

BIOFUELS - AT WHAT COST ?

Government support for ethanol and biodiesel in Switzerland: 2008 Update

October 2008

Prepared by:

Ronald Steenblik, Christopher Beaton and Juan Simón

Prepared for:

The Global Subsidies Initiative (GSI)

The International Institute for Sustainable Development (IISD)



GSI Global
Subsidies
Initiative

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For the Global Subsidies Initiative (GSI)
of the International Institute for Sustainable Development (IISD)
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Abbreviations and acronyms

B5	A blended fuel comprised of 5 percent biodiesel and 95 percent petroleum diesel
B20	A blended fuel comprised of 20 percent biodiesel and 80 percent petroleum diesel
CHF	Swiss franc
CO ₂	Carbon dioxide
DINF	<i>Département des infrastructures</i> (Swiss department of infrastructure)
DETEC	Department of Environment, Transport, Energy and Communications
E10	A blended fuel comprised of approximately 10 percent ethanol and 90 percent gasoline
E85	A blended fuel comprised of approximately 85 percent ethanol and 15 percent gasoline
EC	European Commission
ECX	European Climate Exchange
EFTA	European Free Trade Area
EMPA	Swiss Federal Laboratories for Materials Testing and Research
EPFL	Ecole Polytechnique Fédérale de Lausanne
ETBE	ethyl tertiary butyl ester
EU	European Union
FFV	flexible-fuel vehicle
FOE	Swiss Federal Office of Energy
GHG	greenhouse gas
GJ	gigajoule
GSI	Global Subsidies Initiative
GSP	Generalised System of Preferences
IISD	International Institute for Sustainable Development
ILO	International Labour Organisation
ISO	International Standards Organisation
LCA	Life-cycle assessment
MFN	Most Favoured Nation
ML	million litres
MPS	market price support

OECD	Organisation for Economic Cooperation and Development
PFEV	<i>Office fédérale de l'environnement</i> (Swiss federal department of environment)
RME	rape methyl ester
SAB	Swiss Alcohol Board
SVO	straight vegetable oil (used as a fuel)
TSE	total support estimate
WTO	World Trade Organization
\$	U.S. dollar

Executive Summary

In recent years, various governments around the world have promoted industrial-scale production and use of liquid biofuels—fuel-grade ethanol and biodiesel¹—and backed that commitment with financial support. This report, one of a series of country studies undertaken by or for the Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD), examines the types and magnitude of support to biofuels in Switzerland.

By world standards, Switzerland is a minor producer and consumer of liquid biofuels—ethanol, biodiesel and straight vegetable oil (SVO)—especially compared with its neighbours, Germany, France, Italy and Austria. Although total consumption of biodiesel and SVO more than quadrupled between 2003 and 2007, to almost 12 million litres (ML), this volume accounted for less than half of one per cent of total domestic consumption of petroleum diesel (see Figure).² Production and consumption of ethanol for fuel accounted for an even smaller share — around 3 ML in 2007 (Annex Table 1), compared with 4 568 ML of gasoline consumed in the same year.³

As of July 2008 there were 21 plants in Switzerland producing liquid biofuels, and nine producing gas from biomass (biogas) for transportation purposes. Biodiesel, mainly rape methyl ester (RME), was being produced in nine plants of relatively small capacity, one of which has been in production since 1996, and the others from 2003 or later. Within the last year, four new companies have announced their intention to enter the biodiesel market. Five plants produce SVO⁴, and six plants produce a similar fuel from recycled plant oil. Only one facility currently produces ethanol in Switzerland, although its owners have announced plans to expand their operations by 2012.⁵

¹ Biofuels refers to liquid renewable fuels such as ethanol (an alcohol fermented from plant materials) and biodiesel (fuels made from vegetable oils and animal fats) that can substitute for petroleum-based fuels in road transport.

² In 2007, the Swiss Federal Customs Administration calculated Swiss consumption of petroleum diesel to be 2 326ML per year. “Quantités imposées 2007”

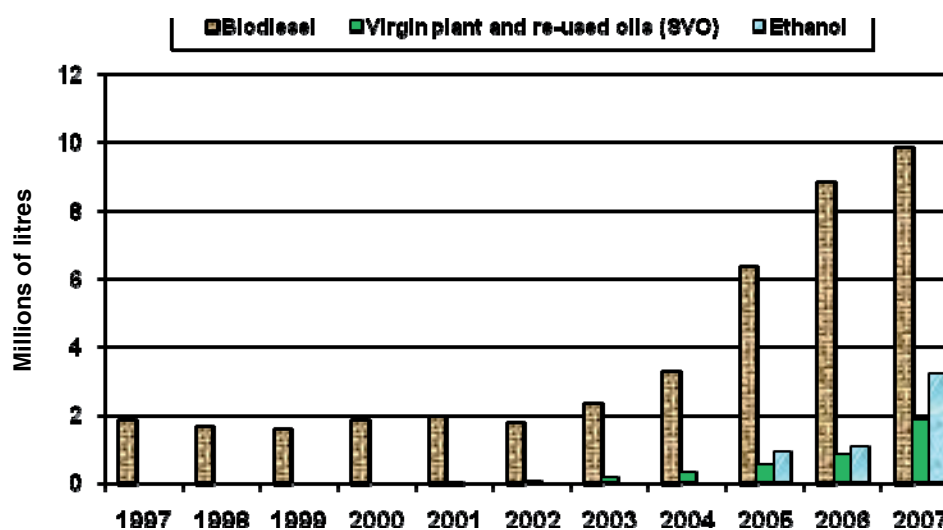
http://www.ezv.admin.ch/zollinfo_firmen/steuern_abgaben/00382/00632/01466/index.html?lang=fr&download=M3wBPgDB/8ull6Du36WenojQ1N1TjaXZnqWfVp7Yhmfnapmmc7Zi6rZnqCkkIN1fXqCbKbXrZ6llhuDZz8mMps2gpKfo&typ=.pdf

³ For petroleum consumption, see Swiss Federal Customs Administration, “Quantités imposées 2007”.

⁴ This purified vegetable oil is also used directly as fuel in some engines, which require a second component for heating the oil (given its high viscosity) and some additives in winter. It benefits from many of the same government support measures available for biodiesel.

⁵ *Data source:* Biofuels Schweiz.

Biofuels consumption in Switzerland 1997–2007 (millions of litres)



Data source: EZV – Eidgenössische Zollverwaltung [Federal Customs Administration], 2007.

Government policies, among other factors (notably prices for petroleum fuels), have played an important role in determining the scale and evolution of the industry. The largest support element is the exemption of biofuels from the “mineral oil tax”, Switzerland’s main volumetric excise tax on fuels. Additional support has been provided to producers of biodiesel from virgin vegetable oils to help bridge the cost differential between imported and domestically produced feedstocks.

Little support of Swiss biofuels production is provided by border protection per se: biodiesel can be imported duty-free, and although there is a CHF 0.0056 per litre import tariff on denatured ethanol (CHF 0.28 per litre for undenatured ethanol), most of Switzerland’s trading partners would not be subject to it. However, until a new law came into effect on 1 July 2008, imports were disadvantaged because they were subjected to a mineral oil tax, while biofuels produced at recognized (Swiss) “pilot and demonstration plants” were exempted. Moreover, only the Swiss Confederation—through the Swiss Alcohol Board (SAB) and its for-profit company, Alcosuisse—was entitled to import products containing more than 80 percent alcohol by volume. Through the end of 2007, no ethanol had been imported to Switzerland for use as an automotive fuel.⁶

In Switzerland, as elsewhere, biofuels have attracted particularly high levels of assistance because of their several perceived benefits: providing new income opportunities for

⁶ Switzerland has import some ethyl alcohol, mainly undenatured, in the past — 44.3 million litres in 2006, for example — but the imported alcohol has been used for industrial or medical purposes, and for making alcoholic beverages, not for fuel. *Source:* F.O. Licht’s *World Ethanol & Biofuels Report*, 5, no. 13, (2007).

agricultural and forest-product producers; improving urban air quality, and greenhouse gas emissions; and, in the future, providing economic opportunities for developing countries.

But the ability of biofuels to deliver against these objectives may be questioned. Biofuels can have unintended effects that undermine the fiscal and environmental goals they are purported to support. By scrutinising the extent of government support for biofuels, this study highlights the opportunity cost of financial assistance to biofuel industries over other options available to policy makers. It also questions whether such levels of support are justified in the context of long-term viability of the industry in the absence of subsidies.

In 2007, the Swiss federal government spent (or exempted from taxes) around CHF 12 million supporting the production and consumption of biofuels (see Table). This number could grow to more than one hundred million Swiss francs a year in the coming decade if currently planned expansion of the industry comes to pass. Most of the support to date has benefitted biodiesel.

Government support for ethanol and biodiesel in Switzerland, 2005-2007

Metric	Units	Ethanol			Biodiesel and SVO		
		2005	2006	2007	2005	2006	2007
Consumption	Million litres	0.9	1.1	3.2	6.9	9.7	11.7
Total support	CHF million	0.7	0.8	2.4	7.1	8.1	9.5
Marginal support per litre ¹	CHF/litre	0.73			Made from waste cooking oil: 0.72 Made from Swiss oilseeds: 2.14		
Marginal support per gigajoule ¹	CHF/GJ	35			Made from waste cooking oil: 22 Made from Swiss oilseeds: 65		
Support per litre of petrol or diesel equivalent ^{1,2}	CHF/litre equivalent	0.75–1.10			Made from waste cooking oil: 0.80 Made from Swiss oilseeds: 2.30		

1. The range in the values for biodiesel and SVO represent the range between biodiesel and SVO made from waste cooking oils and biodiesel and SVO made from Swiss-grown oilseeds.

2. Adjusted for the lower heat contents of these fuels compared with their corresponding petroleum fuels.

Source: main report.

Although the marginal rates of support per litre are roughly similar for ethanol and biodiesel made from imported oilseeds or from domestic or imported recycled oils, support per gigajoule (GJ), a standard unit of energy, is higher for ethanol than for most forms of biodiesel, except biodiesel made from domestically grown oilseeds, which is twice as high (see table).

In 2008, Switzerland's biofuel policies underwent an important transformation. In May 2006, the Government issued draft legislation to amend its Mineral Oil Tax Law, which was finalised on 30 January 2008 and came into force on 1 July 2008. A major change was to extend access to a reduced rate of mineral oil tax to imported biofuels. However, importers must prove a set of qualifying criteria in order to be granted the exemption: proof that the fuels have a positive global ecological effect (calculated on a life-cycle basis) and that production conditions have been 'socially acceptable.' In order to keep total revenues raised through the mineral oil tax constant, the government also increased its tax rate on gasoline.

At the same time, the government removed Alcosuisse's monopoly on importing products containing more than 80 per cent alcohol (Federal Department of Agriculture, 2008). An exemption was granted to allow other blenders to import fuel ethanol and mix it with gasoline.

The regulations setting out the implementation for the new law, particularly the qualifying criteria for the tax exemption were as of October 2008 still under development by the Department of Environment, Transport, Energy and Communications (DETEC). A public consultation phase is expected to be completed in November 2008. In the mean time, imported biofuels can benefit from the tax exemption. However, if an importer's biofuels were later found to be ineligible under the new life-cycle assessment criteria, it would have to pay the tax. Few importers are likely to take this risk while the criteria on which the biofuels will be assessed are still being drafted.

Notably, in contrast with many other national governments, the Swiss federal government has so far — wisely, in the GSI's view — resisted calls from the industry to mandate particular volumes or blending ratios in the nation's transport fuels.

Although it is unclear what effect the new arrangements will have on Swiss biofuel production, it is generally expected that the increased competition from imports will put pressure on domestic producers. For this reason, the government granted Swiss pilot and demonstration plants an exemption period until 2011, during which they will not be required to prove that they meet the qualifying criteria (i.e. they will continue to receive the tax exemption regardless of life-cycle assessment results). The idea is to give these producers time to restructure their production and find new feedstock suppliers, if necessary.⁷

Biofuels can have some greenhouse gas and local pollution benefits. But the cost in Switzerland of obtaining a unit of CO₂-equivalent reduction through subsidies to biofuels is very high, especially for biofuels produced from virgin materials. Buying CO₂ reductions by subsidizing Swiss rapeseed biodiesel production is estimated to cost at least CHF 1 500 (€ 940) per tonne of CO₂-equivalent avoided (see table, next page). For the same cost, the government could purchase roughly 30 tonnes of CO₂-equivalent offsets on the European Climate Exchange. Ethanol derived from wood cellulose has a better life-cycle emissions profile than biodiesel, with a subsidy cost in Switzerland of between CHF 460 (€ 290) and CHF 550 (€ 340) per tonne of CO₂-equivalent avoided. For the same cost, the government could purchase around 10 tonnes of CO₂-equivalent offsets. The cost-effectiveness of biodiesel made from recycled waste oil is better still, on the order of CHF 300 (less than € 200) per tonne of CO₂-equivalent avoided. Nevertheless, even in this “best-case scenario,” the government could purchase six times more CO₂-equivalent offsets in the European Climate Exchange. If carbon emission reductions are the primary policy objective, then subsidizing biofuel at the current levels is not cost-effective.

7 “Mineral oil taxation law (Limpmin)”, <http://www.biofuels-platform.ch/en/infos/ch-limpmin.php#note4>; “Ordonnance sur l'imposition de huiles minérales (Oimpmin)”, <http://www.admin.ch/ch/f/as/2008/583.pdf>; and the Office fédérale de l'environnement (PFEV), <http://www.bafu.admin.ch/aktuell/medieninformation/00004/index.html?lang=fr&msg-id=19469>.

Support per tonne of CO₂-equivalent avoided through the use of for ethanol and biodiesel in Switzerland, 2008

Metric	Units	Ethanol	Biodiesel from used cooking oil	Biodiesel from Swiss-grown oilseeds
Avoided non-renewable energy: support per litre of petrol- or diesel-equivalent displaced	CHF per litre equivalent	0.80–1.60	0.95–1.05	3.55–4.20
Assistance per tonne of CO ₂ -equivalent emission reduced	CHF per tonne CO ₂ -eq	460–550	290–310	1500–1880
<i>NB: Market price of a CO₂-equivalent offset¹</i>	CHF per tonne CO ₂ -eq	48 (€30)		

1. Average of the highest value of ECX CFI Futures Contracts attained on the European Climate Exchange for December 2008 and December 2009 settlements in 2008 (through mid-October 2008), rounded to the nearest euro. Converted to Swiss francs at an exchange rate of CHF 1.6 per euro.

Source: main report.

The overall rationale for Switzerland's elaborate arrangements for certifying biofuel sustainability warrants careful examination by Swiss policy-makers. While it is understandable that the government, reflecting consumer concerns, should desire to assure that any biofuels used in the country satisfy minimum environmental and social criteria, any system will have to be very carefully designed if it is to be consistent with WTO rules. But the larger point is that, without the fuel-tax breaks that enable biofuels to compete with petroleum fuels, the volume of biofuels consumed in Switzerland (certainly of biodiesel) would probably be much less, and there might be little need for creating and administering a sustainability standard.

Compared with the situation even two years ago, there is today much more information available to the public on the amount and types of biofuels used, the policies supporting them, and their environmental effects. In June 2008, the Government published a document that explained in great detail its position in respect of ethanol. Extending the analysis to biodiesel, and publishing regular updates, would facilitate a more informed discussion.

The study concludes with several recommendations for the federal government. In the GSI's opinion, it should:

- Continue to resist calls for instituting blending mandates for biofuels, at least without first undertaking a thorough examination of the costs and benefits.
- Avoid providing new specific subsidies to the industry, and develop a plan for reducing or phasing-out the exemptions from the mineral oil tax granted to biofuels.
- Continue to stress technologically neutral policies for reducing reliance on petroleum in the transport sector and curbing emissions of greenhouse gases.
- Improve the information available on transfers provided to the biofuels industry and the effects of such assistance.

- Establish an on-going evaluation process to assess:
 - the cost-effectiveness of support policies at all levels of government in attaining the declared objectives behind biofuels policy, and
 - the long-term economic viability and international competitiveness of a Swiss biofuels industry, in the absence of assistance.

1. Introduction

This report examines government support for biodiesel, SVO and ethanol in Switzerland. It forms part of a multi-country effort by the Global Subsidies Initiative (GSI) to characterize and quantify subsidies to biofuels production, distribution and consumption, as well as the subsidies to producers of key factor inputs. Such information, the GSI believes, is vital to understanding the cost-effectiveness of different policy options. Given the growing share of crops that are being diverted to energy production, the amount and form of support provided to biofuels is also relevant to issues relating to agriculture, such as trade and food security.

1.1 Objectives and outline of the study

The report follows a standardized outline common to all the reports in this series.

After a brief explanation of the framework used in the GSI's studies, Chapter 2 surveys the domestic biofuel industry and the history of the country's biofuel policies.

Chapter 3 explains the different elements of support for biodiesel, SVO and ethanol at the federal and (to the extent that information could be obtained) cantonal levels. The discussion is informed by a standard economic classification scheme, which proceeds from the most economically distorting (production-linked), to the least-distorting (expenditure on research, development and innovation).

Chapter 4 discusses the latest changes to federal policies affecting biofuels and projects being planned in response to those changes. New proposals relating to fuel ethanol, such as Alcosuisse's Etha+ programme, and the exemption of imports from the mineral oil tax, presume that a significant share of ethanol will be imported in the future. To put these plans into perspective, the chapter concludes with some observations on the potential for expanding biofuel production in Switzerland.

In Chapter 5 the authors present summary estimates of total support to biofuels in Switzerland. In addition to providing subsidy costs in Swiss francs (CHF) and francs per litre, the chapter estimates the amount of support costs in terms of several indicators relevant to the question of cost-effectiveness. These include: subsidy per litre of gasoline or diesel equivalent; subsidy per litre of fossil fuel avoided; and subsidy per tonne of CO₂-equivalent avoided.

Finally, Chapter 6 offers some concluding observations and recommendations. These recommendations should be seen as tentative, given that the latest revisions to the Mineral Oil Tax Law have only just come into force.

1.2 Framework of the analysis

Figure 1.1 illustrates the framework used in the report to discuss subsidies provided at different points in the supply chain for biofuels, from production of feedstock crops to final consumers. Defining a baseline requires deciding how many attributes to look at and

determining what programmes are too broadly cast to consider in an analysis of one particular industrial sector. This analysis focuses on subsidies that affect production attributes that are significant to the cost structure of biofuels, including subsidies to producers of intermediate inputs to production, namely crop farmers. More remote subsidies, such as to particular modes of transport used to ship biofuels or their feedstocks, were beyond the boundaries of this analysis. For the purpose of this report, consumption occurs downstream of the point at which the biofuel leaves the manufacturing plant.

