INTERNATIONAL ENERGY AGENCY
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ENERGY EFFICIENCY INDICATORS FOR PUBLIC ELECTRICITY PRODUCTION FROM FOSSIL FUELS

IEA Information paper

In Support of the G8 Plan of Action

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International Energy Agency

INTERNATIONAL ENERGY AGENCY

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- To maintain and improve systems for coping with oil supply disruptions.
- To promote rational energy policies in a global context through co-operative relations with non-member countries, industry and international organisations.
- To operate a permanent information system on the international oil market.
- To improve the world's energy supply and demand structure by developing alternative energy sources and increasing the efficiency of energy use.
- To promote international collaboration on energy technology.
- To assist in the integration of environmental and energy policies.

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The OECD is a unique forum where the governments of thirty democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Republic of Korea, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom and United States.
The European Commission takes part in the work of the OECD.

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Foreword

At their 2005 summit in Gleneagles, leaders of the G8 asked the International Energy Agency (IEA) for advice on how to achieve a clean, clever and competitive energy future. Improved energy efficiency is often the most economic and readily available means of improving energy security and reducing greenhouse gas emissions. To support better energy efficiency policy-making and evaluation, the IEA is therefore developing in-depth indicators of energy use, efficiency trends and CO_2 emissions.

As part of this work, the IEA published in May 2008 *Worldwide Trends in Energy Use and Efficiency: Key Insights from IEA Indicator Analysis*. For the first time the report included indicators examining the efficiency of electricity generation from fossil fuels. This Information Paper expands on the key results for the electricity generation sector. The additional analysis includes efficiency indicators for electricity production from the individual fossil fuels, as well as an analysis of the sensitivity of the results to some of the key assumptions.

The report was prepared by the Office of Energy Technology and R&D in co-operation with the Energy Statistics Division. Peter Taylor is the co-ordinator of the IEA indicators work and had overall responsibility for the report, with input from Olivier Lavagne d'Ortigue, Nathalie Trudeau and Michel Francoeur. Many other IEA colleagues provided helpful comments. Particular thanks go to IEA Communication and Information Office for their work in producing this publication.

This paper was prepared in support of the G8 Plan of Action in 2008. It was drafted by the Energy Technology Policy Division in collaboration with the Energy Statistics Division. This paper reflects the views of the IEA Secretariat and may or may not reflect the views of the individual IEA Member countries. For further information on this document, please contact the Energy Technology Policy Division at energyindicators@iea.org.

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Summary

- Electricity production is responsible for 32% of total global fossil fuel use, accounting for 132 EJ, and 41%, or 10.9 Gt of energy-related CO_2 emissions. Improving the efficiency of electricity production therefore offers economic benefits and a significant opportunity for reducing dependence on fossil fuels, which helps to combat climate change and improve energy security.

- A set of indicators has been developed to analyse the energy efficiency of electricity production from fossil fuels on a global level and for a number of key countries and regions. These indicators show the efficiency of electricity production from coal, natural gas and oil separately and from all fossil fuels together. The technical potentials for energy and CO_2 savings from improving the energy efficiency of electricity production are also calculated.

- The global average efficiencies of electricity production are 34% for coal, 40% for natural gas and 37% for oil. For all fossil fuels, the global average efficiency is 36%. Wide variations are seen in efficiencies amongst countries, with OECD countries typically having the highest efficiencies. The level of efficiency has been slowly improving in recent years in most countries.

- However, significant fuel and CO_2 saving potentials still exist. Across all fossil fuels the technical fuel savings potential is between 21 EJ and 29 EJ per year, with an associated CO_2 reduction potential of 1.8 Gt CO_2 to 2.5 Gt CO_2 per year. The largest savings are from improving the efficiency of coal-fired plants, which alone could provide savings of between 15 EJ and 21 EJ (1.4 Gt CO_2 to 2.0 Gt CO_2). On a regional basis, just less than half the global savings would come from OECD countries, with the remainder from developing countries.

Introduction

Electricity production accounts for 32% of total global fossil fuel use and around 41% of total energy-related CO_2 emissions. Improving the efficiency with which electricity is produced is therefore one of the most important ways of reducing the world's dependence on fossil fuels, thus helping both to combat climate change and improve energy security. Additional fuel efficiency gains can be made by linking electricity generation to heating and cooling demands through high efficiency combined heat and power (CHP) systems (*e.g.* in industry and for district heating).[1]

This paper presents a set of indicators that are used to analyse the energy efficiency of electricity production from fossil fuels on a global level and for a number of key countries and regions. The analysis is based on IEA statistics and includes public electricity plants and public CHP plants. Electricity production by autoproducers is not included and represents less than 6% of global electricity production. However, the share of autoproducers is significant in certain countries, particularly in Europe. Austria, Finland, Luxembourg, the Netherlands and Spain all have a share of electricity production from autoproducers that is more than twice the global average.

[1] The potential for carbon savings from increased use of combined heat and power in industry is analysed in IEA, 2007b, and is calculated to be between 110 Mt CO_2 and 170 Mt CO_2 per year.

Country specific indicators are calculated for all OECD countries[2] plus Brazil, China, India, Russia and South Africa. Information is also presented for two country groupings, OECD countries and non-OECD countries, and for the world.

The analysis compares the trends and levels of fossil-fuelled electricity production by developing indicators showing the efficiencies for coal, natural gas and oil separately and then aggregating the results to provide an indicator for all fossil fuels. Finally, a calculation is made of the technical potential for energy and CO_2 savings from improving the energy efficiency of electricity production.

Methodology

Data on fuel inputs to public electricity and CHP plants and electricity and heat outputs from these plants are taken from IEA statistics. In the case of OECD countries the data are from *Electricity Information 2007* (IEA, 2007c), and for other countries they come from *Energy Balances of Non-OECD Countries* (IEA, 2007d). The IEA statistics provide a consistent set of data for all countries in which:

- Energy inputs for both electricity plants and CHP plants are based on net calorific values; and

- Energy outputs are defined as the gross production of electricity and heat. In the case of electricity, this is defined as all the electricity produced including the auxiliary electricity consumption and losses in transformers at the power station.

The methodology used to calculate the energy efficiency of electricity production is based on Graus et al, 2007 and Phylipsen et al, 1998. The energy efficiency (E) of electricity production is defined as:

$$E = (P + H \times s)/I$$

Where:

P = electricity production from public electricity plants and public CHP plants;
H = useful heat output from public CHP plants;
s = correction factor between heat and electricity, defined as the reduction in electricity production per unit of heat extracted;
I = fuel input for public electricity plants and public CHP plants.

