BIOFUELS – AT WHAT COST?

Government support for ethanol and biodiesel in selected OECD countries

A synthesis of reports addressing subsidies for biofuels in Australia, Canada, the European Union, Switzerland and the United States

September 2007

Prepared by:

Ronald Steenblik, Director of Research, Global Subsidies Initiative

GSI Global Subsidies Initiative

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Biofuels—At What Cost? Government Support for Ethanol and Biodiesel in Selected OECD Countries

By Ronald Steenblik

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Preface

In 2006, the Global Subsidies Initiative (GSI) — a new program under the International Institute for Sustainable Development — embarked on a series of studies to examine the nature and extent of government intervention in the markets for liquid biofuels: fuel ethanol and biodiesel. At the time, neither biofuels nor government support to biofuels were new. What was unprecedented, however, was the rapid pace at which the industry was expanding.

The proximate cause was the rise in the international price of crude oil which, after ten years of languishing at below US$ 25 per barrel, started rising steeply in 2003, crossing US$ 60 per barrel for the first time in August 2005. But the foundation for a rapid surge in biofuel production had already been laid, through many years of support for biofuel facilities, production-related payments and exemption of biofuels from fuel-excise taxes. Once in place, these measures ensured that ethanol and biodiesel would burst onto the scene, like desert blossoms after a heavy rain.

And burst forth they did. Globally, ethanol production jumped by 13 percent between 2004 and 2005. But the increase was not uniform. While output in Brazil — the world's lowest-cost producer — grew by a relatively modest 6 percent, the USA's grew by 20 percent and Germany's by 60 percent, despite both being higher-cost producers. Even more astounding was the rate of investment in new capacity. On 1 January 2006, some 6.7 billion litres of new fuel-ethanol capacity was under construction in the United States, compared with less than half that number a year earlier.

A similar situation could be observed for biodiesel. Between 2004 and 2005, the total capacity to produce biodiesel in the European Union almost doubled, to 4.2 billion litres a year. Over the following year it expanded by another 45 percent. Australia, Canada and the United States, having produced only 0.3 billion litres of biodiesel between them in 2005, witnessed an explosion in new facilities, such that their combined annual capacity is likely to reach 8 billion litres by the end of this year.

The problem, as we saw it, was that nobody was really monitoring the situation, at least in respect of the levels and effects of subsidies and trade barriers. Yet the need for such review seemed self-evident. As the GSI's Director, Simon Upton, puts it crisply: "When there's a feeding frenzy, it's time to check the bait." So that is what we set out to do.

This publication details the results of studies of five OECD economies (counting the EU as a single economy). The studies do not cover all members of the OECD (omitted are Iceland, Japan, Korea, Mexico, New Zealand, Norway, and Turkey), but they do cover the economies that account for the bulk of biofuel production and consumption. Switzerland was included in the initial series even though it is not a significant producer of biofuels by world standards because of its recent radical change in policies. The GSI has also commissioned studies of support policies in several other countries, all outside the OECD region: Brazil, China, Indonesia and Malaysia — respectively, the world's second and third-largest producers of ethanol, and the two leading producers of palm oil (one of several plant oils used as feedstock for manufacturing biodiesel).

Country studies are particularly useful for policy analysts in the countries examined. The first of the series released, under the provocative title of "Biofuels—At What Cost? Government Support for Ethanol and Biodiesel in the United States", written by Doug Koplow of Earth Track, was released in October 2006 and has been widely read — we know that from the 250,000 downloads recorded to date — and cited. We expect the same will be true for our studies of Australia, Canada, the EU and Switzerland.

But there is also value in looking at the bigger picture — comparing policy approaches and drawing common lessons — which is why we decided to produce this synthesis of the studies of OECD countries. This report will be followed by a companion document, summarizing the results of the studies of Brazil, China, Indonesia and Malaysia, early in 2008. What we have found already is astonishing. By 2006, government support to biofuels in the OECD had reached US$ 11 billion a year. Because most of that support is related to production or consumption, and government mandates (if not rising petroleum prices) assure that both will expand rapidly over the next decade or even beyond, that level of support can be expected to grow rapidly as well. The kinds of support policies now in place mean that it will be very difficult to avert soaring subsidy costs even if policymakers wanted to.

The risk of a fiscal blow-out on the scale that looks likely should be exercising the minds of Treasurers and Finance Ministers around the world. But the IISD remit requires it to ask also what does this mean for sustainable development? Accordingly, the report outlines some of the environmental and developmental pressures that are already being felt. These include profound changes in the cropping patterns of the EU and the United States, in favour of two row crops — respectively, canola (oilseed rape) and maize (corn) — that are among the heaviest users of chemical inputs.

These changes have also had knock-on effects on commodity markets, helping to push up prices not only of the biofuel feedstocks themselves, but also of close substitutes, putting pressure on an already strained world food system. Farmers in developing countries will no doubt benefit from these higher prices, but the urban poor, especially in net food-importing countries, will not.

The question has to be asked: can governments justify gambling so much of the public's money when the benefits are so questionable? Do biofuels represent the best use of scarce resources given the range of fronts on which governments need to act?

Producing these studies of government support to biofuels has been an ambitious undertaking, involving experts in many countries, the generous time and efforts of numerous peer reviewers, and of course the hard work of the GSI staff. Neither the GSI nor the IISD claim to have the last word on this important topic. But we believe that, by shedding light on an aspect of the biofuels boom that had heretofore remained obscure, we have ensured that the question of whether it makes sense to subsidize biofuels will get the public airing it deserves.

David Runnalls
President & Chief Executive Officer
International Institute for Sustainable Development
Ottawa, Ontario
September 2007

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This report was written by Ronald Steenblik, Director of Research, with the assistance of many individuals in the Global Subsidies Initiative. Tara Laan, the GSI's assistant researcher, provided invaluable support on numerous tasks, including contributing much of the material for Chapter 2 and cheerfully taking on the unenviable task of formatting early drafts of the report. Other colleagues, including Chris Charles and Damon Vis-Dunbar, also pitched in, providing information and proofing the text. Simon Upton, the GSI's Director, helped improve the report's key messages by making them sharper than might otherwise have been the case. And Javed Ahmad deftly steered the document through the printers.

The report draws heavily on the findings of five country reports, each with the title "Biofuels—At What Cost?", that have been prepared, or are being prepared for the GSI on government support for ethanol and biodiesel in the respective countries. The authors of these reports, and their affiliations at the time of working on the reports, are:

- *Australia:* Derek Quirke (Centre for International Economics), Ronald Steenblik (GSI) and Bob Warner (Centre for International Economics)
- *Canada:* Todd Alexander Litman (Victoria Transport Policy Institute), Ronald Steenblik (GSI) and Mark Frickel (independent consultant)
- *EU:* Géraldine Kutas (Sciences Po), Carina Lindberg (independent consultant) and Ronald Steenblik (GSI)
- *Switzerland:* Ronald Steenblik and Juan Símon (both of the GSI)
- *United States:* Doug Koplow (Earth Track, Inc.)

Each of those reports, in turn, benefited greatly from the input of peer reviewers, whose names are mentioned in the acknowledgements to those reports. However, special acknowledgement is due to several people who took on the task to review several of the reports, or who provided ideas or advice, or who pointed to useful sources. At the risk of missing out somebody, they include (in alphabetical order), Richard Doornbosch, Lukas Gutzwiller, Masami Kojima, Doug Koplow, Géraldine Kutas, Lyn Martin, Tadeusz Patzek, Stephen Perkins, David Pimentel, Lee Schipper, Ralph Sims, Martin von Lampe and Rainer Zah. Needless to say, any errors or inaccuracies remain the responsibility of the author.

The author is also grateful to the International Transport Forum for supporting work on an earlier, shorter version of this report, which will appear in the proceedings of a Round Table on "Biofuels: Linking Support to Performance", organized by the ITF on 7-8 June 2007.

Finally, this effort and the other work of the GSI could not have been undertaken without the generous support for the GSI provided by the governments of Sweden, the Netherlands, and New Zealand, and the William and Flora Hewlett Foundation. The views expressed in this study do not necessarily reflect those of the GSI's funders, nor should they be attributed to them.

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Abbreviations and acronyms

2006$	U.S. dollars at their year-2006 value
A$	Australian dollar
AoA	WTO Agreement on Agriculture
ASCM	WTO Agreement on Subsidies and Countervailing Measures
B20	a blend of 20% biodiesel and 80% petroleum diesel, by volume
B100	pure biodiesel
C$	Canadian dollar
CHF	Swiss franc
€	Euro
E5	A blend of 5% bio-ethanol and 95% gasoline (petrol), by volume
E10	A blend of 10% bio-ethanol and 90% gasoline (petrol), by volume
E85	A blend of 85% bio-ethanol and 15% gasoline (petrol), by volume
ETBE	ethyl tertiary butyl ether
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
GSI	Global Subsidies Initiative
GSP	Generalized System of Preferences
HS	Harmonized Commodity Description and Coding System
IISD	International Institute for Sustainable Development
MTBE	methyl tertiary butyl ether
OECD	Organisation for Economic Co-operation and Development
SVO	straight vegetable oil
US$	U.S. dollar
WCO	World Customs Organization
WTO	World Trade Organization

Executive summary

Biofuels are being promoted as contributing to a wide range of policy objectives, most notably, providing greater energy security in respect of liquid fuels, increasing rural incomes, and lowering greenhouse gas emissions. Production of ethanol and biodiesel in the OECD region has soared in recent years, and the rush of new capacity soon to come on line means that it will continue increasing through the end of this decade at least.

This is not, however, a phenomenon that has occurred simply in response to market forces. The production and demand for biofuels has been, and continues to be, profoundly shaped by government policies, both regulatory and fiscal.

In order to assist policymakers in gaining a better understanding of the magnitude, direction and coherence of government policies supporting liquid biofuels, the Global Subsidies Initiative (GSI) — a programme under the International Institute for Sustainable Development (IISD) — embarked in 2006 on a series of country studies to determine the scale and impact of support policies in major biofuel producing and consuming countries.

This paper provides an overview of the current state of biofuel support policies in Australia, Canada, the EU, Switzerland, and the United States. As such, it provides the first comprehensive study of support policies in economies that account for over 95 percent of biofuel production within the OECD region. It is based on the individual country studies carried out for the GSI — studies which have adopted a common analytical framework so as to allow cross-country comparisons — but also provides additional analysis. As a result of applying a common framework, this synthesis is able to highlight the similarities and differences among support policies, and some of the fiscal, economic and environmental consequences of those policies.

The paper concludes with several recommendations to policy makers. An urgent case for a moratorium on new support measures, and a thorough review of existing ones, is advanced in order to avert undesirable fiscal and environmental consequences.

Policy drivers

Biofuels have attracted particularly high levels of assistance in some countries given their promise of benefits in several areas of interest to governments, including agricultural production, greenhouse gas emissions, urban air quality, energy security, trade balances, rural development and economic opportunities for developing countries. Such alleged benefits have enabled those promoting biofuels to assemble unusually broadly-based support for fiscal and regulatory relief. While the idea is superficially attractive, not all these objectives can necessarily be pursued at the same time through policies supporting a pair of fuels. The political economy of public transfers is such that the risk of public policy being co-opted in support of private ends is and will remain great.

While aware of these concerns, this study starts from the premise that the declared public policy objectives behind biofuel subsidies must be taken at face value and subjected to scrutiny. Basically, do the policy measures deployed secure the ends that they purport to support? Evidence of an imminent collision between the different policy drivers and on-going requirements for governments to deliver sustainable fiscal and environmental outcomes sets the scene for the report's conclusions.

The structure of support for biofuels

Government measures to support biofuels bear the imprint of history. Government interventions in this market are not new, dating back almost thirty years in the case of some OECD economies. At the time, government intervention was motivated in large part by the woes of the rural sector, which in turn caused in part by agricultural policies. Crop production levels, thanks to subsidies, were too high, and commodity prices too low. The attraction of biofuels was that they offered a new domestic market for agricultural products that could stimulate demand and push up prices, thus ultimately reducing the level of farm-subsidy payments.

Yet the markets for biofuel feedstocks were already distorted by subsidies, and high tariffs and other trade barriers. Governments then added new off-farm subsidies for biofuel production and consumption. The accretion of subsidies created a highly artificial and protected environment which depended for its existence on extensive public intervention. Once in place, that edifice of subsidies and protective measures has proved extremely difficult to alter.

Border protection, mainly in the form of tariffs on ethanol, has provided a protective barrier behind which domestic producers have thrived. Brazilian exporters, in particular, face tariffs that add at least 25 percent to the price of their product in the United States, and over 50 percent in the European Union. Some governments, especially at the sub-national level, have even granted exemptions from fuel-excise taxes that are available only to biofuel producers within their borders, a possible violation of trade rules.

Exemption from fuel-excise taxes has been the most common policy used to support biofuels. Almost all OECD countries in which biofuels are consumed have used that form of tax concession at some point, whether the tax being exempted was relatively small or large. The highest fuel-excise taxes — and therefore the largest fuel-excise tax exemptions — are to be found in the EU, where per-litre rates of € 0.40 (US$ 0.55) or even higher are not uncommon. Biofuels also benefit from exemptions from sales taxes in several U.S. states and Canadian provinces.

For various reasons, the trend in recent years among OECD countries has been to reinstate fuel-excise taxes on biofuels, and (with the exception of the EU and Switzerland) to subsidize production directly or indirectly instead, typically through income tax credits or bounties tied to volumes blended or produced. Often, the rate of subsidization has been kept at the same per-litre rate as the fuel-tax exemption it replaced. In countries with federal systems, payments may be available from both the federal and sub-national governments. In the U.S. State of Kentucky, for example, a producer of biodiesel can tap into both the US $1.00 per gallon federal (US$ 0.26 per litre) and a US$ 1.00 per gallon state subsidy.

A considerable amount of assistance has been provided to the biofuels industry in the form of grants and loans for investment in productive capacity. Some of this assistance has been provided by energy ministries, some by agricultural ministries. As with other forms of support, "subsidy stacking" — whereby companies tap into multiple sources of government assistance — is commonplace.

While high prices for agricultural commodities have reduced crop subsidies tied to prices, several OECD countries still subsidize most of the crops that are used as feedstocks for biofuel production in their countries, with varying degrees of decoupling. The EU encourages the growing of crops specifically for energy, both with a per hectare program and through rules that allow farmers to grow crops for energy on set-aside land.

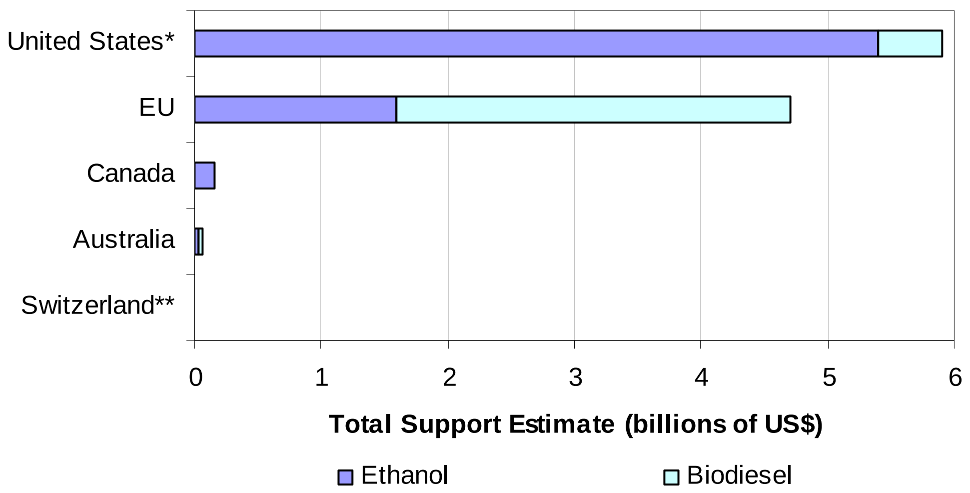
The main bright light in the panoply of public support for biofuels is the fact that government funds for research and development are now focussed on bringing to commercialization second-generation biofuel technologies, which can make fuels out of a much wider variety of feedstocks, including a broader range of waste materials.

Costs and cost-effectiveness

Adding up all the various elements of support provided by OECD governments in 2006 yields a total value of at least US$ 11 billion dollars. Among the group of five countries covered, the United States provided the most support, followed by the European Union (see chart). Ethanol receives twice as much support as biodiesel, mainly because a lot more of it is produced. The heavy fiscal cost of these support measures speaks for itself.

Proponents of biofuels — ethanol and biodiesel — like to refer to these substitutes for petroleum-derived liquid fuels for transport as "transformational". That is true, in more ways than one. Coinciding with the recent boom in production has been a tightening of prices for agricultural commodities. This has come about as a result of a number of factors, including climatic conditions and the changing pattern of demand for food crops in a growing and increasingly affluent world. Against the backdrop of these already challenging conditions, government interventions in favour of biofuels have caused the diversion of greater and greater shares of traditional food crops to feed biofuel production facilities — maize and wheat in the case of ethanol, canola and soybeans in the case of biodiesel. The result has been very large shifts in production patterns from one year to the next.

Total Support Estimates for Selected OECD Countries, 2006[1]



(1) All values should be considered provisional.
*Low end of the range of estimates.
**Values are too small to display at this scale.
Data source: Chapter 4.

These shifts have come at a price. The rising prices of crops such as wheat, maize and oilseeds has led to knock-on increases in the prices of staple foods and consumer products. In the case of maize and palm oil, for instance, price increases over the last two years have exceeded 60 percent. Furthermore, changes in the pattern of crop rotation and the expansion of areas cropped have meant growing use of fertilisers and an increasing demand for water. These effects are not confined within the borders of the countries under study since global trade in the commodities in question means that the displacement effects – and hence the environmental pressures — are also global. Given the open-ended nature of many of the support measures in the countries studied, these impacts are likely to grow.

Against this background, the report identifies several commonly held assumptions that are open to serious question in the light of the evidence, namely:

- *That biofuel support measures save governments money.* The evidence suggests that, given the structure of existing support regimes, the sum of biofuel subsidies and farm payments will not only continue to be significant, but is likely to rise over time.
- *That biofuel mandates will save motorists money.* Biofuels' share of the liquid fuels market currently and in the foreseeable future is nowhere near big enough to influence petroleum prices significantly.
- *That biofuel subsidies are a cost-effective way of reducing reliance on imported fossil fuel from unstable regions of the world.* Aside from the fact that biofuels suffer from their own sources of insecurity (caused by droughts or disease afflicting the feedstock crops), the transfers per unit of energy produced are

high — in most countries above US$ 0.45 per litre, and for some biofuels above US$ 2.00 per litre, of gasoline or diesel equivalent. The transfers per unit of fossil fuel displaced is generally higher, owing to the significant use of fossil fuel in many biofuel production systems.

- *That supporting biofuels is a cost-effective way of reducing greenhouse gas emissions.* Again, the evidence is to the contrary, with costs ranging from US$ 150 to over US$ 1500 per metric tonne of CO_2-equivalent avoided. The evidence is strongly suggestive that it would be much cheaper to vigorously promote efficiency standards given a social cost of carbon, and prices in the marketplace, of below US$ 50 per tonne of CO_2-equivalent. Even with very optimistic assumptions, second generation cellulosic ethanol would involve avoidance costs of over US$ 140 per tonne.
- *That the need for subsidies is temporary.* After thirty years of subsidies in some markets, this claim should be met with scepticism. Against a backdrop of rising commodity prices, there are good reasons to believe that directing food crops to biofuels will remain uneconomic in the absence of subsidies.
- *Subsidies are needed to establish the infrastructure needed to support a biofuels-based transport sector.* This argument, applied particularly in respect of flex-fuel engine technology and refuelling stations, suffers from the reality that it will be several more years before the share of biofuels in biofuel blends starts reaching the technical limit (10 percent ethanol in the case of gasoline-powered vehicles) beyond which conventional engine technology cannot go. As consumption approaches those levels, the private investment case for the infrastructure would stand on its own merits.

Policy recommendations

The titles of the series of country reports that the GSI has produced asks the question, "Biofuels—At What Cost?" It would seem, however, that the attitude of policy makers in some countries is "Biofuels at *any* cost!". Already, the level of support enjoyed by the industry in OECD countries in 2007 is probably of the order of US$ 13-15 billion a year, for a pair of fuels that account for less than 3 percent of overall liquid transport fuel demand on an energy-equivalent basis. Bringing that share to 30 percent — a level frequently suggested by proponents — without making radical changes to the current support system, and without substantially reducing the demand for transport fuels, would imply annual subsidies of US$ 100 billion a year or more. At that level they would approach the order of magnitude of support currently provided to the entire arable crop sector by OECD countries. In the face of this prospect, it is time to pull back and re-consider the entire policy landscape. Six specific recommendations are proposed.

1. Institute a top-to-bottom rethink of the overall rationale for supporting biofuels

The first is to dispense with open-ended, production-stimulating subsidies for biofuels. These are costly, often arbitrary, and inefficient. The experience with similar subsidies in the agriculture and energy sectors is that they inflate the value of fixed factors of production. Once that happens, the subsidies become much more difficult and costly to phase out.

Compared with production- or consumption-linked subsidies, support for capital facilities at least has the merit of being more easily brought to an end. But they shift a significant amount of risk from private investors to taxpayers and therefore should be used sparingly.

Support for R&D is, by comparison (apart from the chance of supporting non-viable technologies), a relatively "no-regrets policy". Nonetheless, resources available for research and development have opportunity costs as well. In the current political climate, there is a real possibility that government support for R&D related to biofuels could crowd out resources that might otherwise be allocated to technologies and energy pathways that could ultimately prove more efficient. Governments have to ask themselves whether their own R&D investment portfolios are appropriately balanced given the wide range of other energy alternatives, both on the supply side and the demand side.

Governments need also to ask whether promoting a supply-side solution, like biofuels, to challenges such as energy security and greenhouse-gas emissions can withstand scrutiny when placed alongside simple demand-side measures. Compared with increasing the supply of liquid transport fuels from sources such as energycrops, simple measures to improve fuel economy or encourage less use of vehicles may be much less costly. Spending huge sums promoting biofuels without first quantifying the scale and reach of the incentives needed to influence consumer behaviours is folly.

2. Stop creating new subsidies for first-generation liquid transport fuels, develop plans to phase them out, and make those plans stick

While subsidies to biofuels are unlikely to be phased out overnight, serious thought needs to be given now to ways in which they can be scaled down and eventually phased out. Some biofuel support programs have declining payment schedules written into them. Notwithstanding that, policy makers almost invariably find themselves under pressure to extend and expand subsidies, and even make them permanent.

Rather than proposing yet more subsidies, policy makers should be thinking of how to turn off the tap, or at least prevent an already strong flow from turning into a torrent. As long as support measures are not budget-limited, the pressures to go on spending will continue to build. Capping these spending programs and giving clear notice of timeframes over which they will be wound back should be a high priority.

3. In the meantime, implement existing commitments to biofuels with smarter policies

Many OECD governments have plans for biofuel support policies still in the pipeline. If they remain determined to continue with those commitments, they should at least ensure that any proposed measures are cost-effective, environmentally defensible and minimize negative spill-over effects on other markets. They should also keep options open — including the option of terminating support for the industry without incurring large adjustment costs. This is simply standard 'good policy' advice.

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 levels. A tax of US$ 50 per tonne of CO_2, for example, would equate to US$ 0.12 per litre of gasoline. That is far lower than the current excise-tax differential between gasoline and ethanol, or diesel and biodiesel, in most OECD countries that grant tax concessions. In any case, that differential would represent an upper limit even if biofuels could offset 100 percent of the CO_2 emissions from petroleum fuels. They do not, but moreover the life-cycle GHG emissions of biofuels differ enormously, depending on the kind of feedstock used, and how they are produced and processed, and these differences would somehow need to be reflected in the tax rates.

Governments should also **resist industry pressure to mandate biofuel production or consumption**. While mandates create certainty for investors, they simply transfer market risks to other sectors and economic agents. They are blunt instruments for reducing net petroleum use and greenhouse gas emissions, especially given that most of the existing ones do not differentiate among biofuels according to their net energy or environmental performance characteristics.

There is a further problem with mandates. Setting them when the potential supply of biofuel feedstocks that can be sustainably produced is unknown, and the future commercial viability of second-generation technologies remains an assumption, is highly risky. Several countries have started to investigate ways to differentiate biofuels according to their life-cycle GHG emissions. But it is still unclear how they can do that in a way that is compatible with WTO rules. It would seem prudent to understand these issues before setting ambitious mandate targets.

The inflexible nature of mandates makes it likely that they will set up significant distortions in related markets. Concerns over competition for crops between fuel and food are legitimate and should argue for caution. There are many niche markets for which biofuels—especially cellulosic ethanol and biodiesel made from waste biomass— could co-exist with food production. But if biofuels production is only viable thanks to mandates and heavy subsidies, then a misallocation of resources in agriculture is inevitable.

Another way to improve the current policy setting is to **make access to government support competitive**. A number of innovative mechanisms have been used in several of the countries that the GSI studies. Generally, governments could greatly improve the efficiency of their policies to reduce dependence on fossil fuels and emissions of greenhouse gases by forcing all potential solutions — including on the demand side — to compete for support based on the smallest required subsidy per unit of petroleum or greenhouse gas emissions displaced.

