IEA Scoreboard 2011



Implementing energy efficiency policy: Progress and challenges in IEA member countries

International Energy Agency

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IEA Scoreboard 2011

Implementing energy efficiency policy: Progress and challenges in IEA member countries

On the occasion of its 35th Anniversary in 2009, the International Energy Agency published the first edition of the *IEA Scoreboard* focusing on *35 Key Energy Trends over 35 Years*. In parallel, the IEA published *Implementing Energy Efficiency Policies: Are IEA Member Countries on Track?* Both publications found that although IEA member countries were making progress in implementing energy efficiency, more work was needed.

In the 2011 edition of the *Scoreboard*, the IEA has decided to focus on energy efficiency. The publication combines analysis of energy efficiency policy implementation and recent indicator development. The resulting *IEA Scoreboard 2011* provides a fuller picture of the progress as well as the challenges with implementing energy efficiency policy in IEA member countries.

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Implementing energy efficiency policy: Progress and challenges in IEA member countries



International Energy Agency

INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its mandate is two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply and to advise member countries on sound energy policy.

The IEA carries out a comprehensive programme of energy co-operation among 28 advanced economies, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency aims to:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

IEA member countries:

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Hungary
Ireland
Italy
Japan
Korea (Republic of)
Luxembourg
Netherlands
New Zealand
Norway
Poland
Portugal
Slovak Republic
Spain
Sweden
Switzerland
Turkey
United Kingdom
United States

The European Commission also participates in the work of the IEA.



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Foreword

In 2009, on the occasion of its 35th anniversary, the International Energy Agency (IEA) released the *IEA Scoreboard 2009: 35 Key Energy Trends over 35 Years*. Combining concise text and graphic elements, the IEA *Scoreboard 2009* assessed the efforts undertaken over the years by IEA member countries to live up to the underlying principles of the IEA "Shared Goals", agreed to by IEA Ministers in 1993.

One of the "Shared Goals" is to improve energy efficiency. The *IEA Scoreboard 2009* highlighted that although energy efficiency programmes dramatically reduced energy consumption of IEA member countries over the 35 years, actual energy efficiency gains had dropped considerably over that time. 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 effectively halved annual gains to only 1%.

In parallel, the IEA also published *Implementing Energy Efficiency Policies: Are IEA Member Countries on Track?* The publication highlighted that even where policy implementation was underway, there was a need to amplify actions and measures.

At a time when growing economic uncertainty reigns in countries around the world while energy demand continues to grow, prices remain stubbornly high and achieving the 450 Scenario described in the *World Energy Outlook 2010* looks increasingly problematic, the role of energy efficiency in securing a sustainable energy future has become more important than ever.

For this reason, this second edition of the *IEA Scoreboard* focuses largely on energy efficiency in IEA countries. Analysis in the *IEA Scoreboard 2011*, *Implementing Energy Efficiency Policy: Progress and Challenges in IEA Member Countries* is both quantitative and qualitative. It quantifies the savings allocated to energy efficiency from the establishment of the IEA in 1974 to 2008 (the most recent year for which detailed data are available) and qualifies the measures and actions IEA countries have taken since 2009 towards implementing the IEA 25 energy efficiency policy recommendations.

Assessing the impact of energy efficiency on demand and monitoring efficiency programmes are no easy tasks; each country is unique in terms of economy, geography, climate and energy resources. The graphs and the underlying data should, therefore, not be seen as a measure of government performance but more as indicative and evolutionary trends towards the shared goal of becoming more energy efficient.

Although this assessment is far from comprehensive, the *IEA Scoreboard 2011* demonstrates that energy efficiency can play a major role in reducing the energy consumption of a country and consequently its greenhouse-gas emissions. The *IEA Scoreboard 2011* shows some evidence that energy efficiency trends could be reversing after the decline witnessed since 1990. It also highlights the importance of activities to support energy efficiency in the energy policy of a country – from data collection and establishing indicators to assessing the impact of policies and measures implemented. All constitute necessary and important steps towards an effective energy efficiency policy.

The IEA will continue to strengthen its actions in the area of energy efficiency. It is my sincere hope that we will have many opportunities to engage further with countries around the world: effective energy efficiency programmes are one of the most important solutions to enhancing energy security and sustainability.

Maria van der Hoeven
Executive Director

This publication has been produced under the authority of the Executive Director.

Acknowledgements

The *IEA Scoreboard 2011* reflects the vital interconnect between energy statistics, analysis and energy policy, particularly in the area of enhancing energy efficiency as a means of improving energy security. It is the result of co-operation between the Energy Statistics Division and the Sustainable Energy Policy and Technology Directorate (SPT) with the strong support of the Communication and Information Office at all the stages of the preparation.

The *IEA Scoreboard 2011* publication was managed by Mr. Jean-Yves Garnier, Head of the Energy Statistics Division, with the effective co-operation of Ms. Sara Pasquier and Mr. Robert Tromop, Energy Efficiency Unit in SPT, for the section on *Qualifying energy efficiency actions* and of Ms. Nathalie Trudeau, Energy Technology Policy Division in SPT, for the section on *Quantifying energy efficiency trends*. Additional IEA staff members greatly contributed to the preparation of the data and graphs: Ms. Anne Durand with the assistance of Mr. Paolo Canfora for the energy efficiency trends, and of Mr. Aurélien Saussay for the energy efficiency actions.

Some of the graphs related to energy efficiency trends by sector would not have been possible without the contribution of the ODYSSEE network, for which the IEA Secretariat expresses its gratitude.

Special thanks are given to Ms. Corinne Hayworth for the enormous amount of work and patience dedicated to designing the entire layout and for making basic statistics look quite attractive; to Ms. Sharon Burghgraeve for a wonderful job in helping reformatting the document; and to Ms. Marilyn Smith and Ms. Cheryl Haines for their sharp eyes and helpful advice in the final editing.

The IEA Secretariat would also like to acknowledge the indirect contribution of all energy statisticians and energy efficiency analysts in IEA member countries and elsewhere in the world, who spend time and effort to provide policy makers with the most timely and comprehensive data possible. Without their invaluable work and commitment, the *IEA Scoreboard 2011* and many other publications would not be possible.

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HIGHLIGHTS

- *Overall, the world is becoming less energy intensive: the level of total primary energy supply (TPES) required for each "unit" of gross domestic product (GDP) is falling. Since 1974, global energy demand rose by almost 100% compared to a 170% growth in GDP and a 69% growth in population. However, more energy is needed on a per-capita basis.*

- *In 2009, global energy production decreased by 1% as a consequence of a 2% decline in the world GDP. In fact, it is the first time since 1974 that global energy experienced a decrease, except for the one-year stagnation observed in 1980 after the second oil shock.*

- *In 2009, China surpassed the United States to become the world's largest energy consumer economy, largely because the impact of the economic crisis was less severe on China than on other parts of the world.*

- *As the global economy gradually rebounded, global energy production increased by 4.5% in 2010, a higher level than in 2008.*

- *Since 1974, energy efficiency measures and programmes have contributed substantially to limiting the growth of energy consumption in IEA member countries. Analysis of data available from 11 IEA member countries shows the savings could be as high as 63%. However, it should be noted that the rate of energy efficiency progress dropped over the 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%.*

- *Recent analysis suggests that the 1% rate of gain is starting to rise once again. However, 2009 was an unusual year due to the impact of the financial crisis and until more recent data and evidence are available, it will be difficult to understand how the recession affected economic activity and efficiency – and whether this trend will be sustained.*

- *Substantial policy measures and innovations are evident since 2009. For example, two-thirds of IEA member countries have developed risk mitigation instruments for energy efficiency projects and all are taking steps towards implementing the 1-Watt standby policy for appliances and equipment.*

- *Yet, significant energy savings opportunities remain unexploited in IEA member countries; this is the case for energy performance of existing buildings, optimisation of electric motors and importantly in transport systems, where significant structural investments and modal changes must be made.*

- *Coverage and quality of end-use data collection have improved in some IEA member countries. Nevertheless, additional effort is needed to further increase transparency in order to offer analysts and policy makers, especially those involved in energy efficiency policy, a valid assessment of the energy situation in IEA member countries and in the world.*

- *Energy policy decisions made each day in countries around the world have long-term impacts. To capture the potential savings from energy efficiency, it remains critical that all countries pursue energy efficiency policies that seize the opportunity to "lock in" the early improvement potential already identified – and "lock out" inefficient technologies and policies.*

The IEA dedicates this second edition of its *IEA Scoreboard* to energy efficiency trends and policies in its member countries. According to the *World Energy Outlook* and to *Energy Technology Perspectives*, two key IEA publications, energy efficiency policies and actions could make a substantial contribution to reducing by as much as 50% the increase of global CO_2 emissions in the next 25 to 40 years. Achieving this will require an ambitious strengthening of the role of energy efficiency in energy policy of both IEA member countries and non-IEA countries.

The *IEA Scoreboard 2011* outlines the progress and identifies further priorities in this field by asking the following questions:

- What has been the contribution of energy efficiency policies and measures in limiting energy consumption in member countries since the establishment of the IEA in 1974?
- What is the level of implementation of energy efficiency policies and measures in IEA member countries compared to the IEA 25 energy efficiency policy recommendations?

Based on the latest data and information available from IEA countries, the *IEA Scoreboard 2011* firstly assesses what IEA member countries have achieved in saving energy in selected sectors, with a focus on developments since 1990. After having quantified the degree to which energy efficiency has reduced energy demand in the second section, the third section of the publication compares the energy efficiency policy currently implemented by IEA member countries in relation to the IEA 25 energy efficiency policy recommendations, highlighting both progress and areas for further action.

To be complete and to reflect on the increased globalisation of the energy market, the *Scoreboard* opens with an analysis of supply and demand trends worldwide. It highlights specific developments, with a focus on the impact of the 2009 economic crisis in seven regions, including the IEA as a whole, and three increasingly important participants in energy markets: China, India and the Russian Federation.

IEA in the world

During the past 35 years, most of the countries and regions outside the IEA have experienced economic growth rates higher than those within the IEA. This is particularly true for the year 2009, with non-IEA countries experiencing a 3% increase in GDP while that of IEA member countries fell by 3.5% due to the proportionately greater impact of the financial crisis on the latter. As a consequence, the share of IEA in global GDP has decreased since 1974 – from 81% to 72% using market exchange rates. When using purchasing power parities, the share of IEA in global GDP decreased from 63% to 48%. In fact, 2009 is the first year in which the IEA share is smaller than that of non-IEA countries.

The share of the IEA in global energy demand has experienced an even larger decrease – from 59% to 41% – due to three main factors: delocalisation of some energy-intensive industries; an increase of the relative importance of services in IEA economies; and 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 almost tripled its share over the period and accounted for 19% of global energy demand in 2009. In fact, due to the more severe impact of the 2009 financial crisis on the United States than on China, China became the largest energy consumer economy in 2009.

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 28% in 2010. In fact, the IEA is the largest producer for all fuels but two: oil (second behind the Middle East) and coal (second behind China).

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 per year – the highest of all regions; this is more than twice the world average and almost eight times the average for India.

Nonetheless, IEA member countries also have the lowest energy intensity due to a much higher GDP per capita as well as the impact of energy efficiency measures and policies.

Quantifying energy efficiency trends

At the 2009 IEA Ministerial Meeting, ministers agreed to start collecting the detailed data necessary to build basic energy efficiency indicators using a harmonised template/questionnaire. Although many IEA member countries have made considerable effort to report according to the questionnaire, data are not available for all sectors from all countries. As a consequence, the assessment of the contribution of energy efficiency in restraining the growth of energy consumption can be conducted for only a limited number of countries (varying from 11 to 19 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 one of the main drivers behind the decoupling of energy consumption and GDP in IEA member countries.

But much more could be achieved. 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 2008, the gains dropped significantly to only 1% per year, coinciding with lower real energy prices. On a more optimistic side, data for the most recent years seem to indicate a new inversion in the trends and more gains from energy efficiency policies and measures; however, this needs to be confirmed by additional data and evidence.

All sectors have experienced energy efficiency gains. In freight transport, energy intensity (expressed as energy consumption per tonne-kilometre) declined by 4.5% between 1990 and 2008; the intensity of passenger transport (energy consumption per passenger-kilometre) decreased by 8%. In the residential sector, efficiency of large appliances has been improved but more effort must be directed toward efficiency of smaller devices (*e.g.* personal computers and other home electronics), which now represent the largest share of appliances energy consumption.

Qualifying energy efficiency actions

In 2009, the IEA conducted a first evaluation of member country implementation of the IEA 25 energy efficiency policy recommendations. A second evaluation conducted in 2011 shows notable progress in the adoption of the recommendations in many sectors (including buildings, industry, utilities). This analysis also helps to pinpoint areas in which additional effort is required. The reality is that, despite major progress in the implementation of recommendations, significant energy savings opportunities remain unexploited in IEA countries.

For **buildings**, energy efficiency requirements in building codes are increasingly based on life cycle approaches, maintaining a regular cycle of code reviews, and enabling innovation by using rating and certification processes. Further effort is needed in low-energy new buildings, regulatory requirements for retrofits, and quantifying the social, economic and environmental benefits of efficient buildings.

Appliances and equipment in all IEA countries have become subjected to broader and more stringent minimum energy performance standards (MEPS) and labelling programmes. Newly covered devices include televisions and digital set-top boxes; new standards include limits for low power and standby operation. The **1-Watt standby** policy, first proposed by the IEA in 1999, is the biggest success story in this field. In 2009, all but one IEA country was planning to implement this important policy; in 2011, 75% had achieved significant adoption. That is significant international progress. For appliances, MEPS are increasingly complemented by endorsement schemes. Ongoing priorities continue to be: the adoption of and alignment with international standards, exploring the energy-saving opportunities for network-connected devices, and endorsement of high efficiency products.

In terms of **lighting**, the phase out of inefficient incandescent lamps is gathering momentum: one-third of IEA countries have substantial implementation of polices under way. Many service and quality aspects of lighting systems are a natural follow-on from the current progress in lamp efficiency. This work must continue to be aligned with international standards.

The 2009 evaluation identified **transport** energy efficiency as one of the least mature policy areas; only 14% of the recommended measures were at substantial implementation. A dramatic improvement is seen in this sector; in 2011, countries have moved to 67% substantial completion. The early gains in transport policy must be consolidated through ongoing policy developments if countries are to mitigate the trends for increase in fuel prices while maintaining mobility.

In the **industry** sector, most countries now have well-developed MEPS and efficiency programmes for electric motors. These remain a priority as motors consume 40% of global industry electricity.

Utilities are well-positioned to deliver cost-effective energy efficiency to customers, and a range of policies are being implemented, according to country energy market policies. Utilities are an important conduit for energy efficiency, because of their ongoing relationship with energy-using customers.

To attain the economic and social benefits of energy efficiency while achieving the target of halving GHG emissions, countries must both identify how energy efficiency interventions contribute to economic and social development, and accelerate the rate of fully mature adoption of energy efficiency policies.

The vital role of energy statistics

Globalisation of energy markets creates a growing need to analyse their evolution in terms of production, trade, stock changes and consumption. This, in turn, requires greater transparency on the part of all market players and implies a need for more detailed, complete and timely data. Several initiatives, including the Joint Organisations 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 quality of energy statistics in IEA member countries, as well as in many non-IEA countries that are key producers and consumers. Prior to that time, liberalisation of the market and reduced resource allocation to statistics had lowered the overall quality of energy statistics.

With the growing importance of energy efficiency in energy policy, countries are facing new challenges, including identifying priority areas for energy efficiency policy and measures, and the need to monitor progress in implementation. This requires more detailed data not only on energy consumption by end use, but also by activity (such as floor area, fleet of vehicles or production of goods).

In order to make a valid assessment of the energy efficiency situation and carry out reliable monitoring of the progress/failure in the implementation of policy and measures, energy analysts and policy makers need timely access to accurate, detailed data. IEA member countries – and more generally all countries that make energy efficiency an important component of energy policy – must continue and further strengthen their efforts in collecting data and building indicators.

IEA in the world



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Population and gross domestic product 12

Energy production: total, coal and oil 14

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Total primary energy supply by region 18

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CO_2 emissions from fuel combustion 24

Population and gross domestic product

▶ Several factors affect trends in energy demand in a given country and across the world. Population and gross domestic product (GDP) are two major drivers; thus, it is important to start by assessing their influence on the evolution of global energy demand since 1974.

▶ Global **population** has grown by 69% to reach over 6.8 billion people. Population has more than doubled in the Middle East and in Africa. In absolute terms, Africa has experienced the highest growth (600 million), followed by India (550 million). Growth across all IEA member countries was only 230 million, of which 40% occurred in the United States.

▶ As a result of growth patterns, the share of the IEA countries in global population decreased (from 21% to 16%), as did that of China (from 23% to 20%). Shares of all the other regions increased, with the strongest growth occurring in Africa (from 10% to 15%).

▶ Over the same period, global **GDP** (as measured by market exchange rate or **MER**) grew by 170%, more than double that of the population. This translates into a large increase in wealth per capita. All regions experienced strong growth, but the strongest occurred in China where GDP has been multiplied by a factor of 20. India and Asia (excluding China, India and OECD Asia Oceania) followed with a factor of seven. GDP for IEA countries as a whole rose by a factor of "only" 2.4.

▶ In 1974, IEA countries dominated global GDP, accounting for 81% of the total. Because of more modest growth, their share decreased somewhat to 72%. The United States represented 40% of total IEA GDP, followed by Japan with 17%. Due to strong GDP growth, China experienced the highest growth in share of world GDP, from 1% to 8%.

▶ Comparisons using **GDP** in purchasing power parities (PPP) further highlights the impressive growth of some developing countries in recent years. PPP takes into account the relative cost of living and inflation rates. By PPP measures, China has become the world's largest economy, overtaking in 2009 the United States (by MER, it ranks third after the United States and Japan).

▶ Based on GDP expressed in **PPP** terms, IEA countries currently account for 48% of global wealth compared to 63% in 1974. The share of China was multiplied by almost six (from 2.7% to 19.4%) and that of India doubled (from 3.2% to 7.1%). Stronger growth in both population and GDP in IEA non-member countries has clearly influenced trends in the evolution of the global energy demand.

▶ *Sources*

- *National Accounts of OECD Countries*, Volume 1, 2011, OECD.
- *World Development Indicators*, 2011, the World Bank.

▶ *For further information*

- *World Energy Outlook*, 2011, IEA.

The 2009 economic crisis in GDP terms

In 2009, global GDP (as measured by MER) decreased by 2% as a consequence of the global economic crisis, which hit a large number of countries. However, the global average hides large discrepancies among countries, especially between OECD and non-OECD countries.

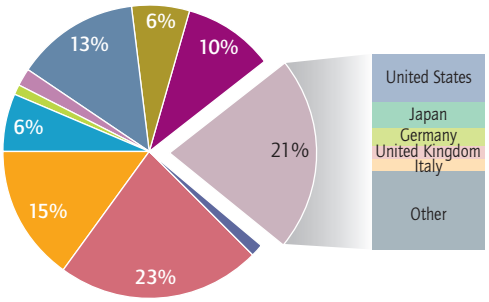
In contrast, with an overall decrease of 3.5% in GDP in 2009, OECD countries were the most severely hit by the crisis, while the overall non-OECD GDP increased by almost 3%. Some large non-OECD countries, such as China and India, even experienced an 8% growth in their GDP.

As a consequence of the crisis and the differential between OECD and non-OECD countries, IEA countries now account for less than half of the total world GDP expressed in PPP. In 2009, IEA accounted only for 48% of global GDP PPP compared to 51% in 2007. Moreover, due to a 2.7% decrease in US GDP PPP and an almost 9% increase in Chinese GDP PPP, China became in 2009 the largest world economy in terms of GDP PPP.

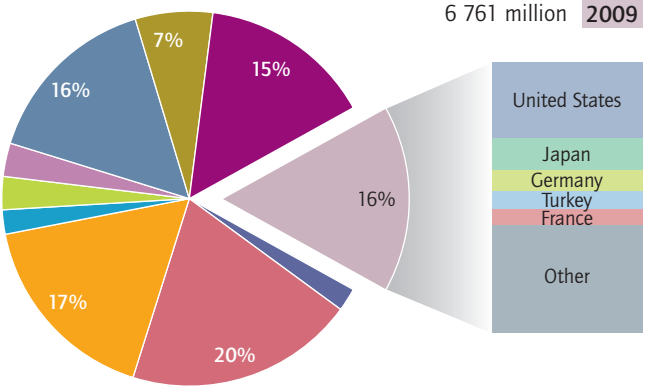
Despite strong growth in absolute terms, the share of IEA countries in global GDP has fallen sharply since 1974, primarily due to faster growth elsewhere in the world.

Population

1974 3 993 million

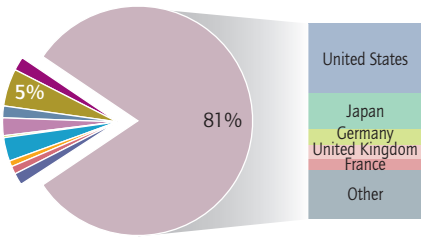


6 761 million **2009**

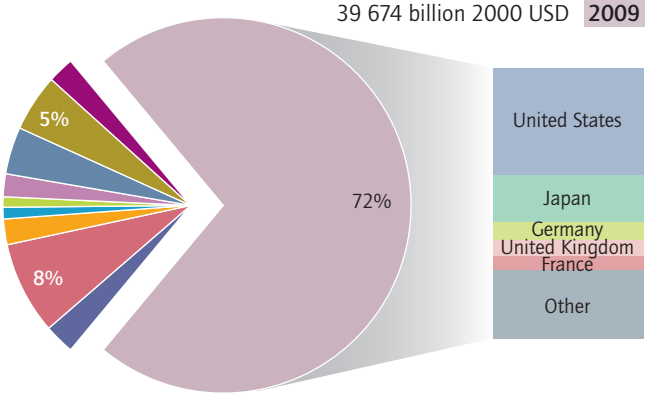


GDP

1974 14 684 billion 2000 USD

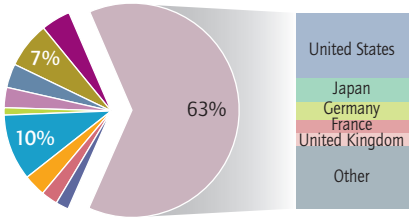


39 674 billion 2000 USD **2009**

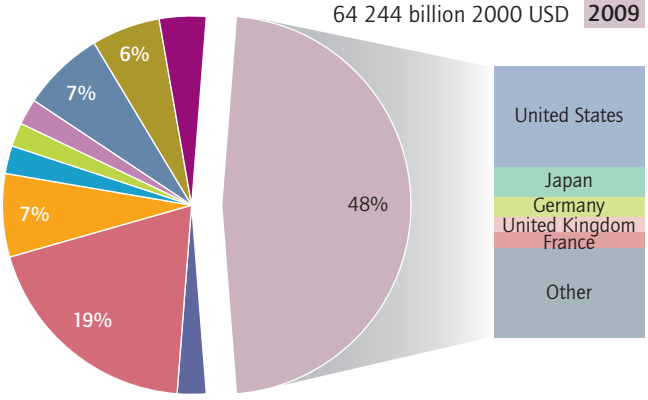


GDP PPP

1974 20 150 billion 2000 USD



64 244 billion 2000 USD **2009**



IEA · OECD non-IEA · China · India · Russian Federation* · Non-OECD Europe and Eurasia* · Middle East** · Asia** · Latin America** · Africa

** For 1974, the Russian Federation includes the rest of Former Soviet Union (FSU). For 2009, Non-OECD Europe and Eurasia excludes Estonia, Slovenia and the Russian Federation.*
*** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

Energy production: total, coal and oil

▶ Since 1974, the average global energy supply (often referred to as demand) per capita rose by 0.4% per year – significantly less than global GDP per capita, which rose by 1.3% per year. This means that even though the world economy is becoming less energy intensive, the world needs more energy on a per-capita basis and in absolute terms. To meet the demand of a population that grew by 69%, global energy production more than doubled, from 6 300 million tonnes of oil equivalent (Mtoe) in 1974 to 12 800 Mtoe in 2010.

▶ Growth of production has varied widely from fuel to fuel and from region to region. Oil is still the main energy fuelling the world economy, but its share in total energy production fell dramatically from 47% in 1974 to 32% in 2010. Shares rose for both coal (from 24% to 29%) and natural gas (from 16% to 21%). Nuclear experienced the highest growth in relative terms (from 1% to 5.5%), but had the lowest growth in absolute terms. Nuclear production grew by 650 Mtoe, much less than half that of either coal or natural gas.

▶ In relative terms, the collective of IEA member countries is still the largest energy producer of the countries/regions reflected in this report, although their share in global production decreased from 38% in 1974 to 28% in 2010. The IEA share fell for all fuels except for renewables and waste, due to the development of wind and solar programmes in IEA countries.

▶ In 1974, IEA countries were the main world producer for all fuels except crude oil (second behind the Middle East) and renewables (on par with China). In 2010, the IEA was still the largest natural gas and nuclear producer. The IEA remained the second-largest producer of crude oil (behind the Middle East). China replaced the IEA as the largest producer of coal.

▶ The composition of global **coal** production has changed remarkably since 1974. Exports of coal have almost doubled, yet the bulk of coal produced is still consumed domestically, mainly in power generation and industry. To meet strong growth in electricity demand and industrial output, China now produces more coal than all IEA countries combined. In 2010, China and the IEA together accounted for 73% of world coal production. Other large producers include India, other Asian countries (*e.g.* Indonesia and Vietnam) and the Russian Federation, which has experienced a drop in production.

▶ Global **oil** production rose less than other fossil fuels, largely because it was relatively more mature in 1974 and countries have since diversified their energy mixes. Major exploration and exploitation programmes in Africa, Latin America, China and other parts of the world have led to a diversification in the zones of production. As a result, shares of the three main producing regions have significantly decreased. In 1974, the Middle East, the IEA and the Russian Federation accounted for roughly 75% of global production; in 2010, they represented only 60%.

▶ *Source*

- *World Energy Balances* online data service, 2011, *http://data.iea.org*, IEA.

▶ *For further information*

- *World Energy Outlook*, 2011, IEA.

Impact of the 2009 economic crisis on energy production and 2010 rebound

As a consequence of the global economic crisis and the reduction in economic activities in some parts of the world, global energy demand decreased in 2009, as did energy production. In 2009, global energy production decreased by 1%; in fact, it is the first time since 1974 that global energy production experienced a decrease, except for the one-year stagnation observed in 1980 after the second oil shock.

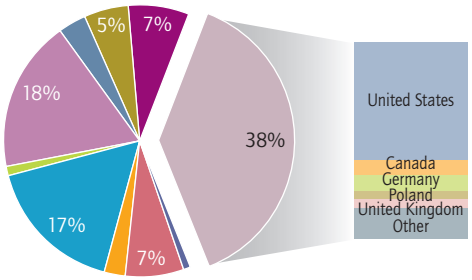
Not all fuels experienced a decrease; while crude oil production fell by 2.5% in 2009, coal production continued to grow (+ 1.5%) due in large part to the GDP growth of both China and India.

With the rebound of the global economy in 2010, preliminary data show that global energy production went up by 4.5% to an even higher level than in 2008. Coal production increased by almost 7% and oil by 2%.

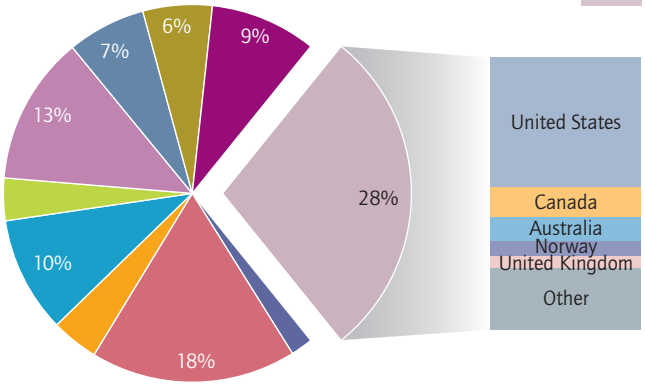
IEA countries are often associated with high energy consumption; collectively, they are also the biggest overall energy producers, second for coal behind China and second for oil behind the Middle East.

Total energy production*

1974 6 296 Mtoe

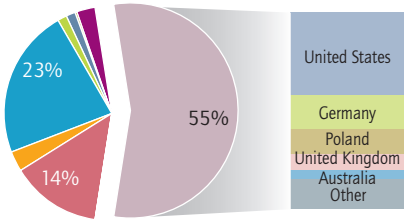


12 837 Mtoe **2010**

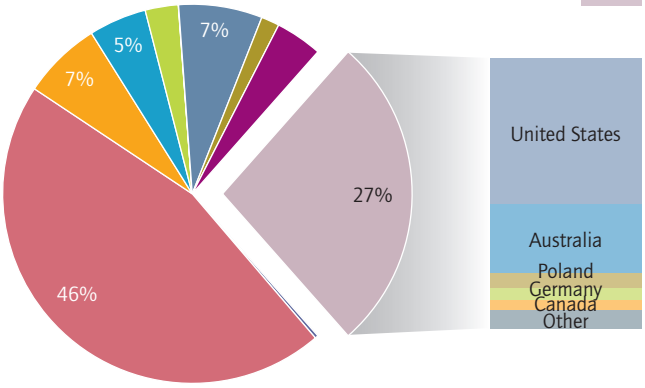


Coal production

1974 1 482 Mtoe

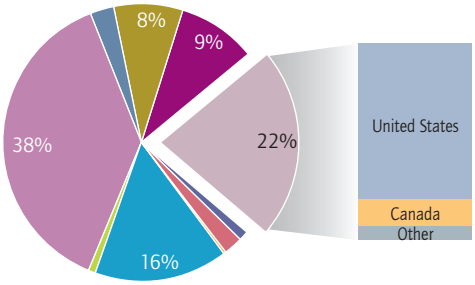


3 684 Mtoe **2010**

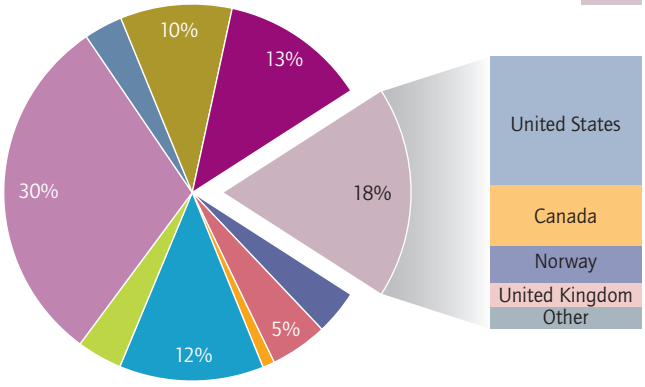


Oil production

1974 2 941 Mtoe



4 066 Mtoe **2010**



IEA | OECD non-IEA | China | India | Russian Federation** | Non-OECD Europe and Eurasia** | Middle East***
Asia*** | Latin America*** | Africa

** Also includes heat pumps and heat from chemical processes.*
*** For 1974, the Russian Federation includes the rest of Former Soviet Union (FSU). For 2010, Non-OECD Europe and Eurasia excludes Estonia, Slovenia and the Russian Federation.*
**** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

Energy production: natural gas, nuclear and renewables

▶ **Natural gas** has seen the second-largest increase (rising by 1 700 Mtoe or 168% since 1974) in global production in absolute terms, after coal (2 200 Mtoe) and before oil (1 100 Mtoe). This rapid growth can be attributed to several factors. Natural gas has a lower environmental impact than coal or oil. Capital expenditure for new infrastructure is lower and lead times for production are shorter than for other fuels. In addition, increased use of liquefied natural gas (LNG) and long-distance pipelines have facilitated development of more remote gas fields.

