

Vegetable Oil as a Bridging Technology

The ResiTrac Project

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Project Coordinator

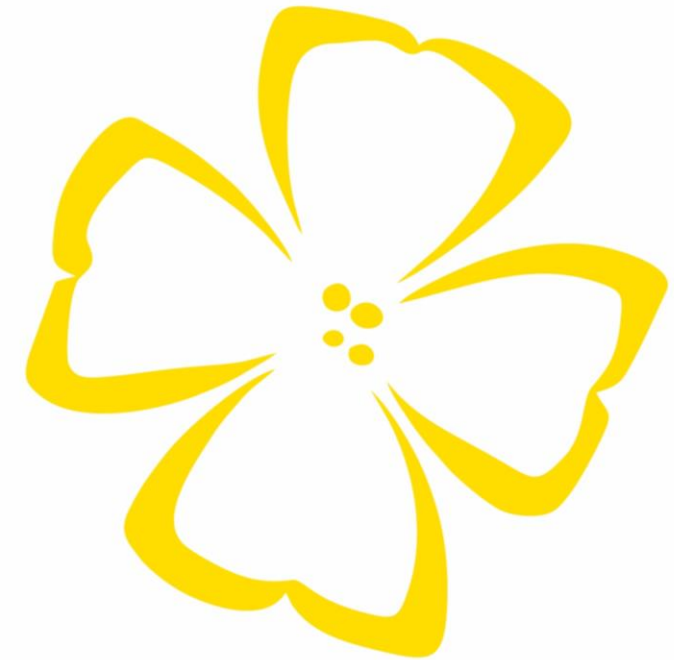
John Deere GmbH & Co. KG

Intelligent Solutions Group

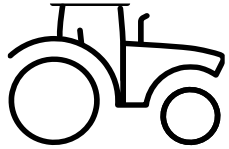


Agenda

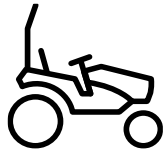
- Motivation
- The ResiTrac project
- Challenges when operating with vegetable oil
- Approaches and results
- Summary and outlook



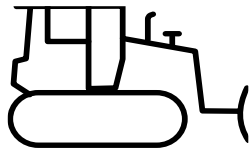
John Deere's electrification strategy until 2026



→ Introducing an autonomous, battery-powered tractor for agriculture



→ Development of an electric drive alternative in every product family of machines for lawn and property care and compact commercial vehicles



→ Introduction of more than 20 construction and forestry machines with electric and hybrid-electric drives



But what about larger agricultural machinery?

Motivation - Achieve climate goals faster with vegetable oil

- Agricultural machines have high power and energy requirements
- Electrification is coming – but not tomorrow
- Independence from fossil fuels
- Vegetable oil as a “bridge fuel”
- Regional value creation potential
- Existing infrastructure usable



