Pure Plant Oil: Clean Engine Fuel Today & Tomorrow

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Plant oil fuelled car in a winter rape field in Denmark

Demonstration of oil press and plant oil car. The simple technology is always convincing and creates immediate sympathy. Århus, Denmark, 2000.
Photos by Jane Kruse, Folkecenter.

Oil plants support sound agricultural practices. They can substitute the fossil fuels now, and they can supplement the emission-free technologies in the future.

Predicted by Rudolf Diesel

The first diesel engines could run on plant oils. In 1912, the inventor, Rudolf Diesel, predicted that plant oil could gain the same importance as fossil engine fuel.

Engine with Higher Efficiency – on Plant Oils

In the 1970's, another German, Ludwig Elsbett, developed the special ELSBETT engine for plant oils with more than 40% efficiency, one third better than contemporary diesel engines. It has also higher efficiency than present fuel cells in cars (Fuel-cell efficiency 40%, conversion of wind-electricity to hydrogen 70% efficiency: the total efficiency for car fuel cells is about 30%).

Prospects in Most Countries

Oil plants are grown in most parts of the world, and they all have one thing in common: the extracted oil is only one of the products. Therefore, oil extraction can be truly integrated in the local agriculture. In some cases, oil as fuel can create a whole new local industry and market.

Winter Rape Seed, a Coming Success

One of the many possible plant oil sources is the winter rape, which is grown in Europe. The oil is useful both as food and as fuel, while the press cake is a valuable fodder.

So far, the success has been limited outside Germany by a number of factors; especially the EU tax rules including the mineral-oil directive, engine modification expenses, and misunderstandings about the environmental aspects of cultivation, production, and use.

Winter is not Spring

Many concerned environmentalists are misjudging rapeseed oil production, simply because they are unaware of the fact that there are two types of rape plants with totally different properties: the robust winter rape and the vulnerable spring rape.

The obvious basis for a large-scale rapeseed production is therefore winter rape.

The Best Crop for Pesticide-free Cultivation

A Danish cross-ministerial investigation into the consequences of pesticide reduction in Danish agriculture, the so-called Bichel-Committee, concluded that pesticide-free cultivation would result in a tremendous overall yield loss (23% in average for corn).

But it also came up with an extraordinary conclusion: winter rape would be the least affected sales crop, with only 7 % yield loss. One of the recommendations by the Committee for a Pesticide-free Agriculture was therefore a significant increase in winter rape cultivation (and a reduction in spring rape).

Organic Cultivation

Winter rape is now finding a place as a natural part of Danish organic agriculture. The production has increased by a factor of four in the last two years. Winter rape is recommended by national agricultural scientists, not only as a crop in itself but also for its beneficial effects on crop rotation and weed problems in other crops.

Why has organic winter rape not reached this position earlier? Because of poor results and many problems with spring rape.

Returns Fertiliser to the Soil

Like winter wheat, winter rape requires more fertiliser (manure or industrial) than average grain cultivation.
But unlike wheat, winter rape returns the difference to the soil, so the next crop can benefit from it. In fact, wheat after rape requires no more fertiliser than the average for grain. So in effect, winter rape only uses average amounts of fertiliser.

Preserves Humus

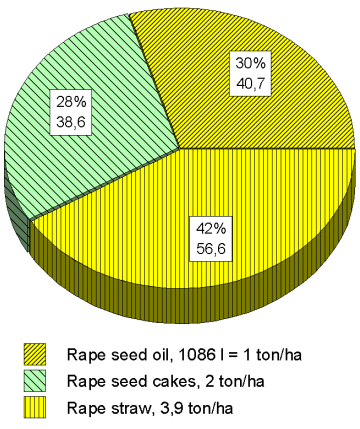
One argument against using energy crops and straw as fuel is that the humus is depleted by the removal of the biomass. Winter rape produces a large amount of biomass, and much of it is left in the field in the form of leaves, pods, lower part of stems, and roots, even if straw is harvested for energy purposes. So, if the straw is ploughed in, only an insignificant amount of the produced biomass is removed with the oil. Therefore, winter rape can actively build up humus.

Integrated Agriculture: Fodder, Food, and Fuel

Unlike energy crops, rapeseed is a truly integrated production. The seeds can be pressed at the farm and yield two thirds of valuable protein fodder which replaces imported fodder and remains in the biomass cycle. The one third which becomes oil can be used to run tractors and other machinery, sold as fuel for cars, or eaten.

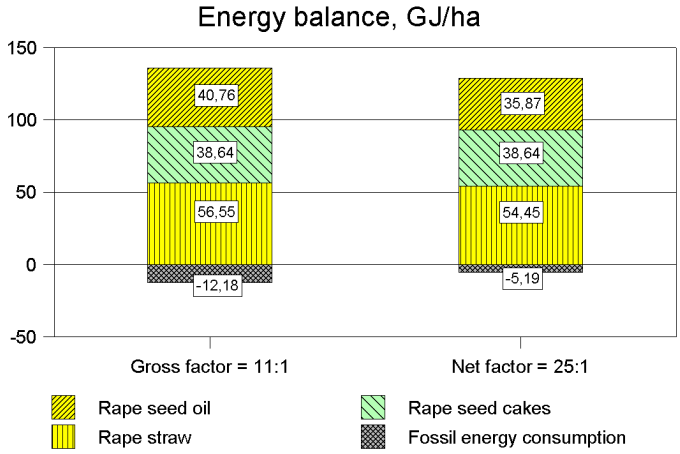
Used as engine fuel, the oil from 10% of the Danish agricultural area could fuel up to 25% of the present passenger traffic on the Danish roads, or the total amount of agricultural machinery - in addition to the protein fodder and the possible energy production from rape straw. In the 1930ies, it took 25% of the area to feed the working horses.