One of the most striking features of the recent explosion in newly constructed biofuel capacity has been the way in which different tiers of government have managed to create multiple layers of support. Hundreds of government programs have been created to support virtually every stage of production and consumption relating to ethanol and biodiesel — from the growing of the crops that are used for feedstock to the vehicles that consume the biofuels. In many individual locations, producers have been able to tap into multiple sources of subsidies. **Disciplining this "subsidy stacking"** through ensuring that national and sub-national policies are aligned would at least avoid the worst excesses of over-subsidization.

Finally, governments should review any policy measures aimed at encouraging flexible-fuel vehicles that can run on very high percentages of ethanol. Since it is the overall displacement rate of petroleum fuels rather than the specific blends in which biofuels are consumed that matters, there is little point in promoting very high ethanol blends when there are (and will continue to be) real limits to the share of the liquid fuels market that biofuels can hope to supply.

4. Eliminate barriers to trade in biofuels, and strive to avoid creating new ones

Mandating increasing levels of biofuels in national road-transport fuel mixes while maintaining barriers to cheaper imports through tariffs and discriminatory domestic taxes is incoherent. Moreover, these trade barriers are inhibiting the access of developing countries — who have a comparative advantage in biofuel production — to several major OECD markets for biofuel. The countries that are applying such trade barriers should remove them as quickly as possible, and not in some distant multilateral trade round.

Some countries have already shown a willingness to do that, but have also taken an interest in the environmental sustainability of the products they would like to import. This goes, unavoidably, to the heart of a vexed question under international trade law — the use of non-product-related processes and production methods (PPMs) as a basis on which to discriminate. While governments are right to be concerned that their enthusiasm for biofuels does not simply engender an environmental disaster far from their shores, the development of standards that are acceptable to exporting nations will not be easy.

The time and the transaction costs involved in developing new sustainability standards for a product should not be under-estimated. Sustainability standards for other products (e.g., forest and fishery products) have taken years to develop, and even now the proportion of trade covered by them remains small. But in those cases, the demand for the products concerned was driven by the market. In the case of biofuels, demand is driven largely by government mandates and subsidies. It is fair to ask whether the urgency with which sustainability standards for biofuel are being called for, and the harm they seek to avert, would be so great if government interventions had not created the need for them in the first place.

5. Improve transparency on financial support to biofuels, especially at the sub-national level

The subsidies that have been provided to the biofuels industry have typically arisen from many independent decisions taken at different levels of government and by enthusiastic legislatures — nationally and sub-nationally. The resulting suite of policies is often poorly coordinated and targeted. Policy-makers need complete, not partial information, and they should use the time that a self-imposed moratorium would give them to acquire that information.

6. Undertake more research into the consequences—intended and not—of current support policies for liquid biofuels

More research into the effects of continuing to subsidize and protect domestic production of liquid biofuels is sorely needed. That in turn requires governments be much more transparent about the nature and extent of their subsidies to biofuels (and, indeed, to all forms of energy). No proper evaluation of the cost-effectiveness of current and proposed policies is possible without precise information detailing the cost of transfers and revenue foregone. This is a basic responsibility of governments and the cornerstone of sound public finance.

In conclusion

The many layers of government policies supporting biofuels, the incoherence between some of them, and their inevitable unintended consequences, provide compelling grounds for a moratorium on new initiatives and a fundamental policy re-think.

The current emphasis on supporting biofuels risks crowding out investment in other technologies that may be much more sustainable, both commercially and environmentally. While road transport's reliance on the internal combustion engine represents an unusual degree of technological lock-in (in comparison with, say, the electricity generation sector), it is not as though there are no alternatives apart from biofuels.

Neither is there a lack of policy instruments that could more neutrally bring them forward. If reducing greenhouse gas emissions is the primary concern, then emissions charges are a well understood way of influencing technological developments. If reducing exposure to insecure foreign oil supplies is the goal, then user fees to recover the costs of securing foreign supplies can be imposed. The profile of the ideal desired alternative — a source of automotive power that is cheap, clean and flexible — requires unpredictable technological change. A prudent policy approach would seek to keep as many options open as possible.

The bewildering array of incentives that have been created for biofuels in response to multiple (and sometimes contradictory) policy objectives bear all the hallmarks of a popular bandwagon aided and abetted by sectional vested interests. Years of production-related incentives and support for investments in the industry have ensured that there will be pressure to maintain current support levels long into the future. While this phenomenon is not unique to biofuels policy, the fiscal, developmental and environmental stakes are so high that the urgent attention of policy makers is required. Capital continues to pour into the industry, and huge shifts in land use are underway. Understanding the consequences of these changes before any further damage is inflicted is the only responsible way forward.

1 Objectives and outline of the report

This paper provides an overview of current policy measures to support the production and consumption of biofuels. It discusses also how the different policies supportive of biofuels interact with broader agricultural, energy, and environmental policies, and the relative effectiveness of biofuels in achieving objectives in these areas. The paper makes several recommendations for further research and concludes with a series of recommendations for policy makers.

In order to assist policymakers in gaining a better understanding of the magnitude, direction and coherence of government policies supporting liquid biofuels, the Global Subsidies Initiative (GSI) — a new programme under the International Institute for Sustainable Development — embarked in 2006 on a series of studies on support policies in selected OECD and non-OECD economies. This report represents an overview of the results of the OECD country studies (Australia, Canada, the EU, Switzerland, and the United States). By adopting a common analytical framework, this has allowed cross-country comparisons to be made.

Chapter 2 provides an overview of the liquid biofuels industry, while Chapter 3 surveys the nature of government support to the industry in the countries covered by this study, highlighting similarities and differences. In general, the sources for the information contained in this chapter are the country studies themselves (see Reference section). To keep the text from being smothered by footnotes, we have therefore not included citations to the original sources; interested readers may find these in the individual country reports.

Chapter 4 presents aggregated information on the scale of subsidisation in the economies under investigation and some of the non-fiscal costs that result from the enhanced production and consumption of biofuels, most notably impacts on related markets and on the environment. Thereafter follows a discussion of some of the questionable assumptions that, inadequately scrutinized, are used to justify support for biofuel support policies. This allows, in turn, for a discussion of how biofuels perform against the key policy objectives in support of which their greater use is often advocated.

It is beyond the scope of this study to assess in detail the ability of biofuels to achieve all of the outcomes claimed for them. It is, however, impossible for anyone to assess the merit of support measures which enlist these objectives in their defence and compare them with alternatives if their extent and operation is not accurately described in the first place. This, at least, this report does for the first time. In doing so it provides a basis for making a better assessment of the opportunity cost of financial assistance to the biofuel industry when set alongside the other options available to policy makers.

Finally, Chapter 5 provides some recommendations to policy makers which centre on the need for a moratorium on new measures, during which existing policies should be carefully re-examined for both their cost effectiveness and environmental impact.

2 Overview of the liquid biofuels industry

2.1 Global perspective

As proponents of liquid biofuels frequently point out, both ethanol and straight vegetable oil (SVO) were used as motor fuels at the dawn of the internal combustion engine, only to be supplanted within a few years by cheaper petroleum-derived gasoline and diesel.

The fundamentals of biofuel production have changed little since their first application (Box 2.1). While technological advances have improved the economics of the industry, the main factors influencing the uptake of biofuels have been the price of their petroleum-equivalents and the existence of incentives. Relatively low oil prices for much of the 20th century meant there was little motivation for governments or industry to pay much attention to biofuels up until the 1970s, when the international price of oil rose dramatically following the 1973 energy crisis.

The sudden rise in oil prices reignited interest in biofuels. Several countries began programs to develop domestic biofuel industries, and production of ethanol rose rapidly (Figure 2.1), primarily driven by production in Brazil. Meanwhile, European governments began investing in research into biodiesel. However, lower oil prices from the mid-1980s once again removed the heat from biofuel development. Even after commercial biodiesel production commenced in the early 1990s, its take up was gradual (Figure 2.2).

A dramatic shift in biofuel production occurred in 2003, when prices for a barrel of crude oil began to rise above US$ 25. For the first time, governments in OECD counties started to regard biofuels as serious potential rivals to petroleum fuels, and created a raft of new biofuel incentives. From that point on, biofuel production in OECD countries has risen exponentially.

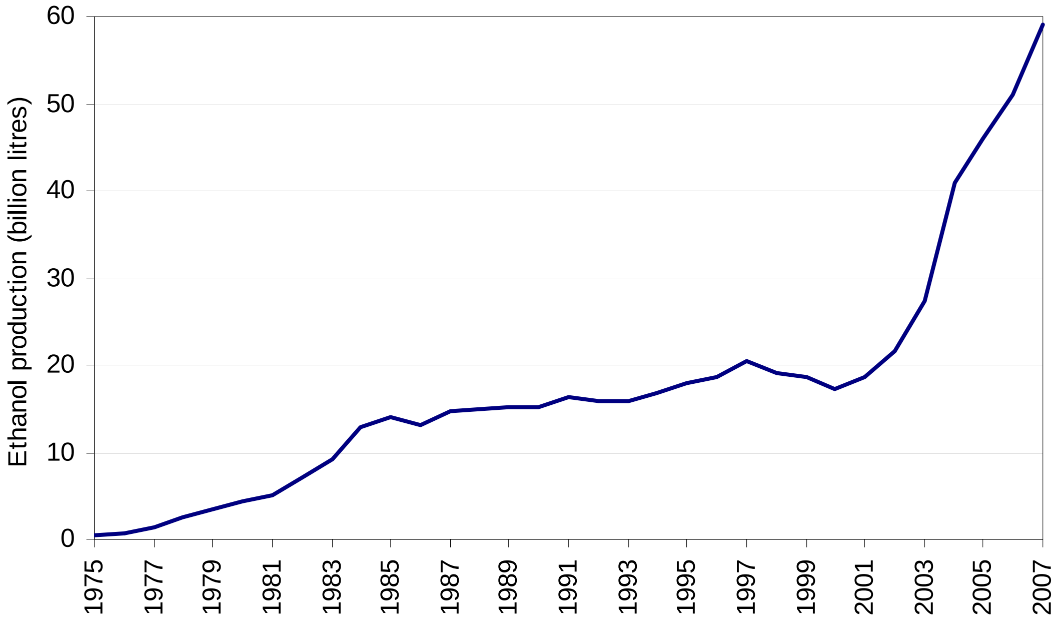
Total world biofuel production is now somewhere between 60 and 65 billion litres a year, compared with production of just under over 5,000 billion litres of petroleum (IEA, 2006).

2.1.1 Ethanol

In the decade between 1991 and 2001, world ethanol production rose from around 16 billion litres a year to 18.5 billion litres. From 2001 to 2007, production is expected to have tripled, to almost 60 billion litres a year.

The majority of this ethanol production occurs in the countries discussed in this report (Table 2.1). Brazil was the world's leading ethanol producer until 2005 when U.S. production roughly equalled Brazil's. In 2006 the United States moved into first position. China holds a distant but important third place in world rankings, followed by India, Germany, Spain and France. Production of ethanol for fuel commenced only recently (in 2005) in Switzerland, in large part because of the high prices of its sugar and starch yielding crops, but also because of a law that remained in effect until 1997, effectively banning the domestic production of ethanol from crops. In contrast with other countries, its production (just under 1 million litres in 2005) is based entirely on wood cellulose.

Figure 2.1 World production of ethanol, 1975-2007[1]



(1) All grades, including beverage and industrial use as well as fuel use.

Data source: • **1975-2003:** F.O. Licht, as reported by Worldwatch Institute (Vital Signs Online): www.wordwatch.org/node/4344; • **2004-2006:**.Renewable Fuels Association: www.ethanolrfa.org/industry/statistics/; • **2007:** GSI estimate.

Table 2.1 Biofuel production in the OECD countries studied by the Global Subsidies Initiative, relative to world production (million litres)

Region or country	2006 ethanol production	2006 biodiesel production[1]
Australia	148	82
Canada (estimate)	422	59
European Union	1 592	4 859
Switzerland	1	10
United States	18 378	850
Other OECD	223	100
OECD total	20 764	5 960
Rest of the world	30 297	650
.of which Brazil	*17 000*	*68*
World	**51 061**	**6 510**

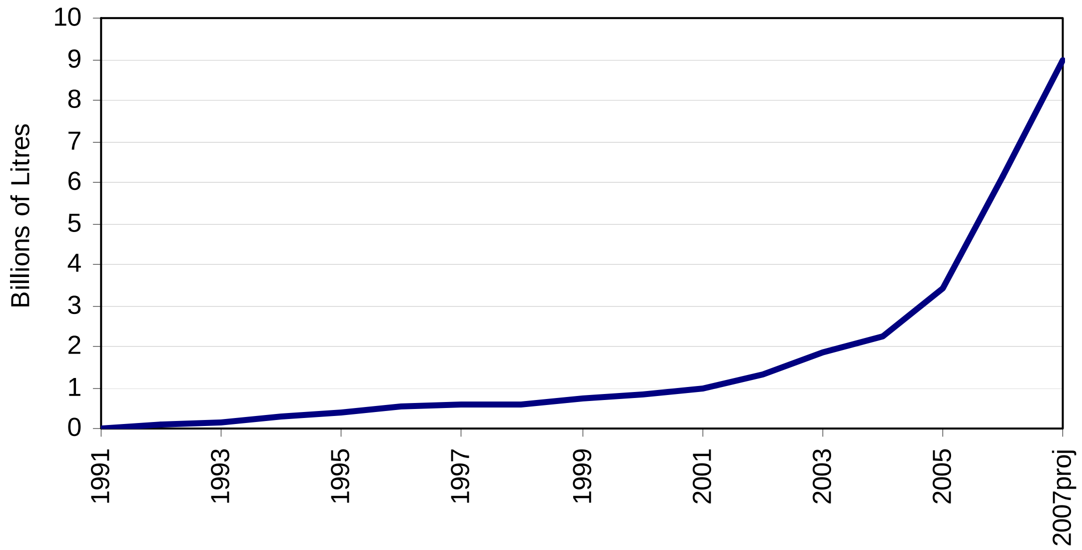
(1) Includes straight vegetable oil used as a fuel.

Sources: • **Ethanol:** Renewable Fuels Association (www.ethanolrfa.org/industry/statistics/) based on data from F.O. Licht; • **Biodiesel:** OECD countries are GSI estimates from various sources; non-OECD countries are from F.O. Licht.

2.1.2 Biodiesel

Growth in biodiesel production has followed a similar trajectory. Between 1991 and 2001, world production grew steadily to approximately 1 billion litres. Most of this production was in OECD Europe and was based on virgin vegetable oils. Small plants using waste cooking oils started to be built in other OECD countries by the end of the 1990s, but the industry outside Europe remained insignificant until around 2004. Since then, governments around the world have instituted various policies to encourage development of the industry, and new capacity in North America, south-east Asia and Brazil has begun to come on stream at a brisk rate. As a result, between 2001 and 2007, biodiesel production will have grown almost ten-fold, to 9 billion litres (Figure 2.2). The majority of world biodiesel production takes place in the OCED countries included in this report (Table 2.1)

Figure 2.2 World production of biodiesel, 1991-2007



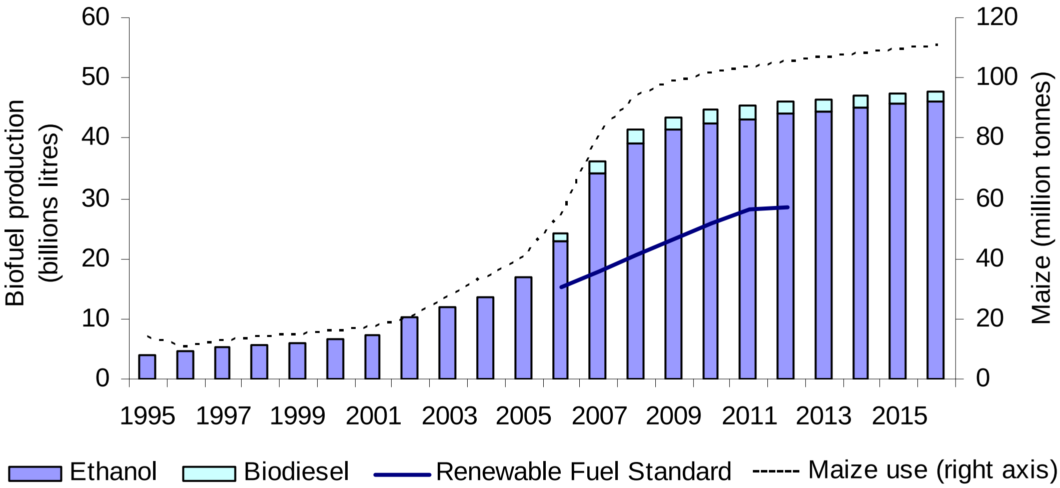
Data sources: • **1991-1999:** F.O. Licht, as reported by Worldwatch Institute (Vital Signs Online): www.wordwatch.org/node/4344; • **2000-2007:**.F.O. Licht, "World biodiesel production growth may slow in 2007", *FO Licht's World Ethanol & Biofuels Report*, Vol.5, No.14, 23 March 2007.

Most of the new biodiesel capacity is designed to use virgin vegetable oils, although facilities using recovered waste oil continue to be built, as well as some large-scale plants using tallow as feedstocks. In Argentina, Brazil and the United States, soybean oil has so far been the feedstock of choice. In Canada, the EU, Switzerland, Russia and Eastern Europe, oilseed rape (canola) remain dominant. Companies in Malaysia and Indonesia are building plants based on palm oil and palm-kernel oil. Elsewhere, governments and entrepreneurs are experimenting with producing biodiesel from nitrogen-fixing and drought-tolerant plants such as like *Jatropha* or *Jajoba*, which produce non-edible oils.

2.1.3 Projected growth

Growth in biofuel production is expected to continue well into the next decade. New capacity continues to be built in many OECD countries and more plants are in the planning process. Mandated supply requirements, such as now exist in Canada, several member states of the EU, and the United States, provide certainty of demand and have encouraged ongoing investment in the industry. Figure 2.3 illustrates the expected rise in ethanol production in the United States. Based on OECD and FAO projections, production will far exceed mandatory consumption requirements and continue to expand even 10 years from now.

Figure 2.3 US ethanol and biodiesel production and corn use, 1995 to 2016 (projected)



Source: OECD and FAO, *OECD-FAO Agricultural Outlook 2007-2015,* Paris, 2007.

Biodiesel manufacturing capacity is also expected to continue to expand dramatically in the United States in the near-term. The National Biodiesel Board reports production capacity of over 7 billion litres for 2007, with a further 5.2 billion litres forecast to come online over the next 18 months.[1] However, Carriquiry (2007) estimates average capacity utilization at only 43 to 57 percent. And in 2006, estimated biodiesel sales were less than 1 billion litres. The Food and Agricultural Policy Research Institute (FAPRI, 2007) has estimated that, unlike ethanol, U.S. biodiesel production will start to decline, after peaking at around 2.2 billion litres in 2009. By 2016, production could fall to around 1.7 billion litres.

Both ethanol and biodiesel production are projected to rise strongly in the European Union over the next decade, with roughly equal quantities of each fuel (Figure 2.5). In all major biofuel-producing countries, the rise in biofuel production in the foreseeable future will be fed by crops traditionally used for food (e.g. Figures 2.3 and 2.4). This is partly because alternative feedstocks (such as crop waste, wood or oil-rich algae) are unlikely to be economically viable for many years. It is also because food-based crops provide a subsidized source of feedstock in some OECD countries.

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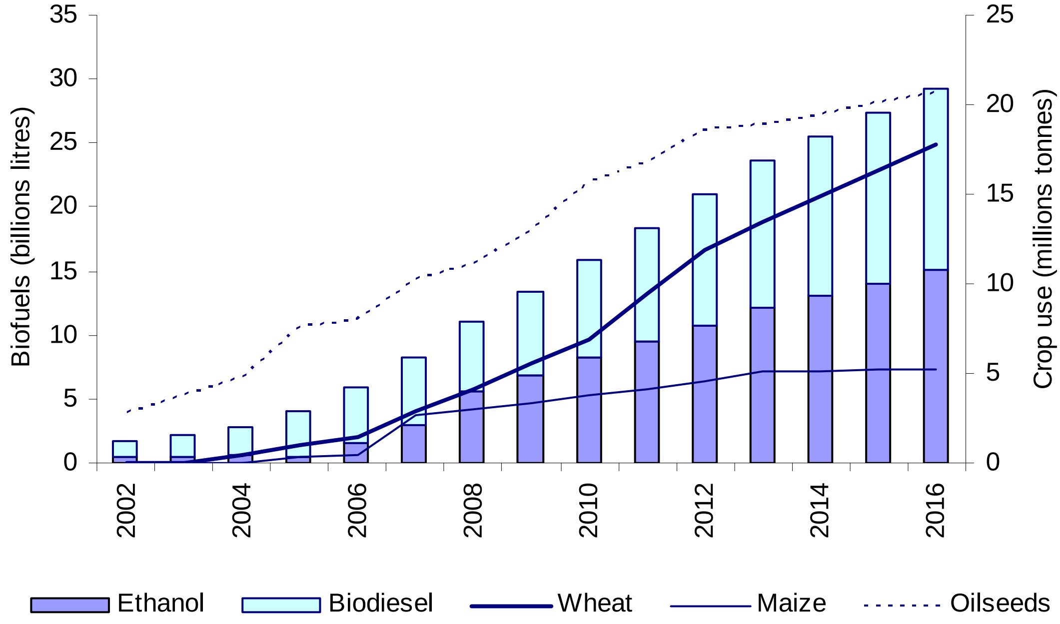
[1] National Biodiesel Board, "U.S. Biodiesel Production Capacity", mimeo, Washington, D.C., 7 September 2007 <www.biodiesel.org/pdf_files/fuelfactsheets/Production_Capacity.pdf>

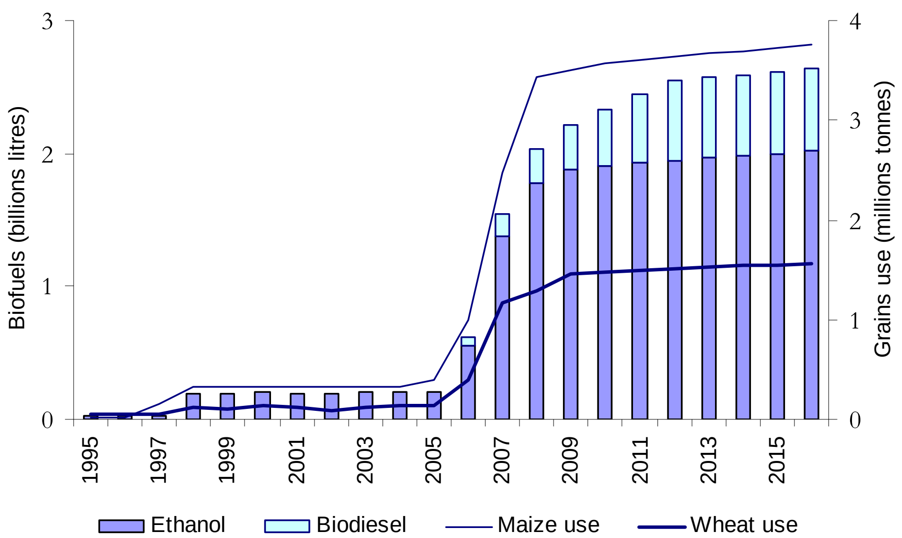
Figure 2.4 EU biofuel production and feedstock crop use, 2002 to 2016 (projected)



Source: OECD and FAO, *OECD-FAO Agricultural Outlook 2007-2015,* Paris, 2007.

Canada (Figure 2.5) and Australia have both been producing fuel ethanol and biodiesel for several years, but in relatively small volumes. As new capacity comes on line over the next few years, their output could increase substantially. In Canada's case, if all planned plants are built, it could have the capacity to produce 4 billion litres per year — 3 billion litres of ethanol and 1 billion litres per year of biodiesel — by 2010. The OECD and the FAO expect actual production in 2010 to be only slightly more than half that.

Figure 2.5 Canadian biofuel production and grain use, 1995 to 2015 (projected)



Source: OECD and FAO, *OECD-FAO Agricultural Outlook 2007-2015,* Paris, 2007.

2.2 Industry structure

The structure of the biofuel industry is highly diverse. It includes the individual farmers that grow the biofuel feedstock crops and small local companies that produce biofuel. Increasingly, it also includes large multi-national agricultural and petroleum companies that manufacture, blend and distribute the fuels. The biofuel industry is not vertically integrated like the petroleum industry to which it is often compared, although there is a trend towards consolidation of biofuel manufacturers and integrated processing to improve cost efficiency.

2.2.1 Feedstock production

Biomass feedstocks are produced mainly on farms, the size and ownership structures of which differ by crop and location The size of farms producing sugarcane tends to be larger than farms producing sugar beets, starch-based crops, such as maize and wheat, and oilseeds. Sugar cane is generally grown as a monocrop, but maize (for ethanol) and soybeans (for biodiesel) are often grown in rotation on the same parcel of land, as are wheat, sugar beets and oilseeds. The other providers of feedstock are companies that collect yellow grease and other waste oils and fats. These companies tend to be small and local.