The ResiTrac Project

Resilient Food Production with Green Tractors



Co-funded by the
European Union



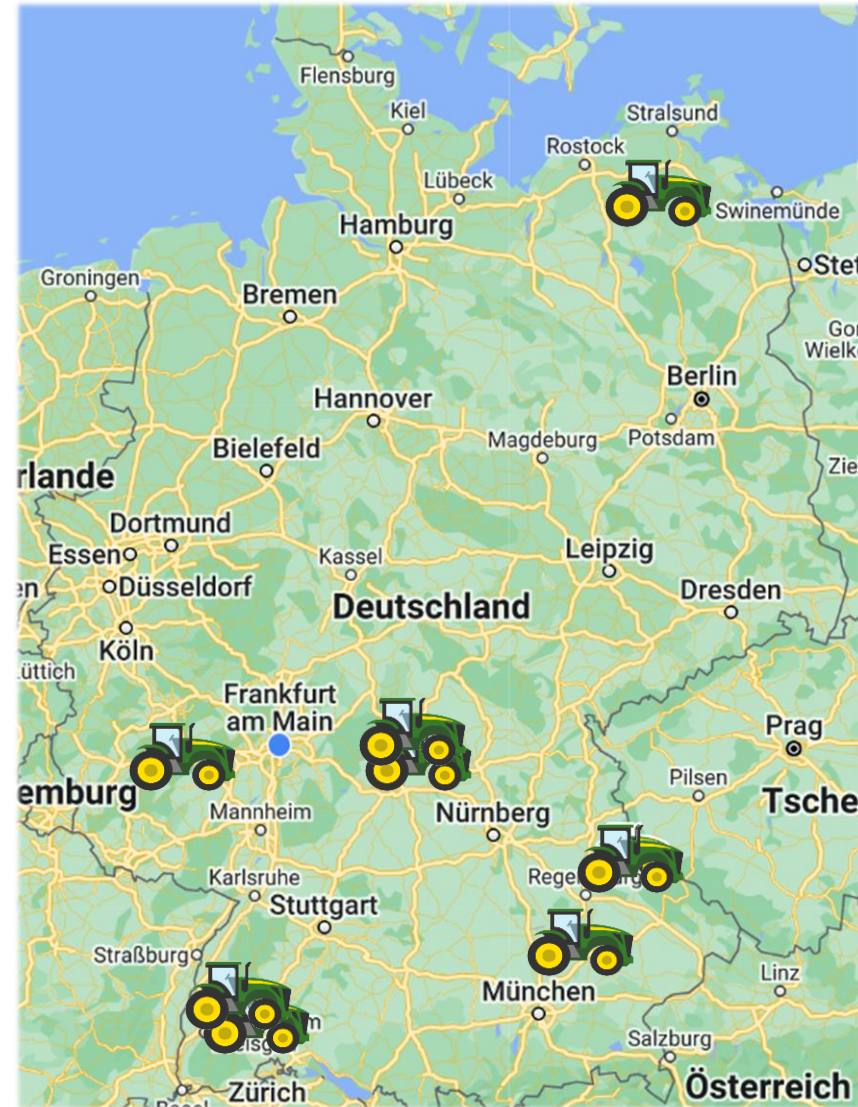
- Practical test of vegetable oil tractors of various performance classes
 - 6R 150 bis 6R 215
- Test fleet of 10 tractors
- Only vegetable oils according to DIN51605 and DIN51623
- Project goals
 - Verification through performance and emissions measurements
 - Investigations of the influences on engine lubricating oil and exhaust aftertreatment systems
 - Development of a regeneration strategy for the diesel particulate filter



Locations ResiTrac

Test Fleet

- 2x 6R 150
- 3x 6R 185
- 1x 6R 195
- 2x 6R 215
- (2x 5130 ML Orchard)



Challenges when operating with vegetable oil

| Fuel Property | Challenges |
|------------------|--|
| Boiling behavior | Engine oil dilution, DPF regeneration |
| Heating Value | Power adaption |
| Viscosity | Cold start, Pumping in the low-pressure system |
| | Being compliant to emission regulations |



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Approaches and results

Engine oil dilution and DPF regeneration

- Diesel particulate filters must be burned out regularly
- Fuel runs into the engine oil
- Diesel evaporates again during operation, but vegetable oil remains in the engine oil



- Adapted regeneration strategy for vegetable oil necessary



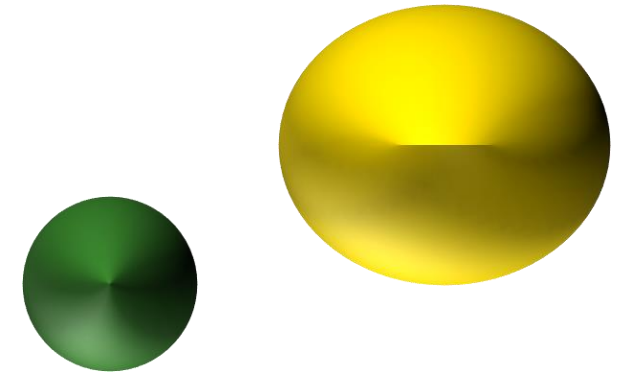
- Approach 1: Adapted injection strategy
- Approach 2: Disabling regeneration in vegetable oil operation

Approaches and results

Engine oil dilution and DPF regeneration

- Approach 2: Disabling regeneration in vegetable oil operation
- Positive results in the past
- Comparative studies carried out on engine test benches
- Smaller particles in vegetable oil operation
- Higher surface area to volume ratio
- Particles may oxidize at lower temperatures

- Current results are not yet clear
- Further investigations during the project



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On the test bench and in the field

- Installation of sensors and data collection in everyday operations
- Tracking the fleet via Operations Center
- Emissions and performance measurements
 - On a vehicle test bench
 - PEMS-Measurements (Portable Emission Measurement System)



