

Reforming Energy Subsidies

Opportunities to Contribute to the Climate Change Agenda

**United Nations Environment Programme
Division of Technology, Industry and Economics**

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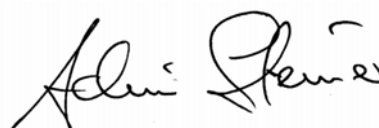
Foreword

Greenhouse gas emissions, primarily caused by fossil fuels, are the main drivers of climate change. Through the Intergovernmental Panel on Climate Change, the international community agreed that global greenhouse gas emissions need to be halved by 2050 - relative to 1990 levels - to avoid irreversible and possibly catastrophic changes for millions of people. These impacts include endangered water and food security, widespread melting of glaciers and dramatic rises of sea-levels threatening entire populations.

Nevertheless, many governments continue to subsidise the use of fossil fuels. In recent years, some have even intensified their financial support for social reasons to compensate for the steep increase in international oil prices. However, such subsidies often do not reach those that they are intended for. They are also very costly in economic terms, creating a large drain on government budgets and distorting national and international markets. On the other hand, energy subsidies can be beneficial, where they are aimed at promoting cleaner and more efficient technologies and at improving poor households' access to modern forms of energy.

Some countries have already taken steps in assessing their subsidies programmes in terms of their environmental, social and economic impacts and in reforming their harmful policies. However, much greater national and international efforts are indispensable to reduce those subsidies that enhance fossil-fuel use and thus act as a hurdle to combating climate change and achieving more sustainable development paths.

With this booklet, UNEP aims to raise awareness of the various types of energy subsidies, their size and impact and the direct relationship with climate change and sustainable development. I hope that the key policy lessons and recommendations will help policy makers to design reform of energy subsidies in an environmentally, socially and economically sound manner. With this guidance document, I am calling on you to help us tackle the problem of climate change by using your resources wisely and stop investments in energy practices that have proved to be detrimental to the environment, development and society as a whole.



Achim Steiner
Executive Director
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Introduction

Reforming environmentally harmful energy subsidies will need to play a central role in moving the world onto a more sustainable development path. Consensus on the detrimental impact of rising fossil-energy consumption on climate change now calls for renewed attention and urgency of the reform process. However, there is a lack of information and understanding about the size of the problem, the need for policy reform and the best way to go about it.

This report summarises, in non-technical language, the issues and challenges in removing or modifying subsidies on energy that undermine the pursuit of sustainable development. It updates the first edition, published jointly by the United Nations Environment Programme (UNEP) and the International Energy Agency (IEA) in 2002, drawing on the findings of recent work related to energy subsidies by various organisations.

This report was commissioned by the Division of Technology, Industry and Economics (DTIE) of UNEP. Trevor Morgan of Menecon Consulting (now with the IEA) was the principal author. The report also benefited from comments and suggestions from a panel of external reviewers, including Florian Ziegler of Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) and Ron Steenblik of the International Institute for Sustainable Development (IISD). Their help is gratefully acknowledged.

At UNEP, Anja von Moltke from the Economics and Trade Branch was responsible for overseeing the preparation and editing of the report. Martina Otto from the Energy Branch and Fulai Sheng from the Economics and Trade Branch of DTIE provided substantive comments. Additional support was provided by Mirjam Harteisen and Theresa Schmitt.

For more information about UNEP's current and past work on energy subsidies, please visit: <http://www.unep.ch/etb/areas/energySub.php>.

Energy, Climate Change and Sustainable Development

“Sustainable development” has become a guiding principle for public policy. But translating that principle into practical policies and measures can be difficult, not least because of the complex inter-relationships that exist between the interests of present and future generations and between the three dimensions of sustainable development – the economy, social welfare and the environment. Energy is implicated deeply in all three dimensions. It is essential for economic and social development. But current energy systems harm the environment in lots of ways, notably by contributing to climate change.

The Role of Energy in Sustainable Development

A lack of access to reliable and affordable energy is holding back economic and social development in many parts of the world today.

Energy is essential to all economic activities and to human well-being. Economies rely on commercial energy to transport goods and people, to heat homes and offices, to power engines and appliances, and to run shops and factories. Energy services help to meet basic human needs such as the production of food, the provision of shelter and access to health services, while contributing to social development by enabling education. Lack of access to reliable and affordable modern energy is holding back economic and social development in many parts of the world today. An estimated 1.6 billion people in the world have no access to electricity, while more than two billion people rely on traditional fuels for cooking and heating. Raising their living standards and productivity depends on improving their access to modern energy services.

However, patterns of energy production and use around the world still threaten the stability of eco-systems and the health and well-being of current and future generations. Rising consumption of fossil fuels – coal, oil and gas – in all regions is the leading cause of rising man-made emissions of carbon dioxide and other greenhouse gases that trap heat in the earth’s atmosphere. The resulting increase in atmospheric concentrations of these gases is threatening to cause catastrophic and irreversible damage to global climate. The Intergovernmental Panel on Climate Change (IPCC), in its 2007 *Fourth Assessment Report*, presents unequivocal evidence that rising concentrations have already led to an increase in average global temperature, estimated at around 0.7°C compared with pre-industrial levels. Global warming is expected to lead to accelerated melting of ice and snow, rising sea levels and profound changes in weather patterns. The economic and social consequences are potentially disastrous.

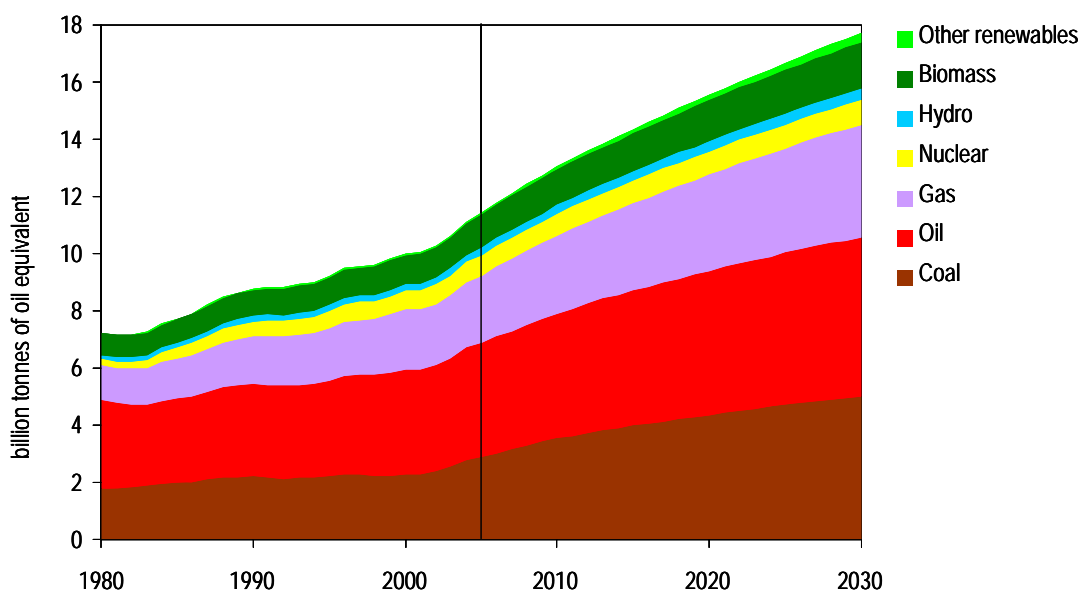
Burning fossil fuels also causes urban smog and acid rain, while producing them can pollute water supplies. In many towns and cities, local pollution

caused by burning oil, gas and coal in houses, factories, cars and power stations is a leading cause of human health problems. Concentrations of the main local air pollutants – particulates, sulphur dioxide and nitrogen oxides – in the big cities of many developing countries are well above World Health Organisation maximum guideline levels. Acidification of lakes and soils is also a big problem in many parts of the world.

