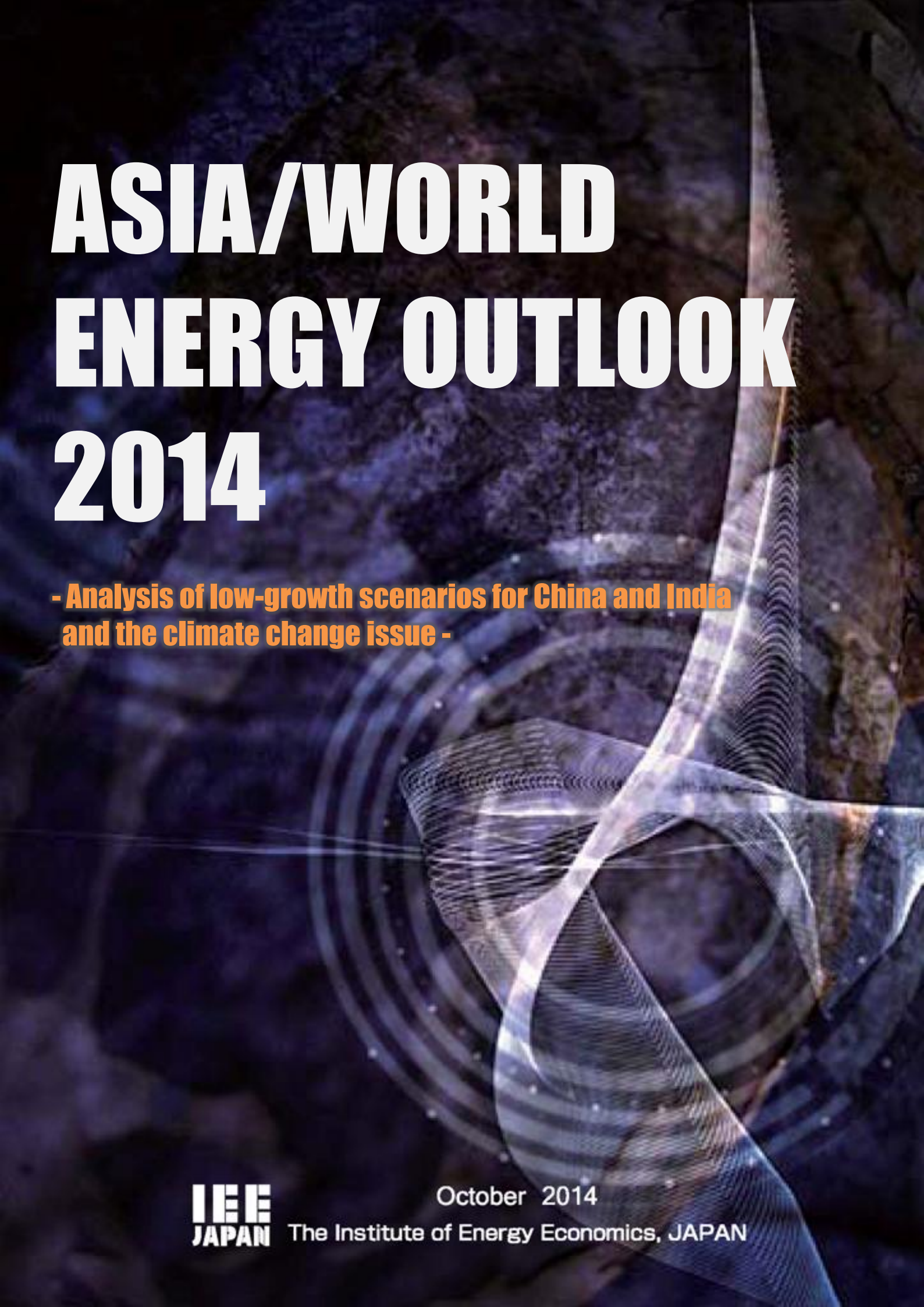
ASIA/WORLD ENERGY OUTLOOK 2014

- Analysis of low-growth scenarios for China and India and the climate change issue -



October 2014
IEE JAPAN The Institute of Energy Economics, JAPAN

Asia/World Energy Outlook 2014

– Analysis of low-growth scenarios for China and India and the climate change issue –

Foreword

The year 2014 marks a century since the start of World War I, a three-quarter century since the start of World War II and a quarter century from the Berlin Wall's collapse symbolising the end to the East-West Cold War. In this commemorative year, the world saw tensions accompanied by armed clashes in Ukraine, the Middle East and Asia. These tensions triggered worries about the future of world peace and security, and concerns over the stability of energy supplies worldwide.

Until recently, potential threats to the global energy system stability included the geopolitical risks in energy supplying regions and sea-lanes security, as well as the impact of rapid energy demand growth, mainly from Asia. The views on Asian energy demand are now changing slightly. While the world's first and third largest energy consuming countries, China and India, are still expected to lead the global energy consumption growth, various projections have emerged about a slower pace of energy consumption growth in these two countries.

China recorded economic growth topping 10% in 16 of the 30 years between 1981 and 2010. Even when developed countries were economically sinking due to financial and debt crises, China managed to achieve growth above 9%. However, the growth rates have recently slipped below the 8% level, considered as a committed target. Given a decline in productive population and wide-ranging social problems, talks of a slowdown or a rapid deceleration in economic growth have emerged. In the face of such situation, the central government is investigating a soft landing path to stable growth, while securing job opportunities. The emerging conflicts between central and local governments, the lopsided economic structure, the growing materialism among citizens, and other problems, point to many high walls for China to overcome. Whether the second largest economic power in the world can smoothly achieve its structural shift from quantity to quality is now attracting global attention.

India, now home to more than 1.2 billion people, will become the most populated country in the world in a little more than 10 years. Its demographics and stage of economic development indicate the country as having greater growth potential than China. Meanwhile, underdeveloped infrastructure, inefficient administrative systems and protectionist policies are often cited as impediments to growth. In fact, economic growth in the past two years was limited to less than 5%, the lowest level in 10 years. It was affected by short-term factors such as monetary tightening responding to inflation, as well as external factors including the European sovereign debt crisis. Attracting attention in such situation is whether India rich with potential can get on a high growth path again after the May 2014 government change that was the first in 10 years.

If the two major Asian emerging countries change their growth paths, the world's energy supply-demand picture will be altered dramatically. The changes will not be limited to a deceleration of their energy consumption growth but will directly affect the energy production of countries considered as energy

suppliers for China and India. Changes in the energy trade structure would spill over to other areas including international politics.

For example, Russia recently enhanced its relationships with China after its dispute with Europe and the United States over the Ukrainian situation had intensified. In May 2014, Russia concluded a 30-year natural gas supply contract with China. It later began to construct the so-called Siberian Power pipeline totalling 4,000 kilometres for gas supply to China. If energy consumption fails to grow as expected in China, Russia may have to reconsider its energy strategy and even its international political strategy. How would the Middle East react as it was most expected to cover the anticipated oil demand growth in China? Where will Australian and Indonesian coal go after losing sales to China if coal consumption growth decelerates in India set to become the world's largest coal importer? What would happen to United States coal that is expected to go abroad due to a domestic demand decline under the shale revolution and tougher regulations on carbon dioxide emissions?

Our "Asia/World Energy Outlook 2014" has taken advantage of all its resources – various models and expertise in various areas – to provide the best possible answers to these questions.

Uncertainties facing the world also include the future course of the climate change problem that cannot be separated from energy issues. Even after long discussions, negotiators have failed to find when and how to establish a truly effective target and framework for reducing greenhouse gas emissions. As time has gone by, the wide scope of relevant areas, the abundance of people affected by climate change and insufficient scientific knowledge have made it even more difficult to find solutions and make political decisions on the best package of measures including adaptation to climate change. Since the Intergovernmental Panel on Climate Change unveiled its First Working Group report for its Fifth Climate Change Assessment Report in September 2013, the range of potential relations between the GHG emissions, the atmospheric GHG concentration and the temperature increase has been growingly recognised as wider than earlier conceived.

Regrettably, our Asia/World Energy Outlook 2014, as well as many other responsible study reports, does not directly provide any magic prescription to resolve the great challenges facing mankind. In order to contribute to the right prescription, this report discusses the potential of carbon dioxide emission reduction through the global penetration of energy conservation and low-carbon technologies and reviews the possible impact on a temperature increase, based on up-to-date information and sophisticated analyses.

We would be pleased if our Asia/World Energy Outlook 2014 could serve as a lighthouse guiding energy stakeholders in the growingly uncertain energy situation.

Tokyo, October 2014

THE INSTITUTE OF ENERGY ECONOMICS, JAPAN

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Executive summary

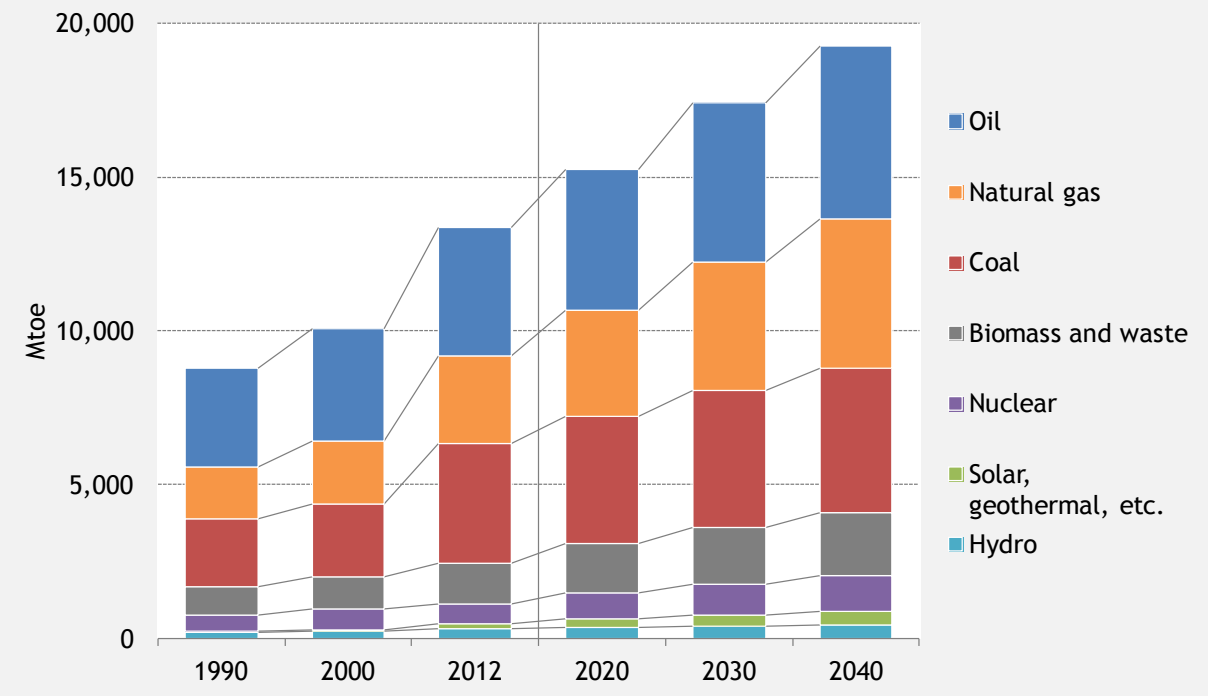
Asia/world energy supply and demand outlook – Reference Scenario

Energy consumption will expand 1.4-fold in 28 years. Natural gas will replace coal as the second largest energy source.

Humans will continue increasing energy consumption.

Primary energy consumption in the world will increase from 13,371 million tonnes of oil equivalent (Mtoe) in 2012 to 19,276 Mtoe in 2040 in the Reference Scenario. This means that global energy demand will annually expand by more than an equivalent of consumption in the United Kingdom and Ireland. Progress in energy conservation will make energy consumption growth slower than economic growth. Nevertheless, energy consumption will expand 44% over the next 28 years.

Figure 1 Global energy consumption [Reference Scenario]



At present, fossil fuels (oil, coal and natural gas) account for 82% of primary energy consumption. As they will still capture more than 70% of future consumption growth, the world will thus remain heavily dependent on fossil fuels.

Oil consumption stood at 88.6 million barrels per day in 2012, will top 100 Mb/d in the next 10 years and will reach 116.5 Mb/d in 2040. The increase of 27.9 Mb/d amounts to more than 90% of present crude oil production by the Organization of Petroleum Exporting Countries (OPEC). Up to two-thirds

or 18.9 Mb/d of the increase will be attributable to the transport sector including automobiles. In 2040, 57% of oil supply will be consumed in the transport sector, with 15% being used as petrochemical feedstocks. Demand will shift to gasoline, diesel oil and naphtha from other petroleum products.

Natural gas will post a faster consumption increase than any other energy source, becoming the second largest energy source after oil by 2040. Natural gas consumption will expand 1.7-fold from 3.44 trillion cubic metres (Tcm) in 2012 to 5.88 Tcm in 2040. Of the total natural gas consumption, liquefied natural gas will increase from 237 million tonnes to 548 Mt. The largest driver of natural gas consumption growth will be the power generation sector but the industry and buildings sectors will also expand natural gas consumption remarkably. Natural gas consumption will also expand geographically. Although OECD and non-OECD Europe accounted for more than two-thirds of global natural gas consumption in 2012, the other countries will capture more than half of global consumption in 2040. In the United States, natural gas will surpass oil in consumption by 2030, becoming the largest energy source.

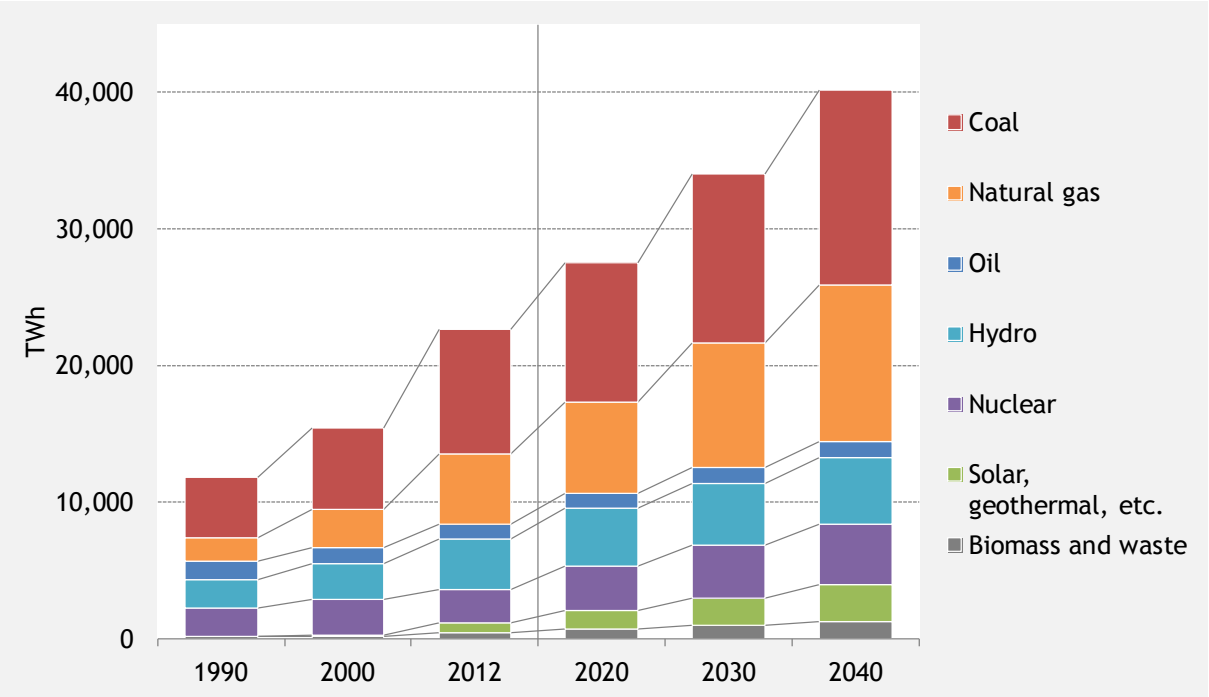
Among fossil fuels, coal will follow a different path. Coal consumption growth will slow down from the fast increase in the early 21st century due to changes in China's industrial production trends, the rising efficiency of coal use, energy switching and other factors. Coal consumption in 2040 will total 6,722 million tonnes of coal equivalent (1 Mtce = 0.7 Mtoe), up 1,181 Mtce from 2012. The increase over the next 28 years will be far below the 2,054 Mtce of the past decade. Steam coal for power generation will account for most of the coal consumption growth. Coking coal consumption for coke production will slightly decrease.

Renewables and nuclear will increase steadily

Overall, renewable energy covering from hydro to biomass will post a consumption increase of 1,120 Mtoe through 2040, the third largest growth after natural gas and oil. Rapidly expanding solar, wind, etc. will jump 3.4-fold from 2012 to 2040. Renewables will cover 22% of global power generation totalling 40,000 terawatt-hours (TWh). However, low-cost biomass and waste including fuel wood and manure in developing countries will account for more than a quarter of the renewables growth.

Nuclear will also increase in many regions. Nuclear power generation capacity will rise from 389 gigawatts (GW) in 31 economies in 2013 to 618 GW in 39 economies in 2040. Russia, Korea and the Middle East will proactively expand nuclear power generation. But particularly remarkable growth of nuclear will come in China, India and other emerging countries where electricity demand will expand substantially.

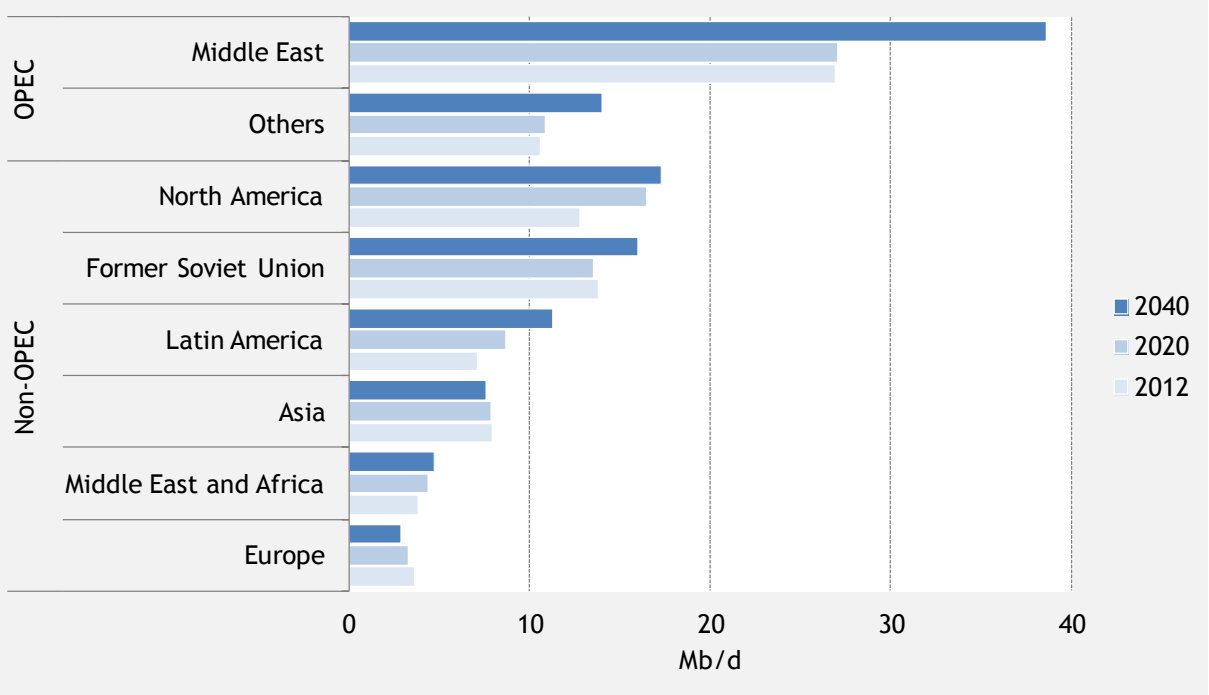
Figure 2 World power generation mix [Reference Scenario]



The emergence of new oil and natural gas suppliers will not affect the importance of traditional suppliers

Against the backdrop of unconventional resources development symbolised by the shale revolution, as well as resource development in deep-water and other extreme environments, multiple regions are about to emerge or resurge as key oil and natural gas suppliers. A crude oil production increase through 2020 in North and South Americas excluding OPEC members Venezuela and Ecuador will total 5.3 Mb/d accounting for an outstanding 93% of the global net expansion. However, their rise as major oil and natural gas suppliers will not necessarily expel traditional suppliers such as Middle Eastern and North African OPEC members and the Former Soviet Union from the international energy market. Traditional suppliers will play an even greater role in satisfying growing demand while making up for a decline in existing oilfields. This phenomenon will be remarkable particularly in the second half of the outlook period. OPEC and the Former Soviet Union will account for 84% of a net crude oil production increase of 20.4 Mb/d between 2020 and 2040.

Figure 3 Crude oil production in major regions [Reference Scenario]



Energy trade will grow even more important in the future

Regions that will sharply expand energy consumption in the future will not necessarily be identical to those endowed with abundant fossil fuel resources. Therefore, international energy trade will grow more prosperous. As crude oil trade is growingly regionalised, however, the share for crude oil for trade between major regions will remain almost unchanged at 40%. As for natural gas for which international trade is not as prosperous as for oil at present, the share for trade between major regions will rise from 14% to 22%. Energy is the largest tradable commodity at present and will maintain its great political and economic significance for most countries including both consumers and producers. An exception will be the United States that will take advantage of fuel efficiency improvements and the shale oil production expansion to increase substantially its energy self sufficiency and terminate crude oil imports from the Middle East by 2040.

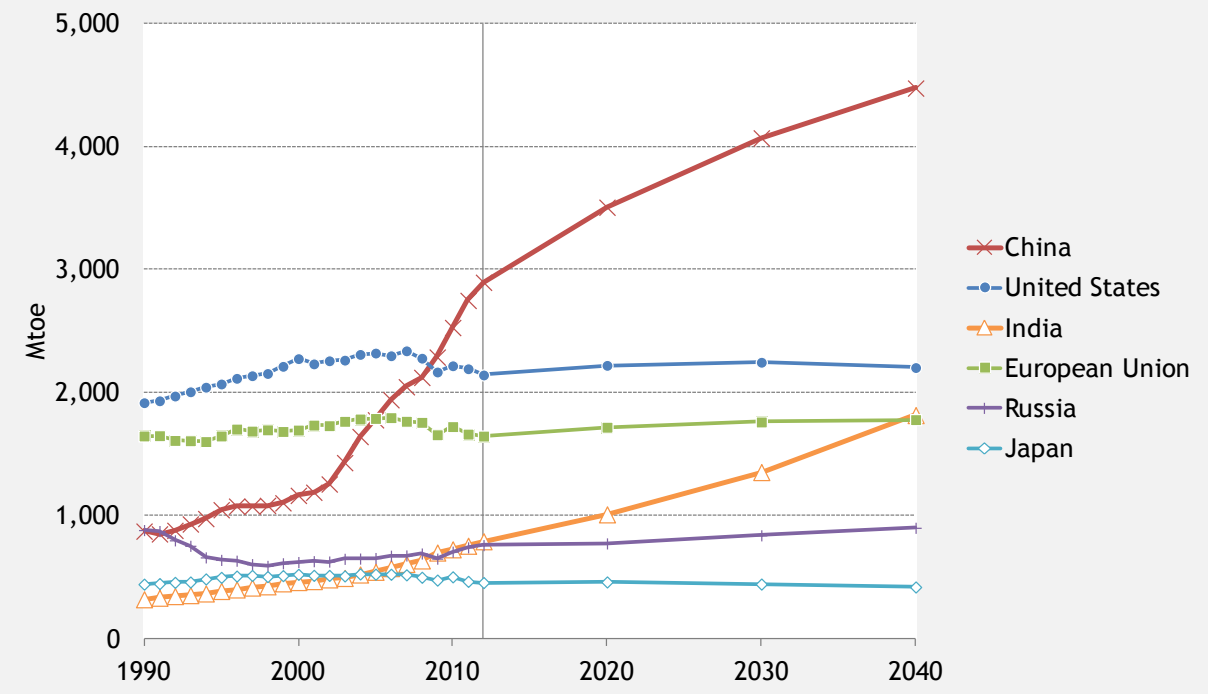
Chinese and Indian energy supply and demand and their impact on the world

China and India will drive global energy demand growth

China now consumes more energy than any other country and will continue expanding energy consumption. It will take an unrivalled position by expanding energy consumption in 2040 to 4,474 Mtoe, more than double the consumption level in the United States, the second largest energy consumer in the world. Per-capita energy consumption in China has already exceeded the global average and will increase close to the European Union level in 2040. Another major Asian power, India,

will also expand energy consumption remarkably. India's energy consumption now falls short of half of the European Union consumption but will exceed the European Union level in the late 2030s. In the 2040s, India will replace the United States as the world's second largest energy consumer. China and India will depend more heavily on imports to satisfy their rapidly expanding energy demand. The two countries will consume 45% of the crude oil traded between major regions in the world and 40% of the natural gas traded.

Figure 4 Energy consumption in major economies [Reference Scenario]



Low economic growth in China and India is shaking energy markets in the world

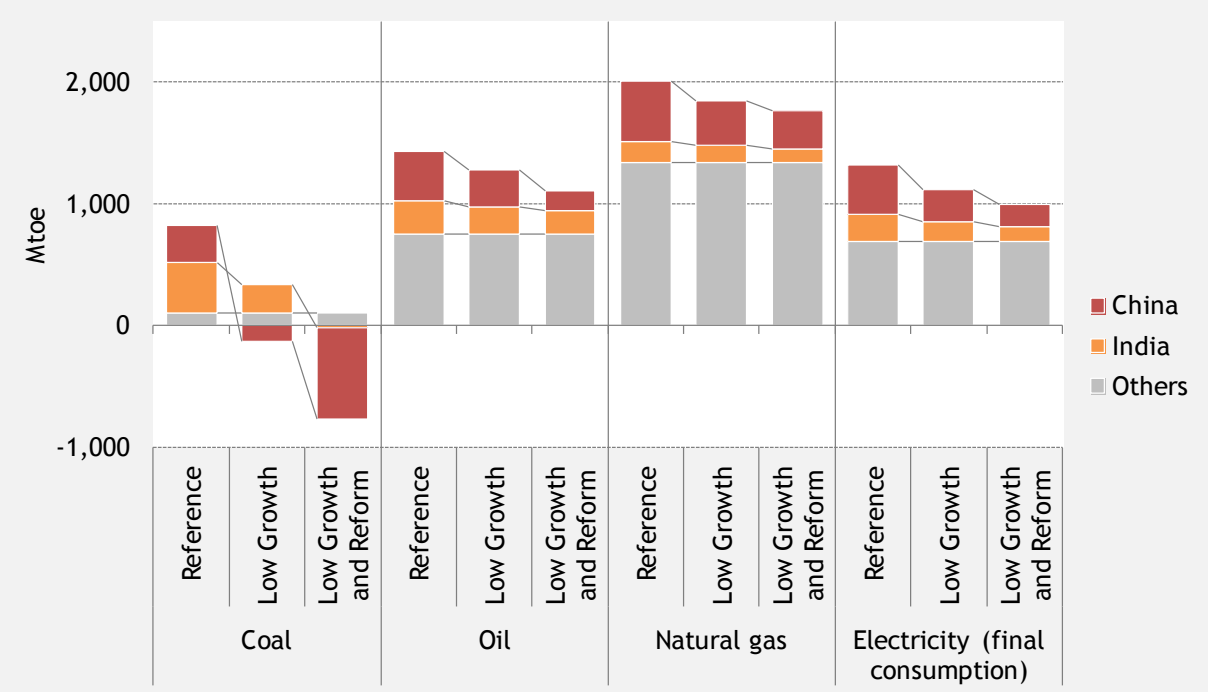
China is now plagued with various challenges. If they become major problems, China's annual economic growth rate through 2020 may plunge from the 7.2% assumed in the Reference Scenario to 6.0%. Throughout the outlook period, the Chinese growth rate may be limited to 3.9%, down 1.6 percentage points from the level assumed in the Reference Scenario. While China is assumed to replace the United States as the world's largest economy in terms of real gross domestic product in the late 2030s in the Reference Scenario, the Chinese economic size in the Low Growth Scenario is estimated at less than 70% of the United States size even in 2040. The economic growth slowdown will reduce an energy consumption increase, working to ease the international energy supply-demand balance. However, the economic growth deceleration accompanying social reform stagnation and the investment- or export-oriented economy may lead to wider income gaps, employment opportunity shortages and a delay in solutions to energy and environmental problems. If structural reforms are promoted to expand services industries absorbing more labour and consuming less energy, to support China's shift to a consumption-driven economy and to thoroughly introduce energy conservation and

low-carbon technologies for energy systems, social welfare may be upgraded even under the lower economic growth.

Indian economic growth is likely to hit the bottom and get on a recovery path after decelerating in recent years. In the Reference Scenario, India grows at an annual rate of 6.2% through the outlook period, the fastest growth among major countries. However, foreign investment's outflow, a prolonged European economic slump, a protracted Chinese economic deceleration, an economic and administrative reform stagnation and other risks factors could work to lower the annual growth by some 1 percentage point from the assumed level to 5.3%. While the Indian economy is assumed to exceed Japan's economic size in the mid-2030s in the Reference Scenario, it is expected to be slightly smaller than the Japanese size even in 2040 in the Low Growth Scenario.

An increase in energy consumption by China and India through 2040 will total as much as 2,606 Mtoe in the Reference Scenario, surpassing the present annual consumption by the United States and Japan. In the Low Growth and Reform Scenario in which China and India will energetically reform their social and energy consumption systems under slower economic growth, their energy consumption growth will be reduced by 71% to 768 Mtoe. Although coal, a mainstay energy source in the two countries, will post the largest consumption change among energy sources, drops in oil and natural gas consumption will also be of great significance to the international energy market due to the two countries' growing dependence on oil and natural gas imports.

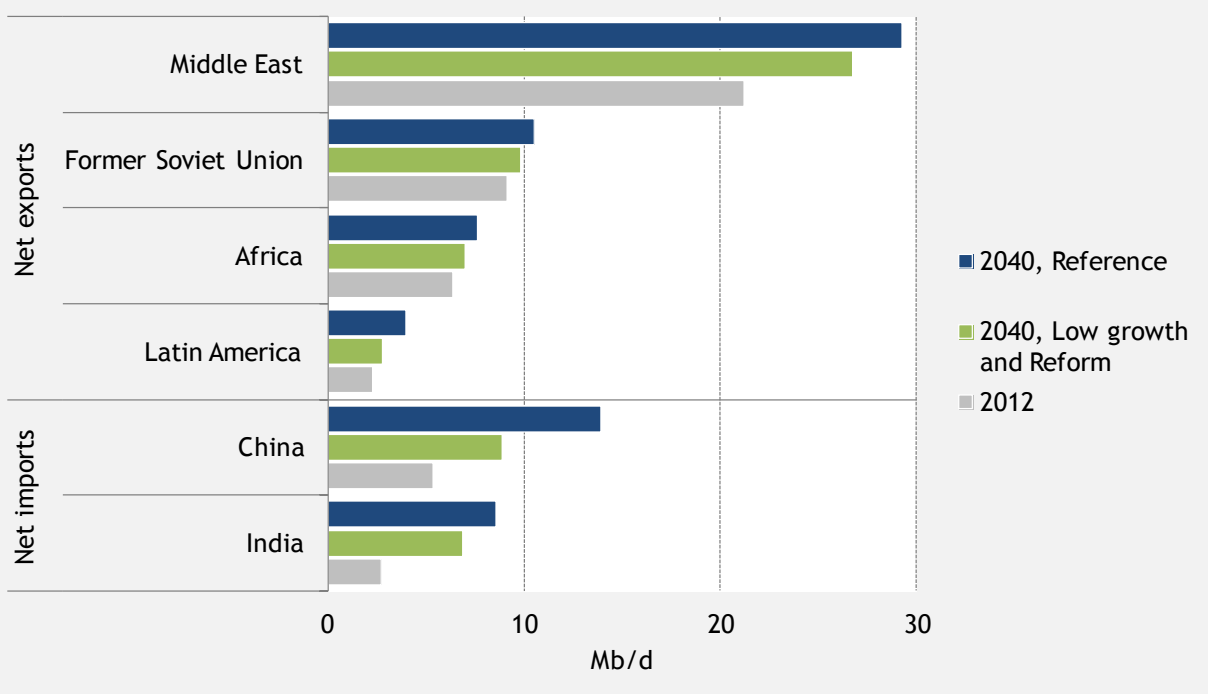
Figure 5 Chinese and Indian energy consumption growth [2012-2040]



China and India have diversified oil procurement sources more than Japan, although the three countries are located in Asia. Nevertheless, the two countries' energy demand growth deceleration will

bring about a remarkable change in the Middle East. If their oil consumption growth in 2040 is cut by 6.9 Mb/d from the Reference Scenario, 2.5 Mb/d will be covered by a production cut in the Middle East with 31% of the region's net export growth lost. The Former Soviet Union's net export growth will be halved. Similarly, net export growth for natural gas in the Former Soviet Union and the Middle East will be cut by 30%. As a result, the Middle Eastern economy will contract by some 5% from the Reference Scenario. The Former Soviet Union economy will shrink by some 4%. Energy suppliers that place great expectations on China and India as their promising customers will have to diversify further export destinations and their economies. They particularly include the second largest natural gas producer that now cannot expect to expand oil and natural gas exports to Europe that had been its major export market.

Figure 6 Net oil imports by China and India, and major regions' net exports



"Turning the circuitous into the direct, and turning adversity into advantage" (Sun Tzu)

Not only China and India but also many other emerging countries have pursued high economic growth to improve national livelihood, stabilise society and enhance public support for government. If high growth is given too much priority, however, respect for human rights, environmental conservation and legal compliance may be undervalued, leading to undesirable results. Infrastructure development may also fail to catch up with rapid economic growth, resulting in chronically insufficient social services including energy.

If China is to get on a stable growth path as planned by its government, it will have to overcome a large number of challenges. If China shifts its priority from quantitative aspects of society to qualitative aspects, however, it may be able to reduce energy consumption and halve sulphur oxide emissions

causing particulate matter 2.5 pollution while securing job opportunities. Then, China may make the first step forward to building more sustainable systems for social development, resources and the environment.

Infrastructure underdevelopment has become a chronic issue in India. Electricity shortages amounting to 10% of demand triggered a large-scale blackout affecting 600 million people – half India's population – in 2012. Electricity demand has increased so rapidly that power generation capacity expansion fell short of solving the electricity shortages. Even if the current economic growth deceleration is prolonged over a medium term, infrastructure development and administrative efficiency enhancement for the future are indispensable for upgrading the stage of economic development over a long term.

Can a lower economic growth be turned into an advantage?

Low-carbonisation and climate change mitigation measures – Advanced Technologies Scenario

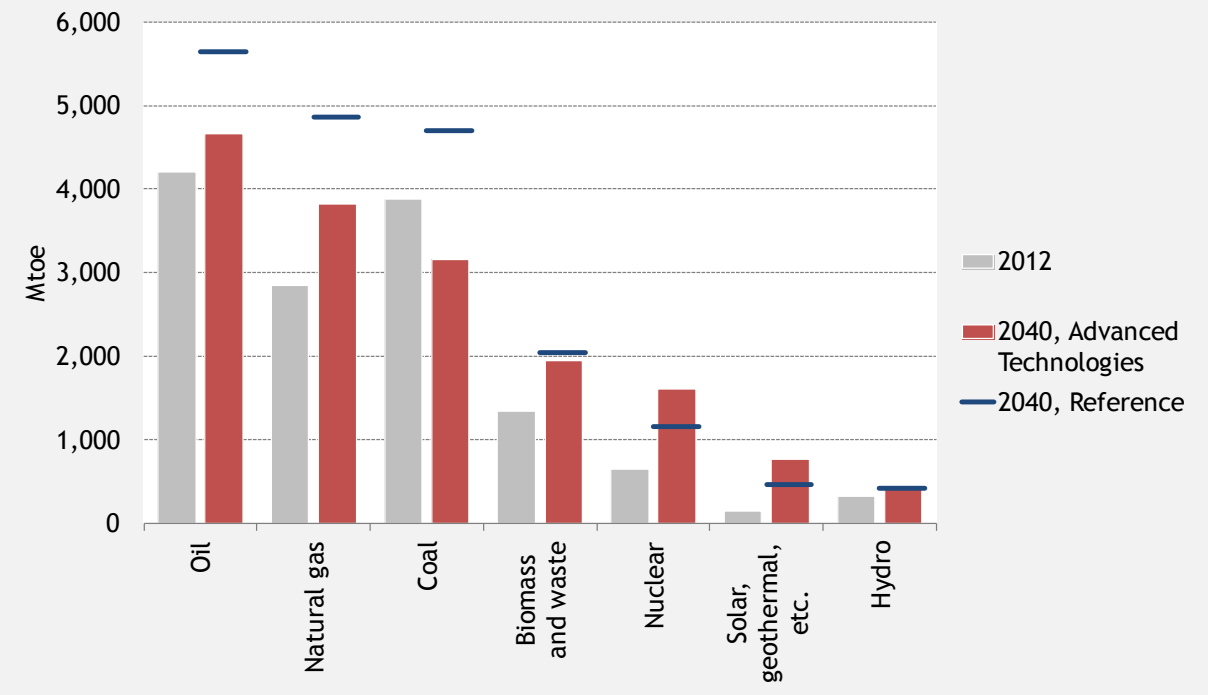
Global energy efficiency enhancement could bring about energy savings amounting to China's consumption

In the Advanced Technologies Scenario in which energy technologies on both the supply and demand sides will be substantially developed and penetrated widely to enhance energy security and climate change measures, global primary energy consumption in 2040 will be limited to 16,374 Mtoe, 15% less than in the Reference Scenario. The cut of 2,902 Mtoe exceeds present annual consumption by China, the largest energy consumer in the world.

Coal consumption will peak out and by 2040; it will be 19% less than the present level, posting the largest consumption decline among energy sources. Oil consumption will total 96.2 Mb/d in 2040, far less than 116.5 Mb/d in the Reference Scenario. The savings totalling 20.3 Mb/d amount to present crude oil production by Saudi Arabia and Russia. Natural gas consumption in 2040 will aggregate 4.62 Tcm, with a future increase halved from the Reference Scenario. The savings of 1.26 Tcm from the Reference Scenario exceed the production of Russia and the Middle East.

While reducing fossil fuel consumption or slowing down consumption growth, the world will further expand non-fossil energy consumption including nuclear, solar and wind energy. In 2040, zero-emission electricity sources will account for a half of power generation in the world and two-thirds of generation in OECD. Biofuel consumption will increase mainly in the transport sector, reaching 243 Mtoe exceeding an equivalent of present crude oil production by the United Arab Emirates and Qatar. Traditional biomass use, seen frequently in the residential sector in developing countries, will decline by 13% from the Reference Scenario.

Figure 7 Global energy consumption [Advanced Technologies Scenario]

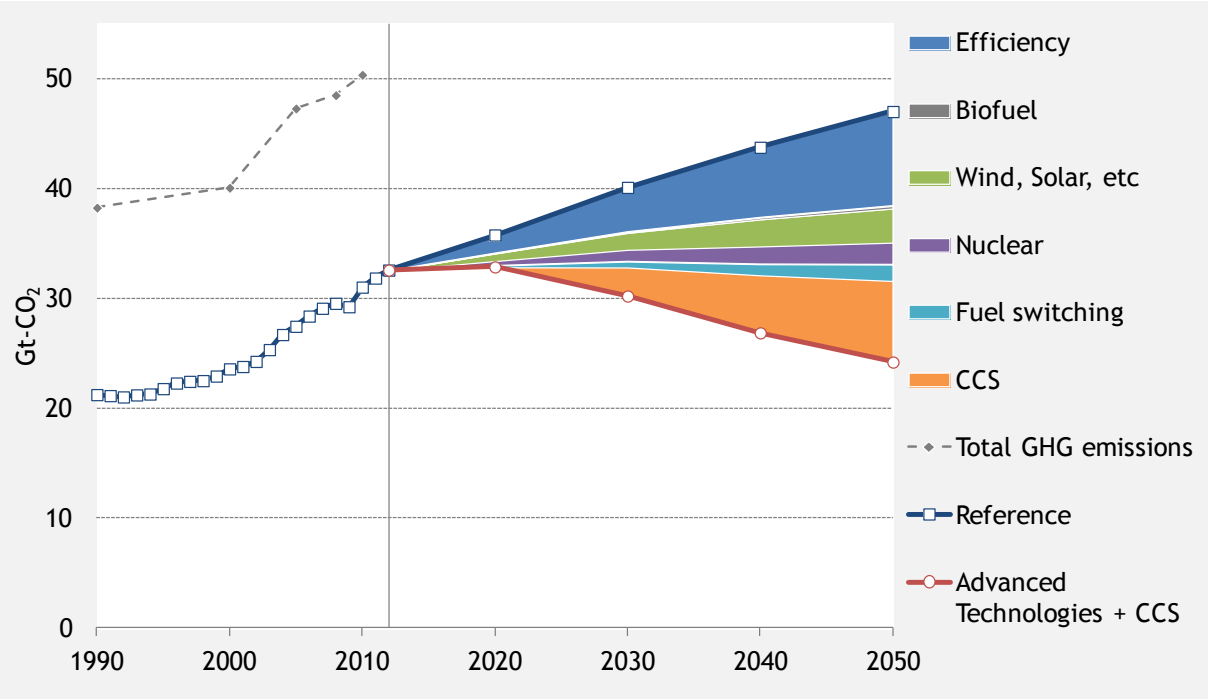


Not only advanced technology development but also cost reduction for higher economic efficiency and the global penetration of advanced technologies through their adaptation to local needs will be required to realise such massive energy conservation and low-carbon potentials. Energy conservation potentials in non-OECD and Asia, where inefficient energy consumption now accompanies rapid economic expansion, account for two-thirds and a half of global energy conservation potentials, respectively. Non-OECD and Asia hold the key to reforming global energy systems.

If you can dream it, you can do it except for halving greenhouse gas emissions

Energy-related carbon dioxide emissions, accounting for 60% of global greenhouse gas emissions, will continuously increase in the Reference Scenario. In 2050, energy-related CO_2 emissions will jump by 44% from 2012 to 47.0 gigatonnes (Gt). In the Advanced Technologies Scenario, energy-related CO_2 emissions will level off or decrease slightly instead of increasing substantially. If carbon capture and storage (CCS) is introduced in the fossil fuel power generation and industry sectors, energy-related CO_2 emissions will clearly turn downward in or after 2020 and reach 24.2 Gt in 2050, up 14% from 1990 but down 26% from 2012. However, the reduction will fall far short of the target of halving GHG emissions in 2050 from the present level.

Figure 8 Global energy-related CO_2 emissions and each measure's contribution to reducing emissions [Advanced Technologies Scenario + CCS]



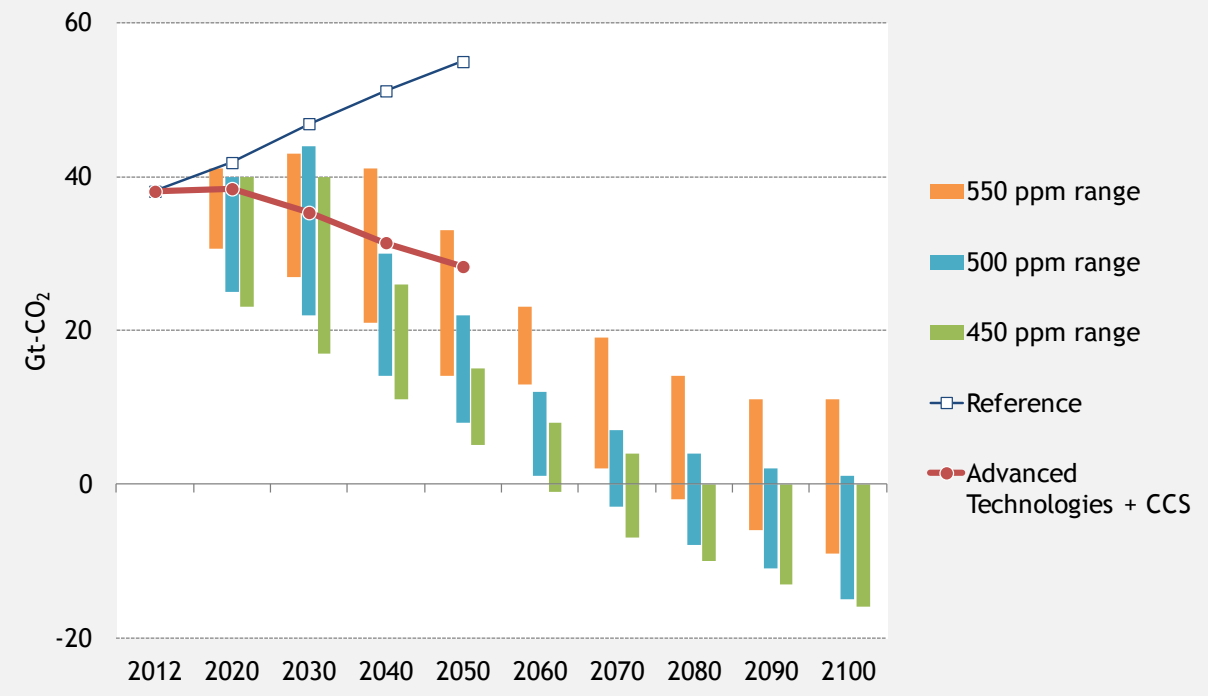
"Make efforts until your goal is attained. See your goal being attained as it is." (Gautama Siddhartha)

A scenario for reducing the atmospheric concentration of GHGs to about 450 ppm (parts-per-million CO_2-equivalent) in 2100 is well known as a climate change mitigation scenario in which the temperature rise from the pre-industrialisation level attributable to human-induced GHG emissions will be restricted to less than 2 degrees Celsius. The 450 ppm scenario depends on bioenergy with carbon capture and storage (BECCS) systems, afforestation and their wide penetration in the second half of this century. However, the availability and scales of BECCS systems, afforestation and other CO_2 removal technologies or means are uncertain, indicating that there will be more or less challenges or risks.

The Working Group III report published in April 2014 for the Fifth Assessment Report by the Intergovernmental Panel on Climate Change does not limit scenarios for holding down the temperature rise to less than 2°C to the 450 ppm scenarios. Noteworthy is the report cites 500 ppm scenarios as having about a 50%-100% probability of restricting the temperature increase to less than 2°C. According to the report, the probability of staying the temperature increase below 2°C will be 50-100% without a concentration overshoot and 33-66% with such overshoot in the 500 ppm scenarios. If the temperature increase is allowed to widen to 2.5°C with appropriate adaptation measures assumed, 550 ppm scenarios (with the probability of staying the temperature increase below 2.5°C through the 21st century at 65-80%) can become one of the options. The Advanced Technologies

Scenario + CCS amounts to a 550 ppm scenario regarding emission paths and to a 500 ppm scenario regarding cumulative emissions.

Figure 9 Global CO_2 emissions and emission ranges for 450, 500 and 550 ppm scenarios



Note: Including CO_2 emissions other than energy-related emissions.
Sources: Prepared from the 5th IPCC Assessment Report (Working Group III), and UNEP, "The Emissions Gap Report 2013," etc.

If participants in international negotiations on a new emission control framework stick to the 450 ppm scenarios, the negotiations will be prolonged with major countries' coordination remaining difficult. As a result, it could become more difficult to hold down the temperature increase. In order to solve the dilemma, negotiators should adopt the 500 ppm or 550 ppm scenarios to conclude the negotiations as early as possible. A conceivable option would be to proceed with adaptation measures including the enhancement of disaster prevention facilities and a switch to heat resistant crops while developing BECCS, carbon capture and utilisation (CCU), space solar power system and other advanced technologies to restore the 2°C scenario later. In a realistic manner, we must consider climate change mitigation measures with various scenario options other than the 450 ppm scenarios being kept in mind.

Climate change mitigation, adaptation and damage are closely related to each other and should be considered simultaneously. An optimum balance between mitigation and adaptation costs should be achieved to minimise efficiently and effectively total climate change damage. However, correlations between mitigation costs, climate change impacts and adaptation costs have yet to be clarified, with optimum assessment failing to be conducted. Research into the three costs, particularly the adaptation cost, must be promoted quickly. Nevertheless, it may be needless to say that all countries should make maximum efforts to do what they can.

Part I

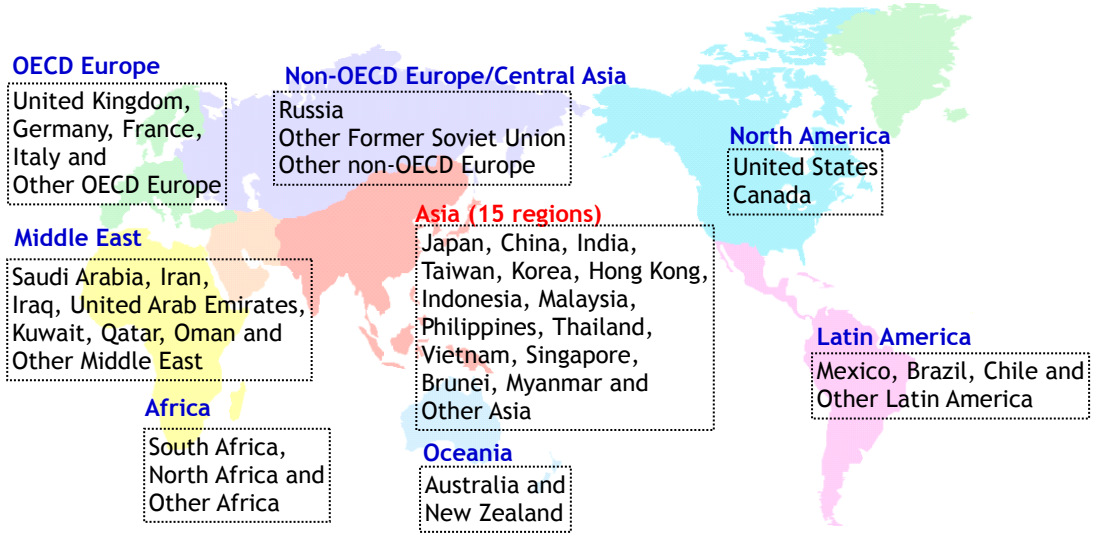
World and Asia energy supply/demand outlook – Reference Scenario –

1. Major assumptions

1.1 Model and scenarios

In this Outlook, we used a quantitative analysis model with an econometric approach adopted as the core to develop an energy supply and demand outlook to assess quantitatively energy supply and demand in the world through 2040. The model, based on the energy balance tables of the International Energy Agency, covers various economic indicators as well as population, vehicle fleet, materials production and other energy-related data collected for modelling. We aggregated the world into 42 regions, built a detailed supply and demand analysis model for each region and made the projection.

Figure 10 Regional aggregation



We assumed the following three Scenarios for the projection:

Reference Scenario

This is the core scenario for this Outlook. For this Scenario, a future outlook is developed according to the past trends as well as the energy and environment policies that have been in place so far. Only traditional and conventional policies are incorporated into this Scenario. We assumed that any aggressive energy conservation or low-carbon policies deviating from the past ones will not be adopted in this Scenario.

Low Growth Scenarios for China and India

Given that various risks can affect any future economic outlook, we assumed lower economic growth than in the Reference Scenario for China and India, both countries holding the key to future world energy supply and demand, and assessed implications of such lower growth in these Scenarios. Specifically, we analysed the Low Growth Scenario where unintended risks will force the two economies to stagnate and the Low Growth and Reform Scenario where the two countries, particularly

China, will try to achieve a low-carbon energy supply and demand structure even under lower economic growth to reform their economic structure and achieve a more stable society.

Advanced Technologies Scenario

In this Scenario, not only China and India but also the rest of the world are assumed to implement strongly energy and environment policies helping secure stable energy supply and enhancing climate change measures, with these policies' effects being successfully maximised. Specifically, our projection is based on an assumption that advanced technologies for the energy supply and demand sides as given in Figure 11 will be introduced as much as possible.

Figure 11 Technologies assumed for Advanced Technologies Scenario

Demand side technology

- Industry

Under sectoral and other approaches, best available technologies for industrial processes (for steelmaking, cement, paper-pulp and oil refining) will be deployed globally.

- Transport

Clean energy vehicles (highly fuel efficient vehicles, hybrid vehicles, plug-in hybrid vehicles, electric vehicles, fuel cell vehicles) will penetrate further.

- Buildings

Efficient electric appliances (refrigerators, televisions, etc.), highly efficient water-heating systems (heat pumps, etc.), efficient air conditioning systems and efficient lighting will penetrate further, with heat insulation enhanced.

Supply side technology

- Renewables

Wind power generation, solar photovoltaic power generation, concentrated solar power (CSP) generation, biomass power generation and biofuel will penetrate further.

- Nuclear energy promotion

Nuclear power plant construction will be accelerated with operating rates improved.

- Highly efficient fossil-fired power plant technology

Coal-fired power plants (A-USC, IGCC and IGFC) and natural gas-fired more advanced combined cycle (MACC) plants will penetrate further.

- CCS

Carbon capture and storage (CCS) deployment will expand in the power generation (new and old coal-fired and natural gas-fired plants) and the industry (steelmaking, cement and plants that emit massive CO_2).

Following are major assumptions for the Scenarios:

1.2 Major assumptions

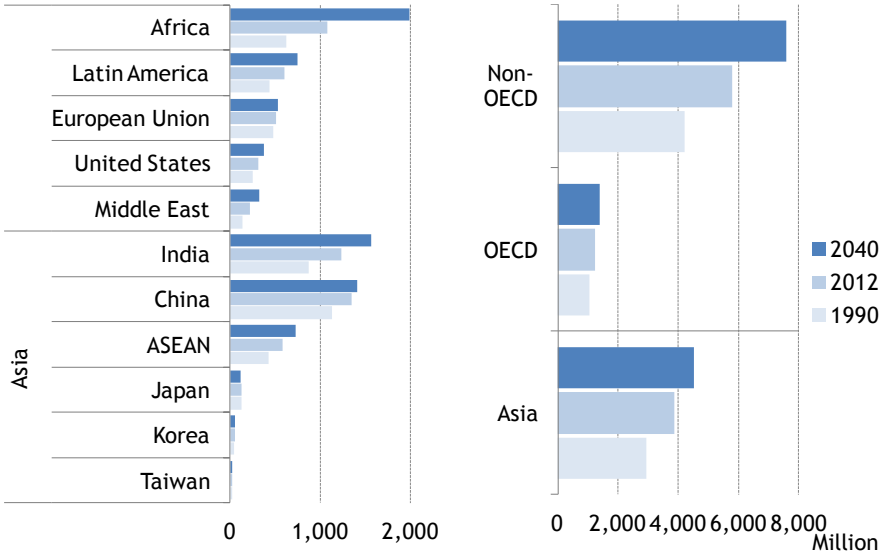
The future energy supply and demand structure will be subject to population, economic growth and other social and economic factors, as well as energy prices, energy utilisation technologies, and energy and environment policies. The following assumptions for population, economic growth and energy prices are common to the Reference Scenario and the Advanced Technologies Scenario.

Population

In assuming population changes, we referred to the United Nations' "World Population Prospects." In many OECD countries where the total fertility rate (TFR), or the average number of children that would be born to a woman during her lifetime, has slipped below two, downward pressure on

population will increase. In non-OECD countries as well, the TFR is trending down in line with income growth and women's increasing social participation. But their population will continue increasing as the mortality rate is declining due to developing medical technologies and improving food and sanitation conditions. Overall, global population will increase at an annual rate of 0.9%, expanding to 9 billion in 2040 from 4.4 billion in 1980 and 7 billion in 2012 (Figure 12, Appendix Table 3).

Figure 12 Population in selected countries/regions



Among OECD countries, the United States will post a relatively steady population increase due to a massive population influx from abroad and a high TFR. The overall increase will be moderate, with the United States' share of global population falling slightly. Japan's population turned downward in 2012 and will decline at the fastest pace in the world in the future. Europe includes East European and other countries with decreasing population, as well as countries such as France and the United Kingdom with rising TFRs. The entire European Union will post a very slow population increase. Russia has been plagued with a population drop since the collapse of the Soviet Union and will maintain a downward trend in population. China, now with the largest population in the world, will see its population peaking at 1.43 billion around 2030 and then decreasing by more than 17 million toward 2040.

In contrast, many other non-OECD countries will continue increasing population, accounting for most of a global population expansion through 2040. Africa, though having passed its population explosion period, will rise at a rapid annual average of 2.2%. In the Middle East, population will expand some 1.5-fold over the next 30 years. Indian population will maintain high growth, exceeding Chinese population by the mid-2020s and reaching 1.57 billion in 2040. The population of Asia will continue to grow, but its share of global population will fall slowly to some 50% in 2040.

Economy

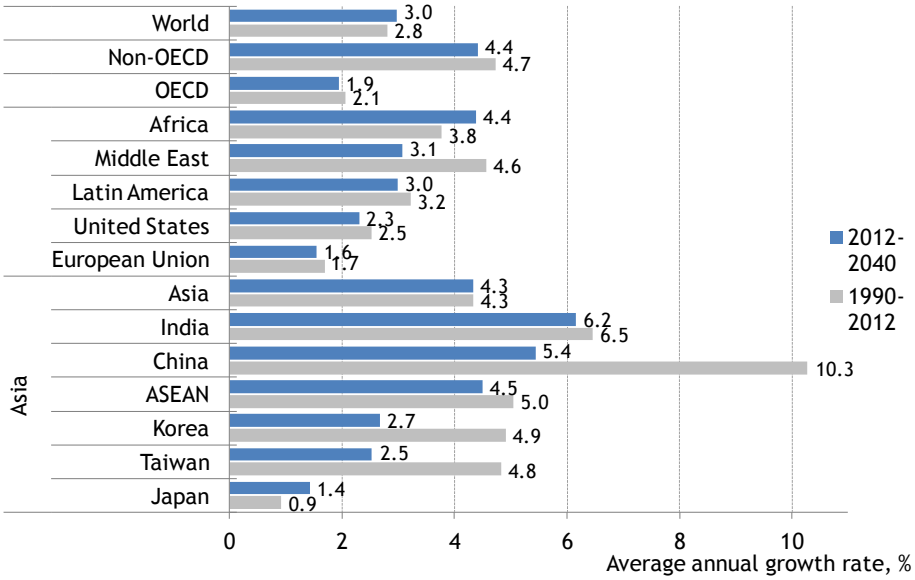
Dark clouds are about to hang again over the world economy that has been moderately recovering. Developed countries' recovery is still fragile, while growth in emerging countries is losing momentum. Among developed countries, the United States launched its economic recovery ahead of others and is currently posting a relatively robust economic expansion. The impacts of its coming termination of monetary easing and the expected interest rate hikes on the United States and the world economy are, however, matters of concern. A European economic rebound is likely to end up as a short dream, falling short of leading to improvements in employment. At present, a slump in the German economy, which has driven the European economy, has become a destabilising factor. In Asia, the Japanese economy was expected to escape from stagnation on the strength of Prime Minister Shinzo Abe's Abenomics economy-boosting policy. Forecasts, however, are divided over whether Japan will overcome its consumption tax (VAT) hike to launch a full-blown economic recovery. Meanwhile, China is no longer on its extreme rapid economic growth path with annual growth at only 7.5% due to malaise in its real estate market and manifestation of financial risks. India has not restored its strong growth of the past, facing "twin deficits" in international trade and budget. India is expected to reaccelerate its economic growth on the emergence of the Narendra Modi administration. Countries such as Russia, Brazil and Australia that have been heavily dependent on primary goods exports, will no longer benefit from resources boom.

Over a medium to long term, however, the world economy is expected to get back on a growth path, with these matters of concern being overcome or resolved. Nevertheless, a global economic boom similar to the one seen in the 1990s and early 2000s is unlikely to come in the near future. Some regions will take no small amount of time to restore growth lost over the past several years.

After its strong growth, Asia is expected to remain the world economy's growth centre. But rising wage levels and citizens' growing rights consciousness will prompt Asian countries to switch from their traditional export-led economic growth that has taken advantage of abundant surplus labour and low costs. The present deceleration of economic growth does not necessarily put any limit on growth. But the environment supporting the past rapid growth in Asian emerging countries including China has changed so much that a warning is required against a middle-income trap.

Given the abovementioned situation, we assumed real gross domestic product growth rates as shown in Figure 13 and Appendix Table 4, taking into account economic outlooks of the International Monetary Fund, the Asian Development Bank and other international organisations, and each government's economic development plans.

Figure 13 Economic growth



As for China and India whose future economic courses are growing uncertain, we developed and analysed lower growth scenarios where their average annual real GDP growth rates will be 1.0 to 1.6 percentage points lower than in the Reference Scenario, assuming that their growth will decelerate with various risk factors being realised (Part II).

International energy prices

In 2012 and 2013, the prices of international benchmark oil such as Brent and Dubai remained at historically high levels, above $100 per barrel. These prices retained their high levels in early 2014. The price of another international benchmark oil, West Texas Intermediate, followed an upward trend as the United States economy recovered with the transportation bottleneck eased through the development of a pipeline network linking the WTI delivery point in Cushing, Oklahoma, to the Mexican Gulf coast. Contributing to the high oil prices were the Arab Spring democratic movements in early 2011, the prolonged Iranian nuclear problem, the side effects of United States monetary easing since 2012, and the speculations and investment funds.

In the first half of 2014, new geopolitical risks emerged, including tensions between Russia and Western countries over Ukraine and the Iraqi government's military clashes with the radical Sunni "Islamic State" rebel group. As a result, the Brent price rose to a one-year high of $115/bbl in mid-June 2014. Since then, however, oil prices have continued a downward trend due to fears of economic deceleration in Europe and China, and an easing of the supply-demand balance in part the result of surplus supply amid a United States oil production expansion. In September, the Libyan oil production expansion prompted Organization of the Petroleum Exporting Countries (OPEC) production to hit a one-year high. In October, the Brent price slipped below $84/bbl for the first time in about four years.

Over a medium to long term, however, oil demand will continue to increase in line with robust world economic growth. While the United States and other non-OPEC oil producing countries are increasing production on the supply side, the demand side is likely to remain heavily dependent on OPEC countries and Russia plagued with geopolitical risks. At the same time, marginal cost for oil production is expected to rise due to a shift to smaller, polar, ultra-deep offshore and other higher-cost oil fields. Speculation and investment funds may continue raising oil prices with no powerful control expected on excessive money flow into the oil futures market. Given these points, oil prices are assumed to rise gradually over a medium to long term while expanding their short-term fluctuations.

Real oil price (in 2013 dollars) will reach $116/bbl in 2020 and $127/bbl in 2040 (Table 1). Nominal oil price will reach $133/bbl in 2020 and $217/bbl in 2040 under an assumed annual inflation rate of 2%.

Table 1 International energy prices

Real prices		2013	2020	2030	2040
Crude oil	$2013/bbl	110	116	122	127
Natural gas Japan	$2013/MBtu	16.1	13.6	14.0	14.5
Europe	$2013/MBtu	10.6	10.9	11.5	12.8
United States	$2013/MBtu	3.7	4.4	6.0	7.7
Steam coal	$2013/t	112	123	134	140
Nominal prices		**2013**	**2020**	**2030**	**2040**
Crude oil	$/bbl	110	133	171	217
Natural gas Japan	$/MBtu	16.1	15.6	19.6	24.8
Europe	$/MBtu	10.6	12.5	16.1	21.8
United States	$/MBtu	3.7	5.1	8.4	13.1
Steam coal	$/t	112	141	188	238

Note: The annual inflation rate is assumed at 2%.

In the United States, growing unconventional natural gas production has continued to bring about sufficient supply. While expanding unconventional natural gas production should sustain natural gas prices at low levels in the future, the price will rise from the present record-low levels according to development and production cost hikes. In Europe, natural gas demand declined for the third straight year from 2011. Liquefied natural gas planned for exports from the Middle East to the United States has begun to flow into Europe, leading natural gas prices to become further lower than indicated by oil price. In Japan, unconventional natural gas imports from the United States are becoming a reality and raise expectations that such imports would contribute to resolving or reducing the so-called Asian premium on LNG prices. Japan's imported natural gas prices are expected to fall from $16.1 per million British thermal units to $14.5/MBtu in 2040, in contrast to United States and European prices expected to increase. But the Japanese price will fail to decline as much as seen in North America in recent years because of limits on drops in liquefaction and maritime transportation costs. A gap with European and North American prices will still remain.

Present coal prices have recently been considerably low, reflecting an easing supply-demand balance. While coal features less resource constraints than other energy sources, global demand for coal mainly for power generation has been increasing. Given a rebound from present low prices, coal price is

assumed to rise more rapidly than oil and natural gas prices. But coal price per thermal unit will still be lower than those for oil or natural gas.

The above international energy price assumptions are common to all of the Scenarios.

2. World and Asia energy demand

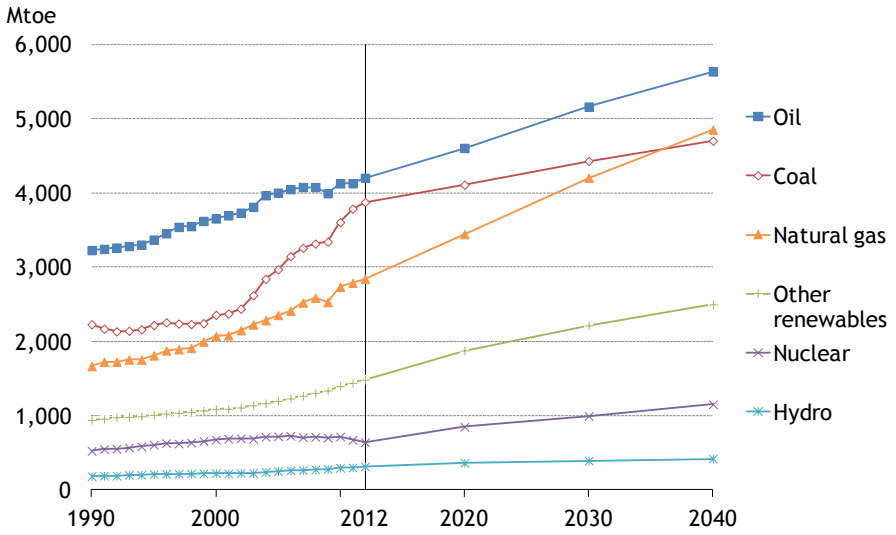
2.1 Primary energy consumption

World

Primary energy consumption in the world will increase from 13,371 million tonnes of oil equivalent in 2012 to 19,276 Mtoe in 2040 in the Reference Scenario. This means that global energy demand will annually expand by more than an equivalent of consumption in the United Kingdom and Ireland combined. Energy consumption will thus increase 1.44-fold with the world economy expanding 2.27-fold over the 28-year outlook period, indicating that progress in energy conservation will allow energy consumption to be saved more than indicated by the economic expansion. At the same time, the projection shows how difficult it may be to hold down energy consumption while promoting economic growth even if currently expected energy policies and energy conservation technologies are taken into account.

At present, fossil fuels (oil, coal and natural gas) account for 82% of primary energy consumption. As they will still capture more than 70% of future consumption growth, the world will remain heavily dependent on fossil fuels (Figure 14).

Figure 14 Global primary energy consumption [Reference Scenario]



Oil consumption stood at 88.6 million barrels per day in 2012, will top 100 Mb/d in the next 10 years and will reach 116.5 Mb/d in 2040. The increase of 27.9 Mb/d is equivalent to more than 90% of the current OPEC crude oil production. Up to two-thirds or 18.9 Mb/d of the increase will be attributable to the transport sector dominated by automobiles. In 2040, 57% of the oil supplied will be consumed by the transport sector, and 15% will be used as petrochemical feedstocks.

Natural gas will post a faster consumption increase than any other energy source, becoming the second largest energy source after oil by 2040. Natural gas consumption will expand 1.7-fold from 3.44 trillion cubic metres in 2012 to 5.88 Tcm in 2040. Of the total natural gas consumption, liquefied natural gas will increase from 237 million tonnes to 578 Mt. The largest driver of natural gas consumption growth will be the power generation sector. The industry and buildings sectors will also expand natural gas consumption remarkably. Natural gas consumption will also expand geographically. Although OECD and non-OECD Europe accounted for more than two-thirds of global natural gas consumption in 2012, the other countries will capture more than half of the global consumption in 2040. In the United States, natural gas will surpass oil in consumption, becoming the largest energy source by 2030.