▶ Many regions (Asia, Latin America, Africa and the Middle East) have greatly increased natural gas production to meet increases in domestic power generation and to supply growing gas exports worldwide. Production in IEA member countries, still largely dominated by the United States, has increased from 690 Mtoe to 925 Mtoe since 1974. However, since this increase is much less than growth in other regions, the IEA share of total gas production fell by about one-half from two-thirds to one-third.

▶ With 19% of global production, the Russian Federation was the largest gas producer in 2010, followed by the United States (18%), the Middle East (15%), Asia (9%) and Africa (7%, primarily from Algeria, Egypt and Nigeria).

▶ In relative terms, **nuclear** energy has experienced the largest growth in production, a tenfold increase since 1974. At that time, nuclear was much less developed and accounted for 1% of the world total energy production. Notable increases in production have since been seen in several IEA countries, the Russian Federation and China, mostly during the 1980s and 1990s. Nuclear now accounts for 5.5% of global energy production and for 15% of production in IEA countries. Three countries, the United States (30%), France (16%) and Japan (10%), accounted for more than half of global nuclear production in 2010.

▶ By contrast, energy production from **renewables and waste** is very well-distributed globally. Renewable consumption varies from traditional biomass (for cooking and heating) to hydropower, wind and solar. Renewables have recently gained much attention and their share (15%) of the world's energy has slightly increased over the last years.

▶ In 2010, as in 1974, combustible renewables (solid biofuels) accounted for most (76%) of the global production of renewables, followed by hydropower (17%) and others (7%, primarily geothermal, wind, solar, etc.).

▶ These aggregate numbers obscure several underlying trends. As people in developing countries become richer or move to cities, they often switch from traditional biomass for cooking and heating to modern energy sources, such as kerosene, liquefied petroleum gases (LPG), natural gas and electricity. Some countries have developed modern renewables (such as hydro, wind, solar and biomass for power generation, as well as biofuels) in an effort to replace fossil fuels, limit their imports and de-carbonise the energy supply.

▶ *Source*

- *World Energy Balances* online data service, 2011, *http://data.iea.org*, IEA.

▶ *For further information*

- *Natural Gas Information*, 2011, IEA.
- *Electricity Information*, 2011, IEA.
- *Renewables Information*, 2011, IEA.

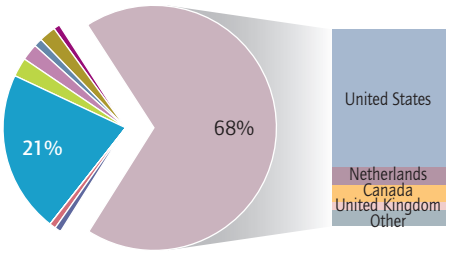
Production of renewables continues to grow faster than total energy

Since the 2009 global economic crisis mainly hit the OECD countries, the demand for traditional biomass (used for a large part for cooking in developing countries) has continued to grow in 2009 as well as in 2010. Moreover, development of wind programmes and photovoltaic projects has also boosted the production of energy from wind and solar. As a consequence, the production of energy from renewables has experienced a higher rate of growth than overall energy production. From 2008 to 2010, renewables production increased by 5% while overall energy production only experienced a 3.5% growth over the same period.

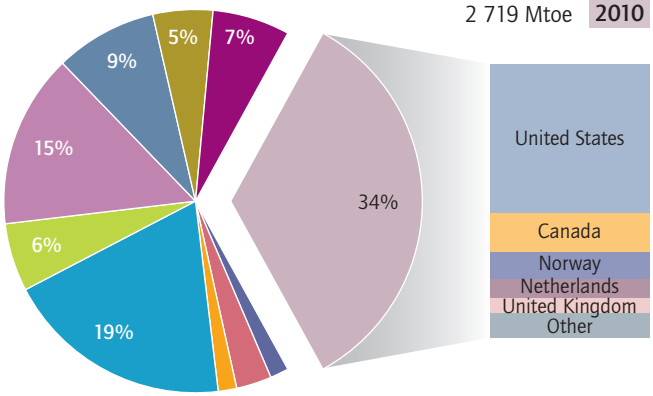
Nuclear and natural gas have experienced the highest growth in their share of global energy production since 1974. Renewables account for 13% of global energy production.

Natural gas production

1974 1 013 Mtoe

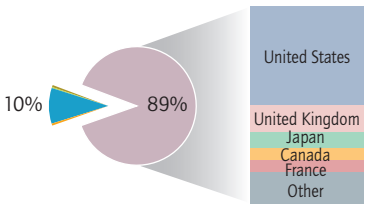


2 719 Mtoe **2010**

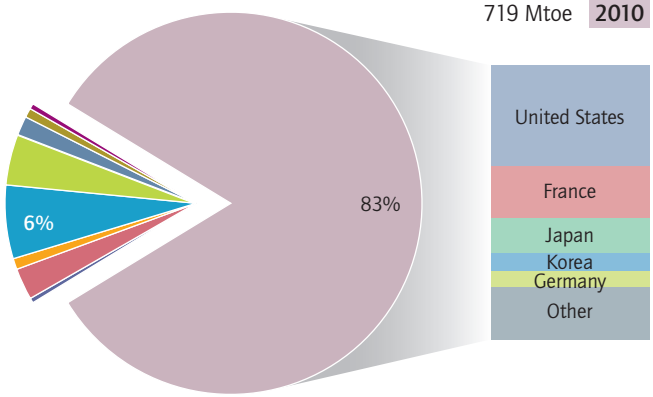


Nuclear production

1974 71 Mtoe

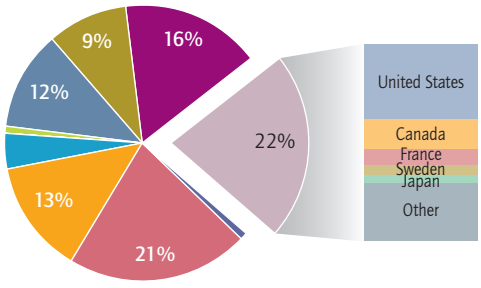


719 Mtoe **2010**

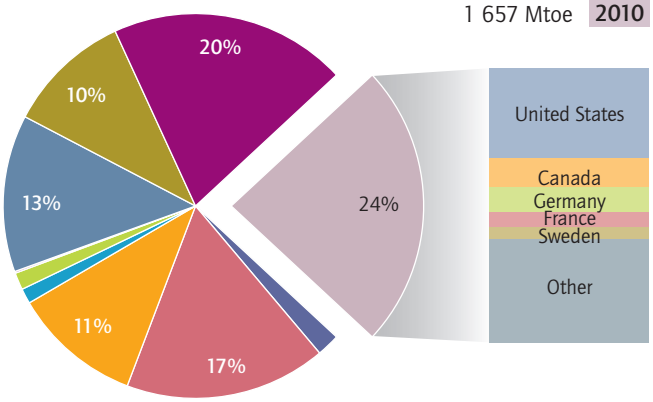


Renewables and waste production

1974 789 Mtoe



1 657 Mtoe **2010**



IEA OECD non-IEA China India Russian Federation* Non-OECD Europe and Eurasia* Middle East**
Asia** Latin America** Africa

** For 1974, the Russian Federation includes the rest of Former Soviet Union (FSU). For 2010, Non-OECD Europe and Eurasia excludes Estonia, Slovenia and the Russian Federation.*
*** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

Total primary energy supply by region

▶ Global total primary energy supply (TPES) has almost doubled since 1974, rising to 12 150 Mtoe in 2009. Growth has been much stronger in non-IEA countries (nearly 200%) than in IEA member countries (+38%). As a result, more energy is now consumed outside the IEA than inside. Overall, the IEA share dropped from 59% in 1974 to 41% in 2009.

▶ China, which accounted for 7% of global TPES in 1974, grew rapidly to represent 19% in 2009 and is now the largest consuming country in the world in front of the United States (18%), while Other Asia (6%), India (6%) and the Middle East (5%) saw strong increases in their respective shares.

▶ Strong growth in energy consumption in non-IEA countries should not distract attention from the large disparities,that remain in energy consumption per capita. IEA countries, with greater wealth and access to energy services, have an average per-capita energy consumption of about 4.5 toe – more than twice the world average and almost eight times that of India.

▶ The Middle East and China have experienced the highest growth in energy consumption per capita since 1974. Per-capita consumption tripled for both, reflecting increasing wealth associated with the exploitation of vast domestic energy reserves and/or major economic development.

▶ Africa and India have the lowest energy consumption per capita and the lowest electrification access. They also have the highest rates of people living in poverty. The strong link between poverty and lack of access to electricity is well documented. Improving access to electricity is one of the most effective ways to alleviate poverty.

▶ The **energy intensity** of an economy is a measure of how much energy is required to produce each unit of national revenue (in this report, measured using the US dollar or USD). It is usually expressed in tonne of oil equivalent (toe) per unit of GDP, using either MER or PPP. There is no direct correlation between energy consumption per capita and energy intensity: for example, IEA countries have the highest consumption per capita, but the lowest consumption per GDP. With more economic output deriving from less energy-intensive sectors (*e.g.* the services sector) and with generally more energy-efficient equipment, the energy intensity of IEA countries is about half that of the global average.

▶ In 1974, China's economy was driven by manufacturing and export: almost 3 toe were needed to produce USD 1000 of GDP (MER) and the country's energy intensity was almost seven times the global average. Today, China's energy intensity is less than 1 toe per USD 1 000 of GDP, which is largely due to successful efforts to restructure the economy, strong wealth creation and the introduction of energy efficiency programmes (it should be noted that China still exceeds the global average by a factor of 2.5). India has achieved similar improvements in energy intensity. The Russian Federation and the Middle East now have the highest TPES per GDP PPP.

▶ *Source*

- *World Energy Balances* online data service, 2011, *http://data.iea.org*, IEA.

▶ *For further information*

- *World Energy Outlook*, 2011, IEA.

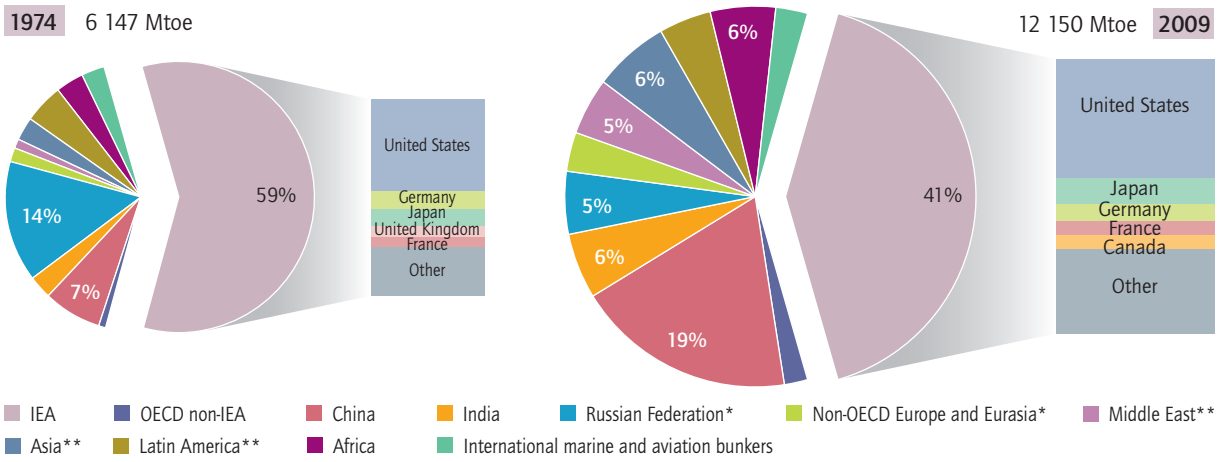
People's Republic of China became the largest energy consumer in 2009

Based on forecasts from various organisations and analysts around the world, taking into account the growth in population and GDP, China should have overtaken the United States in terms of energy supply (or energy demand) either in 2010 or in 2011.

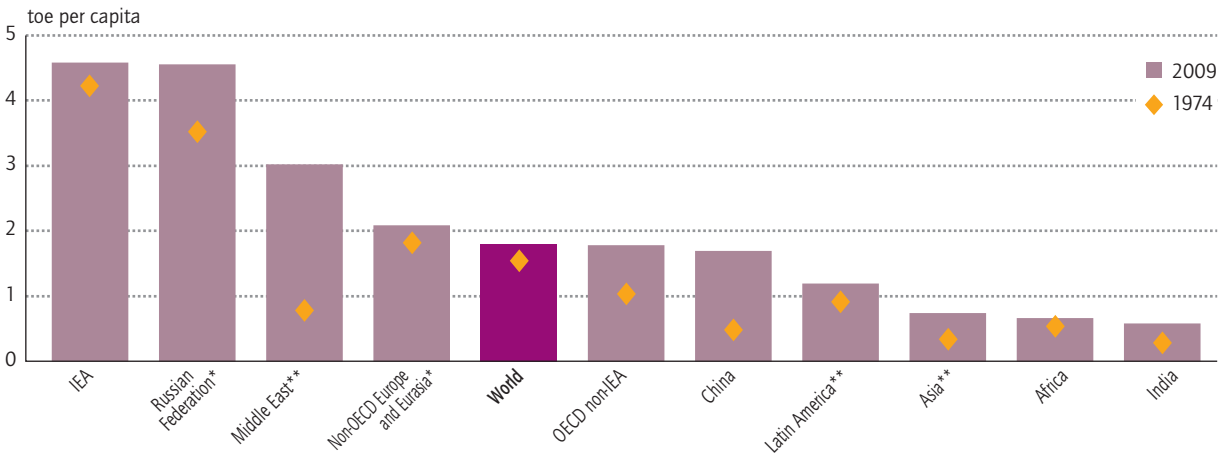
However, the 2009 global economic crisis had a more severe impact on the economy of the United States than on China. The US GDP decreased by 2.7% in 2009, while Chinese GDP went up by almost 9%. As a consequence, the energy supply of the United States went down by 5% to 2 160 Mtoe, while the energy supply for China went up by 6.6% to 2 270 Mtoe. Therefore, China is now the largest energy consumer country in the world. The two countries together account for more than 36% of total global demand.

Energy consumption per capita has increased in all regions; yet significant regional differences remain in both consumption per capita and energy intensity.

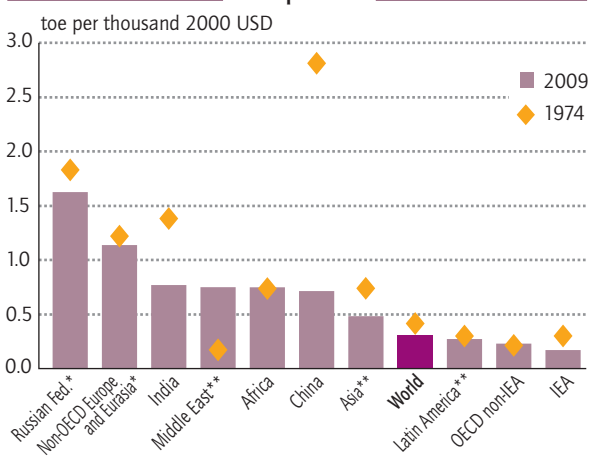
Total primary energy supply (TPES)



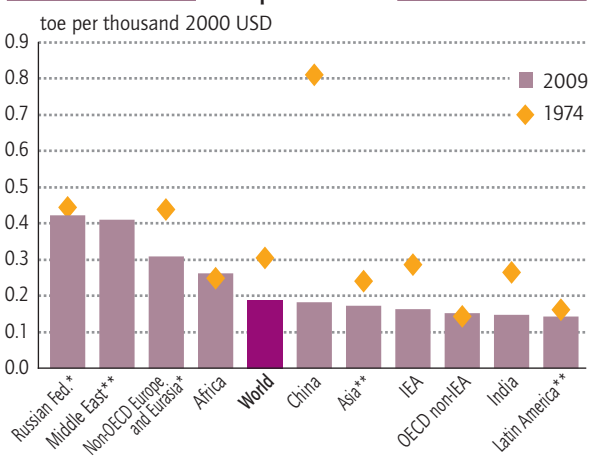
TPES per capita



TPES per GDP



TPES per GDP PPP



** For 1974, the Russian Federation includes the rest of Former Soviet Union (FSU). For 2009, Non-OECD Europe and Eurasia excludes Estonia, Slovenia and the Russian Federation.*
*** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

Primary energy supply by fuel

▶ Analysis of regional changes in primary fossil fuel supply since1974 reveals two striking trends: the decreased importance of IEA member countries and the Russian Federation in the global picture; and the rise of Asian countries (led by China and India) driven by increasing populations and rising GDP.

▶ Since 1974, growth in supply for the three main fossil fuels is as follows: oil rose the least (+44%), while coal supply doubled (+120%). Natural gas had the largest increase (+153%).

▶ The increase in global **coal** supply is largely due to a nearly sevenfold increase in both China and India with regard to power generation and industry (particularly iron and steel production). China now accounts for 46% of global coal consumption, which is more than all IEA countries combined and more than double that of the United States, the second-largest consumer.

▶ In 1974, the Russian Federation, together with other economies of the Former Soviet Union, consumed 21% of global coal supply. Due to diversification towards oil and natural gas in its energy mix, the share of the Russian Federation alone dropped to 3% of global coal consumption in 2009.

▶ In 1974, IEA countries consumed more than two-thirds of global **oil**, mainly in transport, but also in residential, industry and power generation. Today, the IEA share is less than half of global oil consumption, with the largest share in transport. The share of oil in residential and industry shows large decreases; oil in power generation has been almost completely phased out.

▶ With the exception of the Russian Federation, all regions have seen growth in their share of global oil consumption. China's share has increased from 2% to 10%. The Middle East has seen its importance in global oil markets shift, from that of major oil exporter to also a major oil consumer. This trend reflects large oil subsidies in many Middle Eastern countries, which keep domestic oil prices low and encourage domestic consumption. In turn, higher domestic consumption means that a smaller share of the increase in Middle East oil production is available to international oil markets.

▶ **Natural gas** consumption has also increased sharply in all regions. Growth has been fastest in developing countries, led by Asia and the Middle East (both with sizeable local reserves). As a result, the IEA share in global supply decreased, from 70% in 1974 to 47% in 2009.

▶ With 21% of the global natural gas consumption, the United States remains the largest gas consumer, ahead of the Russian Federation (14%) and the Middle East (11%). Globally, the bulk of natural gas is consumed in power generation, followed by industry and residential. Compared to its 46% share in global coal consumption and 10% in oil, China remains a modest natural gas user, consuming only 3% of total world demand.

▶ *Source*

- *World Energy Balances* online data service, 2011, *http://data.iea.org*, IEA.

▶ *For further information*

- *World Energy Outlook*, 2011, IEA.

The 2009 economic crisis further decreased IEA share in world TPES

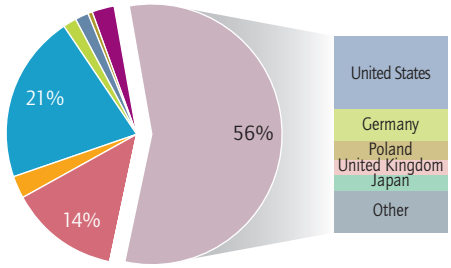
The 2009 global economic crisis contributed to decreasing the share of IEA countries in global total primary energy supply. IEA countries accounted for 59% of world demand in 1974, 55% in 1980, 51% in 2000, 44% in 2007 and 41% in 2009. The decrease of the IEA share can be observed for all fuels except renewables, which is due to significant developments made in solar and wind energy programmes.

While the IEA share in global TPES has decreased, both China and India have seen a dramatic increase in their respective shares. Chinese share increased from 7% to 19% and from 3% to 6% in India. This increase can be observed for all almost all fuels, but particularly for coal in China, which surged from 14% in 1974 to 46% in 2009. This means that almost one-half of global coal is now consumed in China.

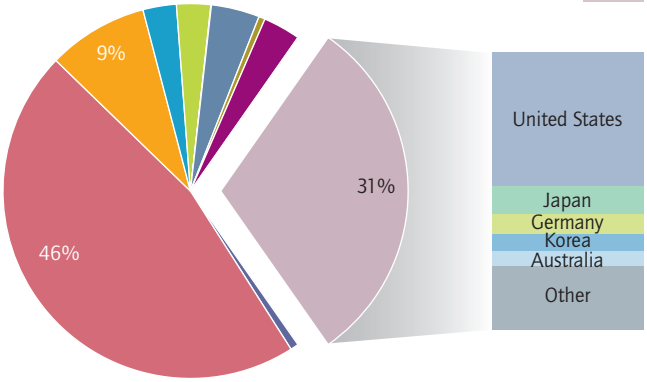
Global supply for fossil fuels is better distributed amongst regions now than in 1974, with the exception of coal supply which is largely dominated by China and IEA countries.

Coal primary energy supply

1974 1 495 Mtoe

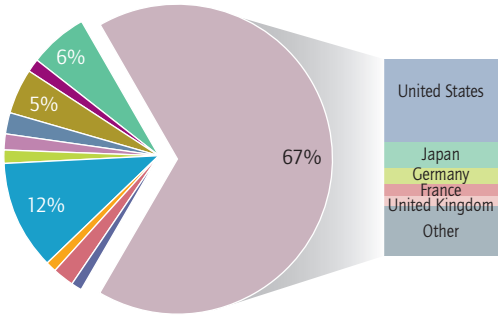


3 296 Mtoe **2009**

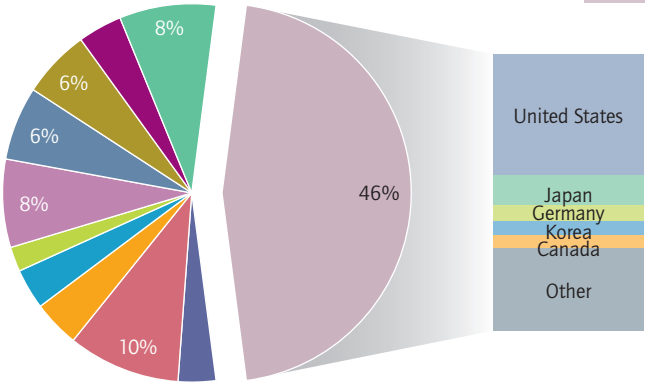


Oil primary energy supply

1974 2 775 Mtoe

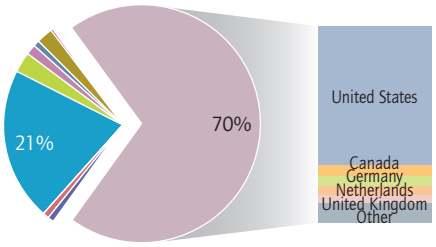


3 987 Mtoe **2009**

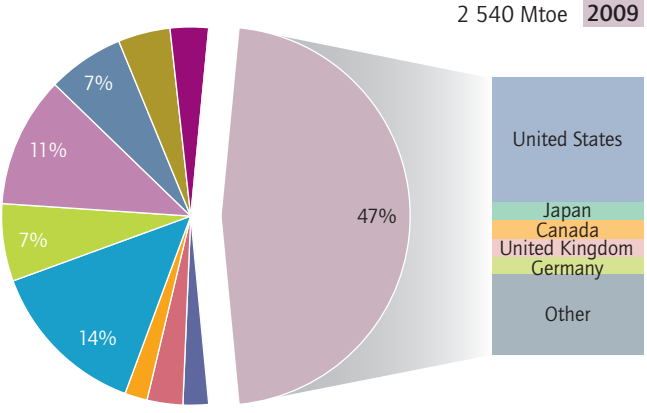


Natural gas primary energy supply

1974 1 005 Mtoe



2 540 Mtoe **2009**



IEA · OECD non-IEA · China · India · Russian Federation* · Non-OECD Europe and Eurasia* · Middle East** · Asia** · Latin America** · Africa · International marine and aviation bunkers

** For 1974, the Russian Federation includes the rest of Former Soviet Union (FSU). For 2009, Non-OECD Europe and Eurasia excludes Estonia, Slovenia and the Russian Federation.*
*** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

Electricity consumption

▶ Notable shifts have occurred in electricity consumption since 1974. The share consumed by the residential sector rose from 23% in 1974 to 28% in 2009, largely due to electrification programmes in developing countries and the penetration of more appliances and video/computer equipment in developed countries. The services sector has experienced the fastest growth, rising from 15% to 24%. Industry remains the largest consumer, despite a dramatic decrease – from 54% to 40%.

▶ The situation is slightly different across IEA member countries, with the industrial, residential and services sectors representing more or less equal shares (one-third) of total electricity consumption. This is a major shift from 1974, when industry accounted for almost half of consumption and services only 20%. The United States remains the dominant electricity consumer, accounting for 42% of IEA consumption; total US consumption is greater than the whole of IEA Europe and around one-quarter of global use.

▶ The four biggest electricity consumers outside the IEA – China, the Russian Federation, India and Brazil – account for approximately 60% of non-IEA countries' electricity consumption. China is by far the largest non-IEA consumer, accounting for 19% of the world total. This reflects a sixfold absolute growth since 1990 and an average annual increase of almost 9% since 1974.

▶ Analysis of final average **consumption of electricity per capita** by region reveals that even though consumption is increasing for all regions, major differences still exist. Globally, average annual per-capita consumption rose from 1 300 kWh in 1974 to 2 500 kWh in 2009. It should be noted, however, that referring to a "world average" is not meaningful as a large part of the global population still lacks access to electricity.

▶ In absolute terms, electricity consumption per capita has increased the most in IEA countries (from 4 400 kWh to 8 000 kWh); somewhat lower increases occurred in the Middle East, China and the Russian Federation.

▶ In relative terms, China (+1 450%) and the Middle East (+800%) show the fastest growth; both presented very low consumption per capita in 1974 and have since experienced strong increases in GDP. Per-capita demand in India, Africa and Asia (excluding China and India) is still three to five times less than the world average.

▶ Sources

- *World Energy Balances* online data service, 2011, *http://data.iea.org*, IEA.
- *World Energy Outlook*, 2011, IEA.

▶ For further information

- *Electricity Information, 2011, IEA.*
- *Gadgets and Gigawatts: Policies for Energy Efficient Electronics*, 2009, IEA.

Opposite trends in per-capita electricity consumption between IEA and other regions

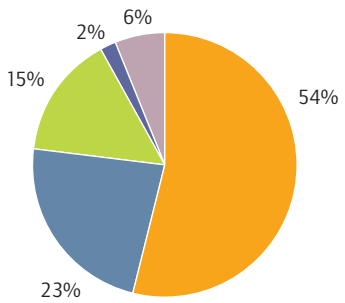
Because most IEA countries started with already high electricity consumption per capita in 1974, after 30 years of growth, IEA countries observed a plateau in their consumption. This plateau is due in part to the near saturation of appliances, video and computer equipment, more efficient appliances and delocalisation of electricity intensive industries.

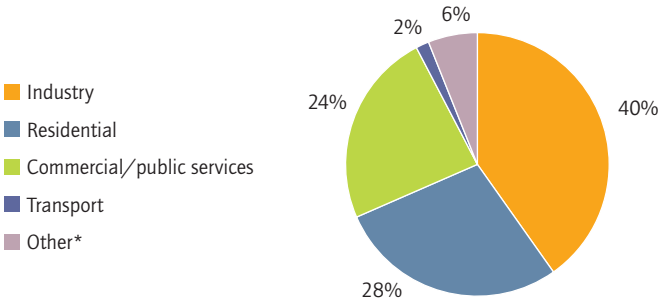
In contrast, many non-IEA countries are currently experiencing a boom in their electrification programmes and in the penetration of appliances, electronic equipment, lighting and air conditioning. Therefore, many countries currently face a steep increase in electricity consumption per capita. While the average IEA consumption per capita was almost the same in 2009 as in 2000, the average non IEA consumption per capita increased by 550 kWh over the same period. The average consumption per capita increased by 1 000 kWh for the Middle East and by more than 1 600 kWh for China.

Despite massive electrification programmes in many regions and countries, there are still large differences in regional electricity consumption per capita.

Final consumption of electricity: world

1974 5 261 TWh

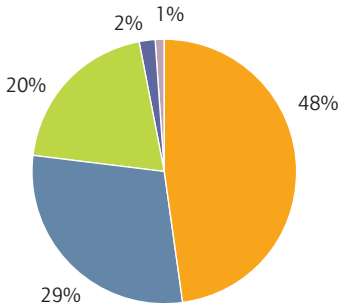


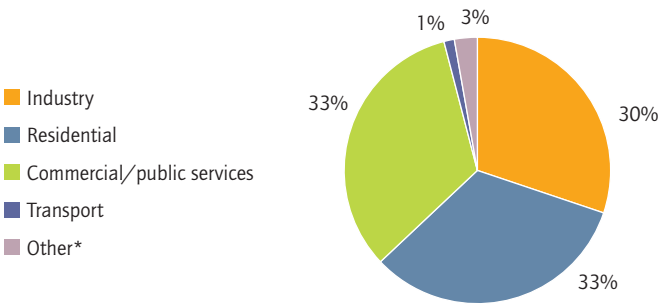


16 760 TWh **2009**

Final consumption of electricity: IEA member countries

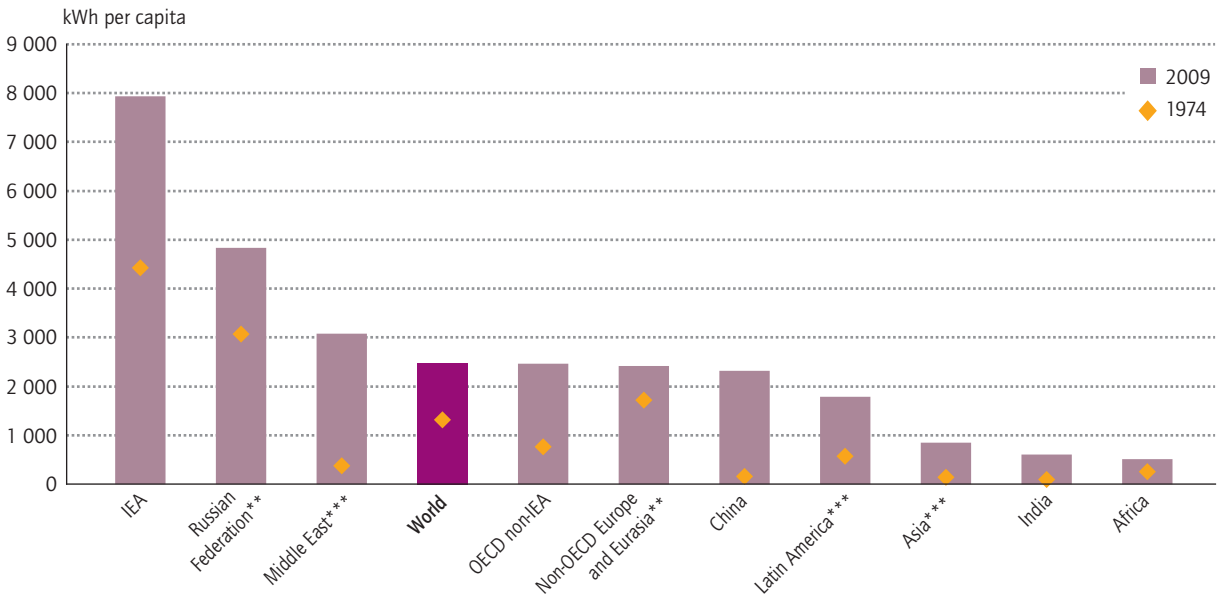
1974 3 792 TWh





8 645 TWh **2009**

Final consumption of electricity per capita by region



** Other includes agriculture/forestry, fishing and other use not specified elsewhere.*
*** For 1974, the Russian Federation includes the rest of Former Soviet Union (FSU). For 2009, Non-OECD Europe and Eurasia excludes Estonia, Slovenia and the Russian Federation.*
**** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

CO_2 emissions from fuel combustion

▶ Carbon dioxide (CO_2) emissions reflect the carbon content of the fuels consumed. Some energy sources, such as coal, oil and gas, emit CO_2; others, including nuclear, hydro, geothermal and solar, produce no CO_2 emissions. Because supply influences emissions in this way, there is no "one-to-one correspondence" between regional shares in global TPES and global CO_2 emissions. Regions that use "cleaner" fuels – even if they use much greater quantities – may have lower emissions than regions that rely on smaller quantities of carbon-based fuels (it should be noted that CO_2 emissions from biomass combustion are not accounted for in the emissions from fuel combustion).