However, environmental problems are not limited to fossil fuels. Nuclear power production gives rise to radioactive waste and the risk of contamination. And even the production of certain types of renewable energy can have severe environmental consequences, such as the ecological effects of hydroelectric dams or toxic heavy metals used in batteries for solar home systems.

Energy use worldwide is expected to continue to grow steadily for the next two decades and, in the absence of radical intervention by governments, fossil fuels will remain the dominant energy sources. The latest *World Energy Outlook* of the International Energy Agency (IEA) projects global primary energy consumption to expand by 55% between 2005 and 2030 in a Reference Scenario, which assumes no new government policies. Fossil fuels account for 84 per cent of the increase in energy use (Figure 1). As a result, energy-related emissions of carbon dioxide rise by 57 per cent. Most of the increase in energy demand and resulting emissions is projected to occur in developing countries, especially in the emerging economies of China and India.

Figure 1: World Primary Energy Supply (Mtoe)



Source: International Energy Agency, *World Energy Outlook 2007*.

These trends imply that the availability of energy services to households and productive activities in developing countries will expand, which should help improve the employment opportunities, living conditions and health of millions of poor people. Nevertheless, they also entail worsening pollution problems and potentially catastrophic global warming. The IEA's Reference Scenario projections are consistent with a long-term rise in average global temperature of around 5-6°C – the most extreme of all the scenarios assessed by the IPCC.

Public Policies and the Energy Sector

Achieving energy sustainability requires a radical change in present trends. This can only be achieved, in principle, in the following ways, which differ in terms of costs and feasibility:

- Conserving energy. The cleanest energy is that which is not used at all.
- Increasing the energy efficiency of output so that we produce goods and services with less energy.
- Switching from fossil fuels to other sources that emit little or no noxious and greenhouse gases, such as renewable energy.
- Capturing carbon and other substances at the point of combustion before they are emitted into the atmosphere.
- Increasing the capacity of the earth's forests to absorb carbon.

None of these things will happen without any effort. Governments individually and collectively will need to make them happen through strong policies and measures, including a range of regulatory and market-based interventions. There is considerable potential for moving the global energy system onto a more sustainable path within a generation. In the IEA's Alternative Policy Scenario, which assumes that policies that governments are currently considering are implemented (including some energy-subsidy reforms), the growth in fossil-fuel consumption and emissions in the period to 2030 is halved.

Getting market signals right so that prices better reflect the true costs of producing and consuming energy – i.e. taking account of the environmental and social consequences – should be a key guiding principle.

The right policy approach for each country must take account of local market conditions, the structure of the energy sector, patterns of energy use, institutional characteristics, and changing circumstances. However, there is a broad consensus on the need for an approach that promotes efficient, competitive energy markets as the foundation upon which government policies should be superimposed. Getting market signals right so that prices better reflect the true costs of producing and consuming energy – i.e. taking account of the environmental and social consequences – should be a key guiding principle in all cases.

The Impact of Energy Subsidies

Energy subsidies have important implications for climate change and sustainable development more generally through their effects on the level and composition of energy produced and used. For example, a subsidy that ultimately lowers the price of a given fuel to end-users would normally boost demand for that fuel and the overall use of energy. This can bring social benefits where access to affordable energy or employment in a domestic industry is an issue, but may also carry economic and environmental costs. Subsidies that encourage the use of fossil fuels often harm the environment through higher emissions of noxious and greenhouse gases. Subsidies that promote the use of renewable energy and energy-efficient technologies may, on the other hand, help to reduce emissions.

What is an Energy Subsidy?

An energy subsidy is any government action that influences energy market outcomes by lowering the cost of energy production, raising the price received by energy producers or lowering the price paid by energy consumers.

There is enormous confusion about what is meant by an energy subsidy. The narrowest and perhaps most common definition is a direct cash payment by a government to an energy producer or consumer to stimulate the production or use of a particular fuel or form of energy. Broader definitions attempt to capture other types of government interventions that affect prices or costs, either directly or indirectly. For example, a recent OECD study defined a subsidy in general terms as *any measure that keeps prices for consumers below market levels, or for producers above market levels or that reduces costs for consumers and producers*. 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*. In a similar way, the IEA defines 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*.

The assumed baseline level of costs and prices is crucial, whatever the chosen definition. The assumption of market costs and prices as suggested by the above definitions implies that any attempt by a government to address market failures by reducing the price or cost of energy to internalise an external environmental or social benefit would constitute a subsidy. On the other hand, if baseline costs and prices are assumed to take account of external costs and benefits, a failure by the government to address a market failure involving an external cost could be considered a subsidy. In practice, assessing quantitatively the magnitude of externalities is extremely difficult so empirical studies of subsidies often use a conventional definition that simply assumes market prices and costs.

Energy subsidies take many different forms (Table 1). Some have a direct impact on costs or prices, like grants and tax exemptions. Others affect prices or costs indirectly, such as regulations that skew the market in favour of a particular fuel or government-sponsored technology research and development. How governments choose to go about subsidising energy depends on a number of factors. These include 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 entail considerable accounting and transaction costs. It also involves a direct financial burden on the national treasury.

Table 1: Main Types of Energy Subsidies

| 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 | ● | | |
| | Grants to consumers | | | ● |
| | Low-interest or preferential loans | ● | | |
| Preferential tax treatment | Rebates or exemptions on royalties, sales taxes, producer levies and tariffs | ● | | |
| | Tax credit | ● | | ● |
| | Accelerated depreciation allowances on energy-supply equipment | ● | | |
| Trade restrictions | Quotas, technical restrictions and trade embargoes | | ● | |
| Energy-related services provided directly by government at less than full cost | Direct investment in energy infrastructure | ● | | |
| | Public research and development | ● | | |
| | Liability insurance and facility decommissioning costs | ● | | |
| Regulation of the energy sector | Demand guarantees and mandated deployment rates | ● | ● | |
| | Price controls | | ● | ● |
| | Market-access restrictions | | ● | |

Governments like to keep subsidies “off-budget” for political reasons, since “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 set prices below full cost, especially where the energy company is state-owned, or of a requirement on energy buyers to take minimum volumes from a specific, usually domestic, supply source. Subsidies may be aimed at producers, such as a grant paid for each unit of production, or at consumers, such as a rebate or exemption on the normal sales tax.

Subsidies to domestic energy production, usually directed at protecting jobs, remain common throughout the world. They have, nonetheless, been declining in many countries over the last decade, with the shift towards more market-oriented economic and energy policies as well as liberalisation of international trade. Subsidies to coal producers, for example, have been phased out or reduced sharply in recent years in several OECD countries. On the other hand, subsidies designed to encourage the uptake of renewable technologies are growing, driven mainly by environmental and energy-security concerns and, in some cases, by regional employment objectives. For example, a growing number of countries subsidise the production of biofuels, such as transport fuels derived from agricultural products, waste or residues.

It is important to make a distinction between gross subsidies and subsidies net of taxes in measuring how big they are and how they affect energy supply and use. Taxes reduce the effect of subsidies on final prices. In some cases, energy subsidies are more than offset by special taxes and duties that raise the price to end-users to above free-market levels. What matters in practice is the overall impact of all subsidies and taxes on the absolute level of prices and costs and the competitiveness of each fuel or technology.

