JD Training Center Bruchsal

- Training delivered to 550+ service technicians at JD Training Center

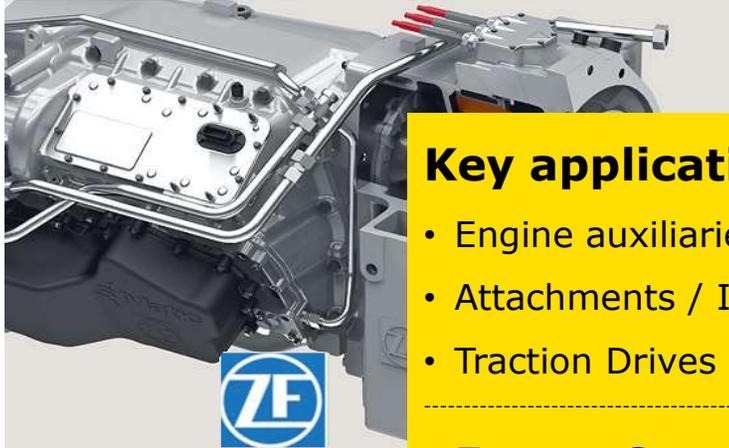
H.A.G. Hauptarbeitsgemeinschaft Landmaschinenhandel und -handwerk
BG Berufsgenossenschaft
DGUV Deutsche Gesellschaft für Unfallverhütung
IHK Industrie- und Handelskammer
HWK Handwerkskammer

Milestones: Electrification Building Blocks

- ✓ - Technology & Design Knowledge
 - High power range, up to: 480 VAC & 700 VDC
 - Mid power range, up to: 50 VAC & 75 VDC, e.g. 48 VAC
- ✓ - Standards and Compliance
 - AEF Interface Guidelines
 - ISO Standards
- ✓ - Manufacturing, Training, Sales & Maintenance
- ✓ - Distinct Customer Value
 - Traction Assist and Function Drives on Implements
- ✓ - Building the Foundation for the Future
 - Regulations
 - CO2 Neutrality
 - Customer Perceived Value Impact



Electric Drives: Building the Foundation for the Future



Key applications:

- Engine auxiliaries
- Attachments / Implements
- Traction Drives
- Energy Storage:
- Legal Requirements
- CO2 Reduction / Neutrality
- Customer Perceived Value Impact



Sources:
KvernelandRauch,
Amazonen Werke,
ZF

The Advantage of Electric Drive Based Powertrains: Flexibility - Peek into on-road developments



Basiert auf Quelle: e-mobil BW Landesagentur für Mobilitätslösungen und Automotive Baden-Württemberg

The Advantage of Electric Drive Based Powertrains: Flexibility - Peek into on-road developments



Electric drivetrain interfaces, compatible to various power sources:

- Engine-Generator
- Battery
- Fuel Cells
- Hybrid Configurations
 - Engine + Battery
 - Engine + Fuel Cell
 - ...
- Grid Power
- ...
- Nuclear

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The Advantage of Electric Drive Based Powertrains: Flexibility - Peek into on-road developments