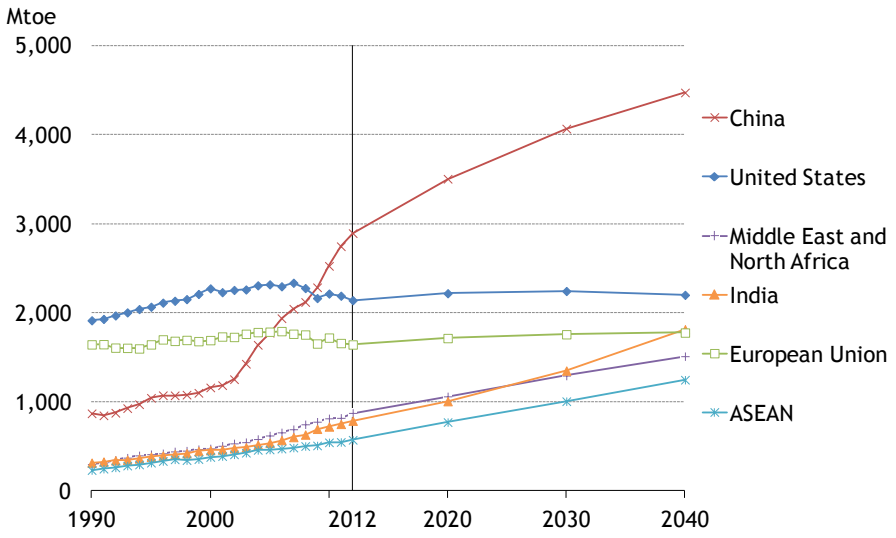
Among fossil fuels, coal will follow a different path. Coal consumption growth will slow down from the fast increase in the early 21st century due to changes in China's industrial production trends, the rising efficiency of coal use, fuel switching and other factors. Coal consumption in 2040 will total 6,722 million tonnes of coal equivalent (1 Mtce = 0.7 Mtoe), up 1,181 Mtce during the 28-year outlook period from 2012. The increase over the period will be far less than that of 2,054 Mtce of the past decade. Steam coal for power generation will account for most of the coal consumption growth. Growth in coking coal consumption for coke production will be very limited because China's coking coal for steel production is expected to peak-out before 2040.

Meanwhile, overall renewable energy covering from hydro to biomass will post a consumption increase of 1,120 Mtoe through 2040, the third largest growth after natural gas and oil. But low-cost biomass and waste consumption including fuel wood and livestock manure in developing countries will account for more than a quarter of the renewable energy consumption growth.

Nuclear energy consumption will also increase in many regions. The number of economies having nuclear power plants will rise from 31 in 2013 to 39 in 2040. Russia, Korea and the Middle East will proactively expand nuclear power generation. Remarkable nuclear growth will come in China, India and other emerging countries where electricity demand will expand substantially.

While global primary energy consumption will increase at an annual rate of 1.3% through 2040, growth will widely differ from region to region (Figure 15). While OECD's energy consumption growth will be limited to a very low level, non-OECD will continue expanding energy consumption rapidly, accounting for some 90% of global consumption growth. As a result, non-OECD's share of global energy consumption will expand from slightly more than 50% at present to two-thirds in 2040.

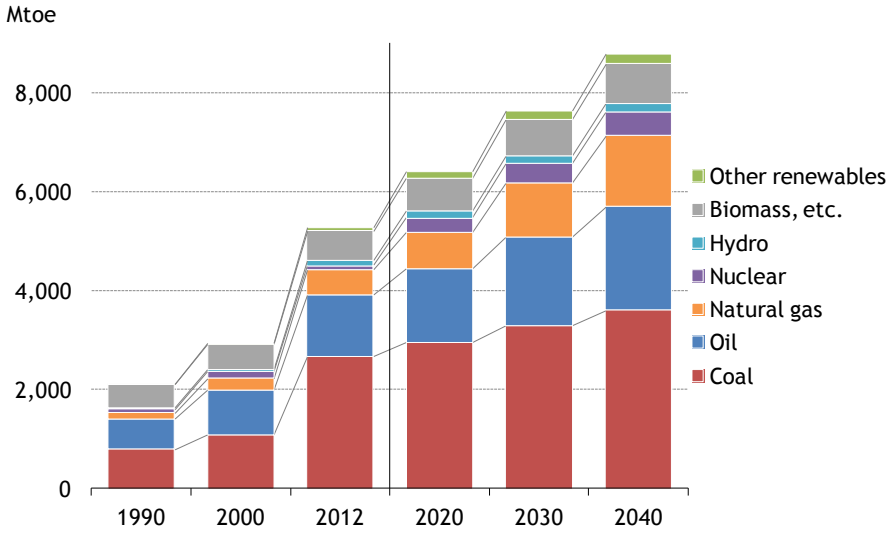
Figure 15 Primary energy consumption in selected countries/regions [Reference Scenario]



Asia

Asian primary energy consumption will expand from 5,268 Mtoe in 2012 to 8,794 Mtoe in 2040 in the Reference Scenario (Figure 16). This means that the annual increase is equivalent to demand in Australia. Over the next 28 years, the Asian economy will grow 3.28-fold, with energy consumption expanding 1.67-fold, accounting for 60% of the global energy consumption growth.

Figure 16 Asian primary energy consumption [Reference Scenario]



Primary energy consumption in Asia will increase at an annual rate of 1.8% through 2040 in line with robust economic growth mainly in China, India and ASEAN. Energy consumption will level off in mature economies such as Japan, Korea and Taiwan while energy consumption in China, India and ASEAN will continue increasing, accounting for 93% of the overall Asian energy consumption

expansion. As a result, the share for China, India and ASEAN in Asian energy consumption will rise from 81% at present to 86% in 2040.

Fossil fuels account for 84% of Asian primary energy consumption at present and will cover more than 77% of the future increase. Asia's share of global fossil fuel consumption will rise from 40% in 2012 to 47% in 2040.

Asian oil consumption will expand from 25.7 Mb/d in 2012 to 43.3 Mb/d in 2040. The average annual growth will be 1.9%, 0.8 percentage points higher than the global growth. China, India and ASEAN will boost oil consumption mainly in the transport sector, widening their share of overall Asian oil consumption from 68% in 2012 to 83% in 2040.

Asian natural gas consumption will increase 2.83-fold from 0.61 Tcm in 2012 to 1.74 Tcm in 2040. The increase will be much faster than the global growth of 1.71-fold. Asian LNG imports will expand from 178 Mt to 363 Mt accounting for 60% of global LNG trade. China, India and ASEAN will boost natural gas consumption mainly in the power generation sector, raising their share of Asian natural gas consumption from 58% in 2012 to 78% in 2040.

Asian coal consumption will rise from 3,813 Mtce in 2012 to 5,150 Mtce in 2040, surpassing global growth. While China will slow down its coal consumption growth, India and ASEAN will continue to increase their consumption, mainly in the power generation sector. The three's share of Asian coal consumption will expand from 90% in 2012 to 92% in 2040.

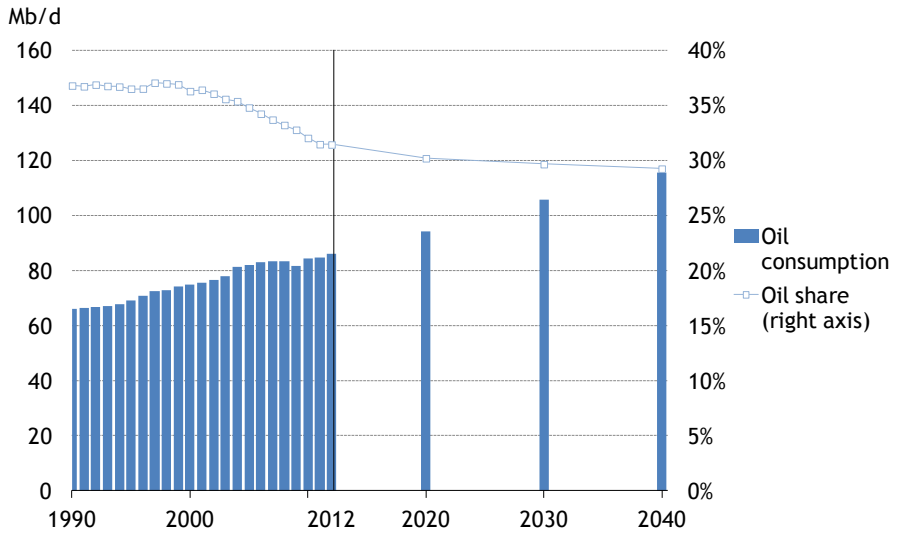
Meanwhile, Asian renewable energy consumption will increase from 759 Mtoe in 2012 to 1,174 Mtoe in 2040. Asia, which offers great potential to penetrate renewables, will raise its share of global renewable energy consumption including hydro, geothermal, solar, wind and other energy, excluding biomass and waste, from 36% in 2012 to 42% in 2040. China will capture more than half of the Asian renewable energy consumption.

Asian nuclear energy consumption will go up from 342 TWh in 2012 to 1,866 TWh in 2040, accounting for 77% of the global expansion. Most of the growth will come from China and India where electricity demand will substantially increase.

Oil

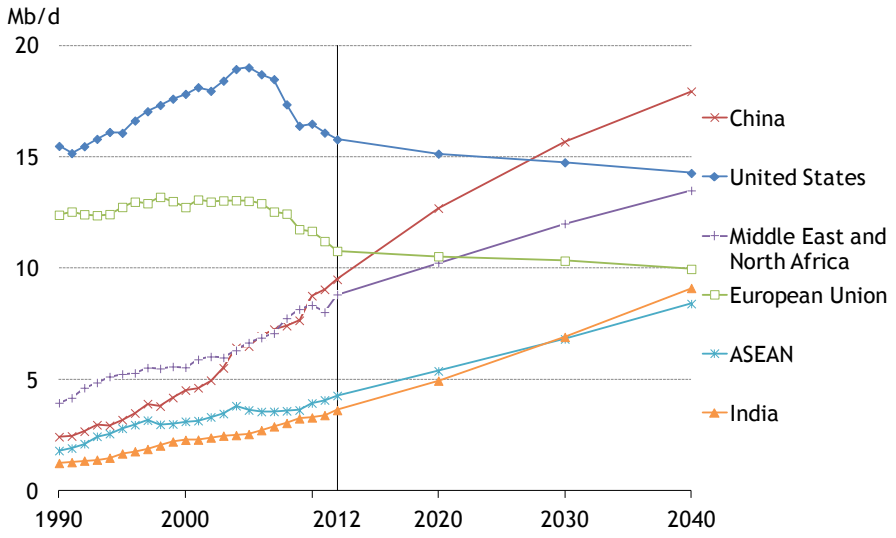
Global oil consumption will rise at an annual rate of 0.9% from 88.6 Mb/d in 2012 to 116.5 Mb/d in 2040 (Figure 17). Oil will remain the largest energy source, although its share of overall primary energy consumption will slightly shrink from 31% in 2012 to 29% in 2040.

Figure 17 Global oil consumption and its share of primary energy consumption [Reference Scenario]



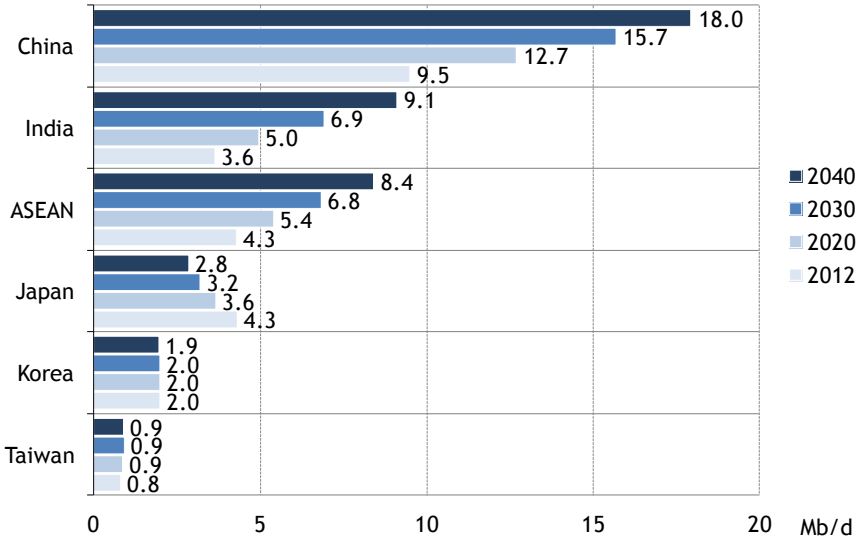
In 2012, non-OECD oil consumption surpassed OECD consumption for the first time ever. Non-OECD oil consumption will increase at an annual average rate of 1.9% over the next three decades (Figure 18). The non-OECD will account for all of the oil consumption growth through 2040. Oil consumption growth will be remarkable in the Middle East and North Africa including oil producing countries, as well as China, India and ASEAN. Middle Eastern and North African oil consumption will rival United States consumption in 2040. Meanwhile, OECD oil consumption will decline at an annual rate of 0.3% over the next three decades, shrinking its share of global consumption. In the United States, the largest oil consumer in the world at present, oil demand is increasing now due to shale oil development. In the future, however, the United States will rapidly reduce oil imports due to a domestic demand fall and a shale oil production expansion. As a result, required oil reserves will decline, leading the International Energy Agency's present oil reserves scheme to lose its function of responding to emergencies. (The IEA consists of the OECD member countries).

Figure 18 Oil consumption in selected countries/regions [Reference Scenario]



In the future, the non-OECD will exert great influences on the international oil market. Particularly, Asia will increase its presence in the market. Asian oil consumption will expand from 26 Mb/d in 2012 to 43 Mb/d in 2040 (Figure 19). Asia will account for more than 60% of global oil demand growth, with its share of global demand widening from 30% to 37%.

Figure 19 Asian oil consumption [Reference Scenario]

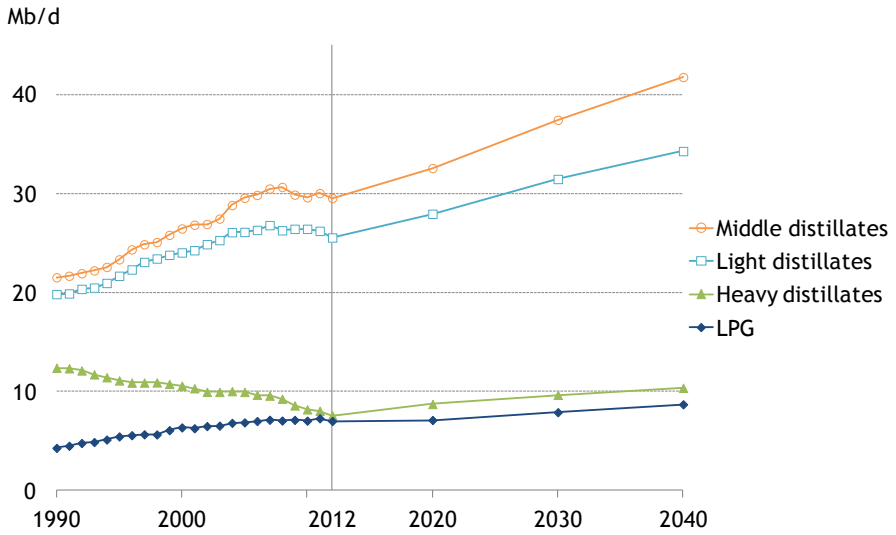


China is about to become the world's largest oil importer and will replace the United States as the world's biggest oil consumer by 2030. India and ASEAN will double their respective oil consumption from 2012 to 2030; India will experience the fastest oil consumption growth in the world from 2020. Asia depends more heavily on the Middle East for oil supply than European and United States oil markets. Resource-poor Japan and Korea have no choice but to depend fully on imports for oil supply

and, China, India and ASEAN will expand oil imports to meet domestic consumption growth. Therefore, energy security will become an even more important challenge for Asian countries.

The transport sector will account for about 60% of future oil consumption growth. Oil consumption will thus further concentrate in the transport and non-energy use sectors. Demand for lighter distillates among petroleum products will increase (Figure 20).

Figure 20 Global petroleum product consumption [Reference Scenario]

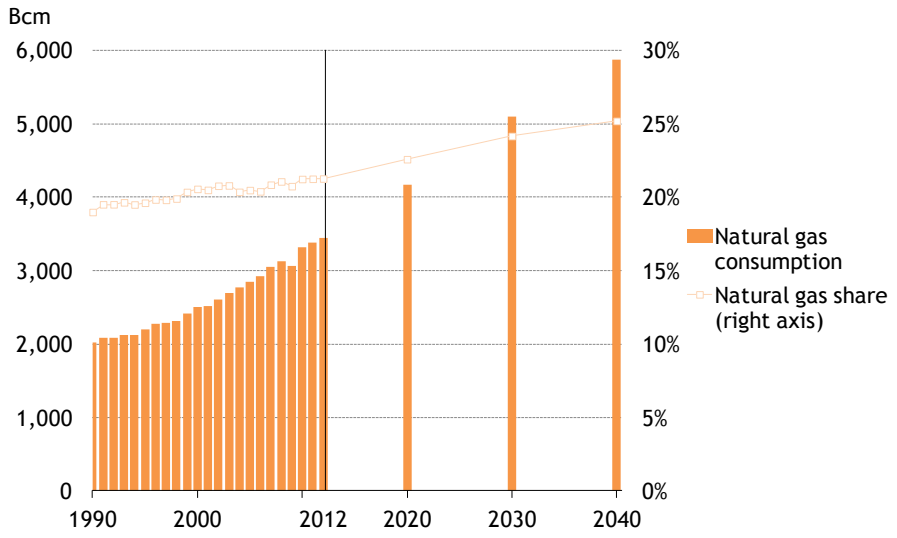


From the viewpoint of climate change and air pollution problems, Asia must curb its oil consumption growth in the transport sector. China has increasingly recognised that it should further accelerate the penetration of fuel efficient and electric vehicles in consideration of serious air pollution and future resource shortages. ASEAN has launched moves to reduce fuel subsidies. The whole of Asia is paving the way for promoting fuel efficiency improvement and clean technologies. Asia should energetically promote the improvement of fuel efficiency and the penetration of next-generation vehicles to contribute to global energy security. The time has come for Asia to consider the best energy mix for the transport sector.

Natural gas

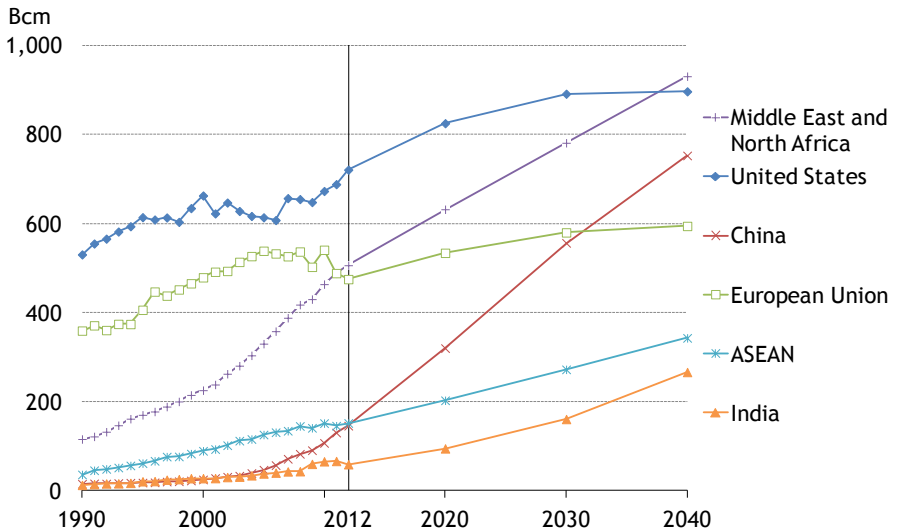
Global natural gas consumption will increase from 3,443 billion cubic metres in 2012 to 5,878 Bcm in 2040, scoring an annual average rise of 1.9%, the fastest growth among fossil fuels (Figure 21). Natural gas's share of primary energy consumption will widen from 21% in 2012 to 25% in 2040. China will promote fuel switching to natural gas in response to air pollution and energy consumption growth and shale gas development in China will also stimulate demand growth (China has proven abundant unconventional natural gas deposits). The country, though having lowered medium-term targets for shale gas development due to water, layer and pricing problems, is expected to continue expanding investment in shale gas development. China is also expected to procure natural gas at lower cost from Central Asia, Russia and other neighbouring regions.

Figure 21 Global natural gas consumption and its share of primary energy consumption [Reference Scenario]



OECD will account for only 17% of the natural gas consumption growth, leaving non-OECD responsible for most of the growth (Figure 22). The non-OECD's share of natural gas consumption in the world will rise from a little more than 50% to two-thirds. Among regions, the Middle East and North Africa, and China will post particularly remarkable growth. The Middle East and North Africa will replace the United States as the world's largest natural gas consumer in the 2030s.

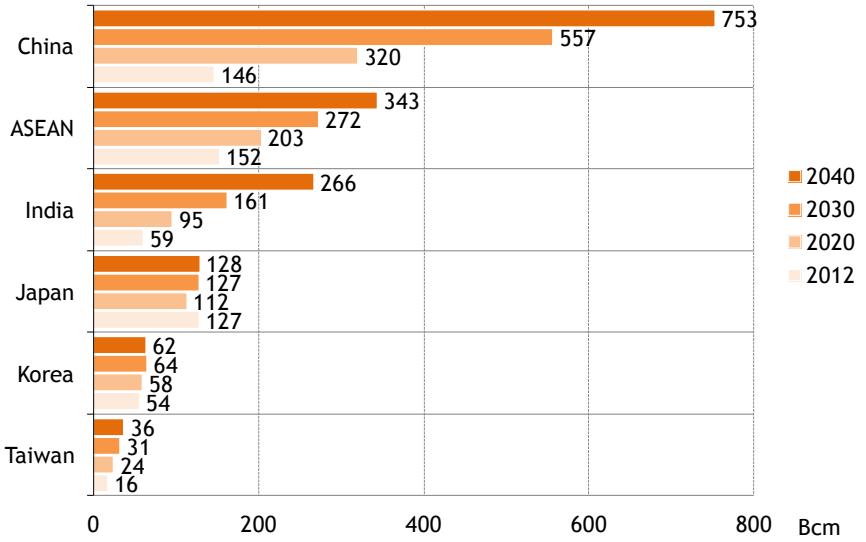
Figure 22 Natural gas consumption in selected countries/regions [Reference Scenario]



Asian natural gas consumption will grow 2.8-fold from 507 Bcm in 2012 to 1,434 Bcm in 2040 (Figure 23). Many countries in the region will expand natural gas consumption. In 2040, China alone will consume more natural gas than the present total Asian consumption. In India, natural gas consumption will increase at a moderate pace mainly for power generation and fertilizer production in the next three

decades. India is also promoting gas for public transportation systems to prevent air pollution. In the current major LNG importing countries, such as Japan and Korea, natural gas consumption growth will be moderate as their economies have matured.

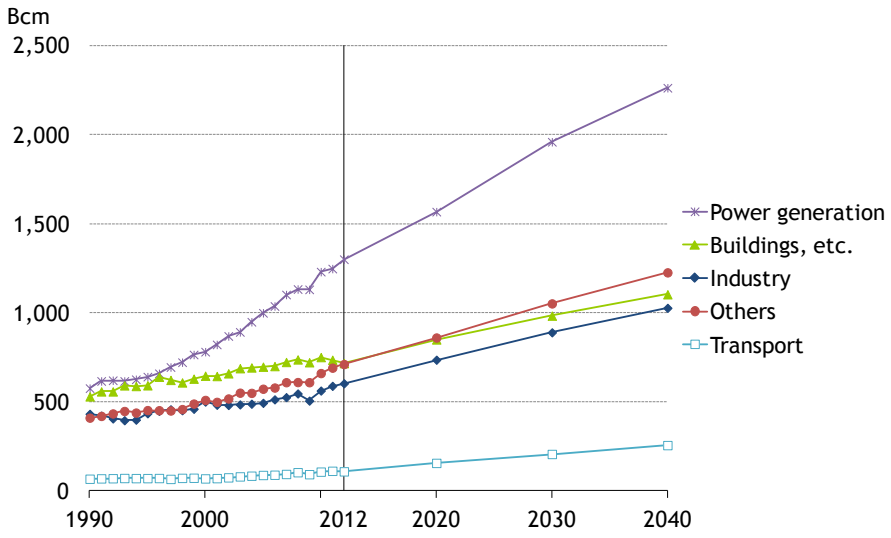
Figure 23 Asian natural gas consumption [Reference Scenario]



Over the next three decades, Asian emerging countries, China, ASEAN members and India will consume far more natural gas than the United States, the Middle East and North Africa combined. Asia, led by China and India, will become the largest consuming region. Therefore, emergency response mechanisms will have to be developed for natural gas supply as well as for oil supply.

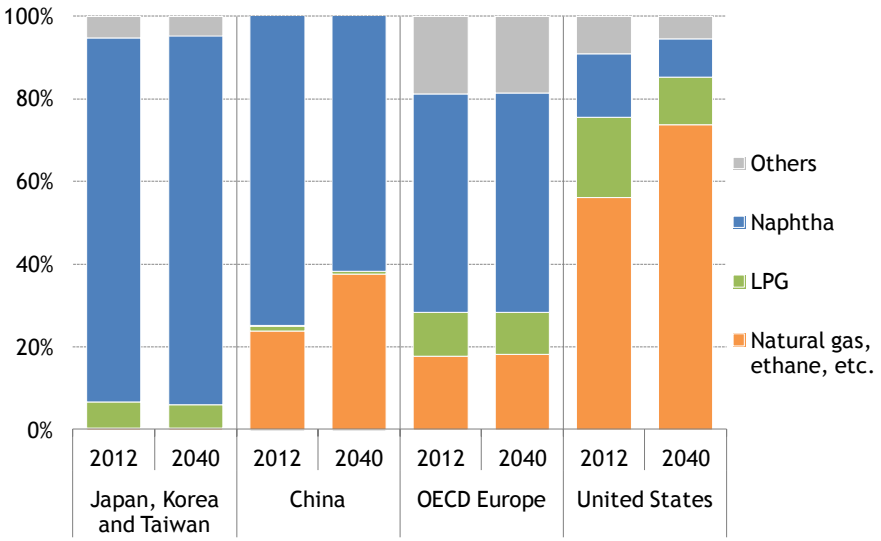
In the future, natural gas combined-cycle will increase steadily due to its relevant technological advancements, economic efficiency and environmental friendliness. Therefore, the power generation sector will account for half of the future natural gas consumption growth (Figure 24). Given high costs for oil and environmental problems with coal, the power generation sector will increasingly switch away from oil or coal towards gas. In 2040, power generation using natural gas will account for 29% of the total and natural gas will become the second largest electricity source after coal. In the industry sector, the petrochemical industry using cheap natural gas will expand production in the United States, contributing to natural gas consumption growth. Its impact on overall natural gas consumption, however, will be relatively limited. The buildings sector will expand natural gas consumption due to high economic growth and urbanisation in emerging countries.

Figure 24 Global natural gas consumption [Reference Scenario]



Backed by the shale revolution, ethane's cost competitiveness against naphtha as an ethylene feedstocks is increasing (Figure 25). Europe, where the petrochemical industry is feared to lose competitiveness, has already been importing ethane from the United States. The Asian petrochemical industry still depends heavily on naphtha and is losing its competitiveness.

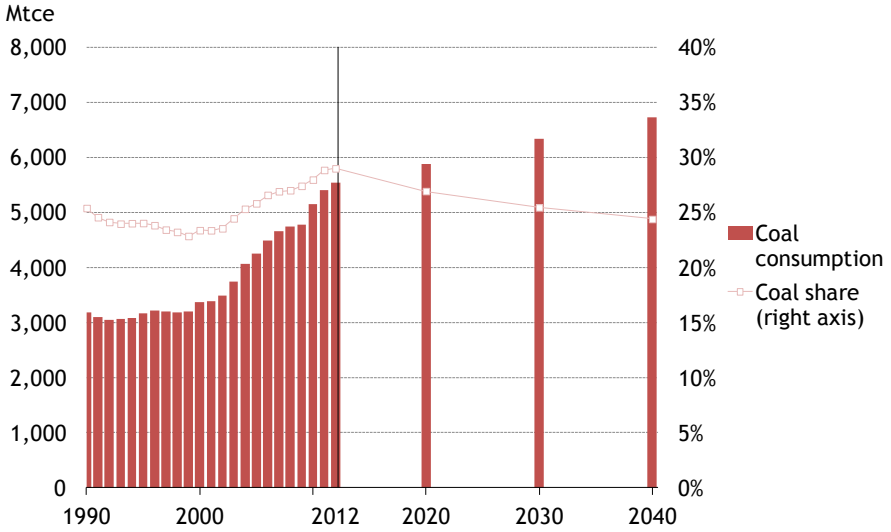
Figure 25 Petrochemical material mixes in selected regions [Reference Scenario]



Coal

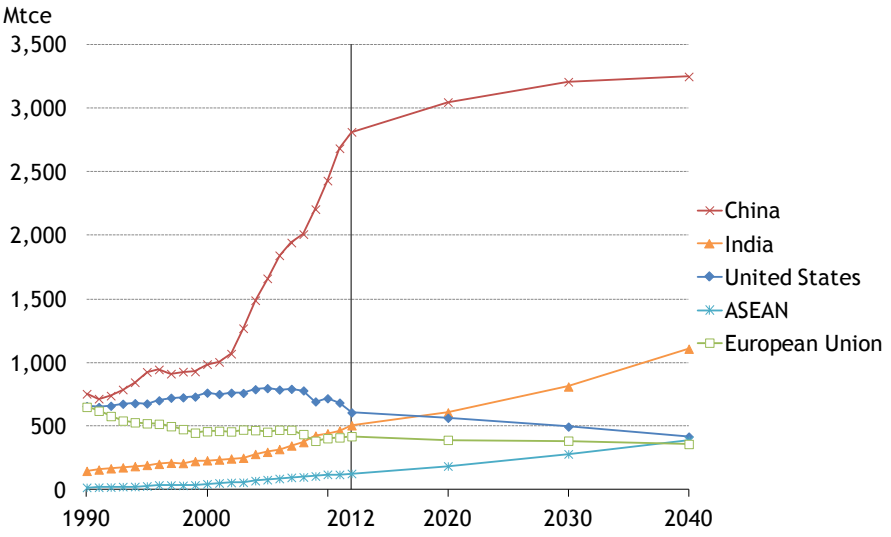
Global coal consumption will increase at an annual rate of 0.7% from 5,541 million tonnes of coal equivalent in 2012 to 6,722 Mtce in 2040 (Figure 26). While coal consumption will grow more slowly than oil or natural gas consumption, coal will still account for 24% of primary energy consumption even in 2040.

Figure 26 Global coal consumption and its share of primary energy consumption [Reference Scenario]



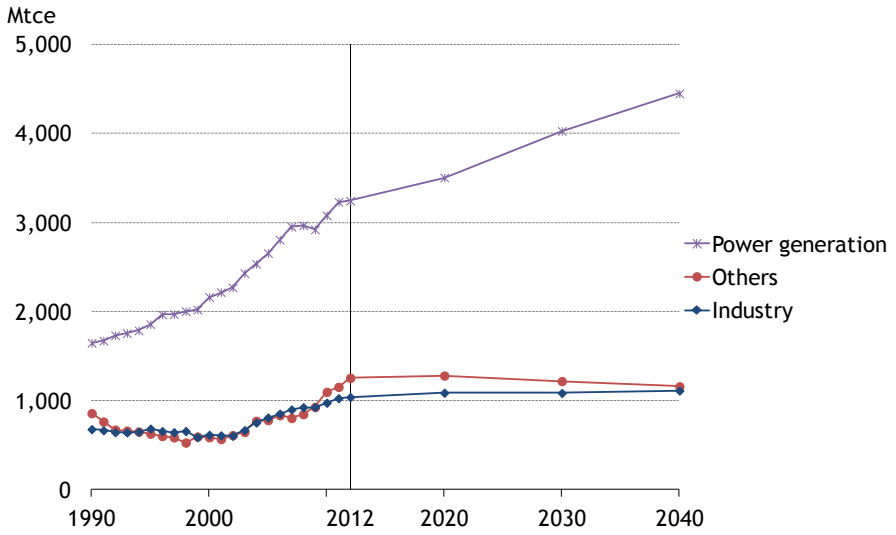
Asia will account for about 90% of the global coal consumption growth, with China alone capturing more than 30% of the global growth. India will replace the United States as the world's second largest coal consumer after China by 2020 (Figure 27). OECD will reduce coal consumption so that non-OECD will be responsible for all of the global coal consumption growth over the next three decades. Non-OECD's share of global coal consumption will rise from 74% in 2012 to 82% in 2040. The United States has expanded its natural gas consumption for power generation over the last few years, in response to a decline in natural gas prices caused by shale gas developments. The United States government has drafted environmental standards that would ban coal-fired power plants without carbon capture and storage systems, indicating that tougher environmental regulations would work to reduce United States coal consumption.

Figure 27 Coal consumption in selected countries/regions [Reference Scenario]



Various areas in the world are endowed with coal resources so that coal has less supply risk than oil or natural gas resources found in a limited range of regions. Due to lower prices for coal, consumption will increase mainly in the power generation sector where fuel costs are significant for economic efficiency (Figure 28). Coal consumption for power generation will increase at an annual rate of 1.1% through 2040, for a total rise of 1.4-fold.

Figure 28 Global coal consumption [Reference Scenario]



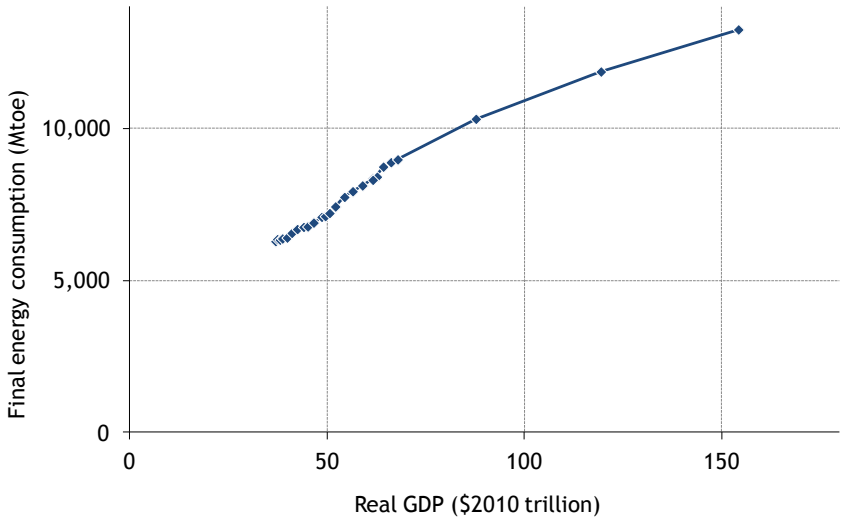
Asia including China and India will drive the global coal consumption growth. The Intergovernmental Panel on Climate Change has successively published reports describing coal consumption's effects on future climate change and the need for relevant countermeasures. The United States has drafted regulations setting carbon dioxide emission standards for existing power plants, indicating a great impact on coal-fired power plants that emit more CO_2 than others. The future challenge is how to reduce coal's disadvantage of greater CO_2 emissions through cleaner combustion and processing.

2.2 Final energy consumption

By region

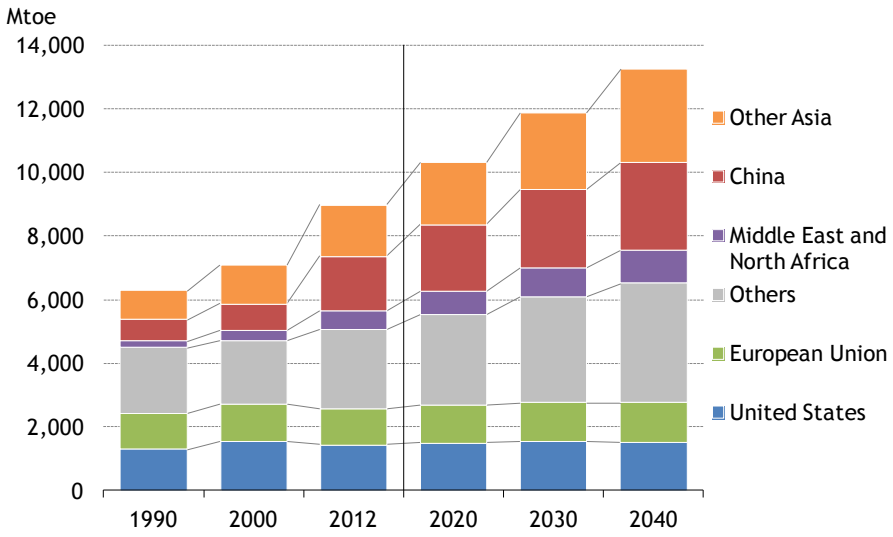
The average annual growth rate for final energy consumption between 1990 and 2012 stood at 1.6% against that for real GDP growth of 2.8%. The average annual growth in OECD was limited to 0.6% as consumption was held down by an economic slowdown and progress in energy conservation. In contrast, non-OECD boosted final energy consumption by an average annual rate of 2.4% through high economic and industrial production growth. As these trends continue in the future, global final energy consumption will increase from 8,979 Mtoe in 2012 to more than 10,000 Mtoe by 2020 and reach 13,254 Mtoe in 2040. Between 2012 and 2040, final energy consumption will grow at an average annual rate of 1.4% against real GDP at 3.0%, indicating that progress in energy conservation will curb final energy consumption in non-OECD as well as OECD (Figure 29).

Figure 29 Global GDP and final energy consumption [1990-2012, Reference Scenario for 2020, 2030, 2040]



Asian final energy consumption will increase at an annual rate of 1.9% from 3,323 Mtoe in 2012 to 5,681 Mtoe in 2040 due to its industrial structure advancement, urbanisation progress and living standard improvements through remarkable economic development (Figure 30). Asia will account for 2,358 Mtoe or 55% of the global final energy consumption growth of 4,275 Mtoe through 2040. Of the global growth, China will capture 1,043 Mtoe and India 649 Mtoe. The two countries will thus be responsible for about 40% of the global growth. The Middle East and North Africa will expand final energy consumption from 588 Mtoe in 2012 to more than 1,000 Mtoe in 2040, posting an annual growth rate of 2.1% exceeding Chinese growth and accounting for about 10% of global growth.

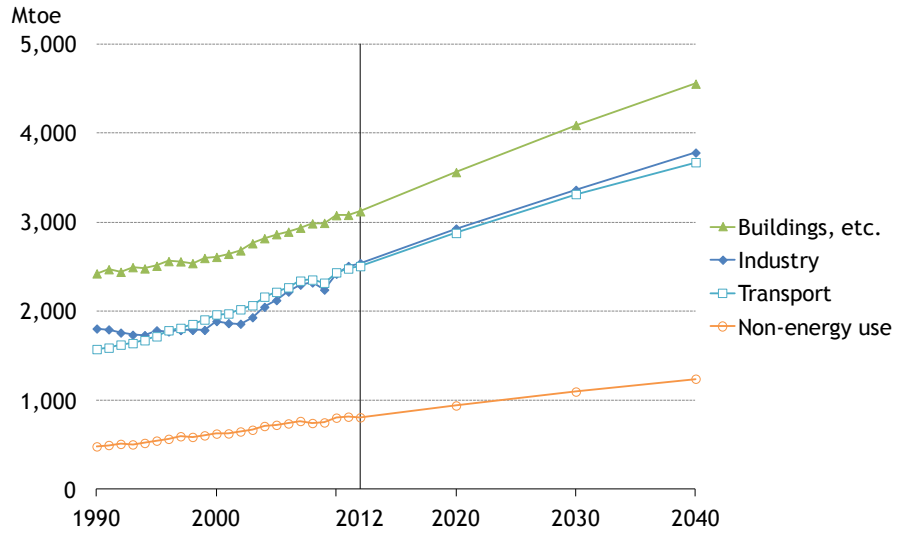
Figure 30 Final energy consumption by region [Reference Scenario]



By sector

The buildings sector will account for 1,434 Mtoe or one-third of the final energy consumption growth of 4,275 Mtoe between 2012 and 2040 (Figure 31), followed by 1,241 Mtoe for the industry sector, 1,167 Mtoe for the transport sector and 433 Mtoe for the non-energy use sector. The annual growth rate will be 1.4% each for the industry, transport and buildings sectors. In all sectors, non-OECD's rapid consumption growth will have a great impact. Non-OECD will expand energy consumption mainly in the buildings sector in line with the maturing of their living standards, gradually shifting to the past energy consumption path for OECD countries.

Figure 31 Global final energy consumption by sector [Reference Scenario]



Even in OECD, the buildings sector will slightly expand its share of final energy consumption in line with a further shift to services and lifestyle changes. Energy conservation in the buildings sector is linked to household or personal lifestyles and behaviours and is relatively difficult in contrast to that in the industry sector where the replacement of small machines with large ones and technological advancement can easily produce energy conservation effects. In non-OECD, energy consumption in the transport and buildings sectors will firmly increase thanks to economic and population growth. The transport and buildings sectors in non-OECD will account for more than 50% of final energy consumption in 2040. Therefore, these sectors are the most important for energy conservation.

Progressing motorisation will drive the transport sector's energy consumption growth. The global vehicle fleet will expand from 1,150 million vehicles in 2012 to 2,090 million vehicles in 2040. As motorisation makes further progress on income growth in non-OECD Asia, the Asian vehicle fleet will expand from 290 million vehicles in 2012 to 810 million vehicles in 2040. Asia will thus account for a little more than 50% of the global fleet expansion. Around 2030, the non-OECD vehicle fleet will surpass the OECD fleet.

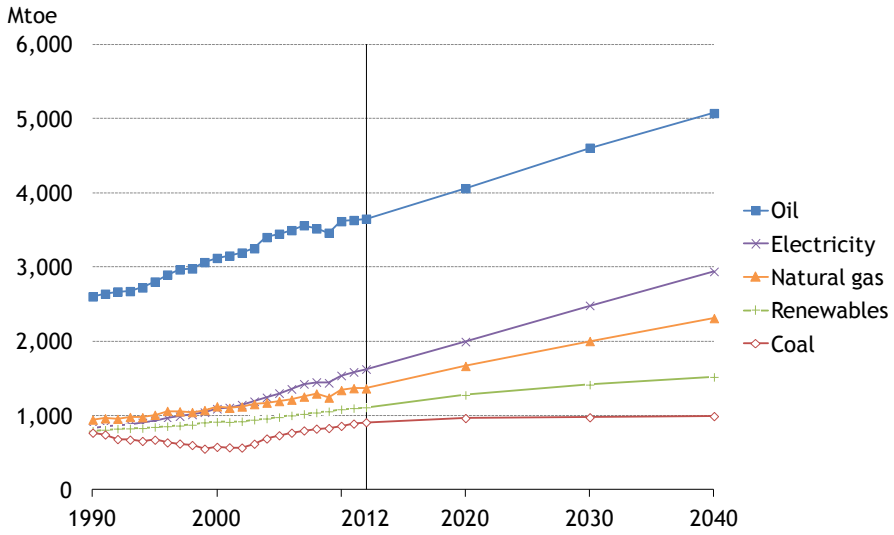
The buildings sector's energy consumption will increase in many countries. As China, India and ASEAN countries improve their living standards and penetrate electrical appliances in line with income growth, their annual energy consumption growth rate will reach 2%, higher than for most other countries. The Chinese buildings sector's increase in consumption from 2012 to 2040 is remarkably large totalling 397 Mtoe, easily surpassing Japan's current total final energy consumption. Although China's population will peak in 2030 and turn downward later, China will still account for about 20% of global population. Its large energy consumption in the buildings sector will exert great impacts on the world energy market and the climate change issue.

By energy source

A breakdown of global final energy consumption by energy source for the coming 30 years indicates an average annual consumption growth rate of 2.1% for electricity and 1.2% for fossil fuels (Figure 32). While coal among fossil fuels will log a small annual increase of 0.3%, oil will post a 1.2% rise. Natural gas will record a 1.9% increase, the fastest growth among fossil fuels. Electricity will expand its share of total final energy consumption from 18% in 2012 to 22% in 2040, with natural gas's share widening from 15% to 17%, while the share will fall from 41% to 38% for oil and from 10% to 7% for coal.

Nevertheless, oil will post the largest increase in volume. Even in 2040, oil will account for more than 30% of total final energy consumption, remaining the most important energy source. Driving the oil consumption growth will be the transport sector and the non-energy use sector including petrochemical feedstocks in China, India and the Middle East. As a result, demand will shift to light petroleum products. Given that oil concentrates further in the two sectors where their consumption is less elastic to prices and substitutes for oil are limited, oil is expected to grow more strategic.

Figure 32 Global final energy consumption by source [Reference Scenario]



Natural gas consumption will increase substantially in the buildings sector of China and in the industry sector of Latin America and the Middle East. In China, natural gas will expand its share of

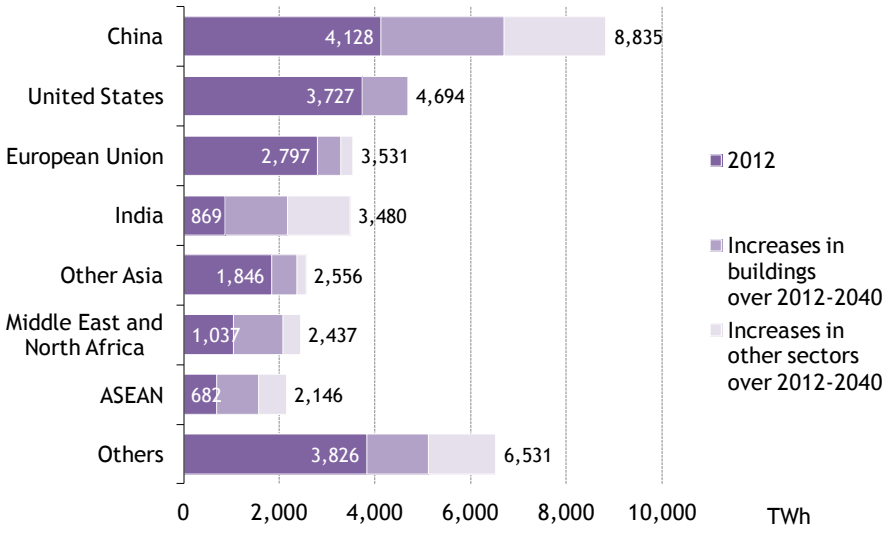
final energy consumption from 5% in 2012 to 13% in 2040. China's residential sector, which used coal and biomass including firewood and livestock manure, will switch to cleaner city gas due to income growth, health risks and sanitation problems. Latin America, Brazil and Mexico will switch to natural gas in industries such as steel, chemicals, and cement. Middle Eastern countries will promote a fuel switch to natural gas while giving priority to oil exports. In a bid to create jobs, they will also enhance petrochemical plants to use natural gas as feedstocks. In the United States, natural gas has traditionally been used for ethylene production. Petrochemical projects using cheaper natural gas are increasing in the United States.

Final coal consumption will decline at an annual rate of 0.5% toward 2040 even in China that has driven global coal consumption. In China, coal's share of the industry sector's final energy consumption will decline from 54% in 2012 to 35% in 2040, as steel and non-ferrous metal production peaks out after accounting for 50% of the sector's energy consumption in 2012. The introduction of electric arc furnaces and the replacement of old equipment will also help cut coal consumption. In India and ASEAN, blast furnace steel production will expand due to steel demand growth accompanying motorisation. As a result, coal consumption will increase at an annual rate of 1.9% in India and at 3.5% in ASEAN toward 2040.

Usually, electricity (being convenient) is selected as income grows; this trend will remain unchanged. Among major energy sources, electricity will post the largest consumption growth in both OECD and non-OECD. Global electricity consumption will expand at an annual rate of 2.1% and raise its share of total final energy consumption to 22%. Driving the growth will be the Asian region including China and India, and other emerging countries like Russia and Brazil (Figure 33). Demand growth in urban regions, growing electricity infrastructure investment mainly in rural regions and the penetration of air conditioners, televisions and other electrical appliances amid income growth will drive electricity consumption growth. The commercial sector will increase energy consumption due to a structural shift from secondary industries to tertiary industries including services. Particularly, office automation of buildings will boost electricity consumption.

OECD accounts for 49% of global final electricity consumption at present. In the decade through 2020, China will increase consumption by 1,576 terawatt-hours, more than the present consumption of the United Kingdom, Germany, France and Italy combined. Non-OECD including China will boost electricity consumption rapidly. In several years, non-OECD's share of global electricity consumption will exceed that of OECD. Similarly, China has replaced the United States as the world's largest electricity consumer. In 2040, it will consume 8,835 TWh, more than 1.8 times as much as United States consumption in that year. India's consumption will increase at an annual rate of 5.1% to 3,480 TWh. Non-OECD will account for 80% of global electricity consumption growth through 2040.

Figure 33 Global final electricity consumption [Reference Scenario]



As seen in the past, economic expansion and income growth have backed up an increase in electricity consumption and energy conservation efforts have failed to completely offset the increase or drag down electricity consumption. One reason for this phenomenon is that electricity is a very convenient energy source and can lead to an increase in equipment that uses electricity as a power source or an energy source for control. Another reason is that energy conservation technologies include electric vehicles and heat pumps that additionally consume electricity and reduce fuel consumption by more than the additional consumption.

3. World and Asia energy supply

3.1 Oil

Production

Both OPEC and non-OPEC oil supply will continue to increase in response to global oil demand growth (Table 2). Non-OPEC oil production, including growing United States shale oil production, will expand substantially through 2020. Non-OPEC oil producers' share of global oil supply, including a process gain, will increase from 58% in 2012 to 60% in 2020.

Table 2 Global oil supply [Reference Scenario]

(Mb/d)

	2012	2020	2030	2040	Changes over 2012-2040
Total supply	89.2	95.2	106.7	116.5	27.4
OPEC	37.5	37.9	44.8	52.7	15.2
Middle East	26.9	27.1	33.0	38.7	11.8
Others	10.6	10.9	11.8	14.0	3.4
Shale oil	-	-	0.4	0.4	0.4
Non-OPEC	49.5	54.8	58.9	60.5	11.0
North America	12.8	16.5	17.3	17.3	4.5
Shale oil	2.0	3.6	3.6	3.2	1.2
Latin America	7.1	8.7	10.3	11.3	4.2
Shale oil	-	0.2	0.4	0.4	0.4
Europe and former Soviet Union	17.4	16.8	18.3	18.8	1.4
Shale oil	-	0.3	0.7	0.7	0.7
Middle East	1.5	1.5	1.5	1.6	0.1
Africa	2.3	2.9	3.0	3.1	0.8
Asia	7.9	7.9	7.8	7.6	-0.4
China	4.2	4.3	4.3	4.2	-
Shale oil	-	0.5	0.6	0.6	0.6
Indonesia	1.0	0.9	0.9	0.9	-0.1
India	0.9	0.8	0.7	0.7	-0.3
Others	2.4	2.6	2.7	2.7	0.4
Oceania	0.5	0.6	0.7	0.8	0.3
Shale oil	-	0.1	0.2	0.3	0.3
Processing gains	2.2	2.5	3.0	3.4	1.2

United States shale oil production will retain a level of 3.6 Mb/d from 2020 to 2030 as the productivity improvement rate exceeds the production depletion rate. From the 2030s, however, United States shale oil production will decline moderately. Over a long term, OPEC rich with oil resources available for low-cost development will increase oil supply, leading non-OPEC oil's share of global supply to fall from 58% in 2030 to less than 55% in 2040. As non-United States shale oil production grows from the 2030s, shale oil production in 2040 will rise to 5.6 Mb/d.

OPEC oil production will expand by 15.2 Mb/d from 2012 to 52.7 Mb/d in 2040. OPEC leader Saudi Arabia will continue to serve as a swing producer to stabilise oil supply and prices. By developing new oil fields in response to growing consumption, Saudi Arabia will maintain and expand its oil

production capacity that stood at 12.4 Mb/d as of September 2014. Iraq plans to increase rapidly production by raising its capacity to 12.0 Mb/d by 2017. Given a possible decline in the life of oil fields, a delay in arrangements for procuring pressured water for maintaining and expanding oil production capacity and a lag in enhancing oil shipment capacity, Iraq is likely to lower the target capacity. Iran, now subjected to a Western oil embargo, can be expected to get out of the embargo in the future. Unless Iran conducts oil development and maintains existing productive oil fields sufficiently, however, its production may fail to restore pre-embargo levels immediately after the embargo is lifted.

Non-OPEC oil production will increase by 11.0 Mb/d from 2012 to 60.5 Mb/d in 2040. Russia, the largest non-OPEC oil producer, sees a sign of decline in crude oil exports to Europe and is revising its oil export strategy to target Asia, including China, as an alternative export destination. Therefore, it may focus on oil development in Eastern Siberia and the Far East in the future. Kazakhstan, which had continuously delayed its Kashagan oil field development, is expected to expand oil supply after oil production started in September 2013 under a Kashagan project joined by a Japanese company. Brazil, known as a pioneer in developing deep-sea oil fields, aims to expand production from 2.0 Mb/d in 2010 to 4.9 Mb/d in 2020 under production plans given by state-run oil company Petrobras.

Trade

Under the above oil production outlook, we project global crude oil trade flows as of 2040. Figures 34 and 35 show global crude oil trade flows in 2013 and 2040, respectively.

Figure 34 Crude oil trade flows between major regions [2013]

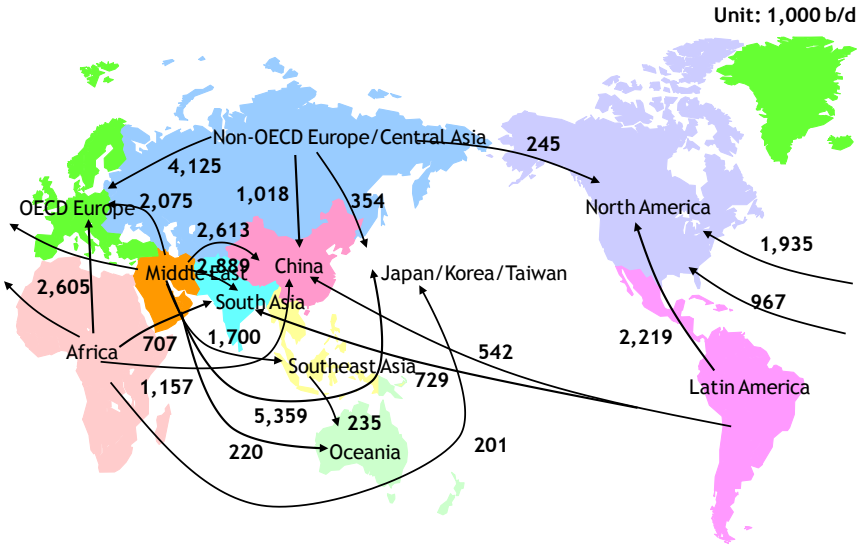
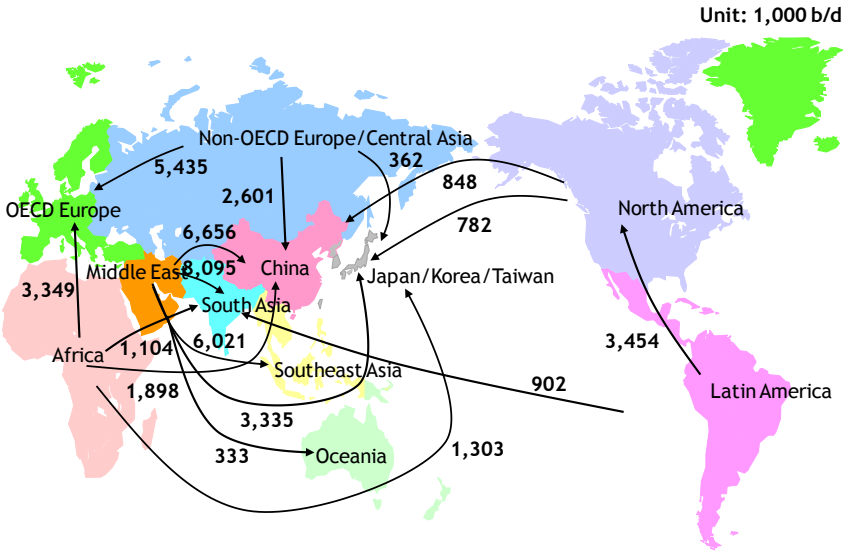


Figure 35 Crude oil trade flows between major regions [Reference Scenario, 2040]



Global crude oil trade will increase by more than 10 Mb/d from 37.7 Mb/d in 2013 to 48.9 Mb/d in 2040 in line with global oil consumption growth. Emerging economies, including China, South Asia (mainly India) and ASEAN, will remarkably increase their dependence on oil imports in line with their substantial oil demand growth under high economic growth in the absence of growth in their domestic crude oil production. Meanwhile, OECD will generally reduce crude oil imports due to a shale oil production expansion in North America and a petroleum product consumption decline amid fuel efficiency improvements.

Crude oil trade flows in 2040 will feature the general regionalisation of crude oil trade. The United States will increase domestic production and maintain robust imports from Latin America and Canada, allowing the Americas to achieve their oil independence. The United States, which imported nearly 2.0 Mb/d of crude oil from the Middle East in 2013, will come under pressure to import relatively cheaper heavy crude oil from Latin America and Canada and gradually reduce Middle Eastern crude oil imports costing more for transportation. In 2040, there will be no United States oil imports from the Middle East.

Europe will also see oil trade regionalisation in which it will eliminate crude oil imports from the Middle East due to stagnant domestic consumption and robust imports from Russia and Africa and limit its oil import sources to non-OECD Europe, Central Asia and Africa, closer to the European market. This is because massive Russian and African crude oil will lose the United States as a major market and flow into the European market as the Americas increase their oil independence through a production expansion in North America. Crude oil from the Former Soviet Union region linked to the European market through pipelines and from adjacent Africa will be positioned as more competitive for Europe.

Meanwhile, the Asian market experiencing a substantial oil demand growth, will expand crude oil imports from the Middle East, though importing oil from other oil producers such as Africa, Russia, South America and Canada. Asia, however, will remain heavily dependent on Middle Eastern oil supply.

China will double its crude oil imports from 5.7 Mb/d in 2013 to 12.0 Mb/d in 2040, becoming the world's largest crude oil importer. China's import mix will be very diverse with crude oil from throughout the world coming into its market. Crude oil imports from Canada will increase to 0.9 Mb/d. Pipeline and other crude oil imports from Russia and Central Asia will expand to 2.6 Mb/d, those regions remaining an important oil supply source. The Middle East will become the largest crude oil supplier to China at 6.7 Mb/d. China will also continue to import crude oil from ASEAN and Africa.

Japan, Korea and Taiwan combined will reduce crude oil imports from 6.3 Mb/d in 2013 to 5.8 Mb/d in 2040 due to their domestic consumption drop. The Middle East will remain a major oil supply source for them although increasing oil imports from Africa will attract attention. Their imports from Africa will expand from 0.2 Mb/d in 2013 to 1.3 Mb/d in 2040. This is because African crude oil will lose the United States market and target the Asian market as a substitute export destination.

South Asia will also be dependent mainly on the Middle East for oil supply. Its crude oil imports from the Middle East will increase to 8.1 Mb/d in 2040, exceeding China's imports from the region. South Asia's geographical proximity to the Middle East will be a major factor behind the increase. Indian refineries with advanced crude oil cracking facilities will continue to receive Latin American crude oil, including heavy crude from Venezuela and production from new Brazilian offshore oil fields.

3.2 Natural gas

Production

Over a quarter century through 2040, both conventional and unconventional natural gas production will globally expand to meet growing consumption (Table 3). Particularly, unconventional natural gas production will expand mainly in North America, expanding its share of total natural gas production from 12% in 2012 to 27% in 2040.

In North America where unconventional natural gas production has expanded rapidly in recent years, conventional natural gas production will decline with unconventional production growing substantially. As a result, North America will score the third largest production growth after the Middle East and non-OECD Europe/Central Asia. In 2040, unconventional gas's share of North American natural gas production will reach 75%. Unconventional gas production will also increase in other regions than North America. Shale and other unconventional gas production will be gradually commercialised from 2018 in Argentina and Mexico and from 2021 in the Middle East, Africa, non-OECD Europe/Central Asia and OECD Europe. Unconventional gas's share of total gas production in 2040 will reach 28% in Latin America and 19% in Africa. Coal-bed methane production will increase in Australia from 2014 and shale gas production will gradually grow in China and Australia from 2021.

Unconventional gas's share of total gas production in 2040 will reach 50% in Oceania and 36% in China, following the North American level.

Of the above regions where natural gas production will increase, China and the Middle East will see their production growth slipping below their respective domestic consumption increase, consuming additional production domestically. Incremental supply to the international market will come mainly from Russia and other non-OECD Europe/Central Asia countries, Africa, Australia and the United States. Australia will become the world's largest LNG exporter by around 2020, and the United States will become an LNG exporter because of the shale gas production growth.

Table 3 Global natural gas supply [Reference Scenario]

(Bcm)

	2012			2040			Changes over 2012-2040	
		Unconven-tional	Unconven-tional		Unconven-tional	Unconven-tional		Unconven-tional
North America	838	414	49%	1,220	915	75%	382	501
Latin America	220	-	-	458	128	28%	238	128
Middle East	529	-	-	944	28	3%	415	28
OECD Europe	276	-	-	231	12	5%	-45	12
Non-OECD Europe/Central Asia	873	-	-	1,311	66	5%	438	66
Africa	211	-	-	519	99	19%	308	99
China	107	-	-	418	151	36%	311	151
India	40	-	-	105	31	30%	65	31
ASEAN	209	-	-	396	83	21%	187	83
Indonesia	77	-	-	137	23	17%	60	23
Malaysia	61	-	-	92	9	10%	31	9
Other Asia	74	-	-	93	6	6%	19	6
Australia	61	7	11%	182	91	50%	121	85
World	3,438	421	12%	5,877	1,609	27%	2,439	1,189

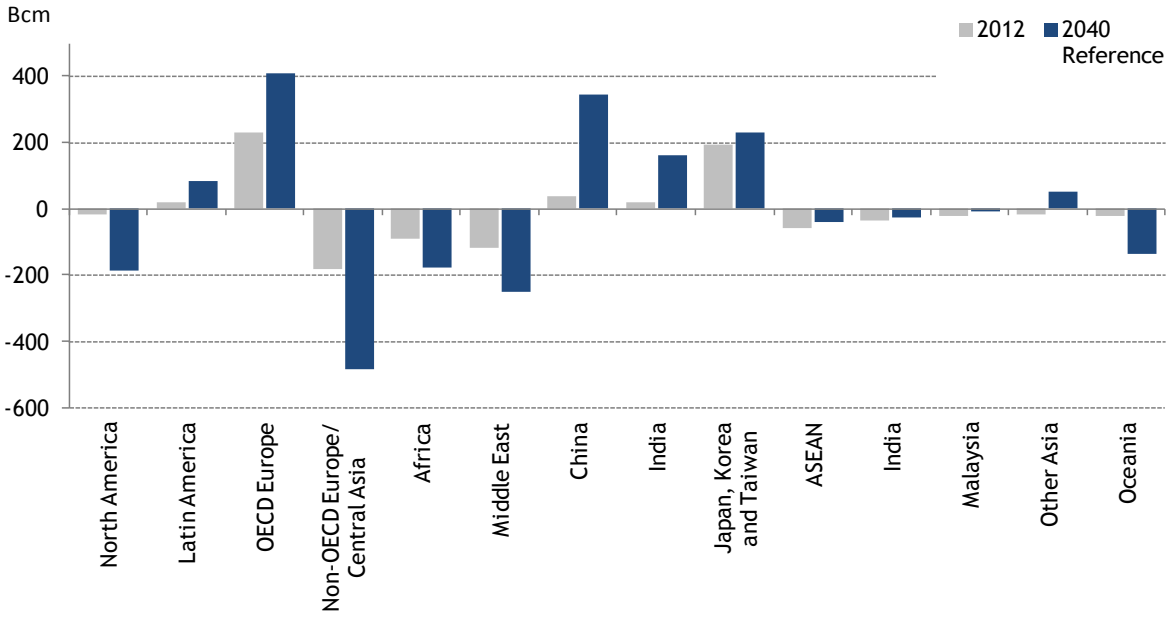
Trade

In 2012, 1,055 Bcm or 30% of natural gas production was exported. Interregional trade accounted for 400 Bcm of the exports (Figure 36). Major exporters for interregional trade included Russia and other non-OECD Europe/Central Asia, and the Middle East. Among major importers were OECD Europe and Asia, including Japan, Korea and Taiwan.

Natural gas trade will increase faster than consumption, with interregional trade growing 2.6-fold to more than 1,000 Bcm. Regions expanding exports dramatically will include non-OECD Europe/Central Asia that will increase exports to China, as well as North America and Oceania where unconventional natural gas production will grow. Among importers, China and India will expand imports to meet their growing consumption.

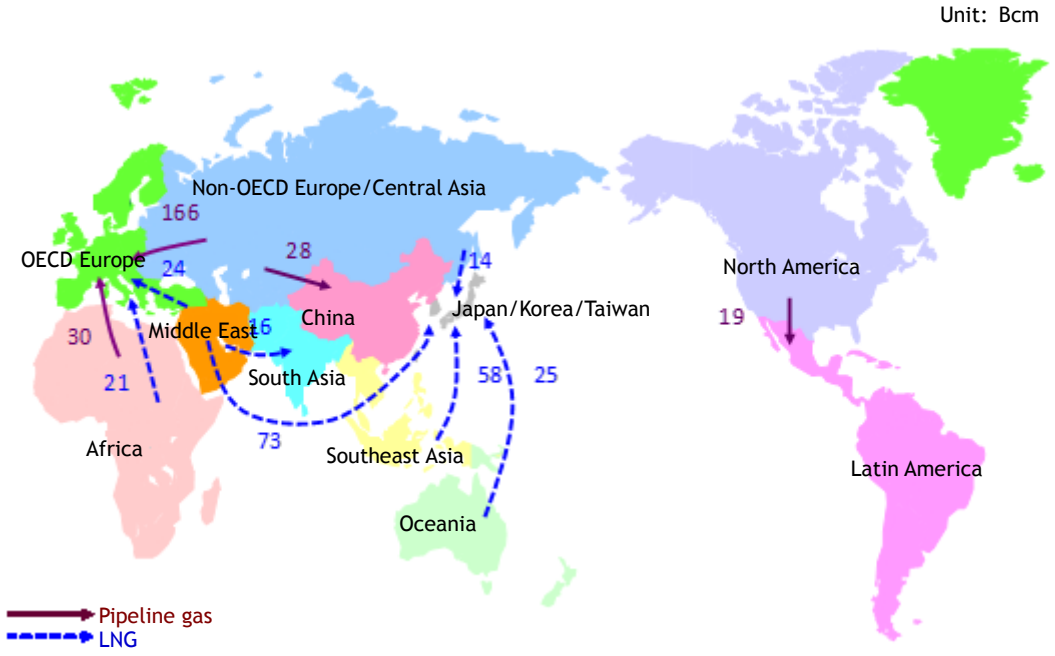
Net exports from non-OECD Europe/Central Asia in 2040 will increase to 486 Bcm, led by Russian export growth. Net exports will total 188 Bcm for North America and 136 Bcm for Australia. Net imports in 2040 will rapidly increase to 343 Bcm in China and 162 Bcm in India.

Figure 36 Net natural gas imports [Reference Scenario, 2040]



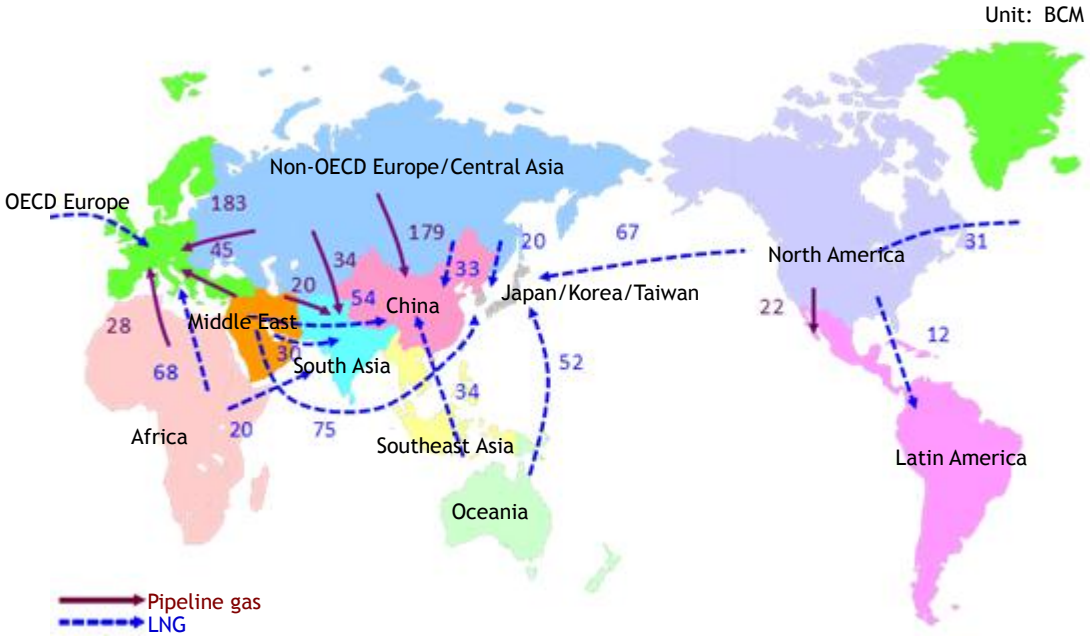
The abovementioned regional changes in net natural gas imports and exports will greatly influence trade flows. Major interregional natural gas trade flows in 2013 were pipeline gas exports from Russia and other OECD Europe/Central Asia countries to OECD Europe and LNG exports from Southeast Asia, Oceania and the Middle East to Japan, Korea and Taiwan (Figure 37).

