29th Members’ Meeting of the Club of Bologna

Agricultural Mechanization and Sustainability

10-11 November 2019
Hannover, Germany

Electric Tractor Perspectives

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Agenda

• CNH Industrial Megatrends
• Why Electrification in Agricultural Machinery?
• Challenges
• CNH Industrial Approach to Electrification
• CNH Industrial Electrification Concepts
• Final Discussion
INDUSTRY AND TECHNOLOGY MEGATRENDS

DIGITALIZATION
Broad diffusion of digital and connected applications
Connected is the "new normal"

AUTONOMOUS
Automation enabled by digitalization and robots
Vehicle, process and task automation

SERVITIZATION
Rise of "as a service" offerings in capital goods
Emerging service models

ALTERNATIVE PROPULSION
Tightening emission rules and awareness of climate change
Alternative power sources
Diesel to LNG to Electrification and Fuel Cells

LNG is a bridging strategy for heavy duty applications

- Reduction of NO\textsubscript{2} emissions by 90%
- Decreases particulate matter by 99%
- Decreases CO\textsubscript{2} up to 15% – up to 95% with biomethane

In 2018 FPT launched the e-Powertrain organization in Arbon, Switzerland

- Hydrogen Fuel Cell Concept Powertrain, developed by FPT Industrial for heavy duty commercial applications
- New E-Axles, and Diesel-Hybrid and Gas-Hybrid Powertrains
Nikola Partnership

ZERO-EMISSION: FUEL CELLS & BEV
WE WILL PARTNER WITH NIKOLA TO DISRUPT THE INDUSTRY

IVECO

• High-quality truck technology, superior design
• World-class engineering and manufacturing
• Strong European distribution network
• Proven technology disruptor with LNG

NIKOLA

• Leader in fuel cell truck technology
• Own hydrogen filling infrastructure
• New & disruptive business model
• Founder’s mentality with zero-emission intent

WE WILL PARTNER WITH NIKOLA TO DISRUPT THE INDUSTRY

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VIDEO – https://www.youtube.com/watch?v=m_thgeZiMcs
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Why Electrification in Agricultural Machinery?
What’s driving the business case for electrification?

1. Decouple loads and drives from the powertrain
2. Emission reduction and Zero Emission Vehicle
3. Expanded functionalities
   – **Electronomous** – Electrification enabler for automation and Autonomous System
   – Productivity – increase precision, do more with less
4. New maintenance model
5. Technological advancements accelerating OEM adoption of technology
6. Potential government incentives driving unit shipment growth
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Product Challenges/Opportunities

Across industry, battery will benefit of cost reduction and improved performances but challenges for off-road application are still

1. **Safety**: current is not visible, this requires monitoring and diagnostic systems
2. **Higher upfront cost** of hybrid powertrain systems
3. **Cost and availability of battery** components and challenges in battery technology raising application concerns
4. **Reliability and performances** of the electric components in an off-road environment (e.g. vibration level)
5. **Supply/value chain** and technical support not yet trained
6. **Lack of standardization**

![Graph showing future battery cost, 2020-2030](image)
Challenges

Daily plough mission

16 Tons typical working weight
Terrus Heavy Duty

630 liters
0,56 Tons

10000 liters
5000 liters @ 2025
4800 liters @ 2030

12 Tons Li-Ion battery
7 Tons @ 2025 Li-Ion battery
4,2 Tons @ 2030 new technology (e.g. solid state)
Infrastructure Challenges/Opportunities

- Infrastructure around the electric machine not yet clear, e.g. charging system or cables application like the John Deere GridCon or both? Which is the best solution for the end-user? Are we going to change the “shape” of the field and adapt it to the technology or vice versa?
- Coherent with local production of energy – circular economy (e.g. bio methane)

- The technology of an electric tractor connected to the power grid via a cable would allow to use all the benefits of an electric tractor without the limitations of batteries or other electric power sources.
- Beside the availability of electric power on the field, this technology would need a flexible cable guiding system.
- If this technology is further considered, the shape of the field might be changed (shown on the illustration on the right side) to allow easier cable guiding...and for sure a different approach for farming processes!

Sources: Ludger Frerichs, Lars Thielke, VDI-Berichte Nr. 2226, 2014; farmingahead.com.au;
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- **CNH Industrial Approach to Electrification**
- CNH Industrial Electrification Concepts
- Final Discussion
CNH Industrial Approach on Technology development

Natural gas leadership

THE ONLY COMPLETE GAS RANGE FROM 3,5 TO 40 ON THE MARKET

IVECO is the only manufacturer worldwide to offer the entire range of commercial vehicles from light panel vans and medium-heavy trucks to heavy articulated gas-powered trucks for long-distance transport with robust and everyday gas vehicles. The gas engine technology used is the result of decades of intensive research and development work that is now paying off for you. Whether you are looking for a solution for inner-urban deliveries, for municipal tasks, for construction site logistics or for intercontinental transportation, you are sure to find the right gas vehicle in our wide range of highly specialised models.

IVECO NAMED INDUSTRY CHAMPION IN NATURAL GAS VEHICLES

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CNH Industrial Approach on Technology development

Leader in EU in full electric and hybrid buses since 2010
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Huge technology evolution – same basic architecture designed around transmission and engine

1984

2019

Time for a new vehicle?
Electrification roll-out

TODAY

Power supply to implements

Provide low and high voltage power to implements

Tractor auxiliaries

Various actuations converted from hydraulic

Hybrid and full electric tractor

Electric Transmission

New vehicle modular layout possible and additional function enabled. Major shift in the industry? How the tractor will appear in the future?
Steyr Hybrid Konzept

What requirements will a tractor have to meet in future? / The STEYR Concept highlights potential solutions / Possible hybrid drive with zero-emissions mode / Combustion engine in combination with electric engines / Modular drive system allows modifications to suit different conditions

- High performance downsized engine with generator
- Electric hub motors for perfect single-wheel drive
- Electrically driven hydraulic and PTO
- High and Low voltage connectors for implements
- Zero-emissions driving
- Outstanding operator experience and the ultimate in ride comfort
- Precision Farming re-thought
VIDEO – https://www.youtube.com/watch?v=ieM7njSajFg

THE STEYR KONZEPT

OUR VISION OF THE FUTURE

A CONCEPT TRACTOR WITH HYBRID TECHNOLOGY THAT PROVIDES SUSTAINABLE PERFORMANCE

Targeting contractors, farms and municipalities
Looking into the future and giving some possible answers to agricultural challenges of the future
Thanks for Your Attention
POWERING SUSTAINABLE TRANSFORMATION