The Size of Energy Subsidies

Although energy subsidies are widespread, they vary greatly in importance and type according to the fuel and amongst countries. They also fluctuate over time. Estimating their size can be very hard. Because of differences in definitions, methodologies and the transparency of fiscal systems, it is difficult to compare regional or individual country studies measuring the magnitude and impact of energy subsidies. This complicates discussions about subsidies and their reform.

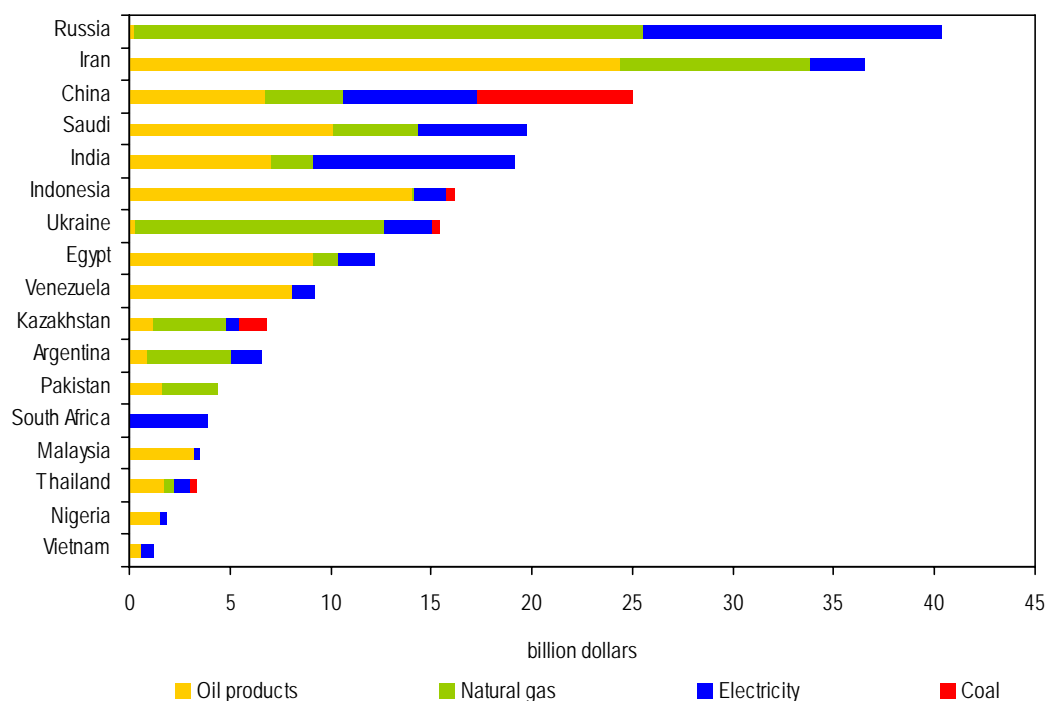
Few studies have attempted to quantify subsidies for the world as a whole, because of data deficiencies and the sheer scale of the exercise. Those studies that have been undertaken demonstrate that, globally, subsidies are large and that non-OECD countries account for the bulk of them, whether calculated in gross terms or net of taxes. They also suggest that the majority of energy subsidies in non-OECD countries benefit consumers, by lowering the prices they pay. Subsidies to producers, usually in the form of direct payments or support for research and development, are more common in OECD countries. In most OECD and some non-OECD countries, gross energy subsidies to consumption and production are more than offset by taxes, levied mainly on oil products. Worldwide, fossil fuels are nonetheless the most heavily subsidised energy sources on a net basis. 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.

Worldwide, energy subsidies might amount to \$300 billion per year, or around 0.7 per cent of world GDP, most of which go to fossil fuels.

The most recent quantitative analysis of energy subsidies worldwide was carried out by the IEA in 2006, the results of which were published in its *World Energy Outlook*. It found that energy subsidies – as measured by the extent to which actual prices fall short of the full economic cost of supply – in the twenty largest non-OECD countries amount to around US\$220 billion based on 2005 data, of which subsidies to fossil fuels account for around \$170 billion. Assuming that subsidies per unit of energy consumed are of the same magnitude in other non-OECD countries and that OECD consumption subsidies are minimal, energy subsidies worldwide might amount to around \$300 billion per year, or around 0.7 per cent of world GDP.

Russia has the largest subsidies in dollar terms, amounting to about \$40 billion, most of which go to natural gas (Figure 2). Iran's energy subsidies are almost as large, at an estimated \$37 billion. Six other countries – China, Saudi Arabia, India, Indonesia, Ukraine and Egypt – each have subsidies in excess of \$10 billion per year. In percentage terms, underpricing is most prominent for natural gas: on average, consumers pay less than half the true economic value of the gas they use in the countries analysed by the IEA.

Figure 2: 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 US\$1 billion in each case. The aggregated results are based on net subsidies only for each country, fuel and sector. Results are converted to dollars at market exchange rates.
Source: International Energy Agency, *World Energy Outlook 2006*.

Although most energy subsidies still go to fossil fuels, support for so-called “clean” energy technology is growing. The 2006 *Stern Report* estimates that direct government support to the deployment of low-carbon energy sources worldwide is currently of the order of \$26 billion per year: \$10 billion on deploying renewable sources of electricity and around \$16 billion on supporting existing nuclear power. The report estimates that, in addition, some \$6.4 billion is also spent on biofuels (assuming global production of 40 billion litres). A more recent estimate by the Global Subsidies Initiative of the International Institute for Sustainable Development puts biofuels subsidies in OECD countries alone at around \$11 billion in 2006. Public funding of research and development of renewable technology has also been rising steadily in recent years.

Economic, Social and Environmental Effects

A subsidy, by its very nature, involves a complex set of changes in economic resource allocation through its impact on costs or prices. These shifts inevitably have economic, social and environmental effects. Quantifying these different effects is extremely difficult and judgmental. This is especially true when measuring the social and environmental benefits. However, there are lots of examples from different countries and regions of the high *economic costs* associated with energy subsidies. A 1999 IEA study, for example, estimated the net present value of the loss of economic growth due to consumer energy subsidies in just the eight largest non-OECD countries at \$257 billion per year. In many cases, these costs are likely to outweigh any overall social and environmental benefits that might accrue from those subsidies, which could often be achieved more effectively and at lower cost in ways that do not involve subsidising energy.

Depending on the type of subsidy, the loss of economic efficiency is manifested in one or more of the following ways:

Subsidies reduce incentives to use energy efficiently, act as a drain on government finances and hold back economic development.

- Subsidies to consumption or production, by lowering end-use prices, can lead to higher energy use and reduce incentives to conserve or use energy more efficiently. One example is the disregard for energy efficiency in some former Soviet Union countries, which resulted from a failure to price heating and electricity services properly. The situation has improved in most of the transition economies since the 1990s, with price reform and increased investment in more energy-efficient equipment. However, large subsidies and waste persist in some cases.
- By reducing the price received by producers, a consumption subsidy may undermine energy providers’ return on investment and, consequently, their ability and incentive to invest in new infrastructure. As a result, it may encourage reliance on out-dated 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.