In CHP plants the combined production of heat and electricity is more efficient in terms of the use of primary energy compared to separate production of heat and electricity. However, heat extraction causes the energy efficiency of electricity production to decrease. The loss of efficiency depends on the temperature of the heat extracted. To account for this, a correction for heat extraction is applied. As public CHP is mainly used to provide district heating the appropriate substitution factor lies somewhere between 0.15 and 0.2 (Phylipsen, 1998). In this analysis a value of 0.175 is used, with the sensitivity of the results to higher and lower values also examined in Annex A. It should be noted that when heat is delivered at higher temperatures (e.g. to industrial processes), the substitution factor can be significantly higher. However, the amount of high-temperature heat delivered to industry by public utilities is small in most countries.

[2] OECD countries are Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, the Republic of Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

To counter the effects of unusual circumstances in a particular year leading to higher or lower than average efficiencies for electricity production in a particular country, the fuel-specific efficiencies presented for each country or region are the simple average of efficiencies over the five years from 2001 to 2005.[3] The average efficiencies of all fossil-fuelled electricity production for the 2001 to 2005 period are the weighted average of the annual fuel-specific efficiencies.

Fossil-Fuelled Electricity Production and Fuel Mix

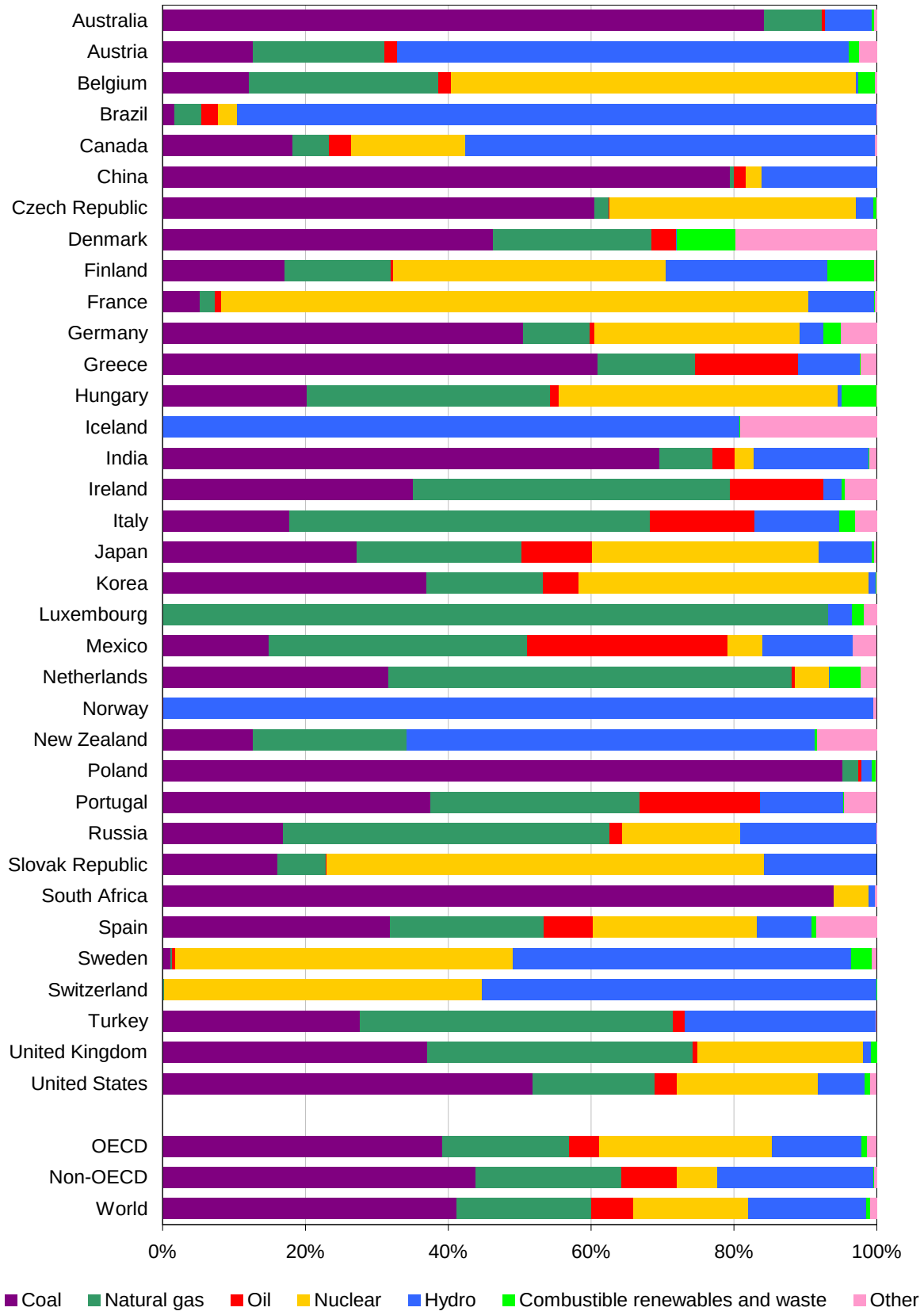
The share of electricity production from fossil fuels (coal, natural gas and oil) in 2005 varies considerably amongst the countries analysed (Figure 1), as do the absolute levels of electricity production (Figure 2). On average, the share of electricity production from fossil fuels in OECD countries is around 61%. In contrast, non-OECD countries have a higher share, 72% on average. A number of individual countries also have significantly higher shares of fossil-fuelled electricity production than these average figures *e.g.* Poland (98%), South Africa (94%), Luxembourg (93%), Australia (93%), Ireland (93%), Greece (89%), the Netherlands (89%), Portugal (84%), Italy (83%), China (82%) and India (80%).

In absolute terms, the United States and China have the highest production of electricity from fossil fuels and account for 44% of world production. A further five countries, Russia, Japan, India, Germany and the United Kingdom, account for another 20% of fossil-fuelled electricity production.

Globally most fossil-fuelled electricity production is from coal (63%), followed by natural gas (29%) and oil (9%).