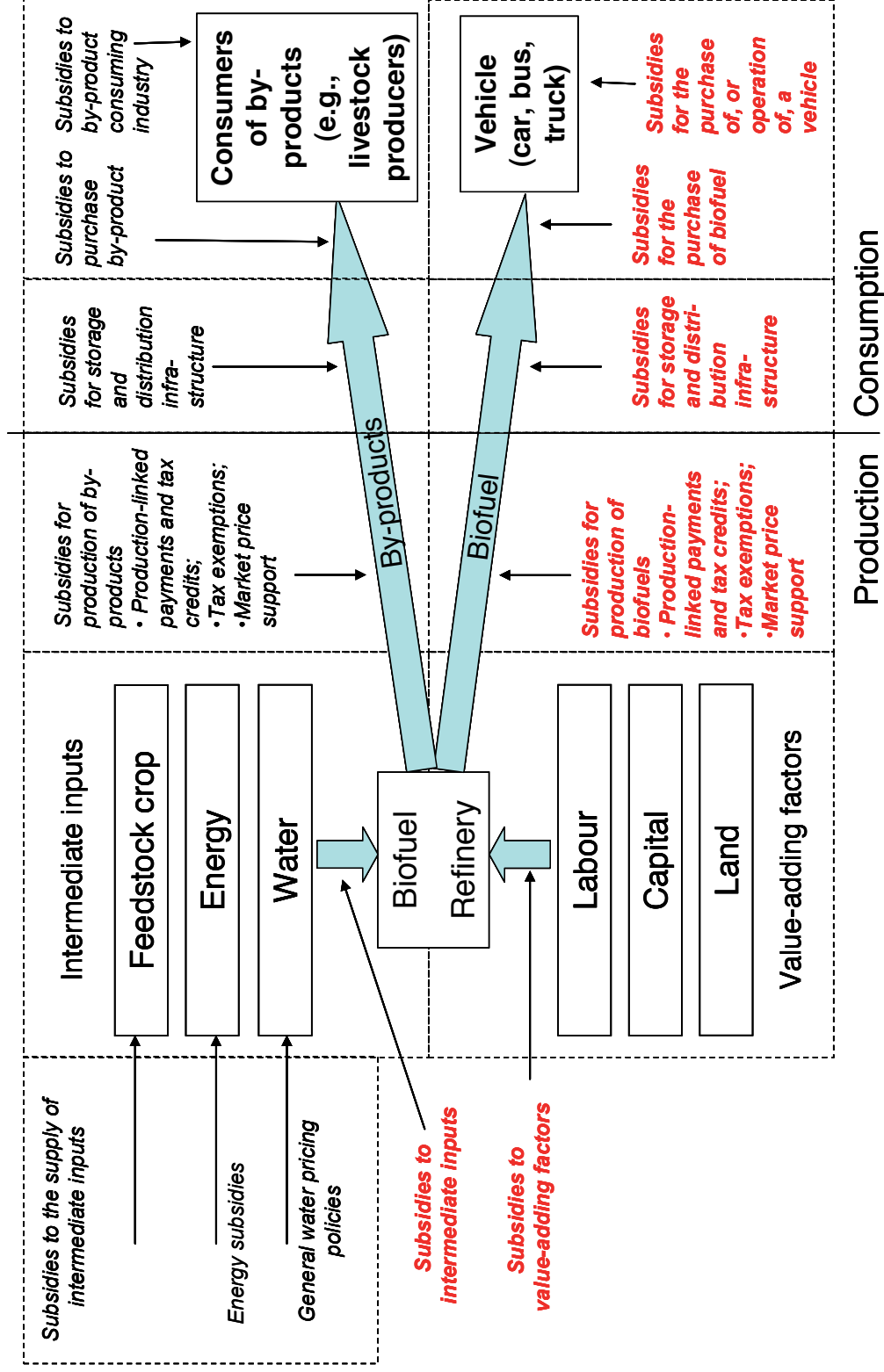
Support for production and consumption is provided at many points in the supply chain. At the beginning of the supply chain are subsidies to what economists call “intermediate inputs”—goods and services consumed in the production process. The largest of these are subsidies to producers of feedstock crops used to make biofuels, particularly oilseeds for biodiesel. In Switzerland, these subsidies do not depress the prices of domestically produced oilseeds below those of imported oilseeds. However, to the extent that production of the feedstock crops creates a demand for the crop and thereby for subsidies, the proportional share of the total subsidies to those crops used in the production of biofuels (excluding market price support for the crops) can be considered one element of the gross costs to government of promoting biofuels. (The net cost would take into account any increased taxes paid by farmers as a result of increasing their taxable incomes.)

Subsidies to intermediate inputs may be complemented by subsidies to value-adding factors—capital goods; labour employed directly in the production process; and land for plant construction. In the case of biodiesel, those few subsidies that have supported value-adding factors in Switzerland have been linked to productive capital. These have in the past taken the form of grants, or reduced-cost credit, for the building of biodiesel manufacturing plants. These types of subsidies lower both the fixed costs and the investor risks of new plants, improving the return on investment.

Further down the chain are subsidies directly linked to output. Output-linked support includes exemptions from the mineral oil tax, which enables biodiesel, ethanol and SVO to be sold at retail prices that are roughly at parity with their taxed fossil-fuel counterparts. Government policies that discriminate between imports and domestic supplies are also relevant. Most imports, or potential imports, of biofuels into Switzerland enjoy low applied tariffs. However, up until 2008, they were not exempt from the mineral oil tax, which impeded the ability of foreign producers to capture domestic market share. Following legislated changes in 2008, imports will also be eligible for tax exemptions if they can demonstrate sustainable origins. Swiss “pilot and demonstrations facilities” are not required to meet the sustainability criteria until 2011.

Subsidies for consumption are minor in Switzerland, and have been provided mainly through government assistance to municipalities that run vehicles (particularly buses) on biofuels.

Figure 1.1 Subsidies provided at different points in the biofuel supply chain



2 Overview of the liquid biofuels industry in Switzerland

2.1 Historical evolution of policies supporting liquid biofuels

Between 1996 and 1998, the Swiss government enacted three laws that were instrumental in shaping the country's future biofuel industry. The first law gave an exemption from the mineral oil tax to fuels produced from "renewable raw materials" in "pilot and demonstration plants" located in Switzerland. The exemption was available only for fuel manufactured at plants producing no more than 5 million litres (ML) of diesel equivalent a year, with an upper limit from all plants of 20 ML per year. None of the plants that have been built since the law went into effect have surpassed the 5 ML per year threshold,⁸ and without the tax exemption, no domestically produced biofuels would be able to compete with their fossil-based equivalents, diesel and gasoline, unless the price of crude petroleum were to rise significantly. Designation as a pilot or demonstration plant is also time-limited, though to date no plant has lost that designation.

The second law, actually an amendment to an existing law, was enacted by the Swiss Parliament in 1997. Prior to that point, production of ethanol from agricultural raw materials (potatoes, molasses, sugar beets, etc.), for whatever purpose, was prohibited in the interest of reducing the incidence of alcoholism. The only exception was some wood-based ethyl alcohol, because cellulose, its raw material, was not listed among prohibited feedstocks. This policy change thus removed a major impediment to domestic production of ethanol from crops.

The third important policy change involved a reduction in area payments to farmers growing rapeseed and other oilseeds for non-food, non-feed uses (or, in Swiss policy terms, "technical uses"). For some time prior to 1998, these payments had been set at CHF 3 000 per hectare. In that year, however, the Swiss Parliament passed a sweeping new Law on Agriculture,⁹ which decoupled price from income policy in respect of oilseeds. Prices for oilseeds fell¹⁰ and the differential between oilseeds used for food or fuel effectively disappeared. Growers of biodiesel feedstock oilseeds saw their area payments cut in half, to CHF 1 500 per hectare, the same as received by producers of oilseeds for food uses.¹¹

8 The highest production figures since the law came into effect are those of Biocarb, who produced 3.7 ML per year in 2006, although it should be noted that their plant has a production capacity of 8 ML per year. Production in 2007 dropped due to restructuring but it can be expected to rise again in 2008. "Biodiesel Production in Switzerland", <http://www.biofuels-platform.ch/en/infos/ch-biodiesel.php>

9 RS 910.1, Loi Fédérale sur l'agriculture (Lagr), 29 April 1998. http://www.admin.ch/ch/f/rs/c910_1.html

10 Prior to the policy change, the price of oilseeds destined for human consumption was around CHF 1 500 per tonne.

11 Another decision from the Federal Customs Administration determined that biodiesel returned to the cooperative members and used in their farming activities should not be eligible for the reimbursement of a portion of the oil tax that some activities are entitled to by law. The cooperative members responded by selling the biodiesel to fuel distributors, buying mineral diesel instead, and continuing to receive tax

At the same time, a federal Ordinance¹² created a new form of support for the processing of oilseeds (rapeseed, sunflower seed, and soybean). From 2002 onwards, a maximum of CHF 8.5 million would be allocated each year towards the processing of oilseeds used as renewable raw materials in pilot and demonstration plants recognized by the Agriculture Office, as well as for food. From 2004, oilseeds produced for seed and feed were also brought under this subsidy programme. The purpose of the subsidy was to close the price gap between domestic oilseeds and lower-priced imported oilseeds. This price differential mainly reflects the relatively high cost of producing oilseeds in Switzerland, as the import duty on seeds for technical uses is low.

2.2 Production and capacity

2.2.1 Biodiesel and SVO

Switzerland's first biodiesel plant began operation in 1996, the same year that biofuels from pilot and demonstration plants were made exempt from the mineral oil tax. The plant, Eco Energy Etoy, located in Etoy in the Canton of Vaud, produces methyl ester (a kind of biodiesel) from rapeseed oil, though at times it has also produced biodiesel from sunflower seed oil. It was built with a capacity to produce up to 3.35 ML of biodiesel per year (9 300 litres from 25 tonnes of seeds a day), equivalent to 9 000 tonnes of rapeseed. However, for most of the past decade its annual production of biodiesel has varied between 1.4 ML and 3.0 ML (Table 2.1). The biodiesel produced in this plant conforms to the standard DIN 51606. The plant also produces a by-product, glycerine, which is exported to Germany for use in the chemical and pharmaceutical industries.

Eco Energy Etoy is owned by a cooperative of nearly 980 farmers from the Romande region (the French-speaking part of Switzerland), which collectively grows over 1 300 hectares of rapeseed for the plant's production. Additional rapeseed feedstock is purchased from the regions of Zurich and Thurgau, as well as from France.

Initially, the farmer members of the Eco Energy Etoy cooperative delivered rapeseed to the plant in accordance with contracts issued to them for specific cultivated areas. In return they received biodiesel and meal (a source of protein in animal feeding) for their own use. In 1999, however, they started selling the biodiesel to intermediaries.

reimbursements. Farmers (as well as public transport fleets) are exempted from paying the mineral oil tax on normal diesel and gasoline, which is why they have no incentive to use their own biofuels at costs higher than the corresponding tax-exempted fossil fuel.

12 Based on the provision of Article 56 and 59 of the Law on Agriculture relating to support to oilseeds production and transformation of renewable raw materials. RS 910.17, Ordinance on Contributions to Surface and Processing in Agricultural Land (OCCCh), 7 December 1998. http://www.admin.ch/ch/f/rs/c910_17.html (also see Chapter 4).

Table 2.1 Annual biodiesel production at Eco Energy's plant at Etoy

Year ending 30 June	Litres
1997	1 760 000
1998	1 458 000
1999	1 580 000
2000	1 420 000
2001	2 130 000
2002	1 887 000
2003	1 914 000
2004	2 500 000
2005	2 650 000
2006	2 950 000
2007	3 000 000
Total	23 249 000

Source: Eco Energy Etoy; 2004 and 2005 figures as reported by:

<http://www.plateforme-biocarburants.ch/infos/ch-biodiesel.php>.

Switzerland's other biodiesel plants have come on stream since 2003 (Table 2.2). All are producing at or below the 5 ML per year limit, so as to qualify as a pilot or demonstration plant and thus benefit from the exemption from the mineral fuel tax. It is not clear how they will respond to the recent change in legislation extending this exemption to imports, but they will certainly face greater competition.

In addition to the plants listed in Table 2.2, there is also Mekan Ecosystems AG, which makes mobile biodiesel production units. It produces small volumes of biodiesel during the testing of its plants—from 5 to 15 tonnes (5 700–17 000 litres) a year, depending on the number of units sold. The fair trade pioneer, Gebana, manufactures biodiesel from organic, fair-trade soybeans imported from Brazil. The "Bio&Fair" biodiesel is marketed in collaboration with MIGROL (a fuel-station subsidiary of Switzerland's largest supermarket chain).¹³ Finally, there are three other companies which produce small amounts of biodiesel from used cooking oil.

Four new companies have announced plans to enter the market in the period 2008–2010: RESAG, KAZGreen, Centravo GZM and Green BioFuel (GBF) Switzerland AG. Of these, RESAG is due to build a 40 ML per year plant in Basel; KAZGreen a 22 ML per year plant in Moudon, using home-grown algae as feedstock; Centravazo GZM a 28 ML per year plant in Lyss, with animal fat as a feedstock; and GBF a 130 ML per year plant in Bad Zurzach, using 80 per cent jatropha oil from Mozambique and 20 per cent domestic rapeseed oil.

13 http://www.gebana.com/htm/vom_bauern_e.htm?lang=e

Together, the new projects would have a combined capacity of 220 ML per year, taking total Swiss capacity to almost 250 ML per year.¹⁴

Table 2.2 Principal biodiesel-producing plants in Switzerland as of mid-2008

Company name	Town, Canton	Year of first production	Principle feedstock(s)	Production in 2007 (ML/year)	Annual capacity (ML/year)
Eco Energie Etoy	Etoy, Vaud	1996	Swiss and French rapeseed	3.0	3.0
BioCarb	Geneva, Geneva	2003	Imported rapeseed; used cooking oil	0.55	8.0
Humbel	Stetten, Aargau	Dec. 2005	Swiss and EU used cooking oil	1.5	1.8
BioPower Fardin	Rudolfstetten, Aargau	Dec. 2005	Various virgin plant oils	2.0	4.5
Admano	Altdorf, Uri	Aug. 2007	Swiss and EU used cooking oil	0.225	5.0
MP Biodiesel	Domdidier, Fribourg	Jan. 2007	Various virgin plant oils	0.34	5.0
RB Bioenergie	Laupen, Bern	May 2007	Various virgin plant oils	0.3	5.0
EcoDiesel SàRl	Yverdon, Vaud	Dec 2007	Various waste oils	n.d.	2.0

n.d. = no data; n.a. = not applicable

Sources: Based on <http://www.biofuels-platform.ch/en/infos/ch-biodiesel.php>, company web sites, information from Biofuels Schweiz and personal conversations with companies.

However, it is unclear as yet whether these companies will alter their plans due to the increasing prices of raw materials. KAZGreen, for example, originally intended to import coconut or jatropha oils during its first two years of production, which have since become too expensive. There is also the problem of increasing public opposition to the use of using food crops as biofuel feedstocks. The solutions to these problems, second- and third-generation biofuels, such as from algae, theoretically would have high yields and not threaten food production, but they are still in the experimental stage. Therefore, any projection of future capacity must be treated with caution.

At least five companies produce SVO from domestic or imported rapeseed or soybeans, and another six produce a similar fuel from used cooking oil. In total, around 1 846 000 litres of SVO were consumed in 2007. Most of it was sold to companies operating fleets with centralized proprietary fuelling stations, such as in the quarrying and goods transportation (e.g. trucking) sectors.

Numerous retail outlets are now selling biodiesel in Switzerland. Initially they were concentrated in the central north-west of the country (the Swiss German region), where

¹⁴ Source: correspondence with company representatives, and 'Biodiesel Production in Switzerland', <http://www.platforme-biocarburants.ch/infos/ch-biodiesel.php>.

Flamol Mineralöl AG, one of the country's largest fuel distributors, sells Swiss-made biodiesel at several stations. Several companies operate fleets which buy biodiesel from Flamol either in pure form (B100) or as "combi-diesel" (B30), a mixture of 30 per cent biodiesel and 70 per cent petroleum diesel.

In October 2005 another company, Migrol, the leading petrol distributor in Switzerland, began selling a B5 blend (marketed as "Migrol Diesel Greenlife Plus") at all of its approximately 200 retail stations throughout Northern and Western Switzerland. Its parent company, the supermarket chain Migros, now uses biodiesel to help power its vehicle fleets. In addition, there is some Cantonal support of biodiesel fuels. Although the Zurich Transport Authority (a company that belongs to the Canton of Zurich) only requires that operators use sulphur-free diesel, some, including the transport operator for the city of Zurich (VBZ), choose to use a 5 per cent biodiesel-blended fuel.¹⁵ The Canton of Vaud also purchases biodiesel-blends to power its vehicle fleets. Recently, it attempted to suspend all purchases until it could confirm that its biodiesel supplies have a positive overall ecological effect—in other words, once the qualifying standards established by the amendment to the Mineral Oil Tax Law had come fully into force. However, this suspension was not possible due to contractual obligations with its supplier, EcoEnergie Etoy.¹⁶

2.2.2 Ethanol

Production of ethanol for fuel did not commence in Switzerland until 2005, and the first two retail outlets for ethanol blends began dispensing E5 (a blend of 5 per cent ethanol and 95 per cent gasoline) only in June 2005.¹⁷ Ethanol is blended straight with gasoline, rather than being transformed first into ethyl tertiary butyl ether (ETBE), as is the common practice in France and several other EU countries.¹⁸

The production and sale of all high-alcohol drinks (spirits, brandies, aperitifs, etc.), as well as high-grade alcohol for industrial purposes, is regulated by a state body, the Swiss Alcohol Board (SAB). Alcosuisse, the profit-making arm of the SAB, has contracts with several companies producing ethanol. One of the oldest of these companies¹⁹, acquired by Borregaard AG, a Norwegian-based company that is a world leader in ligninum substrate, currently produces ethanol from sugars and other by-products released during the production of wood cellulose (50 kg of ethanol per 1 000 kg of wood).²⁰ Borregaard sells

15 Correspondence with the Zurich Transport Authority (Ms. Beatrice Henes).

16 Gillibert, G  el, June 2008, "Les biocarburants:   tat des lieux en Suisse et pour le Canton de Vaud", D  partement des infrastructures (DINF), Unit   de developpement durable,   tat de Vaud; information here has been supplemented by personal correspondence with the author.

17 "E5 blends on sale", F.O. Licht's World Ethanol & Biofuels Report, 8 June 2005.

18 ETBE is added to gasoline to improve its octane rating and to increase its oxygen content. It is created by mixing ethanol and isobutene and heating the mixture in the presence of a catalyst.

19 Attisholz, the plant in question, has been producing ethanol since 1915 in Riedholz in the Canton of Solothurn.

20 "L'  thanol produit de la for  t," Communica, Alcosuisse, 2/2006, pp. 13-15.