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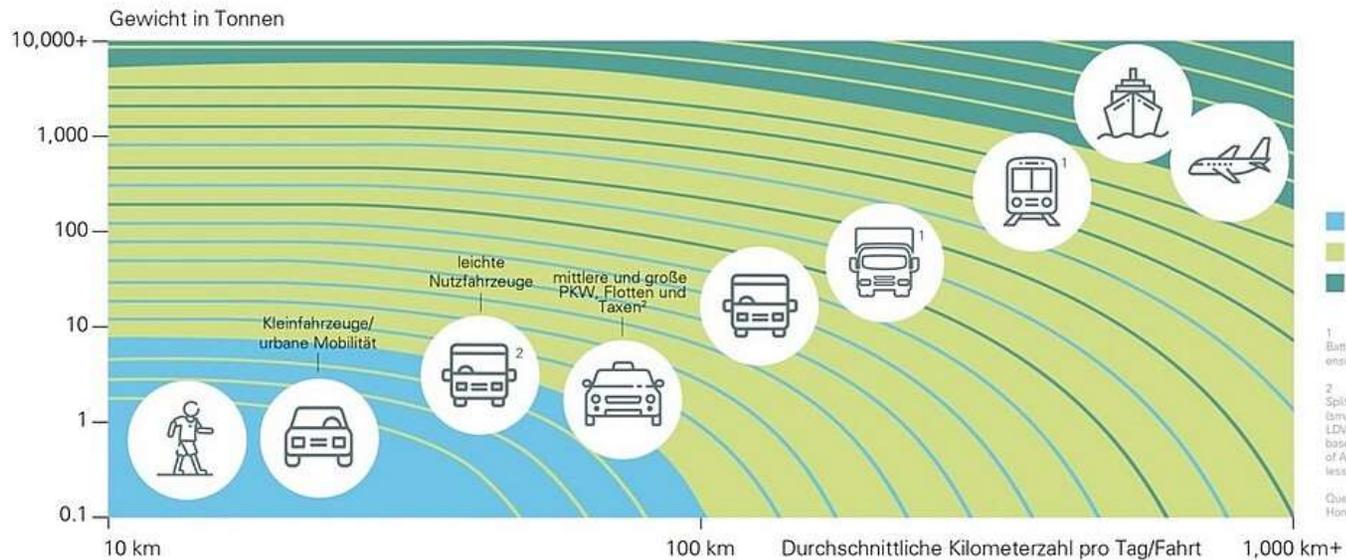
- Battery
- Fuel Cells
- Hybrid Configurations
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 - ...
- Grid Power



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und Automotve
Baden-Württemberg

Future Energy Storage and Fuels: Driven by Application Requirements

Vielfalt der Antriebsarten



BEV: low-intermediate power
moderate energy per shift

FCEV: intermediate Power
quick refill

Alternative liquid fuels:
high power
high energy per shift
combustion engines

¹ Battery-hyd ensure sufficient power

² Split in A- and B-segment LDVs (small cars) and C-segment LDVs (medium to large cars) based on a 30% market share of A/B-segment cars and a 50% less energy demand

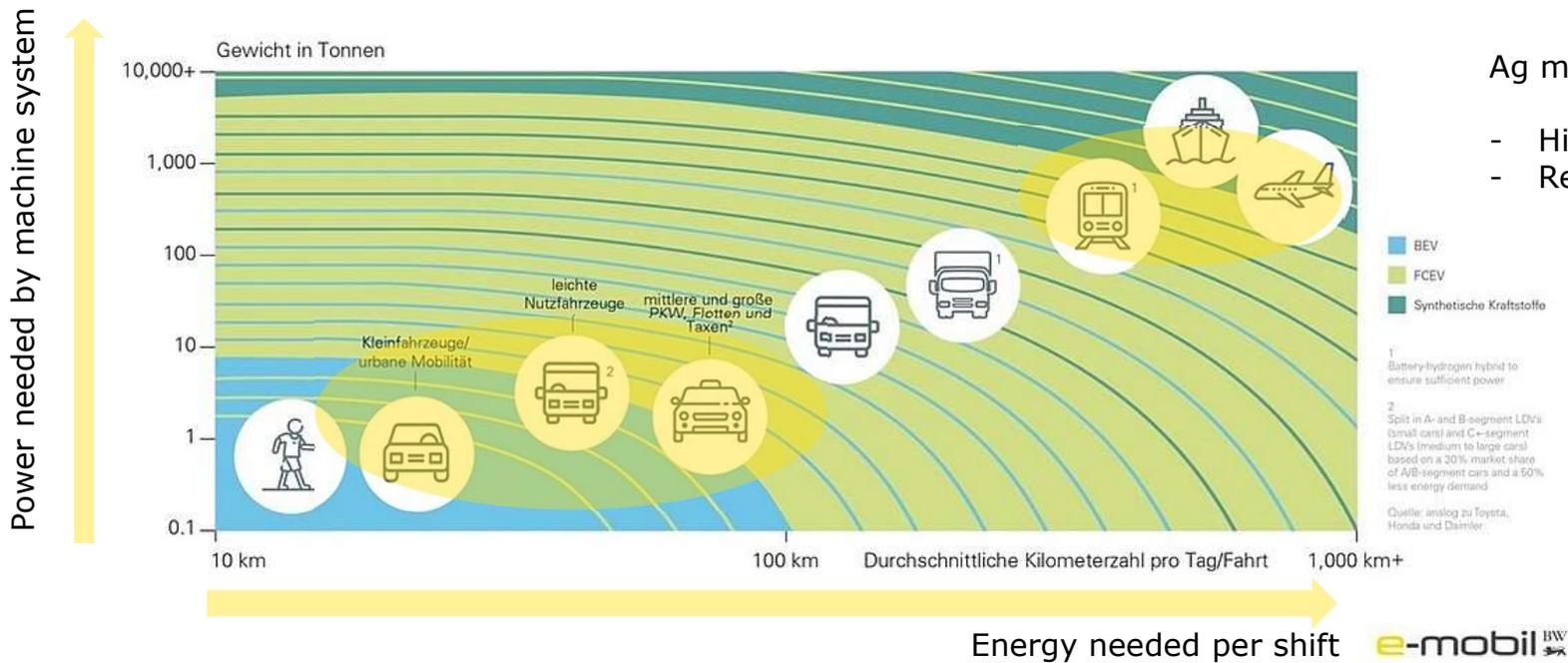
Quelle: analog zu Toyota, Honda und Daimler.