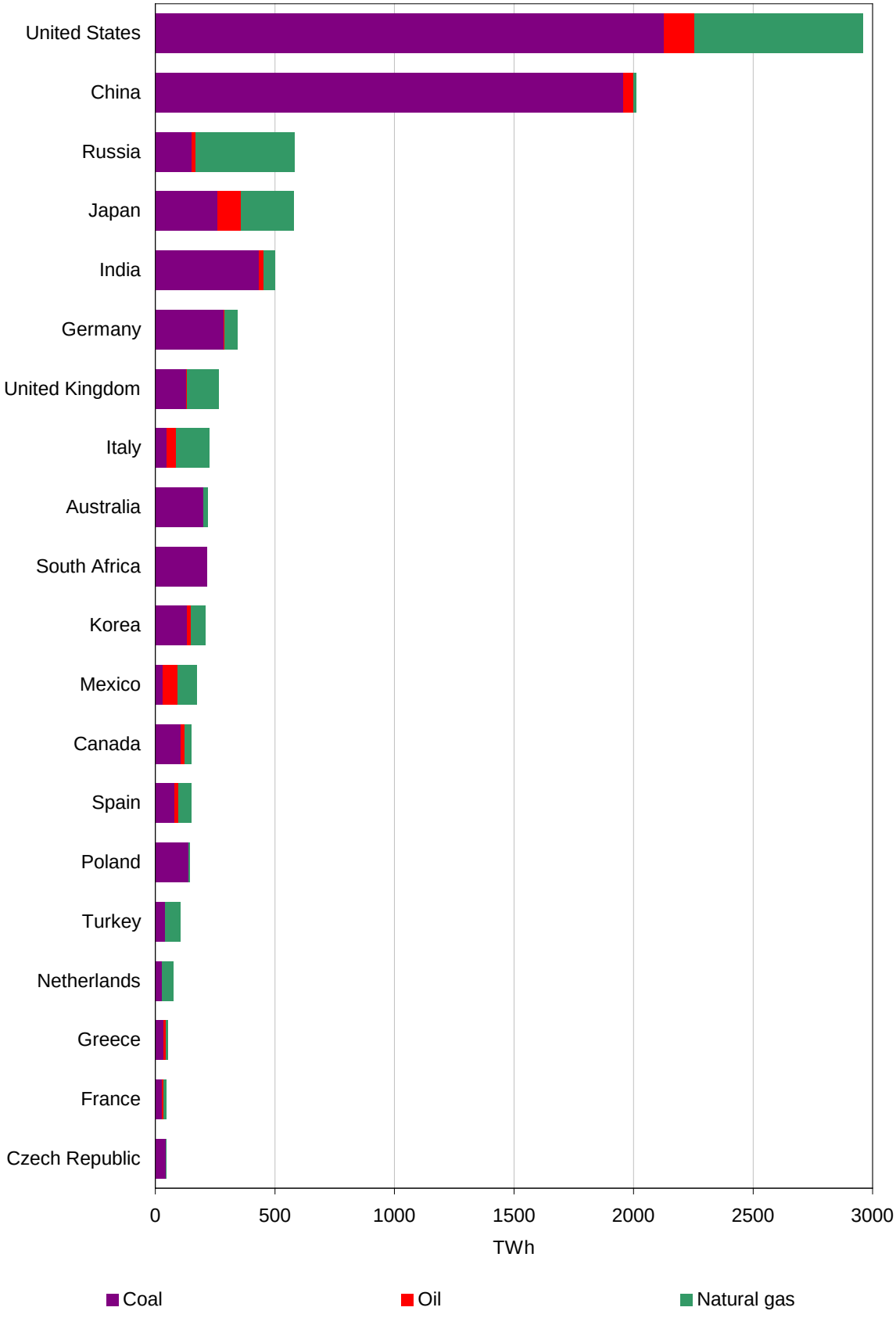
[3] These country average efficiencies are for electricity production from both electricity only and CHP plants.

Figure 1 Share of Electricity Production by Fuel Type in Public Electricity Plants and CHP Plants, 2005



Sources: IEA, 2007c, IEA, 2007d.
Note: Other includes geothermal, solar, tide and wind.

Figure 2 Electricity Production by Fossil Fuels in Public Electricity and CHP Plants, 2005



Sources: IEA, 2007c, IEA, 2007d.

Efficiency of Coal-Fired Electricity Production

Coal is the main fossil fuel used for electricity production. The share of coal-fired electricity production in total electricity production in OECD countries was 39% in 2005, down from 42% in 1990. The share of coal in non-OECD countries was higher, at 44%.

In absolute terms, coal-fired electricity production was highest in the United States (2 129 TWh) and China (1 957 TWh). These two countries accounted for 58% of global coal-based electricity production. Other countries with significant coal-fired electricity production include India, Germany, Japan, South Africa, Australia, Russia, Poland, the Republic of Korea, the United Kingdom and Canada.

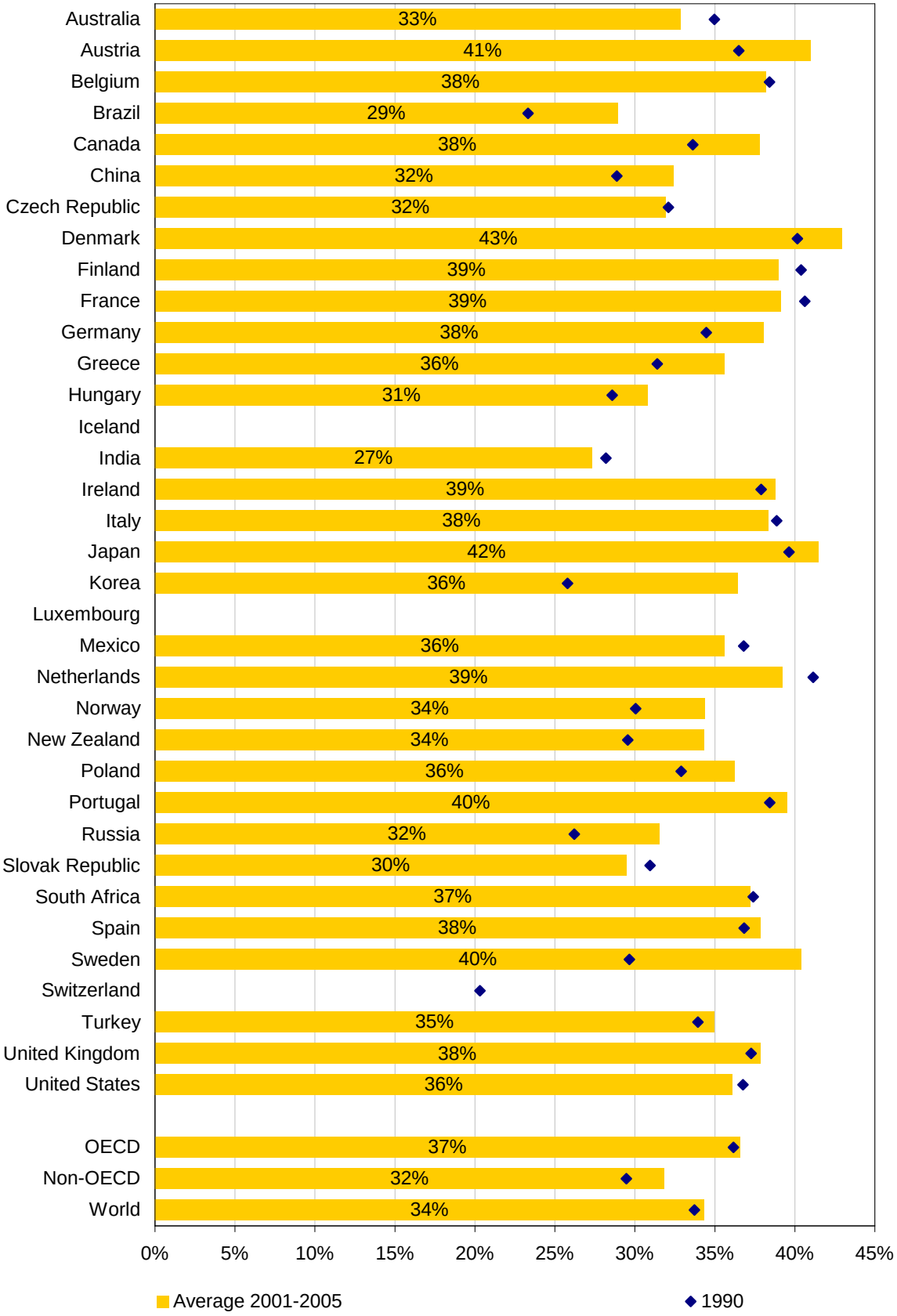
In most countries, the vast majority of coal-fired electricity production is in electricity-only plants. However, in Russia, Denmark, Norway, Poland and Sweden all electricity production from coal is reported in IEA statistics as coming from combined heat and power plants. The Slovak Republic and Finland also have more than half of coal-fired electricity generation from CHP plants.

