Relative Subsidies to Energy Sources: GSI estimates

19 APRIL 2010

GSI | Global Subsidies Initiative

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I. INTRODUCTION

The true scale of energy subsidies is difficult to ascertain, due to different definitions of subsidies, calculation methodologies, levels of transparency and data collection regimes in different countries around the world. This document summarizes a series of estimates of how large subsidies might be, by energy source, based on a preliminary investigation of publicly available research.

It also outlines the assumptions behind the estimates. The estimates will be progressively refined as the Global Subsidies Initiative's (GSI) program on fossil-fuel subsidy reform progresses.

Readers should exercise caution when comparing one energy type's subsidy estimate with another, given the range of error made clear by the various assumptions, as well as the differing economic and political rationales that may explain why individual subsidy policies exist: from helping alternative technologies develop fully in the market, to enhancing energy security of supply, to currying political favour from vested interests.

In the GSI's view, almost all subsidies can be at least partially reformed to better ensure the rational use of public finances and to reduce adverse impacts. Whether to reform a given subsidy is not necessarily indicated by its total or per-unit magnitude alone.

II. ESTIMATES OF GLOBAL SUBSIDIES TO ENERGY SOURCES, 2007

Table 1 summarizes global estimates. The final column presents averaged figures: it simply divides the total subsidy estimate by the quantity of energy produced. The scale of subsidies can vary markedly around these averages: the table does not imply that all energy sources are subsidized in all applications or that subsidies received are necessarily all at average levels.

It should be noted that the estimate of fossil-fuel subsidies applies only to consumer subsidies and only within non-OECD (Organisation for Economic Co-operation and Development) countries. The GSI believes that there are significant subsidies to fossil-fuel producers in many countries, but the estimates available are not sufficiently robust to include at the current time. Estimating the scale and impacts of subsidies to fossil-fuel producers is a major element of the GSI's ongoing work program on fossil-fuel subsidy reform.

Energy subsidies continue to be used in the developed world. Direct subsidies to non-fossil-fuel energy alone are at least US$100 billion per year.

Subsidies to Carbon Capture and Storage (CCS) also have been estimated, at US$2.5 billion to $4 billion per year for the period 2010 to 2020. All these subsidies are projected to occur within OECD countries.

Details of the calculations and assumptions made to generate the numbers in Table 1 are provided in Section III.

TABLE 1: ESTIMATES OF RELATIVE SUBSIDIES TO ENERGY SOURCES

Energy type	Subsidy estimate (US$ billion/year)	Energy produced (2007)	OECD share of production (2007) %	Subsidies per energy unit (US cents/kWh)
Nuclear energy	45	2,719 TWh electricity	84	1.7
Renewable energy (excluding hydroelectricity)	27	534 TWh electricity	82	5.0
Biofuels	20	34 Mtoe	68	5.1
Fossil fuels (non-OECD consumers)	400	4,172 Mtoe	n/a	0.8

III. DETAILS OF CALCULATIONS AND ASSUMPTIONS MADE

Nuclear power

Estimates of subsidies to nuclear power are available only on an ad hoc basis, typically covering a single plant or a single supporting policy in a single country. The *World Nuclear Industry Status Report 2009*,[1] which reviews the range of studies and information available on nuclear subsidies, concludes:

> Although there is no comprehensive record of historical subsidies to nuclear power since inception, a review of a number of studies that have been done over the years demonstrate government's central role in the sector's market viability….subsidies were generally equal to one-third or more of the value of the power produced.

An assumption has therefore been made that the level of subsidy to the nuclear power industry is one-third the value of the power produced.

The value of electricity generation is clearly highly dependent on fuel prices and varies according to a number of other criteria (for example, the level of scarcity of generating capacity). Giving precise figures is not a straightforward task. For example, average wholesale prices in the United States during the period 2001 to 2007 were $36 to $57/MWh.[2] A range of $30 to $70 MWh, with a midpoint of $50/MWh (5 U.S. cents per kWh), is considered indicative and is almost certainly lower than average values over the past few years.

Nuclear power generated 2,719 TWh of electricity in 2007, 84 per cent of which was in OECD countries.[3]

Renewable energy (excluding hydroelectric power)

Again, there are no coordinated estimates of the level of global subsidies to renewable electricity generation. The majority of recent growth in renewable electricity generation has taken place in OECD countries and has typically not included the large hydroelectric schemes that still account for the majority of renewable electricity generation worldwide. This new generation has typically been supported by feed-in tariffs (FITs) and, to a lesser extent, by so-called renewable portfolio standards.

