The international status quo report will provide an overview on regional situation with all relevant information about the production and use of PPO in the agricultural sector. A clear description will help to monitor the relative impact of the project at regional levels. The most important information will be presented and used within the WSO key market start up activities.

Complete information’s at national level (e.g. scale of cultivation, processing capacity, import, export, legislation, tax, political support, agricultural subsidies) and technologies will be included in information materials.
A. INTRODUCTION

In the EU, transport is responsible for an estimated 21% of all greenhouse gas emissions that are contributing to global warming, and the percentage is rising. In order to meet sustainability goal, in particular the reduction of green-house gas emissions agreed to under the Kyoto Protocol, it is therefore essential to find ways of reducing emissions from transport. This is not the only challenge. Nearly all the energy used in the EU transport sector comes from oil. It is known, oil reserves are limited in quantity and restricted to a few world regions. Securing energy supplies for the future is therefore not only a question of reducing import dependency, but calls for a wide range of policy initiatives, including diversification of sources and technologies.

Processed from biomass, a renewable source, biofuels are a direct substitute for fossil fuels in transport and can readily be integrated into fuel supply systems. Biofuels can be used in liquid or gaseous fuel forms as an alternative fuel for transport. The involvement of European farmers in the biofuel market is mainly limited to the role of a raw material supplier for the production of biodiesel or bioethanol.

The EU countries have different experience regarding pure vegetable oil. For example, Austria with their policies is a good example how to develop it. Unfortunately, most other countries, for different reasons are not developing this sector which could represent a good opportunity especially for farmers to be independent from fuel perspective. Further to that, in some EU countries like France, the use of PVO is forbidden by law which hinders the development of PVO not only in France but also in the surrounding countries.

B. PURE VEGETABLE OIL USE IN PARTNER COUNTRIES

1. Austria

Status Quo of PVO in Austria

Successful examples from Austria show (e.g decentralised oil mill in Fürstenfeld/Styria, www.agriforenergy.com ) that farmers are able to open up a new area of business as regional supplier of biofuels like biodiesel, biogas or pure vegetable oil.

Pure vegetable oil is produced from oil plants through cold pressing and filtering and is crude or refined but chemically unmodified. It can be used as biofuel when compatible with the type of engine involved and the corresponding emission requirements. It has been tested in vehicle fleets with controversial results. For Rapseed pure vegetable oil exists a pre-norm (DIN V 51605) stating „Requirements and test methods for the use of rapeseed oil”. Before pure vegetable oil is used as a fuel, the engine must be refitted for the fuel to correspond to the oil's viscosity and combustion properties. Several suppliers in Europe have developed different refitting concepts for this. These either preheat the fuel and the injection systems or are equipped with a so-called “2-tank system” in which the engine is started with diesel and only changes to vegetable oil when the required operating temperature has been reached. In particular, modifications to older, pre-combustion chamber diesel engines are well proven, whereas not all problems are regarded as fully solved in modern commonrail or pump/injector systems.

Plant oils are extracted by pressing the plants, and it is particularly the seeds that have the highest oil contents. The best-known plant oils come from rapeseed, sunflower, corn, soybean, palm, olive, linseed and peanut, among others. The uses and the qualities of plant oils are determined through their fatty acid compositions.
PVO produced in oil mills is mainly used by farmers within small agricultural cooperatives. There is no use of PVO at large scale in Austria at this time (estimation for 2008).
Oil mill sector in Austria

The decentralized oil mill sector has developed in recent years in the seeds converting very positive. In 2007 alone, there was a rise of more than 25,000 tons of rapeseed per year.

Fig. 3: Development of seed processing of decentralized oil mills, source: Bundesverband Pflanzenöl

The decentralized oil mills in Austria can be divided as follows:

**Traditional industrial oil mills:** Especially in Styria there are mills that are run for generations. Almost all processed pumpkin seeds for an old process in which the oil is extracted from the roasted seeds stamp presses. Today, other oilseeds, including rape seeds are pressed.

**Traditional oil mills:** This development is relatively new and serves the refining of the grown seed. Apart from the Oil for these companies, the rape cake was especially important as food for cattle. Today the oil is extra virgin cooking oil as well as more and more used as a bio-fuel for the tractor. They work mostly with screw presses.

**Mills and farm products dealers:** Today many cereals and farm products dealers operate and market the oil as a fuel for farmers.

Fig 4: PVO filling stations in Styria
Fig 5: Use of biofuels in Austria (tons/year)

Fig 6: Use of biofuels in Austria 2009 (tons/year)
National legislation and support schemes

Business Law

If a farmer-generated oil plants (in this specific rape and sunflower), it produces vegetable oil, this is permitted as an agricultural sideline without a business license. (§ 2 Abs. 4 Z1 GewO) This means in this context that more than half of the processed product to come from their own production. In addition to the value of the natural product (in this case exceed: oil seeds) did not jointly processed supplements.

Since the industrial law amendment in 1997, the restriction to typical farm products is eliminated. Regardless of an industrial equipment authorization is required if a reasonable estimate for sideline is not recognized until 1997. This in turn also the case only if the capital is disproportionately high for the production of vegetable oil compared to the agriculture, forestry, or if foreign workers are mainly employed for the oil production.

Income Tax

The production of vegetable oils from oil itself cultivated plants can be an ancillary agricultural tax if the gross income 24 200 per year (including VAT) does not exceed. That is, the proceeds of the sale are from vegetable oil to farm and raise in the tax return the income from agriculture and forestry. Exceeding the limit is 24 200 tax to start from a business enterprise.

VAT

Accounting principle duty is only at a unit value of more than 150,000 € or a turnover of over 400,000 €/year. Do not keep books of account agriculture and forestry enterprises are at a flat rate of VAT no sales tax allocation and are carried out with the tax office.

Under the lump-sum tax for agriculture and forestry the sale of vegetable oils to entrepreneurs (eg other farmers, cooperatives), is at a tax rate of 12% and the sale to nonentrepreneurs at a tax rate of 10%. The proceeds from the sales tax used to cover the operational input taxes and are therefore not deliver to the revenue.

Austrian targets

The transport sector sets out indicative targets for Member States for the use of biofuels or other renewable fuels in the transport sector. Thus, 2% (calculated on the basis of energy content) of all the fuels used in transport should be replaced by biofuels and other renewable fuels after 2005, rising to 5.75% in 2010. The Directive was transposed into Austrian national law by amendment to the Fuel Order in November 2004, followed by a subsequent amendment in June 2009. Under that Order, since 1 October 2005 a person subject to the substitution requirement has had to substitute with biofuels 2.5% (calculated on the basis of energy content) of all petrol and diesel fuels used in transport. This increased to 4.3% (calculated on the basis of energy content) as of 1 October 2007, and to 5.75% (calculated on the basis of energy content) on 1 January 2009. Since October 2005 biofuels have been placed on the market in Austria primarily by mixing biodiesel with diesel and since October 2007 by mixing bioethanol with sorts of fossil petrol. By the beginning of 2009, the overall percentage by volume (vol.) of biodiesel blends and bioethanol blends was approximately 4.7%. From January 2009, the maximum proportion for the blending of biodiesel was raised to 7% vol.

Pure vegetable oil

In recent years, the use of vegetable oil as a fuel has been increasing. However, it is difficult to estimate the quantities produced for conversion into fuel, as the records of the quantities produced cannot be sufficiently differentiated between according to their purpose and use. Another problem is the fact that there are various distribution channels for this fuel, e.g. sale through private fuel pumps and pumps used in the agriculture sector. It can nevertheless be assumed on the basis of the regional distribution patterns that the 2 656 tonnes of vegetable oil used in agriculture are from domestic production. According to the Austrian Vegetable Oil Association, this drop in the use of vegetable oil as a fuel is largely due to the fact that the price of fossil fuels has fallen while, at the same time, the price for grains and seeds has increased (as a result of bad harvests).
Biodiesel

According to ARGE Biokraft (the Austrian association of liquid biofuel producers), there were 14 biodiesel plants operating in Austria in 2009, with a total capacity of approximately 650,000 tonnes. It can be assumed that the same capacity will be maintained in 2010. A small increase in total production capacity to approximately 700,000 tonnes is forecast for 2011 as a result of planned extensions of existing plants. According to information provided by ARGE Biokraft's members, 323,147 tonnes of biodiesel were produced in Austria in 2009 (by ten biodiesel producers). Of this amount, 291,657 tonnes were sold in Austria, 193,782 tonnes of which were supplied to the oil industry for blending. Disregarding any variations in stocks, some 31,490 tonnes of biodiesel were exported in 2009. 97,875 tonnes of biodiesel were used in the Austrian transport sector either as pure biofuel or as biogenic additives for diesel with a higher, non-standard biofuel content.

Bioethanol

The first bioethanol production plant (Pischelsdorf, Lower Austria) was completed in autumn 2007. The plant was put into service in 2008 with an annual capacity of 160,000 tonnes. According to ARGE Biokraft, the plant's annual capacity increased to 191,000 tonnes in 2009 after an enlargement (approx. 240,000 m³). According to the operator, up to 620,000 tonnes of cereals per year – predominantly wheat and corn at present – can be processed into biofuels on the Pischelsdorf site. In addition to bioethanol, up to 190,000 tonnes of DDGS (Distiller's Dried Grain with Solubles) – a protein-rich feedstuff – are produced annually in Pischelsdorf. According to ARGE Biokraft's data, 138,073 tonnes of ethanol were produced in the reporting year, almost double the amount produced in the previous year. Of this amount, 86,592 tonnes were sold in Austria – the entire output was supplied to the mineral oil industry. The rest (51,481 tonnes) was exported.

