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Initiative

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# RESEARCHREPORT

## *State of Play on Biofuel Subsidies: Are policies ready to shift?*

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*June 2012*





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## About GSI

GSI is an initiative of the International Institute for Sustainable Development (IISD). GSI is headquartered in Geneva, Switzerland and works with partners located around the world. Its principal funders have included the governments of Denmark, the Netherlands, New Zealand, Norway, Sweden and the United Kingdom. The William and Flora Hewlett Foundation have also contributed to funding GSI research and communications activities.

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## *Acronyms and Abbreviations*

ASCM	Agreement on Subsidies and Countervailing Measures
B	Biodiesel
B-20	Business 20 (an event which is part of the G-20 Summit)
Bio-SG	Bio-Synthetic Gas
BtL	Biomass to Liquids
E	Ethanol
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EU	European Union
FAME	Fatty Acid Methyl Ethers
FAO	Food and Agriculture Organisation
G-20	Group of Twenty
GHG	Greenhouse Gas
GSI	Global Subsidies Initiative
HVO	Hydrotreated Vegetable Oil
IEA	International Energy Agency
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IISD	International Institute for Sustainable Development
ILUC	Indirect Land Use Change
IMF	International Monetary Fund
LCA	Life Cycle Assessment
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
RFS	Renewable Fuels Standard
U.K.	United Kingdom
UN	United Nations
UN HLTf	United Nations Secretary General's High Level Task Force
UNCTAD	United Nations Commission for Trade and Development
U.S.	United States
VAT	Value Added Tax
VEETC	Volumetric Ethanol Excise Tax Credit
WFP	World Food Programme
WTO	World Trade Organisation



## *Welcome Words*

The International Institute for Sustainable Development's Global Subsidies Initiative (GSI) shines a spotlight on subsidies and how they undermine efforts to place the world economy on a path toward sustainable development. Over recent years, governments throughout the world have increasingly struggled to reconcile the objectives of providing affordable energy to all and keeping public spending under control; biofuel subsidies have been just one, but a very illustrative, part of this puzzle. Decisions on providing energy subsidies to specific interest groups too often stem from political considerations rather than sound analysis on the efficiency of public spending and the impacts on all stakeholders involved. But this reality is knocking on the door of policy-makers who convene at G-20 summits, Rio+20 and beyond. We hope that this report will assist governments to design and implement more prudent and sustainable energy policies.

Mark Halle  
Executive Director, International Institute for  
Sustainable Development (Europe)

Over the last five to ten years, a quite diverse set of particular interests groups formed a coalition presenting biofuels as an effective way to simultaneously mitigate climate change, reduce dependence from imported energy and support farmers' incomes. This coalition was able to mobilize strong political support for an accelerated growth of food-based fuels, a "success" achieved in many instances at a high economic and social cost: substantial subsidies from already overstretched government budgets, increased food insecurity (both volumes and, in particular, prices) and additional overdraft of freshwater. This very timely and well researched report by IISD/GSI provides the necessary facts for an urgently needed public discussion on the possible merits and negative repercussions of biofuels policies, particularly subsidies and mandates.

Peter Brabeck-Letmathe  
Chairman Nestlé SA  
Chairman of the 2030 Water Resources Group



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## *Introduction*

The debate on the costs and benefits of governments' support to biofuels development has gained considerable momentum, especially in light of fiscal austerity measures and the "food versus fuel" debate associated with the impacts of biofuels expansion on agricultural markets. The number of stakeholders in this debate has also significantly grown as more and more developing countries have begun producing biofuels or are currently considering this move.

The positions held by various interest groups and countries in relation to biofuel subsidies are often polarized. This can be illustrated by the stances of Mexico and Brazil, hosts of the next two policy events which could have a major impact on the biofuels industry. Mexico, the host of the G-20 Summit, has gone as far as to ban the use of corn for ethanol production on food security grounds. In contrast, Brazil, the host of Rio+20, is one of the world's "biofuel superpowers" and actively promotes the production and export of ethanol from sugarcane.

The purpose of this paper is to summarize and discuss the current state of play around over US\$20 billion in subsidies and other forms of government support to the production and consumption of biofuels globally. The report examines whether the state of play on biofuel subsidies is now changing under the influence of three dynamic factors: the "food versus fuel" debate, advanced biofuels developments and the austerity policies necessitated by the financial and economic crisis.

The report is written in non-technical language and aims to address the need for further research as well as analysis and synthesis of the information that key stakeholders have already published on this issue (B-20, 2012). As such, the paper is addressed to government, corporate and civil society circles and is designed to act as a reference document for those participating in discussions on biofuel subsidies around the G-20 Summit in Los Cabos (June 18-19, 2012) and the UN Conference on Sustainable Development "Rio+20" in Rio de Janeiro (June 20-22, 2012).

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## *Biofuel Subsidies: Definitions and approach*

The term "biofuel" refers to liquid and gaseous fuels produced from biomass—organic matter derived from plants or animals. There is considerable debate on how to classify biofuels depending on whether technology maturity, greenhouse gas (GHG) emission balance or the feedstock is used to guide the distinction. This report follows the classification of biofuels introduced by the International Energy Agency (IEA), which divides all biofuels into "conventional" and "advanced" (see Text Box 1 and Table 1). The paper considers subsidies to liquid biofuels used as motor fuels only.



**TEXT BOX 1. THE GENERATIONS OF BIOFUELS**

The International Energy Agency (IEA) uses a definition based on the maturity of a technology, adopting the terms “conventional” and “advanced” for classification. It is important to realize that, on a lifecycle basis, some advanced biofuels can generate higher levels of GHG emissions and have more negative impacts on land and water use—as well as biodiversity and local livelihoods—than some conventional biofuels.

Conventional biofuel technologies include well-established processes that are already producing biofuels on a commercial scale. These biofuels, commonly referred to as first-generation, include sugar- and starch-based ethanol, oil-crop-based biodiesel and straight vegetable oil, as well as biogas derived through anaerobic digestion. Typical feedstocks used in these processes include sugarcane and sugar beets, starch-bearing grains like corn and wheat, oil crops like rape (canola), soybean and oil palm, and, in some cases, animal fats and used cooking oils. Hydrotreating vegetable oils or fats is also now a proven, although still quite an expensive technology, which has so far been used mainly to produce bio-jet fuel for use in commercial and military jet airplanes.

Advanced biofuel technologies are conversion technologies that are still in the research and development (R&D), pilot or demonstration phase, commonly referred to as second- or third-generation technologies. This category includes biofuels based on lignocellulosic biomass, such as cellulosic ethanol, biomass-to-liquids diesel and bio-synthetic gas. The category also includes novel technologies that are mainly in the R&D and pilot stage, such as algae-based biofuels and the conversion of sugar into diesel-type biofuels using biological or chemical catalysts.

Source: IEA, 2011a; IISD-GSI analysis

**TABLE 1. KEY CHARACTERISTICS OF CONVENTIONAL AND ADVANCED BIOFUELS**

	<b>FEEDSTOCK-TO-FUEL CONVERSION PROCESSES</b>	<b>FEEDSTOCKS</b>	<b>CROPS</b>	<b>LAND USE IMPACTS</b>	<b>WATER RESOURCE IMPACTS</b>
Conventional biofuels (First generation)	<ul style="list-style-type: none"> <li>• Fermentation</li> <li>• Transesterification</li> <li>• Hydrogenation</li> </ul>	<ul style="list-style-type: none"> <li>• Sugars</li> <li>• Starch</li> <li>• Vegetable oils</li> <li>• Animal fats</li> <li>• Used cooking oil</li> </ul>	<p>For ethanol:</p> <ul style="list-style-type: none"> <li>• Wheat</li> <li>• Corn</li> <li>• Potatoes</li> <li>• Beet</li> <li>• Sugarcane</li> <li>• Cassava</li> </ul> <p>For biodiesel and bio-jet:</p> <ul style="list-style-type: none"> <li>• Palm oil</li> <li>• Soybean</li> <li>• Rapeseed (canola)</li> <li>• Sunflower</li> <li>• Jatropha curcus</li> <li>• Camelina sativa</li> </ul>	<ul style="list-style-type: none"> <li>• Direct use of agricultural land</li> <li>• Indirect land use change</li> <li>• No land take for waste-based biofuels</li> </ul>	<ul style="list-style-type: none"> <li>• Restriction of physical access to water</li> <li>• Reduction of water available</li> <li>• Impoundment of water courses</li> <li>• Change in ground water depth</li> <li>• Less significant water take for waste-based biofuels</li> </ul>
Advanced biofuels (Second/third generation)	<ul style="list-style-type: none"> <li>• Bio-chemical</li> <li>• Thermochemical</li> <li>• Hybrid (biorefinery)</li> </ul>	<ul style="list-style-type: none"> <li>• Lignin</li> <li>• Cellulose</li> <li>• Hemi-cellulose</li> </ul>	<ul style="list-style-type: none"> <li>• Woody biomass</li> <li>• Grasses</li> <li>• Agricultural by-products</li> <li>• Waste streams</li> <li>• Algae</li> <li>• Seaweed</li> </ul>	<ul style="list-style-type: none"> <li>• Direct use of agricultural land</li> <li>• Indirect land use change</li> <li>• Possible use of marginal / semi-arid land</li> <li>• No land take for waste-based biofuels and some algae and seaweed</li> </ul>	<ul style="list-style-type: none"> <li>• Restriction of physical access to water</li> <li>• Reduction of water available</li> <li>• Impoundment of water courses</li> <li>• Change in ground water depth</li> <li>• Less significant water take for waste-based biofuels and some algae and seaweed</li> </ul>

Sources: IEA, 2011a; FAO, 2011; Roundtable on Sustainable Biofuels, 2012; IISD-GSI analysis