▶ Global CO_2 emissions from fuel combustion increased by 86% since 1974, a rate that is 12% lower than the increase in world TPES (98%). This gap between emissions and supply is due to efforts to reduce the overall share of fossil fuel in the energy mix through the development of nuclear, and to decarbonise the fossil fuel mix by partially substituting natural gas for oil.

▶ IEA member countries are still the main emitters of CO_2, despite a major decrease (from 64% to 40%) of their share in global emissions. China's share jumped from 6% to 24%, making it the second-largest emitter followed by the Russian Federation, other Asia, the Middle East and India (each accounting for about 5% of global emissions).

▶ On **a per capita basis**, IEA countries and the Russian Federation have the highest emissions – more than 10 tCO_2 per capita. India and Africa have the lowest emissions per capita, largely due to low TPES per capita and the large share of renewables in their respective energy mixes. The Middle East has experienced the highest growth in emissions, from 2.0 to 7.8 tCO_2 per capita.

▶ It is noteworthy that IEA countries have the highest emissions per capita but the lowest **emissions per GDP** measured as CO_2 per USD, using Market Exchange Rate. IEA emissions per GDP were almost halved since 1974 due to the uncoupling of economic growth and energy consumption.

▶ With 3.9 tCO_2 per 2000 USD, the Russian Federation had the highest emissions per GDP, followed by non-OECD European and Eurasian countries, China, the Middle East, and India. In the case of China, CO_2 emissions per GDP decreased dramatically (from 5.8 in 1974 to 2.2 tCO_2 per USD 2000 in 2009) due to strong growth in the economy. The decrease is even more spectacular in terms of GDP PPP; the emissions decreased by a factor of almost three from 1.7 to 0.6 tCO_2 per USD 2000.

▶ *Source*

- *CO_2 Emissions from Fuel Combustion*, 2011, IEA.

▶ *For further information*

- Intergovernmental Panel on Climate change National Greenhouse Gas Inventories Programme, *www.ipcc-nggip.iges.or.jp/.*
- *World Energy Outlook*, 2011, IEA.

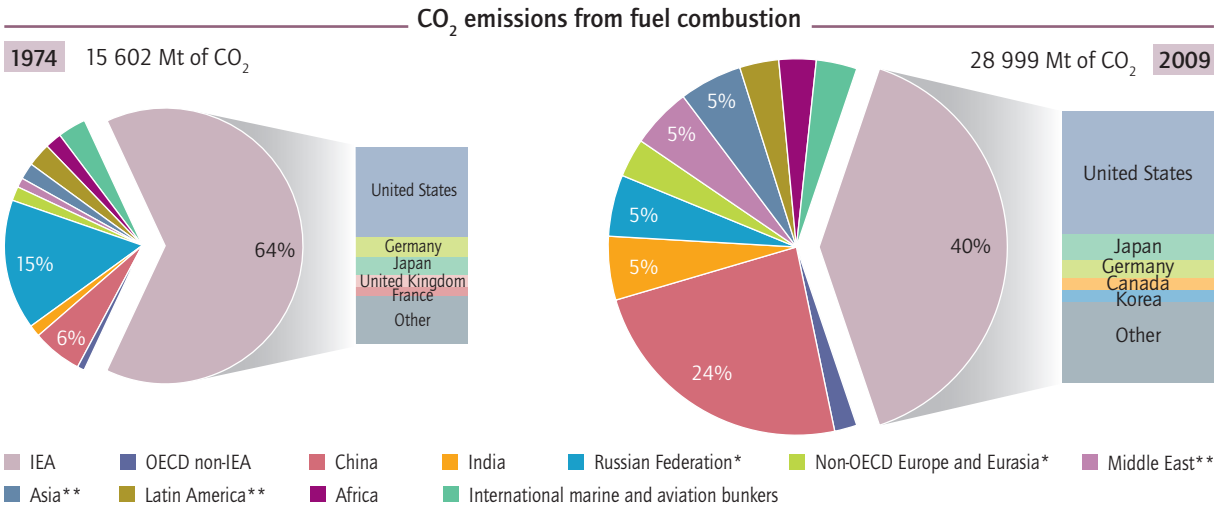
Limited impact of the 2009 economic crisis on CO_2 emissions

CO_2 emissions from fuel combustion of IEA countries decreased in 2009 as a consequence of the decrease in energy consumption due to the global economic crisis. Yet, energy consumption continued to grow in other regions and coal contributed to a large part of this growth. Therefore, while there was a slight decrease in global CO_2 emissions overall, the decrease was limited in the face of consumption growth among some non-IEA countries. Preliminary information shows that both global energy consumption and CO_2 emissions resumed their growth in 2010.

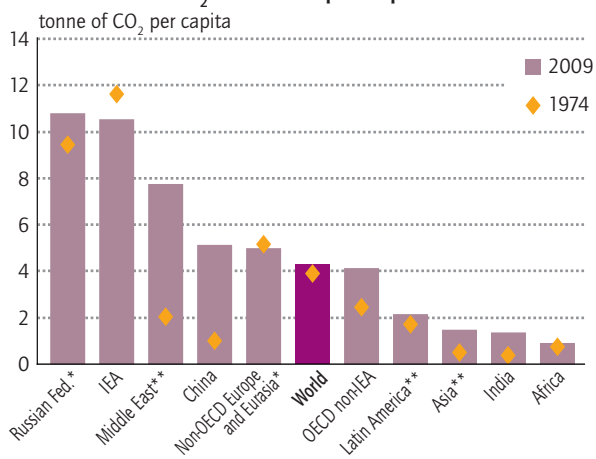
Such global CO_2 emissions trends make it more difficult, if not impossible, to achieve the objectives of the 450 ppm scenario, in terms of CO_2 emissions reduction, described in the World Energy Outlook 2010 *(IEA, 2010).*

The share of IEA countries in global CO_2 emissions from fuel combustion dropped from 64% to 40% since 1974. These countries have the highest emissions per capita, but the lowest per GDP.

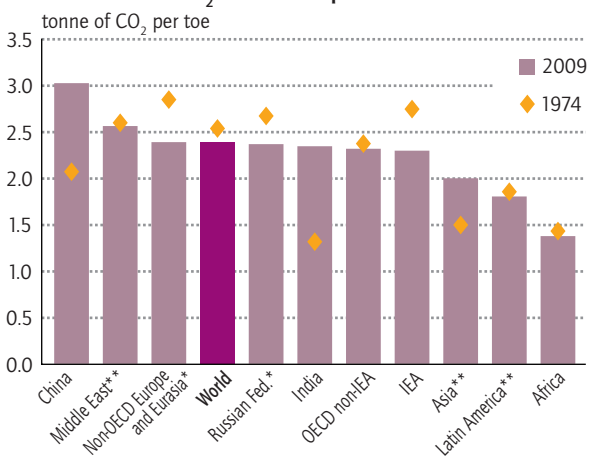
CO_2 emissions from fuel combustion



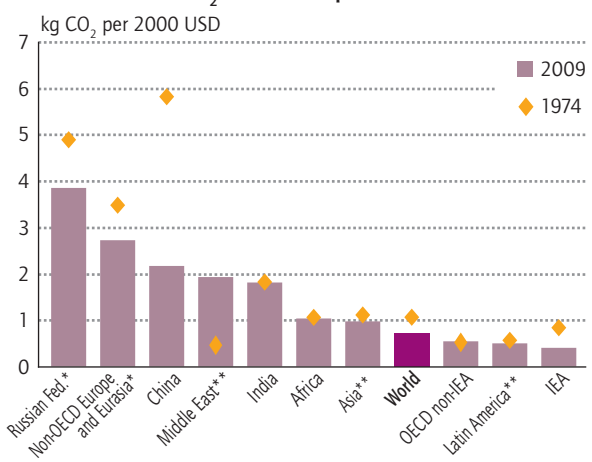
CO_2 emissions per capita



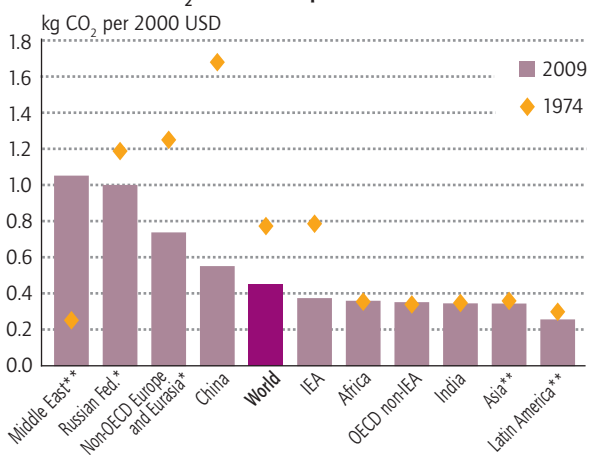
CO_2 emissions per TPES



CO_2 emissions per GDP



CO_2 emissions per GDP PPP



** For 1974, the Russian Federation includes the rest of Former Soviet Union (FSU). For 2009, Non-OECD Europe and Eurasia excludes Estonia, Slovenia and the Russian Federation.*
*** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

Quantifying energy efficiency trends



Quantifying energy efficiency trends

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Energy efficiency in households 40

TPES per capita

▶ With a little less than 5 toe per capita in 2010, IEA member countries have the highest energy consumption per capita, almost three times more than the world average. IEA consumption per capita is just ahead of the Russian Federation, but more than eight times that of India. However, in relative terms, IEA consumption per capita has increased moderately (12%) since 1974, much less than many regions (the Middle East, for instance) and emerging countries (China, in particular).

▶ Several factors explain the gap in absolute terms between the IEA and other regions/countries: a much higher starting point in 1974 (4.2 toe per capita); the structure of the respective economies; a higher GDP per capita; the level of development; climate; and the energy mix.

▶ A wide range of consumption per capita is evident within IEA countries, from 8.3 toe per capita in Luxembourg to 1.4 toe per capita in Turkey. Except for Luxembourg where fuel tourism (due to lower taxation of gasoline and diesel oil) artificially increases the consumption per capita, the other six countries in the top seven IEA consumers are either large countries in terms of area or colder countries (Nordic countries, for instance) or both as in the case of Canada.

▶ As for the lower IEA consumers, five out the bottom seven are Mediterranean countries that have lower demand for heating. It should be noted that Portugal experienced the second-highest growth (+171%) in consumption per capita since 1974, followed by Turkey, Greece and Spain. Consumption in all these countries is approaching levels seen in other IEA countries.

▶ Korea experienced by far the most dramatic increase (+648%), reflecting several factors: low consumption in 1974 compared to other IEA countries; impressive development of its industry and commercial and public services sectors; and a major jump of its GDP per capita.

▶ Almost all IEA countries experienced an increase of consumption per capita. Decreases noted in seven countries can be explained on a case-by-case basis, taking account of factors such as higher starting points in 1974, changes in economic structure, changes in energy mix or gains in energy efficiency.

▶ *Sources*

- *National Accounts of OECD Countries*, Volume 1, 2011, OECD.
- *World Development Indicators*, 2011, the World Bank.
- *World Energy Balances* online data service, 2011, *http://data.iea.org*, IEA.

▶ *For further information*

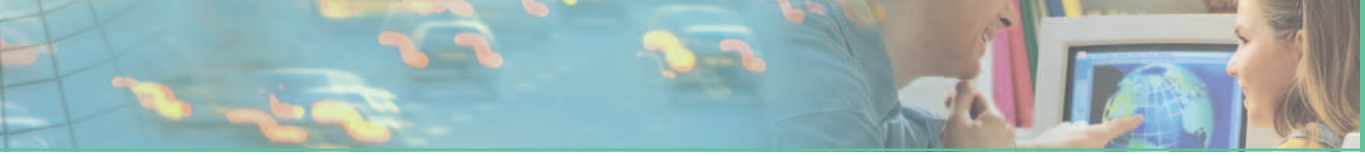
- *World Energy Outlook*, 2011, IEA.

An informative gap between TPES per capita and electricity per capita trends

Although energy consumption should not be considered as a direct indicator of energy efficiency, the observation of trends over a long period gives some useful information on consumption.

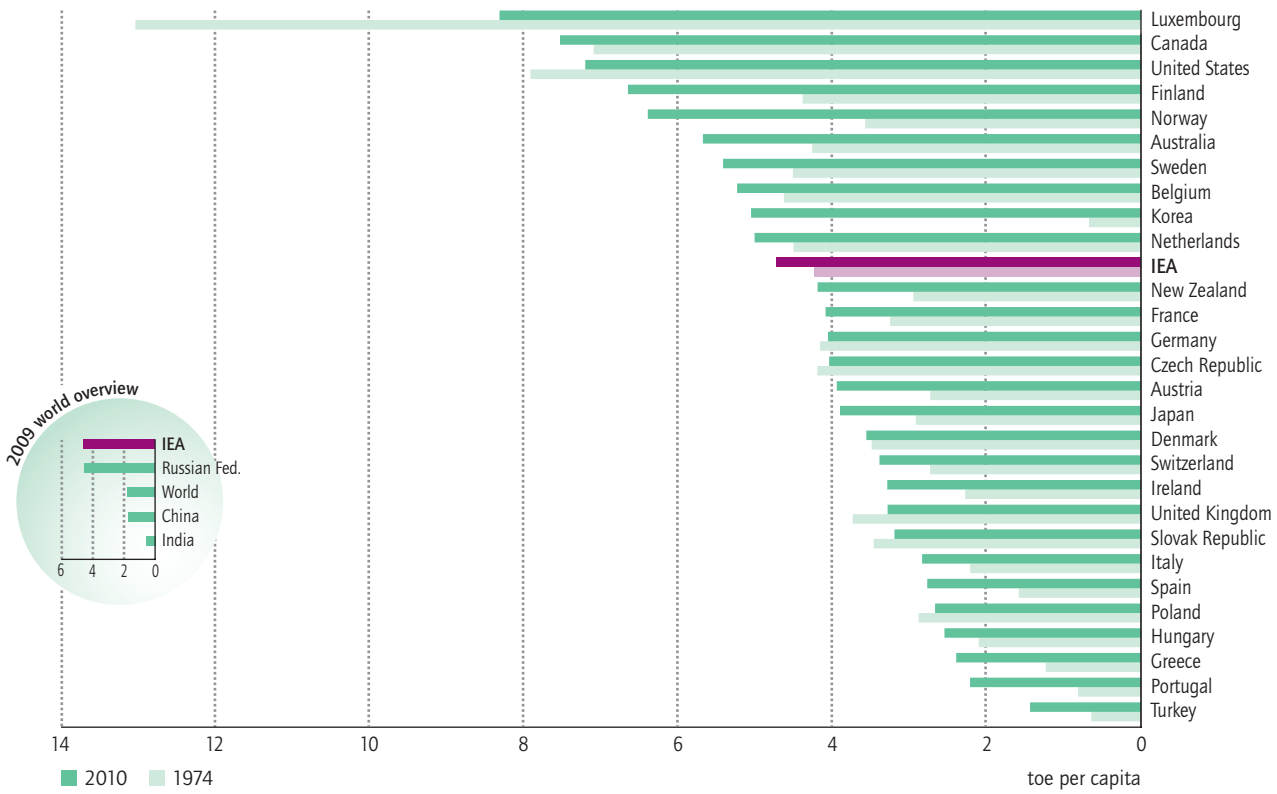
While the average IEA electricity consumption per capita has more than doubled since 1974, the average IEA TPES per capita has increased by only 12%. Moreover, since 2000, one can observe a plateau in the average IEA TPES per capita, while the plateau seems to come five years later (2005) for the average electricity per capita.

Saturation of the fleet of vehicles, impact of building codes and other efficiency measures, faster expansion of the service sector, and delocalisation of some energy-consuming industries collectively explain part of the lower growth in TPES per capita. Penetration of freezers, dishwashers and other white appliances, together with the booming penetration of video, hi-fi and computer equipment as well as electrical heating in several countries, explain the high growth of electricity per capita. However, as this equipment has recently reached saturation levels, growth in electricity consumption per capita has fallen.

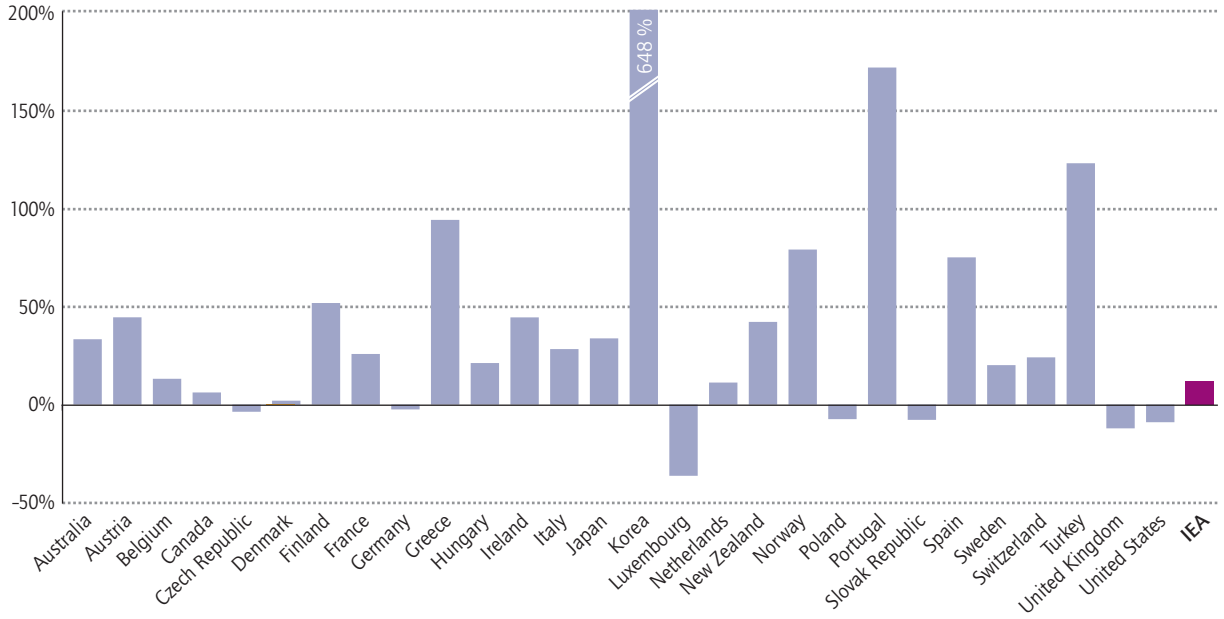


Average energy consumption per capita in IEA countries has increased by 12% since 1974, a much lower rate than the 90% GDP per capita growth. Consumption per capita varies considerably among countries.

Total primary energy supply per capita



Percentage change in TPES per capita between 1974 and 2010



TPES per GDP

▶ Energy intensity is often (although wrongly) associated with energy efficiency, and erroneously used to assess (if not to measure) how efficiently energy is used in a country. The energy intensity of an economy is a measure of how much energy is required to produce each unit of national revenue – in this report, measured in US dollars (USD).

▶ Efficiency is a contributing factor in intensity, but many other elements – often more significant – need also be considered. These include: the structure of the economy (presence of large energy-consuming industries, for instance); the size of the country (higher demand from the transport sector); the climate (higher demand for heating or cooling); and the exchange rate. In order to take into account the impact of the purchasing power parity (PPP) on the intensity of the countries, intensity can also be expressed in GDP PPP.

▶ Between 1974 and 2010, overall IEA energy intensity dropped by 42%, from 0.30 to 0.18 toe per 1 000 USD. This reflects changes in the economic structure of most IEA member countries (less industry and more services, especially with the delocalisation of high-consuming industries) combined with the savings of almost 60% from energy efficiency programmes. In fact, in 2009 the IEA had the lowest intensity (TPES per GDP) of the main countries and regions, slightly more than half of the world average (0.31 toe per 1 000 USD).

▶ All IEA countries, with the exception of Portugal and Greece, have experienced a decrease in their energy intensity since 1974. Intensity increased as these two countries "caught up" with other IEA countries in terms of industrialisation and, more generally, economic development. These countries also showed a high increase in terms of TPES per capita.

▶ The four IEA Eastern European countries (Czech Republic, Slovak Republic, Hungary and Poland) recorded the highest energy intensities, between two to three times higher than the IEA average. This is largely due to the comparatively low GDP and low efficiency in some sectors. Yet it is interesting to note that these four countries are also among those showing the greatest reduction in energy intensity since 1974. Again, the decrease can be attributed to economic restructuring and energy efficiency policies. By contrast, Switzerland reported the lowest intensity, due in part to the dominance of the service sector with high value added.

▶ Intensity trends in IEA countries are somewhat different when compared using GDP expressed on a PPP basis. The decrease in the average intensity is the same as for GDP using MER, but large variations are evident in the countries' respective levels of intensity. Contrary to TPES per GDP using MER, when using GDP PPP, Canada had the highest intensity.

▶ *Sources*

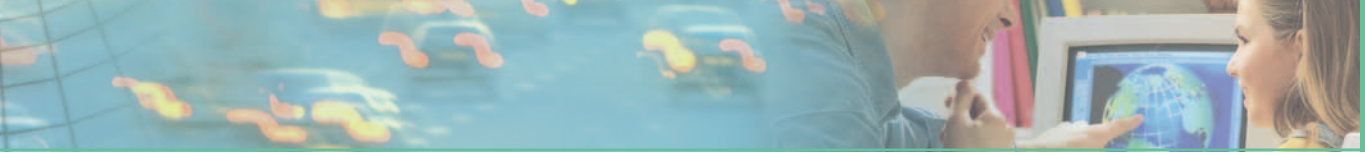
- *National Accounts of OECD Countries*, Volume 1, 2011, OECD.
- *World Development Indicators*, 2011, the World Bank.
- *World Energy Balances* online data service, 2011, *http://data.iea.org*, IEA.

▶ *For further information*

- *World Energy Outlook*, 2011, IEA.

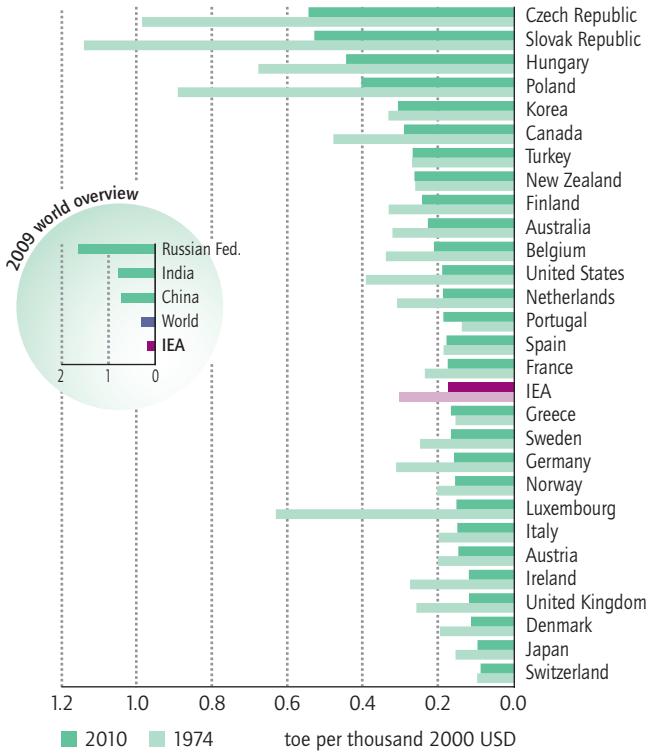
Energy intensity versus energy efficiency

TPES per GDP or TPES per GDP PPP is used to measure the energy intensity of a country's economy. Because TPES and GDP are numbers that are readily available for any country, energy intensity is often used as a proxy for energy efficiency. This is a mistake, however, since it is not because a given country has a low energy intensity that its efficiency is high. For instance, a small service-based country with a mild climate would certainly have a much lower intensity than a large industry-based country in a very cold climate, even if energy is consumed less efficiently in the first country than in the second. Energy efficiency is difficult to assess for a country as a whole. It is a concept associated with specific sectors and end-uses; thus, its analysis requires more detailed data. However, detailed data are only available up to 2008.

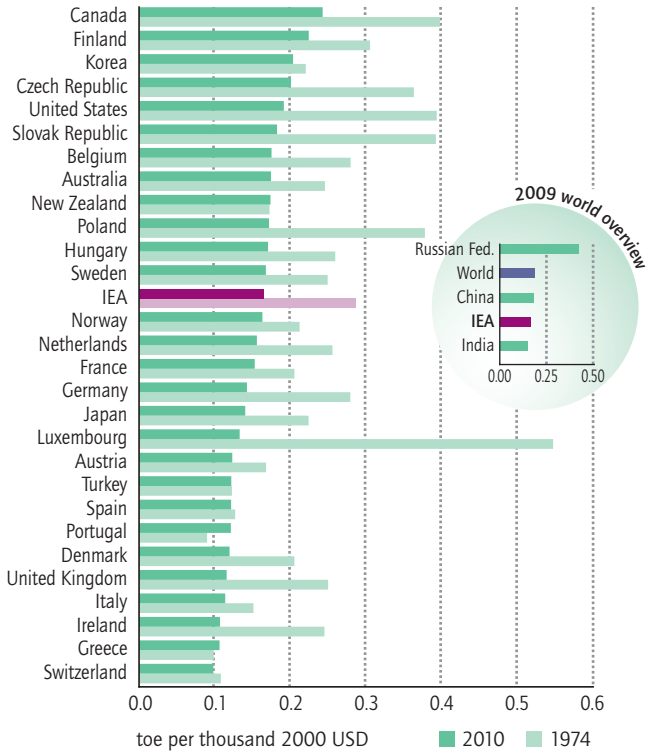


Decoupling of energy consumption and GDP growth is linked to delocalisation of energy-intensive industries, a shift to a service-based economy, and improved energy efficiency.

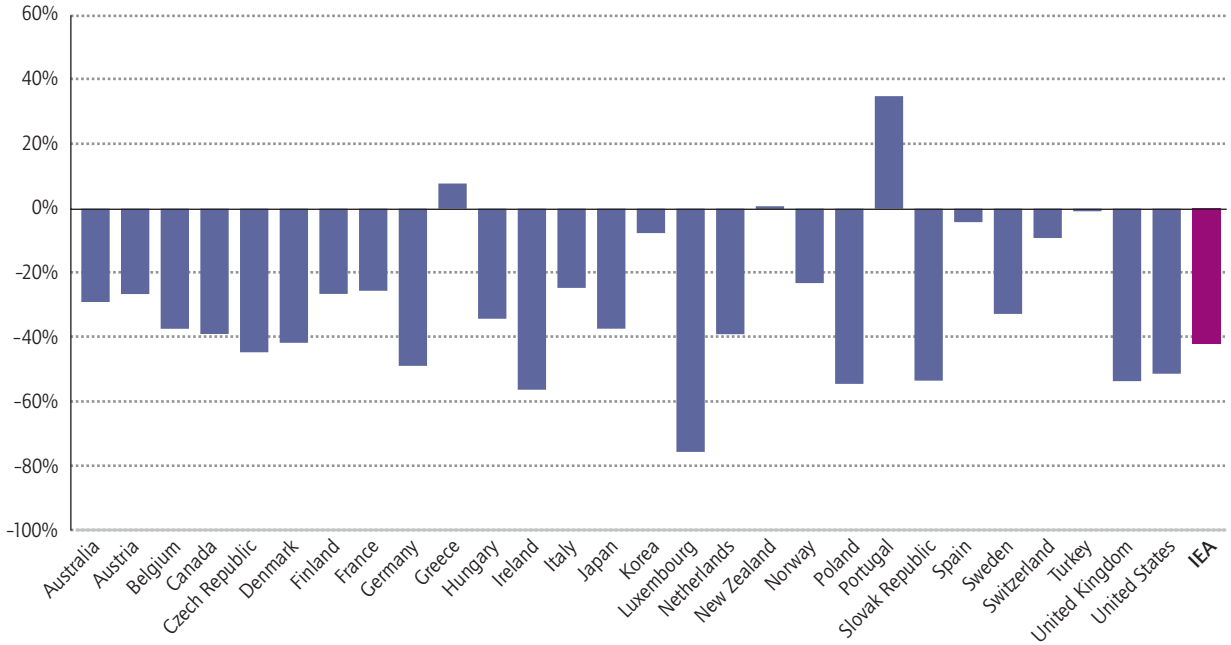
TPES per GDP



TPES per GDP PPP



Percentage change in TPES per GDP between 1974 and 2010



Energy efficiency savings in IEA member countries

▶ Since 1974, IEA countries have experienced a decoupling of the growth in energy consumption and GDP. The aggregate energy intensity (total final energy consumption per GDP) fell by 47% while GDP grew by a factor of 2.5 between 1974 and 2008.

▶ One of the most important issues from an energy policy perspective is, therefore, to understand to what extent improvements in energy efficiency have contributed to the decline in average energy intensity. It would be misleading to use the aggregate intensity indicators to assess efficiency, as intensity is affected by numerous factors not directly related to energy, such as climate, geography, travel distance, home size and manufacturing structure.

▶ Better understanding of the factors affecting energy use over time, including the role of energy efficiency, requires indicators based on more detailed data than are available in the IEA energy balances. This more detailed information is currently available, on a comparable basis, for 11 IEA countries for the period 1974 to 2008, and for 16 IEA countries for the period 1990 to 2008.

▶ These disaggregated indicators show that improved energy efficiency has been the main reason for the decoupling of energy use and GDP between 1974 and 2008 in those 11 IEA countries. Without the efficiency improvements that occurred, energy consumption would have been 63% higher in 2008 than it actually was.

▶ Energy efficiency gains for the 11 IEA countries analysed were approximately 2.1% per year from 1974 to 1990; subsequently, lower energy prices have had a negative impact on efforts to increase efficiency. Between 1990 and 2008, the gains decreased significantly to less than 1.0% per year.

▶ In the decomposition approach used by the IEA, changes in aggregate intensity in each country are attributed to changes in the ratio of energy services to GDP (structure) and to changes in specific energy intensity (a proxy for energy efficiency). For the 16 IEA countries analysed, the results show that both structure and energy efficiency contributed to reducing aggregate intensity between 1990 and 2008, with each factor contributing differently depending on the period. For the overall period, energy efficiency accounted for 61% of the total decline in aggregate energy intensity.

▶ The relative contribution of structure and efficiency to the overall trend varies among countries. All countries analysed show that the energy efficiency effect contributed to reducing the ratio of energy use to GDP. For about half of the countries, it was the dominant factor.

▶ The reasons for the different trends in energy efficiency amongst countries are complex. Canada and the United States had high levels of energy intensity in 1990, but are now slowly converging with the IEA average. In Norway and the United Kingdom, changes in the manufacturing structure and the relative importance of the different sectors in the overall economy partly explain the high structure impact. In Germany, all sectors of the economy improved their energy efficiency.

▶ *Source*

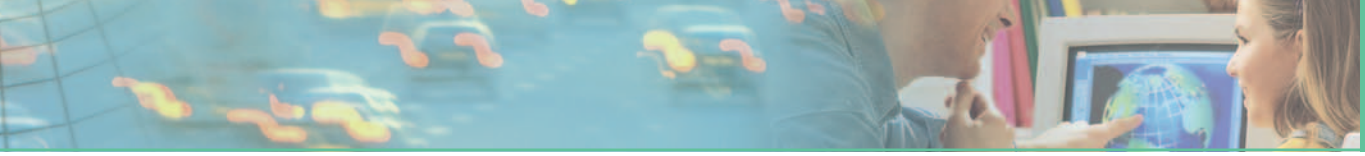
- IEA Indicators Database, 2011, OECD/IEA.