Quelle: e-mobil BW
Landesagentur für
Mobilitätslösungen
und Automotive
Baden-Württemberg

e-mobil BW

Future Energy Storage and Fuels: Does this translate into Ag machinery?

Vielfalt der Antriebsarten

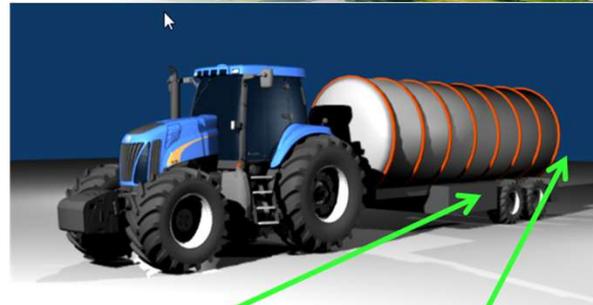
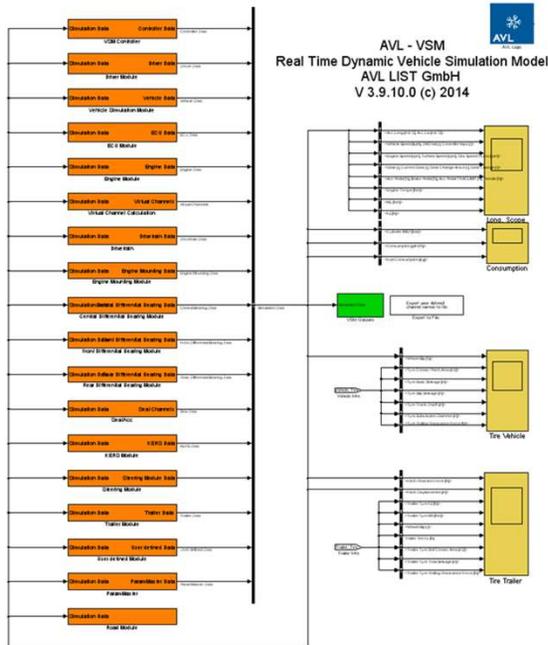


Ag machinery needs:

- High density energy storage
- Relatively high power (kW...MW)

Basiert auf Quelle:
e-mobil BW
Landesagentur für
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und Automotive
Baden-Württemberg

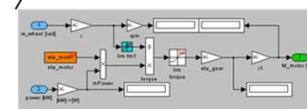
Building Confidence: Simulation and Validation