Figure 37 Natural gas trade flows between major regions [2013]



An increase in net exports from North America, Oceania and non-OECD Europe/Central Asia will go mainly to Asia (Figure 38). North America will become a net exporter around 2020 and rapidly boost exports in line with progress in LNG projects. In 2040, North America will export 67 Bcm to Japan, Korea and Taiwan combined and 31 Bcm to Europe, emerging as a major LNG supplier for the two regions. Non-OECD Europe/Central Asia will export 179 Bcm in pipeline gas to China, enhancing a shift to the Asian market, with a majority of exports destined to Asia. Oceania, also with great export potential, will export 52 Bcm to Japan, Korea and Taiwan and 34 Bcm to China, expanding exports primarily to Asia.

Figure 38 Natural gas trade flows between major regions [Reference Scenario, 2040]



For Japan, Korea and Taiwan, the Middle East will remain a major natural gas supplier although the increase in exports from the region will be limited to 2 Bcm. Their consumption growth will be covered by an increase of 67 Bcm in imports from North America and a rise of 27 Bcm in those from Oceania. They will thus diversify natural gas import sources to reduce their dependence on the Middle East.

As is the case with Japan, Korea and Taiwan, OECD Europe will import gas from North America. But OECD Europe will remain linked via pipelines to Africa, the Middle East and non-OECD Europe/Central Asia and absorb an increase in African production. The region will thus expand imports while keeping its import sources diversified.

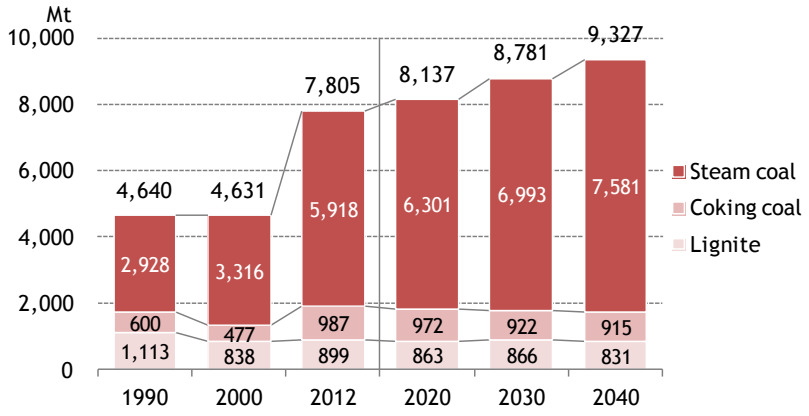
China and South Asia will increase gas imports from non-OECD Europe/Central Asia and the Middle East as traditional exporters due to their geographical proximity. Particularly, China will import 212 Bcm from non-OECD Europe/Central Asia, replacing OECD Europe as the largest importer from the region.

3.3 Coal

Production

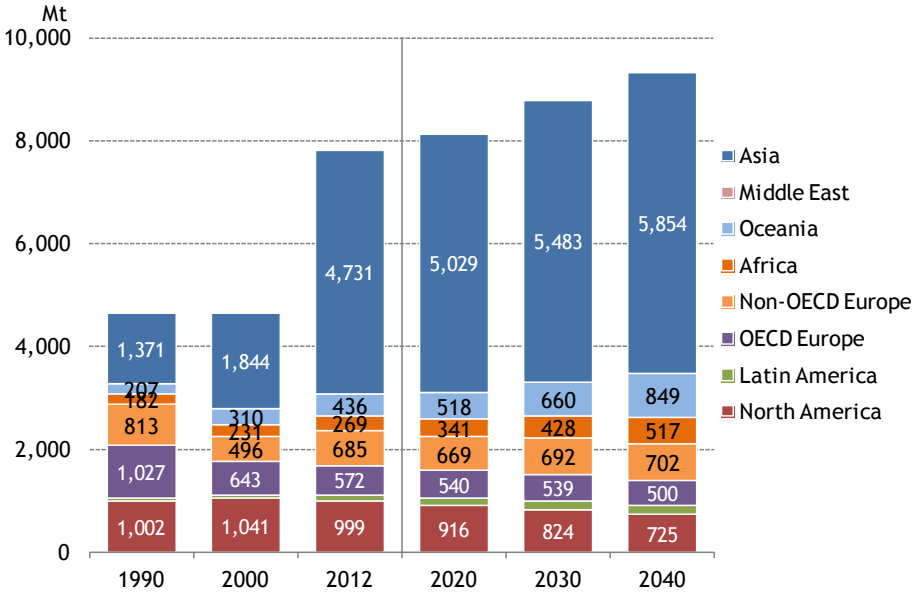
Global coal production will increase from 7,805 Mt in 2012 to 9,327 Mt in 2040 as coal demand expands in Asia and other non-OECD. Steam coal production will rise 1.3-fold from 5,918 Mt in 2012 to 7,581 Mt in 2040, while coking coal production will decrease from 987 Mt in 2012 to 915 Mt in 2040 and lignite production from 899 Mt in 2012 to 831 Mt in 2040 (Figure 39).

Figure 39 Coal production by type [Reference Scenario]



Coal production trends will differ between Asia and other non-OECD with growing demand, North America and OECD Europe with declining demand, and major coal exporting countries (Figure 40).

Figure 40 Coal production by region [Reference Scenario]



Asian coal production will grow from 4,731 Mt in 2012 to 5,854 Mt in 2040. China is the largest coal consumer, producer and importer in the world. Steam coal production in China will increase in line

with its domestic demand growth, and the coking coal production will decline as its demand peaks out. In India, both steam and coking coal production will increase as demand expands. India will also expand steam and coking coal imports, as its domestic coal features high ash content, and its infrastructure development for coal transportation from production zones fails to catch up with demand growth and coalmine development. In the past, Indonesia has greatly increased steam coal production to meet Asian market growth. As the Indonesian government has vowed to use its domestic resources sustainably and efficiently for national interests under a new mining industry law, it came up in 2014, with a plan to restrict coal production. While the restriction may depend on the government's talks with coal producers, Indonesian coal production is not expected to rise at a high pace as in the past. Mongolia is developing coking coalmines in southern Gobi and is still facing the great challenge of transporting/exporting coal to the Asia Pacific market. At present, Mongolia exports to China only but as Chinese coking coal demand will decline, Mongolia's production will decrease.

North American coal production will decrease from 999 Mt in 2012 to 725 Mt in 2040. United States production will decline due to a domestic demand fall, production cost hikes and environmental problems involving coal mining. While United States steam coal exports will expand in line with demand growth in Latin America, Africa and Asia, steam coal production will decline sharply from 779 Mt in 2012 to 561 Mt. in 2040 due to a steep drop in demand for coal for power generation under environmental regulations. Canada will also reduce coal production as domestic demand falls.

In OECD Europe, coal production will fall from 572 Mt in 2012 to 500 Mt in 2040 due to a domestic demand decline, production cost hikes and the elimination of subsidies for the coal industry in some countries.

Non-OECD will slightly expand coal production to meet their domestic demand growth. Russian steam coal production will rise as the Asian market expands despite a decline of the European market.

As African steam coal demand expands along with the Asian steam coal market, with Indian demand for coking coal increasing, South Africa will boost steam coal production and Mozambique will raise both coking and steam coal production.

Latin America will increase coal production to meet domestic and export demand growth. Major coal exporter Colombia will expand steam coal production due to domestic demand growth and African and South American countries' import expansion, despite the shrinking European market.

In Oceania, Australia will greatly expand its coal production in response to the growing coal market, including Asia. Australian steam coal production will grow 2.9-fold from 2012 to 2040 to meet an increase in exports to Asia and cover for a decline in steam coal exports from Indonesia.

Table 4 Steam coal production by region [Reference Scenario]

(Mt)

	2012	2020	2030	2040	Changes over 2012-2040
North America	805	738	660	572	-233
United States	779	719	647	561	-219
Latin America	103	113	140	162	59
Colombia	85	91	110	124	40
OECD Europe	107	100	92	83	-24
Non-OECD Europe	359	353	377	398	39
Russia	206	209	231	247	42
Middle East	0	0	0	0	0
Africa	264	326	408	496	232
South Africa	257	309	383	462	205
Asia	4,064	4,374	4,882	5,252	1,188
China	3,017	3,197	3,490	3,598	581
India	514	599	784	1,012	498
Indonesia	441	472	476	481	41
Oceania	215	297	433	617	402
Australia	212	295	431	615	403
World	5,918	6,301	6,993	7,581	1,663

Table 5 Coking coal production by region [Reference Scenario]

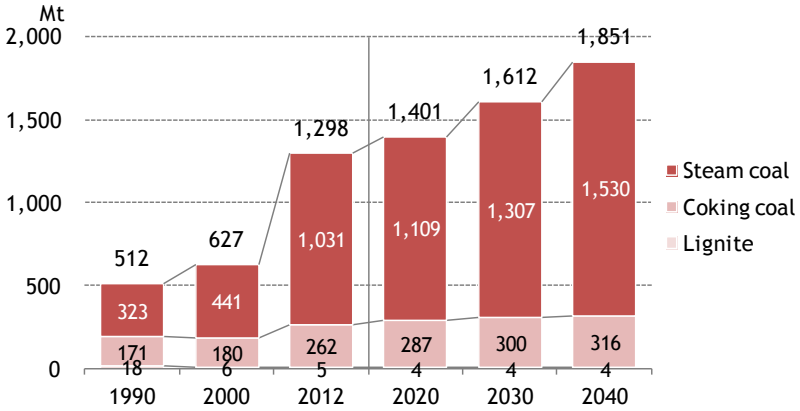
(Mt)

	2012	2020	2030	2040	Changes over 2012-2040
North America	112	104	102	102	-11
United States	81	76	75	76	-5
Latin America	7	5	6	7	0
Colombia	4	4	5	6	1
OECD Europe	25	24	23	20	-4
Non-OECD Europe	107	97	100	103	-4
Russia	73	69	74	78	5
Middle East	1	1	1	1	0
Africa	5	15	20	21	16
Mozambique	3	13	18	19	16
Asia	582	580	515	494	-89
China	516	501	415	363	-152
India	43	58	76	105	62
Mongolia	20	16	15	14	-6
Oceania	149	145	155	167	18
Australia	147	143	153	165	19
World	987	972	922	915	-72

Trade

Coal trade will expand 1.4-fold from 1,298 Mt in 2012 to 1,851 Mt in 2040 in line with demand growth. Steam coal trade will increase 1.5-fold from 1,031 Mt in 2012 to 1,530 Mt in 2040 in response to demand growth in India and Southeast Asia. Coking coal trade will grow 1.2-fold from 262 Mt in 2012 to 316 Mt in 2040 (Figure 41).

Figure 41 Coal trade by type [Reference Scenario]



Steam coal imports will substantially increase in response to growing demand for coal for power generation in India and Southeast Asia (including Malaysia, Thailand, the Philippines and Vietnam). China's imports have increased in line with domestic demand growth but will decelerate growth in response to slower domestic demand growth. Australia, South Africa, Russia and Colombia will expand steam coal exports, while Indonesia will reduce exports by restricting production even amid domestic demand growth.

Figure 42 Net steam coal imports [Reference Scenario]

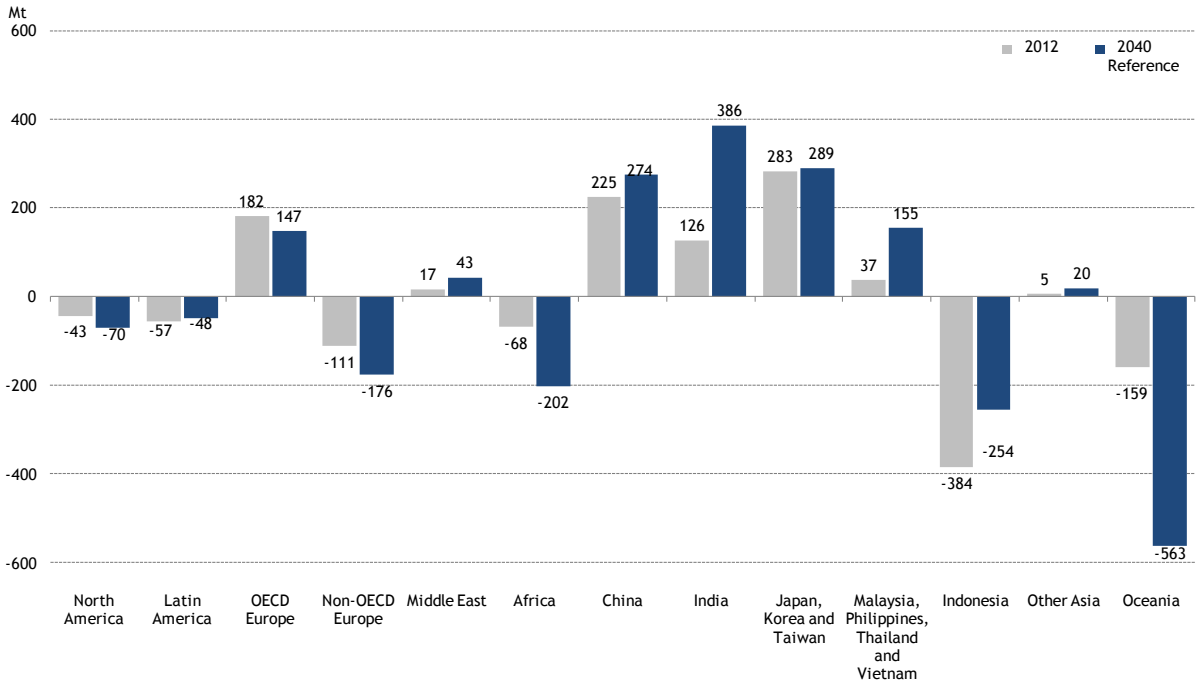
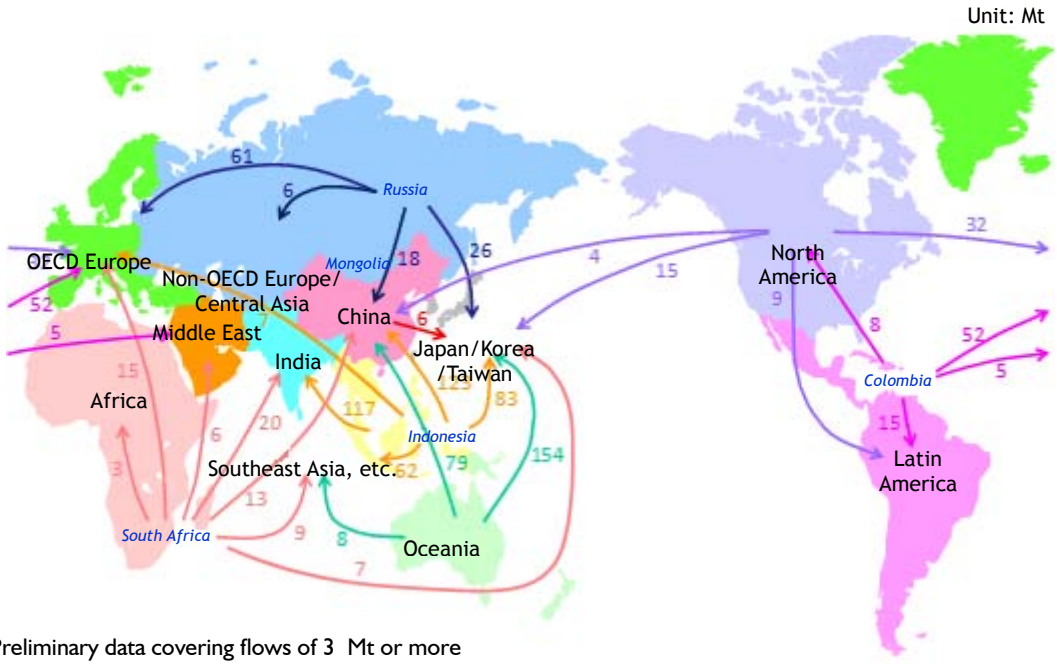
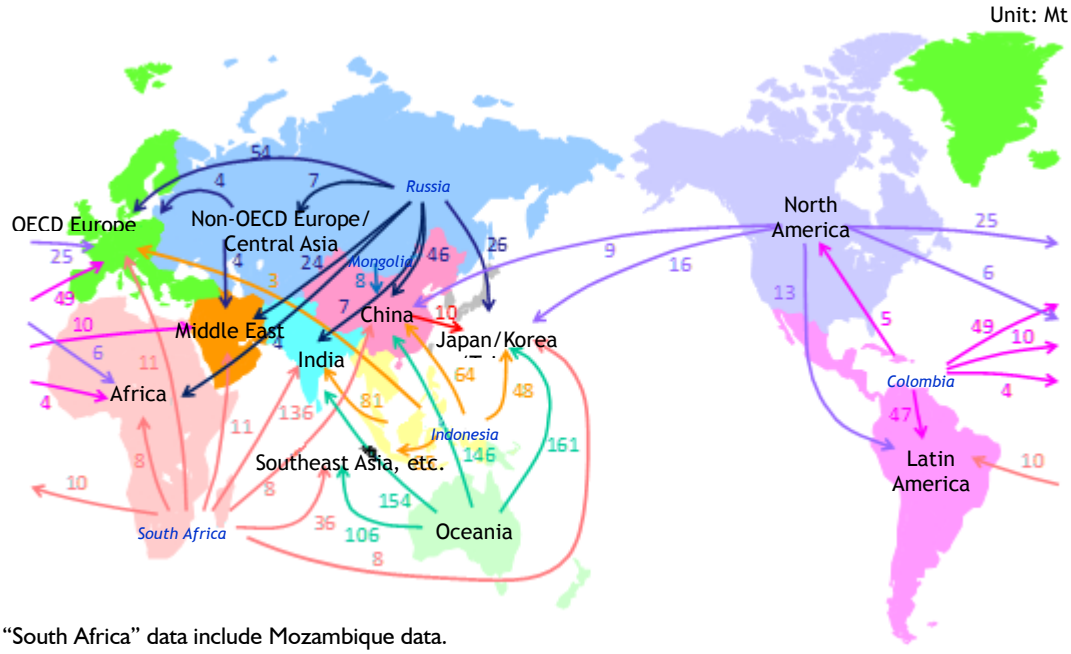


Figure 43 Major steam coal trade flows [2013]



Note: Preliminary data covering flows of 3 Mt or more
Source: Prepared from IEA, "Coal Information 2014"

Figure 44 Major steam coal trade flows [Reference Scenario, 2040]



Note: "South Africa" data include Mozambique data.

Coking coal imports will increase sharply in India while declining in China and Japan due to demand decline. Imports will slightly expand in OECD Europe due to domestic production cuts despite demand decline. Coking coal exports will increase in Australia as well as Mozambique that is developing coking coal resources. Exports will slightly fall in Canada and the United States as China and Japan reduce imports. Exports will also decline in Mongolia due to a drop in China's imports.

Figure 45 Net coking coal imports/exports [Reference Scenario]

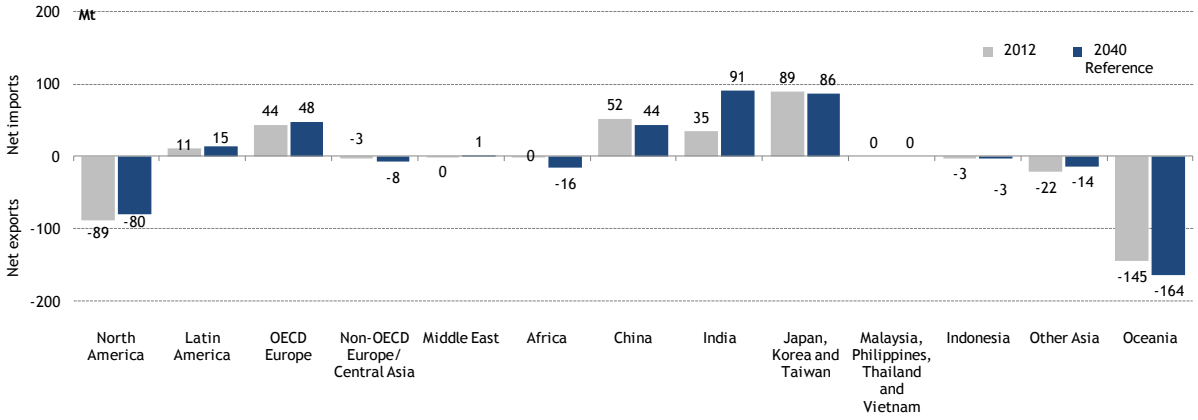
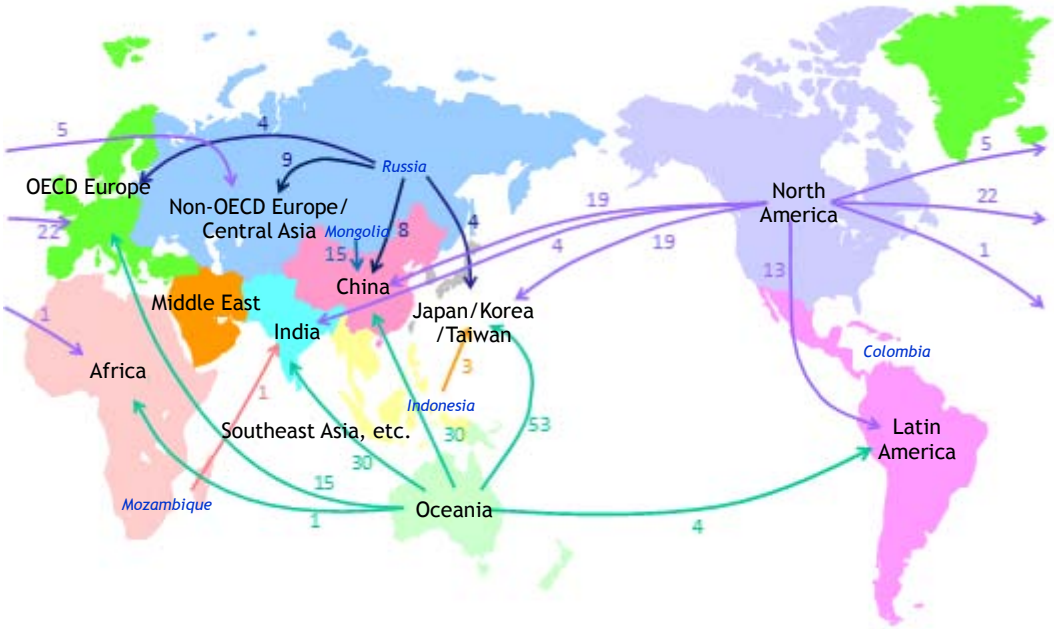


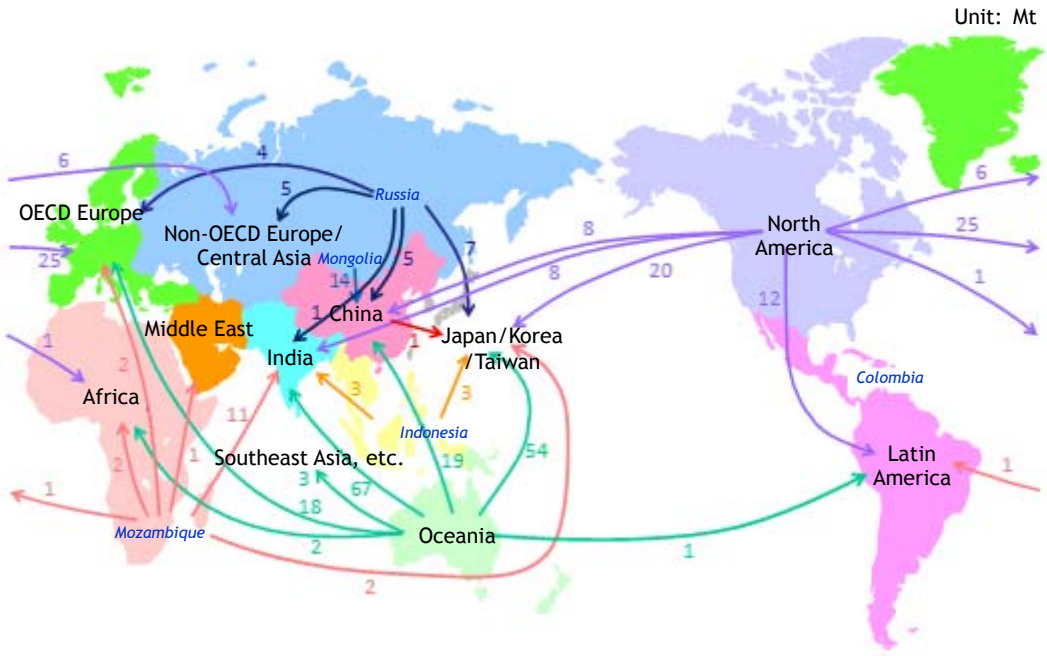
Figure 46 Major coking coal trade flows [2013]

Unit: Mt



Note: Preliminary data covering flows of 1 Mt or more
Source: Prepared from IEA, "Coal Information 2014"

Figure 47 Major coking coal trade flows [Reference Scenario, 2040]



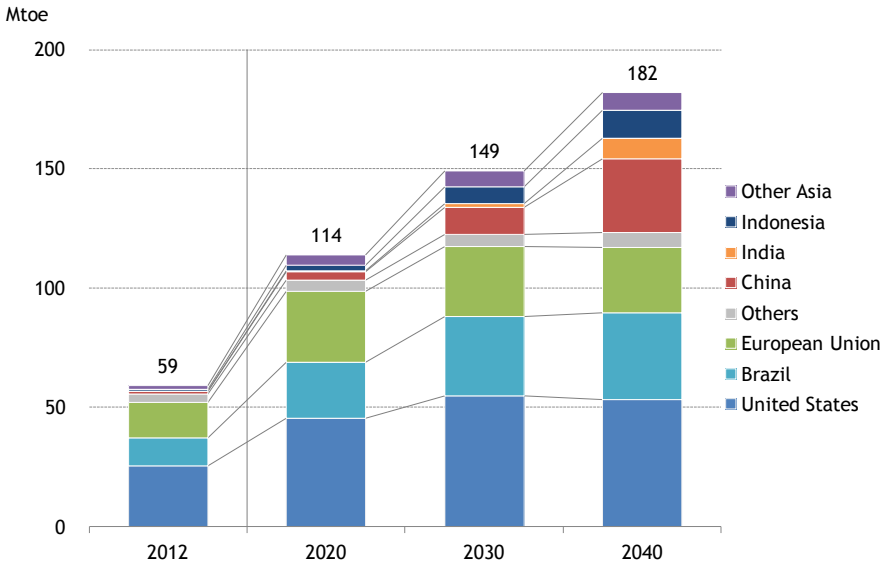
3.4 Biofuels

The penetration of liquid biofuels including bioethanol and biodiesel has made progress as part of measures on climate change, energy security and agriculture promotion. But biofuel consumption remains concentrated in the United States, Brazil and the European Union with the three economies accounting for nearly 90% of the global biofuel consumption in 2012.

Biofuel consumption will continue to expand mainly in the United States, Brazil and the European Union. In the United States, biofuel consumption will peak out in or after 2020 in the Reference Scenario as gasoline demand declines and the bioethanol content in gasoline is feared to exceed a safety limit. In the European Union, biofuel consumption will slightly decrease from 2020 as liquid fuel demand growth decelerates and fears grow over first-generation biofuels' environmental impact. In Brazil, biofuel consumption will continuously expand thanks to the penetration of flexible fuel vehicles that can use both ethanol and gasoline. Apart from the United States, Brazil and the European Union, Asian developing countries including China, India and Indonesia will sharply boost biofuel consumption as liquid fuel demand increases.

In the Reference Scenario, global biofuel consumption will increase from 59 Mtoe in 2012 to 182 Mtoe in 2040 (Figure 48).

Figure 48 Liquid biofuel consumption [Reference Scenario]

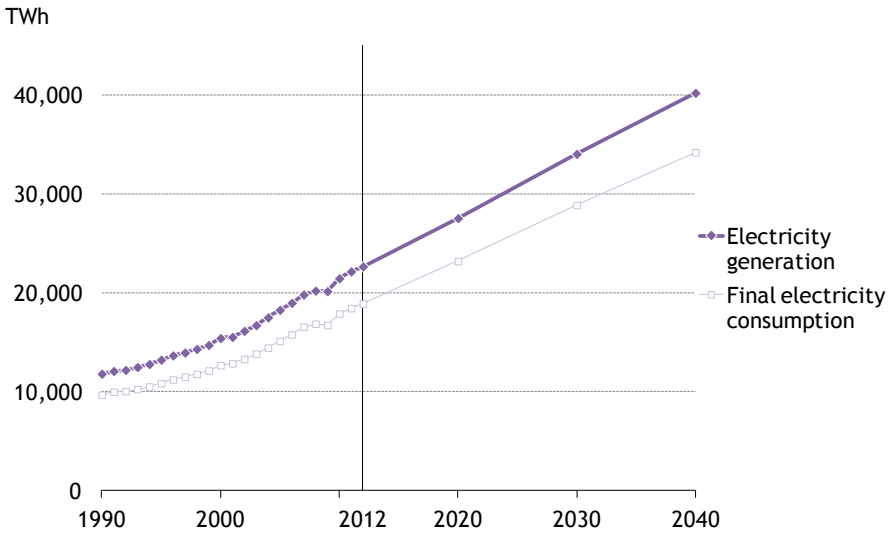


3.5 Electricity generation

Electricity generation and power generation mix

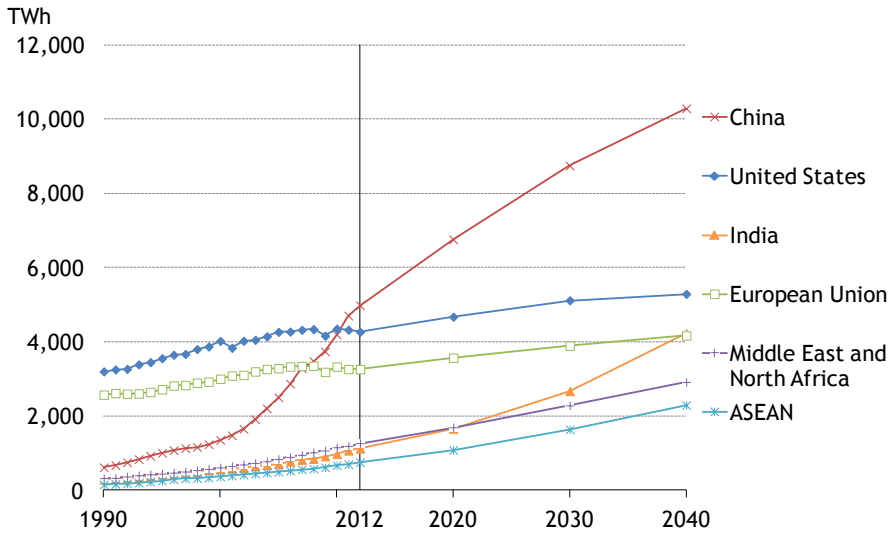
In line with electricity demand growth, global electricity generation will increase from 22,668 terawatt-hours in 2012 to 40,217 TWh in 2040 (Figure 49). The annual electricity generation growth rate of 2.1% will be somewhat lower than the final electricity consumption growth rate of 2.1% as power plants' own-use of electricity and the transmission and distribution losses decrease gradually.

Figure 49 Global electricity generation and final electricity consumption [Reference Scenario]



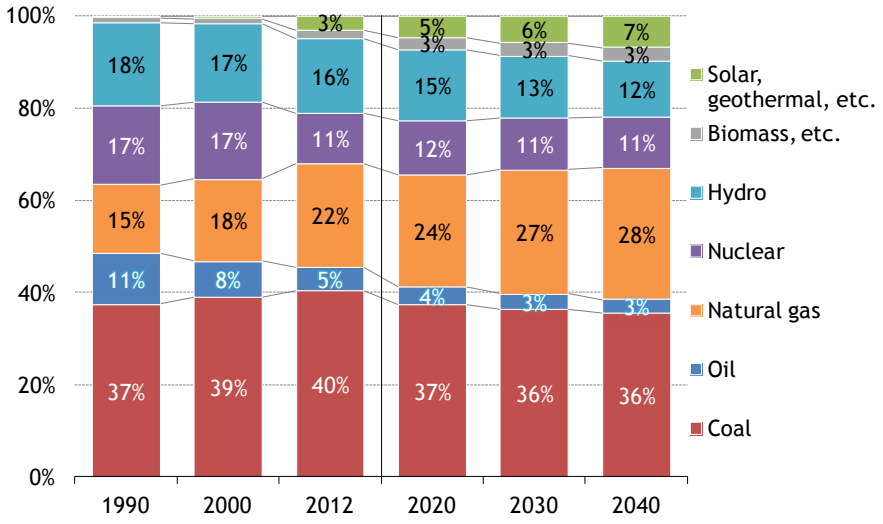
Non-OECD will account for more than 80% of the electricity generation growth through 2040 (Figure 50). Asian electricity generation will increase at an annual rate of 2.9% from 8,921 TWh in 2012 to 19,630 TWh in 2040. Cross-border trade in electricity may increase as electric grids are enhanced in response to the expansion of wind power, solar photovoltaic and other variable renewable energy power generation. Some ASEAN countries plan to export electricity for earning foreign currencies by developing rich hydroelectric resources.

Figure 50 Electricity generation in selected countries/regions [Reference Scenario]



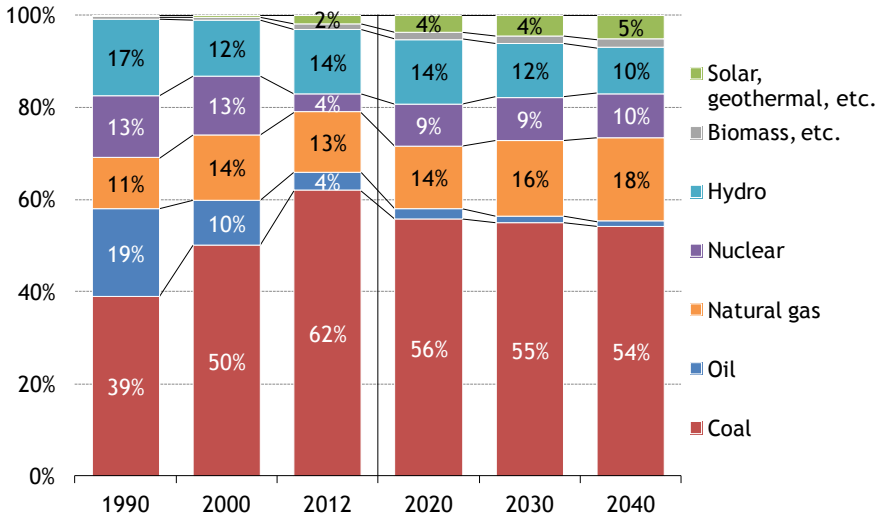
Coal accounted for the largest share of global electricity generation in 2012 at 40%, followed by 22% for natural gas, 16% for hydro and 11% for nuclear (Figure 51). Through 2040, coal will retain the largest share, continuing to serve as a mainstay electricity source. As technological development allows combined cycle gas turbines (CCGTs) to penetrate, with gas turbines used to adjust for variable renewable energy generation, a shift to natural gas for power generation will make progress. The share for natural gas will thus expand from 22% in 2012 to 28% in 2040. The share for oil will trend down in developed countries as well as in the oil-rich Middle East. Nuclear power plant construction will make progress mainly in Asia as a measure to ensure energy security and prevent climate change. But nuclear power generation growth will not be enough to cover electricity demand growth through 2040. Nuclear's share of electricity generation will thus level off from 2012 to 2040 at 11%. Wind power, solar photovoltaic and other renewable energy generation will expand at an unrivalled annual rate of 5.0% on the strength of policy support and cost reduction. But renewable energy's share of electricity generation will still be limited to 10% in 2040.

Figure 51 Global power generation mix [Reference Scenario]



In Asia including China and India, coal-fired generators will remain a mainstay electricity source in response to the rapid electricity demand growth (Figure 52). ASEAN has made a great shift from oil to natural gas as electricity generation fuel since the 1990s due to natural gas development in the Bay of Thailand and other locations. Since natural gas production peaked out and natural gas demand emerged in other sectors than electricity generation in the 2000s, however, natural gas supply capacity for electricity generation has become short. As demand for natural gas for electricity generation is growing, ASEAN as well as China and India are going ahead with plans to import natural gas. As coal's share of electricity generation decreases while being the highest, natural gas's share will increase from 13% to 18%.

Figure 52 Asian power generation mix [Reference Scenario]



Nuclear

The Fukushima Daiichi nuclear power plant accident has directly affected nuclear energy policies in Japan and some European countries. But the United States, France, Russia and Korea that have proactively promoted nuclear power generation, and emerging countries like China, have made no change to their respective nuclear promotion policies aimed at securing stable energy supply, preventing climate change, and maintaining and enhancing international competitiveness through their nuclear industry development.

The United States is currently the world's largest nuclear power generation country with 100 nuclear reactors for power generation. The increased economic advantages resulting from the shale gas and oil developments have caused the construction of new nuclear power plants to slow down and plans to shut down some existing reactors for economic reasons are under consideration. Given fuel price fluctuation risks accompanying a shift from nuclear energy to natural gas as well as climate change implications, however, the United States will retain the policy of maintaining nuclear power plants. Installed capacity for nuclear power generation will decline to 101.8 GW in 2020 as old existing reactors are shut down. As new reactors now under construction will become operational later, the capacity will rise back to 106.2 GW in 2040. The future capacity will thus change little from 103.3 GW as of 2014.

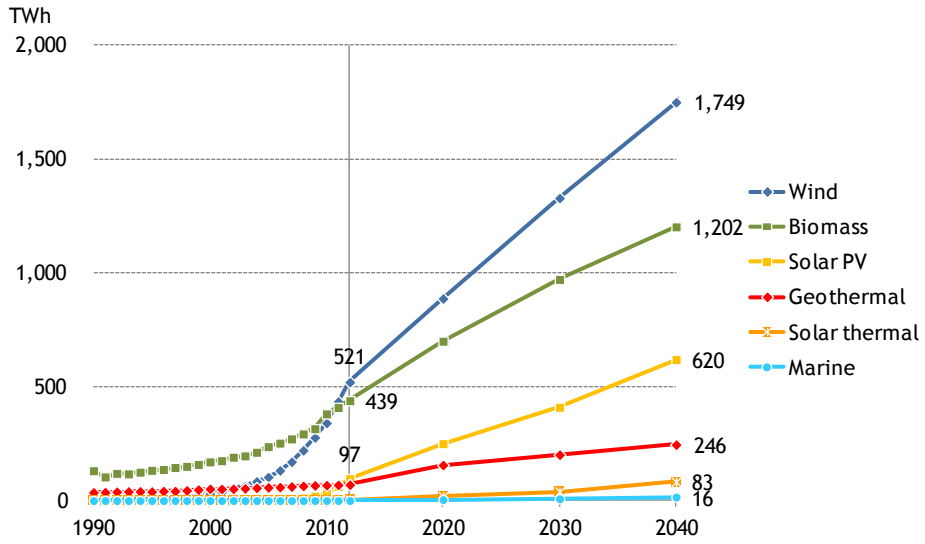
In France known as the largest nuclear energy promoter in Europe, Parliament is considering an energy transition law to reduce nuclear energy's share of electricity generation to 50% by 2025. But France has faced electricity rate hikes and employment problems, indicating that the target could fail to be achieved as planned. The present situation, including installed nuclear power generation capacity at 65.9 GW as of 2014, will be maintained for the immediate future. Germany, Switzerland and Belgium have made clear their nuclear phase-out plans in response to the Fukushima accident and will eliminate nuclear power generation from 2030 to 2035. While outdated nuclear reactors are decommissioned in Europe, moves to construct new reactors are also seen. Therefore, Europe's installed nuclear power generation capacity will fall to 120 GW temporarily in 2035 and rise back later. Russia has vowed to use proactively nuclear energy at home and abroad. Its domestic installed nuclear power generation capacity in 2040 will be 56.8 GW, more than double the level of 25.2 GW for 2014.

The presence of Asia including China and India will increase more and more in nuclear power generation. China will boost its installed nuclear power generation capacity from 14.8 GW in 2014 to 114.6 GW in 2035, replacing the United States as the largest nuclear power generator in the world. Asian installed nuclear power generation capacity will reach 259 GW in 2040, surpassing the combined OECD Europe and United States capacity of 247 GW. The United Arab Emirates and Saudi Arabia will lead the Middle East to raise installed nuclear power generation capacity to 11 GW in 2025. South Africa and Brazil undertook the initiative, in their respective regions, to plan for the introduction of nuclear energy and steadily construct nuclear power plants.

Renewables

Great expectations are placed on renewable energy including solar and wind energy. Renewable energy penetration will accelerate thanks to rich resources and government incentives in some regions. But renewable energy-based electricity generation, which costs more and is intermittent depending on natural conditions, will fall short of becoming a mainstay electricity source rivalling fossil resources on a global scale (Figure 53).

Figure 53 Global renewable energy power generation (excluding hydro) [Reference Scenario]

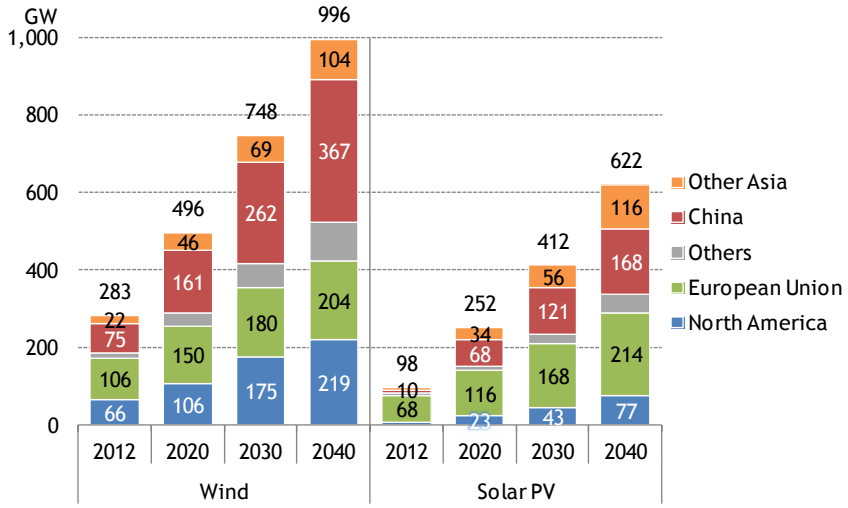


Renewable energy penetration may contribute to expanding low-carbon electricity sources, reducing dependence on energy imports and potentially holding down fossil fuel prices. Large-scale renewable energy penetration may depend on cost reduction, improved efficiency and harmonisation of renewable energy with energy systems through continuous research and development.

Through 2040, mainly offshore wind electricity generation will penetrate in Europe including Germany, Spain, Denmark and the United Kingdom (Figure 54). The penetration will also take place in China and India among Asian countries. Installed wind electricity generation capacity will increase nearly four-fold from 283 GW in 2012 to 996 GW in 2040. The penetration will accelerate particularly in Europe, Asia and North America.

The global solar photovoltaic market will continue expanding as the Asia Pacific region including Japan, China and the United States replaces Europe as market leader. Behind the rapid penetration will be government incentives. However, cost cuts through the market expansion and technological development will help accelerate the penetration. Solar photovoltaics, while still having economic efficiency problems, are seen as a useful electricity source for low-population areas where electricity infrastructure has yet to be developed. In the Reference Scenario, installed solar photovoltaic generation capacity in the world will expand six-fold from 98 GW in 2012 to 622 GW in 2040.

Figure 54 Installed wind and solar photovoltaic generation capacity in world [Reference Scenario]



Part II

China and India energy supply/demand and their impact on the world

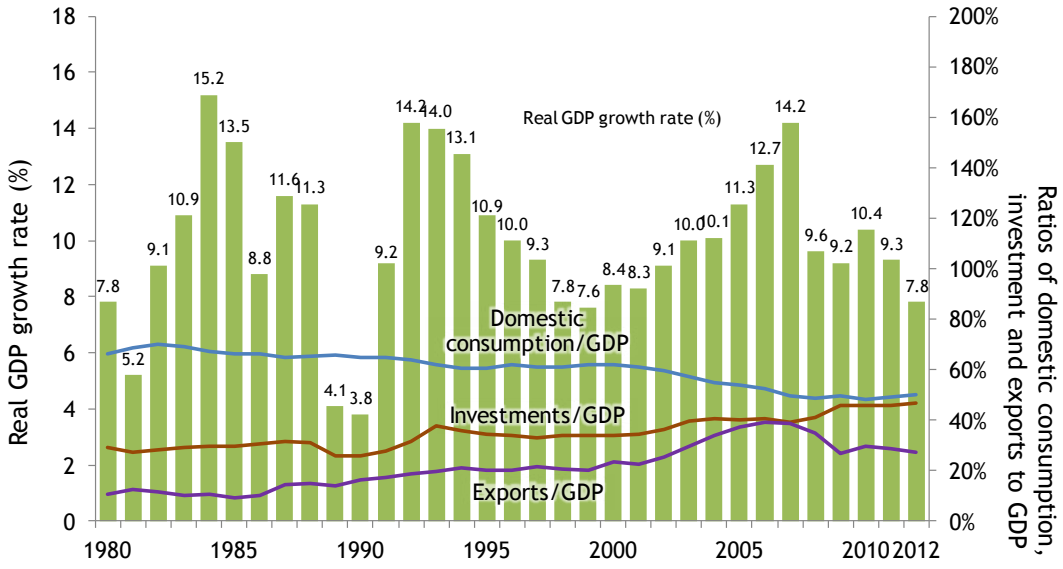
4. China energy supply and demand

4.1 Society and economy

Present situation and challenges

Since the 1980s, the Chinese economy has grown rapidly, with the annual average growth rate standing around 10% (Figure 55). Particularly since the 21st century started, China has expanded exports further on the strength of its accession to the World Trade Organization. Driven by a real estate boom and infrastructure development as well as its export expansion, China has continued rapid economic growth. As represented by rapid growth in steel and cement production, heavy and chemical industries have achieved great development so that China has become the world's largest producer of many industrial products and is called "the factory of the world." As motorisation made rapid progress in the last decade, China has become the world's largest automobile market, with both automobile production and sales exceeding 20 million units in 2013. Even after the 2008 financial crisis, the Chinese government implemented large-scale fiscal spending to expand investment, maintaining high economic growth.

Figure 55 Chinese GDP growth and economic structure



Since the Lehman Shock, however, China's export growth has slowed down due to the European and United States recession, with foreign investment into China levelling off reflecting higher labour cost. Due to some inefficient investments, local governments and businesses are facing increasing debts; the Chinese economy depends too much on the industry sector; a delay in environmental protection measures has led to serious environmental issues, including water and air pollution, and; the gap between the rich and the poor is widening. These problems have made it difficult for China to continue its traditional growth path dependent on exports and investments. China is now approaching the Lewisian Turning Point at which labour force population peaks out with birth rates falling and

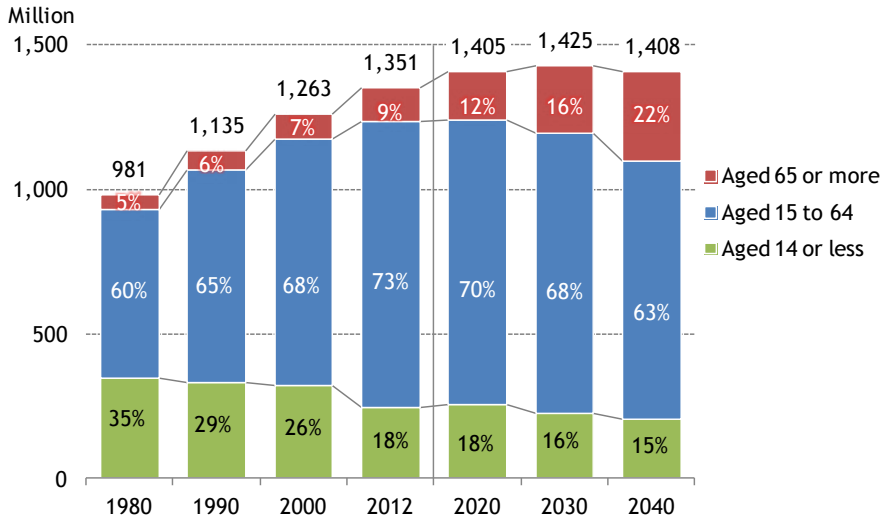
population aging fast. The Chinese government has recognised such situation and is attempting to stimulate domestic growth, shifting from quantitative expansion to qualitative improvement, restructuring the economy and upgrading its industries. The government has become tolerant of moderate economic growth, shifting from the past attitude of sticking to real GDP growth rate of 8% or more. Already, China's GDP growth slipped below 8% to a 7.5-7.9% range in 2012 and 2013.

Based on the above, this Outlook assumes China's future economy and society as follows:

Population assumption

At present, China is the world's most populated country, with a population totalling 1.35 billion. But China has lowered its birth rate by maintaining a "single child" family planning policy for more than 30 years. Population growth between 1980 and 2012 was limited to 1.0%. In assuming future population, this Outlook refers to the United Nations' median variant in "World Population Prospects: The 2012 Revision." According to the prospects, China's population will increase more moderately in the future, peak at 1.43 billion around 2030 and fall at an annual rate of 0.1% later (Figure 56). As the birth rate drop and aging make progress, the population share for young people aged 14 or less will fall from 18% in 2012 to 15% in 2040. Elderly population aged 65 or more will account for 22% of total population, a 2.5-fold increase from 9% in 2012. Working-age population will turn downward around 2015 and fall to 63% of total population in 2040 with a decline of some 100 million people from 2012.

Figure 56 Chinese population



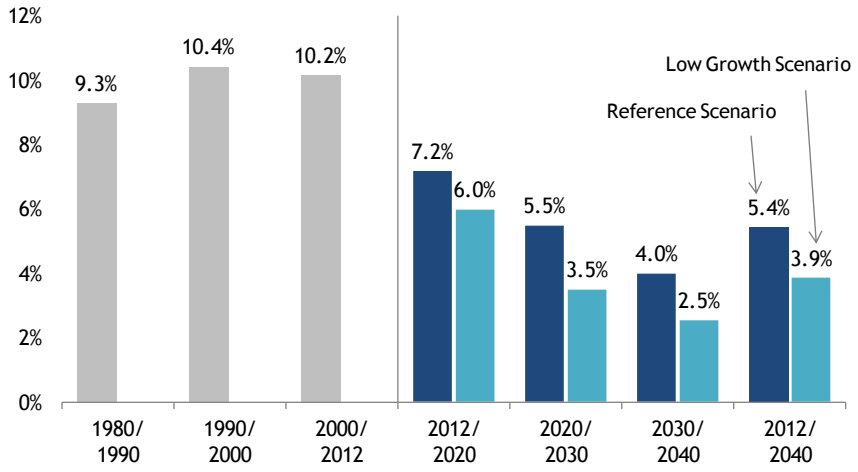
Economic assumption

China's GDP per capita in 2012 was more than 15 times larger than it was in 1980 reaching $5,200 (in 2010 dollars), and yet only one-eighth of the Japanese level. The urbanisation rate has risen from less than 30% in the 1980s to a 50-55% range, a much lower rate than the 70-80% for developed countries. China still has large room to grow even after achieving a certain level of industrialisation and after introducing advanced technologies. But the growth engine's shift from exports and investment to

domestic consumption and the disappearance of its demographic bonus are expected to reduce gradually China's growth potential.

In this Outlook, we assume that Chinese GDP will grow at an average annual rate of 5.4% between 2012 and 2040 in the Reference Scenario as China makes relatively smooth progress in industrialisation, maintains its traditional preference for high growth to some extent and proceeds with moderate economic structure adjustment. Specifically, China's annual GDP growth will fall from just below 8% at present to 6% in a restructuring period through 2020, averaging 7.2%. The annual growth rate will gradually fall to 5.5% in the 2020-2030 period and 4.0% in the 2030-2040 period, reflecting a labour force decline and a rise in the economy's dependence on domestic consumption (Figure 57). Even so, China's GDP per capita in 2040 will reach $21,800 (in 2010 dollars), approaching present levels for developed countries.

Figure 57 Chinese GDP growth



As described above, the Chinese economy has reached a major turning point. The Chinese government has given top priority to upgrading industries to mitigate a growth potential decline resulting from constraints on stable labour supply and economic structure changes. But it is uncertain whether the upgrading would achieve the objectives as planned. Growing financial risks, the deteriorating environment and the widening gap between the rich and the poor have also increased uncertainties about economic growth.

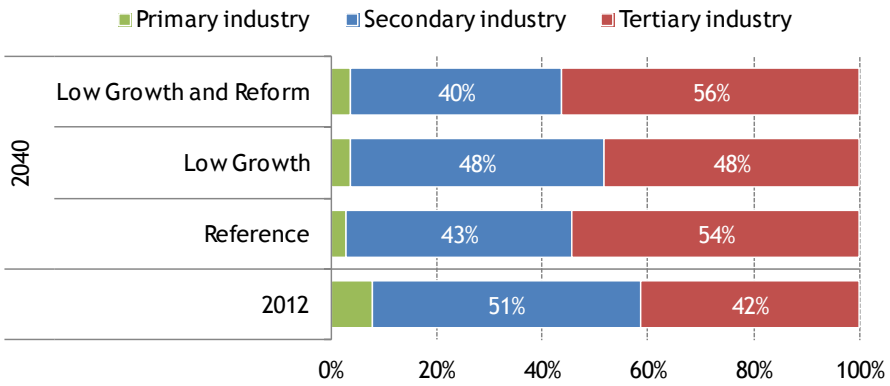
In this Outlook, we developed the Low Growth Scenario to analyse how the world economy and energy market would be affected if the adverse impacts of these problems could further lower the Chinese economic growth (Table 6). In the Low Growth Scenario, economic structure adjustment will be slower than in the Reference Scenario as China fails to make progress in reforms and to get out of the traditional dependence on investment, exports and heavy industries amid a lower economic growth path.

Table 6 Overview of Scenarios reflecting uncertainties about China's economic growth

	Reference Scenario	Low Growth Scenario	Low Growth and Reform Scenario
Overview	Continued current high economic expectations	Unintended low growth with stagnant reform	Upgrading economy and low-carbonisation under low growth
Growth rates	5.4%	3.9%	3.9%
Changes in economic structures	Gradual progress	Slower than Reference Scenario	Transforming to consumption-driven economy and enlarging service sectors
Energy policies and technologies	Backed by those have been in place so far	Same as for Reference Scenario	Promoting strongly energy security and low-carbonisation

In contrast to the Low Growth Scenario in which China will plunge into unexpectedly low growth, we can assume a scenario in which successful reform will allow China to shift to a domestic consumption-led economy and make more progress in economic structure adjustment than in the Reference Scenario while harmonising with the environment even under lower economic growth. We developed this case as the Low Growth and Reform Scenario. In this Scenario, China will realise sustainable, stable growth, make great progress in energy conservation by enhancing relevant policies and accelerate the penetration of low-carbon energy.

Figure 58 Chinese GDP by sector



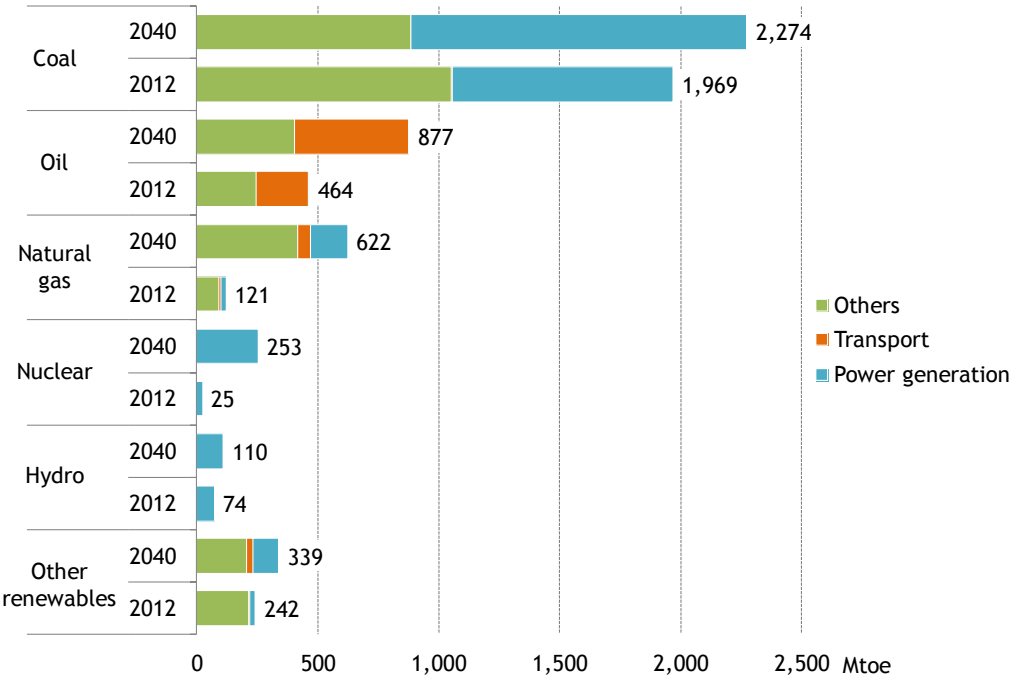
4.2 Reference Scenario

China is the world's largest energy consumer, with its primary energy consumption accounting for 2,894 Mtoe or 21.6% of the total. In the Reference Scenario, energy consumption will continue expanding mainly in the transport and buildings sectors under relatively high economic growth. Its primary energy consumption will expand at an annual rate of 1.6% to 4,474 Mtoe in 2040, up 55% from 2012. Its share of the global total will rise to 23.2% (Figure 59).

China's oil consumption will nearly double in the next three decades, reaching 877 Mtoe in 2040; by 2030, China will replace the United States as the world's largest oil consumer. Influencing the oil consumption growth will be the transport sector, more specifically road transport. China's vehicle ownership rate is currently only 80 vehicles per 1,000 of population, one-seventh of the Japanese level, indicating great growth potential for the Chinese automobile market. China's automobile fleet will expand to 370 million vehicles in 2040, increasing the transport sector's oil consumption to 2.2 times its current level. Given that no large increase in domestic oil production can be expected, China's rate of dependence on oil imports will rise from 55% at present to 78% in 2040.

China has politically promoted the penetration of natural gas as the cleanest energy source among the major fossil fuels. Given that natural gas supply sources will increase in both China and foreign countries, China's natural gas consumption will rapidly expand. By 2040, all sectors will expand natural gas consumption for a total reaching 622 Mtoe, far exceeding Japan's total energy consumption in 2012. Among the sectors, the buildings and power generation sectors will score remarkable growth. The Chinese government is promoting domestic shale gas development, but there are many challenges for developing technologies that would lower costs and respond to geological and water problems to meet the Chinese conditions.

Figure 59 China's primary energy consumption [Reference Scenario]



At present, China has the third largest nuclear power generation capacity in Asia after Japan and Korea. At the end of 2013, China was constructing 29 nuclear reactors with capacity totalling some 30 GW. The Chinese government plans to raise installed nuclear power generation capacity to more than 58 GW by 2020. China has given great priority to nuclear energy for multiple reasons including climate change, air pollution and energy security and is expected to expand further its nuclear generating capacity.

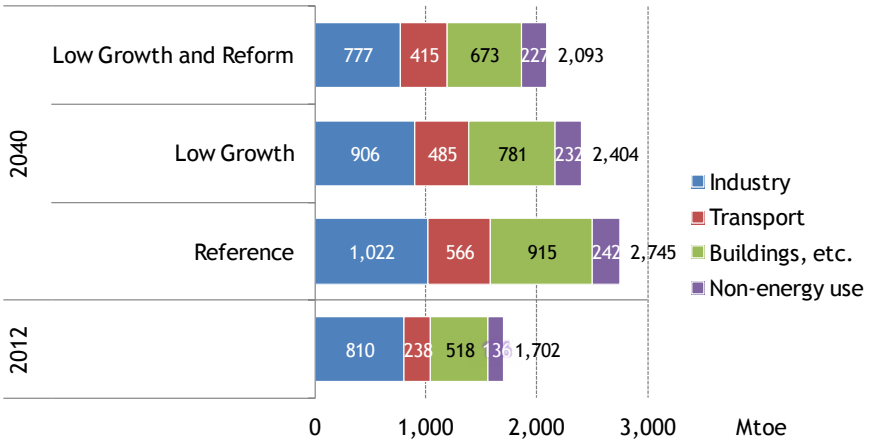
China will account for half of the increase in nuclear power generation capacity in the world between 2012 and 2040 and will become the largest nuclear power generator by 2040.

Renewable energy will account for 10% of China's primary energy consumption and 20% of its total power generation in 2040. China has the Three Gorges Dam as the world's largest hydro power plant and the large Xiluodu Dam, which power generation equipment has been just completed, boasting the biggest hydro generation capacity in the world. Symbolised by this fact, hydro accounts for most renewable energy source at present. China is also proactively expanding wind and solar photovoltaic power generation. At present, China has the world's largest wind power generation capacity. Since 2013, China has enhanced policy support for solar photovoltaic power generation and raised capacity targets several times to support solar photovoltaic power generators. In 2040, wind and solar photovoltaic power generation will be given the same priority as nuclear, hydro and natural gas-fired power generation.

4.3 Low Growth Scenario and Low Growth and Reform Scenario

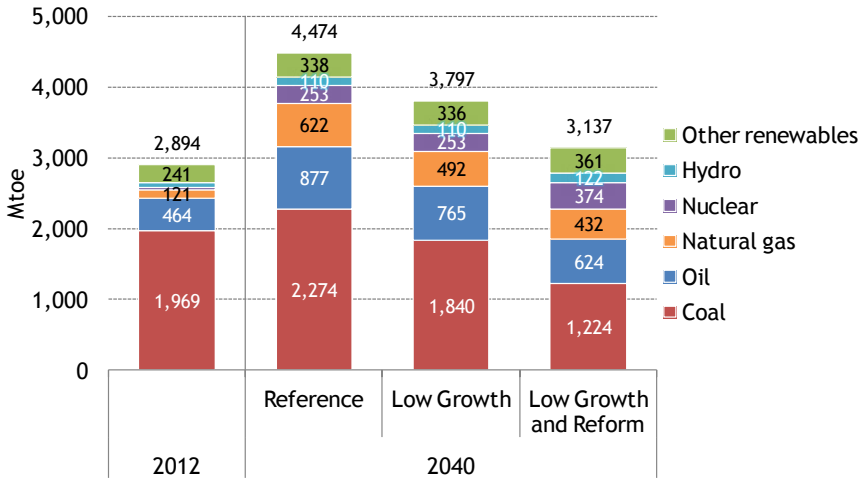
In the Low Growth Scenario in which economic growth will decelerate further with industrial restructuring failing to make smooth progress, the Chinese economy will remain dependent on investment, with the secondary industries' share of GDP being higher than in the Reference Scenario and with energy conservation investment being sluggish. The industry sector's final energy consumption in 2040 will total 906 Mtoe, only 11% or 116 Mtoe lower than in the Reference Scenario (Figure 60). As income growth decelerates, automobile ownership will be 24% less than in the Reference Scenario, with the penetration of fuel efficient vehicles failing to make progress. As a result, the transport sector's energy consumption will be 14% or 81 Mtoe less than the Reference Scenario. Energy consumption will be 15% or 134 Mtoe less than in the Reference Scenario for the buildings sector and 4% or 10 Mtoe less for non-energy use. Total final energy consumption will be 12% or 341 Mtoe less.

Figure 60 China's final energy consumption



In the Low Growth Scenario, primary energy consumption in 2040 will be 15% or 677 Mtoe less than in the Reference Scenario (Figure 61). Of the primary energy consumption, coal consumption will be 19% or 434 Mtoe less than in the Reference Scenario due to less consumption for power generation. Oil consumption will be 13% or 112 Mtoe less due to lower consumption in the transport sector. Natural gas consumption will be 21% or 130 Mtoe less due to less consumption for buildings and power generation.

Figure 61 China's primary energy consumption



In the Low Growth and Reform Scenario, China will make a smooth structural transition from the energy-intensive secondary industries to service industries under successful reform, even when the economic growth is decelerating. Labour-intensive service industries feature more employment per value added than capital-intensive manufacturing industries. Services industries in the Low Growth and Reform Scenario will be more developed than in the Low Growth Scenario, creating more employment. The loss of employment opportunities through the growth deceleration will thus be mitigated.

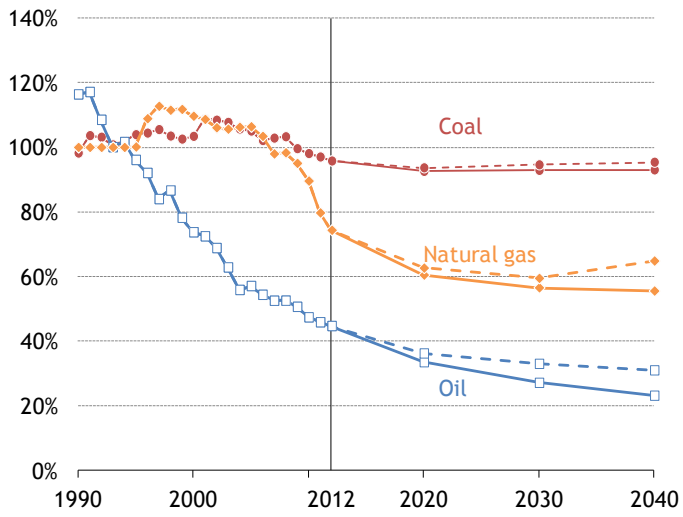
In the energy area, stronger energy and environment conservation measures will be implemented. China's final energy consumption in 2040 in the Low Growth and Reform Scenario will be 24% or 652 Mtoe less than in the Reference Scenario. Final energy consumption will be 24% or 245 Mtoe less for the industry sector, 27% or 151 Mtoe less for the transport sector and 26% or 242 Mtoe less for the buildings sector.

Primary energy consumption in the Low Growth and Reform Scenario will be 30% or 1,337 Mtoe less than in the Reference Scenario. Fossil fuel consumption will be far less due to further development of clean energy sources. Particularly, coal consumption will be 46% less, slipping far below the 2012 level. Consumption will be 29% less for oil and 31% less for natural gas. But consumption will be 47% more for nuclear, 11% more for hydro and five times more for solar photovoltaic and wind energy.

In the Low Growth and Reform Scenario, China's oil imports in 2040 will be 253 Mtoe or about 40% less than in the Reference Scenario. The oil self-sufficiency rate will be some 10 percentage points higher,

exceeding 30% (Figure 62). In the Low Growth and Reform Scenario, the natural gas self-sufficiency rate will increase from 2030 and exceed 60% in 2040. Domestic coal demand in this Scenario will be far less thanks to progress in the structural transition, energy conservation and low-carbon measures. Due to less demand, the coal self-sufficiency rate will turn upward in or after 2020. But the rate in 2040 will be less than in 2012. The improvement in the fossil energy self-sufficiency rate will contribute to enhancing China's energy security, curbing national wealth outflow through energy imports and easing the supply-demand balance in the international energy market.