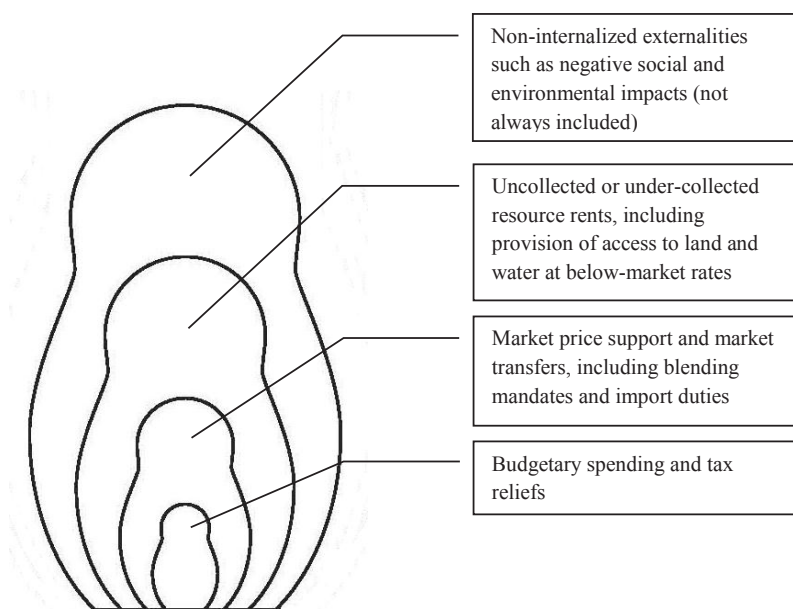
The term “subsidy” is more controversial. In layman’s terms, the word “subsidy” is often thought to refer only to a direct transfer of funds from a government to a private actor. In contrast, in policy circles **the notion of subsidy includes a wide range of preferential treatment—financial and otherwise—that governments provide to consumers and producers on various grounds.** Subsidies are often justified as being designed to supply public goods that the market fails to create or as being temporary measures to enable maturation of new technologies and to create a larger market for subsidized products with the objective of reducing their cost and increasing their competitiveness over time (OECD, 1996).

One of the most authoritative “subsidy” definitions is formulated in Article 1 of the Agreement on Subsidies and Countervailing Measures (ASCM), which has been agreed by 155 members of the World Trade Organization (WTO) and covers the direct and indirect transfer of funds and liabilities, various forms of tax relief, and the provision of access to capital, land, water and public infrastructure at below-market rates, as well as market and price support.

Importantly for the subject matter of this report, the ASCM definition does not include market price support induced through tariffs or mandates. Meanwhile, consumption mandates have become the main policy providing government support to biofuels in many countries.

Therefore, a number of stakeholders and experts, including the International Energy Agency and the Global Subsidies Initiative, consider the market price support enabled by consumption mandates to be a subsidy (Lang, 2010; IEA, 2011b). Mandates act in the same way as other subsidy forms, driving up market clearing prices, setting the demand floor and thereby improving competitiveness of otherwise unviable biofuel producers who are thus able to raise extra capital in financial markets (Koplow, 2009) (see below and Text Box 2 for more detail).

To summarise, the term “subsidy” can be visualized as a matryoshka nesting doll—at the centre of the definition are ideas that everyone agrees on, but as the definition expands to include other layers, it becomes more complicated and more controversial (see Figure 1).



**FIGURE 1. THE “NESTING DOLL” OF SUBSIDY DEFINITIONS**

Source: IISD-GSI interpretation using OECD, 2010.



As with any other policy instrument, biofuel subsidies should be evaluated against their stated policy objectives. The legislation underlying subsidies in various countries, including the Energy Independence and Security Act of 2007 in the U.S. and the EU Renewable Energy Directive of 2009 respectively, names **energy security (through diversification of energy sources)**, **environmental sustainability (abatement of greenhouse gas emissions and air pollution)** and **regional economic development (particularly in rural areas)** as key objectives of bioenergy development through the provision of subsidies.

**Reducing foreign trade deficits** is another important objective of stimulating biofuels development for some countries. Some countries that import fossil fuels (e.g., Tanzania and several other sub-Saharan nations) started developing biofuels aiming thus to replace the imports and save foreign exchange (Jumbe et al., 2009; Bekunda et al., 2009). Some other countries (e.g., Malaysia, Indonesia, and Argentina) are developing biofuels for exports to the attractive subsidized European and American markets.

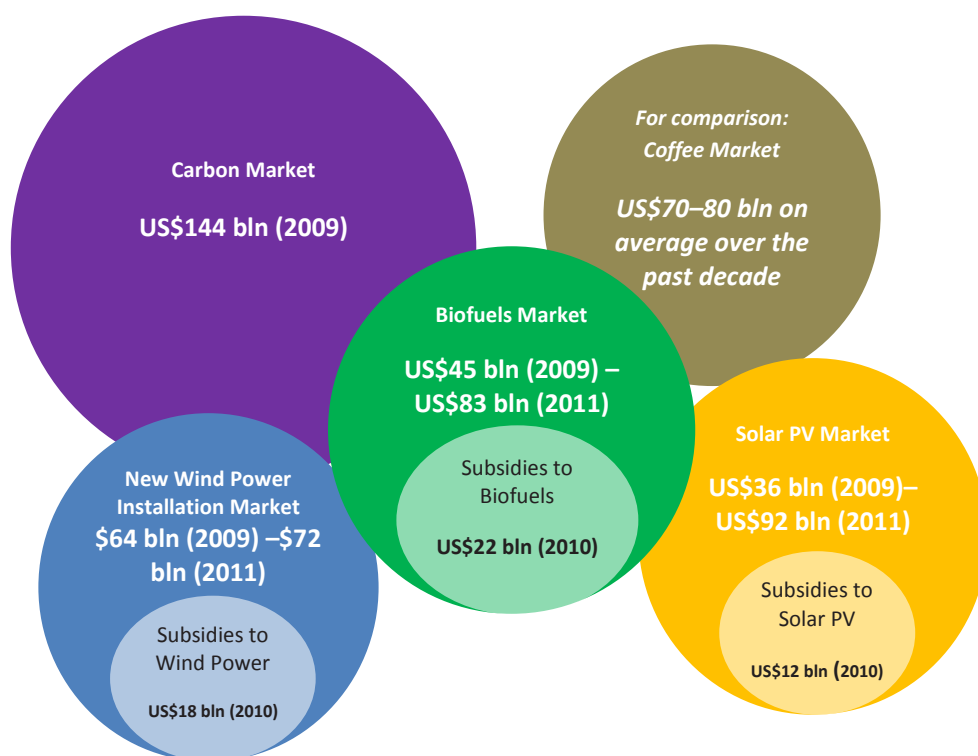
Meanwhile, subsidies are transfers of public money to private interests, and often become “captives” of rent-seekers (Victor, 2009). The main beneficiaries of biofuel subsidies are biofuel producers, which form part of a very influential agricultural sector that has always played an important role in politics. An important objective for governments granting or maintaining biofuel subsidies has therefore also been **accommodating the demands of powerful agribusiness constituents** (Erixon, 2009).

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## *The Scale of Biofuel Subsidies and the Biofuel Market*

The global market for biofuels (ethanol and biodiesel) in 2011 was worth US\$83 billion, according to Clean Edge estimates based on global production and wholesale pricing data (Pernick, Wilder & Winnie, 2012). This is equal or even bigger than the size of the world market for coffee (see Figure 2).

Supply is highly concentrated in a relatively small number of countries: based on the 2010 data, the U.S. was the single largest market player (43 per cent of the global production), followed by Brazil (26 per cent), Germany (4.9 per cent), France (3.9 per cent) and Spain (2 per cent) (Figure 3).



**FIGURE 2. ESTIMATED ANNUAL VALUES OF SELECTED GLOBAL MARKETS AND SUBSIDIES FOR THEIR DEVELOPMENT\* (CURRENT PRICES)**

\*IEA estimates, for IISD-GSI estimates see discussion below. The IEA estimates fossil-fuel consumption subsidies in 37 developing countries at US\$409 billion in 2010.

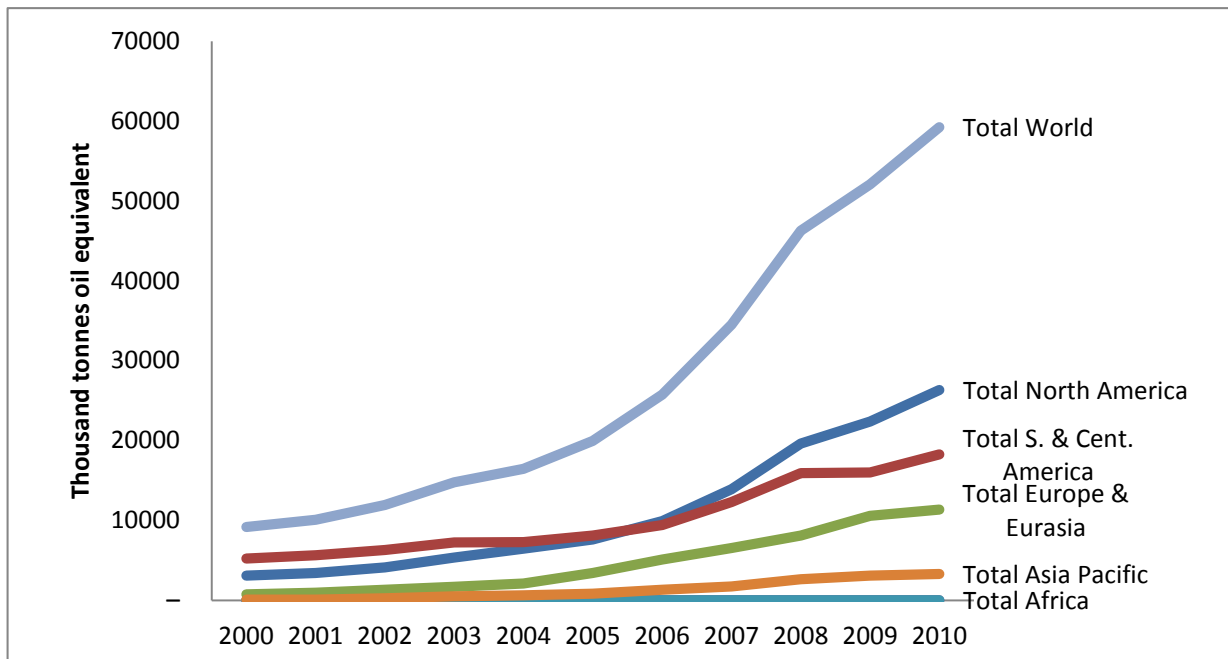
Source: IISD-GSI analysis based on estimates reported in Pernick, Wilder & Winnie, 2012, p. 4; World Bank, 2011, p. 9; Adley, 2009; IEA, 2011b, pp. 530-532.