- Subsidies to producers, by cushioning them from competitive market pressures, tend to reduce incentives to minimise costs, resulting in less efficient plant operation and less investment in more efficient technology. Subsidies for coal production in several countries have long hampered efforts to improve productivity.
- Direct subsidies in the form of grants or tax exemptions act as a drain on government finances. For example, the Asian Development Bank estimates the Indonesian government's direct spending on petroleum products and electricity at about \$13 billion in 2007 – close to one-quarter of its budget and 5 per cent of the country's gross domestic product. Such direct subsidies can lead to acute pressure on the government budget, especially during periods of rising international prices. Indonesia and Yemen currently spend more on oil subsidies alone than on health and education combined.
- Price caps or ceilings below market-clearing levels may lead to physical shortages and a need for administratively costly rationing arrangements. This is the case in Cuba, where subsidised oil products are rationed.
- By increasing 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 supply security by increasing the country's dependence on imports. For example, Iran, a major oil exporter, was obliged to import about 40 per cent of its gasoline needs in 2006 at a cost of more than \$4 billion to meet strong demand for the heavily subsidised fuel.
- Fuel subsidies encourage smuggling of fuels to neighbouring countries where selling prices are higher. This is a common problem in parts of Africa, Asia and the Middle East. As much as 40 000 barrels per day of subsidised gasoline was smuggled out of Iran before the authorities introduced rationing in early 2007.
- Subsidies to specific energy technologies inevitably undermine the development and commercialisation of other technologies that might ultimately become more economically (as well as environmentally) attractive. In this way, subsidies can "lock-in" technologies to the exclusion of other, more promising ones.

Some of these arising costs are ultimately borne at least in part by the intended beneficiaries of the subsidies as well as the rest of society. And not all of these costs disappear straight away with the removal of subsidies because it can take a very long time to replace the stock of energy-related equipment used in supply and end use.

The *social implications* of energy subsidies vary according to the type of subsidy. Subsidies to modern cooking and heating fuels, such as kerosene,

liquefied petroleum gas (LPG) and natural gas, as well as electricity are common in developing countries. They are aimed at improving poor households' living conditions by making those fuels more affordable and accessible. Where they result in switching from traditional fuels and in improved access to electricity, those subsidies can bring considerable benefits to poor communities. These include less indoor pollution and a reduction in the time women and children spend gathering fuel and, therefore, more time for productive activities like farming, and education.

Many energy subsidy programmes intended to boost poor households' purchasing power or rural communities' access to modern energy can, paradoxically, leave the poor worse off.

In reality, however, these subsidies often benefit mainly the energy companies, equipment suppliers and the better-off households, especially in the towns and cities. In some cases, they may not even reach the poor at all. As a result, many energy-subsidy programmes intended to boost poor households' purchasing power or rural communities' access to modern energy through lower prices can, paradoxically, leave the poor worse off, since the costs are shared by the entire population including the poor. There are three main reasons for this:

- The poorest households may be unable to afford even subsidised energy or may have no physical access to it, for example when a rural community is not connected to the electricity grid.
- Even if the poor are able to benefit from an energy subsidy, the financial value to them may be very small since their consumption is generally modest. Rich households tend to benefit much more in nominal terms since they consume more of the subsidised fuel. Subsidies on LPG in India are one example (Box 1).
- Consumption subsidies that involve price caps may lead to a need for rationing. Middle and higher income households tend to get hold of the bulk of subsidised energy in countries where it is rationed, through petty corruption and favouritism. Price caps also encourage subsidised household fuels, such as kerosene, to be diverted to the black market or to other uses, such as transport. Barely half of all subsidised kerosene in India is actually used by the poor for cooking or lighting.

Subsidies can hurt the interests of poor people in other ways, too. In practice, energy subsidies often go to large capital-intensive projects, such as hydroelectric dams, at the expense of local, small-scale labour-intensive alternatives, such as biomass digesters. The construction of dams usually involves displacing communities, although the improved availability of electric power and water for irrigation can bring important social benefits as well. Subsidies to large-scale thermal power plants, oil refineries and gas processing plants affect poor households close to those facilities most, since they are usually less able to move away to avoid local pollution and safety risks.

Box 1: Case Study of LPG Subsidies in India

The Indian government continues to subsidise, for social reasons, LPG sold in small cylinders and kerosene. LPG in 2007 was priced at about 60 per cent of the supply cost. Those subsidies have resulted in large distortions in the Indian energy market. At present, subsidised LPG is generally only available in large towns and cities, though distribution networks are gradually being extended to smaller towns and rural areas. The state-owned LPG wholesale suppliers have been forced to ration the supply of subsidised LPG to limit their financial losses with rising demand and international prices. The government covers less than half of the losses made by refiners and oil-product wholesalers through oil bonds. The total cost of LPG subsidies to the state oil companies and the government amounted to almost 70 billion Rupees (\$1.7 billion) in the first half of the 2007/08 financial year.

LPG subsidies mainly benefit higher-income households that generally give preference to LPG for cooking and water heating. An estimated 76 per cent of this subsidy is allocated in urban areas, which contain only one quarter of the population. Of this urban subsidy, over half is enjoyed by approximately one quarter of households. This means that almost 40 per cent of the LPG subsidy benefits a mere 7 per cent of the population. Moreover, the subsidy represents less than 5 per cent of expenditure for this segment of the population. This is a far lower share than what Indians living below the poverty line spend on kerosene. In spite of the ineffectiveness of the LPG subsidy in meeting the goal of alleviating poverty, the government recently extended the programme until 2010.

Subsidies that encourage the production and use of fossil fuels inevitably have some harmful consequences for the environment.

The *environmental effects* of energy subsidies are complex. They can be positive and negative, depending on the precise nature of the subsidy and energy source. Subsidies that result in a lower price to end-users normally increase the consumption of the respective fuels and, thus, inevitably have harmful impacts on the environment – including higher airborne emissions of noxious and greenhouse gases (Box 2). Higher fossil-fuel production can also damage the environment directly by polluting water supplies and spoiling the landscape. Subsidies for biofuels, used by several OECD countries, usually trigger more intensive farming. This results in greater use of fertilisers and pesticides, which can damage local eco-systems and increase both soil and water pollution.

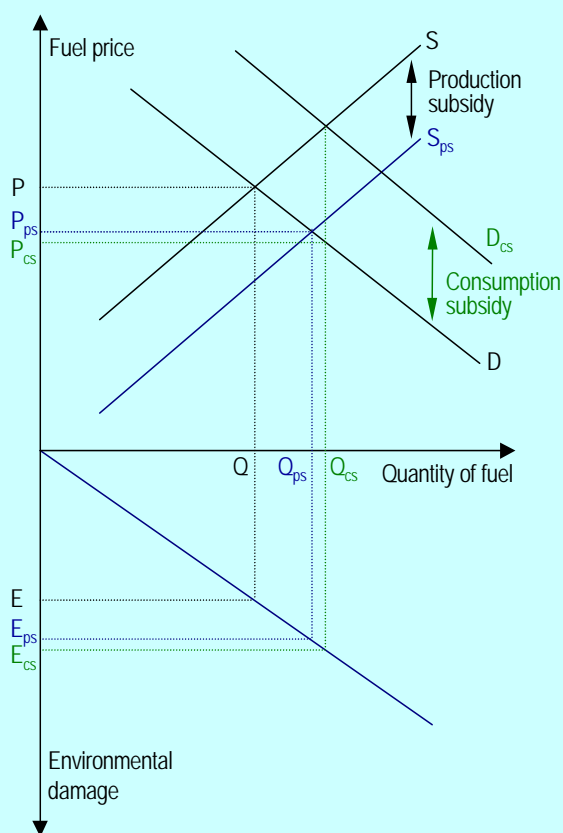
However, there may be instances in which subsidising modern energy use might bring some environmental benefits. For example, encouraging the use of oil products can curb deforestation in developing countries as poor rural and peri-urban households stop using firewood. This can in turn boost carbon sinks and potentially offset the emissions from fuel combustion. Additionally, subsidies for oil products and electricity in poor countries can reduce indoor pollution by encouraging inhabitants to switch away from traditional energies like wood, straw, crop residues and dung.