<http://www.eav.admin.ch/alcosuisse/dokumentation/communica/00605/index.html?lang=fr>. Borregaard processes the ethanol from wood cellulose using four distillation columns to produce ethanol of 99.9%

approximately 12 million litres of ethanol a year to Alcosuisse. This ethanol ends up in chemicals, cosmetics and beverages, as well as transport fuel. Alcosuisse has separate annual contracts with Borregaard for each one of these products.

Until at least 1 July 2008, when its import monopoly over fuel ethanol was abolished, Alcosuisse managed the storage, blending and wholesale distribution of ethanol throughout the country. The main retailer of fuel ethanol is AGROLA, a subsidiary of FENACO, which in turn is owned by a consortium of Swiss farmer cooperatives. AGROLA operates 400 of the nation's approximately 3 500 petrol stations. In 2005 the company started selling E5 at two outlets in the Canton of Jura. As of March 2008, around 150 service stations were supplying a fuel mixed with 5 per cent ethanol, mainly in the Cantons of Jura, Bern and Lucerne.²¹

Figure 2.1 Locations of petrol stations selling E5 and E85 in Switzerland as of 2008



Note: star denotes location of Borregaard's ethanol plant in Solothurn.

Data source: Adapted from www.etha-plus.ch/page-e.asp?page=6151 ©Alcosuisse. (Note: image is accurate of January 2008. In those Cantons where marks are most numerous, such as Jura, and parts of Berne, one circle may represent several stations.)

Availability of E85 (85 per cent ethanol mixed with 15 per cent gasoline) in the country is still limited. E85 can be safely used only by specially designed “flex-fuel vehicles” (FFVs) that can operate on blends containing anywhere from 0 to 85 per cent ethanol. In 2006, the fuel distributor, AGROLA, in association with the carmaker, GM-Saab, and Alcosuisse, announced it would start selling E85 in Switzerland. Its first distribution point, in Winterthur (near Zürich), began dispensing the fuel in July 2006. Three more pumps were installed over the course of 2006, and 16 in 2007 (Table 2.3). As of March 2008, Alcosuisse reported that

purity. The final product contains minor traces of cyclohexane, a component used to obtain anhydrous ethanol.

21 http://www.etha-plus.ch/fileadmin/templates/main/pdf/cp_du_11.03.08/10720_PLAcpEcoMobileListe_F.doc

around 40 service stations were selling E85. It is envisaged that some 60 outlets will sell E85 by the end of 2008.²²

As of October 2008, Borregaard was the only producer of fuel ethanol in Switzerland. Its fuel production is currently limited to 3 ML per year because of the size of its dehydration unit. This is in part due to constraints put in place by the Mineral Oil Tax Law, which has until 2008 only granted tax exemption to domestic biofuels produced in pilot or demonstration plants operating at or under 5 ML capacity per year. Given the recent changes in the law, Borregaard could theoretically install added dehydration capacity and produce up to 12 ML of fuel-grade anhydrous ethanol per year with its existing facilities.

Alcosuisse's business plan, as published on its website in the summer of 2008, proposes the construction of a separate large-scale dehydration plant which could convert domestic and imported hydrous ethanol into anhydrous ethanol, to be completed by the end of 2008. They envisage the construction of a second ethanol production plant in 2012.²³ Green BioFuel (GBF) Switzerland also plans to build a 130 ML per year plant for the dehydration of certified Brazilian hydrous ethanol by 2009.

In 2005, Swisscom, a telecoms company certified under the norm ISO 14001, identified its greenhouse gas emissions as significantly affecting its environmental performance.²⁴ In response, it adopted measures aimed at cutting back on vehicle fuel consumption (which was 2.74 ML of petrol and 1.86 ML of diesel in 2005). It reduced the size of its vehicle fleets and replaced some of its vehicles with gas-powered or hybrid vehicles. It also started using E5 in some of its vehicles in the Bern region. Originally, it was planned that all Swisscom vehicles would be fuelled by E5, but following public debate about the sustainability of biofuels the plans were put on a "provisional halt." Swisscom have stated that if they use biofuels, they want to ensure that the fuels are derived predominantly from waste materials.²⁵

Some Swiss Cantons have also decided to use ethanol in official and public transport fleets. For example, within the last two years the Cantons of Geneva and Jura have switched to run all Cantonal vehicles on E5. The Canton of Vaud has considered purchasing ethanol but, as of September 2008, had not done so, due to concerns regarding the fuel's sustainability and its reliability of supply.²⁶

22 http://www.etha-plus.ch/fileadmin/templates/main/pdf/cp_du_11.03.08/10720_PLAcpEcoMobileListe_F.doc

23 <http://www.etha-plus.ch/index.php?id=57&L=2> and <http://www.biofuels-platform.ch/en/infos/ch-bioethanol.php>

24 http://www.swisscom.com/NR/rdonlyres/0A694B89-8B59-428E-8939-DDAC11FC5C6E/0/GB05_4_umwelt_en.pdf

25 http://www.swisscom.com/NR/rdonlyres/8EA3AF4D-DDEE-4908-B6C2-DA1A2B34090C/0/umweltbericht2007_en.pdf

26 *Source:* correspondence with Cantonal administration. The Canton of Vaud had previously been using biodiesel in its transport fleets, not ethanol.

Table 2.3 AGROLA's schedule of existing and planned petrol stations in Switzerland with pumps to dispense E85, as of 24 December 2007

Town	Canton	Month or Quarter and Year
Winterthur	Zürich	July 2006
Beringen	Schaffhausen	October 2006
Regensdorf	Zürich	November 2006
Pfäffikon	Zürich	December 2006
Küssnacht am Rigi	Schwyz	January 2007
Wetzikon	Zürich	April 2007
Obfelden	Zürich	May 2007
Matzingen	Thurgau	May 2007
Steffisburg	Bern	June 2007
Littau	Lucerne	June 2007
Diessenhofen	Thurgau	July 2007
Weinfelden	Thurgau	July 2007
Interlaken	Bern	August 2007
Oberkirch	Lucerne	August 2007
Châtel-St-Denis	Fribourg	September 2007
Jegenstorf	Bern	September 2007
Oensingen	Solothurn	October 2007
Subingen	Solothurn	October 2007
Ebikon	Lucerne	October 2007
Ried b. Kerzers	Fribourg	November 2007
Kölliken	Aargau	January 2008
Stans	Nidwalden	March 2008
Worb	Bern	March 2008
Boll	Bern	1st Quarter 2008
Thörishaus	Bern	1st Quarter 2008
Düdingen	Fribourg	1st Quarter 2008
Koppigen	Bern	1st Quarter 2008
Menzigen	Zug	1st Quarter 2008
Landquart	Grisons	1st Quarter 2008
Riedikon	Zurich	1st Quarter 2008
Delémont	Jura	2nd Quarter 2008
Bellach	Solothurn	2nd Quarter 2008

Town	Canton	Month or Quarter and Year
Schötz	Lucerne	2nd Quarter 2008
Zug	Zug	2nd Quarter 2008
Ins	Bern	3rd Quarter 2008
Marly	Fribourg	4th Quarter 2008
Möhlin	Aargau	4th Quarter 2008

Data source: "AGROLA, E85 aux stations-service AGROLA".
<http://www.agrola.ch/contentexpress/cexpdfs/default/Planning%20de%20lancement%20E85.pdf>

2.3 Technical norms

Currently in Switzerland, the maximum amount of either biodiesel or ethanol that may be incorporated into publicly marketed petroleum fuels is 5 per cent on a volumetric basis. (The exception is E85 sold for use in flex-fuel vehicles.) These rules are governed by the Swiss quality norms for diesel (SN EN 590) and gasoline (SN EN 228). Generally, vehicle vendors in Switzerland will not guarantee fuel sold with higher concentrations. Accordingly, operators of captive fleets who wish to use biofuels in higher concentrations must purchase a special insurance policy, or assume the risk of damage to their vehicles' engines.

However, this may soon change. In February 2007 the European Commission proposed raising the legal maximum ethanol blend for unmodified vehicles to 10 per cent on a volumetric basis.²⁷ This blend is used elsewhere in the world, notably in Australia, Canada and the United States. It is not clear whether or not Switzerland will make the same changes to its own law. Alcosuisse report that the government intends to bring itself into accordance with European Commission regulations, and according to the Federal Office for the Environment, the only means by which this legal maximum could be introduced is if the EC sets mandatory standards for vehicle production. In this situation, Switzerland would have had little choice in the matter—it imports all of its cars.²⁸ Similarly, growth in the number of registered flex-fuel vehicles (capable of running on blends containing a high proportion of ethanol) in Switzerland would, of course, increase the market for ethanol fuels in Switzerland.

27 'Bioethanol Today', <http://www.etha-plus.ch/index.php?id=34&L=2>; and 'Stricter fuel standards to combat climate change and reduce air pollution',

<http://europa.eu/rapid/pressReleasesAction.do?reference=IP/07/120>

28 Source: Federal Office for the Environment (Hans-Peter Fahrni).

3 Current policies supporting biodiesel and ethanol

Compared with neighbouring countries in the EU, the scale of support provided by Switzerland for its domestic biofuels industry is small. Switzerland has not set a goal for consumption or production of biofuels, which in other countries has spurred incentives for new investments in the sector. However, some other types of subsidies have been provided.

Assistance to **output** through border measures has been provided through differential taxation, rather than tariffs. Bound tariffs²⁹ are set from CHF 35 to almost CHF 50 per 100 kg of biodiesel and ethanol. The applied favoured nation (MFN) tariff³⁰ on biodiesel is zero, on undenatured ethyl alcohol (HS 2207.10) it is CHF 0.35 per kg (CHF 0.28 per litre), and on denatured ethyl alcohol (HS 2207.20) it is CHF 0.007 per kg (CHF 0.0055 per litre). However, because of the number of bilateral and regional trade agreements to which Switzerland is a party, and because Switzerland's Generalized System of Preferences (GSP) includes exporters like Brazil, most ethanol can enter the country duty free. The most important measure is the exemption of the mineral oil tax for fuels produced from renewable raw materials.

There is no programme of assistance to **value-adding factors**, though land for biofuel processing plants may be provided on an *ad hoc* basis. Capital grants were provided in the past to build Switzerland's first demonstration plant for biodiesel production, Eco Energy's plant at Etoy, for example.

The Government has used several other measures to support the biofuels sector. One of the subsidies relates to the assistance to **intermediate inputs** used in the production of biodiesel, specifically to offset the higher cost of using domestic over imported rapeseed (which mainly comes from the EU) in recognized pilot and demonstration plants.

Support to biofuels in the form of **general services** has been provided mainly in the form of government expenditure on energy-related R&D.

3.1 Biodiesel and Straight Vegetable Oil

3.1.1 Output-linked support

One of the ways in which a commodity can be supported is through border protection, which raises the internal price of that commodity. Although Switzerland has bound its tariff on biodiesel (HS 3824.9030) at CHF 0.499 per kg (crude), its applied tariff is zero. Importers must obtain a license from Carbura, the Swiss Central Office for the Import of Liquid Fuels, but these licenses are granted automatically.

29 http://www.ezv.admin.ch/zollinfo_firmen/abfertigungshilfen/00378/index.html?lang=fr

30 See Annex, <http://www.tares.ch>

Nevertheless, between 1996 and 1 July 2008, imports of biodiesel and SVO used for fuel were subject to a mineral oil tax. In its original form, the tax was levied on natural gas and mineral fuels, unmixed or mixed, at rates dependent on the product in question (see Table 3.1). Fuels used for transportation were surtaxed an extra CHF 0.30 per litre.³¹ With these two rates combined, biodiesel and SVO were taxed at CHF 0.7206 per litre. However, being made from “renewable raw materials”, they could be exempt from the charges if they were produced at designated “pilot and demonstration plants,” defined as production facilities operating in accordance with the environmental and energy policies of the Confederation and in which at most five million litres of diesel equivalent were being produced annually. In practice, this was equivalent to a tariff on imported biofuels because no provisions were made to extend this exemption to facilities outside of Switzerland. This measure was reinforced by the fact that rapeseed oil imported for purposes other than animal feeding (which enters the country for CHF 0-15 per 100 kg) is subject to an MFN tariff of CHF 134 per 100 kg (gross weight).³²

Table 3.1 Total tax rates on mineral fuels in Switzerland, as of May 2007

Fuel	Mineral oil tax (CHF/litre)
Diesel ¹	0.7587
Biodiesel, ethanol and SVO ¹ (except exempted domestically produced)	0.7206
Unleaded gasoline ¹	0.7312
Natural gas, for other than heating ²	0.8092
Natural gas for heating	0.0021
Heating oil	0.0030

1. Including the CHF 0.30 per litre surtax.

2. Including CHF 0.3993 per litre surtax.

Data source: Département fédéral des finances de la Confédération Suisse, 2006, “Loi Projet sur l'imposition des huiles minérales (Limpmin)”, *Feuille fédérale*, No. 20, 23 May 2006, pp. 4089-4092.

As of 1 July 2008, the Mineral Oil Tax Law was amended to extend tax exemption to sustainably produced biofuels regardless of their provenance. Depending on future

31 These taxes are reimbursed on fuels used in agriculture, silviculture, fisheries and public transport. In 2005, taxes on 10 percent and 0.7 percent of the consumed diesel and gasoline, respectively, were reimbursed, equivalent to almost 3 percent of total mineral oil tax revenues.

http://www.ezv.admin.ch/zollinfo_firmen/steuern_abgaben/00382/00632/01471/index.html?lang=fr

32 To qualify for the special tariff for fuel-purpose imports, a security deposit is required as a guarantee to ensure that oil will be used as intended. The payment of this obligation must take place before the oil is imported, and the reduced tariff must then be requested in the declaration. In addition to the tariff, there is an inspection fee of CHF 0.15 per 100 kg (gross), or a minimum of CHF 7.00, per consignment. Source for tariff rates for feed and other purposes: <http://mkaccd.db.eu.int/>

consumption patterns, this could have had a significant effect on government funds: fuel taxes account for almost 10 per cent of central-government revenues, totalling CHF 5 billion in 2005, mostly used to finance road and rail projects.³³ On the same date, in order to maintain budget neutrality, the Swiss government brought into force an increase in the gasoline tax rate, from CHF 0.7312 per litre to CHF 0.7447 per litre. This is to be adjusted every two years in order to ensure the continued neutrality of revenues.³⁴

As an additional safety mechanism, there is a clause which states that the tax exemption may be partially or wholly removed depending on the price of biofuels relative to fossil fuels. In the initial phase of its implementation, biofuels are only exempt if their market price is 70 per cent or above that of the after-tax value of their fossil-fuel alternatives. If they fall below this level, they will be taxed until they return to a 70 per cent relative price or they have been taxed at the same rate they were previously apportioned. The government has said that this boundary of 70 per cent might be raised if market conditions permit.³⁵

The amendment will create conditions that make the playing field more even between Swiss firms and importing companies. The value of this exemption to sellers of biodiesel and SVO is estimated to have been CHF 8.4 million in 2007.³⁶

Table 3.2 Estimates of the value of the exemption of the mineral oil tax granted to biodiesel and SVO ('000 CHF)

Fuel	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Biodiesel	1 199	1 126	1 315	1 396	1 278	1 675	2 276	4 453	6 281	7 030
Plant and reused oils	0	0	0	9	43	104	226	381	609	1 330
Total value	1 199	1 126	1 315	1 404	1 321	1 779	2 501	4 835	6 890	8 360

^o These estimates consider only the quantity actually sold (not actually produced).

Note: Because of rounding, the total values do not always equal the sum of the individual biodiesel and plant and re-used oil exemptions.

Data source: Annex Table 1 data (from the Federal Customs Administration) multiplied by the tax exemption.

33 'Carburants et combustibles imposés: vue d'ensemble 2005' and 'Impôt sur les huiles minérales', respectively:

http://www.ezv.admin.ch/zollinfo_firmen/steuern_abgaben/00382/00632/01471/index.html?lang=fr; and http://www.ezv.admin.ch/zollinfo_firmen/steuern_abgaben/00382/index.html?lang=fr

34 <http://www.biofuels-platform.ch/en/infos/ch-limpmin.php#note3>, and http://www.news-service.admin.ch/NSBSubscriber/message/fr/attachments/17092/36083/10943/24---01-31-Mineral%C3%B6lsteuer-VO_Benzin_-_f.pdf

35 'Commentaires: Modification de l'ordonnance sur l'imposition des huiles minérale; Ordonnance sur l'adaptation des taux d'impôt sur les huiles minérale applicables à l'essence',

<http://www.ezv.admin.ch/dokumentation/00474/01993/index.html?lang=fr&download=M3wBPgDB/8u1l6Du36WenojQ1NTTjaXZnqWfVp7Yhmfnapmmc7Zi6rZnqCkkIN3gn9+bKbXrZ6lhuDZz8mMps2gpKfo&typ=.pdf>

36 Quantities sold multiplied by the exemption rate.

An additional form of support given to the use of biodiesel and SVO is the exemption these fuels receive from the levy of CHF 0.015 per litre of diesel and gasoline collected by the Climate Cent Foundation to fund projects for CO₂ reduction (Box 3.1). This exemption is estimated to have been worth around CHF 175 700 for the biodiesel and SVO sector in 2007.³⁷ If the climate cent levy is treated as a CO₂ tax, its subsidy equivalent could be estimated by taking the ratio of its net greenhouse gas (GHG) emissions (in CO₂ equivalent) to those emitted by consuming petroleum diesel. For biodiesel produced from virgin vegetable oils, GHG emissions would be generated at several points: by machinery during the sowing, cultivation and harvesting of the oilseeds, and in the manufacture of fertilizers and pesticides used on the crops; in the transport of the oilseeds to the crushing and transesterification plant; and in the transesterification process itself. The latter would include the (natural-gas-derived) methanol used as an input, and energy used in crushing the seeds and powering the transesterification unit.

Box 3.1 Climate Cent initiative for CO₂ reduction

The Swiss government has estimated that if the current trend in CO₂ emissions persists, the country would still be emitting 2.5 million more tonnes of CO₂ in 2010 than its target objectives for that year, set pursuant to the Kyoto Protocol. Heating and transport fuels accounted for more than 75 per cent of Switzerland's CO₂ emissions of close to 40 million tonnes in 2003.

On 23 March 2005, the Federal Council decided to tax fuels used for heating at CHF 35 per tonne of CO₂, subject to the approval of the Federal Assembly. For transport fuels, however, in accordance with the Law on CO₂ it decided to allow Swiss industry to implement a voluntary measure, the "Climate Cent" (actually, CHF 0.015 per litre), to be levied on gasoline and diesel fuel, and to evaluate the effect of this levy by the end of 2007. Proceeds from the Climate Cent levy accrue to the Climate Cent Foundation, which uses the money to reduce greenhouse gas emissions by investing in projects both in Switzerland and abroad. Its target is to reduce nine million tonnes of CO₂ over the period 2008 to 2012, with at least one million of these tonnes being reduced within Switzerland.