Competitiveness and price of PVO

Operating cost per rape to press given as an example by the association Hausruck oil in Grieskirchen: 

<table>
<thead>
<tr>
<th>planned quota each year</th>
<th>3,000 Rape und sunflowers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Running operation</td>
<td>amount</td>
</tr>
<tr>
<td>Tax write-off</td>
<td>40,000 €</td>
</tr>
<tr>
<td>Operating costs, electricity</td>
<td>19,000 €</td>
</tr>
<tr>
<td>Office supplies</td>
<td>1,000 €</td>
</tr>
<tr>
<td>Filterhilfsstoffe</td>
<td>3,000 €</td>
</tr>
<tr>
<td>Maintenance</td>
<td>8,000 €</td>
</tr>
<tr>
<td>Laboratory costs</td>
<td>2,500 €</td>
</tr>
<tr>
<td>WAGES for support</td>
<td>10,000 €</td>
</tr>
<tr>
<td>Rent Pressroom</td>
<td>12,000 €</td>
</tr>
<tr>
<td>Membership fee PLO Austria</td>
<td>500 €</td>
</tr>
<tr>
<td>Legal and consulting expenses</td>
<td>5,000 €</td>
</tr>
<tr>
<td>Telefon costs</td>
<td>300 €</td>
</tr>
<tr>
<td>Loaded, telescopic loader</td>
<td>8,000 €</td>
</tr>
<tr>
<td>Insurance</td>
<td>2,000 €</td>
</tr>
<tr>
<td>Administration costs</td>
<td>45,000 €</td>
</tr>
<tr>
<td>Advertisement</td>
<td>2,500 €</td>
</tr>
<tr>
<td>Chamber of commerce</td>
<td>520 €</td>
</tr>
<tr>
<td>Interest financing</td>
<td>6,000 €</td>
</tr>
<tr>
<td><strong>Total Cost</strong></td>
<td><strong>165,320 €</strong></td>
</tr>
</tbody>
</table>
Development of PVO in Austria

The energy produced from liquid biomass in Austria has increased from 2007 to 2008 by 20.4%, resulting primarily from the legal framework of admixture obligation. 58.9% of the energy used in 2008 from liquid biomass produced in Austria, 41.1% was imported.

![Renewable energy sources in 2008](source: Erneuerbare Energie in Zahlen; 2009)

If we look even at the possible potential of energy production on agricultural land by the year 2020, we can recognize that the sector of vegetable oils and biodiesel have the highest potential.

![Demand for agricultural land for energy production](source: LK Österreich)

In recent years, vegetable oil is increasingly used as fuel. From the estimate of the quantities produced for fuel purposes is difficult, because the drawings relating to the production is not sufficient for the purpose of use can be distinguished. Another problem is the different distribution channels this fuel, such as the distribution of private house-or yard-service stations. Nevertheless, it can be assumed due to the regional distribution pattern that the amount of vegetable
oil used in the agricultural sector is from 2,656 tons of domestic production. The decline in volume of vegetable oil fuel is vegetable oil, according to the Federation Austria significantly decrease in the price of fossil fuels while increasing the price of seeds and seeds (because of poor harvests) founded.

2. Bulgaria

The biofuel industry is an emerging sector in Bulgaria. Bulgaria has a surplus of oilseeds with the main oil crops being sunflower and rape and at a lesser extent maize and wheat. However, the PVO market is not established in Bulgaria yet. For it to happen, the changes within the legislation and support schemes should take place as there is no support in national legislation. Therefore, the Bulgarian partner is trying to influence the changes in the national legislation that would promote the use of PVO and include a support measure such as a tax exemption for the use of PVO.

The annual sunflower oil production is around 1 million tons while the internal consumption amounts at around 140 000 – 150 000 t. 90% of it goes to the food industry. Bulgaria exports between 500 000 – 600 000 t of sunflower seeds per year. In 2008 the area of rapeseeds has almost doubled. 25 000 – 30 000 t tons of rape seed is used for biodiesel production and the rest of production is exported.

According to the Ministry of Economy, in the biofuel sector, Bulgaria will need 509 001 ha of oilseeds which is 16.3% of the arable land (3 128 210 ha in 2005) in order to be able reach the national target of 10% in 2020. The total agricultural area covers about 5,5 million ha.

Development of the PVO sector

Forecast for the use of mineral and biofuels including the national targets for the period 2008 – 2020

<table>
<thead>
<tr>
<th></th>
<th>Measure</th>
<th>2005</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2015</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional fuels</td>
<td>000 t</td>
<td>1 952,0</td>
<td>2 193,1</td>
<td>2 264,7</td>
<td>2 317,3</td>
<td>2 731,9</td>
<td>3 146,0</td>
</tr>
<tr>
<td>Fuel</td>
<td>000 t</td>
<td>572,0</td>
<td>485,3</td>
<td>456,0</td>
<td>426,0</td>
<td>417,1</td>
<td>370,5</td>
</tr>
<tr>
<td>Diesel</td>
<td>000 t</td>
<td>1 380,0</td>
<td>1 707,8</td>
<td>1 808,7</td>
<td>1 891,3</td>
<td>2 314,8</td>
<td>2 775,5</td>
</tr>
<tr>
<td>Biofuels</td>
<td>000 t</td>
<td>0,0</td>
<td>43,9</td>
<td>79,3</td>
<td>133,2</td>
<td>218,6</td>
<td>314,5</td>
</tr>
<tr>
<td>Bioethanol</td>
<td>000 t</td>
<td>0,0</td>
<td>9,7</td>
<td>16,0</td>
<td>24,5</td>
<td>33,4</td>
<td>37,0</td>
</tr>
<tr>
<td>Biodiesel</td>
<td>000 t</td>
<td>0,0</td>
<td>34,2</td>
<td>63,3</td>
<td>108,7</td>
<td>185,2</td>
<td>277,5</td>
</tr>
<tr>
<td>Total</td>
<td>000 t</td>
<td>1 952,0</td>
<td>2 237,0</td>
<td>2 344,0</td>
<td>2 450,5</td>
<td>2 950,5</td>
<td>3 460,5</td>
</tr>
<tr>
<td>National target</td>
<td>%</td>
<td>0,0</td>
<td>2,0</td>
<td>3,5</td>
<td>5,75</td>
<td>8,0</td>
<td>10</td>
</tr>
</tbody>
</table>

Source: Ministry of Economy

Biodiesel and bioethanol are currently produced only in small quantities, however, more and more investors are building facilities for biofuels production, mainly biodiesel. During the last 3 – 4 years the number of biodiesel plants continued to rise. According to the Research Institute of Agricultural Economy in Bulgaria, there are about 20 plans to build large scale biofuel production plants with an annual biodiesel production capacity between 180 – 200 ktoe.

The support for the RES utilization is achieved mainly via the means of the price and taxation policy. The main piece of legislation is the National Long-Term Program for Promotion Usage of Renewable Energy Sources (NLTPPURES) which involves RES targets (including biofuels target), encourages investments in the energy efficiency and renewable energy sources offering lower interest rates for RES (the annual interest rate for the loan varies from 4 to 9 %), aim to replace the fossil fuel systems for heating into the RES ones and puts in place an obligation to buy RES electricity coming from RES. According to the new Excise Duty Law, the pure biodiesel has a 0 excise rate but the formulation of the law remains vague.

Despite the favourable climate conditions, the share of the biofuels within the diesel consumption in transport is negligible and reaches only 0,28-0,30% within the gross diesel consumption. The
disappointment in biofuels sector occurred in 2008, when the biofuels manufacturers were affected by the uncertain state policy regarding tax exemption. In addition to this, other administrative burdens such as a lack of minimum three independent laboratories for quality control also limit the production of biofuels.

A more transparent and sustainable policy is needed in Bulgaria which together with adequate financial measures and instruments would reinforce the development of this sector. This would have a positive impact on the development of rural areas and creation of new jobs throughout the whole chain. Further efforts are also needed to stimulate farmers to produce and use biofuels which would result in an increase of the biofuels competitiveness.

3. Finland

A status Quo of PVO in Finland

In Finland, Neste Oil uses most of the rape oil in their processes. There are 20 farm level producers in the country. They have experimental and complete equipment for production of biodiesel from oil seeds. Some of the producers mainly use waste bio greases as their raw materials. Produced bio-oil is used for heating.

There are several reasons for the low interest in distributed biodiesel production from oil seeds:
- Low price of fossil fuels,
- High price of rape seeds and labour,
- Biodiesel made from oil seeds has the same taxes as fossil fuels,
- Lack of competitiveness in the markets.

Finland is also a country located in the north, so oil seed plants grow best in the southern parts of the country. Harvests have usually been lower than the annual demand of even in feed and food industry. Ministry of Agriculture and Forestry has a strategy to increase rape production to 200 000 t in 2015. The aim is to have a high quality protein to feed the animals. Some amount of oil could be used in biodiesel production. On the other hand, oil seed biodiesel production is only a tiny part of the planned, centralised biofuel production of Finland.

Annual use of oil in Finland is about 9 million tonnes, used for heating, traffic and industry etc., figure 1. Annual oil consumption for transport is about 4 million tonnes, and the demand of heating about 2 million tonnes. About 230 000 t bio diesel will be needed in transport sector to meet the target of 5.75%.

In Finland there are several possibilities to solve the biodiesel production in near future and fulfil environmental requirements. Neste Oil has already started production of biodiesel at large scale. Bioethanol is made in quantities by ST1 from food and other side products. Companies study and plan large scale production of biodiesel from wood and peat.
At a farm level, however, there has been silence since a study carried out on 2006-2007 which demonstrated the use of PVO by a farmer for his own needs: in his car and in his tractor. After this research there was a big silence, even the farmer "disappeared".