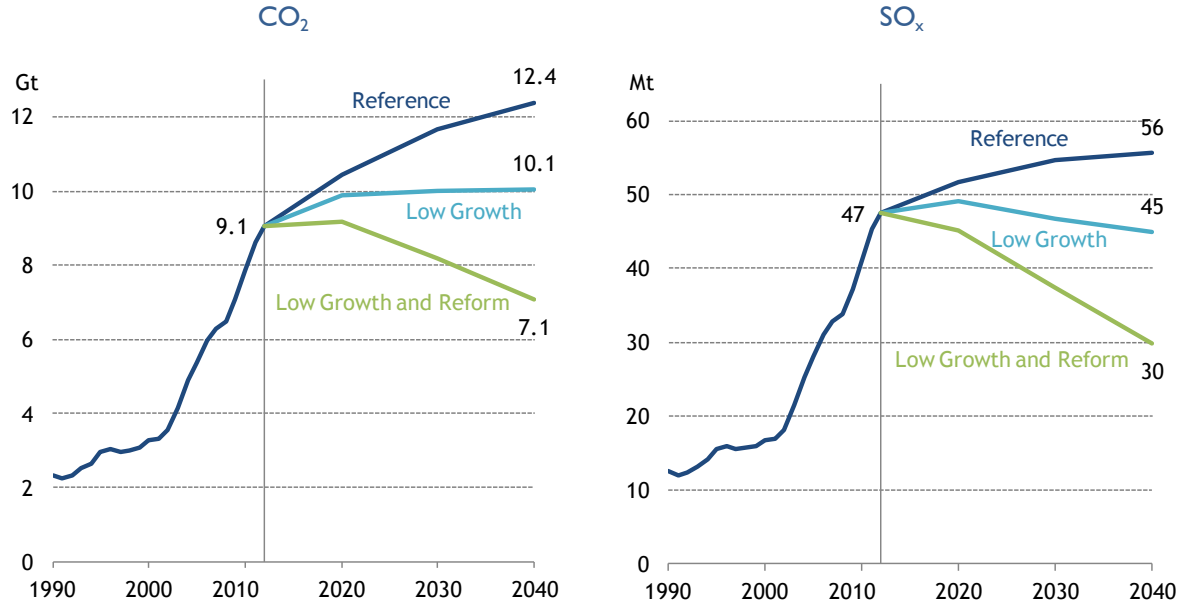
Figure 62 China's fossil fuel self-sufficiency rates



Note: The solid lines are for the Reference Scenario and the dashed lines for the Low Growth and Reform Scenario.

At the same time, less fossil fuel consumption including coal will contribute to improving air pollution and climate change problems. Energy-related carbon dioxide (CO_2) and sulphur oxide (SO_x) generation will be 43% and 46% less than in the Reference Scenario, respectively, posting substantial declines from 2012 (Figure 63).

Figure 63 China's energy-related CO_2 emissions and SO_X generation



5. India energy supply and demand

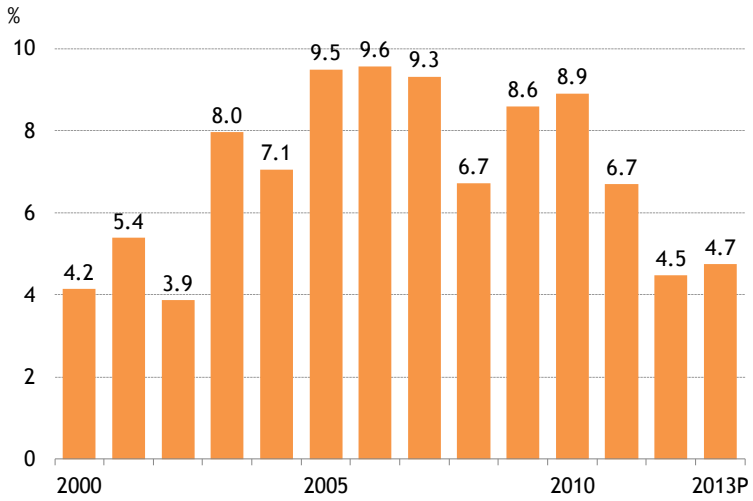
5.1 Society and economy

Present situation and challenges

India has attracted global attention by maintaining high economic growth along with China after the Lehman Shock while many other emerging countries decelerated growth. In terms of purchasing power parity, India is now the world's third largest economy after the United States and China.

Over recent years, however, the economic growth of India has been slowing down. Between 2000 and 2010, India achieved the highest economic growth since its independence in 1947, with annual growth rates rising above 8.0%. But its real GDP growth (in FY2004/2005 prices on a preliminary report basis[1]) in FY2013 was as low as 4.7% following 4.5% in FY2012 (Figure 64). These growth rates were the lowest in some 10 years.

Figure 64 Indian GDP growth

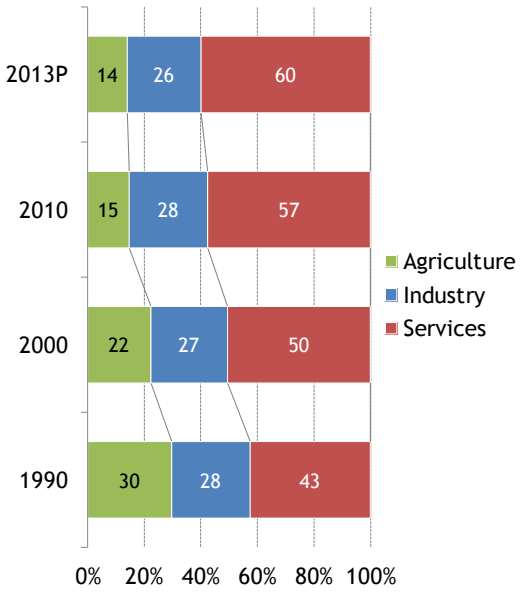


Note: Fiscal year data in FY2004/2005 prices. P for preliminary data.
Sources: Planning Commission, Government of India

While the services sector, accounting for 60% of GDP, scored a high growth rate of 7.0%, the industry sector, capturing a little more than 20% of GDP, posted a low growth rate of 0.7% (Figures 65 and 66). One of the factors behind the low growth over recent years is a demand decline caused by the European sovereign debt crisis since FY2012.

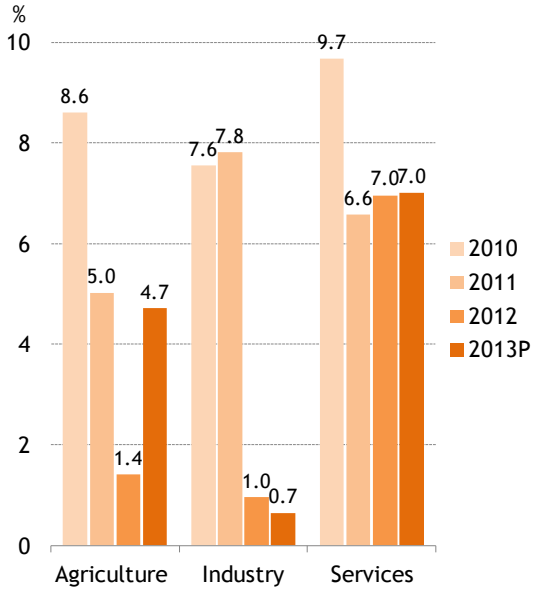
[1] Planning Commission, Government of India "Data-book Compiled for use of Planning Commission 3rd July, 2014"

Figure 65 Indian GDP by sector



Source: Planning Commission, Government of India

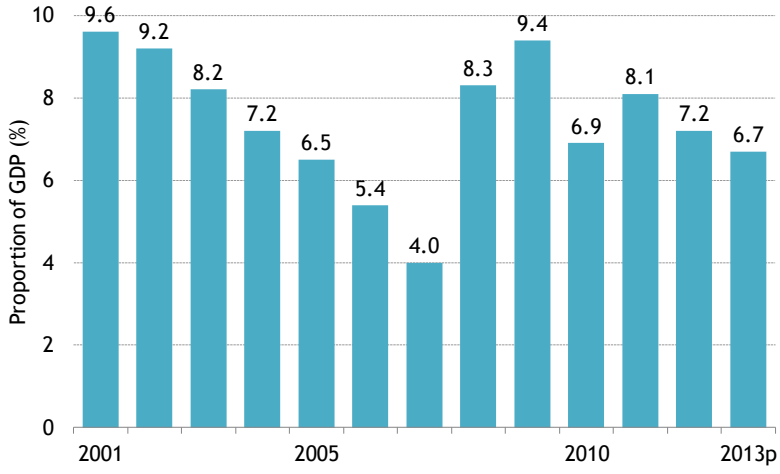
Figure 66 Indian real GDP growth by sector



Note: In FY2004/2005 prices on a fiscal year basis
Source: Planning Commission, Government of India

The swelling budget deficit is the largest challenge for the Indian economy. The budget deficit as proportion of GDP reached 10% in the 2000s and shrank in line with economic growth before expanding again in response to the Lehman Shock. In FY2013, the percentage was still as high as 6.7% (Figure 67).

Figure 67 Indian budget deficit (as proportion of GDP)



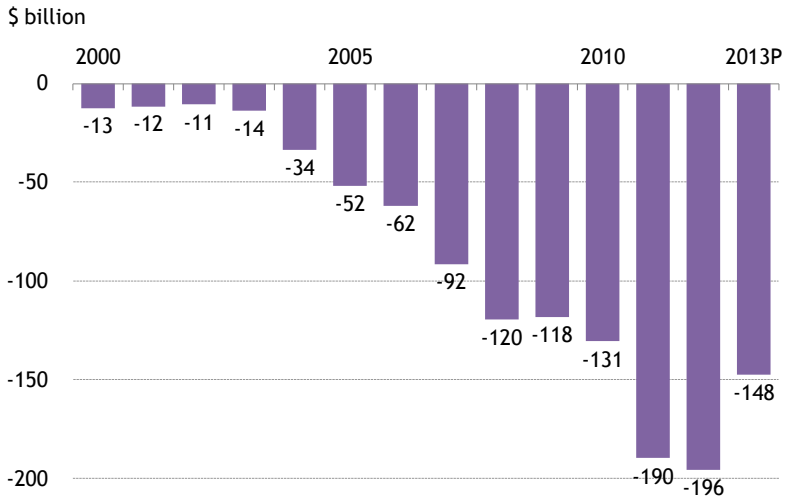
Note: The budget deficit covers central and state governments budgets.
Source: Planning Commission, Government of India

During a period of low tax revenue growth, India has provided a wide range of daily necessities to citizens under poverty reduction programs. Chronic electricity shortages have also helped expand the

budget deficit. In India, blackouts are frequent even in metropolitan areas, indicating very poor electricity supply conditions. Electricity consumption per capita in India is far less than in other Asian emerging countries plagued with poor electricity supply conditions. The government has provided subsidies to promote electricity consumption, while increasing its budget deficit.

The second challenge for the Indian economy after the budget deficit is the expanding international trade deficit. In 2012, India's trade deficit hit an all-time high of $196 billion (Figure 68). The largest factor behind the rising trade deficit was the Indian rupee's depreciation that inflated import prices. India's domestic demand has been increasing through economic development and population growth, prompting imports from China and other countries to expand. India also depends heavily on fossil fuel imports, which account for 40% of the total import value. Most of India's crude oil and petroleum product imports come from the Middle East. In addition to the rupee's depreciation, rises in international energy prices have been a factor behind the expanding trade deficit over recent years.

Figure 68 Indian international trade balances



Source: Planning Commission, Government of India

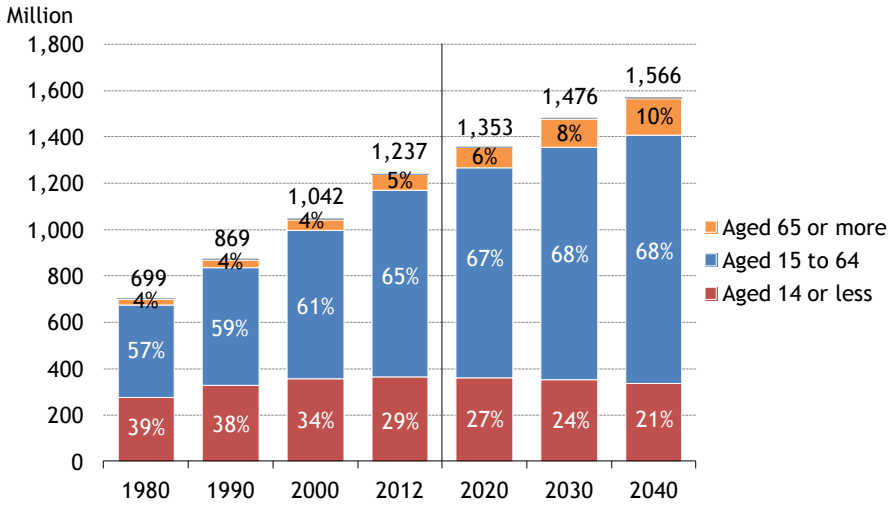
If the economy stagnates, the government and enterprises will fail to create sufficient jobs for rural young people, resulting in slower labour force growth. Such situation will cause a slump in industry and agriculture and increase social unrest, leading to a delay in infrastructure development. In many major economic powers including Japan, government and business sectors promoted economic development by providing good jobs to rural workers plagued with poverty. Sufficient infrastructure development and effective utilisation of the demographic bonus will be the key to supporting the demand side of the future Indian economy.

Supporting the supply side will be investment that meets demand. In the Low Growth Scenario, supply side investment including subsidies and employment policies will make less progress than in the Reference Scenario. Over the next three decades, therefore, India will remain structurally vulnerable to inflation and to current account deficit. A priority challenge will be the government's maintenance of momentum to break free from inflation and current account deficit.

Population assumption

India's population totalled 1.24 billion in 2012, the second biggest in the world after China's. India differs from China in that the Indian population includes more young people and will continue increasing. India will replace China as the world's most populated country by 2030 and boost its population to 1.57 billion by 2040 (Figure 69). Even in 2040, elderly (65-year-old and older) people's share of the total population will still be limited to 10%, meaning that the Indian population will continue to increase further later. According to the United Nations' median variant, the Indian population will peak around 2065 before declining moderately. Until the end of the 21st century, the Indian population will remain 1.5 billion to 1.6 billion.

Figure 69 Indian population



Economic assumption

While the Indian economy is now weakening, the policies of the Narendra Modi administration inaugurated in May 2014 are expected to induce the economy onto a high growth path over a medium term. In July, the new administration released a FY2014 budget proposal, its first one. Under the Modi administration, India may give priority to development and attract manufacturing industries under the slogan of "Make in India," promoting urban development focusing on the power generation and transport sectors.

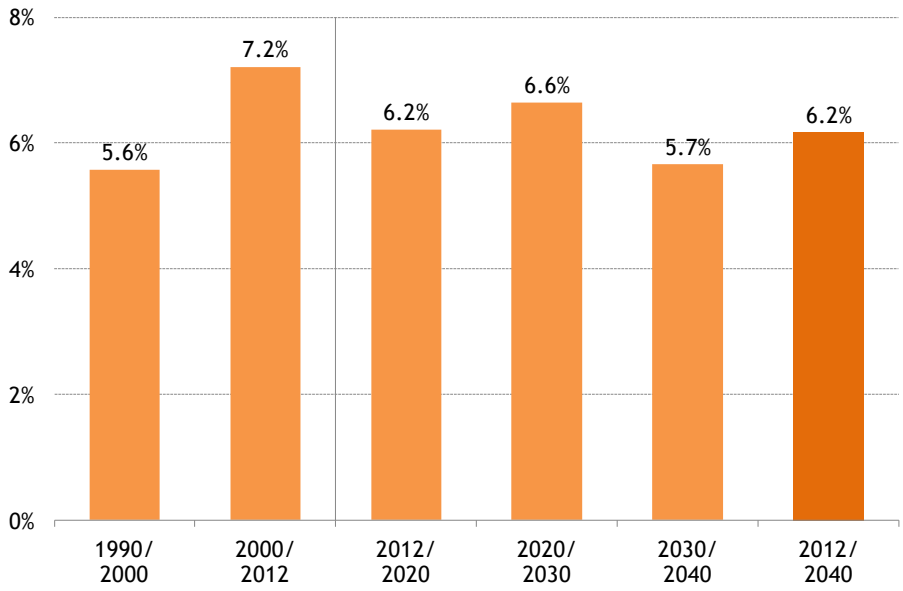
An impediment to free competition in India is the license system under which private enterprises must obtain government licenses to expand into new businesses. The investment climate deterioration has affected power generation and other sectors. The new administration is expected to promote electrification and blackout prevention and establish a stable electricity supply system by deregulating foreign investment and attracting foreign companies for industrial development. Prime Minister Modi successfully implemented an electricity reform in Gujarat when he served as Chief Minister of the state. The key point is whether he could build on the experience to spread the reform throughout India. If the electricity reform is realised, the Indian economy may develop further.

In the transport sector, India will develop expressways, bullet train lines under a high-speed railway project, and large bus terminals. It is expected to promote the Delhi-Mumbai Industrial Corridor Project that has been delayed but has attracted Japanese investment. The transport sector infrastructure development also covers an agriculture reform for rural regions that account for 70% of the total India population. The development will contribute to reducing poverty.

India is expected to improve the painful, chronic budget deficit by proceeding with fiscal consolidation under the new Fiscal Responsibility and Budget Management Act. There is a plan to repeal government subsidies in energy and other areas that have been cited as a major factor behind the budget deficit expansion. The FY2014/2015 budget proposal, released after the inauguration of the Modi administration, vowed to implement the previous administration's pledge to cut the budget deficit as proportion of GDP to 4.1% in the fiscal year and maintain its medium-term fiscal plan later.

In the Reference Scenario, policies are assumed to securely produce effects. The economy is assumed to grow at an annual rate of 6.2% through 2040, continuing high growth (Figure 70). India's economic size will account for 7% of the world economy in 2040, meaning that the country will expand its presence in the world economy over the next three decades.

Figure 70 Indian GDP growth [Reference Scenario]



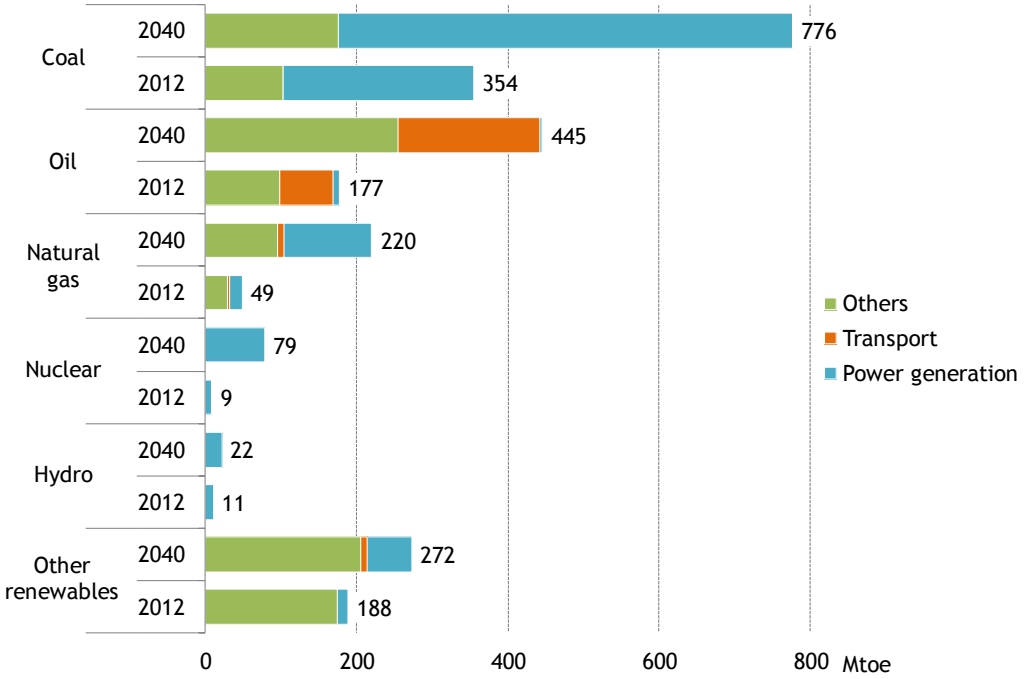
Tertiary industries including the information and communications sector, which account for 60% of GDP, will continue expanding, driving the Indian economy. Agriculture now captures a little more than 10% of GDP and will reduce its presence over a long term. Manufacturing industries are not expected to grow as much as services industries. However, a factor behind the present inflation in India is that supply cannot catch up with domestic demand that is increasing in line with economic development. Contributing to overcoming this weakness will be the development of manufacturing industries. India has followed a unique economic development path in which service industries have

developed ahead of manufacturing industries. But the economy cannot absorb labour force with services industries' development alone. In the Reference Scenario, the government will steadily enhance manufacturing to secure job opportunities and introduce advanced technologies.

5.2 Reference Scenario

As of 2012, India was the world's third largest energy consumer after China and the United States. Its energy consumption totals 788 Mtoe, 1.7 times as much as Japan's consumption and roughly equal to the combined consumption of the United Kingdom, France and Germany. As in China, the largest energy source in India is coal, but India differs from China because 71% of India's coal consumption is accounted for by the power generation sector. As electricity demand grows fast in India, coal consumption will expand rapidly (Figure 71).

Figure 71 India's primary energy consumption [Reference Scenario]



The second largest energy source is renewable energy (excluding hydro) accounting for 188 Mtoe of primary energy consumption in 2012. Most (93%) renewable energy is used in residential and industry in the final consumption sector. Almost all of the renewables are non-commercial biomass including firewood and manure. Biomass consumption has grown at a slower pace than other energy sources. As a result, non-hydro renewable energy's share of primary energy consumption shrank from 33% in 2000 to 24% in 2012. As living standards improve, non-commercial biomass energy's share of total energy consumption will decline. Meanwhile, renewable energy power generation including wind power generation will make progress.

Oil and natural gas consumption, though less than coal consumption, also continued expanding rapidly. Oil consumption has far exceeded domestic production and India's oil self-sufficiency rate fell from 58% in 1990 to 33% in 2000 and 24% in 2012. As oil demand expands to meet the transport sector's

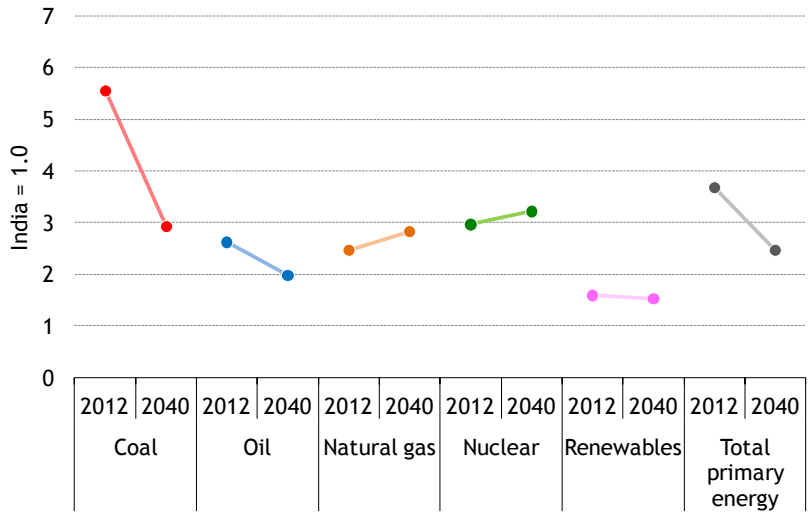
growth that accompanies an automobile ownership increase, India's oil self-sufficiency rate will substantially decline to around 7%.

Natural gas, though capturing the smallest share of total energy consumption among fossil fuels, has scored the fastest demand growth between 2000 and 2011. India used to be self-sufficient in natural gas but since the mid-2000s, it began importing natural gas as domestic gas field development failed to make progress. In 2012, natural gas consumption declined temporarily due to supply shortages. In the future, India will further expand its LNG imports to meet fast-increasing natural gas demand.

India's total primary energy consumption will increase at an annual rate of 3.0% from 788 Mtoe in 2012 to 1,814 Mtoe in 2040. The growth rate will be remarkably faster than the global average of 1.3%, boosting India's share of global primary energy consumption from 6% to 9%.

In 2012, China's primary energy consumption stood at 2,894 Mtoe, about 3.7 times as much as India's. The ratio will decline as India expands energy consumption faster than China and the ratio will stand at 2.5 times in 2040, indicating a wide energy consumption gap between the two countries (Figure 72). The coal consumption ratio will remarkably fall from 5.6 times in 2012 to 2.9 times in 2040 as China's consumption expansion decelerates with India's growth remaining rapid.

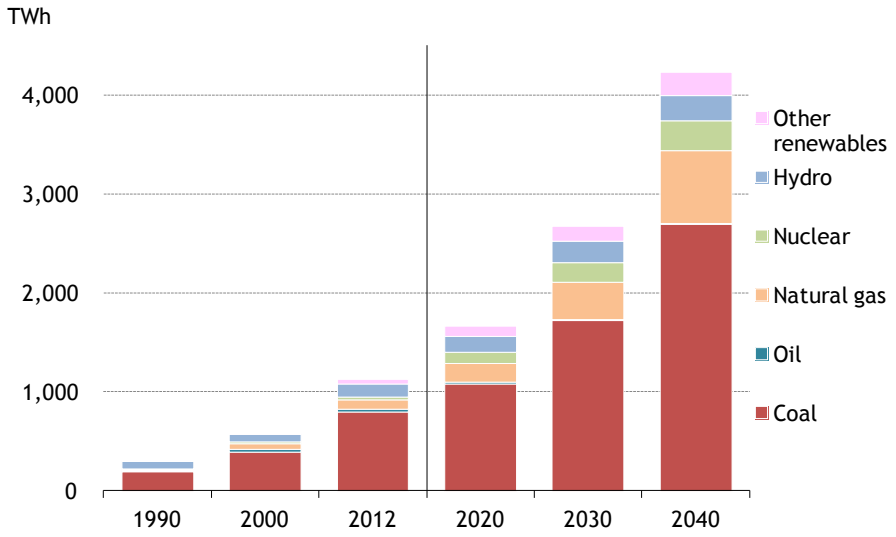
Figure 72 Ratio of China's energy consumption to India's [Reference Scenario]



As electricity demand grew rapidly in recent years, electricity supply remained short with frequent blackouts. As electricity demand continues to increase rapidly in the future, electricity generation will rise at an annual rate of 4.8% from 1,128 TWh in 2012 to 4,230 TWh in 2040 (Figure 73). Coal's share of electricity generation will stand at 64% in 2040 against 71% in 2012, indicating that coal will remain the largest electricity source. Natural gas consumption for electricity generation will expand, focusing on imported LNG, and natural gas's share of electricity generation will rise from 8% in 2012 to 17% in 2040.

Since an early stage after World War II, India's nuclear energy research and development aimed to utilise rich domestic thorium resources and establish a thorium cycle different from the uranium-plutonium cycle that has been used widely in the world. Therefore, most existing nuclear facilities are relatively small and use heavy water. For the last decade, however, India has introduced large light water reactors using foreign technologies, indicating that installed nuclear power generation capacity will expand rapidly. Nuclear's share of electricity generation will increase from 3% in 2012 to 7% in 2040.

Figure 73 India's power generation mix [Reference Scenario]



Renewable energy power generation has expanded in India, focusing on wind power generation. India's installed wind power generation capacity totalled 18 GW in 2012, making the country the fifth largest wind power generator in the world after China, the United States, Germany and Spain. In the Reference Scenario, wind power generation capacity will expand to 79 GW in 2040. Solar photovoltaic capacity will reach 17 GW close to the present wind power generation capacity. Due to overall power generation's rapid growth, however, the share for renewable energy power generation excluding hydro generation will be limited to 6% in 2040.

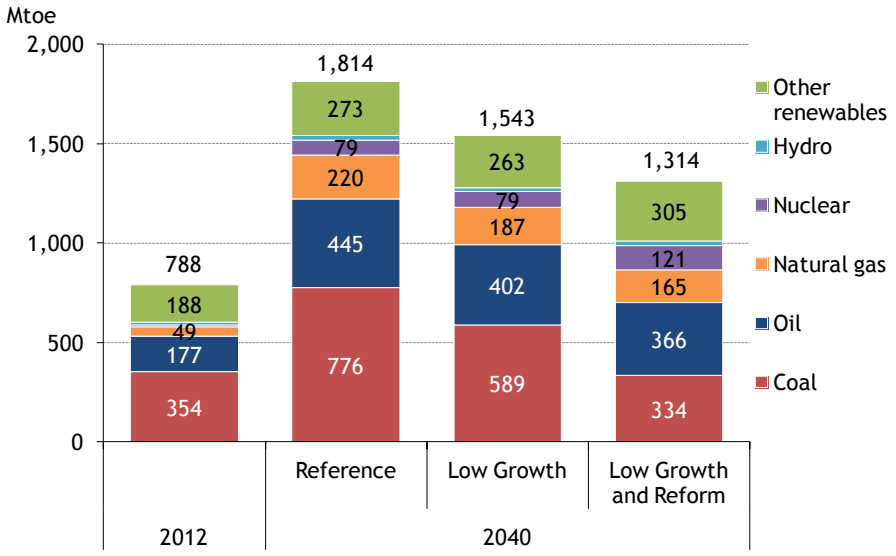
5.3 Low Growth Scenario and Low Growth and Reform Scenario

In the Low Growth Scenario, India's energy consumption in 2040 will total 1,543 Mtoe, 15% less than in the Reference Scenario (Figure 74). In the Low Growth and Reform Scenario where energy conservation technologies will penetrate greatly even under lower economic growth, energy consumption will come to 1,314 Mtoe, 501 Mtoe or 28% less than in the Reference Scenario. The gap is 10% more than Japan's current primary energy consumption. Compared with the Reference Scenario, coal consumption in India will be 24% less in the Low Growth Scenario and 57% less in the Low Growth and Reform Scenario. The respective percentages will be 10% and 18% for oil and 15% and 25% for natural gas. Fossil fuel consumption in the Low Growth Scenario and the Low Growth and Reform

Scenario will thus be far less than in the Reference Scenario. Particularly, coal consumption will indicate large gaps between the Scenarios.

Fossil fuels' share of primary energy consumption will rise from 74% in 2012 to 79% in 2040 in the Reference Scenario. In the Low Growth Scenario, the share in 2040 will be limited to 76%. In the Low Growth and Reform Scenario, the fossil fuel share will decline due to expanding nuclear and renewable energy, but it will remain high at 66% in 2040. In any Scenario, India will thus depend on fossil fuels for the majority of energy needs through 2040.

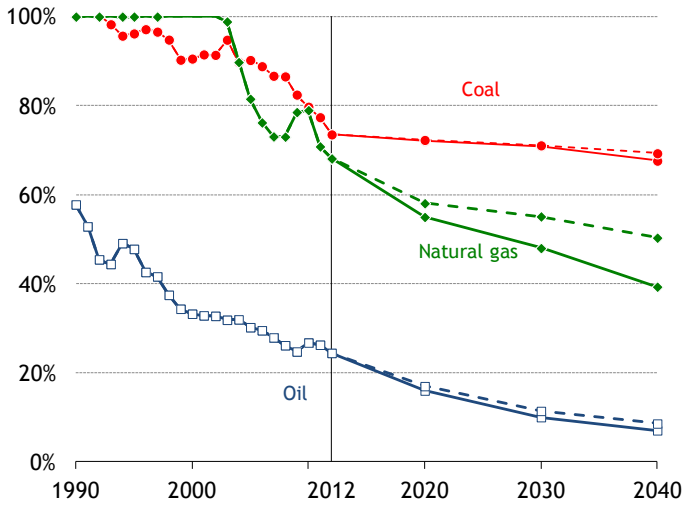
Figure 74 India's primary energy consumption



Compared with the Reference Scenario, energy consumption in the Low Growth Scenario will be 16% less in the industry sector, 6% less in the transport sector and 13% less in others (including the buildings sector). Energy consumption will decline in the industry sector due to the economic deceleration and it will drop in other sectors because of modest private spending, which will also affect the mobile phone and information technology sector. A slump in the automobile and motorcycle market will work to cut oil consumption in the transport sector by 11 Mtoe from the Reference Scenario. The cut amounts to Taiwan's present oil consumption in the transport sector. In the Low Growth and Reform Scenario, the transport sector's oil consumption will decline by an additional 19 Mtoe due to improved fuel efficiency.

The energy self-sufficiency rate in the Low Growth and Reform Scenario will be higher than in the Reference Scenario because of less fossil fuel consumption (Figure 75). India's fossil fuel self-sufficiency rates have continued declining, standing at 24% for oil, 68% for natural gas and 74% for coal in 2012. These rates will further continue decreasing through 2040 in the Reference Scenario, reaching 7%, 39% and 68%, respectively. In the Low Growth and Reform Scenario, fossil fuel self-sufficiency rates will decline more slowly to 9% for oil, 50% for natural gas and 69% for coal in 2040.

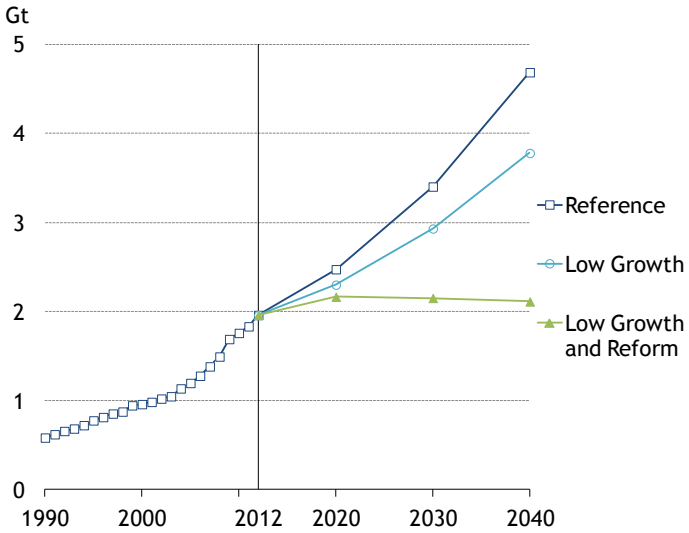
Figure 75 Indian fossil fuel self-sufficiency rates



Note: The solid lines are for the Reference Scenario and the dashed lines for the Low Growth and Reform Scenario.

India's energy-related CO_2 emissions will more than double from 2.0 Gt in 2012 to 4.7 Gt in 2040 in the Reference Scenario (Figure 76). In the Low Growth Scenario, emissions in 2040 will be 19% less than in the Reference Scenario, at 3.8 Gt. In the Low Growth and Reform Scenario in which energy conservation and low-carbon technologies will make further advancement, emissions in 2040 will total 2.1 Gt, 55% less than in the Reference Scenario and slightly more than at present.

Figure 76 Indian energy-related CO_2 emissions



In the Low Growth and Reform Scenario, however, very ambitious technological advancement is assumed, including the penetration of CCS systems for all coal- and natural gas-fired power plants going into operations in or after 2030. It will actually be difficult to achieve fully such technological advancement. If CCS systems fail to penetrate, CO_2 emissions in 2040 will be 2.6 Gt, meaning that

emissions will continue expanding without CCS systems even if low growth is combined with technological advancement. In all cases, economic stagnation will lower CO_2 emissions less than technological innovation. The penetration of advanced technologies will thus be indispensable for reducing emissions substantially.

6. Impacts of lower demand in China and India on the world

6.1 Oil

Production

Table 7 indicates global oil supply and regional crude oil production in the Low Growth and Reform Scenario. Oil supply in 2040 will total 109.7 Mb/d, 6.8 M/b less than 116.5 Mb/d in the Reference Scenario, reflecting a consumption decline in China and India. As the world's crude oil market is integrated into one, an oil consumption decline from those specific countries will affect oil suppliers throughout the world. Under this assumption, oil production in the Low Growth and Reform Scenario is projected based on each supply source's resource potential, production costs and development policies.

Table 7 Global oil supply [Low Growth and Reform Scenario]

(Mb/d)

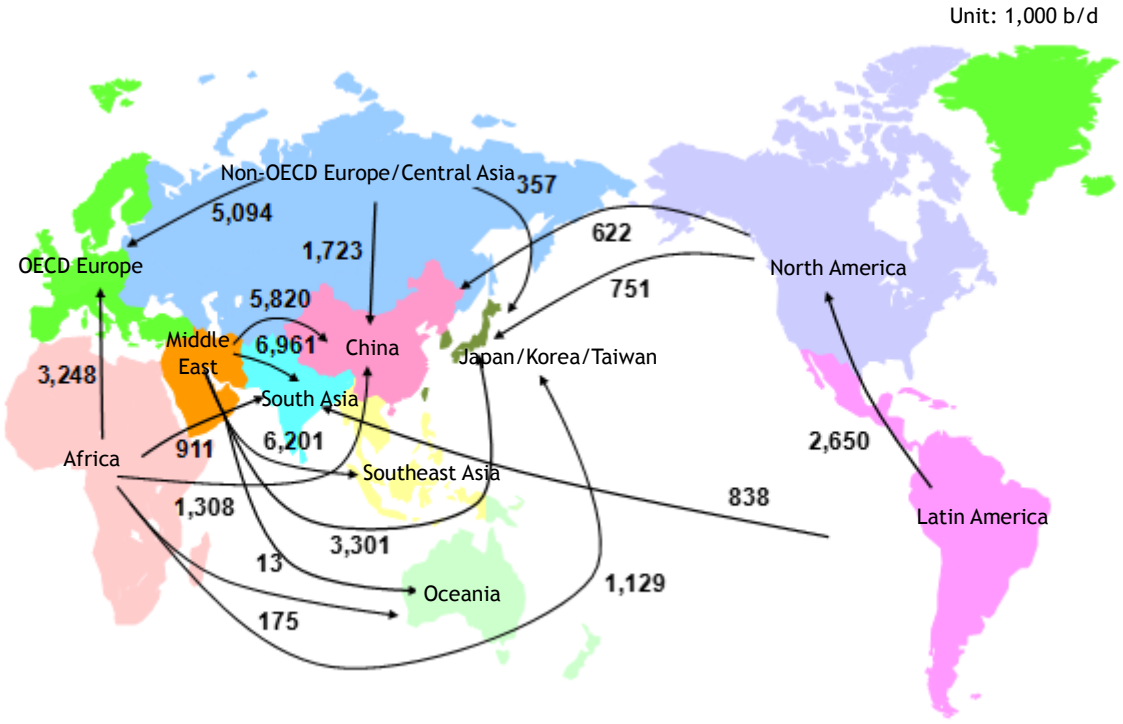
	2012	2020	2030	2040	Changes over 2012-2040
Total supply	89.3	93.9	102.8	109.7	20.4
OPEC	37.5	37.1	42.7	49.3	11.8
Middle East	26.9	26.6	31.4	36.4	9.4
Others	10.6	10.6	11.3	12.9	2.3
Shale oil	-	-	0.4	0.3	0.3
Non-OPEC	49.6	54.3	57.1	56.9	7.3
North America	12.8	16.5	16.9	16.3	3.5
Shale oil	2.0	3.6	3.6	3.0	1.0
Latin America	7.1	8.6	9.9	10.7	3.6
Shale oil	-	0.2	0.4	0.4	0.4
Europe and former Soviet Union	17.4	16.5	17.7	17.6	0.2
Shale oil	-	0.3	0.6	0.6	0.6
Middle East	1.5	1.5	1.4	1.4	-0.1
Africa	2.4	2.8	2.9	3.0	0.6
Asia	7.9	7.9	7.6	7.3	-0.7
China	4.2	4.3	4.2	4.0	-0.2
Shale oil	-	0.5	0.6	0.6	0.6
Indonesia	1.0	0.9	0.8	0.8	-0.2
India	0.9	0.8	0.7	0.7	-0.3
Others	2.4	2.6	2.7	2.6	0.3
Oceania	0.5	0.6	0.7	0.7	0.2
Shale oil	-	0.1	0.2	0.3	0.3
Processing gains	2.2	2.5	3.0	3.5	1.3

Trade

Figure 77 indicates global crude oil trade flows resulting from the production projection. Global crude oil trade in 2040 will total 43.2 Mb/d, down 5.7 Mb/d from 48.9 Mb/d in the Reference Scenario. China's crude oil imports will be down 2.5 Mb/d from the Reference Scenario. The decline is smaller than the fall in consumption because China not only imports crude oil but petroleum products as well. India's imports will be down 1.4 Mb/d from the Reference Scenario. The decline is almost equal to the

consumption drop. As regions exporting petroleum products to China and India reduce crude oil production, crude oil trade flows for other countries than China and India will also be affected. Therefore, the decline in global crude oil trade will be greater than the consumption drop in China and India.

Figure 77 Crude oil trade flows between major regions [Low Growth and Reform Scenario, 2040]



China's crude oil import mix will not change so much from the Reference Scenario. But the degree of its dependence on the Middle East for oil supply in the Low Growth and Reform Scenario will rise from 55% in the Reference Scenario to 61%. The Middle East with various types of crude oil and greater transport cost advantage will obtain a greater share of the shrinking Chinese market than other oil producing regions. In contrast, the Former Soviet Union including Russia will see its Chinese market share shrinking from the Reference Scenario. This is because the region produces oil similar to Middle East oil and will continue to give priority to supply to Europe while cutting production.

India's crude oil import mix will also remain unchanged. The decline in supply from Latin America will be relatively small because oil refineries with excellent cracking facilities for heavy crude oil, such as Reliance and Essar, will continue to give refining priority to heavy, low-cost crude, while investment in refining capacity will be curbed in line with a consumption drop.

No remarkable change will be seen from the Reference Scenario in crude oil import mixes in Japan, Korea and Taiwan. But their petroleum product exports will decline in line with the Chinese oil consumption drop, leading their crude oil refining to decrease. Therefore, their crude oil imports will decline by 0.2 Mb/d from the Reference Scenario.

6.2 Natural gas

Production

In the Low Growth and Reform Scenario, natural gas consumption in China, in 2040, will drop to 525 Bcm (or 69% of the Reference Scenario level) and in India it will be 201 Bcm (or 75% of the Reference Scenario level). In this Scenario, global natural gas production will be 296 Bcm less than in the Reference Scenario due to the lower natural gas demand in China and India (Table 8).

Table 8 Global natural gas supply [Low Growth and Reform Scenario]

(Bcm)

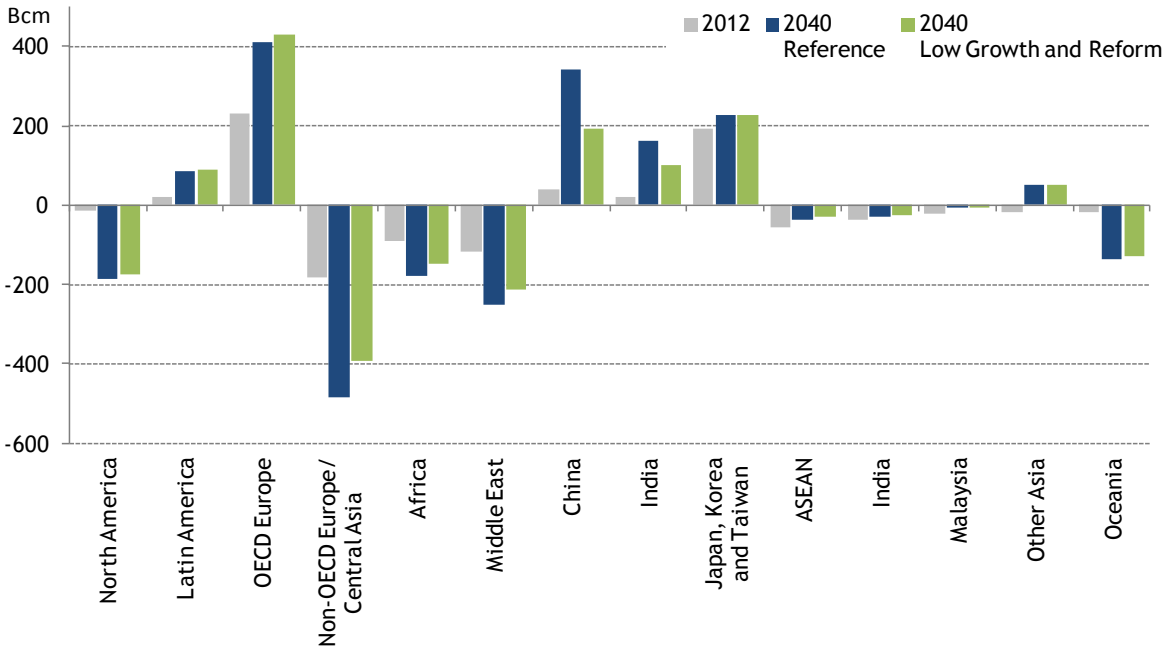
	2012			2040			Changes over 2012-2040	
		Unconven-tional	Unconven-tional		Unconven-tional	Unconven-tional		Unconven-tional
North America	838	414	49%	1,208	906	75%	370	492
Latin America	220	-	-	453	126	28%	233	126
Middle East	529	-	-	906	26	3%	377	26
OECD Europe	276	-	-	210	11	5%	-66	11
Non-OECD Europe/Central Asi	873	-	-	1,219	52	4%	346	52
Africa	211	-	-	488	89	18%	277	89
China	107	-	-	339	112	33%	232	112
India	40	-	-	101	29	29%	61	29
ASEAN	209	-	-	388	80	21%	179	80
Indonesia	77	-	-	134	22	16%	57	22
Malaysia	61	-	-	90	9	10%	29	9
Other Asia	74	-	-	92	-	-	18	-
Australia	61	7	11%	177	88	49%	116	81
World	3,438	421	12%	5,582	1,517	27%	2,144	1,097

China's natural gas production in this Scenario will grow at an annual rate of 4.0-4.5% against 4.5-6.0% in the Reference Scenario due to slower domestic demand growth and will total 339 Bcm in 2040, 79 Bcm less than in the Reference Scenario. India's production in this Scenario will not change much from the Reference Scenario as a demand decline from the Reference Scenario offsets an import drop. Production in non-OECD Europe/Central Asia as a major natural gas import source for China will be as much as 92 Bcm less than in the Reference Scenario.

Trade

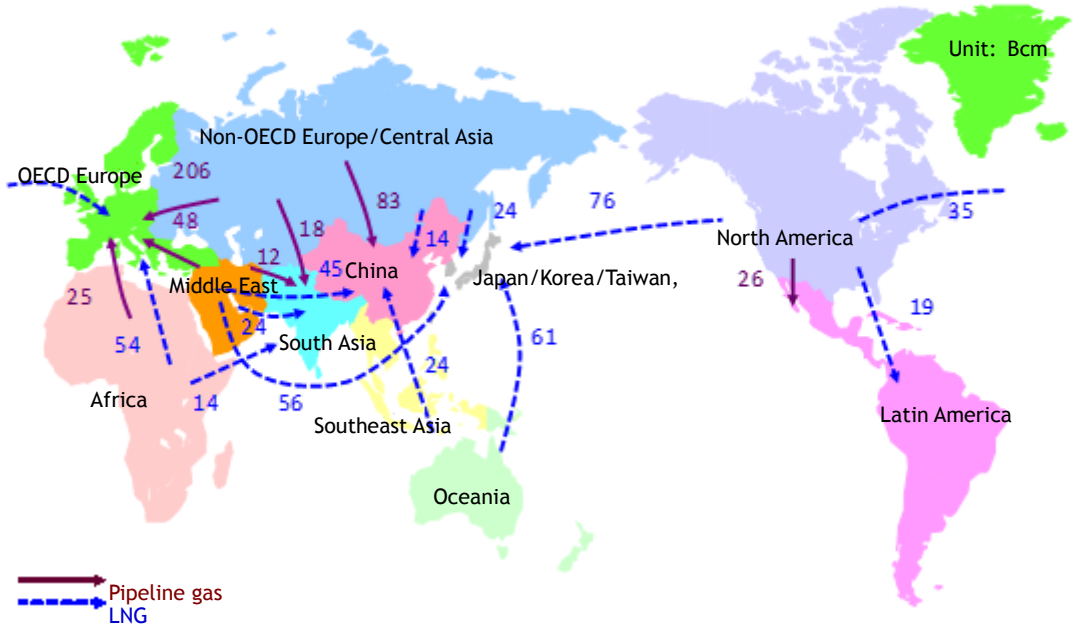
Even if natural gas demand growth is slower, China and India will refrain from lowering their natural gas production as much as indicated by slower demand growth from the viewpoint of improving supply security through less dependence on imports. As a result, demand growth deceleration in the two countries will have a great impact on imports. Net natural gas imports in 2040 in this Scenario will be limited to 192 Bcm in China and 100 Bcm in India, far less than in the Reference Scenario (Figure 78).

Figure 78 Net natural gas imports in world [Reference and Low Growth and Reform Scenarios, 2040]



As a result, non-OECD Europe/Central Asia and the Middle East, which are assumed to substantially expand natural gas exports to the two countries in the Reference Scenario, will limit their exports to Asia in the Low Growth and Reform Scenario (Figure 79). Particularly, pipeline gas supply to China from non-OECD Europe/Central Asia will be limited to 83 Bcm, meaning that only 30% of the region's total exports will head for Asia. Under such situation, countries in the region may intensify their competition for exports to other Asian countries including Japan, as well as Europe.

Figure 79 Natural gas trade flows between major regions [Low Growth and Reform Scenario, 2040]

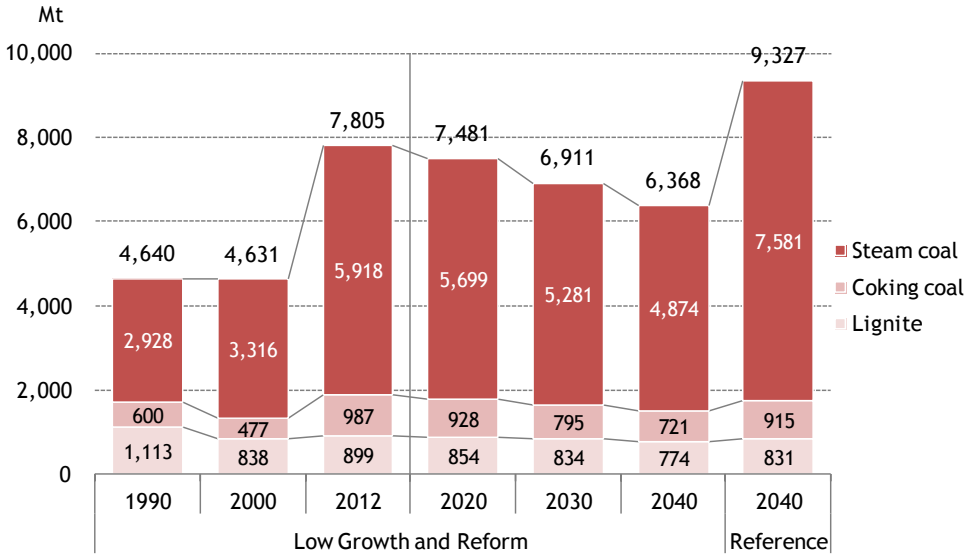


6.3 Coal

Production

In the Low Growth and Reform Scenario, steam and coking coal demand will substantially decline in China. India's steam and coking coal supply and demand will peak out around 2020 before slipping a little below the present level in 2040. As a result, global coal production will decline at an annual rate of 0.7% from 7,805 Mt in 2012 to 6,368 Mt in 2040, 82% of the production in 2012. The production in 2040 will be 2,959 Mt less than in the Reference Scenario. Steam coal production will decline by 1,047 Mt from 5,918 Mt in 2012 to 4,874 Mt in 2040 (2,707 Mt less than in the Reference Scenario). Coking coal production will decline by 267 Mt from 987 Mt in 2012 to 721 Mt in 2040 (195 Mt less). Lignite production will decline by 125 Mt from 899 Mt in 2012 to 774 Mt in 2040 (56 Mt less) (Figure 80).

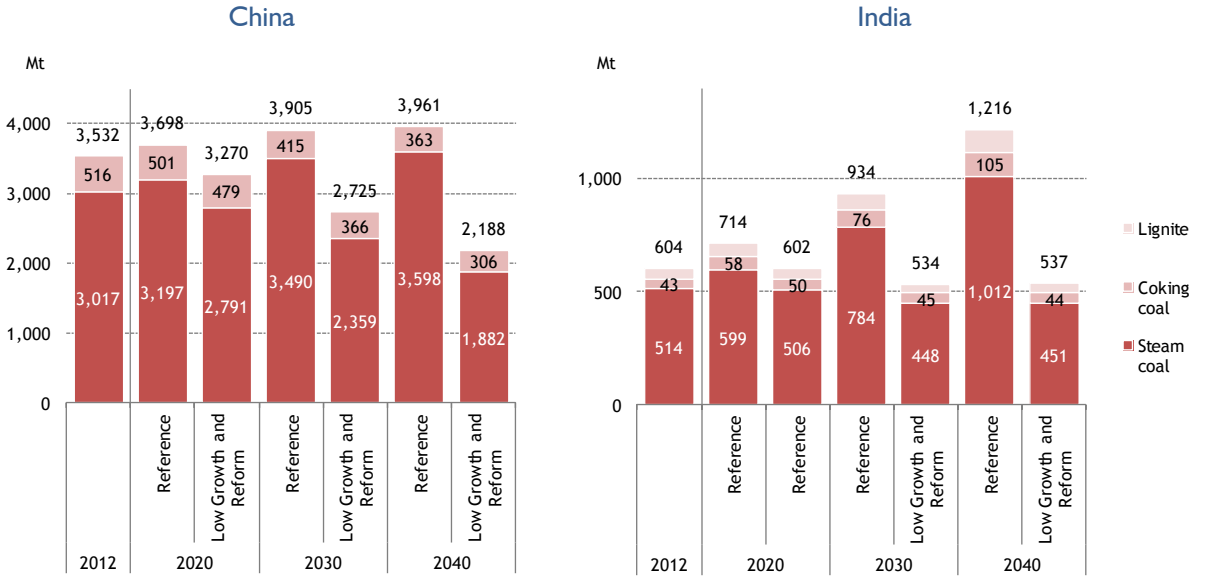
Figure 80 Coal production by type [Low Growth and Reform Scenario]



In response to a substantial drop in demand, China's coal production will decline from 3,532 Mt in 2012 to 2,188 Mt or 62% of the 2012 level in 2040. The production in 2040 will be 1,773 Mt less than in the Reference Scenario. Steam coal production will decline by 1,135 Mt from 3,017 Mt in 2012 to 1,882 Mt in 2040 (1,716 Mt less than in the Reference Scenario) and coking coal production by 210 Mt from 516 Mt in 2012 to 306 Mt in 2040 (57 Mt less) (Figure 81).

India's coal production will drop from 604 Mt in 2012 to 537 Mt in 2040. Steam coal production will decline from 514 Mt in 2012 to 451 Mt in 2040. Coking coal production will increase from 43 Mt in 2012 to 50 Mt in 2020 before declining to 44 Mt in 2040. India's overall coal production in 2040 will be limited to 44% of the Reference Scenario level. Steam coal production will be limited to 45% of the Reference Scenario level and coking coal production to 41%.

Figure 81 Coal production in China and India [Reference and Low Growth and Reform Scenarios]



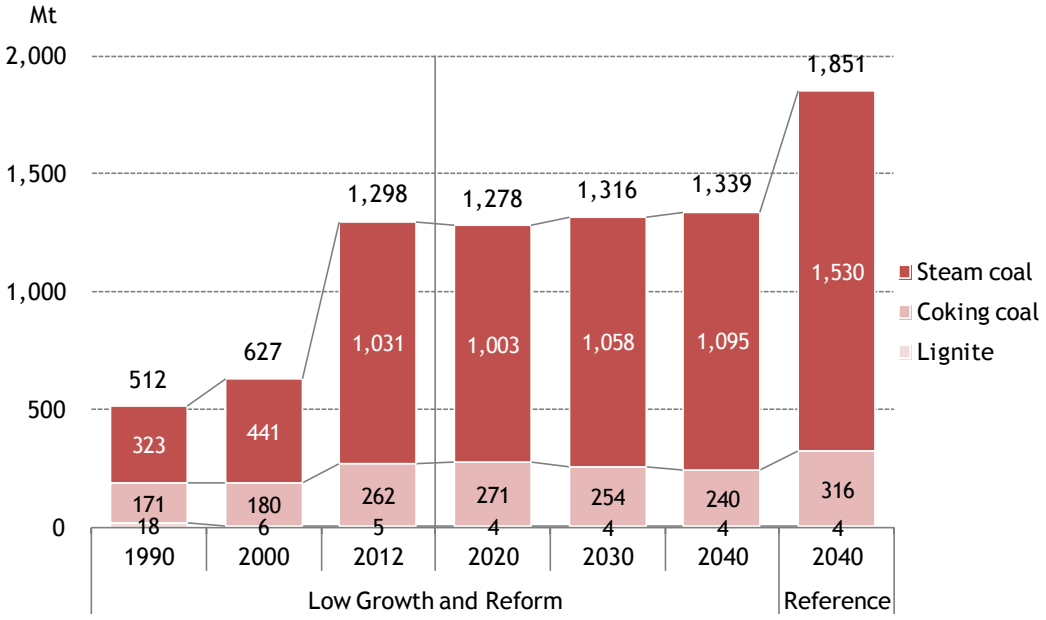
Trade

China's steam and coking coal imports will decline as its domestic demand decreases. Steam coal imports will drop from 235 Mt in 2012 to 84 Mt in 2040. Coking coal imports will fall from 54 Mt in 2012 to 23 Mt in 2040. Given a large production decline, domestic production can be expected to cover demand quantitatively. In order to maintain the price relationship between domestic and overseas coal markets, however, mainly coastal zones in southeast China far away from major Chinese coal production areas will continue importing coal. Another reason for China to continue importing coal will be that the absence of any coal market expansion will lead imported coal prices to slip below domestically produced coal prices.

While India's coal demand will level off or fall slightly, its coal imports will expand from 163 Mt in 2012 to 195 Mt in 2040. This is because India's domestically produced coal features a high ash content and must be mixed with imported coal for power generation. As India builds power plants for burning a mixture of domestically produced and imported coal and those for only imported coal, it will grow more dependent on coal imports. Imported coal's share of steam coal consumption will rise from 20% in 2012 to 26% in 2040. Steam coal imports will increase from 129 Mt in 2012 to 158 Mt in 2040. Coking coal imports will expand from 35 Mt in 2012 to 43 Mt in 2020 due to a demand increase before falling to 37 Mt toward 2040 because of a demand decline.

As a result, global coal trade in the Low Growth and Reform Scenario will almost level off as an import increase in non-OECD countries in Southeast Asia, Africa and Latin America offsets an import drop in China. Steam coal trade will increase by 64 Mt from 1,031 Mt in 2012 to 2040, while coking coal trade will decrease by 22 Mt from 262 Mt in 2012 to 2040. Overall coal trade in 2040 will total 1,339 Mt, 505 Mt less than in the Reference Scenario (Figure 82).

Figure 82 Coal trade by type [Low Growth and Reform Scenario]



Among steam coal exporters, Australia and Russia that were exporting large amounts of coal to China in the Reference Scenario in 2040, will be exporting far less in the Low Growth and Reform Scenario. Australia and South Africa as major exporters to India will also face far less exports. Net exports will be 272 Mt less than in the Reference Scenario for Oceania, 79 Mt less for Africa and 44 Mt less for non-OECD Europe/Central Asia. South Africa will expand exports to Europe in the absence of growth in those to India, affecting exports by the United States and Colombia that target Europe as their main market (Figures 83 and 84).

Figure 83 Net steam coal imports/exports [Reference and Low Growth and Reform Scenarios, 2040]

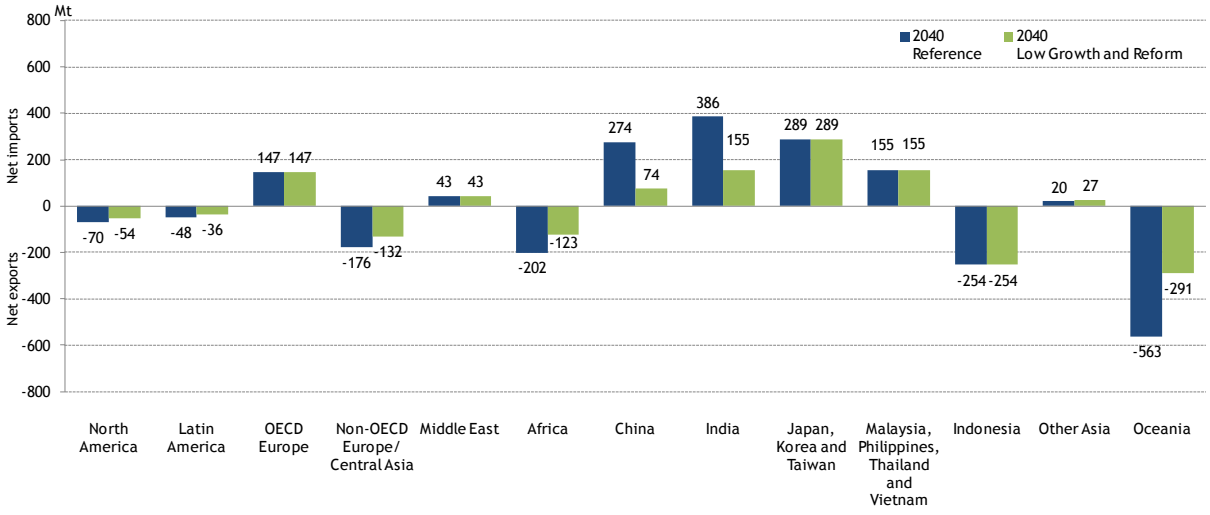
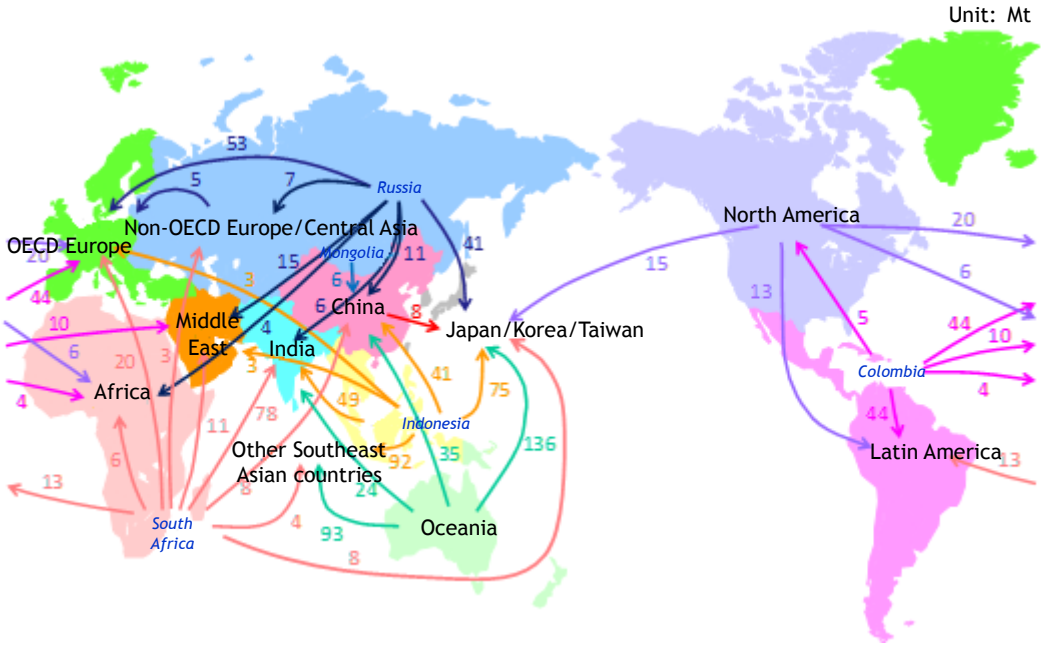


Figure 84 Major steam coal trade flows [Low Growth and Reform Scenario, 2040]



Note: South Africa includes Mozambique.

Among coking coal exporters, Australia, the United States, Canada and some others will post less exports than in the Reference Scenario in 2040. Particularly, Australia as a major exporter to India and China will reduce exports substantially. Its exports will fall from 124 Mt in 2012 to 111 Mt in 2040. Mozambique, which is attracting global attention with its coking coal development, will boost exports mainly to India, affecting Australian exports. Mongolia's exports will decline in line with a drop in China's coking coal imports (Figures 85 and 86).

Figure 85 Net coking coal imports/exports [Reference and Low Growth and Reform Scenarios, 2040]

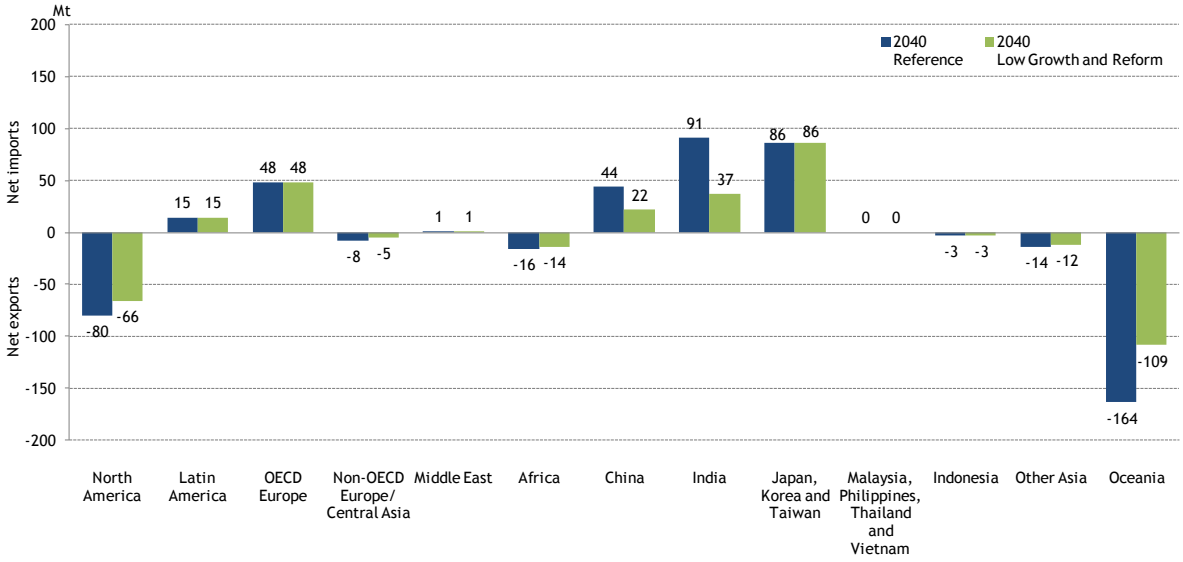
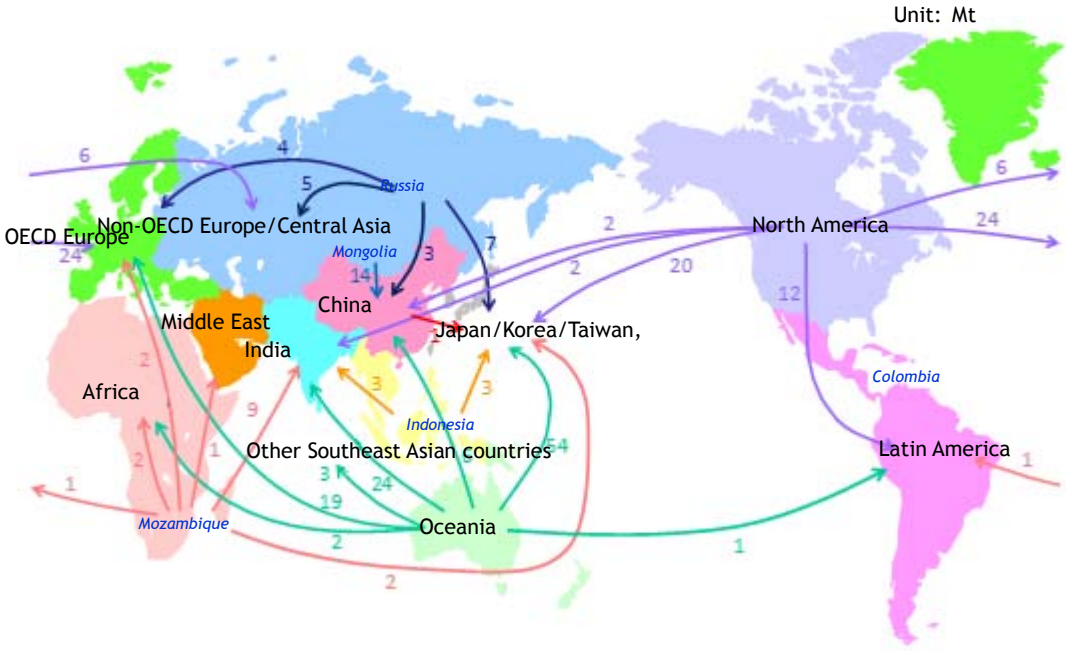


Figure 86 Major coking coal trade flows [Low Growth and Reform Scenario, 2040]



Part III

Low-carbon and climate change measures
– Advanced Technologies Scenario –

7. Effects of energy conservation and low-carbon measures

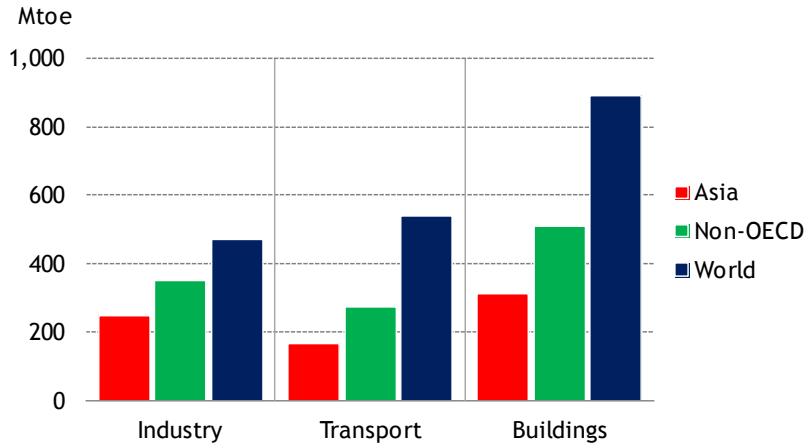
7.1 Key measures

In the Advanced Technologies Scenario, each country will powerfully implement radical energy conservation and low-carbon policies contributing to further securing stable energy supply and enhancing climate change measures, accelerating the development and introduction of innovative technologies on a global scale. Against the backdrop of the introduction of environmental regulations and national targets, the enhancement of technology development and the promotion of international technological cooperation, the penetration of energy-efficient equipment on the demand side and the promotion of renewables and nuclear on the supply side will be powerfully implemented (Figure 11).