Subsidies to domestic fossil-fuel production do not systematically lead to higher consumption if they result in a switch from imported to domestically produced fuel on a one-for-one basis. This has been a strong argument to defend coal-production subsidies in Germany because they cover the difference between actual production costs and import prices. It is pointed out that they do not involve lower prices and, thus, higher consumption. Nonetheless, the financial and economic cost of keeping

inefficient mines open can be very high. The money saved by ending such subsidies would be better spent on measures to promote energy efficiency or renewables, which would lead to lower emissions in the long term.

The key to determining whether a subsidy is good or bad for mitigating climate change is whether the energy source it supports is more or less carbon-intensive than the alternative. Various empirical studies provide strong evidence that the large subsidies to fossil-fuel consumption worldwide in place today contribute to higher greenhouse-gas emissions and exacerbate climate change. A study by the OECD in 2000, for instance, showed that global CO₂ emissions would be reduced by more than 6 per cent and real income increased by 0.1 per cent by 2010 if all subsidies that lower the prices of fossil fuels used in industry and the power sector were removed everywhere in the world. An earlier study by the IEA revealed that the removal of consumption subsidies in eight of the largest non-OECD countries would reduce primary energy use by 13 per cent, lower CO₂ emissions by 16 per cent and raise GDP by almost 1 per cent in those countries as a whole. Because coal is the dirtiest fuel, removing coal subsidies generally yields the biggest environmental benefits.

Box 2: The Environmental Effects of Subsidies



The graph on the left demonstrates how production and consumption subsidies on fuel production can be bad for the environment, on the assumption that the supply and/or use of the fuel results in some air pollution or 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 leads to an increase in environmental damage 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 environmental damage to E_{cs} .

The precise impact of any production or consumption subsidy depends on the shapes of the demand, supply and environmental damage curves. The less sensitive supply and demand are to prices, 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.

Subsidies to support renewable energies and energy-efficient technologies may help reduce noxious and greenhouse-gas emissions depending on how they are structured as well as on prevailing 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 renewable energy replaces fossil fuels and the amount of fossil fuel-based energy consumed in building plants and equipment is not too high, then the net effect on emissions will generally be positive. However, some types of renewables may also have adverse environmental consequences, such as marring the aesthetic impact on the landscape and in the case of biofuels, for instance, encouraging over-use of chemical fertilizers. The long-term impact on emissions of public funding of energy-related research and development of renewables is highly variable and unpredictable, depending on whether it leads to commercially viable technology.

Most industrialised countries have introduced and increased subsidies to renewables or energy-efficient combustion technologies for environmental and energy-security reasons. They use support measures such as grants to produce biofuels or electricity based on renewable technologies and to buy energy-efficient combustion plant and equipment, preferential feed-in tariffs for renewables-based electricity (Box 3) and spending on research and development of clean energy technologies. However, the cost-effectiveness of subsidies to clean energy varies considerably.

Box 3: Feed-in Tariffs for Renewables-Based Electricity in Spain

A number of countries, including several members of the European Union, have introduced feed-in tariffs – specially designed preferential tariffs to cross-subsidise sales of electricity produced from renewable sources of energy. The premia for renewables-based power over and above market prices are set by the government. In non-liberalised power markets, the utility is obliged to purchase renewable power at these premium rates. The premia are paid by electricity consumers through a per-unit charge that is added to their electricity bill. This type of subsidy scheme has proven successful in stimulating the production of renewable energy, as it guarantees a higher return on investment and planning security for project developers.

In Spain, for example, feed-in tariffs were introduced in 1997. Tariffs vary according to the technology used and the capacity of the facility. Each year, the producer can choose between a fixed price and a premium added to the price negotiated in the electricity market. Prices are highest for solar photovoltaic electricity, which currently sells for 42 eurocents per kWh for facilities of less than 100 kW, compared with an average wholesale price in 2006 of around 6 eurocents. Feed-in tariffs have been the main driver of the rapid expansion of renewables-based electricity production in Spain, notably wind power. Installed wind-turbine capacity reached almost 12 000 MW in 2006, accounting for around 8 per cent of total electricity production. Solar power capacity has also grown rapidly, reaching close to 350 MW in late 2007. Today, Spain is the world's 4th largest producer of both wind and solar power. Nonetheless, the tariff scheme has been criticised for over-remunerating some low-cost producers and for failing to provide sufficient certainty over future prices.

Governments around the world are introducing or increasing subsidies to biofuels, on the grounds that they can help reduce greenhouse-gas emissions and dependence on imported oil. However, farm support is often a key driver. For most biofuel pathways, incentives were considered necessary to spur uptake. But with increasing oil prices, more options have become economically viable.

Whether and to what extent emissions of pollutant gases and CO₂ are being reduced by biofuels replacing fossil fuels, depends on crops and where they are grown, and the energy input for producing, transporting and converting the feedstock. Emissions will have to be assessed throughout the entire life-cycle, from feedstock production, conversion, transportation to end use.

UNEP and the IEA have reviewed existing life-cycle assessments for different pathways, which show huge variations. For example, a recent European Commission study shows that conventional ethanol production in Europe can result in net emission savings of over 30 per cent, considering the life-cycle emissions associated with growing feedstock and transforming it into biofuels. The net reduction through biodiesel derived from rapeseed is estimated at between 40 per cent and 60 per cent compared with conventional automotive diesel. Other studies suggest that the emission savings may be much lower, depending largely on impacts of land conversion, both directly and indirectly. The negative effect is largest if carbon rich areas, e.g. forests, grasslands and peatlands, are converted.

However, not only the GHG balance needs to be taken into account in deciding whether a subsidy to biofuels is justifiable on sustainability grounds, but also its impacts on water, soil, biodiversity and social aspects such as food security and implications for the livelihood of small farmers.

Subsidies for biofuels should only be considered in connection with a set of sustainability safeguards grounded in the concept of sustainable use of natural resources and resource efficiency. UNEP is engaged in the Roundtable on Sustainable Biofuels and is working with other UN agencies and the G8 Global Bioenergy Partnership towards such a set of acceptable and applicable sustainability standards.

Designing and Reforming Energy Subsidies

Access to modern forms of energy like electricity is one of several elements that underpin economic and social development and improved living conditions. However, protecting the environment and combating climate change requires that the production, supply and use of energy be as clean and efficient as possible. In many countries, the removal or reform of energy subsidies – especially those that encourage fossil-fuel consumption – in combination with more rational taxation structures and other policies could help steer their development onto a more sustainable path. In practice, however, the rigidity and inertia of many subsidy programmes, as well as institutional and political barriers, can make reform very difficult. There are, nevertheless, many examples of successful reforms, from which useful lessons can be drawn.

Any subsidy can be justified if the gain in social welfare or environmental improvement that it brings exceeds the net economic cost.

Grounds for Subsidising Energy

Left to their own devices, free markets in energy services do not always work effectively. In particular, they do not take account of any social and environmental benefits and costs that might be associated with certain types of energy activities. Consequently, there is a role for governments to intervene in energy markets in pursuit of social and environmental objectives, as long as the cost associated with the risk of policy failure is less than the gain to society of addressing the market failure.

Energy markets can malfunction in various ways. A market is said to fail when it does not put a price on the production or degradation of a public good, that is a good or service which is freely accessible by everyone but which carries no explicit charge. Clean air is a classic example of a public good. Governments have a responsibility to intervene to protect air quality by regulating emissions from energy-related and other activities, since individual polluters would otherwise not pay for the environmental damage they cause. Levying charges on polluting activities is one way to make the polluter pay for that damage. Examples of this so-called “polluter pays-principle” are carbon taxes and cap-and-trade systems, such as the EU Greenhouse Gas Emissions Trading Scheme. Subsidies on less or non-polluting activities can, in theory, achieve similar end-results. If taxes are the stick, then subsidies are the carrot.

