



Soy oil in biodiesel -
A *Greenenergy* perspective

The meal from the soy bean plant is used to produce both protein and oil. The oil accounts for around 20% of the bean and is used in a variety of food and non-food products including biodiesel. This Perspective presents Greenergy's views on soy oil usage in biodiesel, on its characteristics as a biodiesel feedstock and on sourcing soy oil from sustainable sources.

Summary

Greenergy is a significant producer and supplier of petroleum and biofuels into the UK transport fuels market, supplying over 15% of the UK's overall petrol and diesel market and approximately one third of the biofuels market. The company has extensive worldwide sourcing experience, with manufacturing operations in the UK and a blending facility in Rotterdam from which we supply customers across Europe. Greenergy is also a supplier of high percentage biofuel blends the fastest growth area within the biofuels market, in particular B50 for commercial usage and E95 for buses.

The biodiesel Greenergy supplies is derived from a combination of rape, soy and palm. The relative proportions depend on customers' requirements, on season as well as on quality, availability and price.

In this Perspective Greenergy presents the following:

- The characteristics of soy oil make it an attractive food source and the majority of worldwide soy oil goes into food products.
- Consumption of soy oil and soy meal has continued to grow steadily worldwide. South America is the largest exporter of soy and the EU continues to be the largest importer.
- Assuming there has been no change to land use, soy based biodiesel enables a better level of CO2 savings per litre of fuel than biodiesel derived from rapeseed.
- Concerns about the environmental impact of increased soy production, especially in South America, are being addressed by bodies such as the Roundtable on Responsible Soy.
- Greenergy operates a sustainable biofuel policy which applies to all feedstocks including soy.

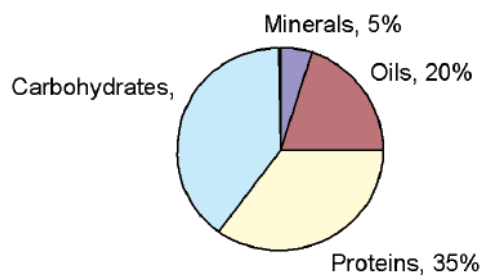
1 Characteristics of soy

Perspective

The soy bean consists mostly of proteins and carbohydrates, with a small proportion of oil. It is primarily cultivated for its meal which is used as an animal feedstock and the oil is a by-product which is mainly used in food products.



Chemical composition of soybean



Source: Villela, O. "Case of Soy Producers for RTRS"
May 8th 2007

In 2008, the US was the world's largest producer of soy with a 33% share of the world market, closely followed by Brazil with a 28% market share and Argentina with a 21% market share. In the same year in the US, oil from soybean accounted for only 6% of the exported crop whereas meal accounted for 16% and the bean, 77% of the crop¹.

¹ <http://www.soystats.com/2009>

2 Uses of soy oil

Perspective

The majority of soy oil produced in the world is used in food products. It is a healthy alternative to other vegetable oils as it contains no cholesterol, is low in saturated fat and contains natural antioxidants.

Soy oil is used in a variety of food products including margarine, bread, mayonnaise, salad dressings and various snack foods. In the United States it accounts for nearly 71% of edible oil consumption². Soy oil is also increasingly being used in non food products such as soap, cosmetics, resins, plastics, inks, solvents and biodiesel.

In the US, the world's largest consumer of soy oil, only 18% of soy oil goes into industrial products including biodiesel, with the majority being used as cooking oil and other food products³.

3 Production of soy

Perspective

Production of soy has continued to rise over the last two years and South America is the largest combined exporter.

Table 1: Largest exporters of soy (million metric tonnes) from USDA FAS

	Meal		Oil		Soybean	
	2006/07	2007/08	2006/07	2007/08	2006/07	2007/08
Latin America	40.3	40.1	8.9	8.0	38.3	39.1
Argentina	25.6	26.7	5.9	5.7	9.5	13.8
Brazil	12.7	12.1	2.4	2.3	23.4	25.3
United States	7.9	8.4	0.8	1.3	30.4	31.5

Source: United States Department of Agriculture FAS⁴

The largest exporter of soybeans and soy products is South America, with Argentina dominating. Outside South America, North America is the next largest producer of soybeans and soy products.