Direct production of oil seeds change annually. In the record year 2006 about 137 million kilos of turnip rape seed and 111 million kilos of rape oilseed were produced from production area of 101 000 ha. In 2008 the total production was 88.8 million kilos and in 2009 it will be about 100 000 kilos. Food and feed industry uses about 150 million kilograms seeds per year so seeds have to be imported. Ministry of Agriculture and Forestry favour larger production of rape seeds increasing the yield of harvest and the production area. It is important to get domestic pure protein source for livestock. Industry imports rapeseeds because the domestic production is insufficient for use of all actors. Raisio Group press oil to produce rapeseed oil for e.g. margarine and food industry. It uses the shells of rapeseeds for production of protein-rich feed, etc. The oil production, however, exceeds the domestic consumption. The surpluses have to be exported and sold e.g. to Neste oil for raw material.

Energy policy measures - support of PVO

Government favours the cultivation of rape for rape cakes, protein rich feed for cattle. But they are not able to fight against the northern nature which results in low harvests, also in 2010. On the other hand, Neste Oil pays rather well to Raisio Oy for the oil (residue, EU rules). Raisio Oy can press more oil (yield) from the seeds than farmers and makes good feed to cattle. Most of the rape seeds go through the Raisio Oy and the oil to Neste Oil.

Cultivation of rape seeds gets subsidies (2009, 616 – 660 €/ha depending on the production area), but there are several other possibilities to get subsidies in agriculture and even in an easier way. Government wants to increase the cultivation of rapeseeds for domestic protein for livestock. Good quality rape seeds are used in food industry and the surpluses can be processed to fuel, if the price of raw material is reasonable.

Present price of fossil diesel is about 1 €/l including taxes, gasoline 1.30 €/l and light heating oil 0.8 €/l (autumn 2009). Researchers of MTT Agrifood Research Finland (Vihma et al 2006) calculated, that the production of one litre turnip rape biodiesel costs 0.74 €/l in farmer scale production and reference price in small industry is 0.56 €/l, Both prices are without taxes. Heating with biodiesel fuel is free from excise duty tax, but the VAT has to be paid if you want to sell biofuel for heating. In construction machines there is not the excise duty today. The excise duty for the fuels used in traffic is 35 cents per litter. After the excise tax and VAT the turnip rape diesel oil produced in farms costs 1.33 €/l produced and 1.07 €/l if produced in small-scale industry. At service station the present price for fossil diesel is about 1 €/l. Situation of taxation is same with taxes if grease is used as a raw material.

The study of Vihma et al. (2006) shows that biodiesel production is economically almost viable when produced professionally in large quantities. On the other hand, one must remember that prices have changed. Key factors are the taxes, the price of a fossil alternative, the price of rapeseed and labour input to the esterification process. When used in transportation, the high proportion of the excise duty of the total price highlights the political dimension of profitable biodiesel production. It has also been noticed that while some of the estimates, used in the cost study, are rather conservative, it is clearly possible to strengthen the whole biodiesel chain, from turnip rape crop yields (in research 1500 kg/ha) to technological improvements in the esterification process.

According to the law biodiesel, if used in working machines, has be made easily recognizable with a colour. Fuel producer pays also the registration fee of 2500 e. Besides heating other potential users of bio-oils are work- and forest machines, nature friendly lubrication, hydraulic and chain oils etc. Production of biodiesel in Finland is small and scattered if compared with countries in Central-Europe. Some farms make biodiesel only for themselves. Economical profitability would grow significantly, if e.g. the excise tax would be removed. There is interest to biodiesel in Finland. At present there are less than twenty producers. For example Bel Oy produced about 40 tons of biodiesel per year from turnip rape. However, they have ceased the production, because the production was unprofitable. Political authorities have discussed several years on changing the taxation for rape based decentralized biodiesel production, but no decisions have been made.
National and regional targets

There are no national or regional special targets for rapeseed based biodiesel. Producers would delight change of taxation and there are no special support schemes to encourage the use of PVO at regional or national level.

Most of the Finnish biodiesel is made of once used rapeseed oil WVO. Because of the present prices of raw materials, fossil fuels and taxes it is not profitable to sell biodiesel on the same price as fossil fuels. Hence the trade with biodiesel is very low. Most of biodiesel is used for local heating.

Competitiveness

At the moment oil seed based fuel production is in difficulties, because the price of rape oil has increased, the price of fossil fuels is low and the taxation of biodiesel is equal to fossil fuels. Especially taxation prevents the local use of bio fuels. There are still some small producers in Finland, but they use waste vegetable oils (WVO) of food industry, which have already used once, as raw material. It is also possible, that Neste Oil will use more and more domestic raw materials in their giant process.

Production technology is well known and new raw materials are also developed from animal and fish greases. A Finnish standard for biodiesel has also been made, but it is used seldom, because of the high expenses to use.

Solution to produce biodiesel from oilseeds is almost completely drawn down. One reason is that small scale production is too expensive and the volumes are low. There are only few producers left and they use waste vegetable oils as their raw materials. The possibilities to produce oil seed based biodiesel oils were studied some years ago in several researches. About 20 private producers started also to produce biodiesel from turnip rape and oilseed rape. There are also other vegetable oil containing plants, e.g. seed flax, oil hemp, hairy cameline and mustards. The harvests of them are usually lower compared to turnip rape. However, most of the biodiesel producers have stopped using pure rape raw material. Some have started to process and use waste vegetable oils from restaurants and industry. Fuel is used for heating of producers estates. If it is sold to neighbours the VAT of 22% has to be paid, so the business would not be profitable.

Price of PVO

It is not reasonable to focus on PVO at small scale level in Finland because the use is very low, even for farmer made biodiesel.

Furthermore, there are no special taxes; there is no special taxation for own use in heating or in working machine, however, if one sells PVO to his neighbour then there will be VAT.

Regarding the support for PVo and biodiesel and diesel, all fuels have heavy taxes, it is perhaps possible to support in the future by taxation (different amount of tax to different fuels), but the new taxation does not exist yet.

Antti Sarvela (http://www.savonsiemen.com/biodiesel.htm), that produces PVO can sell PVO at the price of 70 c/l and VAT (22%), and if you use the fuel in the car you must add 37 c/l (same as biodiesel).

PVO is very marginal fuel. People press(ed) fuel to the cars, pay taxes and found drawbacks. It is difficult to use it in winter, carbon builds-up in the engine after some thousand kilometres and the machine brakes.

Future PVO development

The objective of the new National strategy of grain cultivation (Kansallinen viljastrategia 2006-2015), prepared by the Ministry of Agriculture and Forestry, for turnip rape is to increase cultivation area and increase the yield of harvest to 2.0 tonnes per hectare till 2015. Increase of yield might be possible by using new spring species of turnip rape even by using the present cultivation area. This would mean harvest of over 200 000 t/a of rape seeds in 2015. In the strategy it is also said: “Cultivation of oil seed plants will enhance rotation of corn species, improve the quality of soil and increase domestic protein production”. The cultivation area of rape has to be less than 20% of total field area because rape needs rotation of the production area, and there are also other restrictions, so the cultivation area of rape can be at highest to 200 000– 250 000 hectares.

In order to boost the PVO sector, the following would be needed:
− Explosion of suitable new vehicles, impossible, expensive,
− Big surplus of rape oil, do not exist in the north,
− No taxes, perhaps a small boost, but several broken engines, experiments,
− Big fuel companies, quality of biodiesel is better than small producers
− Probably government has done this kind reasoning in Finland

4. Germany

Status Quo of PVO in Germany

Under the current legal situation in Germany, neither production nor use of vegetable oil as a biofuel are able to compete with fossil diesel fuel. With the coming into force of the new legal and political framework, since the beginning of 2008 there has been a large decrease in the turnover of rapeseed oil and this has caused many operators of oil mills to stop their production. About three-quarters of the former 600 oil producers have largely continued to operate at a greatly reduced output and have maintained a strategy of ‘hanging on’. The reason for this is that there is a demand for press cake used as a protein feedstuff for livestock. In addition, the oil mills are increasingly focusing on the production of feedstock or edible oils as well as covering their own requirements. According to the oil producers, the level of tax charged on rapeseed oil is the main reason for the large fall in demand for rapeseed diesel as fuel for cars, and particularly for commercial vehicles and buses. However, relatively low current price level of diesel fuel plus the price fluctuations affecting raw materials and rapeseed are also contributing to the present turnover problems suffered by biofuel producers.

The strict conditions imposed by the sustainability regulations applying to biomass electricity generation and biofuel production have led to a high bureaucratic and administrative burden on small and medium-sized enterprises. A marginal increase in interest shown by operators of combined heat and power plants (CHP) in using German rapeseed may open up new possibilities for at least a few oil mill enterprises. The background to this is the concerns of the CHP operators that with the coming into force of the sustainability provisions, they could lose the so-called ‘NaWaRo bonus’ - the bonus paid for the use of renewable resources - when using imported, non-certified vegetable oil (TFZ regulation, 2009).

The most important and productive of the vegetable oil crops in Germany is rapeseed (Brassica napus L.). From rapeseed harvests of 30 - 50 dt/ha with 40% oil content, about 1,600 litres of rapeseed oil is produced per hectare. Rapeseed oil finds use in a number of applications. As well as being an important resource in the food industry, it is becoming increasingly important as a lubricant and fuel (biodiesel/RME or as a pure vegetable oil).