Based on the existing commitments of the key governments that are supporting the biofuels industry, biofuels production and consumption are projected to continue their rapid growth. Table 2 shows a summary of the projections from the IEA's *World Energy Outlook 2010* (IEA, 2010) and Figure 4 shows scenarios from BP (BP, 2011) up to 2030. The range of predictions indicates a dramatic threefold to sevenfold increase of the global biofuels market.

**TABLE 2: IEA SCENARIOS OF FUTURE CONSUMPTION OF BIOFUELS**

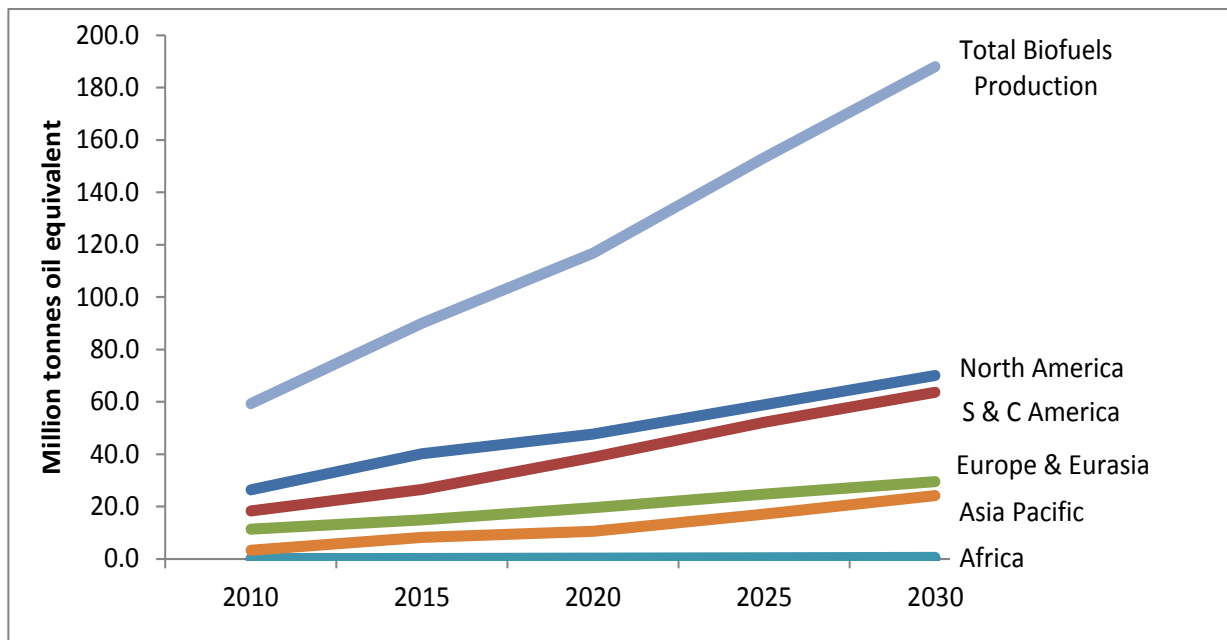
	YEAR	GLOBAL CONSUMPTION (MB/D)	SOURCE
Actual	2000	0.19	IEA data
	2009	1.11	IEA data
Projection	2035	4.38	New Policies Scenario
	2035	3.50	Current Policies Scenario
	2035	8.11	450 Scenario

Source: IEA, 2010



**FIGURE 3: BIOFUELS PRODUCTION FROM 2000 TO 2010**

Source: Based on data from BP, 2011



**FIGURE 4: BIOFUELS PRODUCTION PROJECTED FROM 2010 TO 2030**

Source: Based on estimates from BP, 2011



The rapid growth of the biofuels industry would not have been possible without government subsidies because many biofuel producers, especially in developed countries, are not cost competitive (IEA, 2011b). Meanwhile, although the role of subsidies for the development of biofuels is fundamental, there is surprisingly little reporting by governments as to the magnitude of support, mechanisms used and provision by sub-national jurisdictions (Steenblik, 2007). To overcome these shortcomings in transparency on biofuel subsidies, there are several methodologies to estimate the state and dynamics of government support to the industry.

The IEA estimates biofuel subsidies by accounting for tax reductions and differences between the prices of biofuels and oil-based substitutes on an ex-tax energy-equivalent basis. Following this approach, **the IEA estimates that, on a global scale, biofuel subsidies, including the support provided through consumption mandates, amounted to US\$22 billion in 2010 and, under the New Policies Scenario, can increase to US\$67 billion per year in 2035.** Thus the IEA estimates the cumulative cost of biofuels subsidies at US\$1.4 trillion between 2011 and 2035 (IEA, 2011b). The IEA approach is most instrumental in providing the lump sum estimates of subsidies, but the accuracy of those largely depends on the reliability of the data on fuel prices used.

Following a complementary methodology based on detailed bottom-up inventories of individual biofuel support measures at the national level, the Global Subsidies Initiative has produced a series of reports “Biofuels—At What Cost?” as well as a number of policy briefs covering major “biofuel economies.” These bottom-up inventories of biofuel subsidies look at individual programs of support to the biofuel industry across the entire value chain. Such subsidies include, but are not limited to, those described in Figure 5.

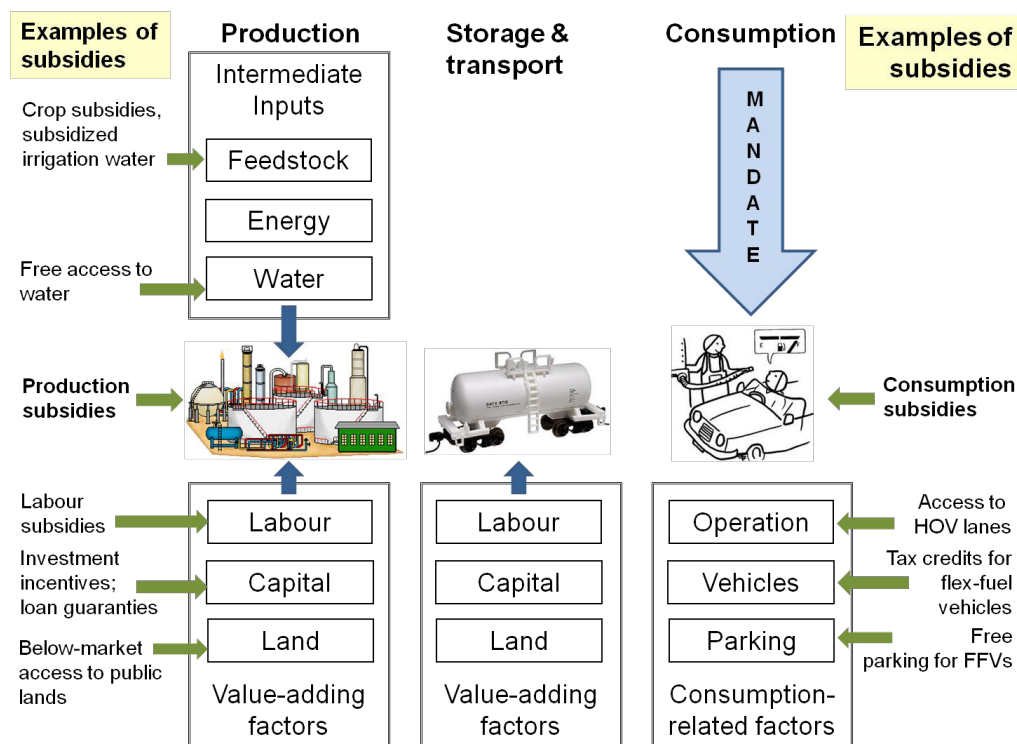
However, in practice, not all of the identified subsidies can be quantified. Some estimates exist for the most significant values of government support induced through consumption mandates (Text Box 2), but valuating some other subsidies (such as preferential provision of access to land, water and capital) may present a methodological challenge. Moreover, subsidies in one country can affect the biofuel industry in other countries as well, which further complicates the analysis. In particular, in recent years the support provided to biofuels consumption in developed countries has contributed to export-oriented expansion of biofuels in many developing countries.

The Annex table summarizes the IEA and GSI estimates of biofuel subsidies in major producing countries, but it is important to bear in mind that these values include only the core forms of government support (approximately captured by the two inner “nesting dolls” in Figure 1).

#### **TEXT BOX 2. THE COST OF BIOFUEL BLENDING MANDATES**

Biofuel mandates have become the preferred policy mechanism used by governments to support the biofuels industry (Jung et al., 2010) and have been introduced in at least 25 countries (Lane, 2011). Biofuel mandates lead to a market transfer, shifting the burden of supporting the industry from the government on to consumers.

For instance, the Global Subsidies Initiative has calculated the cost of the biofuels consumption mandate in the U.K. to be in the range of GBP1.0 to GBP2.0 billion for the year 2020. This would add 2 to 4 pence per litre on average to all fuel sold in the U.K. in 2020 to be borne by U.K. consumers. (Charles, Wooders, 2012). In the U.S., the cost of supporting the biofuel industry through biofuels mandates (assuming they are met), was estimated at US\$159 billion over 2008–2022 (Koplow, 2009).