² <http://www.soystats.com/2009>

³ <http://www.soystats.com/2009>

⁴ USDA FAS <http://www.fas.usda.gov/psdonline/psdHome.aspx>

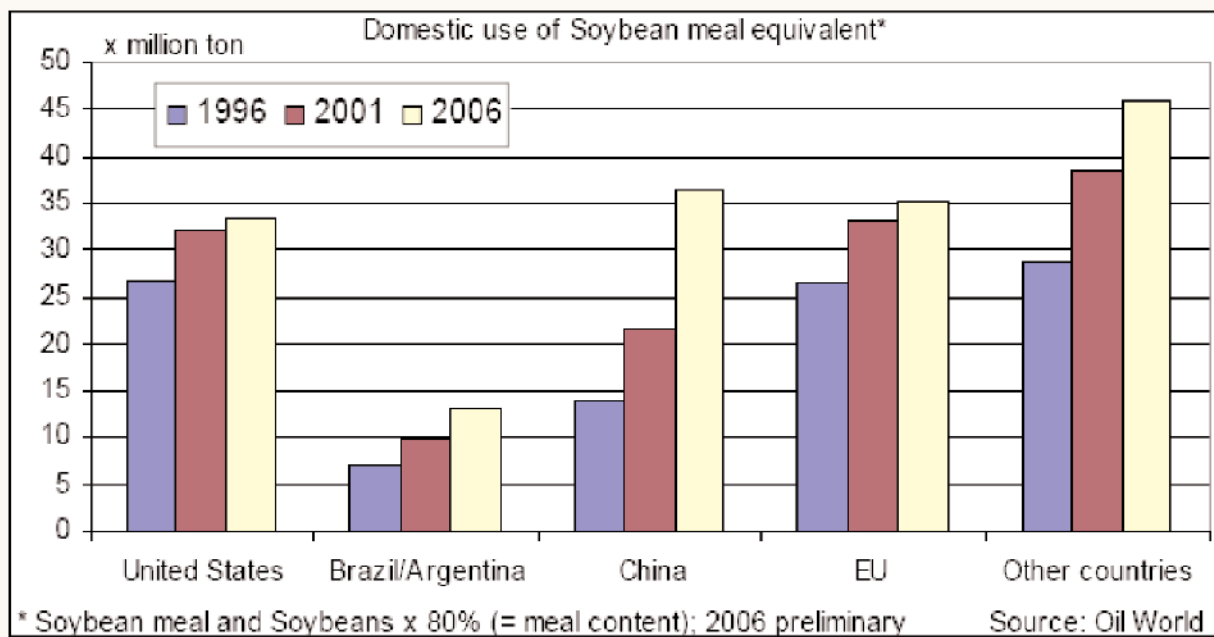
4 Soy oil demand growth

Perspective

Soy bean consumption is growing steadily on a worldwide scale and demand for soy based biodiesel has also increased.

The United States and Europe continue to be large consumers of soya beans, but China has shown the highest increase in consumption since 1996 putting further pressure on demand.

Figure 1: Domestic use of soybean meal



Source: Claassen F. "Road to Responsible Soy" May 8th 2007

Table 2: Largest Importers of soy (million metric tonnes) from USDA FAS

	Meal			Oil			Soybean	
	2006 /07	2007 /08		2006 /07	2007 /08		2006 /07	2007 /08
EU	22.3	24.0	Peoples Republic of China	2.4	2.7	Peoples Republic of China	28.7	37.8
Vietnam	2.2	2.4	India	1.4	0.7	EU	15.2	15.1
Indonesia	2.2	2.4	EU	0.9	1.0	Japan	4.1	4.0
Thailand	2.2	1.0	Iran	0.6	0.5	Mexico	3.8	3.6
Republic of Korea	1.8	1.7	Morocco	0.3	0.4	Taiwan	2.4	2.1
Japan	1.7	1.7	Venezuela	0.3	0.3	Argentina	1.9	2.9
Canada	1.4	1.5	Republic of Korea	0.3	0.3	Thailand	1.5	1.7
Mexico	1.7	1.4	Peru	0.3	0.3	Indonesia	1.3	1.2
Philippines	1.3	1.4	Bangladesh	0.3	0.4	Republic of Korea	1.2	1.2

Source: United States Department of Agriculture FAS⁵

The largest importer of soy meal is the EU. The EU has a growing reliance on soybean meal to satisfy feed protein requirements⁶. East Asia, specifically China, is the largest importer of soy oil and soybeans.

⁵ USDA FAS <http://www.fas.usda.gov/psdonline/psdHome.aspx>

⁶ USDA FAS, Oilseeds, World Markets and Trade, August 2007

5 Soy oil in EU biodiesel

Perspective

Approximately 50% of all biodiesel used in the EU is derived from soy.

Soy is a good biodiesel feedstock in all respects except its cetane number. It needs to be blended with other oils or biodiesels to meet the cetane requirements of the European biodiesel standard. Typically the cetane number for soy methyl ester is 48. The minimum cetane number for diesel is 46 (EN590) and 51 for biodiesel (EN14214).

6 The carbon footprint of soy-based biodiesel

Perspective

Soy based biodiesel enables a better level of CO₂ savings per litre of fuel than biodiesel produced from rapeseed.