2.2.2 Manufacturing

Because ethanol has emerged by and large as a by-product or alternative product of processing sugar and starch crops, ownership of production plants has so far been dominated by companies that were already major players in the agri-food business. The structure of the biodiesel industry can be described as bi-polar, with a few large companies involved in producing biodiesel on an industrial scale, and at the other end a large number of very small, often locally or farmer-owned companies. Many countries have instituted policies intended to encourage farmer-owned value-adding activities and therefore the number of plants owned by agricultural co-operatives remains significant.

Several companies stand out from among the crowd as major players on the manufacturing side, most notably Archer Daniels Midland (ADM), Bunge, Cargill and Louis Dreyfus. ADM is not only the leading manufacturer of bio-ethanol in the United States, but it is also the second-largest manufacturer of biodiesel in the EU. It has also invested in plants in Brazil and Indonesia. Few other companies have the same scale of international presence as the agri-business giants, though the number of companies operating in more than one country is increasing rapidly. Examples include Malaysia's Golden Hope (in The Netherlands), Spain's Abengoa (in the United States), and France's Tereos (in Brazil).

Although agri-food companies dominate, some energy companies — most notably BP and Conoco — have entered the business, as well as chemical companies (Dow), and specialist biodiesel producers (e.g., D1 Oils).

2.2.3 Distribution

The wholesale distribution (including blending) and retail segments of the biofuels industry is carried out by small and medium-sized companies in some countries and by large, sometimes state-owned, oil companies in others. In *Australia, Canada,* the *United States* and the *EU*, both ethanol and biodiesel are distributed through the existing networks of gasoline and diesel fuel distributors. A few companies have been created expressly to distribute and sell biofuels. In *Switzerland*, Alcosuisse, the commercial arm of the State Alcohol Board, manages the storage, blending and wholesale distribution of ethanol throughout the country, but fuel retailers sell the blended fuel to final customers.

2.2.4 End users

The majority of end users of biofuels are individual owners of private automobiles. In some countries, however, government agencies, including military forces, account for a significant share of purchases. In many countries, municipal governments have taken the lead in converting their fleets of vehicles to run on E85 or biodiesel-diesel blends. A number of cities around the world, from Auckland to Helsinki, now run at least some of their public buses on biodiesel blends.

Many state-owned enterprises have also decided to buy biofuels for their fleets. Switzerland's fuel-ethanol industry, for example, was kick-started by a decision by Swisscom, the state telecoms company, to cut back its fuel consumption by reducing the size of its fleet and using E5 in some of its vehicles.

Perhaps the biggest single consumer of biodiesel is the U.S. military, through its Defence Energy Support Center (DESC), which coordinates the U.S. federal government's fuel purchases. The DESC is the largest single purchaser of biodiesel in the United States and has been procuring B20 for its administrative vehicles since 2000.

Box 2.1 Ethanol and biodiesel production processes

Ethanol is a clear alcohol that can be used as a fuel in spark-ignition engines, either neat or blended with gasoline. The energy content of fuel ethanol is only around two-thirds that of gasoline (regardless of the feedstock used), but it has a significantly higher octane rating.

Fuel ethanol can be either hydrous (also called "hydrated") and anhydrous. Hydrous ethanol typically has a purity of about 95 percent and has been used in Brazil since the late 1970s as a fuel in motor vehicles with modified engines. Further processing to remove the water produces a high-purity anhydrous ethanol that is typically blended with petrol for use in unmodified engines.

More than 95 percent of the world's ethanol is produced from plant-derived matter, mainly sugars and starches. The rest is produced synthetically, from petroleum or coal. The majority of world ethanol production is derived from fermentation of plant material and used as fuel. Less than 25 percent of total ethanol production is used for beverage or industrial purposes, and the rest is used for fuel (Berg, 2003).

Fermentation from sugar-cane or molasses involves the decomposition of glucose into ethanol and carbon dioxide, then heating to distil the ethanol. Nowadays, bagasse (sugar-cane residue) is typically burnt to generate the heat needed for processing. Most sugar-derived ethanol is produced in the tropics and subtropics but some is produced in northern climates from sugar-beet.

Starch-derived ethanol can be made from crops such as maize (corn), wheat, rye, cassava, potatoes or sorghum. Manufacturing facilities usually use either a dry-milling or a wet-milling process. In dry milling, the grain is ground and water added to form a mash, to which enzymes are added to convert the starch to dextrose. The mash is fermented, yielding a "beer" containing ethanol, carbon dioxide, water and solids. Further processing concentrates the ethanol and dehydrates the solids, yielding dried distillers' grains, a high-protein feed for livestock. In wet milling, the grain is broken down using water and dilute sulphuric acid, and then processed to yield germ, fibre, gluten and starch. The starch is fermented and distilled as in the dry-milling process and gluten meal is produced as stock feed.

Distillation of ethanol from wine involves heating to separate the ethanol content. It is common only in Europe and is expected to diminish over time as the wine industry is restructured to avoid major surpluses.

These processes are known as *first-generation* technologies. *Second-generation* technologies are under development to commercialise production of ethanol from cellulosic material, such as crop waste, wood and grasses. In second-generation ethanol manufacturing plants, the cellulose and hemi-cellulose constituents of the biomass are typically converted into simple sugars either biologically, using enzymes, or chemically, using acids and high temperatures.

Biodiesel is typically produced from vegetable oil or animal fat. In a process known as transesterification, the fat or oil is reacted with an alcohol (usually methanol synthesized from natural gas) in the presence of a catalyst to yield mono-alkyl esters (biodiesel) and glycerine. Other by-products can include fatty acids, fertilizer and oilseed meal. Many of these by-products have a value, particularly the glycerine and oilseed meal (e.g. soybean meal used for both human and animal food). The energy content of biodiesel varies between 88 percent and 99 percent that of diesel, depending on the feedstock and esterification process used (Love and Cuevas-Cubria, 2007).

In OECD countries, biodiesel manufacturing has typically started out using low-value oils, such as used cooking oil (also known as "yellow grease"), fish oil or tallow as feedstocks. Because of the limited supply of these sources, manufacturing plants based on them rarely exceed annual capacities of 30 million litres, and most have capacities of 5 million litres per year or less. As low-cost supplies of these fats are exhausted, additional capacity has been based on virgin vegetable oils. The largest plants now being built have annual capacities greater than 325 million litres per year.

Over 50 plant species produce extractable oils. All have potential for use as fuel, but most are prohibitively expensive. The main oils used for fuel are derived from soybeans, oil-palm fruit or kernels, coconut, rapeseed (canola), sunflower seed, and physic nut (*Jatropha curcas*). Another possible source of lipids are oil-rich microalgal feedstocks. Producing biodiesel from algae is still at the research and demonstration phase, however.

Several alternative technologies are vying to replace trans-estification, the costs of which are highly sensitive to rises in the prices of oils and fats. One new process uses existing equipment at the oil refineries to create a diesel substitute (called "renewable diesel") from animal fats or vegetable oils. Longer term, diesel substitutes may be synthesized from almost any type of low-moisture biomass using the Fischer-Tropsch (F-T) process. Although the F-T process is well developed, and has been used to make liquid fuels from fossil-fuel feedstocks, production from biomass is still at the research and demonstration stage.

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3 Government support for liquid biofuels

3.1 A framework for understanding industry support

Figure 3.1 illustrates the framework used in the GSI's country studies 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. In the GSI's analyses, we focused 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, fell outside the boundaries of the analyses.

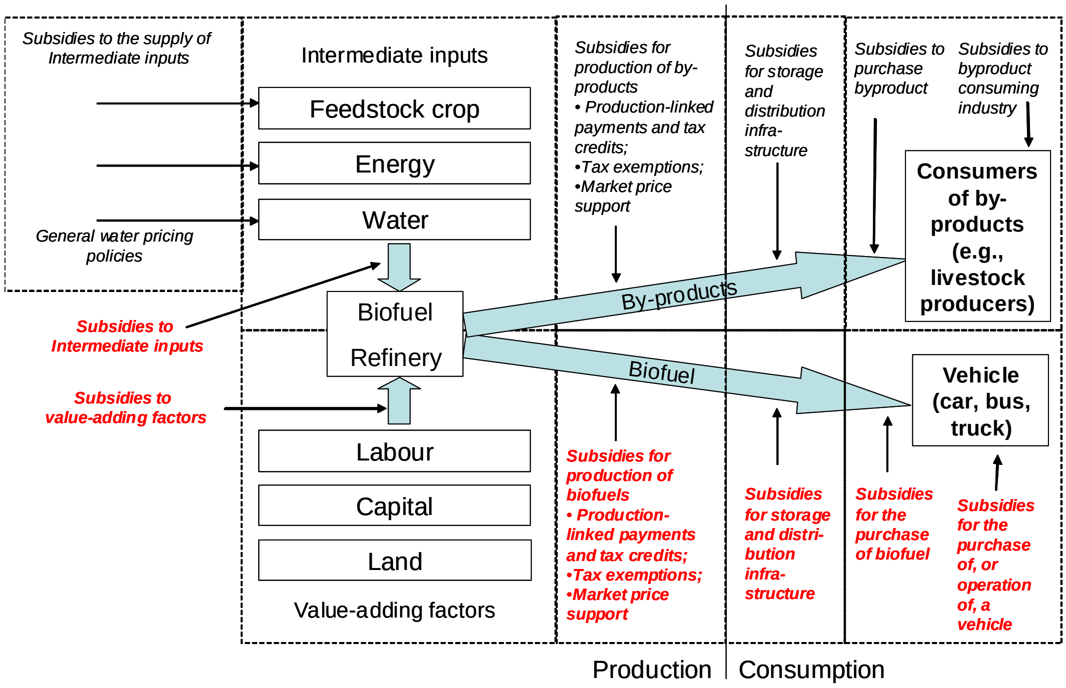
At the beginning of the supply chain are subsidies to what economists call "intermediate inputs"— goods and services that are consumed in the production process. The largest of these are usually subsidies to producers of feedstock crops used to make biofuels — maize (corn), wheat, sugar beet and sugarcane for ethanol, and oilseed rape and soybeans for biodiesel. In some countries, the crop subsidies are small enough, or decoupled from inputs or outputs, that they can therefore be considered largely wealth transfers that do not materially affect supply or prices. In others, border protection raises the domestic prices of the crops above international prices, thereby effectively taxing consumers of those crops, including biofuel producers. A few countries compensate for these "taxes" on the input feedstocks by providing countervailing subsidies to biofuel producers. To the extent that production of the feedstock crops creates a demand for subsidies, the proportional share of the total subsidies to those crops used in the production of biofuels 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 are often complemented by subsidies to value-adding factors—capital goods; land; and occasionally labour employed directly in the production process. These may take the form of grants, or reduced-cost credit, for the building of ethanol refineries and biodiesel manufacturing plants. Some localities are providing land for biofuel plants for free or at below market prices as well. 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 protection from foreign competition through import tariffs on ethanol and biodiesel; exemptions from fuel-excise taxes; and grants or tax credits related to the volume produced, sold or blended. Although in a few cases, tax exemptions and subsidies have been used to actually depress biofuel (mainly ethanol) prices below the energy-equivalent cost of competing petroleum fuels, mainly they have enabled biofuels to be sold at retail prices that are roughly at parity with their (taxed) fossil-fuel counterparts.

Support to the downstream side of the biofuel market has generally been provided in one of five ways: credit to help reduce the cost of storing biofuels, which often have to be segregated from fossil fuels until just before blending; grants, tax credits and loans to build dedicated infrastructure for the wholesale distribution and retailing of biofuels; grants to demonstrate the feasibility of using biofuels in particular vehicle fleets (e.g., biodiesel in municipal buses); measures to reduce the cost of purchasing biofuel-capable fleets; and government procurement programs that give preference to the purchase of biofuels.

Figure 3.1 Subsidies provided at different points in the biofuel supply chain



Source: Global Subsidies Initiative.

A diagram such as Figure 3.1 is helpful for visualizing the different points at which governments intervene in the market for biofuels. When discussing support policies, however, it is standard to structure the discussion in an order reflecting the degree of influence on market outcomes. Generally, policies that directly bear on the level of production or consumption are considered to have the greatest level of distortion on production decisions, followed by subsidies to intermediate inputs, and subsidies to value-adding factors. Government support for research and development (R&D), as long as it is not production support in disguise, is normally the least distorting.

Following this structure, this section of the paper provides a brief survey of the types of support measures identified in the course of the GSI's studies of support for ethanol and biodiesel in Australia, Canada, the EU and its Member States, Switzerland, and the United States. Most other OECD countries are also producing some biofuels, and several are considering mandating their use. A synopsis of the situation in these countries is provided in Box 3.1.

Box 3.1 Biofuel policies of OECD countries not covered in this report

Biofuels are being promoted in other OECD countries besides the ones examined so far by the GSI. While some have looked to emulate the policies of other countries, others have decided to proceed more cautiously, or to rely on imports instead of domestic production.

Japan

Japan's ability to become a significant producer of biofuels from crops is constrained by the high opportunity cost of growing biomass on its limited arable land, and the priority it gives to producing some of its food and feed requirements domestically. (The country already imports some 60 percent of its food.) However, in 2006, the government unveiled a plan to reduce fossil-fuel dependency by 20 percent by 2030; a goal that would be achieved in part by policies to promote the consumption of biofuels (Siu, 2007).

A number of these policies are slated to come into effect in 2008 fiscal year. The Ministry of Economy, Trade and Industry announced plans to introduce a preferential tax system for biofuels for FY 2008, which would see the ethanol component of blended gasoline exempt from the gasoline tax of ¥ 53.8 (US$ 0.47) per litre, and the biodiesel component of petroleum diesel exempt from the oil delivery tax of ¥ 32.1 (US$ 0.28) per litre. Subsidies to retail outlets that sell gasoline blended with biofuels will also be offered; US$ 8.40 million has been allocated for the first year of the program [1].

Currently, Japan imports the bulk of its ethanol (some 509 million litres in 2006), most of which comes from Brazil [2]. Import duties, currently 20.3 percent for undenatured ethanol, will be systematically lowered through to 2010. Japan's limited agricultural land has not stopped it from looking at innovative ways to produce biofuels domestically, however. Notably, the government has said it is eyeing disposable wooden chopsticks (the nation uses some 90,000 tonnes of them each year) as a possible source of fuel. The Ministry of Agriculture, Forestry and Fisheries says it is currently weighing the "pluses and minuses" of such a strategy.

Mexico

Mexico produces 170 million litres a year of ethanol, mainly for beverage and pharmaceutical uses. Manufacturers are protected by a most-favoured nation tariff of 10 percent plus US$ 0.36 per litre on both undenatured and denatured ethanol. The country's annual production of biodiesel is approximately 3,300 tonnes (3.75 million litres) [3].

In April 2007, the Mexican parliament passed a Bio-Fuels Promotion and Development Law that would have required the state-owned Mexico Oil Company to add 2.6 million litres of ethanol daily (950 million litres annually) to the fuels it sold. A recent government study had identified sugar as the most feasible ethanol feedstock, but noted Mexico's arid and dry climate as a significant barrier to increasing irrigation-based production. However, on 1 September 2007 Mexican president Felipe Calderón vetoed the proposed law, saying that it focused too much on producing ethanol from sugarcane and maize, while ignoring other new technologies that could allow for seaweed-based and cellulosic biofuel feedstocks [4].

New Zealand

Ethanol is currently produced mainly from whey in New Zealand, and provides just 0.3 percent of the country's overall gasoline requirements. Ethanol is exempted from the NZ$ 0.42524 (US$ 0.30) per litre excise tax charged on gasoline. To date very little biodiesel has been produced, but that situation could soon change. New Zealand's substantial meat processing industry is well placed to provide tallow to be converted to biodiesel, and several companies have announced that they are looking for suitable sites to construct plants.

Legislation set to be passed in 2007 establishes mandatory targets for the use of biofuels. Under this legislation, fuel merchants will be required to incorporate an amount of biodiesel equal to 0.53 percent (on an energy equivalent basis) of their total fuel sales, beginning 1 April 2008. The legislation also foresees the introduction in 2012 of a requirement that biofuels account for 3.4 percent of total petrol and diesel sales, on an energy equivalent basis [5].

Norway

In the late 1990s Norway passed legislation that provided tax incentives for biodiesel capital investments, but it remains a minor producer, mainly from fish oil and used cooking oil. In 2005, the country consumed approximately 1.4 million litres of biodiesel in the transport sector, mostly as a 2 to 5 percent blend with fossil diesel [6]. More recently, there has been substantial new production capacity based on imported rapeseed oil [7]. Meanwhile, Norwegian oil company Norsk Hydro ASA and paper maker Norske Skog ASA are studying the feasibility of producing biodiesel from wood products, with the aim of building a biomass-to-liquids (BTL) plant in Norway by 2012 [8].

The Norwegian government has announced a mandatory blending requirement of 2 percent volume share of biofuels in 2008 and a 5 percent share in 2009, with the goal of reaching a 7 percent volume share in 2010 — equivalent to the EU's target of 5.75 percent on energy-content basis [6]. Low blends of biodiesel are exempt from fuel-excise taxes in Norway, which has helped spur uptake of B5. By contrast, low blends of ethanol in gasoline do not benefit from any tax exemption and therefore their uptake has been lower than for biodiesel. E85 is, however, tax exempt.

In September 2007, the Norwegian oil company, Statoil, and Brazil's main oil company, Petrobras, agreed to cooperate on the development and production of biofuels, as well as to expand petroleum-sector cooperation [9].

South Korea

South Korea's biofuel policies have focused mainly on biodiesel. In 2007, the government announced that diesel would be blended with three percent biodiesel by 2012. The government has said that it intends to eventually impose a mandatory five-percent blend. South Korea imports the bulk of its fuel stocks for biodiesel (mainly soybean oil and used frying oil). However, the government has indicated that it is interested in producing biomaterials domestically [10]. For 2007 the government has allocated 2.6 billion won (US$ 2.8 million) to encourage the domestic production of rapeseed.

South Korea has been less enthusiastic in its support of ethanol as a transport fuel: the country is a major producer of the fuel additive methyl tertiary butyl ether (MTBE), which ethanol often replaces when blended with gasoline [11]. Nonetheless, the Ministry of Commerce, Industry and Energy plans to spend some US$ 7 million in 2006-2007 on feasibility studies for using ethanol [12].

Turkey

Production of biodiesel in Turkey is expected to take off in coming years as the country aligns its regulations with those of the EU, including the EU directives relating to the encouragement of biofuels. Displacing 2 percent of Turkey's annual consumption of petroleum products or around 35 million tones would require at least 700,000 tonnes a year of vegetable or animal oil. In order to increase supplies, the Ministry of Agriculture is considering providing incentives for the production of canola [13].

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Information sources:

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[2] "Japan Biofuels Production Report 2006", GAIN Report, USDA Foreign Agricultural Service, 26 May 2006

[3] "Mexico Biofuels Production Report 2006", GAIN Report, USDA Foreign Agricultural Service.

[4] Arturo Barba, "Mexican president vetoes biofuel law", *SciDev.Net*, 14 September 2007, <www.scidev.net/news/index.cfm?fuseaction=printarticle&itemid=3892&language=1 >

[5] "New Zealand Biofuels Policy, Production and Market Potential 2007", GAIN Report, USDA Foreign Agricultural Service, 21 February 2007.

[6] "Norway announces $3.2 billion biofuel fund", *Biofuel Review*, 13 June 2006, downloaded on 17 September 2007 from <www.biofuelreview.com/content/view/102/>.

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[9] Statoil, Collaboration agreement with Petrobas (media release), 14 September 2007, downloaded on 17 September 2007 from www.statoil.com.

[10] "South Korea Biofuels Production Report 2006", GAIN Report, USDA Foreign Agricultural Service, 26 May 2006

[11] "Snapshot of the agrofuel situation in some Asian countries", *Seedling*, July 2007IOL, Norwegians explore biodiesel options, 26 May 2006 <www.iol.co.za/index.php?set_id=14&click_id=143&art_id=qw1148645885588B256>.

[12] Globe-net market reports, 14 September 2007.

[13] U.S. Commercial Service (2006), Turkey: Biogas and biodiesel market in Turkey, January 2006 <http://commercecan.ic.gc.ca/scdt/bizmap/interface2.nsf/vDownload/ISA_5940/$file/X_3617351.DOC>.

3.2 Current support for ethanol and biodiesel

3.2.1 Output-linked support

Domestic production of biofuels is supported by governments through two main instruments: border protection (mainly import tariffs) and volumetric production subsidies. Regulations mandating usage or blending percentages, and fuel-tax preferences, stimulate production indirectly as well. But whether that production occurs within a country's borders or elsewhere depends in part on the level of border protection.

Tariffs applied by several OECD countries on fuel ethanol remain high, while tariffs on biodiesel are low

Most countries producing bio-ethanol apply a most-favoured nation (MFN) tariff that adds at least 25 percent, or US$ 0.13 per litre, to the cost of imported ethanol (Table 3.1). Some tariffs, such as the EU's for denatured ethyl alcohol, can add 50 percent to the import cost.[2] The import duty on ethyl alcohol applied by Australia is set at the same level as the federal fuel excise tax on ethanol (and is among the highest in the OECD); however, domestically produced ethanol can qualify for a rebate of that tax.

Table 3.1 Applied tariffs on undenatured ethyl alcohol (HS 2207.10) in several representative countries, as of 1 January 2007

Country	Applied MFN tariff (local currency or ad valorem rate)	At pre-tariff unit value of $ 0.50/litre		Exceptions (in addition to other WTO member economies with which country has a free-trade agreement) or notes
		Ad valorem equivalent (percent)	Specific-rate equiv. (U$/litre)	
Australia	5% + A$ 0.38143/litre	51%	0.34	USA, New Zealand
Brazil	0%	0%	0.00	Lowered from 20% in March 2006
Canada	C$ 0.0492/litre	9%	0.047	FTA partners
European Union	€ 19.2/hectoliter	52%	0.26	EFTA countries, developing countries in GSP
Switzerland	CHF 35 per 100 kg	46%	0.232	EU, developing countries in GSP
United States	2.5% + $0.51/gallon	28%	0.138	FTA partners; CBI partners

Sources: GSI country reports and DG Trade, European Commission, "Market Access Database", http://mkaccdb.eu.int/mkaccdb2/indexPubli.htm.

Various exemptions from the MFN tariff and tariff-rate quotas apply. Biofuels are often charged at zero or reduced duty when imported from countries with which the importing country has signed a free-trade

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[2] The World Customs Organization (WCO), of which all OECD countries are members, specifies two tariff lines for ethyl alcohol (ethanol) under its Harmonized Commodity Description and Coding System (HS): HS 2207.10 (undenatured ethyl alcohol of an alcoholic strength of at least 80 percent by volume) and HS 2207.20 (denatured ethyl alcohol of an alcoholic strength of at least 80 percent by volume). Most fuel-grade ethanol is traded in undenatured form — i.e., containing only pure ethyl alcohol and a small percentage of water. The United States further distinguishes between ethyl alcohol intended for use as a fuel from ethyl alcohol destined for beverages and other end uses, and charges an additional, "secondary" tariff on the former.

agreement, or which are covered by their General System of Preferences (GSP) (Box 3.1). The country coverage of these GSPs differ. Switzerland includes Brazil in its GSP, the EU does not. The United States maintains a low tariff-rate quota for ethanol imported from certain Caribbean countries under its Caribbean Basin Initiative, and Canada and the United States, as partners in the North American Free Trade Agreement (NAFTA), allow in imports of biofuels from each other duty-free.

Biodiesel, which is classified as a chemical under HS 3420.90, along with a wide number of other chemicals, is subject to much lower import tariffs than ethanol; these tariffs range from 0 percent in Switzerland to 6.5 percent in the EU. Australia applies an excise duty of A$ 0.38143 per litre on imported biodiesel, but as this duty is refunded, the effective duty is zero.

Box 3.1 Trade preferences for ethanol and their consequences

Besides offering protection for domestic producers of these biofuels and feedstocks, enabling some production to take place that would not otherwise, the differential application of tariffs due to bilateral and regional trade arrangements and general systems of preferences can be trade-diverting. For example, prior to 1 July 2005, Pakistan benefited from Special Arrangements for Combating Drug Production and Trafficking under the EU's Generalized System of Preferences (GSP) anti-drug regime. Able to export its ethanol to the EU at zero tariff, it became the EU's second-leading foreign supplier of ethanol (Bendz, 2005). Once brought under the General Regime, Pakistan was still able to benefit from a 15 percent reduction in the import duty on ethanol for six months. But as of 1 January 2006, ethanol was withdrawn from the scope of the General Regime, which meant that Pakistan lost all preferences on its ethanol. Following the change in July 2005, Pakistan reported that the resulting loss of trade had led to the closing of two of its seven operating distilleries, and that another five new distilleries would probably abandon plans to begin operations due to uncertainties in the market situation (Bendz, 2005).