Quality and properties

As is the case with other fuels, a consistently high quality is required in the use of rapeseed oil fuel in order to achieve a trouble-free and environmentally-friendly operation of the engine. Additionally, the storage of the fuel has a big influence on the qualities of the product. While there is an existing norm DIN EN 14214 which applies to biodiesel (FAME), for rapeseed oil fuel there is only the pre-norm DIN 51605 and an intention to further increase the operating efficiency through stricter requirements applying to minimum quality standards. The most important parameters are listed below.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total pollution</td>
<td>&lt; 24 mg/ kg</td>
</tr>
<tr>
<td>Oxidation stability</td>
<td>(110°C) &lt; 6.0 h</td>
</tr>
<tr>
<td>Phosphorus content</td>
<td>&lt; 12 mg/ kg</td>
</tr>
<tr>
<td>Kinetic viscosity</td>
<td>(40°C) &lt; 36 mm²/ s</td>
</tr>
</tbody>
</table>

Table 1: Rapeseed oil fuel requirements of prenorm DIN 51605

The production and use of vegetable oil as a fuel offers an ideal way of achieving the vision of regional value creation. The by-product resulting from the oil production - rapeseed cake – can be used as a protein-rich feedstuff in livestock farming.
Because of the favorable taxation rates for biofuels made from oil seeds and comparatively low raw materials costs, a growing market has become established in Germany since 2008 for the products. In 2006, biogenic fuels made up over 6% of fuel consumption in road transport. As well as the 2.5 million tons of biodiesel, 1.08 million tons of vegetable oil (source: BMU 2008) were used as a fuel.

![Biofuels in Germany in 2008](image)

Fig 1: Biofuel consumption in Germany, 2008 (source: BAFA,FNR 2009)

However, the current strong fluctuations in raw material and vegetable oil prices, plus the introduction of taxation for vegetable oil fuels, has led to a substantial decline in the use of such fuels since the start of 2008 in Germany (see fig. 2: Development of Biofuels in Germany). It should be noted that pure plant oil (PPO) and biodiesel (B100) are not permitted for use as a fuel in some European countries.
The national biomass action plan of the German federal government is an overall concept intended to increase the proportion of bioenergy in the energy supply for Germany, taking sustainability criteria into account. The aim is that bioenergy should make an optimal contribution to climate protection, fuel security and to economic development and thereby support domestic value creation, particularly in rural areas (source: National Biomass Action Plan for Germany, BMVEL, April 2009).

The National Biomass Action Plan has the intention of increasing the proportion of biofuel used up to 2020 as part of the overall measures aimed at climate protection.

The federal government subsidises the use of biofuels using statutory powers to achieve quotas. The biofuel quota refers to the increasing minimum proportion of biofuels, which related to the yearly total turnover of fossil fuels (petrol and diesel) is to be used in transport fuels in addition to the existing biofuel proportion.

Energy policy measures

In Germany, there are currently no plans to extend subsidy support for the use of vegetable oil to users outside of agriculture. Under the current legal framework, vegetable oil fuel used in farming is tax free until the year 2012. The Agency for Renewable Resources (FNR) uses various measures to support the use of biofuels in agriculture. Support for own-use fuelling stations started in 2009.

Regional and national energy policy measures for PVO

For the operation of oil mills as well as for the production and bringing to the market of rapeseed oil fuel, various legal conditions need to be considered.

Energy tax law

The energy tax law of 15.07.2006 lifted the tax exemption until 2009 under § 2a of the law on mineral oil tax and in its place introduced a graded energy tax (see table) valid until 2012 for biofuels. In the supporting regulations which quickly followed, the rules and requirements on inspection and control by the customs authorities were set down.

![Development of Biofuels in Germany](image)
Biofuel Quota Act

The Biofuel Quota Act (BQA) of 18.12.2006 sets out the obligation of the mineral oil industry to admix a specific proportion (quota) of biofuel with normal fuels. No account is taken that vegetable oil fuel is not admixed at all. The admixture is fully taxed just as the mineral oil component. Pure biofuels are charged at the full tax rate on a 'fictive quota' based on the amount of the admixture quantity (4.4% tax rate until 2008 then increasing to 8% by 2015).

Despite the tax exemption in 2007, vegetable oil fuel has been, in fact, taxed at about 2 euro cents. However, the energy tax rates were correspondingly reduced. Vegetable oil is only considered as a fuel when it complies with §50 para. 4 of the BQA and the recently inserted §37 of the federal law on air quality which relates to DIN V 51605. This is a prenorm for rapeseed fuel requiring the exclusion of all other vegetable oils. In a regulation issued for this purpose, specific values listed in the pre-norm must be demonstrated by the oil manufacturer (verification and where necessary, a full analysis may be required by customs). However, whether fuels such as sunflower, flaxseed or jatropha oils can comply with the iodine number or energy density as rapeseed oil has not been clarified. For the operation of oil mills and the production and marketing of rapeseed oil fuel, it is also necessary to observe various legal conditions.

Manufacture of rapeseed oil fuel

The manufacture of rapeseed oil fuel or the assignment of rapeseed as a fuel falls under the 'manufacture of energy products' (§ 6 of the Energy Tax Law). The tax is due immediately on manufacturing and must be paid to the responsible authority (§ 9 para. 1 Energy Tax Law). An excise duty suspension via tax warehouses is possible for manufacturing enterprises under § 5 of the law but requires permission from the responsible customs authority (§ 6 para. 3).

Rapeseed fuel as a replacement for fossil diesel (transport applications) Under § 2 para. 4 of the Energy Tax Law, rapeseed fuel and other vegetable oils used in transport applications are subject to basically the same taxation as diesel, as they are similar in their properties and usage. However, § 50 of the Energy Tax Law permits a tax reduction for rapeseed and other vegetable oils as pure fuels until 31 December 2011. The amount of the reduction decreases in stages after 1 January 2008. As a condition for eligibility for paying the reduced rate for rapeseed, the manufacturer must register the activity with the customs authority and make an application.

Under § 50 para. 1 of the Energy Tax Law, the lower tax rate for rapeseed fuel is only granted for that proportion which exceeds the amount of the biofuel admixture quota. For the amount up to this quota level, the energy taxation to be paid is 47.04 cents per litre (fictive quota). Thus, for rapeseed fuel there has been effectively since January 2007 an energy tax amounting to 2.07 cents per litre. Table bellow shows the effective tax rates for rapeseed fuel and biodiesel.

<table>
<thead>
<tr>
<th>Year</th>
<th>Biodiesel (Energy tax in cent/l)</th>
<th>Vegetable oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2006</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>9</td>
<td>2.15</td>
</tr>
<tr>
<td>2008</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>2009</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>2010</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>2011</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td>2012</td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

Table 2: Taxation levels for vegetable oil fuels under the Energy Tax Law
(source: Agency for Renewable Resources - FNR)

For vegetable oils used for transportation purposes, an application for favourable tax rates can only be made under the condition of compliance with DIN V 51605 for rapeseed fuel. For vegetable oils which
do not comply with the prenorm, the full tax rate of 47.04 cents per litre is payable. For the purposes of verification of compliance with the norm, the Energy Tax Law does not require consideration of all parameters of DIN V 51605 but only a selection of seven:

1. Density at 15 °C
2. Iodine number
3. Sulphur content
4. Acid number
5. Phosphorus content
6. Total calcium and magnesium
7. Water content

In accordance with an enactment of the Federal Ministry of Finance of 16 July 2007, every oil mill is required to present at least one certificate of analysis to the main customs authority each quarter for the purposes of verification of compliance with these parameters. The oil mill operators must take oil samples and send these for analysis and they are liable for the resulting costs. Smaller oil mills which produce less than 10,000 litres per year of rapeseed fuel may apply for an exemption of the duty to provide a certificate of analysis, in agreement with the responsible customs authority. In the case that less than 100,000 litres of rapeseed fuel per year is produced, the responsible customs authority can agree to accept one certificate per year.

Approval rights for rapeseed fuel

In accordance with statutory reporting requirements for goods subject to market regulation, oil mill operators must report information on the receiving, processing and trading of specified goods such as oil seeds, oleaginous fruits, oils and fats as well as oil cake, slops and expeller waste. The reporting requirement and frequency is dependent on the actual amount of seed processed per year (under 500t - no requirement, 500t - 10,000t - six-monthly reporting, above 10,000t - every month). The report must go to the responsible federal state office and the information is used for statistical purposes. Under company health and safety legislation, rapeseed oil is not classed as a dangerous substance.

Customs duty for rapeseed fuel

For all edible animal and vegetable oils and fats, that is, suitable for human consumption and without further processing, which are listed in § 12 para. 2 No. 1 subject to No. 26 of the appendix to the VAT Act under the points 15.01 to 15.03 and 15.07 to 15.17, the reduced rate of VAT (currently 7%) applies. Rapeseed fuel falls into this category, so far as it is not denatured or has received additives (e.g. mixed with small amounts of diesel). Otherwise, the normal rate of VAT (currently 19%) applies (source: OFD Frankfurt 29.04.2002, S 7220 A – 30 – St I 22).

Potential of renewable resources

Since the 1990s, rapeseed has been second to soya in its share of the world market. In 2007, rapeseed made up 12.9% of the worldwide production of oilseed and in the financial year 2008/9, about 54.1 million tonnes were produced. Also, rapeseed oil production continues to grow rapidly. It is estimated that for 2008/9, rapeseed oil made up 14.5% of the total vegetable oil production (source: Agrarmärkte 2008). 91% of the world output is in the European Union, China, Canada and India. Canada is the leading export country. An increasing supply of rapeseed in the CIS countries, particularly in the Ukraine, has raised the importance of east Europe for the international rapeseed market. Within the European Union, Germany is the main grower with about 5.2 million tonnes, just ahead of France with 5 million tonnes, in 2008. Poland and Great Britain are also important growers of the crop in the EU.

