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ENERGY SUBSIDIES:

Their Magnitude, How they Affect Energy Investment and Greenhouse Gas Emissions, and Prospects for Reform

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Contents

SUMMARY

Energy subsidies – government interventions that affect energy prices or costs – are large, widespread and diverse. They vary greatly in size and type among fuels, end-use sectors and countries. They also fluctuate markedly over time. Today, energy subsidies are of the order of USD 250 to USD 300 billion per year net of taxes worldwide, equal to 0.6% to 0.7% of world GDP, according to the latest estimates by the International Energy Agency (Table 1). Non-OECD countries account for the bulk of these subsidies, with most of them going to consumption by lowering prices paid by consumers. In OECD countries, most subsidies go to production, usually in the form of direct payments to producers or support for research and development.

Worldwide, fossil fuels are the most heavily subsidised energy sources, totalling an estimated USD 180 to 200 billion per year. Support to the deployment of low-carbon energy sources currently amounts to an estimated USD 33 billion each year: USD 10 billion to renewables, USD 16 billion to existing nuclear power plants and USD 6 billion on biofuels. Overall energy subsidies fell sharply in the early to mid-1990s, with the transition to market economies in the former communist bloc countries. But they may have risen in recent years as many non-OECD countries have sought to prevent higher international energy prices from feeding into final prices for social reasons.

Energy subsidies deliberately distort price signals and, therefore, investment in infrastructure to supply different fuels and in the capital stock that transform or consume energy. Because the bulk of energy subsidies worldwide result in a lower price for fossil fuels to end users, they cause more of those fuels to be consumed, increasing carbon-dioxide and other greenhouse-gas emissions and contributing to climate change. Empirical studies suggest that the potential emissions reductions from removing all subsidies that encourage fossil energy consumption could be substantial. Moreover, such a move could bring major economic benefits too. In many cases, the social costs of eliminating those subsidies would be small.

Subsidies to support renewables and energy-efficient technologies can be an effective way of overcoming market barriers to their development and deployment, and helping to reduce greenhouse-gas emissions. In principle, taxing carbon-intensive fuels and activities can be a more economically efficient and practical approach to internalising external environmental costs than subsidising low- or zero-carbon fuels, but may be difficult politically. In practice, targeted subsidies to clean energy can play an important role in mitigating emissions as part of a portfolio of market-based and regulatory measures.

The prospects for energy subsidies depend entirely on whether and how governments decide to reform their energy policies. In the absence of reform, the value of those subsidies will tend to rise as demand for energy increase. The need to reduce and eliminate subsidies that encourage the production and use of fossil fuels within the framework of broader pricing and tax reform is widely accepted. But, in many instances, governments are faced with awkward economic, social and environmental trade-offs and face strong resistance from those groups that benefit from the subsidies.

Energy-subsidy reform requires strong political will to take tough decisions that benefit society as a whole. Implementing reforms in a phased manner can help to soften the financial pain of those who stand to lose out and give them time to adapt. The authorities can also introduce compensating measures that support the real incomes of targeted social groups in more direct and effective ways. Politicians also need to communicate to the general public the overall benefits to the economy and to society as a whole of cutting subsidies, and consult with stakeholders in formulating reforms.

Table 1: **Summary of Estimatesof Value of Energy Subsidies** (USD billion, nominal terms)

	OECD	*Non-OECD*	*World*
Oil	Not available	90-110[a] (IEA, 2006)	90-130[b] (GTZ, 2007)
Natural gas	Not available	70-90[a] (IEA, 2006)	Not available
Coal	5.8 (IEA, 2001) 6.7[d] (EC, 2002)	10-13[a] (IEA, 2006)	16-23[c]
Electricity	Not available	55-70[e] (IEA, 2006)	Not available
Nuclear power	4[f] (IEA database)	Not available	16 (Stern, 2006)
Renewables	1[f] (IEA database)	Not available	16 (Stern, 2006)
Total	20-30 (UNEP/IEA, 2002) 32[h] (EEA, 2004) 80 (Van de Beers et al, 2001) 49-100 (Koplow, 2006b)[i]	220-280 (IEA, 2006) 160 (Van de Beers et al, 2001)	240-310[g] 240 (Van de Beers et al, 2001)

[a] Final consumption only. The lower number represents the actual estimate for twenty countries surveyed; the upper number is scaled up according to the share of the twenty countries (81%) in total non-OECD primary energy consumption.
[b] Gasoline and diesel/gas oil only.
[c] Based on IEA (2006) and IEA (2001).
[d] European Union only (15 members); converted at EUR 1 = USD 1.061 (average exchange in 2002).
[e] Including subsidies to fuel inputs to power generation.
[f] Public research and development budgets only.
[g] Based on IEA (2006) and UNEP/IEA (2002).
[h] European Union only (15 members), based on 2001 data; converted at EUR 1 = USD 1.117 (average exchange in 2001).
[i] US federal subsidies only.

1. Introduction

101 Subsidies to energy, by encouraging the use of fossil fuels and discouraging the production of zero- or low-carbon fuels, can lead to higher greenhouse-gas emissions. Environmentally harmful subsidies remain important in many countries, especially in the developing world. That is why energy-subsidy reform has emerged as a major issue in international discussions and negotiations about climate change.

102 Determining what constitutes a subsidy is critical to any analysis of the implications of energy subsidies for investment in energy-related infrastructure and greenhouse-gas emissions. No consensus definition exists, making comparisons of individual studies of specific countries or regions difficult and complicating objective discussion of issues relating to subsidies and their reform. The narrowest definition is a direct payment by a government to a producer or consumer. Broader definitions attempt to capture other types of government interventions that affect prices or costs both directly and indirectly. For example, the Organisation for Economic Cooperation and Development has defined subsidy in general terms as *any government measure that keeps prices for consumers below market levels, or for producers above market levels, or that reduce costs for consumers and producers* (OECD, 1998). The US Energy Information Administration has defined an energy subsidy as *any government action designed to influence energy market outcomes, whether through financial incentives, regulation, research and development or public enterprises* (US DOE/EIA, 1992). In a similar way, the International Energy Agency has defined energy subsidies 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). It is this definition that is adopted for this paper.[1]

103 Energy subsidies take many different forms (Table 2). Some subsidies have a direct impact on price, like grants, tax exemptions and price controls. Others affect prices or costs indirectly, such as regulations that skew the market in favour of a particular fuel, trade instruments, direct public investment in energy infrastructure or government-sponsored technology research and development. Subsides can benefit consumers and/or producers.

104 How governments choose to subsidise energy depends on a number of factors, including the overall cost of the programme, the transaction and administration costs it involves and how the cost of the subsidy affects different social groups. A per-unit cash payment to producers or consumers is the simplest and most transparent form of subsidy, but can involve considerable accounting and transaction costs. It also involves a direct financial burden on the national treasury. Governments often prefer to keep subsidies "off-budget" for political reasons; on-budget subsidies are an easy target for pressure groups interested in reducing the overall tax burden. For this reason, subsidies often take the form of price controls that result in prices below full cost, especially where the energy company is state-owned, or a requirement on energy buyers to take delivery of minimum volumes from a specific, usually indigenous, supply source.

105 Subsidies to any economic activity can in principle be rationalised on the basis of theoretical arguments concerning market failure or imperfections that lead to economically, socially and environmentally sub-optimal outcomes. Government intervention, which may involve the use of subsidy, is intended to remedy market failures, such as pollution and global warming, either by addressing their causes or by trying to replicate the outcome of an efficient market that maximises social welfare. Social considerations, such as concern for the poor, sick or otherwise disadvantaged, may also provide a rationale for subsidising energy. In practice, governments subsidise energy for one or more of the following reasons (UNEP/IEA, 2001):

[1] In practice, government interventions primarily aimed at other sectors can lead to lower energy prices or costs in an indirect way. Government actions that primarily concern the transport sector, for example, can significantly affect the cost and price of providing an energy service.