A similar fate could one day befall ethanol exporters in Caribbean Basin nations, which currently benefit from a special concession dating from 1983 that grants them tariff-free access to the U.S. market on volumes up to 7 percent of U.S. domestic consumption. Rather than produce ethanol themselves, most dehydrate ethanol imported from Brazil, a value-adding step that meets the U.S. requirement that products qualifying under the tariff quota be "substantially transformed" if they do not originate from the countries themselves. In the past, Caribbean Basin nations have consistently been under-quota. But the prospect of exporting up to 9.3 billion litres of ethanol to the United States tariff-free (while still benefiting from the tax credit) — should a new, much higher level of renewable fuels be mandated by the United States — is now attracting a flurry of new investments in dehydrating capacity (Etter and Millman, 2007). Almost all of this capacity would become redundant should the U.S. Congress not renew the secondary tariff on ethanol when it expires at the end of 2008, or if it were to revoke the tariff-rate quota.

Source: Doornbosch and Steenblik (2007).

Most OECD countries exempt, or have at some stage exempted, biofuels from fuel-excise taxes

In addition to providing border protection, most OECD countries (and some U.S. states and Canadian provinces) support biofuel use (and therefore production, where border protection is effective) through tax preferences tied to fuel-excise taxes or sales taxes (Annex 1) normally charged on transport fuels.

The ***United States*** was one of the first OECD countries to grant reductions in taxes applied to a biofuel. In 1978 it started exempting gasohol (E10) from the US$ 0.04 per gallon fuel-excise tax, a benefit that was worth US$ 0.40 per gallon (US$ 0.11 per litre) of pure ethanol to producers at the time. However, over the ensuing decades, as volumes sold increased, the drain on the Federal Highway Trust Fund (to which the tax revenues were hypothecated), and the distortions it caused became untenable (Box 3.2). In 2004, therefore, the U.S. Congress eliminated the tax preference and introduced an income tax credit in its place. Numerous U.S. states still offer concessions on state-level fuel-excise taxes, sometimes on pure biofuels but in many cases for specific blends, such as E85. These preferences are typically around US$ 0.20 per gallon (US$ 0.055 per litre) but exceed US$ 0.40 per gallon (US$ 0.11 per litre) in Montana (for ethanol) and New York (for biodiesel). Several states also exempt biofuels or biofuel blends from state sales taxes (similar to VAT in other countries) which are normally applied to petroleum fuels.

Box 3.2 The problem with exempting liquid biofuels from road taxes

In many countries, revenues from fuel-excise taxes flow straight into the treasury, and are not truly an element of "transport policy". In Canada, Switzerland and the United States, however, revenues from fuel-excise taxes are hypothecated to separate Trust Funds, from which investments in transport infrastructure are financed.

The United States was one of the first OECD countries to exempt ethanol-petrol blends from a fuel-excise tax, in 1979. The exemption had the unintended economic consequence of reducing appropriations from the Highway Trust Fund even to states that sold no gasohol. Rask (2004) estimates that between 1981 and 1996 U.S. state governments lost between US$ 3.2 billion and US$ 7.6 billion in highway funds (compared with the counterfactual of no federal tax relief on gasohol), and that some of the biggest losers were states such as Florida, New York, and Pennsylvania, which during those years sold very little fuel containing ethanol.[1] The hemorrhaging of the Highway Trust Fund only came to an end with enactment of the 2004 JOBS Creation Act, which eliminated the federal tax exemption for E10 and replaced it with a $0.51 per gallon credit against corporate income tax, called the Volumetric Ethanol Excise Tax Credit (VEETC). Meanwhile, at least one-third of U.S. states continue to apply lower fuel taxes to E10, E85, or biodiesel blends.

Switzerland has recently taken a slightly different approach. Although legislation passed by its Parliament in October 2006 would in the future exempt all liquid biofuels from at least a portion of the normal fuel-excise taxes, not just liquid biofuels produced in recognized "pilot and demonstration plants", the new policy is intended to have a neutral effect on the total stream of revenues from fuel taxes. The government will maintain this revenue neutrality by raising taxes on petroleum-derived liquid transport fuels.

1. These totals do not include revenue losses from the exemption of ethanol from fuel-excise taxes levied by some of the states themselves.

Canada began exempting the ethanol portion of blended fuels from the federal excise tax on petrol (now C$ 0.10 per litre) in 1992. In 2003 it created an exemption, worth C$ 0.04 (US$ 0.034) per litre, for biodiesel as well. Several of Canada's Provinces created their own exemptions for ethanol, and British Columbia, Manitoba, and Ontario exempt the biodiesel proportion of fuel blends from their fuel excise taxes. A few also have exempted biofuels from provincial sales taxes. The recent trend in Canada, however, is to replace fuel-tax exemptions with producer payments. Ontario and Alberta made the conversion (for ethanol) in 2007, and the federal government and Manitoba are expected to make the switch in 2008.

The ***EU*** has no Community-wide excise tax on transport fuels. Rather, it has authorized its Member States to grant tax preferences to biofuels, within limits. Exemptions or reductions from fuel excise taxes, expressed on a pure biofuel-equivalent basis, range up to € 0.65 (US$ 0.90) per litre, with many in the neighbourhood of € 0.30 to € 0.40 (US$ 0.40 to US$ 0.55) per litre. Since tax concessions are considered as state aids, they must be notified to and authorized by the Commission. The majority of Member States have notified tax-exemption schemes and as of July 2007 the Commission had approved all the requests it had received so far. Exemptions are usually granted for a fixed period of six years, and can be renewed.

EU Member States have pursued different paths regarding the taxation of biofuels. Some extend full or partial tax exemptions to all types of biofuels (blended or not), while others, such as Germany, limit this benefit to specific types of biofuels such as pure biodiesel (B100) or E85. Several countries — among which France and Italy — have opted for a production-quota system, whereby tax relief is granted only on the agreed amount of production from approved operators. A few other countries provide tax relief for an unlimited quantity of biofuels. Finally, some Member States have imposed mandatory supply objectives for biofuels and grant partial, full or simply no tax exemptions to all or some types of biofuels.

Several national and sub-national taxation policies have been implemented in such a way that they appear to violate the national treatment clause embodied in the General Agreement on Trade and Tariffs (GATT) and in most regional-trade agreements. In Canada, for example, several provinces exempted from provincial-level fuel-excise taxes only ethanol or biodiesel that is produced in the province. Similarly, ***Switzerland*** has also allowed only biodiesel, SVO and ethanol produced in approved Swiss "pilot and demonstration plants", on up to 20 million litres per year nationwide, to benefit from exemption from its fuel-excise taxes, though those stipulations are expected to be relaxed at the beginning of 2008 (see below). ***EU Member States*** that auction annual quotas for biofuel deliveries, and then grant those biofuels exemption from fuel-excise taxes, effectively restrict participation to these auctions to EU suppliers. ***Australia's*** policy of applying its national fuel-excise tax equally to domestically produced as well as imported ethanol, but then providing a grant to domestic producers that exactly offsets the excise tax, may be compatible with the letter of the WTO's national treatment clause, but discriminates against imports nonetheless.

Switzerland's planned transition to a new support scheme for biofuels is significant because of its implications for trade and the environment. In March 2007, the Swiss Government amended its Mineral Fuel Tax in a way that will in the future (probably starting in 2008) also tie tax benefits for biofuels to a system based on various environmental and social criteria (Box 3.3). Under the new rules, both domestic and imported biofuels that benefit from a reduced fuel excise tax require "proof of a positive total ecological assessment that ensures also that the conditions of production are socially acceptable". In addition, the government, "taking into account of the amount of domestically available renewable fuels, shall establish the quantity of renewable fuels that can be exempted from the tax at the time of the importation."

Box 3.3 The 23 March 2007 Amendments to Switzerland's Mineral Oil Tax Law pertaining to tax exemptions for biofuels

Article 12b — Tax exemption for fuels derived from renewable raw materials

Domestically produced fuels derived from renewable raw materials are exempted from the [mineral oil] tax in accordance with Paragraph 3.

The Federal Council, taking into account of the amount of domestically available renewable fuels, shall establish the quantity of renewable fuels that can be exempted from the tax at the time of the importation. This tax exemption can be granted only if the requirements of Paragraph 3 are also met.

The Federal Council shall establish for fuels derived from renewable raw materials:

a. The amount of the tax exemption, taking into account:

   i) in particular, the domestic supply of renewable raw materials;

   ii) the contribution that these fuels will make to environmental protection and the objectives of [the country's] energy policy;

   iii) the competitiveness of these fuels compared with fuels of fossil origin;

b. the minimal requirements relating to the proof of a positive total ecological assessment that ensures also that the conditions of production are socially acceptable.

Even more recently, a group commissioned by the government of the Netherlands in 2006 submitted their proposals to the Dutch Minister of Housing, Spatial Planning and the Environment on how to create a market for sustainable bio-energy (Creative Energie, 2007). The report proposes that access to any subsidies for biofuels be contingent on satisfying nine major criteria and numerous sub-criteria (Annex 2). According to Rembrant (2007):

> Many of these criteria still need to be worked out in further detail regarding how to monitor their compliance by bioenergy companies. A preliminary system with less stringent criteria will come into effect in the course of 2008 when the new subsidy scheme for sustainable energy of the Dutch Government will start to function. After that, several years of development and testing will take place, [so] as to put the full system of criteria with the relevant indicators and monitoring systems in place in 2011. By then, the European Commission probably will have proposed a similar system for the entire European Union.

Taken together, the proposed criteria are extremely stringent, and would be a challenge to satisfy, even by many producers in OECD countries. Moreover, they are in several cases highly prescriptive. For example, Criterion 2.2 stipulates that the biomass production "will not take place in areas with a high risk of significant carbon losses from the soil, such as certain types of grasslands, peat lands, mangroves and wet areas."

Direct production subsidies are becoming more common

The trend, however, has been to move away from fuel-tax exemptions or reductions, and towards volumetric (i.e., per litre or gallon) subsidies or consumption mandates, and in some countries even both. Concern to avoid trade disputes may be one reason for this shift; another is to reduce the cost to the public purse, especially where fuel-excise taxes are the main source of funding for highway construction or maintenance.

The leading country in the use of volumetric subsidies is the ***United States***. In 2004 the federal government started providing a "volumetric ethanol excise tax credit" (VEETC) of US$ 0.51 per gallon ($ 0.135 per litre) to blenders according to the amount of pure ethanol they blend with gasoline.[3] It also grants a similar tax credit (the "volumetric biodiesel excise tax credit", or VBETC) to companies that blend biodiesel with petroleum diesel: US$ 1.00 per gallon ($ 0.264 per litre) for biodiesel derived from virgin agricultural fats and oils, and US$ 0.50 per gallon ($ 0.132 per litre) for biodiesel derived from waste oils. Moreover, they are worth more to recipients than the former excise-tax exemptions, because they are not themselves taxed as corporate revenue. An additional "federal small producer tax credit" of US$ 0.10 per gallon ($ 0.026 per litre) is granted on the first 15 million gallons (56 million litres) of ethanol or biodiesel produced by plants with an annual capacity of less than 60 million gallons (225 million litres).

Several U.S. states provide their own volumetric subsidies to support in-state production of ethanol or biodiesel at rates equivalent to US$ 0.20 per pure biofuel gallon or more. In August 2007, for example, the State of Kentucky introduced a US$ 1.00 per gallon tax credit for biodiesel, which will supplement the US$ 1.00 per gallon tax credit already provided by the federal government. At prevailing prices for petroleum diesel in that month, and adjusting for biodiesel's lower energy density, the combined US$ 2.00 per gallon ($ 0.528 per litre) subsidy is equivalent to almost 90 percent of the pre-tax retail value of the fuel. While state-level production subsidies add substantially to the profitability of production from existing facilities, they are often provided up to an annual limit.

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[3] Because the direct recipients of the VEETC and VBETC are blenders, they are not in a formal sense production subsidies. By raising the price at which blenders are willing to procure biofuels, however, producers benefit indirectly.

In a few U.S. states, producer payments or tax credits are contingent on the use of feedstock produced in the same state. Montana based ethanol producers, for example[4],

> … are entitled to a tax incentive of $0.20 per gallon of ethanol solely produced from Montana agricultural products, or if the ethanol was produced from non-Montana agricultural products when Montana products were unavailable. The amount of the tax incentive for each gallon is reduced proportionately, based upon the amount of agricultural or wood products not produced in Montana that are used in the production of the ethanol.

Missouri makes access to its Qualified Biodiesel Producer Incentive Fund contingent not only on local content (at least 80 percent of the feedstock used by a facility must originate in-state, and 100 percent in the United States), but also on ownership: at least 51 percent of the production facility must be owned by agricultural producers who are residents of the state and who are actively engaged in agricultural production for commercial purposes.[5]

In March 2007, with the release of its budget, ***Canada's*** federal government announced that, as from 1 April 2008, it too would eliminate the fuel-excise tax exemptions it provides for ethanol and biodiesel, and institute in their place specific producer payments. The federal government has allocated C$ 1.5 billion (US$ 1.4 billion) over seven years for these "operating incentives" to producers of renewable alternatives to gasoline, such as ethanol, and renewable alternatives to diesel, such as biodiesel, "under conditions where industry requires support to remain profitable" (Department of Finance Canada, 2007).[6] Payment rates from 2007 through 2009 will range up to C$ 0.10 (US$ 0.095) per litre for "renewable alternatives to gasoline" and up to C$ 0.20 (US$ 0.19) per litre for "renewable alternatives to diesel", then decline thereafter. Uniquely, no government support will be provided when rates of return earned by producers exceed 20 percent on an annual basis. Support under the program to individual companies will also be capped.

As in the United States, several Canadian Provinces (Alberta, Ontario and Quebec) have also created production incentives in the form of payments or income-tax credits. Manitoba's is expected to go into effect early in 2008. In all four cases, the production incentives cover ethanol. (Alberta's also covers biodiesel and biogas). Ontario's and Quebec's are calculated according to formulas that take into consideration relative prices between crude oil and ethanol. Alberta's and Manitoba's are straight-forward per-litre payments. Alberta caps the amount paid per plant (and provides a 55 percent higher per-litre payment for plants with an annual capacity less than 150 million litres). Manitoba will apply only a total cap, proportional to the province-wide mandated ethanol content in each year.

Australia began providing production subsidies for ethanol in 2003 and biodiesel in 2004. These open-ended subsidies completely offset the A$ 0.38143 (US$ 0.31) per litre fuel-excise tax charged on ethanol and biodiesel (as well as on gasoline and petroleum diesel), and are scheduled to be phased out between July 2011 and June 2015. By the end of this period, "normal" excise taxes will be applied to the fuels. These excise taxes will be lower than those for petroleum fuels, in line with the federal government's decision to move towards tax rates that are roughly proportional to the energy density of each fuel.

In the ***EU***, around 5 percent of its fuel-ethanol production is directly subsidized through the crisis-distillation mechanism for wine. This mechanism pays companies to distil alcohol out of wine low-quality wine, provided that the alcohol must then be sold for purposes other than potable use. In 2005, some 780 million litres of wine (equivalent to around 95 million litres of pure ethanol) were removed through

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4 Source: www.eere.energy.gov/afdc/progs/search_state.cgi?afdc/MT

5 The feedstock requirement may be waived on a month-to-month basis if the facility can provide proof that adequate feedstock is not available. See www.eere.energy.gov/afdc/progs/search_state.cgi?afdc/MO.

6 Prior to this decision, the Canadian province of Quebec was already offering a sliding-scale tax credit for ethanol that is based on the market price for West Texas Intermediate crude oil.

the crisis-distillation mechanism, at a total cost to the EU of € 185 million (US$ 230 million), or almost € 2 per litre of pure ethanol distilled. Slightly less than 30 percent of these quantities were subsequently sold as fuel ethanol. In 2006 the share of alcohol dedicated to fuel ethanol reached 50 percent. Other direct production subsidies to manufacturers of biofuels are granted mainly by the newer of the EU's Member States. This support has taken various forms. The Czech Republic applies subsidies based on current volume of output, whereas Latvia bases its subsidies on historical levels of output.

More and more, biofuel content is being mandated

Complementing many of the aforementioned volumetric support measures are various targets and mandated requirements for the amount or share of designated "renewable fuels" consumed as components of ethanol-petrol or biodiesel-diesel blends. Some of these targets and mandates do not discriminate by biofuels (Table 3.2). Many others are specific to either ethanol or biodiesel (Table 3.3). Generally, where specific blending targets or requirements are established, ones for ethanol are more commonplace than for biodiesel, and they tend to be set higher than for biodiesel. An example is Canada's recently established federal renewable fuel standards, which require "renewable alternatives to gasoline" to account for 5 percent (averaged nationwide) of the gasoline pool in 2010, versus 2 percent "renewable alternatives to diesel" in the diesel pool in 2012.

The most significant biofuel mandates — if only because of the volumes implied — are those of the United States and several member states of the European Union. The U.S. mandate (confusingly called a renewable-fuels "standard", which implies voluntary compliance) was established in the Energy Policy Act of 2005 and requires that 4.2 percent of the volume of fuel sold or dispensed to U.S. motorists in 2007 come from renewable resources. The minimum volume for 2007 will equate to about 4.7 billion gallons (17.8 billion litres) in 2007 and will increase each year until it reaches 7.5 billion gallons (28.4 billion litres) in 2012. The target volume for 2012 is actually expected to be achieved by 2008 or 2009, mainly by ethanol. In June 2007, the U.S. Senate passed a draft Energy Bill that would increase the RFS to 36 billion gallons (136 billion litres) a year by 2022.[7] About 60 percent of that is designated to come from cellulosic ethanol sources.

The ***EU*** first set an indicative target for biofuels content, aiming for 2 percent of liquid motor fuel demand in 2005 be met by "renewable fuels", which category includes straight vegetable oil (SVO) and biogas, as well as ethanol and biodiesel. The actual incorporation ratio in 2005 was less than 1 percent. The EU's target for 2010 is 5.75 percent and, despite it being only indicative, nine of its Member States have set mandatory blending requirements of their own in order to ensure that a certain percentage of biofuels is supplied on the market. While the majority of countries consider that their biofuel supply requirements do not alone provide adequate support for the sector, and therefore couple this obligation with partial or full excise-tax exemptions, two Member States, Germany and Luxembourg, have recently decided to abolish tax privileges for some biofuels.

A new ***EU*** directive on biofuels, expected by the end of 2007, might establish a mandatory requirement of 10 percent by 2020. If so, it could well allow only those biofuels whose cultivation complies with minimum sustainability standards to count towards the EU's renewable fuel targets. As a prelude to taking such a step, in January 2007 the ***European Commission*** announced a new pollution standard for motor fuels that would rely on developing an agreed method for measuring the full fuel-cycle carbon output of alternative fuels and a system of certification of the life-cycle carbon emissions of fuels, including biofuels.

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[7] Other bills submitted to Congress would set a target of 60 billion gallons (227 billion litres) by the year 2030.

Table 3.2 Use and blending share targets (T) and mandates (M) for liquid biofuels that can be met by either ethanol or biodiesel

Country	Type	Quantity or blending share	Comment
Australia	T	350 million litres by 2010	Indicative target
Victoria	T	5% by 2010	Voluntary but could become mandatory
EU	T	2% by 2005; 5.75% by 2010; 10% by 2020	2020 target still under discussion
Austria	M	2.5% by 2006 rising to 5.75% by 2009	
Belgium	T	2.5% by 2005, 5.75% by 2010	
Czech republic	T	3.7% by 2005, 5.75% by 2010	
Estonia	T	2% by 2005, 5.75% by 2010	
…Finland	M	2% by 2008, 4% by 2009, 5.75% by 2010	
France	M	7% by 2010; 10% by 2015	
Greece	T	0.7% by 2005, 5.75% by 2010	
Hungary	T	0.6% by 2005, 5.75% by 2010	
...Ireland	T	0.06% by 2005 (not applicable thereafter)	Ireland provides tax exemption within a quota
Italy	T	1% by 2005, 2.5% by 2010	
…Netherlands	M	2% by 2007, gradually rising to 5.75% by 2010	
Latvia	T	2% by 2005, 5.75% by 2010	
Lithuania	T	2% by 2005, 5.75% by 2010	
...Luxembourg	M	2% from 2007 onwards	
Poland	T	0.5% by 2005, 5.75% by 2010	
Portugal	T	2% by 2005, 5.75% by 2010	
...Slovakia	M	2% by 2006, 5.75% by 2010	
...Slovenia	M	1.2% by 2006, gradually rising to 5% by 2010	
...Spain	M	3.4% by 2009, rising to 5.83% by 2010	
...Sweden	T	3% by 2005, 5.75% by 2010	
...United Kingdom	M	2.5% by 2008, 3.75% by 2009, 5% by 2010	
USA (federal)	M	2.78% by volume of gasoline consumption in 2006 (4 billion gallons, or 15 GL); 7.5 billion gallons (28 GL) by 2012	Of which 0.25 billion gallons (0.95 GL) must be cellulosic ethanol in 2013. Credit rate varies by feedstock.
Iowa	T	10% by 2009; 25% by 2020	

Source: Global Subsidies Initiative based on country reports.

State and provincial-level biofuel mandates have been established by several sub-national jurisdictions in the Australia, Canada and the United States, often at higher levels than those in force at the time at the federal level, or even before a federal mandate existed. The U.S. State of Minnesota, for example, announced in 2003 that it would require 10 percent of gasoline consumption in 2010 be met by ethanol and that 2 percent of diesel consumption in 2005 be met by biodiesel. Subsequently, at least seven states (Hawaii, Louisiana, Missouri, Montana, New Mexico, Oregon and Washington) have established their own biofuel content requirements, as well as the city of Portland, Oregon. In 2006, Minnesota enacted legislation raising the ethanol content of gasoline to 20 percent, starting on 30 August 2013 (subject to federal approval).[8]

In ***Canada***, three provinces (Saskatchewan, Ontario and Quebec) had already established blending or volumetric requirements for biofuels prior to the announcement of the federal renewable fuel standards (RFS) in December 2006. Manitoba established a mandate for ethanol in 2003 under the Bio-fuels and Gasoline Tax Act, but never enforced it due to lack of production capacity in the province. It is expected that the completion of a new ethanol plant in the province at the end of 2007 will trigger early in 2008 a new mandate requiring that 8.5 percent of the gasoline pool contain ethanol.

In ***Australia***, the States of New South Wales and Queensland have both established their own mandatory state-wide blending targets for ethanol, even though the federal government has so far avoided establishing mandated levels or blends of biofuel use. ***Switzerland***, like the Australian federal government, has so far resisted pressure to mandate biofuel use.

Typically, establishing a biofuel content mandate has necessitated writing complex regulations and creating a considerable amount of bureaucracy to administer them. Not only do blenders or merchants have to register and report the volumes of biofuels they have sold or incorporated into fuel blends, but procedures have had to be developed for dealing with collective or individual failure to meet the target volumes or blending percentages. In many jurisdictions, penalties apply in the case of non-compliance. In some, tradable credits have been created, allowing companies that cannot easily comply with the regulations to purchase surplus credits from companies that can.

Several U.S. states (Louisiana, Montana, Oregon and Washington) and Canadian provinces (British Columbia, Saskatchewan, Manitoba and Quebec), have linked implementation of their biofuel-content mandates with the development of in-state or in-province manufacturing capacity for the mandated fuel. For example, Washington State requires that, for its requirement to go into effect before 2008, a positive determination would have to be made by the Director of the State Department of Ecology that feedstock grown in Washington State can satisfy a 2 percent biodiesel blending requirement. The biodiesel requirement would increase to 5 percent once in-state feedstocks and oil-seed crushing capacity can meet the needs of a 3 percent average blend. While not strictly a local-content requirement (and thus prohibited under WTO rules), such linkage between the development of local productive capacity and a regulation is likely to inhibit trade — not just international trade, but also within countries.

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8 239.791, Minnesota Statutes 2006.

Table 3.3 Use and blending share targets and mandates specifically for ethanol or biodiesel

Country	Ethanol			Biodiesel		
Province or state	**Type**	**Quantity or average blending share (percent)**	**Year**	**Type**	**Quantity or average blending share (percent)**	**Year**
Australia						
New South Wales	M	2% | 10%	2007 | 2011	—	None	—
Queensland	M	10%	2010	—	None	—
Canada						
Canada (federal)	M	5%	2010	M	2%	2012
British Columbia	M	5% (proposed)	2010	M	5% (proposed)	2010
Saskatchewan	M	1% | 7.5%	200X | *	M	2.5% | 5%	2008 | 2010
Manitoba	M	8.5% (proposed)	expected early 2008	—	None	—
Ontario	M | T	5% | 10%	2007 | 10%	—	None	—
Quebec	M	5% (proposed)	2012	—	None	—
EU						
Germany		3.6%	2010		4.4%	2007
USA						
Hawaii	M	85% of gasoline must contain ≥10% ethanol	2006	—	None	—
Louisiana	M	2%	(1)	M	2% (2)	200?
Minnesota	M	20%	2013	M	2%	2005
Missouri	M	10%	2008	—	None	—
Montana	M	10%	(3)	—	None	—
New Mexico	—	None	—	M	5%	2012
Oregon	M	10%	2007	M	2% | 10%	2007 (2010)
Oregon (Portland)	M	10%	2007	M	2% | 10%	2007 | 2010
Washington	M	2%	2008(4)	M	2%	2008(4)

(1) Requirement starts to apply within six months after monthly production of denatured ethanol, produced in the state, equals or exceeds an annual production volume of at least 50 million gallons (190 million litres). To qualify, the ethanol must be produced from domestically grown feedstock.

