

Picture: Conservatoire National des Arts et des Métiers

Wieselburg, Jan. 27th 2020

Trends in Tractor Development

Trends in der Traktorenentwicklung

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FUTURE TECHNOLOGY ZONE




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Agritechnica – JD’s Future Technology Zone Exhibits and Technology Fields




Autonomous Electric Tractor

- Automation & Autonomy
- Electrification



Autonomous Sprayer

- Artificial Intelligence
- Automation & Autonomy



See and Spray

- Artificial Intelligence




Large Spraying Drone

- Automation & Autonomy
- Electrification



Autonomous Drone Sprayer

- Automation & Autonomy
- Electrification




Command Cab

- Artificial Intelligence
- Automation & Autonomy



Zero Emission Compact Utility Tractor

- Electrification



eAutoPower

- Electrification



Semi-Autonomous Tractor

- Automation & Autonomy

Electrification - Key Enabling Technology

- Efficiency
- Controllability and dynamic response behaviour

John Deere ExactEmerge

Electric system characteristics

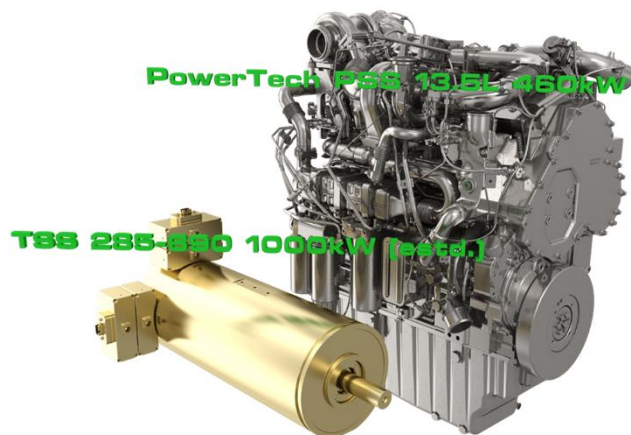
- 48V PTO generator or high power AEF connector
- 2 servo-motors per row unit



Electrification - Key Enabling Technology

- Efficiency
- Controllability and dynamic response behaviour
- Increased power density

TSS285-690 vs PowerTech PSS 13.5



Electrification - Key Enabling Technology

- Efficiency
- Controllability and dynamic response behaviour
- Increased power density
- Using renewable energy

SESAM-Farm Vision

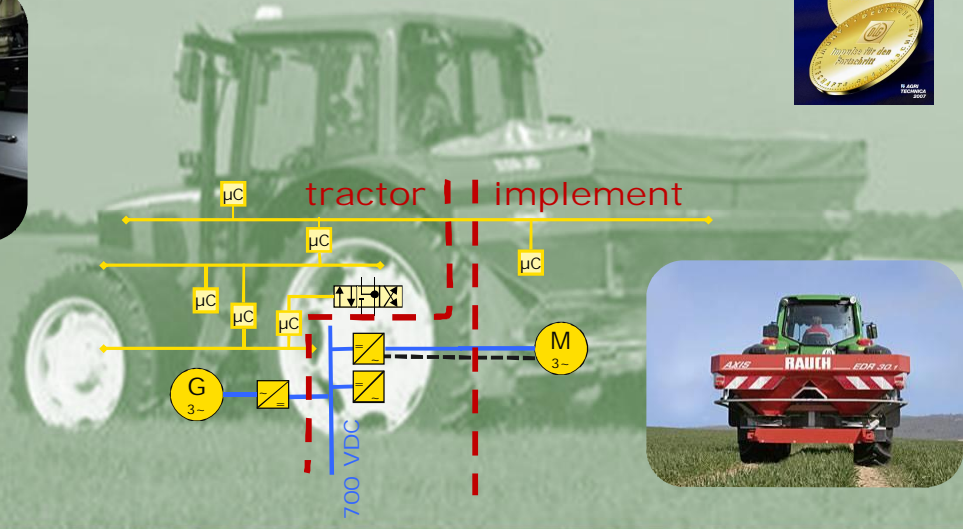
Decentralized
Energy Supply
in Rural Areas





International Green Week
Berlin, Jan. 17th-26th 2020

Automation – The electric vision (Rauch Axis EDR)