- To protect employment in a particular indigenous industry or sector against international competition or to promote job creation.
- To stimulate regional or rural economic development.
- To reduce a country's dependence on imports for energy-security reasons.
- To lower the effective cost of and/or provide access to modern energy services for specific social groups or rural communities for social policy reasons.
- To protect the environment.

Table 2: **Main Types of Energy Subsidy**

Government intervention	*Example*	*How the subsidy usually works*		
		Lowers cost of production	*Raises price to producer*	*Lowers price to consumer*
Direct financial transfer	Grants to producers	v		
	Grants to consumers			v
	Low-interest or preferential loans	v		
Preferential tax treatment	Rebates or exemptions on royalties, sales taxes, producer levies and tariffs	v		
	Tax credit	v		v
	Accelerated depreciation allowances on energy supply equipment	v		
Trade restrictions	Quotas, technical restrictions and trade embargoes		v	
Energy-related services provided directly by government at less than full cost	Direct investment in energy infrastructure	v		
	Public research and development	v		
	Liability insurance and facility decommissioning costs	v		
Regulation of the energy sector	Demand guarantees and mandated deployment rates	v	v	
	Price controls		v	v
	Market-access restrictions		v	

Source: Adapted from UNEP/IEA (2002).

106 Subsidy programmes may be designed to support several of these objectives simultaneously. For example, support to a national renewable energy industry, such as wind power, might be aimed at boosting employment and regional development, as well as reducing dependence on energy imports and lowering greenhouse-gas and other emissions.

107 Subsidies make sense if overall social welfare is increased. But experience around the world shows that, in many instances, the net effects of energy subsidies are negative (von Moltke et al, 2004). This may be the case if the rationale for the subsidy is invalid, for example, because too much emphasis is put on a particular policy goal to the detriment of others, or because the subsidy is applied ineffectively or inefficiently. Even where the net benefits are judged to be positive, an energy subsidy may not be the most efficient way of achieving policy goals. In practice, many subsidies that were introduced for social reasons, such as price controls on household fuels or support to coal mining to protect jobs, carry large financial, economic and environmental costs, and sometimes bring only minor benefits to the people for whom they are intended.

2. The Size and Pervasiveness of Energy Subsidies

2.1 Measuring Subsidies

201 Energy subsidies are widespread and diverse, varying greatly in size and type among fuels, end-use sectors and countries. They also fluctuate over time. Putting a monetary value on some types of subsidies can be extremely difficult. The impact of a particular government intervention on production cost or price has to be differentiated from the effects of all other factors that influence costs and prices. In addition, reliable data on actual selling prices are not always available. Estimates of the size of subsidies in a given country and to a given fuel depend heavily, therefore, on the definitions and methodologies used and the time period considered. Big differences in definitions can make comparisons of individual studies of the impact of energy subsidies in specific countries or regions difficult and complicate discussions of issues relating to subsidies and their reform. Most studies attempt to measure specific types of subsidy, or use approaches that capture only some of the effects of subsidies.

202 The assumed baseline level of costs and prices is crucial when measuring the size of a given subsidy. If actual production costs and market prices are assumed, any government intervention to reduce the price or cost of energy, including one designed to internalise an external environmental or social benefit (i.e., a positive externality), would constitute a subsidy (UNEP/IEA, 2001). On the other hand, if baseline costs and prices are assumed to take account of external costs and benefits (i.e., they are economically optimal), a failure by the government to address a market failure involving an external cost – for example, by levying a tax equal to the size of the externality – could be considered a subsidy. In practice, however, assessing quantitatively the magnitude of externalities is extremely difficult, so empirical studies of subsidies typically use a conventional definition that assumes market prices and costs. Even then, measuring those prices and costs is far from straightforward. Determining the baseline cost for regulated network industries (electricity, gas and district heat) can be particularly difficult.[2]

203 Taxes must also be taken into account in any quantification of subsidies and their effects since they offset the effect of subsidies on price (Koplow and Martin, 1998). In many cases, energy subsidies are more than offset by special taxes and duties that raise the final end-use price to above market levels. For example, price controls may set the retail or wholesale price of a fuel below its full supply cost, but the application of an excise duty may result in a retail price that is above cost. This is the currently the case with oil products in India. What matters in practice is the overall impact of all subsidies and taxes on the absolute level of prices and supply costs and the relative competitiveness of each fuel or technology.[3]

2.2 Global Estimates

204 Few studies have attempted to quantify subsidies for the world as a whole in a consistent manner because of data deficiencies and the sheer scale of the exercise (Varangu and Morgan, 2002).[4] Those studies that have been undertaken demonstrate that, globally, subsidies are large, and

[2] Long-run marginal cost (LRMC) is widely accepted as the most appropriate basis for determining efficient (non-subsidised) prices in a regulated electricity or natural gas market, as it provides incentives for investment in new capacity. LRMC includes the capital costs of new generation and network capacity to provide an additional unit of output in addition to the related short-run marginal operating costs (SRMC). In principle, the average price of wholesale electricity in a competitive market would gravitate towards LRMC. In practice, however, efficient prices might be expected to lie somewhere below LRMC and above SRMC in countries where there is large surplus capacity due to stagnant demand and where LRMC pricing would over-remunerate past investment.

[3] Differential rates of taxation can give a competitive advantage or disadvantage to one fuel or energy form over another in the same way as a subsidy.

[4] Earthtrack, a non-governmental organisation, maintains an international database on government interventions in the energy sector, but does not estimate their impact on costs or prices in every case (http://earthtrack.net/earthtrack/interventions/index.asp).

that non-OECD countries account for the bulk of them, whether calculated in gross terms or net of taxes. They also suggest that the bulk of energy subsidies go to encouraging consumption, by lowering final prices paid by end users, in non-OECD countries; production subsidies, usually in the form of direct payments to producers or support for research and development, are more common in OECD countries (IEA, 2006a; Von Moltke et, 2004). Worldwide, fossil fuels are the most heavily subsidised energy sources. Subsidies are thought to have fallen sharply in the early to mid-1990s, with the transition to market economies in the former communist bloc countries, but may have risen in recent years as many non-OECD countries have sought to prevent higher international energy prices from feeding into final prices for social reasons.[5]

205 The most recent global quantitative analysis of energy subsidies was carried out by the IEA in 2006, the results of which were published in its *World Energy Outlook* (IEA, 2006a). The study measures only consumption subsidies – government measures that result in an end-user price that is below the price that would prevail in a truly competitive market including all the costs of supply – using a price-gap approach.[6] The analysis covers the twenty largest non-OECD countries in terms of primary energy consumption, making up 81% of total non-OECD energy use. Total subsidies (net of taxes on each fuel) in these countries are estimated to amount to around USD 220 billion based on 2005 data, of which subsidies to fossil fuels account for around USD 170 billion.[7] On the assumption that subsidies per unit of energy consumed are of the same magnitude in other non-OECD countries, world subsidies might, therefore, amount to USD 280 billion per year, or around 0.6% of world GDP. Energy is found to be most often subsidised by means of price controls, often through state-owned companies. Russia has the largest subsidies in dollar terms, amounting to about USD 40 billion, most of which go to natural gas (Figure 1). Iran's energy subsidies are almost as large, at an estimated USD 37 billion. Six other countries – China, Saudi Arabia, India, Indonesia, Ukraine and Egypt – have subsidies in excess of USD 10 billion per year each.

