GSI Global Subsidies Initiative

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RESEARCH REPORT

Subsidies to Liquid Transport Fuels: A comparative review of estimates

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About GSI

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1. Introduction

Governments spend substantial amounts of money subsidizing energy. The last decade has seen an unprecedented increase in the support provided globally to the biofuels sector. In 2007 the International Energy Agency (IEA) estimated global biofuel subsidies at US$14 billion, increasing to US$20 billion in 2009. Energy demand for transportation in 2005 was met almost exclusively by oil, at approximately 98 per cent (ExxonMobil, 2008).Oil also receives significant support, with the IEA (2010) estimating subsidies to all consumers of oil were approximately US$185 billion in 2007, US$275 billion in 2008 and US$125 billion in 2009. The transport sector is the principal consumer of oil products, representing two-thirds of final consumption (International Energy Agency).

This report surveys the publicly available estimates of subsidies to biofuels and conventional liquid transport fuels, including both consumption subsidies and the production subsidies provided to the oil industry. This report:

- reviews the information currently available for each fuel type;
- describes the principal methods for quantifying subsidies;
- identifies the major information gaps in the literature on subsidies;
- makes a preliminary comparison of results.

There are a number of challenges to accurately measuring subsidies for each fuel type and comparing the results. Furthermore, there is a geographical disconnect between the countries that are the main subsidizers of oil and those that subsidize biofuels. There are also different interpretations of what constitutes the right reference price against which fossil fuels should be benchmarked.

Using available data relating to the magnitude of subsides and the global energy demand for biofuels and conventional fuels, the relative subsidy provided on a per unit of energy basis is calculated for each. Caution should be exercised when interpreting these results—comparing energy subsidies is problematic—as the true scale of subsidies to biofuels and conventional fuels is challenging to ascertain, and there are differences in where they are applied geographically amongst other complicating factors.

This report is one of a pair, the other being ***Subsidies and External Costs in Electric Power Generation: A comparative review of estimates***.

a. Defining Subsidies

Defining subsidies is often considered to be a complicated and a controversial issue. In practice, many of the issues revolve around how a subsidy is evaluated — whether it is "good" or "bad" — rather than how it is defined.

This report employs the definition used by the Global Subsidies Initiative (GSI), who define a subsidy as any form of preferred treatment granted to consumers or producers by a government. The definition is based on the World Trade Organization's Agreement on Subsidies and Countervailing Measures, agreed by 153 Member states, and tried and tested through a rigorous negotiating process and legal analysis and jurisprudence by the Dispute Settlement Body and Appellate Body. A full definition, extracted from (GSI, 2010) is given in Box 1.

This definition of subsidies captures transfers from government. However, other forms of support also exist which involve transfers from consumers, notably blending mandates which require a proportion of biofuels to be blended with a conventional fuel. These tend to increase the price of the final fuel to the consumer, and result in a transfer from the consumer to the producer of the biofuel. Such support measures are included in within the GSI's definition of a subsidy under the "income or price support category," since a government has mandated a course of action

which has led to a transfer which would not otherwise have occurred. Further, the GSI definition does not include the "externalities" associated with the production of conventional fuels or biofuels—the additional costs to the environment and to society that are not captured in the market price of either product. Negative externalities from biofuel production can include direct and indirect land-use changes, involving the release of carbon emissions into the atmosphere when forested land is cleared to make way for bio-feedstock production (Searchinger, et al., 2008). Negative externalities, such as an increase in the price of staple food products for consumers, have also been linked to the increased biofuel production associated with blending mandates and binding targets for the share of renewable energy use in the transport sector. In response to rising food prices, a recent joint report released by a number of key policy organisations recommended that "G20 governments remove provisions of current national policies that subsidize (or mandate) biofuels production or consumption" (FAO, IFAD, IMF, OECD, UNCTAD, WFP, the World Bank and the WTO, 2011). For conventional fuels, negative externalities include the costs of treating health-related respiratory problems resulting from inhaling vehicle-exhaust fumes (Koplow, D. Lin, Cynthia,L. Jung, A. Thöne, M. & Lontoh, L., 2010). Some analysts would like to see a broader definition of what is considered a subsidy in order to better reflect the cost of particular energy sources to society (Koplow, 2004). While a review of the literature on externalities is beyond the scope of this analysis presented in this report, it is important that externalities are considered in assessments of policies supporting the production or consumption of particular transport fuels.

BOX 1: SUBSIDY DEFINITION (ADAPTED FROM (GSI, 2010))

The Global Subsidies Initiative adopts a three-step approach to: *define, measure and evaluate* subsidies (GSI, 2010). This approach starts with a broad definition of "subsidy" with the purpose of identifying all existing subsidies in a sector, whether those subsidies are subsequently considered "good" or "bad." This provides a comprehensive starting point for the analysis to follow. Therefore, it should not be assumed, that because a subsidy is identified at the beginning of a process that it is necessarily in need of reform.

The GSI uses a definition of "subsidy" based on the World Trade Organization's (WTO) Agreement on Subsidies and Countervailing Measures (ASCM). Under Article 1: Definition of a Subsidy, the ASCM determines that four types of subsidies exist, where:

1. Government provides direct transfer of funds or potential direct transfer of funds or liabilities,
2. Revenue is foregone or not collected,
3. Government provides goods or services or purchases goods,
4. Government provides income or price support.

The ASCM also requires that a subsidy be specific to an enterprise, industry, or group of enterprises or industries under Article 2. So although in some cases government support is offered to more than one sector, it can still be considered a subsidy—if, for example, it is offered only to the oil, gas and mining sectors, or if one sector disproportionately benefits from the support.

Based on the ACSM list above, GSI has developed subcategories of subsidies that form the framework identifying subsidies. (This) forms a comprehensive framework for identifying and analyzing subsidies in any country. The analysis in this report is based on this framework.