The average efficiency of electricity production from coal in both public electricity-only and public CHP plants is 37% in the OECD (averaged over the 2001 to 2005 period).[4] This is significantly higher than the average efficiency of 32% in non-OECD countries. Average efficiencies of coal plant in individual countries range from 27% in India to 43% in Denmark (Figure 3). Amongst OECD countries the spread of efficiencies is more limited, from 36% in the United States to 43% in Denmark. Since 1990, the average efficiencies of coal-fired plants have risen in most countries, with increases of about half a percentage point in OECD countries and of two percentage points in non-OECD countries.

The efficiencies of coal-fired plants depend on a range of factors including the technology employed, the type and quality of coal used and the operating conditions and practices. The low average efficiencies in India are at least partly explained by the widespread use of subcritical plants burning unwashed coal with high ash content, as well as the use of coal-fired plants for peak load electricity production. In contrast, Denmark has some of the most efficient coal-fired power plants in the world, including a new generation of pulverised coal supercritical plants that were introduced in the 1990s (IEA, 2007a).

[4] Efficiencies in this paper are presented on a gross output basis using net calorific values. On a net output basis using gross calorific values, the global average coal-fired power plant efficiency was around 28% in 2004.

Figure 3 Efficiency of Electricity Production from Coal in Public Electricity and CHP Plants



Source: IEA analysis.
Note: According to IEA statistics, some countries do not have any public electricity generation from coal-fired plants.

Efficiency of Natural Gas-Fired Electricity Production

The share of natural gas-fired electricity production has increased rapidly in recent years in many countries and by 2005 represented 19% of global electricity production, up from a share of 14% in 1990. In OECD countries, the increase has been more rapid, from a share of 9% in 1990 to 18% in 2005. In contrast, the share of natural gas in non-OECD countries has fallen slightly over the same period from 22% in 1990 to 20% in 2005.

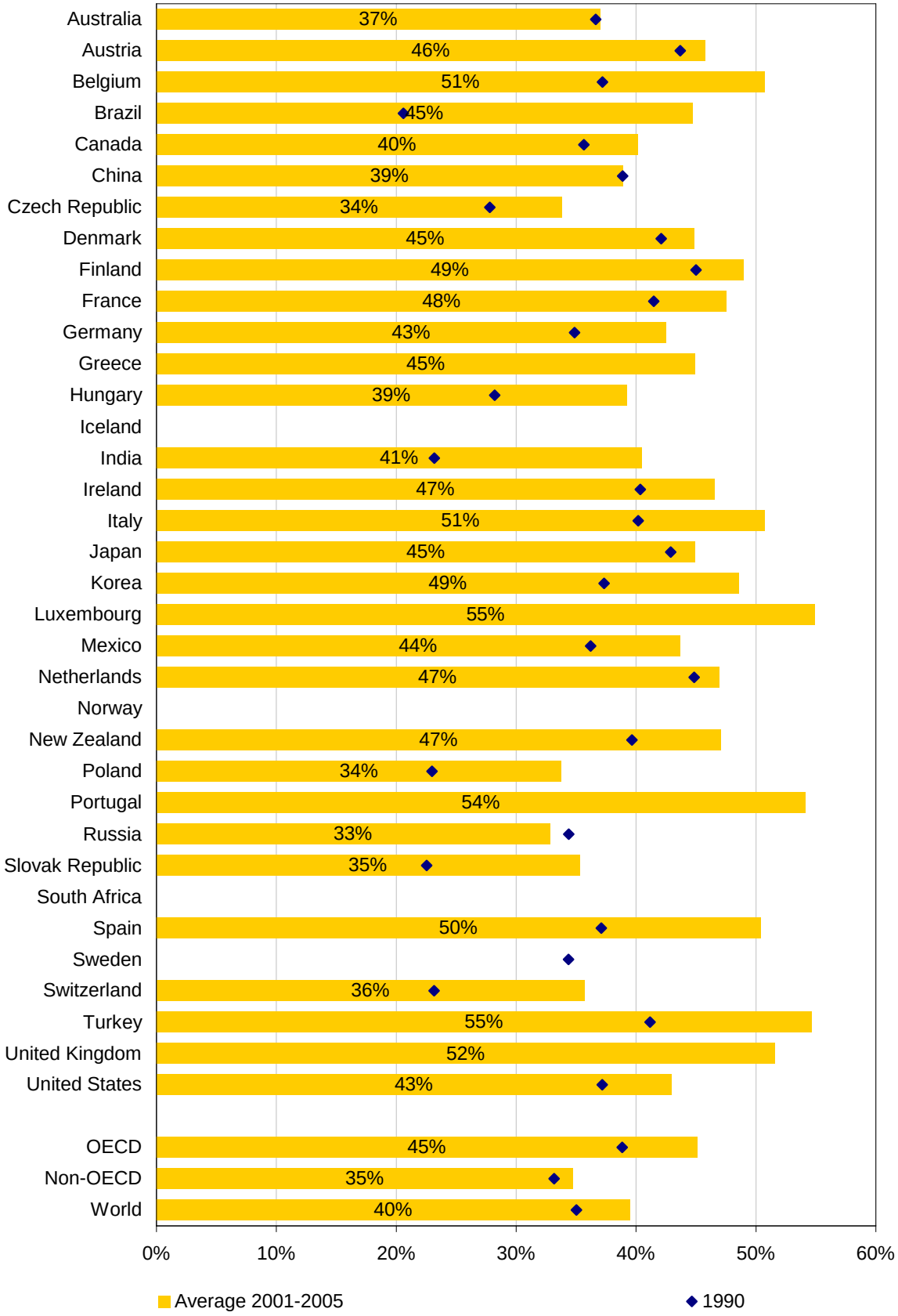
The United States and Russia have the highest absolute levels of natural gas-fired electricity production, accounting for 35% of global natural gas-fired production. Other countries with significant electricity production from natural gas include Japan, Italy and the United Kingdom.

