

## HIGHLIGHTS

▲ Overall, the world is becoming less energy intensive but needs more energy on a per capita basis. Over the last 35 years, global energy demand rose by 96% compared to a 167% growth in GDP and a 66% growth in population.

▲ Despite decreases of their share in global energy consumption (from 59% to 44%) and production (from 38% to 29%), IEA member countries still represent the largest share in both when assessing major countries and regions.

▲ IEA member countries have successfully diversified their energy mix in production, supply and sectoral consumption. The combined share of oil, coal and natural gas dropped in both total energy production (from 90% to 74%) and total primary energy supply (from 93% to 82%). However, for both production and supply, the drop mostly occurred in the 1970s and the 1980s. The share of oil has been more than halved in all sectors but transport; oil has been almost phased out in electricity generation. All countries but two have decreased the share of oil in total primary energy supply (TPES).

▲ Major development programmes for nuclear energy in the 1970s and 1980s - and more recently for non-hydro renewables, mainly wind - have largely contributed to the defossilisation of energy production and supply of IEA member countries. Nuclear accounted for 43% of the growth in IEA energy production since 1974; renewables, including hydro and biomass, accounted for 15% of the growth.

▲ IEA member countries have successfully established, maintained and improved an efficient emergency response system to provide security against oil supply disruptions. Total crude oil and petroleum stocks in IEA member countries at the end of March 2009 were the equivalent of 162 days of the previous year's net imports, well above the 90-day requirement, but down from more than 180 days in 1985.

▲ Energy efficiency measures and programmes have contributed to a dramatic reduction in the energy consumption of IEA member countries; based on data available for 11 IEA member countries, the savings could be as high as 58%. However, it should be noted that energy efficiency gains have dropped considerably over this period. Gains were about 1.9% per year from 1974 to 1990; subsequently, lower energy prices and a relative slowdown in the implementation of efficiency measures have effectively halved annual gains to only 1%.

▲ Despite the defossilisation of the energy mix, IEA CO<sub>2</sub> emissions from fuel combustion increased by 17% between 1990 and 2007. Only eight IEA member countries reduced their emissions in real terms. IEA member countries present the highest average CO<sub>2</sub> emissions per capita among the major countries and regions analysed, but have the lowest average CO<sub>2</sub> emissions per GDP.

▲ IEA member countries have successfully launched numerous Implementing Agreements (open to IEA non-member countries and industry, as well as international organisations) to accelerate research, development and demonstration (RD&D) of energy technologies. However, total public sector budgets for energy RD&D have declined sharply in real terms compared to the early 1980s. Moreover, the share of energy RD&D in total research and development has dropped significantly - from 12% in 1981 to 4% in 2008.

▲ Detailed, comprehensive and timely data are the basis for any sound energy policy. IEA member countries have successfully reversed the trend toward lower-quality data observed in the early 2000s. However, additional effort is needed to increase transparency in order to offer analysts and policy makers a valid assessment of the energy situation in IEA member countries and in the world.

This first edition of the *IEA Scoreboard*, published on the occasion of the 35<sup>th</sup> anniversary of the International Energy Agency (IEA), offers an excellent opportunity to review the evolution of the energy situation in IEA member countries.

The publication brings together the latest data on energy production and demand, stocks, trade, prices, carbon dioxide (CO<sub>2</sub>) emissions from fuel combustion, and research, development and demonstration (RD&D) budgets. The primary objective is to assess what IEA member countries have achieved in creating national policy frameworks that are consistent with the aims of the IEA Shared Goals (see Annex 1), particularly in terms of diversifying energy mixes, promoting non-fossil fuels, and encouraging research and development.

Reflecting the increased globalisation of the energy market, the *Scoreboard* opens with an analysis of supply and demand trends worldwide. It highlights specific developments in seven regions, including the IEA as a whole, and three increasingly important participants in energy markets: China, India and the Russian Federation.

Subsequent chapters examine how IEA member countries have adapted their supply-demand situation to the fast-evolving energy market in line with the principles of the IEA Shared Goals. Each chapter focuses on a specific goal; when data are available, the assessment is enlarged from IEA member countries to include China, India, the Russian Federation and, more broadly, the world.

## IEA in the world

During the past three and half decades, most of the countries and regions outside the IEA have experienced economic growth rates higher than that of the IEA. As a consequence, the share of IEA in global GDP has decreased since 1974 – from 81% to 74% using market exchange rates and from 63% to 51% using purchasing power parities.