2. Subsidies to the Biofuels Sector: Background

a. Policy Objectives for Subsidies

Any analysis of biofuel (and conventional transport fuels) subsidization needs to recognize the government objectives for implementing these policy measures. Depending on the country, policy- makers will have differing economic and political rationales for creating particular subsidy policies. The key objectives for supporting the biofuels industry, while accounting for some differences between countries, have remained fairly consistent over time. The commonly cited government objectives are to (European Commission, 1997):

- help address security of supply issues concerning fossil fuels;
- assist with regional economic development; and
- promote environmental sustainability involving greenhouse-gas (GHG) emissions reduction.

There may also be unofficial objectives for governments to provide support to the biofuels sector, such as swaying rural voters. Once in place, subsidies channel resources to industry groups or regions which have influence over a government's re-election or who bring political pressure to bear on policy-makers (Victor, 2009).

b. Subsidy Types

Government intervention in the biofuels market spans production processes, storage and delivery, consumption, as well as support for intermediary inputs, such as water and energy. The following box contains the main typology of subsidies provided to the sector.

BOX 2: MAIN TYPOLOGY OF BIOFUEL SUBSIDIES

Market transfers: Affect both consumer and producer prices by artificially elevating the price of biofuels. In the European Union and the United States, they include mandatory blending rates and border protection through import tariffs. The former establishes mandatory requirements for the share of biofuels in transport fuels sold (thus providing a guaranteed domestic market), whereas the latter aims at protecting domestic production of biofuels through tariffs on biofuel imports (thus reducing price competition). Mandatory blending requirements are major drivers of investment as they guarantee a minimum volume or share of the transport fuel market for the product.

Budgetary support linked to volume produced or consumed: The common policies include tax exemptions and reductions applied to certain levels of production. Without a quota system an undefined amount of consumption is exempted or reduced from taxation and thus foregone tax revenue highly depends on the level of production. These covert subsidies can be calculated but few governments collect sufficient information on them.

Support for intermediate inputs: Support of intermediate inputs can include subsidies to feedstocks. 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 reduce the costs of production, compensate producers for market prices that fall below a target price, while others—especially trade barriers—raise domestic prices.

Support for production factors: This includes support for capital goods; land; and occasionally labour employed directly in the production process. It is one of the most difficult forms of support to track for any industry, particularly capital for plants. By definition, general policies designed to spur capital investment 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. [Canada's ecoABC program is an example.]

Support related to distribution and consumption: Several OECD countries are subsidizing or mandating investments in biofuel storage, transport and distribution infrastructure, and vehicles capable of operating on high blends of biofuels, in order to increase consumption.

Support for research and development (R&D): Biofuel-producing countries have established government-funded programs to support research, development and innovation in respect to 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, and environment), there are a wide variety of programs directly and indirectly benefiting the industry (Steenblik, 2007).

c. Measurement of Subsidies

This section provides a non-exhaustive summary of the main methods for calculating biofuel subsidies and sources of data. There are three common approaches to measuring subsidies in general:

i. The **price gap approach** estimates the gap between domestic energy prices (for example, oil products) within an economy and world reference prices (or the price for which the energy would be sold without government support programs). For further discussion of the difficulties associated with the price gap approach see Section 2.2 of IEA, OPEC, OECD, World Bank (2010). It is similar to the measurement of market transfers to consumers in the CSE (see below).

ii. The **transfer measurement approach** relies on a bottom-up assessment to quantify the subsidy associated with a given program, regardless of whether it has an effect on end-user prices. Whilst this enables quantification of any particular measure, the data requirements are substantial and studies tend to focus on a particular intervention. For further information see Koplow (2009) and World Bank (2010).

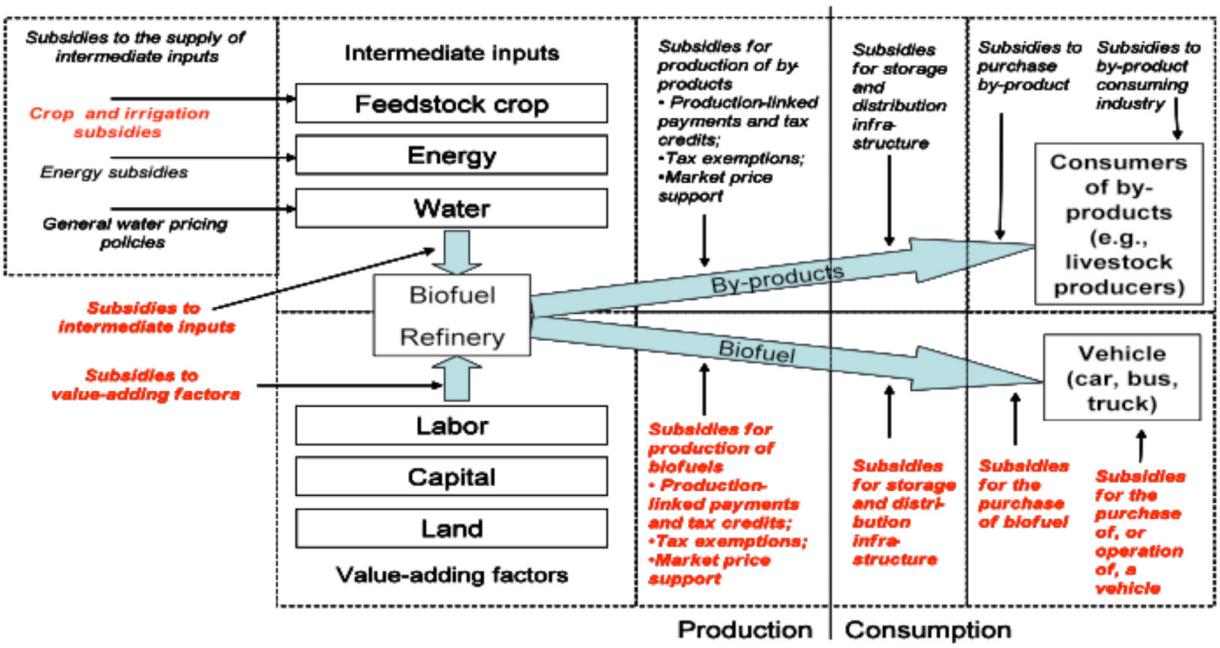
iii. The **integrated approach**, the main example of which is the Producer Support Estimate and Consumer Support Estimate (PSE-CSE) framework applied in particular by the OECD. This combines direct financial transfers (including those benefiting producers through government assumption of risk) as well as transfers generated between producers and consumers and vice versa as a result of government policies. The Effective Rate of Assistance (ERA) builds on the same information required to construct a PSE, but expresses the resulting transfers (adjusted for policies, such import tariffs, that raise an industry's input costs), in terms of the industry's value added.