The majority of natural gas-fired electricity production is from electricity-only plant (74% of the total). However, the share of natural gas based electricity production from CHP plants is important in some countries. For instance, in Denmark, Poland, the Slovak Republic, Sweden, Switzerland and Russia, IEA statistics record all natural gas-fired electricity production as coming from CHP plants. Higher than average shares for CHP plants are also found in France, Finland, the Czech Republic, the Netherlands, Hungary, Germany, Austria, Canada and Italy.

The average efficiency of natural gas-fired electricity production (over the period 2001 to 2005) in both public electricity-only and public CHP plants is 45% in the OECD and around 35% in non-OECD countries. Average efficiencies of natural gas plants in individual countries range from 31% in Sweden (which produces very little electricity from natural gas) to 55% in Luxembourg (Figure 4). Since 1990, the average efficiencies of natural gas-fired plants have risen significantly in many countries. As a result, the average efficiency in OECD countries has increased by almost eight percentage points, while non-OECD countries have seen a two percentage points rise.

The widespread introduction of successively more efficient combined-cycle gas turbine (CCGT) plants in OECD countries has been the main driver behind the increase in both the use of natural gas for electricity production and the average generation efficiency. The latest CCGTs can have efficiencies of about 60%. New, high efficiency, CCGT plants are also the reason behind the substantial increase in efficiency for Brazil and India (24 and 17 percentage points respectively).

Figure 4 Efficiency of Electricity Production from Natural Gas in Public Electricity and CHP Plants



Source: IEA analysis.
Note: According to IEA statistics, some countries do not have any public electricity generation from natural gas-fired plants.

Efficiency of Oil-Fired Electricity Production

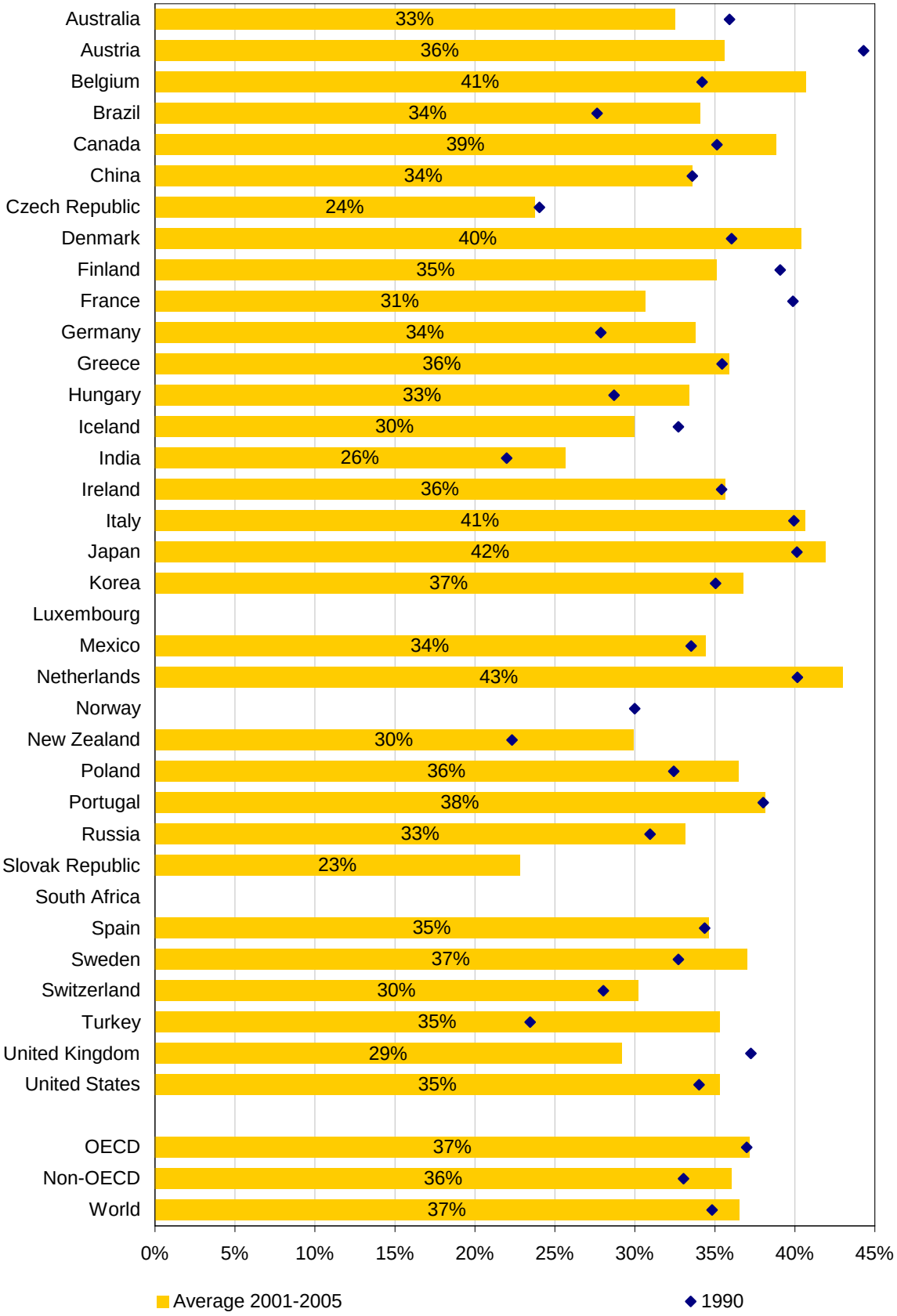
The share of electricity production from oil has fallen sharply since 1990 in many countries. On average, oil-fired electricity production in 2005 accounted for 4% of total electricity production in the OECD, down from 9% in 1990. A similar fall was seen in non-OECD countries, where the share of oil in 2005 was 8%.