206 In terms of fuels, the biggest subsidies overall go to oil products, estimated at over USD 90 billion. Industrial and residential fuels other than gasoline and automotive diesel – notably kerosene and liquefied petroleum gas – and other forms of energy are generally subsidised more than road fuels. Subsidies to gasoline and diesel have fallen sharply in recent years in many countries – despite rising international prices – but remain high in many countries (see Section 2.3).. In percentage terms, under-pricing is most acute for natural gas (Table 3). On average, consumers pay less than half the true economic value of the gas they use in the countries analysed by the IEA. Gas subsidies are estimated at $70 billion in the twenty countries surveyed. They are biggest in the transition economies, Saudi Arabia and Egypt. Electricity subsidies are generally smaller, totalling USD 55 billion, but are large in some countries, including Saudi Arabia. Coal subsidies amount to around USD 10 billion, with China accounting for most of this.

207 The IEA previously estimated gross subsidies in OECD countries at around USD 20 to 30 billion (UNEP/IEA, 2002).[8] Of this, government funding for research and development accounts for close to USD 10 billion (see below). Most OECD energy subsidies are thought to go to production; those consumption subsidies that remain mostly involve tax rebates on residential

[5] As no organisation attempts to track the value of global energy subsidies over time, it is hard to draw firm conclusions about trends. Comparing the results of ad hoc studies carried out at different times can be misleading, because of differences in coverage, definitions and methodologies. Nonetheless, a 1997 World Bank study found that global energy subsidies fell by more than half in the five years to 1996, mainly as a result of price reform in the Former Soviet Union. Subsidies may have risen between 2003 and 2006 with rising international oil prices, as many governments held down domestic prices to protect consumers. There is evidence that subsidies may have fallen back recently, as several countries – including China and Indonesia – have raised prices.

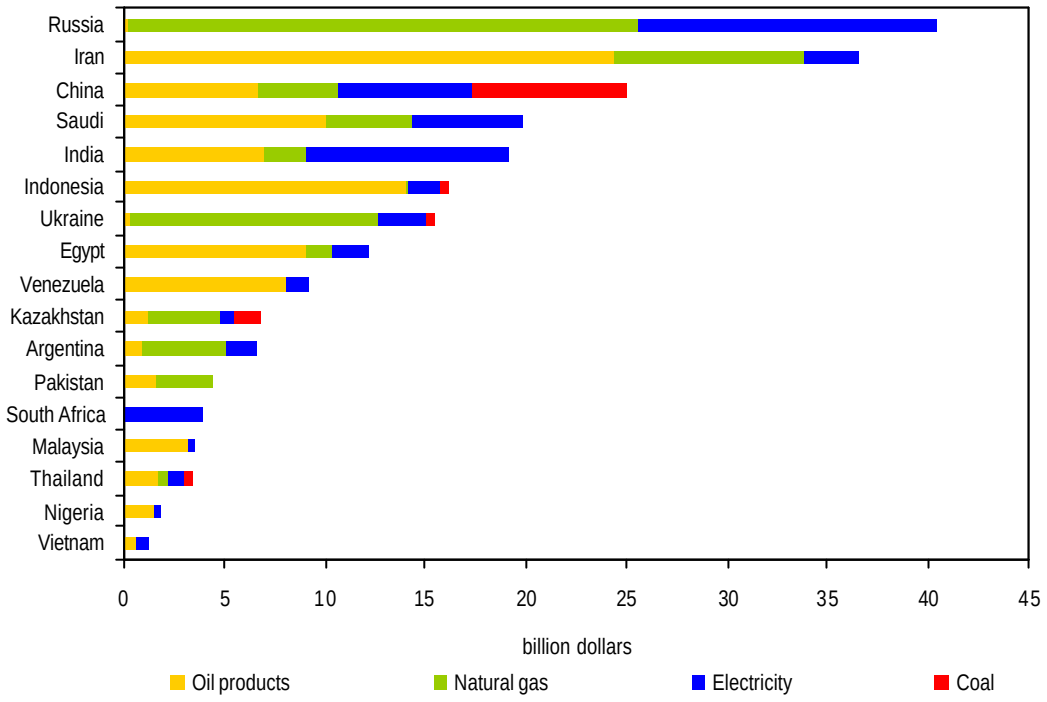
[6] This involves comparing actual end-user prices of energy products with reference prices, defined as those prices that would prevail in undistorted markets in the absence of subsidies. For traded forms of energy such as oil products, the reference price corresponds to the export or import border price (depending on whether the country is an exporter or importer) plus internal distribution. For non-traded energy, such as electricity, the reference price is the estimated LRMC (IEA, 2006a). The difference between the two is the "price gap".

[7] All figures cited in this paper are in nominal or money-of-the-day terms, unless otherwise stated.

[8] Van Beers and de Moor (2001) suggest that the figure may be USD 80 billion in nominal terms. They estimate non-OECD subsidies at USD 160 billion.

electricity and gas supplies, cross-subsidised tariffs to rural or low-income households and preferential tariffs for large energy-intensive end users. In most, if not all, OECD countries, gross energy subsidies are heavily outweighed by taxes. In the four largest European states, for example, revenues from special duties and taxes on sales of motor gasoline alone (not including value-added taxes) amounted to almost USD 60 billion in 2004 – more than twice gross subsidies to all forms of energy.[9] The overall balance of production subsidies in most OECD countries is thought to be shifting towards renewables and end-use efficiency and away from fossil fuels and nuclear power – as evidenced by research and development funding (see below). This reflects increasing efforts to mitigate climate change and address concerns about energy security, as well as the maturity of the nuclear industry.

Figure 1: **Economic Value of Energy Subsidies in non-OECD Countries, 2005**



Note: Subsidies in Brazil, the Philippines and Chinese Taipei are not shown, as they amount to less than USD 1 billion in each case. The aggregated results are based on net subsidies only for each country, fuel and sector. Results are converted to US dollars at market exchange rates.
Source: IEA (2006a).

208 Earlier studies confirm that energy subsidies in non-OECD countries are generally much bigger than in the OECD and are mainly directed at consumption. For example, a 1997 World Bank study put annual fossil-fuel subsidies at USD 48 billion (in year-1995 dollars) in twenty of the largest countries outside the OECD and at USD 10 billion in the OECD.[10] A 1998 OECD study estimated that Member countries' gross energy subsidies amounted to USD 19 to 24 billion per year, but these subsidies were more than offset in aggregate by taxes. A 1999 IEA study, which examined eight of the largest non-OECD countries covering almost 60% of total non-OECD energy demand, put the total value of energy subsidies in those countries at around USD 95 billion in 1998. End-use prices were found to be about a fifth below market levels in those countries.

[9] Based on IEA data.
[10] Cited in Pearce and Von Fincklestein (2000).

Table 3: **Consumption Subsidy as Percentage of Reference Price in Non-OECD Countries, 2005**

	Gasoline	*Diesel*	*Kerosene*	*LPG*	*Light fuel oil*	*Heavy fuel oil*	*Natural gas*	*Coal*	*Electricity*
China	5	13	3	18	0	0	45	17	0
Chinese Taipei	0	0	n.a.	9	27	6	0	5	0
India	0	0	47	26	0	0	70	0	5
Indonesia	24	54	58	30	35	n.a.	0	58	13
Malaysia	26	37	0	33	9	0	n.a.	n.a.	5
Thailand	0	16	0	35	0	0	65	57	10
Pakistan	0	28	19	0	19	0	59	0	0
Philippines	0	0	5	0	34	n.a.	n.a.	n.a.	0
Vietnam	6	26	5	0	0	0	0	n.a.	14
Iran	82	96	76	67	32	73	66	n.a.	30
Saudi Arabia	51	81	6	n.a.	81	n.a.	89	n.a.	54
Egypt	65	80	88	94	80	71	76	n.a.	4
South Africa	0	0	0	0	0	0	n.a.	21	41
Nigeria	19	17	42	6	0	n.a.	0	n.a.	24
Brazil	0	0	n.a.	0	0	n.a.	n.a.	80	0
Argentina	20	5	0	0	0	0	58	70	27
Venezuela	90	96	0	82	94	84	n.a.	n.a.	25
Russia	0	0	0	0	0	16	57	17	34
Kazakhstan	28	20	n.a.	n.a.	49	48	4	86	24
Ukraine	0	23	n.a.	n.a.	n.a.	n.a.	83	36	27
Weighted average	1	15	27	19	5	10	57	12	6

n.a.: not available.

