Rape methyl-esther as a renewable energy resource in transport

Methylester řepkového oleje jako obnovitelný zdroj energie v dopravě

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Abstract: The conception of the agricultural politicy of the Czech Republic is in accordance with the European model of agriculture, and one of this politicy pillars has been concentrated on the development of the multifunctional agriculture. In this contribution, several findings from the solution of the research project QF 4142 have been summarised in a synthetic form. It introduced financing and support programme of the rape methyl-esther (RME) and mixed fuel production. In the article, the availability and economic potential of the renewable energy sources till the year 2010 are shown primarily. The RME and the bio-diesel form an important part of the biomass in the Czech Republic. We describe in brief the RME characteristics in the year 1997–2004 in the following fields: production and support of the RME and mixed fuel. We have the capacity of the RME production 150 000 t in the Czech Republic with the average costs 20 CZK/l RME.

Key words: rape oil methyl-esther, non-food products, supports, renewable source of energy

Abstrakt: Koncepce zemědělské politiky ČR je v souladu s evropským modelem zemědělství a s tím pilířem, který je soustředěn na rozvoj multifunkčního zemědělství. V předloženém příspěvku jsou uvedeny některé závěry z řešení výzkumného projektu NAZV QF 4142. Je uvedeno financování a podpůrné programy produkce MEŘO a směsného paliva – bionafty. Popisujeme přehledně přínosy produkce a podpor MEŘO a směsného paliva – bionafty v letech 1997–2004 pro nárůst obnovitelných zdrojů energie. V České republice dosahuje kapacita produkce 150 tis. t MEŘO s průměrným nákladem 20 Kč/l MEŘO.

Klíčová slova: metylester řepkového oleje, nepotravinářský produkt, podpory, obnovitelné zdroje energie

In the Czech Republic, we have extensive energetic reserves in the use of renewable sources of energy. Agriculture has possibilities to use the surplus of corn and rape straw and to produce such crops on the unused agricultural land and forest land which can extend the assortment of ecological fuels. The National Program of the Economical Energy Use and the Renewable and Secondary Resources Utilisation continues in reaching results regarding the realisation in the particular years of the Program for Energy Saving and RSE Use formed in 1991–1998 and the State Program for Support in Energy Saving and RSE Utilisation in 1999–2001 (Table 1). The aims of the National Program are, regarding the RSE part, defined up to the end of the year 2005 as follows:

- To reach the share of electricity from the RSE in the gross electricity consumption on the level of 3% (without water power stations above 10 MW);
- To reach the RSE share in the primary energy sources consumption on the level of 2.9% (excluding water power stations above 10 MW);
- To reduce the emissions, namely SO_2 to 1.9 kg/1000 USD HDP (2 kg in the year 1999) or 26 kg SO_2 per inhabitant in the year 2005 and NO_x to 35 kg per inhabitant in the year 2005 (38.4 kg in the year 1999).

Supported by the Ministry of Agriculture of the Czech Republic (Grant No. QF 4142 – Higher utilisation of non-food agricultural production in the industry).

Table 1. Available and economic potential of the RSE[1] in the CR till 2010

		Available potential			Economic potential		
		total investment	energy production	Indicator share on TSPEZ[2)]	total investment	energy production	share in TSPEZ[2]
		mill. CZK	TJ/year	%	mill. CZK	TJ/year	%
Biomass		109 800	83 700	4.50	45 100	50 960	2.91
Waste		6 830	3 700	0.20	0	1 520	0.09
Solar collectors		76 670	11 500	0.62	0	140	0.01
Photovoltaic conversions		8 680	100	0.00	0	0	0.00
Heat pumps		21 180	8 800	0.47	6 110	2 540	0.15
Water power plant	over 10 MW	0	5 700	0.31	0	5 700	0.34
	under 10 MW	16 290	4 100	0.22	6 030	2 930	0.18
Wind		16 020	4 000	0.21	270	100	0.01
Total		255 470	121 600	6.53	57 510	63 890	3.69

[1] RSE – renewable source of energy, [2] TSPEZ – Inland consumption of primary energetic sources
Source: National programme of economical use of energy and renewable and secondary sources. Ministry of Industry and Trade 2001

The State Program is managed by several departments. Especially, it is incorporated in the programmes of the State Environmental Fund of the Czech Republic, further in the programmes of the Czech Energy Agency (ČEA) and in the support programmes of the Ministry of Agriculture and the Ministry of Regional Development. A specific department of the Ministry of Agriculture has a key role as animportant producer of raw material and energy biomass for the other departments.