Energy conservation

Final energy consumption in the Advanced Technologies Scenario in 2040 will be 1,900 Mtoe less than in the Reference Scenario due to progress in the penetration of energy conservation technologies. The figure amounts to the current final energy consumption in Europe and the Former Soviet Union. The energy savings include 469 Mtoe in the industry sector, 539 Mtoe in the transport sector and 892 Mtoe in the buildings sector (Figure 87). In each sector, non-OECD will account for more than 50% of energy savings, indicating that these countries hold the key to progress in global energy savings.

Figure 87 Energy conservation through technologies [Advanced Technologies Scenario, 2040] (compared with Reference Scenario)



In the industry sector, non-OECD energy consumption is now increasing remarkably. While energy efficiency in non-OECD is improving through the introduction of new equipment, energy-intensive industrial material producers' share of the industry sector is growing to boost overall energy consumption in the industry sector. The industry sector thus has great potential to improve energy efficiency mainly in non-OECD. As highly efficient technologies currently available are used for energy-intensive industries including steel, cement, chemicals and paper-pulp in the Advanced Technologies Scenario, the industry sector's energy consumption will be 469 Mtoe less than in the

Reference Scenario. Asia, where industrial material producers are expected to remarkably boost production, will account for 53% of the energy savings.

The transport sector will consume 539 Mtoe less energy than in the Reference Scenario as fuel efficiency and vehicle fleet mix improvements make further progress. Developed countries have already introduced or are expected to introduce soon next-generation vehicles including plug-in hybrid vehicles, electric vehicles and fuel cell vehicles. In Japan, FCVs will be launched as early as 2014. In developed countries, next-generation vehicles' automobile fleet share will thus increase faster. Therefore, non-OECD's share of energy savings in the transport sector will be smaller than in the industry sector.

The buildings sector differs from the cost-conscious industry sector in that energy conservation incentives fail to work smoothly. Therefore, both OECD and non-OECD have great potential to save energy consumption in the buildings sector. The sector's energy consumption in the Advanced Technologies Scenario will be 892 Mtoe less than in the Reference Scenario. Particularly, energy efficiency improvements for water heating systems in cold regions and insulation improvements in non-OECD will make great contributions to saving energy.

Nuclear

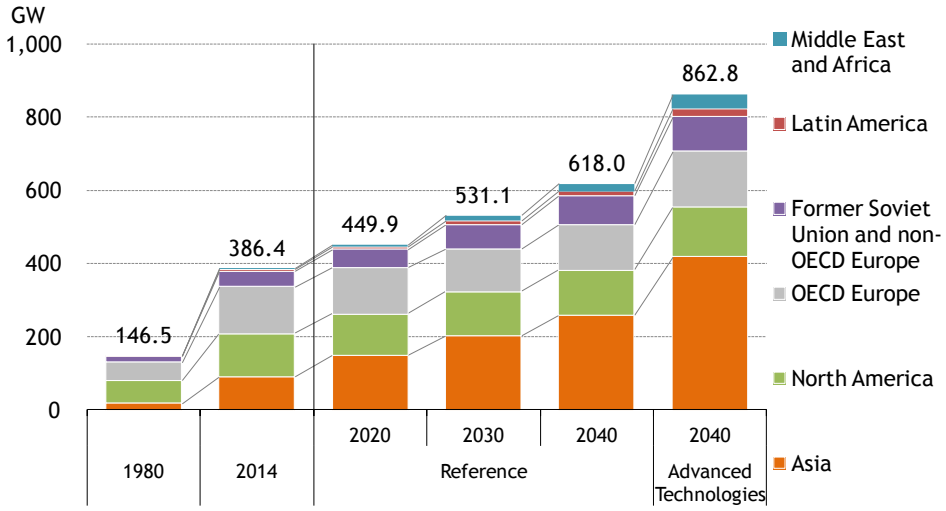
Great expectations are placed on nuclear power generation as a low-carbon measure. Particularly, emerging countries are considering penetrating nuclear power generation to meet rapid growth in domestic electricity demand and reduce CO_2 emissions. The United States, France, Russia and Korea, which have traditionally and proactively promoted nuclear power generation, are expected to extend the service life of existing nuclear reactors and build new reactors overwhelming existing capacity. Germany, Switzerland, Belgium and Italy have decided to phase out nuclear power plants in response to the Fukushima Daiichi nuclear power plant accident. They, however, may revise their nuclear phase-out policies and consider maintaining their present nuclear power generation capacity and lifting their freezes on new nuclear power plant construction plans from the viewpoint of reducing CO_2 emissions and maintaining industrial competitiveness.

North America will expand its installed nuclear power generation capacity to 137 GW in 2040 mainly through a United States capacity increase. The United States has extended the service life to 60 years for more than half of the existing nuclear reactors and is considering lengthening the life further to 80 years. The service life extension and proactive new plant construction will boost United States nuclear power generation capacity to 125 GW in 2040.

OECD Europe will expand its nuclear power generation capacity to 152 GW in 2040 (from 128 GW in 2014) as outdated reactors are decommissioned and replaced with new ones. In the United Kingdom, for example, the capacity will decline to 10.4 GW with some existing reactors being decommissioned before expanding to 14 GW by 2040. Germany, Switzerland, Belgium and Italy had once adopted a nuclear phase-out policy in view of the 1986 Chernobyl nuclear power plant accident and reversed it later. Therefore, they could revise the nuclear phase-out policy readopted after the Fukushima accident

in view of the international situation. Russia will accelerate nuclear power plant construction to boost its nuclear power generation capacity sharply from 25.2 GW in 2014 to 60 GW in 2040. Eastern Europe will make steady efforts to achieve nuclear power generation capacity targets.

Figure 88 Installed nuclear power generation capacity



In Asia, India, China and Southeast Asia will make progress in new nuclear power plant construction. Asia's installed nuclear power generation capacity will exceed a combined 277 GW for OECD Europe and the United States by 2030 and reach 418 GW in 2040. China's capacity will increase by 30 GW every five years from 2020 and exceed United States capacity at 119 GW in 2030 to become the world's largest. Its capacity will reach 195 GW in 2040. India will expand its nuclear power generation capacity from 4.8 GW in 2014 to 56.6 GW in 2030 and 88.8 GW in 2040 under the government's proactive nuclear energy diffusion target. Emerging markets such as the Middle East, Africa and Latin America will launch new nuclear power plants around 2020 and steadily increase their nuclear power generation capacity. Given new nuclear power plant construction plans mainly in the United Arab Emirates and Saudi Arabia, the Middle East will boost its capacity to 20 GW in 2030 and 30 GW in 2040.

Renewables

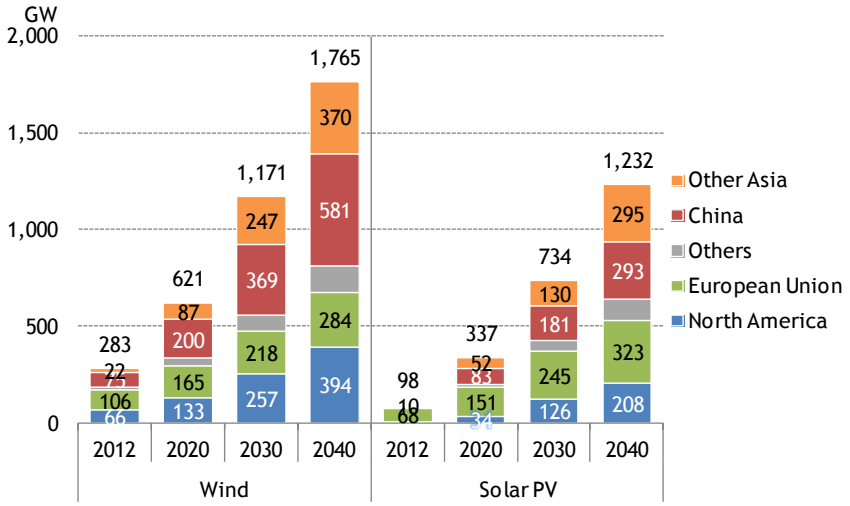
Offshore wind power generation will increase mainly in Europe as costs decline for construction, operation and management, and connection to electric grids (Figure 89). Onshore wind power generation costs will also decline, encouraging emerging and developing countries to accelerate the penetration of onshore wind farms. Wind power generation capacity in the Advanced Technologies Scenario in 2040 will total 1,765 GW, almost double the Reference Scenario level.

Solar photovoltaic power generation will start and accelerate its penetration thanks to system cost cuts in emerging and developing countries where its introduction has been very limited. Particularly, solar PV capacity will greatly grow in the Middle East, North Africa, Southeast Asia and other sun-belt

regions with abundant sunlight resources. Global installed solar PV capacity in the Advanced Technologies Scenario in 2040 will expand to 1,232 GW, more than double the Reference Scenario level.

Major factors to accelerate the penetration of wind, solar PV and other intermittent power sources include construction costs and system price cuts. Power generation projection, output curtailment, energy storage and grid enhancement technologies, as well as their combination into smart grid systems to enhance grid stabilisation measures, will also play a major role in the penetration.

Figure 89 Global installed wind and solar PV power generation capacity [Advanced Technologies Scenario]



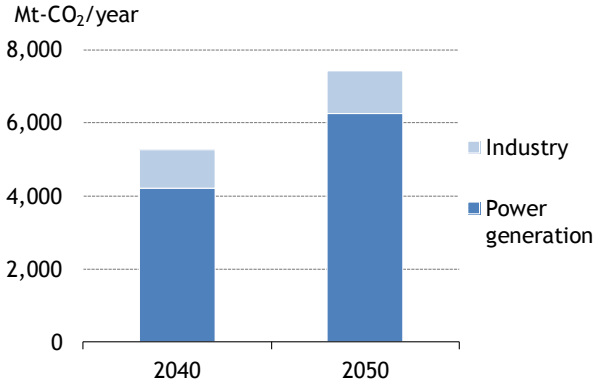
Carbon capture and storage

Carbon capture and storage (CCS) is one of the key low-carbon technologies in the world to curb CO_2 emissions into the atmosphere that is expected to remain heavily dependent on fossil fuels. CCS is expected to penetrate in the power generation and industry sectors that emit large amounts of CO_2. As of February 2014, 21 major CCS projects were underway. They include a Japanese project to demonstrate a CCS capacity of more than 10 kt per year for a refinery in Tomakomai, Hokkaido.

As climate change measures are enhanced, captured and stored CO_2 will increase more rapidly, reaching 5.3 Gt in 2040 and 7.4 Gt in 2050[2] (Figure 90). The power generation sector will account for a large share of the captured and stored CO_2.

[2] The power generation sector is assumed to fit CCS systems on new coal- and natural gas-fired power plants to be built in and after 2030. As for the industry sector where CCS will be introduced for steel and cement producers, CCS capacity is estimated in accordance with crude steel and cement production.

Figure 90 CO_2 emission reductions by CCS [Advanced Technologies Scenario]

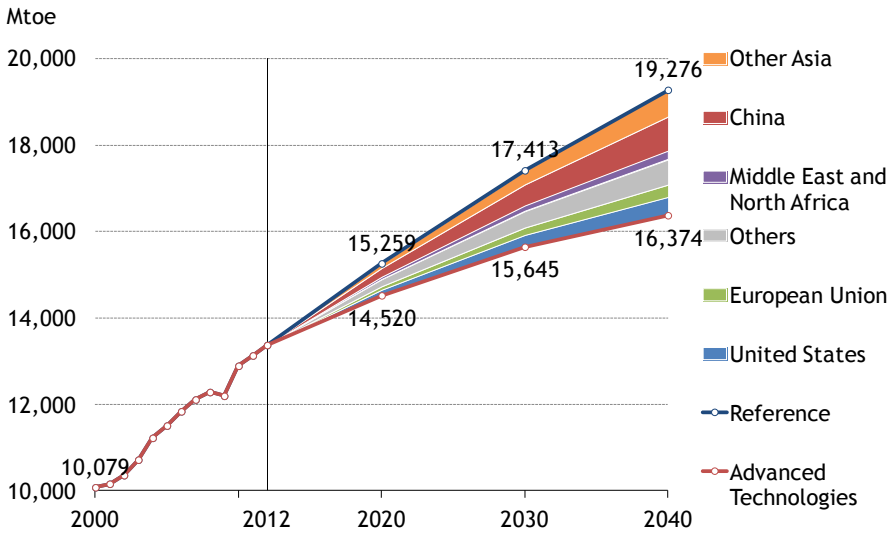


7.2 Energy supply and demand

Primary energy consumption

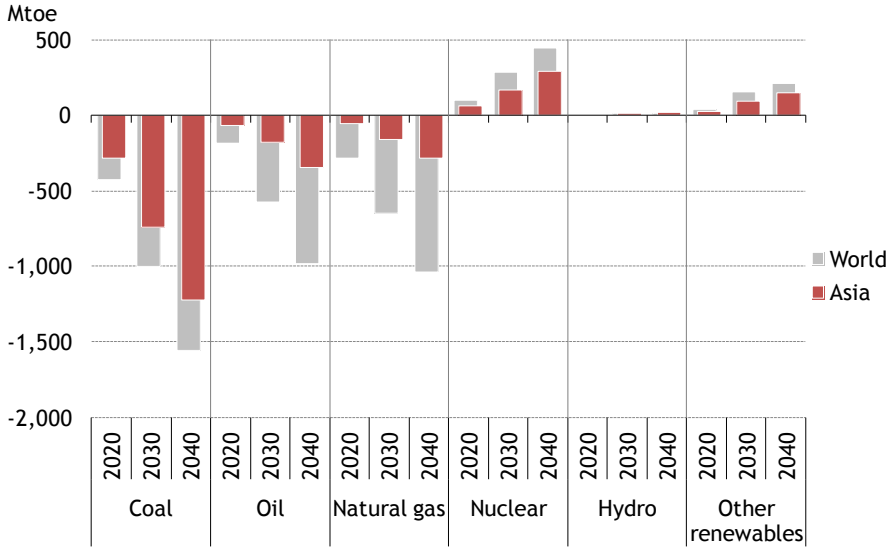
Strong energy conservation and climate change measures will substantially reduce primary energy consumption (Figure 91). The world's primary energy consumption in 2040 in the Advanced Technologies Scenario will total 16,374 Mtoe, down 2,902 Mtoe from in the Reference Scenario. The consumption reduction amount is equivalent to China's present consumption. Accumulated energy savings through 2040 will reach about 40 Gtoe, about three times as much as global primary energy consumption in 2012. In the Advanced Technologies Scenario, non-OECD or Asia that are expected to expand energy demand will play a major role in energy conservation. Of the potential global energy consumption reduction in 2040, non-OECD countries will account for 67% and Asia for 48%. Non-OECD or Asia will hold the key to global energy system reform.

Figure 91 Global primary energy consumption and energy savings by region



Fossil fuels will cover a very large share of the primary energy consumption reduction (Figure 92). Of the primary energy consumption reduction of 2,902 Mtoe from the Reference Scenario, coal will account for 1,555 Mtoe, natural gas for 1,039 Mtoe and oil for 982 Mtoe. Nuclear and renewable energy will penetrate more rapidly in the Advanced Technologies Scenario. Nuclear energy consumption will thus be 445 Mtoe (including 290 Mtoe in Asia) more than in the Reference Scenario and renewable energy consumption other than hydro will be 214 Mtoe (147 Mtoe) more. As a result, fossil fuels' share of primary energy consumption in the Advanced Technologies Scenario will fall from 82% in 2012 to 71% in 2040.

Figure 92 Global primary energy consumption changes [Advanced Technologies Scenario] (compared with Reference Scenario)



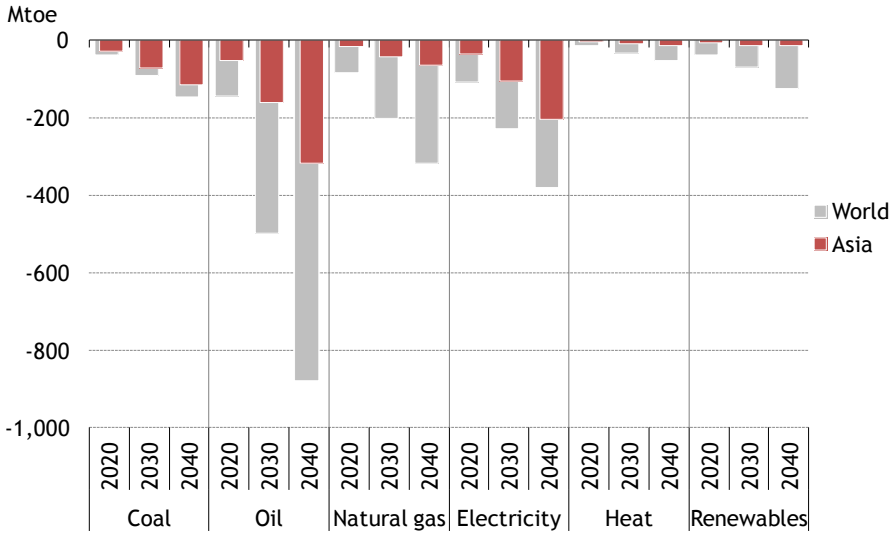
Of the fossil fuel consumption reduction, Asia including China and India will account for 52%. Particularly, Asia will cover as much as 79% of the coal consumption cut. Asia will capture more than two-thirds of the increase in consumption of nuclear and renewable energy other than hydro. Asia will thus play a key role in realising the energy system assumed in the Advanced Technologies Scenario. International cooperation will be required for penetrating efficient products and equipment through technology transfers, while institutional assistance will be needed for sharing information through forums between industrial and emerging countries, as well as ASEAN Plus 3 (Japan, China and Korea), APEC and other multilateral frameworks. It is important to promote energy conservation and the penetration of new technologies through technology transfers and institutional assistance.

Final energy consumption

Final energy consumption will be reduced by 1,900 Mtoe from the Reference Scenario in 2040. The reduction will include 879 Mtoe in oil (down 46%), 380 Mtoe in electricity (down 20%) and 318 Mtoe in natural gas (down 17%). The three energy sources will account for 83% of the energy consumption reduction (Figure 93). In emerging countries, energy conservation in the transport sector will greatly

contribute to cutting oil consumption. Fuel efficiency improvements for a growing number of vehicles and the greater utilisation of public transportation systems will help reduce energy consumption.

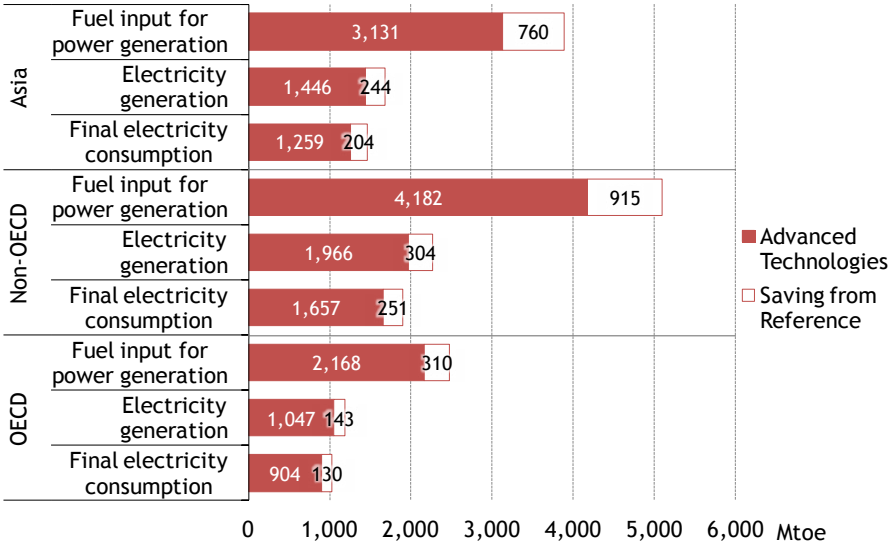
Figure 93 Global final energy consumption changes [Advanced Technologies Scenario] (compared with Reference Scenario)



Asia will make great contributions to reducing final coal consumption, accounting for some 80% of the global coal consumption reduction from the Reference Scenario in 2040. In this respect, steelmakers' energy conservation will be important in India and other countries where crude steel production will expand rapidly. Japan's energy consumption per unit of steel production is one of the lowest levels in the world. Japan's energy intensity for crude steel production is some one-third of the Indian level. If the efficient Japanese steelmaking technology is transferred to India and other countries where steelmakers' energy consumption will expand rapidly in the future, steelmakers will have great potential to save energy consumption. Japan can greatly contribute to energy conservation not only through the provision of energy-saving equipment but also through operational support.

Electricity consumption will be reduced by 380 Mtoe from the Reference Scenario, allowing power generation to be cut by 447 Mtoe. If power generation efficiency improvements are taken into account, primary energy consumption will be reduced by 1,225 Mtoe (Figure 94), equivalent to 42% of the total primary energy consumption reduction. Contributing greatly to the reduction will be Asia. The penetration of new power generation equipment will raise power generation efficiency in Asian emerging countries to levels close to those for developed countries.

Figure 94 Primary energy consumption reduction accompanying final electricity consumption savings [Advanced Technologies Scenario, 2040]

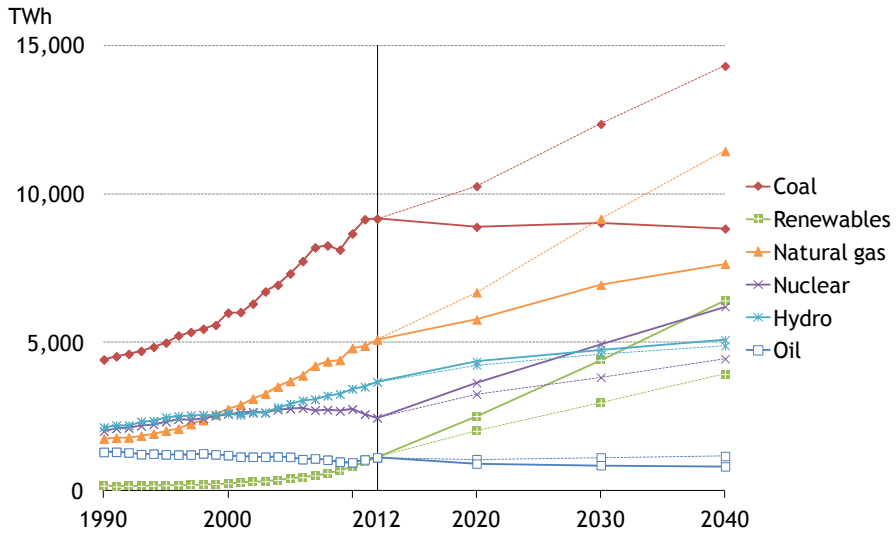


Developed countries should cooperate with Asian and other emerging countries in improving the latter's power generation efficiency. Emerging countries frequently fail to take into account environmental conservation while giving top priority to high economic growth. They also hesitate to address air pollution as a nationwide effort to solve growing air pollution problems which are likely to suppress economic growth. Therefore, developed countries will have an even greater role to play. It is important for developed countries to take advantage of their accumulated highly efficient electricity generation technology for expanding business operations in emerging countries to improve power generation efficiency.

Electricity generation mix

In the Advanced Technologies Scenario, final electricity consumption savings will work to cut electricity generation by about 5,000 TWh, five times more than Japan's electricity generation. In this Scenario, the integrated gasification combined cycle (IGCC) for coal-fired power generation and the development of technology for mixing coal with biomass energy will contribute to cutting coal consumption for electricity generation (Figure 95). In contrast to coal, natural gas, nuclear and renewables will increase their presence in electricity generation. In the Advanced Technologies Scenario, natural gas-fired power generation will exceed coal-fired generation around 2030.

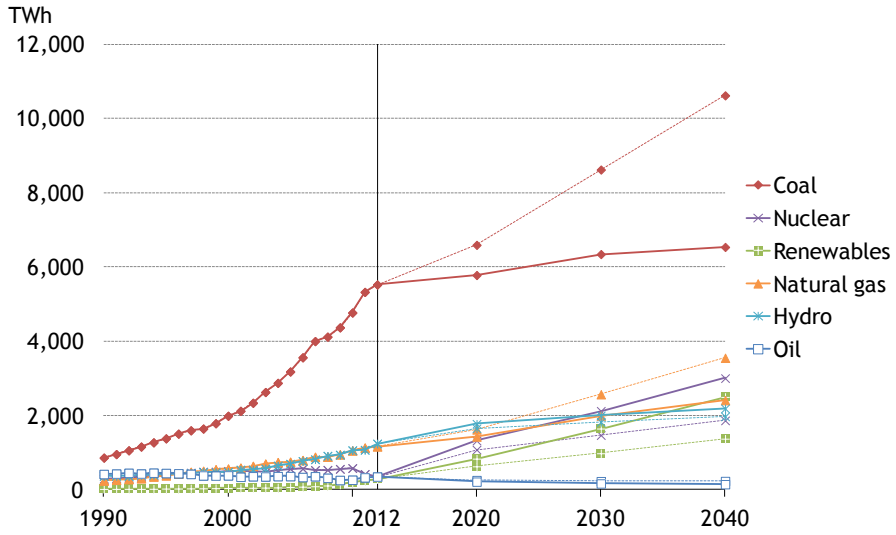
Figure 95 Global electricity generation by source [Advanced Technologies Scenario]



Note: Dotted lines indicate the Reference Scenario.

In Asia as well as in the entire world, coal-fired power generation will be reduced substantially. Nevertheless, coal will account for a remarkably large share of Asian electricity generation in 2040 (Figure 96). China and other Asian countries have promoted the introduction of renewable energy technology. It is important for them to reduce coal-fired power generation while continuing to expand renewable energy consumption.

Figure 96 Asian electricity generation by source [Advanced Technologies Scenario]



Note: Dotted lines indicate the Reference Scenario.

As well as technologies for improving power generation efficiency to reduce primary energy consumption, those for curbing electricity consumption itself are important. Particularly, a key challenge in developed countries as well as others is how to curb electricity consumption in the

buildings sector that is increasing consumption in line with living standard improvements. If developed countries establish smart meters and other energy management technologies for curbing energy consumption and export such infrastructure to emerging countries, they may benefit from both energy consumption savings and industrial exports.

Oil supply and trade

In the Advanced Technologies Scenario, all regions and sectors will make progress in oil consumption savings. Therefore, oil production will decline from the Reference Scenario globally, without the reduction being limited to any specific regions (Table 9).

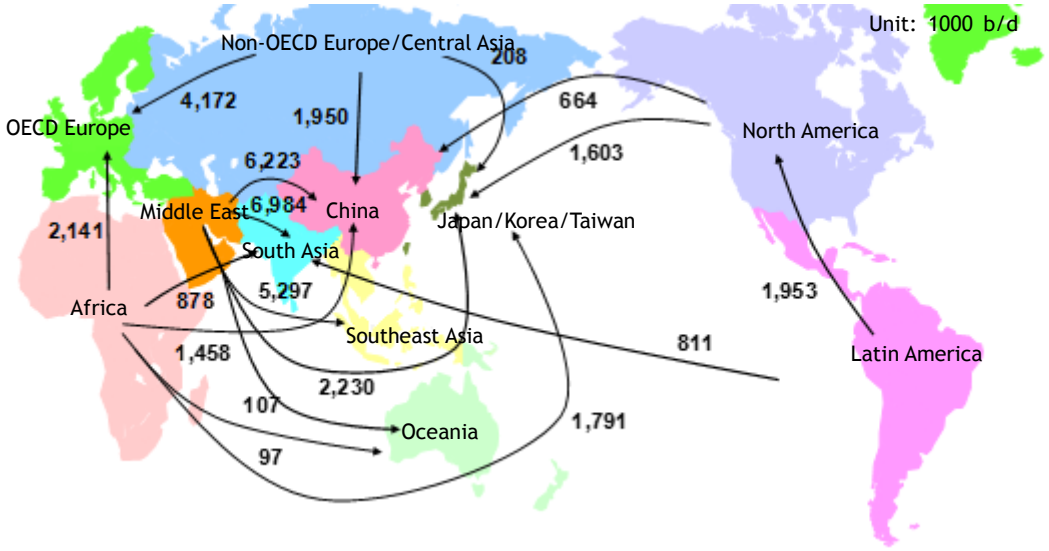
Table 9 Global oil supply [Advanced Technologies Scenario]

(Mb/d)

	2012	2020	2030	2040	Changes over 2012-2040
Total supply	89.3	91.5	95.0	96.3	7.0
OPEC	37.5	36.3	38.9	43.9	6.3
Middle East	26.9	26.0	28.6	32.0	5.1
Others	10.6	10.4	10.3	11.9	1.3
Shale oil	-	-	0.1	0.2	0.2
Non-OPEC	49.6	52.9	53.4	49.5	-0.1
North America	12.8	16.1	15.9	15.1	2.3
Shale oil	2.0	3.5	3.4	2.9	0.9
Latin America	7.1	8.5	9.3	8.8	1.7
Shale oil	-	0.1	0.3	0.3	0.3
Europe and former Soviet Union	17.4	16.1	16.3	15.2	-2.3
Shale oil	-	0.1	0.2	0.2	0.2
Middle East	1.5	1.4	1.2	1.3	-0.2
Africa	2.4	2.7	2.7	2.7	0.3
Asia	7.9	7.7	7.5	6.1	-1.9
China	4.2	4.1	4.1	3.9	-0.3
Shale oil	-	0.3	0.4	0.4	0.4
Indonesia	1.0	0.9	0.9	0.7	-0.3
India	0.9	0.8	0.7	0.5	-0.5
Others	2.4	2.4	2.5	2.8	0.5
Oceania	0.5	0.5	0.5	0.4	-0.1
Shale oil	-	-	0.1	0.2	0.2
Processing gains	2.2	2.3	2.7	3.0	0.8

Due to a global oil consumption decline, crude oil trade in 2040 will fall by 7.9 Mb/d from 48.9 Mb/d in the Reference Scenario to 41.1 Mb/d in the Advanced Technologies Scenario (Figure 97). Compared with trade flows in the Reference Scenario in 2040, exports from North America to Asia will increase in line with a consumption drop in North America. While exports from all other major oil producing countries/regions will decline, those from the Middle East and the Former Soviet Union/Eastern Europe will be reduced the most, dropping by 3.7 Mb/d and 1.9 Mb/d, respectively.

Figure 97 Crude oil trade flow between major regions [Advanced Technologies Scenario, 2040]



Natural gas supply and trade

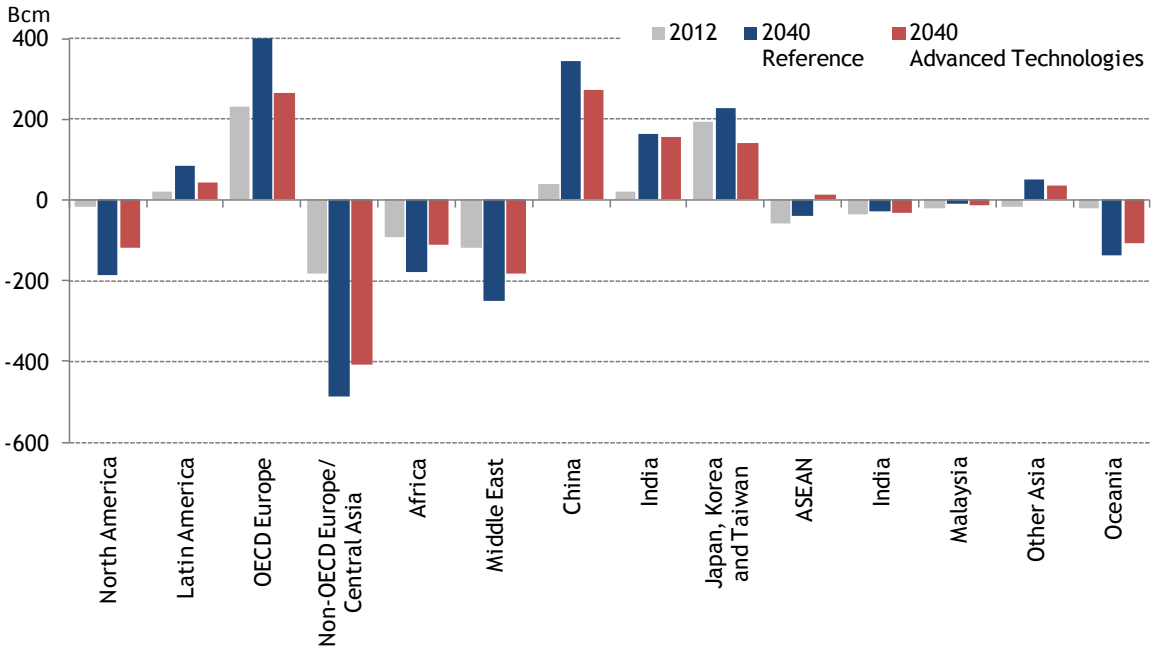
In the Advanced Technologies Scenario, global natural gas production will decline by some 20% from the Reference Scenario in accordance with a demand fall (Table 10). North America, the largest market for natural gas demand and production, will see its production fall by 415 Bcm from the Reference Scenario to 805 Bcm, below the 2012 level, due to a steep demand decline. In China where coal's share of energy consumption in the Reference Scenario will be large, natural gas demand's drop from the Reference Scenario will be limited, resulting in the largest production growth from 2012 in the world. In non-OECD Europe/Central Asia where exports' share of production growth is relatively large, the production drop from the Reference Scenario will be relatively smaller. Specifically, the region's production will drop by 170 Bcm from the Reference Scenario to 1,141 Bcm.

Table 10 Global natural gas supply [Advanced Technologies Scenario]

	2012			2040			Changes over 2012-2040	
		Unconven-tional	Unconven-tional		Unconven-tional	Unconven-tional		Unconven-tional
North America	838	414	49%	805	604	75%	-33	190
Latin America	220	-	-	376	84	22%	156	84
Middle East	529	-	-	746	15	2%	217	15
OECD Europe	276	-	-	185	9	5%	-91	9
Non-OECD Europe/Central Asia	873	-	-	1,141	40	4%	268	40
Africa	211	-	-	420	67	16%	209	67
China	107	-	-	376	130	35%	269	130
India	40	-	-	82	20	25%	42	20
ASEAN	209	-	-	269	27	10%	60	27
Indonesia	77	-	-	121	17	14%	44	17
Malaysia	61	-	-	83	7	8%	22	7
Other Asia	74	-	-	71	-	-	-3	-
Australia	61	7	11%	149	67	45%	88	60
World	3,438	421	12%	4,620	1,063	23%	1,182	642

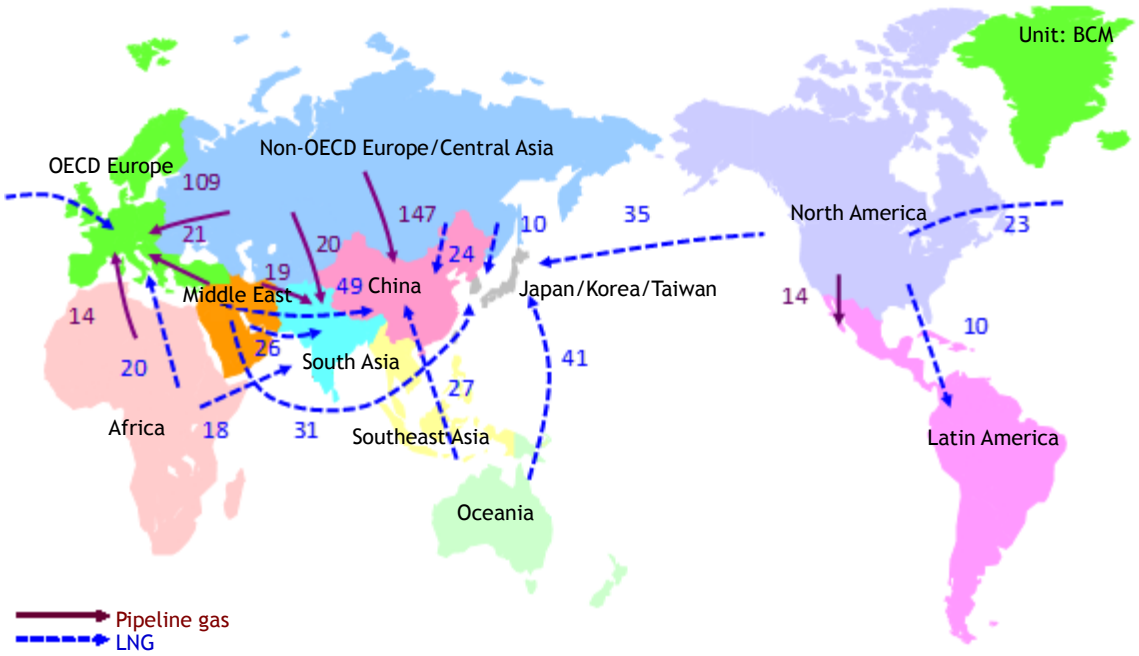
In the Advanced Technologies Scenario, interregional natural gas trade will slacken due to a demand decrease. Natural gas imports in 2040 will fall substantially from the Reference Scenario to 274 Bcm for China and 154 Bcm for India (Figure 98). As a result, net exports will decline from the Reference Scenario.

Figure 98 Net natural gas imports/exports [Advanced Technologies Scenario, 2040]



In the Advanced Technology Scenario where all regions will cut net imports, trade flows will be widely affected (Figure 99). The traditional importers, Japan/Korea/Taiwan and OECD Europe, will further diversify their supply sources as suppliers intensify competition for decreased demand. Particularly, Japan/Korea/Taiwan will remarkably reduce their dependence on the Middle East, with their imports from the region decreasing from 75 Bcm in 2013 to 31 Bcm. Growth in supply from non-OECD Europe/Central Asia and the Middle East to China and India will considerably decelerate from the Reference Scenario.

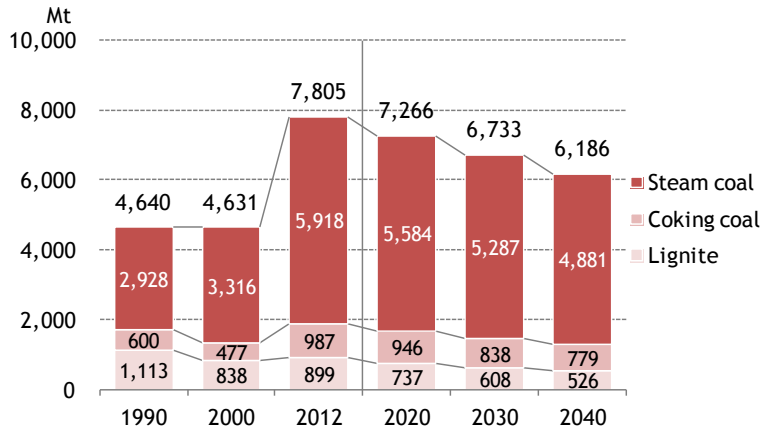
Figure 99 Natural gas trade flows between major regions [Advanced Technologies Scenario, 2040]



Coal supply and trade

In the Advanced Technologies Scenario, coal demand will decline substantially in North America, OECD Europe and China, while increasing in India, Southeast Asia and other non-OECD countries. As a result, global coal production will decline from 7,805 Mt in 2012 to 6,186 Mt in 2040 (Figure 100).

Figure 100 Coal production by type [Advanced Technologies Scenario]



Steam coal production will decrease from 5,918 Mt in 2012 to 4,881 Mt in 2040 (Table 11). Production will fall in North America and OECD Europe where demand will decline. Production will also drop in China and Japan among Asian countries. But production will increase in India with growing demand and in some steam coal exporting countries.

Table 11 Steam coal production by region [Advanced Technologies Scenario]

(Mt)

	2012	2020	2030	2040	Changes over 2012-2040
North America	805	623	466	328	-477
United States	779	609	459	324	-456
Latin America	103	90	95	88	-15
Colombia	85	69	71	59	-26
OECD Europe	107	83	63	50	-58
Non-OECD Europe	359	292	275	254	-105
Russia	206	161	152	137	-68
Middle East	0	0	0	0	0
Africa	264	275	298	316	51
South Africa	257	259	276	285	28
Asia	4,064	4,003	3,865	3,622	-442
China	3,017	2,890	2,734	2,399	-618
India	514	547	549	632	118
Indonesia	441	470	470	470	29
Oceania	215	219	224	223	8
Australia	212	217	222	221	9
World	5,918	5,584	5,287	4,881	-1,037

Coking coal production will decline from 987 Mt in 2012 to 779 Mt in 2040 (Table 12). China will substantially reduce production due to a demand decline. North America and Europe will also cut coking coal production. But coking coal production will increase in India with growing demand, as well as Mozambique that is developing coking coal mines.

Table 12 Coking coal production by region [Advanced Technologies Scenario]

(Mt)

	2012	2020	2030	2040	Changes over 2012-2040
North America	112	100	94	89	-23
United States	81	74	69	66	-15
Latin America	7	5	5	5	-1
Colombia	4	4	4	5	0
OECD Europe	25	22	19	16	-9
Non-OECD Europe	107	96	96	95	-11
Russia	73	69	72	74	1
Middle East	1	1	1	1	0
Africa	5	15	18	17	13
South Africa	3	13	16	15	13
Asia	582	568	472	423	-159
China	516	493	397	342	-174
India	43	54	55	61	18
Indonesia	20	15	11	9	-11
Oceania	149	139	134	132	-17
Australia	147	137	132	130	-17
World	987	946	838	779	-208

In steam coal trade, imports into India, Southeast Asia and other non-OECD with growing demand will increase. But those into OECD Europe, China and Japan will decline (Figures 101 and 102). Particularly, China's imports will decrease by more than 100 Mt from 2012 to 2040. As a result, steam coal trade will shrink from 1,031 Mt in 2012 to 845 Mt in 2040.

Figure 101 Net steam coal imports/exports [Advanced Technologies Scenario, 2040]

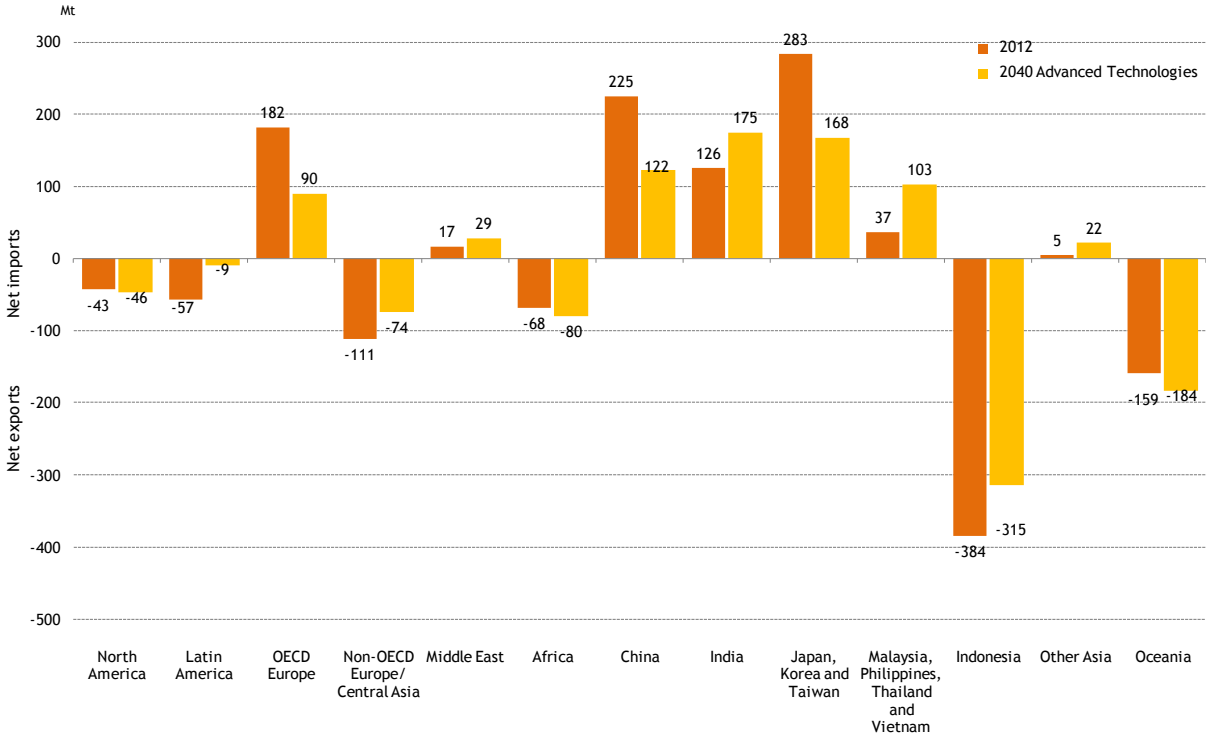
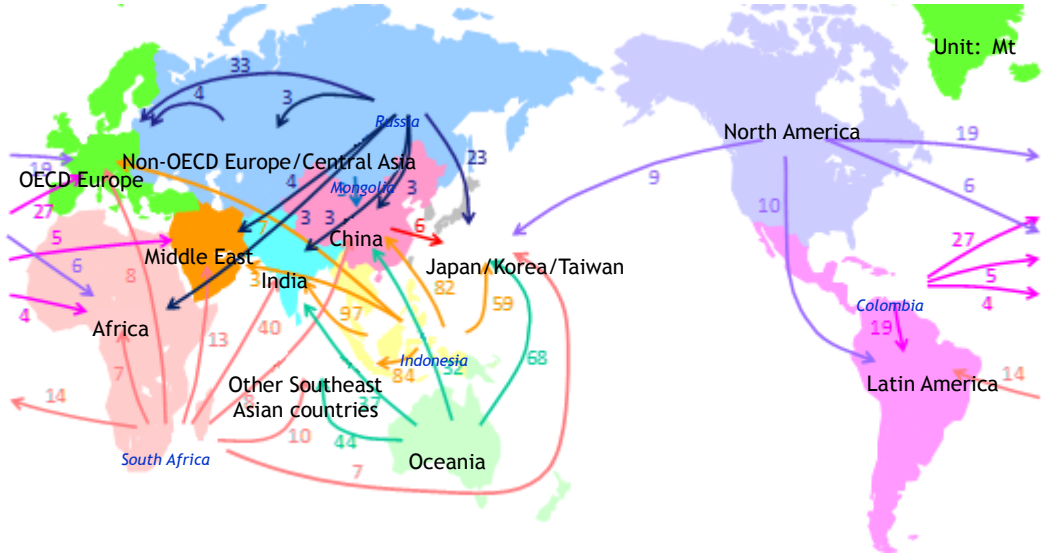


Figure 102 Major steam trade flows [Advanced Technologies Scenario, 2040]



Note: South Africa covers Mozambique.

In coking coal trade, imports into China and Japan will decline. But those into India and Korea will increase (Figures 103 and 104). Those into OECD Europe will level off as both demand and domestic production decline. As a result, coking coal trade will decrease slightly from 262 Mt in 2012 to 254 Mt in 2040.

Figure 103 Net coking coal imports/exports [Advanced Technologies Scenario, 2040]

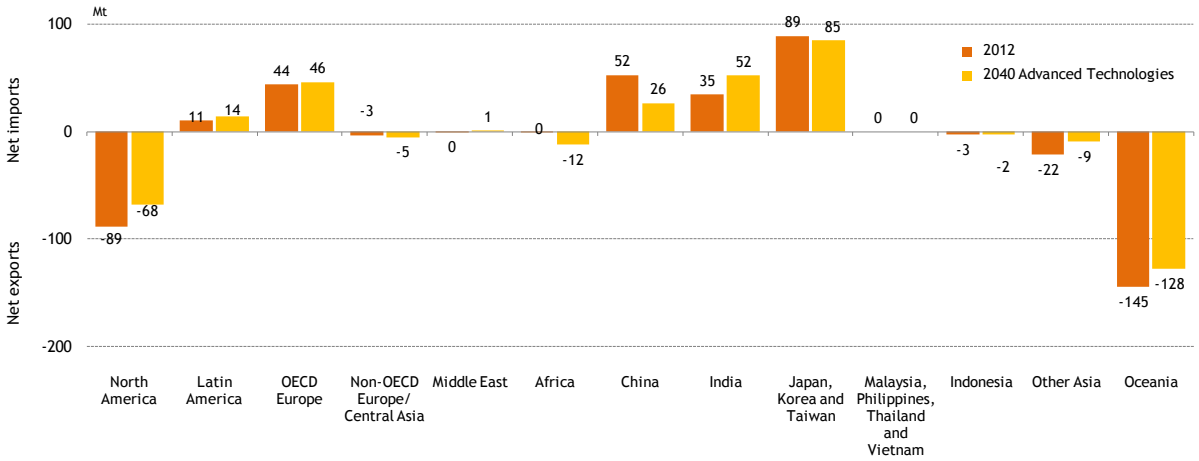


Figure 104 Major coking coal trade flows [Advanced Technologies Scenario, 2040]

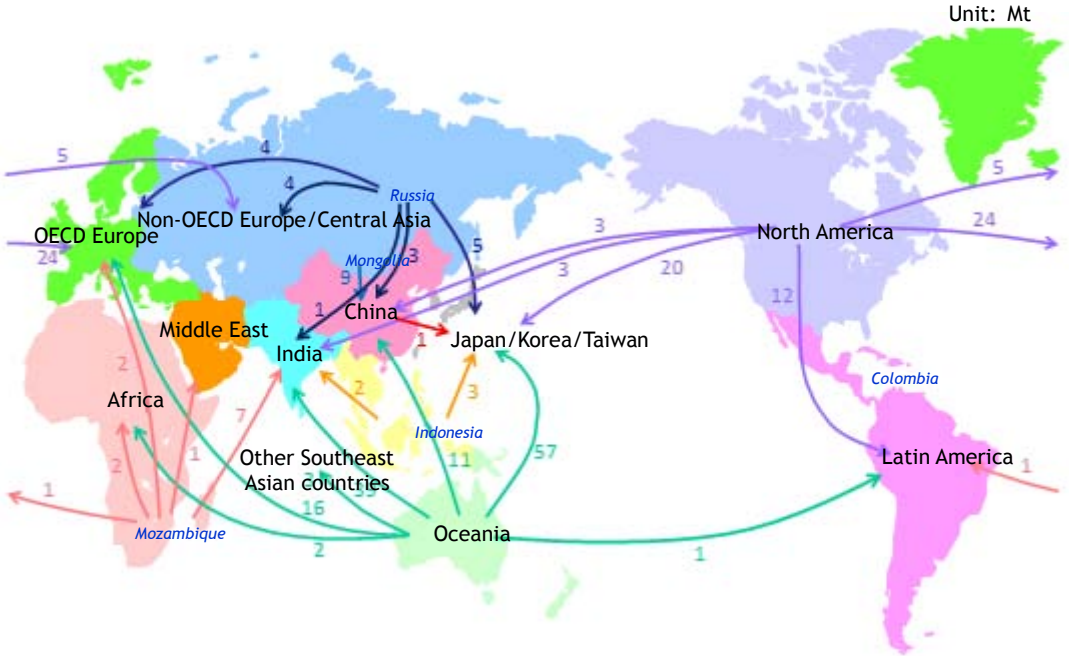
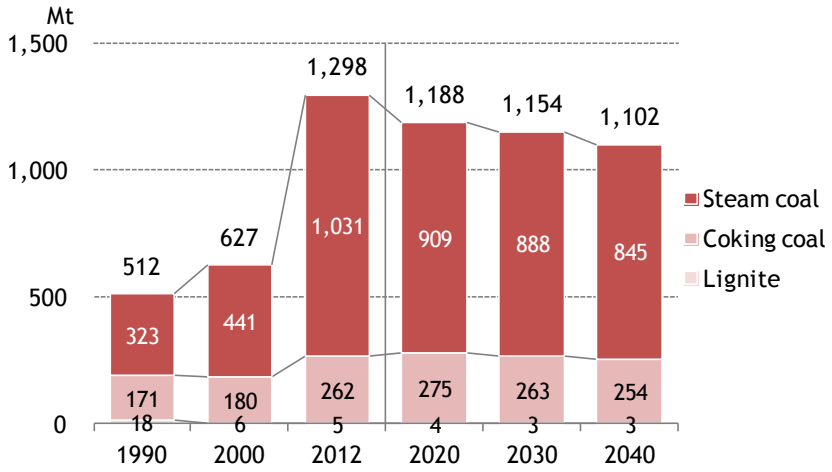


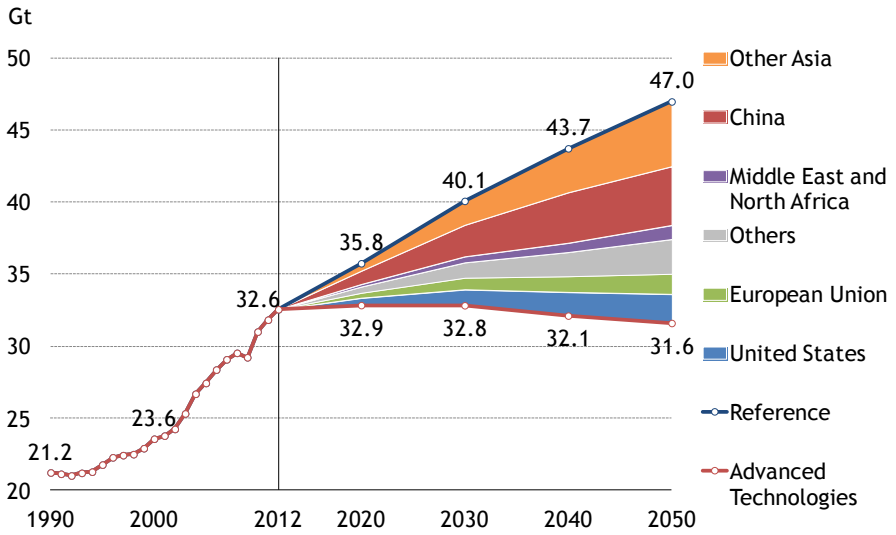
Figure 105 Coal trade by type [Advanced Technologies Scenario]



7.3 CO_2 emissions

Global energy-related CO_2 emissions in the Advanced Technologies Scenario will roughly level off from 2012 and post a decline in 2050 of about 1 Gt from 2012 thanks to the further advancement of energy conservation and low-carbon technologies (Figure 106). The CO_2 emission reductions from the Reference Scenario in 2050 will total 15.4 Gt, exceeding the combined United States and Asian emissions at present. Accumulated emission reductions through 2050 will come to 300 Gt, more than nine times as much as the current global emissions.

Figure 106 Global CO_2 emissions and each region's contribution to emission reductions [Advanced Technologies Scenario]

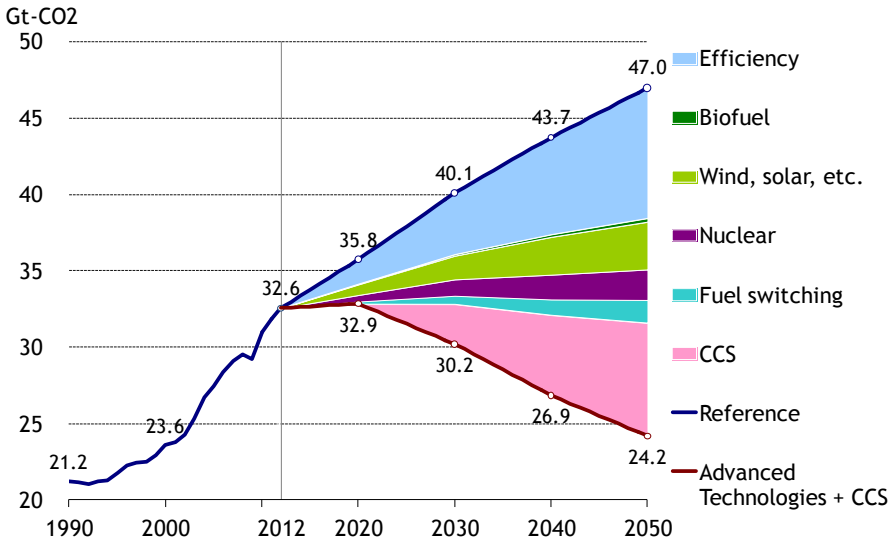


Non-OECD will account for 70% of the CO_2 emission reductions from the Reference Scenario in 2050. The reductions by China as the largest CO_2 emitter in the world will amount to 4.1 Gt, triple the present

Japanese level, covering about 50% of the Asian emission reductions. CO_2 emission reductions by China and other non-OECD will be indispensable for mitigating climate change. In this sense, developed countries' support for energy conservation in non-OECD through technology transfers and institutional assistance will be significant.

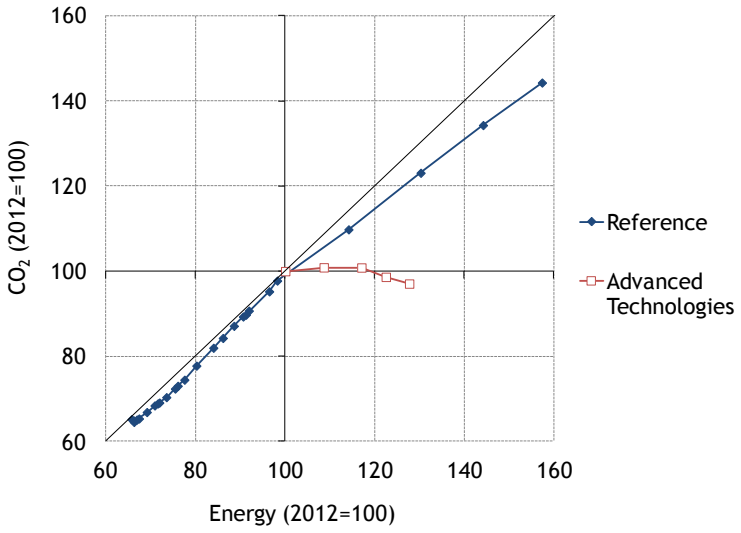
Of the global CO_2 emission reductions from the Reference Scenario to the Advanced Technologies Scenario in 2050, energy conservation will account for the largest share at 8.6 Gt, renewables for 3.1 Gt, nuclear for 2.0 Gt and fuel switching for 1.5 Gt (Figure 107). The carbon capture and storage technology will account for 7.4 Gt mainly in the power generation sector. Any measure alone may not be able to lead global CO_2 emissions to turn down. Energy conservation will have to be integrally and widely combined with electricity generation efficiency improvements, non-fossil energy penetration, fuel switching and CCS systems to effectively reduce CO_2 emissions.

Figure 107 Global CO_2 emissions and each measure's contribution to emission reductions [Advanced Technologies Scenario + CCS]



From the viewpoint of the carbon content of primary energy consumption, energy conservation technologies assumed for the Advanced Technologies Scenario may lead the world to reduce energy-related CO_2 emissions. CO_2 emission growth in the Advanced Technologies Scenario will be far slower than primary energy consumption growth (Figure 108). In the Reference Scenario, the penetration of nuclear and renewable energy will lead CO_2 emission growth to slip only slightly below primary energy consumption growth. This means that the current energy policy promotion pace may fall short of bringing about any low-carbon society to the world.

Figure 108 Global primary energy consumption and CO_2 emissions [1990-2012, 2020, 2030, 2040 and 2050]



The Kyoto Protocol adopted in 1997 gave the world an opportunity to pay attention to the importance of energy conservation and was very significant for reducing greenhouse gas emissions. More than 15 years after the adoption, however, emerging countries have replaced developed countries as the driver of global economic growth and CO_2 emissions. The top-down approach giving priority to emission controls led by developed countries is unlikely to impose any effective constraint on global GHG emissions. At the same time, serious air pollution has led emerging countries to grow directly and indirectly interested in the climate change issue. The world now must focus on a bottom-up review approach in which countries will report their emission control efforts in an international arena and review their implementation of specific measures with priority given to energy efficiency.

Among Asian countries including major emerging economies, there are wide gaps not only in economic development but also in environmental regulations and administrative systems. The bottom-up approach focusing on technology transfers features an advantage in which country-by-country characteristics can be taken into account. Under the approach, each country should fully understand the risks emerging from interregional gaps and take flexible and fine-tuned measures to prevent truly global warming. Japan should cooperate with the United States and Europe to penetrate advanced model cases in Asia.

Recently, air pollution in emerging countries has affected not only their domestic environment but also their neighbours. In this sense, Japan's technology transfers to Asian countries must aim not only to explore fast-growing Asian markets and reduce their energy consumption and CO_2 emissions, but also to solve pollution problem. Technology transfers are not limited to systems or equipment. They should also cover processes for commercialisation of systems and equipment, law and regulations, human resources and organisations, the plan-do-check-act cycle and energy management. Japan is expected to take advantage of its past experiences for penetrating technologies for goods and experience-based knowhow overseas.

8. Climate change options and energy conservation technology and measures

8.1 Implications of 450 ppm, 500 ppm and 550 ppm scenarios

In April 2014 when the Intergovernmental Panel on Climate Change released the Working Group III contribution to the Fifth Assessment Report (WGIII AR5), some media reports stated that the greenhouse gas concentration would have to be 450 ppm CO_2 equivalent or less to limit the global mean surface temperature increase from pre-industrial levels to less than 2°C and that the world would have to reduce GHG emissions by 40-70% by 2050. But climate change mitigation scenarios where the temperature increase from pre-industrial levels through anthropogenic GHG emissions would be less than 2°C are not limited to the scenario for the concentration of 450 ppm. In the 500 ppm scenario, the likelihood of the temperature increase being under 2°C throughout the 21st century will be 50-100%, if the concentration does not overshoot at 530 ppm; if it overshoots to that level, the likelihood is 33-66% (Table 13).

Table 13 Key characteristics of the scenarios collected and assessed for WGIII AR5

GHGs concentrations in 2100 (CO_2-eq) Category label (concentration range)	Subcategories	Change in emissions in 2050 (compared to 2010, CO_2-eq, %)	Temperature change (compared to 1850-1900)	
			Temperature change in 2100 (°C) Data in brackets include uncertainties of the carbon cycle and weather system	Likelihood of temperature increase being under 2°C throughout 21st century
450 (430 - 480)	Overshoot of 480 ppm CO_2-eq in most scenarios	-72 - -41	1.5 - 1.7 [1.0 - 2.8]	66 - 100%
500 (480 - 530)	No overshoot of 530 ppm CO_2-eq	-57 - -42	1.7 - 1.9 [1.2 - 2.0]	50 - 100%
	Overshoot of 530 ppm CO_2-eq	-55 - -25	1.8 - 2.0 [1.2 - 3.3]	33 - 66%
550 (530 - 580)	No overshoot of 580 ppm CO_2-eq	-49 - -19	2.0 - 2.2 [1.4 - 3.6]	0 - 50%
	Overshoot of 580 ppm CO_2-eq	-16 - +7	2.1 - 2.3 [1.4 - 3.6]	0 - 50%

Note: For all parameters, the 10th and 90th percentiles of the scenarios are shown. Overshoot means that the GHG concentration temporarily exceeds a long-term target. After exceeding the long-term target, the concentration would return to the path toward the target as CO_2 is removed from the atmosphere with bioenergy with carbon dioxide capture and storage as described later.
Source: IPCC WGIII AR5 Summary for Policymakers

A typical scenario where the GHG concentration will reach about 450 ppm CO_2-eq in 2100 depends on the utilisation and wide penetration of bioenergy with carbon dioxide capture and storage (BECCS)[3] and afforestation. But the scenario contains challenges and risks as the availability and scales of BECCS, afforestation and other CO_2 elimination technologies are uncertain.

[3] CCS systems will be used to absorb CO_2 generated when biomass absorbing CO_2 is converted into energy. BECCS has potential to eliminate CO_2 from the atmosphere.

Delaying additional climate change mitigation efforts until 2030 is assumed to narrow the range of options for keeping the temperature increase from pre-industrial levels to less than 2°C throughout the 21st century.

The WGIII AR5 cites 450 ppm and 500 ppm scenarios for the GHG concentration in 2100 as those where the temperature increase from pre-industrial levels is similarly (33-66%) likely to remain under 2°C. For a case where additional climate change mitigation measures will be considerably delayed or the availability of bioenergy, CCS, BECCS and other technologies is limited, many models have failed to develop 450 ppm scenarios.

Given these points, the IEEJ concludes that it is important for the WGIII AR5 to have cited the 500 ppm scenario as a case in which the temperature increase is around 50% likely to remain below 2°C from pre-industrial levels, because the 450 ppm scenario contains challenges and risks. The WGIII AR5 cites the following two scenarios in which the temperature increase is around 50% or more likely to remain under 2°C throughout the 21st century.

(1) 450 ppm scenario (66-100%)

(2) 500 ppm scenario (50-100% with no overshoot, 33-66% with overshoot)

If the temperature increase of 2.5°C is tolerated on the precondition of appropriate adaptation[4] measures, the following scenario would be conceivable:

(3) 550 ppm scenario (in which the temperature increase is 65-80% (the 10th and 90th percentiles) likely to remain under 2.5°C throughout the 21st century[5]).

In the following, we compare the Advanced Technologies Scenario with the above three scenarios and with developed countries' GHG emission reduction targets and developing countries' emission reduction actions (Cancun Pledges) based on the agreement at the 16th Conference of Parties to the United Nations Framework Convention on Climate Change in Cancun, Mexico. The WGIII AR5 categorises various scenarios primarily by CO_2-equivalent GHG concentration in 2100 and secondarily by CO_2-equivalent concentration of gases covered by the Kyoto Protocol and by cumulative CO_2 emissions between 2011 and 2100. Here, we use CO_2 emission pathways and cumulative emissions between 2011 and 2050 for the comparison.

Comparison by emission pathway

Figure 109 compares CO_2 emission pathways (10th and 90th percentiles) of the 450 ppm, 500 ppm and 550 ppm categories with the Advanced Technologies Scenario. As the Advanced Technologies Scenario

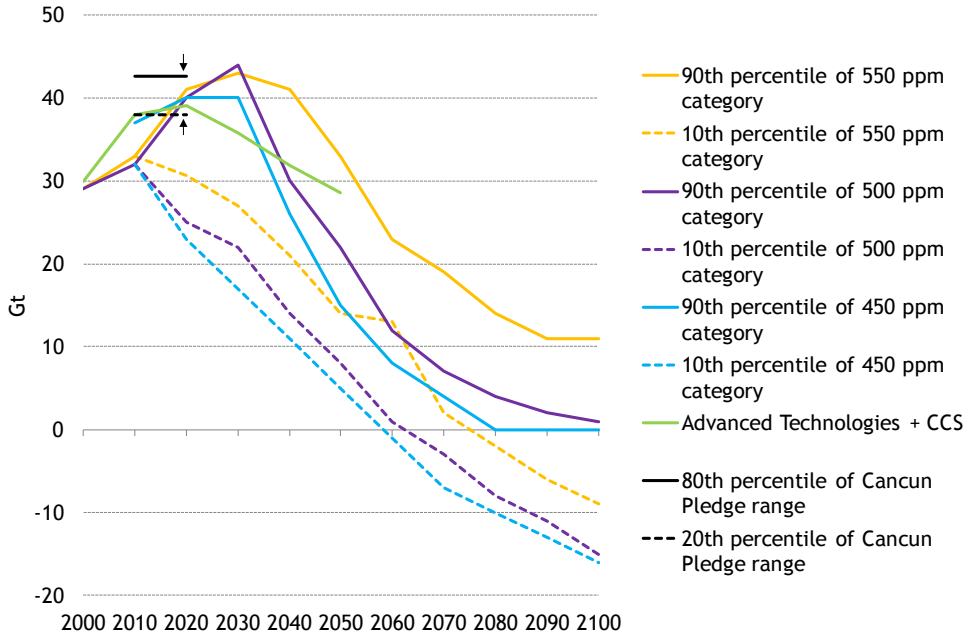
[4] While climate change mitigation is designed to artificially reduce GHG generation sources and increase GHG absorbers, adaptation is the process of changing behavior in response to anticipated climate change and its effects. Adaptation measures include river and coastal banks, reservoirs, agricultural research, and disease prevention and treatment. In the human systems, adaptation mitigates losses and takes advantage of beneficial opportunities. In the natural systems, artificial efforts are made to promote responses to anticipated climate change and its effects.

