

*GREEN POWER*  
*Feeds Your Engine*



2<sup>nd</sup> VegOil

## Demonstration of 2<sup>nd</sup> Generation Vegetable Oil Fuels in Advanced Engines

Work Package WP2: Engine Development

Deliverable N° 2.14:  
Redesign of Stage 3a Serial Adaptation Technology

### Publishable Summary

Version: 2.6

Allersberg, August 7, 2009

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*This publication has been produced with financial support of the European Commission in the frame of the FP7 Seventh Framework Programme under the grant agreement N° TREN/FP7EN/219004/"2ndVegOil".*

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## Summary

At the time the proposal for 2<sup>nd</sup> VegOil was accepted with a written and signed contract in August 2008, the John Deere plant oil technology for the 2007 produced tractors with six-cylinder EU stage 3a common rail engines was ready for field test demonstration.

In 2008 two tractors were built and directly converted for the use of vegetable oil at JDWM. Both tractors (model year MY 2008) showed a strong deterioration of their cold start capability<sup>1</sup> compared to preceding converted tractors (MY 2007 and older). When running with diesel, the engines behaved similarly, but with pure plant oil as fuel the cold start capability of the new 2008 tractor declined to 37°C outside temperature in comparison to 5°C for the 2007 tractors. There was no evidence for this sudden decline in cold start capability with pure plant oil because there were no changes in materials or assembly technologies used at the tractor production line at the John Deere Works Mannheim (JDWM) between 2007 and 2008. Also the John Deere engine manufacturer in Saran, France reported no changes in their engine material list to JDWM.

In August 2008 JDWM and Vereinigte Werkstätten für Pflanzenöltechnologie (VWP) started a redesign and development program to prepare and improve the 2007 state of the art plant oil adaptation technology for the field test tractors and test bench engines of 2<sup>nd</sup> VegOil starting in 2009.

The redesign program had three major goals:

- The technical and software differences between engine and tractor production lines of 2007 and 2008 had to be detected. Then technical solutions to make up for the differences found between the two tractors and engines had to be discovered. The first milestone was to regain a cold start capability of 5°C.
- A so far well performing fuel pump for pure plant oil of a certain producer suddenly showed unknown early damage rates. The duration of functionality dropped to less than 10% of its original lifespan. The second milestone of the redesigning phase was to reach a 100% functionality time again.

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<sup>1</sup> Cold start in this case means the first start of a day. Cold is referred to the engine, which has not been at operating temperature during the last few hours prior to the start.



- For a third milestone the 2007 state of the art adaption kit had to be improved in its technical and prefabrication standard. The reason for this work was to reduce cost of material and labor in production, installation and maintenance or repair of the pure plant oil adaptation kit.
- To evaluate the technical changes of the adaptation kit and the fuel pump an intense testing program had been imposed to accomplish the JDWM warranty and durability regulations for their tractor production.

Over a period of eight months all milestones have been reached: the cold start capability is 5°C again after a new cold start software map and an internal preheating system was implemented in the engines. With a technical modification on the fuel pump it regained its 100% functionality with both diesel and pure plant oil. A final cost effective technical and prefabrication standard of the redesigned adaption kit was carried out, including a detailed exploded assembly diagram and a part list of the adaption kit. The functionality and durability tests for the internal preheating system and the modified fuel pump reached all technical goals and warranty regulations of JDWM.

The new 2008 state of the art adaptation kit was ready for use with 2<sup>nd</sup> VegOil demonstration tractors and test bench engines.