The share of the IEA in global energy demand has experienced an even larger decrease – from 59% to 44% – due to three main factors: delocalisation of some energy-intensive industries; an increase of the relative importance of services in IEA economies; and faster deployment of energy efficiency policies.

A large part of the decrease in the IEA share of energy demand has been taken over by rapid economic growth in China, which more than doubled its share over the period and accounted for 16% of global demand in 2007.

Although often associated with energy consumption, the collective of IEA member countries is still the largest energy producer when assessing the major countries and regions – even though its share in global production fell from 38% in 1974 to 29% in 2007. In fact, the IEA is the largest producer for all fuels but two: oil (second behind the Middle East) and coal (second behind China). The IEA is also the largest net importer of energy.

Energy consumption per capita has increased in almost all countries and regions around the world, yet significant differences remain in both consumption per capita and energy intensity. Average energy consumption per capita in IEA member countries is about 5 toe: this is the largest of all regions, and is more than twice the world average and almost ten times the average for India. Nonetheless, IEA member countries also have the lowest energy intensity due to a much higher GDP per capita.

## Diversity within the energy sector

IEA member countries successfully diversified their energy production, which grew by 52% since 1974. Nuclear contributed to 43% of the growth, followed by natural gas, coal and renewables. Oil accounted for only 6% of the growth. As a consequence, the share of oil in total IEA production dropped from 28% to 20% while the share of nuclear surged from 2% to 16%.

Between 1974 and 2007, IEA TPES grew by 45% – about three times less than GDP growth. This shows a decoupling of energy demand from economic growth, which can be attributed to a larger share of services in the economy and savings resulting from energy efficiency measures. IEA member countries have also been successful in diversifying their TPES: the share of oil dropped from 51% to 37%, while that of nuclear surged from 2% to 11%. All IEA member countries but two have reduced the share of oil in their supply. Conversely, all countries but two have increased their share of natural gas.

The displacing of oil consumption by other fuels has been spectacular in some sectors. In the commercial and public services sector, the share of oil dropped from 42% to 13%; industry and residential sectors also experienced significant shifts. Oil has been almost phased out in electricity production.

Transport is the only sector in which the share of oil is virtually unchanged, at around 95%. Transport has become the largest of the four main energy-consuming sectors, primarily as a result of decreased demand in industry.

### Ability to respond promptly to energy emergencies

Total IEA energy demand grew by 1 600 Mtoe since 1974, while total net imports increased by only 450 Mtoe. Despite increased energy production in all but four IEA member countries, and despite diversification towards nuclear and renewables, the IEA as a whole remains highly dependent on imported fossil fuels.

In 1974, energy self-sufficiency for the IEA as a whole was 66%; after a slight dip, it rose to 76% in 1984 but fell back to approximately the original level (69%) in 2008. Self-sufficiency varies from fuel to fuel. For coal, the overall IEA self-sufficiency reaches 90%, but for oil it is only 37%.

To cope with possible oil supply disruptions, IEA member countries have successfully established, maintained and improved an effective emergency response system. Total crude oil and petroleum stocks in IEA member countries at the end of March 2009 were the equivalent of 162 days of the previous year's net imports, well above the 90-day requirement. However, in 1985 these countries had total stocks of more than 180 days.

### Development of economic non-fossil fuel: nuclear and renewables

The IEA member countries have successfully defossilised their energy mix by developing large nuclear and renewables programmes. Nuclear generation rose most rapidly in the 1980s, then more gradually in the early 1990s (very little growth occurred in the 2000s).

Although 12 IEA member countries do not currently have commercial nuclear generating capacity, nuclear accounted for 22% of total IEA electricity production in 2008 (up from 5% in 1974).

The share of renewables in IEA TPES has increased from 5% in 1974 to 7% in 2008, primarily because of dramatic development of wind and solar programmes in recent years in many IEA member countries. The impact of these programmes is particularly impressive when looking at electricity generation. Between 1990 and 2008, wind electricity production increased by 48 times; in 2008, wind turbines produced 11% of total IEA renewable electricity.

Biomass, mainly wood and agro-residues, still represents the largest renewables contribution to energy supply of IEA member countries. Hydro continues to rank second, despite relatively little development since 2000. Other renewables, such as geothermal and more recently biofuels, also contribute to the relative growth of renewables in the energy mix of IEA member countries.