The area of cultivation has been significantly extended in the last few years, particularly in the new EU member states such as Romania, Poland and the Czech Republic. In Europe, the cultivar 00-rapeseed is almost exclusively grown as winter rape, which is free from erucic acid and is therefore suitable for human consumption. The cultivation of summer crops has diminished greatly. In Germany, the cultivation of summer rape has decreased by almost 90% since the middle of the 1990s, down to 12,800 hectares (source: ZMP 2008).

The 00-rapeseed cultivar, which is grown frequently in Germany, is suitable for use in the food industry and also finds application as a renewable resource. On areas of agricultural land which are designated as set-aside, it is not allowed to grow food or feedstuff crops. Rapeseed which is grown on this land can only be used as a renewable resource. As the obligatory set-aside rules were abolished in 2006 and the EU energy crop premium for rapeseed on non-set-aside land was paid for the last time in
2009, there is competition among the various uses of rapeseed products which is not affected by agricultural subsidy. The area of cultivation in Germany has expanded greatly in the last few decades. At the beginning of the 1980s, the level stood at under 20,000 hectares, rising to over 1 million at the start of the 90s and about 1.5 million in 2009. However, after years of growth, the figure for 2009 is down to about 1 million hectares rapeseed cultivated as a renewable resource, 20% less compared to the previous year.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Raw material</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial crops:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial starch</td>
<td>140000</td>
<td>130000</td>
<td></td>
</tr>
<tr>
<td>Industrial sugar</td>
<td>22000</td>
<td>22000</td>
<td></td>
</tr>
<tr>
<td>Industrial rapeseed oil</td>
<td>120000</td>
<td>120000</td>
<td></td>
</tr>
<tr>
<td>Industrial sunflower oil</td>
<td>8500</td>
<td>8500</td>
<td></td>
</tr>
<tr>
<td>Linseed oil</td>
<td>2500</td>
<td>2500</td>
<td></td>
</tr>
<tr>
<td>Plant fibres</td>
<td>1000</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>Drugs and dyes</td>
<td>10000</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>Industrial crops total</td>
<td>304000</td>
<td>294000</td>
<td></td>
</tr>
<tr>
<td>Energy crops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rapseased for diesel/vegetable oil</td>
<td>915000</td>
<td>942000</td>
<td></td>
</tr>
<tr>
<td>Starch/sugar for bioethanol</td>
<td>187000</td>
<td>226000</td>
<td></td>
</tr>
<tr>
<td>Biogas crops</td>
<td>500000</td>
<td>530000</td>
<td></td>
</tr>
<tr>
<td>Permanent crops for solid fuels</td>
<td>2000</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>Energy crops total</td>
<td>1604000</td>
<td>1701500</td>
<td></td>
</tr>
<tr>
<td>Cultivation total</td>
<td>1908000</td>
<td>1995500</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Cultivation of renewable resources in 2009 (source: FNR – provisional assessment)

Future PVO developments in Germany

In the biofuels industry, different future growth trends are to be expected (source: German Biomass Research Centre (DBFZ) and the Eco-Institute IEA Task 40, study on the mid-term future of the German bioenergy market, IEA Bioenergy Task 40: Country Report Germany) Bioethanol production will increase from the 0.64 million tonnes produced in 2008 to about 0.9 million tonnes by 2020. The same amount of 0.9 million tonnes is predicted by the study for the production of bioethanol from cellulose. On the other hand, biodiesel production will decrease. In 2008, Germany produced about 2.7 million tonnes but this is expected to fall to about 2.1 million per year by 2020. In addition, the consumption and production of vegetable oil is decreasing (0.36 million tonnes in 2008). In total, the consumption of biofuels should increase from 3.7 million tonnes in 2008 to about 5.4 million tonnes by 2020.

PVO Oil processing and motor technologies

For the production of rapeseed oil, there are two manufacturing processes: decentralised cold pressing and centralised manufacture through refining in large industrial plants.

Decentralised oil manufacture (cold pressed)

Rapeseed processing takes place in two main stages - the initial pressing of the cleaned rapeseed and the following purification and filtration procedures. The water content of the seed should not exceed 7% - 8%. Pressing takes place at a seed temperature between 15 and 25°C, mainly in screw presses. Decentralised production is capable of achieving an oil output of 75% - 85%. After pressing, the cloudy oil is cleaned (0.5% - 6% by weight solids), through sedimentation, filtration or centrifugation. The press cake is used in agriculture as a valuable protein feed.
### Centralised oil production (refining)

The rapeseed is cleaned, dried if necessary, crushed and heat treated with steam in order to make the oil cells easier to process. A screw-press is used in an initial pressing to release a large part of the oil content. The residual material, the so-called press cake, still has an oil content of 10% - 25%. In the next stage, chemical extraction, hexane - a light petrol - is used to obtain more than 98% of the remaining oil at temperatures up to 80°C. After this, the oil is filtered and the hexane removed for reuse through distillation. Because of the heat treatment and the chemical extraction, the oil is contaminated with several impurities, which must be removed by refining. This entails degumming (to improve storage life and technical scope), deacidification (removal of free fatty acids), bleaching (removal of colorants) and deodourisation (removal of aromas and flavours). The oil treated in this way is known as fully refined and can among other things be used as a fuel in converted engines (see fig. 3).

<table>
<thead>
<tr>
<th>Number of decentralised vegetable oil production plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany total</td>
</tr>
<tr>
<td>1999</td>
</tr>
<tr>
<td>79</td>
</tr>
</tbody>
</table>

Table 4: Development of decentralised oil mills with capacities over 15,000 t/year (source: TFZ/KTBL)

![Flowchart of oil production in centralised industrial oil mills](source: 3N)

Fig. 3. Oil production in (centralised) industrial oil mills (source: 3N)
The various techniques used in both processes mean that different levels of oil extraction are achieved, as shown in table 5.

<table>
<thead>
<tr>
<th>Oil extraction from 1 t rapeseed*</th>
<th>decentral</th>
<th>central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extrusion rate</td>
<td>[%]</td>
<td>80</td>
</tr>
<tr>
<td>Oil output</td>
<td>[kg/t seed]</td>
<td>336</td>
</tr>
<tr>
<td>Rapeseed cake output</td>
<td>[kg/t seed]</td>
<td>660</td>
</tr>
<tr>
<td>Extraction slops output</td>
<td>[kg/t seed]</td>
<td>–</td>
</tr>
<tr>
<td>Oil yield</td>
<td>[l/t seed]</td>
<td>365</td>
</tr>
<tr>
<td>Oil yield</td>
<td>[l/ha]</td>
<td>1,278</td>
</tr>
</tbody>
</table>

Table 5: Comparison of (de)centralised vegetable oil production. Source: FNR Biofuels - Basic data Germany: nachwachsenderohstoffe.de: October 2009

Pure vegetable oil has clearly different qualities to diesel fuel. Above all, the higher viscosity and flashpoint as well as the different combustion characteristics require special considerations for the engines in order to achieve a trouble-free performance. Pure vegetable oil can therefore only be used in converted engines and is suitable for commercial vehicles as operating with rapeseed oil requires the engine to run as close to full-load as possible while at the same time avoiding long periods of idleness. Agricultural machines and lorry fleets of large haulage companies are suitable for conversion to rapeseed oil fuel. Currently, there are two concepts in operation: the single-tank and two-tank systems.

**Single-tank system**

In the single-tank system, the engine is operated with vegetable oil in all operating modes. Different conversion techniques offer various technical solutions. In many systems, preheating of the vegetable fuel and engine takes place and the diameter of the fuel lines are increased, in addition to modifications to the fuel injectors. This system is used by, among others, the manufacturer John Deere in their tractor engines, and has shown very positive results in various technical studies of the system.

**Two-tank system**

The two-tank system is the simpler and often more affordable concept to install. Here, a second fuel tank is fitted which is filled with diesel. In the cold-start phase and at low power, the engine is fuelled with diesel. Once the optimal operating temperature is reached, the second tank containing vegetable oil can be manually or automatically engaged. Before the engine is switched off, the vegetable oil must be flushed out of the injection system with diesel. This system is offered by manufacturers of tractors such as Fendt or Deutz ex works. The oil-change intervals are shorter in the case of both systems for using vegetable oil fuels. Care must be taken in the purchase of rapeseed oil fuel that the delivery note or receipt has a reference to the prenorm so that the manufacturer is liable for the quality of the product. In addition, this can be assured by taking a retained sample for future reference. The minimum conditions for achieving quality conforming to standards are proper storage, which should be clean and dry, as well as sufficient filtration units.

**Biodiesel manufacturing**

In the manufacture of biodiesel from rapeseed, a further procedure involves the esterification of the fully refined product in which methanol and catalysts are added. The correct term rapeseed methyl ester (RME) indicates the process used in the manufacture. Waste fat, for example from large scale food fryers, can also be used as a raw material in the production process and can be esterified to
FAME (fatty acid methyl ester). A by-product of this is glycerine, which can again be used in industrial and agricultural applications. Most of the rapeseed oil which goes into the manufacture of fuels ends up as biodiesel. In Europe, biodiesel production increased by 35% to 7,750 million tonnes from 2008 to 2009 and the next set of figures is expected to show a further increase in capacity up to 21 million tonnes.