**FIGURE 5. ILLUSTRATIVE EXAMPLES OF BIOFUEL SUBSIDIES**

Source: Sauvage, Steenblik & Sumicka, 2012

## Conventional Biofuels: Expectations and reality

The impacts of subsidies for conventional biofuels have ranged far beyond their stated policy objectives or the jurisdictions within which these policies have been adopted. Expansion of biofuels has both direct and indirect impacts for each of the policy areas discussed below.

### Energy Security

Aspirations to achieve independence from foreign supplies of fossil fuels—especially oil—as the main feedstock for liquid motor fuels, have been used as an important argument to mount government support for biofuels in the U.S. (Energy Independence and Security Act of 2007), Brazil, India, China and, to a lesser extent, in the EU (Stromberg et al., 2010).

On the global scale, biofuels provide only around 2 per cent of total transport fuel at present. An energy security success story is Brazil, where, since the mid-1970s, the government's PROALCOOL program has promoted the production and use of sugar cane ethanol, leading to an almost 21 per cent share of biofuels in the total volume of transport fuel consumed in the transport sector in 2008, or 12 million tonnes of oil equivalent (IEA, 2010). Many countries concerned about energy security have tried to copy Brazil's energy mix diversification through biofuels,



with varying degrees of success. In 2009 the rate of biofuels penetration in the market of liquid transport fuels was about 7–8 per cent in Germany and Spain, 6 per cent in France, 4 per cent in Italy, and 3 per cent in Great Britain (Al-Riffai, Dimaranan, & Laborde, 2010). In the U.S., biofuels are expected to account for about 9 per cent of all transportation fuels in 2012 (EPA, 2011).

Diversifying the transport energy mix through biofuels, especially if they are produced domestically, can be a benefit for individual countries. But, with the exception of Brazil, this benefit has yet to be fully realized. At present, there are just a few processes for conversion of conventional biofuel feedstock to liquid fuels, and limited physical volumes of biomass available for conversion. For instance, the U.S. now uses 40 per cent of its corn to produce biofuels (Wise, 2012), which means that, even if all corn harvested in the U.S. was converted into biofuels, it could only supply less than a quarter of the U.S. annual vehicle fuel use. Moreover, this estimate is for comparison only, as at present the vast majority of American motor vehicle engines are not able to operate safely if the biofuel content in the fuel mix is beyond about 10 per cent.

**Meeting the objective of energy security through biofuels will largely depend on the commercialization of a much wider range of technologies capable of producing biofuels from a variety of biomass sources as well as matching conversion arrangements in motor vehicles engines.** Based on this assumption, the International Energy Agency predicts that by 2050 biofuels will provide as much as 27 per cent of world transport fuel (IEA, 2011a).

Importantly, **to meet the stated objectives of improving the energy security of individual nations, the supply of biofuels also needs to be reliable, which may prove to be a challenge.** Like other crops, yields of biofuel feedstock depend on weather conditions, and are forecasted to become increasingly vulnerable due to more frequent draughts and extreme weather events caused by climate change (Stromberg, Esteban, & Thompson-Pomeroy, 2009; Eaves & Eaves, 2007). Moreover, coupled with fluctuations in the related food markets, prices for biofuel feedstock are volatile (FAO et al., 2011). Unlike oil producers that may have free capacity to increase output relatively quickly, farmers may not be able to meet short-term increases in demand for fuel, as agricultural supply takes time to respond due to the natural time lag associated with crop production and harvesting cycles (Henry, 2010).

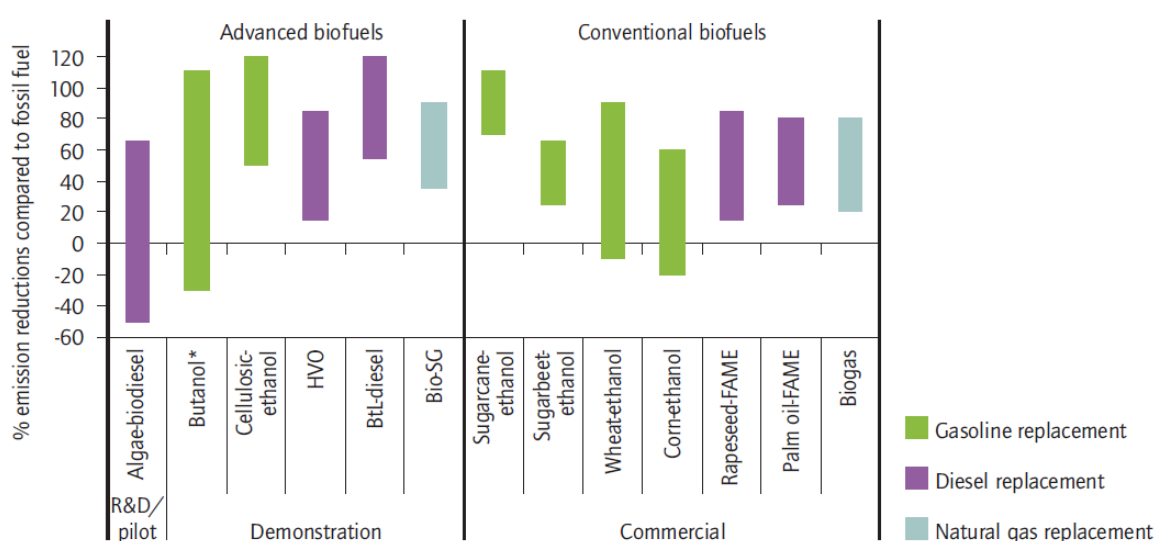
## Reduction of GHG Emissions and Other Aspects of Environmental Sustainability

**Reduction of GHG emissions and pollution from transport using blended motor fuels as opposed to pure gasoline and diesel is an important objective of biofuel subsidies. However, the extent to which this objective is achievable is still uncertain in many cases.**

The role of bioenergy systems in reducing GHG emissions needs to be evaluated by comparison with the energy systems they replace using life-cycle assessment (LCA, or “well-to-wheel”) methodology. LCA covers emissions not only from the end use of biofuels in engines, but also from the energy used for cultivation, processing and transport of biofuels. Such an approach often reveals that the transition from petroleum products to biofuels may involve more GHG emissions than anticipated at the stage when the current biofuel subsidies were designed. For instance, emissions of nitrous oxide, a potent GHG associated with the use of nitrogenous fertilisers, can make up the majority of GHG emissions from some biofuels (Ackom, Mabee, & Saddler, 2010). **GHG emissions resulting from direct change of land use** have also been significant in the cases of clearing forests for biofeedstock plantations in Malaysia and Indonesia as such land conversion may disrupt any future potential for storing carbon in biomass and soil (Lopez & Laan, 2008; Dillon, Laan, & Dillon, 2008).



Figure 6 represents a visual summary of IEA's review of 60 LCA studies of GHG emissions from biofuels against the replaced fossil fuel. It demonstrates that, depending on the details of the process and way the feedstock is produced (including the amount of fertilizers used) the net balance of life cycle GHG emissions can vary significantly even for the same fuels. This analysis concludes that ethanol from sugar cane (e.g., in Brazil or Thailand) has a much higher potential for GHG abatement than other conventional biofuels. Some advanced biofuels, e.g., ethanol or diesel from ligno-cellulosic feedstocks, offer more promise in terms of GHG emissions reduction, but estimates for these processes are theoretical or based on pilot plants and the uncertainties are higher, since such plants are not yet operating at a commercial scale. In the meantime, this sample of life-cycle assessments does not cover effects from indirect land-use change (see below).



**FIGURE 6. LIFE-CYCLE GREENHOUSE GAS BALANCE OF DIFFERENT CONVENTIONAL AND ADVANCED BIOFUELS EXCLUSIVE OF INDIRECT LAND USE CHANGE IMPACTS\***

\*Emission savings of more than 100 per cent are possible through use of co-products. Bio-SG = bio-synthetic gas; BTL = biomass-to-liquids; FAME = fatty acid methyl esters; HVO = hydrotreated vegetable oil

Source: IEA, 2011a. Reproduced with permission of IEA.

However, even in cases where biofuels generate GHG emissions reductions, they present a very costly option for meeting this policy objective compared to other means, such as purchasing carbon credits on the international market. This conclusion has been consistent through all country-level studies of the Global Subsidies Initiative. For instance, over 2008–2009, in the EU the cost of avoided CO<sub>2</sub> emissions was estimated to range from EUR90/tonne for biodiesel from waste cooking oil to EUR1422/tonne for ethanol from grains. By comparison, the price of CO<sub>2</sub> emissions allowances under the European Emissions Trading Scheme averaged only EUR16.25/tonne over the same period (Jung et al., 2010).

**Indirect land use change (ILUC)** resulting from expansion of biofuels is another source of GHG emissions and negative environmental impacts that is usually considered separately. For example, if fertile land now used for food crops (such as corn, soybeans, palm nuts, or canola) is used to produce bioenergy, this could lead, within the same jurisdiction or elsewhere in the world, to farmers clearing wild lands to meet displaced demand for crops. In this way, indirect land-use effects of biofuels can include extra GHG emissions, on the one hand, and deforestation





and biodiversity loss, on the other (Tilman, 2009). Against this backdrop, a number of studies have highlighted the danger of large-scale biofuel mandates. For instance, it was estimated that the additional usage of conventional biofuels required to meet the blending mandates in the 27 EU member states by 2020 would result in indirect land use change across the area between 4.7 million hectares (about the size of the Netherlands) and 7.9 million hectares (about the size of the Republic of Ireland). Taking into account such significant impacts on the land use, the same study estimates that, counter to GHG emission reduction targets, such policies will lead to an increase in GHG emissions in the range from 31.3 to 64.6 Mt of CO<sub>2</sub> equivalent (Bowyer & Kreschmer, 2011).