Table 2. Production of bio-diesel in the EU (1 000 t)

Country	2002	2003	2004
Germany	450	715	1 035
France	366	357	348
Italy	210	273	320
Denmark	10	41	70
Austria	25	32	57
United Kingdom	3	9	9
Spain	0	6	13
Sweden	1	1	1.4
Czech Republic	x	x	77
Slovakia	x	x	15
Lithuania	x	x	5
EU total	1 065	1 434	1 950.4

Source: EurObservER EBB (European Biodiesel Board) 2004

MATERIAL AND METHODS

Biodiesel is a renewable fuel produced from vegetable oils such as those from rape seed and sunflower seed. In the transport sector, it may be effectively used both when blended with the fossil diesel fuel and in the pure form. Tests undertaken by motor manufacturers in the European Union on blends with the diesel oil between 2% and 30% and 100% pure have resulted in guarantees for each type of use.

Biodiesel in the EU

Biodiesel has been produced on the industrial scale in the European Union since 1992, largely in

Table 3. Production of biodiesel in the EU in 1992– 2003 (1 000 t)

Year	1992	1994	1996	1998	2000	2001	2002	2003	2004
Production	55	150	435	390	680	780	1 065	1 434	1 950.4

Source: EurObservER, EBB (European Biodiesel Board) 2004

response to the positive signals from the EU institutions (Součková 2004). Today, there are approximately 40 plants in the EU producing up to 1 350 000 tones of biodiesel annually. These plants are mainly located in Germany, Italy, Austria, France and Sweden. A specific legislation to promote and regulate the use of biodiesel is in force in various countries including Austria, France, Germany, Italy and Sweden. The EU has also published strick guidelines in compliance with the CEN Standardization (EN14214) in order to insure quality and performance (Table 2 and 3).

RESULT AND DISCUSSION

Methyl-esther of the rape oil (RME) and the blended fuel production in the CR

At the beginning of the 1990s, the Ministry of Agriculture CR has launched the Oil Programme to investigate the scope for converting oilseed rape to an alternative fuel for diesel engines and promoting its establishment in the domestic market. This programme became operational very quickly, primarily as a result of the substantial aid from the state, granted on the basis of the Government Decree No 42 of January 22, 1992. Some 772.7 million CZK in the form of refundable grants were allocated from the state budget in the years 1991–1995 to establish the manufacturing capacity for rapeseed methyl-esther (RME). This state assistance enabled the technological basis for the RME production to be established within a very short time. Additional public resources made available under the Oil Programme have already been and are being dedicated exclusively to promoting the RME and the bio-diesel production. A bio-diesel blend, i.e. a blend of the diesel and the RME containing 31% of the RME in volume, is produced for the domestic market according to the national standard ČSN 656508. This product is distributed separately from conventional diesel at petrol stations.

This type of bio-fuel for diesel engines was introduced in the Czech Republic from 1997. The higher costs and lower energy efficiency of the bio-fuel component were offset by the direct subsidies to manufacturers of RME and fuel blends in the period 1999–2001 (Table 4). From 2001 to April 30, 2004, the compensation took the form of price rebates for the raw material (oilseed rape) grown on the set-aside land and the limit on the RME production was partially increased to 230 000 t of the processed rapeseed oil; in addition, RME producers received a direct support for processing rapeseed oil for non-food uses. The aid was paid by the State Agricultural Intervention Fund (SZIF) in the framework of the compensation aid and the set-aside support. This support will be continued in the form of the national aid from the SZIF in the context of the non-food uses of agricultural production.

A production enlargement of the methyl-esther rape oil and the bio-diesel fuel is supported by the Government of the Czech Republic. In connection withthe amendment to the Act No. 587/1992 about duty taxes, there was removed from the act the system of duty tax refund and it was replaced by the system of grant support. Bio-diesel has from 1st April 2000 the same duty tax as diesel, 8.15 CZK/l. For that reason, it was divided into the non-investment, direct, non-returnable grant 1.J "Support of the Ecological Fuel Usage in the year 2000" to three parts for the RME and bio-diesel:

– 1.J.a. Support of the methyl-esther rape oil production (ČSN 65 6507/Z1), which is valid for the period 1. 1.–31. 3. 2000, with the support amounting to 3 000 CZK per 1 t of the produced and sold RME.
– 1.J.c. Support of the methyl-esther rape oil production (ČSN 65 65 07/Z1), which is valid for the period

Table 4. Balance of production, import and, consumption of the RME and the blended fuel (t)

	1997	1998	1999	2000
Production of the RME in the CR	27 598	15 710	30 643	67 246
Import of the RME to the CR	20 100	26 360	22 909	3 237
RME processed in the CR[1]	47 698	42 070	53 552	70 411
Production of blended fuel in the CR	149 056	131 209	167 350	227 131
Import of blended fuel to the CR	18 600	14 113	10 370	8 463
Consumption of blended fuel in the CR[2]	167 656	145 322	177 720	231 754