As a fuel, biodiesel is already well-adapted to the requirements of engines. As an admixture with fossil diesel, it is contained in every tankful, thanks to the biodiesel quota. A proportion of the biodiesel is used as pure fuel (B100). It is possible to use this in traditional unconverted diesel engines. However, it would be necessary to obtain the approval of the vehicle manufacturer as there are potential problems with gaskets, rubber and synthetic parts as well as coatings because the fuel can act as a solvent. When subsequently changing fuels from fossil diesel to RME, frequent changes of fuel filter are necessary over the conversion period.

![Fig 5. Biodiesel production capacity in Germany (source: UFOP 2008)](image)

There are environmental advantages here in the reduction of pollutants (except for NOx, up 10%), including 50% less particulates and substantially lower levels of sulphur. In addition, biodiesel has better biodegradability compared to fossil diesel and unlike this, is not classed as a hazardous material (in Germany, water hazard class 1).
Table 6: Diesel and biofuels compared (source: FNR Biofuels; 2008)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Fossil diesel</th>
<th>Refined rapeseed</th>
<th>Biodiesel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calorific value</td>
<td>MJ/kg</td>
<td>40.6 - 44.4</td>
<td>37.6</td>
<td>37.2</td>
</tr>
<tr>
<td>Density at 20°C</td>
<td>Kg/l</td>
<td>0.81 - 0.85</td>
<td>0.91</td>
<td>0.88</td>
</tr>
<tr>
<td>vol. calorific value</td>
<td>MJ/l</td>
<td>35.2</td>
<td>34.4</td>
<td>32.7</td>
</tr>
<tr>
<td>kin. viscosity at 20°C</td>
<td>Mm²/s</td>
<td>1.2 - 10</td>
<td>98</td>
<td>6.3 – 8.1</td>
</tr>
<tr>
<td>Flammability (centane number)</td>
<td>CN</td>
<td>&gt;51</td>
<td>51</td>
<td>54</td>
</tr>
</tbody>
</table>

**Competitiveness and profitability of vegetable oil fuels**

Vegetable oil is the most cost-effective of the biofuels on the market. For the use of pure vegetable oil to be worthwhile for the consumer, it must remain at least 12 cents per litre cheaper than fossil diesel. In the case of biodiesel, about 5 cents per litre is sufficient because of increased consumption and reduced service intervals. On the other hand, engines need to be converted for the use of vegetable oils. In addition, the use of vegetable oils invalidates the engine warranty in most cases, even where the fuel is properly used. Consequently, a corresponding risk premium must be allowed for. In January 2008, the price of vegetable oil at the pump was only about 2 - 8 cents under that of fossil diesel (source: FNR 2009).

**Monitoring of the regional PVO market, number of public filling stations**

In Germany alone, there are about 20,000 vehicles which run on vegetable oil, according to an estimate of the Transport Association Germany (VCD). At vegetable oil filling stations and at oil mills, the price for pure vegetable oil including tax is similar to the level for diesel fuel at normal filling stations. In contrast to traditional fuels, rapeseed is only available at 400 plus filling stations (http://www.pflanzenoel-tankstelle.de/). On the other hand, many suppliers and oil mills offer vegetable oil in tankful quantities. Because of the taxation on vegetable oil in place in Germany since 2008, its production in agricultural enterprises has become disadvantageous and its usage here has since reduced sharply. Following several years of rising sales, the sale of biodiesel pure fuel in Germany has declined since 2008. Increases in fuel consumption, technical residual risks and where necessary, conversion costs can only be compensated by a price advantage for biodiesel. However, the actual price advantage for biodiesel has fallen continuously since 2006 as a consequence of the annual increase in taxation and in part through price developments in the vegetable oil and crude oil markets. On occasions, the market price for biodiesel has risen above that for fossil diesel. Because of the obligatory admixture of biodiesel to fossil diesel, sales have increased in this segment. This, however, does not compensate for the loss made for pure fuels. The EU directive 2003/30/EC of May 2003 requires that after 31 December 2005, at least 2% of transport fuels should be from renewable resources, essentially plant-based, with this figure rising to 5.75% by 31 December 2010.

**Usage of new technologies**

At the end of 2005, John Deere carried out research work on the use of vegetable oil as a fuel. The company investigated whether it was feasible to convert a tractor to run on vegetable oil without compromising their own high quality requirements. The technical partners of the world leader in the manufacture of agricultural machinery were the united workshops for vegetable oil technology and the Department of Piston Machines and Internal Combustion Engines at the University of Rostock. The project was supported by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) via the Agency for Renewable Resources (FNR) which as projector organiser administered the support programme for renewable resources.

www.agriforenergy.com
In Germany, Austria, France and Poland, since spring of 2009, private customers have been testing the latest versions of tractors in practice within the framework of the European research project ‘2ndVegOil’ (second generation vegetable oil).

Conclusions

Under the current legal situation in Germany, neither the manufacture nor use of vegetable oil as a biofuel are able to compete with fossil diesel fuel. With the coming into force of the new legal and political framework, there has been a large decrease in the turnover of rapeseed oil since the beginning of 2008 and this has caused many operators of oil mills to stop production.

About three-quarters of the erstwhile 600 oil producers have largely continued to operate at a greatly reduced output and have maintained a strategy of ‘hanging on’. The reason for this is that there is demand for press cake used as a protein feedstuff for livestock. In addition, the oil mills are increasingly focusing on the production of feedstuff or edible oils as well as covering their own requirements. According to the oil producers, the level of tax charged on rapeseed oil is the main reason for the large fall in demand for rapeseed diesel as fuel for cars, and particularly for commercial vehicles and buses. However, the relatively low current price level of diesel fuel plus the price fluctuations affecting raw materials and rapeseed are also contributing to the present turnover problems suffered by biofuel producers.

The strict conditions imposed by the sustainability regulations applying to biomass electricity generation and biofuel production have led to a high bureaucratic and administrative burden on small and medium-sized enterprises. A marginal increase in interest shown by operators of combined heat and power plants (CHP) in using German rapeseed may open up new possibilities for at least a few oil mill enterprises. The background to this is the concerns of the CHP operators that with the coming into force of the sustainability provisions, they could lose the so-called ‘NaWaRo bonus’ - the bonus paid for the use of renewable resources - when using imported, non-certified vegetable oil (TFZ regulation, 2009).

5. Italy

Status Quo of PVO in Italy

In Italy the PVO is produced using rape and sunflower oil seeds. During the last couple of years, on average about 3.000 ha of sunflower (2,5% of total national surface) and 20.000 ha of rape (100%) were planned for PVO and biodiesel production. It can be estimated that in 2009 there was a (potential) production of 1.700 t/y of PVO. Biodiesel national production is 660.000 t/y (2008) of which 250.000 t/y are used internally for blending with Diesel.

In Italy 12 power plants are supplied with liquid bio-oils with a total capacity installed of 121 MWe and 64,6 GWhe produced. Almost all the biofuel used to supply the plants is imported from abroad and it is mainly palm oil. At farm scale there are 1 CHP (420 kWe+200 kWt) supplies (55%) with PVO processed in a local decentralized oil mill located in Ancona (Marche Region) and 3 adapted tractors running on PVO.

The Italian PVO market is characterized by a huge import of oil seeds and raw-oil from foreign countries. The raw oil is used for supplying big power plants and the oil seeds are processed by biodiesel industries. The involvement of national farmers is totally absent or in some cases (biodiesel) really marginal. The low level of seeds price proposed by industries to farmers discourage farmers to stipulate the so called “supply chain-agreements”. The few decentralized oil mills in operation need to monitor systematically the quality of the oil based on DIN 51605, in order to permit a correct use of PVO into the modified engines.

In Italy there are 20 biodiesel producers (figure 5.1) with a potential production capacity of 2,5 Mt/y. In 2008 the total production of biodiesel was 660.000 t. All those national companies are using almost entirely imported raw material.
Oil mill in Italy

The decentralized oil mill and the 420 kWe CHP managed by the farmers cooperative Komaros from Ancona, Italy (www.komarosagroenergie.it).

In early 2009 in the Marche region a new CHP plant (0.42 MWe+0.2 MWt) supply with sunflower oil entered in operation. The oil is produced in a decentralized oil mill (capacity 450 kg/h seeds) processing sunflower seeds. At the moment ca. 55-60% of pure plant oil used to supply the CHP is produced with seeds coming from local farmers, while the rest of oil is bought on the market (palm oil). The entire PVO energy chain is managed by a local cooperative of farmers which acts as energy seller in the frame of the contracting model. The cooperative is pressing the seeds sells also the produced cake (about 66% of the seed’s weight) to the local animal foods industries and this is a significant part of the income which is at the end of the agricultural year distribute to the cooperatives members. On the other hand the CHP is selling power to the public net and a part of the heat is sold to the sport hall and this contribute to the annual income.

National legislation and support schemes

To implement the Biofuels Directive in Italy, a tax exemption mechanism, presently only for biodiesel, has been applied. Currently a contingent of 250,000 tons/year of biodiesel paid 20% of taxes, with priority on biodiesel produced thought national chain-contracts agreements made with national farmers. More recently, National Law No. 81 of 11 March 2006 imposed a biofuels obligation mechanism with a starting share of 1% that is scheduled to gradually rise to 3% till January 2009.

The development of PVO market based on decentralized oil mills involving local farmers is strongly hindered by legislative and fiscal barriers.