▶ *For further information*

- *Towards a More Energy Efficient Future*, 2009, OECD/IEA.
- *IEA Scoreboard 2009: 35 Key Energy Trends over 35 Years*, 2009, OECD/IEA.
- ODYSSEE database on energy efficiency indicators, *www.odyssee-indicators.org.*

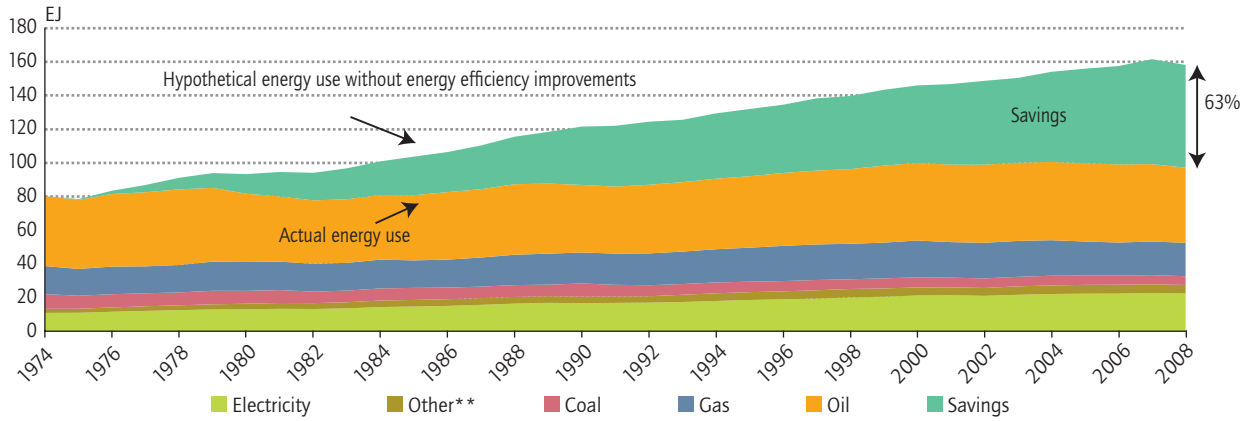
Accelerating the energy efficiency rate of improvement

The IEA indicators analysis shows that improvements in energy efficiency over the past years have played a key role in limiting global increases in energy use and CO_2 emissions. Of serious concern, however, was the rapid deceleration of the rate at which energy efficiency has improved since 1990. But there is now a good sign that this trend is changing. The analysis indicates that the rate of improvement increased in the past few years, a step in the right direction in achieving a more sustainable energy future.

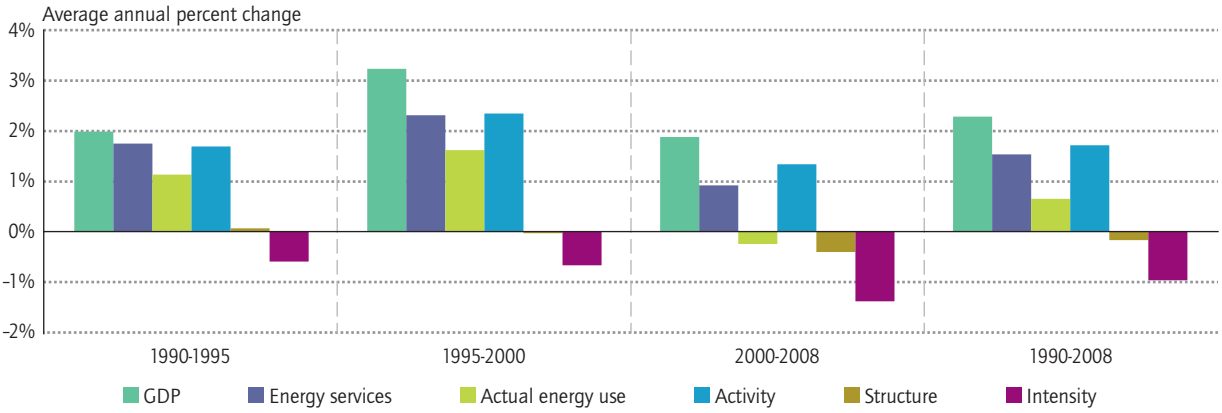


While the rate of efficiency improvement declined from 2.1% prior to 1990 to less than 1.0% thereafter, recent data show that the rate of improvement accelerated in the past 5 years.

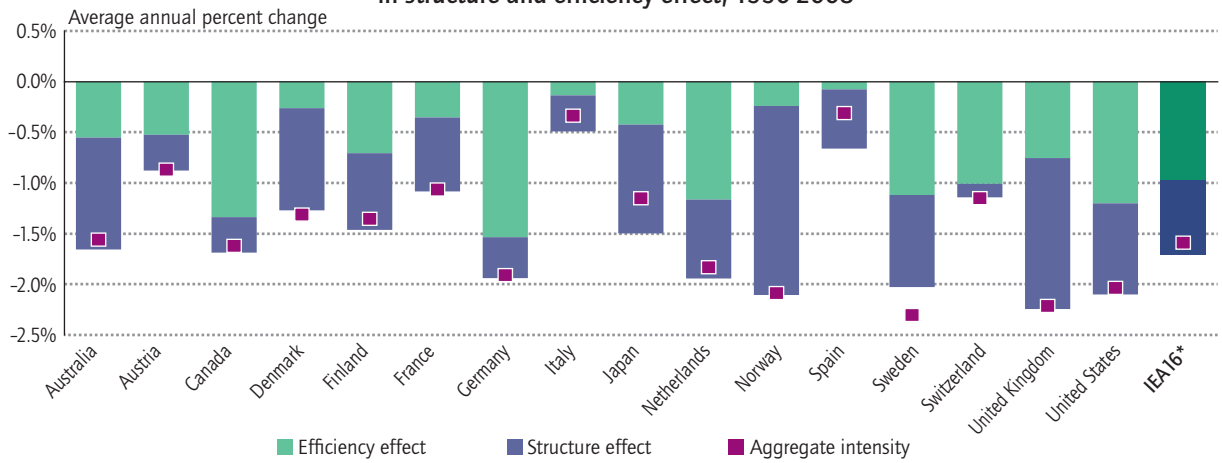
Long-term energy savings from improvements in energy efficiency, IEA11*



Factors affecting final energy consumption, IEA16*



Changes in aggregate intensity decomposed into changes in structure and efficiency effect, 1990-2008



** IEA average is limited to countries shown in graph. See Annex 3 for list of countries included in IEA groupings.*

*** Other includes combustible renewables and waste, heat, geothermal and solar thermal energy.*

Energy intensity in manufacturing industries

▶ A measure of aggregate manufacturing energy intensity (not efficiency) can be obtained by dividing total manufacturing energy use by total manufacturing value-added. Final energy use in manufacturing industry can either include or exclude energy consumed in coke ovens, blast furnaces and steam crackers, as well as feedstocks for the production of synthetic organic products; this analysis includes energy consumed but excludes feedstocks.

▶ To have a true comparison of efficiency between countries, detailed data are needed on both energy use and corresponding physical output per sub-sector and per product. At present, such data are unfortunately not available for most IEA member countries. Clearly, there is a strong need to collect this information to facilitate more meaningful analysis.

▶ For a group of 19 IEA member countries for which consistent data are available, the aggregate energy intensity in manufacturing fell by 34% between 1990 and 2008, at an average rate of 2.3% per year. This reflects a strong decoupling of energy use from output (as measured by value-added). Despite a 51% increase in output, final industrial energy use remained stable.

▶ All countries analysed have shown reductions in their energy intensity. Variations in aggregate intensity can be explained, at least to some extent, by two main factors: the differences in the composition of the manufacturing sector (the structure effect) and the relative intensity of each sub-sector.

▶ The composition of the industrial sector changed gradually through the 1990s and the 2000s. An increase in the value-added share of several less energy-intensive sub-sectors, especially in Finland, Japan and Sweden, contributed to the decoupling of energy use and value-added.

▶ IEA countries for which data are available show significant differences in the composition of their manufacturing sector. In several countries, more than 35% of total output comes from energy-intensive industries in 2008 (Australia, Belgium, Canada, the Netherlands, New Zealand and Norway). By contrast, in Finland, Germany, Italy, Japan and Korea, these sub-sectors account for less than one-quarter of total manufacturing output.

▶ The current analysis shows that, in about half of the countries analysed, energy efficiency improvements (as measured by changes in the structure-adjusted intensities) were the main factor restraining growth in energy consumption. Overall, about half of the improvement in the aggregate intensity can be explained by improved energy efficiency. However, the contribution of energy efficiency was significantly lower than it was from 1974 to 1990.

▶ A few of the countries analysed showed results that differed from the overall trends. For example, in Finland, Japan and Sweden structural changes were the main factor restraining the growth in energy consumption. In the case of Finland and Sweden, this effect was augmented by important improvements in energy efficiency.

▶ *Source*

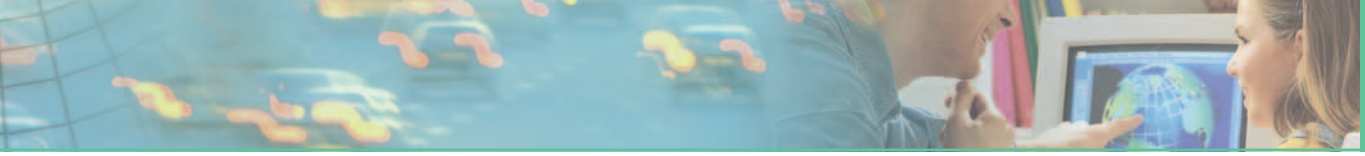
- IEA Indicators Database, 2011, OECD/IEA.

▶ *For further information*

- *Towards a More Energy Efficient Future*, 2009, OECD/IEA.
- *Energy Technology Transitions for Industry*, 2009, OECD/IEA.
- ODYSSEE database on energy efficiency indicators, *www.odyssee-indicators.org*.

Estimating energy efficiency trends in the manufacturing sector

IEA methodology for analysing trends of end-use energy consumption distinguishes among three main components that affect energy use: activity levels (measured as value-added), structure and energy intensities (energy use per unit of sub-industry activity, a proxy for energy efficiency). In the industry sector, detailed energy and activity data are required to accurately capture the changes in energy attributable to structural changes and quantify energy efficiency improvements. However, not all countries report the level of information requested by the IEA. For example, Australia, Japan and Switzerland report on their energy consumption of several sub-sectors in "other manufacturing"; as such, the structural changes within the other manufacturing sector are included in the energy efficiency improvements.

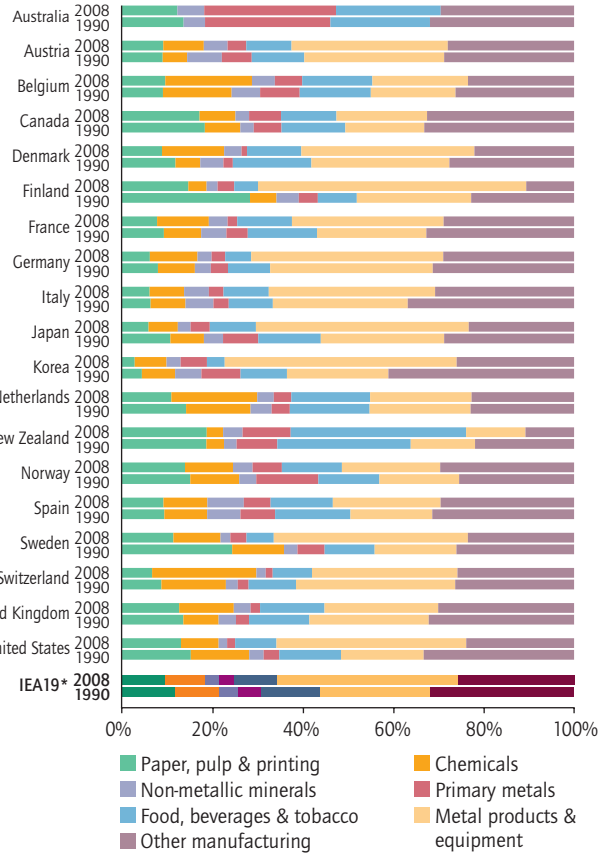


A rapid increase in the share of several less-intensive sub-sectors helped the decoupling of energy use and value-added in the manufacturing sector.

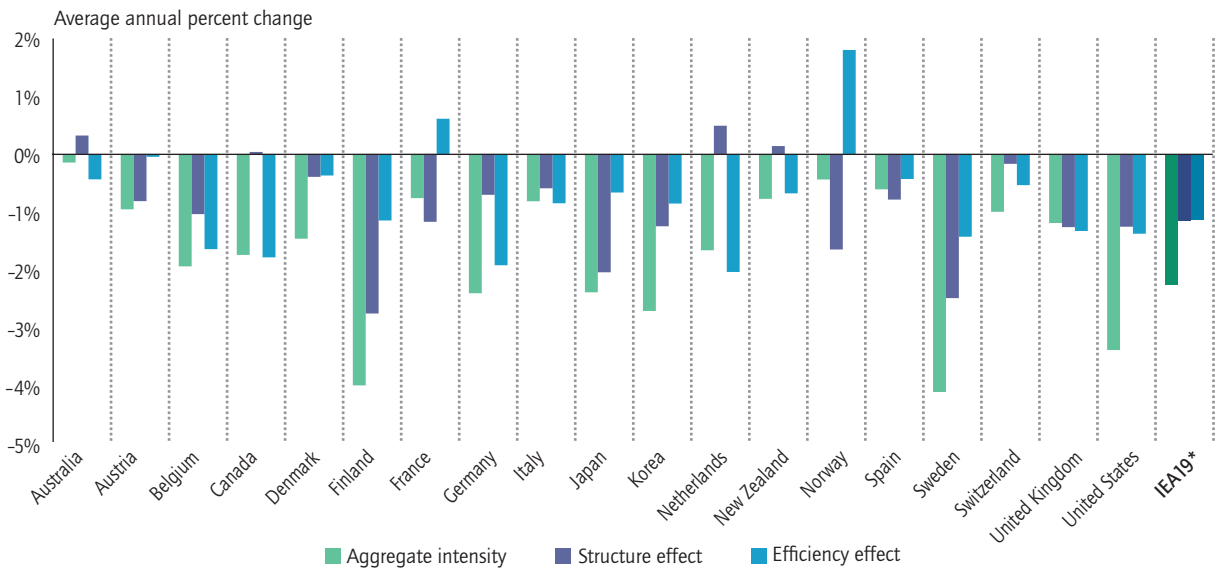
Manufacturing energy use per value-added



Composition of manufacturing value-added



Decomposition of changes in manufacturing energy intensity, 1990-2008



** IEA average is limited to countries shown in graph. See Annex 3 for list of countries included in IEA groupings.*

Energy efficiency in freight transport

▶ In IEA member countries, the transport sector accounts for roughly one-third of total final energy consumption. However, detailed information on energy consumption by transport segment and by mode of transport is not available from country energy balances. As a result, analysis of freight transport energy consumption can be performed only for 18 member countries for which the information is available.

▶ For the 18 member countries analysed, freight transport accounted for roughly 34% of total transport in 2008, up from 32% in 1990. Its consumption, largely dominated by trucks with 88% of the sector's demand, increased by 32% between 1990 and 2008.

▶ Freight haulage, as measured by tonne-kilometres (tkm), increased by 39% between 1990 and 2008, mostly due to an increase in trucking activity in all the IEA member countries analysed. Trucks accounted for 46% of total freight haulage, followed by rail (37%) in 2008. However, the respective shares vary dramatically from country to country, largely in relation to the size of the country, the length of coasts, the network of large rivers, the development of the rail network, etc.

▶ For instance, lower shares can be observed in terms of tkm for trucks in large countries with coasts and rivers, such as Canada and the United States. By contrast, truck shares are typically higher for smaller countries with less favourable rivers, such as Greece or Denmark. Switzerland has a strong policy for encouraging rail (including trucks on trains) and, thus, has the second-highest share for rail (43%); while the Netherlands, with large ports and a well-developed network of canals, has a high share for ships.

▶ The energy intensities of trucks, ships and train vary significantly, with trucks being the most intensive. On average, trucks use up to 13 times more energy than train to move one tonne of goods. Taking into account the specific intensity of each mode, the average intensity of freight transport for the countries analysed declined by 4.9% between 1990 and 2008, as reductions in the intensity of individual modes more than offset the increased share of energy-intensive trucking.

▶ The large differences in country intensities reflect many factors, but particularly the relative importance of trucking versus rail. Countries with low intensity (such as Australia, Canada and the United States) have higher shares of rail transport. Conversely, the highest energy intensities are generally found in smaller countries with low shares of rail freight (Greece and Denmark, for example).

▶ Because of the importance of trucking in the freight sector, its intensity is a main driver of the overall energy-use pattern of freight transport. The range for energy intensity of trucking in a given country reflects numerous factors, such as the type of goods moved, size and geography, average load factors, vehicle fuel efficiency, and driving behaviour, as well as the split between urban delivery trucks and long-haul trucks (the latter of which are much larger and less energy intensive).

▶ *Source*

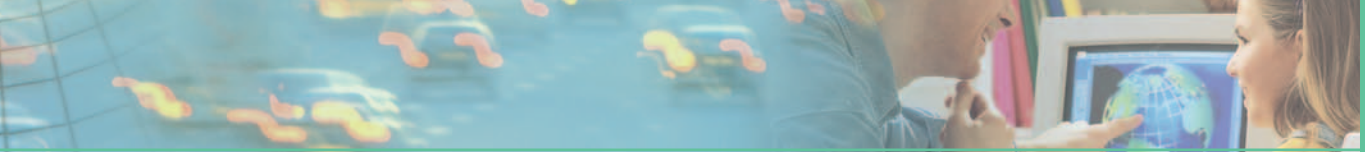
- IEA Indicators Database, 2011, OECD/IEA.

▶ *For further information*

- *Transport, Energy and CO_2: Moving toward Sustainability*, 2009, OECD/IEA.
- *Towards a More Energy Efficient Future*, 2009, OECD/IEA.
- ODYSSEE database on energy efficiency indicators, *www.odyssee-indicators.org.*

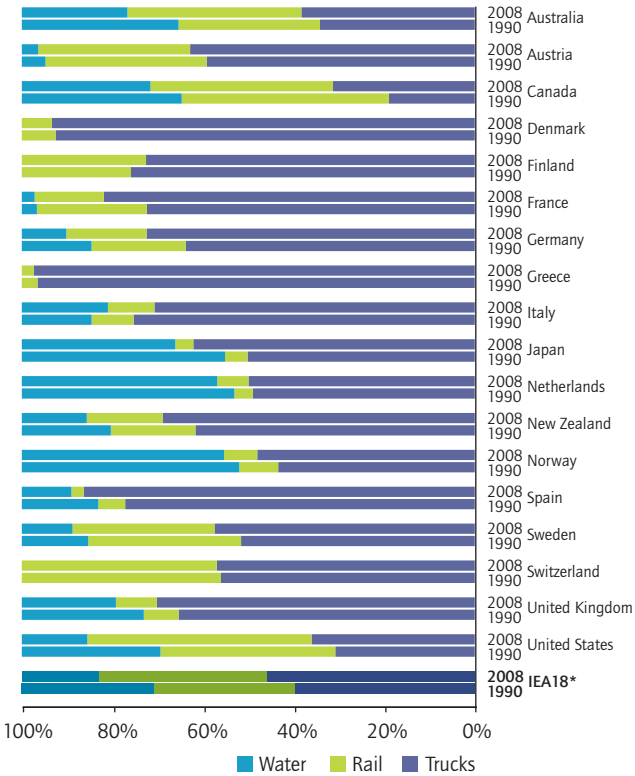
Energy efficiency of freight transport

When examining the energy intensity by mode, country comparisons show three areas for large reductions in freight energy consumption: better management of load factors; greater use of trains and ships where possible; and improved fuel economy for trucks. Furthermore, even though trucks have become somewhat more efficient over time, IEA analysis reveals major opportunities to realise more significant savings through technical and operational measures (such as driver training), and logistical systems to improve efficiency in the handling and routing of goods. According to IEA estimates, better technologies can increase the efficiency of new trucks by 30% to 40%.

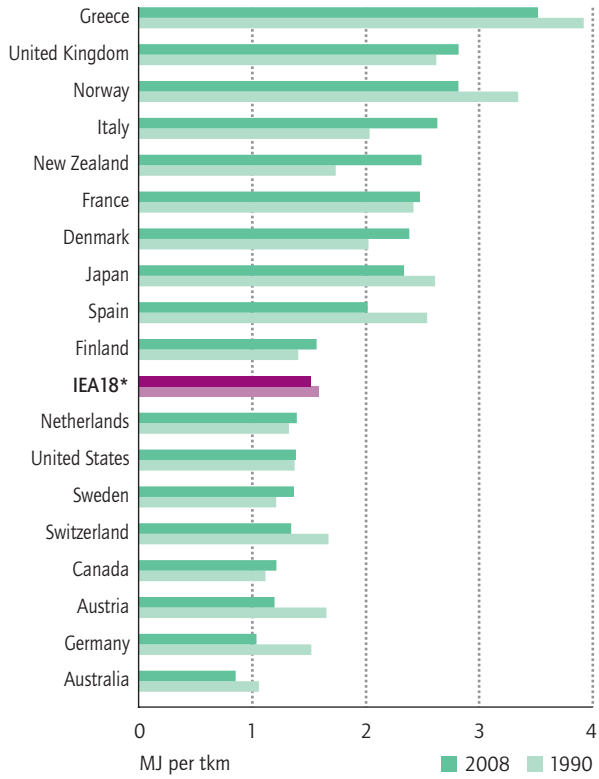


More efficient trucks and load management have reduced the overall energy consumption per tonne-km and offset the increase in energy consumption due to higher share of trucks.

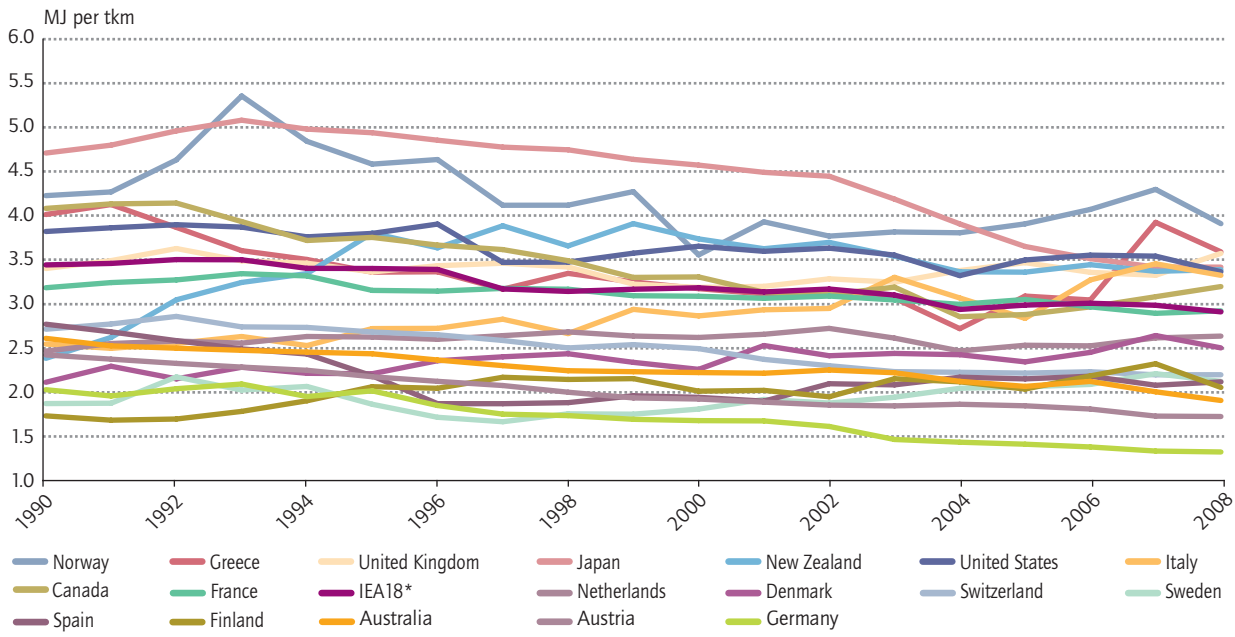
Share of tonne-km by transportation mode



Freight transport energy per tonne-km



Truck freight energy intensity



** IEA average is limited to countries shown in graph. See Annex 3 for list of countries included in IEA groupings.*

Energy efficiency in passenger transport

▶ As is the case for freight transport, detailed information on passenger transport is only available for 18 IEA member countries. According to 2008 data for these 18 countries, approximately 66% of energy consumption in the transport sector goes to passenger transport.

▶ Passenger transport accounts for a very high share of IEA oil consumption, due to the massive dominance of cars, planes and buses (all of which are almost exclusively dependent on petroleum products). As a result, approximately 44% of the total final oil consumption in the countries analysed is used in passenger transport. Thus, it is important to look closely at this sector when defining policies to decrease oil consumption.

▶ Many factors, such as travel patterns (including passenger travel activity), income levels, car ownership rates and average fuel economy affect the level of passenger transport energy use. Passenger travel activity in these countries, one of the key factors, increased by 33% between 1990 and 2008. Over the same period, passenger transport energy consumption increased by 22% indicating an improvement in the sector's average energy intensity.

▶ The share of travel by mode differs from country to country, reflecting diverse demographic and geographic characteristics as well as different levels of provision for urban and intercity transport. For all countries analysed but one, cars accounted for more than 70% (and often more than 80%) of passenger-kilometres. Japan stands out because of the large share of passenger-kilometre travelled by rail (29% in 2008).

▶ The share of each mode, together with its respective energy intensity, influences the trend in the overall energy intensity for passenger transport. From 1990 to 2008, the energy intensity of passenger transport for the 18 IEA countries analysed decreased by 8%. This improvement varies greatly country by country, with Germany, Greece and New Zealand having improved their intensity by over 20%. In 2008, France, Italy and Norway had the lowest intensities.

▶ Cars (with an 87% share) are by far the largest energy user; thus, it is important to focus on the fuel intensity of new cars. In most countries, the fuel intensitiy of new cars decreased, even though the levels of intensity vary greatly from country to country. In some cases, higher intensity can be explained by the consumers' preference towards bigger vehicles to drive long distance.

▶ Through much of the 1980s and 1990s, new car lab-tested fuel economy remained fairly constant across many IEA member countries. It began to show steady improvements in Europe and Japan in the mid- to late 1990s in response to new national and regional policies. This has increased the disparity in fuel economy between North American, European and Asian-Oceania IEA countries.

▶ *Sources*

- IEA Indicators Database, 2011, OECD/IEA.
- IEA Mobility Model (MoMo), 2011, OECD/IEA.

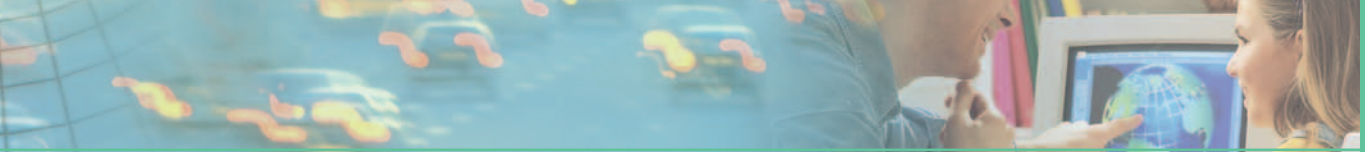
▶ *For further information*

- *Transport, Energy and CO_2: Moving toward Sustainability*, 2009, OECD/IEA.
- *Towards a More Energy Efficient Future*, 2009, OECD/IEA.
- ODYSSEE database on energy efficiency indicators, *www.odyssee-indicators.org.*

Consistency between transport energy and activity data

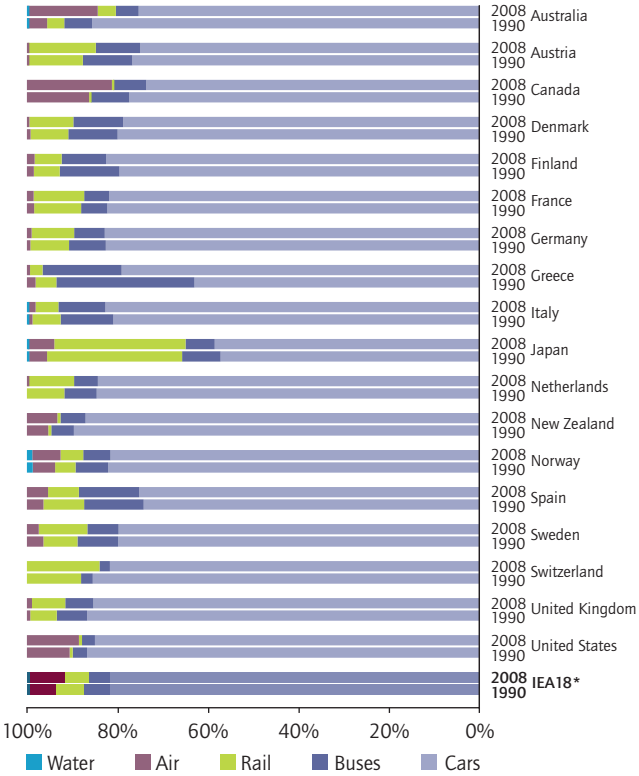
The indicators used in the energy efficiency analysis of the transport sector (such as the energy intensity of passenger and freight transport) are only meaningful if calculated with a consistent set of energy and activity data. However, this is not always the case: while some countries are "adjusting" the energy data to take into account "fuel tourism", this is not the case for all countries; activity data reported by countries do not always follow the same definition or boundaries as the energy data; and it may be difficult to distinguish between domestic and international transport.

There is an urgent need to improve transparency of the transport data and develop common definitions and methodologies to raise the quality of data and analysis.

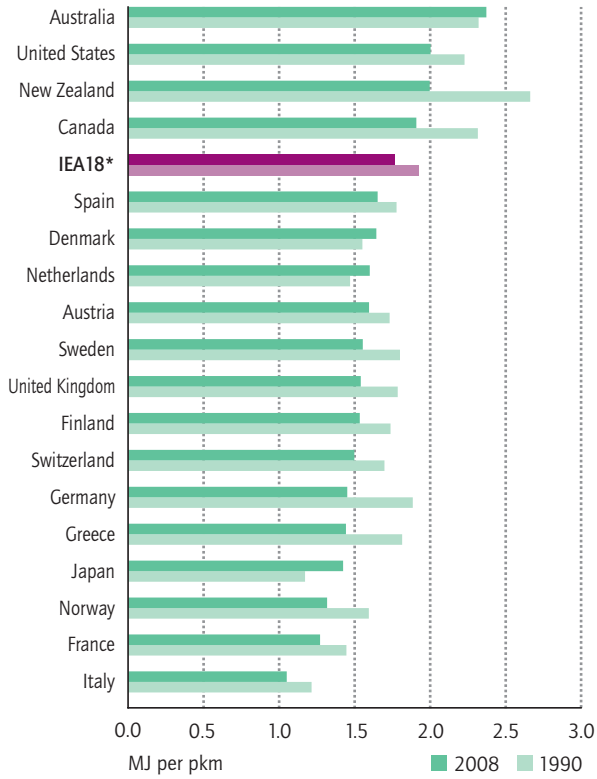


Cars continue to dominate passenger transport, thus improved fuel efficiency of new cars led to a decrease in energy per passenger-km in most countries.