[5] The data are from Figure 6.14b of the WGII AR5.

covers only energy-related CO_2 emissions, we built on these emission estimates to compute overall CO_2 emissions for the comparison[6]. We then found that the Advanced Technologies Scenario amounts to the 550 ppm category.

As noted later, the Advanced Technologies Scenario will be achieved only if the global CO_2 emission intensity is improved to the present Japanese or European level. But barriers exist against such improvement. Costs and policies for the improvement are difficult.

Figure 109 CO_2 emission pathways for 450 ppm, 500 ppm and 550 ppm categories, Cancun Pledge Range and Advanced Technologies Scenario



Note: Data for the Advanced Technologies Scenario represent overall CO_2 emissions based on energy-related CO_2 emissions in the scenario.
Sources: Prepared from Chapter 6 of IPCC WG III Contribution to AR5 and UNEP's "The Emissions Gas Report 2013"

Next, we compute total emissions based on emission reduction targets and actions reported by major countries as Cancun Pledges and analyse their relationship with the Advanced Technologies Scenario.

The GHG emission range for the Cancun Pledges is 50-56 Gt CO_2-eq[7]. As the WGIII AR5 specifies CO_2 emissions as 76% of GHG emissions as of 2010, we consider the CO_2 emission range for the Cancun

[6] In converting energy-related CO_2 emissions into overall CO_2 emissions, we added CO_2 emissions from fuel-related leaks, industrial processes and forest destruction to the energy-related emissions. As emissions other than energy-related emissions, we used emission data in the IEA's "CO_2 Emissions from Fuel Combustion 2013." To make overall CO_2 emissions in 2010 in the Advanced Technologies Scenario equal to the IEA data, we determined the corrective coefficient for adjusting energy-related CO_2 emissions in the Advanced Technologies Scenario to the IEA's energy-related CO_2 emissions and adopted the coefficient for later energy-related CO_2 emissions in the Advanced Technologies Scenario. CO_2 emissions from fuel-related leaks and industrial processes are assumed to remain unchanged from 2.2 Gt in 2010 through 2050. CO_2 emissions from forest destruction are assumed to linearly decline by 50% from 5.2 Gt in 2010 to 2050. Non-CO_2 emissions are assumed at the same level as in other scenarios.

Pledges as 38-43 Gt-CO_2. Overall CO_2 emissions in the Advanced Technology Scenario are computed at 39.1 Gt-CO_2 based on 32.8 Gt-CO_2 in energy-related CO_2 emissions in the Scenario.

The Cancun pledges represent the upper limit of the 450 ppm, 500 ppm and 550 ppm categories while the Advanced Technologies Scenario indicates the lower limit of the Cancun Pledges.

Comparison by cumulative emissions

Table 14 compares cumulative CO_2 emissions between 2011 and 2050 for each CO_2 concentration category in the AR5 and the Advanced Technologies Scenario. Cumulative overall CO_2 emissions in the Advanced Technologies Scenario are computed at 1,404 Gt-CO_2 with the abovementioned computation method based on energy-related CO_2 emissions. In this way, the Advanced Technologies Scenario amounts to the 500 ppm category in terms of cumulative emissions.

Table 14 Cumulative CO_2 emissions in each GHG concentration category in AR5 and Advanced Technologies Scenario

	Cumulative CO_2 emissions in 2011-2050 (Gt-CO_2)
450 ppm category	550 - 1,300
500 ppm category	860 - 1,600
500 ppm category (without overshoot)	860 - 1,180
500 ppm category (with overshoot)	1,130 - 1,530
550 ppm category	1,070 - 1,780
Advanced Technologies Scenario + CCS	1,404

Note: 10th and 90th percentiles. Data for the Advanced Technologies Scenario represent overall CO_2 emissions based on energy-related CO_2 emissions in the scenario.
Source: Prepared from Chapter 6 of IPCC WG III Contribution to AR5

Even in the Advanced Technologies Scenario, CO_2 emissions will increase by more than 30% from 2000 to 2014 and fall to the 2000 level in 2050. The emission pathway in this scenario is close to that for the upper percentile of the 550 ppm scenario and the cumulative emissions in this scenario are close to those in the 500 ppm scenario.

The reason for the Advanced Technologies Scenario's similarity to the 550 ppm scenario in terms of emission pathways and to the 500 ppm scenario in cumulative emissions is that the emission decline after a low peak in the Advanced Technologies Scenario is moderate. This means that the Advanced Technologies Scenario assumes the maximum technology penetration over a short to medium term while failing to take into account the penetration of unforeseeable innovative technologies over a medium to long term.

[7] As for Japan, a 25% cut from 1990 is assumed as a target.

Nevertheless, the Advanced Technologies Scenario may be close to the 500 ppm scenario for the following reason: Over a short to medium term, it will be feasible for technologies to penetrate in the world as far as seen in Japan and Europe. But effective financing and desirable technology transfers should be considered for the global penetration. Over a medium to long term, new technologies that are unavailable now may be introduced. Technology development efforts should be stepped up to this end.

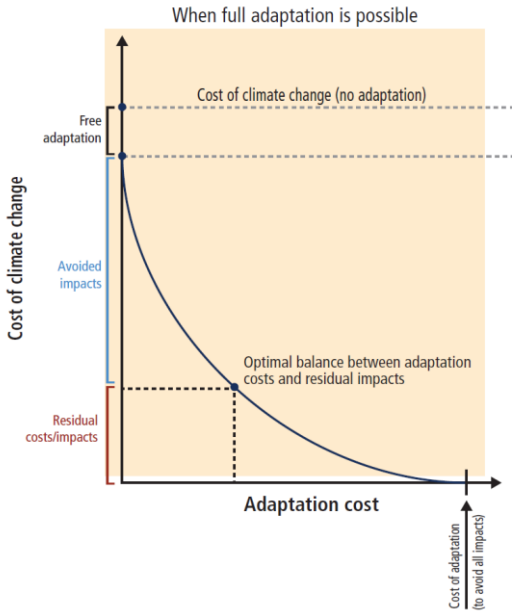
We touched on appropriate adaptation measures in respect to the 550 ppm scenario. In the following, we analyse the relationship between damage inflicted by climate change and adaptation measures.

8.2 Link between adaptation costs, climate change damage and mitigation costs

We would like to begin with summarising the AR5 report about adaptation costs, climate change damage (adaptation and mitigation benefits) and mitigation costs.

Adaptation benefits are the reduction in damages plus any gains in climate-related welfare that occur following an adaptation action, according to Chapter 17 the WGII AR5. The gains may include yield growth through breed improvement. Meanwhile, the cost of adaptation is the cost of any additional investment needed to adapt to or exploit future climate change. Figure 110 indicates a link between the cost of adaptation and the residual cost of climate change[8]. As adaptation costs increase, climate change costs will decline. Economics tells that the optimal level of adaptation equalises the marginal adaptation cost and the marginal adaptation benefit.

Figure 110 Link between cost of adaptation and residual cost of climate change



Source: Chapter 17, IPCC WG II Contribution to AR5

[8] The WGII AR5 provides two figures – one for a case where full adaptation is possible with residual costs being zero and the other for a case where there are unavoidable residual costs. But we here use the former alone to simply introduce the concept.

Mitigation, impacts and adaptation are linked to each other and should be simultaneously analysed. An optimal balance between adaptation, climate change and mitigation costs is desirable. Therefore, it is important to use both mitigation and adaptation measures to efficiently and effectively minimise climate change damage. The following considers adaptation, climate change and mitigation costs.

Adaptation costs

Adaptation costs are analysed in Chapter 17 of the WGII contribution to the AR5. Studies estimating global and regional adaptation costs over recent years are limited and their estimates range widely (Table 15). The latest, most comprehensive estimates of annual global adaptation costs range from $70 billion to $100 billion through 2050. But a special IPCC report on adaptation in 2011 described the reliability of these estimates as low. These studies limit their analysis to a small number of climate scenarios and fail to specify the correlative relationship between these costs and climate change damage.

Table 15 Estimates of global costs of adaptation

Study	Results ($billion per year)	Time frame
World Bank (2006)	9 - 41	Present
UNFCCC (2007)	28 - 67	2030
World Bank (2010)	70 - 100	2010 - 2050

Note: The time frame for World Bank (2010) is cited as 2050 in the AR5.
Source: Chapter 17, IPCC WG II Contribution to AR5

The World Bank (2010)[9] defines the cost of adaptation as "the minimum cost of adaptation initiatives to restore welfare to levels prevailing before climate change" for a scenario where the temperature increase from pre-industrial levels to 2050 will be limited to around 2°C. Based on the definition, it estimates annual adaptation costs between 2010 and 2050 as 0.11-0.22% of GDP.

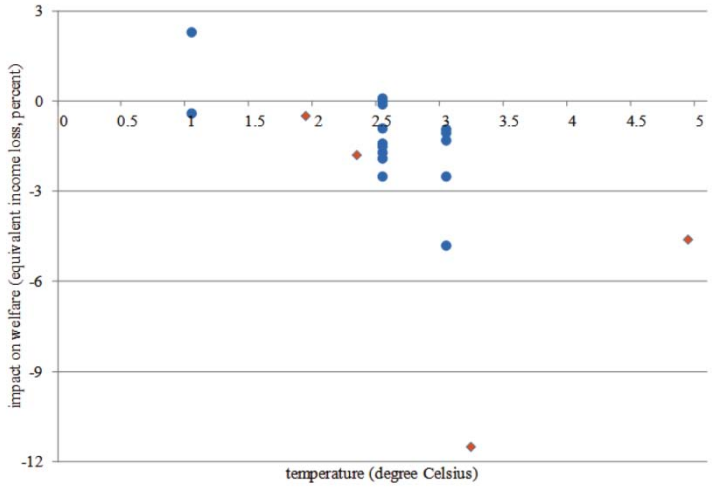
Climate change impacts

Climate change impacts are analysed in Chapter 10 of the WGII contribution to the AR5. Figure 111 indicates the relationship between the climate change impact (income drop) and the increase in the global mean surface air temperature[10]. Since the Fourth Assessment Report, four estimates of a median climate change's impact on human welfare have been released, including two for a temperature increase of 3°C or more. A median climate change has some positive benefits. But a greater temperature increase has negative benefits. New estimates have increased uncertainties about climate change's economic impacts. The impact is estimated at -0.5% of GDP for a 1.9°C temperature increase, at -1.8% of GDP for a 2.3°C increase and at -2.5% to +0.1% of GDP for a 2.5°C increase.

[9] World Bank: The Costs to Developing Countries of Adapting to Climate Change: New Methods and Estimates. 2010. World Bank, Washington DC

[10] The original figure in Tol (2013) specifies the temperature increase as from pre-industrial levels.

Figure 111 Climate change impact on welfare and increase in global mean surface air temperature

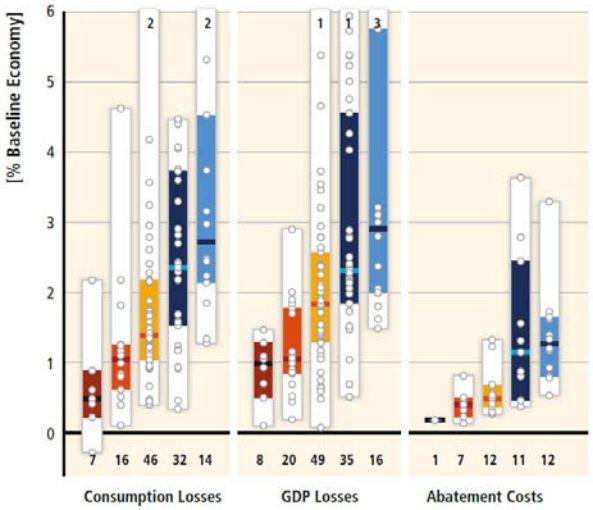


Note: Impact on welfare as measured by income drop rate.
Source: Chapter 10, IPCC WG II Contribution to AR5.

Mitigation costs

Mitigation costs are analysed in Chapter 6 of the WGIII AR5. Figure 112 indicates global mitigation costs for each GHG concentration scenario. Global mitigation costs increase in line with the toughness of CHG concentration targets. In the 450 ppm and 500 ppm categories where the temperature increase from pre-industrial levels has a chance of at least 50% to remain below 2°C, median consumption or GDP losses are 2.3-2.9%, against 1.4-1.8% for the 550 ppm category where the temperature increase is close to 2.5°C. Consumption and GDP losses in the 450 ppm and 500 ppm categories are 1.3 to 1.9 times greater than in the 550 ppm category.

Figure 112 Global mitigation costs



Note: Net present value for 2015-2100. The discount rate is at 5%. From the right are the 450 ppm category, the 500 ppm category and the 550 ppm category. Consumption is GDP excluding investment, imports/exports and government spending, indicating the value that consumers can spend. Consumption is used to proxy welfare change.
Source: Chapter 6, IPCC WG III Contribution to AR5

Link between adaptation costs, climate change damage and mitigation costs

Adaptation cost, climate change impact and mitigation cost estimates as reviewed above are based on different preconditions and discount rates and include uncertainties. Nevertheless, we would like to analyse their links.

We analyse the link between adaptation costs and climate change impacts first. Adaptation costs are estimated at 0.11-0.22% of GDP for a scenario in which the temperature increase from pre-industrial levels to 2050 will be about 2°C. Climate change damage is estimated at 0.5% of GDP for a temperature increase of 1.9°C and 1.8% for 2.3°C. Given that adaptation costs have not been estimated for scenarios in which the temperature increase will exceed 2°C, adaptation costs might have been underestimated. If adaptation costs are smaller than climate change costs, the implementation of adaptation measures may effectively respond to climate change impacts.

Next, it is difficult to analyse the link between adaptation and mitigation costs as adaptation costs for scenarios for a temperature increase above 2°C have not been estimated. We must wait for progress in research on adaptation costs for scenarios in which the temperature increase will exceed 2°C.

Finally, we consider the link between climate change damage and mitigation costs. At the 2°C level, climate change damage is estimated at 0.5% of GDP for a temperature increase of 1.9 °C. Mitigation costs are estimated at 2.3-2.9% of GDP. At the 2.5°C level, climate change impacts range from a loss at 2.5% of GDP to a gain at 0.1% for a temperature increase of 2.5°C. Mitigation costs are given as 1.8% of GDP. Climate change damage as a percentage of GDP at the 2.5°C level would thus rise by 0.9 percentage points from 0.5% at the 2°C level to 1.4% (a median between 2.5% in loss and 0.1% in gain). Mitigation costs as a percentage of GDP at the 2.5°C level would fall by 0.8 points from 2.6% (an average between 2.3% and 2.9%) to 1.8%. Overall costs would remain almost unchanged. We may have to consider two options – increasing mitigation costs to minimise climate change damage, and minimising overall damage or costs while implementing mitigation measures.

Correlative relationships between adaptation costs, climate change impacts and mitigation costs are so unclear that optimal assessment has yet to be done. Particularly, we may have to proceed with research on adaptation costs.

If CO_2 emission reduction costs are far less than adaptation costs and climate change losses, negotiations on the global warming prevention will make progress. Since it is uncertain whether CO_2 emission reduction costs are far less than adaptation costs and climate change losses, sticking to the 450 ppm scenario would make negotiations more difficult. On the other hand, the Cancun pledges represent the upper limit of the 500 ppm and 550 ppm categories. Some limit on mitigation measures should be considered.

Both mitigation and adaptation measures should be implemented efficiently and effectively to minimise climate change damage. As far as research on the three cost categories remains insufficient, all countries should accelerate such research and do what they can to help mitigate climate change.

8.3 Case where global CO_2 emission intensity will fall to present Japanese and European levels

Comparison of present national CO_2 emission intensities indicates a large difference between Japan and the rest of the world (Figure 113). If global CO_2 emission intensities are to be improved to Japanese and European levels, emerging countries will need to greatly reduce CO_2 emissions.

Figure 113 CO_2 emissions per unit GDP in selected economies (2012)

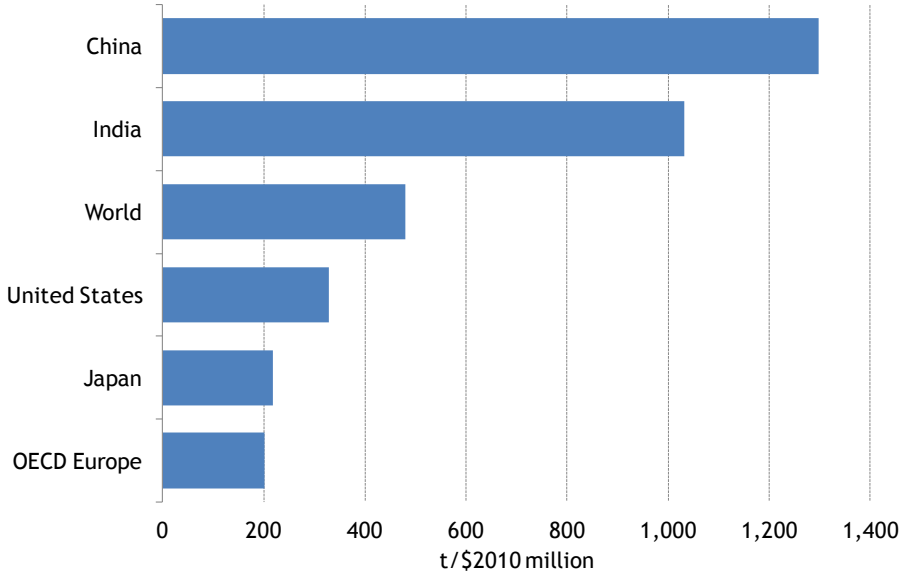


Table 16 compares CO_2 emission intensities (excluding emission reductions through CCS) in 2012 and 2050 in the Advanced Technologies Scenario. The scenario is close to a case in which major countries (including China and India) will lower their CO_2 emission intensities to the present Japanese or European levels in 2050. If Japanese and European levels represent a top runner, all others should make efforts to achieve these levels first.

Table 16 CO_2 emissions per unit GDP in selected economies [Advanced Technologies Scenario]

(t/$2010 million)

	2012	2050
World	480	163
OECD Europe	202	60
Japan	219	57
United States	328	67
India	1,032	255
China	1,298	194

Note: Excludes CCS.

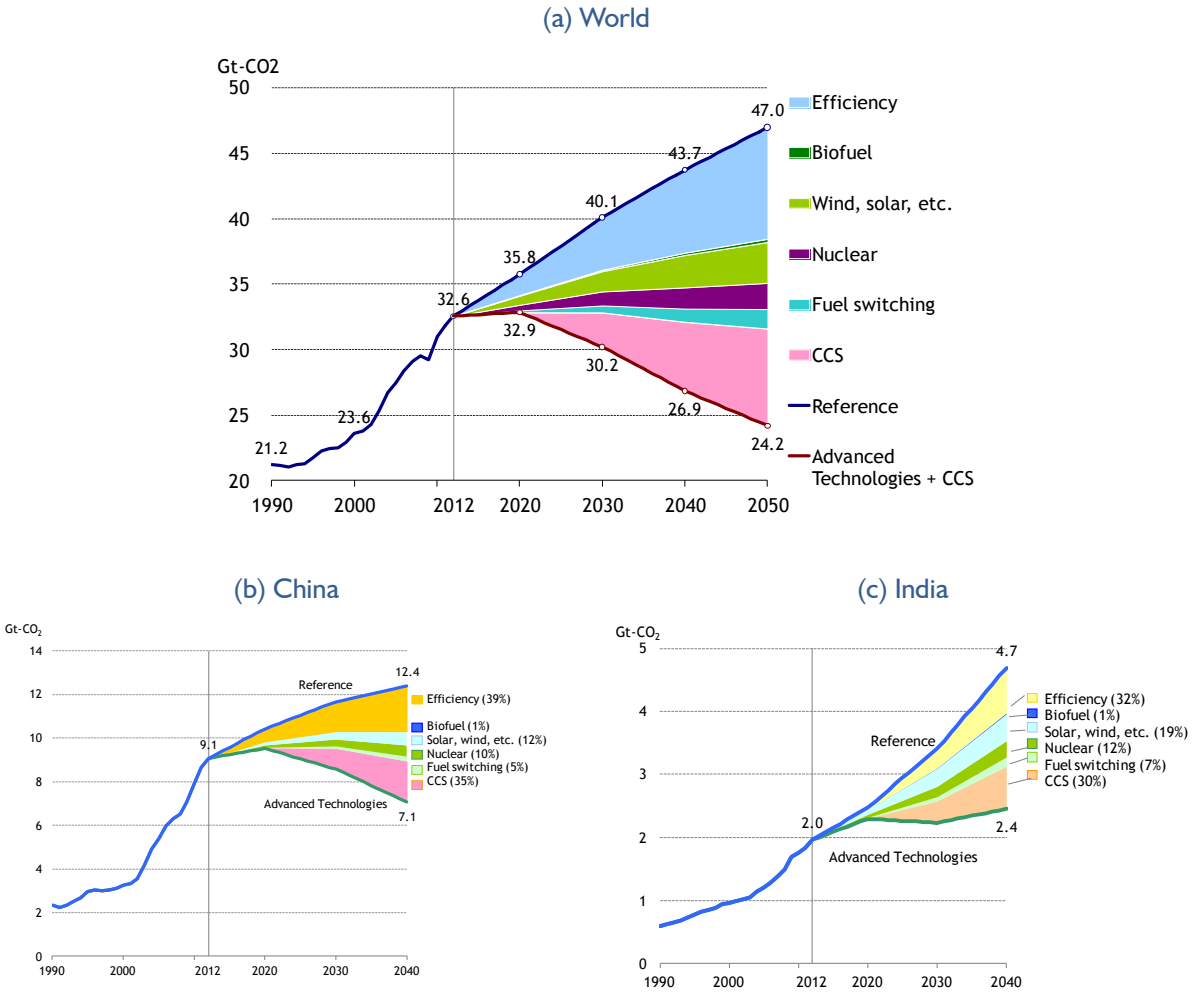
Figure 114 indicates CO_2 emissions and each measure's contribution to emission reductions in major countries (Reference Scenario and Advanced Technologies Scenario + CCS). Energy conservation, CCS

and others (fuel switching, nuclear and renewable energy penetration, etc.) each account for about one-third of the reductions. CO_2 emission reduction potential will depend on energy conservation over a short to medium term and on CCS over a medium to long term (through 2050). China and India offer the greater energy conservation potential. The power generation sector's potential for energy conservation including the improvement of coal-fired power generation efficiency is not large as the efficiency improvement is taken into account in the Reference Scenario.

There will actually be cost, policy and international framework barriers against realising the Advanced Technologies Scenario. Cumulative additional investment (in 2013 prices) through 2040 for realising the Advanced Technologies Scenario is estimated at $20.6 trillion. Institutional measures will have to be taken first to pave the way for such investment.

In the policy area, effective financing and technology transfers will have to be considered to realise short- to medium-term energy conservation potential. As for CCS, it is important now to prepare technology penetration policies (direct support covering investment and operation costs) using carbon tax revenues in order to produce results over a medium to long term.

Figure 114 CO_2 emissions and each measure's contribution to reductions in world, China and India



Need for various scenario options

As noted at the outset, the IPCC AR5 admits a wide range of scenarios for the temperature increase of 2°C, including the 500 ppm overshoot scenario that is described as having a 33-66% probability of staying the temperature increase below 2°C.

Implications of the IPCC AR5 are as follows: Under the 450 ppm scenarios that are difficult to realise, international negotiations on a new emission control framework may fail to be concluded, with major countries' coordination remaining difficult. In order to solve the dilemma, negotiators should adopt the 500 ppm or 550 ppm scenarios to conclude the negotiations as early as possible. A conceivable option would be to proceed with adaptation measures while developing BECCS, carbon capture and use (CCU), space solar power system and other advanced technologies to restore the 2°C scenario later. We must seriously consider climate change mitigation measures with various scenario options other than the 450 ppm scenarios kept in mind.

Annex

Table 1 Regional groupings

Asia	People's Republic of China		
	Hong Kong		
	India		
	Japan		
	Korea		
	Chinese Taipei		
	ASEAN	Brunei Darussalam	
		Indonesia	
		Malaysia	
		Myanmar	
		Philippines	
		Singapore	
		Thailand	
		Viet Nam	
	Others	Bangladesh, Cambodia, D. P. R. Korea, Mongolia, Nepal, Pakistan, Sri Lanka, and Other Asia in IEA statistics	
North America	United States		
	Canada		
Latin America	Brazil		
	Chile		
	Mexico		
	Others	Argentina, Bolivia, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Jamaica, Netherland Antilles, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay, and Other Non-OECD Americas in IEA statistics	
Europe	OECD Europe	France	
		Germany	
		Italy	
		United Kingdom	
		Others	Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, and Turkey

	Non-OECD Europe	Russia	
		Other non-OECD former Soviet Union	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Moldova, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan
		Others	Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Gibraltar, Kosovo, Former Yugoslav Republic of Macedonia, Malta, Montenegro, Romania, and Serbia
Africa	Republic of South Africa		
	North Africa	Algeria, Egypt, Libya, Morocco, and Tunisia	
	Others	Angola, Benin, Botswana, Cameroon, Democratic Republic of Congo, Congo, Côte d'Ivoire, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Mozambique, Namibia, Nigeria, Senegal, Sudan, Togo, United Republic of Tanzania, Zambia, Zimbabwe, and Other Africa in IEA statistics	
Middle East	Iran		
	Iraq		
	Kuwait		
	Oman		
	Qatar		
	Saudi Arabia		
	United Arab Emirates		
	Others	Bahrain, Israel, Jordan, Lebanon, Syrian Arab Republic, and Yemen	
Oceania	Australia		
	New Zealand		
International bunkers			
European Union	Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, the Slovak Republic, Slovenia, Spain, Sweden, and the United Kingdom		
OECD	Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States		

Notes: (1) ASEAN includes neither Cambodia nor Lao P.D.R., (2) Other non-OECD former Soviet Union includes energy data of Estonia before 1990, and (3) OECD does not include Israel.

Table 2 Major energy and economic indicators

		1990	2012	2040		CAGR (%) 1990/2012	2012/2040	
				Reference	Advanced Technologies		Reference	Advanced Technologies
Population (Million)	**World**	**8,780**	**13,371**	**19,276**	**16,374**	**1.9**	**1.3**	**0.7**
	Asia	2,119	5,268	8,794	7,398	4.2	1.8	1.2
	China	871	2,894	4,474	3,684	5.6	1.6	0.9
	India	316	788	1,814	1,519	4.2	3.0	2.4
	Japan	439	452	416	362	0.1	-0.3	-0.8
GDP ($2010 billion)	**World**	**3,231**	**4,205**	**5,639**	**4,657**	**1.2**	**1.1**	**0.4**
	Asia	618	1,243	2,096	1,748	3.2	1.9	1.2
	China	119	464	877	752	6.4	2.3	1.7
	India	61	177	445	377	5.0	3.3	2.7
	Japan	250	210	139	113	-0.8	-1.5	-2.2
Total primary energy consumption (Mtoe)	**World**	**1,667**	**2,844**	**4,856**	**3,817**	**2.5**	**1.9**	**1.1**
	Asia	116	507	1,434	1,152	6.9	3.8	3.0
	China	13	121	622	531	10.7	6.0	5.4
	India	11	49	220	195	7.2	5.5	5.1
	Japan	44	105	106	59	4.0	0.0	-2.0
Oil consumption (Mtoe)	**World**	**2,231**	**3,879**	**4,705**	**3,150**	**2.5**	**0.7**	**-0.7**
	Asia	796	2,669	3,605	2,383	5.7	1.1	-0.4
	China	528	1,969	2,274	1,543	6.2	0.5	-0.9
	India	103	354	776	448	5.8	2.8	0.8
	Japan	77	112	99	69	1.7	-0.4	-1.7
Natural gas consumption (Mtoe)	**World**	**11,825**	**22,668**	**40,217**	**35,025**	**3.0**	**2.1**	**1.6**
	Asia	2,215	8,921	19,630	16,795	6.5	2.9	2.3
	China	621	4,985	10,294	8,907	9.9	2.6	2.1
	India	293	1,128	4,230	3,652	6.3	4.8	4.3
	Japan	836	1,026	1,171	1,006	0.9	0.5	-0.1
Coal consumption (Mtoe)	**World**	**21,233**	**32,562**	**43,734**	**32,124**	**2.0**	**1.1**	**0.0**
	Asia	4,959	14,564	22,422	15,856	5.0	1.6	0.3
	China	2,339	9,067	12,402	8,913	6.4	1.1	-0.1
	India	585	1,961	4,688	3,121	5.7	3.2	1.7
	Japan	1,070	1,220	969	659	0.6	-0.8	-2.2
Power generation (TWh)	**World**	**238**	**197**	**125**	**106**	**-0.9**	**-1.6**	**-2.2**
	Asia	286	280	143	120	-0.1	-2.4	-3.0
	China	1,072	414	145	120	-4.2	-3.7	-4.3
	India	660	415	179	150	-2.1	-3.0	-3.6
	Japan	96	81	50	44	-0.8	-1.7	-2.2
Energy-related carbon dioxide emissions (Mt)	**World**	**1.67**	**1.90**	**2.15**	**1.82**	**0.6**	**0.4**	**-0.2**
	Asia	0.72	1.37	1.94	1.63	2.9	1.3	0.6
	China	0.77	2.14	3.18	2.62	4.8	1.4	0.7
	India	0.36	0.64	1.16	0.97	2.6	2.2	1.5
	Japan	3.56	3.55	3.63	3.15	0.0	0.1	-0.4
Primary energy consumption per GDP (toe/$2010 million)	**World**	**36,939**	**67,904**	**154,291**	**154,291**	**2.8**	**3.0**	**3.0**
	Asia	7,398	18,808	61,633	61,633	4.3	4.3	4.3
	China	812	6,988	30,784	30,784	10.3	5.4	5.4
	India	479	1,901	10,148	10,148	6.5	6.2	6.2
	Japan	4,553	5,571	8,278	8,278	0.9	1.4	1.4
Primary energy consumption per capita (toe/person)	**World**	**5,272**	**7,033**	**8,983**	**8,983**	**1.3**	**0.9**	**0.9**
	Asia	2,931	3,854	4,531	4,531	1.3	0.6	0.6
	China	1,135	1,351	1,408	1,408	0.8	0.1	0.1
	India	869	1,237	1,566	1,566	1.6	0.8	0.8
	Japan	124	128	115	115	0.1	-0.4	-0.4

Table 3 Population

(Million)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**5,272** (100)	**6,093** (100)	**7,033** (100)	**7,667** (100)	**8,372** (100)	**8,983** (100)	1.3	1.1	0.9	0.7	0.9
Asia	**2,931** (55.6)	**3,401** (55.8)	**3,854** (54.8)	**4,129** (53.9)	**4,382** (52.3)	**4,531** (50.4)	1.3	0.9	0.6	0.3	0.6
China	**1,135** (21.5)	**1,263** (20.7)	**1,351** (19.2)	**1,405** (18.3)	**1,425** (17.0)	**1,408** (15.7)	0.8	0.5	0.1	-0.1	0.1
India	**869** (16.5)	**1,042** (17.1)	**1,237** (17.6)	**1,353** (17.7)	**1,476** (17.6)	**1,566** (17.4)	1.6	1.1	0.9	0.6	0.8
Japan	**124** (2.3)	**127** (2.1)	**128** (1.8)	**126** (1.6)	**121** (1.4)	**115** (1.3)	0.1	-0.2	-0.4	-0.5	-0.4
Korea	**43** (0.8)	**47** (0.8)	**50** (0.7)	**52** (0.7)	**53** (0.6)	**53** (0.6)	0.7	0.4	0.3	0.0	0.2
Chinese Taipei	**20** (0.4)	**22** (0.4)	**23** (0.3)	**24** (0.3)	**24** (0.3)	**23** (0.3)	0.6	0.2	0.0	-0.3	0.0
ASEAN	**427** (8.1)	**503** (8.3)	**587** (8.3)	**638** (8.3)	**691** (8.3)	**729** (8.1)	1.5	1.1	0.8	0.5	0.8
Indonesia	**179** (3.4)	**209** (3.4)	**247** (3.5)	**269** (3.5)	**293** (3.5)	**311** (3.5)	1.5	1.1	0.9	0.6	0.8
Malaysia	**18** (0.3)	**23** (0.4)	**29** (0.4)	**33** (0.4)	**37** (0.4)	**40** (0.4)	2.2	1.5	1.2	0.8	1.1
Myanmar	**42** (0.8)	**48** (0.8)	**53** (0.8)	**56** (0.7)	**59** (0.7)	**59** (0.7)	1.0	0.8	0.4	0.1	0.4
Philippines	**62** (1.2)	**78** (1.3)	**97** (1.4)	**110** (1.4)	**128** (1.5)	**144** (1.6)	2.0	1.7	1.5	1.2	1.4
Singapore	**3** (0.1)	**4** (0.1)	**5** (0.1)	**6** (0.1)	**7** (0.1)	**7** (0.1)	2.6	1.7	0.8	0.5	0.9
Thailand	**57** (1.1)	**62** (1.0)	**67** (0.9)	**68** (0.9)	**68** (0.8)	**66** (0.7)	0.8	0.2	0.0	-0.3	-0.1
Viet Nam	**66** (1.3)	**78** (1.3)	**89** (1.3)	**95** (1.2)	**100** (1.2)	**102** (1.1)	1.4	0.8	0.5	0.2	0.5
Asia excl. Japan	**2,808** (53.3)	**3,274** (53.7)	**3,726** (53.0)	**4,004** (52.2)	**4,261** (50.9)	**4,416** (49.2)	1.3	0.9	0.6	0.4	0.6
North America	**277** (5.3)	**313** (5.1)	**349** (5.0)	**372** (4.8)	**399** (4.8)	**422** (4.7)	1.0	0.8	0.7	0.6	0.7
United States	**250** (4.7)	**282** (4.6)	**314** (4.5)	**334** (4.4)	**359** (4.3)	**379** (4.2)	1.0	0.8	0.7	0.6	0.7
Latin America	**441** (8.4)	**521** (8.6)	**605** (8.6)	**656** (8.6)	**711** (8.5)	**750** (8.4)	1.4	1.0	0.8	0.5	0.8
OECD Europe	**499** (9.5)	**521** (8.6)	**555** (7.9)	**570** (7.4)	**583** (7.0)	**590** (6.6)	0.5	0.4	0.2	0.1	0.2
European Union	**478** (9.1)	**488** (8.0)	**506** (7.2)	**518** (6.7)	**526** (6.3)	**529** (5.9)	0.3	0.3	0.2	0.1	0.2
Non-OECD Europe	**344** (6.5)	**341** (5.6)	**341** (4.9)	**344** (4.5)	**340** (4.1)	**333** (3.7)	0.0	0.1	-0.1	-0.2	-0.1
Africa	**627** (11.9)	**806** (13.2)	**1,082** (15.4)	**1,310** (17.1)	**1,632** (19.5)	**1,995** (22.2)	2.5	2.4	2.2	2.0	2.2
Middle East	**132** (2.5)	**166** (2.7)	**221** (3.1)	**256** (3.3)	**293** (3.5)	**325** (3.6)	2.4	1.8	1.4	1.1	1.4
Oceania	**20** (0.4)	**23** (0.4)	**27** (0.4)	**30** (0.4)	**33** (0.4)	**36** (0.4)	1.3	1.2	1.0	0.9	1.0
OECD	**1,062** (20.2)	**1,150** (18.9)	**1,246** (17.7)	**1,300** (17.0)	**1,353** (16.2)	**1,388** (15.5)	0.7	0.5	0.4	0.3	0.4
Non-OECD	**4,209** (79.8)	**4,943** (81.1)	**5,787** (82.3)	**6,367** (83.0)	**7,019** (83.8)	**7,594** (84.5)	1.5	1.2	1.0	0.8	1.0

Source: United Nations "Population Estimates and Projections: The 2012 Revision", World Bank "World Development Indicators"

Note: Figures in parentheses are global shares (%).

Table 4 GDP [Reference Scenario and Advanced Technologies Scenario]

($2010 billion)

							CAGR (%)				
	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**36,939** (100)	**48,631** (100)	**67,904** (100)	**87,739** (100)	**119,426** (100)	**154,291** (100)	2.8	3.3	3.1	2.6	3.0
Asia	**7,398** (20.0)	**10,658** (21.9)	**18,808** (27.7)	**28,042** (32.0)	**43,252** (36.2)	**61,633** (39.9)	4.3	5.1	4.4	3.6	4.3
China	**812** (2.2)	**2,190** (4.5)	**6,988** (10.3)	**12,175** (13.9)	**20,797** (17.4)	**30,784** (20.0)	10.3	7.2	5.5	4.0	5.4
India	**479** (1.3)	**825** (1.7)	**1,901** (2.8)	**3,079** (3.5)	**5,854** (4.9)	**10,148** (6.6)	6.5	6.2	6.6	5.7	6.2
Japan	**4,553** (12.3)	**5,093** (10.5)	**5,571** (8.2)	**6,501** (7.4)	**7,422** (6.2)	**8,278** (5.4)	0.9	1.9	1.3	1.1	1.4
Korea	**374** (1.0)	**675** (1.4)	**1,074** (1.6)	**1,438** (1.6)	**1,874** (1.6)	**2,250** (1.5)	4.9	3.7	2.7	1.8	2.7
Chinese Taipei	**168** (0.5)	**307** (0.6)	**473** (0.7)	**663** (0.8)	**835** (0.7)	**952** (0.6)	4.8	4.3	2.3	1.3	2.5
ASEAN	**702** (1.9)	**1,137** (2.3)	**2,074** (3.1)	**3,124** (3.6)	**4,901** (4.1)	**7,101** (4.6)	5.0	5.3	4.6	3.8	4.5
Indonesia	**282** (0.8)	**426** (0.9)	**802** (1.2)	**1,261** (1.4)	**2,046** (1.7)	**3,097** (2.0)	4.9	5.8	5.0	4.2	4.9
Malaysia	**79** (0.2)	**158** (0.3)	**275** (0.4)	**405** (0.5)	**630** (0.5)	**872** (0.6)	5.8	5.0	4.5	3.3	4.2
Myanmar	**7** (0.0)	**13** (0.0)	**47** (0.1)	**79** (0.1)	**138** (0.1)	**214** (0.1)	9.3	6.8	5.8	4.5	5.6
Philippines	**95** (0.3)	**125** (0.3)	**221** (0.3)	**356** (0.4)	**565** (0.5)	**851** (0.6)	3.9	6.2	4.7	4.2	4.9
Singapore	**67** (0.2)	**134** (0.3)	**247** (0.4)	**335** (0.4)	**449** (0.4)	**522** (0.3)	6.1	3.9	3.0	1.5	2.7
Thailand	**135** (0.4)	**209** (0.4)	**340** (0.5)	**465** (0.5)	**670** (0.6)	**910** (0.6)	4.3	4.0	3.7	3.1	3.6
Viet Nam	**29** (0.1)	**61** (0.1)	**130** (0.2)	**205** (0.2)	**382** (0.3)	**610** (0.4)	7.0	5.9	6.4	4.8	5.7
Asia excl. Japan	**2,845** (7.7)	**5,565** (11.4)	**13,237** (19.5)	**21,542** (24.6)	**35,830** (30.0)	**53,355** (34.6)	7.2	6.3	5.2	4.1	5.1
North America	**10,036** (27.2)	**14,027** (28.8)	**17,303** (25.5)	**21,237** (24.2)	**27,001** (22.6)	**32,507** (21.1)	2.5	2.6	2.4	1.9	2.3
United States	**9,054** (24.5)	**12,717** (26.2)	**15,658** (23.1)	**19,280** (22.0)	**24,593** (20.6)	**29,621** (19.2)	2.5	2.6	2.5	1.9	2.3
Latin America	**2,714** (7.3)	**3,665** (7.5)	**5,446** (8.0)	**6,975** (7.9)	**9,664** (8.1)	**12,418** (8.0)	3.2	3.1	3.3	2.5	3.0
OECD Europe	**12,172** (33.0)	**15,317** (31.5)	**18,000** (26.5)	**20,510** (23.4)	**24,203** (20.3)	**27,543** (17.9)	1.8	1.6	1.7	1.3	1.5
European Union	**11,433** (31.0)	**14,229** (29.3)	**16,542** (24.4)	**18,848** (21.5)	**22,299** (18.7)	**25,446** (16.5)	1.7	1.6	1.7	1.3	1.6
Non-OECD Europe	**2,167** (5.9)	**1,507** (3.1)	**2,644** (3.9)	**3,223** (3.7)	**4,455** (3.7)	**5,642** (3.7)	0.9	2.5	3.3	2.4	2.7
Africa	**819** (2.2)	**1,075** (2.2)	**1,847** (2.7)	**2,660** (3.0)	**4,102** (3.4)	**6,125** (4.0)	3.8	4.7	4.4	4.1	4.4
Middle East	**919** (2.5)	**1,393** (2.9)	**2,449** (3.6)	**3,328** (3.8)	**4,506** (3.8)	**5,717** (3.7)	4.6	3.9	3.1	2.4	3.1
Oceania	**715** (1.9)	**989** (2.0)	**1,407** (2.1)	**1,765** (2.0)	**2,243** (1.9)	**2,704** (1.8)	3.1	2.9	2.4	1.9	2.4
OECD	**28,548** (77.3)	**37,129** (76.3)	**44,727** (65.9)	**53,245** (60.7)	**65,257** (54.6)	**76,636** (49.7)	2.1	2.2	2.1	1.6	1.9
Non-OECD	**8,391** (22.7)	**11,503** (23.7)	**23,177** (34.1)	**34,494** (39.3)	**54,169** (45.4)	**77,654** (50.3)	4.7	5.1	4.6	3.7	4.4

Source: World Bank "World Development Indicators", etc. (historical)

Note: Figures in parentheses are global shares (%).

Table 5 International energy prices

Real prices			2013	2020	2030	2040
Crude oil		$2013/bbl	110	116	122	127
Natural gas	Japan	$2013/MBtu	16.1	13.6	14.0	14.5
	Europe	$2013/MBtu	10.6	10.9	11.5	12.8
	United States	$2013/MBtu	3.7	4.4	6.0	7.7
Steam coal		$2013/t	112	123	134	140
Nominal prices			**2013**	**2020**	**2030**	**2040**
Crude oil		$/bbl	110	133	171	217
Natural gas	Japan	$/MBtu	16.1	15.6	19.6	24.8
	Europe	$/MBtu	10.6	12.5	16.1	21.8
	United States	$/MBtu	3.7	5.1	8.4	13.1
Steam coal		$/t	112	141	188	238

Note: 2% per annum of inflation rates are assumed.

Table 6 Primary energy consumption [Reference Scenario]

(Mtoe)

							CAGR (%)				
	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**8,780** (100)	**10,079** (100)	**13,371** (100)	**15,259** (100)	**17,413** (100)	**19,276** (100)	1.9	1.7	1.3	1.0	1.3
Asia	**2,119** (24.1)	**2,936** (29.1)	**5,268** (39.4)	**6,403** (42.0)	**7,638** (43.9)	**8,794** (45.6)	4.2	2.5	1.8	1.4	1.8
China	**871** (9.9)	**1,161** (11.5)	**2,894** (21.6)	**3,505** (23.0)	**4,069** (23.4)	**4,474** (23.2)	5.6	2.4	1.5	1.0	1.6
India	**316** (3.6)	**456** (4.5)	**788** (5.9)	**1,007** (6.6)	**1,351** (7.8)	**1,814** (9.4)	4.2	3.1	3.0	3.0	3.0
Japan	**439** (5.0)	**519** (5.1)	**452** (3.4)	**457** (3.0)	**440** (2.5)	**416** (2.2)	0.1	0.1	-0.4	-0.6	-0.3
Korea	**93** (1.1)	**188** (1.9)	**263** (2.0)	**294** (1.9)	**324** (1.9)	**326** (1.7)	4.9	1.4	1.0	0.0	0.8
Chinese Taipei	**48** (0.5)	**85** (0.8)	**105** (0.8)	**116** (0.8)	**121** (0.7)	**120** (0.6)	3.6	1.3	0.4	-0.1	0.5
ASEAN	**233** (2.7)	**380** (3.8)	**573** (4.3)	**772** (5.1)	**1,007** (5.8)	**1,248** (6.5)	4.2	3.8	2.7	2.2	2.8
Indonesia	**99** (1.1)	**156** (1.5)	**214** (1.6)	**310** (2.0)	**403** (2.3)	**507** (2.6)	3.6	4.8	2.7	2.3	3.1
Malaysia	**22** (0.3)	**49** (0.5)	**81** (0.6)	**106** (0.7)	**134** (0.8)	**160** (0.8)	6.1	3.4	2.4	1.8	2.5
Myanmar	**11** (0.1)	**13** (0.1)	**15** (0.1)	**18** (0.1)	**24** (0.1)	**30** (0.2)	1.6	2.4	2.6	2.6	2.5
Philippines	**29** (0.3)	**40** (0.4)	**43** (0.3)	**55** (0.4)	**72** (0.4)	**93** (0.5)	1.8	3.2	2.8	2.6	2.8
Singapore	**12** (0.1)	**19** (0.2)	**25** (0.2)	**30** (0.2)	**37** (0.2)	**41** (0.2)	3.6	2.4	2.0	1.1	1.8
Thailand	**42** (0.5)	**72** (0.7)	**127** (0.9)	**161** (1.1)	**200** (1.1)	**237** (1.2)	5.1	3.1	2.2	1.7	2.3
Viet Nam	**18** (0.2)	**29** (0.3)	**65** (0.5)	**86** (0.6)	**132** (0.8)	**174** (0.9)	6.0	3.6	4.3	2.8	3.6
Asia excl. Japan	**1,680** (19.1)	**2,417** (24.0)	**4,816** (36.0)	**5,946** (39.0)	**7,198** (41.3)	**8,378** (43.5)	4.9	2.7	1.9	1.5	2.0
North America	**2,124** (24.2)	**2,525** (25.0)	**2,392** (17.9)	**2,485** (16.3)	**2,533** (14.5)	**2,506** (13.0)	0.5	0.5	0.2	-0.1	0.2
United States	**1,915** (21.8)	**2,273** (22.6)	**2,141** (16.0)	**2,219** (14.5)	**2,244** (12.9)	**2,201** (11.4)	0.5	0.4	0.1	-0.2	0.1
Latin America	**468** (5.3)	**600** (6.0)	**837** (6.3)	**1,018** (6.7)	**1,279** (7.3)	**1,492** (7.7)	2.7	2.5	2.3	1.6	2.1
OECD Europe	**1,619** (18.4)	**1,746** (17.3)	**1,745** (13.1)	**1,818** (11.9)	**1,863** (10.7)	**1,879** (9.7)	0.3	0.5	0.2	0.1	0.3
European Union	**1,645** (18.7)	**1,693** (16.8)	**1,644** (12.3)	**1,716** (11.2)	**1,758** (10.1)	**1,778** (9.2)	0.0	0.5	0.2	0.1	0.3
Non-OECD Europe	**1,537** (17.5)	**1,003** (10.0)	**1,194** (8.9)	**1,225** (8.0)	**1,337** (7.7)	**1,427** (7.4)	-1.1	0.3	0.9	0.7	0.6
Africa	**391** (4.5)	**497** (4.9)	**733** (5.5)	**895** (5.9)	**1,084** (6.2)	**1,272** (6.6)	2.9	2.5	1.9	1.6	2.0
Middle East	**222** (2.5)	**375** (3.7)	**705** (5.3)	**841** (5.5)	**1,014** (5.8)	**1,165** (6.0)	5.4	2.2	1.9	1.4	1.8
Oceania	**99** (1.1)	**125** (1.2)	**147** (1.1)	**156** (1.0)	**162** (0.9)	**165** (0.9)	1.8	0.7	0.4	0.2	0.4
OECD	**4,511** (51.4)	**5,273** (52.3)	**5,225** (39.1)	**5,481** (35.9)	**5,646** (32.4)	**5,670** (29.4)	0.7	0.6	0.3	0.0	0.3
Non-OECD	**4,068** (46.3)	**4,534** (45.0)	**7,795** (58.3)	**9,361** (61.3)	**11,263** (64.7)	**13,030** (67.6)	3.0	2.3	1.9	1.5	1.9

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%). World includes international bunkers.

Table 7 Primary energy consumption, coal [Reference Scenario]

(Mtoe)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**2,231** (100)	**2,358** (100)	**3,879** (100)	**4,112** (100)	**4,433** (100)	**4,705** (100)	2.5	0.7	0.8	0.6	0.7
Asia	**796** (35.7)	**1,078** (45.7)	**2,669** (68.8)	**2,948** (71.7)	**3,291** (74.2)	**3,605** (76.6)	5.7	1.2	1.1	0.9	1.1
China	**528** (23.7)	**691** (29.3)	**1,969** (50.8)	**2,133** (51.9)	**2,245** (50.6)	**2,274** (48.3)	6.2	1.0	0.5	0.1	0.5
India	**103** (4.6)	**161** (6.8)	**354** (9.1)	**425** (10.3)	**568** (12.8)	**776** (16.5)	5.8	2.3	2.9	3.2	2.8
Japan	**77** (3.4)	**97** (4.1)	**112** (2.9)	**101** (2.5)	**104** (2.3)	**99** (2.1)	1.7	-1.3	0.3	-0.5	-0.4
Korea	**25** (1.1)	**42** (1.8)	**77** (2.0)	**81** (2.0)	**92** (2.1)	**94** (2.0)	5.2	0.6	1.3	0.1	0.7
Chinese Taipei	**11** (0.5)	**30** (1.3)	**40** (1.0)	**40** (1.0)	**39** (0.9)	**34** (0.7)	5.8	0.2	-0.4	-1.3	-0.5
ASEAN	**13** (0.6)	**32** (1.4)	**89** (2.3)	**130** (3.2)	**197** (4.4)	**272** (5.8)	9.3	4.9	4.2	3.3	4.1
Indonesia	**4** (0.2)	**12** (0.5)	**30** (0.8)	**51** (1.2)	**84** (1.9)	**125** (2.7)	10.2	6.9	5.1	4.1	5.3
Malaysia	**1** (0.1)	**2** (0.1)	**16** (0.4)	**23** (0.6)	**30** (0.7)	**36** (0.8)	11.8	4.8	2.8	1.8	3.0
Myanmar	**0** (0.0)	**0** (0.0)	**0** (0.0)	**1** (0.0)	**1** (0.0)	**2** (0.0)	9.4	1.5	5.8	5.0	4.3
Philippines	**2** (0.1)	**5** (0.2)	**9** (0.2)	**12** (0.3)	**18** (0.4)	**27** (0.6)	8.4	3.6	4.6	3.8	4.0
Singapore	**0** (0.0)	**-** (-)	**0** (0.0)	**0** (0.0)	**0** (0.0)	**0** (0.0)	-4.7	-9.7	4.3	1.9	-0.7
Thailand	**4** (0.2)	**8** (0.3)	**17** (0.4)	**21** (0.5)	**27** (0.6)	**33** (0.7)	7.1	2.3	2.5	2.2	2.3
Viet Nam	**2** (0.1)	**4** (0.2)	**17** (0.4)	**23** (0.6)	**37** (0.8)	**49** (1.0)	9.5	4.3	4.7	2.9	4.0
Asia excl. Japan	**719** (32.2)	**981** (41.6)	**2,557** (65.9)	**2,847** (69.2)	**3,188** (71.9)	**3,506** (74.5)	5.9	1.4	1.1	1.0	1.1
North America	**485** (21.7)	**565** (24.0)	**443** (11.4)	**409** (9.9)	**355** (8.0)	**299** (6.3)	-0.4	-1.0	-1.4	-1.7	-1.4
United States	**460** (20.6)	**534** (22.6)	**425** (11.0)	**395** (9.6)	**347** (7.8)	**292** (6.2)	-0.4	-0.9	-1.3	-1.7	-1.3
Latin America	**20** (0.9)	**27** (1.2)	**37** (1.0)	**46** (1.1)	**64** (1.4)	**79** (1.7)	2.8	2.7	3.2	2.2	2.7
OECD Europe	**449** (20.1)	**330** (14.0)	**315** (8.1)	**292** (7.1)	**286** (6.5)	**268** (5.7)	-1.6	-0.9	-0.2	-0.7	-0.6
European Union	**456** (20.4)	**321** (13.6)	**294** (7.6)	**274** (6.7)	**270** (6.1)	**251** (5.3)	-2.0	-0.9	-0.2	-0.7	-0.6
Non-OECD Europe	**367** (16.5)	**209** (8.9)	**248** (6.4)	**227** (5.5)	**225** (5.1)	**222** (4.7)	-1.8	-1.1	-0.1	-0.1	-0.4
Africa	**74** (3.3)	**90** (3.8)	**105** (2.7)	**123** (3.0)	**141** (3.2)	**162** (3.4)	1.6	1.9	1.4	1.4	1.6
Middle East	**3** (0.1)	**8** (0.3)	**12** (0.3)	**16** (0.4)	**22** (0.5)	**28** (0.6)	6.3	4.5	2.9	2.4	3.2
Oceania	**36** (1.6)	**49** (2.1)	**48** (1.2)	**51** (1.2)	**48** (1.1)	**43** (0.9)	1.3	0.6	-0.5	-1.1	-0.4
OECD	**1,078** (48.3)	**1,094** (46.4)	**1,011** (26.1)	**954** (23.2)	**918** (20.7)	**845** (18.0)	-0.3	-0.7	-0.4	-0.8	-0.6
Non-OECD	**1,152** (51.7)	**1,264** (53.6)	**2,867** (73.9)	**3,157** (76.8)	**3,516** (79.3)	**3,860** (82.0)	4.2	1.2	1.1	0.9	1.1

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%). World includes international bunkers.

Table 8 Primary energy consumption, oil [Reference Scenario]

(Mtoe)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**3,231** (100)	**3,658** (100)	**4,205** (100)	**4,608** (100)	**5,165** (100)	**5,639** (100)	1.2	1.2	1.1	0.9	1.1
Asia	**618** (19.1)	**917** (25.1)	**1,243** (29.6)	**1,498** (32.5)	**1,803** (34.9)	**2,096** (37.2)	3.2	2.4	1.9	1.5	1.9
China	**119** (3.7)	**221** (6.0)	**464** (11.0)	**620** (13.5)	**766** (14.8)	**877** (15.6)	6.4	3.7	2.1	1.4	2.3
India	**61** (1.9)	**112** (3.1)	**177** (4.2)	**242** (5.2)	**338** (6.5)	**445** (7.9)	5.0	4.0	3.4	2.8	3.3
Japan	**250** (7.8)	**255** (7.0)	**210** (5.0)	**178** (3.9)	**156** (3.0)	**139** (2.5)	-0.8	-2.0	-1.4	-1.1	-1.5
Korea	**50** (1.5)	**99** (2.7)	**97** (2.3)	**97** (2.1)	**97** (1.9)	**95** (1.7)	3.1	0.0	0.0	-0.2	-0.1
Chinese Taipei	**26** (0.8)	**38** (1.0)	**39** (0.9)	**42** (0.9)	**44** (0.9)	**43** (0.8)	1.9	1.1	0.4	-0.1	0.4
ASEAN	**88** (2.7)	**153** (4.2)	**209** (5.0)	**263** (5.7)	**333** (6.5)	**411** (7.3)	4.0	2.9	2.4	2.1	2.4
Indonesia	**33** (1.0)	**58** (1.6)	**77** (1.8)	**95** (2.1)	**122** (2.4)	**154** (2.7)	3.9	2.7	2.5	2.3	2.5
Malaysia	**11** (0.4)	**19** (0.5)	**29** (0.7)	**33** (0.7)	**37** (0.7)	**41** (0.7)	4.3	1.7	1.2	1.0	1.3
Myanmar	**1** (0.0)	**2** (0.1)	**2** (0.1)	**3** (0.1)	**4** (0.1)	**7** (0.1)	5.1	2.8	4.6	4.9	4.2
Philippines	**11** (0.3)	**16** (0.4)	**14** (0.3)	**17** (0.4)	**21** (0.4)	**27** (0.5)	1.1	2.4	2.6	2.3	2.4
Singapore	**11** (0.4)	**17** (0.5)	**17** (0.4)	**21** (0.5)	**26** (0.5)	**30** (0.5)	1.9	2.4	2.2	1.4	2.0
Thailand	**18** (0.6)	**32** (0.9)	**49** (1.2)	**66** (1.4)	**79** (1.5)	**92** (1.6)	4.7	3.9	1.8	1.5	2.3
Viet Nam	**3** (0.1)	**8** (0.2)	**20** (0.5)	**28** (0.6)	**42** (0.8)	**60** (1.1)	9.6	4.0	4.3	3.5	3.9
Asia excl. Japan	**368** (11.4)	**662** (18.1)	**1,032** (24.6)	**1,320** (28.6)	**1,647** (31.9)	**1,957** (34.7)	4.8	3.1	2.2	1.7	2.3
North America	**833** (25.8)	**958** (26.2)	**854** (20.3)	**828** (18.0)	**817** (15.8)	**801** (14.2)	0.1	-0.4	-0.1	-0.2	-0.2
United States	**757** (23.4)	**871** (23.8)	**771** (18.3)	**740** (16.1)	**721** (14.0)	**697** (12.4)	0.1	-0.5	-0.3	-0.3	-0.4
Latin America	**237** (7.3)	**303** (8.3)	**388** (9.2)	**430** (9.3)	**507** (9.8)	**561** (10.0)	2.3	1.3	1.7	1.0	1.3
OECD Europe	**606** (18.8)	**650** (17.8)	**559** (13.3)	**544** (11.8)	**532** (10.3)	**510** (9.0)	-0.4	-0.3	-0.2	-0.4	-0.3
European Union	**606** (18.8)	**623** (17.0)	**526** (12.5)	**515** (11.2)	**505** (9.8)	**487** (8.6)	-0.6	-0.3	-0.2	-0.4	-0.3
Non-OECD Europe	**468** (14.5)	**203** (5.5)	**252** (6.0)	**259** (5.6)	**282** (5.5)	**296** (5.3)	-2.8	0.4	0.8	0.5	0.6
Africa	**86** (2.7)	**98** (2.7)	**160** (3.8)	**190** (4.1)	**220** (4.3)	**249** (4.4)	2.8	2.2	1.5	1.3	1.6
Middle East	**146** (4.5)	**217** (5.9)	**349** (8.3)	**402** (8.7)	**474** (9.2)	**532** (9.4)	4.0	1.8	1.7	1.2	1.5
Oceania	**35** (1.1)	**40** (1.1)	**51** (1.2)	**47** (1.0)	**50** (1.0)	**53** (0.9)	1.7	-1.0	0.7	0.5	0.1
OECD	**1,861** (57.6)	**2,103** (57.5)	**1,888** (44.9)	**1,823** (39.6)	**1,793** (34.7)	**1,749** (31.0)	0.1	-0.4	-0.2	-0.2	-0.3
Non-OECD	**1,169** (36.2)	**1,283** (35.1)	**1,966** (46.8)	**2,377** (51.6)	**2,891** (56.0)	**3,349** (59.4)	2.4	2.4	2.0	1.5	1.9

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%). World includes international bunkers.

Table 9 Primary energy consumption, natural gas [Reference Scenario]

(Mtoe)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**1,667** (100)	**2,073** (100)	**2,844** (100)	**3,446** (100)	**4,207** (100)	**4,856** (100)	2.5	2.4	2.0	1.4	1.9
Asia	**116** (6.9)	**232** (11.2)	**507** (17.8)	**738** (21.4)	**1,094** (26.0)	**1,434** (29.5)	6.9	4.8	4.0	2.7	3.8
China	**13** (0.8)	**21** (1.0)	**121** (4.2)	**264** (7.7)	**460** (10.9)	**622** (12.8)	10.7	10.3	5.7	3.1	6.0
India	**11** (0.6)	**23** (1.1)	**49** (1.7)	**78** (2.3)	**133** (3.2)	**220** (4.5)	7.2	6.1	5.4	5.2	5.5
Japan	**44** (2.6)	**66** (3.2)	**105** (3.7)	**93** (2.7)	**105** (2.5)	**106** (2.2)	4.0	-1.6	1.2	0.1	0.0
Korea	**3** (0.2)	**17** (0.8)	**45** (1.6)	**48** (1.4)	**53** (1.3)	**51** (1.1)	13.6	0.8	1.0	-0.2	0.5
Chinese Taipei	**1** (0.1)	**6** (0.3)	**13** (0.5)	**20** (0.6)	**26** (0.6)	**30** (0.6)	10.8	5.0	2.8	1.4	2.9
ASEAN	**30** (1.8)	**74** (3.6)	**126** (4.4)	**168** (4.9)	**225** (5.3)	**283** (5.8)	6.7	3.7	3.0	2.3	3.0
Indonesia	**16** (0.9)	**27** (1.3)	**35** (1.2)	**49** (1.4)	**67** (1.6)	**90** (1.9)	3.7	4.2	3.3	3.0	3.4
Malaysia	**7** (0.4)	**25** (1.2)	**32** (1.1)	**47** (1.4)	**59** (1.4)	**70** (1.4)	7.4	4.6	2.4	1.7	2.8
Myanmar	**1** (0.0)	**1** (0.1)	**1** (0.0)	**3** (0.1)	**6** (0.1)	**9** (0.2)	2.2	12.4	6.2	4.3	7.2
Philippines	**-** (-)	**0** (0.0)	**3** (0.1)	**5** (0.1)	**8** (0.2)	**12** (0.2)	-	5.6	4.9	3.9	4.7
Singapore	**-** (-)	**1** (0.1)	**7** (0.3)	**7** (0.2)	**8** (0.2)	**8** (0.2)	-	-0.3	0.9	-0.2	0.2
Thailand	**5** (0.3)	**17** (0.8)	**35** (1.2)	**42** (1.2)	**55** (1.3)	**69** (1.4)	9.3	2.2	2.8	2.2	2.4
Viet Nam	**0** (0.0)	**1** (0.1)	**8** (0.3)	**11** (0.3)	**18** (0.4)	**23** (0.5)	43.9	4.4	4.6	2.5	3.8
Asia excl. Japan	**72** (4.3)	**167** (8.0)	**401** (14.1)	**645** (18.7)	**989** (23.5)	**1,329** (27.4)	8.2	6.1	4.4	3.0	4.4
North America	**493** (29.6)	**622** (30.0)	**679** (23.9)	**777** (22.5)	**838** (19.9)	**849** (17.5)	1.5	1.7	0.8	0.1	0.8
United States	**438** (26.3)	**548** (26.4)	**596** (20.9)	**682** (19.8)	**736** (17.5)	**741** (15.3)	1.4	1.7	0.8	0.1	0.8
Latin America	**76** (4.6)	**117** (5.7)	**197** (6.9)	**265** (7.7)	**361** (8.6)	**444** (9.2)	4.4	3.8	3.2	2.1	2.9
OECD Europe	**260** (15.6)	**393** (19.0)	**417** (14.7)	**469** (13.6)	**509** (12.1)	**520** (10.7)	2.2	1.5	0.8	0.2	0.8
European Union	**297** (17.8)	**396** (19.1)	**392** (13.8)	**441** (12.8)	**479** (11.4)	**491** (10.1)	1.3	1.5	0.8	0.2	0.8
Non-OECD Europe	**603** (36.1)	**488** (23.6)	**570** (20.0)	**594** (17.2)	**641** (15.2)	**681** (14.0)	-0.3	0.5	0.8	0.6	0.6
Africa	**30** (1.8)	**47** (2.3)	**100** (3.5)	**144** (4.2)	**208** (5.0)	**281** (5.8)	5.7	4.7	3.8	3.0	3.8
Middle East	**72** (4.3)	**148** (7.2)	**340** (12.0)	**413** (12.0)	**493** (11.7)	**568** (11.7)	7.3	2.5	1.8	1.4	1.8
Oceania	**19** (1.1)	**24** (1.2)	**34** (1.2)	**37** (1.1)	**40** (0.9)	**42** (0.9)	2.7	1.3	0.7	0.5	0.8
OECD	**843** (50.5)	**1,156** (55.8)	**1,343** (47.2)	**1,504** (43.6)	**1,645** (39.1)	**1,689** (34.8)	2.1	1.4	0.9	0.3	0.8
Non-OECD	**824** (49.5)	**917** (44.2)	**1,501** (52.8)	**1,932** (56.1)	**2,539** (60.3)	**3,130** (64.5)	2.8	3.2	2.8	2.1	2.7

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%). World includes international bunkers.

Table 10 Final energy consumption [Reference Scenario]

(Mtoe)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**6,288** (100)	**7,088** (100)	**8,979** (100)	**10,313** (100)	**11,869** (100)	**13,254** (100)	1.6	1.7	1.4	1.1	1.4
Asia	**1,579** (25.1)	**2,042** (28.8)	**3,323** (37.0)	**4,052** (39.3)	**4,877** (41.1)	**5,681** (42.9)	3.4	2.5	1.9	1.5	1.9
China	**664** (10.6)	**816** (11.5)	**1,702** (19.0)	**2,099** (20.4)	**2,464** (20.8)	**2,745** (20.7)	4.4	2.7	1.6	1.1	1.7
India	**250** (4.0)	**318** (4.5)	**512** (5.7)	**660** (6.4)	**874** (7.4)	**1,161** (8.8)	3.3	3.2	2.8	2.9	3.0
Japan	**298** (4.7)	**341** (4.8)	**309** (3.4)	**302** (2.9)	**291** (2.5)	**277** (2.1)	0.2	-0.3	-0.4	-0.5	-0.4
Korea	**65** (1.0)	**127** (1.8)	**166** (1.9)	**180** (1.7)	**193** (1.6)	**195** (1.5)	4.4	1.0	0.7	0.1	0.6
Chinese Taipei	**29** (0.5)	**49** (0.7)	**65** (0.7)	**73** (0.7)	**78** (0.7)	**79** (0.6)	3.7	1.5	0.6	0.1	0.7
ASEAN	**173** (2.8)	**271** (3.8)	**412** (4.6)	**526** (5.1)	**697** (5.9)	**877** (6.6)	4.0	3.1	2.8	2.3	2.7
Indonesia	**80** (1.3)	**121** (1.7)	**160** (1.8)	**208** (2.0)	**278** (2.3)	**359** (2.7)	3.2	3.4	2.9	2.6	2.9
Malaysia	**14** (0.2)	**30** (0.4)	**49** (0.6)	**62** (0.6)	**79** (0.7)	**95** (0.7)	5.9	2.9	2.4	1.9	2.4
Myanmar	**9** (0.1)	**11** (0.2)	**14** (0.2)	**17** (0.2)	**21** (0.2)	**27** (0.2)	2.0	1.8	2.2	2.5	2.2
Philippines	**20** (0.3)	**24** (0.3)	**24** (0.3)	**30** (0.3)	**40** (0.3)	**52** (0.4)	0.9	2.9	2.9	2.6	2.8
Singapore	**5** (0.1)	**8** (0.1)	**16** (0.2)	**20** (0.2)	**26** (0.2)	**29** (0.2)	5.4	3.0	2.4	1.3	2.2
Thailand	**29** (0.5)	**51** (0.7)	**92** (1.0)	**113** (1.1)	**140** (1.2)	**168** (1.3)	5.4	2.5	2.2	1.8	2.2
Viet Nam	**16** (0.3)	**25** (0.4)	**54** (0.6)	**74** (0.7)	**111** (0.9)	**145** (1.1)	5.7	4.0	4.2	2.7	3.6
Asia excl. Japan	**1,281** (20.4)	**1,701** (24.0)	**3,014** (33.6)	**3,750** (36.4)	**4,586** (38.6)	**5,405** (40.8)	4.0	2.8	2.0	1.7	2.1
North America	**1,452** (23.1)	**1,736** (24.5)	**1,641** (18.3)	**1,716** (16.6)	**1,766** (14.9)	**1,766** (13.3)	0.6	0.6	0.3	0.0	0.3
United States	**1,294** (20.6)	**1,546** (21.8)	**1,433** (16.0)	**1,497** (14.5)	**1,530** (12.9)	**1,516** (11.4)	0.5	0.5	0.2	-0.1	0.2
Latin America	**346** (5.5)	**452** (6.4)	**607** (6.8)	**730** (7.1)	**912** (7.7)	**1,061** (8.0)	2.6	2.3	2.2	1.5	2.0
OECD Europe	**1,122** (17.8)	**1,226** (17.3)	**1,218** (13.6)	**1,283** (12.4)	**1,320** (11.1)	**1,331** (10.0)	0.4	0.6	0.3	0.1	0.3
European Union	**1,129** (18.0)	**1,175** (16.6)	**1,139** (12.7)	**1,203** (11.7)	**1,242** (10.5)	**1,257** (9.5)	0.0	0.7	0.3	0.1	0.4
Non-OECD Europe	**1,073** (17.1)	**654** (9.2)	**742** (8.3)	**796** (7.7)	**903** (7.6)	**996** (7.5)	-1.7	0.9	1.3	1.0	1.1
Africa	**292** (4.6)	**371** (5.2)	**539** (6.0)	**655** (6.4)	**785** (6.6)	**919** (6.9)	2.8	2.5	1.8	1.6	1.9
Middle East	**157** (2.5)	**254** (3.6)	**468** (5.2)	**561** (5.4)	**692** (5.8)	**807** (6.1)	5.1	2.3	2.1	1.6	2.0
Oceania	**66** (1.1)	**83** (1.2)	**92** (1.0)	**101** (1.0)	**109** (0.9)	**116** (0.9)	1.5	1.1	0.8	0.6	0.8
OECD	**3,099** (49.3)	**3,631** (51.2)	**3,568** (39.7)	**3,747** (36.3)	**3,873** (32.6)	**3,903** (29.4)	0.6	0.6	0.3	0.1	0.3
Non-OECD	**2,988** (47.5)	**3,185** (44.9)	**5,061** (56.4)	**6,148** (59.6)	**7,492** (63.1)	**8,775** (66.2)	2.4	2.5	2.0	1.6	2.0

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%). World includes international bunkers.