The way by which the two most comprehensive sources of biofuel subsidy estimates—by the GSI and the IEA—measure subsidies is discussed below.

GSI Methodological Framework

From 2006 to 2010, the GSI conducted a series of country-level studies examining the extent of government intervention in the markets for liquid biofuels: ethanol and biodiesel (the series is entitled "Biofuels—At What Cost?"). The GSI framework for identifying and classifying biofuel subsidy programs provides a consistent "bottom-up approach" to quantify biofuel subsidies, rendering the series of country reports comparable. The framework of analysis is provided in figure. 1.

FIGURE 1. GSI FRAMEWORK FOR IDENTIFYING AND CLASSIFYING BIOFUEL SUBSIDY PROGRAMS



Source: Steenblik, 2007

The dividing line between production and consumption subsidies is the point at which the biofuel leaves the manufacturing plant (volumetric (i.e., per-unit subsidy) subsidies provided to organisations blending biofuels were an exception—and classified as a production subsidy). The focus is on subsidies affecting attributes of production which are significant to the cost structure of biofuels. These include subsidies to producers of intermediate inputs to production, such as farmers growing bio-feedstock[1] (an important issue as more crops are diverted to energy production). Subsidies to energy inputs would have been appropriate to include, especially as biofuel production systems can be energy-intensive. However, due to data limitations they were not included in the analysis.[2]

[1] GSI's 2007 EU study included the €45 per hectare payment to farmers growing biofuel feedstocks provided under the EU's *Energy Crops Scheme* (Kutas, G, Lindberg, C., & Steenblik, R., 2007).

[2] Subsidies to ancillary programs, like in-land transport networks, often used to transport biofuels, were not included but are often used to transport a range of energy products at below market rates.

IEA Subsidy Analysis

The IEA, as part of its *World Energy Outlook (WEO) 2010*, analyzed biofuel support measures in 20 countries[3] covering 94 per cent of world's biofuel consumption. The IEA (2010) noted the increased use of tax credits, tax exemptions, import tariffs on foreign biofuels and blending mandates, with some of these measures not considered to be subsidies.[4] The method used by the IEA to calculate the monetary value of government support from full or partial tax exemptions for biofuels in relation to oil-based equivalent fuel (petrol and diesel) followed a well-established approach: the tax advantage to biofuels (in relation to conventional fuels) was multiplied by the volume of biofuels consumed. Calculating the financial value for blending mandates (MPS) used tax reductions and biofuels prices to quantify the implicit support provided to the biofuels industry via the use of mandates. Government support represented a monetary value of government interventions, regardless if the cost was met by the government or consumer (IEA, 2010).

Policies, such as mandatory consumption targets, now make up the bulk of biofuel support. The following text box explains the challenges of measuring market price support (MPS).

BOX 3: MEASURING MARKET PRICE SUPPORT (MPS)

Market price support is generated by public policy measures that affect producer and consumer prices and artificially elevate the price of biodiesel and ethanol. For the biofuels industry it is considered to be how much additional income ethanol or biodiesel producers receive as a result of government interventions in the market that artificially raises their returns. Quantifying market support provides a sense of the magnitude of government backing provided to the biofuels industry. However, the influence these transfers have on patterns of research, investment or production should be seen as a separate issue, one that is a lot more challenging to ascertain (Koplow, 2007). In both the United States and the EU, the two main policies that have supported market prices for biofuels have been tariffs on imported biofuels, which provides some market protection, and purchase or blending mandates (Koplow, 2006) (Kutas, G, Lindberg, C., & Steenblik, R., 2007).

Examples of policies that give rise to MPS can include:

- U.S. government procurement programs directing federal and state agencies to prefer vehicles (flex-fuel vehicles) which can run on biofuels, thereby indirectly providing a reliable market for biofuels and helping to stimulate sales at prices higher than market-clearing.
- The EU's Renewable Energy Directive (RED), which requires Member States to ensure that, by 2020, 10 per cent of the energy used in transport comes from renewable sources. The RED sets out an indicative trajectory for increasing blended biofuel with conventional fuels (European Commission, 2009).

[3] United States, Germany, Spain, India, China, United Kingdom, Denmark, Portugal, France, Italy, Netherlands, Australia, Canada, Japan, Ireland, Greece, New Zealand, Austria, Brazil and Poland.

[4] The IEA defines an energy subsidy as "any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers or lowers the price paid by energy consumers" (IEA, 1999). The IEA definition applies an "effects test" that determines a subsidy exists if it has a certain effect, for example, changing prices; the limitation of these definitions is that often the effect may be the result of more than one government intervention. By contrast, the GSI definition focuses on the transfer mechanisms—the types of policy instruments used to pass the subsidy benefit to the recipient (Lang, K. & Wooders, P., 2010).