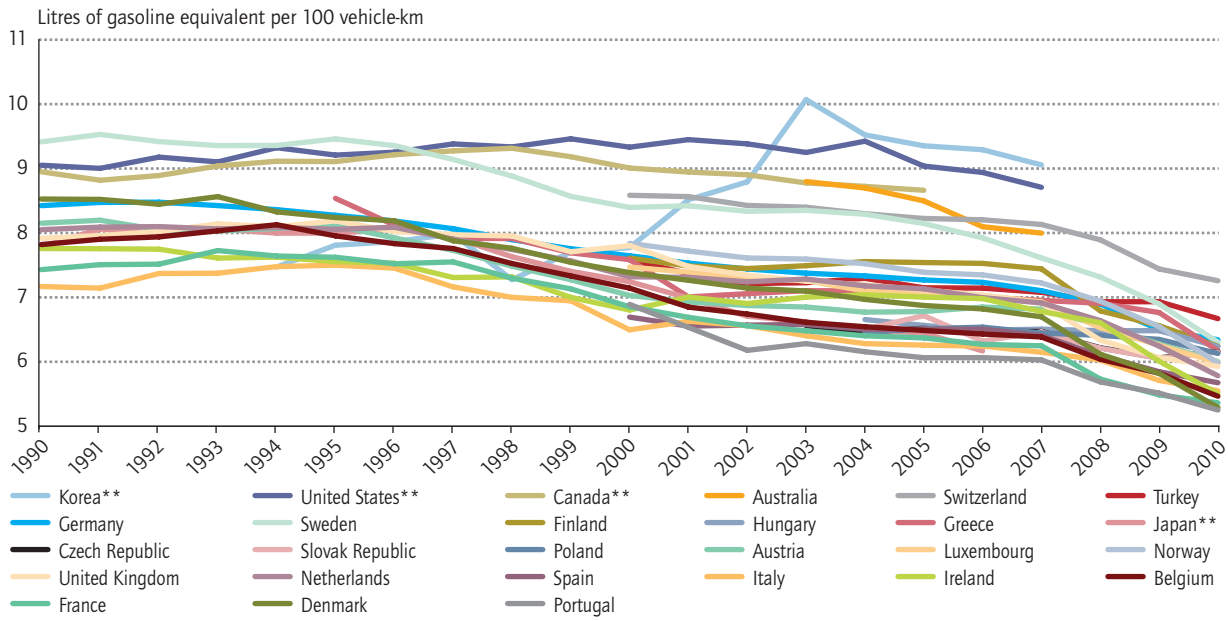
Share of passenger-km by transportation mode



Passenger transport energy per passenger-km



Trends in new car fuel economy



** IEA average is limited to countries shown in graph. See Annex 3 for list of countries included in IEA groupings.*

*** Data for Canada, Japan, Korea and the United States are not directly comparable with the other countries.*

Energy efficiency in households

▶ Total households final energy consumption in IEA member countries increased by 20% between 1990 and 2008, while population grew by 13%. This improvement in aggregate energy intensity may be explained in part by improvements in the intensity of each end-use or a change to the structure of households.

▶ Aggregate indicators can be developed for all IEA countries. However, an understanding of the factors explaining the changes in energy consumption require detailed indicators corrected to take into account climatic variations. Such indicators are available only for a group of 18 member countries.

▶ Space heating energy consumption remained relatively stable between 1990 and 2008, while consumption from other end-uses grew substantially. Nevertheless, space heating remained, by far, the most important end-use in the residential sector for all countries analysed, except Japan. The share of space heating energy consumption in the sector actually fell from 58% in 1990 to 51% in 2008. This reflects a rapid growth in appliances energy use, as well as a significant reduction in the per capita energy requirement for space heating, driven by higher efficiencies of space heating equipment and improved thermal performance of new and existing dwellings. On a country basis, Germany has the highest share for heating (74%) and Japan the lowest (24%).

▶ Overall, for the countries analysed, more than half of the energy requirements for space heating is met by natural gas. However, fuel shares vary significantly from country to country. In Japan and Switzerland, oil remains the dominant fuel. Electricity is important for Canada, Norway and Sweden, but represents only 9% of the total energy consumed for space heating in the 18 countries together. In Denmark, Finland and Sweden, district heating represents the most important energy commodity for space heating.

▶ Several factors affect energy use for space heating in households including dwelling size, number of occupants, efficiency of heating equipment and demand for useful energy per unit of area heated (useful energy intensity).

▶ For most of the countries analysed, fewer occupants and larger homes have tended to drive up energy demand for space heating. This increase was offset, however, by lower end-use conversion losses and, more importantly, a decline in the useful intensity of space heating. Spain is the noticeable exception: useful intensity of space heating is calculated based on total floor area; the increase in intensity in Spain is due to a higher share of floor area heated.

▶ Energy efficiency policies, such as mandatory building codes and minimum energy performance standards for heating equipment, can play an important role in improving the overall efficiency of meeting space heating needs. However, it is not possible with the current set of space heating indicators to analyse separately how such policies affect energy use.

▶ *Source*

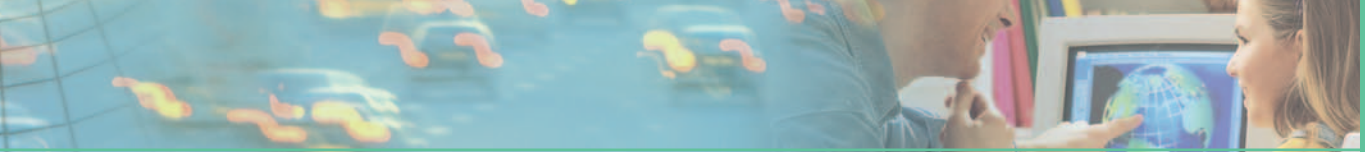
- IEA Indicators Database, 2011, OECD/IEA.

▶ *For further information*

- *Gadgets and Gigawatts: Policies for Energy Efficient Electronics*, 2009, OECD/IEA.
- *Towards a More Energy Efficient Future*, 2009, OECD/IEA.
- ODYSSEE database on energy-efficiency indicators, *www.odyssee-indicators.org.*

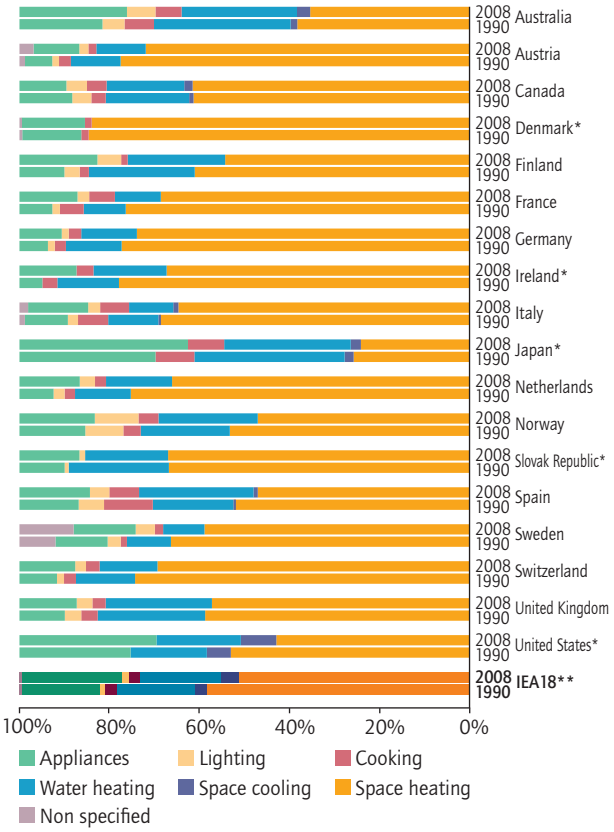
The role of policies in energy trends

Energy efficiency policies targeting households in IEA countries have focused on restraining energy demand from space heating and large appliances through mandatory building codes, energy performance standards and targets, voluntary agreements with industry, and labelling to help guide consumer choices. These policies played a key role in achieving energy efficiency improvements. However, in the case of appliances, these savings were offset by the rapid expansion in the stock and use of a broader array of small appliances.

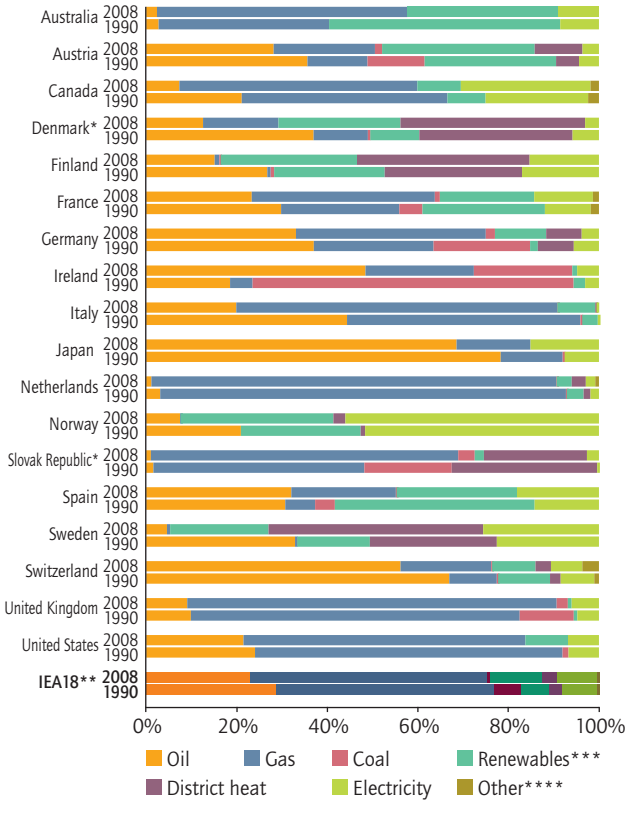


Despite the decrease in its intensity, space heating still accounts for more than half of household energy consumption in IEA member countries.

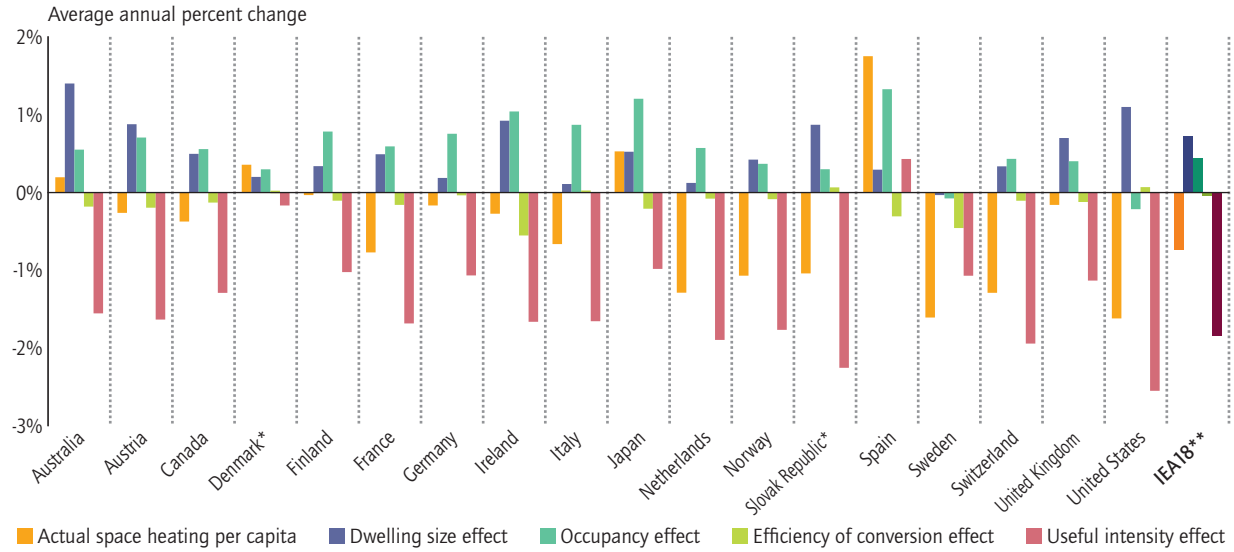
Household energy use by end use



Share of space heating by energy source

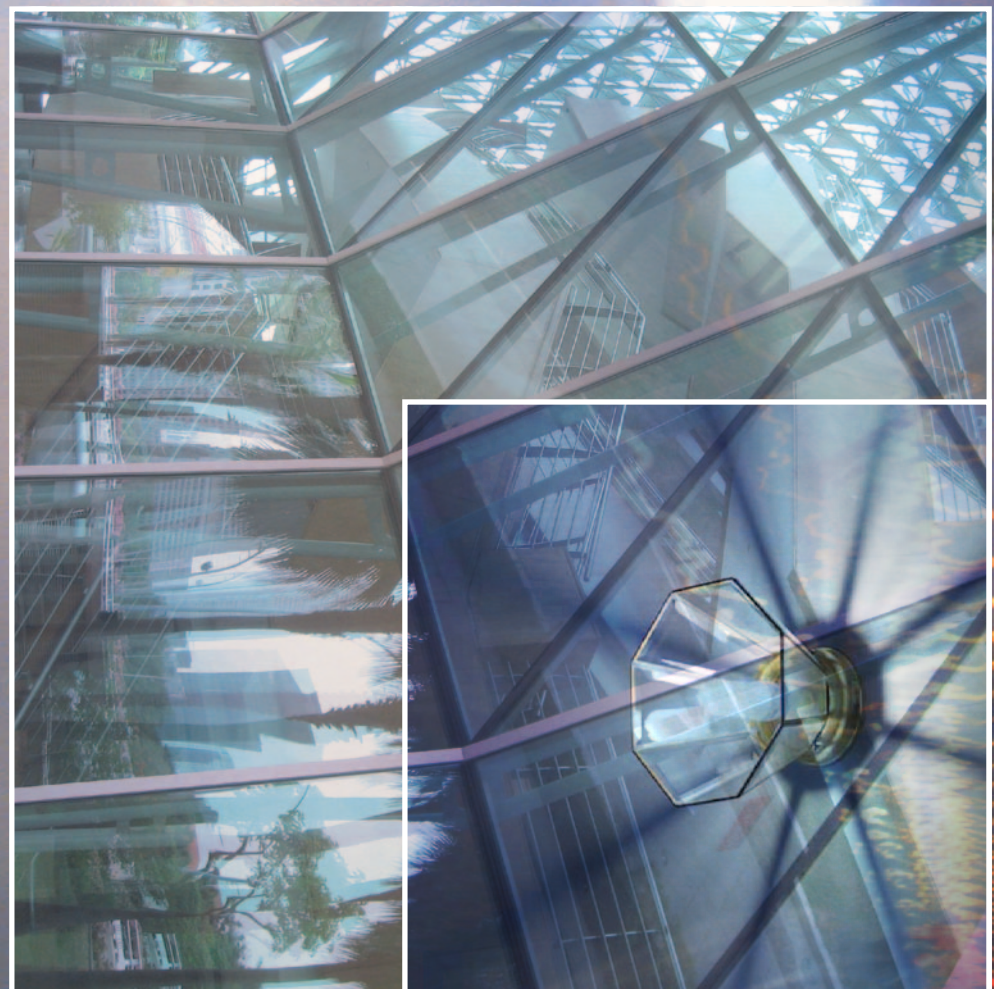


Decomposition of changes in space heating per capita, 1990-2008



** Lighting is included in appliances for Denmark, Ireland and Japan; water heating is included in space heating for Denmark; cooking is included in space heating for the Slovak Republic; lighting and cooking are included in appliances for the United States. ** IEA average is limited to countries shown in graph. See Annex 3 for list of countries included in IEA groupings. *** Renewables includes combustible renewables and waste. **** Other includes geothermal and solar thermal energy.*

Qualifying energy efficiency actions



Qualifying energy efficiency actions

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Summary of recent energy efficiency policy developments

To support governments with their implementation of energy efficiency, the IEA recommended the adoption of specific energy efficiency policy measures at the G8 Summits in 2006, 2007 and 2008. The consolidated set of recommendations presented to these summits covers 25 fields of action across seven priority areas: cross-sectoral activity; buildings; appliances; lighting; transport; industry; and energy utilities. The IEA estimates that if implemented globally without delay, proposed actions could save as much as 7.6 $GtCO_2$/yr by 2030, which is almost 1.5 times current US annual CO_2 emissions.

In 2009, the IEA conducted a first evaluation of member-country implementation of the IEA energy efficiency recommendations and similar measures. The 2009 evaluation revealed that governments were implementing a wide array of innovative energy efficiency measures. These included national strategies and action plans; minimum energy performance standards (MEPS) for appliances and equipment; financial instruments and policies requiring improved energy efficiency in buildings; adoption of standby power; and the phase out of inefficient lighting. Policies also promoted proper tyre inflation and provided incentives for energy utilities to promote end-use energy efficiency.

An overview of the results of the 2011 evaluation revealed important energy efficiency policy developments since 2009. In particular, by 2011, IEA member countries had implemented many of the policies in the transport, appliance and lighting sectors, which had only been planned in 2009.

Some of the developments highlighted in the 2011 evaluation include policies to improve energy efficiency in the building sector by introducing and strengthening MEPS in building codes, implementing building certification, and collecting and publishing information on energy efficiency in existing buildings.

In the appliance sector, IEA countries are strengthening and expanding MEPS and implementing planned standby power requirements.

The transport sector has experienced noteworthy policy development since 2009, especially related to regulations for tyre-pressure monitoring systems (TPMS), tyre rolling resistance and labelling, CO_2 emissions standards for passenger cars, and policies to promote eco-driving and feedback instruments. Energy management and promotion of MEPS for motors have strengthened energy efficiency policy in industry and some governments have further implemented policies to encourage energy utilities to deliver cost-effective energy savings to end-users.

These examples illustrate the significant progress IEA countries have made with implementing energy efficiency policies since 2009. This policy implementation experience is a valuable resource for IEA member and non-member countries alike. The IEA is disseminating policy implementation experience through the *Policy Pathway* series, activities that contribute to the International Partnership for Energy Efficiency Cooperation (IPEEC), and the IEA Training and Capacity-Building Programme.

IEA and non-IEA countries can profit further from the numerous benefits of energy efficiency – energy security, climate change mitigation, job creation and health improvements – by identifying areas where cost-effective energy savings potential remains and implementing policies to capture these savings.

IEA 25 energy efficiency policy recommendations

Cross-sectoral

1. *Energy efficiency investment*
2. *National energy efficiency strategies and goals*
3. *Compliance, monitoring and enforcement*
4. *Energy efficiency indicators*
5. *Evaluating energy efficiency policy implementation*

Buildings

6. *Building codes for new buildings*
7. *Passive energy houses and zero energy buildings*
8. *Energy efficiency incentives for existing buildings*
9. *Building certification schemes*
10. *Energy efficiency improvements in glazed areas*

Appliances and equipment

11. *MEPS and labels*
12. *Low-power modes, including standby power*
13. *Televisions and "set-top" boxes*
14. *Test standards and measurement protocols*

Lighting

15. *Phase-out of incandescent bulbs*
16. *Non-residential building lighting*

Transport

17. *Fuel-efficient tyres*
18. *Fuel economy, light-duty vehicles*
19. *Fuel economy, heavy-duty vehicles*
20. *Eco-driving*

Industry

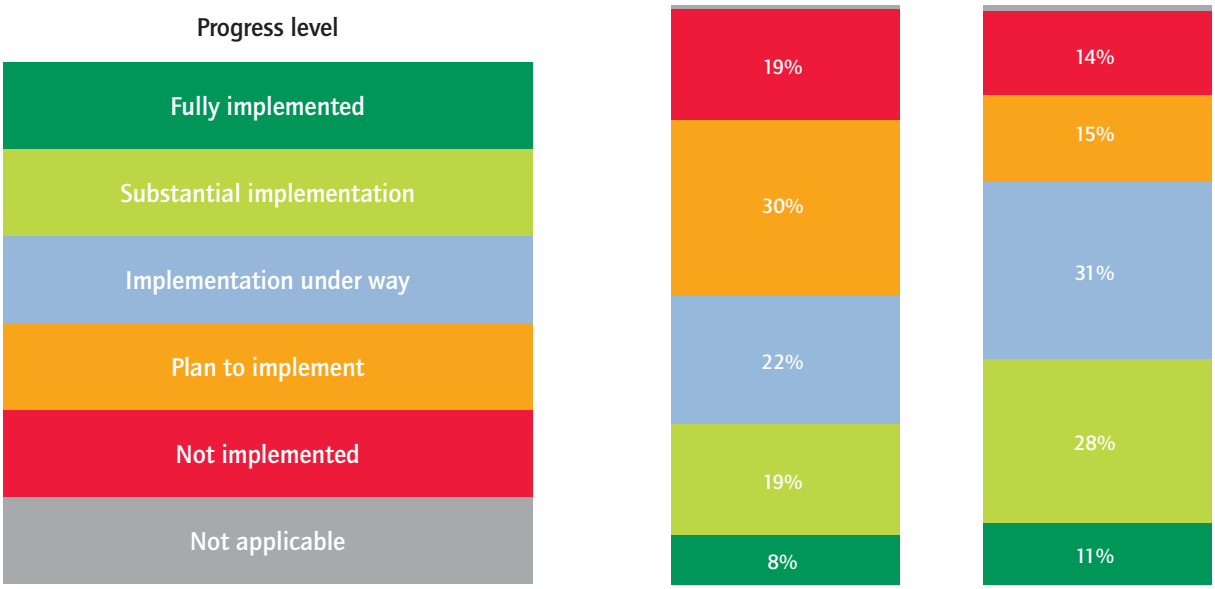
21. *Industry indicators*
22. *MEPS for electric motors*
23. *Energy management*
24. *Energy efficiency in SMEs*

Energy utilities

25. *Utility end-use energy efficiency schemes*

The 2011 evaluation reveals that 11% of IEA energy efficiency policy recommendations are now fully implemented, as compared to 8% in 2009.

Implementation of all applicable recommendations, all IEA member countries



Colour grading system used for reporting implementation of the IEA 25 energy efficiency policy recommendations

Multiple targets contribute to overall energy efficiency goal

The IEA 25 energy efficiency policy recommendations deliver large reductions in energy demand, at low cost and with considerable economic benefit for consumers. The policies address market barriers by helping consumers benefit from better services from more efficient equipment.

The 2011 IEA survey reveals substantial policy implementation and innovations since 2009. All member countries have developed and implemented new energy efficiency policies, and stakeholders in all sectors have benefited from recent policy developments.

Significant additional energy savings could be achieved through further energy efficiency policy implementation.

The experience IEA countries have gained with implementing energy efficiency policies is a valuable resource for other member countries and for non-IEA countries. Creating opportunities to share experience will accelerate energy efficiency improvements globally and stimulate the development of markets for energy-efficient technologies.

Energy efficiency policy highlights

All member countries have used the IEA energy efficiency recommendations as the basis to develop and implement new policies – and all sectors have benefited from recent policy initiatives. Yet, many areas remain in which further implementation of cost-effective energy efficiency policy would provide additional benefits.

It is vitally important that countries consider additional energy efficiency policies in the context of their energy economies and national goals for energy security, economic development and environmental protection.

Recent policy highlights	Areas for further development
Cross-sectoral	
▶ Many IEA countries implementing policies to increase energy efficiency investment. ▶ New efforts to ensure voluntary and mandatory energy efficiency policies are adequately monitored, enforced and evaluated in Australia, Canada, the European Union, Turkey and the United States.	▶ Improve national energy efficiency strategies and action plans. ▶ Expand efforts in financing, particularly with the development of savings verification and measurement protocols, and establishing public-private partnerships. ▶ Increase efforts to promote risk-mitigation instruments, such as public-private partnerships. ▶ Improve quality and coverage of energy indicators.
Buildings	
▶ Policies put in place to strengthen building codes for new buildings in Canada, Korea, Luxembourg, Netherlands and the United Kingdom ▶ Building certification implemented and strengthened in the European Union. ▶ Information on energy efficiency in existing buildings systematically collected and reported, with limitations, in Canada, Germany, Japan, Korea and New Zealand.	▶ Strengthen minimum energy performance requirements (MEPS) for new and existing buildings. ▶ Enforce building codes and MEPS. ▶ Scale up construction of positive-energy houses (PEHs) and zero-energy buildings (ZEBs). ▶ Implement policies to increase the rate of deep renovations to meet strengthened MEPS for existing buildings. ▶ Increase efforts to promote energy-efficient windows and glazing.
Appliances and equipment	
▶ MEPS strengthened and expanded to cover new appliances and equipment in many IEA countries. ▶ Introduction of new MEPS and labelling for televisions, set-top boxes and digital television adaptors (DTAs) in Australia, Canada and Japan. ▶ Many planned standby power requirements are now implemented	▶ Ensure that network-connected electronic devices minimise energy consumption, with a priority on establishing industry-wide protocols for power management. ▶ Ensure that appropriate policies are in place to encourage television service providers to deliver a product that is as energy efficient as possible.



Recent policy highlights	Areas for further development
Lighting	
▶ All but two governments continue to phase out inefficient incandescent lamps. ▶ Canada, Japan, the Netherlands, the United Kingdom and the United States support international efforts to stimulate adoption of higher-efficiency alternatives to fuel-based lighting in off-grid communities in developing countries.	▶ Develop measures for promoting energy efficiency in non-residential lighting. ▶ Support adoption of high-efficiency alternatives to fuel-based lighting.
Transport	
▶ The European Union adopted regulations for TPMS, tyre rolling resistance and labelling. ▶ Japan started a voluntary tyre labelling scheme. ▶ The European Union adopted a regulation for CO_2 emissions for light-duty vehicles. ▶ The United States tightened CAFE standards for model year (MY) 2012-16. ▶ Gear-shift indicators mandatory in all new passenger cars with manual transmission in the European Union.	▶ Create fuel efficiency standards and labelling for heavy-duty vehicles. ▶ Ensure implementation of planned policies. ▶ Include eco-driving in driving education.
Industry	
▶ Coverage of industry energy statistics is high in all countries, particularly in Canada, Denmark and Switzerland. ▶ Developments in policies to promote MEPS for motors in the European Union, Japan, the United States and other countries. ▶ Energy management in industry strengthened in Australia, Norway, Slovak Republic and the United Kingdom. Several governments have made advances in policies for SMEs, including Italy, Slovak Republic, Spain and Sweden.	▶ Examine barriers to the optimisation of energy efficiency in electric motor-drive systems, and design and implement comprehensive policy portfolios aimed at overcoming such barriers. ▶ Design and improve policies and measures to assist small and medium-sized enterprises (SMEs).
Energy utilities	
▶ Further implementation of policies to encourage utilities to deliver cost-effective energy savings to end-users in Canada, Denmark, Ireland, Poland, Spain, the United Kingdom and United States.	▶ Devote more attention to providing incentives for utilities to promote energy efficiency in all IEA countries.

▶ *Sources*

- *Implementing Energy Efficiency Policies: Are IEA Member Countries on Track?*, 2011, IEA.
- *Implementation of the 25 energy efficiency policy recommendations: Recent developments*, 2011, IEA.
- *World Energy Outlook*, 2009, IEA.
- *Implementing Energy Efficiency Policies: Are IEA Member Countries on Track?*, 2009, IEA.

Cross-sectoral

Five of the 25 IEA energy efficiency policy recommendations aim to help governments set effective cross-sectoral frameworks for energy efficiency. These recommendations encourage policies to strengthen energy efficiency investments, strategies, goals, compliance, monitoring, enforcement, evaluation and indicators.

Since 2009, IEA member countries have made some progress with developing cross-sectoral policies. Several governments are implementing policies that were only planned in 2009. Others have improved implementation of policies already under way.

▶ Increasing investment in energy efficiency

Obstacles such as access to capital and perceived risk associated with energy efficiency projects often limit investment in energy efficiency. At the time of the 2009 evaluation, many IEA countries were developing policies to address barriers to energy efficiency investment.

The 2011 evaluation reveals several new efforts to design and implement policies to overcome these barriers, particularly related to measuring energy efficiency. Examples include: Canada and the United States (Global Superior Energy Performance Partnership); and EU Member States (Directive on Energy End-use Efficiency and Energy Services [2006/32/EC] Articles 9 and 15).

Several governments have launched partnership programmes to fund energy efficiency improvements. The Korea Energy Management Corporation (KEMCO) is working with commercial banks. Both Poland and the Slovak Republic are implementing funding arrangements through the European Bank for Reconstruction and Development (EBRD).

▶ Strategies and goals

In 2009, most IEA countries had already employed a strategy development or action planning process as a means to engage stakeholders, build consensus and galvanise action on energy efficiency. In fact, as of March 2009, all EU Member States had created or updated national energy efficiency action plans (NEEAPs) in compliance with the European Community's Energy Services Directive (2006/32/EC). At the time of the 2011 evaluation, EU Member States were finalising and submitting a second NEEAP to the European Commission.

Several non-EU countries, including Australia and Turkey, reported strategy and action plan development.

▶ Compliance, monitoring, enforcement and evaluation

The 2009 evaluation found that most governments conduct ex ante evaluations of energy efficiency policies and institutional compliance infrastructures.

In the 2011 evaluation, IEA countries reported on efforts to ensure that voluntary and mandatory energy efficiency policies are adequately monitored, enforced and evaluated. Examples include: Australia (Energy Efficiency Opportunities Act); Canada (Energy Efficiency Act); Spain (NEEAP); Turkey (Division of Monitoring and Evaluation established in the General Directorate of Electrical Power Resources Survey Administration [EİE]); the United Kingdom (National Measurement Office); and the United States (new funding and test facility).

Common methods needed for measuring energy efficiency

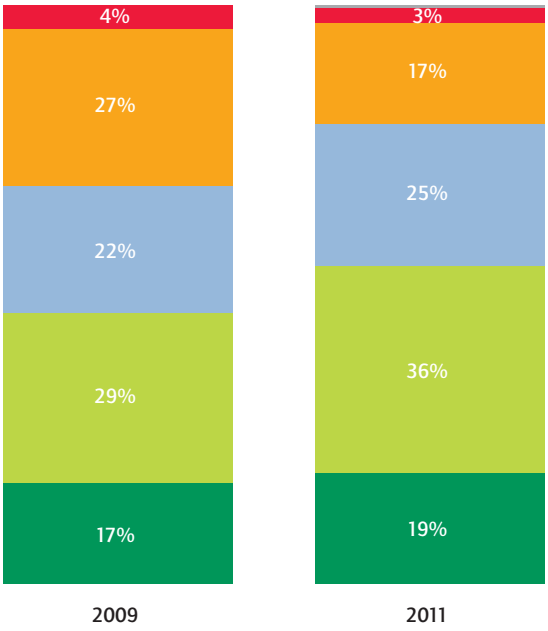
More than two-thirds of IEA countries have not yet implemented a common means of measuring energy efficiency. National protocols are essential for reducing uncertainties in quantifying the benefits of energy efficiency investment and stimulating increased private sector funding.

One-third of IEA countries have not implemented financial risk-mitigation instruments, such as public-private partnerships, for investments in energy efficiency. International experience suggests that public-private partnerships are a highly effective tool for addressing the issue of perceived risk.

Many countries continue to improve their efforts to gather essential energy-use data, and the IEA expects to have a more complete data set when it receives country submissions for the 2009/10 energy efficiency data template. However, the IEA is also aware that some countries have reduced data-gathering activities in response to budget cuts.