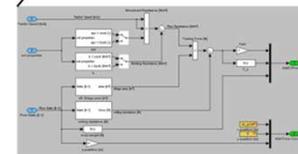
Traction Assist
Implement Drives
Automation



aux. Propulsion



Implements



Component Models

New Powertrain Configurations

Next Steps: Automation, SWARMS & Autonomy

Built on: Controllability, Communication and Innovative Powertrains

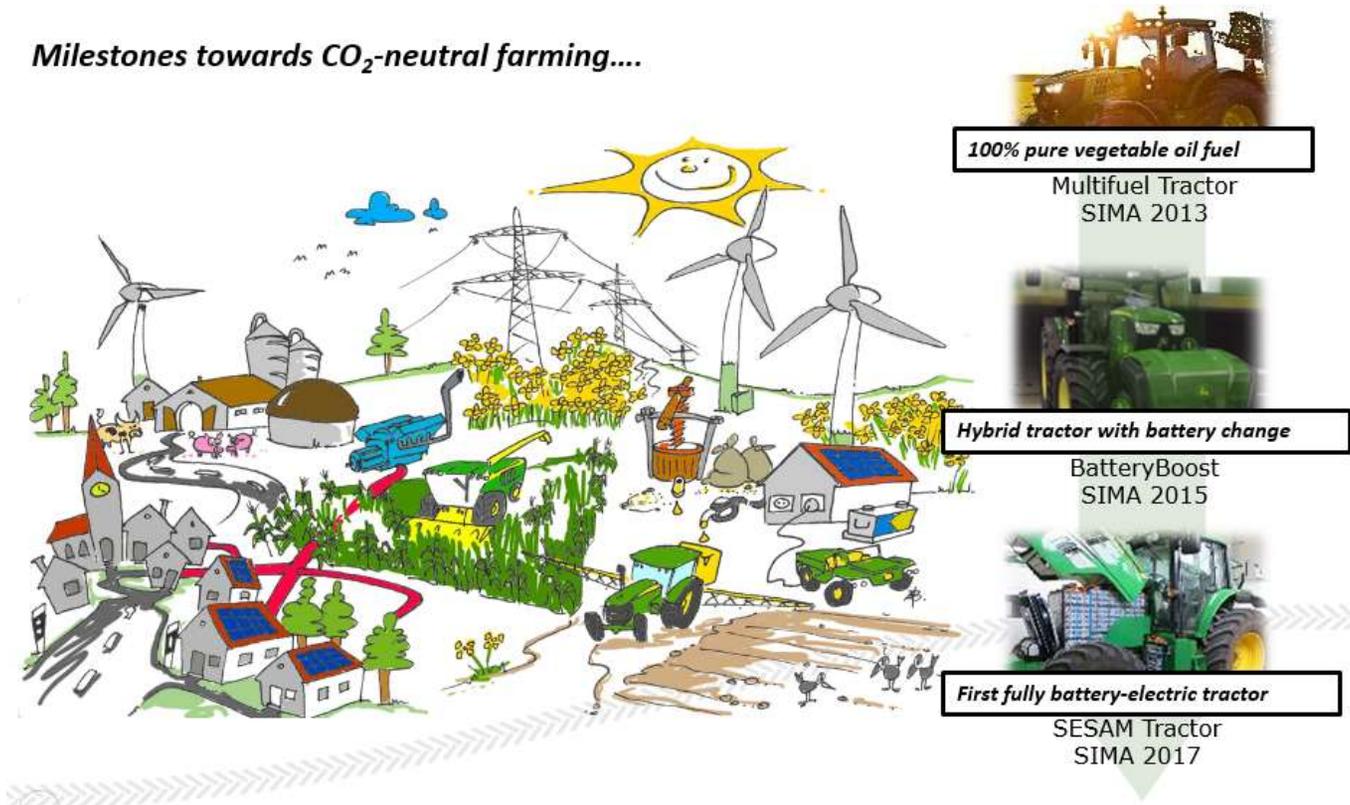


Perspectives / Take aways

- Electric Drives have arrived in Ag machinery
- Key Building Blocks: Technology, Safety, Design, Standards, ...
- Electric Drives on Implements: Evolution takes Time
- Electric Drivetrains are flexible relative to Power Sources
- The Future: Diverse Powertrain Configurations
- Collaboration and Leverage of Heavy Duty Commercial Solutions

Build on a Solid Backbone: Making a Vision become Reality

Milestones towards CO₂-neutral farming....



Research and advanced development is supported thru various public funded projects
IP for several slides @ Prof. Pickel, Dr. Tarasinski, Dr. Kunz and their teams



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