The Climate Cent levy went into effect on 1 October 2005. Upon evaluation in 2007, the Federal Department of the Environment, Transport, Energy and Communications acknowledged the Climate Cent Foundation's important contribution to Switzerland's climate protection targets and gave it the green light to continue with its activities until 2012.

The Foundation receives nearly CHF 100 million a year from the Climate Cent levy and has invested its funds in a variety of projects: from renovating buildings for energy efficiency in Switzerland, to a hydropower plant in China. In order to receive support, projects must generate a reduction of at least 1 000 tonnes of CO₂ reduction per year and have a Project Design Document, and a monitoring plan, approved by the Foundation. Commissions can be made up until 1 January 2010. As of June 2008, its website reported having signed contracts representing 7.7 million of its planned 10 million Kyoto certificates. Although it announces its general "support ... of alternative fuels such as bioethanol, biodiesel or biogas", it has not invested in any projects promoting biofuels in Switzerland.

Source: http://www.stiftungklimarappen.ch/klimarappen/_data/pages/images/medienmitteilung_280907_en.pdf

³⁷ = 11.715 million * 0.015.

According to EMPA (Zah *et al.*, 2007), on a life-cycle basis biodiesel produced from rapeseed oil emits 52 per cent of the greenhouse gas emissions associated with petroleum diesel. The CO₂ emissions associated with biodiesel produced from waste oils include only those associated with the methanol and energy used in transesterification, and, therefore, the amount of greenhouse gas emissions is even lower (around 16 per cent). Emission ratios for SVO and refined recycled oil can be estimated by assuming they emit, respectively, 25 per cent less CO₂ than biodiesel produced from rapeseed and biodiesel produced from waste oils.³⁸ Applying the net CO₂ coefficients from biodiesel, SVO and recycled plant oil, the subsidy equivalent value of the exemption from the Climate Cent Foundation tax would, therefore, have been roughly CHF 80 400 in 2007.

3.1.2 Support for biodiesel production factors and intermediate inputs

3.1.2.1 Subsidies to factors of production

In Switzerland, there are currently no programmes or policies in place at the federal level to specifically support capital, labour, or land for plant construction used in the processing of plant oils into biodiesel. However, capital grants have been provided in the past by both the federal and cantonal governments. For example, in 1994, the Canton of Vaud provided a subsidy in the form of a CHF 300 000 capital grant for the construction of Switzerland's first Swiss biodiesel plant, Eco Energy Etoy. An additional grant of CHF 600 000 was provided by the Federal Office for Energy and a grant of CHF 400 000 by the Fonds d'investissement agricole (FIA). The remaining CHF 2.75 million was provided by a CHF 1.6 million bank loan and CHF 1.15 of the cooperative's own capital.

3.1.2.2 Policies affecting the costs of intermediate inputs

The main intermediate inputs used in the production of biodiesel are vegetable oils, methanol, sodium hydroxide and fuel or electricity used to provide process heat. There is no evidence that government policies materially affect the prices of any of these inputs, with the exception of the prices of vegetable oils, which are influenced by agricultural policies.

Rapeseed is the most widely grown oilseed in Switzerland in terms of quantities and number of producers, and is the main feedstock for biodiesel produced in the country. Rapeseed is planted on around 15 000 hectares (five per cent of the arable surface), and annual output between 2004 and 2007 varied from 57 900 to 61 500 tonnes.³⁹ Some 59 100 tonnes were produced in 2004, of which 52 000 tonnes were grown under contract (including that part used to produce biodiesel). In 2005 and 2006 it is estimated that 54 000 tonnes of rapeseed

³⁸ The 25 per cent lower value for SVO is derived from Table D (p. 59) in Commission of the European Communities, "Proposal for a Directive of the European Parliament and of the Council on the Promotion of Energy from Renewable Sources", COM(2008) 19 final, Brussels, 23 January 2008.

³⁹ 'Production indigène', http://www.swissgranum.ch/pdf/5cf1_F_Marche_production.pdf. Note: this document's estimate of 61 000 tonnes in 2007 was corrected by correspondence with SwissOlio, who have since confirmed an actual production of 61 500 tonnes. Swissgranum advised that the low payments made in 2007 were due to an increase in demand for rapeseed from the food industry, due to which rapeseed supply for biodiesel was compensated by imports from abroad.

were produced under contract.⁴⁰ In 2007, the amount grown under contract is thought to have been almost the entire year's crop of 61 500 tonnes.⁴¹

In recent years, demand for rapeseed from the food industry reduced availability for biodiesel or SVO production. Domestic crops supplied only 1 812 tonnes for technical uses in 2006, and a little under 1 500 tonnes in 2007; these amounts were supplemented by 1 038 tonnes and 2 800 tonnes of imports, respectively.⁴²

3.1.2.2.1 Area payments

Before 1999, Swiss farmers received direct payments of CHF 3 000 per hectare sown to oilseeds for non-food uses each year. Pursuant to the 1998 Law on Agriculture, an Ordinance⁴³ established that these direct payments would henceforth be CHF 1 500 per hectare per year for all oilseeds (rape, soy, sunflower, hemp, flax and pumpkin). The surface planted to rape has increased since 2001, as has the total payment provided by the government (Table 3.3). The quantity of domestic rapeseed used as biofuel feedstock was around 4 000 tonnes until 2006.⁴⁴ This equates to an area sown for rape for production for biofuels of approximately 1 100 hectares, corresponding to area payments supporting biodiesel production of an estimated CHF 1.1 million per year.⁴⁵ In 2006, the amount of domestically-grown rapeseed converted to biofuels was half that of the previous years, as more rapeseed was used in the production of food products. The area payments dropped correspondingly, to around CHF 0.5 million.

Despite the area payments, the domestic price of rapeseed in Switzerland tends to be almost twice that of neighboring European countries, mainly because of the high tariffs on rapeseed used for products for human consumption. For example, in 2005, the price of one kilogramme of rapeseed was CHF 0.75 in Switzerland, compared with CHF 0.42 per kilogramme imported from France. The net effect of government policies is equivalent to placing a tax on domestic feedstock. Producers of biodiesel are relieved of most of this input "tax", however, through a policy that compensates processors of oilseeds.

40 "Oléagineux: les quantités contractuelles de colza sont contractées," Swissgranum, 26 June 2006. <www.swissgranum.ch/pdf/2efz36_F_prixol_05_06.pdf>

41 Source: SwissOlio (Beat Hodler).

42 Source: Federal Office for Agriculture (Nicole Locher); and Swissgranum, 'Rapport Annuel 2006/6', http://swissgranum.ch/pdf/1df8_F_Rapp_annuel07.pdf

43 Article 1 of the Ordinance on Contributions to Surface and Processing in Agriculture Land (RS 910.17). <http://www.admin.ch/ch/f/as/1999/393.pdf>

44 According to estimates from Swissolio.

45 The calculation is based on 2004 data, where almost 4 000 tonnes of rapeseed was transformed into biodiesel. The average yield in that year was 3.5 tonnes of rapeseed per hectare, thus 1 100 hectares would have been utilized to produce that year's biofuel feedstock. With an area payment rate of CHF 1 500 per hectare, this equates to areas payments of CHF 1 632 000. However, rapeseed meal is also produced as a by-product of processing the oil for biodiesel, which can be sold as an animal feed. In estimating the share of the area payments that can be attributable to biofuels (biodiesel or SVO), we apportion it according to the relative values of the oilseed products: 26 per cent to the production of rapeseed meal, with the remainder (74 per cent) to SVO or biodiesel.

Table 3.3 Area payments and rape production (including use as renewable raw material)

	Units	2001	2002	2003	2004	2005	2006	2007e
Area sown to rape	ha	13 129	15 311	15 998	16 839	17 651	18 723	20 218
Yield ¹	t/ha	3.00	3.19	2.83	3.51	3.33	3.08	3.04
Rape production	tonnes	39 440	48 870	45 300	59 100	58 800	57 900	61 500
Area sown for renewable materials	ha	1 020	1 063	1 123	1 088	1 117	588	491
Payment rate	CHF/ha	1 500	1 500	1 500	1 500	1 500	1 500	1 500
Total payments	million CHF	1 530	1 595	1 685	1 632	1 676	882	737
Share to biofuels ²	million CHF	1.130	1.180	1.1250	1.210	1.240	0.65	0.55

e = Estimated.

Note: (1) Yields are those reported by Swissgranum, except for 2006 and 2007, which are calculated by taking total production of rapeseed and dividing it by the area sown to rape.

(2) 74 per cent of the value of the area payment has been allocated to biodiesel, with the remaining portion of the subsidies attributed to rapeseed meal, a by-product of oilseed processing that can be sold as animal feed.

Data source: Based on data obtained in Swissgranum's *Annual Reports* from 2001-2002 through 2006/2007.

From 2009, these payments are set to change. As part of its 'Agriculture Policy for 2011' program, the Swiss government introduced a series of amendments on 25 June 2008. The sixth of these, 'Ordonnance sure les contributions à la surface et à la transformation dans la culture des champs', announced that, as from 2009, such area payments will be reduced to CHF 1 000 per hectare grown of rapeseed, soya, sunflowers and other oil-producing plants.⁴⁶

3.1.2.2.2 Oilseed-processing payments

The 1998 Ordinance created a new type of support to the processing of (mainly domestically sourced) oilseeds: compensation for differences in the technical productivity of oil pressing companies compared with imports (food and feed use). Contributions were also made to pilot and demonstration plants processing renewable raw materials (technical use). This works, in effect, as a direct payment from the Federal Office for Agriculture (FOAG) to Swiss biodiesel plants for the higher cost of using domestic rapeseed, sunflower seed, or soybeans instead of imported oilseeds.

Initially, the per-tonne payment was fixed at CHF 200,⁴⁷ but for 2000 it was increased to CHF 300, for total payments of CHF 505 000.⁴⁸ In 2001, the rate was reduced back to

⁴⁶ 'Ordonnance sure les contributions à la surface et à la transformation dans la culture des champs', <http://www.blw.admin.ch/dokumentation/00016/00387/index.html?Lang=fr&download=m3wbpgdb/8u1l6du36wcnoin14in3qsbnpwva2ianu6p1rjgsyfhyt3nhqbdqiv+bay9bkbxrxz6lhudzz8mmmps2go6fo>

⁴⁷ OCCCh, 7 December 1998. <http://www.admin.ch/ch/f/as/1999/393.pdf>.

CHF 200, for total payments of CHF 431 000.⁴⁹ The volume of oilseeds eligible for this payment was not limited until 2002, when the government capped the total amount of support for oilseed processing. In addition, responsibility for administering and determining the subsidy was transferred to Swissgranum—the federation of Swiss cereals, oilseeds, and protein-plant growers and processors. Every two years since then, Swissgranum has calculated the subsidy available for different uses of oilseeds as a function of the market situation in each sector (biofuels, food, and feed).

In 2002 and 2003, the FOAG made available CHF 8.5 million a year to be paid out by Swissgranum, within a range of between CHF 200 and CHF 350 per tonne of oilseeds. The resulting subsidy to pilot and demonstration plants producing biodiesel⁵⁰ was, respectively, nearly CHF 522 000 (on purchases of 3 600 tonnes of rapeseed) and CHF 459 000 (on purchases of 3 200 tonnes of rapeseed). In 2004, annual processing payments for the roughly 4 000 tonnes of rapeseed used in the biofuels sector were above CHF 722 000 per year (Table 3.4). More recently, the increased demand in the food sector led to a lower amount of domestically grown rapeseed being converted to biofuel, and oilseed processing payments dropped accordingly, to around 0.5 million per year.

For 2005 and 2006, the total amount provided by FOAG was expected to be halved, to CHF 4.1 million⁵¹, with around CHF 4.2 million expected to have been distributed in 2007.⁵²

The subsidy rates in Table 3.4 are the official rates and not the actual amounts paid out. The real subsidy on biodiesel and SVO can be calculated by taking the actual contributions paid and dividing them by the quantity produced. This would show, for example, that the actual subsidy paid out in 2007 was CHF 317 per tonne.

Although the subsidies allocated by Swissgranum are primarily directed towards Swiss crops, they can also be paid to imports when Swiss production is not sufficient for domestic needs. In 2006 and 2007 this was the case, with more rapeseed than normal being used to produce oils for the food industry. Accordingly, a payment rate of CHF 40 per tonne was offered for processing of imported rapeseed. Swissgranum advised that this rate was determined as the necessary level of subsidy required to encourage sufficient rapeseed imports to maintain domestic biodiesel production at similar levels to previous years.⁵³

⁴⁸ Rapeseed meal is produced as a by-product of processing the oil for biodiesel, and can be sold as animal feed. A proportion of the area payment is attributed as a subsidy to the rapeseed meal, with the remainder (74 per cent) attributed to biodiesel.

⁴⁹ http://www.blw.admin.ch/old/agrarbericht2/d/anhang/tabellen_26-29.pdf, Table 29.

⁵⁰ The volume of domestic rapeseed used in plant and re-used oil plants was actually much lower than for biodiesel, hence the generalization.

⁵¹ In fact, the total amount spent by Swissgranum on subsidies in 2005 was not CHF 4 million, but CHF 6.76 million. This was done in order to soften the impact of reductions in overall payment rates to farmers. *Source*: personal communication with Mr Dider Peter, Swissgranum, July 2008.

⁵² “Les mesures d’économie de la Confédération entraînent des coupes dans les soutiens à la transformation des oléagineux,” Swissgranum, 8 October 2004. http://www.swissgranum.ch/pdf/2afz37_F_mvvoelsaaten10_04.pdf

⁵³ *Source*: Swissgranum.

Domestic processing of oilseeds for technical uses is also privileged by a low MFN tariff on oilseeds imported for purposes other than the production of oil fit for human consumption, which as of July 2008 was CH 0.10 per 100 gross kg, combined with a high MFN tariff (CHF 133.7 per 100 gross kg) on imported vegetable oils made from soybeans, sunflower seeds, rapeseed or groundnuts (other than for use as an additive to animal feed).

Support for oilseed processing for food and feed use is due to be phased out by the end of 2008, under the Agriculture Policy for 2011. This change in policy is intended to improve the competitiveness and market orientation of the country's oilseeds sector; target payments more directly at producers; simplify the administration of the support; and lower administrative costs. No change is currently envisaged in payments for oilseeds used in the production of biofuels (Article 59 of the Law on Agriculture). However, the administration of the programme is expected to revert back from Swissgranum to FOAG.

3.1.2.3 Support for research, development and innovation

Switzerland has never had a full-fledged, formal programme of research and development (R&D) for biofuels. Nonetheless, the government has financed or mandated several specific studies and pilot projects.

In the late 1970s, the Federal Station for Research in Agricultural Economics started analyzing alternatives to petroleum-based fuels used in tractors, such as gas produced from wood or biogas and plant oil. Together with the Swiss Federal Laboratories for Materials Testing and Research (EMPA), they conducted successful analyses and tests on biodiesel in the early 1990s. One result of this was the construction of Switzerland's first pilot and demonstration biodiesel plant, Eco Energy Etoy. During the following years, additional *ad hoc* research was carried out at other federal institutes, such as the Ecole Polytechnique Fédérale de Lausanne (EPFL).

Every two years Switzerland's Federal Office for Energy (FOE) publishes a compendium⁵⁴ of nationally financed energy research projects. Those relating to liquid biofuels during the period 1998–2005 are listed in Annex Table 2. Projects relating to biodiesel and SVO have included:

- 1) 1998–2001: Applied research on using plant oil as a fuel in passenger cars;
- 2) 1999–2001: Applied research on fuel-mix preparations for direct-injection diesel engines (Mahler system) using biodiesel;
- 3) 2000–02: Applied research on the use of vegetable oil in a turbo-charged, direct-injected automotive diesel engines;
- 4) 2002–03: Applied research on “Fuels from rapeseed oil and kerosene (Naturdiesel)”;
- 5) *Beginning 2005*: Support for a private-sector project on the direct catalytic liquefaction of biomass.

54 “Liste des projets de la recherche énergétique de la Confédération 2002/2003,” Swiss Federal Office of Energy. http://www.bfe.admin.ch/themen/00519/00524/index.html?lang=fr&dossier_id=00801 (list of projects R&D).

Annual public expenditure on the first, third and fourth of the above projects was less than CHF 100 000. The expenditure on the second and fifth projects was between CHF 100 000 and CHF 500 000 a year. A reasonable assumption, therefore, is that the federal government's expenditure on R&D related to biodiesel and SVO has been roughly CHF 100 000 per year.

In 2003, the Swiss Parliament declared that the FOE was no longer authorized to support the construction of pilot and demonstration projects, including facilities for producing biofuels. Currently, it supports only R&D efforts.

Table 3.4 Contributions to oilseeds transformation in 2004–07

Oilseed	Sector	2004			2005			2006			2007		
		Quantity (tonnes)	Subsidy rate (CHF/t)	Contribution (CHF)	Quantity (tonnes)	Subsidy rate (CHF/t)	Contribution (CHF)	Quantity (tonnes)	Subsidy rate (CHF/t)	Contribution (CHF)	Quantity (tonnes)	Subsidy rate (CHF/t)	Contribution (CHF)
Rape	Edible oil	47 817	75	3 586 309	57 946	27.50	2 911 011	57 188	27.50	1 572 676	615 000 ¹	n/a	n/a
Sunflower	Edible oil	17 915	120	2 149 857	10 550	72.50	1 189 801	4 594	72.50	333 036	n/a	n/a	n/a
Sunflower (high oleic)	Edible oil	n.d.	n/a	n.d.	4 178	52.50	219 363	10 424	52.50	547 263	n/a	n/a	n/a
Soya	Edible oil	6 009	270	1 622 537	4 215	180	979 151	1 976	180	355 649	n/a	n/a	n/a
Soya	Food products	6	270	1 624	89	180	24 059	58	180	12 111	n/a	n/a	n/a
Soya	Seeds	0	250	0	98	180	24 494	76	180	13 705	n/a	n/a	n/a
Soya	Feeds	408	240	98 014	877	150	167 575	1 150	150	172 551	n/a	n/a	n/a
Rape	Renewable raw materials ²	3 948	259.80	722 000	3 904	270	874 000	1 812	270	374 000	1 493	280	373 000
Imported Rape	Renewable raw materials	n.d.	n/a	n.d.	n.d.	n/a	n.d.	1 038	40	41 502	2 800	40	112 000
Total		76 105	--	8 484 093	81 858	--	6 755 826	78 315	--	3 537 660	617 800 (rape only)	--	530 040 (rape only)

Notes: (1) Total domestic production including biofuel feedstock component.

