PROJECT

2NDVEGOIL

Demonstration of 2ND generation VEGetable OIL fuels in advanced engines

**Funding:** European (7th RTD Framework Programme)
**Duration:** Aug 2008 - Dec 2011
**Status:** Complete with results
**Total project cost:** €3,461,538
**EU contribution:** €2,178,356

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**Call for proposal:** FP7-ENERGY-2007-2-TREN
CORDIS RCN : 90327

**Background & policy context:**

Future farming should contribute to efficient sustainable resources management and to sufficient production and supply of high quality nutrients and energy. Carbon dioxide neutral engines will be a key issue for future farming since this will open the energy market for farmers and contribute to sustainability at the same time. Pure vegetable oil use as engine fuel has the potential for the most comprehensive ecologic, economic and social benefits of all biofuels.

The production of vegetable oil involves few process steps and can be done economically with small production units. The production process has only small energy losses and provides potential for additional income generation on farms, thereby strengthening rural economic structures. The challenges to be met by pure vegetable oil are engine adaptation, fuel quality control, emissions control and limits to total production potential.

State-of-the-art concepts allow for achieving EURO3 emission levels for road vehicles in specifically adapted diesel engines for rape seed oil fitting to the German pre-norm DIN V 51605. However, advanced biofuels should allow that emissions keep within the limits of the forthcoming EURO6 norm for road vehicles and EU Stage 4 / US Final TIER4 for non-road vehicles.

The introduction of 2nd generation vegetable oil and engines into the agricultural markets will set standards for other branches and vehicles.

**Objectives:**

This project covered research and demonstration on 2nd generation vegetable oil fuels in advanced engines. It responded to the mentioned challenges while keeping the principle advantages of pure vegetable oil compared to other biofuels. The concept of this work included the following central elements:

- Combining the adaptation of the engine with an adaptation of the fuel;

- Widening the potential for pure vegetable oil fuels by considering a broader range of oil seeds, in particular camelina sativa which can be grown in combined culture (mixed-cropping) with cereals or leguminosae, thus increasing the fuel potential tremendously in EU, and jatropha which increases considerably the fuel potential in hot arid and tropical countries (also important for EU Mediterranean countries once climate change will have turned these countries into rather arid areas) without harming the environment;

- Introducing additives to the oil filtering process in small decentralised oil-presses for achieving ultra-pure vegetable oil with reduction of undesired substances to the limit of traceability;

- Introducing fuel additives without giving up the non-toxicity and to rise the flammability in a controlled manner (additives rising the flammability could be added at a very late stage, e.g. just when fuelling the vehicle, thus keeping the flammability low during the major part of the logistics chain);
Introducing engine oil additives to better adapt with the corresponding vegetable oil fuel;

Focussing on engine concepts allowing profiting from the advantages of vegetable oil under quasi-steady-state conditions, such as hybrid engines, thereby exploiting to the maximum the specific advantages of vegetable oil compared to other biofuels.

Methodology:

The outcome of the project includes advanced engine and fuel concepts for vegetable oil and the preparation of a European standard for 2nd generation vegetable oil. The project specifically contributed to:

- The widening of the range of considered oils
- The research and demonstration of additives for vegetable oils
- The research and demonstration of improved engine oils
- Achieving EU stage 4 / US TIER4 emission levels in medium-scale demonstration fleets running in France, Austria, Germany and Poland
- Transferring the engine and fuel concepts to hybrid engines, allowing to achieve forthcoming EURO6 emission levels
- Preparing proposals for future fuel standards.

Parent Programmes:
FP7-ENERGY - Specific Programme "Cooperation": Energy

Institute name: Directorate-General for Research and Innovation Research Programmes: Directorate K - Energy

Funding type: Public (EU)

Other programmes: FP7-ENERGY

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Key Results:

Field tests of the innovations
The developed engine concepts, 2nd generation pure plant oil (2G-PPO) fuels with selected additives, and two appropriately formulated lubricants were subjected to comprehensive, scientific field tests and a fleet demonstration and monitoring programme in Germany, France, Austria and Poland. 16 tractors were tested in the field, under a broad range of operating conditions, with 8 different 2G-PPO fuels, for a total of 24,000 operating hours. Zero total failures were reported and all minor failures that were attributed to the use of 2G-PPO, instead of diesel as fuel could be traced back to fuel contamination and/or inappropriate fuel storage. Hence, the proof of concept was provided for the developed combinations of modified diesel engines, 2G-PPO fuels with additives, and lubricants.

European Standardisation Committee Workshop Agreement
A major result of the project with regard to fuel standardisation is a European Standardization Committee (CEN) Workshop Agreement (CWA). This CWA defines minimum requirements for two classes of pure plant oil used as fuel in engines with and without exhaust gas after treatment system and has been published on 7 December 2011 as CWA 16379, Fuels and biofuels - Pure plant oil fuel for diesel engine concepts - Requirements and test methods.

Main difference between diesel and 2G-PPO fuelled tractors
An accompanying project assessment has shown that the main difference between a diesel and a 2G-PPO fuelled tractor lies in the saving of Green House Gas (GHG) emissions. The saving can be more than 60% for a tractor fuelled with 2G-PPO from rape seed, if the 2G-PPO is also used in the cultivation of the seed, and almost 70% for 2G-PPO from false flax (camelina sativa) seed if the seed is produced in mixed cultivation with wheat.

Innovation aspects

2ndVegOil has met the challenges of using pure plant oil as fuel in advanced diesel engines. This success was achieved by adapting advanced engine hard- and software and developing 2nd generation pure plant oil (2G-PPO) fuels along with suitable additives and lubricants.

Strategy targets

Innovating for the future: technology and behaviour: Promoting more sustainable development

Documents:
- Final project report.pdf (Final report)

STRIA Roadmaps: Low-emission alternative energy for transport
Transport mode: Road transport
Transport policies: Environmental/Emissions aspects, Decarbonisation