The complexity of direct and indirect impacts of biofuels expansion on water use is comparable to those on land use. Some biofuel feedstocks, for instance sugar cane, require significant quantities of water, particularly in hot and changing climates. This means that, **in countries already experiencing water stress, particularly China, India and many African countries, development of biofuels will exert additional pressure on water systems, with feedback into global food markets.**

Given the controversial impacts of biofuels' expansion on the environment, governments have tried to design targeted biofuel sustainability policies, but this approach faces a number of challenges (Text Box 3).

#### **TEXT BOX 3. BIOFUELS SUSTAINABILITY BENCHMARKS**

A number of schemes have addressed the increasing concerns over negative environmental impacts of biofuels expansion. At present such schemes include, but are not limited to, the provisions of the EU-Renewable Energy Directive (RED), the criteria of the Roundtable on Sustainable Biofuels, International Sustainability & Carbon Certification, U.K. Renewable Transport Fuel Obligation, and U.S. Renewable Fuel Standard (RFS). The purpose of these sets of criteria is twofold: to assess the environmental impacts of individual biofuels and to place restrictions on the use of biofuels not meeting these criteria.

The above-mentioned schemes mostly rely on assessing GHG emission minimum savings and direct land use change impacts. For both the U.S.-RFS and the EU-RED, efforts are underway to include the impacts through indirect land use change, too. But this would require cross-border monitoring and an internationally acceptable methodology which have yet to be developed. Traceability of biofuels' origin from either sustainable or unsustainable production practices proves very difficult. Enforcing biofuels sustainability criteria in countries with poor governance presents a further challenge.

*Source: based on Scarlat & Dallemand, 2011*

## **Rural Economic Development**

Subsidies for biofuels are commonly stated to promote investment in agriculture on the grounds of generating income for farmers (who are entering a new market with higher prices and stable demand underpinned by government support), creating new jobs and having wider positive economic spillovers in rural areas (Energy Future Coalition and UN Foundation, 2007). This is a very attractive objective to pursue for both developed and, particularly, developing nations where rural areas are homes to poorer and more vulnerable population groups.

In practice though, "depending on which feedstocks, production systems and ownership model is proposed and ultimately adopted, these multiple benefits may or may not materialize. Production systems that are large in scale and owned primarily by outside investors would limit the rural development potential" (Kleinschmit, 2007). This has been particularly the case in a number of African and Latin American countries where foreign investors absorb the revenues from biofuel production and exports, without a considerable "trickle-down effect" on the local communities (ActionAid, 2012).



In many cases, biofeedstock producing companies are not the local farmers switching to growing biofuel crops, but large national or foreign corporations acquiring land from the local communities. According to the International Land Coalition, between 2000 and 2010 at least 71 million hectares of land have been subject to land deals or there had been some form of negotiation for land purchases, of which 78 per cent are for agricultural purposes. Of these, over three-quarters are likely to be devoted to crop production for biofuels (Anseeuw et al., 2012). Despite this land often being presented as idle or unused, in practice, land acquisition involves more fertile land and in most cases results in the loss of access for—and lack of compensation for—the poorest and least powerful groups (ActionAid, 2012, also see Text Box 4).

#### **TEXT BOX 4. A CASE STUDY OF BIOFUELS DEVELOPMENT IN KISARAWA, TANZANIA**

Because the biofuels market is volatile and highly depending on government support, the jobs and regional development resulting from biofuels development are not always stable. ActionAid has undertaken several case studies of biofeedstock production operations to highlight some scenarios in which biofuel subsidies in Europe may have imposed additional pressures on fragile rural developments in Africa and Latin America. One of them describes the situation around the Tanzanian operations of Sun Biofuels Ltd, a U.K.-registered biofuel company. Sun Biofuels cited the EU legislation establishing biofuel subsidies and mandates as an important reason for the development of jatropha and other biofeedstocks with view to exports to the European market.

In 2009, Sun Biofuels started clearing land to establish an 8,200 hectare jatropha plantation in Kisarawe, Tanzania. The arrangement involved employment of about 700 local workers and commitment to fully compensate the cost of the land loss to the villagers. However, in 2011 a change of ownership occurred, and almost all of the locally hired staff were fired. Many people claim not to have received compensation for their land that was taken three to four years ago.

*Source: ActionAid, 2012*

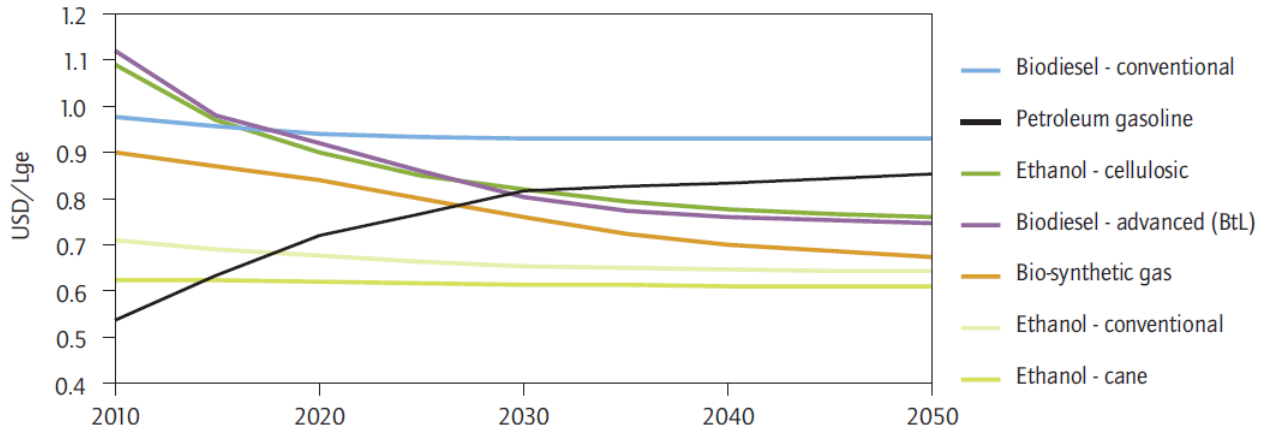
## **Reduction of Foreign Trade Deficits**

For oil-importing countries, an important driver behind subsidies to domestically produced biofuels is the intention to reduce foreign trade deficits and save foreign currency earnings. The exceptional case is again Brazil, which established its PROALCOOL program as a response to the 1970s oil price shock based on low prices for its domestically produced sugar cane (Bastos, 2007). It is estimated that its transitioning to ethanol has enabled Brazil to reduce the cost of oil imports by US\$43.5 billion between 1976 and 2000 (Langevin, 2005).

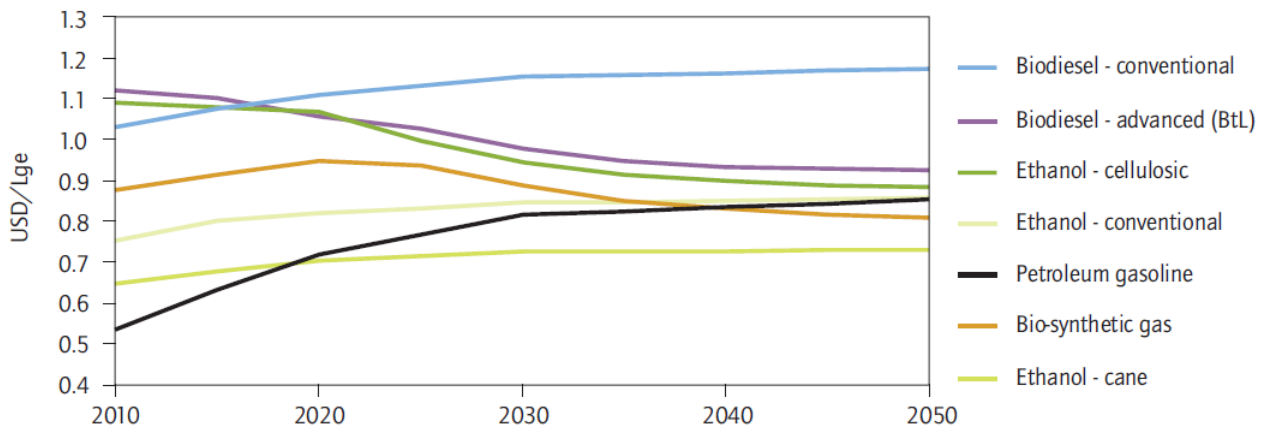
However, the substitution of imported oil products with domestically produced biofuels is only feasible if biofuels are effectively cheaper on the domestic market than oil products. The actual price relationship varies for different types of biofuels and changes over time, with Brazil's sugar cane-based ethanol being on average the cheapest biofuel option available. However, overall at present biofuels are largely costlier than petroleum gasoline, and there are different assumptions as to when the price parity can be reached (see Figure 7).



**Low-cost scenario**



**High-cost scenario**



Note: costs reflect global average retail price without taxation. Regional differences can occur depending on feedstock prices and other cost factors.

**FIGURE 7. COSTS OF DIFFERENT BIOFUELS COMPARED TO PETROLEUM GASOLINE.**

Source: IEA, 2011a. Reproduced with permission of IEA.



Exporting biofuels to heavily subsidized markets in the U.S. and Europe is a very attractive opportunity for biofuels producers in developing countries. For instance, virtually all biofuels produced in Argentina and Guatemala are exported to Europe (Sorda et al., 2010; ActionAid, 2012) (see Table 3 for more detail). However, both the EU and U.S. environmental authorities have questioned the sustainability of some biofuels imported from developing countries, especially palm oil biodiesel from South East Asia (*The Hill*, May 18, 2012). As a result, Indonesia, Malaysia and some other biofuel-exporting countries have expressed concerns about losing access to the European and American markets as a result of trade restrictions that might be in contradiction to the WTO principles (ICTSD, 2010; AgroAsia, 2012).