(2) For the purpose of estimating this support element in the total support and marginal support estimates, we allocate 74 per cent of the value of the area payment to biodiesel or SVO, with the remaining portion of the subsidies attributed to rapeseed meal, a by-product of oilseed processing that can be sold as animal feed.

n/a = not available; n.d. = no data.

Data sources: Swissgranum's year reports for 2005, 2006, and 2007: http://swissgranum.ch/pdf/1df6_F_Rapp_annuel05.pdf; http://swissgranum.ch/pdf/1df7_F_Rapp_annuel06.pdf and http://swissgranum.ch/pdf/1df8_F_Rapp_annuel07.pdf

3.2 Ethanol

3.2.1 Output-linked support

Switzerland's tariff on undenatured ethanol is CHF 35 per 100 kg (CHF 0.28 per litre at 15°C), and CHF 0.70 per 100 kg (CHF 0.0055 per litre) on denatured ethanol (Table 3.5 and Annex 1). Since any ethanol sold for fuel use in Switzerland has to be denatured prior to entering the country, or by the importer before placing the fuel on the market, the lower of the two tariffs is the one that generally applies. Moreover, for most of Switzerland's trading partners — member states of the EU and the European Free Trade Association (EFTA) and developing countries listed in Switzerland's Generalized System of Preferences — imports of ethanol can enter duty free. The applied MFN tariffs,⁵⁵ therefore, affect mainly imports from a few non-European OECD-member countries, such as the United States.

Table 3.5 Switzerland's applied tariffs on ethanol

Tariff position	Description	General Tariff	Special tariffs
2207.1000	Undenatured ethanol from renewable raw materials (Ethanol)	CHF 35.00 per 100 kg, gross weight (= CHF 0.28/ litre)	<i>EU or EFTA</i> : duty-free <i>GSP</i> : duty-free
2207.2000	ethyl alcohol and other spirits, denatured, of any strength	CHF 0.70 per 100 kg, gross weight (= CHF 0.0055/ litre)	<i>EU or EFTA</i> : duty-free <i>GSP</i> : duty-free

Source: Federal Customs Administration (<http://xtares.admin.ch/>).

Until June 2008, only the Swiss Confederation, via Alcosuisse, was entitled to import products that contain more than 80 percent alcohol by volume. From 1 July 2008, however, an exemption was granted for biofuels, which allows fuel blenders to import ethanol for mixing with gasoline (Federal Office of Agriculture, 2008). The ethanol can only be sold when blended with gasoline.

As is the case for biodiesel, ethanol was included in the list of domestically produced biofuels that qualified for an exemption from the mineral oil tax. The official mineral oil tax on ethanol is CHF 0.7206 per litre. However, the full value of the fuel-tax exemption is the difference between the tax applied to ethanol and that applied to its petroleum substitute, gasoline, which was CHF 0.7312 per litre through June 2008 and was thereafter raised to CHF 0.7447 per litre.

As for biodiesel and SVO, the exemption was only available until recently to ethanol produced in a pilot or demonstration plant recognized by the Federal Customs Administration and, according to the 1996 Mineral Oil Tax Law, if each plant produced five

55 <http://www.tares.ch>

million litres of diesel equivalent a year or less. Assuming an energy-conversion factor of 1.66, this meant that any plant should not produce more than 8.33 million litres of ethanol a year if it wanted to benefit from the exemption. In 2006 and 2007, production of ethyl alcohol for fuel, at 1.06 and 3.188 million litres, fell well short of this limit. In 2007, the total value of the exemption from the mineral oil tax on this volume was around CHF 2.3 million.

Tax treatment has however changed following the 2008 amendment to the Mineral Oil Tax Law. There is no longer discriminatory taxation between domestic and imported biofuels, tax exemption now being granted solely on the basis of minimum standards established by a life-cycle assessment, regardless of plant-type or scale of annual production. Although these standards are still in development, it is clear that Swiss producers will face increased competition and that the implicit cost of biofuel-related tax exemptions will increase.

To offset the cost to government of the tax exemption, the Swiss government raised the gasoline tax on 1 July 2008, from 0.7312 per litre to 0.7447 per litre. This will confer an additional advantage to ethanol, by increasing the price gap between ethanol fuels and gasoline.

Additional support given to the production of ethanol is provided through its exemption from the CHF 0.015 per litre “climate cent” levy applied to gasoline collected by the Climate Cent Foundation (see Box 3.1). This exemption was worth an estimated CHF 47 820 in 2007. If the climate cent levy is treated as a CO₂ tax, its subsidy equivalent could be estimated by taking the ratio of its net CO₂ emissions to those emitted by consuming gasoline. Given that, to date, most of the fuel-ethanol consumed in Switzerland has been produced as a by-product of cellulose production, the net CO₂ emissions per litre are small, perhaps 20 percent of those of gasoline. The subsidy equivalent value of the exemption would, therefore, have been only around CHF 9 560.

One production-related subsidy for ethanol has existed on the books for almost a decade but has yet to be used. The 1998 Ordinance on Contributions to Surface and Processing in Agriculture Land (RS 910.17, Article 10 paragraph 5) established payments of CHF 200 per hectolitre (CHF 2 per litre) for ethanol produced in recognized pilot and demonstration plants using domestically grown crops (cereals, graminaceous crops, sugar beets, or potatoes), with a maximum contribution to a single plant of CHF 400 000. However, given the added stipulation that a plant can only be recognised as in its pilot and demonstration stages for three years, there are currently no facilities able to take advantage of this subsidy. By September 2008, no producers had used it, and as part of their Agriculture Policy for 2011, the Swiss government reduced the available payment to CHF 100 per hectolitre.⁵⁶

56 *Source* : Federal Department of Economic Affairs and Art 10, al. 4 et 5 of ‘Ordonnance sur les contributions à la surface et à la transformation dans la culture des champs’,

<http://www.blw.admin.ch/dokumentation/00016/00387/index.html?lang=fr&download=M3wBPgDB/8ull6Du36Wcn0jN14in3qSbnpWVa2ianU6p1rJgsYfhyt3NhqbdqIV+bay9bKbXrZ6lhuDZz8mMps2go6fo>

3.2.2 Support to production factors and intermediate inputs

3.2.2.1 Subsidies to factors of production

Currently, the Swiss Federal Government does not provide support for capital, labour, or land used in the production of ethanol. However, according to unclassified information provided by the Federal Government, Cantons are thought to be considering offering land as an incentive to investors to install plants for producing ethanol in their jurisdictions.

3.2.2.2 Policies affecting the costs of intermediate inputs

The main intermediate inputs used in the production of ethanol in Switzerland (biomass feedstock) include wood-cellulose, water, and fuels for providing process heat in the distillation processes. No subsidies to these inputs have been identified.

Ethanol feedstocks other than cellulose are made prohibitively expensive by policies, mainly border tariffs, which raise their internal prices by 50 per cent or more. If domestic firms were to start producing ethanol from domestically grown crops, using a standard fermentation and distillation process, the cost of the feedstock would be much higher than faced by ethanol producers in other countries. According to calculations made by the OECD, in 2005 the consumer nominal protection coefficients — which measure the ratio of the average price paid by consumers and the price at the border (both measured at the farm gate) — for crops in Switzerland were: 1.46 for wheat; 1.91 for maize; 1.76 for other grains; and 3.50 for sugar. In other words, wheat cost 46 percent more, maize was 91 percent more, and other grains were 76 percent more expensive in Switzerland than the prices of these commodities on international markets. Prices for sugar were almost three and a half times the world price. With the recent rise in world prices for grains and sugar, these price gaps have narrowed somewhat but the dynamic of the situation remains unchanged. A 2007 study by the Federal Office for Agriculture indicated that although world prices had risen—in the case of maize, from CHF 15.56 to CHF 35.72 per 100 kg, compared with a Swiss price drop of CHF 42.2 per 100 kg to CHF 41.02 per 100 kg—in no case did this make domestic products more competitive than their foreign counterparts. It stated, “the change to the world market will have no practical effect on the revenues of Swiss farmers in 2007. The only notable thing is that the gap between the products mentioned has been considerably reduced.”⁵⁷

57 ‘Rapport Agricole 2007’, Chapter 3.2 ‘Aspects Internationaux : Comparaisons Internationales’,

<http://www.blw.admin.ch/dokumentation/00018/00103/index.html?lang=fr&download=M3wBUQCu/8ulmKDu36WenojQ1NTTjaXZnqWfVp7Yhmfhnappmmc7Zi6rZnqCkkIN5hHeEbKbXrZ2lhtIN34al3p6YrY7P1oah162apo3X1cjYh2+hojVn6w==>

3.2.2.3 Support for research, development or innovation

The FOE's compendiums of research projects financed by the Confederation⁵⁸ identify only a handful of projects directly relating to ethanol during the period 1998-2005 (see Annex Table 2 for details).

- *1998-2000*: A study to characterize possible ethanol production chains in the Swiss context;
- *2002-03*: A preliminary study of the potential for the production of ethanol by fermentation of whey, grass and Jerusalem artichoke; and
- *Beginning in 2005*: Participation in an international applied-research project on New Improvements in Ligno-cellulosic Ethanol (NILE);

In the case of each project, the amount of government expenditure has been less than CHF 100 000 per year. The Swiss Government has also funded a number of projects related to the gasification of biomass, which could potentially become a transport fuel. For the purposes of this report, it is assumed that federal government expenditure on R&D related to fuel ethanol has averaged CHF 50 000 per year over the last several years.

58 "Liste des projets de la recherche énergétique de la Confédération 2002/2003," Swiss Federal Office of Energy. http://www.bfe.admin.ch/themen/00519/00524/index.html?lang=fr&dossier_id=00801

4 Recent developments in Swiss biofuel policy and the potential for expanding domestic production

4.1 Amendments to the Mineral Oil Tax Law

In August 2002, the Swiss Federal Council was given a mandate⁵⁹ to modify legislation on the mineral oil tax with the objective of reaching Switzerland's target on CO₂ emissions, in accordance with the country's obligations under the Kyoto Protocol.

The 1999 Law on CO₂ Reduction⁶⁰ had prescribed that CO₂ emissions must be reduced on average by 10 percent by 2010 (8 percent in respect of fuels for transportation), compared with the 1990 level. To achieve this goal, the law envisaged voluntary measures undertaken by Swiss industry and the possibility that the Swiss Federal Council would introduce a tax on CO₂ applied on fuels if the former did not appear to be sufficiently effective (see Box 3.1).⁶¹

On 6 May 2006 the Federal Council proposed in the Draft Amendment of the Mineral Oil Tax Law⁶² to reduce the mineral oil tax on biofuels, natural gas, liquid gas and biogas used as fuels by the equivalent of at least CHF 0.40 per litre of gasoline. Under this amendment, for the first time, imported biofuels would have been exempted totally from the mineral oil tax.

However, this version of the amendment was not adopted; according to the Swiss Federal Council, it would have resulted in almost CHF 200 million a year in lost revenues by 2010 (Table 4.1).⁶³ The Council's estimates about CO₂-emissions reductions were also thrown into question. Originally it was said that some 630 000 tonnes of CO₂ emissions would have been avoided by the third or fourth year after the new law came into effect.⁶⁴ However, this projection assumed a 100 per cent offset, on a litre-for-litre basis, compared with each biofuel's corresponding petroleum fuel, and only comparing end-of-pipe emissions—i.e.,

59 Motion CEATE-CN 02.3382, 20 August 2002. http://search.parlament.ch/f/cv-geschaefte?gesch_id=20023382; www.admin.ch/ch/f/ff/2006/4089.pdf

60 RS 641.71, Loi fédérale sur la réduction des émissions de CO₂, 8 October 1999. www.admin.ch/ch/f/rs/641_71/

61 Climate Cent Initiative's website: <http://www.stiftungsklimarappen.ch/klimarappen/>

62 Message relative à la modification de la loi sur l'imposition des huiles minérales (06.035), 3 May 2006. <http://www.admin.ch/ch/f/ff/2006/4057.pdf>

63 The amount of this exemption considers the estimated fuel consumption, which also reflects the effects of the "Climate Cent initiative" and the CO₂ tax on fuels used for heating.

64 "Bundesratvarianten zur Umsetzung des CO₂-Gesetzes", Prognos SA, March 2005. Cited in Confederation Suisse, Département fédéral des finances, 2006, "Message relatif à la modification de la loi sur l'imposition des huiles minérales", Feuille fédérale, No. 20, 23 May 2006, pp. 4057-4088. http://www.admin.ch/ch/f/ff/2006/index0_20.html

taking into consideration neither the lower energy density of the biofuels (especially ethanol⁶⁵) nor emissions over the full production life-cycle of each fuel (Table 4.1).

Table 4.1 Value of tax exemption and claimed CO₂ reduction through substitution of biofuels in Switzerland, according to the draft Mineral Oil Tax Law amendment of May 2006

Fuel	Annual consumption (in 10 ⁶ litres)			Avoided CO ₂ emission ¹ (kg of CO ₂ per litre)	CO ₂ avoided (in tonnes per year)	Total value of mineral oil tax exemption after 3–4 years (CHF per year)
	in 2005	in year 1	in years 3–4			
Gasoline	5 000	4 500	4 000	—	—	—
Diesel	1 900	2 300	2 700	—	—	—
Ethanol	0.90	80	200	2.34	468 000	146 240 000
Biodiesel	4.56	10	70	2.61	164 000	51 184 000

(1) Assuming 100 percent displacement on a litre-for-litre basis, and considering only tailpipe emissions.

Source: elaboration based on Confederation Suisse, Département fédéral des finances, 2006, "Message relatif à la modification de la loi sur l'imposition des huiles minérales", *Feuille fédérale*, No. 20, 23 May 2006, pp. 4057-4088. <http://www.admin.ch/ch/f/ff/2006/4057.pdf>

Early drafts of the amendment received wide approval from participants during consultations undertaken by the government from 2004 to 2005.⁶⁶ Nevertheless, there was some dissent over the inclusion of other substances from the EU directive 2003/30/CE in the list of exempted fuels. Some participants also wanted to create a system for certifying that a particular biofuel was indeed contributing positively to the environment, while others wanted to protect domestic production of biofuels from imports.

In October 2006, Switzerland's Nationalrat (Lower Chamber) approved a version of the amended Law that would still have fully exempted biogas, ethanol and biodiesel from the mineral oil tax. In addition, it would have accorded preferential treatment to biofuels produced in Switzerland.⁶⁷ The final version, however, adopted in March 2007, stipulated that not all biofuels would automatically be exempted from the mineral oil tax (Box 4.1). Those that do not fulfil regulations relating to air pollution and climate protection would bear the full tax. In addition, the Federal Council stated (see Box 4.1) that it "shall also

65 This assumption is defended in the Government's proposal through reference to a study by field trials with actual vehicles, undertaken by the Laboratoire fédéral d'essai des matériaux et de recherche (LFEM/EMPA), which showed that the gasoline containing 5 percent ethanol could actually achieve better performance than when running on 100 percent gasoline.

66 Consultation undertaken by the Federal Department of Finance from 21 October 2004 to 21 January 2005. <www.admin.ch/ch/f/gg/pc/documents/1163/Bericht_f.pdf>

67 "Nationalrat approves tax exemption for biofuels", F.O. Licht's World Ethanol & Biofuels Report, 23 October 2006.

establish the minimal requirements relating to the *proof of a positive total ecological assessment* that ensures also that the *conditions of production are socially acceptable*.” (Emphasis added.)

A new Amendment to the Mineral Oil Tax Law was promulgated on 30 January 2008 and came into force on 1 July 2008. The law states that, in order to be exempt from the tax, biofuels:

- must generate 40 per cent less greenhouse gases than conventional gasoline, from production to use;
- must not damage the environment in ways that are significantly greater than the environmental damage caused by gasoline;
- must not endanger conservation of tropical forests or biodiversity;
- must provide proof of the above, unless they are ‘manufactured in accordance with the latest technologies’; and
- must provide proof that they were produced under ‘socially acceptable conditions’, either those of the producer country or the fundamental conventions of the International Labour Organisation (ILO).

These conditions were not uncontroversial and were considered by some to be a way to limit imports, especially considering the amendment’s explicit statement that fuel produced by palm oil, soybeans or grains would not generally meet the necessary criteria.

Box 4.1 The 30 January 2008 Amendment to Switzerland’s Mineral Oil Tax Law pertaining to tax exemptions for biofuels⁶⁸

Article 19b – Minimum conditions for a positive global ecological effect

1. The minimum requirements for a positive global ecological effect are met:

- a. if the fuels made from primarily renewable materials emit, from their production to their use, in that part of them generated from biological materials, at least 40% less greenhouse gases than fossil fuels;
- b. if the fuels made from primarily renewable materials, from their production to their use, do not harm the environment in a way notably worse than fossil fuels, and
- c. if the production of primarily renewable materials from which they come do not endanger either the conservation of tropical forests or biological diversity.

2. These conditions are considered in all cases to have been met for fuels manufactured in accordance with the latest technologies using waste or biogenic residues from the production or processing of agricultural and forestry products.

3. It is considered that fuels from palm oil, soybeans and grains do not meet the minimum requirements prescribed in article 1.

[...]

Article 19c – Proof of a positive global ecological effect

[...]

⁶⁸ <http://www.admin.ch/ch/f/rs/6/641.611.fr.pdf>

c. The information required to prove a positive global ecological effect can be submitted for fuels made from raw materials mentioned in article 19b, article 3.

Article 19d – Minimum requirements regarding socially acceptable production conditions

1. The minimum requirements for “socially acceptable” production conditions are fulfilled if, in the raw materials’ cultivation and fuel production, social legislation applicable at the location of production, or at least the fundamental conventions of the International Labour Organisation (ILO), have been met.

[...]

On 20 June 2008, the Department of Environment, Transport, Energy and Communications (DETEC) released draft regulations specifying the means by which importers are expected to prove conformity with the minimum criteria for their products (Box 4.2). Importers will be asked to provide a range of information about their product. First among these are facts about its production: what techniques were used, the types of energy and fertilisers involved, and such like. Importers will also be expected to provide information about how the biofuel was transported and whether any extraneous ecological effects may have occurred, such as impacts on biodiversity, tropical forestation or the fertility of soil. The department will then calculate a full life-cycle assessment for the fuel. Officials state that the information itself is relatively easy to provide and this should dispel worries that meeting the standard could impose prohibitive costs. (Questions have been raised, however, over whether the Swiss government can ensure the validity of any information provided.) Additionally, the DETEC maintains that the new law will not conflict with Switzerland’s WTO commitments. After a grace period—ending in 2011—these same standards will be applied to domestic biofuel production at that point, making the policy non-discriminatory between domestic and foreign producers.