### Improved energy efficiency

Many IEA member countries have made considerable effort to collect the basic data needed to assess the contribution of energy efficiency policy in the relative decrease of energy consumption. However, as such data are not yet available for all member countries, this analysis can only be conducted for a limited number of countries (varying from 11 to 21 depending on the sectors).

Disaggregated indicators built from the data available show that IEA member countries have been quite successful in promoting energy efficiency. Improved energy efficiency is the main driver behind the decoupling of energy consumption and GDP in IEA member countries. Without the efficiency improvements that occurred between 1974 and 2006, energy consumption in the 11 countries for which complete detailed data are available would have been 58% higher in 2006 than it actually was.

Energy efficiency gains for a group of 11 IEA member countries (for which data were available) were about 1.9% per year from 1974 to 1990. Unfortunately, between 1990 and 2006, the gains decreased significantly to only 1% per year, coinciding with lower real energy prices.

All sectors have experienced energy efficiency gains. In freight transport, energy intensity (expressed as energy consumption per tonne-kilometre) declined by 5% between 1990 and 2006; the intensity of passenger transport (expressed as energy consumption per passenger-kilometre) decreased by 6%. In the residential sector, efficiency of large appliances has been improved but more effort must now be directed toward efficiency of small appliances (*e.g.* personal computers and other home electronics) which now represent the largest share of household energy consumption.

### Environmentally sustainable provision and use of energy

It is increasingly clear that energy production and use will play key roles in moving toward an environmentally sustainable future. Total IEA CO<sub>2</sub> emissions from fuel combustion increased by 17% between 1990 and 2007; this growth is less than the 45% increase in TPES, due to the relatively higher contribution of nuclear and renewables in the energy mix. Oil remains the largest source (42%) of IEA CO<sub>2</sub> emissions, especially in transport. Coal (mostly consumed in power generation) accounts for 35% and natural gas for 22%.

All IEA member countries but one have reduced their emissions per GDP, but only 13 have reduced their emissions per capita. Only eight countries have reduced their absolute level of emissions since 1990.

### Undistorted energy prices

Liberalisation of energy markets has made information on energy prices and taxes less transparent. This lack of transparency arises from the rapid changes in prices (to reflect primary energy price fluctuations and volatility, or to adjust to competition), as well as from increased confidentiality due to negotiated prices.

On an ex-tax basis, a 63% difference is observed between the average lowest price and highest price for gasoline in IEA member countries; the difference surges to 350% when comparing total gasoline prices (including taxes). These figures reflect a wide range of taxation policies among IEA member countries; data show that the tax component is not linked to a country's volume of imports or its dependency rate.

### Continued research development and market deployment

IEA member countries have been successful in promoting research and development through Implementing Agreements, which are open to non-member countries and industry, as well as to international organisations. There are currently 42 Implementing Agreements encompassing a wide range of areas including fossil fuels, renewables, buildings, electricity, industry, transport and fusion.

However, total public sector budgets for energy research, development and demonstration (RD&D) in IEA member countries have declined in real terms over the past 35 years, with 2008 nominal levels only slightly above 1976 budgeted levels. Moreover, the share of energy RD&D in total research and development has declined significantly from 12% to 4% since 1981. The overall decline masks the fact that the share of RD&D budgets has steadily increased in some areas (efficiency, renewables) but decreased in others (fission and fusion).

### A few words on energy statistics

With the globalisation of energy markets, there is a growing need for more transparency to analyse the evolution of the markets in terms of production, trade, stock changes and consumption. This implies a need for more detailed, complete and timely data – and for greater transparency on the part of all market players. Several initiatives, including the Joint Oil Data Initiative (JODI) – launched in the early 2000s – have contributed to improving the quality and availability of data worldwide. But more needs to be done.

Since the early 2000s, major progress has been observed in the coverage and the quality of energy statistics in IEA member countries. Prior to that time, liberalisation of the market and reduction in the resources allocated to statistics had lowered the overall quality of energy statistics.

IEA member countries are facing new challenges, including identifying priority areas and monitoring progress in energy efficiency, assessing development of renewables, and better tracking trade flows of energy. IEA member countries must, therefore, continue their efforts to increase transparency in order to be able to offer analysts and policy makers a valid assessment of the energy situation in IEA member countries and in the world.