The analysis of the PVO sector in the Italian market showed that the barriers hindering the market are especially related to current legislative framework - there is a missing definition of oil seeds traceability across the EU market which hinders the application of the “all-inclusive feed-in-tariff” 280 €/MWhe for plants <1MW. Concerning the use of PVO for transport purposes in agriculture the considerable delay of the Commission’s notification of the Italian law (Min. Decree) is stopping for long time (since early 2008) the possibility to use PVO for feeding tractors by farmers. Since 1st January 2008 the national financial Law foresees that an amount of PVO can be used which is corresponding to 1 M€ avoided tax yield (no-taxation-area). This issue is a big concern considering the fact that in neighbouring EU countries - like Germany and Austria - farmers can run on PVO tractors without paying any taxes. It is a clear situation of disparity which has a relevant impact on competitiveness. It also means that today (Jan 2010) for transportation use (motors like tractors but not only) PVO can be used only paying taxation like diesel which is ranging from 350-450 €/t depending on the production costs. PVO can be, however, used in CHP plants and receive the “All-inclusive feed-in-tariff”.

Nevertheless, that “All-inclusive feed-in-tariff” for power output less than 1 MWe (280 €/MWhe) is right now still not applicable because the Ministry of Agriculture must still figure out and afterward release the applicative criteria how to define the traceability of the oil seeds based on the European legislative framework. For plants running before 15 August 2009, by legislative vacancy is in force the
previous “All-inclusive feed-in tariff” it means 220 €/MWh. If the plant (CHP) is not able to demonstrate that the oil can be traceable, the “All inclusive feed-in-tariffs” is 180 €/MWh.

For farmers at national level each Region can support in the frame of Rural Development Plan (Programme 2007-2013) the building of PVO chains (measure 311, Action 3) at farm level giving subsidies to farmers of the total investment costs like oil mill and CHP. The incentive is given only for plants with capacity less than 1 MW (both power and heat). The main aim of this measure is promoting investments in the sector of production and selling renewable energy by farmers (power and heat).

**Level of subsidies**

- For oil mills is foreseen a subsidies up to 60% (but they must have no other kind of subsidies)
- For CHP plants is foreseen a subsidies up to 40% in order not to lose the "All inclusive feed-in-tariffs”.

FISCAL ADVANTAGES: by Law in Italy if you are a farmer as defined by the Civil Code and the farmer sell either power or heat the income related is a part of the so called “Agrarian income” which level of taxation comes from the land surface cultivated (owned/rented) and independently of what is cultivated (see level of income) on it. A limit is that the at least 50% in term of the raw material (seeds) must be produced within the farm.

The other strategic issue regarding the involvement of farmers in the PVO energy chain which for the Italian agricultural conditions seems to be the “decentralized oil mill” model supplying small-medium scale CHP (up to 500 kW) and tractors. A key aspect is the introduction in the decentralized oil mill of a monitoring system for the assessment of oil quality according to DIN 51605.

Those model enables: -active engagement of farmers in the energy market, -more agronomic-friendly practices (crop rotation, water saving), -increasing the rate of locally produced protein and a sustainable development of PVO market avoiding risks of no-food vs food conflict.

**Taxation on fuels used by farmers**

The Italian farmers can have fossil diesel for their tractors or agri-machinery in general paying 22% of the whole taxation (423 €/1000 litres) of the diesel for the normal consumers. This means of 93 €/1000 litres. The amount of “agro-diesel”

**Specific taxation for PVO consumption by farmers**

At the moment the use of PVO for transport purposes is subjected also for farmers at taxation but deputy authorities cannot still indicate exactly the amount of them in case someone would like it use.

**The Italian biofuels target**

In 2008 the share of biofuels in the transport sectors was about 1,7% and the target in the National Action Plan is set up to 6,38%. Prominent seems to be the rule of biodiesel (of I° and II generation) where the national capacity of biofuels is about 2 Mt/anno, mainly biodiesel. Follow then contribution of bioethanol. The rule played of PVO is estimated in 0,15%, which is 50 ktep.

**Competitiveness**

At the moment fossil fuel diesel price is to low so that PVO can be competitive. The main difference (PVO vs Fossil Diesel) can be the following:
- Very small difference on power-take engine (less ca. 2%) which means more consumption.
- less emission in term of particulate matter (PM) and HC (Hydro-carbon)
- more emission in term of NOx
- CO₂ saving

**Future PVO development**

The legislative barriers are now the main problem to be overcome and it’s hard to foreseen any rapid change in the short term. The potential for PVO produced in Italy is “restricted” to satisfy partially the agricultural consumption of fuels but surely not the private consumptions.
6. Slovenia

Status Quo of PVO in Slovenia

The development of pure vegetable oil (PVO) as a fuel in Slovenia is relatively slow. PVO is mainly used for production of biodiesel or for other purposes than transport. The Slovenian Biofuel Policy is based on EU legislation which is translated into the Slovenian laws and ordinances in order to promote and support biofuel use and production.

At present, liquid biofuels production is based on conventional plants from agricultural sector. The most common plant for PVO production in Slovenia is rapeseed. In 2007, Slovenia covered 4,442 ha of rapeseed planted and 14,740 tons of seed produced. The areas planted with rapeseed are steadily growing from 398 ha in 2001 to 4442 ha in 2008.

Rapeseed production in Slovenia is low due to limited availability of agricultural land for energy plantations. Average annual mileage driven by the diesel vehicles in Slovenia is 21,127 km. Vehicles use on average 1484 litres of fuel per year (7.02 l/100km). If the cars use B20 we will need 28,000 tons of PVO and with this amount it is possible to supply only 1900 cars, representing only 2% of all registered cars in Slovenia (in 2007). This simple calculation shows the biggest problem of biofuels sector in Slovenia which is the limited availability of agricultural land for biofuel production and limited capacity of existing producers.

As PVO is also used for biodiesel production, there is a strong competition between PVO as biofuel and PVO as source for biodiesel.

There are no official data about PVO use in agriculture sector and or transport. But there are maybe dozen examples when farmers are mixing diesel and PVO in the summer time and using it in their tractors without any engine modifications. Some of them they have small size pressing machines to produce oil from their rapeseed. There are 3 tractors with modified engine for PVO use at Slovenian Agriculture Institute used for research purpose.

National legislation and support schemes

When Slovenia joined the EU, it benefited from the EU market regulations and Direct Payments Policy. Direct payment plus energy plant support (45EUR/ha) for rapeseed production in 2008 amounted for 405,18 EUR/ha.

Slovenia signed a commitment to achieve 5.2 % shares of biofuels. That means that Slovenia will need 34,000 ha of agriculture land on which it is possible to produce 40,000 t of biofuel. The potential of areas suitable for the production of rapeseed in Slovenia by various scenarios is from 7.000 up to 18,000 hectares. At present, there is one industrial scale PVO producer and a few private, un-registries producers.

However, PVO as biofuel has an insignificant role and maybe because it was not included in the list of biofuels that are free of excise tax. That is why; it is possible to state that there is no tax support for PVO users. This is an important barrier for further development of PVO use in Slovenia. Despite the fact that PVO is not directly included in biofuel support system but there is an exemption of excise tax for other biofuels (bioethanol, biodiesel, biogas...) to maximum 5% of biofuel in fossil fuel. That means that if you are using PVO you have to pay excise tax even if you produce it for self-consumption.

Level of excise tax is regulated by government every 14 day together with fuels price changes. For October 2010 it was approx. 35 %.

Legislation is setting a biofuel share which distributors have to add into the mineral fuel. It is expected that average proportion should be 7% in 2015. In 2009 it was estimated that 2% of biofuel was added in the mineral fuel.

Investments in PVO production are supported in RDP support scheme but there are no supports for vehicle modifications to PVO or pure biodiesel.

It is estimated that there are around 20 vehicles in Slovenia that can use PVO (modified). PVO market, however, is not organized and PVO users are producing their own PVO from plants or they use plant
oil from restaurants or get it in neighbour country. Oil mill Biel is producing the larger share of PVO in Slovenia and sell it for biodiesel production.

As regards to biodiesel, there is one biodiesel producer who has produced approx. 7,000 tons of biodiesel in 2008 in Slovenia.

In addition to cars, however, there are also agricultural tractors. Farmers in Slovenia will have to give notice to more than 20,000 hectares of agricultural land, to produce PVO for self-subsistence with PVO for theirs tractors. As mentioned previously, Slovenia does not have such potential of land for rapeseed (PVO).

If we consider only the top three customers: the oil companies which add biodiesel to oil, drivers which want to use pure vegetable oil and farmers who wish to be self-supply, we find out that the theoretical demand is really high but options to fulfil this demand is limited.

**Competitiveness**

As mentioned above, the PVO use is insignificant comparing to the use of diesel. And there are only 2 petrol stations that are selling pure biodiesel in Slovenia and they are both on highways. Majority of biodiesel is blended with diesel.

The competitiveness of PVO could be improved if there were legislations changed that abolish excise tax for PVO.

**Future PVO development**

According to different studies done in the past, it can be estimated that theoretically Slovenia has from 15,000 to 26,000 hectares of potential land suitable for rapeseed production. In practice seed sellers are estimating that 7,000 hectares represents a possible capacity for rapeseed production. This is much lower that needed to meet 5,2% RES transport target. 34,000 hectares would be necessary to meet this target with biofuels.

7. Sweden

**A status Quo of PVO in Sweden**

PVO is one for the general public relatively unknown fuel in Sweden. 2.2 TWh - it means that PVO gives an almost equal contribution of renewable energy like wind power (currently about 3 TWh) and more than biogas (approximately 1.2 TWh). Thanks to the high carbon tax, Sweden is one of the countries in Europe that use the most PVO.

PVO’s are the most commonly used in Swedish heat and power production amongst the liquid biofuels. Vegetable oils can be extracted from a variety of different crops.

Biooil is used for the production of heat and electricity and transport (biodiesel) in Sweden. Swedish district heating plants are using more PVO than fossil oil. The latest available figures show a usage of 2.2 TWh of PVO in district heating plants compared to 1.46 TWh of fossil fuel oil. PVO is used for heating and electricity production, mainly for peak load during the cold winter days, but also as a reserve for business interruption and at low load during summer.