[1] in 2000 exports of RME to the extend 72 t, [2] in 2000 exports of mixture fuel to the extend 3 840 t
Source: Report on the State of Agriculture in the Czech Republic 2004

1. 4.–31. 12. 2000 with the support amounting to 13 000 CZK per 1 t of the produced and sold RME.
– 1.J.d. Support of the production of the fuel mixture – bio-diesel (ČSN 65 6508) with volume contents of the RME 31%, valid for the period 1. 4.–31. 12. 2000 in the amount of 16 000 CZK per 1 ton of the RME produced in the Czech Republic and the grant supported by Programme 1.J.a.

The supports were granted to the production of the methyl-esther rape oil produced on the base of rape processing from the farm production to 14 legal persons in the Czech Republic. The bio-diesel grant is aimed at the support of the bio-diesel competitiveness against the diesel. Due to the change of the rules for the grant support of non- food rape usage after the amendment of consumer taxes act, there increased the positive influence of grants to the whole branch development, so called "Oil Program". A higher level of home production support of the RME substantially reduced its high import from the EU states, which was in the years 1997 and 1998 a reason of the fast reduction of the home non- food rape usage. Fast sales of the produced RME, good economics of its home producers and an increasing demand for bio-diesel made a full usage of the manufacturing capacities possible. In the Table 4, there is documented a substantial increase of the RME production in the Czech Republic, in comparison with the year 1999 – 36 603 tonnes and the import reduction in comparison with the year 1999 amounting to 19 672 tonnes of the RME. In the year 2000, there were processed from 185 000 tonnes of the rape seed 67 246 tonnes of the methyl-esther rape oil. The production of 62 705.1 tonnes of the RME was supported by grants.

In the year 2001, the non-investment, direct, non-returnable grant 1.J. "Non- food usage of farming land – support of the ecological fuels use" was divided into two parts for the RME and the mixture fuel (bio-diesel):
– 1. J.b. Support of the methyl-esther rape oil production (ČSN 656507/Z1), for the period 1. 1. 2001 – 30. 9. 2001, with the subsidy of 13 000 CZK per 1 ton of the produced and sold RME.
– 1. J.c Support of the blended fuel – biodiesel production (ČSN 656508) with volume content of the RME 31 %, in the period 1. 1.–30. 9. 2001, in the amount of 14 000 CZK per 1 ton of the RME produced in the Czech Republic and the grant supported by the programme 1. J.b.

In the year 2001, the department of the RME and bio-diesel production was supported in two different ways. Grants 1. J.b "Support of the RME production" and 1. J.c. "Support of the blended fuel – bio-diesel production" were in force for the period 1. 1.–30. 9. 2001. From 1. 10. 2001, there was solved the RME and blended fuel (bio-diesel) support by the SZIF due to the principles of the Government Regulation No. 86/2001, in which there are established the conditions for the financial support for set-aside agricultural land, and the financial compensatory support for set-aside agricultural land and the rules for the sale of rape produced on the set-aside agricultural land, in wording of the Government Regulation No. 454/2001. The calculation of the support of the blended fuel (bio-diesel) sales in the domestic market was in the year 2001 fixed on the scale of the preferential support of the blended fuel (bio-diesel) cost against the cost of the diesel 10% without the VAT influence. In the year 2000, the preferential sale cost of bio-diesel was fixed in the level 12.5% (Table 5).

With the support by the grants 1. J.b. and 1. J.c., there were produced in the year 2001 24 607 tonnes of the

Table 5. Balance of the supported production of the RME and the bio-diesel

Product	Legislation	Season	Measure unit	Production	Support 1 000s CZK
RME	1.J.b. – Support of the RME production	1. 1.–30. 9.	t	24 607	264 858
	RG No 86/2001 Coll.[1]	1. 10.–31. 12.	t	14 957	195 916
	total		t	39 564	460 774
Bio-diesel	1.J.c. – Support of production – bio-diesel with the RME content 31%	1. 1.–30. 9.	1 000s l	91 393	224 980
	RG No 86/2001 Coll.	1. 10.–31. 12.	1 000s l	54 833	0
	total		1 000s l	146 226	224 980

[1] The volume of the RME support is given according to the Government Regulation No 86/2001 Coll. It is counted from the difference between the RME producers sale price of the rape and the market price of rape on MATIF commodity exchange calculated in CZK and corresponding to 1 t RME.