Estimating MPS for a commodity ideally involves calculating a **price gap**: the gap between the average annual unit value, or price, of the good (usually measured at the factory gate) with a reference price, usually either an average (pre-tariff) unit import price or the export price (Koplow, 2006). The GSI's 2007 EU study measured price support provided to ethanol by calculating a price-gap between EU ethanol prices and the Brazilian ethanol price (taken as a world reference price), and applied to ethanol produced in the EU. The analysis showed "the price gap between the Brazilian and the EU prices is significant and MPS in the EU increased from €184 million in 2005 to €306 million in 2006"[5] (Kutas, G, Lindberg, C., & Steenblik, R., 2007).

The underlying information supporting the IEA's country and global estimate have not yet (to the knowledge of the authors) been made publically available. Access to supporting data and information would allow analysts to review the methods used by the IEA to quantify certain complicated support measures, such as blending mandates. The publication of the individual country estimates constituting the EU-wide biofuel subsidy estimate (US$7.9 billion) would also help national policy makers in EU Member States.

d. Subsidy Estimates for Biofuels

GSI Country-Level Studies

The GSI series of country-level biofuel studies generated national subsidy estimates for specific countries and years. Existing subsidy programs were also used to estimate potential subsidies for future years. The main biofuel subsidy estimates from that series are found below:

TABLE 1: NATIONAL ESTIMATES FOR BIOFUEL SUBSIDIES

Country	Ethanol (US$ millions)	Biodiesel (US$ millions)	Total Subsidy (US$ millions)	Year
Australia	44	32	75	2006/2007*
Canada	317–387	44–62	361–449	2008
China	940		940	2006
European Union	1,799 1,115 1,173	3,396 3,481 3,025	5,195 4,597 4,198	2006 2007 2008
Indonesia		79	79	2006
Malaysia		19	19	2006
Switzerland	3.5	12.8	16.2	2007
United States	5,800–7,000 6,900–8,400 9,200–11,000 11,570–14,200	530–650 1,200–1,500 1,500–1,900 1,480–1,690	6,330–7,650 8,100–9,900 10,700–12,900 13,050–15,890	2006 2007 2008 2014**

Estimates generated in local currencies have been converted into USD using an average exchange rate for 2009
* For Australia this represents a financial year
** Forecast U.S. biofuel subsidy estimates for 2014 based on a continuation of 2010 policies

[5] EU production of ethanol was 930 million litres in 2005 and 1,565 million litres in 2006. Imports were 250 million litres in 2005 and 230 million litres in 2006.

International Energy Agency (IEA)

The IEA's *2010 WEO* contained a chapter on renewable transport fuels, providing subsidy estimates to ethanol and biodiesel in four key economies: Brazil, China, the EU and the U.S. Subsidies provided by these four economies amounted to US$19.2 billion, with US$0.8 billion in subsidies attributed to other countries, such as India and Canada (Table 2).

TABLE 2: BIOFUEL SUBSIDIES IN 2009

Country	Ethanol (US$, billions)	Biodiesel (US$, billions)	Total Subsidy (US$, billions)
United States	7.7	0.4	8.1
European Union	2.1	5.8	7.9
Brazil	2.6	0.1	2.6
China	0.4	0.1	0.5
Other	0.8		0.8
Total			19.9

* Source: IEA

The GSI studies quantifying subsidies in countries (such as Australia: US$75 million and Canada: US$317–449 million) outside of the four key ones surveyed by the IEA, would confirm the scale of the IEA's attribution of US$0.8 billion in annual biofuel subsidies to "other" countries. The *2010 WEO* summarized biofuel subsidy policies in these key countries and provided estimates for future levels of biofuel production and subsidization.

Government Agencies and Non-Governmental Researchers

A number of non-governmental organizations (NGOs) and government agencies conduct research quantifying and analyzing biofuel subsidies. The definition of an energy subsidy, and the methodology used to quantify it, varies across studies, making a comparison of research difficult.

Yet efforts by NGOs and government agencies are invaluable for identifying new subsidy programs, or rigorously critiquing specific subsidy programs that fall under their area of expertise or interest. A full review of the literature on government and NGO studies on biofuel subsidies is outside the scope of this report. However, it is noteworthy that an analysis conducted by the U.S Congressional Budget Office (CBO), which assessed federal public expenditure for biofuels (including tax expenditure), estimated the tax credit generated US$6 billion in foregone federal tax revenue (Congress of the United States Congressional Budget Office, July, 2010).

3. Subsidies to Conventional Transport Fuels: Background

a. Policy Objectives for Subsidies

Policy-makers justify the selling of fossil fuels at below world-market prices on the basis it contributes to economic growth, the reduction of poverty, and improved security of energy supply (IEA,OPEC,OECD,World Bank, 2010). It is claimed that fossil-fuel subsidies help address market failures or counter social and distributional wealth issues, especially where mechanisms for supplying social welfare support or directly providing income support to the poor are not available. Fossil-fuel subsidies can also be an important tool for delivering access to modern energy services, including electricity, for the poorest (Komives et al., 2005 and 2007); the literature does not tend to highlight the specific role played by subsidies to transport fuels.

b. Subsidy Types

Fossil energy subsidies generally either aim to reduce the cost of consuming energy, or to support domestic production (Lang, K. & Wooders, P., 2010). While the ultimate incidence of a subsidy—i.e., who benefits—may differ from the formal incidence (to whom the subsidy is given), the classification of subsidies is by convention done according to formal incidence and divided between consumer and producer subsidies.

A common form of consumer subsidy involves the regulation of the energy sector through price controls, which maintain prices below international market prices. For example, the Indonesian government regulates the sale of certain petroleum products to the public through its state owned oil company, PERTAMINA (IISD's Global Subsidies Initiative and the Institute for Essential Services Reform , 2011).