Almost all bio-oil used in energy production comes from different types of crop residues. Most common are mixed, pine tar oil, palm oil and rapeseed. Biooil used in energy production comes from around the world (Brazil, Malaysia, Indonesia, Denmark, Sweden, other EU, U.S., India, China, Honduras, Norway, Nigeria,...). In Sweden there are a handful of established dealers / suppliers. There are about 30 users of bio-oil in Sweden including some large users (Fortum, Lunds Energi, Vattenfall, North Energy, C4).

Sweden's largest producer of RME are chemicals company Perstorp with an annual production of 160 000 tonnes of RME at its factory in Stenungsund. In addition Lantmännen Ecobränsle have a RME factory in Karlskrona. Due to high prices on rape and low profitability, no RME was produced in 2008 and during 2009 the factory produced only a small amount of RME. There are also a number of medium-sized and small producers of RME, some of them run by farmer-owned companies. Several
new plants are planned. The biggest investment can be realized in Norrköping Sweden Bioenergy AB wants to build a plant that each year will produce 330 000 tonnes of biodiesel.

Profitability at the RME production is steered by the price of rapeseed and the price of diesel. In autumn 2007, canola prices were so high that many proposed facility were not realised.

### Table 1. (Use of bio oils and bio fuels in Swedish heat- and power generation year 2007. Source: The Swedish District Heating Association)

<table>
<thead>
<tr>
<th>Bolag</th>
<th>Bioolja exkl tallbeck (GWh)</th>
<th>Tallbeck (GWh)</th>
<th>Flytande biobränsle (bioolja inkl tallbeck) (GWh)</th>
<th>Andel biobränsle av allt flytande bränsle (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fortum Värme</td>
<td>949</td>
<td>386</td>
<td>1 335</td>
<td>86</td>
</tr>
<tr>
<td>Lunds Energikoncern</td>
<td>241</td>
<td>0</td>
<td>241</td>
<td>99</td>
</tr>
<tr>
<td>Vattenfall</td>
<td>103</td>
<td>33</td>
<td>137</td>
<td>44</td>
</tr>
<tr>
<td>Norrenergi</td>
<td>0</td>
<td>87</td>
<td>87</td>
<td>89</td>
</tr>
<tr>
<td>C4 Energi</td>
<td>76</td>
<td>0</td>
<td>76</td>
<td>97</td>
</tr>
<tr>
<td>Södertörns Fjärrvärme</td>
<td>2</td>
<td>63</td>
<td>65</td>
<td>85</td>
</tr>
<tr>
<td>Mälarenenergi</td>
<td>1</td>
<td>59</td>
<td>60</td>
<td>91</td>
</tr>
<tr>
<td>Telge Nät</td>
<td>10</td>
<td>47</td>
<td>57</td>
<td>73</td>
</tr>
<tr>
<td>Karlstads Energi</td>
<td>43</td>
<td>0</td>
<td>43</td>
<td>55</td>
</tr>
<tr>
<td>E.ON</td>
<td>40</td>
<td>0</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>Oskarshamn Energi</td>
<td>31</td>
<td>0</td>
<td>31</td>
<td>77</td>
</tr>
<tr>
<td>Lidköpings</td>
<td>26</td>
<td>0</td>
<td>26</td>
<td>77</td>
</tr>
<tr>
<td>Värmeverk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sala-Heby Energi</td>
<td>25</td>
<td>0</td>
<td>25</td>
<td>96</td>
</tr>
<tr>
<td>Göteborg Energi</td>
<td>21</td>
<td>0</td>
<td>21</td>
<td>70</td>
</tr>
<tr>
<td>ÖVRIGA 17 bolag</td>
<td>102</td>
<td>5</td>
<td>107</td>
<td>-</td>
</tr>
<tr>
<td><strong>TOTALT</strong></td>
<td><strong>1 671</strong></td>
<td><strong>681</strong></td>
<td><strong>2 352</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: [www.energimyndigheten.se](http://www.energimyndigheten.se)

![Table 20: Final energy use of renewable motor fuels, 2000-2008, TWh](http://www.agriforenergy.com)
National legislation, targets and support schemes

For the operation of oil mills as well as for the production and bringing to the market of pure vegetable oil, various legal conditions need to be considered. Restrictions for handling and combustion of animal and vegetable based liquid waste products are partly unclear since this is covered in several regulations that are not easy to interpret. The new directive for combustion of waste (2000/76/EG) is valid for animal based waste products but not for cadaver or vegetable based waste products from provisions industries.

According to the Swedish Environmental Protection Agency’s regulations and advices about emission allowances for carbon dioxide PVO is regarded carbon dioxide neutral. PVO and other liquid biofuels are playing an important role in replacing fossil oil for heating purposes in Sweden.

Only biofuels and PVO that comply with the Law (2010:598) about criterions for sustainability of biofuels may be considered as renewable energy. Law (2010:598) meets some of the regulations set by the European commission for the support of renewable energy sources, renewable electricity production and biofuel for transportation (2009/28/EG, 2001/77/EG, 2003/30/EG).

Transportation and handling of PVO

Regulations for transportation, handling, import/export etc. in Sweden depend on the classification of the PVO according to different rules and regulations. The quality of PVO is the decisive factor if the oil classifies as waste or not according to the waste regulation (SFS 2001:1063). Liquid vegetable rest products can contain additives and therefore be classified as dangerous waste according to the waste regulation (SFS 2001:1063). If the PVO classifies as dangerous waste according to the waste regulation specific rules for transportation, handling etc. apply. Apart from that the same requirements for transportation and storage for heating oil apply for PVO.

Combustion of PVO

An environmental permit is required for the combustion of PVO in district heating systems.

Taxation and support

Pure vegetable oils are classified as renewable fuel and therefore exempted from energy and carbon dioxide taxes for combustion in Sweden. No Sulphur tax applies for liquid or gaseous fuel if its sulfur content is less than 0.05 weight percent (Act 2001:962). Certain PVO’s are eligible for the Electric certificate. The electricity certificate system is a market based system to support electricity production from renewable energy sources. Transport biofuels including PVO are tax-exempt. This means that transport biofuels are exempted from energy taxes as well as carbon dioxide taxes. The aim with this exemption is to promote the introduction of new transport fuels and contribute to the energy policy target security of supply through supporting use and domestic production of transport biofuels. Furthermore, a law that larger filling stations are obliged to sell at least one renewable transport fuel was introduced in April 2006. The law had an impact on the development of the area for transport biofuels.

There are currently no direct subsidies for PVO. There are however national and international research and development initiatives as well as projects with information and knowledge transfer supporting the development of the PVO.

Competitiveness

Competitiveness depends on prices for raw materials, supports and prices for fossil fuels.
Future development

Biooils and other liquid biofuels – how much and what for? The compilation of information and data on biooils/liquid biofuels in Sweden shows that for the transport sector Sweden has mainly developed ethanol and biogas sectors, however, there is a good potential for biooils/liquid biofuels to partly substitute fossil heating oil (Total final use of energy in Sweden was 397 TWh in 2009).

<table>
<thead>
<tr>
<th>Biooil/liquid biofuel</th>
<th>Estimated volume t/year</th>
<th>Energy TWh/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>RME/Rapeseed fatty acid Glycerol</td>
<td>&gt; 20 000</td>
<td>&gt;0,21</td>
</tr>
<tr>
<td>Tallbeckoil1</td>
<td>&gt; 300 000</td>
<td>&gt;3,2</td>
</tr>
<tr>
<td>Imported biooils</td>
<td>Depending on enduser</td>
<td></td>
</tr>
<tr>
<td>Recycled oil</td>
<td>&gt; 15 000</td>
<td>&gt;0,15</td>
</tr>
<tr>
<td>Rapeseed oil for energy purposes</td>
<td>&gt; 10 – 20 000</td>
<td>&gt;0,11-0,21</td>
</tr>
<tr>
<td>Pyrolysis oil</td>
<td>No production of pyrolysis oil for fuel usage in Sweden today</td>
<td></td>
</tr>
<tr>
<td>Oil from animal grease</td>
<td>-----------------------</td>
<td>-----------------</td>
</tr>
</tbody>
</table>

The specific energy content of biooils varies between 34 and 38 MJ/kg.

To be able to use biooils and other liquid biofuels the most effective way further research and development within, amongst others, the following fields is necessary: Standardisation, quality control, application.

Biooils/liquid biofuels are able to substitute fossil heating oil partly, but it might even be interesting to look at other application areas such as chemicals and materials or motor fuels.
B. CONCLUSION

The experience of the partner countries show that there is a high potential to use PVO for transport purposes as well as the farmers will to use it in their vehicles/tractors, nevertheless, the legislative framework is not nearly enough to develop the PVO sector. Further to that, in some countries like Slovenia or Italy the existing framework hinders the development of PVO whilst Germany, for example, used to be a good example on how to promote this sector until the point when the legislative framework changed and most mills partly stopped their biofuels production.

### Taxation for biodiesel and PVO in Germany

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biodiesel (B100)</strong></td>
<td>9 ct/l</td>
<td>15 ct/l</td>
<td>18 ct/l</td>
<td>24 ct/l</td>
<td>30 ct/l</td>
<td>42 ct/l</td>
<td>45 ct/l</td>
</tr>
<tr>
<td><strong>Reines Pflanzenöl</strong></td>
<td>10 ct/l</td>
<td>18 ct/l</td>
<td>26 ct/l</td>
<td>33 ct/l</td>
<td>45 ct/l</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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