Statistics from the International Energy Agency (IEA)[4] indicate that 534 TWh of electricity was generated from renewable energy sources other than hydroelectric power in 2007, 82 per cent of which was within the OECD. The leading technologies were wind and biomass.

FITs and renewable portfolio standards tend to lead to renewables being paid significantly in excess of wholesale electricity prices. FITs in Denmark and Spain currently give a minimum premium of approximately $50/MWh (5 U.S. cents per kWh); FITs for wind in Germany and South Africa ($122/MWh and $138/MWh, respectively) imply a slightly higher premium.[5] FITs are often higher for smaller schemes and for technologies that are further from commercialization (e.g., solar). The U.K.'s Renewable Obligation imposes a portfolio standard that increases annually. In its first five years, payments to qualifying schemes were around £50/MWh ($75/MWh) per unit of electricity generated.

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[1] See http://www.bmu.de/files/english/pdf/application/pdf/welt_statusbericht_atomindustrie_0908_en_bf.pdf.

[2] Figures taken from the North American Electric Reliability Corporation (NERC) on the U.S. Energy Information Administration website, http://www.eia.doe.gov/cneaf/electricity/wholesale/wholesale.html.

[3] International Energy Agency, *IEA energy statistics*, 2010, www.iea.org/statistics.

[4] International Energy Agency, www.iea.org/statistics.

[5] Wind-works.org summarizes feed-in tariffs (FITs) from around 30 countries at http://www.wind-works.org/articles/feed_laws.html#Renewable Energy Tariffs by Country. The FITs have been compared to a typical wholesale generation cost of US$50/MWh.

It can be argued that significant amounts of new, non-hydroelectric electricity generation from renewable energy would not have occurred in the past, and would not continue to occur now, without government support. This support has been provided, and continues to be provided, at support levels of at least 5 U.S. cents per kWh. This is used as the basis for the GSI's estimate.

Biofuels

The GSI's *Biofuels—At What Cost?* series[6] includes detailed estimates of the levels of subsidies given to biofuels in eight countries and regions: Australia, Canada, China, the European Union, Indonesia, Malaysia, Switzerland and the United States. The most significant subsidies were found to be in the United States and the European Union. In 2008, subsidies to ethanol and biodiesel production were estimated at $10.7 billion to $12.9 billion in the United States and at $7.4 billion in the European Union. Subsidies in the six other countries studied were much lower and totalled around $0.5 billion per year. The total for all the countries and regions studied is therefore around $20 billion per year.

World production of biofuels in 2008 was 34 Mtoe, 68 per cent of which was in OECD countries.[7] This gives a world average of 5.1 U.S. cents per kWh, calculated by applying the estimate of subsidies from the eight countries and regions studied by the GSI to all world production. This clearly gives a lower average per unit than if the subsidy had been applied to only that production from the eight countries and regions. The average presented would also be higher if subsidy estimates were factored in from other countries and regions, notably Brazil.

Subsidies to fossil-fuel consumers in non-OECD countries

For fossil fuels, the total final consumption of all energy sources in non-OECD countries in 2007 was 4,172 Mtoe.[8] The IEA's estimate of subsidies to energy consumers in the 20 largest non-OECD countries,[9] using the price-gap approach with opportunity costs based on world market price levels, was $310 billion, using 2007 data. The IEA extrapolates this to $400 billion for all non-OECD countries.

Assuming that the subsidy of $400 billion is applied evenly on a delivered energy basis to all energy carriers, including fossil fuels, this gives an average subsidy of 0.8 U.S. cents per kWh. Clearly, the actual level of subsidy may vary from this average quite significantly by country, by fuel type and by consumer. The estimates do not include any support to fossil-fuel producers that are not captured in the price-gap approach.

Carbon Capture and Storage (CCS)

A review has been undertaken, for the GSI, of the stated plans for CCS support of demonstration schemes over the period 2010 to 2020. Eight countries and regions have been considered: Australia, Canada, the European Union, Japan, Netherlands, Norway, the United Kingdom and the United States, using publicly available documents. Capital finance support is estimated at US$18.5 billion over the period, with other direct incentives ranging from US$8 billion to $23 billion. Applying a simple average gives annual support in the range of US$2.5 billion to $4 billion per year.

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[6] See http://www.globalsubsidies.org/en/research/biofuel-subsidies.

[7] International Energy Agency, www.iea.org/statistics.

[8] International Energy Agency, *World energy outlook 2009*, www.worldenergyoutlook.org.

[9] International Energy Agency, *World energy outlook 2008*, www.worldenergyoutlook.org/2008.asp.

www.globalsubsidies.org