The highest absolute levels of electricity production from oil are in the United States, Japan, Mexico, China and Italy. These five countries now account for more than 36% of global oil-fired electricity production.

The overwhelming majority of oil-fired electricity production is in electricity-only plants (91% of the total). However, for the Netherlands, Poland and Russia all electricity production from oil is recorded in IEA statistics as being from CHP plants. CHP plants also have a high share of total oil-fired electricity production in Austria, the Czech Republic, Denmark, Finland and Sweden.

The average efficiency of oil-fired electricity production in OECD countries is 37% (over the 2001 to 2005 period). In non-OECD countries the average efficiency is similar at 36%. The efficiencies in individual countries range from 23% in the Slovak Republic to 43% in the Netherlands (Figure 5). Since 1990, average efficiencies for oil-fired electricity production have increased slightly in most regions.

Figure 5 Efficiency of Electricity Production from Oil in Public Electricity and CHP Plants



Source: IEA analysis.
Note: According to IEA statistics, some countries do not have any public electricity generation from oil-fired plants.

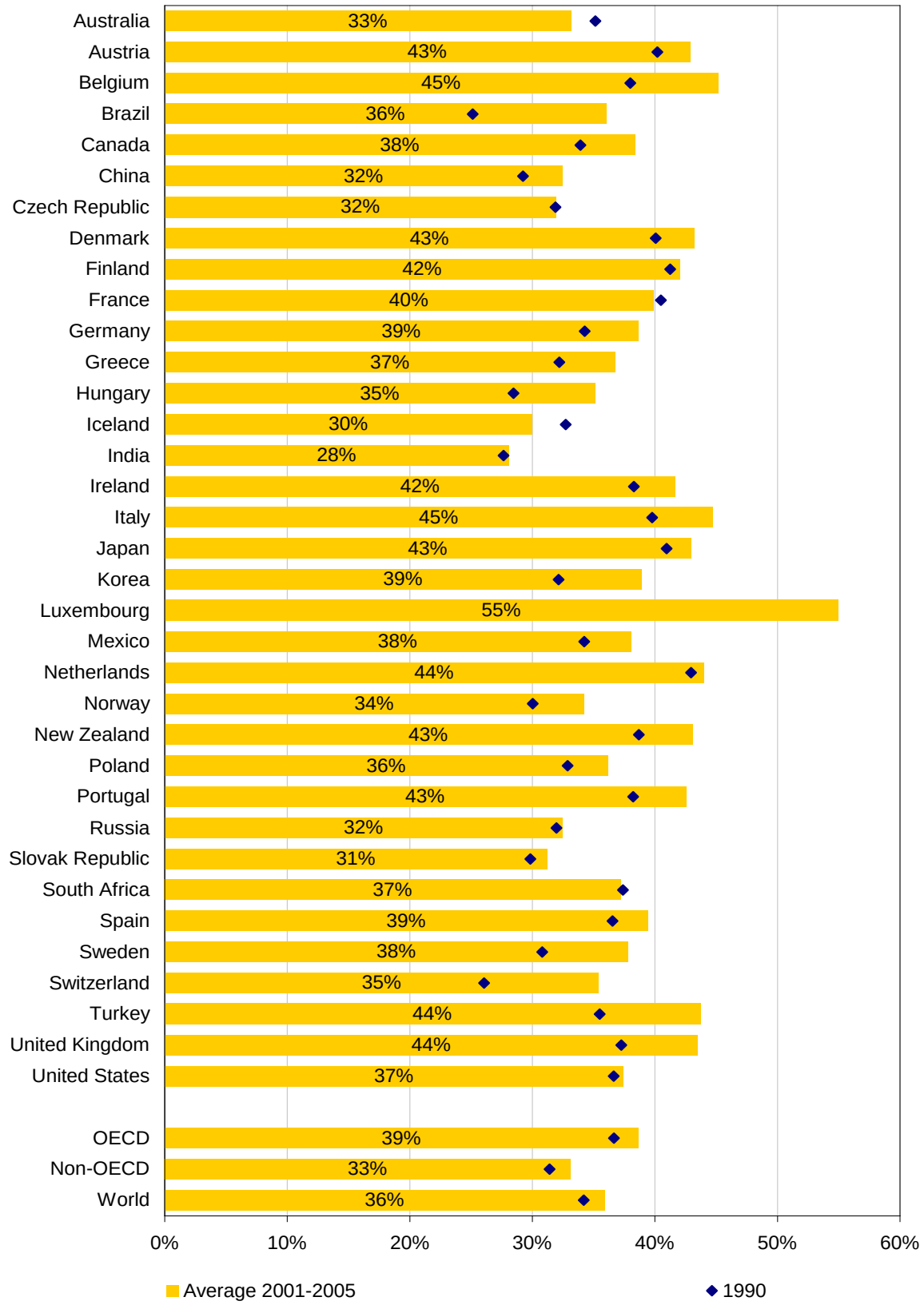
Efficiency of Fossil Fuel-Fired Electricity Production

The efficiencies calculated for coal, natural gas and oil can be combined to give weighted average efficiencies for all fossil fuels for the period 2001 to 2005. The average efficiencies of all fossil-fired electricity production are 39% for OECD countries and 33% for non-OECD countries. Average efficiencies in individual countries range from 28% in India to 55% in Luxembourg (Figure 6).

Since 1990, the average efficiency of fossil fuel-fired electricity production has increased by almost two percentage points in both OECD and non-OECD countries.

The overall efficiency of fossil fuel-fired electricity production is strongly influenced by the mix of fuels used. Countries with a large share of natural gas generally have much higher average efficiencies than countries that mainly rely on coal and oil. Similarly, for many countries an increasing share of natural gas in the electricity production mix has been the main factor driving up efficiencies over time. One exception to this is Russia, where the efficiency of gas-fired electricity production, at 33%, is low compared to the world average. Thus the overall efficiency of Russia's fossil-fuelled electricity production (71% of which is gas) is very similar to that of China (of which 97% is from coal). In both countries there are significant potentials for improving the efficiency of electricity production.