Note: Based on weighted average subsidies and prices across final sectors for each fuel. Cross-subsidies between sectors are, therefore, not included. See footnote 6 for an explanation of the methodology used to calculated reference prices and subsidies.

Source: IEA (2006a).

2.3 Partial Estimates

209 Most recent studies that have attempted to quantify subsidies and ongoing data collection efforts focus on specific types of interventions or fuels, often in selected countries or regional groupings. The Stern Report estimates that government support to the deployment of low-carbon energy sources is currently of the order of USD 33 billion each year worldwide: USD 10 billion on deploying renewables (based on 2004 data), around USD 16 billion on supporting existing nuclear power activities and USD 6.4 billion on biofuels (assuming global production of 40 billion litres). These figures only take account of direct financial payments and do not include the value of the subsidy implicit in other types of intervention to encourage these energy sources (Table 4).

Table 4: **Existing Approaches to Subsidising Clean Energy**

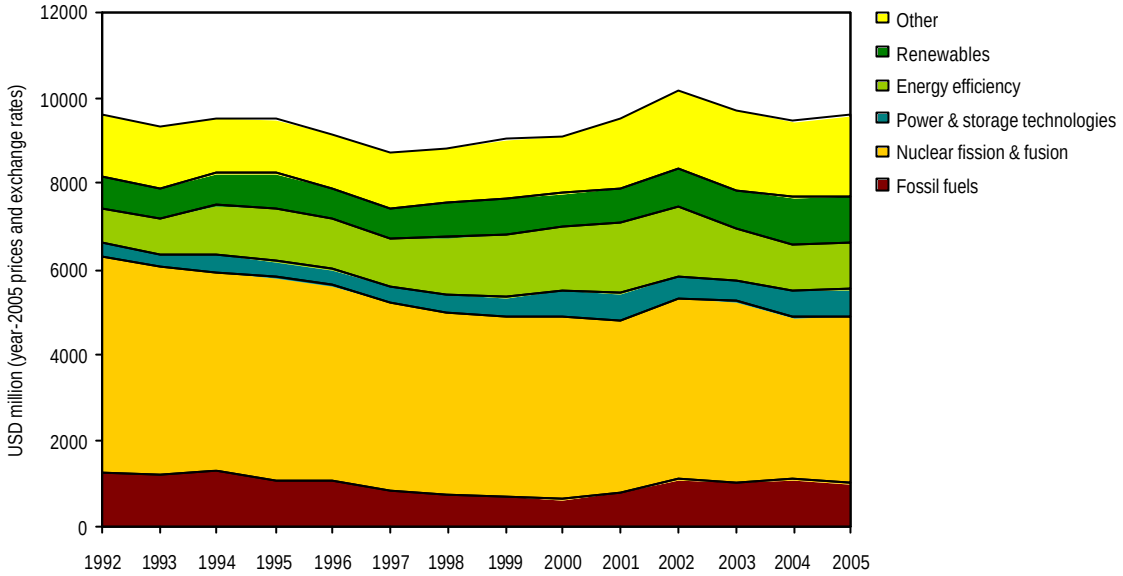
Incentive	*Example*
Fiscal incentives	Reduced taxes on biofuels; investment tax credits
Capital grants	For demonstration projects such as the clean coal programme in the US; photovoltaic (PV) rooftop programmes in the US, Germany and Japan; marine renewables in the UK and Portugal.
Feed-in tariffs	Fixed price support mechanism, usually combined with a regulatory incentive to purchase low-carbon power output, e.g., wind and PV in Germany; biofuels and wind in Austria; wind and solar schemes in Spain; wind in Netherlands.
Quota-based schemes	Renewable Portfolio Standards in 23 US states; vehicle fleet efficiency standards in California.
Tradable quotas	Renewables Obligation and Renewable Transport Fuels Obligation in the UK.
Tenders for tranches of output	Uplifted output prices paid for a general levy on electricity tariffs, e.g., the former UK Non-Fossil Fuel Obligation.
Grants to infrastructure	Covering the cost of connecting new technologies to the electricity network.
Public utility procurement	Historically the approach of public electricity monopolies for the purchase of nuclear power in OECD countries. Currently used by China. Often combined with regulatory agreements to ensure cost recovery, soft loans and government assumption of nuclear waste liabilities.
Government procurement	Demonstration projects for public buildings; use of fuel cells and solar technologies by defence and aerospace industries; hydrogen fuel cell buses and taxis in cities; energy efficiency in buildings.

Source: Stern (2006).

210 The IEA compiles detailed data on public funding for energy research and development in its member countries (Figure 2). In real terms, total energy research and development spending has remained broadly constant since the early 1990s, amounting to USD 9.6 billion in 2005. This contrasts with overall research spending in the OECD, which grew by nearly 50% between 1988 and 2004 (Stern, 2006). Spending on fossil fuels fell steadily during the second half of the 1990s, but rebounded at the start of the current decade. The share of nuclear fission and fusion in total spending has dropped since the early 1990s, but still accounts for about 40% of total spending. Spending on energy efficiency rose significantly in the 1990s and then fell back sharply after 2002. Research on renewables and power technologies – including hydrogen – has continued to grow steadily.

211 Up to 2001, the IEA complied data on subsidies to OECD coal producers using a producer-subsidy equivalent approach.[11] In 2000 (the last year for which data is available), these subsidies amounted to USD 5.8 billion (IEA, 2001). Most of this amount was accounted for by European countries, notably Germany. OECD coal subsidies fell steadily over the second half of the 1990s, with Germany accounting for most of the fall. The volume of subsidised production fell by 55% between 1991 and 2000. A 2002 European Commission study of EU energy subsidies found that direct financial payments to coal producers in 2001 were higher than those estimated by the IEA, totalling EUR 6.3 billion.[12]