Technologie- und Förderzentrum
im Kompetenzzentrum
für Nachwachsende Rohstoffe



Vor 39 Minuten

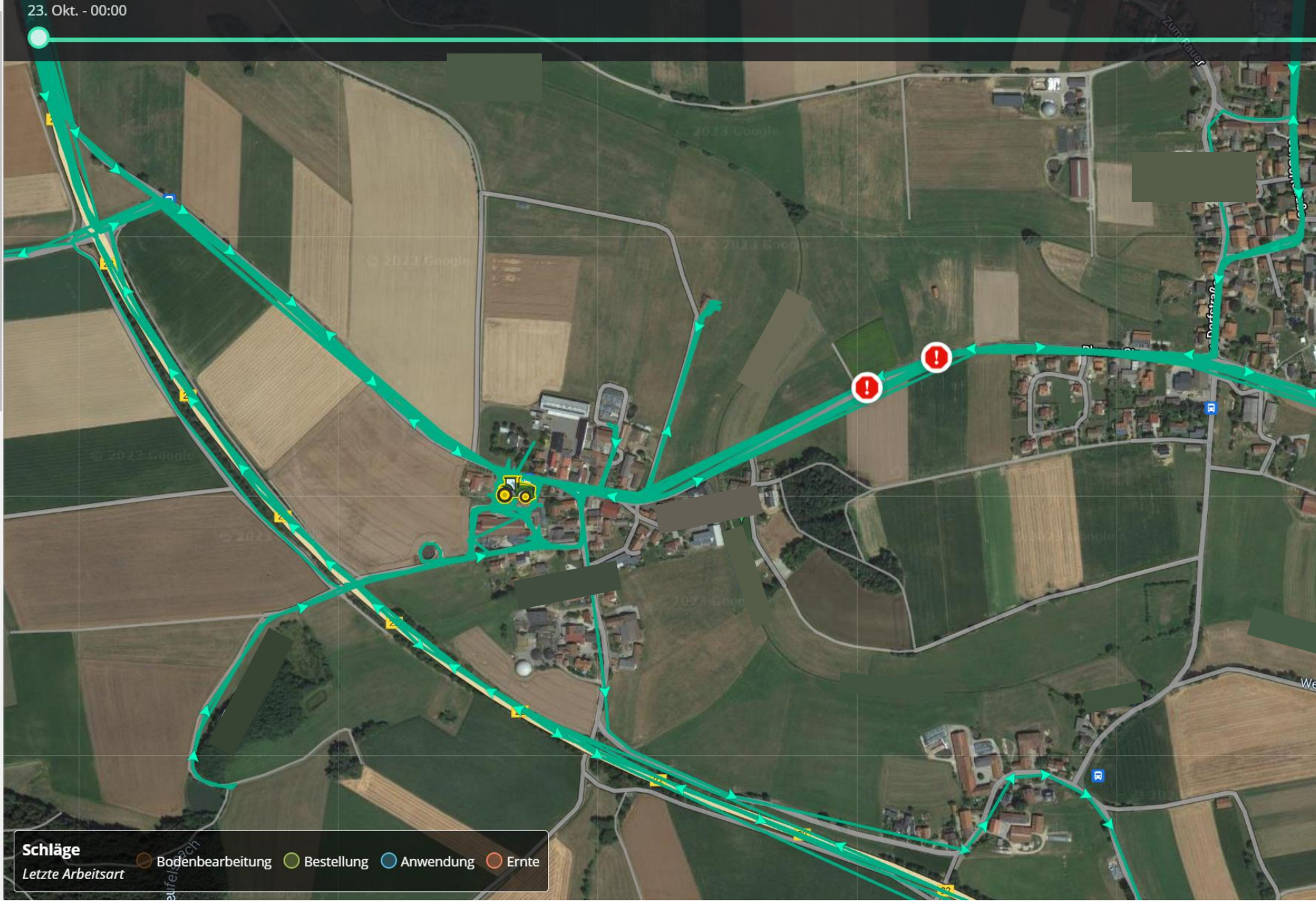
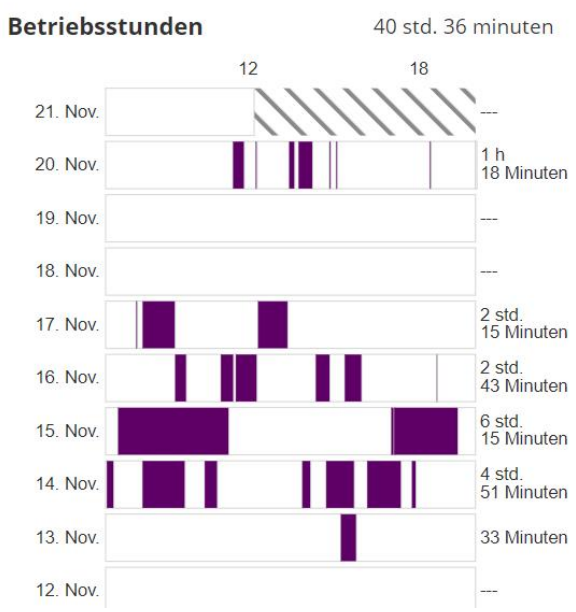
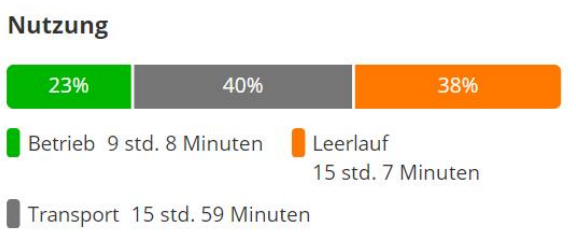
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Tags verwalten