Producer subsidies can include preferential tax treatment, such as accelerated-depreciation provisions, royalty concessions, and tax credits and rebates. Typically they support upstream activities, such as oil and gas exploration, or the upgrading of refineries (Sawyer & Stiebert, 2010).

c. Measurement of Subsidies

The IEA Method for Measuring Consumer Fossil-Fuel Subsidies (Price-Gap Approach)

The principal approach used by analysts for measuring subsidies across multiple countries at the same time has been the "price-gap" approach. In the context of fossil-fuel subsidies, the method estimates the gap between domestic energy prices within an economy and world reference prices (or the price for which the energy would be sold without government support programs). With market-clearing price data, adjusted based on transportation costs, the price-gap approach can effectively measure when domestic prices for fossil products are kept below internationally traded prices and large transfers to consumers are occurring. A simplified version of the price-gap formula is:

Price-gap = Reference Price – End-User Internal Price

The IEA adopts this approach for measuring consumer subsidies to fossil fuels and notes the "... approach establishes lower bounds for the impacts of [subsidies] on economic efficiency and trade" (International Energy Agency, 1999). The price-gap approach does not pick up subsidy programs which may affect market behavior, such as upstream subsidies relating to investment in energy infrastructure, and not always programs which may directly change the final price of fossil fuels paid by the consumer. There are also challenges in identifying the appropriate price when calculating the price-gap. Although the price cited in global markets is typically used as a measure of opportunity cost, international prices can be distorted by a range of factors and may experience a high level of volatility. High price volatility can lead to large differences in the estimates for market transfer from one year to another (IEA, 2010) (Koplow, 2009).

Setting the world reference price: The reference price for oil is often defined as the U.S. market price. However, this illustrates the problems which can be faced in the method, as a zero price-gap can result for the U.S. given it sets the world reference price (IEA, 2011). Some resource-rich countries that export oil (sold in hard currency at world prices) but choose to support its domestic sale at below international market prices recommend an alternative world reference price when applying the price-gap approach. They prefer instead that the benchmark should be the cost of production (for the energy product) rather than the international price at which it is traded (IEA,OPEC,OECD,World Bank, 2010). While not directly affecting a country's budget, subsidizing the domestic sale of oil does, however, represent an opportunity cost for the producer or government to the extent that the country could have sold the oil at the international market price and reaped greater revenues under the assumption of unchanged world-benchmark prices (IEA, 2011).

The GSI Method for Quantifying Fossil-Fuel Subsidies to Producers

The GSI has started a series of studies investigating producer subsidies, responding to a lack of research conducted in this area, and the potential for large subsidies to exist.[6] The following method was developed to quantify subsidies to upstream activities for the oil and gas sectors, based on the definition of "subsidy" used as part of the World Trade Organization's (WTO) Agreement on Subsidies and Countervailing Measures (ASCM). Under *Article 1: Definition of a Subsidy*, the ASCM identified four types of subsidies: GSI used them (with a number of sub-categories) as the basis for classifying and calculating producer subsidies (refer Table 3.)

[6] The analysis of upstream subsidies is difficult as a lot of producer subsidies do not affect market-clearing prices in the short term, and can include tax related policy tools which have not been properly evaluated as they are off-budget support and not drawing directly on treasury funds (Koplow, D. Lin, Cynthia,L. Jung, A. Thöne, M. & Lontoh, L., 2010).

TABLE 3: GSI SUBSIDY FRAMEWORK

	Direct spending	Earmarks, Agency appropriations and contracts, Research and development support
Direct and indirect transfer of funds and liabilities	Government ownership of energy-related enterprises	Security-related enterprises, Municipal utilities and public power
	Credit support	Government loans and loan guarantees, Subsidized credit to domestic infrastructure and power plants, Subsidized credit to oil and gas related exports
	Insurance and indemnification	Government insurance or indemnification, Statutory caps on commercial liability
	Occupational health & accidents	Assumption of occupational health and accident liabilities
	Environmental costs	Responsibility for closure and post-closure risks: Waste management, Environmental damages
Government revenue foregone	Tax breaks and special taxes	Tax expenditures, Overall tax burden by industry, Exemptions from excise taxes or special taxes
Provision of goods or services below market value	Government-owned energy minerals	Process for mineral leasing, Royalty relief or reductions in other taxes due on extraction, Process of paying royalties due
	Government-owned natural resources or land	Access to government-owned natural resources land
	Government-owned infrastructure	Use of government-provided infrastructure
	Government procurement	Government purchase of goods or services for above-market rates
	Government-provided goods or services	Government-provided goods or services at below-market rates
Income or price support	Market price support and regulation	Consumption mandates, Border protection or restrictions, Regulatory loopholes, Regulated prices set at below-market rates, Regulated prices set at above-market rates

The method was used to develop two studies focusing on upstream activities.[7] The first investigated producer subsidies to the oil and gas sectors in Indonesia, one of the first developing country producer studies, identifying US$1.8 billion in subsidies (Braithwaite, et al., 2010). The second quantified producer subsidies to the oil sector in three of Canada's provinces (Alberta, Saskatchewan, and Newfoundland and Labrador), calculating provincial and federal government subsidies to be C$2.8 billion annually and identifying 63 different subsidy programs (Sawyer & Stiebert, 2010).

[7] Defined as exploration, development, production, and upgrading, thereby excluding refining, storage, transportation, distribution and retail activities.

d. Subsidy Estimates

The International Energy Agency (IEA)

The IEA provides data on subsidies to fossil energy consumption for multiple countries for oil, natural gas and coal (IEA, 2010) relying on the measurement of price-gaps. Consumer subsidies to oil were approximately US$185 billion in 2007, US$275 billion in 2008 and US$125 billion in 2009 (IEA, 2010). This drop in subsidy from one year to another reflects some of the price volatility seen in oil markets at the time, and the choice of the reference price used in the IEA's "price-gap method," which is based on international prices at the nearest trading hub.

Coady et al.