Figure 6 Efficiency of Electricity Production from all Fossil Fuels in Public Electricity and CHP Plants



Source: IEA analysis.
Note: According to IEA statistics Luxembourg does not have any public electricity generation from fossil fuelled-fired plants in 1990.

Energy Savings Potential from Improving Efficiency

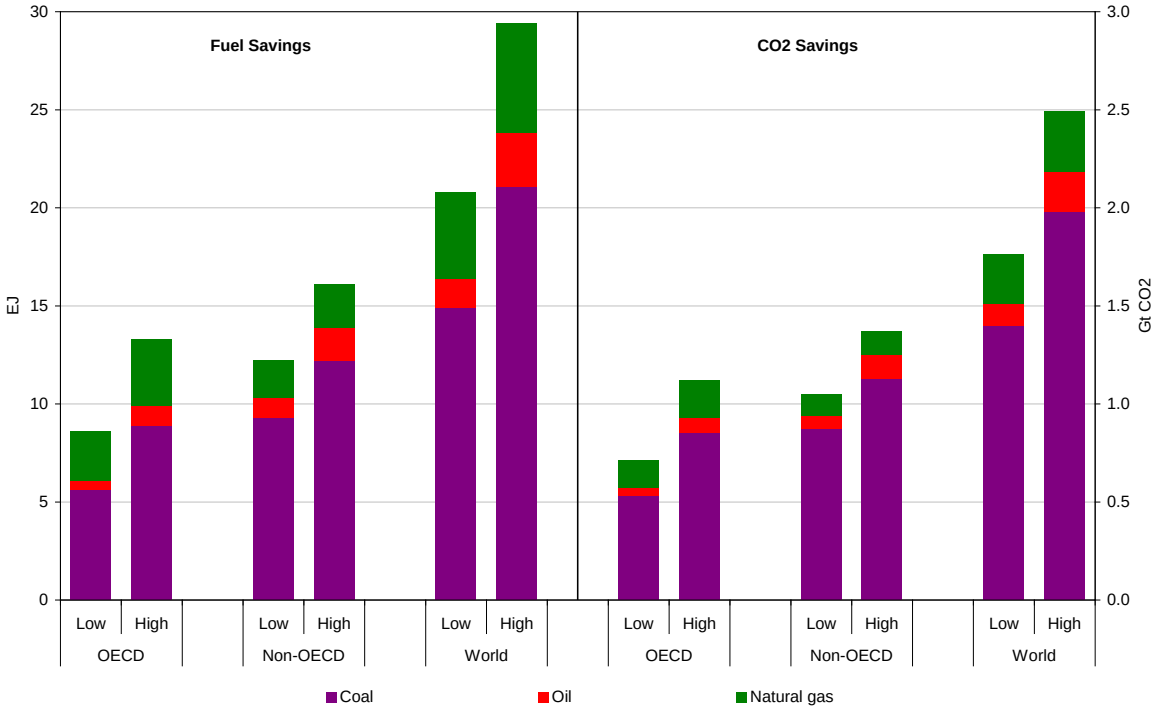
Substantial energy and CO_2 savings potential are available from improving the energy efficiency of fossil fuel-fired electricity production.[5] The savings potentials[6] are calculated for both a "Low" and a "High" savings case, as follows:

- the Low savings case assumes that all countries produce electricity at the highest efficiencies currently observed for the countries studied (43% for coal and oil and 55% for natural gas); and

- the High savings case is calculated on the basis that all countries produce electricity at efficiencies that represent best practice for new power plants (48% for coal, 50% for oil and 60% for natural gas).

The results (which do not consider the impacts of fuel switching) show that across all fossil fuels the "technical" fuel savings potential is between 21 EJ and 29 EJ per year, with a CO_2 reduction potential of 1.8 Gt CO_2 to 2.5 Gt CO_2 per year (Figure 7). Not surprisingly, the largest savings are from improving the efficiency of coal-fired plants, which alone provide savings of 15 EJ to 21 EJ (1.4 Gt CO_2 to 2.0 Gt CO_2). Looking at the regional breakdown of savings, it can be seen that just less than half the global savings are from OECD countries. This underscores the importance of improving the efficiency of power production in developing as well as developed countries.

Figure 7 Technical Fuel and CO_2 Saving Potentials from Improving the Efficiency of Electricity Production



Source: IEA analysis.

[5] These calculations do not include fuel and CO_2 savings from increased use of combined heat and power plants.
[6] The potentials calculated are "technical" potentials as they do not take account of economic factors, such as variations in fuel prices between countries or the age profile of the capital stock. The economic potential may be substantially lower than these technical potentials.

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Annex A: Electricity Production Efficiencies by Fuel

The following tables show the calculated efficiencies by fuel for each country, including the impact of different choices for the parameter *s* (the correction factor between heat and electricity, defined as the reduction in electricity production per unit of heat extracted). The default value for *s* is 0.175, with the efficiencies also calculated for values of *s* of 0.15 and 0.2 as a sensitivity analysis. The countries highlighted in each table are those for which the impact of varying the value of *s* changes the calculated efficiency by more than 0.5 percentage point.

Efficiency of Electricity Production from Coal in Public Electricity and CHP Plants, Average 2001-2005

	s=0.175	s=0.15	s=0.2
Australia	32.9%	32.9%	32.9%
Austria	41.0%	40.8%	41.1%
Belgium	38.2%	38.2%	38.2%
Brazil	28.9%	28.9%	28.9%
Canada	37.8%	37.8%	37.8%
China	32.4%	32.4%	32.4%
Czech Republic	32.0%	31.6%	32.3%
Denmark	43.0%	42.4%	43.5%
Finland	39.0%	38.2%	39.7%
France	39.1%	39.1%	39.1%
Germany	38.1%	37.9%	38.2%
Greece	35.6%	35.6%	35.6%
Hungary	30.8%	30.6%	31.1%
Iceland			
India	27.3%	27.3%	27.3%
Ireland	38.8%	38.8%	38.8%
Italy	38.3%	38.3%	38.4%
Japan	41.5%	41.5%	41.5%
Korea	36.5%	36.5%	36.5%
Luxembourg			
Mexico	35.6%	35.6%	35.6%
Netherlands	39.2%	39.1%	39.3%
Norway	34.4%	32.6%	36.1%
New Zealand	34.3%	34.3%	34.3%
Poland	36.2%	35.9%	36.5%
Portugal	39.5%	39.5%	39.5%
Russia	31.5%	30.6%	32.4%
Slovak Republic	29.5%	29.1%	29.9%
South Africa	37.2%	37.2%	37.2%
Spain	37.8%	37.8%	37.8%
Sweden	40.4%	39.2%	41.6%
Switzerland			
Turkey	35.0%	35.0%	35.0%
United Kingdom	37.8%	37.8%	37.8%
United States	36.1%	36.1%	36.1%
OECD	36.6%	36.5%	36.6%
Non-OECD	31.9%	31.8%	31.9%
World	34.3%	34.3%	34.4%

Source: IEA analysis.