(2) Requirement starts to apply within six months after monthly production of biodiesel produced in the state equals or exceeds an annual production volume of 10 million gallons (38 million litres). To qualify, the biodiesel must be produced from domestically grown feedstock.

(3) Requirement starts to apply within one year after the Montana Department of Transportation has certified that the state has produced 40 million gallons (150 million litres) of ethanol and has maintained that level of production on an annualized basis for at least 3 months.

(4) Requirement could apply earlier if a positive determination is made by the Director of the State Department of Ecology that feedstock grown in Washington State can satisfy a 2 percent fuel blend requirement. The biodiesel requirement would increase to 5 percent once in-state feedstocks and oil-seed crushing capacity can meet a 3 percent requirement.

Data sources: GSI country studies.

3.2.2 Support to production factors and intermediate inputs

The main intermediate inputs used in the production of ethanol are the biomass feedstock, which in Australia is mainly molasses from sugarcane or waste wheat starch; in Canada, wheat; in the EU grains, sugarbeets and wine; in Switzerland wood-cellulose; and in the United States corn. Water, and fuels for providing process heat in the fermentation and distillation processes, are also important inputs to ethanol manufacturing, and methanol and sodium hydroxide to biodiesel manufacturing, but identifying subsidies to these inputs was beyond the scope of the GSI's studies.

OECD policies work in both directions on the prices of crops used as feedstocks and, indirectly (through the markets for fats and oils), on the prices of used cooking oil and tallow. Some policies help reduce the costs of production, some compensate producers for market prices that fall below a target price, while others — especially trade barriers — raise domestic prices.

One indicator of the degree to which the price paid for a product by consumers is raised by market-intervention policies is the consumer nominal protection coefficient (consumer NPC), which measures the ratio of the average price paid by consumers and the price at the border (both normalized to the price at the farm gate). Table 3.4 shows that in 2005, in most of the countries studied, the consumer NPC was close to unity for major biofuel feedstock crops — i.e., biofuel producers were not being penalized by policies that kept domestic prices for these crops higher than the same crops available from foreign suppliers.

Table 3.4 Nominal consumer protection coefficients for crops used, or that could be potentially used, as biofuel feedstocks, 2005

	Sugar (source)	Starchy grains	Oilseeds
Australia	Sugar cane: 1.00	Common wheat: 1.00	NA[1]
Brazil	Sugar cane: 1.00	NA	Soybeans: 1.00
Canada	NA	Wheat: 1.00 Maize: 1.00	Rape seed (canola): 1.00
EU	Beet sugar: 2.40	Common wheat: 1.08 Maize: 1.29 Potatoes: 1.10	Rape seed: 1.00 Sunflower seed: 1.00
Switzerland	Beet sugar: 3.51	Wheat: 1.46 Maize: 1.91	Oilseeds: 3.87
United States	Cane & beet sugar: 2.09	Maize: 1.00 Sorghum: 1.00	Soybeans: 1.00

1. Biodiesel in Australia is made principally from tallow and waste cooking oil.

Sources: • **Brazil:** OECD (2005); • **All other countries:** OECD, Producer and Consumer Support Estimates, OECD Database 1986-2005, www.oecd.org/document/55/0,2340,en_2649_37401_36956855_1_1_1_37401,00.html

There were some exceptions. Some potential ethanol feedstocks in several countries are made prohibitively expensive by policies, mainly border tariffs, that raise their internal prices. Thus, were domestic firms in Switzerland to start producing bio-ethanol from domestically grown crops, using a standard fermentation and distillation process, their costs of the feedstock would be much higher than faced by ethanol producers in other countries. The consumer NPC for crops imply that wheat was 46 percent more, maize 91 percent more, other grains 76 percent more expensive within Switzerland than available on international markets. Prices for sugar were 250 percent more expensive (i.e., almost 3½ times the world price).[9] Not surprisingly, Switzerland produced just over 1 million litres of ethanol in 2006, based entirely on wood cellulose.[10]

In the ***EU***, energy crops (which include crops used for heat and electricity, as well as for biofuel production) are subsidized both indirectly and directly. Since 1993, it has been possible to grow crops on set-aside land for industrial and energy purposes — i.e. non-food crops — in the EU. The available set-aside area has varied over time and is currently around 10 percent of total EU farmland. In 2006, the Commission reported that the regime has been, in practice, a significant measure favouring the development of energy crops, and that more than 95 percent of non-food crops grown in set-aside areas were indeed dedicated to energy crops. Farmers are compensated for setting aside land and thus this derogation can be considered as an indirect support to the production of crops used in the production of some form of energy.[11] In the ***Czech Republic***, the subsidy is more direct. Since 2001 its State Agricultural Intervention Fund has been buying rapeseed produced on set-aside lands and selling the feedstock to producers of RME at a price that enables the final product to be sold 10 percent cheaper than petroleum diesel fuel.

A separate, Energy Crop Scheme, was introduced by the EU as part of the 2003 reform of the Common Agricultural Policy. The scheme offers producers € 45 (US$ 61) per hectare of land that is used to grow crops for energy use. Initially, the scheme was only available to EU-15 members and Slovenia and Malta,[12] and all energy crops, except sugar beet, grown on a maximum guaranteed area of 1.5 million hectares were eligible for annual support. However, the reform of the EU sugar regime, beginning in 2006–2007, includes the possibility for sugar beet grown as a non-food crop to qualify for set-aside payments and energy crop aid, and to be excluded from production quotas.

3.2.3 Support to production factors

One of the most difficult forms of support to track for any industry is support for factors used in production, particularly capital plant. By definition, general policies designed to spur capital investment generally are not considered specific subsidies and therefore not counted in sectoral subsidy accounting. Specific budgetary allocations for grants, government loans or government guaranteed loans for capital investment are often reported, but details of the actual allocations (and in the case of loans and loan guarantees, the financial details) are less often made publicly available. That certainly seems to be the case for public assistance to investments in biofuel plants, which have benefited from a host of subsidies, many provided by sub-national governments.

In Australia, investments in biofuel facilities have been supported over the years by numerous, largely short-term and ad hoc grant schemes. The main programme in recent times was the Biofuels Capital Grants Program, which channelled A$ 37.6 million (US$ 28 million) to support three ethanol and four biodiesel plants in 2004. But other grants, worth tens of millions of dollars in total, were awarded between

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9 With the recent rise in world prices for grains and sugar, these price gaps may have narrowed.

10 Production of bio-ethanol for fuel commenced only very recently in Switzerland, in large part because of the high prices of its sugar and starch yielding crops, but also because of an anti-intoxication law that remained in effect until 1996, effectively banning the domestic production of ethyl alcohol from crops.

11 COM (2006) 500, "Report from the Commission to the Council on the review of the energy crops scheme", 22 September 2006.

12 The new member states choosing not to apply the Single Area Payment Scheme — SAPS (Slovenia, Malta) are subject to the same general conditions as the EU–15 Member States, except that the "phasing–in" established under Article 143a of Council Regulation (EC) No 1782/2003 applies. The energy crop scheme and its maximum guaranteed area and mandatory set aside (including the possibility of cultivating energy crops on those areas) therefore apply.

2001 and 2006 to support investment in biofuel plants under programmes to promote innovation, restructure the sugar industry, or reduce greenhouse gas emissions.

Information on support for capital investment in biofuel facilities in the EU is more difficult to come by than for other countries. No aggregate estimate is available, but Member State reports to the European Commission on their state aids to the industry indicate that government support may cover as much as 60 percent of total investment costs, though grant ratios of 15 to 40 percent are more common.

Canada, in contrast with the other countries examined, generally prefers to provide assistance to new plants through contingent loans — i.e., loans for which repayment depends on market conditions. Canada's first such programme, the Ethanol Expansion Program (EEP), ultimately provided over C$ 100 million (US$ 90 million) in contingent loans to support the construction of more than 1 billion annual litres of capacity. More recently, Canada announced that it would provide another C$ 200 million (US$ 190 million) in contingent loans to renewable fuels projects, starting April 2007.

The United States federal and state governments have used a mixture of capital grants and loan guarantees to support the construction of new biofuel facilities. Section 1512 of the United States' Energy Policy Act of 2005, for example, authorizes grants for building cellulosic ethanol plants, starting at US$ 100 million per year in 2006 and rising to US$ 400 million per year in 2008; Section 1510 authorizes loan guarantees on up to US$ 250 per facility producing ethanol from cellulosic biomass or municipal solid waste. State governments themselves have supported first-generation biofuel plants through various means, including providing access to tax-exempt bonds. And a number of municipalities have granted property-tax waivers or exemptions, or are financing upgrades of local infrastructure.

One phenomenon increasingly witnessed in federal systems is "subsidy stacking", wherein investors tap into multiple sources of public financing assistance. It is not uncommon for biofuel plants in the United States to benefit from a combination of municipal-government support, often in the form of free land or utility connections; state-level support, such as tax credits for investment, or economic development grants or loans; and support from federal agencies under various regional development, agricultural or energy programmes. While any one investment aid may not be sufficient to trigger development of a new plant, when they are combined with other programs the total value can be significant. In one specific plant examined in the U.S. state of Ohio, for example, more than 60 percent of the plant's capital is being provided by government-intermediated credit or grants.

In this context, one of the innovative features of Canada's Ethanol Expansion Program was the inclusion of a "stacking provision". This provision required that total assistance from all federal, provincial or territorial and municipal government sources represent no more than 50 percent of total project costs.[13] Moreover, successful recipients of EEP assistance had to disclose all sources of funding required for their project before entering into an agreement with the government. Upon completion of the project, the recipients must disclose all sources of funds received.

As with producer payments, grants and government loans have been used in several countries to encourage increased farmer participation in biofuel manufacturing, particularly in small and medium-size biofuel plants. The U.S. state of Minnesota, for example, specifically targeted farmer-owned ethanol co-operatives in its Ethanol Production Facility Loan Program (which ended in 1999). Similarly, Canada's two-year, C$ 20 million (US$ 19 million), Biofuels Opportunities for Producers Initiative (BOPI), is designed to help farmers and rural communities participate in increased Canadian biofuels production; its more recent, five-year C$ 200 million (US$ 190 million) ecoAgricultural Biofuels Capital Initiative specifically supports investments that involve at least 5 percent agricultural producer equity. Several U.S. states and Canadian provinces have also favoured small-scale producers in the way that they have structured loan or grant programmes. In Europe, Austria provides support for biofuel production facilities

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[13] As defined in the *Invitation to Proponents*, the document setting out the terms of the assistance.

on up to 55 percent of the total investment costs as long as at least 51 percent of the facility in question is owned by farmers.

In total, the subsidy-equivalent values of support for capital have probably been much less than the value of production-related incentives. But they have nevertheless played an important role in stimulating expansion.

3.2.4 Support for distribution and use

Ethanol and biodiesel are similar to their petroleum counterparts, gasoline and diesel fuel, but not identical to them. Ethanol is hydroscopic and corrosive, and therefore any storage vessel, pipeline, pump or automobile fuel-system component must be able to cope with these properties. Ethanol also has a higher octane value than gasoline, but a one-third lower energy density. Biodiesel's problem is that the different possible feedstocks from which it can be made result in fatty acid methyl esters that differ slightly in their chemical and physical properties, particularly viscosity at low temperatures.

Having deemed expanding the use of biofuels to be desirable, several OECD countries are subsidizing or mandating investments in biofuel storage, transport[14] and distribution infrastructure, and vehicles capable of operating on high blends of biofuels. The bulk of this government support has been directed at ethanol, because the handling of ethanol typically necessitates expensive investments in new equipment. There is also a strongly held view in many governments, encouraged by the ethanol and automobile manufacturing industries, that ethanol faces a chicken-and-egg problem: greater penetration of E85 in the market (and vehicles capable of running on it) will not occur until there is a sufficient density of distribution points, and growth in ethanol production will soon be constrained unless more and more consumers start using ethanol in high-percentage blends.

It is common for 30 percent of the cost of upgrading or creating new infrastructure to be underwritten by governments

Beginning in 2006, the ***United States*** government, and several states, began offering numerous grants and loans to subsidize investments in biofuel storage, transport and distribution infrastructure. The federal alternative-fuel refuelling property credit allows a tax credit to be taken on up to 30 percent of the cost of installing qualified clean-fuel vehicle refuelling property, up to a limit of US$ 30,000 per taxable year per location. Despite this subsidy (and others provided by states), the number of retail locations selling E85 in the United States remains small — 1,300 as of September 2007, or less than 1 percent of total retail gasoline dispensing locations — and concentrated in the Midwest.

The ***Australian*** federal government's Ethanol Distribution Program (EDP), also launched in 2006, is pursuing a more modest goal: to increase the number of retail distribution points selling E10. About half of the EDP's A$ 17.2 million (US$ 14 million) in grants will go to upgrade infrastructure; the other half will be used to encourage the sale of E10 at a price lower than that of regular unleaded gasoline.

In the ***EU***, both France and the UK provide capital allowances or grants for refuelling infrastructure, mainly for ethanol. In 2005**,** Sweden enacted legislation which stipulates that from 1 April 2006 onwards, petrol stations selling more than 3,000 cubic metres per year of gasoline or diesel must also sell renewable fuels such as biogas or ethanol. From 2009, this requirement will apply to stations providing 1,000 cubic metres per year of conventional fuel; smaller enterprises will be exempted from the regulations. Operators investing in the distribution of renewable fuels can receive a subsidy of up to 30 percent of their investment cost.

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[14] In the United States, for example, numerous states and municipalities are helping to finance the upgrading or construction of new rail spurs to biofuel, particularly ethanol, plants.

Flexible-fuel vehicles are increasingly subsidized or the beneficiaries of regulatory favours

Almost all gasoline-powered vehicles built in OECD countries since the late 1970s are capable of operating on blends containing up to 10 percent ethanol without modification. Some can operate in blends containing up to 20 percent. But beyond that, most vehicles' fuel systems and engines have to be specially designed in order to be able to use high-percentage blends of ethanol. Such vehicles are commonly referred to as flexible-fuel vehicles (FFVs), because they can operate on any blend of ethanol and gasoline up to E85.[15]

Both the United States and several member states of the EU (Cyprus, France, Ireland and Sweden) actively promote the production or purchase of FFVs. Among the incentives used are reduced registration fees and road taxes for FFVs. Sweden provides tax incentives to purchasers of FFVs, and some cities offer free parking and have waived congestion fees for FFVs. The Swedish Energy Agency estimates that FFV owners can realize combined benefits equivalent to €2,350 (US$ 3,200) per year under its country's rules.

In the United States, regulatory favours provided by some states or municipalities include the use by FFVs of high-occupancy traffic lanes (no matter how many people are riding in the vehicle), and exemptions from emission testing or from motor-vehicle inspection. But the biggest regulatory favour is the so-called "dual-fuel" loophole, created by a 1988 federal law that allows makers of FFVs (and several other approved categories of alternative-fuel vehicles) to obtain credits against corporate average fuel-economy (CAFE) standards. The motivating hypothesis of the law was that, as the number of FFVs on the road increased, pumps for dispensing E85 would follow. It did not happen that way.

The problem the "dual-fuel" loophole, as with any subsidies or regulations supporting FFVs, is that it depends only on the capability of a vehicle to use E85, not actual use of the fuel. In the United States, the vast majority of owners of FFVs ran, and still run, their vehicles exclusively on gasoline, and many have not even been aware that their vehicle could run on E85. Moreover, because the fuel-economy credit for FFVs in the United States is greatest in respect of the least-efficient models, automobile manufacturers have concentrated on the larger, more-expensive end of the market — sport utility vehicles (SUVs) and "light trucks". Even in 2005 (the latest year for which figures are available), only 25 percent of the FFV models sold in the United States were sedans or minivans; the rest were SUVs, light trucks, or "medium-duty" vehicles. The consequence of avoiding having to comply with tighter fuel-economy standards means that the United States in 2005 actually imported 80,000 more barrels of oil a day than it would have in the absence of the dual-fuel loophole (MacKenzie *et al.*, 2005).

Meanwhile, most of the six million or so FFVs on the road in the United States continue to run mainly on gasoline. That makes little contribution to the nation's goal of reducing gasoline use, but should be of some relief to the U.S. taxpayer. As the 2006 study shows, keeping a typical 2007 model FFV (most of which have 5.3-liter engines) running exclusively on E85 for a year requires over 1,000 gallons of ethanol, which in turn costs the federal government some US$ 520 a year in lost tax revenues, and taxpayers in ethanol-producing states even more. Keeping all six million FFVs running on E85 would cost taxpayers US$ 3 billion at a minimum, and probably closer to US$ 4 billion, *each year*. Nevertheless, U.S. automakers are planning to ramp up their rate of production of such vehicles, to perhaps a million new FFVs this year.

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[15] In the 1980s, Brazil encouraged the sale and consumption of cars designed to run on 100 percent hydrous alcohol. These were not flex-fuel vehicles (FFVs), however, as they could not use gasoline. The policy was initially a success, measured by share of the market, but ended in tragedy at the end of the decade, when high sugar prices and low petrol prices resulted in shortages of hydrous ethanol, and long queues at filling stations. The market for alcohol-only vehicles dried up almost overnight. More recently, Brazilian automobile manufacturers have started selling true FFVs, and now the majority of new cars bought are FFVs. The fuel these vehicles actually consume depends on the relative prices of ethanol and gasoline.

3.2.5 Support for research, development and innovation

Most biofuel-producing countries have established government-funded programmes to support research, development and innovation in respect of different stages in the biofuel supply chain. Because of the multitude of specializations involved, from agronomy to combustion, and the different government agencies with an interest in biofuels (agriculture, energy, transport, environment), identifying all the programmes directly and indirectly benefiting the industry was beyond the scope of the GSI studies.

What does seem clear from the pattern of current funding across countries is that an increasing proportion of R&D funds are being channelled in support of second-generation biofuels, particularly cellulosic ethanol and biomass-derived alternatives to petroleum diesel. Calls for proposals issued in the framework of the European Commission's 2007 work program under its Seventh Framework Programme (2007–2013), for example, reveal that while two projects will focus on first-generation biofuels from biomass, seven concern second-generation biofuels. Notable other examples include:

- Canada's C$ 145 million (US$ 138 million) Agricultural Bioproducts Innovation Program, which, beginning in 2007, will provide support for cross-sector research networks conducting scientific research and development related to the advancement of a Canadian bio-based economy.
- The EU's Sixth Framework Programme for research, technological development and demonstration, which will provide at least €68 million (US$ 93 million) to, among other aims, support research in the area of biomass to develop second-generation biofuels and integrated biomass use through biorefineries.
- The United States' Biofuels Initiative, launched in 2006, which aims to accelerate research so as to make cellulosic ethanol cost-competitive by 2012. This multi-agency programme focuses on the use of non-food based biomass, such as agricultural waste, trees, forest residues, and perennial grasses in the production of transportation fuels, electricity, and other products. One of its goals is to displace up to 30 percent of the nation's transport fuel use by biofuels by 2030. Funding is around US$ 150 million a year.

3.2.6 Summary

The biofuels industry in much of the OECD has been supported by a multitude of subsidies and tax concessions, protected by high tariffs (in the EU and the United States), and government interventions to guarantee it a market. Although the industry and its government proponents speak of these interventions as temporary and transitional, many of the support elements trace back decades. And while there have been some positive changes in policies, such as a refocusing of R&D expenditure on second-generation biofuels and introducing formulas or review procedures to adjust producer payments or fuel-excise tax concessions in light of changes in petroleum prices, many new subsidy programs benefiting first-generation biofuels continue to be promulgated.

4 Cost effectiveness

4.1 Estimates of aggregate support for biofuels

A principle aim of the GSI country-study series has been to estimate the magnitude of government support to biofuels and to generate metrics that can help policy makers better understand what the taxpayer and consuming public is getting for its money.

Table 4.1 provides a rough idea of the magnitude of current transfers[16] supporting to biofuels in the economies that actively support its production or consumption. A few caveats are in order. First, the total support estimates shown pertain mainly to support for production, though for some countries imports also benefit from certain volumetric (usually, in the case of fuel ethanol, while also being penalized by import duties). We have not produced separate estimates of producer and consumer subsidies because of the unavailability data and because some support measures could be classified as either subsidy type. Excise-tax concessions, for example, are designed as consumer subsidies but, in the presence of import barriers, they can and do also stimulate domestic production.

Table 4.1 Provisional total support estimates (TSE) for ethanol and biodiesel in selected OECD countries in 2006

OECD economy	Ethanol		Biodiesel		Total liquid biofuels	
	TSE (billions of US$)	Variable share[1] (percent)	TSE (billions of US$)	Variable share[1] (percent)	TSE (billions of US$)	Variable share[1] (percent)
United States[2]	5.4 – 6.6	60% – 65%	0.5 – 0.6	~ 85%	5.9 – 7.2	~ 65%
EU[3]	1.6	98%	3.1	90%	4.2	93%
Canada	0.15	70%	0.013	55%	0.11	65%
Australia[4]	0.035	~ 70%	0.021	~ 70%	0.05	~ 70%
Switzerland	>0.001	94%	0.009	99%	0.01	98%
Total	7.2 – 8.4		3.6 – 3.7		10.8 – 12.1	

(1) This refers to the percentage of support that varies with increasing production or consumption, and includes market price support, production payments or tax credits, fuel-excise tax credits, and subsidies to variable inputs.

(2) The range reflects largely alternative treatment of the income fuel-tax credits (revenue loss basis vs. outlay equivalent basis).

(3) Total for the 25 member states of the European Union in 2006.

(4) Calendar year.

Source: GSI country reports.

Second, the estimates in all likelihood underestimate the total value of investment incentives, especially in the EU and the United States. Information on these incentives is notoriously difficult to obtain, especially those provided by sub-national and local governments. Finally, some elements of support that are also picked up in estimates of total support to primary agriculture (as reported by the OECD (2006 and earlier

[16] The term *transfer* is used in this chapter in place of *subsidy* when referring to market price support as well as conventional subsidies and tax incentives.

years), for example), are included in the biofuel support estimates (prorated to the volume used for biofuel production), especially if they are closely tied to feedstock crops.[17]

The estimates in Table 4.1 show several things. First, the bulk of support to biofuels (because of the size of the countries and of their industries) is provided by the United States and the EU. The United States and Canada support more ethanol production than biodiesel production, while the reverse is the case for the EU and Switzerland. Australia's support is about evenly divided between ethanol and biodiesel. In aggregate, over the economies covered by this report, ethanol receives about twice the support provided to biodiesel — at least US$ 7.2 billion against US$ 3.6 billion, respectively, in 2006. In total, support for the two liquid biofuels can provisionally be estimated to have been at least US$ 10.8 billion in 2006.

The other interesting feature of the current pattern of support is the high degree to which it is coupled to production, consumption or variable inputs, as reflected in the estimates of the "variable share" in the table. (Better information on support for capital investment would lower the variable shares, but not the total support estimates.) Some of the current variable support elements are partially decoupled, inasmuch as they include caps per plant — e.g. the small producer's credit payment in the United States, and several Canadian operating grant payments — but the bulk of support is still not constrained by annual or per-plant limits.

That means that as production and consumption of biofuels increases, so will subsidies in support of them. Given that the volume of biofuels sold has been expanding at double-digit rates of growth, the cost of these programs can be expected to climb rapidly.

In the United States, for example, the federal excise-tax credits for ethanol and biodiesel alone cost the federal treasury around US$ 3 billion in 2006, on total consumption of 5.8 billion gallons (approximately 22 billion litres).[18] If the same subsidies were kept in place, the revenue losses associated with these tax credits in 2022 (when the proposed 136 billion litre mandated volume would be reached) would be at least US$ 19 billion a year. (And more than that, to the extent the target is met by biodiesel, which is subsidized at a higher rate.) State-level subsidies could inflate that value further.

Similarly, in the EU, assuming current subsidization rates (Table 4.2), meeting the biofuels content target of 5.75 percent by 2010 rates of exemptions from fuel excise taxes would cost the treasuries of its member states at least € 20 billion (US$ 26 billion) a year. Canada, too, could see a huge increase in transfers. Although its total liquid biofuel production was just under 0.5 billion litres in 2006, if all of the biofuel plants currently under construction and planned are built it could be producing around 4.0 billion litres by 2010. At scheduled rates of federal and provincial subsidization, the budgetary cost of supporting that level of biofuel production could exceed C$ 1 billion (US$ 0.95 billion) a year.[19] By comparison, Canada's total support for producers of grains and oilseed in 2004 (the last year for which PSEs on individual commodities are available), was C$ 1.36 billion (OECD, 2005).

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[17] Examples would be the energy-crop payments in the EU, direct payments for maize and soybeans in the United States, and area and processing payments for oilseeds in Switzerland.

[18] The numbers quoted for the VEETC and VBETC here refer to revenue losses to the U.S. Treasury.

[19] The current policy limits federal payments to 2 billion litres per year, but that ceiling can be raised if funds become available.