Figure 2: **Public Energy Research and Development Funding in IEA Countries**

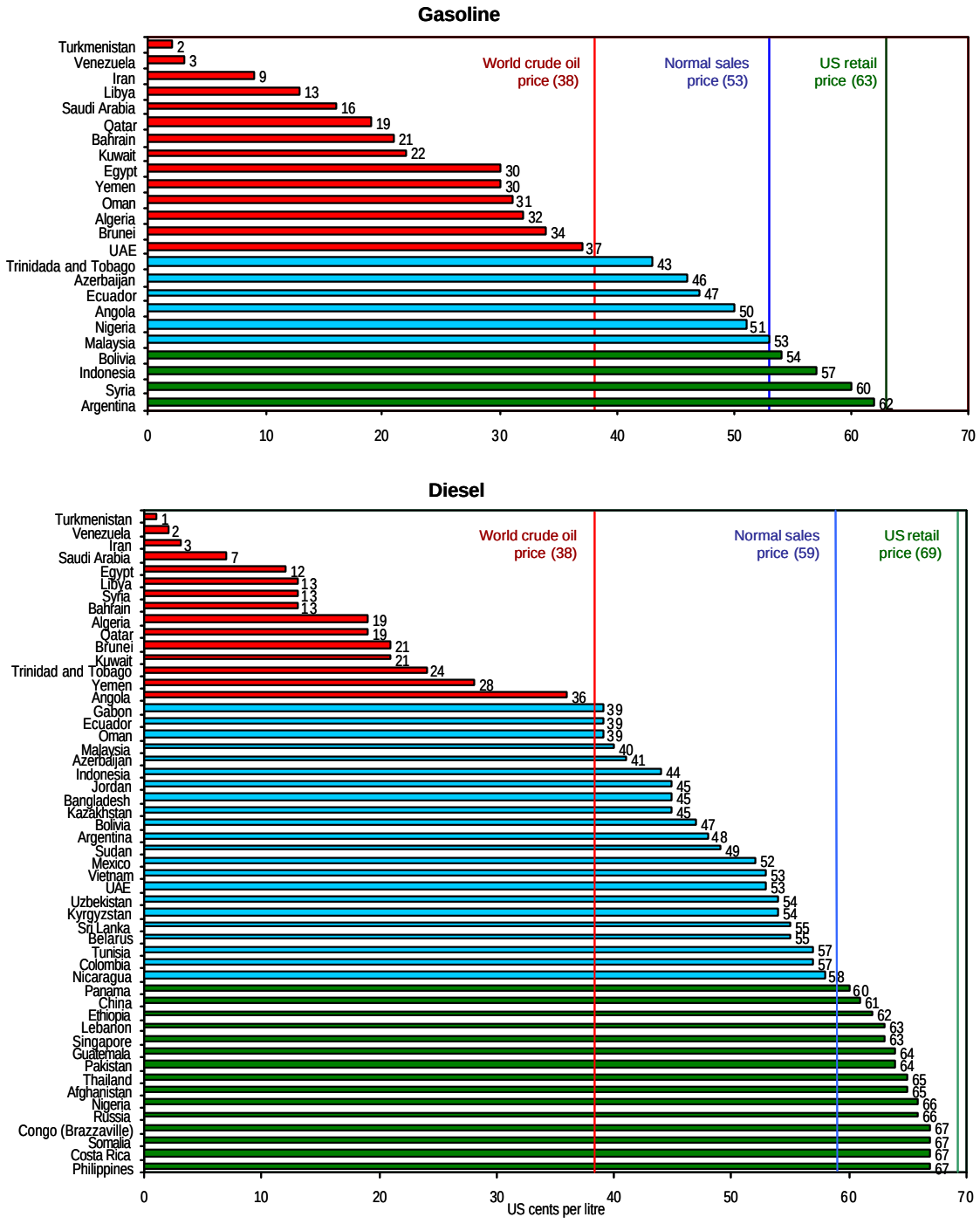


Note: Among OECD Member states, only Iceland, Mexico, Poland and the Slovak Republic are not IEA Members.
Source: IEA R&D database.

212 One of the more easily observable types of subsidy is that to road transport fuels. Good data on national pump prices and international spot prices are usually available and local distribution costs are, in most cases, relatively easy to estimate. Differences in pump prices among countries largely reflect differences in taxation and pricing policies: in many non-OECD countries, pump prices are still set or administered by the state. A recent survey of 171 countries by GTZ, a German state-owned organisation, shows that a number of countries subsidise gasoline and diesel net of taxes (Figure 3). Diesel is subsidised in more countries than gasoline, though in most cases only lightly. In 14 countries, gasoline prices are lower per litre than the international price of crude oil, implying a large subsidy; in 15 countries, diesel prices are lower. Prices are below US retail levels – the benchmark GTZ uses for determining whether fuel is subsidised at all – in 24 countries for gasoline and 52 countries for diesel. Prices are most heavily subsidised in oil-producing countries, where there is a strong tradition of underpricing. Turkmenistan has the most heavily subsidised gasoline and diesel in the world. In the majority of countries surveyed, pump prices are unsubsidised on a net basis – usually because of excise duties. Among OECD countries,

[11] PSE defines the nominal cash transfers to domestic producers equivalent to the total value of existing support, provided at current levels of output, consumption and trade.
[12] That study judged subsidies to oil to be very small. The Commission was unable to quantify support to other fuels, but noted that budgeted regional policy and research funding alone for renewables was almost EUR 1.2 billion for 2002-2006. Nuclear research funding was estimated to have averaged USD 2.2 billion per year during 1974-1998, amounting to USD 942 million in 1998 (mostly accounted for by France).

Figure 3: **Countries that Subsidise Gasoline and Diesel, November 2006**



Note: Three benchmarks are used to determine the extent of subsidisation of gasoline and diesel: the first is the price of crude oil on the world market; the second is the estimated "normal" sales price, a theoretical price that corresponds to the international spot market plus distribution costs; and the third is the average pump price in the United States less a 10 cents per litre highway tax. Prices in the United States are among the lowest in the OECD, mainly because of very low rates of state and federal taxes. Only those countries with prices below the US price are assumed to subsidise fuel.
Source: GTZ (2007).

the share of taxes in gasoline prices among OECD countries varies from 13% in Mexico to 67% in the United Kingdom according to IEA data (IEA, 2007).

213 The value of transport fuel subsidies, based on the GTZ data and 2004 consumption data from the IEA, amounts to USD 90 billion using GTZ's estimates of normal supply cost (the international fuel price plus a distribution margin). Gasoline subsidies total USD 28 billion and diesel subsidies USD 61 billion.[13] The aggregate amount is exactly the same as the IEA's 2006 estimate, using a similar methodology, of *total* oil subsidies in the world's twenty largest consuming countries in 2005. Using the average US retail price as the benchmark, total gasoline and diesel subsidies amount to USD 133 billion, according to GTZ.

214 Detailed estimates of energy subsidies are available for some countries and regional groupings, notably the European Union and the United States. A 2004 European Environment Agency study estimates subsidies in EU-15 at a minimum of EUR 29 billion in 2001 (excluding external costs). Fossil-fuel subsidies are highest, with coal and other solid fuels accounting for almost 45% of all subsidies (Table 5).[14] Support for renewable energy is increasing steadily, but still amounts to only EUR 5 billion. The bulk of support to the energy sector is off-budget.

Table 5: **Indicative Estimates of Total Energy Subsidies in EU-15, 2001** (EUR billion)

	Solid fuels	*Oil and gas*	*Nuclear power*	*Renewables*	*Total*
On-budget	> 6.4	> 0.2	> 1.0	> 0.6	> 8.2
Off-budget	> 6.6	> 8.5	> 1.2	> 4.7	> 21.0
Total	> 13.0	> 8.7	> 2.2	> 5.3	> 29.2

Source: EEA (2004).

215 A two-stage US government study completed in 2000 estimated total federal subsidies to the energy sector at USD 6.2 billion based on 1999 data (US DOE/EIA, 1999 and 2000), a figure broadly in line with that of the 1998 OECD study. An earlier study had suggested a range of USD 5 to 10 billion (US DOE/EIA, 1992). However, other recent studies carried out by non-governmental organisations have produced significantly larger estimates. In a paper for the National Commission on Energy Policy, federal subsidies are estimated at between USD 40 and 69 billion in 2003 in year-2006 dollars (Koplow, 2004). The Energy Policy Act of 2005 added an estimated USD 85 billion in subsidies over 10 years (TCS, 2005). Subsidies to biofuels alone are put at between USD 5.5 and 7.3 billion a year (Koplow, 2006a). Earth Track, a non-governmental organisation that monitors energy subsidies, estimates total federal energy support in 2006 at between USD 49 and 100 billion (Koplow, 2006b).

216 A 2002 study by IMF staff attempts to quantify domestic oil subsidies in major net oil-exporting countries (Gupta *et al.*, 2002). It concludes that subsidies in 1999 were, on average, equal to 3% of GDP and 15.2% of total government spending. Subsidies were biggest in Azerbaijan, at 16.6% of GDP. Only Norway and Mexico – both OECD countries – do not subsidise oil products at all.

[13] The estimate for diesel includes light heating oil, which is included in IEA data on diesel consumption. In most non-OECD countries, the retail price of automotive diesel is similar to that of heating oil.

[14] A 2007 EEA study of EU transport subsidies uses a different approach, including differential taxation of fuels as off-budget subsidies and yielding much higher estimates. It estimates the value of subsidies from fuel-tax exemptions and rebates at EUR 11 billion, assuming a baseline tax equal to the minimum EU excise duty on diesel, and EUR 36 billion, based on a carbon tax of EUR 20 per tonnes of CO2 (the average for 2006). In both cases, most subsidies go to aviation and shipping.