Adopting a similar price-gap method, a staff position paper by Coady et al. of the IMF (Coady, Gillingham, R., Piotrowski, Tareq, & Tyson, 2010) focused on petroleum products, estimating the global cost of subsidizing gasoline, diesel and kerosene. The study presents estimates based on reference prices pre-tax and with tax rates of US$0.30/litre and US$0.40/litre. These two tax rates are designed to be indicative of optimal tax rates for transport fuels, although the study recognises that calculating the optimum tax rate should be done on a country-specific basis and that it presents methodological difficulties.

Estimates are presented in Table 4. Without including taxation, subsidies worldwide were estimated at around US$ 60 billion at the end of 2003, rising to over US$500 billion in mid-2008 and then falling back to under US$ 140 billion in mid-2009. The fluctuations are driven principally by changes in the world oil price, with pricing systems in many countries being partially or entirely unresponsive, at least in the short term.

Including taxation within the formulation of the reference price — in effect arguing that prices are considered subsidised if they are lower than the world price plus the taxation level considered — leads to significantly higher estimates of subsidies. Worldwide, assuming the optimum tax rate should be US$0.30/litre adds around US$400 billion to the pre-tax estimates, with an optimum tax rate of US$0.40.litre adding approximately another US$200 billion. Only positive subsidies are included in the study's estimates—they do not include the possibility of negative subsidies, i.e., taxes that are above the optimum tax rate.

TABLE 4: TOTAL WORLD FUEL SUBSIDIES

	End-2003	Mid-2008	Mid-2009	End-2010 (proj.)
		(In nominal billions US$)		
Pre-tax subsidy	57	519	136	240
Tax-inclusive subsidy				
Tax threshold US$ 0.30 per liter	406	998	524	742
Tax threshold US$ 0.40 per liter	579	1206	721	965
		(In percent of total GDP)		
Pre-tax subsidy	0.1	0.7	0.2	0.3
Tax-inclusive subsidy				
Tax threshold US$ 0.30 per liter	0.9	1.3	0.8	1.0
Tax threshold US$ 0.40 per liter	1.3	12.6	1.0	1.3
		(In percent of total subsidy)		

Source: Coady et al. (2010).

The GSI Producer Subsidy Estimates

The GSI estimates producer subsidies as being at least US$100 billion per annum, with producers of oil benefiting from many forms of support, including grants, and preferential tax treatment (Lang, K. & Wooders, P., 2010). If we assume that the level of subsidy to oil production alone is on the order of US$100 billion worldwide and that it is equally shared between all global production (which was around 4 billion tonnes oil equivalent (toe) in 2007, 2008 and 2009 **(International Energy Agency)**), then the average level of subsidisation would be US$25/million toe or US$ 0.6/gigajoule (Gj), of crude oil produced. This is clearly only an indicative estimate. By comparison, the international price of crude oil has so far ranged from around US$600 to US$900 per toe in 2011. The GSI's detailed country case studies for Canada and Indonesia support this subsidization range: in Canada, the GSI estimated subsidies of US$2.84 billion, which across approximately 160 million toe (Mtoe) crude oil production would average US$18/toe, or US$0.4/Gj; in Indonesia, the GSI subsidy estimates of US$1.8 billion across approximately 50 Mtoe crude oil production indicate an average subsidy of US$36/toe, or US$ 0.9/Gj. A lack of detailed estimates of support to fossil fuels in OECD countries, especially to producers, is being filled by the OECD, which expects to publicly release its first set of estimates in October 2011.[8]

4. Comparison

There are a range of issues which need to be considered when comparing the relative subsidy provided on a per unit of energy basis for biofuel and conventional fuels. Research conducted by the GSI into subsidies to biofuels and conventional fuels confirms subsidy estimates vary depending on how a subsidy is defined; and the scope of the framework or method used to quantify them (GSI, 2010). The boundaries of the methodologies used to quantify subsidies to both energy sources are often quite different and can vary by geographical scope, temporal coverage, the subsidies captured, and the various feedstocks used as part of the production process. Subsidy estimates also generally are not adjusted to take into account the differing economic and political rationales that may explain why individual subsidy policies exist. Consequently, the following estimates for the level of subsidy provided on a per-unit of energy basis is an initial estimate which is likely to be refined as more robust methods for calculating complex support measures are developed and greater transparency of subsidy data is achieved. Table 5 summarizes the subsidy per unit of energy for oil products and biofuels. It contains the 37 countries surveyed by IEA for consumer subsidies to oil products. It also includes the four key biofuel producing and consuming countries analyzed in the IEA's *2010 WEO*.

[8] Information on the OECDs research into fossil/fuel subsidies is available at http://www.oecd.org/document/57/0,3746,en_2649

TABLE 5: BIOFUEL AND PETROLEUM ENERGY CONSUMPTION AND SUPPORT

2008 DATA - SUBSIDIES (US CENTS), PER KILOWATT HOUR (kWh)				
Country	**Energy content (Ktoe)**	**Ethanol (US cents/kWh)**	**Biodiesel (US cents/kWh)**	**Oil products (transport) (US cents/kWh)**
Argentina	(12128)			2.51
Bangladesh	(1764)			1.32
Brazil	[14100]	1.75	0.72	–
Brunei	(380)			–
China	[1400], (147431)	3.13	2.87	0.67
Chinese Taipei	(11775)			0.30
Colombia	(7314)			0.71
Egypt	(12366)			6.42
EU	[8700]	10.62	7.12	–
India	(42184)			2.26
Indonesia	(25791)			2.28
Kazakhstan	(4883)			1.66
Korea	(27779)			–
Malaysia	(14074)			1.87
Mexico	(51714)			2.47
Other Biofuel Countries	[4400]	1.56	1.56	–
Pakistan	(8872)			2.78
Peru	(4293)			0.29
Petroleum Producing Countries†	(192563)			3.35
Philippines	(7550)			0.12
South Africa	(15488)			0.08
Sri Lanka	(1960)			1.93
Thailand	(16671)			0.64
Ukraine	(8449)			–
U.S.	[23100]	3.08	2.15	–
Vietnam	(8330)			0.71

Notes: • The reader should note the table compares information on individual countries while the EU represents a union of 27 countries. There are individual differences between EU countries in terms of energy production and subsidy per unit of energy which are not reflected in this table as disaggregated data for the 27 EU countries was not available • Energy content of oil products is in kilotonnes oil equivalent, representing final consumption for transport purposes • For oil products—2008 figures are for energy consumption—represented with curved brackets ( ) • 2007 figures for the relative subsidy estimate to oil products are approximately one-third lower than 2008 figures • For biofuels—2009 figures are for energy production and are represented with square brackets [ ] • The per unit of energy estimate for "Other biofuels" is an average for ethanol and biodiesel as IEA data on subsidies to this group of countries providing only a combined subsidy estimate to ethanol and biodiesel.