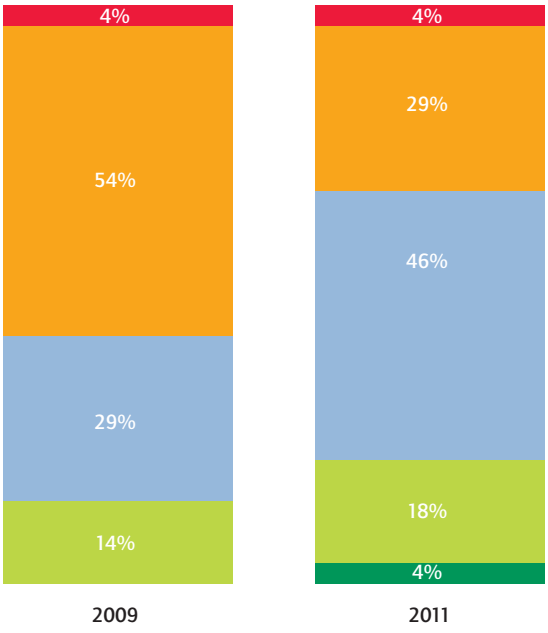
Steady progress is seen in the development of cross-sectoral enegy efficiency policies, while significant gains are evident in the examples of policies to stimulate private sector investment.

Planning action to boost energy efficiency



All EU Member States have developed National Energy Efficiency Action Plans (NEEAPS) in compliance with the European Community's Energy Services Directive. The Directive is expected to stimulate numerous new business areas, including new energy services, energy auditing, smart metering, more informative billing and a range of financial instruments and subsidy schemes, which will benefit households and businesses alike. It should also improve access to subsidy schemes – for example, in the form of rebates to buy energy efficient appliances, or to insulate homes, or for retrofitting lighting systems – and information to encourage efficiency improvements, and investments in energy efficient technologies.

Overcoming barriers to investment in energy efficiency



The European Bank for Reconstruction and Development (EBRD) is helping banks in **Poland** with significant loans (EUR 50 million to BGZ and EUR 35 million to Millenium) to facilitate lending to small and medium enterprises (SMEs) undertaking sustainable enegy investments. This is part of the EBRD's EUR 150 million Poland Sustainable Energy Financing Facility (PolSEFF), which offers to SMEs a line of credit up to EUR 1 million through partner banks and leasing companies. In the **Slovak Republic**, the Slovenská inovačná a energetická agentúra (SIEA, Slovak Innovation and Energy Agency) is collaborating with the private financial sector to establish tools to facilitate energy efficiency financing. SIEA prepares draft model contracts for energy services and financial instruments for achieving energy savings. The EBRD has also established a SlovSEFF programme through the Bohunice International Decommissioning Support Fund and administered by Slovak commercial banks. SIEA also uses this source to fianance a project called "Energy Efficiency in Public Buildings".

Buildings

The 2009 evaluation found that energy efficiency requirements for buildings were a key feature of all IEA member country policies.

At the time of the 2011 evaluation, many IEA countries reported recent policies to strengthen building energy efficiency. In May 2010, for example, EU Member States adopted the Energy Performance of Buildings Directive Recast (2010/31/EU), which articulates the application of minimum requirements to the energy performance of new and existing buildings.

Building codes for new buildings

Since 2009, IEA countries, including Canada, Korea, Luxembourg, Netherlands and the United Kingdom, have strengthened and enforced building codes for new buildings.

Passive-energy houses and zero-energy buildings

The 2009 evaluation found that Austria, Denmark, France, Germany and the United Kingdom had planned policies to promote very-low or no-net energy consumption in buildings (passive-energy houses [PEH] and zero-energy buildings [ZEB]). In the 2011 evaluation, several of these governments reported further work to support low-energy buildings, including Canada, Denmark and Italy.

Existing buildings

In the 2011 evaluation, many governments reported systematically collecting information on energy efficiency in existing buildings. Examples include: Canada; Germany (Energy Service Act and Zukunft Haus, operated by the German Energy Agency); Japan (Database for Energy Consumption); Korea (Housing Act); and New Zealand (Building Energy End Use Study).

Building certification

In 2009, several governments reported full implementation of mandatory building energy performance certificates (EPCs) whenever a building is sold, rented or constructed. This group includes Austria, the Czech Republic, Denmark, Finland, Germany, Ireland and Portugal, all of which have policies in line with the Energy Performance of Buildings Directive (2002/91/EC).

By April 2011, all EU Member States had implemented mandatory EPC requirements, although there is some variation among governments.

Windows and other glazed areas

In 2009, only some IEA countries had adopted policies to promote energy-efficient glazing in windows. One country had fully implemented the recommendation related to establishing MEPS for windows and glazing, but no country had fully implemented the recommendation on window labelling.

In 2011, several IEA countries reported implementing policies to promote efficient windows and other glazed areas. In EU Member States, for example, windows and glazed areas are included in the indicative list of product groups that can be covered by the work plan (2012-14) of the Ecodesign Directive recast (2009/125/EC), which establishes energy efficiency requirements for energy-related products in the residential, service and industrial sectors. Countries that have gone beyond the EU requirements are: Denmark (through the Association of Danish Window Manufacturers); Ireland (National Standards Authority); Italy (labelling scheme with manufacturers); Korea; Norway (Enova label scheme Enova anbefaler); and the United States (National Fenestration Rating Council).

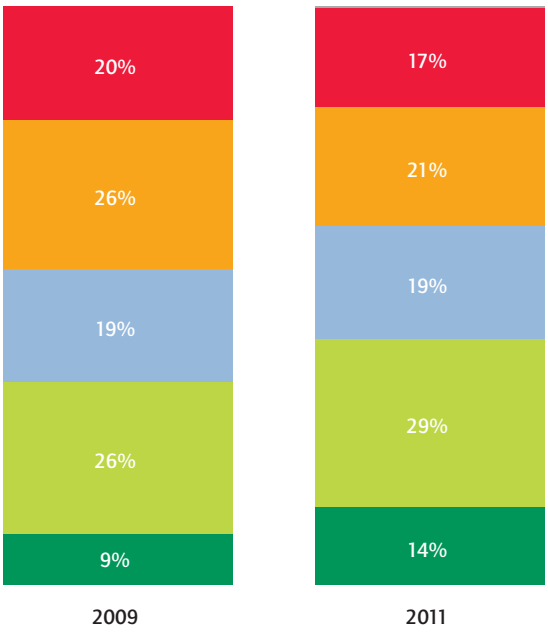
Ongoing priorities for existing and new buildings

Strengthening the energy performance of existing buildings is the biggest challenge facing most IEA countries. To do this, governments should improve MEPS for existing buildings and put in place policies to increase the rate of energy performance renovations.

At the same time, policies are needed to increase the energy performance of new buildings. Factoring in energy performance at the building design and construction stage is highly cost effective and needs to be at the forefront of building energy efficiency policies. All IEA countries should periodically set stronger energy efficiency requirements for buildings. Greater effort to support highly energy-efficient buildings, such as passive-energy houses (PEHs) and zero-energy buildings (ZEBs), would significantly bolster energy efficiency in IEA countries' building stock.

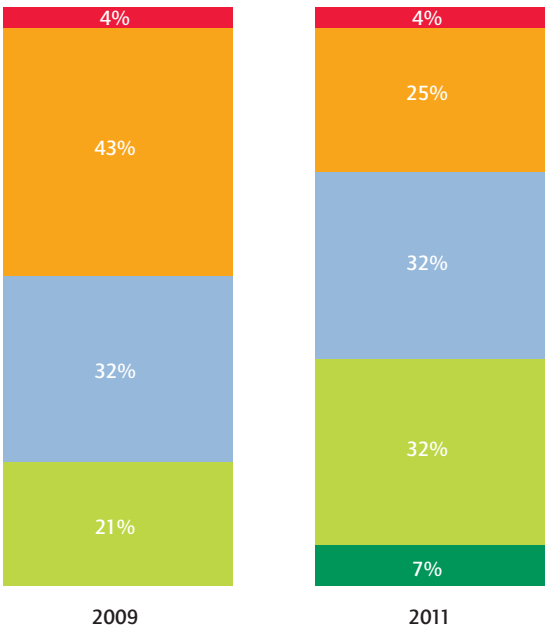
More stringent building codes and adoption of certification schemes are examples of effective means to enhance the energy efficiency of existing and new buildings.

Progress with implementing building recommendations



All levels of government in Canada are collaborating to develop a more stringent National Energy Code for Buildings, with an aim of a 25% improvement in efficiency of commercial buildings by 2011 and for houses by 2012. Additional effort is under way to incorporate MEPS in the EnerGuide for Houses, and to update the entire building code by 2015. The National Energy Code for Canada for Buildings (NECB) will be published in autumn 2011. Canada is developing the next generation of its voluntary energy-efficiency design standards for new houses to be seamless with the new energy requirements being developed for the building code.

Mandatory building energy certification schemes



All EU Member States will require mandatory energy performance certificates (EPC), although there is some variation in implementation by country. In Sweden, EPCs must be displayed in all public buildings and EPCs are required for buildings over a certain size that house any public-sector functions. The EPCs must also contain recommendations on how to improve energy efficiency (see Regulation 2006:1592 and Stipulations by the Swedish National Board of Housing [BFS 2007:4]). The United Kingdom reported rolling out mandatory EPCs for all buildings on sale or lease, which must contain recommendations for cost-effective action to improve efficiency and links to sources of advice. The UK government is exploring options to strengthen EPCs to ensure information for buyers or renters is relevant, targeted and applicable to a specific property.

Appliances and equipment

Since 2009, IEA member countries have made substantial progress with implementing policies to improve the energy efficiency of appliances and equipment.

Appliance and equipment MEPs and labels

The 2009 evaluation revealed that nearly all IEA countries had in place minimum energy performance standards (MEPS) for some appliances and equipment. Governments have since implemented a range of policies to enlarge the scope and stringency of MEPS. For example, in EU Member States, energy requirements for numerous products covered under the Ecodesign Directive (2005/32/EC) have entered into force.

Also in EU Member States, the European Parliament passed a directive (2010/30/EU) in May 2010 requiring labelling and standard product information on the consumption of energy. This directive is the recast of the previous labelling Directive (92/75/EEC).

Outside of the European Union, the United States established MEPS for over 40 types of appliances and equipment and voluntary ENERGY STAR labelling guidelines for more than 50 products. Over the past two years, the US Department of Energy (US DOE) expanded the coverage and updated the stringency of standards for a number of major energy-using products and has allocated resources to further accelerate these efforts.

Televisions, television "set-top" boxes and digital television adaptors (DTAs)

In 2009, most IEA countries had in place policies to address energy use in televisions. By the 2011 evaluation, several additional governments had introduced MEPS and labelling for these products.

For example, Australia introduced related MEPS and/or labelling for televisions from October 2009, and Canada amended the Energy Efficiency Act to include the regulation of TV set-top boxes.

Japan revised its Top Runner standards for TV sets in February 2010, adding TV sets using energy efficient LED backlight to improve energy performance. As a result of this standard, the energy consumption of TV sets is expected to decline more than 37% by 2012 over 2008.

Low-power modes for electronic equipment

The 2009 evaluation found that all but one IEA country was planning to adopt a "horizontal" 1-Watt limit (*i.e.* a limit of 1 Watt consumption when on standby power across all appliance types). The 2011 evaluation reveals IEA countries have made significant progress in implementing planned policies in this area.

Australia plans to implement a 1-watt standby limit in 2013. The coverage of products follows a horizontal approach and applies to most energy-using appliances. Australia introduced minimum low-power mode requirements for several products including televisions in 2009 and air conditioners in 2011.

Korea is adopting policies to promote low-power modes. The Ministry of Knowledge Economy established Standby Korea 2010, a roadmap to limit standby power below 1W. In 2011, Korea has mandatory 1W standards for around 30 products through the e-Standby Programme and Energy Efficiency Label and Standard Program. Korea mandated an innovative standby warning label for 19 products that do not meet the specified standby power standards.

Turkey's Ministry of Industry and Trade plans to publish a measure on standby power consumption in line with Ecodesign (2005/32/EC) by the end of 2011.

New approaches needed for network-connected electronic devices

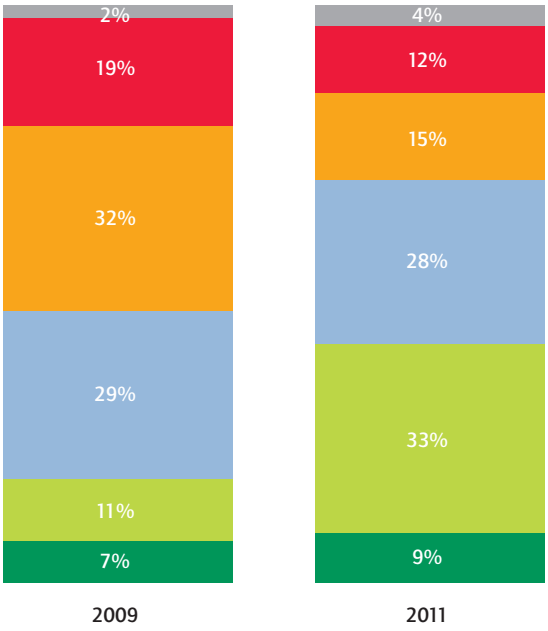
Although most IEA countries are planning policies to ensure that network-connected electronic devices minimise energy consumption, only 18% are actually implementing policies to this effect.

Very few governments have put in place policies to encourage television service providers to ensure that their leased set-top boxes are as energy efficient as possible.

Governments can maximise the market transformation effect of their MEPS by implementing complementary endorsement programmes, which encourage suppliers and consumers to adopt highest energy efficiency appliances.

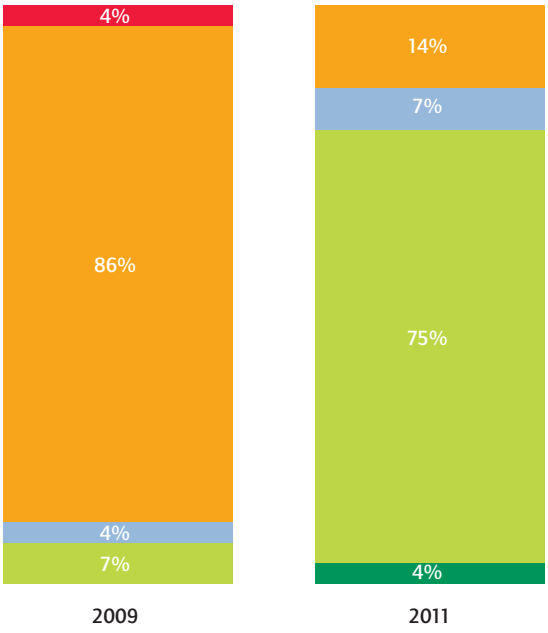
All IEA countries are now in the process of adopting a horizontal 1-Watt standby limit across all electronic devices; 4% have reached full implementation.

Stricter standards for appliances and equipment



In May 2010, the European Parliament passed a directive (2010/30/EU) requiring labelling and standard product information on the consumption of energy (this is a recast of the previous labelling directive (92/75/EEC). The United States established MEPS for more than 40 types of applicances and equipment, and voluntary ENERGY STAR labelling guidelines for more than 50 products. Since 2009, the US DOE has expanded the coverage and updated the stringency of standards for a number of energy-using products and has allocated resources to further accelerate these efforts.

Breakthrough achievement on standby power mode



After many years of awareness of the significant power consumption of electronic devices operating in standby mode, the IEA proposed in 1999 the adoption of a 1-Watt standard across all devices. IEA countries have since individually and jointly tackled this challenge effectively, with standards being implemented in all countries. Korea's Ministry of Knoweldge Economy, for example, has closely followed the aims of its "Standby Korea 2010" roadmap; as of 2011, it has set mandatory 1W standards on about 30 products through the e-Standby Programme and the Energy Efficiency Label and Standard Programme.

Lighting

IEA member countries continue to implement policies to increase energy efficiency in the lighting sector.

Phase-out of inefficient incandescent lamps

The 2009 evaluation found that almost all IEA countries had planned to phase out inefficient incandescent lamps. At the time of the 2011 evaluation, all but two IEA countries were in some stage of implementing these planned phase-out policies.

The 2011 evaluation revealed further efforts to improve lighting energy efficiency. For example, European Commission Regulation 244/2009 phases out non-directional incandescent bulbs in EU Member States between 2009 and 2012. Directional (reflector) incandescent bulbs will also be phased out. Also related to lighting, the Energy Performance of Buildings Directive (2010/31/EU) requires lighting to be considered within the whole building energy performance. However, as opposed to other technical building systems, it is not mandatory for EU Member States to set separate requirements on lighting systems. Non-mandatory EU harmonised standards (CEN) exist, which contain reference values for different types of efficient lighting systems.

The phase out of incandescent lamps began in Korea in June 2010. Incandescent lamps of 10 lm/W to 15 lm/W are no longer manufactured or sold on the market because MEPS were set at 20 lm/W. Incandescent lamps of 70 W to 150 W (mainly 100 W which accounts for 26% of all incandescent lamps) will be phased out of the market from January 2012. Incandescent lamps of 25 W to 70 W (mainly 60 W and 30 W, which account for 74% of all incandescent lamps) will be phased out of the market from January 2014.

Phase-out of inefficient fuel-based lighting

Several governments reported on programmes to support international efforts to stimulate the adoption of higher efficiency alternatives to fuel-based lighting in off-grid communities in developing countries.

Japan supports the spread of solar-cell based lighting in villages detached from power supply grids through the Japanese International Co-operation Agency (JICA) and the New Energy and Industrial Technology Development Organization (NEDO), which promotes research and development, as well as the dissemination of industrial, energy and environmental technologies.

The Netherlands supports international lighting efforts through the Energising Development programme and the Daeij Ouwens Fund.

The UK's Department for International Development is supporting action in developing countries to replace fuel-based lighting, such as the Lighting Africa Programme.

Through the Clean Energy Ministerial, the United States is sponsoring the Solar and LED Energy Access Program (SLED), a multi-million dollar effort that focuses on the approximately 1.6 billion people who lack access to grid electricity. It aims to transform the global market for affordable, clean and quality-assured off-grid appliances by addressing fundamental barriers to market development. The programme will initially focus on replacing fossil fuel-based light sources such as kerosene lanterns with solar LED lights. The programme is expected to improve lighting services for 10 million people within five years.

Non-residential lighting the next challenge area

To improve energy efficiency in the lighting sector, further policy developments are needed, particularly to promote energy efficiency in non-residential lighting. In 2009, many governments had plans to phase out inefficient street lighting technologies, such as mercury vapour lamps. The 2011 evaluation reveals that these policies are now under way. The IEA encourages further implementation.

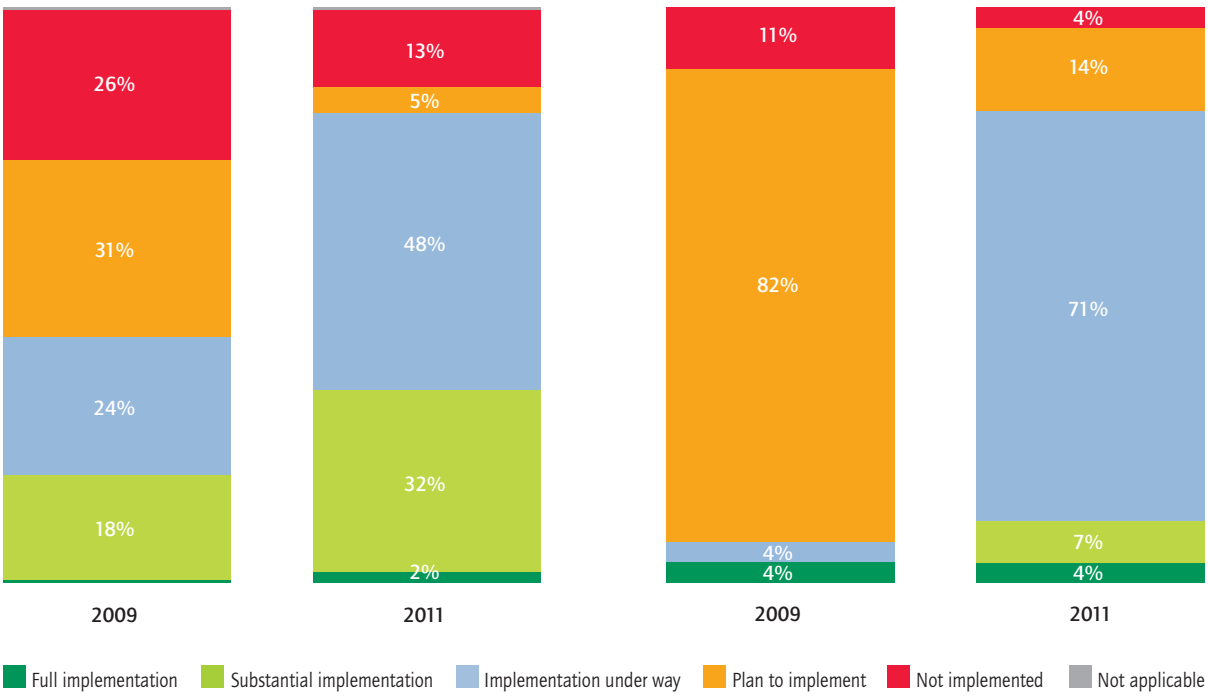
The majority of electricity used for lighting is for indoor lighting in non-residential buildings, i.e. within public, commercial and industrial buildings. In order to tap into the many highly cost-effective opportunities to save lighting energy in these buildings, the IEA encourages member countries to put in place policies that target the performance of the lighting system as a whole.

Phase out of inefficient incandescent lamps is on the policy agenda in 26 IEA countries; other lighting recommendations are also taking hold.

Significant uptake of lighting policies

82% of IEA countries are now actively engaged in implementing lighting recommendations.

Phase out of the most inefficient incandescent bulbs is under way in 82% of IEA countries.



Transport

Mandatory fuel efficiency standards for LDVs and HDVs

Four of the 25 energy efficiency policy recommendations focus on road transport and include policies to improve fuel economy standards for light- and heavy-duty vehicles, eco-driving and tyre energy efficiency. IEA member countries have implemented many of these recommendations since the 2009 evaluation.

Mandatory fuel-efficiency standards for light-duty vehicles

Several governments reported introduction of new mandatory fuel-efficiency standards for light-duty vehicles. In April 2010, for example, Environment Canada proposed Passenger Automobile and Light Truck Greenhouse Gas (GHG) Emission Regulations (*de facto* fuel efficiency standards). These regulations were finalised in October 2010 and impose new stringent standards for vehicles of model year (MY) 2011 and increase in stringency on an annual basis until MY 2016. For MY 2011, the Canadian standards are aligned with fuel-economy standards established by the US National Highway Traffic Safety Administration. For MY 2012-16, the Canadian standards are aligned with similar greenhouse gas emissions standards established by the US Environmental Protection Agency.

In July 2009, Korea announced a new fuel-economy standard for passenger cars as part of the national Green Growth strategy. The new standards will be phased in from 2012 and then fully implemented in 2015. Each automobile manufacturer can choose between two corporate average targets, *i.e.* 5.9 L/100 Km or 140 gCO_2/km, which allows for some flexibility.

In May 2010, the United States required manufacturers to meet an estimated combined mpg-rating of 34.1 for light-duty vehicles by MY 2016. Government agencies have announced their intention to propose light-duty vehicle fuel economy standards for years beyond 2016 by September 2011.

In July 2010, the Australian government announced plans to introduce mandatory CO_2 emissions standards for light-duty vehicles to take effect from 2015.

Mandatory fuel-efficiency standards for heavy-duty vehicles

Japan is the only country in the world to have fuel-efficiency standards in place for heavy-duty vehicles. In November 2010, the United States proposed, for the first time, fuel economy standards for medium- and heavy-duty vehicles. These standards are expected to be made final in 2011. In May 2010, Canada announced that it also would introduce such standards, in alignment with those of the United States.

Rapid expansion needed in policies for heavy-duty vehicles

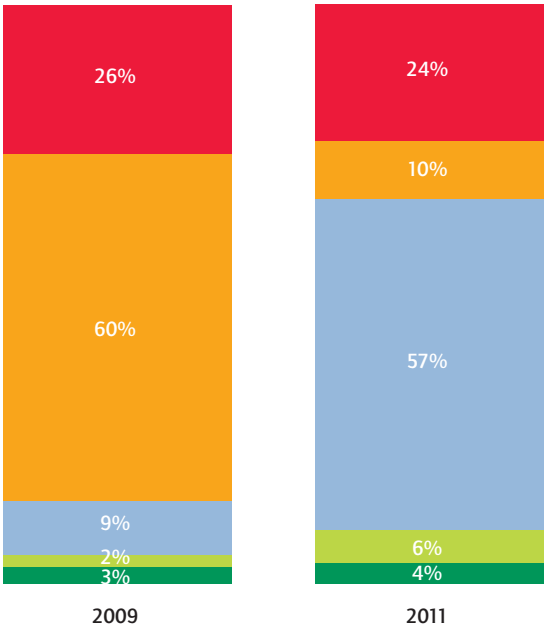
Policies for heavy-duty vehicles lag behind those for light-duty vehicles. Only Japan has policies establishing mandatory fuel-efficiency standards for heavy-duty vehicles. Heavy-duty vehicles are responsible for 30% of worldwide fuel use (IEA, 2008c). IEA countries should urgently implement policies aimed at accelerating fuel-efficiency improvements and labelling in trucks and other heavy-duty vehicles.

The benefits of eco-driving are well known, as is its cost-effectiveness as a policy to reduce energy consumption from vehicle transport. Yet most governments have not made eco-driving an obligatory part of driver education or a requirement as part of the driving test. The IEA encourages governments to introduce these measures as soon as possible.

Several IEA countries, including Korea, New Zealand, Norway, Switzerland and Turkey, need to quickly put in place planned transport energy efficiency policies and implement policies where there are currently none.

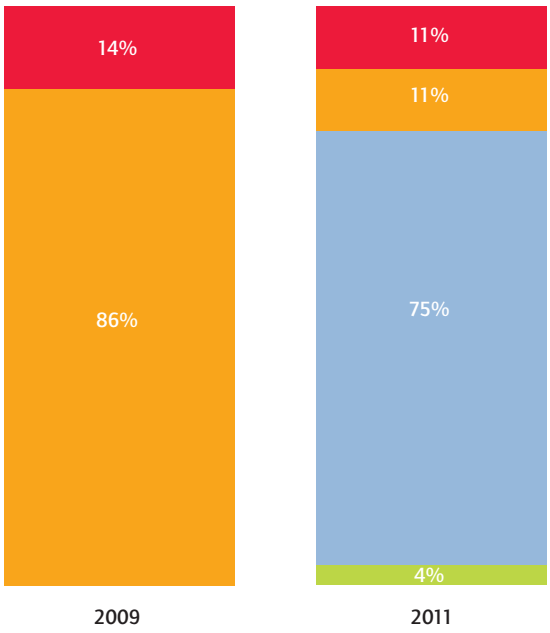
Transport recommendations accelerated rapidly: 67% of policies are now at "implementation under way" or better.

Noteworthy progress is seen in initiating transport policies



Transport policies for energy efficiency span a wide range of opportunities across all vehicle components. Measures include efficiency improvements for car components with the highest impact on fuel consumption, such as tyres and air-conditioning systems, and a gradual reduction in the carbon content of road fuels, notably through greater use of biofuels. Efficiency requirements for these components are being discussed. Several IEA countries, including Korea, New Zealand, Norway, Switzerland and Turkey, need to quickly put in place planned transport energy efficiency policies and implement policies where they currently lag behind international progress.

New passenger cars have substantially reduced emissions



In April 2009, EU Member States adopted the regulation "setting emission performance standards for new passenger cars" as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles (EC 443/2009). Average emissions from new passenger vehicles sold in the European Union must reach the 120 gCO_2/km target by 2015. Improvements in motor technology will reduce average emissions to no more than 130 gCO_2/km, while complementary measures will contribute a further emissions cut of up to 10 gCO_2/km, thus reducing overall emissions to 120 gCO_2/km.

Transport

Ecodriving and tyre efficiency

Eco-driving

Many IEA member countries have made recent strides to ensure that efficient driving habits – or "eco-driving" – are a central component of government initiatives to improve energy efficiency and reduce CO_2 emissions. In 2009, for example, EU Member States adopted the regulation (EC 661/2009) that stipulates the mandatory fitting of a gear-shift indicator (GSI) in all new passenger cars with manual transmission, as part of a European strategy on reducing CO_2 emissions from road vehicles.

The implementation of eco-driving training, as a part of the driving licence education and examination, can improve fuel economy. Eco-driving measures introduced to the UK driving test require new drivers to show that they can drive with fuel efficiency as well as safely.

Many governments have implemented national and regional eco-driving programmes. In the Netherlands, for example, the Institute for Sustainable Mobility runs partly government-financed campaigns to promote eco-driving for professional drivers and the importance of correct tyre pressure.

Tyres

Many IEA countries that had planned policies aimed at tyre rolling resistance and proper tyre inflation are now implementing those policies.

Switzerland is closely following EU tyre regulation. Tyre labelling will enter into force in November 2012.

In December 2008, the Japanese government established the Fuel-Efficient Tire Promotion Council. This council published a final report in July 2009 recommending measurement methods of tyre rolling resistance and wet grip, and the establishment of a labelling scheme. In response, the test procedures for tyre rolling resistance referring to the ISO 28580 were established as JIS D4234 in December 2009. The labelling scheme, which is applied to replacement tyres for passenger cars, has been implemented on a voluntary basis since January 2010.

In April 2010, the Korean government announced a master plan to introduce tyre fuel efficiency standards and labelling for passenger cars. The details of the labelling scheme and test procedures are being finalised in 2011. It will be implemented on a voluntary basis from the second half of 2011 and on a mandatory basis from the second half of 2012. The label will provide the rolling resistance coefficient and wet grip of tyres. The government is also considering the insertion of external noise and tread wear on the label.

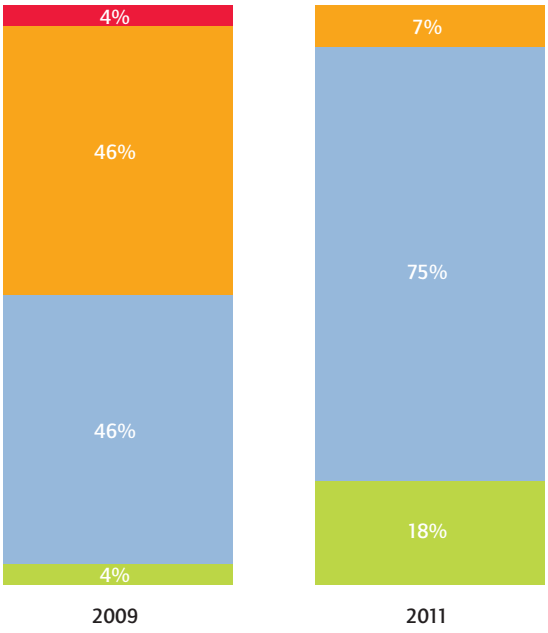
Many governments have also made progress with implementing measures to promote proper tyre inflation levels. EU regulations EC 661/2009 and EC 1222/2009 (described earlier) include mandatory fitting of tyre pressure monitoring systems (TPMS) by November 2012 for new passenger cars and by November 2014 for all newly registered passenger cars.

In the United States, all new vehicles have been required to have tyre pressure monitoring systems since 2007. TPMS are now mandatory for all passenger cars, trucks and buses.

Several IEA countries, including Korea, New Zealand, Norway, Switzerland and Turkey, need to quickly put in place planned transport energy efficiency policies and implement policies where there are currently none.

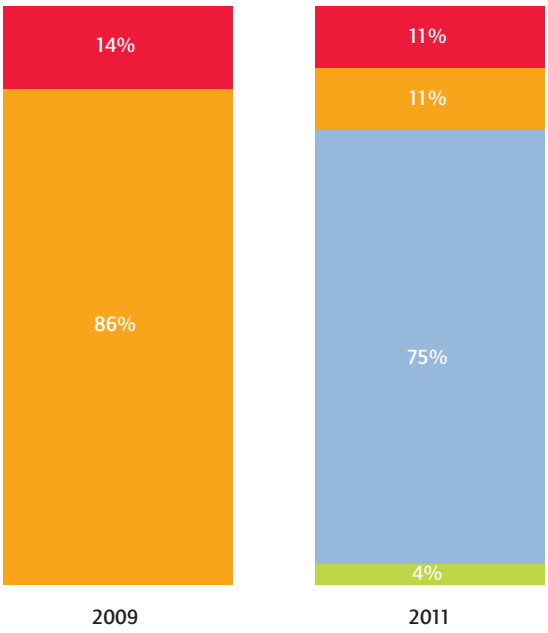
More efficient components, from improved tyres to driver feedback instruments, now becoming standard equipment on many vehicles and help raise driver awareness .