3. Impact on Investment and Greenhouse-Gas Emissions

3.1 Economic and Investment Distortions

301 A subsidy, by affecting cost and/or price, always causes a shift in economic resource allocation. Energy subsidies deliberately distort price signals and, therefore, investment in infrastructure to supply different fuels and in the capital stock that transform or consume energy. If the subsidy successfully corrects a market failure, such as internalising the cost of an environmental externality, it can improve social welfare. But if the subsidy fails to address a targeted market failure or worsens another one, it will result in a loss of economic efficiency.

302 Quantifying the costs and benefits – especially social and environmental – is extremely difficult and judgmental. Because of the importance of energy to economic activity, the removal of energy subsidies have complex general equilibrium effects that are hard to predict and measure. Critical factors include inter-fuel competition and changes in energy intensity in response to price changes: when energy prices rise following the removal of a subsidy, the costs of production of other goods and services will rise, especially energy-intensive goods. Changes in production costs will affect the relative prices of goods and services, and, therefore, international trade flows (Saunders and Schneider, 2000). Nonetheless, there are lots of examples from different countries and regions of the ineffectiveness of energy subsidies in addressing social policy goals and the high economic (and environmental) costs associated with them (Von Moltke *et al.*, 2004). The 1999 IEA study, for example, estimates the net present value of the loss of economic growth due to consumer energy subsidies in the eight largest non-OECD countries at USD 257 billion per year (using a discount rate of 7%).

303 The way in which energy investment is distorted and the resulting impact on the level and fuel mix of energy supply depends on the type of subsidy, its size and the manner in which it is applied. Subsidies can undermine economic efficiency and investment in more efficient and cleaner energy technologies in one or more of the following ways:

- Subsidies to energy consumption and/or production, by lowering end-use prices, can lead to higher energy use and reduced incentives to invest in more energy-efficient equipment. An extreme example is the almost total disregard for energy efficiency in housing blocks in Russia and other transition economies during the Soviet era, which resulted from a failure to price heating services properly – in some cases, not at all. The situation has improved in the last decade, but subsidies and waste persist in many cases.
- By reducing the price received by producers, a consumption subsidy may undermine energy providers' returns on investment and, consequently, their ability and incentive to invest in new infrastructure. As a result, it may encourage reliance on out-of-date and dirtier technology. The dire financial straits of energy companies and the resulting under-investment in several developing countries, such as the state electricity boards in India, are largely due to under-pricing and poor collection rates (IEA, 2002; EIA, 2003).
- Subsidies to producers, by cushioning them from competitive market pressures, tend to reduce incentives to minimise costs, resulting in less investment in more efficient technologies. Subsidies on coal production in several OECD countries have hampered efforts to improve productivity in past decades.
- Subsidies to specific energy technologies inevitably undermine the development and commercialisation of other technologies that might ultimately become more economically and environmentally attractive. In this way, subsidies can "lock-in" technologies to the exclusion of other, more promising ones.

304 Energy subsidies can also incur macroeconomic costs. In particular, direct subsidies such as grants or tax exemptions act as a drain on government finances. For example, direct subsidies

to oil products in Indonesia reached almost USD 10 billion in 2005 – equal to 3.5% of GDP (ADB, 2006). In the long run, indirect subsidies that reduce economic growth also lead to lower government tax revenues. If they increase overall energy use, consumption subsidies boost demand for imports or reduce the amount of energy available for export. This harms the balance of payments and energy security by increasing the country's dependence on imports. Price caps or ceilings below market-clearing levels may also lead to physical shortages and a need for administratively costly rationing arrangements. Some of these costs are ultimately borne at least in part by the intended beneficiaries of the subsidies as well as the rest of society.

305 Subsidies to energy efficiency, renewables and other low- or zero-carbon energy sources may be successful in supporting environmental and energy-security goals, though these benefits need to be weighed against any macroeconomic and social costs that may be incurred. In principle, taxing carbon-intensive fuels and activities can be a more economically efficient and practical approach to internalising external environmental costs, but may be difficult politically. In practice, subsidies to clean energy technologies can be an effective way of overcoming market barriers to their development and deployment and can play an important role in mitigating emissions as part of a portfolio of market-based and regulatory measures.

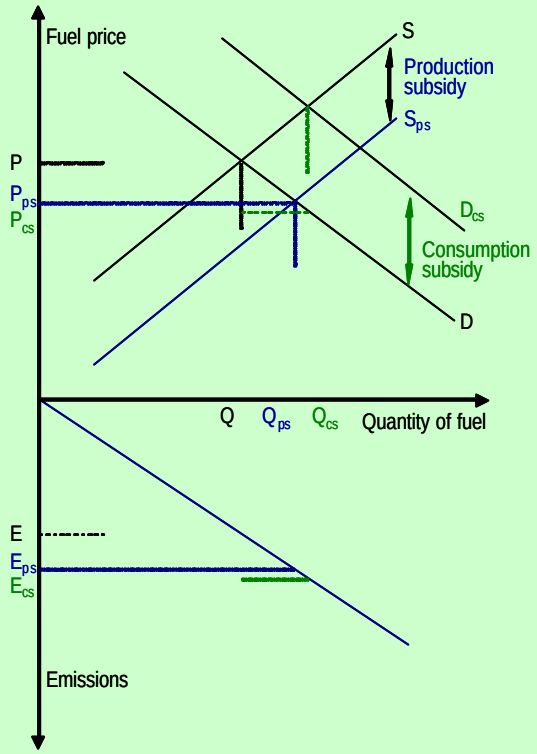
3.2 Impact on Emissions

306 The effects of energy subsidies on greenhouse-gas emissions are as complex as those on economic activity and investment. Subsidies to producers or consumers that result in a lower price for fossil fuels to end users normally cause more of those fuels to be consumed, which (in the absence of carbon sequestration) lead to higher greenhouse-gas emissions (Box 1). However, there may be instances when this is not the case. For example, encouraging the use of oil products can curb deforestation in developing countries as poor rural and peri-urban households switch from firewood, boosting carbon sinks and offsetting the emissions from fuel combustion. Protecting forests is one reason for the maintenance of subsidies to kerosene and LPG in many countries.[15] Similarly, public funding of fossil-fuel research and development could yield positive emissions effects insofar as it results in the development and deployment of more efficient production or end-use technologies. Nonetheless, the key to determining whether a subsidy is good or bad for climate mitigation is whether the energy source it supports is more or less carbon-intensive than the alternative (OECD, 2005). Overall, the large subsidies to fossil-fuel consumption worldwide undoubtedly contribute to higher greenhouse-gas emissions and exacerbate climate change.

307 Evidence of the net effects on greenhouse-gas emissions of introducing or removing energy subsidies is generally qualitative or partial. This reflects the immense practical difficulties in estimating quantitatively the different short- and long-term effects of subsidies on demand and supply. A few studies have quantified the harmful effects of various types of fossil-fuel subsidies on greenhouse-gas emissions. A major study by the OECD looks at the impact of eliminating coal-production subsidies worldwide as part of a broader study of the environmental effects of liberalising trade in fossil fuels (OECD, 2000). The study uses a price-gap approach together with the OECD's in-house general equilibrium model, GREEN. It demonstrates that trade liberalisation and policy reforms involving the elimination of all subsidies to fossil fuels used in industry and the power sector in both OECD and non-OECD countries would result in a net reduction of more than 6% in global energy-related CO_2 emissions by 2010 (Table 6). Real income would also be increased by 0.1%. These improvements would be brought about by a major shift in energy consumption and international trade patterns. The study also shows that if these reforms occur solely in the OECD, fossil-fuel demand would increase marginally in the long run due to a fall in prices and some substitution of high-priced domestically produced coal with cheaper imports in Japan and Europe. In this case, CO_2 emissions and economic welfare would increase slightly.