Box 4.2 The 20th June 2008 proposed regulation on proof of a positive global ecological effect for fuels made from primarily renewable materials

Art 4 — Putting in danger tropical forests (or other natural CO₂ reservoirs) and biological diversity

The applicant must provide information establishing:

- a. the origin of the plants used, and the exact designation and description of the site on which they were grown;
- b. how the land was used between 1 January 2006 and the date it was first used to grow the materials in question;
- c. adherence to relevant environmental regulations, including those concerning the protection of the air, soil, biological diversity, water and subterranean waters, as well as against invasive organisms;
- d. adherence to good practice during the growth of the raw materials, in particular information determining the sensible use of herbicides and fertilizers, the method of growth and harvest, including the system of crop rotation to maintain the quality of the soil and avoid erosion, as well as information showing the choice of soil is appropriate for the crop.

Art 5 — Cultivation of the raw materials

The description of the production must contain information establishing:

- a. the crop rotations practiced on the cultivated land;
- b. the yield, in quantity and in the value of plants used;
- c. the type and the quantitative and in-value yields of the by-products and wastes generated during the harvest;

- d. the methods of cultivation and harvest, with information on the use of machines and the types of energy used;
- e. the type and the quantity of fertilizer and the herbicides used;
- f. the method of irrigation, along with the quantity of water consumed and the type of the water source from which it was taken up.

Art 6. – Production of fuels

The description of the production must contain information establishing:

- a. the technique used to produce the fuels;
- b. the type and the quantity of energy used;
- c. the nature and the quantity of auxiliary products used;
- d. the nature and the quantity of by-products obtained during the production;
- e. the yield in energy and in value of the products and by-products;
- f. the nature and the quantity of waste created during production along with its means of elimination;
- g. the greenhouse gases emitted during the production of the fuels.

Art.7 – Transport

The description of transport used must contain information concerning the means of transport, the sites of production and the distance travelled between the place of production and purchase by consumers.

Art.8 – Specific ecological advantages

In addition to supplying the information required by articles 3 to 7, ecological benefits particular to the mode of production can be submitted. Especially invited is information concerning:

- a. the increase of biological diversity;
- b. making soil more fertile;
- c. the protection of non-renewable water sources.

Source: <http://www.news-service.admin.ch/NSBSubscriber/message/attachments/12369.pdf>

The regulations set out in Box 4.2 are *draft* proposals and the final approach could differ significantly. The draft regulations were issued for public consultation by DETED which, as of October 2008, was in the process of consolidating them into a summary report to be published in November. According to sources within the DETEC, the most noteworthy reactions have been:

- an increased sense of caution about the promotion of biofuels, given the fact that they may have significantly contributed to rising food prices;
- anxiousness about the destruction of biogenic carbon resources, such as carbon sinks, for the growth of biofuels;
- anxiousness about the complexity of the data requested in order to calculate a life-cycle analysis.

Regarding the last point, it has been suggested that the DETEC should establish mean values for various common agricultural activities that emit CO₂ — e.g. use the average CO₂ emitted by tractor-use in the growth of a particular crop. Producers unable to furnish certain pieces of information could then appeal to these mean values in order to be considered for the tax exemption.

Following the publication of these responses, the tax exemption qualification mechanisms will be revised and re-presented to the government. Since 1 July 2008, biofuels can be imported with the tax reduction, but the tax has to be paid later if the concerned biofuel should be found to not be eligible under the tax exemption criteria. Importers are unlikely to take such a risk given that criteria under which the biofuels will be assessed are still not determined. The final regulations are likely to come into effect towards the end of 2008 or the beginning of 2009.⁶⁹

To keep overall tax revenues received by the Federal Government (or affected cantons) constant, the tax on gasoline was raised on 1 July 2008 from 0.7312 per litre to 0.7447 per litre. This amount is to be reviewed every two years and changed as necessary in order to offset the effect on government revenues of blending an increasing volume of tax-exempt biofuels in the nation's transport fuels.⁷⁰ As an additional safety mechanism, it was also decided that the exemption could be partially or wholly removed depending on the relative prices of biofuels and fossil fuels. In its initial phase of implementation, biofuels will only be exempt from the mineral oil tax if their market price is 70 per cent or above that of the after-tax price of the fossil fuel alternative. If the price falls below this limit, the biofuel will be subject to tax until it returns to a relative price of 70 per cent or it has been apportioned the full rate of tax to which it is liable. The government have also stated that, dependent on market conditions, this boundary of 70 per cent could be raised.⁷¹

4.2 Alcosuisse's Etha+ project

In anticipation of changes to the Mineral Oil Tax Law, in 2006 Alcosuisse developed a new programme to promote ethanol, called Etha+. Its primary goal is to replace all the pure petrol sold in Switzerland with E5 before 2010, by using imported ethanol and ethanol produced from waste and wood-cellulose materials and what it considers to be "surplus" agricultural products.

As described in Section 2.2.2, the programme started with a pilot project for producing ethanol from cellulose. This is done at Borregaard's plant in Riedholz by fermenting the sugar compounds obtained as by-products from the manufacture of cellulose, with a yield of approximately 50 litres of ethanol from 1 000 kg of wood (Vaudroz, 2006). The plant is

⁶⁹ *Source:* Lukas Lukas Gutzwiller, Federal Office of Energy, Switzerland. Note: Biofuels produced from waste materials do not require a lifecycle assessment and therefore imports can benefit from the tax exemption immediately without the possibility of being required to re-pay the tax.

⁷⁰ <http://www.platforme-biocarburants.ch/infos/ch-limpmin.php>. N.B. This rise in gasoline tax is in fact quite large in monetary value and this is because it is accounts for two sets of tax reductions aimed at combating global warming: the first, being the tax exemption for imported biofuels, and the second, a tax reduction for imported natural gas, liquefied gas and biogas. Further information about these other changes can be found on page 9 of 'Commentaires: Modification de l'ordonnance sur l'imposition des huiles minerale; Ordannance sur l'adaptation des taux d'impôt sur les huiles minerale applicables à l'essence',

<http://www.ezv.admin.ch/dokumentation/00474/01993/index.html?lang=fr&download=M3wBPgDB/8u1l6Du36WenojQ1NTTjaXZnqWfVp7Yhmfhnappmmc7Zi6rZnqCkkIN3gn9+bKbXrZ6lhuDZz8mMps2gpKfo&typ=.pdf>

⁷¹ 'Commentaires: Modification de l'ordonnance sur l'imposition des huiles minerale; Ordannance sur l'adaptation des taux d'impôt sur les huiles minerale applicables à l'essence', as above.

currently producing 12 million litres a year, “all uses combined.” In recent years, the proportion of this output dedicated to the fuel market has risen sharply: in 2005, only 1.0 ML was sold as fuel, but rose to 1.5 ML in 2006 and 2.5 ML in 2007. The plant can only produce a maximum of 3 ML per year of fuel-grade ethanol, due to the size of its dehydration unit, but could produce up to 8 ML per year if it were to expand this capacity.^{72, 73}

According to Alcosuisse, the company plans to complete construction of an independent large-scale dehydration unit by the end of 2010. With an annual capacity of 160 ML, and potentially capable of processing lignocellulosic biomass, this would be able to produce ethanol from domestic and imported materials. Other sources report that Alcosuisse may supplement this with a multi-feedstock plant of 50 ML annual capacity. Alcosuisse’s web site confirms that they envisage the construction of a second plant by 2012, also with the ability to process lignocellulosic biomass.

Table 4.2 Forecast average quantities of raw materials consumed and ethanol produced at Alcosuisse’s planned multi-feedstock ethanol facility

Feedstock	Processing Period (months)	Daily feedstock use during season (tonnes per day)	Annual feedstock consumption (tonnes)	Ethanol production capacity	
				(litres per day)	(million litres per year)
Wheat	January-June	400	65 000	150 000	24
Molasses	July-September	490	40 000	150 000	12
Potatoes	October-December	860	70 000	110 000	9
Total			175 000	—	45

Source: Alcosuisse.

Alcosuisse has combined forces with the automobile manufacturers GM-Saab and Ford, and fuel distributor AGROLA, to promote E85.⁷⁴ The companies were seeking possible government incentives for the purchase of vehicles capable of using E85. As of September 2008, these were still in progress. Representatives from Saab were optimistic about the outcome, estimating that up to fifty percent of Swiss cantons may offer a 15 per cent to 20 per cent tax reduction on flex-fuel cars, or a reduction on vehicle taxes, like those available in Sweden. Some Cantons—such as Schwyz and Thurgau—already have such tax reduction policies and all have previously made similar arrangements to support electric cars.

72 <http://www.biofuels-platform.ch/en/infos/ch-bioethanol.php>

73 <http://www.eners.ch/plateforme/infos/ch-ethanol.php>

74 “Autofahren wird grün”, joint press release from Saab and Alcosuisse, available at [www.etha-plus.ch/upload/GMEinladungPK\(5Jan05\).doc](http://www.etha-plus.ch/upload/GMEinladungPK(5Jan05).doc).

Establishing procedures for homologation (certification) of vehicles and the infrastructure for distributing E85 will be critical if the technology is to gain market share.⁷⁵

4.3 Switzerland's longer-term potential for biofuel production

The technical, much less the economic, potential for Switzerland to produce more than a small fraction of its own fuel from domestic feedstocks is highly limited. Even if oilseed rape were to be planted on one-quarter of the country's arable land — which would be five times the area planted to oilseeds currently—Switzerland could in theory produce only 85 million litres of biodiesel a year from domestically grown oilseeds (Eco Energy Etoy, 2005), displacing only four per cent of the country's current diesel consumption, which was 2 160 ML in 2006. A 2007 study by the Federal Institute of Technology acknowledged that although biofuels would almost certainly play a part in Switzerland's future energy needs, it would not be a big one. It estimates that even in a best-case scenario, if Switzerland devoted 80 per cent of its arable land to domestic biofuel production it could only replace around 8 per cent of its fossil-fuel use.⁷⁶

Small amounts of additional biodiesel could be derived from increased recovery of waste cooking oil and fats. In 2002 Switzerland recycled 14 per cent of the 100 000 tonnes of the vegetable oils it consumed in that year.⁷⁷ Some of the oil was burned in cement factories or in cantonal incinerators, some was exported and the rest was sold for diverse uses. If the country's recycling rate could be increased to 20 per cent (a level achieved in several European countries), and all the 20 000 tonnes per year of used cooking oil thereby collected were turned into biodiesel, that would supply only an additional 23 million litres per year, equivalent to just over 1 per cent of current diesel fuel consumption.

The technical potential for ethanol production in Switzerland based on domestically produced sugar beet, grasses, scrap paper and cheese — i.e., not including the potential from wood cellulose — was estimated in a study carried out by the Ecole Polytechnique Fédéral de Lausanne (Fromenten *et al.*, 2000) to be almost 300 ML a year. Given that Switzerland currently consumes around 4 600 million litres of gasoline annually, such a level of production would slightly exceed the volume required to ensure an average 5 per cent mix of ethanol in nationwide gasoline sales. The Association for the Development of Renewable Energy is currently working on the 'Betalcool' project, which aims to produce ethanol from sugarbeets, although it is still in its early stages of development.⁷⁸

The economic potential for the production of ethanol from dedicated crops is likely to be small, however. Figure 4.1 shows that although the price gaps between world market prices and the Swiss prices for crops has narrowed over the last 20 years, the prices of potential feedstock crops in the country remain at least 50 per cent higher than world prices in the

75 *Source:* Saab (Christoph Bleile); and 'Kantonale Motorfahrzeugsteuern: Öko-Rabatte' credited to www.autoinfo.ch.

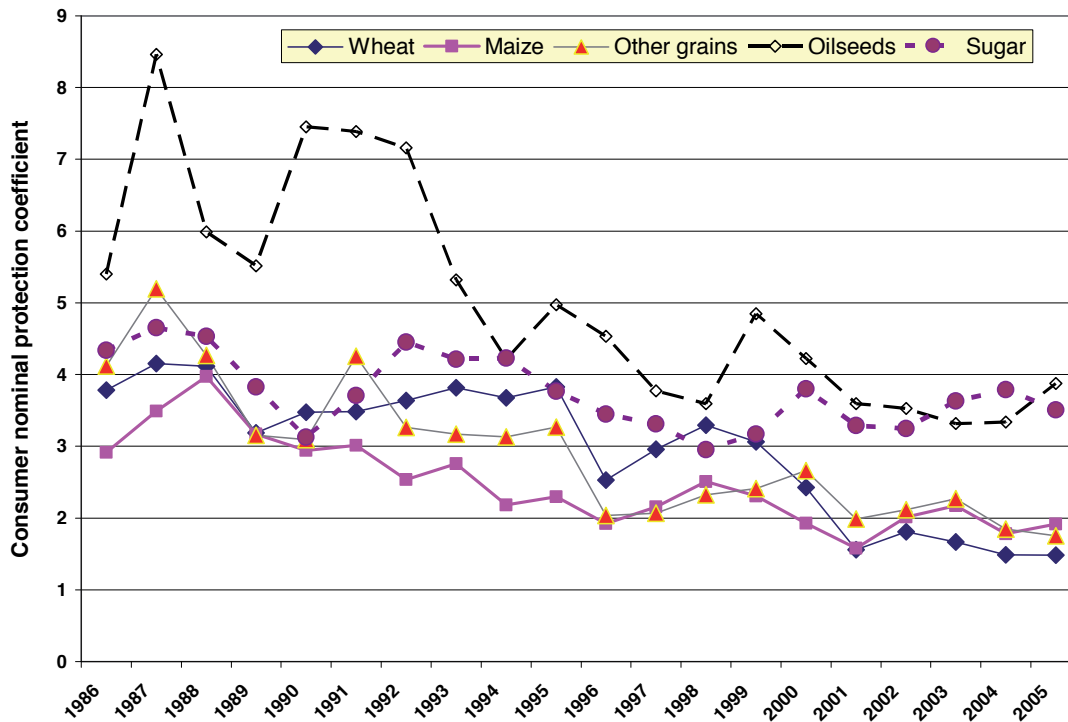
76 Peter, Simon, 2008, "Assessing the Potential of a Crop-Based Biofuel Production in Switzerland and its Impact on Swiss Agriculture", ETH Zürich, Institute for Environmental Decisions (IED).

77 *Source:* <http://www.biocarb.ch/what.htm#carburant>

78 *Source:* <http://www.ader.ch/projets/index.php>

case of wheat, and around three times higher in the case of oilseeds and sugar. These prices, moreover, do not reflect the opportunity cost of using domestically produced crops, which would also include direct payments to farmers for producing those crops.

Figure 4.1 Trends in consumer nominal protection coefficient values for major crops in Switzerland



Source: OECD, *Producer and Consumer Support Estimates*, OECD Database 1986-2005: Switzerland. <http://www.oecd.org/dataoecd/12/24/36998606.xls>

Looked at in another way, comparing domestic prices for crops with their potential ethanol yields shows that the raw material costs alone would make domestic manufacturing of ethanol very expensive, unless producers could take advantage of much cheaper, down-graded crops. Per litre costs for the feedstock would be CHF 1.08 if maize were the feedstock, CHF 1.18 if sugar beets were the feedstock, CHF 1.41 if wheat were the feedstock, and almost CHF 3 if potatoes were the feedstock (Table 4.3). At this time, of the other plant products, only ethanol made from molasses looks potentially viable, and then only if prices for gasoline were to rise and stay at levels higher than they were at the beginning of 2007, once costs of fermenting and distilling the molasses were also factored in.

Whey, which is a byproduct of cheese production, could also be an economic feedstock, especially if its price remains low. (Currently, some cheese makers have to pay for its disposal.) However, its potential supply at costs of CHF 10 per tonne or less (the price Alcosuisse considers the upper limit of the price for ethanol production to be commercially viable) is only around 8.5–10 million litres a year (Alcosuisse and FROMARTE, 2006: 6).

Table 4.3 Yields and prices of raw materials for ethanol production in Switzerland

Raw material	Sugar (% PF)	Crop yield (tonnes/ha)	Ethanol yield (litres/tonne)	Ethanol yield (litres/ha)	Producer price (CHF/t) ¹	Raw material cost (CHF/litre)
Sugar beet	16	60	100	6000	115	1.15
Molasses (40 kg/t of sugar beet)	50	(2.4)	300	(720)	220	0.73
Jerusalem artichoke (Topinambur)	16	40	90	3600	1200e	13.33
Maize	58	8.3	400	3000	445	0.83
Potatoes	20	20	120	2400	381	3.175
Wheat	60	5.5	370	2040	445	0.91
Hay, dried		2-13 (MS)	150	300 – 1950	250	1.67
Whey	4.9	NA	23	NA	-5 to 28	-0.22 to +0.61

ND= No data.

(1) Producer prices refer to the latest available published prices as of early October 2008. The price per tonne of Jerusalem artichoke is taken as 20 percent of the recommended on-farm price for small purchases (CHF 6-7/kg), which is based on the ratio between retail and producer prices for potatoes.

Sources: • **producer prices for sugar beet and potatoes (avg. 2006)**: Office federal de l'agriculture, Rapport Agricole 2007, Table A11; • **producer prices for Jerusalem artichoke (January 2007)**: Terre & Nature, "Sur les Marches", 8 February 2007; • **producer prices for hay (30 Sept. 2008)**: Terre & Nature, "Sur les Marches", 2 October 2008, <www.terrenature.ch/marche>; • **producer prices for maize and wheat (average July 2007 to June 2008)**: Office Federal de L'Agriculture, "Evolution dex prix de juillet 2006 à juin 2008", August 2008, p.2. • **price of molasses in EU (Oct. 2008)**: F.O. Licht's; • **sugar yields and projected prices for whey (2008)**: Alcosuisse, "Le potentiel du petit-lait", Rapport du 10 January 2006; • **raw material cost**: calculated; • **all other data**: Alcosuisse.

5 Aggregate Support for Biodiesel and Ethanol

To develop a better sense of how all of the individual subsidy programs affect the overall environment for biofuels, we have compiled several aggregate measures of support. The aggregate data provide important insights into a variety of policy questions. These range from the financial cost of the subsidy policies to taxpayers, to estimates of the costs of achieving particular policy goals. Among arguments put forth in support of biofuel subsidies are that they help a country to diversify from fossil fuels in general, and petroleum in particular; and that they have a better environmental profile than fossil fuels. We discuss in turn total financial support to the sectors; subsidies per unit of energy output; subsidies per unit of fossil energy displaced; and the subsidy cost for greenhouse gas reductions. Policy implications and recommendations, as well as areas for additional research, are discussed in Chapter 6.

5.1 Total support estimates

In comparison with neighbouring countries in the EU, the scale of support provided by Switzerland for its domestic biofuels industry is small in absolute terms. Switzerland has not set a goal for consumption or production of biofuels, which in other countries (e.g., the EU and the United States) has spurred new investments in the sector. However, some other forms of support have been provided.