Eco-driving through vehicle technology and driver education



Canada's ecoENERGY for Personal Vehicles includes eco-driving initiatives, which provide tools and resources for existing licensed drivers and for driver-education students. Korea is actively involved in promoting eco-driving. As part of the presidential committee adopted five-year action plan for green growth (2009-13), several initiatives to promote eco-driving have been established. Korea reports that buses, taxis and vans shall be equipped with idling stop devices from 2011. The Ministry of Knowledge Economy will give a subsidy to fleet operators to install an eco-driving indicator in 2011. Spain is promoting eco-driving through numerous eco-driving courses co-ordinated by the Institute for Diversification and Saving of Energy (IDAE) and various industry and community associations.

Tyre standards improve fuel efficiency



In July 2009, EU Member States adopted regulation "concerning tyre-approval requirements for the general safety of motor vehicles, their trailers and systems, components and separate technical units" (EC 661/2009). The European Union also adopted a separate regulation on "the labelling of tyres with respect to fuel efficiency and other essential parameters" (EC 1222/2009) in November 2009. Fuel efficiency, wet grip and external rolling noise of tyres will be indicated in the label. Similar to measures for tyre rolling resistance and noise limits, this regulation will cover almost all tyres used on public roads, such as tyres for passenger cars, light commercial vehicles and heavy-duty vehicles.

IEA member countries have made some progress with implementing policies to promote energy efficiency in industry.

MEPS for electric motors

Electric motor-driven systems (EMDS) consume the largest amount of electricity of any end-use – more than 40% of global electricity consumption – and most of this is in industry. The IEA estimates that the efficiency of EMDS can realistically be improved by 10% to 15%, equivalent to reducing total global electricity use by 5%. MEPS are required to deliver energy efficiency improvements in EMDS.

Japan, Australia, Canada, Korea, New Zealand and the United States continue to report well-developed energy efficiency policies for medium-sized industrial electric motors.

Energy management

In 2009, many IEA countries highlighted policies to promote energy management (EM) in industry. At the time of the 2011 evaluation, a few member countries provided updates on policies to further develop EM capability through the development and maintenance of EM tools, training, certification and quality assurance, including Australia (through the EEO programme) and Norway (through industrial energy efficiency programmes). A European standard for EM has been adapted as a national standard (NS-EN 16001) and an international standard (ISO 50001) has been published.

To promote energy efficiency in the industrial sector, the United Kingdom has put in place the CRC Energy Efficiency Scheme (previously known as the Carbon Reduction Commitment) – a mandatory energy saving and carbon emissions reduction scheme.

Small and medium-sized enterprises (SMEs)

At the time of the 2009 evaluation, several IEA countries, including Finland, Ireland, Japan, Korea, Turkey and the United States, were planning or had put in place policies to promote energy efficiency in SMEs. In the 2011 evaluation, a handful of additional governments reported energy efficiency policy developments for SMEs. Italy's National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA), for example, is planning activity in this area. Portugal's Cabinet Resolution No. 2/2011 (passed in January 2011) created the legal framework for energy service companies (ESCOs) and procurement management of energy services for SMEs.

The Slovak Republic's Innovation and Energy Agency (SIEA) is implementing the energy efficiency information project Live with Energy. This project is financed through EU structural funds and provides information support to different stakeholders including entrepreneurs in SMEs.

Spain's Energy Efficiency Action Plan 2008-12 includes subsidy programmes for SMEs to improve energy efficiency through equipment renovation and substitution of technical processes (grants of up to 30% of eligible cost).

Sweden put in place a support scheme for energy audits for SMEs in January 2010 (Government Regulation 2009:1577).

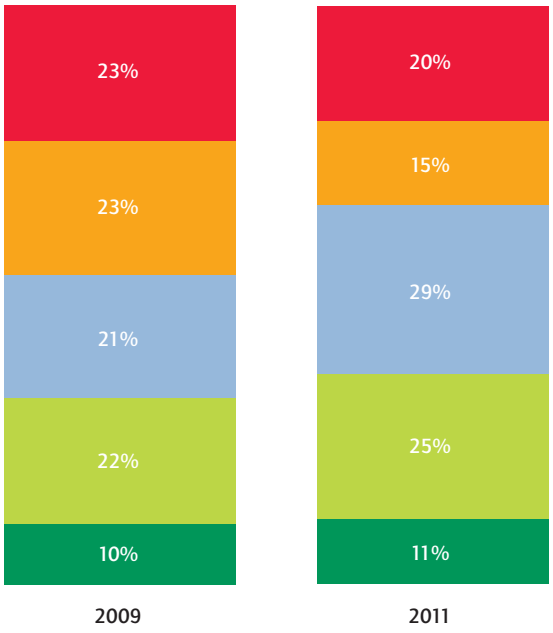
Bringing energy efficiency to electric motors and to SMEs

Although IEA countries have made progress with adopting MEPS for electric motors, few governments are examining barriers to the optimisation of energy efficiency in electric motor-driven systems. There is a need for further effort in the design and implementation of policies to overcome such barriers.

While measures to improve the energy efficiency of SMEs are well developed in several countries, the IEA is concerned that more policy attention is needed. Benchmarking information needs to be made available to SMEs. Appropriate incentives also need to be developed and implemented to encourage SMEs to make investment decisions based on lowest life-cycle costs.

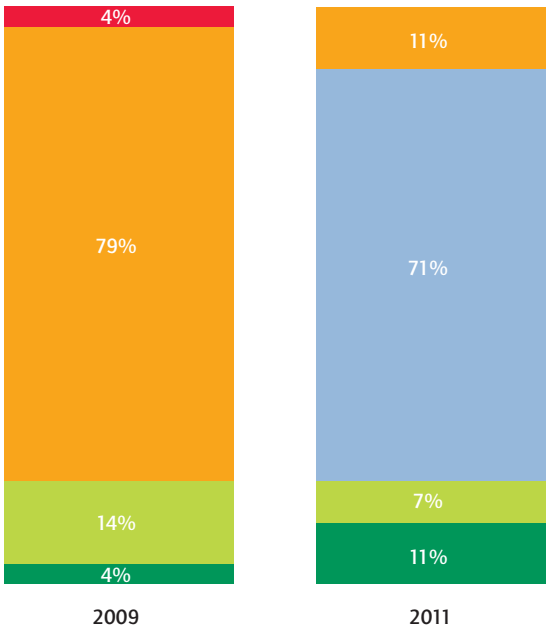
Industry efforts focused on efficiency of electric motors, energy management, and improved efficiency of small and medium-sized enterprises (SMEs).

Better information drives energy efficiency in industry



The Australian 2006 Energy Efficiency Opportunities (EEO) programme uses a mix of mandatory and voluntary approaches to encourage large energy consumers to implement energy efficiency measures. Companies are required to undertake energy efficiency assessments to a regulated standard and to report publicly on the opportunities identified up to a four-year payback; they are not required to implement opportunities, but must report their business approach to their board and to the public. This improves the quality of information to decision makers. Consultation with companies is under way to improve existing monitoring and evaluation procedures for the second five-year EEO cycle, which will start in 2012. As of December 2010, companies representing 44% of Australia's energy end use had committed to an annual savings target of 1% of Australia's total 2008/09 emissions.

MEPS for electric motors in line with international best practice



At the time of the 2009 evaluation, most IEA countries were planning to adopt MEPS for electric motors. Now some of these policies are being implemented. EU Member States, for example, adopted MEPS for certain kinds of motors in July 2009 as part of the 2009 European Commission Regulation No. 640/2009 implementing Directive 2005/32/EC. An EU evidence study has been commissioned by the European Commission as the first stage in developing MEPS to cover electric motors that fall outside the scope of the initial regulation.

Energy utilities

If the right institutional framework and enabling conditions can be established, energy utilities can play an important role in delivering end-use energy efficiency.

The 2009 evaluation found that over half of IEA member countries had some form of policy to encourage utilities to promote end-use energy efficiency.

At the time of the 2011 evaluation, several IEA countries reported further implementation of policies to encourage utilities to deliver cost-effective energy savings to end-users. For example, Canada's Council of Energy Ministers supports collaborative actions to promote and support energy efficiency. Under the auspices of the Steering Committee on Energy Efficiency, the Built Environment and Equipment Working Group (which has representatives from the federal, provincial and territorial governments) has outlined tools and policy measures to encourage stakeholders to implement energy efficiency best practice. In addition, having jurisdictional authority over utilities, several provinces have implemented diverse measures to encourage energy savings at the utility level. In British Columbia, the 2010 Clean Energy Act commits to meeting 66% of future incremental electricity demand from conservation and efficiency improvements by 2020.

In Denmark, all distribution companies have energy-saving obligations with annual targets, which were increased 100% in 2010. The savings are weighted in relation to lifetime CO_2 reduction.

Ireland has outlined a programme, Better Energy: the National Upgrade Programme, for placing obligations on energy suppliers of >75 GWh to deliver energy efficiency to energy end-users. Finalisation of annual targets, eligible measures and savings credits are under way; it is intended that companies will have signed voluntary agreements to meet these targets by mid-2011. Some energy providers have already begun operating in the energy-service market in preparation for the obligation programme. As part of this programme, public sector bodies are supported to achieve an ambitious national energy savings target of 33%. This will ensure that the government is leading by example in the demonstration of the benefits of investing in improved energy efficiency.

The Energy Efficiency Law, passed in Poland in April 2011, introduces a white certificate system. From January 2013, obligations to present white certificates will be imposed on utilities selling electricity, natural gas and heat.

Spain will include several initiatives to prompt utilities to deliver cost-effective energy savings to end-users in its second National Energy Efficiency Action Plan submitted to the European Commission at the end of June 2011.

The United Kingdom established the Carbon Emissions Reduction Target (CERT), a statutory obligation on all domestic energy suppliers in England, Scotland and Wales with a customer base in excess of 50 000. CERT is the third cycle of the UK's household energy supplier obligation. In June 2010, it was announced that a restructured CERT will be extended to December 2012, with a higher target and a focus on improving building insulation (rather than installing compact fluorescent lights). The UK government is currently exploring options for the successor to CERT, to run from 2013.

In the United States, 24 states, representing over 50% of the US population and energy demand, have placed energy efficiency resource obligations on their regulated energy utilities.

Utilities well positioned to be leaders of energy efficiency

Almost one-third of IEA countries have either not implemented or are not planning to implement any of the IEA energy utility recommendations. This is particularly the case for the recommendations regarding decoupling utility revenue and profits from energy sales and allowing energy efficiency measures to be bid into energy pools.

The capacity for utilities to deliver energy efficiency is significant, but entirely determined by the market systems within which they operate. Utilities have an ongoing relationship with each energy-using customer, and can deliver a wide range of value-added services. The regulatory environment may or may not enable utilities to adopt energy efficiency. There is significant scope to ensure the continuation of removing barriers to energy efficiency for utilities.

Utilities remain a key challenge area: almost one-third of IEA countries have either not implemented or are not planning to implement any of the IEA energy utility recommendations.

Slow progress on the part of energy utilities



Despite marked progress in the move from "planning to implement" to "implementing" in some countries, overall progress with policies to encourage energy utilities to promote end-use energy efficiency was largely stagnant.

Note: This chart is based on the four elements of the utility recommendation. As each utility recommendation element is optional, the IEA has calculated this chart based on the element that achieves the highest level of policy implementation in each country.

Delivering energy efficiency can be a viable customer service

In Canada, the United Kingdom and the United States, regulated distribution companies and competitive retail energy suppliers are primary designers and implementers of energy efficiency programmes (IEA, 2010). To prompt energy utilities to deliver energy savings, the IEA encourages implementation of one or more of the following recommendations:

- Establish regulation that decouples utility revenue and profits from energy sales, and allows energy saving delivery to compete on equal terms with energy sales.
- Place energy efficiency obligations on utilities, periodically increasing the stringency based on continuing cost-effectiveness in delivering energy services.
- Allow bidding on energy efficiency measures in energy pools, on an equal basis to energy supply options.
- Develop other policy measures that encourage utilities to play an active part in funding and/or delivering end-use efficiency improvements among their customer base.

Annexes



Annexes

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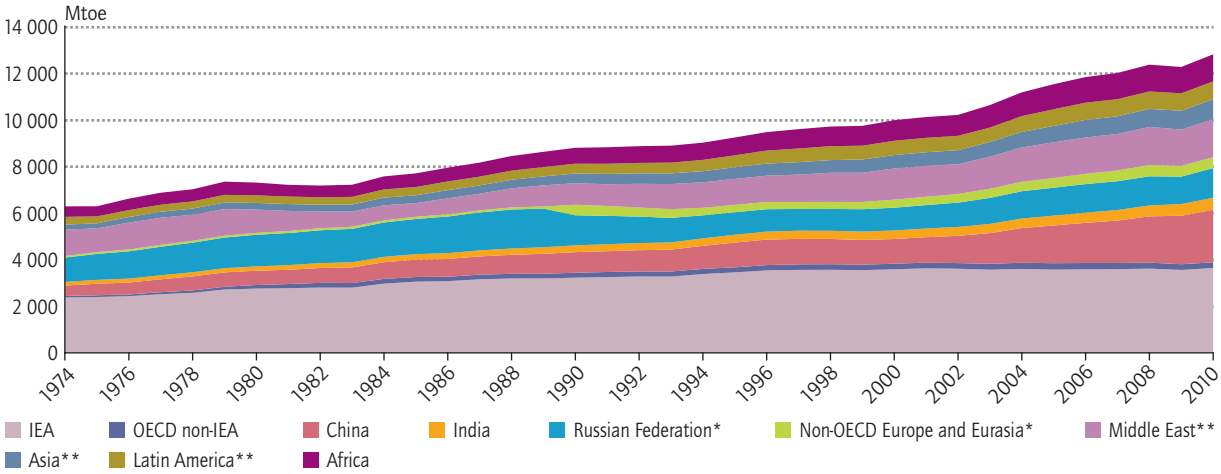
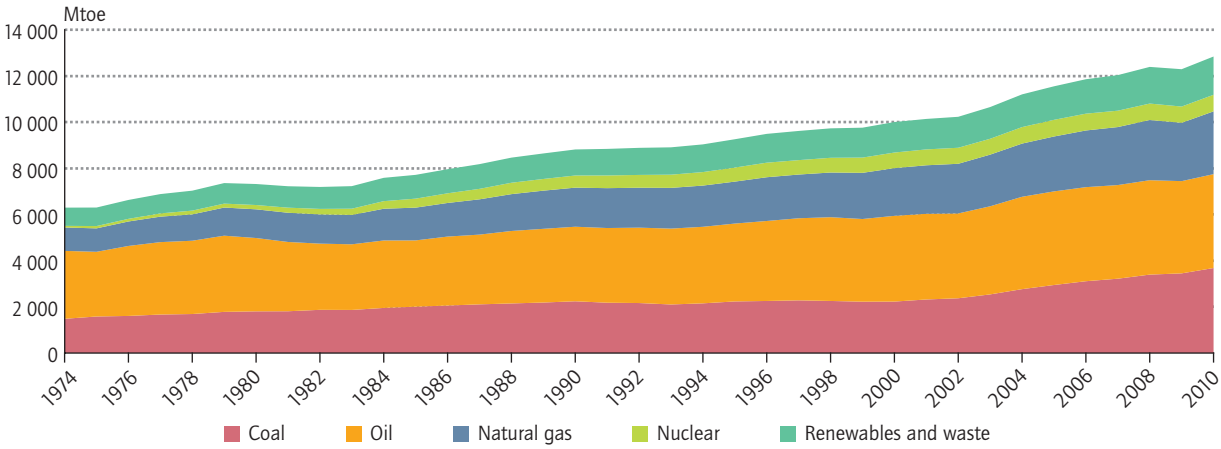
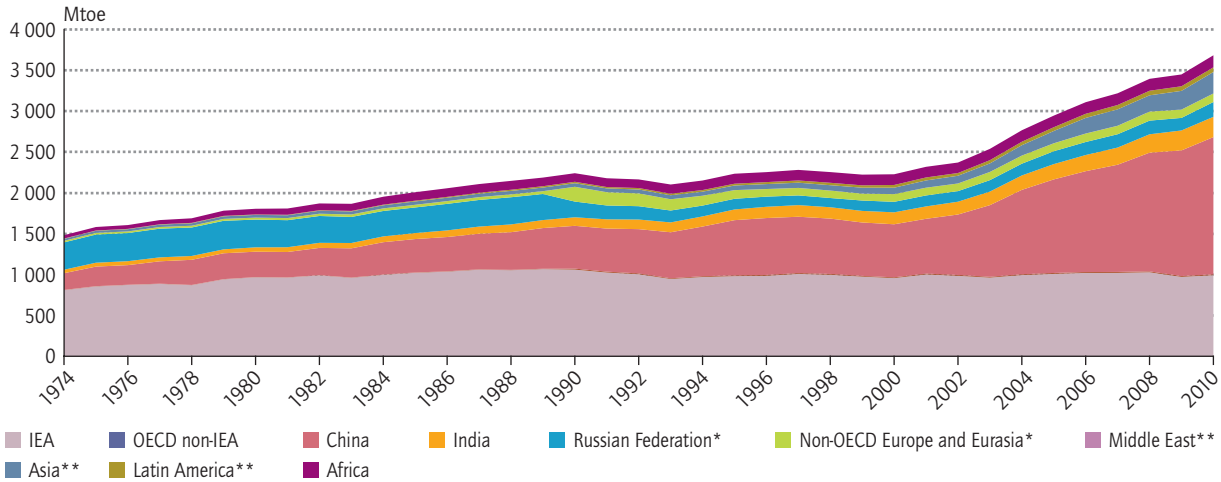
Energy production by region



Energy production by fuel



Coal production by region



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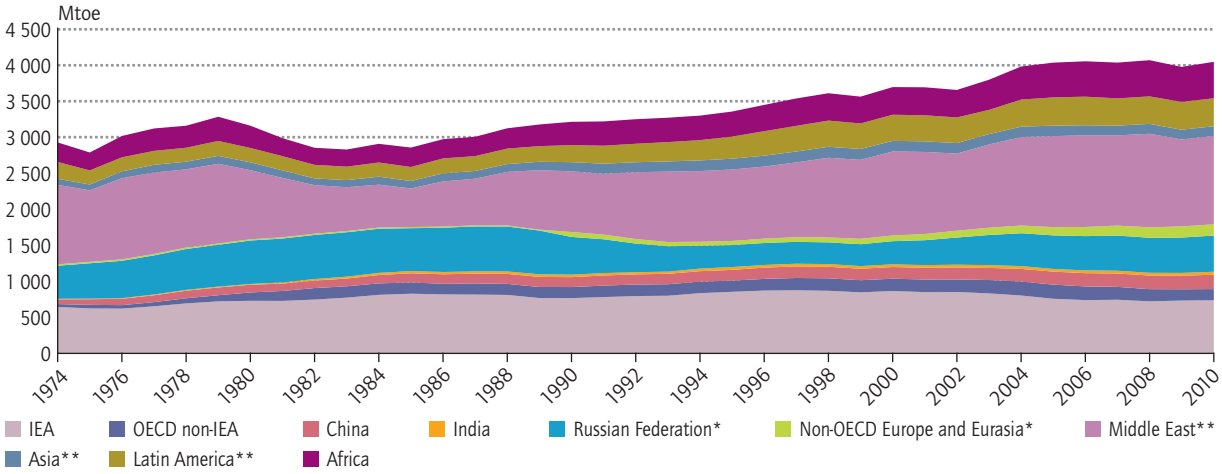
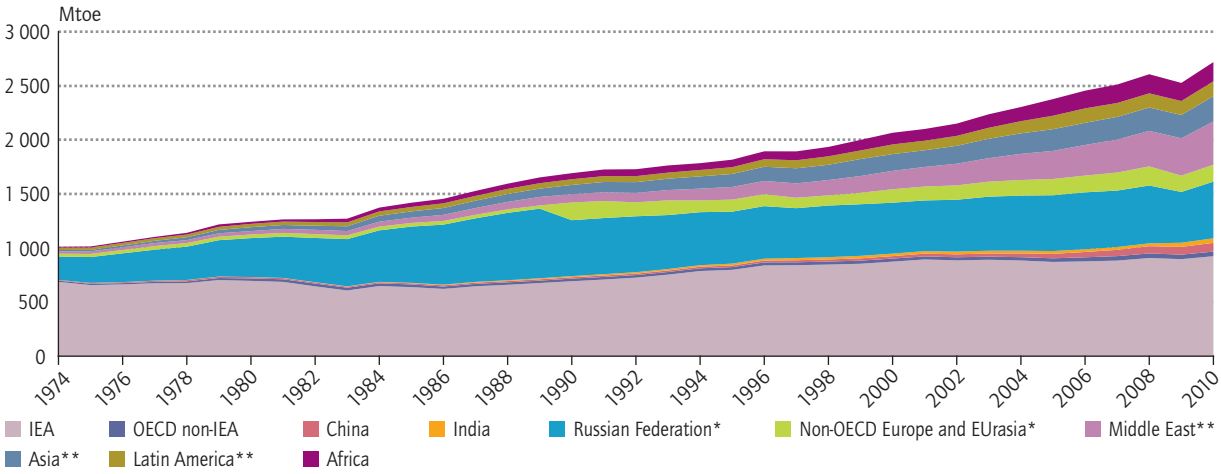
*** Middle East excludes Israel. Asia excludes China, India and OECD Asia Oceania. Latin America excludes Chile and Mexico.*

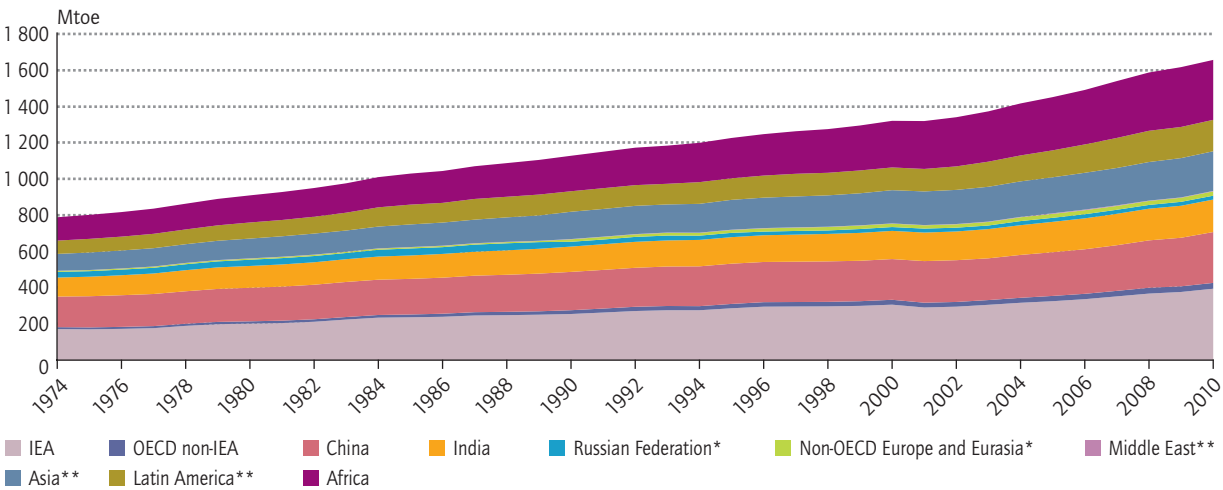
Oil production by region



Natural gas production by region



Renewables and waste production by region



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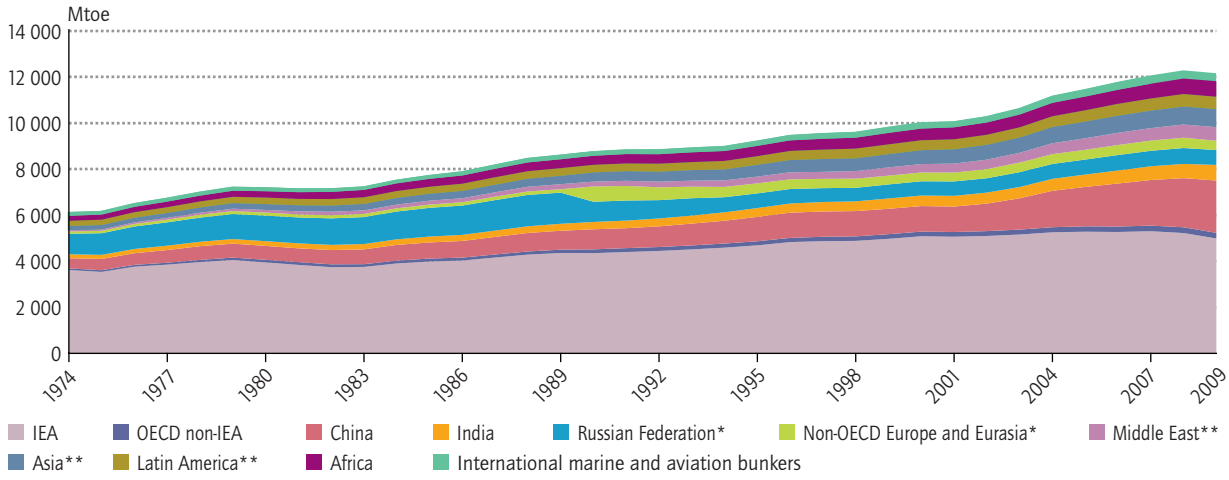
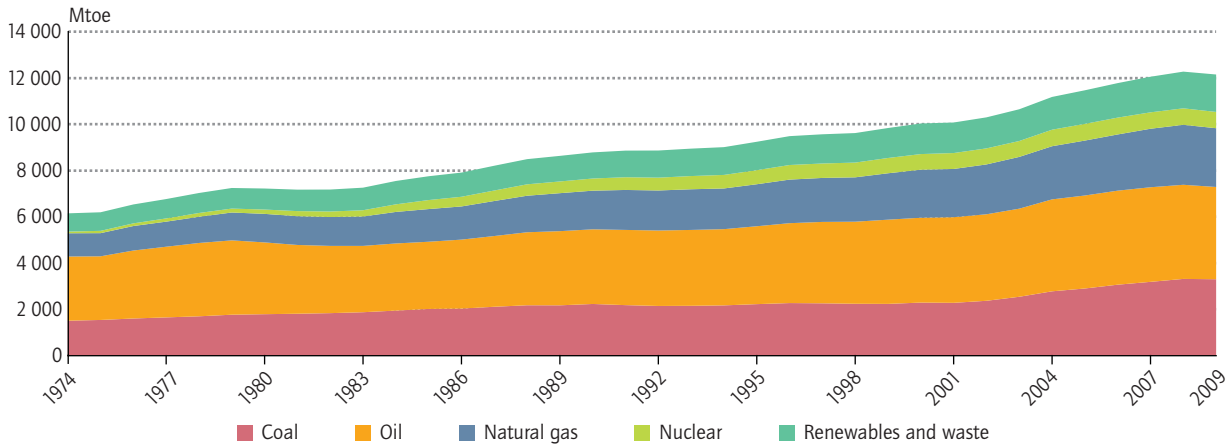
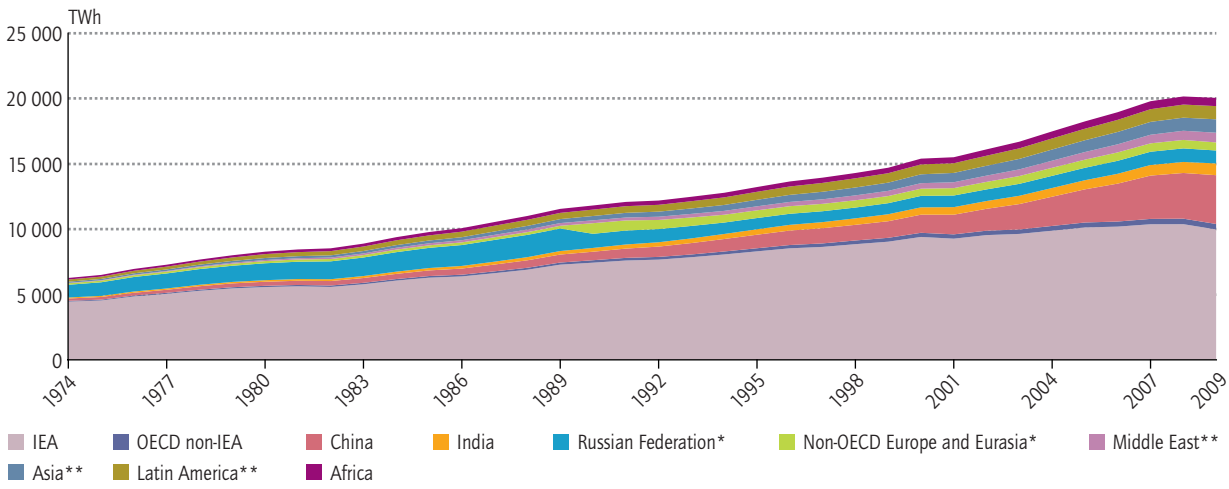
TPES by region