Efficiency of Electricity Production from Natural Gas in Public Electricity and CHP Plants, Average 2001-2005

	s=0.175	s=0.15	s=0.2
Australia	37.0%	37.0%	37.0%
Austria	45.8%	45.0%	46.5%
Belgium	50.7%	50.4%	51.1%
Brazil	44.7%	44.7%	44.7%
Canada	40.2%	39.8%	40.5%
China	38.9%	38.9%	38.9%
Czech Republic	33.8%	32.3%	35.3%
Denmark	44.9%	43.7%	46.1%
Finland	49.0%	47.9%	50.0%
France	47.6%	46.4%	48.7%
Germany	42.5%	41.6%	43.4%
Greece	44.9%	44.9%	44.9%
Hungary	39.2%	38.5%	39.9%
Iceland			
India	40.5%	40.5%	40.5%
Ireland	46.6%	46.6%	46.6%
Italy	50.8%	50.7%	50.8%
Japan	44.9%	44.9%	44.9%
Korea	48.6%	48.3%	48.9%
Luxembourg	54.9%	54.9%	54.9%
Mexico	43.7%	43.7%	43.7%
Netherlands	46.9%	46.3%	47.5%
Norway			
New Zealand	47.1%	47.1%	47.1%
Poland	33.8%	33.3%	34.3%
Portugal	54.1%	54.1%	54.2%
Russia	32.8%	32.0%	33.6%
Slovak Republic	35.3%	34.2%	36.4%
South Africa			
Spain	50.4%	50.4%	50.4%
Sweden			
Switzerland	35.7%	34.2%	37.2%
Turkey	54.6%	54.6%	54.7%
United Kingdom	51.6%	51.6%	51.6%
United States	43.0%	42.8%	43.1%
OECD	45.1%	45.0%	45.3%
Non-OECD	34.8%	34.4%	35.1%
World	39.5%	39.3%	39.8%

Source: IEA analysis.

Efficiency of Electricity Production from Oil in Public Electricity and CHP Plants, Average 2001-2005

	s=0.175	s=0.15	s=0.2
Australia	32.5%	32.5%	32.5%
Austria	35.6%	34.6%	36.7%
Belgium	40.7%	40.7%	40.7%
Brazil	34.1%	34.1%	34.1%
Canada	38.9%	38.8%	38.9%
China	33.6%	33.6%	33.6%
Czech Republic	23.8%	22.1%	25.4%
Denmark	40.4%	39.8%	41.0%
Finland	35.1%	34.0%	36.2%
France	30.6%	30.0%	31.2%
Germany	33.8%	33.2%	34.4%
Greece	35.9%	35.9%	35.9%
Hungary	33.4%	33.1%	33.7%
Iceland	30.0%	30.0%	30.0%
India	25.7%	25.7%	25.7%
Ireland	35.6%	35.6%	35.6%
Italy	40.7%	40.6%	40.7%
Japan	41.9%	41.9%	41.9%
Korea	36.8%	36.7%	36.9%
Luxembourg			
Mexico	34.4%	34.4%	34.4%
Netherlands	43.0%	42.0%	44.0%
Norway			
New Zealand	29.9%	29.9%	29.9%
Poland	36.5%	36.2%	36.8%
Portugal	38.1%	38.1%	38.2%
Russia	33.2%	32.4%	34.0%
Slovak Republic	22.8%	22.5%	23.2%
South Africa			
Spain	34.6%	34.6%	34.6%
Sweden	37.0%		
Switzerland	30.2%	28.7%	31.7%
Turkey	35.3%	35.3%	35.3%
United Kingdom	29.2%	29.2%	29.2%
United States	35.3%	35.3%	35.4%
OECD	37.2%	37.1%	37.2%
Non-OECD	36.1%	36.0%	36.1%
World	36.5%	36.5%	36.6%

Source: IEA analysis.

Efficiency of Electricity Production from all Fossil Fuels in Public Electricity and CHP Plants, Average 2001-2005

	s=0.175	s=0.15	s=0.2
Australia	33.2%	33.2%	33.2%
Austria	42.9%	42.4%	43.3%
Belgium	45.1%	45.0%	45.3%
Brazil	36.0%	36.0%	36.0%
Canada	38.4%	38.3%	38.4%
China	32.5%	32.5%	32.5%
Czech Republic	32.0%	31.6%	32.4%
Denmark	43.2%	42.5%	44.0%
Finland	42.0%	41.2%	42.9%
France	39.9%	39.5%	40.2%
Germany	38.6%	38.4%	38.9%
Greece	36.8%	36.8%	36.8%
Hungary	35.1%	34.7%	35.6%
Iceland	30.0%	30.0%	30.0%
India	28.1%	28.1%	28.1%
Ireland	41.7%	41.7%	41.7%
Italy	44.7%	44.7%	44.8%
Japan	43.0%	43.0%	43.0%
Korea	38.9%	38.8%	39.0%
Luxembourg	54.9%	54.9%	54.9%
Mexico	38.0%	38.0%	38.0%
Netherlands	44.0%	43.6%	44.5%
Norway	34.2%	32.4%	36.0%
New Zealand	43.1%	43.1%	43.1%
Poland	36.2%	35.9%	36.5%
Portugal	42.6%	42.5%	42.6%
Russia	32.5%	31.6%	33.3%
Slovak Republic	31.2%	30.6%	31.8%
South Africa	37.2%	37.2%	37.2%
Spain	39.5%	39.5%	39.5%
Sweden	37.8%	36.5%	39.1%
Switzerland	35.4%	33.9%	36.9%
Turkey	43.7%	43.7%	43.7%
United Kingdom	43.5%	43.5%	43.5%
United States	37.4%	37.4%	37.5%
OECD	38.7%	38.6%	38.7%
Non-OECD	33.1%	33.0%	33.3%
World	35.9%	35.8%	36.0%

Source: IEA analysis.