Table 3: Carbon savings of soy-based biodiesel

	Seed tonnes per hectare	Oil produced tonnes per hectare	Fossil inputs litres per hectare	CO ₂ savings as a biodiesel per litre	CO ₂ savings as a biodiesel kg per hectare
Rapeseed (UK)	3.0	1.30	66	11%	886.34
Soya oil (Brazil)	2.5	0.43	76	32%	557.61
Soya oil (USA)	2.6	0.44	76	63%	1,006.12
Palm oil (Indonesia)	18.0	3.60	30	41%	4,812.73

Source: Renewable Fuels Agency, 2008

The CO₂ savings for US soy are almost double the savings for Brazilian soy because it is assumed that prior to conversion, Brazilian soybeans are transported a greater distance than US soybeans (1500 km versus 100 km).⁷

⁷ USDA FAS, Oilseeds, World Markets and Trade, August 2007

7 Land use efficiency

Perspective

The soy bean produces less oil per hectare than either rape or palm oil as the meal accounts for the majority of the crop, with the oil being a by-product. Therefore the amount of land that would be needed to deliver 1% of the EU's 2006 biofuel objective is higher than the land needed for fuel made from either rape or palm oil to meet the objective.

Table 4: Land use efficiency by feedstock

Feedstock	Oil produced per hectare	Hectares to deliver 1% of EU transport fuels	Reference area	% of land under cultivation
Soy	0.4	79,257	Brazil	8.6%
Rapeseed	1.3	25,853	UK	20%
Palm Oil	3.6	11,111	Indonesia	6%

Source: RTFO Default Factors – LowCVP Expert Group (2007)⁸



⁸ For E4Tech: Ausilio Bauen, Philip Watson and Jo Howes, for Ecofys: Bart Dehue, Carlo Hamelinck, Richard Archer, Esther Garcia, Gemma Reece, Eric van den Heuvel. 2007. Carbon and Sustainability Reporting within the Renewable Transport Fuel Obligation: Second Draft Technical Guidance for Pilot Companies.

8 US soy production and its impact on land use

Most of the soy oil in the biodiesel Greenergy supplies is from the United States.

In 2007 the US was the world's largest producer of soy with a 32% share of the world market⁹. The majority of this production satisfied domestic demand limiting the requirement of imported soy to 452 thousand tonnes¹⁰ which equated to only 2-3% of total US soy consumption.

US demand for soy reached a peak in 2006 and the total area planted for soy production increased to 75.5 million hectares¹¹. Production dropped off slightly in 2007 when favourable market prices saw farmers converting to planting corn, but production increased again in 2008 meaning total area planted for soy reached 75.7 million hectares¹².

Land allocated to soybean production in the US has remained steady over the last 10 years, rising by only 2.7% from 72 million acres in 1998 to 74 million acres in 2008¹³.

9 <http://www.soystats.com/2008>

10 United States Soybeans and Products Supply and Distribution Local Marketing Years, USDA Foreign Agricultural Service

<http://www.fas.usda.gov/psdonline/psdreport.aspx?hidReportRetrievalName=BVS&hidReportRetrievalID=720&hidReportRetrievalTemplateID=13>

11 <http://www.soystats.com/2008>

12 ibid

13 USDA, NASS Quick Stats

Database http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/

9 Impact of soy production

Perspective

There are various environmental, social and economic issues surrounding soy bean production as there are with other forms of agricultural production.

In South America in particular, there are a number of issues facing soy bean production. Environmental issues include the protection of local biodiversity and natural habitat, soil erosion, the use of agrochemicals and the preservation of water resources. These issues have been addressed in the Cerrado for example, by prohibiting growers planting on hilltops and ensuring they dedicate 20% of their land holdings to natural vegetation. This figure rises to 80% natural vegetation land use in rain forest regions. Non-compliance with this policy incurs a hefty fine¹⁴.

Socially there are concerns about compliance with labour laws, land rights and the long-term impact on local communities in Brazil. These need to be balanced against the positive impact that soy production has had on the Brazilian economy. It was largely due to the export of agro products including soy that topped Brazil being a debtor nation¹⁵.

The Roundtable on Responsible Soy (RTRS) has been established with the aim of addressing the various environmental, social and economic issues surrounding soy bean production¹⁶. It has members from across the supply chain including producers, suppliers, buyers and NGO's who are working together to establish an international standard for the sustainable production of soy.

¹⁴ Hecht S.B & Mann C.C How Brazil Outfarmed the American Farmer, January 2008 in Fortune

¹⁵ ibid

¹⁶ <http://www.responsiblesoy.org/eng/index.htm>

10 Greenergy's commitment to sustainable soy oil

Perspective

Greenergy actively supports the development of a rigorous, and internationally recognised, standard for sustainably produced soy.

The Round Table on Responsible Soy (RTRS – www.responsiblesoy.org), of which Greenergy is a member, is making progress on the development of such a standard and Greenergy is working with suppliers with a view to sourcing soy oil or soy biodiesel certified to RTRS standards once an international certification process has been established.

Currently the majority of Greenergy's soy purchases are derived from soy beans grown in the United States.