TPES by fuel



Electricity production by region



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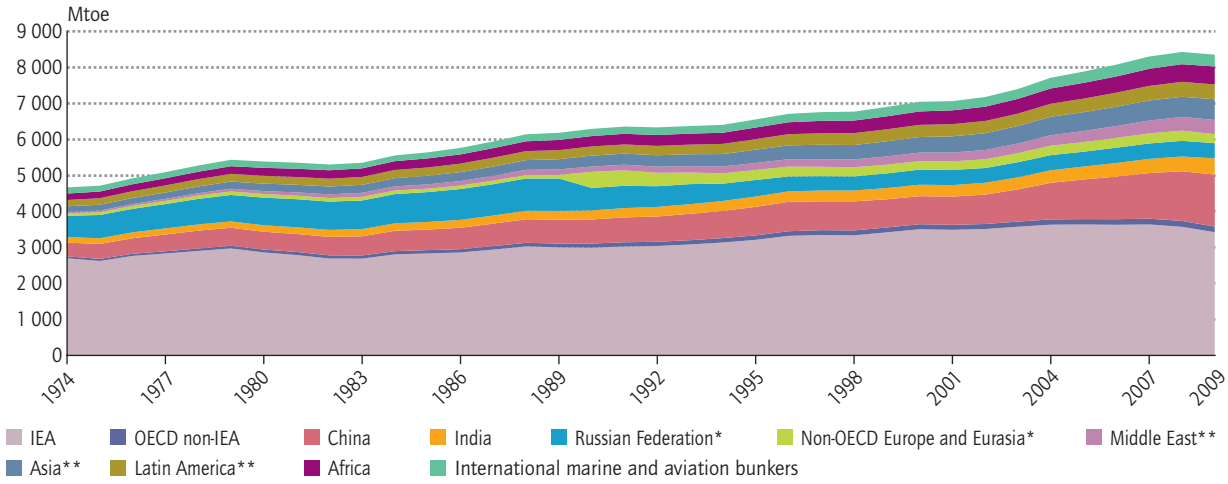
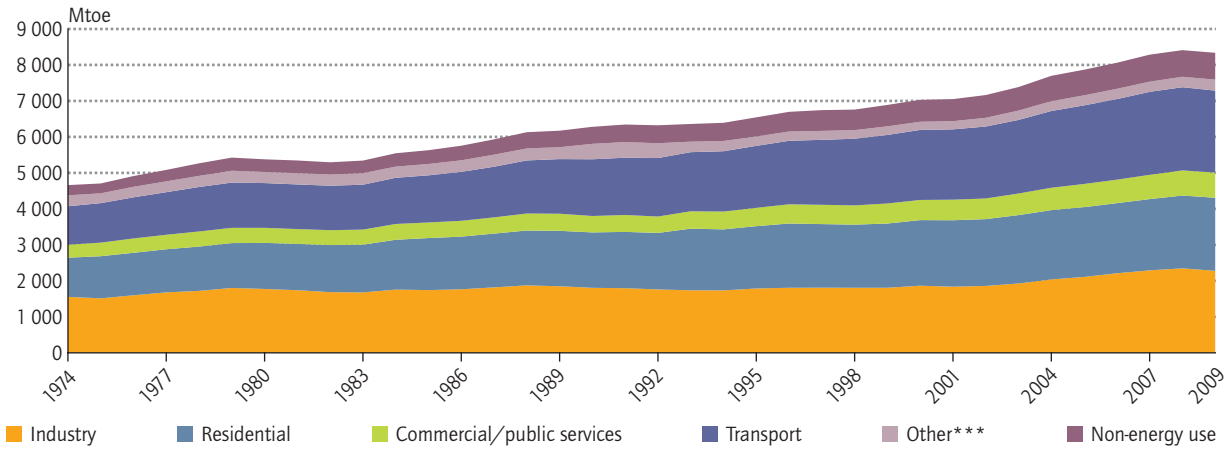
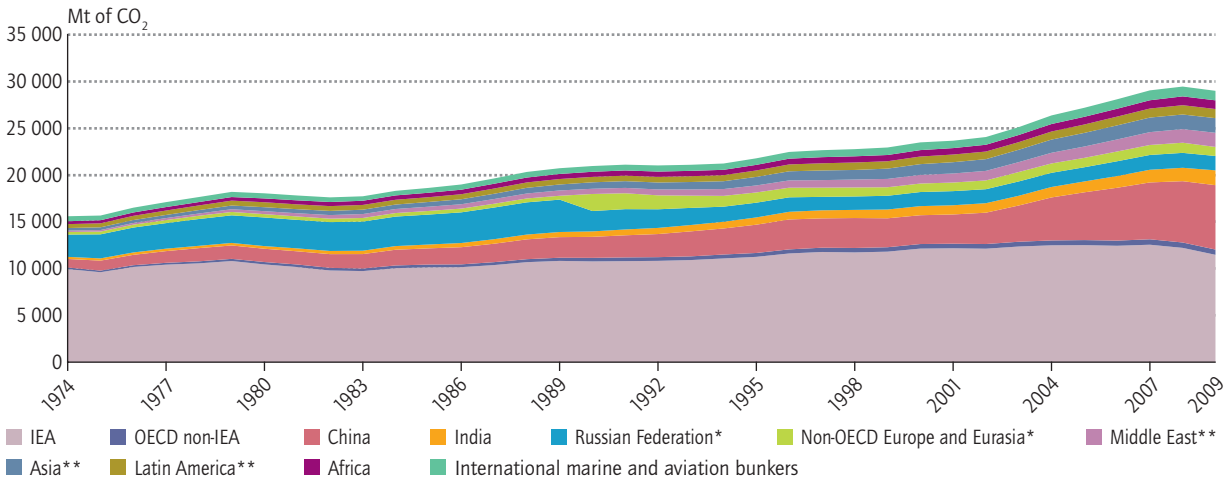
Final consumption by region



Final consumption by sector



CO_2 emissions by region



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**** Other includes agriculture/forestry, fishing and other use not specified elsewhere.*

Selected key indicators for 140 countries, economies and regions

Region / Country / Economy	Population	GDP	GDP PPP	Energy prod.	Net imports	TPES	Elec. cons.	CO_2 emissions	TPES/ pop.	TPES/ GDP	TPES/ GDP PPP	Elec. cons./ pop.	CO_2/ TPES	CO_2/ pop.	CO_2/ GDP	CO_2/ GDP PPP
	(million)	(billion 2000USD)	(billion 2000USD)	(Mtoe)	(Mtoe)	(Mtoe)	(TWh)	(Mt of CO_2)	(toe/ capita)	(toe/000 2000USD)	(toe/000 2000USD)	(kWh/ capita)	(t CO_2/ toe)	(t CO_2/ capita)	(kg CO_2/ 2000USD)	(kg CO_2/ 2000USD)
World	6761	39674	64244	12286	-	12144	18456	29002	1.80	0.31	0.19	2730	2.39	4.29	0.73	0.45
OECD	1225	29633	32114	3807	1644	5238	9813	12045	4.28	0.18	0.16	8012	2.30	9.83	0.41	0.38
Middle East	195	782	1433	1563	-951	589	638	1509	3.03	0.75	0.41	3278	2.56	7.76	1.93	1.05
Non-OECD Europe and Eurasia	335	752	2835	1645	-579	1051	1407	2500	3.14	1.40	0.37	4200	2.38	7.46	3.33	0.88
China	1338	3169	12434	2085	305	2272	3545	6877	1.70	0.72	0.18	2648	3.03	5.14	2.17	0.55
Asia	2208	2486	9094	1310	203	1459	1637	3153	0.66	0.59	0.16	741	2.16	1.43	1.27	0.35
Latin America	451	1957	3769	751	-188	540	850	975	1.20	0.28	0.14	1884	1.80	2.16	0.50	0.26
Africa	1009	896	2565	1125	-452	666	566	928	0.66	0.74	0.26	561	1.39	0.92	1.04	0.36
Albania	3.16	5.88	18.16	1.25	0.48	1.72	5.58	2.70	0.54	0.29	0.09	1768	1.57	0.85	0.46	0.15
Algeria	34.90	76.41	226.31	152.29	-111.67	39.76	33.94	92.52	1.14	0.52	0.18	973	2.33	2.65	1.21	0.41
Angola	18.50	24.30	53.87	100.96	-88.84	11.90	3.75	12.92	0.64	0.49	0.22	203	1.09	0.70	0.53	0.24
Argentina	40.28	397.95	624.85	80.82	-4.95	74.25	110.52	166.61	1.84	0.19	0.12	2744	2.24	4.14	0.42	0.27
Armenia	3.08	4.00	15.63	0.82	1.81	2.60	4.78	4.26	0.84	0.65	0.17	1551	1.64	1.38	1.06	0.27
Australia	22.10	535.23	703.82	310.70	-172.99	131.07	243.96	394.88	5.93	0.24	0.19	11038	3.01	17.87	0.74	0.56
Austria	8.36	218.36	263.22	11.40	20.99	31.66	66.46	63.37	3.79	0.14	0.12	7947	2.00	7.58	0.29	0.24
Azerbaijan	8.78	20.22	76.40	64.56	-51.86	11.97	14.50	25.22	1.36	0.59	0.16	1651	2.11	2.87	1.25	0.33
Bahrain	0.79	13.67	17.91	19.84	-5.58	11.76	10.78	28.18	14.87	0.86	0.66	13625	2.40	35.62	2.06	1.57
Bangladesh	162.22	78.23	330.48	24.84	4.98	29.60	37.00	50.66	0.18	0.38	0.09	228	1.71	0.31	0.65	0.15
Belarus	9.66	24.70	93.18	4.05	22.21	26.76	31.36	60.79	2.77	1.08	0.29	3245	2.27	6.29	2.46	0.65
Belgium	10.79	260.83	317.71	15.32	49.59	57.22	85.33	100.70	5.30	0.22	0.18	7908	1.76	9.33	0.39	0.32
Benin	8.94	3.24	10.08	2.00	1.57	3.47	0.79	4.15	0.39	1.07	0.34	88	1.19	0.46	1.28	0.41
Bolivia	9.86	11.76	27.79	14.19	-8.02	6.23	5.46	12.87	0.63	0.53	0.22	553	2.07	1.31	1.10	0.46
Bosnia and Herzegovina	3.77	8.14	33.13	4.47	1.59	5.95	10.80	19.09	1.58	0.73	0.18	2868	3.21	5.07	2.34	0.58
Botswana	1.95	7.96	18.88	0.94	1.13	2.05	2.98	4.18	1.05	0.26	0.11	1528	2.04	2.14	0.53	0.22
Brazil	193.73	856.02	1652.10	230.31	15.65	240.16	426.34	337.80	1.24	0.28	0.15	2201	1.41	1.74	0.39	0.20
Brunei Darrussalam	0.40	6.82	8.14	18.94	-15.58	3.12	3.39	8.12	7.81	0.46	0.38	8485	2.60	20.30	1.19	1.00
Bulgaria	7.59	19.29	74.84	9.83	8.06	17.48	33.38	42.21	2.30	0.91	0.23	4401	2.41	5.56	2.19	0.56
Cambodia	14.81	7.48	45.54	3.67	1.55	5.18	1.83	4.26	0.35	0.69	0.11	123	0.82	0.29	0.57	0.09
Cameroon	19.52	13.55	37.54	8.85	-2.19	6.92	5.20	4.79	0.35	0.51	0.18	266	0.69	0.25	0.35	0.13
Canada	33.74	846.83	1021.09	389.81	-141.46	254.12	521.85	520.75	7.53	0.30	0.25	15467	2.05	15.43	0.61	0.51
Chile	16.93	103.28	196.05	9.30	20.46	28.78	55.67	64.93	1.70	0.28	0.15	3288	2.26	3.84	0.63	0.33
People's Rep. of China	1331.46	2937.55	12194.40	2084.94	274.92	2257.10	3503.40	6831.60	1.70	0.77	0.19	2631	3.03	5.13	2.33	0.56
Chinese Taipei	22.97	412.14	630.41	12.80	90.73	101.09	220.28	250.11	4.40	0.25	0.16	9588	2.47	10.89	0.61	0.40
Colombia	45.66	141.65	420.98	99.15	-65.90	31.83	47.80	60.56	0.70	0.22	0.08	1047	1.90	1.33	0.43	0.14
Congo	3.68	4.67	5.25	15.28	-14.24	1.40	0.58	1.66	0.38	0.30	0.27	157	1.18	0.45	0.36	0.32

Region / Country / Economy	Population	GDP	GDP PPP	Energy prod.	Net imports	TPES	Elec. cons.	CO_2 emissions	TPES/ pop.	TPES/ GDP	TPES/ GDP PPP	Elec. cons./ pop.	CO_2/ TPES	CO_2/ pop.	CO_2/ GDP	CO_2/ GDP PPP
	(million)	(billion 2000USD)	(billion 2000USD)	(Mtoe)	(Mtoe)	(Mtoe)	(TWh)	(Mt of CO_2)	(toe/ capita)	(toe/000 2000USD)	(toe/000 2000USD)	(kWh/ capita)	(t CO_2/ toe)	(t CO_2/ capita)	(kg CO_2/ 2000USD)	(kg CO_2/ 2000USD)
Dem. Rep. of Congo	66.02	6.38	44.61	23.35	-0.41	22.92	6.67	2.87	0.35	3.59	0.51	101	0.13	0.04	0.45	0.06
Costa Rica	4.58	23.09	46.48	2.71	2.31	4.90	8.32	6.27	1.07	0.21	0.11	1817	1.28	1.37	0.27	0.13
Cote d'Ivoire	21.08	11.30	28.82	11.89	-1.48	10.35	3.94	6.09	0.49	0.92	0.36	187	0.59	0.29	0.54	0.21
Croatia	4.43	28.35	63.14	4.07	4.49	8.70	16.44	19.77	1.96	0.31	0.14	3709	2.27	4.46	0.70	0.31
Cuba	11.20	47.78	110.25	5.57	6.12	11.51	15.18	26.84	1.03	0.24	0.10	1355	2.33	2.40	0.56	0.24
Cyprus	0.81	12.09	17.58	0.08	2.91	2.51	5.04	7.46	3.11	0.21	0.14	6251	2.98	9.26	0.62	0.42
Czech Republic	10.51	75.87	206.01	31.20	11.38	41.99	64.12	109.84	4.00	0.55	0.20	6103	2.62	10.45	1.45	0.53
Denmark	5.52	167.73	161.21	23.91	-3.74	18.61	34.50	46.78	3.37	0.11	0.12	6248	2.51	8.47	0.28	0.29
Dominican Republic	10.09	37.31	105.49	1.89	6.27	8.09	13.31	18.07	0.80	0.22	0.08	1319	2.23	1.79	0.48	0.17
Ecuador	13.63	24.13	60.17	27.32	-14.78	11.35	15.91	28.48	0.83	0.47	0.19	1168	2.51	2.09	1.18	0.47
Egypt	83.00	152.36	362.18	88.19	-15.00	72.01	123.45	175.41	0.87	0.47	0.20	1487	2.44	2.11	1.15	0.48
El Salvador	6.16	15.81	34.76	3.16	2.03	5.10	5.21	6.79	0.83	0.32	0.15	845	1.33	1.10	0.43	0.20
Eritrea	5.07	0.83	4.75	0.56	0.16	0.73	0.26	0.47	0.14	0.88	0.15	51	0.65	0.09	0.57	0.10
Estonia	1.34	8.04	19.15	4.16	1.20	4.75	7.98	14.66	3.54	0.59	0.25	5951	3.09	10.94	1.82	0.77
Ethiopia	82.83	16.62	110.21	30.37	2.30	32.68	3.72	7.42	0.39	1.97	0.30	45	0.23	0.09	0.45	0.07
Finland	5.34	141.16	153.98	16.55	18.35	33.17	81.37	55.01	6.21	0.23	0.22	15241	1.66	10.30	0.39	0.36
France	64.49	1472.79	1702.03	129.50	134.38	256.22	483.32	354.30	3.97	0.17	0.15	7494	1.38	5.49	0.24	0.21
Gabon	1.48	5.98	8.77	13.59	-11.64	1.79	1.36	1.70	1.22	0.30	0.20	924	0.95	1.15	0.28	0.19
Georgia	4.26	5.26	16.23	1.26	2.98	4.00	6.99	8.08	0.94	0.76	0.25	1641	2.02	1.90	1.54	0.50
Germany	81.88	1998.65	2243.18	127.09	202.94	318.53	555.19	750.19	3.89	0.16	0.14	6781	2.36	9.16	0.38	0.33
Ghana	23.84	8.18	62.77	7.05	2.41	9.24	6.32	9.02	0.39	1.13	0.15	265	0.98	0.38	1.10	0.14
Gibraltar	0.03	0.84	0.88	0.00	1.43	0.16	0.17	0.50	5.65	0.19	0.19	6000	3.06	17.26	0.60	0.57
Greece	11.28	168.11	265.88	10.08	22.18	29.44	62.51	90.22	2.61	0.18	0.11	5540	3.06	8.00	0.54	0.34
Guatemala	14.03	26.06	61.07	6.05	3.88	9.84	7.69	14.51	0.70	0.38	0.16	548	1.47	1.03	0.56	0.24
Haiti	10.03	3.91	13.05	1.87	0.75	2.60	0.35	2.37	0.26	0.66	0.20	35	0.91	0.24	0.61	0.18
Honduras	7.47	10.31	31.92	2.19	2.23	4.41	5.05	7.14	0.59	0.43	0.14	677	1.62	0.96	0.69	0.22
Hong Kong (China)	7.00	231.34	239.51	0.05	29.88	14.94	41.49	45.60	2.13	0.06	0.06	5924	3.05	6.51	0.20	0.19
Hungary	10.02	56.40	147.51	11.00	14.86	24.86	37.82	48.16	2.48	0.44	0.17	3773	1.94	4.80	0.85	0.33
Iceland	0.32	11.22	10.46	4.40	0.96	5.22	16.33	2.00	16.38	0.47	0.50	51179	0.38	6.26	0.18	0.19
India	1155.35	874.94	4566.96	502.47	181.97	675.83	689.54	1585.82	0.58	0.77	0.15	597	2.35	1.37	1.81	0.35
Indonesia	229.97	258.49	938.71	351.84	-153.64	202.00	140.11	376.26	0.88	0.78	0.22	609	1.86	1.64	1.46	0.40
Islamic Rep. of Iran	72.90	158.09	576.96	349.78	-132.12	216.20	167.69	533.22	2.97	1.37	0.37	2300	2.47	7.31	3.37	0.92
Iraq	28.95	23.01	31.46	119.64	-86.75	32.17	33.22	98.77	1.11	1.40	1.02	1148	3.07	3.41	4.29	3.14
Ireland	4.47	125.11	141.16	1.53	13.20	14.34	26.91	39.46	3.21	0.11	0.10	6022	2.75	8.83	0.32	0.28
Israel	7.44	162.17	192.20	3.27	19.43	21.55	49.46	64.63	2.90	0.13	0.11	6648	3.00	8.69	0.40	0.34
Italy	60.19	1110.68	1475.11	27.01	141.21	164.63	317.25	389.28	2.74	0.15	0.11	5271	2.36	6.47	0.35	0.26
Jamaica	2.70	9.96	11.56	0.53	2.72	3.26	5.13	8.27	1.21	0.33	0.28	1899	2.54	3.06	0.83	0.72

Selected key indicators for 140 countries, economies and regions (continued)

Region / Country / Economy	Population	GDP	GDP PPP	Energy prod.	Net imports	TPES	Elec. cons.	CO_2 emissions	TPES/ pop.	TPES/ GDP	TPES/ GDP PPP	Elec. cons./ pop.	CO_2/ TPES	CO_2/ pop.	CO_2/ GDP	CO_2/ GDP PPP
	(million)	(billion 2000USD)	(billion 2000USD)	(Mtoe)	(Mtoe)	(Mtoe)	(TWh)	(Mt of CO_2)	(toe/ capita)	(toe/000 2000USD)	(toe/000 2000USD)	(kWh/ capita)	(t CO_2/ toe)	(t CO_2/ capita)	(kg CO_2/ 2000USD)	(kg CO_2/ 2000USD)
Japan	127.33	4872.22	3392.86	93.79	384.46	471.99	997.40	1092.86	3.71	0.10	0.14	7833	2.32	8.58	0.22	0.32
Jordan	5.95	14.86	35.38	0.29	7.50	7.45	12.49	19.20	1.25	0.50	0.21	2099	2.58	3.23	1.29	0.54
Kazakhstan	15.89	37.75	133.48	145.81	-80.07	65.84	71.59	189.54	4.14	1.74	0.49	4506	2.88	11.93	5.02	1.42
Kenya	39.80	17.99	44.88	15.57	3.55	18.72	5.82	10.02	0.47	1.04	0.42	146	0.54	0.25	0.56	0.22
Korea	48.75	752.83	1140.99	44.31	198.10	229.18	437.73	515.46	4.70	0.30	0.20	8980	2.25	10.57	0.68	0.45
DPR of Korea	23.91	11.53	40.56	20.26	-1.00	19.27	17.76	66.20	0.81	1.67	0.48	743	3.44	2.77	5.74	1.63
Kuwait	2.80	63.63	72.41	130.24	-98.58	30.17	46.60	80.72	10.80	0.47	0.42	16673	2.68	28.88	1.27	1.11
Kyrgyzstan	5.32	2.05	11.00	1.16	2.35	3.01	7.46	7.06	0.57	1.47	0.27	1402	2.34	1.33	3.45	0.64
Latvia	2.26	11.21	27.08	2.10	2.70	4.22	6.48	6.75	1.87	0.38	0.16	2875	1.60	2.99	0.60	0.25
Lebanon	4.22	26.78	25.83	0.17	6.67	6.63	13.14	19.33	1.57	0.25	0.26	3110	2.91	4.58	0.72	0.75
Libyan Arab Jamahiriya	6.42	52.02	70.70	87.14	-66.40	20.41	26.12	50.05	3.18	0.39	0.29	4068	2.45	7.80	0.96	0.71
Lithuania	3.34	17.21	45.99	4.21	4.18	8.39	11.46	12.39	2.51	0.49	0.18	3430	1.48	3.71	0.72	0.27
Luxembourg	0.50	26.46	30.55	0.11	4.26	3.95	7.18	9.99	7.95	0.15	0.13	14447	2.53	20.10	0.38	0.33
FYR of Macedonia	2.04	4.41	14.95	1.61	1.25	2.78	7.08	8.34	1.36	0.63	0.19	3467	3.00	4.08	1.89	0.56
Malaysia	27.47	137.13	299.35	89.69	-21.71	66.83	101.00	164.16	2.43	0.49	0.22	3677	2.46	5.98	1.20	0.55
Malta	0.42	4.36	7.73	0.00	1.98	0.80	1.83	2.45	1.93	0.18	0.10	4405	3.06	5.89	0.56	0.32
Mexico	107.44	724.35	1122.95	220.03	-42.34	174.64	217.66	399.67	1.63	0.24	0.16	2026	2.29	3.72	0.55	0.36
Republic of Moldova	3.60	1.97	8.65	0.10	2.37	2.45	3.63	5.75	0.68	1.24	0.28	1007	2.35	1.59	2.91	0.66
Mongolia	2.67	1.91	7.42	7.69	-4.20	3.24	3.83	11.99	1.21	1.69	0.44	1432	3.70	4.49	6.27	1.62
Morocco	31.99	57.89	174.85	0.78	14.84	15.08	23.90	41.30	0.47	0.26	0.09	747	2.74	1.29	0.71	0.24
Mozambique	22.89	8.49	32.16	11.92	-2.07	9.77	10.36	2.24	0.43	1.15	0.30	453	0.23	0.10	0.26	0.07
Myanmar	50.02	19.91	120.41	22.36	-7.17	15.06	4.94	10.14	0.30	0.76	0.13	99	0.67	0.20	0.51	0.08
Namibia	2.17	5.80	18.80	0.33	1.39	1.71	3.53	3.69	0.79	0.30	0.09	1628	2.15	1.70	0.64	0.20
Nepal	29.33	7.65	45.10	8.82	1.21	9.96	2.68	3.40	0.34	1.30	0.22	91	0.34	0.12	0.45	0.08
Netherlands	16.53	432.48	525.84	63.05	35.12	78.17	113.99	176.11	4.73	0.18	0.15	6897	2.25	10.66	0.41	0.33
Netherlands Antilles	0.20	1.28	2.88	0.00	3.92	2.12	1.09	4.97	10.68	1.65	0.73	5505	2.35	25.10	3.88	1.72
New Zealand	4.33	67.48	102.87	15.21	3.45	17.40	40.34	31.31	4.02	0.26	0.17	9311	1.80	7.23	0.46	0.30
Nicaragua	5.74	5.00	19.57	1.71	1.38	3.09	2.62	4.22	0.54	0.62	0.16	457	1.37	0.73	0.84	0.22
Nigeria	154.73	78.33	179.92	228.72	-122.01	108.25	18.62	41.19	0.70	1.38	0.60	120	0.38	0.27	0.53	0.23
Norway	4.83	195.96	188.92	213.64	-185.51	28.24	113.72	37.31	5.85	0.14	0.15	23558	1.32	7.73	0.19	0.20
Oman	2.85	31.63	49.02	67.20	-51.03	15.06	15.52	38.95	5.29	0.48	0.31	5457	2.59	13.69	1.23	0.79
Pakistan	169.71	111.48	394.89	64.86	19.84	85.52	76.61	136.94	0.50	0.77	0.22	451	1.60	0.81	1.23	0.35
Panama	3.45	19.80	30.40	0.67	2.60	3.10	6.01	7.25	0.90	0.16	0.10	1739	2.34	2.10	0.37	0.24
Paraguay	6.35	9.10	28.64	7.43	-2.65	4.75	6.70	4.06	0.75	0.52	0.17	1055	0.85	0.64	0.45	0.14
Peru	29.17	84.96	195.44	15.14	2.50	15.83	32.67	38.55	0.54	0.19	0.08	1120	2.44	1.32	0.45	0.20
Philippines	91.98	111.74	449.68	23.47	16.34	38.84	54.42	70.54	0.42	0.35	0.09	592	1.82	0.77	0.63	0.16
Poland	38.15	241.67	570.39	67.52	30.23	93.99	137.00	286.76	2.46	0.39	0.16	3591	3.05	7.52	1.19	0.50

Region / Country / Economy	Population	GDP	GDP PPP	Energy prod.	Net imports	TPES	Elec. cons.	CO_2 emissions	TPES/ pop.	TPES/ GDP	TPES/ GDP PPP	Elec. cons./ pop.	CO_2/ TPES	CO_2/ pop.	CO_2/ GDP	CO_2/ GDP PPP
	(million)	(billion 2000USD)	(billion 2000USD)	(Mtoe)	(Mtoe)	(Mtoe)	(TWh)	(Mt of CO_2)	(toe/ capita)	(toe/000 2000USD)	(toe/000 2000USD)	(kWh/ capita)	(t CO_2/ toe)	(t CO_2/ capita)	(kg CO_2/ 2000USD)	(kg CO_2/ 2000USD)
Portugal	10.63	123.35	191.32	4.89	20.66	24.10	51.19	53.14	2.27	0.20	0.13	4815	2.21	5.00	0.43	0.28
Qatar	1.41	40.71	36.47	139.95	-115.07	23.82	23.04	56.53	16.91	0.59	0.65	16353	2.37	40.12	1.39	1.55
Romania	21.48	56.00	199.91	28.30	6.62	34.41	48.69	78.36	1.60	0.61	0.17	2267	2.28	3.65	1.40	0.39
Russian Federation	141.90	397.54	1530.15	1181.59	-528.63	646.91	870.33	1532.60	4.56	1.63	0.42	6133	2.37	10.80	3.86	1.00
Saudi Arabia	25.39	249.54	371.91	528.38	-371.80	157.85	199.12	410.47	6.22	0.63	0.42	7842	2.60	16.17	1.64	1.10
Senegal	12.53	6.69	22.60	1.26	1.87	2.94	2.37	5.26	0.23	0.44	0.13	189	1.79	0.42	0.79	0.23
Serbia	7.32	9.00	33.13	9.44	4.89	14.45	30.93	46.26	1.97	1.61	0.44	4225	3.20	6.32	5.14	1.40
Singapore	4.99	143.47	146.68	0.03	58.92	18.48	39.65	44.83	3.70	0.13	0.13	7948	2.43	8.99	0.31	0.31
Slovak Republic	5.42	31.32	91.04	5.94	11.25	16.72	26.69	33.17	3.09	0.53	0.18	4926	1.98	6.12	1.06	0.36
Slovenia	2.04	25.70	44.90	3.54	3.43	6.97	12.45	15.15	3.41	0.27	0.16	6096	2.17	7.42	0.59	0.34
South Africa	49.32	181.92	527.98	160.64	-13.61	144.04	223.52	369.37	2.92	0.79	0.27	4532	2.56	7.49	2.03	0.70
Spain	45.93	713.36	1054.60	29.72	110.69	126.52	275.74	283.37	2.75	0.18	0.12	6004	2.24	6.17	0.40	0.27
Sri Lanka	20.30	25.03	102.14	5.09	4.30	9.28	8.44	12.66	0.46	0.37	0.09	416	1.36	0.62	0.51	0.12
Sudan	42.27	22.68	90.90	35.20	-18.34	15.82	4.85	13.26	0.37	0.70	0.17	115	0.84	0.31	0.58	0.15
Sweden	9.30	286.27	287.08	30.35	17.76	45.41	131.50	41.71	4.88	0.16	0.16	14141	0.92	4.48	0.15	0.15
Switzerland	7.80	286.30	261.12	12.77	15.64	26.95	62.11	42.42	3.45	0.09	0.10	7962	1.57	5.44	0.15	0.16
Syrian Arab Republic	21.09	28.47	78.31	23.58	-3.50	20.77	31.32	54.48	0.98	0.73	0.27	1485	2.62	2.58	1.91	0.70
Tajikistan	6.95	1.73	8.83	1.50	0.82	2.32	13.47	2.77	0.33	1.34	0.26	1937	1.19	0.40	1.60	0.31
United Rep. of Tanzania	43.74	16.24	31.54	10.45	1.71	12.02	3.73	6.26	0.27	0.74	0.38	85	0.52	0.14	0.39	0.20
Thailand	67.76	173.92	550.39	61.71	47.37	103.32	140.49	227.80	1.52	0.59	0.19	2073	2.20	3.36	1.31	0.41
Togo	6.62	1.63	8.95	2.19	0.39	2.63	0.65	1.12	0.40	1.61	0.29	99	0.43	0.17	0.69	0.13
Trinidad and Tobago	1.34	14.11	20.21	44.00	-23.57	20.26	7.57	40.17	15.13	1.44	1.00	5650	1.98	30.00	2.85	1.99
Tunisia	10.43	29.27	90.38	7.81	1.60	9.20	13.69	20.78	0.88	0.31	0.10	1312	2.26	1.99	0.71	0.23
Turkey	71.90	356.96	789.08	30.28	70.25	97.66	165.09	256.31	1.36	0.27	0.12	2296	2.62	3.57	0.72	0.32
Turkmenistan	5.11	9.34	50.38	40.90	-21.32	19.58	12.18	48.77	3.83	2.10	0.39	2384	2.49	9.54	5.22	0.97
Ukraine	46.01	45.39	288.25	76.91	41.84	115.47	147.39	256.39	2.51	2.54	0.40	3204	2.22	5.57	5.65	0.89
United Arab Emirates	4.60	118.06	116.64	168.80	-93.21	59.59	79.54	147.04	12.96	0.50	0.51	17296	2.47	31.97	1.25	1.26
United Kingdom	61.79	1677.10	1742.62	158.91	55.08	196.76	351.80	465.80	3.18	0.12	0.11	5693	2.37	7.54	0.28	0.27
United States	307.48	11357.07	11357.07	1686.40	559.01	2162.92	3961.56	5195.02	7.03	0.19	0.19	12884	2.40	16.90	0.46	0.46
Uruguay	3.35	29.91	42.35	1.52	3.12	4.09	8.93	7.74	1.22	0.14	0.10	2671	1.89	2.31	0.26	0.18
Uzbekistan	27.77	24.79	66.51	60.69	-11.88	48.81	45.43	112.36	1.76	1.97	0.73	1636	2.30	4.05	4.53	1.69
Venezuela	28.38	160.02	191.23	203.53	-129.22	66.90	89.45	154.57	2.36	0.42	0.35	3152	2.31	5.45	0.97	0.81
Vietnam	87.28	58.84	298.94	76.64	-13.83	64.05	78.93	114.07	0.73	1.09	0.21	904	1.78	1.31	1.94	0.38
Yemen	23.58	13.32	20.79	15.22	-8.00	7.56	5.11	22.18	0.32	0.57	0.36	216	2.93	0.94	1.67	1.07
Zambia	12.94	5.19	13.47	7.24	0.66	7.86	8.08	1.69	0.61	1.51	0.58	625	0.22	0.13	0.33	0.13
Zimbabwe	12.52	4.65	19.78	8.53	0.97	9.51	12.80	8.66	0.76	2.05	0.48	1022	0.91	0.69	1.86	0.44

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Note: The countries listed above are those for which the IEA Secretariat has direct statistical contacts.

EJ	exajoule
kg	kilogramme
kg CO_2	kilogramme of carbon dioxide
km	kilometre
kWh	kilowatt hour
lm	lumen
MJ	megajoule
Mt	million tonne
Mt CO_2	million tonnes of carbon dioxide
Mtoe	million tonnes of oil equivalent
pkm	passenger-kilometre
t	tonne
t CO_2	tonne of carbon dioxide
tkm	tonne-kilometre
toe	tonne of oil equivalent
TWh	terawatt hour
USD	United States dollar
W	Watt

GDP	gross domestic product calculated using market exchange rates
GDP PPP	gross domestic product calculated using purchasing power parities
LNG	liquefied natural gas
LPG	liquefied petroleum gases
MER	market exchange rate
PPP	purchasing power parity
TPES	total primary energy supply

EU	European Union
FSU	Former Soviet Union
IEA	International Energy Agency
OECD	Organisation for Economic Co-operation and Development



International Energy Agency

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