**TABLE 3: PRIMARY PRODUCTION, IMPORTS, EXPORTS AND NET IMPORTS OF BIOFUELS IN SELECTED COUNTRIES IN 2010, IN 1,000 TONNES**

	NET EXPORTERS					NET IMPORTERS			
	US	Brazil	Indonesia	Malaysia*	Germany	France	Spain	Italy	United Kingdom
Production	40695.5	5091.6	359.5	80.0	5960.0	2742.0	1261.0	1712.0	379.0
Imports	N/A	616.2	0.0	0.0	674.0	456.0	945.0	799.0	1040.0
Exports	N/A	1512.1	185.7	90.0*	732.0	309.0	494.0	101.0	0.0
Net imports	-3648.4	-895.9	-185.7	-90.0	-58.0	147.0	451.0	698.0	1040.0

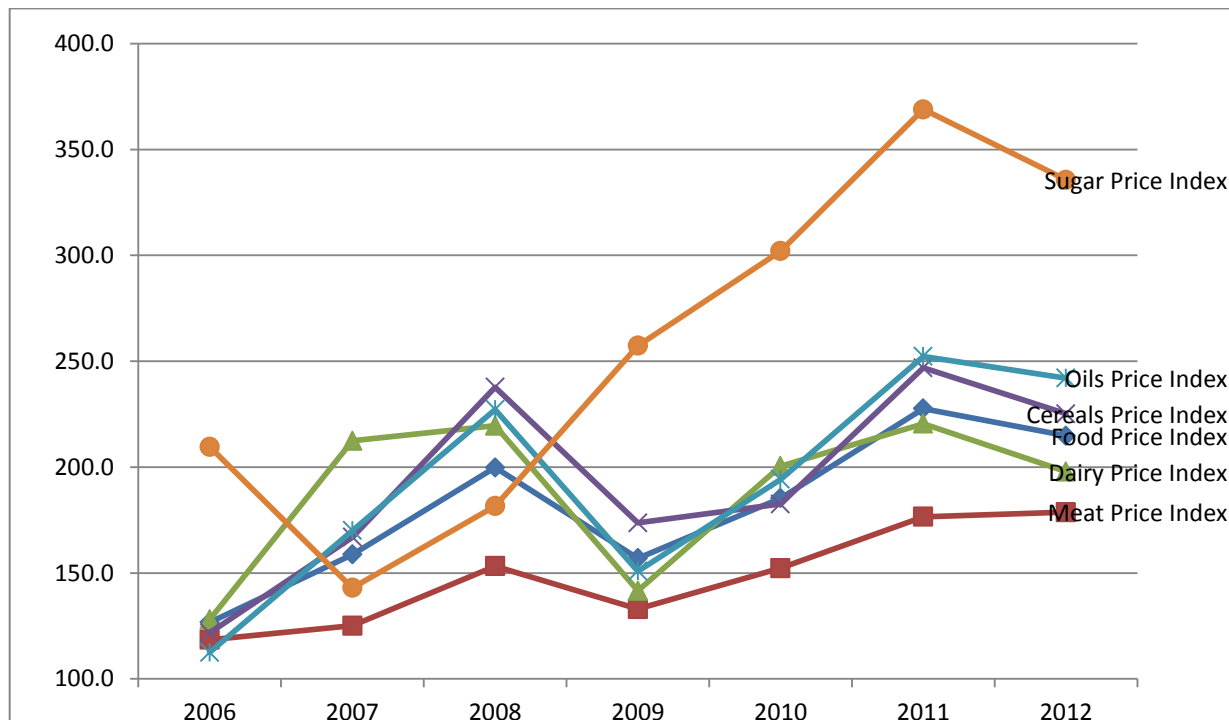
\* Malaysia's export of biofuels is reported to have exceeded its 2010 production due to sale of stock from previous years.

Sources: EIA, 2012; Slette & Wiyono, 2011; EUROSTAT, 2012; Barros & Zimmerman, 2011; Hoh & Rittger, 2011

## Food Security: The “food versus fuel” debate

The debate over the impact of subsidized biofuel-production on food prices spiked in 2006–2008 when, in spite of worldwide record crop yields, global prices for traded food commodities, such as staple cereals and sugars, reached record highs (World Bank, 2011). These hikes in food prices corresponded with the introduction of biofuel consumption mandates in the U.S., Europe and some other countries and the rapid increases in global biofuel production (Jung et al., 2010). Food prices decreased in 2009, but then resumed their growth through 2010–2011 (Figure 8).

Several studies by influential intergovernmental organizations examined this phenomenon and concluded that biofuels' expansion explained between 12 to 75 per cent of the food price rises in 2006–2008, depending on the food commodity, country being analyzed and the type of methodology adopted by the study (see Table 4 for an overview). This wide range of estimates reflects the considerable uncertainty among experts on the actual role biofuels played vis-à-vis other factors, such as weather-related production shortfalls and short-term market speculation.



**FIGURE 8. ANNUAL FOOD PRICE INDICES (2002-2004=100)**

Source: Based on FAO data



**TABLE 4. CONTRIBUTION OF BIOFUELS EXPANSION TO FOOD PRICE RISES ON THE GLOBAL MARKET IN 2006–2008: OVERVIEW OF SELECTED ESTIMATES**

ORGANIZATION (STUDY)	WEIGHTING (PERCENTAGE) ASSIGNED TO BIOFUELS	FOOD BASKET ANALYZED AND METHODOLOGY
The World Bank (Mitchel, 2008)	70–75 per cent	Ad hoc approach not adopting a structural model but attempting to identify key factors affecting food commodity prices focusing on maize, wheat, rice, oilseeds and on the Index of food commodity prices since 2002 (reflecting export prices)
IMF (Lipsky, 2008)	70 per cent of the increase in maize prices and 40 per cent of the increase in soybean prices	Based on IMF research into 2007 price rises with no further explanation of research methodology available
International Food Policy Research Institute (Rosegrant, 2008)	25–30 per cent	Partial equilibrium model (IMPACT Model) analyzing the interactions among agricultural commodity supply focusing on maize, wheat, sugar, oils and cassava
U.S. Federal Reserve (Baier, Clements, Griffiths, & Ihrig, 2009)	12 per cent	Estimated direct effects using simple supply and demand equations then added indirect affects to the equations with focus on corn, sugar, barley and soybean prices. Findings: increase in world biofuel production accounts for 12 per cent of the rise in IMF food price index from June 2006 to June 2008. U.S. biofuel policy accounts for 60 per cent of this effect, Brazil accounts for 14 per cent and the EU accounts for 15 per cent
U.S. Congressional Budget Office (CBO, 2009)	Between 28 per cent and 47 per cent of the increase in U.S. maize prices	Analyzed maize prices between April 2007 and April 2008 in attributing price increases to increased ethanol production

Source: GSI synthesis

Conventional biofuels are predominantly produced from the crops that are the source of cereals, sugars or vegetable oils used as food or fodder for livestock and also compete with other food and feed crops for the same inputs or factors of production such as land, capital, labour, fertilizers, water, and so on. In particular, in 2007–2009 biofuels accounted for a significant share of global use of several crops—20 per cent for sugar cane, 9 per cent for both oilseeds and coarse grains (although biofuel production from these crops generates co-products that are used as animal feed), and 4 per cent for sugar beet (OECD & FAO, 2010).

In 2011, a group of key international organizations released a report entitled “Price Volatility in Food and Agricultural Markets” (FAO et al., 2011) that stressed that **government-imposed consumption mandates aggravate the price inelasticity of demand that contributes to volatility in agricultural prices**. The report recommended that G-20 governments should “remove provisions of current national policies that subsidize (or mandate) biofuels production or consumption.” However, in recognition of the political economy challenges of such a step, the recommendation also provided for a “second best option”: when global markets are under pressure and food supplies are endangered, the countries should replace the rigid biofuel production or consumption targets with more flexible arrangements. The reference point in this respect is Brazil, which uses flexible biofuel support policies to reconcile its interests in both remaining the world’s largest exporter of sugar and increasing the share of bioethanol from sugar cane in the domestic transport fuel mix (see Text Box 5).



#### **TEXT BOX 5. FLEXIBLE SOLUTIONS FOR FOOD AND FUEL MARKETS: BRAZIL'S EXPERIENCE**

In Brazil, biofuels policies incorporate a significant degree of flexibility in switching between the use of sugar cane for food or fuel needs: biofuel mandates are not binding at current prices, and production and consumption decisions are determined by relative prices.

Importantly, the flexibility of policies is enabled by the adoption of adequate technologies. On the production side, many Brazilian mills can modify the share of sugar-cane used for ethanol or for sugar production. On the consumption side, the so-called "fuel flex" cars mean that consumption depends on the relative level of oil and sugar cane and is not bound by the technical capacity of Brazilian cars to use the different fuels.

In contrast, in the U.S. and Europe biofuel mandates are not flexible.

*Source: FAO et al., 2011, Annex D*

**There is increasing evidence that the effects of biofuels expansion on the food markets are most negative for the poorer and more vulnerable segments of the society.** First, the world's poor already spend a disproportionately high share of their income on food (International Bank for Reconstruction and Development, 2008). Therefore, hikes in prices for such foods have particularly significant consequences for these vulnerable segments of society. In particular, empirical research shows that in most developing countries women bear a disproportionate share of the burden of the food price hikes, both as producers and consumers, due to the existing discrimination in labour markets (FAO, 2008).

Second, there are very different patterns of interaction of biofuel expansion policies with food markets depending on the commodity and locality in question. In this respect, world-average prices for internationally traded commodities may not tell the full story (Hossain & Green, 2011). A lot of rural livelihoods in developing countries depend on locally grown foods, and many of the local markets are not fully aligned with global trends due to undeveloped transport networks and other factors (Keats et al., 2010). Launch of biofuel production activities in such areas usually means that these local food markets become part of the global trade system, which introduces price food volatility for which local communities are not prepared (see Text Box 6).