RDA Fahrtrouten

Letzte 30 Tage 23.10.2023 21.11.2023

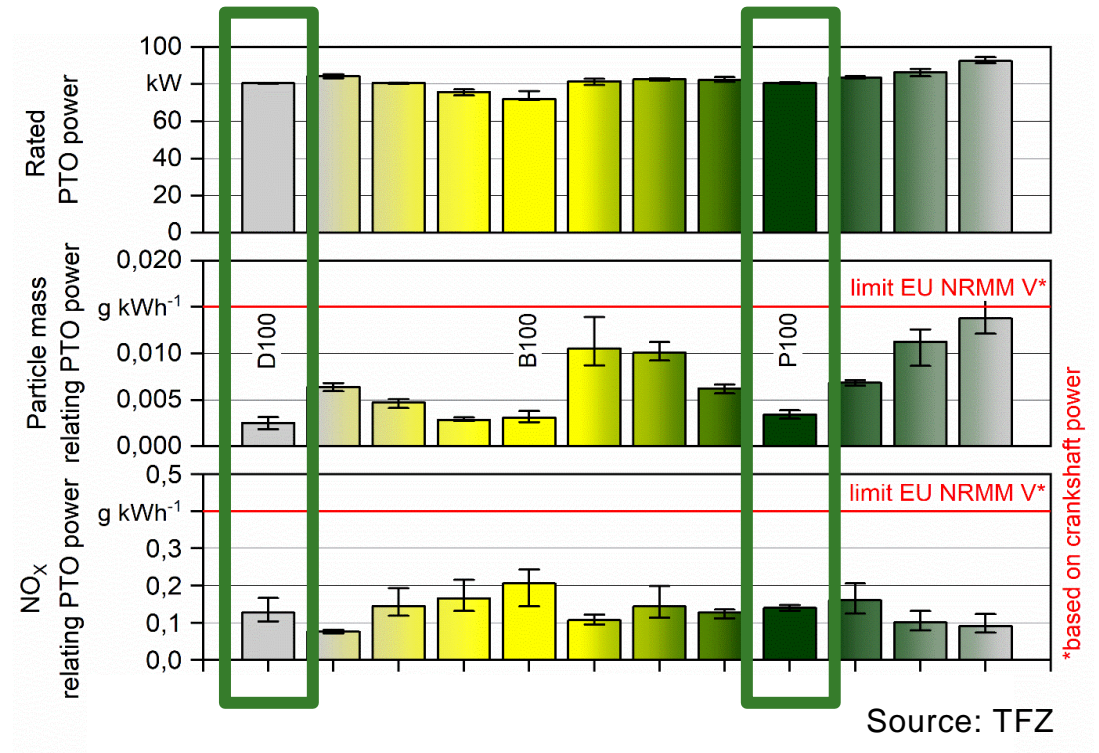
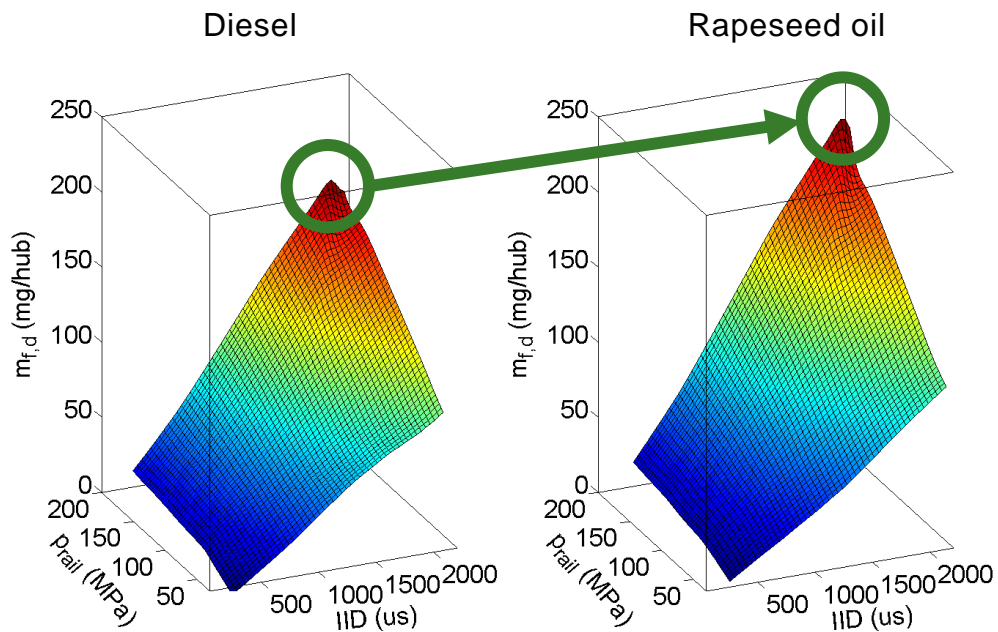
Ergebnis Warnungen Wartung Einrichtung