Table 11 Final energy consumption, industry [Reference Scenario]

(Mtoe)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**1,805** (100)	**1,889** (100)	**2,541** (100)	**2,929** (100)	**3,364** (100)	**3,782** (100)	1.6	1.8	1.4	1.2	1.4
Asia	**520** (28.8)	**672** (35.6)	**1,284** (50.5)	**1,527** (52.1)	**1,758** (52.3)	**1,996** (52.8)	4.2	2.2	1.4	1.3	1.6
China	**244** (13.5)	**329** (17.4)	**810** (31.9)	**923** (31.5)	**980** (29.1)	**1,022** (27.0)	5.6	1.6	0.6	0.4	0.8
India	**69** (3.8)	**83** (4.4)	**168** (6.6)	**226** (7.7)	**309** (9.2)	**421** (11.1)	4.1	3.8	3.2	3.2	3.3
Japan	**101** (5.6)	**96** (5.1)	**82** (3.2)	**84** (2.9)	**83** (2.5)	**81** (2.2)	-0.9	0.4	-0.2	-0.2	0.0
Korea	**19** (1.1)	**38** (2.0)	**47** (1.9)	**53** (1.8)	**58** (1.7)	**58** (1.5)	4.2	1.4	0.8	0.1	0.7
Chinese Taipei	**12** (0.7)	**19** (1.0)	**22** (0.9)	**25** (0.9)	**26** (0.8)	**26** (0.7)	2.8	1.3	0.3	0.0	0.5
ASEAN	**43** (2.4)	**76** (4.0)	**115** (4.5)	**160** (5.5)	**227** (6.8)	**292** (7.7)	4.6	4.2	3.6	2.5	3.4
Indonesia	**18** (1.0)	**31** (1.6)	**37** (1.5)	**57** (1.9)	**80** (2.4)	**107** (2.8)	3.3	5.4	3.5	2.9	3.8
Malaysia	**6** (0.3)	**12** (0.6)	**14** (0.6)	**20** (0.7)	**26** (0.8)	**32** (0.8)	4.4	4.1	2.8	2.1	2.9
Myanmar	**0** (0.0)	**1** (0.1)	**2** (0.1)	**2** (0.1)	**4** (0.1)	**6** (0.2)	7.1	4.3	4.3	4.2	4.3
Philippines	**5** (0.3)	**5** (0.3)	**6** (0.3)	**8** (0.3)	**11** (0.3)	**15** (0.4)	1.4	3.3	3.2	2.9	3.1
Singapore	**1** (0.0)	**2** (0.1)	**5** (0.2)	**7** (0.2)	**8** (0.3)	**10** (0.3)	10.2	3.3	2.4	1.3	2.3
Thailand	**9** (0.5)	**17** (0.9)	**29** (1.1)	**36** (1.2)	**48** (1.4)	**62** (1.6)	5.7	2.7	3.0	2.5	2.7
Viet Nam	**5** (0.3)	**8** (0.4)	**20** (0.8)	**30** (1.0)	**49** (1.5)	**61** (1.6)	7.1	4.8	5.2	2.2	4.0
Asia excl. Japan	**420** (23.2)	**575** (30.5)	**1,202** (47.3)	**1,442** (49.2)	**1,675** (49.8)	**1,914** (50.6)	4.9	2.3	1.5	1.3	1.7
North America	**331** (18.3)	**387** (20.5)	**307** (12.1)	**322** (11.0)	**325** (9.7)	**319** (8.4)	-0.3	0.6	0.1	-0.2	0.1
United States	**284** (15.7)	**332** (17.6)	**248** (9.8)	**257** (8.8)	**257** (7.6)	**247** (6.5)	-0.6	0.4	0.0	-0.4	0.0
Latin America	**116** (6.4)	**150** (7.9)	**196** (7.7)	**242** (8.3)	**317** (9.4)	**388** (10.3)	2.4	2.6	2.7	2.0	2.5
OECD Europe	**322** (17.9)	**324** (17.2)	**288** (11.3)	**305** (10.4)	**312** (9.3)	**316** (8.4)	-0.5	0.7	0.2	0.1	0.3
European Union	**343** (19.0)	**309** (16.3)	**264** (10.4)	**279** (9.5)	**288** (8.6)	**294** (7.8)	-1.2	0.7	0.3	0.2	0.4
Non-OECD Europe	**396** (22.0)	**206** (10.9)	**228** (9.0)	**240** (8.2)	**285** (8.5)	**327** (8.7)	-2.5	0.7	1.7	1.4	1.3
Africa	**55** (3.0)	**58** (3.1)	**82** (3.2)	**110** (3.8)	**140** (4.2)	**170** (4.5)	1.9	3.7	2.4	2.0	2.6
Middle East	**42** (2.3)	**64** (3.4)	**127** (5.0)	**154** (5.2)	**195** (5.8)	**233** (6.2)	5.2	2.4	2.4	1.8	2.2
Oceania	**23** (1.3)	**28** (1.5)	**28** (1.1)	**30** (1.0)	**32** (0.9)	**33** (0.9)	0.9	1.1	0.5	0.4	0.7
OECD	**826** (45.8)	**909** (48.1)	**791** (31.1)	**841** (28.7)	**867** (25.8)	**876** (23.2)	-0.2	0.8	0.3	0.1	0.4
Non-OECD	**979** (54.2)	**980** (51.9)	**1,749** (68.9)	**2,089** (71.3)	**2,497** (74.2)	**2,906** (76.8)	2.7	2.2	1.8	1.5	1.8

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%).

Table 12 Final energy consumption, transport [Reference Scenario]

(Mtoe)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**1,575** (100)	**1,964** (100)	**2,507** (100)	**2,879** (100)	**3,316** (100)	**3,674** (100)	2.1	1.7	1.4	1.0	1.4
Asia	**191** (12.1)	**326** (16.6)	**559** (22.3)	**738** (25.6)	**956** (28.8)	**1,176** (32.0)	5.0	3.5	2.6	2.1	2.7
China	**34** (2.2)	**88** (4.5)	**238** (9.5)	**355** (12.3)	**470** (14.2)	**566** (15.4)	9.3	5.1	2.8	1.9	3.1
India	**21** (1.3)	**32** (1.6)	**74** (2.9)	**101** (3.5)	**149** (4.5)	**209** (5.7)	5.9	4.0	4.0	3.5	3.8
Japan	**72** (4.6)	**88** (4.5)	**75** (3.0)	**68** (2.4)	**60** (1.8)	**53** (1.5)	0.2	-1.1	-1.2	-1.2	-1.2
Korea	**15** (0.9)	**26** (1.3)	**30** (1.2)	**29** (1.0)	**29** (0.9)	**28** (0.8)	3.4	-0.4	-0.2	-0.2	-0.2
Chinese Taipei	**7** (0.4)	**12** (0.6)	**12** (0.5)	**14** (0.5)	**15** (0.5)	**15** (0.4)	2.8	2.0	0.7	-0.2	0.7
ASEAN	**32** (2.1)	**62** (3.1)	**104** (4.2)	**136** (4.7)	**185** (5.6)	**240** (6.5)	5.5	3.4	3.1	2.7	3.0
Indonesia	**11** (0.7)	**22** (1.1)	**44** (1.8)	**60** (2.1)	**87** (2.6)	**119** (3.2)	6.6	3.9	3.9	3.2	3.6
Malaysia	**5** (0.3)	**10** (0.5)	**15** (0.6)	**17** (0.6)	**20** (0.6)	**22** (0.6)	5.2	1.8	1.5	1.0	1.4
Myanmar	**0** (0.0)	**1** (0.1)	**1** (0.0)	**2** (0.1)	**3** (0.1)	**6** (0.2)	4.0	6.3	6.2	6.1	6.2
Philippines	**5** (0.3)	**8** (0.4)	**8** (0.3)	**10** (0.4)	**14** (0.4)	**18** (0.5)	2.8	2.9	2.9	2.5	2.8
Singapore	**1** (0.1)	**2** (0.1)	**3** (0.1)	**3** (0.1)	**3** (0.1)	**3** (0.1)	2.9	2.4	1.0	0.2	1.1
Thailand	**9** (0.6)	**15** (0.7)	**22** (0.9)	**27** (0.9)	**32** (1.0)	**35** (1.0)	4.1	2.8	1.6	1.0	1.7
Viet Nam	**1** (0.1)	**3** (0.2)	**11** (0.5)	**16** (0.6)	**25** (0.8)	**37** (1.0)	10.0	4.7	4.3	4.0	4.3
Asia excl. Japan	**119** (7.5)	**238** (12.1)	**485** (19.3)	**670** (23.3)	**896** (27.0)	**1,123** (30.6)	6.6	4.1	2.9	2.3	3.0
North America	**531** (33.7)	**640** (32.6)	**658** (26.3)	**659** (22.9)	**654** (19.7)	**632** (17.2)	1.0	0.0	-0.1	-0.3	-0.1
United States	**488** (31.0)	**588** (30.0)	**597** (23.8)	**595** (20.7)	**587** (17.7)	**562** (15.3)	0.9	0.0	-0.1	-0.4	-0.2
Latin America	**103** (6.5)	**141** (7.2)	**216** (8.6)	**265** (9.2)	**332** (10.0)	**377** (10.3)	3.4	2.6	2.3	1.3	2.0
OECD Europe	**266** (16.9)	**316** (16.1)	**322** (12.8)	**330** (11.5)	**325** (9.8)	**307** (8.3)	0.9	0.3	-0.2	-0.6	-0.2
European Union	**259** (16.4)	**304** (15.5)	**307** (12.2)	**317** (11.0)	**313** (9.4)	**297** (8.1)	0.8	0.4	-0.1	-0.5	-0.1
Non-OECD Europe	**172** (10.9)	**110** (5.6)	**144** (5.7)	**169** (5.9)	**185** (5.6)	**195** (5.3)	-0.8	2.0	0.9	0.5	1.1
Africa	**38** (2.4)	**54** (2.8)	**92** (3.7)	**112** (3.9)	**132** (4.0)	**151** (4.1)	4.1	2.5	1.6	1.3	1.8
Middle East	**50** (3.2)	**74** (3.8)	**131** (5.2)	**150** (5.2)	**188** (5.7)	**217** (5.9)	4.5	1.7	2.3	1.5	1.8
Oceania	**24** (1.5)	**30** (1.5)	**36** (1.4)	**37** (1.3)	**40** (1.2)	**43** (1.2)	1.8	0.5	0.8	0.6	0.6
OECD	**938** (59.6)	**1,142** (58.2)	**1,180** (47.1)	**1,196** (41.6)	**1,192** (36.0)	**1,156** (31.5)	1.0	0.2	0.0	-0.3	-0.1
Non-OECD	**436** (27.7)	**549** (28.0)	**977** (39.0)	**1,265** (43.9)	**1,619** (48.8)	**1,942** (52.9)	3.7	3.3	2.5	1.8	2.5

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%). World includes international bunkers.

Table 13 Final energy consumption, buildings, etc. [Reference Scenario]

(Mtoe)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**2,425** (100)	**2,610** (100)	**3,123** (100)	**3,563** (100)	**4,092** (100)	**4,556** (100)	1.2	1.7	1.4	1.1	1.4
Asia	**752** (31.0)	**855** (32.8)	**1,151** (36.9)	**1,391** (39.0)	**1,690** (41.3)	**1,962** (43.1)	2.0	2.4	2.0	1.5	1.9
China	**344** (14.2)	**337** (12.9)	**518** (16.6)	**649** (18.2)	**807** (19.7)	**915** (20.1)	1.9	2.9	2.2	1.3	2.1
India	**146** (6.0)	**176** (6.8)	**234** (7.5)	**286** (8.0)	**349** (8.5)	**438** (9.6)	2.2	2.5	2.0	2.3	2.3
Japan	**91** (3.7)	**116** (4.4)	**115** (3.7)	**115** (3.2)	**114** (2.8)	**110** (2.4)	1.1	0.0	0.0	-0.4	-0.1
Korea	**24** (1.0)	**37** (1.4)	**45** (1.5)	**46** (1.3)	**51** (1.2)	**51** (1.1)	2.9	0.2	1.0	0.0	0.4
Chinese Taipei	**7** (0.3)	**10** (0.4)	**12** (0.4)	**13** (0.4)	**13** (0.3)	**13** (0.3)	2.6	1.1	0.5	0.0	0.5
ASEAN	**87** (3.6)	**113** (4.3)	**141** (4.5)	**168** (4.7)	**209** (5.1)	**256** (5.6)	2.2	2.2	2.2	2.0	2.1
Indonesia	**44** (1.8)	**59** (2.3)	**67** (2.1)	**78** (2.2)	**95** (2.3)	**115** (2.5)	2.0	2.0	1.9	1.9	2.0
Malaysia	**3** (0.1)	**5** (0.2)	**10** (0.3)	**14** (0.4)	**19** (0.5)	**24** (0.5)	5.8	4.1	3.3	2.6	3.3
Myanmar	**8** (0.3)	**9** (0.3)	**11** (0.4)	**12** (0.3)	**14** (0.3)	**15** (0.3)	1.4	0.9	1.0	1.0	1.0
Philippines	**10** (0.4)	**10** (0.4)	**9** (0.3)	**11** (0.3)	**14** (0.4)	**19** (0.4)	-0.5	2.5	2.6	2.6	2.6
Singapore	**1** (0.0)	**2** (0.1)	**2** (0.1)	**3** (0.1)	**3** (0.1)	**4** (0.1)	3.3	1.7	2.7	1.9	2.1
Thailand	**11** (0.4)	**14** (0.5)	**22** (0.7)	**26** (0.7)	**33** (0.8)	**39** (0.9)	3.3	2.0	2.4	1.8	2.1
Viet Nam	**10** (0.4)	**14** (0.5)	**20** (0.6)	**24** (0.7)	**31** (0.8)	**40** (0.9)	3.0	2.6	2.6	2.5	2.6
Asia excl. Japan	**661** (27.2)	**739** (28.3)	**1,036** (33.2)	**1,277** (35.8)	**1,576** (38.5)	**1,852** (40.6)	2.1	2.6	2.1	1.6	2.1
North America	**457** (18.8)	**535** (20.5)	**545** (17.4)	**591** (16.6)	**622** (15.2)	**633** (13.9)	0.8	1.0	0.5	0.2	0.5
United States	**403** (16.6)	**473** (18.1)	**483** (15.5)	**528** (14.8)	**554** (13.5)	**562** (12.3)	0.8	1.1	0.5	0.1	0.5
Latin America	**101** (4.2)	**121** (4.6)	**151** (4.8)	**173** (4.8)	**204** (5.0)	**230** (5.0)	1.8	1.7	1.7	1.2	1.5
OECD Europe	**434** (17.9)	**473** (18.1)	**504** (16.1)	**532** (14.9)	**561** (13.7)	**581** (12.7)	0.7	0.7	0.5	0.3	0.5
European Union	**429** (17.7)	**453** (17.4)	**470** (15.1)	**497** (13.9)	**526** (12.9)	**546** (12.0)	0.4	0.7	0.6	0.4	0.5
Non-OECD Europe	**439** (18.1)	**289** (11.1)	**284** (9.1)	**294** (8.3)	**317** (7.7)	**335** (7.4)	-2.0	0.4	0.7	0.6	0.6
Africa	**188** (7.8)	**243** (9.3)	**344** (11.0)	**407** (11.4)	**486** (11.9)	**566** (12.4)	2.8	2.1	1.8	1.5	1.8
Middle East	**40** (1.7)	**76** (2.9)	**121** (3.9)	**149** (4.2)	**183** (4.5)	**219** (4.8)	5.1	2.7	2.1	1.8	2.1
Oceania	**15** (0.6)	**19** (0.7)	**23** (0.7)	**26** (0.7)	**29** (0.7)	**31** (0.7)	2.0	1.5	1.1	0.7	1.1
OECD	**1,045** (43.1)	**1,210** (46.3)	**1,266** (40.5)	**1,349** (37.9)	**1,423** (34.8)	**1,459** (32.0)	0.9	0.8	0.5	0.3	0.5
Non-OECD	**1,380** (56.9)	**1,400** (53.7)	**1,857** (59.5)	**2,214** (62.1)	**2,669** (65.2)	**3,097** (68.0)	1.4	2.2	1.9	1.5	1.8

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%).

Table 14 Final energy consumption, electricity [Reference Scenario]

(TWh)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**9,695** (100)	**12,689** (100)	**18,912** (100)	**23,213** (100)	**28,880** (100)	**34,210** (100)	3.1	2.6	2.2	1.7	2.1
Asia	**1,812** (18.7)	**3,229** (25.4)	**7,525** (39.8)	**10,143** (43.7)	**13,575** (47.0)	**17,017** (49.7)	6.7	3.8	3.0	2.3	3.0
China	**454** (4.7)	**1,037** (8.2)	**4,128** (21.8)	**5,704** (24.6)	**7,456** (25.8)	**8,835** (25.8)	10.6	4.1	2.7	1.7	2.8
India	**215** (2.2)	**376** (3.0)	**869** (4.6)	**1,324** (5.7)	**2,183** (7.6)	**3,480** (10.2)	6.6	5.4	5.1	4.8	5.1
Japan	**750** (7.7)	**944** (7.4)	**923** (4.9)	**991** (4.3)	**1,052** (3.6)	**1,075** (3.1)	0.9	0.9	0.6	0.2	0.5
Korea	**94** (1.0)	**263** (2.1)	**481** (2.5)	**591** (2.5)	**717** (2.5)	**769** (2.2)	7.7	2.6	1.9	0.7	1.7
Chinese Taipei	**77** (0.8)	**160** (1.3)	**223** (1.2)	**249** (1.1)	**268** (0.9)	**275** (0.8)	5.0	1.4	0.7	0.3	0.8
ASEAN	**130** (1.3)	**320** (2.5)	**682** (3.6)	**1,007** (4.3)	**1,541** (5.3)	**2,146** (6.3)	7.8	5.0	4.3	3.4	4.2
Indonesia	**28** (0.3)	**79** (0.6)	**175** (0.9)	**290** (1.2)	**472** (1.6)	**727** (2.1)	8.6	6.5	5.0	4.4	5.2
Malaysia	**20** (0.2)	**61** (0.5)	**121** (0.6)	**180** (0.8)	**258** (0.9)	**338** (1.0)	8.5	5.1	3.6	2.7	3.7
Myanmar	**2** (0.0)	**3** (0.0)	**8** (0.0)	**15** (0.1)	**30** (0.1)	**52** (0.2)	7.3	7.9	7.0	5.8	6.8
Philippines	**21** (0.2)	**37** (0.3)	**59** (0.3)	**85** (0.4)	**125** (0.4)	**177** (0.5)	4.8	4.6	4.0	3.5	4.0
Singapore	**13** (0.1)	**27** (0.2)	**44** (0.2)	**51** (0.2)	**62** (0.2)	**72** (0.2)	5.7	1.7	2.1	1.5	1.8
Thailand	**38** (0.4)	**88** (0.7)	**162** (0.9)	**214** (0.9)	**305** (1.1)	**391** (1.1)	6.8	3.5	3.6	2.5	3.2
Viet Nam	**6** (0.1)	**22** (0.2)	**110** (0.6)	**168** (0.7)	**283** (1.0)	**381** (1.1)	14.0	5.5	5.4	3.0	4.6
Asia excl. Japan	**1,063** (11.0)	**2,285** (18.0)	**6,602** (34.9)	**9,152** (39.4)	**12,523** (43.4)	**15,942** (46.6)	8.7	4.2	3.2	2.4	3.2
North America	**3,052** (31.5)	**3,981** (31.4)	**4,229** (22.4)	**4,665** (20.1)	**5,128** (17.8)	**5,338** (15.6)	1.5	1.2	1.0	0.4	0.8
United States	**2,634** (27.2)	**3,499** (27.6)	**3,727** (19.7)	**4,125** (17.8)	**4,534** (15.7)	**4,694** (13.7)	1.6	1.3	1.0	0.3	0.8
Latin America	**517** (5.3)	**810** (6.4)	**1,217** (6.4)	**1,539** (6.6)	**2,049** (7.1)	**2,502** (7.3)	4.0	3.0	2.9	2.0	2.6
OECD Europe	**2,230** (23.0)	**2,710** (21.4)	**3,066** (16.2)	**3,333** (14.4)	**3,619** (12.5)	**3,844** (11.2)	1.5	1.0	0.8	0.6	0.8
European Union	**2,163** (22.3)	**2,531** (19.9)	**2,797** (14.8)	**3,037** (13.1)	**3,312** (11.5)	**3,531** (10.3)	1.2	1.0	0.9	0.6	0.8
Non-OECD Europe	**1,471** (15.2)	**1,011** (8.0)	**1,254** (6.6)	**1,412** (6.1)	**1,692** (5.9)	**1,938** (5.7)	-0.7	1.5	1.8	1.4	1.6
Africa	**257** (2.7)	**361** (2.8)	**587** (3.1)	**800** (3.4)	**1,133** (3.9)	**1,527** (4.5)	3.8	3.9	3.5	3.0	3.5
Middle East	**199** (2.0)	**379** (3.0)	**786** (4.2)	**1,031** (4.4)	**1,359** (4.7)	**1,689** (4.9)	6.4	3.5	2.8	2.2	2.8
Oceania	**157** (1.6)	**207** (1.6)	**248** (1.3)	**289** (1.2)	**324** (1.1)	**356** (1.0)	2.1	1.9	1.1	0.9	1.3
OECD	**6,399** (66.0)	**8,304** (65.4)	**9,239** (48.9)	**10,240** (44.1)	**11,343** (39.3)	**12,024** (35.1)	1.7	1.3	1.0	0.6	0.9
Non-OECD	**3,296** (34.0)	**4,385** (34.6)	**9,673** (51.1)	**12,973** (55.9)	**17,538** (60.7)	**22,186** (64.9)	5.0	3.7	3.1	2.4	3.0

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%).

Table 15 Electricity generation [Reference Scenario]

(TWh)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**11,825** (100)	**15,426** (100)	**22,668** (100)	**27,547** (100)	**34,044** (100)	**40,217** (100)	3.0	2.5	2.1	1.7	2.1
Asia	**2,215** (18.7)	**3,974** (25.8)	**8,921** (39.4)	**11,841** (43.0)	**15,707** (46.1)	**19,630** (48.8)	6.5	3.6	2.9	2.3	2.9
China	**621** (5.3)	**1,356** (8.8)	**4,985** (22.0)	**6,761** (24.5)	**8,749** (25.7)	**10,294** (25.6)	9.9	3.9	2.6	1.6	2.6
India	**293** (2.5)	**570** (3.7)	**1,128** (5.0)	**1,662** (6.0)	**2,675** (7.9)	**4,230** (10.5)	6.3	5.0	4.9	4.7	4.8
Japan	**836** (7.1)	**1,049** (6.8)	**1,026** (4.5)	**1,090** (4.0)	**1,151** (3.4)	**1,171** (2.9)	0.9	0.8	0.5	0.2	0.5
Korea	**105** (0.9)	**289** (1.9)	**531** (2.3)	**648** (2.4)	**785** (2.3)	**842** (2.1)	7.6	2.5	1.9	0.7	1.7
Chinese Taipei	**88** (0.7)	**181** (1.2)	**247** (1.1)	**278** (1.0)	**298** (0.9)	**305** (0.8)	4.8	1.5	0.7	0.2	0.7
ASEAN	**154** (1.3)	**370** (2.4)	**754** (3.3)	**1,088** (3.9)	**1,642** (4.8)	**2,293** (5.7)	7.5	4.7	4.2	3.4	4.1
Indonesia	**33** (0.3)	**93** (0.6)	**196** (0.9)	**323** (1.2)	**526** (1.5)	**806** (2.0)	8.5	6.5	5.0	4.4	5.2
Malaysia	**23** (0.2)	**69** (0.4)	**134** (0.6)	**199** (0.7)	**283** (0.8)	**370** (0.9)	8.4	5.0	3.6	2.7	3.7
Myanmar	**2** (0.0)	**5** (0.0)	**11** (0.0)	**18** (0.1)	**36** (0.1)	**62** (0.2)	6.9	6.8	7.0	5.8	6.5
Philippines	**26** (0.2)	**45** (0.3)	**73** (0.3)	**103** (0.4)	**151** (0.4)	**210** (0.5)	4.7	4.5	3.9	3.3	3.8
Singapore	**16** (0.1)	**32** (0.2)	**47** (0.2)	**54** (0.2)	**66** (0.2)	**77** (0.2)	5.1	1.7	2.1	1.5	1.8
Thailand	**44** (0.4)	**96** (0.6)	**167** (0.7)	**210** (0.8)	**294** (0.9)	**390** (1.0)	6.2	2.9	3.4	2.8	3.1
Viet Nam	**9** (0.1)	**27** (0.2)	**123** (0.5)	**175** (0.6)	**279** (0.8)	**370** (0.9)	12.8	4.5	4.8	2.8	4.0
Asia excl. Japan	**1,380** (11.7)	**2,925** (19.0)	**7,895** (34.8)	**10,751** (39.0)	**14,556** (42.8)	**18,459** (45.9)	8.3	3.9	3.1	2.4	3.1
North America	**3,685** (31.2)	**4,631** (30.0)	**4,905** (21.6)	**5,341** (19.4)	**5,848** (17.2)	**6,080** (15.1)	1.3	1.1	0.9	0.4	0.8
United States	**3,203** (27.1)	**4,026** (26.1)	**4,271** (18.8)	**4,676** (17.0)	**5,119** (15.0)	**5,292** (13.2)	1.3	1.1	0.9	0.3	0.8
Latin America	**623** (5.3)	**1,003** (6.5)	**1,516** (6.7)	**1,890** (6.9)	**2,494** (7.3)	**3,036** (7.5)	4.1	2.8	2.8	2.0	2.5
OECD Europe	**2,661** (22.5)	**3,223** (20.9)	**3,603** (15.9)	**3,926** (14.3)	**4,250** (12.5)	**4,505** (11.2)	1.4	1.1	0.8	0.6	0.8
European Union	**2,576** (21.8)	**3,005** (19.5)	**3,264** (14.4)	**3,571** (13.0)	**3,895** (11.4)	**4,172** (10.4)	1.1	1.1	0.9	0.7	0.9
Non-OECD Europe	**1,894** (16.0)	**1,432** (9.3)	**1,742** (7.7)	**1,960** (7.1)	**2,336** (6.9)	**2,668** (6.6)	-0.4	1.5	1.8	1.3	1.5
Africa	**316** (2.7)	**442** (2.9)	**720** (3.2)	**975** (3.5)	**1,374** (4.0)	**1,844** (4.6)	3.8	3.9	3.5	3.0	3.4
Middle East	**244** (2.1)	**472** (3.1)	**968** (4.3)	**1,268** (4.6)	**1,647** (4.8)	**2,028** (5.0)	6.5	3.4	2.7	2.1	2.7
Oceania	**187** (1.6)	**249** (1.6)	**293** (1.3)	**345** (1.3)	**387** (1.1)	**425** (1.1)	2.1	2.1	1.2	0.9	1.3
OECD	**7,608** (64.3)	**9,685** (62.8)	**10,722** (47.3)	**11,810** (42.9)	**13,051** (38.3)	**13,834** (34.4)	1.6	1.2	1.0	0.6	0.9
Non-OECD	**4,218** (35.7)	**5,741** (37.2)	**11,946** (52.7)	**15,737** (57.1)	**20,993** (61.7)	**26,382** (65.6)	4.8	3.5	2.9	2.3	2.9

Source: International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%).

Table 16 GDP per capita [Reference Scenario]

($2010 thousand/person)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**7.0**	**8.0**	**9.7**	**11.4**	**14.3**	**17.2**	1.5	2.1	2.2	1.9	2.1
Asia	**2.5**	**3.1**	**4.9**	**6.8**	**9.9**	**13.6**	3.0	4.2	3.8	3.3	3.7
China	**0.7**	**1.7**	**5.2**	**8.7**	**14.6**	**21.9**	9.4	6.7	5.4	4.1	5.3
India	**0.6**	**0.8**	**1.5**	**2.3**	**4.0**	**6.5**	4.8	5.0	5.7	5.0	5.3
Japan	**36.9**	**40.1**	**43.7**	**51.7**	**61.4**	**72.1**	0.8	2.1	1.7	1.6	1.8
Korea	**8.7**	**14.4**	**21.5**	**27.8**	**35.2**	**42.2**	4.2	3.3	2.4	1.8	2.4
Chinese Taipei	**8.2**	**13.8**	**20.4**	**28.1**	**35.3**	**41.7**	4.2	4.1	2.3	1.7	2.6
ASEAN	**1.6**	**2.3**	**3.5**	**4.9**	**7.1**	**9.7**	3.5	4.2	3.8	3.2	3.7
Indonesia	**1.6**	**2.0**	**3.2**	**4.7**	**7.0**	**9.9**	3.3	4.7	4.1	3.6	4.1
Malaysia	**4.4**	**6.7**	**9.4**	**12.3**	**17.1**	**21.9**	3.6	3.4	3.3	2.5	3.1
Myanmar	**0.2**	**0.3**	**0.9**	**1.4**	**2.4**	**3.6**	8.1	6.0	5.3	4.3	5.1
Philippines	**1.5**	**1.6**	**2.3**	**3.2**	**4.4**	**5.9**	1.9	4.4	3.2	3.0	3.5
Singapore	**22.0**	**33.2**	**46.5**	**55.2**	**68.1**	**75.4**	3.5	2.2	2.1	1.0	1.7
Thailand	**2.4**	**3.3**	**5.1**	**6.9**	**9.9**	**13.9**	3.5	3.8	3.8	3.4	3.7
Viet Nam	**0.4**	**0.8**	**1.5**	**2.2**	**3.8**	**6.0**	5.5	5.0	5.9	4.5	5.2
Asia excl. Japan	**1.0**	**1.7**	**3.6**	**5.4**	**8.4**	**12.1**	5.9	5.3	4.6	3.7	4.5
North America	**36.2**	**44.8**	**49.6**	**57.1**	**67.7**	**77.1**	1.4	1.8	1.7	1.3	1.6
United States	**36.3**	**45.1**	**49.9**	**57.7**	**68.6**	**78.2**	1.5	1.8	1.7	1.3	1.6
Latin America	**6.2**	**7.0**	**9.0**	**10.6**	**13.6**	**16.5**	1.7	2.1	2.5	2.0	2.2
OECD Europe	**24.4**	**29.4**	**32.5**	**36.0**	**41.5**	**46.7**	1.3	1.3	1.4	1.2	1.3
European Union	**23.9**	**29.1**	**32.7**	**36.4**	**42.4**	**48.1**	1.4	1.3	1.5	1.3	1.4
Non-OECD Europe	**6.3**	**4.4**	**7.7**	**9.4**	**13.1**	**16.9**	0.9	2.4	3.4	2.6	2.8
Africa	**1.3**	**1.3**	**1.7**	**2.0**	**2.5**	**3.1**	1.2	2.2	2.2	2.0	2.1
Middle East	**7.0**	**8.4**	**11.1**	**13.0**	**15.4**	**17.6**	2.1	2.0	1.7	1.3	1.7
Oceania	**35.1**	**43.0**	**51.8**	**59.1**	**67.7**	**74.9**	1.8	1.7	1.4	1.0	1.3
OECD	**26.9**	**32.3**	**35.9**	**41.0**	**48.2**	**55.2**	1.3	1.7	1.6	1.4	1.6
Non-OECD	**2.0**	**2.3**	**4.0**	**5.4**	**7.7**	**10.2**	3.2	3.8	3.6	2.9	3.4

Source: World Bank "World Development Indicators", International Energy Agency "World Energy Balances", etc. (historical)

Table 17 Primary energy consumption per capita [Reference Scenario]

(toe/person)

							CAGR (%)				
	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**1.67**	**1.65**	**1.90**	**1.99**	**2.08**	**2.15**	0.6	0.6	0.4	0.3	0.4
Asia	**0.72**	**0.86**	**1.37**	**1.55**	**1.74**	**1.94**	2.9	1.6	1.2	1.1	1.3
China	**0.77**	**0.92**	**2.14**	**2.49**	**2.85**	**3.18**	4.8	1.9	1.4	1.1	1.4
India	**0.36**	**0.44**	**0.64**	**0.74**	**0.91**	**1.16**	2.6	2.0	2.1	2.4	2.2
Japan	**3.56**	**4.09**	**3.55**	**3.64**	**3.64**	**3.63**	0.0	0.3	0.0	0.0	0.1
Korea	**2.17**	**4.00**	**5.27**	**5.67**	**6.09**	**6.11**	4.1	0.9	0.7	0.0	0.5
Chinese Taipei	**2.34**	**3.81**	**4.52**	**4.92**	**5.11**	**5.26**	3.0	1.1	0.4	0.3	0.5
ASEAN	**0.55**	**0.76**	**0.98**	**1.21**	**1.46**	**1.71**	2.7	2.7	1.9	1.6	2.0
Indonesia	**0.55**	**0.74**	**0.87**	**1.15**	**1.37**	**1.63**	2.1	3.6	1.8	1.7	2.3
Malaysia	**1.22**	**2.11**	**2.78**	**3.23**	**3.64**	**4.02**	3.8	1.9	1.2	1.0	1.3
Myanmar	**0.25**	**0.27**	**0.29**	**0.33**	**0.40**	**0.51**	0.6	1.6	2.1	2.4	2.1
Philippines	**0.46**	**0.51**	**0.44**	**0.50**	**0.57**	**0.65**	-0.2	1.5	1.3	1.4	1.4
Singapore	**3.78**	**4.63**	**4.72**	**5.01**	**5.65**	**5.99**	1.0	0.8	1.2	0.6	0.9
Thailand	**0.74**	**1.16**	**1.89**	**2.38**	**2.96**	**3.61**	4.4	2.9	2.2	2.0	2.3
Viet Nam	**0.27**	**0.37**	**0.73**	**0.91**	**1.32**	**1.71**	4.6	2.8	3.8	2.6	3.1
Asia excl. Japan	**0.60**	**0.74**	**1.29**	**1.49**	**1.69**	**1.90**	3.6	1.8	1.3	1.2	1.4
North America	**7.66**	**8.07**	**6.86**	**6.69**	**6.35**	**5.94**	-0.5	-0.3	-0.5	-0.7	-0.5
United States	**7.67**	**8.06**	**6.82**	**6.64**	**6.26**	**5.81**	-0.5	-0.3	-0.6	-0.7	-0.6
Latin America	**1.06**	**1.15**	**1.38**	**1.55**	**1.80**	**1.99**	1.2	1.4	1.5	1.0	1.3
OECD Europe	**3.25**	**3.35**	**3.15**	**3.19**	**3.19**	**3.19**	-0.1	0.2	0.0	0.0	0.0
European Union	**3.44**	**3.47**	**3.25**	**3.32**	**3.34**	**3.36**	-0.3	0.2	0.1	0.0	0.1
Non-OECD Europe	**4.47**	**2.94**	**3.50**	**3.56**	**3.93**	**4.28**	-1.1	0.2	1.0	0.9	0.7
Africa	**0.62**	**0.62**	**0.68**	**0.68**	**0.66**	**0.64**	0.4	0.1	-0.3	-0.4	-0.2
Middle East	**1.69**	**2.25**	**3.18**	**3.29**	**3.46**	**3.58**	2.9	0.4	0.5	0.3	0.4
Oceania	**4.86**	**5.44**	**5.42**	**5.21**	**4.89**	**4.58**	0.5	-0.5	-0.6	-0.6	-0.6
OECD	**4.25**	**4.58**	**4.19**	**4.22**	**4.17**	**4.08**	-0.1	0.1	-0.1	-0.2	-0.1
Non-OECD	**0.97**	**0.92**	**1.35**	**1.47**	**1.60**	**1.72**	1.5	1.1	0.9	0.7	0.9

Source: World Bank "World Development Indicators", International Energy Agency "World Energy Balances", etc. (historical)

Note: World includes international bunkers.

Table 18 Primary energy consumption per GDP [Reference Scenario]

(toe/$2010 million)

							CAGR (%)				
	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**238**	**207**	**197**	**174**	**146**	**125**	-0.9	-1.5	-1.7	-1.5	-1.6
Asia	**286**	**275**	**280**	**228**	**177**	**143**	-0.1	-2.5	-2.5	-2.1	-2.4
China	**1,072**	**530**	**414**	**288**	**196**	**145**	-4.2	-4.4	-3.8	-2.9	-3.7
India	**660**	**553**	**415**	**327**	**231**	**179**	-2.1	-2.9	-3.4	-2.5	-3.0
Japan	**96**	**102**	**81**	**70**	**59**	**50**	-0.8	-1.8	-1.7	-1.6	-1.7
Korea	**248**	**279**	**245**	**204**	**173**	**145**	-0.1	-2.3	-1.6	-1.8	-1.9
Chinese Taipei	**285**	**276**	**221**	**175**	**145**	**126**	-1.1	-2.9	-1.9	-1.4	-2.0
ASEAN	**332**	**334**	**276**	**247**	**205**	**176**	-0.8	-1.4	-1.8	-1.5	-1.6
Indonesia	**350**	**365**	**266**	**246**	**197**	**164**	-1.2	-1.0	-2.2	-1.8	-1.7
Malaysia	**279**	**314**	**295**	**263**	**213**	**184**	0.3	-1.5	-2.1	-1.5	-1.7
Myanmar	**1,599**	**964**	**326**	**232**	**171**	**142**	-7.0	-4.2	-3.0	-1.8	-2.9
Philippines	**304**	**319**	**193**	**154**	**128**	**110**	-2.0	-2.8	-1.8	-1.5	-2.0
Singapore	**172**	**140**	**101**	**91**	**83**	**79**	-2.4	-1.4	-0.9	-0.4	-0.9
Thailand	**311**	**346**	**372**	**347**	**298**	**260**	0.8	-0.9	-1.5	-1.4	-1.3
Viet Nam	**606**	**470**	**500**	**420**	**345**	**285**	-0.9	-2.2	-1.9	-1.9	-2.0
Asia excl. Japan	**591**	**434**	**364**	**276**	**201**	**157**	-2.2	-3.4	-3.1	-2.4	-3.0
North America	**212**	**180**	**138**	**117**	**94**	**77**	-1.9	-2.1	-2.2	-1.9	-2.1
United States	**212**	**179**	**137**	**115**	**91**	**74**	-2.0	-2.1	-2.3	-2.0	-2.2
Latin America	**172**	**164**	**154**	**146**	**132**	**120**	-0.5	-0.6	-1.0	-1.0	-0.9
OECD Europe	**133**	**114**	**97**	**89**	**77**	**68**	-1.4	-1.1	-1.4	-1.2	-1.2
European Union	**144**	**119**	**99**	**91**	**79**	**70**	-1.7	-1.1	-1.4	-1.2	-1.3
Non-OECD Europe	**709**	**666**	**452**	**380**	**300**	**253**	-2.0	-2.1	-2.3	-1.7	-2.0
Africa	**478**	**462**	**397**	**337**	**264**	**208**	-0.8	-2.0	-2.4	-2.4	-2.3
Middle East	**242**	**269**	**288**	**253**	**225**	**204**	0.8	-1.6	-1.2	-1.0	-1.2
Oceania	**139**	**127**	**105**	**88**	**72**	**61**	-1.3	-2.1	-2.0	-1.6	-1.9
OECD	**158**	**142**	**117**	**103**	**87**	**74**	-1.4	-1.6	-1.7	-1.6	-1.6
Non-OECD	**485**	**394**	**336**	**271**	**208**	**168**	-1.6	-2.6	-2.6	-2.1	-2.5

Source: World Bank "World Development Indicators", International Energy Agency "World Energy Balances", etc. (historical)

Note: World includes international bunkers.

Table 19 Energy–related carbon dioxide emissions [Reference Scenario]

(Mt)

	1990	2000	2012	2020	2030	2040	CAGR (%) 1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
World	**21,233** (100)	**23,575** (100)	**32,562** (100)	**35,757** (100)	**40,086** (100)	**43,734** (100)	2.0	1.2	1.1	0.9	1.1
Asia	**4,959** (23.4)	**7,048** (29.9)	**14,564** (44.7)	**16,796** (47.0)	**19,702** (49.1)	**22,422** (51.3)	5.0	1.8	1.6	1.3	1.6
China	**2,339** (11.0)	**3,258** (13.8)	**9,067** (27.8)	**10,425** (29.2)	**11,667** (29.1)	**12,402** (28.4)	6.4	1.8	1.1	0.6	1.1
India	**585** (2.8)	**961** (4.1)	**1,961** (6.0)	**2,475** (6.9)	**3,404** (8.5)	**4,688** (10.7)	5.7	3.0	3.2	3.3	3.2
Japan	**1,070** (5.0)	**1,196** (5.1)	**1,220** (3.7)	**1,057** (3.0)	**1,031** (2.6)	**969** (2.2)	0.6	-1.8	-0.2	-0.6	-0.8
Korea	**239** (1.1)	**433** (1.8)	**576** (1.8)	**574** (1.6)	**614** (1.5)	**606** (1.4)	4.1	0.0	0.7	-0.1	0.2
Chinese Taipei	**116** (0.5)	**225** (1.0)	**248** (0.8)	**268** (0.8)	**276** (0.7)	**261** (0.6)	3.5	1.0	0.3	-0.5	0.2
ASEAN	**362** (1.7)	**709** (3.0)	**1,139** (3.5)	**1,536** (4.3)	**2,112** (5.3)	**2,747** (6.3)	5.4	3.8	3.2	2.7	3.2
Indonesia	**134** (0.6)	**262** (1.1)	**405** (1.2)	**570** (1.6)	**822** (2.1)	**1,130** (2.6)	5.2	4.4	3.7	3.2	3.7
Malaysia	**54** (0.3)	**120** (0.5)	**198** (0.6)	**269** (0.8)	**333** (0.8)	**387** (0.9)	6.1	3.9	2.2	1.5	2.4
Myanmar	**4** (0.0)	**10** (0.0)	**11** (0.0)	**17** (0.0)	**29** (0.1)	**47** (0.1)	4.5	5.9	5.6	4.7	5.4
Philippines	**39** (0.2)	**69** (0.3)	**84** (0.3)	**109** (0.3)	**156** (0.4)	**215** (0.5)	3.6	3.2	3.7	3.2	3.4
Singapore	**29** (0.1)	**48** (0.2)	**51** (0.2)	**57** (0.2)	**66** (0.2)	**72** (0.2)	2.6	1.2	1.6	0.9	1.2
Thailand	**81** (0.4)	**152** (0.6)	**244** (0.7)	**314** (0.9)	**396** (1.0)	**479** (1.1)	5.2	3.2	2.4	1.9	2.4
Viet Nam	**17** (0.1)	**43** (0.2)	**139** (0.4)	**193** (0.5)	**301** (0.8)	**409** (0.9)	10.0	4.2	4.5	3.1	3.9
Asia excl. Japan	**3,889** (18.3)	**5,852** (24.8)	**13,344** (41.0)	**15,739** (44.0)	**18,671** (46.6)	**21,453** (49.1)	5.8	2.1	1.7	1.4	1.7
North America	**5,236** (24.7)	**6,125** (26.0)	**5,584** (17.1)	**5,556** (15.5)	**5,394** (13.5)	**5,103** (11.7)	0.3	-0.1	-0.3	-0.6	-0.3
United States	**4,820** (22.7)	**5,617** (23.8)	**5,139** (15.8)	**5,092** (14.2)	**4,927** (12.3)	**4,619** (10.6)	0.3	-0.1	-0.3	-0.6	-0.4
Latin America	**915** (4.3)	**1,199** (5.1)	**1,681** (5.2)	**1,986** (5.6)	**2,494** (6.2)	**2,898** (6.6)	2.8	2.1	2.3	1.5	2.0
OECD Europe	**3,952** (18.6)	**3,892** (16.5)	**3,628** (11.1)	**3,579** (10.0)	**3,594** (9.0)	**3,466** (7.9)	-0.4	-0.2	0.0	-0.4	-0.2
European Union	**4,068** (19.2)	**3,786** (16.1)	**3,408** (10.5)	**3,374** (9.4)	**3,398** (8.5)	**3,285** (7.5)	-0.8	-0.1	0.1	-0.3	-0.1
Non-OECD Europe	**4,123** (19.4)	**2,462** (10.4)	**2,859** (8.8)	**2,840** (7.9)	**2,949** (7.4)	**3,021** (6.9)	-1.6	-0.1	0.4	0.2	0.2
Africa	**593** (2.8)	**719** (3.0)	**1,086** (3.3)	**1,337** (3.7)	**1,648** (4.1)	**1,975** (4.5)	2.8	2.6	2.1	1.8	2.2
Middle East	**559** (2.6)	**936** (4.0)	**1,675** (5.1)	**1,975** (5.5)	**2,358** (5.9)	**2,701** (6.2)	5.1	2.1	1.8	1.4	1.7
Oceania	**281** (1.3)	**357** (1.5)	**410** (1.3)	**411** (1.1)	**415** (1.0)	**407** (0.9)	1.7	0.0	0.1	-0.2	0.0
OECD	**11,095** (52.3)	**12,398** (52.6)	**11,965** (36.7)	**11,823** (33.1)	**11,830** (29.5)	**11,456** (26.2)	0.3	-0.1	0.0	-0.3	-0.2
Non-OECD	**9,521** (44.8)	**10,342** (43.9)	**19,523** (60.0)	**22,657** (63.4)	**26,724** (66.7)	**30,536** (69.8)	3.3	1.9	1.7	1.3	1.6

Source: Compiled from International Energy Agency "World Energy Balances" (historical)

Note: Figures in parentheses are global shares (%). Excludes emission reduction by CCS. World includes international bunkers.

Table 20 World [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	7,211	8,780	10,079	13,371	15,259	17,413	19,276	100	100	100	1.9	1.7	1.3	1.0	1.3
Coal	1,788	2,231	2,358	3,879	4,112	4,433	4,705	25	29	24	2.5	0.7	0.8	0.6	0.7
Oil	3,101	3,231	3,658	4,205	4,608	5,165	5,639	37	31	29	1.2	1.2	1.1	0.9	1.1
Natural gas	1,234	1,667	2,073	2,844	3,446	4,207	4,856	19	21	25	2.5	2.4	2.0	1.4	1.9
Nuclear	186	526	676	642	850	996	1,154	6.0	4.8	6.0	0.9	3.6	1.6	1.5	2.1
Hydro	148	184	225	316	365	395	421	2.1	2.4	2.2	2.5	1.8	0.8	0.6	1.0
Geothermal	12	34	52	67	145	174	199	0.4	0.5	1.0	3.1	10.2	1.9	1.3	4.0
Solar, wind, etc.	0.1	2.4	7.9	75	128	191	259	0.0	0.6	1.3	17.0	6.8	4.1	3.1	4.5
Biomass and waste	741	905	1,029	1,343	1,606	1,850	2,042	10	10	11	1.8	2.3	1.4	1.0	1.5

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	5,381	6,288	7,088	8,979	10,313	11,869	13,254	100	100	100	1.6	1.7	1.4	1.1	1.4
By sector															
Industry	1,775	1,805	1,889	2,541	2,929	3,364	3,782	29	28	29	1.6	1.8	1.4	1.2	1.4
Transport	1,247	1,575	1,964	2,507	2,879	3,316	3,674	25	28	28	2.1	1.7	1.4	1.0	1.4
Buildings, etc.	2,004	2,425	2,610	3,123	3,563	4,092	4,556	39	35	34	1.2	1.7	1.4	1.1	1.4
Non-energy use	354	482	626	809	942	1,098	1,242	7.7	9.0	9.4	2.4	1.9	1.5	1.2	1.5
By energy															
Coal	712	768	577	909	966	976	992	12	10	7.5	0.8	0.8	0.1	0.2	0.3
Oil	2,445	2,605	3,124	3,652	4,064	4,609	5,076	41	41	38	1.5	1.3	1.3	1.0	1.2
Natural gas	816	946	1,123	1,366	1,668	2,004	2,313	15	15	17	1.7	2.5	1.8	1.4	1.9
Electricity	586	834	1,091	1,626	1,996	2,484	2,942	13	18	22	3.1	2.6	2.2	1.7	2.1
Heat	121	335	247	287	304	332	351	5.3	3.2	2.7	-0.7	0.8	0.9	0.6	0.7
Renewables	701	800	926	1,138	1,314	1,465	1,579	13	13	12	1.6	1.8	1.1	0.8	1.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	8,283	11,825	15,426	22,668	27,547	34,044	40,217	100	100	100	3.0	2.5	2.1	1.7	2.1
Coal	3,142	4,425	6,002	9,168	10,266	12,359	14,315	37	40	36	3.4	1.4	1.9	1.5	1.6
Oil	1,654	1,310	1,203	1,128	1,067	1,126	1,173	11	5.0	2.9	-0.7	-0.7	0.5	0.4	0.1
Natural gas	999	1,760	2,753	5,100	6,691	9,168	11,447	15	22	28	5.0	3.5	3.2	2.2	2.9
Nuclear	713	2,013	2,591	2,461	3,259	3,827	4,451	17	11	11	0.9	3.6	1.6	1.5	2.1
Hydro	1,717	2,144	2,620	3,672	4,241	4,594	4,895	18	16	12	2.5	1.8	0.8	0.6	1.0
Geothermal	14	36	52	70	157	202	246	0.3	0.3	0.6	3.0	10.5	2.6	2.0	4.6
Solar, wind, etc.	0.5	5.2	35	628	1,163	1,792	2,482	0.0	2.8	6.2	24.4	8.0	4.4	3.3	5.0
Biomass and waste	44	132	170	439	702	975	1,206	1.1	1.9	3.0	5.6	6.0	3.3	2.2	3.7

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	27,314	36,939	48,631	67,904	87,739	119,426	154,291	2.8	3.3	3.1	2.6	3.0
Population (million)	4,436	5,272	6,093	7,033	7,667	8,372	8,983	1.3	1.1	0.9	0.7	0.9
CO_2 emissions[*2] (Mt)	18,432	21,233	23,575	32,562	35,757	40,086	43,734	2.0	1.2	1.1	0.9	1.1
GDP per capita ($2010 thousand)	6.2	7.0	8.0	9.7	11	14	17	1.5	2.1	2.2	1.9	2.1
Primary energy consump. per capita (toe)	1.6	1.7	1.7	1.9	2.0	2.1	2.1	0.6	0.6	0.4	0.3	0.4
Primary energy consumption per GDP[*3]	264	238	207	197	174	146	125	-0.9	-1.5	-1.7	-1.5	-1.6
CO_2 emissions per GDP[*2, *4]	675	575	485	480	408	336	283	-0.8	-2.0	-1.9	-1.7	-1.9
CO_2 per primary energy consumption[*2, *5]	2.6	2.4	2.3	2.4	2.3	2.3	2.3	0.0	-0.5	-0.2	-0.1	-0.3
Automobile ownership (million)	416	577	767	1,150	1,424	1,758	2,089	3.2	2.7	2.1	1.7	2.2
Automobile ownership rates[*6]	94	109	126	163	186	210	233	1.8	1.6	1.2	1.0	1.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 21 Asia [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	1,445	2,119	2,936	5,268	6,403	7,638	8,794	100	100	100	4.2	2.5	1.8	1.4	1.8
Coal	471	796	1,078	2,669	2,948	3,291	3,605	38	51	41	5.7	1.2	1.1	0.9	1.1
Oil	478	618	917	1,243	1,498	1,803	2,096	29	24	24	3.2	2.4	1.9	1.5	1.9
Natural gas	51	116	232	507	738	1,094	1,434	5.5	9.6	16	6.9	4.8	4.0	2.7	3.8
Nuclear	25	77	132	89	281	381	479	3.6	1.7	5.5	0.7	15.5	3.1	2.3	6.2
Hydro	20	32	41	107	142	157	170	1.5	2.0	1.9	5.7	3.6	1.0	0.8	1.7
Geothermal	2.6	8.2	23	32	76	86	87	0.4	0.6	1.0	6.3	11.5	1.2	0.2	3.7
Solar, wind, etc.	-	1.2	2.1	27	52	81	112	0.1	0.5	1.3	15.0	8.8	4.4	3.4	5.3
Biomass and waste	397	472	510	594	664	740	805	22	11	9.2	1.0	1.4	1.1	0.8	1.1

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,142	1,579	2,042	3,323	4,052	4,877	5,681	100	100	100	3.4	2.5	1.9	1.5	1.9
By sector															
Industry	391	520	672	1,284	1,527	1,758	1,996	33	39	35	4.2	2.2	1.4	1.3	1.6
Transport	127	191	326	559	738	956	1,176	12	17	21	5.0	3.5	2.6	2.1	2.7
Buildings, etc.	570	752	855	1,151	1,391	1,690	1,962	48	35	35	2.0	2.4	2.0	1.5	1.9
Non-energy use	54	116	190	329	396	472	548	7.3	9.9	9.6	4.9	2.3	1.8	1.5	1.8
By energy															
Coal	310	438	407	735	792	794	801	28	22	14	2.4	0.9	0.0	0.1	0.3
Oil	327	464	741	1,073	1,333	1,636	1,922	29	32	34	3.9	2.8	2.1	1.6	2.1
Natural gas	21	47	89	232	352	516	686	3.0	7.0	12	7.5	5.4	3.9	2.9	4.0
Electricity	88	156	278	647	872	1,167	1,463	9.9	19	26	6.7	3.8	3.0	2.3	3.0
Heat	7.5	14	30	77	94	105	109	0.9	2.3	1.9	8.0	2.5	1.1	0.4	1.2
Renewables	388	459	498	559	608	658	700	29	17	12	0.9	1.1	0.8	0.6	0.8

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,196	2,215	3,974	8,921	11,841	15,707	19,630	100	100	100	6.5	3.6	2.9	2.3	2.9
Coal	302	863	1,991	5,529	6,598	8,627	10,627	39	62	54	8.8	2.2	2.7	2.1	2.4
Oil	472	421	385	352	258	228	233	19	3.9	1.2	-0.8	-3.8	-1.2	0.2	-1.5
Natural gas	90	247	567	1,167	1,623	2,571	3,554	11	13	18	7.3	4.2	4.7	3.3	4.1
Nuclear	97	294	505	342	1,079	1,472	1,866	13	3.8	9.5	0.7	15.5	3.2	2.4	6.3
Hydro	232	370	481	1,243	1,655	1,827	1,975	17	14	10	5.7	3.6	1.0	0.8	1.7
Geothermal	3.0	8.3	20	22	56	74	84	0.4	0.3	0.4	4.6	12.2	2.7	1.3	4.8
Solar, wind, etc.	-	0.0	3.0	150	382	631	941	0.0	1.7	4.8	45.7	12.4	5.1	4.1	6.8
Biomass and waste	0.0	11	22	116	190	276	349	0.5	1.3	1.8	11.1	6.4	3.8	2.4	4.0

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	4,347	7,398	10,658	18,808	28,042	43,252	61,633	4.3	5.1	4.4	3.6	4.3
Population (million)	2,442	2,931	3,401	3,854	4,129	4,382	4,531	1.3	0.9	0.6	0.3	0.6
CO_2 emissions[*2] (Mt)	3,289	4,959	7,048	14,564	16,796	19,702	22,422	5.0	1.8	1.6	1.3	1.6
GDP per capita ($2010 thousand)	1.8	2.5	3.1	4.9	6.8	9.9	14	3.0	4.2	3.8	3.3	3.7
Primary energy consump. per capita (toe)	0.6	0.7	0.9	1.4	1.6	1.7	1.9	2.9	1.6	1.2	1.1	1.3
Primary energy consumption per GDP[*3]	332	286	275	280	228	177	143	-0.1	-2.5	-2.5	-2.1	-2.4
CO_2 emissions per GDP[*2, *4]	757	670	661	774	599	456	364	0.7	-3.2	-2.7	-2.2	-2.7
CO_2 per primary energy consumption[*2, *5]	2.3	2.3	2.4	2.8	2.6	2.6	2.5	0.8	-0.7	-0.2	-0.1	-0.3
Automobile ownership (million)	48	86	139	295	433	598	807	5.8	4.9	3.3	3.0	3.7
Automobile ownership rates[*6]	19	29	41	76	105	137	178	4.5	4.0	2.7	2.7	3.1

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 22 China [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	598	871	1,161	2,894	3,505	4,069	4,474	100	100	100	5.6	2.4	1.5	1.0	1.6
Coal	313	528	691	1,969	2,133	2,245	2,274	61	68	51	6.2	1.0	0.5	0.1	0.5
Oil	89	119	221	464	620	766	877	14	16	20	6.4	3.7	2.1	1.4	2.3
Natural gas	12	13	21	121	264	460	622	1.5	4.2	14	10.7	10.3	5.7	3.1	6.0
Nuclear	-	-	4.4	25	118	186	253	-	0.9	5.7	n.a.	21.2	4.6	3.1	8.6
Hydro	5.0	11	19	74	100	106	110	1.3	2.6	2.5	9.1	3.8	0.5	0.4	1.4
Geothermal	-	-	1.6	4.3	6.2	8.4	9.8	-	0.1	0.2	n.a.	4.8	3.1	1.5	3.0
Solar, wind, etc.	-	0.0	1.0	22	42	64	84	0.0	0.7	1.9	34.3	8.6	4.3	2.8	5.0
Biomass and waste	180	200	204	216	221	235	245	23	7.5	5.5	0.3	0.3	0.6	0.4	0.5

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	494	664	816	1,702	2,099	2,464	2,745	100	100	100	4.4	2.7	1.6	1.1	1.7
By sector															
Industry	188	244	329	810	923	980	1,022	37	48	37	5.6	1.6	0.6	0.4	0.8
Transport	24	34	88	238	355	470	566	5.1	14	21	9.3	5.1	2.8	1.9	3.1
Buildings, etc.	272	344	337	518	649	807	915	52	30	33	1.9	2.9	2.2	1.3	2.1
Non-energy use	10	43	62	136	172	208	242	6.5	8.0	8.8	5.4	2.9	1.9	1.5	2.1
By energy															
Coal	220	318	304	558	577	535	489	48	33	18	2.6	0.4	-0.7	-0.9	-0.5
Oil	59	85	180	422	569	706	810	13	25	30	7.6	3.8	2.2	1.4	2.4
Natural gas	6.4	8.9	12	81	159	262	361	1.3	4.7	13	10.6	8.8	5.1	3.3	5.5
Electricity	21	39	89	355	491	641	760	5.9	21	28	10.6	4.1	2.7	1.7	2.8
Heat	7.4	13	25	71	86	94	96	2.0	4.2	3.5	7.9	2.5	0.9	0.3	1.1
Renewables	180	200	205	216	217	225	229	30	13	8.3	0.3	0.1	0.4	0.2	0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	301	621	1,356	4,985	6,761	8,749	10,294	100	100	100	9.9	3.9	2.6	1.6	2.6
Coal	164	443	1,062	3,785	4,485	5,590	6,324	71	76	61	10.2	2.1	2.2	1.2	1.9
Oil	78	49	46	6.8	7.6	7.5	7.4	7.9	0.1	0.1	-8.6	1.5	-0.2	-0.2	0.3
Natural gas	0.7	2.8	5.8	86	300	639	925	0.4	1.7	9.0	16.9	16.9	7.9	3.8	8.9
Nuclear	-	-	17	97	454	713	973	-	2.0	9.4	n.a.	21.2	4.6	3.1	8.6
Hydro	58	127	222	863	1,167	1,228	1,280	20	17	12	9.1	3.8	0.5	0.4	1.4
Geothermal	-	-	-	0.2	0.3	0.3	0.3	-	0.0	0.0	n.a.	6.8	1.5	1.4	2.9
Solar, wind, etc.	-	0.0	0.6	102	271	450	630	0.0	2.1	6.1	58.6	12.9	5.2	3.4	6.7
Biomass and waste	-	-	2.4	45	77	120	155	-	0.9	1.5	n.a.	7.0	4.5	2.6	4.5

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	334	812	2,190	6,988	12,175	20,797	30,784	10.3	7.2	5.5	4.0	5.4
Population (million)	981	1,135	1,263	1,351	1,405	1,425	1,408	0.8	0.5	0.1	-0.1	0.1
CO_2 emissions[*2] (Mt)	1,506	2,339	3,258	9,067	10,425	11,667	12,402	6.4	1.8	1.1	0.6	1.1
GDP per capita ($2010 thousand)	0.3	0.7	1.7	5.2	8.7	15	22	9.4	6.7	5.4	4.1	5.3
Primary energy consump. per capita (toe)	0.6	0.8	0.9	2.1	2.5	2.9	3.2	4.8	1.9	1.4	1.1	1.4
Primary energy consumption per GDP[*3]	1,790	1,072	530	414	288	196	145	-4.2	-4.4	-3.8	-2.9	-3.7
CO_2 emissions per GDP[*2, *4]	4,507	2,879	1,488	1,298	856	561	403	-3.6	-5.1	-4.1	-3.3	-4.1
CO_2 per primary energy consumption[*2, *5]	2.5	2.7	2.8	3.1	3.0	2.9	2.8	0.7	-0.6	-0.4	-0.3	-0.4
Automobile ownership (million)	1.2	5.3	16	109	205	293	374	14.7	8.2	3.6	2.5	4.5
Automobile ownership rates[*6]	1.2	4.7	12	81	146	205	266	13.8	7.6	3.5	2.6	4.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 23 India [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	205	316	456	788	1,007	1,351	1,814	100	100	100	4.2	3.1	3.0	3.0	3.0
Coal	49	103	161	354	425	568	776	33	45	43	5.8	2.3	2.9	3.2	2.8
Oil	33	61	112	177	242	338	445	19	22	25	5.0	4.0	3.4	2.8	3.3
Natural gas	1.3	11	23	49	78	133	220	3.3	6.2	12	7.2	6.1	5.4	5.2	5.5
Nuclear	0.8	1.6	4.4	8.6	29	52	79	0.5	1.1	4.3	7.9	16.5	5.9	4.3	8.2
Hydro	4.0	6.2	6.4	11	14	18	22	1.9	1.4	1.2	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	0.2	3.1	5.6	8.3	14	0.0	0.4	0.8	29.5	7.7	4.0	5.2	5.5
Biomass and waste	116	133	149	185	212	234	259	42	23	14	1.5	1.7	1.0	1.0	1.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	179	250	318	512	660	874	1,161	100	100	100	3.3	3.2	2.8	2.9	3.0
By sector															
Industry	43	69	83	168	226	309	421	28	33	36	4.1	3.8	3.2	3.2	3.3
Transport	17	21	32	74	101	149	209	8.4	14	18	5.9	4.0	4.0	3.5	3.8
Buildings, etc.	113	146	176	234	286	349	438	59	46	38	2.2	2.5	2.0	2.3	2.3
Non-energy use	5.7	13	27	36	47	67	92	5.3	7.0	7.9	4.6	3.6	3.6	3.2	3.5
By energy															
Coal	28	42	33	88	104	120	149	17	17	13	3.5	2.0	1.5	2.2	1.9
Oil	27	50	94	148	215	311	418	20	29	36	5.1	4.7	3.8	3.0	3.8
Natural gas	0.7	5.6	9.7	26	37	55	81	2.3	5.1	6.9	7.2	4.2	4.1	4.0	4.1
Electricity	7.8	18	32	75	114	188	299	7.4	15	26	6.6	5.4	5.1	4.8	5.1
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	116	133	148	174	192	201	214	53	34	18	1.2	1.2	0.5	0.7	0.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	120	293	570	1,128	1,662	2,675	4,230	100	100	100	6.3	5.0	4.9	4.7	4.8
Coal	61	192	390	801	1,084	1,719	2,695	65	71	64	6.7	3.8	4.7	4.6	4.4
Oil	8.8	13	29	23	14	11	11	4.5	2.0	0.3	2.5	-6.0	-2.3	-0.1	-2.6
Natural gas	0.6	10.0	56	94	188	382	730	3.4	8.3	17	10.7	9.1	7.3	6.7	7.6
Nuclear	3.0	6.1	17	33	112	198	302	2.1	2.9	7.1	7.9	16.5	5.9	4.3	8.2
Hydro	47	72	74	126	167	213	256	24	11	6.1	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	1.7	30	60	91	155	0.0	2.7	3.7	36.6	8.9	4.3	5.4	6.0
Biomass and waste	-	-	1.3	21	37	60	80	-	1.8	1.9	n.a.	7.8	4.9	2.9	5.0

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	279	479	825	1,901	3,079	5,854	10,148	6.5	6.2	6.6	5.7	6.2
Population (million)	699	869	1,042	1,237	1,353	1,476	1,566	1.6	1.1	0.9	0.6	0.8
CO_2 emissions[*2] (Mt)	284	585	961	1,961	2,475	3,404	4,688	5.7	3.0	3.2	3.3	3.2
GDP per capita ($2010 thousand)	0.4	0.6	0.8	1.5	2.3	4.0	6.5	4.8	5.0	5.7	5.0	5.3
Primary energy consump. per capita (toe)	0.3	0.4	0.4	0.6	0.7	0.9	1.2	2.6	2.0	2.1	2.4	2.2
Primary energy consumption per GDP[*3]	735	660	553	415	327	231	179	-2.1	-2.9	-3.4	-2.5	-3.0
CO_2 emissions per GDP[*2, *4]	1,016	1,219	1,164	1,032	804	581	462	-0.8	-3.1	-3.2	-2.3	-2.8
CO_2 per primary energy consumption[*2, *5]	1.4	1.8	2.1	2.5	2.5	2.5	2.6	1.4	-0.2	0.2	0.3	0.1
Automobile ownership (million)	1.7	4.3	9.4	29	49	97	190	9.1	6.6	7.1	6.9	6.9
Automobile ownership rates[*6]	2.4	5.0	9.0	24	36	66	121	7.4	5.4	6.2	6.3	6.0

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 24 Japan [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	345	439	519	452	457	440	416	100	100	100	0.1	0.1	-0.4	-0.6	-0.3
Coal	60	77	97	112	101	104	99	17	25	24	1.7	-1.3	0.3	-0.5	-0.4
Oil	234	250	255	210	178	156	139	57	46	33	-0.8	-2.0	-1.4	-1.1	-1.5
Natural gas	21	44	66	105	93	105	106	10	23	25	4.0	-1.6	1.2	0.1	0.0
Nuclear	22	53	84	4.2	59	44	37	12	0.9	8.9	-10.9	39.4	-2.9	-1.8	8.1
Hydro	7.6	7.7	7.5	6.5	7.6	7.6	7.6	1.7	1.4	1.8	-0.8	2.0	0.0	0.0	0.6
Geothermal	0.8	1.6	3.1	2.4	3.7	7.3	8.6	0.4	0.5	2.1	2.0	5.4	7.1	1.6	4.7
Solar, wind, etc.	-	1.2	0.8	1.4	3.1	4.7	6.6	0.3	0.3	1.6	0.7	10.9	4.2	3.4	5.8
Biomass and waste	-	4.9	5.6	10	12	12	13	1.1	2.3	3.1	3.4	1.7	0.4	0.5	0.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	232	298	341	309	302	291	277	100	100	100	0.2	-0.3	-0.4	-0.5	-0.4
By sector															
Industry	91	101	96	82	84	83	81	34	26	29	-0.9	0.4	-0.2	-0.2	0.0
Transport	54	72	88	75	68	60	53	24	24	19	0.2	-1.1	-1.2	-1.2	-1.2
Buildings, etc.	58	91	116	115	115	114	110	31	37	40	1.1	0.0	0.0	-0.4	-0.1
Non-energy use	28	34	41	38	35	34	32	12	12	12	0.4	-0.9	-0.5	-0.5	-0.6
By energy															
Coal	25	32	25	27	26	25	23	11	8.7	8.3	-0.7	-0.4	-0.6	-0.7	-0.6
Oil	157	182	208	164	148	130	113	61	53	41	-0.5	-1.3	-1.3	-1.3	-1.3
Natural gas	5.8	15	23	35	37	39	39	5.1	11	14	3.8	0.8	0.4	0.0	0.4
Electricity	44	64	81	79	85	90	92	22	26	33	0.9	0.9	0.6	0.2	0.5
Heat	0.1	0.2	0.5	0.5	2.6	4.6	6.5	0.1	0.2	2.3	4.6	21.7	6.0	3.4	9.3
Renewables	-	3.9	3.7	3.3	3.2	3.1	2.9	1.3	1.1	1.0	-0.7	-0.6	-0.4	-0.7	-0.6