Needed new interfaces (AEF Gen 2 and successors)

Additional Low Voltage (48VDC) is establishing



Power contacts
DC / AC (High voltage, high power)



Real time Ethernet (EtherCAT)
compliant data interface

Source: Sobotzik

The inherent dimension problem of tractor batteries

Rated power	kW	50	180	290	380
Operational time/day	h	4	10	12	12
Req. battery cap. ¹⁾	kWh	100	900	1740	2280

¹⁾ at 50% utilization

Battery dimension

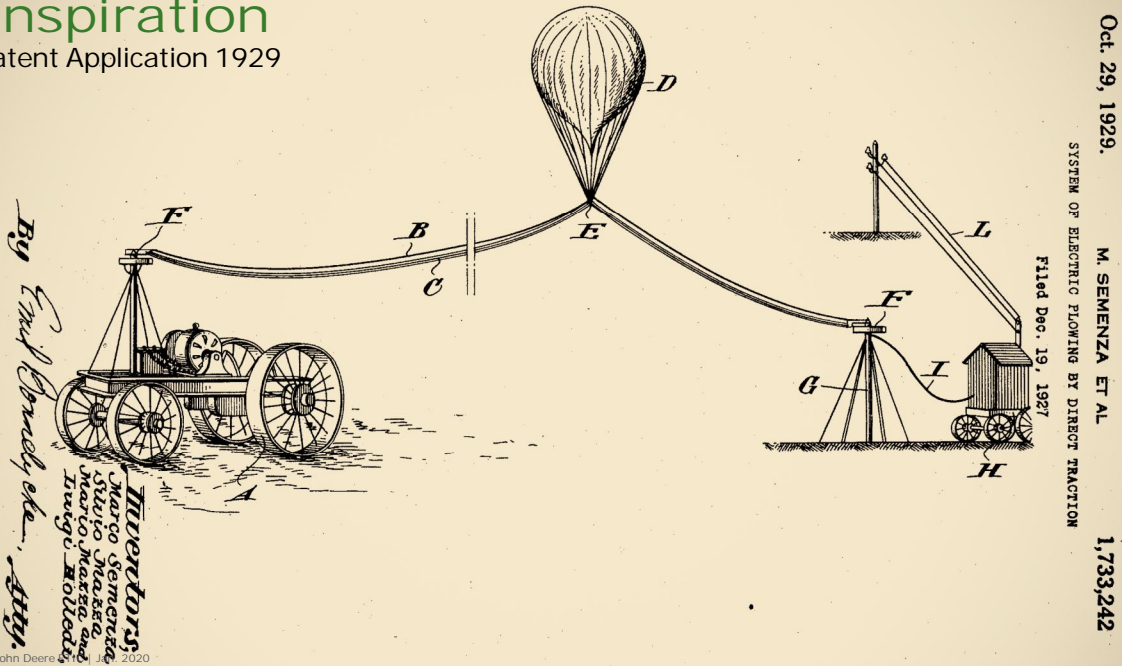


Assumptions:
 ca. 6,6 kg/kWh (for comparison: SESAM bei ~10 kg/kWh)
 ca. 2,2 l/kWh

Source: Fendt / AGCO - modified

Inspiration

Patent Application 1929





Overcoming Limits of Onboard Batteries

Corner Stones

Machine Performance	200%
Power Density	200%
Machine Cost	50%
Operating Cost	50%
Applicability of Renewable Power	up to 100%
Supports different stationary power sources	Power grid Battery Generator

Supported by:

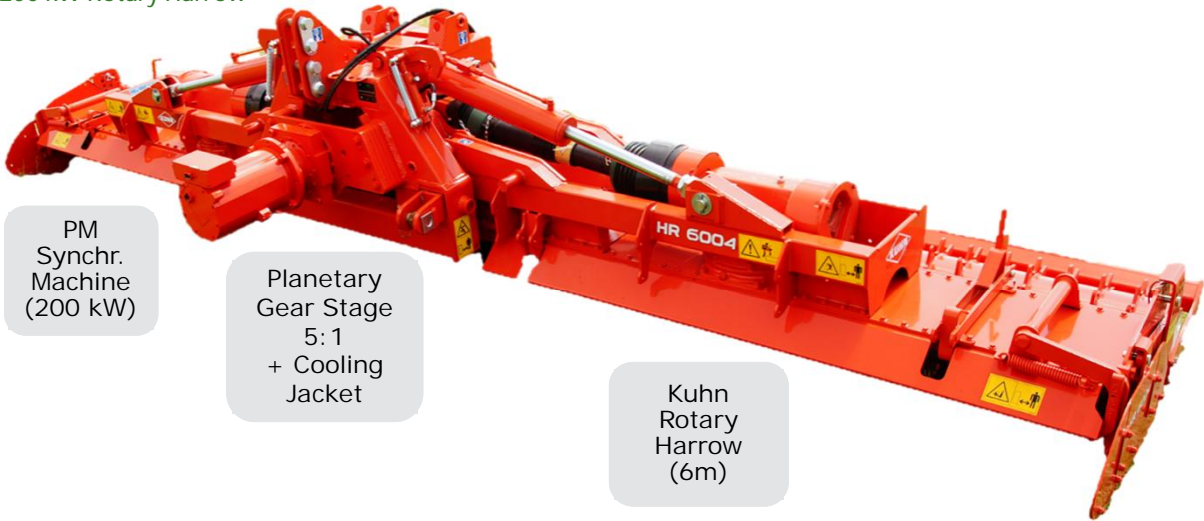


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Electric Implement

200 kW Rotary Harrow



PM
Synchr.
Machine
(200 kW)

Planetary
Gear Stage
5:1
+ Cooling
Jacket

Kuhn
Rotary
Harrow
(6m)

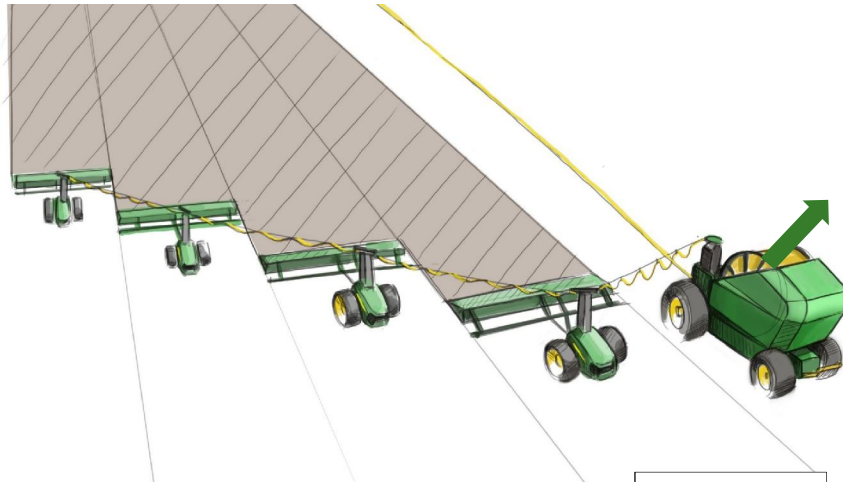
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Field Swarm Unit Concept



John Deere Field Swarm Vision



Source: Pfaffmann



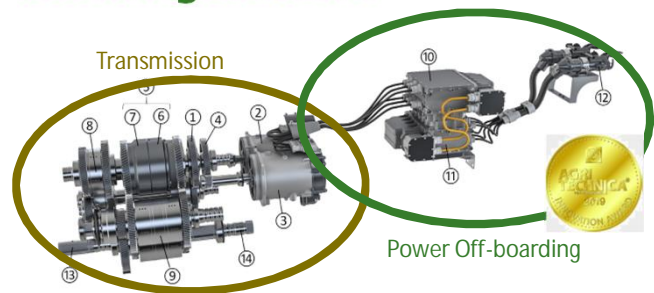
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5 Key Theses for Electrification in Agriculture

1. Electric power trains are the future

- effectivity
- controllability
- access to renewable energy
- power density



2. Tractor-implement-electrification important driver (hen and egg problem)
3. Hybrid systems depending on need for boost power (not range extenders)
4. Still missing business case and poor energy density for battery electric ag machines
5. Grid services and increase of self-supply with grid-plug-in systems as new (secondary) business cases in agriculture

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