Approaches and results

Power adaption

- Higher injection quantities
- Adapted injector control
- Below emission limits and same performance



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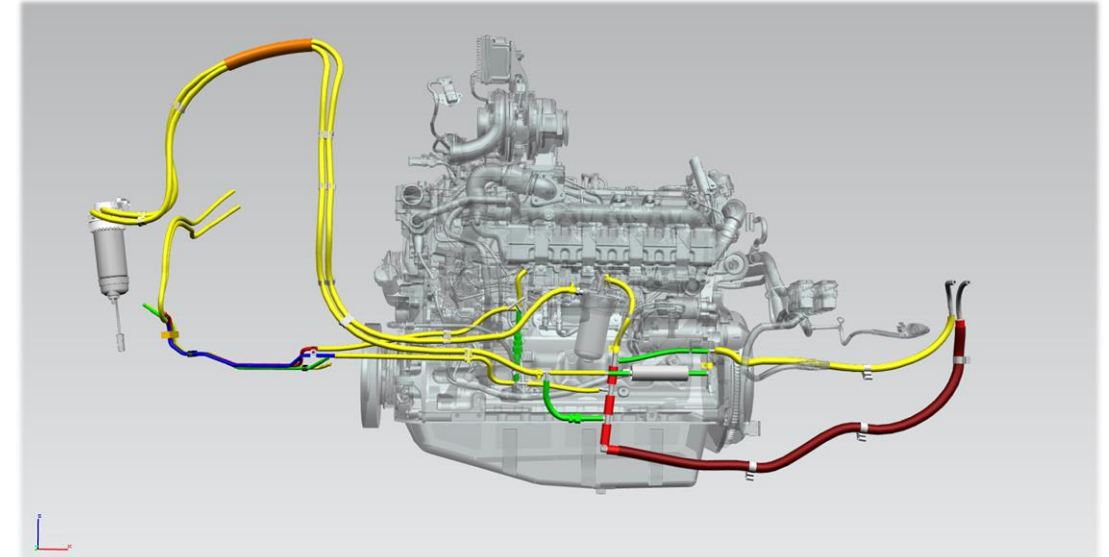
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Approaches and results

Adaption of low-pressure fuel system

- Higher viscosity for rapeseed oil
- Higher dependency on the temperature for rapeseed oil
- Higher line cross-sections from the tank to the high-pressure pump
- Stronger low-pressure pump
 - New model in test
- Adapted fuel cooler
- Optimized line routing and additional overpressure circuits



Summary and outlook

- Different ways to reduce greenhouse gas emissions
 - Electrification is coming – but not tomorrow
 - Vegetable oil fuels are a key technology
 - Initial results of the field tests are positive but there is still room for improvement
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- Further analysis of field test data for at least one year
 - The political discussion is more relevant than ever
 - John Deere is working on mono- and multi-fuel solutions



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