#### **TEXT BOX 6. EXPOSURE OF A CAMBODIAN COMMUNITY TO SHOCKS OF THE VOLATILE CASSAVA MARKET**

The growing demand for cassava as biofuel feedstock in Thailand and China has incentivised farmers in Banteay Meanchay, Cambodia, to move from traditional agricultural patterns to cultivation of cassava. Prior to 2006, only four of 32 households in the two surveyed villages reported having any cassava under cultivation, but by 2009 only two of them did not cultivate cassava. Clearing forest and adopting a new crop type demanded a considerable investment, therefore 17 of 32 surveyed households borrowed money for this purpose.

In late 2008, cassava prices crashed as world agricultural commodity prices plunged, and the Thai/Cambodian border closed due to ongoing border tensions. Cassava growers from Banteay Meanchay lost their market, which has had severe consequences for their livelihoods and food security. By the time of the cassava price crash, many farmers cultivated only this crop and no food. Therefore, their options of buying food and repaying debts were thus limited to selling a portion of land, selling livestock or, for the already landless, to migrating in search of wage work (wages for unskilled labour are below subsistence level).

*Source: Hought et al., 2012*



## Advanced Biofuels: A new factor?

As discussed above, conventional biofuels have been the subject of serious concern due to their controversial social and environmental impacts as well as competition with food crops for agricultural land and other production factors. Therefore, high hopes are often placed on new generations of biofuels that would avoid these setbacks.

Proponents suggest that advanced biofuels (see Table 1 for examples) may have more favourable socioeconomic impacts than conventional ones for three main reasons. First, they may offer increased yields of useful material. Second, feedstocks may be derived from waste streams. Third, crops may be produced on marginal land. It is possible to find examples in support of each of these points, but they are not universally true. A wide variety of options exist for developing advanced biofuels, each with different characteristics.

At present, government support for advanced generation biofuels exists largely in three forms:

- Direct government spending for research and development. In particular, the IEA estimates direct government spending on new biofuels-related R&D to be more than US\$1 billion in the U.S., US\$430 million in Canada and US\$12 million in Australia (IEA, 2010).
- Some blending mandates, depending on the design. For example, in the U.S., the Renewable Fuels Standard has an explicit mandate for cellulosic ethanol (an advanced biofuel) and a target for 60 billion litres of second-generation biofuel by 2022.
- Sustainability criteria. For instance, the EU's sustainability criteria involve GHG standards that grow more stringent over time, which will act as an incentive for biofuels with lower life cycle GHG emissions.

However, even supported by governments, advanced biofuels have yet to mature and prove their competitiveness vis-à-vis other biofuels, renewables, energy efficiency measures and other energy sources in general. At present, the lack of operational projects and the small number of projects under construction indicate the relative infancy of the industry. Experts agree that commercial production of new generation biofuels is likely to remain small in the short- and mid-term future (IEA, 2009; Bacovsky & Dallos, 2010). For instance, under the IEA baseline scenario, conventional biofuels are projected to be predominant up to 2050, although more innovative scenarios provide for a growing role of advanced biofuels (IEA, 2010). There is also a considerable overlap in generations as, for example, co-products of subsidized conventional biofuels—corn kernels and corn stover—are used as an early source of advanced biofuels. This may effectively divert some government support from other advanced technologies (in particular, cellulosic technologies) and delay their commercialization.

To summarise, **whether a biofuel is classified as “conventional” or “advanced,” “first,” “second” or “third” generation is not a useful indicator of its sustainability.** In some cases, advanced biofuels can still be competing with food crops for input factors such as land and water. Further, claims relating to improvement in yield may assume that advanced biofuels are able to use a greater proportion of the feedstock plant. However, in many cases other uses exist for agricultural co-products, reducing this benefit. For instance, many residues serve as fodder for livestock or are needed to protect the surface of arable land from water and wind erosion.

Advanced biofuels can only offer an improvement over conventional biofuels where they show an ability to mitigate net negative impacts. Some advanced biofuels do show promise in this respect, but their deployment and commercialization still requires time.





## *Austerity Measures and Biofuel Subsidy Reform: Political economy challenges*

The financial and economic crisis that unfolded in 2008 has made many governments reconsider their budgetary spending priorities. This has increased attention to the opportunity costs of direct subsidies, tax expenditures and other forms of support they provide to industries; the renewable energy sector has been no exception.

Concerns over the rising costs of biofuel subsidies (US\$22 billion in 2010, projected to increase up to US\$67 billion per year in 2035 according to the IEA), coupled with the controversial social and environmental impacts discussed above, have led to heated debates and, in some instances, policy change. In particular, in July 2011, overcoming the powerful resistance of the “ethanol lobby,” the U.S. Congress voted in favour of discontinuing the Volumetric Ethanol Excise Tax Credit beyond 2011, thus eliminating about US\$6 billion worth of annual subsidies, although a considerable amount of this subsidy has been re-profiled into new forms of support to the industry under the Renewable Fuels Standard (Environment News Service, 2012; U.S. Department of Energy, n.d.).

In the meantime, **many organizations have called on the G-20 and other governments to enact a more drastic overhaul of biofuel subsidies given their questionable record with respect to GHG emissions reduction, the food-versus-fuel debate and other social and economic implications discussed above.** Recommendations to the countries to fully or partially phase out the existing support to biofuels have been voiced by academia (an extensive, but far from complete selection of literature reviews and recent studies is available from <http://www.iisd.org/gsi/biofuel-subsidies>), international organizations (FAO et al., 2011), food and beverages companies (B-20, 2012) and civil society (ActionAid, Oxfam, Worldwatch Institute, FIAN International, and some others).

However, a simple attempt to dismantle biofuel subsidies may be counterproductive, as it fails to recognize the interests of a highly sophisticated industry with a market worth more than US\$80 billion a year. Proposed reform should acknowledge and address the obstacles that have acted against rationalization of biofuel policies in the past.

First, both policy-makers and the general public still remain poorly aware of the increasing body of research discussing the negative social and environmental impacts of biofuel subsidies. On the one hand, this results from the fact that, in the words of John Ashton, the U.K. Foreign Secretary’s Special Representative on Climate Change, “the policy on biofuels is currently running ahead of science” (quoted in Roger, 2007). Interest groups favouring biofuel subsidies promote collection of “policy-based evidence” rather than implementation of “evidence-based policies” (Sharman & Holmes, 2010). On the other hand, as highlighted above, the complex environmental and social issues surrounding biofuels (for example, the net balance of greenhouse gas emissions as a result of indirect land use change) are still characterized by a high degree of uncertainty, and the glut of technical details surrounding them can easily sidetrack those less familiar with the subject matter.

Second, once governments have invested billions of dollars supporting the development of biofuels, there is a strong impetus to continue with the original designs. Sunk capital costs related to the development of refining facilities and infrastructure supporting the industry, such as roads or fueling stations, act as a deterrent for policy-makers to limit or phase out support (Steenblik, 2009). Sudden removal of biofuel subsidies will render this infrastructure idle. However, if biofuel subsidy reform is implemented under an adequately communicated mid-term schedule, capital and technology markets may receive enough notice to enable retrofitting and flexible uses of some of the “first generation” biofuels infrastructure.



Third, a major share of support to the biofuels industry is transferred through consumption mandates that push the burden of subsidy costs on consumers rather than governments themselves. The benefits of subsidies accrue to a relatively small group who are vocal in demanding ongoing support. The costs are widely dispersed and, therefore, the opponents are less easily united (Sharman & Holmes, 2010).

Fourth, there are few alternatives to biofuels as a replacement for petroleum-based liquid fuels for transport, which is a major consideration in terms of energy security. Any attempt to reform biofuel subsidies should be combined with the introduction of a policy framework designed to promote a solution to the “transport challenge”—incentivizing sustainable innovations, from reducing the need for transport at all to the development of alternative vehicles such as hybrid, electric and hydrogen cars.

Last, but not least, biofuel subsidies are often seen by politicians as an easier “fix” of the market signals that do not reflect the full social and environmental costs of the conventional energy, especially fossil fuels. However, in order to eliminate these market distortions and price carbon effectively, the first-best solutions include the phase-out of fossil-fuel subsidies. Fossil-fuel subsidies are estimated at between US\$45–75 billion a year in OECD countries (OECD/IEA, 2011) and at US\$409 billion in 2010 in non-OECD countries (IEA, 2011b). The first-best options also include improving and extending the existing cap-and-trade systems and implementing robust carbon taxes.

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## *Recommendations to Governments*

This report summarizes the current state of knowledge in policy literature relating to biofuels. It finds that large amounts of public money are being used to promote the use of conventional biofuels. It finds significant controversy around the ability of these same fuels to achieve the objectives that governments have set out to achieve—increased energy security, improvements in environmental performance and the generation of additional economic value. At the same time, the report identifies the growing concern around some of the unintended impacts of biofuel production, such as the role that biofuels may play in driving up food prices and land conversion.

On this basis, the GSI has formulated a number of recommendations which, if implemented, will help promote more sustainable biofuel policies. It is likely that, due to the conflicting positions of many of the key stakeholders, certain recommendations may be opposed by different parties. However, given the impact of biofuel policies on energy and agricultural markets, ongoing consideration of the use of biofuel subsidies and policies is important.

The GSI recommends that governments should commit to:

1. **Raise the political profile of evidence-based economic, environmental and social costs and benefits of biofuels.** The remaining uncertainty about the exact mechanics of biofuel expansion’s impacts on food markets should not serve as an excuse for inaction by governments and other stakeholders with respect to addressing these negative impacts. Projected climate change impacts, combined with a growing world population, mean that policy-makers must act to ensure cohesion between energy and agricultural markets.
2. **Report annually the value of subsidies granted to biofuel consumers and producers in a detailed and consistent manner.** Reporting can be based on the existing reporting tools, such as the OECD template for producer and consumer support estimates.