Social considerations such as concern for the poor, infirm or otherwise disadvantaged may, in principle, provide other reasons for subsidising energy. Society as a whole benefits if everyone has access to modern energy services, but the market does not reflect that “social good”. Most governments consider that access to a reasonably priced minimum supply

of modern energy services is socially desirable. Subsidies are often used to that end, although they are not always successful in practice.

The existence of barriers to market entry might also justify subsidising energy. An example is the high up-front cost of developing cleaner energy technologies and the acute technical and financial risks associated with them, which might deter investors. Governments can help to compensate for these risks by subsidising a particular energy source or technology so as to encourage investment either in new capacity or in research and commercial development. The unit costs of production of capital-intensive, emerging renewable technologies tend to fall with the experience that comes from building and operating plants. The time needed to gain this experience may be too long for the market to bear without a degree of government support. The facts bear this out. Few energy technologies have reached maturity without substantial public-sector investment.

In practice, politicians usually justify either bringing in or keeping in place some kind of energy subsidy on one or more of the following grounds:

- To protect a particular domestic industry against international competition and to promote jobs.
- To stimulate regional or rural economic development in the interests of national and social cohesion.
- To reduce dependence on imports for energy-security reasons.
- To make modern energy services more affordable for specific social groups or rural communities as a way of raising incomes and living standards.
- To protect the environment.

Subsidy programmes are often meant to support several of these objectives simultaneously. Subsidies designed to protect jobs and support regional development, to reduce energy import dependence and, in some cases, to contribute to environmental protection, usually involve protection of domestic energy industries. For instance, subsidies to nuclear power in several countries in the early days of this industry were explained by the need to reduce dependence on imported energy. However, the knock-on benefits for local employment and the environment – as well as for the development of nuclear weapons – also played a part.

In practice, there may be a good case for retaining an element of subsidy to improve access to modern energy sources for the poor – especially where social welfare infrastructure for distributing income support to the poor does not exist. This argument is particularly strong for electricity because of its key role in economic and social development, in alleviating poverty and reducing indoor pollution. Therefore, subsidies are likely to remain a major part of pro-poor energy policies in developing countries for some time. The challenge is to make sure that they do not lead to excessive levels of energy consumption and environmental damage. The other main

justification for keeping or introducing certain types of subsidies is to promote the development and use of less environmentally harmful technologies and fuels, such as renewables. However, even in this case, the practicalities and costs need to be examined.

Reforming Harmful Energy Subsidies

Governments are questioning more and more the validity of certain types of energy subsidies as concerns grow about their environmental impacts, their effectiveness in meeting social goals and their economic and financial cost. The prevailing objective of a subsidy reform in most cases should, therefore, be to reduce the overall size of subsidies or remove them completely – especially where they harm the environment, bring few social benefits and carry large economic costs. Subsidy removal, in this case, would be a triple-win policy reform. Many fossil-fuel subsidies fall into this category. However, in most 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 overall net effect is positive. But assessing the implications of such a move is highly judgmental and political.

A good subsidy is one that enhances access to sustainable modern energy or has a positive impact on the environment, while sustaining incentives for efficient delivery and consumption.

The way in which governments subsidise fuels is all-important, regardless of their objectives. A good subsidy is arguably one that enhances access to sustainable modern energy or has a positive impact on the environment, while sustaining incentives for efficient delivery and consumption. There is no single right approach or model. Policymakers must take account of national and local circumstances, including their own set of policy objectives and priorities, the country's stage of economic development, market and economic conditions, the state of public finances and the institutional framework. But there are a number of basic principles that countries need to apply in designing subsidies and implementing reforms to existing programmes.

Experience shows that subsidy programmes should be:

- **Well-targeted** – subsidies should go only to those who are meant and deserve to receive them and should not conflict with other instruments and goals;
- **Efficient** – subsidies should not undermine incentives for suppliers or consumers to provide or use a service efficiently, minimizing market distortion;
- **Soundly based** – subsidy programmes should be justified by a thorough analysis of the associated costs and benefits;
- **Practical** – the overall amount of a subsidy should be affordable and the administration of the subsidy programme should be at reasonable cost;

- **Transparent** – information on the amount of government money spent on the subsidy and on subsidy recipients should be disclosed;
- **Limited in time** – sunset clauses should be included in the design of subsidy programmes to avoid consumers and producers becoming overly dependent on this support and costs spiralling out of control.

Targeting subsidies effectively so that their benefits are limited to a clearly defined group should be the first consideration in designing or reforming a subsidy programme. This group would normally be a certain type of producer or category of consumer, for instance, an investor in a wind turbine or poor households. In practice, though, subsidies often end up helping other categories of producers or consumers too, and result in significant economic distortions and costs. For example, higher income households may get to profit from special low rates for electricity supply – lifeline rates – even though the intention may be to relieve the financial burden on poor households. In Tanzania the lifeline rate was applied to consumption of up to 100 kWh per month until recently, which covered many well-off households. Better targeting could involve applying the subsidy only to households that subscribe to a very low capacity or to the first, small tranche of consumption.

Energy-subsidy programmes should always be designed in a way that does not undermine incentives for producers and suppliers to provide a service efficiently, nor for consumers to use energy efficiently. A key issue for producer subsidies is whether to subsidise capacity or output. The answer depends to some extent on the type of fuel or technology. For example, fixed, subsidised feed-in tariffs for solar photovoltaics and wind power have been effective in boosting capacity in several countries, including Denmark, Germany, Japan, Spain and Sweden. However, these subsidies do not always encourage producers to operate these systems, once they are installed, optimally. Consumer subsidies, on the other hand, should be large enough to encourage investment in supply infrastructure but not so large that they encourage waste.

Given the very real drawbacks with subsidies, it is essential that a decision to introduce or retain a subsidy be soundly based. In other words, the authorities should present a convincing case for the subsidy based on a thorough and coherent analysis of the associated economic, social and environmental costs and benefits. This has to be an on-going exercise. A subsidy may make sense today, but changing circumstances may mean that it does not longer make sense one or two years later. Carrying out this type of analysis requires reliable data and effective analytical capacity – conditions that are often lacking. Where this is the case, the public authorities and energy service providers need to carry out detailed market assessments and customer surveys. Where it is not possible to assess the full implications of a subsidy, it is best not to keep it.

Practical considerations may mean that a subsidy that makes sense in theory is, in fact, a bad idea. There are two main aspects to this. Firstly, the country may simply not be able to afford the subsidy if it involves large financial transfers from the national treasury. Secondly, it may not be feasible to administer the subsidy in a way that does not involve large administration costs including the resources required to monitor, prevent and deal with abuse. Subsidy programmes involving cash payments to producers or consumers are notoriously expensive to administer, since the authorities need to verify that each recipient is entitled to the money. Cheating can be commonplace. For example, subsidised household kerosene and LPG have been diverted to transport uses in several countries, including Turkey and India, depriving the poor of the fuel and causing safety problems.

Transparency in the way a subsidy programme works is essential. The financial costs and the channels through which financial transfers are made must be fully transparent, to prevent abuse and enable the authorities and the public to monitor whether the programme should be continued or not. On-budget costs should be properly accounted for and the results made available to the public.

It often makes sense to establish time limits or “sunset clauses” right from the outset. Once a technology or network is established and economic, the subsidy would normally no longer be required.