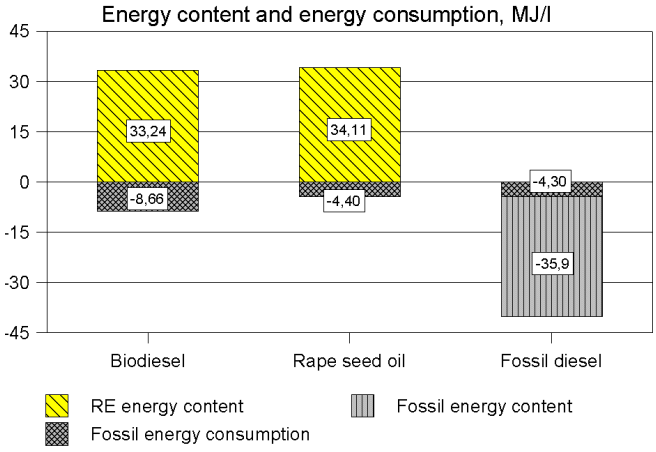
Distribution of gross energy content, GJ/ha



Fine Energy and CO_2 Balance

30% of the available energy produced by the crop is in the oil, 28% in the press cake, and 42% in the straw. When this available energy is compared to the total amount of energy needed for cultivation and processing, the gross factor is 11:1. If renewable energy is used at the farm (plant oil for machinery, straw based CHP), the net factor is as high as 25:1. This means that 25 energy units of biomass can be produced with 1 unit of fossil fuel.





The corresponding gross and net factors in the CO_2 balance are 9:1 and 14:1. When the rape seed oil is viewed separately, disregarding the energy potential of the straw, a calculation based on the EMBIO Report (the Danish Energy Agency's environmental/economic model) shows that about 13% of the energy is lost in the production, the same level as for production of fossil diesel which in addition gives CO_2 in use. According to the EMBIO Report, the loss is twice as much for biodiesel where 26% of the energy is lost in the production.

Engine Conversion

With the present diesel engine technology, it is necessary to convert the fuel injection system to plant oils. In Denmark, conversion of standard diesel engines costs 1500 USD without VAT. The price of the corresponding self-builder kit is about 700 USD. This expense would not exist if all diesel engines were constructed to run on bio fuels. In Germany, some thousands of cars have been converted. The number rises rapidly like the number of workshops offering conversion, today counting 60 – 70 workshops. In Denmark, the number of converted cars is less than 50, and the further development depends on politics.

Emissions: Same as for Diesel

When used in diesel engines, plant oils seem to produce the same emissions as fossil diesel, except that plant oils are sulphur-free and naturally CO_2 neutral. So, improvements leading to cleaner diesel technology will benefit both fuels.

Plant Oils are Green - Biodiesel is Grey

Pure plant oils are completely risk-free. No special precautions are needed: the fuel is harmless to humans, water, and soil. In contrast, biodiesel requires an additional industrial process based on the poisonous methanol, so it requires much more energy and must be handled like fossil diesel. In the German system of water pollution classes, rapeseed oil is not even classified in the lowest class 0, whereas biodiesel is in class 1, and fossil diesel is in class 2.

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What is Needed?

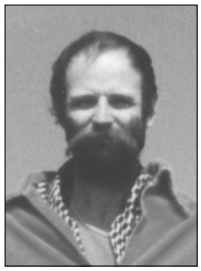
It is time to push the development towards a more sustainable transport sector in the industrialised countries. Plant oils offer the realistic short-term alternative to fossil fuels, and they will also be a necessary supplement to the emission-free technologies further ahead.

The policy instruments to start this should include:

- Fuel Tax exemption for pure plant oils (as proposed in the Danish Parliament in 2001),
- Legal requirements of adequate automobile technology including adaptation to bio fuels, use of most efficient engine technology, and fuel consumption limits.

These achievements would accelerate the development, not only in the industrialised countries but also in the developing countries: with no need to convert engines, it would be much easier to replace imported fossil diesel with local plant oils, for cleaner environment and better economy, especially in the rural areas.

The authors of the article: Niels Ansø, (left) Engineer, works with transfer, implementation, and demonstration, of plant oil technology. Jacob Bugge, (right) Senior Consultant, works with background analyses and agricultural aspects.



Looking into a plant oil fuelled car at Folkecenter for Renewable Energy, Denmark

Folkecenter for Renewable Energy is an NGO supported by the Danish government since 1983.

Folkecenter has promoted plant oils as engine fuel, especially within Denmark, since the beginning of the 1990s. Folkecenter is member of INFORSE.

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