Table 4.2 Approximate average and variable rates of support per litre of biofuel produced in selected OECD countries (US$ per litre)[1]

OECD economy	Ethanol		Biodiesel		Comment
	Average	Variable	Average	Variable	
United States	0.29 – 0.36	Federal: 0.15 States: 0 – 0.11	0.54 – 0.67	Federal: 0.26 States: 0 – 0.26	No limit on VEETC or VBETC; some state payments are budget-limited.
EU[2]	1.00	1.00	0.70	0.70	Situation varies widely by member state
Canada	0.40	Federal: up to 0.10 Provinces: 0 – 0.10	0.20	Federal: up to 0.20 Provinces: 0 – 0.20	Total federal payments and most provincial payments are budget-limited. Several are scheduled to decline.
Australia	0.40	0.30	0.40	0.30	Not budget-limited.
Switzerland[3]	0.60	0.60	1.00	0.60 – 2.00	Through end-2007, excise tax concessions limited to national total of 20 million litres per annum.

Note: see also table notes to Table 4.1.

(1) Rates for countries other than the United States are rounded to nearest 1/10th of a U.S. dollar and have been converted to U.S. dollars at the exchange rate of 31 August 2007.

(2) Refers to support provided by Member States.

(3) Values refer to domestically produced biofuels. The range for biodiesel reflects difference between biodiesel made from recycled cooking oils and rape-methyl ester made from domestically grown and processed rapeseed.

Source: GSI country reports.

4.2 Hidden costs

The policy implications of government interventions in the market for biofuels — particularly use or blending mandates and production-linked subsidies and tax breaks — are manifold. The world is only just beginning to witness some of the effects of policies in this area, and not all are intended. This section provides a brief overview of the implications that continued subsidization of biofuels has for agricultural markets, energy, environmental and transport policies.

4.2.1 Crop and food prices

Until recently, policies in OECD countries to promote biofuels provided an additional outlet for crops, helping at the margin to absorb surpluses, without substantially affecting end-user prices. In the last two years or so, however, prices for all crops used as inputs to biofuel production, except for sugar, have risen dramatically (Table 4.3).

The proximate reasons for these recent increases in the international prices of agricultural commodities have much to do with factors other than the recent dramatic rise in biofuel production. These include drought-related supply shortfalls, and low stocks. Moreover, agricultural commodity prices in 2005, especially for maize, were near historical lows (in real terms), so some cyclical firming of prices could be expected. But as the authors of the *OECD-FAO Agricultural Outlook 2007-2016* note, "structural changes, such as increased feedstock demand for biofuel production, and the recent reduction of surpluses due to past policy reforms, may keep prices above historic equilibrium levels during the next 10 years." (OECD-FAO, 2007) The linkage between biofuel production and government subsidization of the crops used as feedstocks is becoming increasingly important as a higher percentage of these crops is used in energy production.

Table 4.3 Reference international commodity prices for crops used as feedstock for biofuel production, 2005 through July 2007

Commodity	Average price for 2005 (US$/tonne)	Peak price since May 2005 (US$/tonne and week or month ending)	Average price, 1 January 2007 through end July 2007 (US$/tonne)	Percentage change, nominal terms, 2005 to average 2007 to date
Sugar[1]	$ 218	$ 406 (*03.02.06*)	$ 223	2%
Wheat[2]	$ 150	$ 229 (*20.10.06*)	$ 215	43%
Maize[3]	$ 109	$ 203 (*23.02.07*)	$ 179	64%
Rapeseed oil[4]	$ 669	$ 921 (*07.07*)	$ 824	23%
Soybean oil[5]	$ 545	$ 885 (*07.07*)	$ 771	42%
Crude palm oil[6]	$ 422	$ 811 (*07.07*)	$ 703	67%

(1) Based on weekly averages of International Sugar Organization (ISO) daily price, expressed in US cents per pound.

(2) US No.2, Soft Red Winter Wheat, price at U.S. Gulf ports (Tuesday quotations), expressed in US$ per short ton. Note: data point shown in column 3 refers to price in week ending 10 August 2007.

(3) US No.2, Yellow, price at U.S. Gulf ports (Friday quotations), expressed in US$ per short ton.

(4) Monthly averages of ex-mill price (f.o.b.), Netherlands.

(5) Monthly averages of ex-mill price (f.o.b.), Netherlands.

(6) Monthly averages of import price (c.i.f.), north-west Europe.

Source: Data from Food and Agricultural Organization of the United Nations, "International Commodity Prices" website (www.fao.org/es/esc/prices), accessed on 9 September 2007.

Box 4.1 Biofuel mandates and the priority for fuel over food

One often over-looked effect of mandating biofuel content in transport fuels is that it establishes a legal priority for liquid fuels over other competing users of the same biomass feedstocks. For the moment in most OECD countries, those feedstocks, with minor exceptions, are predominantly crops — corn, wheat, soybeans, canola, sugarbeets — that also are used for feeding humans and livestock. That means, effectively, that in the event of a tightening market for these crops, the diversion of crops for fuel will take precedence over food and feed.

A considerable amount of research is being funded to try to improve the technology and reduce the costs of producing biofuels from non-food crops and crop residues, but even a large-scale switch to these feedstocks (which is still at least a decade away) will still put some pressure on land that will in turn affect food supply.

This establishment of priority over feedstocks also affects technological development within the broader bio-energy market. To the extent that mandates ensure that a certain percentage of biomass will be used for producing liquid biofuels, the potential use of that biomass for direct combustion, or conversion to biogas, is thereby reduced.

Producers of the feedstock crops number among the winners of the biofuels boom, of course, at least in the short term. (Time will tell whether there will be a biofuel bust.) The effect on livestock producers has been more mixed, however. The cattle industry, or at least that part of it in the proximity of grain-ethanol plants, has experienced only moderate rises in the price of protein feeds — thanks to increased production of dried distillers' grains with solubles (DDGS). Producers of pigs and poultry, however, have had to contend with steep increases in the prices of energy grains, such as maize.

Rising prices are also affecting the bottom line of companies that purchase sugar, wheat, maize and oilseeds as inputs into foods and other consumer products. Much has been made of the so-called "tortilla crisis" in Mexico, which witnessed a 60 percent rise in the price of tortillas — a staple food of poor families — in December 2006 (Navarro, 2007)[20], but there have been many other industries that have also been adversely affected, including manufacturers of soap (who use tallow) and beer.

While the relatively modest effects on world commodity prices of liberalizing trade in agriculture has commanded much attention and analysis (see., e.g., Polaski, 2006; Minot et al., 2007), the effects on developing countries of a sustained and aggressive expansion of biofuels has not. The general conclusions from the trade-liberalization simulations logically apply: Any sustained large increase in commodity prices would adversely affect net-food importing country consumers, for whom food costs constitute a much larger share of household incomes than in OECD countries, as well as the poor in urban areas of developing countries generally. Producers across the world could be expected to respond to high prices by producing more, which would help mitigate severe price rises. But the levels of biofuel production being advocated by some proponents raise doubts about whether, at a planetary level, there is sufficient net photosynthetic production to meet food and fuel claims. At the very least, the world would be entering uncharted territory.

4.2.2 Environmental effects

Environmental stresses associated with subsidized expansion of production of biofuel feedstocks, and even biofuels themselves, are already being seen. Environmental change wrought by the production of biofuel feedstocks stem from the types of crops grown as feedstock, changes in crop-rotation practices, and the direct and displacement effects of expanding the area planted to these crops.

A large percentage of the production of biofuels in OECD countries is derived from row crops: maize (corn) for ethanol, canola and soybeans for biodiesel. These crops are not only more prone to erosion than crops like wheat and rye, but also are heavy demanders of chemical inputs and water (Wiesenthal et al., 2006). Of the total soybeans, corn and canola in the planted in the United States and Canada in the early part of this decade, the organic share was only 0.22 percent (Brooks and Barfoot, 2004). Although these crops could be farmed less intensively, the incentive faced by farmers is to take advantage of high prices by maximizing yields. In a survey of a large number of potential bio-energy sources, Zah et al. (2007a and 2007b) rated only biofuels made from cellulosic sources, sugar cane (in Brazil), "waste" agricultural products like whey, recycled cooking oil, and manure as having an overall environmental impact roughly equal to or better than low-sulphur gasoline.

In the United States, rapid growth in demand for biofuel feedstocks, particularly corn and soybeans, is also changing cropping patterns in the Midwest, leading to more frequent planting of corn in crop rotations, an increase in corn acreage at the expense of wheat, and the ploughing up of grasslands. This change in land cover has raised alarm bells about possible adverse affects habitat for waterfowl (Ringelman, 2007). The biofuels-led expansion in grain and oilseed production within some OECD countries has also put pressure on set-aside land and land reserved for conservation. In the EU, for

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20. Although Mexican officials suspect uncompetitive behaviour on the part of the country's main tortilla producer, many are also pointing to the increased demand for corn for ethanol production.

example, the European Commission is recommending that the obligatory set-aside requirement be abolished for at least the next crop year[21], much to the dismay of wildlife conservation groups.[22]

Increased intensive production of maize in the U.S. Midwest has also accelerated growth of the "dead" zone in the Gulf of Mexico: a hypoxic (oxygen-deficient) area spreading out from the mouth of the Mississippi River. Scientists attribute its growth to the runoff of nutrients, mainly from crop farming. At risk is the northern Gulf of Mexico's US$ 2.6 billion-a-year fishing industry (Cox, 2007).

Some biofuel feedstock crops, particularly maize, require lots of water. Yet the current trend in the expansion of maize-based ethanol is westward, into areas that are more dependent on fossil water sources, like the Ogallala Aquifer, and irrigation than the rain-fed heart of the U.S. corn belt. The ethanol plants themselves also require significant volumes of water — 3 to 6 litres per litre of ethanol (Stanich, 2007). Press reports of local concerns over their claims on local water supplies are appearing with increased regularity (see., e.g., Kirchhoff, 2007 and Wilson, 2007).

Less thoroughly studied have been the displacement effects — especially internationally — of diverting crops to the production of biofuels. Some displacement occurs directly through the diversion of crops to biofuels. Others occur as a result of changes in the mix of production. The evidence is strong, for example, that as soy plantings and exports in the United States have declined, much of the shortfall is being met by production in Latin America, some on newly cleared land (Butler, 2007).

Proponents of cellulosic ethanol argue that a broader mix of indigenous feedstocks would address many of these problems. However, once cellulosic acreage is scaled to provide meaningful displacement of gasoline, many similar issues regarding crop diversification, land conversion, and the need for additional inputs like water and fertilizers could arise.

4.3 Questionable assumptions and assertions

Government support for biofuels has a relatively long history. Along the way, a variety of arguments have been advanced to justify the continuation (and expansion) of this support. As time has passed, new justifications have emerged. Indeed, a notable feature of biofuels support policies is the extent to which they are frequently claimed to support multiple policy objectives. These include reducing other (agricultural) subsidies, improving the security of supply of liquid fuels, reducing fuel prices, reducing emissions of air pollutants and greenhouse gases, and promoting rural development and employment.

It is rare for governments to be able to meet so many policy objectives across so many fronts with a single policy instrument. This alone might be a ground for scepticism: is it that biofuels hold such promise, or is it that their advocates have felt the need to advance multiple justifications to buttress support for high levels of expenditure that remains vulnerable to question? The political economy of public transfers is such that concerns will always arise that public policy objectives have been co-opted in support of private ends.

While aware of these concerns, this study starts from the premise that the declared public policy objectives must be taken at face value and subjected to scrutiny: Do the policy measures deployed secure the ends that it is argued they support? In our judgement, the appearance of major spill-over effects into other markets, and a mounting body of evidence on the environmental effects of producing biofuel feedstocks on a large scale, should prompt a re-examination of the many assumptions and assertions frequently

[21] "European bioethanol producers welcome end of set aside", *FO Licht's World Ethanol & Biofuels Report*, 14 September 2007.

[22] See, for example, "Wildlife recovery stopped in its tracks" at www.rspb.org.uk/news/details.asp?id=tcm:9-168815

offered in support of biofuel policies. The following section discusses six commonly asserted justifications that deserve to be questioned.

Claim No. 1: Biofuel subsidies save governments money by reducing farm payments

The potential for exponential growth in subsidies to biofuels undermines an argument frequently voiced in support of biofuel production — namely, that by creating a new market for crops (and eventually competition for agricultural land), it will firm up prices and reduce farm payments that are coupled to prices.

In the United States, for one, the rises in the prices of corn and soybeans translate into smaller levels of certain crop-related government subsidies for 2006 and probably for 2007 (Annex 2). However, any savings to be squeezed out of the main price-triggered commodity support programmes — counter-cyclical payments and marketing loan benefits (loan deficiency payments, marketing loan gains, and certificate exchange gains) — have for the most part been realized. Meanwhile, the volumetric excise tax credits for ethanol and biodiesel — the main federal support mechanisms for biofuels in the United States — can be expected to continue to grow along with increased production. Thus while farm payments alone in 2007 are forecast to be at the same level as for 2002 (US$ 12.4 billion), the *total* of farm payments plus the excise tax credits is forecast to be US$ 16.4 billion, or US$ 2.9 billion more than the total of farm payments plus the excise tax exemptions in 2002. If the U.S. Administration's proposed 35 billion gallon per year by 2017 "alternative fuels standard" for the United States were to be passed by the U.S. Congress, the sum of farm subsidies plus losses to the U.S. Treasury from tax credits paid on biofuels could by the middle of the next decade reach the same heights as the total of farm and biofuel subsidies in the record year of 2005 (Figure 4.2).[23]

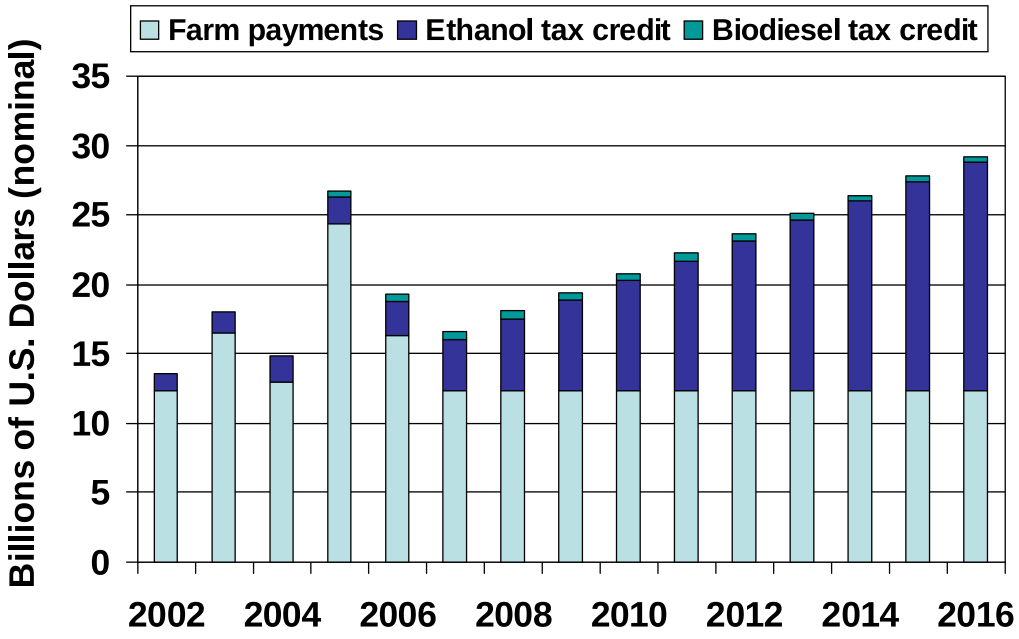
Claim No. 2: Mandating biofuels will save motorists money by reducing fuel prices

It is difficult to see how mandating biofuels can save motorists money. If petroleum prices were to rise above the cost of producing biofuels, the mandates would be redundant. If petroleum prices were to fall, consumers would be prevented from switching to cheaper fuels — which indeed is the point of a mandate — meaning that blended gasoline or biodiesel would cost more than it would otherwise. How much more would depend on market conditions at the time.

Biofuels still account for only a tiny fraction, perhaps one percent of the total world market for petroleum — not enough to substantially bring down the international price of crude oil. Of course, were biofuels to start accounting for a much larger share of the total market for petroleum products — including products used for aviation fuel, direct heating, and petro-chemicals — upward pressures on crude-oil prices would be eased. But falling fuel prices would also stimulate consumption of petroleum, leading to an outcome contrary to one of the rationales for subsidizing biofuels: to reduce reliance on petroleum.

[23] Another effect of support for biofuels has been to raise the value of farm assets, particularly land. While this benefits existing land owners, it raises costs for those who lease land for farming, and also the cost of reserving land for conservation purposes.

Figure 4.1 Total of farm payments and biofuel tax subsidies in the United States, 2002-2016



Note: projection based on the U.S. Administration's proposed 35 billion gallon "alternative fuels" target for 2017, assuming farm support payments remain constant in nominal value; the peak in support in 2005 was due to price support and counter-cyclical payments triggered by low crop prices in the wake of Hurricane Katrina.

Source: Prepared by Ron Steenblik, GSI, for International Transport Forum (2007, forthcoming), *Biofuels: Linking Support to Performance*, OECD/ITF, Paris.

Claim No. 3: Subsidizing biofuels is a cost-effective way of reducing reliance on fossil-fuels

Security of supply is perhaps the pre-eminent goal of "energy policy", often expressed in terms of minimizing risk of interruptions in supplies (such as imports of petroleum or natural gas, or electric-power outages), but more accurately stated in economic terms. All things being equal, governments want to keep prices of energy affordable and minimize price volatility.

The idea that producing biofuels at home will reduce a country's dependence on foreign sources of energy, particularly oil from the Middle East, has helped increase the political popularity of biofuels. This rationale, present at the time that Brazil's and the USA's first biofuel-support programmes were crafted, waned during the 1980s and 1990s as oil prices fell, but has recently returned to centre stage.

Biofuels do offer a diversification benefit, inasmuch as they may be less vulnerable to the same kinds of disruptions that threaten supplies of petroleum from politically unstable regions of the world. Because most liquid biofuels will be consumed as blends with gasoline or petroleum diesel, however, biofuels will for some time to come remain complements to petroleum-based transport fuels, not major competitors with them. Moreover, the feedstocks from which biofuels are currently derived are also vulnerable to their own set of unmanageable and unpredictable risks, such as adverse weather and crop diseases (Eaves and Eaves, 2007).

But the cost per unit of energy displaced is very high. How high depends both on the per unit transfer and the amount of petroleum and other fossil energy that must be invested in creating and delivering a litre of biofuel to the final user.

The degree to which the use of biofuels displaces petroleum in particular, and fossil energy more generally, varies fairly widely depending on the feedstock and how it is processed. Numerous estimates of these displacement values have been generated by different researchers, but even when system boundaries have been standardized their results often differ widely. A major issue of contention is how to apportion energy inputs among the different products coming out of an ethanol or biodiesel manufacturing plant. Typically, the energy content of the feedstock grains or vegetable oil is not counted on the input side, but the energy value of co-products on the output side (e.g., dried distillers grains) is. Not giving credit to the energy contained in co-products typically yields a poor net return on energy value, especially for grain-based ethanol (see Hill et al., 2006; IEA, 2004). For the GSI studies, we have largely side-stepped this controversy by using ranges of values from other researchers' studies (e.g., CSIRO, 2003; Farrell et al., 2006a and 2006b; Zah *et al.*, 2007a and 2007b).

The only GSI-sponsored studies that looked at petroleum displacement have been the U.S. studies (Koplow, 2006 and 2007 forthcoming). These found that both ethanol and biodiesel provide fairly good petroleum displacement, though at a high cost. To displace one litre of petroleum equivalent ethanol, for example, requires between US$ 0.45 and US$ 0.65 per litre in transfers in the case of ethanol and between US$ 0.65 and US$ 0.80 per litre in the case of biodiesel (depending on feedstock and process).

The cost-effectiveness of biofuel transfers in displacing fossil-fuels is generally worse. That is because for many biofuel production processes the main non-renewable energy inputs (apart from the petroleum used in farm machinery) are derived from other fossil fuels, usually natural gas or coal.

Per unit of energy produced, the transfers generated by policies supporting liquid biofuels are typically in the neighbourhood of US$ 12 to US$ 20 per gigajoule (GJ). In a few countries, however, the rates can exceed US$ 40 per GJ (Table 4.4) Translated into litres of gasoline equivalent (LGE) or litres of diesel equivalent (LDE), these rates of subsidization are, with the exception of Australia and Canada for biodiesel, higher than the pre-tax, international spot prices of gasoline and diesel, which were on the order of US$ 0.50 per litre in 2006 (IEA, 2007b). At these levels of transfers, policies to encourage more rational use of fuel would have achieved the same end more efficiently.

Table 4.4 Order-of-magnitude transfer rates for energy and for fossil-fuel displacement through biofuels in selected OECD countries, 2006 (US$)

OECD economy	Ethanol			Biodiesel		
	per GJ[1]	per LGE[2]	per LGE of fossil fuels displaced	per GJ[1]	Per LDE[3]	per LDE of fossil fuels displaced
United States[4]	12.50 – 15	0.40 – 0.50	1.00 – 1.25	16.50 – 20	0.60 – 0.75	0.95 – 1.20
EU[5]	40	1.40	2.00 – 6.20	19	0.70	0.75 – 1.50
Australia[6]	20	0.65	0.80 – 2.10	12	0.43	0.48 – 0.95
Canada[7]	15	0.50	0.70 – 2.20	7	0.24	0.26 – 0.50
Switzerland[8]	28	0.90	1.00 – 1.25	18 – 58	0.60 – 2.10	0.70 – 3.50

(1) GJ = gigajoule (10^9 joules).

(2) LGE = litre of gasoline equivalent.

(3) LDE = litre of diesel equivalent.

(4) The range for ethanol reflects a combination of the low end of the subsidization rates and the low end of values for corn-based ethanol and the high end of the range for both. The range for biodiesel reflects the low end of values for methyl ester produced from used cooking oil, and the high end of the range of values for soy methyl ester.

(5) The range for ethanol reflects the low end of values for ethanol produced from sugarbeets and the high end of the range of values for grain-based ethanol. The range for biodiesel reflects the low end of values for methyl ester produced from used cooking oil, and the high end of the range of values for rape methyl ester made from oilseed rape.

(6) The range for ethanol reflects the low end of values for ethanol produced from C-molasses and the high end of the range of values for grain-based ethanol. The range for biodiesel reflects the low end of values for methyl ester produced from used cooking oil, and the high end of the range of values for rape methyl ester made from oilseed rape.

(7) Provisional estimates. The range for ethanol reflects the low end of values for wheat-starch based ethanol and the high end of the range of values for corn-based ethanol. The range for biodiesel reflects the low end of values for methyl ester produced from used cooking oil, and the high end of the range of values for rape methyl ester made from oilseed rape.

(8) The range for ethanol reflects uncertainty as to the displacement factor for ethanol produced as a by-product of cellulose production; the range for biodiesel reflects low end of values for methyl ester produced from used cooking oil, and the high end of the range of values for rape methyl ester made from Swiss-grown oilseed rape and processed in Swiss biodiesel plants.

Source: GSI country reports.

The high rate of subsidization also calls into question the claim sometimes advanced that subsidies to biofuels are needed to offset subsidies provided to fossil fuels, particularly petroleum. Petroleum and other fossil fuels *have* been subsidized in OECD countries (see, for example, Koplow and Martin, 1998), and continue to be. However, historical data assembled in the GSI's first U.S. report (Koplow, 2006) illustrate that the subsidy intensity of ethanol, whether on a per-litre or an energy-equivalent basis, was already in the late 1980s substantially higher than subsidies received by other energy resources.

Claim No. 4: Subsidizing biofuels is a cost-effective way to reduce greenhouse gas emissions in transport

Another ground for supporting liquid biofuels has come from their emission profiles when used as motor fuels. Especially when compared with low-grade gasoline and diesel, liquid biofuels generate lower levels of particulate matter and sulphur oxides. Ethanol also boosts the octane level of gasoline, and is generally considered less harmful to human health than other octane boosters, such as lead- or methyl-tertiary butyl ether (MTBE). Such factors have been important in gaining support for biofuels in some cities of the United States and Europe.

In Canada and Europe, and increasingly in Australia and the United States, biofuels are being promoted as part of government strategies to limit greenhouse gas emissions. By substituting for fossil fuels, they can (depending on the production process) reduce global emissions of carbon dioxide (CO_2), an atmospheric gas that helps to retard the escape of infra-red radiation from the earth and thus keep it warm. Since the oxidation of the carbon bonds in the biofuel are counterbalanced by the uptake of CO_2 by the feedstock plant material, the photosynthetic and combustion portions of the biofuel life cycle are carbon-neutral.

By contrast, the intermediate stages of the cycle — planting, fertilizing, harvesting, transporting and transforming the feedstock crops into biofuels and their by-products — can require substantial energy inputs. Moreover, if growing the feedstock crops involves exposing carbon resident in the soil to air, or burning down forests, additional CO_2 may be released into the atmosphere. Whether the CO_2 emitted in the various stages of biofuel production (and how one counts those emissions) exceeds the CO_2 absorbed by the crops was already a topic of fierce debate in the 1980s, and remains so today. That the emission balance can vary widely depending on the type of crop, agricultural system, and the technology for transforming it into a biofuel, is, at least, widely acknowledged.