When introducing a subsidy, it often makes sense to establish time limits or “sunset clauses” right from the outset, for instance where the aim is to address a specific market-entry barrier. This sends a signal to producers and consumers to plan their decisions in the knowledge that the subsidy will not always be available. It may also prevent the financial cost of the programme spiralling out of control. Once a technology or a distribution network is established and commercially viable, the subsidy would normally no longer be needed and ought to be removed. The re-introduction of subsidies on coal in the United Kingdom in 2000, designed to give the mining industry a chance to further improve competitiveness at a time of low oil and gas prices, was accompanied by a commitment to remove them in 2002 – as indeed happened.

The removal or reduction of energy subsidies in the context of a move towards more sustainable development policies does not mean the abandonment of social policy goals. In general, they can be achieved more effectively through alternative mechanisms involving direct welfare payments or investment in social services, since the economic efficiency losses and environmental effects are less marked. It is usually better for a government to contribute directly to the cost of building or running a school or hospital than to subsidise the electricity or heating fuels needed to run them.

Dealing with Barriers to Reform

Even when there is general agreement that the cost of a particular subsidy outweighs its benefits, it can be very difficult to reform the subsidy in the face of hostility from those who benefit from it. By its very nature, the costs of an energy subsidy are spread throughout the economy, while most of its benefits are often enjoyed by only a small segment of the population

– not necessarily the targeted group. The beneficiaries will always have an interest in defending that subsidy when their gains exceed their share of the economic or environmental costs. The resistance to cutting subsidies can be very strong. Moves to ration heavily subsidised gasoline in Iran in 2007 led to serious civil unrest. Similarly, massive demonstrations and rioting over fuel-price increases brought down the Indonesian national government in 1998.

The majority of the population, who bear the net cost of the subsidy and lose in net terms, are typically 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. Furthermore, politicians might have problems to reveal the economic costs of a subsidy to the public in a comprehensible way. People who want to maintain a subsidy often find it much easier to provide concrete examples of their social benefits, for example in terms of jobs supported or financial savings to the poor. The problem is even bigger when the environmental costs of a subsidy are global, as with climate change.

These factors help explain why it is so difficult to remove existing subsidies and why new subsidies should be considered very cautiously. As a rule, any new subsidy therefore should only get the green light if the immediate net benefits are demonstratively large and likely to persist for a reasonable period of time after its introduction.

Reforming energy subsidies in practice requires strong political will to take tough decisions that benefit society as a whole. The following approaches can help policymakers to overcome resistance when implementing reforms:

- Reforms can be introduced in a gradual, programmed fashion to alleviate the financial pain of those who stand to lose out. Financial support for coal mining in France, for example, was finally ended with the closure of the country's last mine in 2004 under a closure programme originally agreed upon in 1986. Similarly, coal-mining subsidies in Germany are being phased out progressively (Box 4). Nonetheless, the gradual removal of subsidies carries some drawbacks: the benefits are delayed and the reforms run the risk of being reversed later.
- If reforming an energy subsidy reduces 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 – if that goal is considered socially desirable. This requires the existence of systems and structures for distributing welfare payments to the needy.
- Politicians need to communicate clearly to the public the overall benefits of subsidy reform to the economy and to society in order to counter political inertia and opposition. In many 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.

Lending institutions, aid providers and international organisations have an important role to play in assisting developing countries and emerging economies in designing and implementing subsidy reforms through the transfer of competence and technology and by imposing well-reasoned conditions for lending and development aid. Nonetheless, these organisations need to take account of social considerations in formulating their strategies for developing countries and transition economies even if the primary aim should be to eliminate costly and ineffective subsidies. The World Bank and the United Nations Development Programme, through their joint Energy Sector Management Assistance Programme, and the Global Environment Facility promote investment in modern energy infrastructure aimed at tackling poverty and boosting economic growth in an environmentally responsible manner.

Box 4: Ending Coal-Mining Subsidies in Germany

The German federal and state governments have subsidised the mining of hard coal for more than half a century. The cost of producing coal in Germany is far higher than the price of imported fuel. The difference – currently around €100 per tonne – is made up by a subsidy to Ruhrkohle AG (RAG), a diversified private industrial firm that operates the country's remaining eight mines. The cost of these subsidies peaked at €6.7 billion in 1996, even though production had been declining for many years. They fell to around €2.5 billion in 2007. RAG employs around 28 000 miners, down from 187 000 in 1980. Thus, each mining job is subsidised to the tune of about €90 000 per year.

In mid-2007, the federal government, the governments of the states with mines, the unions and RAG agreed on a detailed road map to end all subsidies by 2018. Under the deal, production will be gradually scaled back. Subsidies will continue to be paid jointly by the federal and state governments until 2014, after which time the federal government will pay all subsidies. At current coal prices, the total amount of subsidy to be paid out between 2008 and 2018 will exceed €20 billion, of which three-quarters will be funded by the federal government. No miner will be made redundant. Mining costs that remain after the closure of the pits will primarily be paid out of a fund which will be filled with the proceeds of a public sale of shares in RAG. Existing shareholders, including E.ON and RWE, are to transfer their shareholdings for a symbolic €1 to a foundation. If the fund falls short, the states of North Rhine-Westphalia, where most mines are located, and Saarland, a smaller mining area, will guarantee two-thirds of the costs, and the federal government one-third.

Reforming energy subsidies needs to be part of a broader process of economic and social reform.

Whatever approach adopted, energy-subsidy reform must always be integrated into a broader process of economic and social reform. Structural reform of the energy sector – a pressing need in many emerging economies – should involve placing more emphasis on the market, encouraging private (including foreign) investment and reorganising state enterprises. Subsidy reform must also go hand in hand with fiscal reform, aimed at establishing a more rational structure of energy taxes. In the long run, competition can help reduce energy supply costs and, therefore, prices, which would ultimately reduce the need for a subsidy. Education and

training, health and welfare policies rather than subsidies should be the primary vehicles for addressing social issues.

Subsidising Electrification Cost-Effectively

Despite the considerable progress that has been made over the past few decades in extending power networks, an estimated 1.6 billion people in the developing world still do not have access to electricity. This may be an underestimate since “access” often means simply that electricity is available in a village, not that all households within it are actually connected to the grid (indirect access). Most people who do not have electricity are located in rural areas and continue to use mainly traditional fuels for their basic energy needs.

Access to electricity services is essential to alleviate dire poverty and improve living standards. Certain energy services can only be provided effectively by electricity. It is the only practical means of running basic domestic appliances, such as telephones and refrigerators. And it provides the best quality and cheapest form of lighting. An electric light bulb gives off much more light and a more regular beam than a kerosene or LPG lamp. Good lighting allows people to extend the day, which, in turn, enables them to read or study longer, raising educational levels. Access to electricity also boosts economic productivity, by reducing manual labour. It also leads to better health, by replacing polluting indoor fuels, by improving hygiene with the use of refrigerators and by making it possible to provide modern health services. Electricity, for example, enables doctors and clinics to keep vaccines and medicines refrigerated, so that routine and emergency treatment can be offered locally.

The world’s energy poor certainly want access to electricity services. And, in many cases, the benefits may well exceed the long-run costs involved in providing those services. However, the energy-deprived are often unable to pay for the high up-front costs of connection, which are usually prohibitive compared with their low initial consumption levels. In other cases, the services are simply not made available to them because of their remoteness from the grid or because they lack access to off-grid technologies. If the initial investment cost is spread over a longer period, the resulting electricity tariffs may be too high for poor rural households to afford. Usage levels and revenue streams would, therefore, be too low to make that investment profitable for electricity service providers. In this case, a degree of government subsidy could in principle be justified.