[15] For example, one of the main objectives of the LPG subsidy programme launched in Senegal in the 1970s was a sharp reduction in charcoal production – the principal cause of deforestation across the country (Von Moltke et al, 2004).

Box 1: **The Impact of Energy Subsidies on Greenhouse-Gas Emissions**



The chart opposite demonstrates how production and consumption subsidies on fossil-fuel production can increase greenhouse-gas emissions. The introduction of a per-unit subsidy on fuel production shifts the supply curve down from S to S_{ps}, causing the price to drop to P_{ps} and the quantity of the fuel sold to rise to Q_{ps}. This equates to an increase in emissions from E to E_{ps}.

A per unit consumption subsidy shifts the demand curve up from D to D_{cs}. This results in a drop in the net price paid by consumers to P_{cs}, an increase in the quantity consumed to Q_{cs} and an increase in emissions to E_{cs}.

The precise impact of any production or consumption subsidy depends on the shapes of the demand, supply and the emission curves. The less sensitive supply and demand are to price, the less impact subsidies have on the environment. Inter-fuel substitution will determine the overall environmental impact of a subsidy on a given fuel, since that subsidy will normally affect the use of other fuels.

Source: Adapted from UNEP/IEA (2002).

Table 6: **OECD GREEN Model Simulations** (% change from business-as-usual scenario)

		OECD only liberalises	*Non-OECD only liberalises*	*All countries liberalise*
Global CO_2 emissions	2000	-0.1	-1.8	-1.9
	2010	+0.1	-6.3	-6.2
Global real income	2000	0.0	0.0	+0.1
	2010	+0.1	0.0	+0.1

Source: OECD (2000).

308 The 1999 IEA study shows that the removal of consumption subsidies in eight of the largest non-OECD countries would reduce their primary energy use by 13%, resulting in a reduction in their CO_2 emissions of 16% (Table 7). GDP would also rise by almost 1% in those countries in aggregate. The reduction in emissions is equal to about 5% of world emissions. Because coal is the dirtiest fuel, the removal of coal subsidies generally yields the biggest environmental benefits.

Table 7: **The Impact of the Removal of All Energy Consumption Subsidies in Selected Non-OECD Countries**

Country	*Average rate of subsidy (% of market price)*	*Annual economic efficiency gain (% of GDP)*	*Reduction in energy consumption (%)*	*Reduction in CO_2 emissions*
China	10.9	0.4	9.4	13.4
Russia	32.5	1.5	18.0	17.1
India	14.2	0.3	7.2	14.1
Indonesia	27.5	0.2	7.1	11.0
Iran	80.4	2.2	47.5	49.4
South Africa	6.4	0.1	6.3	8.1
Venezuela	57.6	1.2	24.9	26.1
Kazakhstan	18.2	1.0	19.2	22.8
Total sample	21.1	0.7	12.8	16.0
Total world	n.a.	n.a.	3.5	4.6

Source: IEA (1999).

309 A study by researchers at ABARE, an Australian research body, reports smaller estimates of the savings in total greenhouse-gas emissions from the removal of fossil-fuel consumption subsidies than those of the IEA, based on simulations using its Global Trade and Environment Model (Saunders and Schneider, 2000). Globally, subsidy removal is projected to reduce world emissions by 1.1% by 2010 relative to a reference case. At more than 8%, emissions reductions are largest in the transition economies, because their energy consumption falls most heavily. Emissions rise slightly in the developed countries, because their coal consumption is boosted by lower international prices. One of the main reasons for the smaller reduction in emissions than that of the IEA is the lower estimated level of coal subsidies in developing countries.

310 Analysis of the impact of remaining coal-production subsidies in OECD countries on greenhouse-gas emissions suggests that their removal of subsidies would not lead to direct increases in prices paid by consumers of coal, and thus may not lower consumption or emissions to any significant degree (OECD, 2005; Von Moltke, 2004; IEA, 2001). The impact of subsidy removal would, however, depend on country-specific circumstances, particularly with respect to the type of subsidy in place, the quality of the coal being subsidised, the degree of competition in the electricity-supply industry (the main coal consumer) and the structure of energy demand. In Germany, where coal subsidies remain largest among OECD countries, consumers of coal are already free to choose suppliers. Subsidies are paid to producers, so removing them would probably lead consumers to simply switch to imported coal. Nonetheless, the increase in demand for imported coal might drive up international coal prices to some extent, pushing down world coal demand and related CO_2 emissions. In addition, the money saved by removing coal subsidies could be spent on measures to promote energy efficiency, conservation and renewables, which could lead to a reduction in CO_2 emissions in the longer term.

311 Subsidies to support renewables and energy-efficient technologies may help to reduce greenhouse-gas emissions depending on how the subsidies are structured and on market conditions. In some cases, subsidies to renewables need to be big to make those technologies competitive with existing ones based on fossil fuels. If renewables replace fossil fuels and the amount of fossil-fuel-based energy consumed in building and operating the plants and equipment is not too high, then the net effect on emissions will generally be positive. The long-term impact

of public funding of research and development on emissions is highly variable and unpredictable, depending on whether it leads to commercially viable technology.

312 Governments around the world are introducing or increasing subsidies to biofuels as a way of mitigating greenhouse-gas emissions. The emissions impact of replacing oil-based fuels with biofuels depends on several factors. These include the type of crop, the amount and type of energy embedded in the fertilizer used to grow the crop and in the water used, emissions from fertilizer production, the resulting crop yield, the energy used in gathering and transporting the feedstock to the bio-refinery, alternative land uses, and the energy intensity of the conversion process (IEA, 2006a). In practice, the amount and type of primary energy consumed in producing biofuels and, therefore, the related emissions of greenhouse gases, vary enormously. A recent study compares several reports on corn-based ethanol production in the United States, in order to compile estimates of net greenhouse-gas emissions using consistent parameters (Farrel *et al*., 2006). It concludes that the "best point estimate" is that greenhouse-gas emissions are only 13% lower per kilometre compared with petroleum-based fuels. Another recent study, published by the European Commission, shows that conventional ethanol production can result in a net saving of over 30% in greenhouse-gas emissions (European Commission, 2006). Estimates for the net reduction in emissions that are obtained from rapeseed-derived biodiesel in Europe range from about 40% to 60%, compared with conventional automotive diesel. Thus, subsidies to biofuels undoubtedly lead to lower CO_2 emissions, though the cost per tonne of CO_2 saved may be high in some cases and less cost-effective than other ways of reducing emissions.

4. Prospects for Energy Subsidy Reform

4.1 The Need for Reform

401 The prospects for energy subsidies depend entirely on whether and how governments decide to reform their energy policies. In the absence of reform, the value of those subsidies will tend to rise as demand for energy increase. In its latest *World Energy Outlook*, the IEA projects global primary energy demand to grow by more than half between 2004 and 2030 in a Reference Scenario that assumes no change in government policies (IEA, 2006a). Fossil fuels continue to dominate the global energy mix, their share of total primary energy use rising slightly from 80% to 81%. The use of modern renewable technologies, including hydro, solar, geothermal and wind power, expands rapidly, but their combined share of global energy demand reaches only 5% in 2030 because they start from a low base. Consequently, global CO_2 emissions increase by 55%. In an Alternative Policy Scenario, which takes account of all the policies governments are currently considering to address climate change and energy-security concerns, including reform of energy subsidies, primary energy use is 10% lower and CO_2 emissions 16% lower in 2030 than in the Reference Scenario.

402 The need to reduce and eliminate subsidies that encourage the production and use of fossil fuels within the framework of broader pricing and tax reform is widely accepted. Indeed, the Kyoto Protocol explicitly requires a reduction of subsidies that encourage greenhouse-gas emissions. But, in many instances, governments are faced with awkward trade-offs between the economic, social and environmental effects of reforming those subsidies. Scrapping or modifying a subsidy is clearly justified where the net effect is positive, but assessing the implications of that reform is highly judgmental and political.