† Refers to the following 16 countries: Algeria, Angola, Azerbaijan, Ecuador, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Russian Federation, Saudi Arabia, Turkmenistan, UAE, Uzbekistan, and Venezuela. The lower bound figure for the group is 1.26 US cents/kWh and the upper bound figure is 6.45 US cents/kWh.

The following tables provide global figures for the subsidy provided on a per unit of energy basis for biofuels, fossil-fuels, and oil products used for transport (a sub-set of fossil-fuels). Caution should be exercised when reviewing these results given the range of subsidy estimates reflect different scope and methodologies used in studies quantifying subsides.

TABLE 6. GLOBAL AVERAGE – SUBSIDIES PER UNIT OF ENERGY FOR BIOFUELS

		Subsidies per energy unit (US cents/ kWh): based on energy production and global estimate of subsidies		
Fuels	**Explanatory Notes**	**2007***	**2008**	**2009**
Biofuels	2007 subsidy estimates drawn from GSI global estimate, 2008 & 2009 subsidy figures are IEA global biofuel estimates • Biofuel subsidies across the full breadth of the production and consumption cycle assessed • Significant differences in the level of subsidies provided by countries for biofuels and fossil fuels not reflected in global subsidies per unit of energy calculations	5.1 (34Mtoe/ US$ 20 billion)*	–	3.3 (51.6Mtoe/ US$ 20 billion)

* Source: GSI Relative Subsidies to Energy Sources: GSI estimates (April, 2010)

TABLE 7: AVERAGE SUBSIDIES – PER UNIT OF ENERGY FOR 37 COUNTRIES THAT SUBSIDIZE FOSSIL FUEL CONSUMPTION

		Subsidies per energy unit (US cents/ kWh): based on energy production and estimates of subsidies in 37 countries		
Fuels	**Explanatory Notes**	**2007**	**2008**	**2009**
Oil products	Consumer subsidies for oil products in 37 countries assessed • Subsidy data from non-OECD countries including 2 OECD countries • Only subsidies to oil products assessed • Subsidies captured for only part of the production and consumption cycle • Subsidy data is fragmented as producer subsidies are not fully analyzed * Subsidy estimates for biofuels and fossil fuels may vary due to different scopes and methodologies used by studies	.74 (2,156 Mtoe/ US$ 185 billion)	1.10 (2,150 Mtoe/ US$ 275 billion)	.49 (2,206 Mtoe†/ US$ 125 billion)
Fossil-fuels*	Results were drawn from an initial review using available subsidy data for non-OECD countries consumer subsidies • Subsidy data for oil, coal and gas sectors included, while subsidies only to oil assessed in next section of the table • Significant differences in the level of subsidization and energy produced by individual countries	.8 (4,172 Mtoe/US$ 400 billion)		

* Source: GSI Relative Subsidies to Energy Sources: GSI estimates (April, 2010)
† Source: IEA Energy balances and Energy statistics publication for OECD and Non-OECD countries for 2009

Biofuels: The IEA's approach to measuring "government support" for biofuels includes all direct and indirect measures of support in their analysis—avoiding the application of a strict or precise definition of what constitutes a subsidy. This would indicate the IEA's 2009 global estimate of US$20 billion captures most of the support provided to the biofuels sector. Support on per unit-of-energy was estimated by dividing the annual global subsidy estimate by the total energy content produced by biofuels (in Mtoe). For 2009 it was on average 3.3 US cents per kilowatt-hour (kWh).[9] A spread of results for the key countries assessed by the IEA was observed, with Brazilian biodiesel production receiving on average .7 US cents per kWh and E.U. ethanol receiving on average 10.6 US cents per kWh (see Table 5).

Conventional fuels: The IEA's estimates are based on the price-gap method, and cover 37 countries. Only two of these are OECD members—South Korea and Mexico—with the remainder being developing countries, plus Russia and other former Soviet Union countries. The IEA consider that their estimates, by covering over 90 per cent of demand outside the developed world, also cover the majority of subsidies to consumers. In 2007, average subsidies to the consumption of transport related oil products in the 37 countries (all demand figures in this section from (International Energy Agency) was 0.74 US cents per kWh across final consumption of energy—2,156 Mtoe. For 2008, subsidies per unit of energy were 1.10 US cents per kWh across final consumption of energy—2,150 Mtoe. For 2009, subsidies per unit of energy decreased to 0.49 US cents per kWh across final consumption of 2,206 Mtoe. The IEA estimates do not show whether transport fuels are more or less subsidized than oil products consumed in all sectors, but anecdotal evidence suggests that they are likely to be higher than the average.

The average estimates for the 37 countries hide a wide range of variation. In some of these countries, the IEA identifies no subsidies to oil. The highest figure is just under 6.5 US cents per kWh (see Table 5). Again, these figures are averages for all final consumption of oil, not specifically to transport, and do not include any account for production subsidies.