Table 5.1 Total Support Estimate for biodiesel in Switzerland, 2004-2007

(millions of Swiss francs)

Support element	2004	2005	2006	2007
Market price support	2.50	4.85	6.96	8.44
<i>Fuel-tax exemption</i>	2.50	4.84	6.89	8.36
<i>Climate Cent tax exemption</i>	0	0.01	0.07	0.80
Support for intermediate inputs and production factors	1.97	2.16	1.01	0.91
<i>Payment to biodiesel plants</i>	0.76	0.92	0.39	0.39
<i>Area payment to oilseed producers</i>	1.21	1.24	0.62	0.52
Support for value-adding factors	0	0	0	0
Support for R&D (estimated)	0.10	0.10	0.10	0.10
Total support estimate (TSE)	4.57	7.11	8.08	9.45

Source: GSI estimates; see Chapter 3.

We estimate that total support for biodiesel and straight vegetable oil (SVO) used as a fuel were roughly CHF 7 million (€ 4.5 million) in 2005, CHF 8 million (€ 5.1 million) in 2006 and approaching CHF 10 million (€ 6.1 million) in 2007 (Table 5.1). The majority of support was provided through the exemption from the mineral oil tax, which until July 2008 acted as an import barrier as well. Subsidies to oilseed producers account for a surprisingly large share of total support.

Ethanol was not sold as an automotive biofuel in Switzerland until 2005. In that year, 901 000 litres were produced, and the main support element was the exemption from the mineral oil tax on gasoline of CHF 0.7312 per litre. Total support was CHF 710 000 (€ 425 000) in 2005 and CHF 830 000 (€ 495 000) in 2006. This had risen to CHF 2.39 million (€ 1.42 million) by 2007. Table 5.2 summarizes the total support estimate for ethanol.

Table 5.2 Total Support Estimate for ethanol in Switzerland, 2004-2007

(millions of Swiss francs)

Support element	2004	2005	2006	2007
Market price support	0	0.66	0.78	2.34
<i>Fuel-tax exemption</i>	0	0.66	0.78	2.33
<i>Climate Cent tax exemption</i>	0	(neg.)	(neg.)	0.01
Support for intermediate inputs	0	0	0	0
Support for value-adding factors	0	0	0	0
Support for R&D (estimate)	0.05	0.05	0.05	0.05
Total support estimate (TSE)	0.05	0.71	0.83	2.39

Source: GSI estimates; see Chapter 3 and Annex Table 2.

5.2 Subsidy intensity

Estimates of total support provide only a crude measure of a potential market distortion. Large subsidies, spread across a very large market, can have less of an effect on market structure than much smaller subsidies focused on a small market segment. Subsidy intensity metrics are a way of measuring subsidies relative to the size of their particular markets, and, in the case of energy markets, taking into account the different heat rates produced by similar volumetric units (i.e., litres) of different fuels.

In Switzerland, there are effectively several marginal rates of subsidization for agricultural-derived liquid substitutes for diesel fuel (Table 5.3). Biodiesel and SVO made from domestically grown oilseeds, and processed in Switzerland, attract the most support, including crop area payments and oilseed transformation payments. On a per-litre basis, the value of the crop area payments, at the average yield in 2007 (3.04 tonnes of rapeseed per hectare), are even higher than the value of the exemption from the mineral oil tax. However, this value is subject to year-to-year variation. Between 1999 and 2007, for example, the

average rapeseed yield in Switzerland ranged from 2.6 to 3.5 tonnes per hectare. Moreover, the reduction of the area payment for oilseeds in 2009 to CHF 1000 per hectare will reduce the per-litre value of the area payment, in respect of biodiesel and SVO derived from Swiss-grown oilseeds, by one-third.

All other renewable diesel substitutes benefit only from exemption from the fuel excise tax and from the Climate Cent. The value of the latter exemption varies according to the actual reduction in life-cycle greenhouse-gas emissions: the higher the emissions, the greater the value of the exemption.

Table 5.3 Approximate marginal rates of subsidization for biodiesel and SVO in 2008 (CHF per litre)

Fuel	Crop area Payments ¹	Oilseed trans-formation payments ²	Exemption from fuel excise tax ³	Subsidy equivalent value of exemption from Climate Cent ⁴	Total unit subsidy
Biodiesel					
Domestically produced from Swiss oilseeds (rape methyl ester)	0.8994	0.5107	0.7206	0.0089	2.140
Domestically produced from recycled waste vegetable oils	—	—	0.7206	0.0027	0.7233
Imported recycled-waste-oil methyl ester	—	—	0.7206	0.0019	0.723
Imported rape methyl ester	—	—	0.7206	0.0123	0.733
Straight vegetable oil (SVO)					
Domestically produced from Swiss oilseeds	0.9040	0.5133	0.7206	0.0067	2.146
Domestically produced from recycled vegetable oils	—	—	0.7206	0.0020	0.723
Imported SVO	—	—	0.7206	0.0092	0.730

Notes:

(1) Based on payments of CHF 1 500 per hectare, an average yield of 3 042 kilograms of rapeseed per hectare, a yield of 37% oil from rapeseed, a specific gravity of 0.883 for RME and 0.915 for rapeseed oil, and a biodiesel yield of 0.97 litres per litre of rapeseed oil. Seventy-four per cent of the value of the rapeseed area payments has been allocated to the oil fraction of the rapeseed, with the remainder assumed to support rapeseed meal production.

(2) Based on a compensation rate of CHF 0.28 per kilogram transformed, and other parameters as specified in footnote (1).

(3) In the case of imported biodiesel, the value represents the difference between the mineral oil tax exemption and the import duty.

(4) The value represents the relative emissions (from Zah *et al.*, 2007) compared with petroleum diesel multiplied by CHF 0.015. Values for SVO have been estimated as 75 percent of their corresponding feedstock values after conversion to biodiesel.

Sources: • **yield estimate:** based on 2007 production and area data from Swissgranum — see Table 3.3 of this report;
 • **rapeseed oil yield:** Hans-Jakob Häberli (2007); • **specific gravity:** http://www.biofuelsb2b.com/useful_info.php?page=Energ; • **biodiesel yield per litre of oil:** http://www.esru.strath.ac.uk/EandE/Web_sites/02-03/biofuels/quant_biodiesel.htm

All fuels derived from “renewable raw materials” benefit from the exemption from the CHF 0.015 per litre Climate Cent. As mentioned in Chapter Three, the value of that exemption, it can be argued, depends on the CO₂-equivalent emissions associated with each fuel: the lower the life-cycle emissions, the less the Climate Cent exemption can be considered a subsidy. Following the amendment to the Mineral Oil Tax Law, the same is true of the central government’s tax exemption for renewable raw materials: in the case of biodiesel and SVO, free from a charge of CHF 0.7206 per litre, and the case of ethanol (since 1 July 2008), free from a charge of 0.7447 per litre. Biodiesel derived from domestically grown oilseed rape (i.e., rape methyl ester, or RME) also benefits at the margin—i.e., not counting general agricultural support for the production of rapeseed in Switzerland—from the government additional area (per-hectare) payments for growing the seed, and oilseed transformation payments for processing it into fuel. These, added together, amount to around CHF 1.40 per litre. The 2009 cut in area payments, from CHF 1 500 to CHF 1 000, will reduce the rate of subsidization by around CHF 0.30 per litre for fuels produced with domestic feedstocks.

One measure of the degree to which a product is supported is the share of support as a percentage of its market value. That ranges from roughly 45 to 70 percent of the estimated market value for ethanol⁷⁹, and 48 to 140 percent of the estimated market value for biodiesel, based on average prices in 2006 and 2007 (Table 5.4). That is to say, if all the support (including exemption from fuel-excite taxes) were reflected in the price of these biofuels, they would cost consumers at least from 45 percent more to more than twice their actual market value. Since none of the support elements decline as prices of either ethanol or biodiesel fuels fall, a decline in the prices of petroleum fuels below those observed in 2006 and 2007 would generate higher levels of support as a share of market prices than indicated here. Conversely, if prices were rise, as observed in the first half of 2008, the share of support as a percentage of its market value will be reduced.

Another way to look at support is per unit of energy and per unit of fossil-fuel equivalent. Since ethanol has a heating value per litre that is 67 percent that of biodiesel, normalizing each in terms of CHF per gigajoule (GJ) makes ethanol, at almost CHF 35 per GJ, more subsidized per unit of energy than biodiesel made from recycled waste vegetable oils (CHF 22 per GJ), though both are much less subsidized than rape-methyl ester produced from domestically grown oilseeds (CHF 65 per GJ). Translating these values into litres of gasoline and petroleum diesel equivalent also shows that the rates of support are less far

79 The rather wide range in the values for ethanol reflects two different assumptions. One assumes that there is no penalty in fuel economy (per litre) using ethanol in ethanol-gasoline blends containing up to 5 percent ethanol. The other assumes that there is a penalty proportional to the ratio of the heating values of ethanol and gasoline multiplied by the share of ethanol in the blended fuel. Ratings of fuel economy in the United States, for example, routinely show that distances travelled in flex-fuel vehicles on an equal volume of E85 are on average 25 percent less than on gasoline, which is only slightly better than the 30 percent reduction in performance one would expect from comparing ethanol’s and gasoline’s heating values.

apart than on a simple, per-litre basis: around CHF 1.10 per LGE (if one assumes a loss in fuel economy, as would be the case for vehicles operating on E85), compared with CHF 0.80 per LDE for biodiesel made from recycled oils. These levels of support are similar to the ex-tax *market prices* of the fuels they replace, which averaged around CHF 0.87 for both premium unleaded gasoline and automotive diesel in 2007. In other words, at the rates at which the government supported the production of biofuels, it could have gone to the world market and bought a similar amount of energy in the form of gasoline or automotive diesel for the same money (or less, in the case of automotive diesel). The subsidy per litre of diesel equivalent for rape-methyl ester made from domestically produced oilseeds, at CHF 2.30 exceeds (by 40 per cent!) even the after-tax price of diesel fuel.

Table 5.4 Marginal support intensity values for ethanol and biodiesel, 2008

Indicator	Unit	Cellulosic Ethanol		Biodiesel made from recycled waste oils		Biodiesel from Swiss-grown rapeseed (RME)	
		Low	High	Low	High	Low	High
Support per litre ¹	CHF/litre	0.75		0.72		2.14	
After-tax price of gasoline or diesel (avg. 2006 and 2007)	CHF/litre	1.59	1.60	1.62	1.64	1.62	1.64
Estimated market value, Average	CHF/litre	1.07	1.60	1.49		1.51	
Support as a % of market value ³	%	~47%–70%		~48%		~140%	
Support per gross GJ of biofuel produced	CHF/GJ	35		22		65	
Support per litre of gasoline or diesel equivalent ⁴	CHF/litre equiv.	0.75	1.10	0.80		2.30	

Notes:

(1) Based on subsidy rates shown in Table 5.3 for biodiesel and the excise tax exemption and carbon-cent-tax exemption for ethanol.

(2) The higher reference market value for ethanol is the average price in 2006 of (RON 98) unleaded gasoline, including excise taxes but not including VAT. The lower reference value assumes the price for ethanol would be proportional to the relative thermal value (67 percent) of ethanol compared with the average price of (RON 98) unleaded gasoline in 2007. The average price for biodiesel is assumed to be proportional to the relative thermal value (roughly 90 percent) of biodiesel compared with non-commercial petroleum diesel sold for non-commercial purposes, including excise taxes, but not including VAT.

(3) The range for ethanol reflects support per litre divided by, respectively, the highest and lowest market values in the previous line.

(4) For ethanol, the lower value in the range is based on an assumed no loss in vehicle performance if used in an E5 blend; the higher value assumes a penalty proportional to the ratio of the heating values of ethanol (21.41 MJ/litre) and gasoline (31.88 MJ), which is more typical of vehicle performance when used in a high ethanol blend, such as E85. For biodiesel, the support per litre estimates are both grossed up by the ratios of the heating values of biodiesel made from recycled waste vegetable oils (32.68 MJ/litre) or rape methyl ester (33.03 MJ/litre) to petroleum diesel (35.95 MJ/litre). Values have been rounded to their nearest CHF 0.05.

Sources: • **support estimate:** GSI; • **heat values:** Zah *et al.* (2007b) • **prices of petroleum fuels:** International Energy Agency, *Energy Prices & Taxes—Quarterly Statistics: First Quarter 2008*, Paris: OECD Publications, 2008.

5.3 Support per unit of fossil-fuel-equivalent displaced

Public financial support for biofuels is often proposed as a way to wean a country from its dependence on fossil fuels in general, and petroleum in particular. To estimate how efficiently biofuels subsidies help to reduce reliance on petroleum, or on fossil fuels in general, one needs to avoid crediting the ethanol or biodiesel with the expenditure of fossil fuels used to create and deliver them.

The degree to which the use of biofuels displaces fossil fuels varies fairly widely across estimates by different researchers, even when system boundaries have been standardized. We have side-stepped this controversy by simply using a range of normalized values drawn from various published sources, such as the International Energy Agency (IEA, 2004); Farrell *et al.* (2006b); Zah *et al.* (2007a and 2007b) and Edwards *et al.* (2007). These sources report the net energy yield as a share of the gross energy content of the biofuel, or the amount of non-renewable energy required to produce a fuel indexed to the value of its corresponding petroleum-derived fuel. The higher the net displacement, the more of the gross energy content remains as a base over which to spread the biofuel subsidy numbers. Generally, fossil-fuel displacement factors are greater for cellulosic ethanol and than for RME. That is because more fossil fuels are used in producing the feedstock oilseeds, and methanol (normally derived from natural gas) is used as a chemical input in transesterification.

The amount of support per litre of fossil-fuel equivalent avoided is not much less than the market value of the fuels they displace (Table 5.5). For ethanol, the support ranges between CHF 0.80 and CHF 1.60 per litre of gasoline-equivalent avoided, depending largely on whether one assumes a vehicle performance penalty when using ethanol or not, and to a lesser extent on the displacement factor. For biodiesel made from recycled waste oils, the subsidy per litre equivalent of fossil fuel displaced is in the order of CHF 1.00 per litre. In the case of domestically-produced RME, the subsidy cost is up to *four times* that, from around CHF 3.55 to CHF 4.20 per litre of diesel-equivalent avoided, depending on the displacement factor assumed. These costs are additional to what consumers pay for the fuel at the pump.

Given that biofuels are not the only means to diversify away from fossil fuels, it is not clear how competitive they would be compared with alternative strategies, especially those that take into consideration the potential for demand-side measures.

Table 5.5 Marginal support for ethanol and biodiesel per unit of fossil fuel displaced, 2008

Indicator	Unit	Cellulosic Ethanol		Biodiesel made from recycled waste oils		Biodiesel from Swiss-grown rapeseed (RME)	
		Low	High	Low	High	Low	High
Support per litre of gasoline or diesel equivalent ¹	CHF/litre equiv.	0.75	1.10	0.80		2.30	
Displacement factor ²	GJ fossil-fuel input / GJ	0.10	0.30	0.16	0.24	0.35	0.45

	output						
Net gain in non-fossil energy	%	70-90%		76-84%		55-65%	
Support per litre equivalent of fossil fuels displaced ³	CHF/litre equiv.	0.80	1.60	0.95	1.05	3.55	4.20

Notes:

(1) For explanation of the ranges, see note (3) to Table 5.4.

(2) Ranges reflect ranges in literature for, respectively cellulosic ethanol and biodiesel made from rapeseed (canola) oil.

(3) Equals support per litre of gasoline equivalent divided by the percentage net gain in non-fossil energy. Values have been rounded to their nearest CHF 0.05.

Sources: • **support estimate:** GSI; • **displacement factor:** GSI estimates, based on Farrell *et al.*, 2006b; SEKAB, 2006; Zah *et al.*, 2007a; Edwards *et al.*, 2007.

5.4 Subsidy per tonne of CO₂-equivalent displaced

A final issue worth examining is the subsidy per unit of greenhouse-gas emissions displaced (expressed in tonnes of CO₂-equivalent) through the substitution of biofuels for their petroleum-derived equivalents. The key policy question is whether these investments are efficient with regard to GHG mitigation.

As a measure of cost-effectiveness, the levels of support per unit of CO₂-equivalent avoided are compared with the cost of purchasing carbon credits. Buying GHG reductions by subsidizing RME production in Switzerland is not very efficient, costing at least CHF 1 500 (€ 940) per tonne of CO₂-equivalent avoided (Table 5.6). Because the ethanol in Switzerland has so far been derived from wood cellulose, which has a better life-cycle CO₂ emission profile than biodiesel, it has a lower level of support: between CHF 460 (€ 290) and CHF 550 (€ 340) per tonne of CO₂-equivalent avoided. The cost-effectiveness of biodiesel made from recycled waste oil is even better, on the order of CHF 300 (less than € 200) per tonne of CO₂-equivalent avoided.

Compared with the price of obtaining a CO₂-equivalent tonne, however, support levels for neither fuel are particularly cost-effective. For the same cost of obtaining one tonne of CO₂-equivalent reduction through public support for ethanol, the government could have purchased around 10 tonnes of CO₂-equivalent offsets on the European Climate Exchange (assuming a price of under € 30 per tonne of CO₂-equivalent). For the same cost of one tonne of CO₂-equivalent reduction through public support for Swiss-rapeseed biodiesel, the government could have purchased at least 30 tonnes of CO₂-equivalent offsets.

Table 5.6 Marginal support per tonne of CO₂-equivalent avoided, 2008

Indicator	Unit	Cellulosic Ethanol		Biodiesel made from recycled waste oils		Biodiesel from Swiss-grown rapeseed (RME)	
		Low	High	Low	High	Low	High
Baseline emissions (from gasoline or petroleum diesel), life-cycle basis	Kg of CO ₂ equiv./GJ	85		86.2		86.2	

Percentage reduction from baseline	%	75	90	82	87	40	50
Support per GJ of biofuel produced	CHF/GJ	35		22		65	
Support per tonne of diesel or gasoline avoided ¹	CHF/tonne of CO ₂ equiv.	460	550	290	310	1 500	1 880
	Euros/tonne of CO ₂ equiv. ²	€290	€340	€180	€190	€940	€1170
Price of a CO ₂ -equivalent offset, European Climate Exchange ³	Euros/tonne of CO ₂ equiv.	€30					

Notes:

1. Calculated as support per GJ divided by the product of the baseline emissions and the percentage reduction. Ranges reflect the combination of ranges of subsidy values and estimated emission reductions.

2. Converted at an assumed exchange rate of CHF 1.60 to the euro.

3. Equals average of the highest value of ECX CFI Futures Contracts attained on the European Climate Exchange for December 2008 and December 2009 settlements in 2008, rounded to the nearest euro.