As with fossil-fuel displacement, the cost of displacing GHG emissions through subsidizing biofuels depends both on the displacement rate and the subsidy rate. Generally, the displacement rate is much better for fuels made from "waste" materials, such as recycled cooking oil and tallow, and from sugar sources than from starch sources. On a life-cycle basis, however, the GHG balance will also vary depending on local agricultural practices and climate, even for the same biomass feedstock. In the case of ethanol, there is also great variety in the type of energy used to convert the starch to sugar (if necessary), ferment it and then distil the ethanol to a high degree of purity. Whether a plant uses biomass, natural gas, or coal (or electricity derived from one of these sources) for process energy can make an enormous difference in the displacement value of a specific litre of biofuel.

Once the intermediate stage is taken into account, the cost of obtaining a unit of CO_2-equivalent reduction through transfers generated by biofuel policies can prove to be much higher than alternatives. In each of the GSI's studies, the cost of reducing a tonne of CO_2-equivalent through biofuels was found to be well over US$ 150, with most ranging from US$ 250 upwards, and some exceeding US$ 1000 (Table 4.5). The higher ranges of values are highly sensitive to the displacement rate — the reduction in life-cycle greenhouse gases compared with the petroleum fuel that they are displacing — than they are to the per-litre value of support, and should therefore be interpreted with caution. That said, they are not by any means unusual. Jaeger et al. (2007), for example, estimated that the total cost (private costs plus indirect subsidies) per tonne of CO_2 avoided through the production of ethanol in Oregon from maize imported from the Midwest U.S. corn belt would be in excess of US$ 10,000.

Two of the studies considered GHG reductions through the use of cellulosic ethanol. Currently, all of Switzerland's production of fuel ethanol (around 1 million litres a year) is a by-product of cellulose production; it has a life-cycle GHG emission profile similar to that expected of dedicated cellulose-to-ethanol production. Even there, the transfer per tonne of CO_2-equivalent avoided (provided through exemption from the fuel-excise tax) is at least CHF 410 (US$ 340). For the GSI's studies of the United States, Koplow (2007, forthcoming) applies the same rate of subsidization as currently available for starch-based ethanol to a hypothetical cellulosic ethanol, but assumes a much better displacement rate (around 90 percent), yet still obtains a transfer of at least US$ 140 per tonne of CO_2-equivalent avoided.

Table 4.5 Order-of-magnitude transfers per greenhouse gas emissions reduced through the use of ethanol and biodiesel in selected OECD countries

(US$ per metric tonne of CO_2-equivalent)

OECD economy	Ethanol	Biodiesel
United States[1]	> 450	250 – 600
EU[2]	700 – 5500	260 – 1000
Australia[3]	250 – 1700	160 – 600
Canada[4]	250 – 1900	250 – 450
Switzerland[5]	330 – 380	250 – 1750

(1) Not shown are negative values: some estimates suggest that GHG emissions are actually increased on a life-cycle basis under certain assumptions regarding input energy.

(2) The range for ethanol reflects differences in displacement rates between ethanol produced from sugarbeets and ethanol produced from rye; the range for biodiesel reflects differences between methyl ester produced from used cooking oil and rape methyl ester.

(3) The range for ethanol reflects differences in displacement rates between ethanol produced from C-molasses and ethanol produced from grains; the range for biodiesel reflects differences between methyl ester produced from used cooking oil and rape methyl ester.

(4) Provisional estimates. The range for ethanol reflects differences in displacement rates between ethanol produced from wheat and ethanol produced from maize; the range for biodiesel reflects differences between methyl ester produced from used cooking oil and rape methyl ester.

(5) The range for ethanol reflects uncertainty as to the displacement factor for ethanol produced as a by-product of cellulose production; the range for biodiesel reflects differences between methyl ester produced from used cooking oil and rape methyl ester produced in the country from domestically grown oilseed rape.

Source: GSI country studies.

These values may be compared with the estimated social cost of a tonne of CO_2 emitted — i.e., the aggregate net economic costs of damages from climate change across the globe, expressed in terms of future net benefits and costs that are discounted to the present. According to the Fourth Assessment Report of the Working Group II Contribution to the Intergovernmental Panel on Climate Change (Adger *et al.*, 2007), peer-reviewed estimates of that social cost in 2005 report an average value of US$ 12 per tonne of CO_2, with a range around this mean that is very large. For example, in a survey of 100 estimates, the values ran from US$ -3 to US$ 95 per tonne of CO_2. In all of the countries that the GSI surveyed, the transfers per CO_2-equivalent avoided were found to be at least an order of magnitude greater than the social cost of CO_2, and some were two orders of magnitude greater.

Another way to look at these numbers is to compare them with the price of a CO_2-equivalent offset on the European Climate Exchange (ECE) or the Chicago Climate Exchange (CCE). A typical transfer of around US$ 500 per tonne of CO_2-equivalent avoided through the use of biofuels is 10 times the maximum price yet observed for a CO_2-equivalent offset on the European Climate Exchange (around US$ 33), or more than 100 times the maximum price on the Chicago Climate Exchange (around US$ 4). In short, governments could have achieved far more reductions in greenhouse gases for the same amount of money by simply purchasing the reductions in the marketplace.

Claim No. 5: The need for subsidies is temporary

Some biofuel proponents assuage critics of subsidy programs with assurances that the subsidies are only temporary, and that within a few years biofuels (or at least ethanol) will be able to compete with petroleum products without them. The implication is that the industry is still in its infancy, and that changing market conditions and technological progress will obviate any need for government support. Such assurances are predicated on a combination of assumptions regarding the price of crude oil — e.g., that it will remain above US$ 60 per barrel (US$ 0.40 per litre) — and the potential for cost reductions in both the production of feedstock and the processing of it into biofuels.

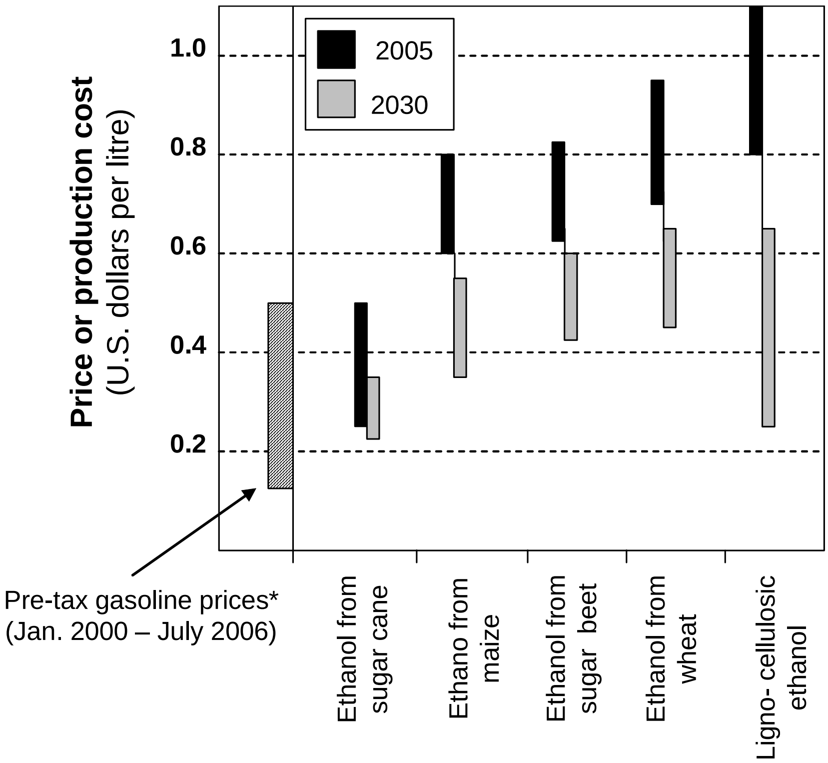
While the GSI country studies did not explore the question of future petroleum prices, other organizations have. The U.S. Energy Information Administration' latest *International Energy Outlook* (EIA, 2007), for example, expects that the most likely trajectory will see crude petroleum prices gradually declining over the next decade, and only rising again to US$ 60 per barrel (in 2005 dollars) towards the end of the 2020s. Its low and high-price cases project prices in 2030 respectively at US$ 36 and $100 per barrel. To acknowledge that there is considerable uncertainty surrounding any oil-price forecasts would be an understatement. Nonetheless, there is enough of a possibility that oil prices will under-cut biofuel prices over the next decade to call into question the economic viability of producing significant amounts of biofuels in OECD countries in the absence of government support. But even if oil prices do remain high, there are reasons to believe that future prices for biomass feedstock will be even firmer.

Ethanol

Figure 4.2 compares the current and projected future costs of producing ethanol from different feedstocks, as calculated by the IEA. Brazil's costs, at US$ 0.20 per litre (US$ 0.30 per litre of gasoline equivalent) for ethanol produced in new plants, are the lowest in the world. Even before the recent rise in maize prices, grain-based ethanol cost some 50 percent more to produce in North America than cane-based ethanol in Brazil, and 100 percent more in the EU than in the United States. These costs do not include the costs of transporting, splash blending and distributing ethanol, however, which can easily add another US$ 0.20 per litre at the pump.

According to the IEA (2006), "further incremental cost reductions can be expected, particularly through large-scale processing plants, but no breakthroughs in technology that would bring costs down dramatically are likely." They foresee such technological improvements helping to reduce costs by one-third between 2005 and 2030, in part driven by reductions in the costs of feedstocks. Whereas they project feedstock costs declining by around one-quarter in the EU, and one-third in Brazil, they assume that net feedstock costs will shrink by more than half in the United States. In all cases, the IEA[24] assumed current rates of subsidies to crops and ethanol production remain in place.

Figure 4.2 Current and projected future ethanol production costs



*Based on monthly average import prices for crude oil into the IEA region.

Note: Cost estimates exclude from consideration subsidies to crops or to the biofuel itself.

Source: Adapted from IEA (2006), Figure 14.7.

Expecting feedstock costs in the EU to fall over the next 25 years is not an unreasonable assumption, given changes in policies (notably the elimination of export subsidies for sugar) and improvements in plant genetics alone could put downward pressure on costs. Yet with pressure on commodities to feed a growing world population, uncertain changes in yields caused by global climate change and rising demand for biomass for fuels, relative prices for feedstocks could well rise significantly. Already, between 2005 and July 2007, prices for key ethanol feedstocks rose by between 2 percent and 64 percent in nominal terms (Table 4.3), with the largest proportional increase being observed for maize. Certainly spot prices can be expected to remain volatile. At its peak in February 2006, for example, the reference price for sugar was more than twice its lowest value only nine months earlier.

It bears stressing that while the costs of producing sugar in Brazil, maize in the United States or wheat in Argentina or Canada will be lower than the international prices shown in Table 4.3 what matters to the economics of biofuels is the *opportunity cost* of diverting these feedstocks to ethanol production, as opposed to selling them to other buyers. Studies of the costs of producing biofuels must make assumptions about the price of the feedstock biomass as well as the price that the fuel will fetch in the market. As Kojima et al. (2007) point out, while the accounting cost of producing a biofuel may be less than the price of its

[24]. In conjunction with the Energy Economics Group of the Vienna University of Technology.

nearest petroleum alternative, it still may not be economical to produce if the market price for the feedstock is high.

An analysis by the Center for Agricultural and Rural Development (CARD) at Iowa State University (Tokgoz *et al*., 2007) found that farmers will not be willing to plant dedicated cellulosic crops like switchgrass unless the crops offer a net return comparable to that of maize. Citing a study by Babcock *et al.* (2007), which calculated the price at which farmers would consider changing to switchgrass as US$ 121 per tonne of switchgrass from land with a yield of 9 tonnes per hectare, and US$ 90 per tonne for land with a yield of 13.5 tonnes per hectare, the authors estimate that the maximum that ethanol plants can bid for these same tonnes is about US$ 41 per tonne in years when ethanol is selling for US$ 1.75 per gallon (US$ 0.46 per litre). "Under these conditions", they note "switchgrass simply cannot offer farmers a market incentive that offsets the advantages of growing corn". Continuing:

> A key and possibly counterintuitive insight is that there is no ethanol price that makes it worthwhile to grow switchgrass because any ethanol price that allows ethanol plants to pay more for switchgrass also allows them to pay more for corn. So long as farms are responding to net returns in a rational manner and so long as ethanol plants are paying their breakeven price for raw material, farmers will plant corn as an energy crop. Switchgrass in the Corn Belt will make economic sense only if it receives an additional subsidy that is not provided for corn-based ethanol.

Not surprisingly, there are now several bills before the U.S. Congress proposing new, additional incentives to encourage farmers to produce feedstock crops other than corn.

Biodiesel

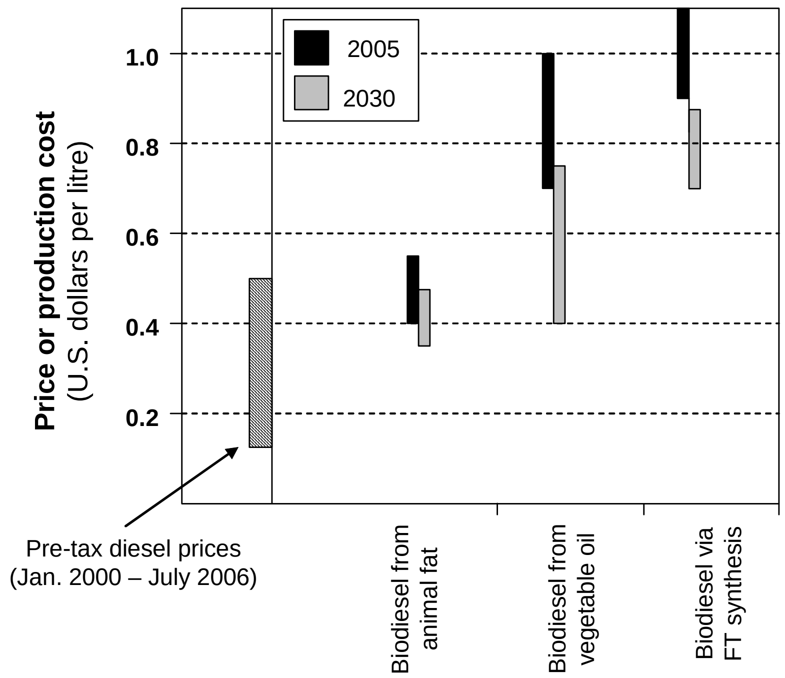
The prospects for biodiesel production become economically viable in OECD countries without subsidies or mandates, except where there are low-cost sources of feedstocks, look even more doubtful than for ethanol. Low-cost supplies of waste cooking oil are in limited supply, as are animal fats. Any major expansion of biodiesel capacity based on the esterification process will therefore have to be based on virgin oils. And, over the long run, it is the cost of procuring virgin vegetable oils that largely determines the cost of producing biodiesel.

The IEA (2006, p. 408), in commenting on further incremental cost reductions for conventional biodiesel production, (Figure 4.3) states that "[t]here remains some scope for reducing the unit cost … production by building bigger plants. But technological breakthroughs on the standard trans-esterification process, leading to substantial cost reductions in the future, are unlikely." They foresee production costs falling to by 37 percent between 2005 and 2030 in the United States (to around US$ 0.33 per litre of diesel equivalent), and by 32 percent in the EU. Again, these projections assume net costs of feedstocks falling by around one-third in real terms over the projection period.

As with feedstocks for ethanol production, the prices of feedstocks for biodiesel production have been heading in the opposite direction since the IEA's cost estimates were produced. Between 2005 and July 2007, international reference prices for rapeseed oil, soybean oil, and crude palm oil rose, respectively, by 23 percent, 42 percent and 67 percent in nominal terms (Table 4.3). The price rises have been steady, exhibiting less volatility than the prices for sugars and grains over the same period. What is interesting is that the prices for lower-value oils have been rising at a faster rate than for the traditionally higher-value oils, suggesting that palm oil is being substituted for the other, generally more-expensive oils.

The economics of biodiesel also depends on the price of crude glycerine, a by-product of the trans-esterification process that is used in a wide range of foods, cosmetics and other products. In the early years of the biodiesel industry, production of glycerine was small enough that it did not substantially affect market prices for the by-product. But as the amount of biodiesel and thus glycerine produced in the world has increased, the market value of the glycerine has declined. In September 2006, *Biodiesel Magazine* (Nilles, 2006) reported that crude glycerine, having once fetched US$ 0.20-0.25 per pound, was heading towards 5 cents per pound (US$ 110 per tonne) and perhaps lower. In response, some of the major biodiesel producers are considering building the capacity to refine crude glycerine to pharmaceutical grades, and are investigating new uses for the chemical. But for the near and medium-term future, the glut of crude glycerine is expected to reduce the profitability of biodiesel production.

Figure 4.3 Current and projected future biodiesel production costs, compared with recent (pre-tax) gasoline prices



*Based on monthly average import prices for crude oil into the IEA region.

Source: Adapted from IEA (2006), Figure 14.7.

Claim No. 6: Subsidies are needed to establish distribution infrastructure and fuel-use flexibility

A related justification for subsidies to first-generation biofuels is that they are helping to establish the necessary infrastructure for using substantially larger volumes in the future.

The potential markets for ethanol and biodiesel as transport fuels, before any modifications to the vehicle fleet are required, are quite large. Yet the current market shares of ethanol and biodiesel are still only a few percentage points on a volumetric basis, and even less on an energy-equivalent basis. It will still be many years before the 10 per cent ethanol limit with the existing fleet will be reached. Even in the United States, where the penetration rate of ethanol is the highest in the OECD, that 10 percent limit implies 14 billion gallons (53 billion litres) a year. This level is not expected to be reached until sometime next decade.

If cellulosic ethanol can become cost-competitive, and the potential supply is seen to be large enough to drive investment in its direction, investments in infrastructure will not need subsidies. There would be a phase-in period during which infrastructure would have adjusted, and automobile manufacturers would start offering flexible-fuel capability on their own.

5 Policy recommendations

The picture that emerges from the GSI's analyses on OECD biofuels markets illustrates not only that subsidies to ethanol and biodiesel are significant and growing, but that they are rarely an efficient way of achieving many of the policy objectives they are supposed to be supporting. The following recommendations would help secure policy outcomes that are more sustainable — fiscally, developmentally and environmentally.

1. Rethink the overall rationale for supporting biofuels

Government intervention in biofuel markets stretches back at least a decade in most OECD countries and in some almost three decades. The motivations for supporting biofuels at the time were heavily influenced by broader agricultural policy considerations, particularly production levels that (thanks to farm subsidies) were too high, and commodity prices that governments considered to be too low. Those circumstances may or may not have been compelling at the time, but circumstances change.

Open-ended, production-linked subsidies for biofuels, especially exemptions from road taxes, are costly, arbitrary and inefficient. Policy makers with experience in either agriculture or energy should be well aware that market price support, direct production subsidies and volumetric controls generate rents that inflate the value of fixed factors of production. This phenomenon, sometimes referred to as "the transitional gains trap", makes phasing out such forms of support very difficult and costly — the more so, the longer the policies remain in place.

While it is not necessarily reason enough to provide subsidies for the construction of biofuel facilities (at least not first-generation facilities), one positive aspect of **support for capital facilities** is it is normally budget-limited and time-bound. Assistance can be provided over a finite period, and at the end of the period the government can simply stop providing new subsidies, with no adverse impact on existing producers. What government-intermediated loans and loan guarantees often do, however, is shift the risk of default to the government body providing the assistance. Given the amount of public capital being used to support new biofuel manufacturing, the degree of risk being taken, and the implications in terms of future local government dependence on the continuation of national biofuels subsidies, support for capital investment in the industry should be provided prudently, if at all.

Support for R&D is also (apart from the risk of supporting non-viable technologies), a relatively "no-regrets policy". Here, at least, OECD countries seem to have largely moved on from supporting first-generation biofuels. Nonetheless, resources available for research and development have opportunity costs as well, with many different technologies within the energy matrix vying for R&D funds. In the current political climate, there is a real risk that government support for R&D related to biofuels could crowd out resources that might otherwise be allocated to technologies and energy pathways that could ultimately prove more efficient.

Then there is the question of **balancing the supply and demand side measures** in pursuit of such goals as energy security and improved environmental outcomes. One casualty of the current rush to promote biofuels is that the demand side of the equation has almost been forgotten in some countries. That is not surprising when governments are fixated on the supply side. Compared with the marginal cost of increasing the supply of liquid transport fuels, the cost to an economy of avoiding consuming fuels in the first place — through individual consumer actions taken in response to price signals — is likely to be lower, at least within the range of petroleum displacement currently achieved. The logic of spending huge sums promoting biofuels while neglecting the incentives that can affect consumption patterns needs to be re-examined.

Even the most ardent proponents of biofuels concede that starch-based ethanol takes a considerable amount of energy to produce, and that the net yield is modest. The argument frequently advanced by biofuel supporters is that promoting their uptake is simply a way of **preparing the ground for second-generation, cellulosic ethanol.** If OECD countries should have learned one lesson from the energy price spikes of the 1970s, it is that governments are very poor at picking winners. Second-generation biofuels may hold much promise, but they are just a sub-set of the many technologies and policy directions that could potentially address issues such as GHG emissions, supply security, and petroleum displacement.

Moreover, uncertainties about technological breakthroughs and the future cost of feedstocks, call into question whether cellulosic ethanol would pass a market test were it forced to compete with a wider range of fuels and demand-side approaches. Precluding such competition by instituting wide-ranging subsidies through the political process is not in the best long-term interest of society. Assessing the future commercial viability of a technology could be one criterion adopted by governments prior to providing long term subsidies that are often difficult to repeal.

Far more efficient approaches could be used to achieve the often-stated underlying policy objectives of improving energy security and reducing greenhouse gas emissions. These include setting appropriate charges on emissions and recovering (e.g., through user fees) expenditures made to secure foreign supplies of petroleum.

The time has come for governments to seriously re-examine their support policies to the industry and consider some radical changes. The price of inaction would be considerable.

2. Stop creating new subsidies for first-generation liquid transport fuels, develop plans to phase them out, and make those plans stick

The GSI is under no illusion that existing subsidies to biofuels will be ended overnight. Many exist under legislation specifying future periods over which they will continue to be provided, and some of those extend out for another ten years or more.

Those biofuel support programs that schedule declining payment rates over time suggest an intention (at least at the time the measure was passed) to phase down support eventually to zero. That may indeed happen in some cases. However, the fact that the biofuels industry has been receiving subsidies for decades (since 1978 in the case of the United States), and policy makers are under sustained pressure to extend and expand subsidies, and even make them permanent, means there are significant vested interests that must be overcome to prevent a business-as-usual outcome.

A waterfall starts with one drop. Rather than proposing yet more subsidies, policy makers should be thinking of how to turn off the tap, or at least prevent the already strong flow from turning into a torrent. The main elements of some countries' production-related support policies, most notably those of Australia, the United States and of some EU member states, are still not budget-limited. As long as those policies remain in place and unchanged, and biofuel production or consumption continues to grow at double-digit rates of growth, the potential for enormous increases in budgetary or tax expenditures is real.

3. In the interim, implement existing commitments to biofuels with smarter policies

A number of OECD governments have committed themselves to supporting the expansion of biofuel production or consumption, but are still working out the details of their new policies. If they remain determined to continue with those commitments, they should ensure that any proposed measures are cost-effective, are environmentally defensible and minimize negative spill-over effects on other markets. They should also endeavour to keep options open — including the option of terminating support for the industry without incurring large adjustment costs. Beyond these standard "good policy" principles some specific priorities suggest themselves:

Provide any tax preferences proportional to benefits

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 levels. A tax of US$ 50 per tonne of CO_2, for example, would equate to US$ 0.12 per litre of gasoline. That is far lower than the current excise-tax differential between gasoline and ethanol, or diesel and biodiesel, in most OECD countries that grant tax concessions. In any case, that differential would represent an upper limit even if biofuels could offset 100 percent of the CO_2 emissions from petroleum fuels. They do not; but, moreover, the life-cycle GHG emissions of biofuels differ enormously, depending on the kind of feedstock used, and how they are produced and processed, and these differences would somehow need to be reflected in the tax rates.

Resist industry pressure to create new mandates for biofuel production or consumption

The biofuels industry has pushed strongly for mandated blending ratios, market shares or volumes. Among the countries that the GSI has surveyed, only the Australian federal government and Switzerland have so far resisted imposing such mandates — and with good reason. While, from the industry's perspective, a mandate creates certainty for investors in biofuel production capacity, it simply transfers market risks to other sectors and economic agents.

Mandates are blunt instruments for reducing net petroleum use and greenhouse gas emissions. Despite large differences in the contributions that particular feedstock-technology combinations can make to achieving these objectives, almost all of the mandates currently used by OECD countries make no distinction among biofuels except between ethanol and biodiesel. The possible exception is the proposed new renewable fuel standard for the USA (as passed by the U.S. Senate), which would require that, by the year 2022, 21 billion out of a mandated 36 billion gallons (79 billion out of 136 billion litres) would have to be met with "advanced" biofuels such as cellulosic ethanol.

The practice of both mandating biofuel consumption and subsidizing its production (as in the United States, Canada and several EU member states) makes little sense except as a way to reduce costs to motorists, or to help local producers compete with suppliers from other countries. Clearly, a mandate is all that is needed to guarantee a market for that product. With a mandate, no subsidy would be needed to obtain the market share or volumetric target desired. Subsidies are only added to the mix if the cost to consumers (and other industries competing for the same inputs) of meeting the mandate would otherwise be are very high.