[9] A gigajoule (GJ) is a metric term used for measuring energy use. http://oee.nrcan.gc.ca/commercial/technical-info/tools/gigajoule-definition.cfm

5. Conclusions: Lessons for Policy-makers

Based on the findings from this report, several suggestions for policy-makers emerge.

a. **Accompany subsidy estimates with a clear description of the method employed:** Biofuel subsidies, which are provided across all stages of the production and consumption cycle, reaching upstream as far as feedstock production, illustrate the need for a clear and transparent method to accompany subsidy estimates. Such meta-data allow analysts to determine which individual subsidy programs are included as part of a national estimate and the value of the subsidy assigned to each program. Differences in the way researchers measure particular subsidy programs, such as MPS, will lead to significant differences in subsidy magnitudes. Transparent methods for valuing subsidy programs allows for differences in subsidy estimates to be identified and interpreted by analysts.

b. **Support further research to fill information gaps:** Subsidy estimates to conventional fuels have hereto relied principally on the price-gap approach, which allows analysts to quickly survey consumer subsidies across a range of countries. Subsidy estimates using this approach will vary from year to year due to oil-price volatility, providing a simplistic way to capture the bulk of consumption subsidies. Data gaps remain, though, in measuring producer subsidies (not usually captured by the price-gap approach[10]), important drivers of investment and influence the direction of fossil-fuel markets. Better estimates for producer subsidies is an important component of building a robust overall estimate for subsidies to oil production, and allowing for a better comparison of the subsides provided to relative energy sources.[11] More thought could also be put into examining energy subsidies from a broader development perspective using methods such as the social cost-benefit analysis (SCBA) approach which evaluates the impacts of energy subsidy changes on social welfare. The SCBA allows a socio-economic evaluation of how changes in policy or regulatory arrangements affect future costs and benefits to enable the calculation of the net economic worth of particular policy options (IEA,OPEC,OECD,World Bank, 2010).

c. **Improve methods for measuring subsidies:** The international structure of the fossil-fuels sector allows analysts using a defined set of market clearing prices for oil to quantify consumer subsidies with some accuracy. Biofuels are traded internationally, though due to market barriers such as tariffs, not to the same degree as petroleum products. The price-gap approach does not lend itself to measuring biofuel subsidies—more resource-intensive country level studies are required to adequately estimate subsidies to biofuels. Further research is also needed to measure fossil-fuel subsidies, especially those generated by indirect subsidies. Methods of calculating tax expenditures for example, differ among reporting countries, so results need to be assessed with caution. Further stakeholder consultation is needed to harmonize the various methods for calculating indirect subsidies—in order to make subsidy estimates more consistent.

d. **Define, measure, evaluate and reform subsides:** When analyzing subsidies, the GSI recommends policy makers follow a three-step approach of defining a subsidy-measuring it-and evaluating its effectiveness (GSI,2010). In defining a subsidy, the use of the WTO ASCM definition is encouraged—given it is widely accepted. When measuring a subsidy, it is important that countries have an understanding of the financial support, both on-budget and off-budget, provided to different forms of energy production. However, a full appreciation of the financial costs of subsidies is only one constituent in developing energy policy.

[10] The notable exceptions are subsidies that are given to producers in order to enable to them to sell the product at a reduced price to final consumers. Most producer subsidies in the energy sector either enable producers to compete with (especially foreign) competitors, or competing forms of energy.

[11] See Koplow et al. (*Mapping the Characteristics of Producer Subsidies*) for more information on the extent of producer subsidies.

The effectiveness of the subsidy in meeting its stated policy objective and the type and extent of externalities they generate, are also important. A key recommendation from this research is that policy-makers design and implement monitoring tools to assess the effectiveness of government expenditure for energy policy. Where subsides are found to act contrary to the aims of sustainable development, governments should move to reform or eliminate them.

e. **Improve subsidy reporting and monitoring:** No organization tracks biofuel subsidies for major producers and consumers using a consistent method or on an annual basis. *Mandating an NGO or an intergovernmental organization (IGO) to publish an annual global estimate for biofuel subsidies would be a significant improvement in subsidy monitoring.* Updating the IEA's 2009 biofuel estimates and expanding the level of country-level detail from four to ten key countries would cover all of the major biofuel producers and consumers. National level subsidy estimates would be more robust and consistent—and allow policy-makers to track subsidy patterns over time. No systematic initiative measuring the magnitude of subsidies to fossil-fuel production has been undertaken across a range of key countries.[12] *Multi-lateral efforts to report fossil-fuel subsidies needs to be encouraged.* The commitment by the leaders of the Group of Twenty (G–20) countries to phase-out inefficient fossil-fuel subsidies over the medium term provides an opportunity to introduce better reporting by subsidy type and establish a standardized submittal process for subsidy information (Koplow, Doug, 2010). Better subsidy reporting and estimation for other important energy sources, such as nuclear power is urgently needed. In the wake of the Fukushima Daiichi Nuclear disaster a number of countries are beginning to assess their policies towards nuclear power. There are significant information gaps relating to information on nuclear subsidies which need to be filled as initial research reveals large subsidies may exist. Further country specific research is needed to generate national subsidy estimates. Better subsidy reporting for the nuclear power sector could be achieved if an international body was mandated to review and publish subsidy information. A similar case can be made for subsidies to renewable energy. The sister to this report, *Subsidies and Externalities in Electric Power Generation: A comparative review of estimates*, reviews the current level of information and analysis available on subsidies to electric power generation from nuclear, renewables and fossil fuels.

[12] There have been numerous national-level efforts to quantify subsidies, both for particular fossil fuels and for energy as a whole. These studies have been conducted by governments departments (e.g., U.S. EIA,), but also by non-governmental researchers (e.g., Koplow, 2010).

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Initially trained as an engineer, Peter first worked in technology research with British Gas. He then spent 15 years as an Energy & Environment consultant, working on issues from energy efficiency in Hungary to the cost-benefit analysis of clean air policies in Egypt to the economics of nuclear waste disposition in the U.K. His clients have included the World Bank, EBRD, various European Commission departments and a wide range of private sector companies.

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