Badly designed programmes can lead to waste and inefficiencies, which can actually impair the ability of electricity companies to extend service.

The case for subsidising electrification for the poor, especially in developing countries, is widely accepted. However, the way the public authorities go about subsidising electrification is crucial in determining how successful these policies turn out to be. Badly designed programmes can lead to waste and inefficiencies, which can deprive electricity utilities of funds and, therefore, impair their ability to extend and improve services. Where this happens, the poor who are supposed to benefit from the subsidies can actually end up worse off.

The goal must be to ensure that electricity subsidies achieve the objective of promoting direct access to electricity for the poor in a cost-effective manner while ensuring the financial viability of the electricity-supply industry. In formulating or reforming an electrification-subsidy programme, the key questions that need to be addressed are:

- *Who?* Normally, subsidies ought to be limited to households and farmers that are not already connected to the distribution network. Subsidies to the poorest existing customers may also be justified if their consumption is very small because of high prices and low incomes.
- *What?* For customers without service, it may be reasonable to subsidise the initial cost of access to the service. For example, grants could be made available to cover part or all of the capital cost of connection, paid for out of the central or local government budget. This is how Chile has successfully encouraged rural electrification (Box 5). The electricity supplier could also roll part of the cost of connection into monthly charges. For both new and existing customers, it may be necessary to subsidise the actual supply of electricity through lifeline rates for poor households.

Box 5: Case Study of Subsidisation of Rural Electrification in Chile

Chile has been highly successful in expanding electricity supplies to remote rural areas through a combination of market liberalisation and well-targeted subsidies. In the early 1990s, more than 1 million people – almost half the rural population – still had no access to any source of electricity. A rural electrification programme launched in 1994 managed to increase rural electricity coverage to 92 per cent by the end of 2006, ahead of target and at a lower cost than originally estimated.

The approach adopted by the government was to turn rural electrification into an attractive business opportunity. Subsidies and the cost of running the programme are delivered through a special central government fund. One-off subsidies are allocated to private electricity companies in a competitive bidding process to cover part of their investment costs in new electrification projects. The companies present their projects to the regional governments, which allocate funds to those projects that score best on various objective criteria, including cost-benefit analysis, the share of the investment to be covered by the company and the social impact. Only projects that show a positive social rate of return but a negative private financial return are eligible for subsidies. Subsidies can cover up to 70 per cent of the investment cost. The central government allocates the subsidies to the regions according to the rate of progress in the previous year and the number of households that still lack electricity. Tariffs for end users must normally cover all operating costs, though the government introduced a scheme in 2005 to temper the rise in final tariffs caused by rising fuel costs.

- *How?* Demand-side subsidies such as those aimed at reducing connection costs often work better than producer subsidies in ensuring that subsidies go to targeted customer groups and in providing incentives for efficient service delivery. However, the management of demand-side subsidy programmes, such as the distribution of connection grants, can be expensive. In some cases,

it may be more practical to provide direct incentives to electricity companies to expand their services to targeted customer groups. Generally, subsidies on providing the service on an ongoing basis should be kept to a minimum to deter consumers from wasting electricity or using it inefficiently.

- *How much?* In principle, subsidies should be large enough to provide an incentive to distributors to extend service to poor households that would otherwise not receive it. How large exactly they need to be will depend on local market conditions. Lifeline-rates, if used, should always be limited to modest levels of consumption – less than 50 kWh per month in most cases. And they should be applied only to small consumers defined by their capacity or their average consumption level, so that poor households get most or all of the benefit. This way, larger consumers would be obliged to pay the full cost-tariff for the whole of their electricity consumption, denying them any access to subsidised electricity (unless they cheat by signing up for more than one subscription at the same address). If the rate is applied to the first tranche of consumption regardless of capacity with full cost-based rates applied to higher levels of consumption, richer households benefit to the same extent in absolute terms as poor households.

India provides an illustration of how subsidisation can stand in the way of rural electrification. According to official data, less than half of the rural Indian population has access to electricity. Current electricity tariffs recover only 85 per cent of the full costs of supplying customers on average throughout the country. Households pay only about half the cost and farmers 10 per cent. Above-cost prices for industrial and commercial customers are insufficient to offset these subsidies. In addition, many farmers do not pay at all while continuing to receive service thanks to lobbying of local politicians. The subsidy on sales to farmers alone amount to about \$6 billion a year – equal to twice the central government's spending on health or rural development. Inadequate metering and billing systems and outright theft add to these problems. As a result, the state electricity boards make big financial losses. The under-recovery of costs reached a massive 280 billion rupees (\$6.9 billion) in 2005. These losses prevent the government from meeting its targets for connecting new villages and rural households.

Key Messages

Energy subsidies come in different forms and guises. Their effects on the economy, society and the environment are wide-ranging and complex. However, it is becoming increasingly apparent that many types of energy subsidies today run counter to the goal of sustainable development:

- Subsidies often lead to increased levels of consumption and waste, exacerbating the harmful effects of energy use on the environment.
- They can place a heavy burden on government finances, weakening the potential for economies to grow and reducing the potential to invest in social equity.
- They can undermine private and public investment in the energy sector, which can impede the expansion of distribution networks and the development of more environmentally benign energy technologies such as decentralised renewable energy technologies.
- They do not always end up helping the people who need them most.

Eliminating environmentally harmful subsidies must play a central role in national efforts to achieve a long-term transition to a truly sustainable and secure energy system. Many countries have already taken great strides in abolishing the most ineffective and costly subsidies or adapting them to changing market conditions and policy goals. Nonetheless, much more needs to be done, including in developing countries where subsidies are generally bigger and their harmful effects – on economic growth, the environment and social welfare – greater.

An increased focus on the issue of energy subsidies by the international community is of utmost importance in accelerating the reform process. Action is urgently needed in three main areas: (1) Reporting and compiling consistent data on energy subsidies as well as analysing their effects (transparency and accountability); (2) enhancing mechanisms of communication with policymakers to show them the need for and benefits of reforming subsidies as well as to assist them in implementing policy reforms at the national level; and (3) capacity building for government officials and other stakeholders from both developed and developing countries, and assistance in reforming subsidies. UNEP, in partnership with other international organisations, can play an active role in carrying forward work in these areas.

About the UNEP Division of Technology, Industry and Economics

The UNEP Division of Technology, Industry and Economics (DTIE) helps governments, local authorities and decision-makers in business and industry to develop and implement policies and practices focusing on sustainable development.

The Division works to promote

- sustainable consumption and production,
- the efficient use of renewable energy,
- adequate management of chemicals,
- the integration of environmental costs in development policies.

The Office of the Director, located in Paris, coordinates activities through:

- **The International Environmental Technology Centre - IETC** (Osaka, Shiga), which implements integrated waste, water and disaster management programmes, focusing in particular on Asia.
- **Production and Consumption** (Paris), which promotes sustainable consumption and production patterns as a contribution to human development through global markets.
- **Chemicals** (Geneva), which catalyzes global actions to bring about the sound management of chemicals and the improvement of chemical safety worldwide.
- **Energy** (Paris), which fosters energy and transport policies for sustainable development and encourages investment in renewable energy and energy efficiency.
- **OzonAction** (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition to ensure implementation of the Montreal Protocol.
- **Economics and Trade** (Geneva), which helps countries to integrate environmental considerations into economic and trade policies, and works with the finance sector to incorporate sustainable development policies.

UNEP DTIE activities focus on raising awareness, improving the transfer of knowledge and information, fostering technological cooperation and partnerships, and implementing international conventions and agreements.

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