Source: Report on the State of Agriculture in the Czech Republic 2004

Table 6. Balance of production, export and consumption of the RME and the blended fuel

	Measure unit	2002	2003	2004	Index 2004/2003
Subsidized RME	t	73 058.00	69 983.70	46 628.00	66.63
Subsidized blended fuel	1 000s l	267 808.00	256 538.00	170 924.00	66.63
Production of non- subsidized RME for export	t	31 379.60	43 492.00	30 500.00	70.13
Production of non- subsidized RME for the CR	t	0.00	0.00	0.00	0.00
Production of RME total	t	104 437.63	113 475.70	77 128.00	67.97
Production of blended fuel total	1 000s l	267 975.60	256 743.00	170 924.00	66.57

Source: Report on the State of Agriculture in the Czech Republic 2004

RME and 91 393 000 litres of the blended fuel. Due to the Regulation No. 86/2001, there were set aside 112 007 ha of arable land. From this area, 67 722 ha were sown by rape . From this area, the SZIF bought from the growers 153 000 tonnes of rape seeds at the average cost 4 410 CZK/t including 5% VAT. With the support by the Government regulation No. 86/2001, there were produced in the last quarter of the year 2001 14 957 t of the RME and 54 833 000 litres of the blended fuel (Report on the State of Agriculture in the Czech Republic 2004).

In comparison with the year 2000, when there were produced with the grant support 62 705 t of the RME and 189 152 t of the blended fuel, in the year 2001 the production with grant support was reduced to the total 39 564 t of the RME and 146 226 000 litres of the blended fuel. During the year, the supply of the blended fuel in the home market did not cover consumers demand. The sale of blended fuel by petrol stations in the Czech Republic was reduced in the year 2001 to 207 500 t and the share of the blended fuel in the total diesel consumption was reduced from 9.7% in the year 2000 to 7.7% in the year 2001.

In the Table 4 is shown an overview of import and export of RME and blended fuel from the year 1997 till the year 2001. The export of the blended fuel

Table 7. Producers of the RME using rape seed from set-aside land (t)

Producer	Capacity of RME from		
	rape 2002	rape 2003	index 2003/2002
A.B.C. s. r. o., Bransouze	9 120	9 280	101.75
Agricos s. r. o., Stod	1 600	2 112	132.00
Standard Oil Company s. r. o., Novosedly[1]	28 124	0	0.00
Agrochem, a. s., Lanškroun	8 236	8 236	100.00
Agropodnik a. s., Jihlava	172 389	175 122	101.59
Oleoprodukt a. s., Milín	15 488	15 488	100.00
Bio Petrol a.s., Praha	8 000	12 000	150.00
Fabio produkt s.r.o., Holín u Jičína	15 360	15 360	100.00
ZS Kratonohy a. s.	1,200	3 200	266.67
Setuza a.s., Ústí nad Labem	220 800	274 400	124.28
Jaroš – Jarimex	14 000	23 000	164.29
RPN s.r.o., Slatiňany	6 400	6 400	100.00
Václav Kavan ELZA EKO Lužany	0	3 225	–
Jan Horák Česká Třebová	0	40 680	–
Total	500 717	588 503	117.53

[1] Setuza in 2003

Source: Report on the State of Agriculture in the Czech Republic 2004

was aimed in the year 2001 to Poland and the RME was supplied to petrol stations in Germany, Poland and Austria.

RME producers

At present, there are 14 RME producers in the Czech Republic (Jevič et al. 2001). They have the actual production capacity of approx. 100 000 tones of rapeseed methyl ester annually and the potential capacity of 150 000 tones (three-shift operation, 330 days per year). Several types of production technology are used in the production process, depending on the quality standards, and the manufacturing plants have a fairly wide product range. Their annual capacity ranges from 2 000 to 55 000 tones of the RME (Table 6 and 7).

The main manufacturing capacity is concentrated into three processing plants

- 42 000 tones of the RME – Setuza a.s., Olomouc plant;
- 15 000 tones of the RME – Setuza a.s., Mydlovary plant;
- 55 000 tones of the RME – Agropodnik a.s., Jihlava – Dobronín.

Quality control

The RME quality is regularly monitored by SZIF in accordance with the ČSN 656507/Z1 and the quality of the blended fuel/bio-diesel by the Czech Trade Inspectorate according to the ČSN 656508. The ČSN 656507/Z1 has been replaced by the European standard for oil acid methyl-esther, EN 14214, following the EU accession.

CONCLUSION

The bio-diesel was proved to have significant environmental benefits in terms of the decreased global warming impacts, reduced emissions, greater energy independence and a positive impact on agriculture. Biodiesel production also plays a useful role in agriculture. Under the current Common Agricultural Policy, the raw materials needed for bio-diesel production may be grown on the set-aside land, land which would otherwise be taken out of production. Biodiesel production utilises around 1.4 million hectares of arable land in the EU.

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Arrived on 16th June 2005

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