Sources: • **emission rates for gasoline and diesel:** Fehrenbach et al., 2008, p. 8; • **support estimates:** GSI; • **CO₂-equivalent reduction values:** GSI estimates, based on Farrell et al., 2006; SEKAB, 2006; Edwards et al., 2007, Zah et al. 2007b and CEC, 2008; • **CO₂-equivalent futures prices.** www.europeanclimateexchange.com/index_flash.php

It must be stressed that the above savings in GHG emissions from using biofuels in place of petroleum fuels relate only to comparisons of life-cycle emissions associated with the production of the feedstock and its processing into a final, usable fuel, and should therefore be considered on the generous side of the spectrum. They do not reflect any assumptions about carbon emissions associated with land conversion, whether directly to grow the feedstock crops⁸⁰, or indirectly as a result of the supply response of producers generally to higher crop prices. Yet the diversion of food crops, especially grains or virgin vegetable oils used as feedstocks to biofuel production, by helping to raise prices of those crops (see, e.g., Mitchell, 2008) can stimulate the production of those crops elsewhere. When such new production involves the conversion of formerly grasslands or forest land to the growing of annual crops, carbon contained in the soil is likely to be released, thus offsetting some of the direct reductions in GHG emissions attributable to fuel substitution.

This offsetting value can be expressed in terms of years that it takes for the annual reductions in GHG emissions associated with the displacement of fossil fuels equal the carbon released from land conversion. Fargionne et al. (2008) estimated that these ratios can range from 17 years for ethanol made from sugarcane grown on former woodland in Brazil's Cerrado savannah, to over 400 years in the case of biodiesel made from oil palms planted on former peatland rainforest. Searchinger et al. (2008) found that, at the global level, increases in biofuel production do displace food production on arable land and, as the demand for food is growing, new land would need to be converted for food production. After taking into account emissions from such land-use change, the study found that maize-based

⁸⁰ Conversion of pastureland or forestland to the growing of feedstock crops in Switzerland is not currently a problem.

ethanol, for example, instead of producing a 20 per cent saving, nearly doubles greenhouse emissions over 30 years and increases greenhouse gases for 167 years.

6 Commentary and recommendations

Switzerland's experiment with biodiesel has been running for 10 years, and has resulted in the emergence of a small domestic industry. Though official government policy, especially agricultural policy, does not especially favour liquid biofuels, government support has nonetheless played a key role in the industry's development. Because of limits placed on eligibility for the main support element—the exemption from the mineral oil tax—the industry did not grow beyond its first single plant until international oil prices started rising in 2003. Current biodiesel and SVO plants use primarily waste cooking oil, or oilseeds imported from the EU, both of which are less expensive feedstock sources than oilseed rape grown in Switzerland.

The production and consumption of ethanol for fuel is a more-recent development in Switzerland, and the quantities involved are smaller. Nonetheless, with the active encouragement of ethanol blends by a consortium of Alcosuisse, fuel retailers and the automobile industry, domestic demand for this fuel could increase substantially in the future. The government's ending of Alcosuisse's monopoly control over imports of fuel ethanol marks a positive step towards creating such a market.

So as to make biofuels competitive with petroleum fuels, however, the government has had to both provide generous tax breaks and subsidies to biodiesel processors, in order to offset the high cost of processing oilseeds. In total, support for biofuels is now in the neighbourhood of CHF 12 million a year, the bulk of which goes to substitutes for diesel fuel.

By any measure, biofuel production in Switzerland is an expensive proposition. On a per-litre basis, total support ranges from around CHF 0.75 per litre of ethanol or biodiesel made from recycled waste oils, to over CHF 2.10 per litre of rape-methyl ester (RME) from domestically grown oilseeds. Adjusted for differences in energy content⁸¹, these subsidies are even higher, at CHF 0.80 per litre of diesel equivalent for biodiesel made from recycled waste oils, to CHF 1.10 per litre of gasoline equivalent for ethanol and CHF 2.30 per litre of diesel equivalent for RME.

Considering the high costs of producing biofuels in Switzerland, the Government's past policies of restricting support for its domestic biofuels industry, and placing its main emphasis on improving the efficiency of transport overall in Switzerland, appears to have been prudent. Until July 2008, exemptions from excise tax, though discriminatory against imports, had been limited to a maximum of 20 million litres of diesel-equivalent a year, and actual production had reached a level of only half of that.

The recent amendment to the Mineral Oil Tax Law extends and generalizes the exemption from the mineral oil (fuel) tax to all biofuels, no matter where produced. That means that foreign producers, including those from developing countries, now enjoy greater market access. Potentially problematic, however, especially for suppliers of biofuels from developing countries, are the criteria that they must meet in order to benefit from the fuel-tax exemption. Importers must provide evidence that their fuel was produced and processed in a way that meets minimum environmental and social standards—i.e., requirements that relate to processes and production methods that do not ultimately affect the

81 See Section 5.3.

characteristics of the product (non-product-related processes and production methods, or PPMs). And although the Swiss government has given assurances that it will apply its criteria fairly to all suppliers, domestic or foreign, the rules of the World Trade Organization (WTO) generally make it difficult for countries to discriminate among trading partners on the basis of non-product-related PPMs. Moreover, until 2011, domestic producers will automatically qualify for exemption from the mineral oil tax, without having to prove that they meet the regulations. Whether Switzerland would be able to sustain this policy remains to be seen.

The Government's decision to increase taxes on petroleum-derived fuels as the volume of tax-exempt biofuels used for transport increases is innovative, and will ensure that whatever changes in the mix between biofuels and fossil fuels occur, the effect on tax revenues will be neutral. This *could* mean that the per-litre value of the tax exemption for biofuels would increase over time. However, since the Amendment to the Mineral Oil Tax Law allows a partial exemption from the mineral oil tax for biofuels, the Government certainly can choose to simply maintain or even reduce the value of the tax exemption.

Indeed, a re-evaluation of the current practice of granting biofuels a full exemption from the mineral oil tax should be considered already. The current value of the exemption,⁸² even for ethanol made from wood cellulose and biodiesel made from recycled waste vegetable oils, exceeds the market value of the CO₂ avoided by almost a factor of ten.

Biofuels can reduce greenhouse gases and local air pollutants. But the cost in Switzerland of obtaining a unit of CO₂-equivalent reduction at current rates of subsidization for biodiesel is very high, especially for biofuels produced from virgin materials. Buying GHG reductions by subsidizing domestic rapeseed biodiesel production is estimated to cost taxpayers at least CHF 1 500 (€ 940) per tonne of CO₂-equivalent avoided. For the same cost of one tonne of CO₂-equivalent reduction through public support for Swiss-rapeseed biodiesel, the government could have purchased roughly 30 tonnes of CO₂-equivalent offsets on the European Climate Exchange. That cost will fall in 2009, with the reduction in the rate of area payments for oilseeds, but only to around CHF 1300 per tonne of CO₂-equivalent. The cost-effectiveness of biodiesel made by recycling cooking oil is better, on the order of CHF 300 (less than € 200) per tonne of CO₂-equivalent avoided. But there is only a limited supply of used cooking oil available, so it is unlikely ever to constitute a major source of liquid fuels in Switzerland.

Because the ethanol produced in Switzerland has so far been derived from wood cellulose, which has a better life-cycle CO₂ emission profile than biodiesel, it has a lower level of support: between CHF 460 (€ 290) and CHF 550 (€ 340) per tonne of CO₂-equivalent avoided. For the same cost of obtaining one tonne of CO₂-equivalent reduction through public support for ethanol, the government could have purchased 10 tonnes of CO₂-equivalent offsets.

Some differential in the excise tax might be appropriate to reflect the lower emissions of atmospheric pollutants produced from biofuels, and their (generally) lower life-cycle emissions of greenhouse gases compared with unleaded petrol and low-sulphur diesel. But the differential is likely to be smaller than the current support level. A tax of € 30 per tonne of CO₂, for example, would equate to € 0.07 (CHF 0.11) per litre of petrol. That is far lower than the current excise-tax differential between petrol and ethanol, or diesel and biodiesel, in Switzerland. In any case, that differential would represent an upper limit even if

82 The exemption accounts for the entirety of the support for ethanol, and more than half of the support for biodiesel.

biofuels could offset 100 percent of the CO₂ emissions from petroleum fuels. They do not; moreover, the life-cycle GHG emissions of biofuels differ enormously, depending on the kind of feedstock used, and how they are produced and processed. This would suggest that only a partial exemption from the tax may be warranted, with an even smaller exemption for RME, since its life-cycle CO₂ emissions are greater than for cellulosic ethanol, especially if land currently storing carbon — e.g., in tropical ecosystems — ends up being converted in order to replace vegetable oils diverted to the production of biodiesel.

The continued existence of a payment to Swiss biodiesel manufacturers to compensate them for the higher cost of using domestically produced oilseeds also appears difficult to justify on economic grounds. Given that there is little prospect that domestic production of biodiesel (except from waste grease and oils) will ever be cost-competitive with imported biodiesel, or biodiesel produced in the country from imported feedstocks, the main purpose of the subsidy is to boost domestic processing crop. Our recommendation is that the subsidy be phased out as soon as possible.

Compared with the situation even two years ago, there is much more information available to the public on the amount and types of biofuels used, the policies supporting them, and their environmental effects. In June 2008, the Government published a document that explained in great detail its position in respect of ethanol. Extending the analysis to biodiesel, and publishing regular updates, would facilitate a more informed discussion.

Although data and resource limitations prevented us from identifying and quantifying all the subsidies now supporting biofuel production and consumption in Switzerland, we believe that this study has assembled a more comprehensive assessment of the level of public support than previously existed. Other researchers, including those within Cantonal and municipal governments, are encouraged to build on this study, correct any errors and continue the process of quantifying support to the industry.

To conclude, the GSI advice to the Swiss federal government is that it should:

- Continue to resist calls for instituting blending mandates for biofuels, at least without first undertaking a thorough examination of the costs and benefits.
- Avoid providing new specific subsidies to the industry, and develop a plan for reducing or phasing-out the exemptions from the mineral oil tax granted to biofuels.
- Continue to stress technologically neutral policies for reducing reliance on petroleum in the transport sector and curbing emissions of greenhouse gases.
- Improve the information available on transfers provided to the biofuels industry and the effects of such assistance.
- Establish an on-going evaluation process to assess:
 - the cost-effectiveness of support policies at all levels of government in attaining the declared objectives behind biofuels policy, and
 - the long-term economic viability and international competitiveness of a Swiss biofuels industry, in the absence of assistance.

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Further Information may be obtained from:

BioCarb (biodiesel): www.biocarb.ch

Biodrive (SVO) : www.biodrive.ch

Biopower Fardin (biodiesel): www.biopower-fardin.ch

Eco Energie Etoy (biodiesel): www.ecoenergie.ch

Humbel (biodiesel): www.humbel-stetten.ch

MP Biodiesel (biodiesel): www.mpbiodiesel.ch

RB Bioenergie (biodiesel): www.rb-bioenergie.ch

Annexes

Annex 1: Tables and Statistics

Annex Table 1 Annual biofuel consumption in Switzerland, 1998-2007
(‘000 litres)

Biofuel	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Domestically produced biodiesel	1 664	1 563	1 825	1 937	1 774	2 324	3 158	6 180	8 717	9 756
Imported biodiesel	2	1	1	18	8	18	104	181	116	113
Total biodiesel	1 666	1 564	1 826	1 955	1 782	2 342	3 262	6 361	8 833	9 869
Pure plant and reused waste oils	—	—	—	12	59	145	313	529	845	1 846
Fuel ethanol	—	—	—	—	—	—	—	901	1 060	3 188

Note: These data actually refer to the part of production that has left the plant and has been sold, and were, therefore, the volumes reported to the Federal Customs Administration. There is evidence that some of the biodiesel being produced is being diverted to stocks.

Data sources:

EZV — Eidgenössische Zollverwaltung [Federal Customs Administration], 2007, “Zeitreihe: Versteuerte Menge von Biotreibstoffen aus erneuerbaren Rohstoffen”, Document T 3,8, Bern.
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Annex Table 2 Government-supported R&D projects for transport fuels from biomass, 1998-2005

Name of project	Year(s)	Research institution(s) ¹	Annual cost of the project
Characterization of ethanol production chains in the Swiss context	1998-2000	University (EPFL)	less than CHF 100 000
Fuel mix preparation for direct injected Diesel engines (Mahler system) using biodiesel	1999-2001	Public-sector institute (HES)	between CHF 100 000 and CHF 500 000
Organization of a Conference	1999	Private sector	less than CHF 100 000
Plant oil as fuel in a passenger car	1998-99 2000-01	Private sector	less than CHF 100 000
Fuel from biomass	1998-99	Private sector	less than CHF 100 000
Use of vegetable oil in a turbo-charged direct-injected automotive diesel engine	2000-02	Public-sector institute (HES)	less than CHF 100 000
Bio-methane through hydrothermal gasification of biomass	2003	Public-sector institute (PSI)	between CHF 100 000 and CHF 500,000
Development of a pilot- and demonstration combined-heat-and-power (CHP) plant using vegetable oil	2002-03	Public-sector institute (HES)	not known
Methane from wood	2003	Public-sector institute (PSI)	between CHF 100 000 and CHF 500 000
Preliminary study of the potential for the production of ethanol by fermentation of whey grass and Jerusalem artichoke	2002-03	University (EPFL)	less than CHF 100 000
Fuel from rapeseed oil and kerosene (Natur-Diesel)	2002-04	Federal institutes	less than CHF 100 000
Running an articulated bus with biogas in the City of Berne	2005-	Private sector	between CHF 100 000 and CHF 500 000
Direct catalytic liquefaction of biomass	2005-	Private sector	between CHF 100 000 and CHF 500 000
NILE: New Improvements in Ligno-cellulosic ethanol	2005-	Private sector and University (ETHZ)	less than CHF 100 000

1. EPFL = École polytechnique fédérale de Lausanne; ETHZ = Zurich; HES = Hautes Écoles Spécialisées; PSI = Paul Scherrer Institute

Sources: Office fédéral de l'énergie, *Liste des projets de la recherche énergétique de la Confédération* (various years), Département fédéral de l'environnement, des transports, de l'énergie et de la communication, Berne.

Annex Table 3 Applied and General Tariffs

Tariff position	Tariff designation	Oil tax in CHF/1000 litres at 15 °C ⁽¹⁾	General Tariff CHF/100 kg gross	Customs duties	Regulations on imports
Ethanol					
2207.1000	Undenatured ethyl alcohol of an alcoholic strength by volume of 80% vol or higher	720.60	35.00 Fr	Normal: 35.00 Fr. per 100 kg gross EUROPEAN UNION/EFTA: duty-free GSP: duty-free ²	Customs duties: Import only with license from Swiss Alcohol Board (SAB)
2208.9010	Undenatured ethyl alcohol of an alcoholic strength by volume of less than 80% vol	720.60	35.00 Fr	Normal: 35.00 Fr. per 100 kg gross GSP: duty-free ²	-
2207.2000	Ethyl alcohol and other spirits, denatured, of any strength	720.60	0.70 Fr	Normal: 0.70 Fr. per 100 kg gross EUROPEAN UNION/EFTA: duty-free ² GSP: duty-free ²	Import only with license from SAB
2710.1111	Gasoline ethanol mixture with a portion of gasoline of > 70%, for use as fuel	731.20	49.90 Fr	duty-free	Imports starting from 20 kg: necessary license from Carbura, the Swiss Central Office for the Import of Liquid Fuels
2710.1112	White spirit – ethanol mixture with a portion of White mirror-image-guessed/advised of > 70%, for use as fuel	752.10	49.90 Fr	duty-free	idem
2710.1119	Mixture from other light oil with ethanol with a portion of light oil of > 70%, for use as fuel	758.70	47.30 Fr	duty-free	idem
2710.1911	Petroleum ethanol mixture with a portion of petroleum of > 70%, for use as fuel	739.50	47.30 Fr	duty-free	idem
2710.1912	Diesel oil ethanol mixture with a portion of diesel oil of > 70%, for use as fuel	758.70	47.30 Fr	duty-free	idem
2710.1919	Mixture from other not renewable raw materials with ethanol with a portion of not renewable raw materials of > 70%, for use as fuel	758.70	47.30 Fr	duty-free	idem
3814.0010	Mixtures from ethanol with products of the TN 2710 (gasoline, diesel oil etc.) < in pure form, with a portion products of the TN 2710: 70%, for use as fuel	720.60	49.90 Fr	duty-free	idem
3824.9030	Other ethanol mixtures with additives, with a portion of ethanol of > 30%, for use as fuel	720.60	49.90 Fr	duty-free	idem

Biodiesel						
3824.9030	Bio Diesel pure	720.60	49.90 Fr	duty-free	idem	
3824.9030	Diesel oil- biodiesel mixture with a portion of biodiesel >30%	720.60	47.30 Fr	duty-free	idem	
2710.1912	Diesel oil- biodiesel mixture with a portion of biodiesel <30%	731.20	47.30 Fr	duty-free	idem	

Source: <http://www.tares.ch>

About the authors

Ronald Steenblik served as the Director of Research for the IISD's Global Subsidies Initiative (GSI) during 2006 and 2007. Ronald's professional career spans three decades, in industry, academia, the U.S. federal government, and inter-governmental organizations, generally on policy issues related to natural resources, the environment, or trade. While with IISD, Ronald was on secondment from the Trade Directorate of the Organisation for Economic Co-operation and Development (OECD), where he is a Senior Trade Policy Analyst. Ronald has written numerous papers and articles on subsidy measurement and classification, and on subsidy disciplines.

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About the Global Subsidies Initiative

The International Institute for Sustainable Development (IISD) launched the Global Subsidies Initiative (GSI) in December 2005 to put a spotlight on subsidies—transfers of public money to private interests— and how they undermine efforts to put the world economy on a path toward sustainable development.

Subsidies are powerful instruments. They can play a legitimate role in securing public goods that would otherwise remain beyond reach. But they can also be easily subverted. The interests of lobbyists and the electoral ambitions of office-holders can hijack public policy. Therefore, the GSI starts from the premise that full transparency and public accountability for the stated aims of public expenditure must be the cornerstones of any subsidy program.

But the case for scrutiny goes further. Even when subsidies are legitimate instruments of public policy, their efficacy—their fitness for purpose—must still be demonstrated. All too often, the unintended and unforeseen consequences of poorly designed subsidies overwhelm the benefits claimed for these programs. Meanwhile, the citizens who foot the bills remain in the dark.

When subsidies are the principal cause of the perpetuation of a fundamentally unfair trading system, and lie at the root of serious environmental degradation, the questions have to be asked: Is this how taxpayers want their money spent? And should they, through their taxes, support such counterproductive outcomes?

Eliminating harmful subsidies would free up scarce funds to support more worthy causes. The GSI's challenge to those who advocate creating or maintaining particular subsidies is that they should be able to demonstrate that the subsidies are environmentally, socially and economically sustainable—and that they do not undermine the development chances of some of the poorest producers in the world.

To encourage this, the GSI, in cooperation with a growing international network of research and media partners, seeks to lay bare just what good or harm public subsidies are doing; to encourage public debate and awareness of the options that are available; and to help provide policy-makers with the tools they need to secure sustainable outcomes for our societies and our planet.