By mandating biofuel consumption and then providing subsidies to make the costs of the mandate acceptable, governments have interfered with the workings of a market that previously was geared to the production of food, animal feed and a small number of industrial products. Concerns over competition for crops between fuel and food are legitimate and should argue for caution. There are many niche markets for which biofuels production — especially cellulosic ethanol — could co-exist with food production. And farmers should, of course, be free to plant crops for biofuel production, and manufacturers to make biofuels, as long as they conform to prevailing environmental standards. But if biofuels production is only viable thanks to mandates and heavy subsidies, then significant disruption of agricultural markets is likely to occur. Before legislation involving volumetric targets and blending mandates is introduced, governments should assess their effects on agricultural markets, as well as on the resources on which farming depends, such as water.

Many assessments of feedstock outlet markets under increasing demand for biofuels are projecting declining crop exports to price-sensitive countries abroad. With demand growing so fast, it is likely that shifts in the food-fuel balance could also occur quickly, with important social implications. There is a further problem with mandates. Setting them when the potential supply of biofuel feedstocks that can be sustainably produced is unknown, and the future commercial viability of second-generation technologies remains an assumption, is risky. Social implications for subsidizing the production of bio-feedstock for example, may result in larger mono-culture operations displacing small holders. Some countries have started to investigate ways to differentiate biofuels according to their life-cycle GHG emissions. But it is still unclear how they can do that in a way that is compatible with WTO rules. It would seem prudent to understand these issues *before* setting ambitious mandate targets.

Increase competition for government support

Increasing competition for access to subsidies would help ensure that governments are getting the best return on their expenditure. Both the federal and some of the provincial governments of Canada have made prospective producers bid for access to subsidies, as did the Australian government in awarding grants under its Biofuels Capital Grants Program. The U.S. government used a reverse auction to award grants under its program to stimulate cellulosic ethanol production. Governments could greatly improve the efficiency of their policies to reduce dependence on fossil fuels and emissions of greenhouse gases by forcing all potential solutions — including on the demand side — to compete for support. Even making compete on the basis of the smallest subsidy per unit of petroleum displaced or greenhouse gas emission reduction would be a step in the right direction.

Introduce disciplines to limit subsidy stacking

Across the OECD, but particularly in the United States and the EU, hundreds of government programs have been created to support virtually every stage of production and consumption relating to ethanol and biodiesel — from the growing of the crops that are used for feedstock to the vehicles that consume the biofuels. In many locations, producers have been able to tap into multiple sources of subsidies.

When transparency is lacking at the sub-national level, central governments cannot adequately take into account support already provided by sub-national governments when designing their own biofuel support programmes. The probable result will be over-subsidization on a significant scale as sub-national tiers of government compete to attract new investment in biofuel-producing capacity.

To the extent that countries continue subsidizing the construction of new biofuel facilities (e.g., second-generation facilities), they can at least do something to discipline this "subsidy stacking". Canada's practice of limiting the aggregation of investment-related subsidies from multiple layers of government (as in its Ethanol Expansion Program), is an example that might be usefully followed. Its requirement that recipients of federal grants had to report all other sources of funds received, has also significantly improved the problem of information sharing.

Let the market determine sales of flexible fuel vehicles and E85

The costly obsession of policymakers in some OECD countries with E85 (a blend of 85 per cent ethanol and 15 per cent gasoline), and the flexible-fuel vehicles (FFVs) that can run on it, is leading to inefficient, and in some cases perverse, outcomes. It is the overall displacement rate of petroleum fuels rather than the specific blends in which it is consumed that matters, whether the policy objective be energy security or reduced greenhouse-gas emissions. The same benefits could be achieved through more widespread use of E10 (a blend of 10 per cent ethanol and 90 per cent gasoline), which any car built since 1980 can safely run on. Rather than spend scarce resources encouraging FFV ownership and the expansion of filling stations equipped with E85 pumps, countries should let consumer demand drive purchases and investments.

In a similar vein, there is no reason why FFVs — or indeed any low emissions vehicle – should be exempted from paying congestion charges or receive special treatment under similar policies aimed at reducing traffic on the roads. The reduced pollution argument for exempting FFVs is difficult to support, since it would be impractical to verify in real time whether an FFV is running on E85, pure gasoline, or an ethanol-gasoline blend in-between. By providing such incentives for FFVs, governments are undermining some of their own policy objectives, and sending conflicting signals to motorists.

4. Eliminate barriers to trade in biofuels, and strive to avoid creating new ones

Mandating increasing levels of biofuels in national road-transport fuel mixes while maintaining barriers to cheaper imports through tariffs and discriminatory domestic taxes is incoherent. Moreover, these trade barriers are inhibiting the access of developing countries — who have a comparative advantage in biofuel production — to several major OECD markets for biofuel. Those countries applying such trade barriers should remove them as quickly as possible, and not wait for some future trade round to do so.

Some countries have already shown a willingness to do that, often in conjunction with instituting new requirements to ensure that the biofuels used in their countries have been produced sustainably. While attention to the sustainability of biofuels is to be welcomed, separate national policies affecting imports could raise problems under international trade law. Most of the sustainability standards being proposed for biofuels relate to non-product-related processes and production methods (PPMs) which are not recognized as a legitimate basis on which to discriminate. It is difficult to imagine that any unilateral mandatory certification scheme (as would be required, for example, if a country treated imported biofuels differently according to their estimated lifecycle GHG emissions) would be immune from challenge at the WTO. Accordingly, countries will need to develop not only sustainability standards for biofuels that are adaptable to a wide range of local circumstances, but also obtain international consensus on them. Without such a consensus, it will be difficult for any sustainability standard for biofuels to form a legitimate basis for regulations applied by importers.

The time and the transaction costs involved in developing new sustainability standards for a product should not be under-estimated. Sustainability standards for other products (e.g., forest and fishery products) have taken years to develop, and even now the proportion of trade covered by them remains small.[25] But in those cases, the demand for the products concerned was driven by the market. In the case of biofuels, demand is driven largely by government mandates and subsidies. It is fair to ask whether the urgency with which sustainability standards for biofuels are being called for, or the harm they seek to avert, would be so great if government interventions had not created the need for them in the first place.

5. Improve transparency on financial support to biofuels, especially at the sub-national level

The subsidies that have been provided to the biofuels industry have typically arisen from many independent decisions taken at different levels of government. The resulting suite of policies is often poorly coordinated and targeted. High levels of legislative activity, especially at the sub-national level, further compound the co-ordination problem.

Considering how much effort went into assembling subsidy data for the GSI studies, it can be surmised that policy makers crafting new incentives at the central government level do not have a clear understanding of the full gamut of support already provided by subsidiary levels of government, nor of the potential impact that government support for biofuels is having on the environment and the economy. They need complete, not partial information.

6. Undertake more research into the consequences—intended and not—of current support policies for liquid biofuels

More research into the effects of continuing to subsidize and protect domestic production of liquid biofuels is sorely needed. But good research requires data, and that in turn requires governments to be much more transparent about the nature and extent of their subsidies to biofuels (and, indeed, to all forms of energy). More is needed than just descriptions of the programs, such as that helpfully provided by

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25 See discussion in Doornbosch and Steenblik (2007).

government websites, and in the EU by member-state submissions to the European Commission on state aids for biofuels. No proper evaluation of the cost-effectiveness of current and proposed policies is possible without precise information detailing the cost of transfers and revenue foregone. Providing information on government expenditure is a basic responsibility of governments and the cornerstone of sound public finance.

In conclusion

The many layers of biofuel subsidies, the incoherence between some of them, and the unintended consequences of government policies that are coming to light, provide compelling grounds for a moratorium on new initiatives and a fundamental policy re-think.

The current emphasis on supporting biofuels risks crowding out investment in other technologies that may be much more sustainable, both commercially and environmentally. While road transport's reliance on the internal combustion engine represents an unusual degree of technological lock-in (in comparison with, say, the electricity generation sector), it is not as though there are no alternatives apart from biofuels.

Neither is there a lack of policy instruments that could more neutrally bring them forward. If reducing greenhouse gas emissions is the primary concern, then emissions charges are a well understood way of influencing technology developers. If reducing exposure to insecure foreign oil supplies is the goal, then user fees to recover the costs of securing foreign supplies can be imposed. The profile of the ideal desired alternative — a source of automotive power that is cheap, clean and flexible — requires unpredictable technological change. A prudent policy approach would seek to keep as many options open as possible.

The bewildering array of incentives that have been created for biofuels in response to multiple (and sometimes contradictory) policy objectives bear all the hallmarks of a popular bandwagon aided and abetted by sectional vested interests. Years of production-related incentives and support for investments in the industry have ensured that there will be pressure to maintain current support levels long into the future. While this phenomenon is not unique to biofuels policy, the fiscal, developmental and environmental stakes are so high that the urgent attention of policy makers is required. Capital continues to pour into the industry, and huge shifts in land use are underway. Understanding the consequences of these changes before any further damage is inflicted is the only responsible way forward.

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Annexes

Annex 1 — Value of excise tax reductions or rebates for liquid biofuels as of 1 August 2007[1]

Country	Ethanol or ETBE		Biodiesel or pure plant oil	
Province or state	Local currency*	US$ per litre of pure ethanol equivalent	Local currency*	US$ per litre of pure biodiesel equivalent
Australia[2]	AUD 0.38143/litre	0.314	AUD 0.38143/litre	0.314
Canada				
Federal[3]	CAD 0.010/l of E10	0.094	CAD 0.002/l of B5	0.038
Alberta	CAD 0.009/l of E10	0.085	—	—
B. Columbia	CAD 0.014/l of E10	0.132	CAD 0.007/l of B5	0.132
Manitoba	CAD 0.025/l of E10	0.237	—	—
Ontario	CAD 0.015/l of E10	0.142	CAD 0.007/l of B5	0.132
Quebec	—	—	CAD 0.152/l of B100	0.144
Saskatchewan	CAD 0.015/l of E10	0.142	—	—
EU				
Austria	€ 445 per 1000 litres (Unleaded) € 517 per 1000 litres (Leaded)	0.607 (Unleaded) 0.706 (Leaded)	€ 325 per 1000 litres	0.444
Belgium	€ 353 per 1000 litres (on 37,884 litres[4])	0.482	€ 163.1 per 1000 litres (on 250,760 litres[5])	0.223
Czech Rep.	Under consideration	—	€ 331.1 per 1000 litres	0.452
Cyprus	Complete exemption but fossil fuel rate unknown	—	Complete exemption but fossil fuel rate unknown	—
Denmark	€ 30 per 1000 litres	0.041	€ 354.9 per 1000 litres	0.484
Estonia	Complete exemption but fossil fuel rate unknown	—	Complete exemption but fossil fuel rate unknown	—
Finland	No exemption	—	€ 319 per 1000 litres	0.435
France	€ 330 per 1000 litres (ETBE: 224 648) (Ethanol: 337,147)	0.450	€ 250 per 1000 litres (1,342,503)	0.341
Germany	Quantities to reach mandatory blending: no exemption	—	Used as additive: no exemption any more but a quota obligation	—
	E85: ethanol exempted from excise tax of € 0.6545 per litre	0.893	Used as pure fuels: tax rebates for the amounts of biofuels exceeding the quota	—

Country	Ethanol or ETBE		Biodiesel or pure plant oil	
Province or state	**Local currency***	**US$ per litre of pure ethanol equivalent**	**Local currency***	**US$ per litre of pure biodiesel equivalent**
Greece	No exemption	—	€ 260 per 1000 litres	0.355
Hungary	ETBE: € 414 per 1000 litres	0.565	€ 340 per 1000 litres	0.464
Ireland	€ 442.7 per 1000 litres (67,087)	0.604	€ 368 per 1000 litres (52,816)	0.502
Italy	No tax exemption	—	€ 382 per 1000 litres (200,000)	0.521
Latvia	€ 270 per 1000 litres	0.369	€ 230 per 1000 litres	0.314
Lithuania	€ 278.8 per 1000 litres	0.381	€ 243.7 per 1000 litres	0.333
Luxembourg	No exemption	—	Pure biofuels only	—
Malta	An exemption exists but rate unknown	—	An exemption exists but rate unknown	—
Netherlands	€ 505 per 1000 litres	0.689	€ 305 per 1000 litres	0.416
Poland	€ 390 per 1000 litres	0.532	€ 260 per 1000 liters	0.355
Portugal	An exemption exist but data not available	—	An exemption exist but data not available	—
Slovakia	€ 372 per 1000 litres	0.508	€ 384 per 1000 liters	0.524
Slovenia	Proportionate to the percentage of biofuels added but may not exceed 25% of the excise duty paid	Depends on market price	Proportionate to the percentage of biofuels added but may not exceed 25% of the excise duty paid	Depends on market price
Spain	€ 371.7 per 1000 litres	0.507	€ 269.8 per 1000 litres	0.368
Sweden	€ 530 per 1000 liters	0.723	€ 390 per 1000 litres	0.532
UK	€ 289 per 1000 litres	0.394	€ 289 per 1000 litres	0.394
Switzerland	CHF 0.7312 per litre	0.0.608	CHF 0.7587 per litre	0.631
USA				
Arkansas	$0.098/gal of E85	0.115	—	—
California	$0.090/gal of E85	0.106	—	—
Delaware	$0.010/gal of E85	0.012	—	—
Florida	$0.200/gal of E85	0.235	—	—
Hawaii	4% on E10 or E85	Depends on market price	4% on ≥B2	Depends on market price
Idaho	$0.025/gal of E85	0.029	$0.025/gal of B2	1.25
Illinois	$6.25% on >E70	Depends on market price	6.25% on >B10	Depends on market price
Indiana	$0.020/gal of E85	0.024	$0.010/gal of B2	0.50

Country	Ethanol or ETBE		Biodiesel or pure plant oil	
Province or state	**Local currency***	**US$ per litre of pure ethanol equivalent**	**Local currency***	**US$ per litre of pure biodiesel equivalent**
Iowa	$0.020/gal of E10	0.200	—	—
Maine	$0.020/gal of E10	0.200	—	—
Minnesota	$0.058/gal of E85	0.068	—	—
Missouri	$0.270/gal of E85	0.318	—	—
Montana	$0.041/gal of E10	0.410	—	—
New York	$0.420/gal of E85	0.494	$0.420/gal of B100	0.420
North Carolina	$0.202/gal of E85	0.238	$0.202/gal of B20	1.01
North Dakota	$0.220/gal of E85	0.256		
Oklahoma	$0.002/gal of E10	0.020	—	—
Pennsylvania	$0.041/gal of E10	0.410	—	—
South Dakota	$0.020/gal of E10	0.200	—	—

* Where quotas exist, they are marked in parentheses and denominated in tonnes.

1. Rates refer to ethanol, biodiesel or pure vegetable oil content of fuels, unless otherwise indicated.
2. Excise tax is rebated in full for ethanol produced within Australia, and for all biodiesel.
3. Proposed for elimination effective 1 April 2008.
4. On 48 million litres from 1 December 2007 through 31 December 2007.
5. From 1 January 2006 until 30 September 2007.

Sources: GSI country reports.

Annex 2 — Criteria for "Sustainable Biomass" proposed by The Netherlands' Project Group for Sustainable Biomass[26]

1. The balance of greenhouse gas emissions in the production chain and application of biomass needs to be positive

Criterion 1.1: The reduction in emission of greenhouse gasses should be at least 50 percent to 70 percent for electricity production and at least 30 percent for biofuels, calculated by means of a mathematical framework (see Creative Energie, 2006). Furthermore, the Group sees it more than fitting to strive for a greenhouse gas emission reduction of 80 percent to 90 percent within ten years with respect to current fossil references.

2. Biomass production should not come at the cost of important carbon reservoirs in the vegetation and the soil.

Criterion 2.1: The plantation of new biomass production units will not take place in areas in which the loss of above-ground carbon storage cannot be regained within a period of 10 years of the start of biomass production.

Criterion 2.2: The plantation of new biomass production units will not take place in areas with a high risk of significant carbon losses from the soil, such as certain types of grasslands, peat lands, mangroves and wet areas.

3. Biomass production for energy may not endanger the supply of food and local biomass applications (energy supply, medicines, building materials)

Criterion 3.1: A report can be issued when requested by the government regarding changes of land use in the region, including future developments.

Criterion 3.2: A report can be issued when requested by the government regarding information on changes in the prices of land and food in the region, including future developments.

4. Biomass production will not harm protected or vulnerable biodiversity and wherever possible will enhance biodiversity

Criterion 4.1: The relevant national and local rules will be upheld regarding land ownership and usage rights, forest and plantation management and exploitation, protected areas, hunting, spatial planning, management of the wild, national rules that originate from ratification of international conventions CBD (Convention on biological Diversity) and CITES (Convention on International Trade in Endangered Species).

Criterion 4.2: Biomass production will not take place in recently developed areas that have by the government been marked as "gazetted protected areas", or in a zone extending 5 kilometers around these areas.

Criterion 4.3: Biomass production will not take place in recently developed areas that by all involved parties have been classified as "High Conservation Value" (HCV) areas, or in a zone extending 5 kilometers around these areas.

Criterion 4.4: When development of new biomass production areas is initiated, 10 percent of the area should be set aside to remain in the historical state to prevent the shaping of large monocultures. In addition, an indication should be given regarding in what land use zones the biomass production unit resides, how

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[26]. Translation from the original Dutch (Creative Energie, 2007), as posted in English on The Oil Drum: Europe blog (http://europe.theoildrum.com/node/2521) by Rembrandt on 8 May 2007, "How a market for sustainable bio-energy is being developed."

fragmentation is being prevented, whether the concept of ecological corridors is being applied and if there is any concern regarding the recovery of already degraded areas.

Criterion 4.5: Good practices will be applied on and around the biomass production area to enhance and strengthen biodiversity, to take ecological corridors into account and to prevent fragmentation of biodiversity as much as possible.

5. When producing and processing of biomass the quality of the soil will be maintained or enhanced

Criterion 5.1: The relevant national and local rules and laws will be upheld regarding waste management, usage of agrochemicals (fertiliser and pesticides), mineral management, prevention of soil erosion, environmental effects report and company audits. At the utmost minimum the Stockholm convention (12 most harmful pesticides) must be upheld, even when the relevant national laws are missing.

Criterion 5.2: The formulation and application of a strategy aimed at sustainable soil use to prevent and combat erosion, to retain the balance of nutrients, to retain organic matter in the soil and to prevent soil salination.

Criterion 5.3: The use of agrarian rest products will not come at the cost of other essential function to maintain the soil quality (such as organic matter and mulch).

6. When producing and processing biomass, soil and surface water will not be exhausted and the water quality will be maintained or enhanced

Criterion 6.1: The relevant national and local rules and laws will be upheld regarding the usage of water for irrigation, the usage of soil water, the usage of water for agrarian purposes in flow areas, water purification, environmental effect reports and company audits.

Criterion 6.2: A strategy focusing on sustainable water management regarding efficient water usage and responsible use of agrochemicals will be formulated and applied.

Criterion 6.3: Water irrigation for the processing of biomass will not originate from non-sustainable sources.

7. When producing and processing biomass the air quality will be maintained or enhanced

Criterion 7.1: The relevant national and local rules and laws will be upheld regarding air emissions, waste management, environmental effect reports and company audits.

Criterion 7.2: A strategy focused on minimising air emissions regarding production and processing and waste management will be formulated and applied.

Criterion 7.3: Burning of land is a practice that will not be used when developing or managing biomass production units unless in specific situations, such as described in ASEAN guidelines or other regional good practices.

8. Production of biomass will add to the local welfare

Criterion 8.1: A report will be written which describes the direct added value to the local economy, the policy, practice and budget regarding local suppliers of biomass, the procedure for the appointment of local personnel and the share of local senior management. This will be based on the Economic Performance Indicators 1,6 & 7 of the GRI (Global Reporting Initiative).

9. The production of biomass will add value to the welfare of the employees and local population

Criterion 9.1: The tripartite declaration of principles concerning multinational enterprises and social policy, as established by the international labour organisation, will be upheld

Criterion 9.2: The Universal declaration of human rights from the United Nations will be upheld

Criterion 9.3: No land will be used without the consent of sufficiently informed original users. Land use will be described in detail and officially registered. Official ownership, usage and rights of the domestic population will be acknowledged and respected.

Criterion 9.4: A report will be written describing the programmes and practices initiated to determine and manage the effects of business activities on the local population. This will be based on the Social Performance Indicator SO1 of the GRI (Global Reporting Initiative).

Criterion 9.5: A report will be written describing the amount of training and risk analysis to prevent corruption and the actions that will be taken to respond to cases of corruption, This will be based on the Social Performance Indicator SO_2, SO_3 and SO_4 of the GRI (Global Reporting Initiative).

Annex 3 — Overview of the U.S. farm economy

(Billions of U.S. dollars, unless otherwise indicated)

Item	2002	2003	2004	2005	2006F[a]	2007F[a]
1. Cash receipts	195.0	215.5	237.9	238.9	242.7	258.7
Crops[b]	101.0	109.9	114.3	114	121.6	133.5
Livestock	94.0	105.6	123.6	125	121.2	125.2
2. Government payments	12.4	16.5	13.0	24.3	16.3	12.4
Fixed direct payments[c]	3.9	6.4	5.2	5.2	5.2	5.3
Counter-cyclical payments	0.2	2.3	1.1	4.1	4.1	1.6
Marketing loan benefits[d]	2.8	1.3	3.5	7.0	2.0	0.8
Conservation	2.0	2.2	2.3	2.8	2.9	2.9
Ad hoc and emergency	1.7	3.1	0.6	3.2	0.4	0.7
All other[e]	1.9	1.2	0.2	2.1	1.7	1.1
3. Farm-related income[f]	14.8	15.7	16.9	17.6	18.0	18.7
4. Gross cash income (1+2+3)	222.2	247.8	267.8	280.9	277.1	289.8
5. Cash expenses	171.6	177.8	186.3	199.7	210.4	222.6
6. NET CASH INCOME (4-5)	50.7	70	81.5	81.2	66.7	67.2
7. Total gross revenues[g]	233.6	260.9	296.2	299.8	298.4	318
8. Total production expenses[h]	193.4	200.4	210.8	226	237.8	251.3
9. NET FARM INCOME (7-8)	40.2	60.4	85.4	73.8	60.6	66.6
Farm Assets	1 304.0	1 378.8	1 584.8	1 805.3	1 919.4	1 994.3
Farm Debt	193.3	196.1	204.7	215.6	226.2	235.5
Farm Equity	1 110.7	1 182.7	1 380.1	1 589.6	1 693.2	1 758.8
Debt-to-asset ratio (expressed as percent)	14.8	14.2	12.9	11.9	11.8	11.8
10. Ethanol production (10^9 gallons)	2.1	2.8	3.4	3.9	4.9	7.1
11. Federal tax loss from $0.51/gal. ethanol excise tax exemption or credit (billions of U.S. dollars)	1.1	1.4	1.7	2.0	2.5	3.6
12. Biodiesel production (10^9 gallons)	neg	neg	neg	0.08	0.25	0.45
13. Federal tax loss from $1/ gal.biodiesel excise tax credit (billions of U.S. dollars)	na	na	na	0.1	0.2	0.4
14. Total of Government Payments + biofuel tax credits (billions of U.S. dollars)	**13.5**	**17.9**	**14.7**	**26.4**	**19.0**	**16.4**

na = not available; neg = negligible.

a. F = forecast.

b. Includes Commodity Credit Corporation (CCC) loans.

c. Direct payments include production flexibility payments of the 1996 Farm Act through 2001, and fixed direct payments under the 2002 Farm Act since 2002.

d. Includes loan deficiency payments, marketing loan gains and commodity certificate exchange gains.

e. Peanut quota buyout, milk income loss payments, and other miscellaneous program payments.

f. Income from custom work, machine hire, recreational activities, forest product sales, and other farm sources.

g. Gross cash income plus inventory adjustments, the value of home consumption, and the imputed rental value of operator dwellings.

h. Cash expenses plus depreciation and perquisites to hired labor.

Sources: • **Items 1-9 in table:** Randy Schnepf (2007), "The U.S. Farm Economy", Update of 21 February 2007, Congressional Research Service, Washington, D.C. Original data from USDA, Economic Research Service, briefing rooms *Farm Income and Costs: Farm Sector Income*, and *Costs: Farm Sector Income*, available at <www.ers.usda.gov/Briefing/FarmIncome>; U.S. farm income data updated as of 14 February 2007; • **Ethanol production:** Renewable Fuels Association <http://www.ethanolrfa.org/industry/statistics/#A > and Food and Agricultural Policy Research Institute (FAPRI); • **Biodiesel production:** National Biodiesel Board and FAPRI <www.fapri.org/outlook2007/tables/7USTables.xls>

About the author

Ronald Steenblik serves as the Director of Research for the IISD's Global Subsidies Initiative (GSI). 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. Immediately prior to joining the IISD in January 2006, Ronald was a Senior Trade Policy Analyst in the Trade Directorate of the Organisation for Economic Co-operation and Development (OECD), where he oversaw the preparation of some twenty case studies on the effects of environmental requirements on the market access of developing countries, as well as several background studies supporting the WTO negotiations on liberalizing trade in environmental goods and services. Ronald has written numerous papers on subsidy measurement and classification, and on subsidy disciplines.

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.