403 Although a subsidy might increase greenhouse-gas emissions, the government may be reluctant to remove it if it judges that the social consequences would be too painful. Subsidies to household heating fuels and electricity, which are common around the world, fall into this category. In some countries, the removal of subsidies to such forms of energy in recent years has had a dramatic effect on living standards, notably in countries in Eastern Europe and the former Soviet Union. But these subsidies can be very expensive. In addition, they often fail to reach the poor, either because they cannot afford even subsidised energy or because they have no access to it, or because subsidised energy is rationed (UNEP/IEA, 2002). The challenge for governments is to find more effective ways of meeting social goals than through energy subsidies that avoid or minimise environmental harm. One approach is to use the money saved in removing energy subsidies to finance directly social-welfare programmes, such as direct income support (where institutions exist to distribute such payments), health and education (Von Moltke *et al.*, 2004).

404 There may be a good case for subsidising energy where it is expected to lead to more sustainable energy use. For example, public support to research and development of clean energy to overcome market barriers is widely considered to make sense. Subsidies aimed at improving poor or rural households' access to modern, commercial forms of energy may also be justified in some cases, especially where mechanisms for supporting the incomes of poor households do not exist. Lifelines rates – subsidised tariffs for modest levels of household electricity consumption – are widely used in developing countries. Often, the incremental energy consumption and, therefore, greenhouse-gas emissions involved is very small. But how those subsidies are applied is of critical importance. There are a number of basic principles that countries need to apply in designing subsidies and implementing reforms to existing programmes. Experience shows that subsidies aimed at mitigating climate change or helping the poor should meet the following key criteria (UNEP/IEA, 2001 and 2002; UNECE, 2002):

- *Well-targeted*, so that subsidies go only to those who are meant and deserve to receive them.

- *Efficient*, in that subsidies do not undermine incentives for suppliers or consumers to provide or use a service efficiently.
- *Soundly based*, that is, justified by a thorough analysis of the associated costs and benefits.
- *Practical*, in the sense that the amount of subsidy is affordable and that it is possible to administer the subsidy in a low-cost way.
- *Transparent*, so that everyone can see the amount of subsidy and who receives it.
- *Limited in time*, so that consumers and producers do not get "hooked" on them and the cost does not spiral out of control.

4.2 Approaches to Implementing Reforms

405 Reforming energy subsidies must take account of practical barriers to reform. The biggest barrier is usually resistance from those groups that benefit from the subsidy and politicians who champion their cause. By its very nature, the costs of an energy subsidy are usually spread throughout the economy, while its benefits are usually enjoyed by only a small segment of the population — not necessarily the targeted group. Those beneficiaries will always have an interest in defending that subsidy when their gains exceed their share of the economic or environmental costs. Conversely, the majority of the population, who bear the net cost of the subsidy, are generally less inclined to support political action to remove the subsidy, since the cost is likely to be much smaller in per capita terms than the benefit to the recipients – a problem known as political mobilisation bias. Furthermore, it can be difficult to demonstrate the economic cost of subsidy in terms that the public can understand. Those that want to keep a subsidy often find it much easier to provide concrete examples of their social benefits, such as the number of jobs supported or the financial savings to poor people. Benefits that involve primarily indirect gains in economic efficiency are abstract and difficult to demonstrate to the public. Where the environmental benefits are global, such as reduced greenhouse-gas emissions, the public may not care much, especially where poverty is widespread.

406 For these reasons, it can be very hard for policy makers to remove subsidies once they have been introduced. In many poor countries, the general public often still considers energy to be a basic social good, like food and housing, the pricing of which should not be left solely to market forces. But these barriers to reform do not justify inaction. Reforming existing energy subsidies calls for strong political will to take tough decisions that benefit society as a whole. In general, politicians tend to be more willing to tackle difficult subsidy issues immediately after elections in the hope that opposition to reform will have diminished by the time new elections come around. The following approaches can help policymakers to overcome resistance (UNECE, 2002):

- Reforms can be implemented in a phased manner to soften the financial pain of those who stand to lose out and give them time to adapt. This is likely to be the case where removing a subsidy has major economic and social consequences. Phased reform could start with local experiments, which can be rolled out nationally as lessons are learned. In France, for example, the government decided in 1986 to phase out coal-production subsidies by shutting uneconomic mines gradually over a period of 20 years.[16] Phasing in reforms can help build public support and momentum for carrying reforms forward. The pace of reform, however, should not be so slow that delaying its full implementation involves excessive costs.
- If reforming an energy subsidy reduces significantly the purchasing power of a specific social group, the authorities can introduce compensating measures that support their real incomes in more direct and effective ways. That goal may be considered socially desirable. It may also be the price that has to be paid to achieve public and political

[16] In fact, the last mine was closed in 2004.

support for removing or reducing the subsidy. Experience has shown that, unless welfare payments are used to offset the higher cost of energy for poor households, eliminating subsidies to network energy services often leads to a decline in collection rates. The abrupt removal of heat subsidies in many cities in Russia in the 1990s, for example, led to a dramatic deterioration in the financial health of the district heat suppliers, undermining investment and the quality of service. In some cities, such as Cherepovetz, part of the savings that arose as a result of removing heat subsidies were used to finance welfare payments, resulting in fewer collection problems and protecting poor households (Bashmakov, 2000). In Europe, redirecting coal subsidies to retraining and regional economic development aid has helped to boost higher-paid, safer and more desirable jobs to replace the jobs lost in the coal industry (UNECE, 2002).

- Politicians need to communicate clearly to the general public the overall benefits of subsidy reform to the economy and to society as a whole and consult with stakeholders in formulating reforms to counter political inertia and opposition. In most countries, the public is becoming familiar with the environmental advantages of renewables and natural gas over coal, making it harder for politicians to maintain support to ailing coal industries.

407 Developing country governments can seek support from multilateral lending institutions and other international organisations in devising and implementing addressing energy-subsidy reforms. They may find it politically safer to have their hands tied by an external commitment, such as an international trade agreement or a formal condition for obtaining a loan. World Bank lending to energy projects in developing countries is often linked to market reforms, involving a move to more cost-reflective pricing. Governments may also gain access to advice and expertise on subsidy reform and broader aspects of energy-policy making.

5. Conclusions

501 Energy subsidies remain large in many countries, especially in the developing world. Subsidies that encourage the production and use of fossil fuels, which still make up the bulk of energy subsidies worldwide, inevitably increase greenhouse-gas emissions and run counter to efforts to mitigate climate change. They can be very costly in economic terms and sometimes bring few benefits to the people for whom they are intended. In many cases, removing such subsidies could bring major economic, social and environmental benefits in the longer term – a win-win-win policy.

502 Subsidies to energy make sense in some cases, especially where they are aimed at encouraging more sustainable energy use. There is a strong case for temporary support for renewable and energy-efficient technologies, aimed at overcoming market barriers and kick-starting their deployment. Measures to improve poor or rural households' access to modern, commercial forms of energy – such as lifeline rates for electricity – may also be justified on social grounds, even if they result in higher overall consumption of fossil fuels and emissions. The way in which specific programmes are designed is crucial to their cost-effectiveness.

503 Reforming energy subsidies, as part of a broader process of reform of energy pricing and taxation, could play a central role in government efforts to mitigate greenhouse-gas emissions. In practice, however, implementing reforms can be extremely hard. Strong political will is needed to take tough decisions that benefit society as a whole in the face of resistance from groups that stand to lose out. Implementing reforms in a phased manner may be the most acceptable and practical approach. Compensating measures that support the real incomes of targeted social groups in more direct and effective ways may also be justified. Whatever the precise design of reform policies, politicians need to sell to the general public the overall benefits of cutting environmentally harmful subsidies and to consult widely with stakeholders in formulating reforms.

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