3. **Abstain from introducing new forms of government support to conventional biofuels.**
4. **In the short term, replace the rigid biofuel production or consumption mandates and targets with more flexible arrangements** in order not to block interactions between the global markets of biofuels, food, fodder and related products during the periods when food supplies are endangered and there is a threat of food price hikes.
5. **In the middle term, establish and implement a plan for removing national policies that support consumption or production of biofuels that a) compete with food uses for the same feedstock crops and b) have negative impacts on the environment.** Phase-out of support for such biofuels should include removal of not only direct subsidies and tax relief provisions, but also legal arrangements enabling access to capital, land, water and public infrastructure at below-market rates, as well as market and price support through consumption mandates and import tariffs.
6. **Continue support for the development of infrastructure that allows for more flexibility in the use of biofuels:** on the demand side, easy switching between the use of biofuels and other energy sources: on the supply side, allowing for production of biofuels and food/feed from the same crops.
7. **View biofuel policies only as a second-best solution to the challenge of diversification from fossil fuels.** The first-best solutions include the phase-out of fossil-fuel subsidies and pricing carbon properly by improving and extending the existing cap-and-trade systems and implementing robust carbon taxes.



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## Annex. Estimates of Government Subsidies, Including Mandates, for Liquid Biofuels Used in Transport for Top Biofuel-Producing Countries

Jurisdiction	IEA 2009 estimates based on inventories of tax advantages and price-gap approach (IEA, 2011b)		Global Subsidy Initiative estimates for various years based on detailed bottom-up inventories						
	Bioethanol	Biodiesel	GSI estimates based on country studies (for certain periods)	Direct budgetary spending and credit support, e.g., for biofuel refineries, R&D	Tax relief (breaks, exemptions, reduced rates, etc.)	Provision of government-owned assets at below-market value, particularly land and water	Market and price support		Information sources for GSI estimates
							Consumption mandates*	Import duties	
United States	US\$7.7 billion	US\$0.4 billion	US\$6.3-7.7 billion (2006), US\$8.1-9.9 billion (2007), US\$10.7-12.9 billion (2008)	R&D grants; Cellulosic grants; Bioenergy research centres; small scale bio-refineries; Cellulosic biofuel processes; Loan guarantees	Volumetric tax credits, particularly the Volumetric Ethanol Excise Tax Credit (expired at the end of 2011); Reductions in State motor fuel taxes; Small producer tax credits (expired at the end of 2011); Domestic production tax deduction for cellulose-based biofuels	Relaxation of emissions regulations	Renewable Fuels Standard mandates:  48 billion litres of which 0.02 bln. cellulosic-ethanol (2011); 136 billion litres, of which 60 bln. cellulosic-ethanol (2022)	Ethyl alcohol intended for use as a fuel US\$ 0.4-0.54/gallon (2006), Applied tariff Ad valorem equivalent (per cent) 28 per cent (2007)	(Steenblik, 2007), (Koplow, 2007) (REN21, 2011) (IEA, 2011a)
EU	US\$2.1 billion	US\$5.8 billion	EUR 3.2 billion (2007), EUR 3.0 billion (2008)	R&D spending	Exemptions for fuel excise tax EUR2.8 billion (2007), EUR2.8 billion (2008)	(Single Payment Scheme payments per hectare of land used in the production of biofeedstocks	5.75 per cent (2012) (varies across member states)	Range of tariffs	(Steenblik, 2007), (Jung, Dörrenberg, Rauch, & Thöne, 2010), (Charles & Wooders, 2012)
Brazil	US\$2.6 billion	US\$0.1 billion	N/A	Significant in the past under the PROALCOOL program; at present there are auctions where the National Petroleum Agency buys given quantities of biodiesel to ensure supply targets	Excise and state duty exemptions, tax exemptions at subnational level	Significant in the past under the PROALCOOL program	E20-25, B5 (2012)	0 per cent (2007) lowered from 20 per cent (2006)	(Steenblik, 2007) (IEA, 2011a)
China	US\$0.4 billion	US\$0.1 billion	US\$0.9 billion (2006)	Low interest loans, direct subsidies to compensate for losses	VAT on biofuels, (US\$9.4 million from 2010); Consumption tax exemption	N/A	E10 (9 provinces)	N/A	(GSI, NDRC, 2008)



Jurisdiction	IEA 2009 estimates based on inventories of tax advantages and price-gap approach (IEA, 2011b)		Global Subsidy Initiative estimates for various years based on detailed bottom-up inventories						
	Bioethanol	Biodiesel	GSI estimates based on country studies (for certain periods)	Direct budgetary spending and credit support, e.g., for biofuel refineries, R&D	Tax relief (breaks, exemptions, reduced rates, etc.)	Provision of government-owned assets at below-market value, particularly land and water	Market and price support		Information sources for GSI estimates
							Consumption mandates*	Import duties	
Canada	N/A	N/A	CAD\$198-210 million (2006); CAD\$287-344 million (2007); CAD\$378-466 million (2008)	Capital grants, feasibility studies, R&D	Fuel tax exemptions (including by sub-national jurisdictions), accelerated depreciation allowance	N/A	E5 (up to E8.5 in 4 provinces), B2-B3 (3 provinces) (2012)	0 per cent within NAFTA, CAD\$0.0492 per litre for ethyl alcohol imported from other countries, including Brazil	(Laan, Litman, & Steenblik, 2011)
Indonesia	N/A	N/A	US\$197 million (January 2006-June 2008)	Research grants; Seedling cultivation subsidies; State oil company losses; infrastructure subsidies	VAT exemption	Land concessions for wood and palm	E5, B5 (2015); E15, B20(2025)	N/A	(Dillon, Laan, & Dillon, 2008)
Australia	N/A	N/A	AUD13 million (2004-2005), AUD34 million (2005-2006), AUD 95 million (2006-2007)	Biofuels Capital Grants Program; Sugar Industry Innovation Fund; Greenhouse Gas Abatement Programme; R&D grants	Domestic production grant (up to 2011); Energy Grants (Cleaner Fuels Scheme (from 2011-2015); Ethanol Distribution Programme	N/A	Various at state level	5 per cent tariff and excise duty	(Quirke, Steenblik, & Warner, 2008)
Malaysia	N/A	N/A	US\$ 19 million (2006)	Soft loans to biodiesel plants; Grants for R&D from Malaysian Palm Oil Board	Investment Tax Allowance	Support for land development	B5 (2011)	No import tariffs on biodiesel and palm oil	(Lopez & Laan, 2008) (Charles & Wooders 2011)
Switzerland	N/A	N/A	CHF4.6 million (2004), CHF7.8 million (2005), CHF8.9 million (2006), CHF11.8 million (2007)	Area payments to oilseed production, Support to processing, ad hoc support to R&D (2008)	Reduced rate for imported biofuel under Mineral Oil Tax Law (2008)	N/A	No consumption mandate	B duty free; E CHF 0.0056 per litre (denatured ethanol) (CHF0.28 per litre (undenatured ethanol))(2007)	(Steenblik, Beaton, & Simón, 2008)
India	N/A	N/A	N/A	National Biofuel Fund under consideration; Subsidised loans to sugar mills	Exemption from central excise tax (4 per cent) for biodiesel, concessional excise duty 16 per cent on bioethanol	N/A	E5 (2003) partially implemented in 9 states; E5 20 states (2006), E5 all states (2008); Target of E20, B20(2017), Minimum Support Price for oil seed growers; Fixed price for ethanol and biodiesel (2010)	Ad valorem import tariffs applicable to Ethanol and biodiesel 28.64 per cent (2011)	(USDA, India Biofuels Annual, 2011), (Sorda, Banse, & Kemfert, 2010)



Jurisdiction	IEA 2009 estimates based on inventories of tax advantages and price-gap approach (IEA, 2011b)		Global Subsidy Initiative estimates for various years based on detailed bottom-up inventories						
	Bioethanol	Biodiesel	GSI estimates based on country studies (for certain periods)	Direct budgetary spending and credit support, e.g., for biofuel refineries, R&D	Tax relief (breaks, exemptions, reduced rates, etc.)	Provision of government-owned assets at below-market value, particularly land and water	Market and price support		Information sources for GSI estimates
							Consumption mandates*	Import duties	
Thailand	N/A	N/A	N/A	Subsidy from the state oil fund, support for R&D, Subsidies for refiners (13.5 baht/litre for E85) (2010)	Ethanol producers excise tax exemption (US\$0.8/litre)		B2 compulsory from 2011, B4 compulsory for 3 months to coincide with harvest; Mandate adapted to match supply	Reduction on import duties for flex fuel vehicles 60 per cent (2011)	(USDA, 2011), (Sorda, Banse, & Kemfert, 2010)
Argentina	N/A	N/A	N/A		Preferential tax for biodiesel		E5, B7 (2011); Price of ethanol set by government US\$0.80 per litre (2010)	20 per cent export tax on corn as feedstock; imports from Mercosur (including Brazil) are duty free other countries are 20 per cent (2010)	(USDA, 2011) (Sorda, Banse, & Kemfert, 2010)
Columbia	N/A	N/A	N/A		Tax exemption to new palm oil in 2004-2012		E10 target (2011), B20 (2015); 60 per cent of vehicles must be flex fuel by 2012; Government regulates minimum price for producers	Basic import duty is 10 per cent for ethanol and 5 per cent for biodiesel (2010); imports from Mercosur countries are exempt	(USDA, 2011)

\* B = biodiesel (B2 = 2 per cent biodiesel blend); E = ethanol (E2 = 2 per cent ethanol blend).

Source: GSI analysis



**GSI** Global  
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durable

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