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	573	836	1,049	1,026	1,090	1,151	1,171	100	100	100	0.9	0.8	0.5	0.2	0.5
Coal	55	116	229	303	256	283	273	14	30	23	4.5	-2.1	1.0	-0.3	-0.4
Oil	265	237	135	181	102	80	80	28	18	6.8	-1.2	-7.0	-2.3	-0.1	-2.9
Natural gas	81	179	256	397	332	417	443	21	39	38	3.7	-2.2	2.3	0.6	0.4
Nuclear	83	202	322	16	227	169	141	24	1.6	12	-10.9	39.4	-2.9	-1.8	8.1
Hydro	88	89	87	75	88	89	89	11	7.4	7.6	-0.8	2.0	0.0	0.0	0.6
Geothermal	0.9	1.7	3.3	2.6	4.1	8.3	9.8	0.2	0.3	0.8	1.9	5.8	7.4	1.7	4.9
Solar, wind, etc.	-	0.0	0.5	12	32	51	73	0.0	1.2	6.2	53.1	13.4	4.7	3.7	6.7
Biomass and waste	-	11	16	39	49	55	62	1.3	3.8	5.3	6.0	3.0	1.1	1.2	1.7

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	2,894	4,553	5,093	5,571	6,501	7,422	8,278	0.9	1.9	1.3	1.1	1.4
Population (million)	117	124	127	128	126	121	115	0.1	-0.2	-0.4	-0.5	-0.4
CO_2 emissions[*2] (Mt)	916	1,070	1,196	1,220	1,057	1,031	969	0.6	-1.8	-0.2	-0.6	-0.8
GDP per capita ($2010 thousand)	25	37	40	44	52	61	72	0.8	2.1	1.7	1.6	1.8
Primary energy consump. per capita (toe)	3.0	3.6	4.1	3.5	3.6	3.6	3.6	0.0	0.3	0.0	0.0	0.1
Primary energy consumption per GDP[*3]	119	96	102	81	70	59	50	-0.8	-1.8	-1.7	-1.6	-1.7
CO_2 emissions per GDP[*2, *4]	317	235	235	219	163	139	117	-0.3	-3.7	-1.6	-1.7	-2.2
CO_2 per primary energy consumption[*2, *5]	2.7	2.4	2.3	2.7	2.3	2.3	2.3	0.5	-1.9	0.1	-0.1	-0.5
Automobile ownership (million)	38	58	72	76	77	74	71	1.3	0.2	-0.4	-0.4	-0.2
Automobile ownership rates[*6]	325	467	570	595	615	612	619	1.1	0.4	0.0	0.1	0.1

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 25 Korea [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	41	93	188	263	294	324	326	100	100	100	4.9	1.4	1.0	0.0	0.8
Coal	14	25	42	77	81	92	94	27	29	29	5.2	0.6	1.3	0.1	0.7
Oil	27	50	99	97	97	97	95	54	37	29	3.1	0.0	0.0	-0.2	-0.1
Natural gas	-	2.7	17	45	48	53	51	2.9	17	16	13.6	0.8	1.0	-0.2	0.5
Nuclear	0.9	14	28	39	61	73	73	15	15	22	4.9	5.7	1.8	0.0	2.2
Hydro	0.2	0.5	0.3	0.3	0.3	0.3	0.3	0.6	0.1	0.1	-2.1	0.0	0.0	0.0	0.0
Geothermal	-	-	-	0.1	0.1	0.1	0.1	-	0.0	0.0	n.a.	0.0	2.1	1.7	1.4
Solar, wind, etc.	-	0.0	0.0	0.2	1.0	2.0	4.3	0.0	0.1	1.3	15.4	19.6	7.4	8.0	11.0
Biomass and waste	-	0.7	1.4	4.3	5.3	6.8	7.8	0.8	1.6	2.4	8.4	2.7	2.6	1.4	2.2

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	31	65	127	166	180	193	195	100	100	100	4.4	1.0	0.7	0.1	0.6
By sector															
Industry	10	19	38	47	53	58	58	30	28	30	4.2	1.4	0.8	0.1	0.7
Transport	4.8	15	26	30	29	29	28	22	18	14	3.4	-0.4	-0.2	-0.2	-0.2
Buildings, etc.	13	24	37	45	46	51	51	38	27	26	2.9	0.2	1.0	0.0	0.4
Non-energy use	3.1	6.7	25	43	51	56	58	10	26	30	8.8	2.1	1.0	0.3	1.0
By energy															
Coal	9.7	12	9.1	9.6	11	11	10	18	5.8	5.1	-0.9	1.9	0.3	-1.3	0.2
Oil	19	44	80	84	87	88	87	67	51	44	3.0	0.3	0.1	-0.1	0.1
Natural gas	-	0.7	11	23	23	24	23	1.0	14	12	17.4	0.0	0.3	-0.2	0.0
Electricity	2.8	8.1	23	41	51	62	66	13	25	34	7.7	2.6	1.9	0.7	1.7
Heat	-	-	3.3	5.0	4.3	4.3	3.9	-	3.0	2.0	n.a.	-1.8	0.0	-1.0	-0.9
Renewables	-	0.7	1.3	3.1	3.6	4.5	5.2	1.1	1.9	2.7	6.8	1.6	2.4	1.4	1.8

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	37	105	289	531	648	785	842	100	100	100	7.6	2.5	1.9	0.7	1.7
Coal	2.5	18	111	239	246	289	310	17	45	37	12.6	0.4	1.6	0.7	0.9
Oil	29	19	35	21	12	8.3	6.6	18	4.0	0.8	0.5	-6.9	-3.5	-2.4	-4.1
Natural gas	-	9.6	29	112	137	176	186	9.1	21	22	11.8	2.5	2.5	0.5	1.8
Nuclear	3.5	53	109	150	235	280	280	50	28	33	4.9	5.7	1.8	0.0	2.2
Hydro	2.0	6.4	4.0	4.0	4.0	4.0	4.0	6.0	0.7	0.5	-2.1	0.0	0.0	0.0	0.0
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	0.0	2.4	11	23	49	0.0	0.5	5.9	42.5	20.9	7.5	8.1	11.4
Biomass and waste	-	-	0.1	1.7	3.5	5.4	6.9	-	0.3	0.8	n.a.	9.8	4.4	2.4	5.2

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	162	374	675	1,074	1,438	1,874	2,250	4.9	3.7	2.7	1.8	2.7
Population (million)	38	43	47	50	52	53	53	0.7	0.4	0.3	0.0	0.2
CO_2 emissions[*2] (Mt)	126	239	433	576	574	614	606	4.1	0.0	0.7	-0.1	0.2
GDP per capita ($2010 thousand)	4.3	8.7	14	21	28	35	42	4.2	3.3	2.4	1.8	2.4
Primary energy consump. per capita (toe)	1.1	2.2	4.0	5.3	5.7	6.1	6.1	4.1	0.9	0.7	0.0	0.5
Primary energy consumption per GDP[*3]	254	248	279	245	204	173	145	-0.1	-2.3	-1.6	-1.8	-1.9
CO_2 emissions per GDP[*2, *4]	777	638	641	536	399	328	269	-0.8	-3.6	-1.9	-1.9	-2.4
CO_2 per primary energy consumption[*2, *5]	3.1	2.6	2.3	2.2	2.0	1.9	1.9	-0.7	-1.4	-0.3	-0.2	-0.6
Automobile ownership (million)	0.5	3.4	12	18	22	25	28	8.0	2.1	1.6	1.0	1.5
Automobile ownership rates[*6]	14	79	257	369	421	478	528	7.2	1.7	1.3	1.0	1.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 26 Chinese Taipei [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	28	48	85	105	116	121	120	100	100	100	3.6	1.3	0.4	-0.1	0.5
Coal	3.9	11	30	40	40	39	34	24	38	28	5.8	0.2	-0.4	-1.3	-0.5
Oil	20	26	38	39	42	44	43	54	37	36	1.9	1.1	0.4	-0.1	0.4
Natural gas	1.6	1.4	5.6	13	20	26	30	2.9	13	25	10.8	5.0	2.8	1.4	2.9
Nuclear	2.1	8.6	10	11	11	8.3	8.3	18	10	6.9	0.9	0.4	-2.7	0.0	-0.9
Hydro	0.3	0.5	0.4	0.5	0.3	0.3	0.3	1.1	0.5	0.3	-0.5	-4.3	0.0	0.0	-1.2
Geothermal	-	0.0	-	-	-	-	-	0.0	-	-	-100	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	0.1	0.2	0.6	0.8	1.2	0.0	0.2	1.0	12.4	11.8	3.8	4.0	6.1
Biomass and waste	-	-	0.6	1.7	2.2	3.0	3.3	-	1.7	2.8	n.a.	2.8	3.2	1.2	2.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	19	29	49	65	73	78	79	100	100	100	3.7	1.5	0.6	0.1	0.7
By sector															
Industry	10	12	19	22	25	26	26	42	34	33	2.8	1.3	0.3	0.0	0.5
Transport	2.9	6.6	12	12	14	15	15	22	18	19	2.8	2.0	0.7	-0.2	0.7
Buildings, etc.	3.6	6.5	10	12	13	13	13	22	18	17	2.6	1.1	0.5	0.0	0.5
Non-energy use	2.0	4.0	7.8	19	22	24	25	14	29	32	7.4	1.5	0.9	0.4	0.9
By energy															
Coal	2.2	3.6	5.0	7.3	8.5	9.1	9.4	12	11	12	3.3	2.0	0.7	0.3	0.9
Oil	12	18	28	36	40	42	41	62	55	52	3.1	1.3	0.4	-0.1	0.5
Natural gas	1.4	0.9	1.6	2.4	2.8	3.3	3.7	3.0	3.7	4.6	4.7	2.1	1.5	1.1	1.5
Electricity	3.2	6.6	14	19	21	23	24	22	29	30	5.0	1.4	0.7	0.3	0.8
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	-	0.0	0.1	0.3	0.6	0.7	0.8	0.1	0.5	1.0	14.4	6.1	2.1	1.2	2.9

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	43	88	181	247	278	298	305	100	100	100	4.8	1.5	0.7	0.2	0.7
Coal	6.0	24	88	125	118	110	90	28	50	29	7.7	-0.7	-0.7	-2.0	-1.2
Oil	26	23	30	7.8	6.0	5.3	5.2	26	3.2	1.7	-4.9	-3.4	-1.2	-0.1	-1.4
Natural gas	-	1.2	17	64	99	134	156	1.4	26	51	19.6	5.6	3.1	1.6	3.3
Nuclear	8.2	33	39	40	42	32	32	37	16	10	0.9	0.4	-2.7	0.0	-0.9
Hydro	2.9	6.4	4.6	5.7	4.0	4.0	4.0	7.2	2.3	1.3	-0.5	-4.3	0.0	0.0	-1.2
Geothermal	-	0.0	-	-	-	-	-	0.0	-	-	-100	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	0.0	1.5	3.9	5.8	9.6	-	0.6	3.2	n.a.	12.2	4.1	5.2	6.8
Biomass and waste	-	-	1.7	3.5	5.4	7.6	8.6	-	1.4	2.8	n.a.	5.6	3.5	1.3	3.3

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	80	168	307	473	663	835	952	4.8	4.3	2.3	1.3	2.5
Population (million)	18	20	22	23	24	24	23	0.6	0.2	0.0	-0.3	0.0
CO_2 emissions[*2] (Mt)	75	116	225	248	268	276	261	3.5	1.0	0.3	-0.5	0.2
GDP per capita ($2010 thousand)	4.5	8.2	14	20	28	35	42	4.2	4.1	2.3	1.7	2.6
Primary energy consump. per capita (toe)	1.6	2.3	3.8	4.5	4.9	5.1	5.3	3.0	1.1	0.4	0.3	0.5
Primary energy consumption per GDP[*3]	347	285	276	221	175	145	126	-1.1	-2.9	-1.9	-1.4	-2.0
CO_2 emissions per GDP[*2, *4]	927	689	733	525	405	330	274	-1.2	-3.2	-2.0	-1.8	-2.3
CO_2 per primary energy consumption[*2, *5]	2.7	2.4	2.6	2.4	2.3	2.3	2.2	-0.1	-0.3	-0.1	-0.5	-0.3
Automobile ownership (million)	0.5	2.9	5.5	7.1	8.3	9.3	9.7	4.2	1.9	1.1	0.4	1.1
Automobile ownership rates[*6]	27	141	249	309	351	392	423	3.6	1.6	1.1	0.8	1.1

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 27 ASEAN [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	142	233	380	573	772	1,007	1,248	100	100	100	4.2	3.8	2.7	2.2	2.8
Coal	3.6	13	32	89	130	197	272	5.4	16	22	9.3	4.9	4.2	3.3	4.1
Oil	58	88	153	209	263	333	411	38	37	33	4.0	2.9	2.4	2.1	2.4
Natural gas	8.6	30	74	126	168	225	283	13	22	23	6.7	3.7	3.0	2.3	3.0
Nuclear	-	-	-	-	-	9.4	20	-	-	1.6	n.a.	n.a.	n.a.	7.9	n.a.
Hydro	0.8	2.3	4.1	8.8	11	14	16	1.0	1.5	1.3	6.2	3.2	2.4	1.2	2.2
Geothermal	1.8	6.6	18	25	65	69	68	2.8	4.4	5.5	6.2	12.8	0.6	-0.2	3.6
Solar, wind, etc.	-	-	-	0.1	0.2	0.5	1.0	-	0.0	0.1	n.a.	14.8	7.7	7.9	9.8
Biomass and waste	70	93	99	114	131	154	172	40	20	14	0.9	1.7	1.6	1.1	1.5

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	112	173	271	412	526	697	877	100	100	100	4.0	3.1	2.8	2.3	2.7
By sector															
Industry	22	43	76	115	160	227	292	25	28	33	4.6	4.2	3.6	2.5	3.4
Transport	17	32	62	104	136	185	240	19	25	27	5.5	3.4	3.1	2.7	3.0
Buildings, etc.	71	87	113	141	168	209	256	50	34	29	2.2	2.2	2.2	2.0	2.1
Non-energy use	2.4	11	21	52	63	75	88	6.3	13	10	7.3	2.4	1.9	1.6	1.9
By energy															
Coal	2.1	6.0	13	28	40	58	75	3.4	6.9	8.5	7.3	4.4	3.9	2.5	3.5
Oil	41	67	123	187	232	301	377	38	45	43	4.8	2.8	2.6	2.3	2.5
Natural gas	2.5	7.5	17	37	53	73	95	4.4	9.0	11	7.5	4.7	3.2	2.6	3.4
Electricity	4.7	11	28	59	87	133	185	6.4	14	21	7.8	5.0	4.3	3.4	4.2
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	62	82	90	101	114	132	146	47	25	17	1.0	1.5	1.4	1.0	1.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	62	154	370	754	1,088	1,642	2,293	100	100	100	7.5	4.7	4.2	3.4	4.1
Coal	3.0	28	79	236	361	585	880	18	31	38	10.2	5.5	4.9	4.2	4.8
Oil	47	66	72	55	64	73	83	43	7.3	3.6	-0.8	1.9	1.3	1.4	1.5
Natural gas	0.7	26	154	334	459	675	917	17	44	40	12.3	4.0	3.9	3.1	3.7
Nuclear	-	-	-	-	-	45	104	-	-	4.5	n.a.	n.a.	n.a.	8.7	n.a.
Hydro	9.8	27	47	102	132	167	187	18	14	8.2	6.2	3.2	2.4	1.2	2.2
Geothermal	2.1	6.6	16	20	51	64	73	4.3	2.6	3.2	5.1	12.7	2.3	1.2	4.8
Solar, wind, etc.	-	-	-	0.9	2.6	5.6	12	-	0.1	0.5	n.a.	15.0	7.8	8.0	9.9
Biomass and waste	-	0.6	1.0	6.9	18	28	37	0.4	0.9	1.6	11.7	12.9	4.6	2.6	6.1

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	405	702	1,137	2,074	3,124	4,901	7,101	5.0	5.3	4.6	3.8	4.5
Population (million)	345	427	503	587	638	691	729	1.5	1.1	0.8	0.5	0.8
CO_2 emissions[*2] (Mt)	205	362	709	1,139	1,536	2,112	2,747	5.4	3.8	3.2	2.7	3.2
GDP per capita ($2010 thousand)	1.2	1.6	2.3	3.5	4.9	7.1	9.7	3.5	4.2	3.8	3.2	3.7
Primary energy consump. per capita (toe)	0.4	0.5	0.8	1.0	1.2	1.5	1.7	2.7	2.7	1.9	1.6	2.0
Primary energy consumption per GDP[*3]	352	332	334	276	247	205	176	-0.8	-1.4	-1.8	-1.5	-1.6
CO_2 emissions per GDP[*2, *4]	507	515	624	549	492	431	387	0.3	-1.4	-1.3	-1.1	-1.2
CO_2 per primary energy consumption[*2, *5]	1.4	1.6	1.9	2.0	2.0	2.1	2.2	1.1	0.0	0.5	0.5	0.4
Automobile ownership (million)	4.4	10	21	48	62	85	114	7.3	3.4	3.2	2.9	3.2
Automobile ownership rates[*6]	13	24	41	82	98	124	156	5.8	2.3	2.3	2.4	2.4

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 28 Indonesia [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	56	99	156	214	310	403	507	100	100	100	3.6	4.8	2.7	2.3	3.1
Coal	0.2	3.5	12	30	51	84	125	3.6	14	25	10.2	6.9	5.1	4.1	5.3
Oil	20	33	58	77	95	122	154	34	36	30	3.9	2.7	2.5	2.3	2.5
Natural gas	4.9	16	27	35	49	67	90	16	16	18	3.7	4.2	3.3	3.0	3.4
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	0.1	0.5	0.9	1.1	1.2	1.4	1.5	0.5	0.5	0.3	3.7	1.3	1.3	0.7	1.1
Geothermal	-	1.9	8.4	16	52	54	51	2.0	7.6	10	10.1	15.7	0.4	-0.6	4.2
Solar, wind, etc.	-	-	-	0.0	0.0	0.0	0.1	-	0.0	0.0	n.a.	50.3	5.3	6.7	17.1
Biomass and waste	30	43	50	54	62	74	86	44	25	17	1.0	1.7	1.8	1.4	1.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	50	80	121	160	208	278	359	100	100	100	3.2	3.4	2.9	2.6	2.9
By sector															
Industry	6.7	18	31	37	57	80	107	23	23	30	3.3	5.4	3.5	2.9	3.8
Transport	6.0	11	22	44	60	87	119	13	28	33	6.6	3.9	3.9	3.2	3.6
Buildings, etc.	36	44	59	67	78	95	115	55	42	32	2.0	2.0	1.9	1.9	2.0
Non-energy use	1.2	7.4	9.8	11	13	15	17	9.2	7.1	4.9	2.0	2.0	1.3	1.4	1.6
By energy															
Coal	0.1	2.1	4.7	4.7	9.2	13	16	2.7	2.9	4.3	3.7	8.8	3.1	2.2	4.4
Oil	17	27	49	69	87	115	146	34	43	41	4.3	2.9	2.8	2.5	2.7
Natural gas	2.4	6.0	12	17	26	37	50	7.5	11	14	4.9	5.1	3.6	3.1	3.8
Electricity	0.6	2.4	6.8	15	25	41	63	3.0	9.4	17	8.6	6.5	5.0	4.4	5.2
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	29	42	49	53	61	73	84	53	33	24	1.1	1.7	1.8	1.4	1.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	7.5	33	93	196	323	526	806	100	100	100	8.5	6.5	5.0	4.4	5.2
Coal	-	9.8	34	95	159	295	492	30	49	61	10.9	6.6	6.4	5.2	6.0
Oil	6.2	15	18	33	37	37	36	47	17	4.5	3.5	1.5	0.0	-0.1	0.4
Natural gas	-	0.7	26	45	77	130	206	2.2	23	26	20.6	6.7	5.4	4.8	5.5
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	1.3	5.7	10	13	14	16	17	17	6.5	2.1	3.7	1.3	1.3	0.7	1.1
Geothermal	-	1.1	4.9	9.4	36	47	53	3.4	4.8	6.5	10.1	18.1	2.7	1.2	6.3
Solar, wind, etc.	-	-	-	0.0	0.2	0.4	0.7	-	0.0	0.1	n.a.	50.4	5.3	6.7	17.1
Biomass and waste	-	-	0.0	0.2	0.4	0.7	0.9	-	0.1	0.1	n.a.	9.5	4.9	2.9	5.5

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	152	282	426	802	1,261	2,046	3,097	4.9	5.8	5.0	4.2	4.9
Population (million)	145	179	209	247	269	293	311	1.5	1.1	0.9	0.6	0.8
CO_2 emissions[*2] (Mt)	71	134	262	405	570	822	1,130	5.2	4.4	3.7	3.2	3.7
GDP per capita ($2010 thousand)	1.0	1.6	2.0	3.2	4.7	7.0	9.9	3.3	4.7	4.1	3.6	4.1
Primary energy consump. per capita (toe)	0.4	0.6	0.7	0.9	1.2	1.4	1.6	2.1	3.6	1.8	1.7	2.3
Primary energy consumption per GDP[*3]	367	350	365	266	246	197	164	-1.2	-1.0	-2.2	-1.8	-1.7
CO_2 emissions per GDP[*2, *4]	471	475	615	505	452	402	365	0.3	-1.4	-1.2	-1.0	-1.2
CO_2 per primary energy consumption[*2, *5]	1.3	1.4	1.7	1.9	1.8	2.0	2.2	1.5	-0.4	1.0	0.9	0.6
Automobile ownership (million)	1.3	2.8	5.4	18	26	39	56	8.8	4.8	4.1	3.7	4.1
Automobile ownership rates[*6]	8.9	16	26	73	97	133	180	7.2	3.7	3.2	3.1	3.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 29 Malaysia [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	12	22	49	81	106	134	160	100	100	100	6.1	3.4	2.4	1.8	2.5
Coal	0.1	1.4	2.3	16	23	30	36	6.1	19	22	11.8	4.8	2.8	1.8	3.0
Oil	7.9	11	19	29	33	37	41	51	35	26	4.3	1.7	1.2	1.0	1.3
Natural gas	2.2	6.8	25	32	47	59	70	31	40	43	7.4	4.6	2.4	1.7	2.8
Nuclear	-	-	-	-	-	2.6	7.7	-	-	4.8	n.a.	n.a.	n.a.	11.6	n.a.
Hydro	0.1	0.3	0.6	0.8	0.7	1.0	1.1	1.5	1.0	0.7	3.8	-1.3	3.2	1.0	1.1
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	0.0	0.0	0.0	0.1	-	0.0	0.0	n.a.	10.9	7.4	13.8	10.6
Biomass and waste	1.8	2.3	2.8	3.5	3.2	4.4	5.0	10	4.3	3.1	1.8	-0.8	3.1	1.3	1.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	7.2	14	30	49	62	79	95	100	100	100	5.9	2.9	2.4	1.9	2.4
By sector															
Industry	3.1	5.6	12	14	20	26	32	40	29	34	4.4	4.1	2.8	2.1	2.9
Transport	2.1	4.8	10	15	17	20	22	34	30	23	5.2	1.8	1.5	1.0	1.4
Buildings, etc.	1.8	2.8	5.4	9.9	14	19	24	20	20	26	5.8	4.1	3.3	2.6	3.3
Non-energy use	0.3	0.8	2.2	11	12	15	17	6.0	22	18	12.3	1.7	1.7	1.6	1.7
By energy															
Coal	0.1	0.5	1.0	1.7	2.3	3.2	4.2	3.7	3.5	4.5	5.7	3.3	3.6	2.7	3.2
Oil	5.3	9.2	18	25	27	31	35	66	51	36	4.7	0.9	1.4	1.1	1.1
Natural gas	0.0	1.1	3.9	10	16	20	25	7.8	21	26	10.7	5.4	2.6	2.0	3.2
Electricity	0.7	1.7	5.3	10	15	22	29	12	21	31	8.5	5.1	3.6	2.7	3.7
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	1.1	1.5	1.7	1.9	2.0	2.5	2.4	11	3.8	2.6	1.1	1.0	1.9	0.0	1.0

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	10	23	69	134	199	283	370	100	100	100	8.4	5.0	3.6	2.7	3.7
Coal	-	2.9	7.7	56	85	116	144	13	42	39	14.3	5.4	3.2	2.2	3.4
Oil	8.5	11	3.6	6.0	6.0	6.0	6.0	46	4.5	1.6	-2.5	0.0	0.0	0.0	0.0
Natural gas	0.1	5.5	51	63	96	134	170	24	47	46	11.7	5.5	3.4	2.4	3.6
Nuclear	-	-	-	-	-	9.8	29	-	-	8.0	n.a.	n.a.	n.a.	11.6	n.a.
Hydro	1.4	4.0	7.0	9.1	8.1	11	13	17	6.7	3.4	3.8	-1.4	3.4	1.1	1.2
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	0.0	0.1	0.2	0.8	-	0.0	0.2	n.a.	11.4	7.6	13.9	10.9
Biomass and waste	-	-	-	0.8	3.7	5.9	7.8	-	0.6	2.1	n.a.	20.4	4.9	2.9	8.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	44	79	158	275	405	630	872	5.8	5.0	4.5	3.3	4.2
Population (million)	14	18	23	29	33	37	40	2.2	1.5	1.2	0.8	1.1
CO_2 emissions[*2] (Mt)	29	54	120	198	269	333	387	6.1	3.9	2.2	1.5	2.4
GDP per capita ($2010 thousand)	3.2	4.4	6.7	9.4	12	17	22	3.6	3.4	3.3	2.5	3.1
Primary energy consump. per capita (toe)	0.9	1.2	2.1	2.8	3.2	3.6	4.0	3.8	1.9	1.2	1.0	1.3
Primary energy consumption per GDP[*3]	272	279	314	295	263	213	184	0.3	-1.5	-2.1	-1.5	-1.7
CO_2 emissions per GDP[*2, *4]	649	681	761	721	664	529	444	0.3	-1.0	-2.2	-1.7	-1.7
CO_2 per primary energy consumption[*2, *5]	2.4	2.4	2.4	2.4	2.5	2.5	2.4	0.0	0.5	-0.2	-0.3	0.0
Automobile ownership (million)	0.9	2.4	5.2	11	13	15	16	7.1	1.7	1.6	1.0	1.4
Automobile ownership rates[*6]	65	133	224	376	383	400	408	4.8	0.2	0.4	0.2	0.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 30 Myanmar [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	9.4	11	13	15	18	24	30	100	100	100	1.6	2.4	2.6	2.6	2.5
Coal	0.2	0.1	0.3	0.5	0.5	1.0	1.6	0.6	3.2	5.1	9.4	1.5	5.8	5.0	4.3
Oil	1.3	0.7	2.0	2.2	2.7	4.3	6.9	6.8	14	23	5.1	2.8	4.6	4.9	4.2
Natural gas	0.3	0.8	1.2	1.2	3.1	5.7	8.7	7.1	8.0	28	2.2	12.4	6.2	4.3	7.2
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	0.1	0.1	0.2	0.7	0.8	1.1	1.5	1.0	4.4	5.0	8.9	3.0	3.0	3.0	3.0
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Biomass and waste	7.6	9.0	9.2	11	11	12	12	84	70	39	0.8	0.5	0.4	0.2	0.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	8.4	9.4	11	14	17	21	27	100	100	100	2.0	1.8	2.2	2.5	2.2
By sector															
Industry	0.6	0.4	1.2	1.8	2.5	3.8	5.7	4.2	12	21	7.1	4.3	4.3	4.2	4.3
Transport	0.6	0.4	1.2	1.1	1.7	3.2	5.7	4.7	7.4	21	4.0	6.3	6.2	6.1	6.2
Buildings, etc.	7.0	8.5	9.1	11	12	14	15	90	79	56	1.4	0.9	1.0	1.0	1.0
Non-energy use	0.1	0.1	0.1	0.2	0.3	0.3	0.3	1.0	1.7	1.2	4.4	1.0	1.0	1.0	1.0
By energy															
Coal	0.1	0.1	0.3	0.3	0.4	0.6	0.9	0.5	2.1	3.3	8.3	3.9	3.9	3.9	3.9
Oil	1.2	0.6	1.5	2.1	2.9	4.7	7.7	6.2	14	29	5.9	4.6	4.9	5.1	4.9
Natural gas	0.1	0.2	0.3	0.7	0.9	1.3	1.7	2.4	5.0	6.5	5.5	3.1	3.2	3.3	3.2
Electricity	0.1	0.1	0.3	0.7	1.3	2.6	4.5	1.6	4.9	17	7.3	7.9	7.0	5.8	6.8
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	6.9	8.4	9.0	11	11	12	12	89	74	44	1.1	0.6	0.4	0.2	0.4

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1.5	2.5	5.1	11	18	36	62	100	100	100	6.9	6.8	7.0	5.8	6.5
Coal	0.0	0.0	-	0.8	0.6	1.6	3.2	1.6	7.2	5.1	14.4	-3.1	10.4	7.1	5.2
Oil	0.5	0.3	0.7	0.1	0.0	0.1	0.2	11	0.5	0.3	-7.3	-3.1	10.4	7.1	5.2
Natural gas	0.2	1.0	2.5	2.1	7.7	21	41	39	20	66	3.7	17.4	10.4	7.1	11.1
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	0.8	1.2	1.9	7.8	9.8	13	18	48	72	28	8.9	3.0	3.0	3.0	3.0
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Biomass and waste	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	5.9	6.7	13	47	79	138	214	9.3	6.8	5.8	4.5	5.6
Population (million)	34	42	48	53	56	59	59	1.0	0.8	0.4	0.1	0.4
CO_2 emissions[*2] (Mt)	5.2	4.1	9.9	11	17	29	47	4.5	5.9	5.6	4.7	5.4
GDP per capita ($2010 thousand)	0.2	0.2	0.3	0.9	1.4	2.4	3.6	8.1	6.0	5.3	4.3	5.1
Primary energy consump. per capita (toe)	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.6	1.6	2.1	2.4	2.1
Primary energy consumption per GDP[*3]	1,603	1,599	964	326	232	171	142	-7.0	-4.2	-3.0	-1.8	-2.9
CO_2 emissions per GDP[*2, *4]	891	608	744	231	216	213	218	-4.3	-0.8	-0.1	0.2	-0.2
CO_2 per primary energy consumption[*2, *5]	0.6	0.4	0.8	0.7	0.9	1.2	1.5	2.9	3.5	3.0	2.1	2.8
Automobile ownership (million)	0.1	0.1	0.3	0.4	0.7	1.3	2.5	8.2	7.3	7.0	6.6	6.9
Automobile ownership rates[*6]	2.2	1.6	5.2	7.3	12	23	43	7.1	6.5	6.5	6.5	6.5

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 31 Philippines [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	22	29	40	43	55	72	93	100	100	100	1.8	3.2	2.8	2.6	2.8
Coal	0.5	1.5	5.2	8.9	12	18	27	5.3	21	29	8.4	3.6	4.6	3.8	4.0
Oil	10	11	16	14	17	21	27	38	32	29	1.1	2.4	2.6	2.3	2.4
Natural gas	-	-	0.0	3.2	5.0	8.0	12	-	7.6	13	n.a.	5.6	4.9	3.9	4.7
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	0.3	0.5	0.7	0.9	1.0	1.0	1.0	1.8	2.1	1.1	2.4	1.4	0.0	0.0	0.4
Geothermal	1.8	4.7	10.0	8.8	13	15	17	16	21	19	2.9	5.4	1.4	1.2	2.5
Solar, wind, etc.	-	-	-	0.0	0.0	0.1	0.1	-	0.0	0.1	n.a.	21.9	6.1	3.7	9.5
Biomass and waste	9.4	11	8.1	7.0	7.0	8.0	9.5	39	16	10	-2.1	0.1	1.3	1.7	1.1

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	17	20	24	24	30	40	52	100	100	100	0.9	2.9	2.9	2.6	2.8
By sector															
Industry	3.4	4.7	5.3	6.4	8.2	11	15	24	26	29	1.4	3.3	3.2	2.9	3.1
Transport	3.5	4.5	8.1	8.4	10	14	18	23	35	35	2.8	2.9	2.9	2.5	2.8
Buildings, etc.	9.4	10	10	9.1	11	14	19	52	38	36	-0.5	2.5	2.6	2.6	2.6
Non-energy use	0.3	0.2	0.3	0.2	0.2	0.3	0.4	1.2	0.7	0.7	-1.3	2.9	2.5	2.4	2.6
By energy															
Coal	0.2	0.6	0.8	1.7	1.7	1.8	1.9	3.1	7.2	3.6	4.8	-0.3	0.5	0.7	0.3
Oil	7.0	8.1	13	12	15	20	25	41	48	48	1.6	3.2	2.8	2.5	2.8
Natural gas	-	-	-	0.1	0.5	1.0	1.5	-	0.2	2.9	n.a.	29.4	7.7	4.4	12.2
Electricity	1.5	1.8	3.1	5.1	7.3	11	15	9.3	21	29	4.8	4.6	4.0	3.5	4.0
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	7.8	9.1	6.9	5.6	5.7	6.9	8.3	46	23	16	-2.2	0.4	1.8	2.0	1.4

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	18	26	45	73	103	151	210	100	100	100	4.7	4.5	3.9	3.3	3.8
Coal	0.2	1.9	17	28	43	71	106	7.3	39	50	13.0	5.4	5.1	4.1	4.8
Oil	12	12	9.2	4.3	4.3	4.3	4.3	47	5.8	2.0	-4.8	0.0	0.0	0.0	0.0
Natural gas	-	-	0.0	20	28	45	66	-	27	32	n.a.	4.8	4.8	3.9	4.5
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	3.5	6.1	7.8	10	11	11	11	23	14	5.4	2.4	1.4	0.0	0.0	0.4
Geothermal	2.1	5.5	12	10	16	18	20	21	14	9.6	2.9	5.4	1.4	1.2	2.4
Solar, wind, etc.	-	-	-	0.1	0.4	0.7	1.0	-	0.1	0.5	n.a.	21.9	6.1	3.7	9.5
Biomass and waste	-	0.4	-	0.2	0.4	0.6	0.8	1.6	0.2	0.4	-3.8	9.1	4.9	2.9	5.3

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	80	95	125	221	356	565	851	3.9	6.2	4.7	4.2	4.9
Population (million)	47	62	78	97	110	128	144	2.0	1.7	1.5	1.2	1.4
CO_2 emissions[*2] (Mt)	33	39	69	84	109	156	215	3.6	3.2	3.7	3.2	3.4
GDP per capita ($2010 thousand)	1.7	1.5	1.6	2.3	3.2	4.4	5.9	1.9	4.4	3.2	3.0	3.5
Primary energy consump. per capita (toe)	0.5	0.5	0.5	0.4	0.5	0.6	0.7	-0.2	1.5	1.3	1.4	1.4
Primary energy consumption per GDP[*3]	280	304	319	193	154	128	110	-2.0	-2.8	-1.8	-1.5	-2.0
CO_2 emissions per GDP[*2, *4]	414	409	550	382	305	277	253	-0.3	-2.8	-1.0	-0.9	-1.5
CO_2 per primary energy consumption[*2, *5]	1.5	1.3	1.7	2.0	2.0	2.2	2.3	1.8	0.0	0.9	0.6	0.5
Automobile ownership (million)	0.9	1.2	2.4	3.3	4.7	7.3	11	4.6	4.6	4.4	4.1	4.3
Automobile ownership rates[*6]	18	20	31	34	43	57	75	2.5	2.9	2.9	2.9	2.9

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 32 Thailand [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	22	42	72	127	161	200	237	100	100	100	5.1	3.1	2.2	1.7	2.3
Coal	0.5	3.8	7.7	17	21	27	33	9.1	14	14	7.1	2.3	2.5	2.2	2.3
Oil	11	18	32	49	66	79	92	43	39	39	4.7	3.9	1.8	1.5	2.3
Natural gas	-	5.0	17	35	42	55	69	12	28	29	9.3	2.2	2.8	2.2	2.4
Nuclear	-	-	-	-	-	0.2	0.7	-	-	0.3	n.a.	n.a.	n.a.	11.6	n.a.
Hydro	0.1	0.4	0.5	0.8	0.8	0.8	0.9	1.0	0.6	0.4	2.6	0.5	0.5	0.5	0.5
Geothermal	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	1.4	1.2	5.9
Solar, wind, etc.	-	-	-	0.1	0.1	0.3	0.7	-	0.0	0.3	n.a.	12.6	8.4	8.1	9.4
Biomass and waste	11	15	15	23	29	34	37	35	18	16	2.1	2.8	1.5	1.0	1.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	15	29	51	92	113	140	168	100	100	100	5.4	2.5	2.2	1.8	2.2
By sector															
Industry	4.0	8.7	17	29	36	48	62	30	32	37	5.7	2.7	3.0	2.5	2.7
Transport	3.2	9.0	15	22	27	32	35	31	24	21	4.1	2.8	1.6	1.0	1.7
Buildings, etc.	7.8	11	14	22	26	33	39	37	24	23	3.3	2.0	2.4	1.8	2.1
Non-energy use	0.2	0.4	5.6	19	24	28	32	1.5	21	19	18.9	2.4	1.6	1.5	1.8
By energy															
Coal	0.1	1.3	3.5	8.8	10	14	19	4.5	9.5	11	9.0	2.0	3.0	3.0	2.7
Oil	7.3	15	29	48	58	70	82	52	52	49	5.4	2.3	1.9	1.6	1.9
Natural gas	-	0.1	1.1	6.1	7.5	9.8	12	0.5	6.6	7.4	18.8	2.7	2.7	2.4	2.6
Electricity	1.1	3.3	7.6	14	18	26	34	11	15	20	6.8	3.5	3.6	2.5	3.2
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	6.7	9.2	9.4	16	19	21	21	32	17	13	2.4	2.3	0.9	0.4	1.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	14	44	96	167	210	294	390	100	100	100	6.2	2.9	3.4	2.8	3.1
Coal	1.4	11	18	33	44	56	66	25	20	17	5.1	3.5	2.4	1.7	2.5
Oil	12	10	10	2.4	2.7	3.7	4.7	23	1.5	1.2	-6.4	1.5	3.1	2.3	2.4
Natural gas	-	18	62	117	144	198	253	40	70	65	8.9	2.6	3.2	2.5	2.8
Nuclear	-	-	-	-	-	9.8	29	-	-	7.6	n.a.	n.a.	n.a.	11.6	n.a.
Hydro	1.3	5.0	6.0	8.8	9.1	9.6	10	11	5.3	2.6	2.6	0.5	0.5	0.5	0.5
Geothermal	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.3	1.4	1.2	5.9
Solar, wind, etc.	-	-	-	0.6	1.6	3.7	7.9	-	0.4	2.0	n.a.	12.6	8.4	8.1	9.4
Biomass and waste	-	-	0.5	4.4	8.7	14	19	-	2.6	4.8	n.a.	9.0	4.9	2.9	5.3

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	63	135	209	340	465	670	910	4.3	4.0	3.7	3.1	3.6
Population (million)	47	57	62	67	68	68	66	0.8	0.2	0.0	-0.3	-0.1
CO_2 emissions[*2] (Mt)	34	81	152	244	314	396	479	5.2	3.2	2.4	1.9	2.4
GDP per capita ($2010 thousand)	1.3	2.4	3.3	5.1	6.9	9.9	14	3.5	3.8	3.8	3.4	3.7
Primary energy consump. per capita (toe)	0.5	0.7	1.2	1.9	2.4	3.0	3.6	4.4	2.9	2.2	2.0	2.3
Primary energy consumption per GDP[*3]	347	311	346	372	347	298	260	0.8	-0.9	-1.5	-1.4	-1.3
CO_2 emissions per GDP[*2, *4]	537	598	727	717	675	591	526	0.8	-0.8	-1.3	-1.2	-1.1
CO_2 per primary energy consumption[*2, *5]	1.5	1.9	2.1	1.9	1.9	2.0	2.0	0.0	0.1	0.2	0.2	0.2
Automobile ownership (million)	0.9	2.8	6.1	13	15	18	21	7.2	2.0	1.8	1.3	1.7
Automobile ownership rates[*6]	19	50	98	193	222	267	315	6.3	1.8	1.9	1.7	1.8

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 33 Viet Nam [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	14	18	29	65	86	132	174	100	100	100	6.0	3.6	4.3	2.8	3.6
Coal	2.3	2.2	4.4	17	23	37	49	12	25	28	9.5	4.3	4.7	2.9	4.0
Oil	1.8	2.7	7.8	20	28	42	60	15	32	35	9.6	4.0	4.3	3.5	3.9
Natural gas	-	0.0	1.1	8.1	11	18	23	0.0	12	13	43.9	4.4	4.6	2.5	3.8
Nuclear	-	-	-	-	-	6.6	12	-	-	6.7	n.a.	n.a.	n.a.	5.9	n.a.
Hydro	0.1	0.5	1.3	4.6	6.8	9.0	10	2.6	7.1	5.8	11.0	5.0	2.9	1.2	2.9
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	0.0	0.0	0.0	0.1	-	0.0	0.1	n.a.	15.2	7.9	8.8	10.2
Biomass and waste	10	12	14	15	16	18	18	70	23	11	0.8	0.9	1.0	0.3	0.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	13	16	25	54	74	111	145	100	100	100	5.7	4.0	4.2	2.7	3.6
By sector															
Industry	3.8	4.5	7.9	20	30	49	61	28	38	42	7.1	4.8	5.2	2.2	4.0
Transport	0.6	1.4	3.5	11	16	25	37	8.6	21	26	10.0	4.7	4.3	4.0	4.3
Buildings, etc.	8.6	10	14	20	24	31	40	63	36	27	3.0	2.6	2.6	2.5	2.6
Non-energy use	0.0	0.0	0.1	2.8	3.8	5.8	7.6	0.2	5.2	5.2	23.4	4.0	4.2	2.7	3.6
By energy															
Coal	1.5	1.3	3.2	11	16	27	34	8.3	21	23	10.1	4.8	5.1	2.4	4.1
Oil	1.7	2.3	6.5	19	27	42	59	15	35	41	10.0	4.5	4.4	3.6	4.2
Natural gas	-	-	0.0	0.5	0.9	1.5	1.9	-	0.9	1.3	n.a.	7.5	5.6	2.3	4.9
Electricity	0.2	0.5	1.9	9.4	14	24	33	3.3	17	23	14.0	5.5	5.4	3.0	4.6
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	9.7	12	13	14	15	17	17	74	26	12	0.8	1.0	1.0	0.3	0.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	3.6	8.7	27	123	175	279	370	100	100	100	12.8	4.5	4.8	2.8	4.0
Coal	1.4	2.0	3.1	22	30	45	70	23	18	19	11.5	3.7	4.4	4.4	4.2
Oil	0.7	1.3	4.5	3.4	3.4	3.4	3.4	15	2.7	0.9	4.4	0.0	0.0	0.0	0.0
Natural gas	-	0.0	4.4	44	62	100	132	0.1	36	36	49.9	4.5	4.8	2.8	4.0
Nuclear	-	-	-	-	-	25	45	-	-	12	n.a.	n.a.	n.a.	5.9	n.a.
Hydro	1.5	5.4	15	53	79	105	118	62	43	32	11.0	5.0	2.9	1.2	2.9
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	-	-	0.1	0.3	0.6	1.3	-	0.1	0.4	n.a.	15.1	7.9	8.8	10.2
Biomass and waste	-	-	-	0.1	0.1	0.2	0.2	-	0.0	0.1	n.a.	8.5	4.9	2.9	5.2

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	17	29	61	130	205	382	610	7.0	5.9	6.4	4.8	5.7
Population (million)	54	66	78	89	95	100	102	1.4	0.8	0.5	0.2	0.5
CO_2 emissions[*2] (Mt)	15	17	43	139	193	301	409	10.0	4.2	4.5	3.1	3.9
GDP per capita ($2010 thousand)	0.3	0.4	0.8	1.5	2.2	3.8	6.0	5.5	5.0	5.9	4.5	5.2
Primary energy consump. per capita (toe)	0.3	0.3	0.4	0.7	0.9	1.3	1.7	4.6	2.8	3.8	2.6	3.1
Primary energy consumption per GDP[*3]	851	606	470	500	420	345	285	-0.9	-2.2	-1.9	-1.9	-2.0
CO_2 emissions per GDP[*2, *4]	860	579	711	1,069	938	786	671	2.8	-1.6	-1.8	-1.6	-1.6
CO_2 per primary energy consumption[*2, *5]	1.0	1.0	1.5	2.1	2.2	2.3	2.4	3.7	0.6	0.2	0.3	0.3
Automobile ownership (million)	0.2	0.2	0.4	1.2	2.0	3.5	6.0	9.3	6.3	5.9	5.6	5.9
Automobile ownership rates[*6]	2.9	2.6	4.8	14	21	35	59	7.8	5.4	5.4	5.4	5.4

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 34 North America [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	1,997	2,124	2,525	2,392	2,485	2,533	2,506	100	100	100	0.5	0.5	0.2	-0.1	0.2
Coal	397	485	565	443	409	355	299	23	19	12	-0.4	-1.0	-1.4	-1.7	-1.4
Oil	885	833	958	854	828	817	801	39	36	32	0.1	-0.4	-0.1	-0.2	-0.2
Natural gas	522	493	622	679	777	838	849	23	28	34	1.5	1.7	0.8	0.1	0.8
Nuclear	80	179	227	234	231	241	250	8.4	9.8	10.0	1.2	-0.1	0.4	0.3	0.2
Hydro	46	49	53	57	60	62	64	2.3	2.4	2.6	0.7	0.6	0.5	0.3	0.5
Geothermal	4.6	14	13	8.7	19	23	29	0.7	0.4	1.2	-2.2	10.2	2.2	2.3	4.5
Solar, wind, etc.	-	0.3	2.1	16	26	43	57	0.0	0.7	2.3	19.3	6.5	5.2	2.8	4.7
Biomass and waste	62	70	85	101	135	153	157	3.3	4.2	6.3	1.7	3.7	1.3	0.3	1.6

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,466	1,452	1,736	1,641	1,716	1,766	1,766	100	100	100	0.6	0.6	0.3	0.0	0.3
By sector															
Industry	437	331	387	307	322	325	319	23	19	18	-0.3	0.6	0.1	-0.2	0.1
Transport	470	531	640	658	659	654	632	37	40	36	1.0	0.0	-0.1	-0.3	-0.1
Buildings, etc.	446	457	535	545	591	622	633	31	33	36	0.8	1.0	0.5	0.2	0.5
Non-energy use	114	134	173	130	145	165	181	9.2	8.0	10	-0.1	1.3	1.3	0.9	1.2
By energy															
Coal	60	59	36	25	23	22	20	4.0	1.5	1.2	-3.8	-1.0	-0.6	-0.6	-0.7
Oil	769	752	874	814	782	772	757	52	50	43	0.4	-0.5	-0.1	-0.2	-0.3
Natural gas	374	346	413	353	398	409	408	24	22	23	0.1	1.5	0.3	0.0	0.5
Electricity	200	262	342	364	401	441	459	18	22	26	1.5	1.2	1.0	0.4	0.8
Heat	1.0	2.8	6.1	7.1	7.3	6.9	6.3	0.2	0.4	0.4	4.4	0.3	-0.6	-0.9	-0.4
Renewables	62	30	64	78	105	115	114	2.1	4.8	6.5	4.4	3.7	1.0	-0.1	1.4

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	2,801	3,685	4,631	4,905	5,341	5,848	6,080	100	100	100	1.3	1.1	0.9	0.4	0.8
Coal	1,303	1,782	2,247	1,707	1,610	1,427	1,214	48	35	20	-0.2	-0.7	-1.2	-1.6	-1.2
Oil	277	147	133	40	43	44	45	4.0	0.8	0.7	-5.7	0.9	0.3	0.2	0.4
Natural gas	380	391	668	1,332	1,663	2,037	2,224	11	27	37	5.7	2.8	2.0	0.9	1.8
Nuclear	304	685	871	896	887	926	958	19	18	16	1.2	-0.1	0.4	0.3	0.2
Hydro	530	570	612	659	693	727	748	15	13	12	0.7	0.6	0.5	0.3	0.5
Geothermal	5.4	16	15	18	40	50	63	0.4	0.4	1.0	0.6	10.4	2.2	2.4	4.5
Solar, wind, etc.	-	3.8	6.7	165	277	470	626	0.1	3.4	10	18.7	6.7	5.4	2.9	4.9
Biomass and waste	1.8	90	80	88	128	167	203	2.5	1.8	3.3	-0.1	4.7	2.8	1.9	3.0

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	7,266	10,036	14,027	17,303	21,237	27,001	32,507	2.5	2.6	2.4	1.9	2.3
Population (million)	252	277	313	349	372	399	422	1.0	0.8	0.7	0.6	0.7
CO_2 emissions[*2] (Mt)	5,169	5,236	6,125	5,584	5,556	5,394	5,103	0.3	-0.1	-0.3	-0.6	-0.3
GDP per capita ($2010 thousand)	29	36	45	50	57	68	77	1.4	1.8	1.7	1.3	1.6
Primary energy consump. per capita (toe)	7.9	7.7	8.1	6.9	6.7	6.3	5.9	-0.5	-0.3	-0.5	-0.7	-0.5
Primary energy consumption per GDP[*3]	275	212	180	138	117	94	77	-1.9	-2.1	-2.2	-1.9	-2.1
CO_2 emissions per GDP[*2, *4]	711	522	437	323	262	200	157	-2.2	-2.6	-2.7	-2.4	-2.5
CO_2 per primary energy consumption[*2, *5]	2.6	2.5	2.4	2.3	2.2	2.1	2.0	-0.2	-0.5	-0.5	-0.4	-0.5
Automobile ownership (million)	169	205	239	273	298	332	359	1.3	1.1	1.1	0.8	1.0
Automobile ownership rates[*6]	671	740	764	784	803	831	850	0.3	0.3	0.3	0.2	0.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 35 United States [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	1,805	1,915	2,273	2,141	2,219	2,244	2,201	100	100	100	0.5	0.4	0.1	-0.2	0.1
Coal	376	460	534	425	395	347	292	24	20	13	-0.4	-0.9	-1.3	-1.7	-1.3
Oil	797	757	871	771	740	721	697	40	36	32	0.1	-0.5	-0.3	-0.3	-0.4
Natural gas	477	438	548	596	682	736	741	23	28	34	1.4	1.7	0.8	0.1	0.8
Nuclear	69	159	208	209	210	210	219	8.3	9.8	9.9	1.2	0.1	0.0	0.4	0.2
Hydro	24	23	22	24	25	26	26	1.2	1.1	1.2	0.1	0.6	0.2	0.1	0.3
Geothermal	4.6	14	13	8.7	19	23	29	0.7	0.4	1.3	-2.2	10.1	2.2	2.4	4.4
Solar, wind, etc.	-	0.3	2.1	15	24	40	53	0.0	0.7	2.4	19.0	6.1	5.3	2.9	4.7
Biomass and waste	54	62	73	89	121	137	141	3.3	4.1	6.4	1.6	3.9	1.3	0.2	1.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,311	1,294	1,546	1,433	1,497	1,530	1,516	100	100	100	0.5	0.5	0.2	-0.1	0.2
By sector															
Industry	387	284	332	248	257	257	247	22	17	16	-0.6	0.4	0.0	-0.4	0.0
Transport	425	488	588	597	595	587	562	38	42	37	0.9	0.0	-0.1	-0.4	-0.2
Buildings, etc.	397	403	473	483	528	554	562	31	34	37	0.8	1.1	0.5	0.1	0.5
Non-energy use	102	119	153	104	117	133	145	9.2	7.3	9.5	-0.6	1.4	1.3	0.9	1.2
By energy															
Coal	56	56	33	22	20	19	18	4.3	1.5	1.2	-4.1	-1.1	-0.5	-0.4	-0.7
Oil	689	683	793	719	684	665	643	53	50	42	0.2	-0.6	-0.3	-0.3	-0.4
Natural gas	337	303	360	296	338	346	343	23	21	23	-0.1	1.6	0.2	-0.1	0.5
Electricity	174	226	301	321	355	390	404	18	22	27	1.6	1.3	1.0	0.3	0.8
Heat	-	2.2	5.3	6.5	6.7	6.3	5.8	0.2	0.5	0.4	5.2	0.3	-0.5	-0.9	-0.4
Renewables	54	23	54	68	94	104	102	1.8	4.8	6.8	5.1	4.1	1.0	-0.1	1.5

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	2,427	3,203	4,026	4,271	4,676	5,119	5,292	100	100	100	1.3	1.1	0.9	0.3	0.8
Coal	1,243	1,700	2,129	1,643	1,567	1,406	1,199	53	38	23	-0.2	-0.6	-1.1	-1.6	-1.1
Oil	263	131	118	33	36	38	37	4.1	0.8	0.7	-6.1	1.0	0.6	-0.2	0.4
Natural gas	370	382	634	1,265	1,572	1,942	2,097	12	30	40	5.6	2.8	2.1	0.8	1.8
Nuclear	266	612	798	801	805	808	839	19	19	16	1.2	0.1	0.0	0.4	0.2
Hydro	279	273	253	279	292	299	302	8.5	6.5	5.7	0.1	0.6	0.2	0.1	0.3
Geothermal	5.4	16	15	18	40	49	62	0.5	0.4	1.2	0.6	10.3	2.2	2.4	4.5
Solar, wind, etc.	-	3.7	6.4	153	250	427	573	0.1	3.6	11	18.4	6.3	5.5	3.0	4.8
Biomass and waste	0.5	86	72	79	114	150	182	2.7	1.8	3.4	-0.4	4.8	2.8	1.9	3.0

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	6,521	9,054	12,717	15,658	19,280	24,593	29,621	2.5	2.6	2.5	1.9	2.3
Population (million)	227	250	282	314	334	359	379	1.0	0.8	0.7	0.6	0.7
CO_2 emissions[*2] (Mt)	4,743	4,820	5,617	5,139	5,092	4,927	4,619	0.3	-0.1	-0.3	-0.6	-0.4
GDP per capita ($2010 thousand)	29	36	45	50	58	69	78	1.5	1.8	1.7	1.3	1.6
Primary energy consump. per capita (toe)	7.9	7.7	8.1	6.8	6.6	6.3	5.8	-0.5	-0.3	-0.6	-0.7	-0.6
Primary energy consumption per GDP[*3]	277	212	179	137	115	91	74	-2.0	-2.1	-2.3	-2.0	-2.2
CO_2 emissions per GDP[*2, *4]	727	532	442	328	264	200	156	-2.2	-2.7	-2.7	-2.5	-2.6
CO_2 per primary energy consumption[*2, *5]	2.6	2.5	2.5	2.4	2.3	2.2	2.1	-0.2	-0.6	-0.4	-0.5	-0.5
Automobile ownership (million)	156	189	221	251	274	305	329	1.3	1.1	1.1	0.8	1.0
Automobile ownership rates[*6]	686	756	785	801	821	850	868	0.3	0.3	0.3	0.2	0.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 36 Latin America [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	385	468	600	837	1,018	1,279	1,492	100	100	100	2.7	2.5	2.3	1.6	2.1
Coal	13	20	27	37	46	64	79	4.4	4.5	5.3	2.8	2.7	3.2	2.2	2.7
Oil	223	237	303	388	430	507	561	51	46	38	2.3	1.3	1.7	1.0	1.3
Natural gas	51	76	117	197	265	361	444	16	24	30	4.4	3.8	3.2	2.1	2.9
Nuclear	0.6	3.2	5.3	8.1	13	18	22	0.7	1.0	1.5	4.3	5.8	3.4	2.2	3.7
Hydro	19	33	50	65	73	82	91	7.1	7.8	6.1	3.1	1.5	1.2	1.0	1.2
Geothermal	1.2	5.1	6.3	8.1	18	26	38	1.1	1.0	2.5	2.2	10.8	3.5	3.8	5.7
Solar, wind, etc.	-	0.0	0.2	1.7	3.1	5.3	9.3	0.0	0.2	0.6	23.0	8.3	5.4	5.8	6.4
Biomass and waste	79	92	90	131	170	216	247	20	16	17	1.6	3.3	2.4	1.3	2.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	290	346	452	607	730	912	1,061	100	100	100	2.6	2.3	2.2	1.5	2.0
By sector															
Industry	99	116	150	196	242	317	388	34	32	37	2.4	2.6	2.7	2.0	2.5
Transport	85	103	141	216	265	332	377	30	36	36	3.4	2.6	2.3	1.3	2.0
Buildings, etc.	89	101	121	151	173	204	230	29	25	22	1.8	1.7	1.7	1.2	1.5
Non-energy use	16	26	41	43	50	59	66	7.4	7.1	6.2	2.4	1.9	1.6	1.2	1.5
By energy															
Coal	6.1	8.5	11	13	14	16	19	2.5	2.2	1.7	2.0	0.7	1.6	1.4	1.3
Oil	159	179	241	309	354	428	485	52	51	46	2.5	1.7	1.9	1.3	1.6
Natural gas	28	39	56	82	107	138	167	11	13	16	3.4	3.5	2.6	1.9	2.6
Electricity	27	44	70	105	132	176	215	13	17	20	4.0	3.0	2.9	2.0	2.6
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	69	74	75	99	123	154	175	22	16	17	1.3	2.8	2.3	1.3	2.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	380	623	1,003	1,516	1,890	2,494	3,036	100	100	100	4.1	2.8	2.8	2.0	2.5
Coal	7.8	23	44	86	131	212	290	3.8	5.7	9.5	6.1	5.4	5.0	3.2	4.4
Oil	111	128	194	212	209	231	219	21	14	7.2	2.3	-0.2	1.0	-0.5	0.1
Natural gas	35	60	138	358	517	824	1,104	9.6	24	36	8.5	4.7	4.8	3.0	4.1
Nuclear	2.3	12	20	31	49	69	86	2.0	2.1	2.8	4.3	5.8	3.4	2.2	3.7
Hydro	218	386	584	754	846	953	1,057	62	50	35	3.1	1.5	1.2	1.0	1.2
Geothermal	1.4	5.9	7.8	9.5	22	31	44	1.0	0.6	1.5	2.2	10.8	3.5	3.8	5.7
Solar, wind, etc.	-	0.0	0.3	11	26	45	74	0.0	0.7	2.4	48.1	11.1	5.5	5.1	6.9
Biomass and waste	3.9	7.6	14	53	90	130	162	1.2	3.5	5.3	9.3	6.9	3.7	2.2	4.1

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	2,349	2,714	3,665	5,446	6,975	9,664	12,418	3.2	3.1	3.3	2.5	3.0
Population (million)	360	441	521	605	656	711	750	1.4	1.0	0.8	0.5	0.8
CO_2 emissions[*2] (Mt)	807	915	1,199	1,681	1,986	2,494	2,898	2.8	2.1	2.3	1.5	2.0
GDP per capita ($2010 thousand)	6.5	6.2	7.0	9.0	11	14	17	1.7	2.1	2.5	2.0	2.2
Primary energy consump. per capita (toe)	1.1	1.1	1.2	1.4	1.6	1.8	2.0	1.2	1.4	1.5	1.0	1.3
Primary energy consumption per GDP[*3]	164	172	164	154	146	132	120	-0.5	-0.6	-1.0	-1.0	-0.9
CO_2 emissions per GDP[*2, *4]	344	337	327	309	285	258	233	-0.4	-1.0	-1.0	-1.0	-1.0
CO_2 per primary energy consumption[*2, *5]	2.1	2.0	2.0	2.0	2.0	2.0	1.9	0.1	-0.4	0.0	0.0	-0.1
Automobile ownership (million)	28	38	55	108	145	192	226	4.8	3.7	2.8	1.6	2.7
Automobile ownership rates[*6]	79	87	105	179	221	270	301	3.3	2.7	2.0	1.1	1.9

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 37 OECD Europe [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	1,494	1,619	1,746	1,745	1,818	1,863	1,879	100	100	100	0.3	0.5	0.2	0.1	0.3
Coal	464	449	330	315	292	286	268	28	18	14	-1.6	-0.9	-0.2	-0.7	-0.6
Oil	688	606	650	559	544	532	510	37	32	27	-0.4	-0.3	-0.2	-0.4	-0.3
Natural gas	206	260	393	417	469	509	520	16	24	28	2.2	1.5	0.8	0.2	0.8
Nuclear	60	205	245	230	227	205	218	13	13	12	0.5	-0.1	-1.0	0.6	-0.2
Hydro	36	38	47	48	49	51	51	2.4	2.8	2.7	1.1	0.3	0.3	0.1	0.2
Geothermal	3.0	4.7	7.1	12	16	20	24	0.3	0.7	1.3	4.4	3.8	2.2	1.7	2.4
Solar, wind, etc.	0.1	0.3	2.7	28	39	49	58	0.0	1.6	3.1	23.3	4.2	2.4	1.7	2.7
Biomass and waste	36	54	71	136	185	213	232	3.4	7.8	12	4.3	3.9	1.5	0.8	1.9

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,081	1,122	1,226	1,218	1,283	1,320	1,331	100	100	100	0.4	0.6	0.3	0.1	0.3
By sector															
Industry	356	322	324	288	305	312	316	29	24	24	-0.5	0.7	0.2	0.1	0.3
Transport	209	266	316	322	330	325	307	24	26	23	0.9	0.3	-0.2	-0.6	-0.2
Buildings, etc.	425	434	473	504	532	561	581	39	41	44	0.7	0.7	0.5	0.3	0.5
Non-energy use	90	100	112	104	116	123	128	8.9	8.6	9.6	0.2	1.3	0.6	0.4	0.7
By energy															
Coal	156	124	62	53	53	49	46	11	4.4	3.5	-3.8	-0.2	-0.7	-0.6	-0.5
Oil	551	518	568	500	495	486	467	46	41	35	-0.2	-0.1	-0.2	-0.4	-0.2
Natural gas	161	201	268	268	294	314	325	18	22	24	1.3	1.2	0.7	0.3	0.7
Electricity	147	192	233	264	287	311	331	17	22	25	1.5	1.0	0.8	0.6	0.8
Heat	35	40	40	46	47	48	48	3.5	3.8	3.6	0.7	0.1	0.3	0.1	0.1
Renewables	31	47	54	86	107	112	114	4.2	7.0	8.6	2.8	2.9	0.4	0.2	1.0

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	2,049	2,661	3,223	3,603	3,926	4,250	4,505	100	100	100	1.4	1.1	0.8	0.6	0.8
Coal	887	1,030	967	955	906	942	909	39	27	20	-0.3	-0.7	0.4	-0.4	-0.2
Oil	364	206	179	66	42	34	28	7.7	1.8	0.6	-5.0	-5.6	-2.1	-2.0	-3.1
Natural gas	138	168	512	671	825	970	1,027	6.3	19	23	6.5	2.6	1.6	0.6	1.5
Nuclear	230	787	939	881	871	786	837	30	24	19	0.5	-0.1	-1.0	0.6	-0.2
Hydro	416	446	546	562	573	591	596	17	16	13	1.1	0.3	0.3	0.1	0.2
Geothermal	2.7	3.6	6.2	12	18	23	28	0.1	0.3	0.6	5.6	5.0	2.6	2.0	3.1
Solar, wind, etc.	0.5	1.4	24	283	419	537	643	0.1	7.9	14	27.5	5.0	2.5	1.8	3.0
Biomass and waste	11	21	49	173	273	367	438	0.8	4.8	9.7	10.1	5.9	3.0	1.8	3.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	9,584	12,172	15,317	18,000	20,510	24,203	27,543	1.8	1.6	1.7	1.3	1.5
Population (million)	476	499	521	555	570	583	590	0.5	0.4	0.2	0.1	0.2
CO_2 emissions[*2] (Mt)	4,164	3,952	3,892	3,628	3,579	3,594	3,466	-0.4	-0.2	0.0	-0.4	-0.2
GDP per capita ($2010 thousand)	20	24	29	32	36	42	47	1.3	1.3	1.4	1.2	1.3
Primary energy consump. per capita (toe)	3.1	3.2	3.4	3.1	3.2	3.2	3.2	-0.1	0.2	0.0	0.0	0.0
Primary energy consumption per GDP[*3]	156	133	114	97	89	77	68	-1.4	-1.1	-1.4	-1.2	-1.2
CO_2 emissions per GDP[*2, *4]	434	325	254	202	174	148	126	-2.1	-1.8	-1.6	-1.6	-1.7
CO_2 per primary energy consumption[*2, *5]	2.8	2.4	2.2	2.1	2.0	1.9	1.8	-0.7	-0.7	-0.2	-0.4	-0.4
Automobile ownership (million)	125	180	239	297	327	357	372	2.3	1.2	0.9	0.4	0.8
Automobile ownership rates[*6]	262	360	458	536	573	612	632	1.8	0.8	0.7	0.3	0.6

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 38 Non-OECD Europe [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	1,241	1,537	1,003	1,194	1,225	1,337	1,427	100	100	100	-1.1	0.3	0.9	0.7	0.6
Coal	362	367	209	248	227	225	222	24	21	16	-1.8	-1.1	-0.1	-0.1	-0.4
Oil	464	468	203	252	259	282	296	30	21	21	-2.8	0.4	0.8	0.5	0.6
Natural gas	355	603	488	570	594	641	681	39	48	48	-0.3	0.5	0.8	0.6	0.6
Nuclear	21	59	64	78	90	124	147	3.9	6.5	10	1.2	1.8	3.2	1.7	2.3
Hydro	20	23	24	24	25	26	27	1.5	2.0	1.9	0.3	0.4	0.3	0.3	0.3
Geothermal	-	0.0	0.1	0.5	1.4	1.7	2.0	0.0	0.0	0.1	14.9	13.1	2.3	1.6	5.0
Solar, wind, etc.	-	-	0.0	0.7	1.5	3.4	6.4	-	0.1	0.4	n.a.	11.1	8.3	6.4	8.4
Biomass and waste	21	17	16	21	28	35	47	1.1	1.8	3.3	1.0	3.5	2.3	2.8	2.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	869	1,073	654	742	796	903	996	100	100	100	-1.7	0.9	1.3	1.0	1.1
By sector															
Industry	394	396	206	228	240	285	327	37	31	33	-2.5	0.7	1.7	1.4	1.3
Transport	107	172	110	144	169	185	195	16	19	20	-0.8	2.0	0.9	0.5	1.1
Buildings, etc.	301	439	289	284	294	317	335	41	38	34	-2.0	0.4	0.7	0.6	0.6
Non-energy use	67	66	49	87	93	117	138	6.2	12	14	1.2	0.9	2.3	1.7	1.7
By energy															
Coal	152	114	37	57	54	57	60	11	7.7	6.0	-3.1	-0.8	0.5	0.5	0.2
Oil	310	280	146	189	202	224	238	26	25	24	-1.8	0.8	1.0	0.6	0.8
Natural gas	215	261	201	218	246	287	324	24	29	33	-0.8	1.6	1.5	1.2	1.4
Electricity	95	126	87	108	121	146	167	12	15	17	-0.7	1.5	1.8	1.4	1.6
Heat	78	279	172	156	156	172	188	26	21	19	-2.6	0.0	1.0	0.9	0.7
Renewables	21	13	12	15	17	19	20	1.2	2.0	2.0	0.6	2.0	0.7	0.5	1.0

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,461	1,894	1,432	1,742	1,960	2,336	2,668	100	100	100	-0.4	1.5	1.8	1.3	1.5
Coal	471	429	338	418	448	486	522	23	24	20	-0.1	0.9	0.8	0.7	0.8
Oil	357	256	70	40	28	27	26	14	2.3	1.0	-8.1	-4.2	-0.7	-0.1	-1.5
Natural gas	295	715	504	693	819	987	1,134	38	40	43	-0.1	2.1	1.9	1.4	1.8
Nuclear	79	226	242	297	343	472	561	12	17	21	1.2	1.8	3.2	1.7	2.3
Hydro	232	267	274	283	293	302	311	14	16	12	0.3	0.4	0.3	0.3	0.3
Geothermal	-	0.0	0.1	0.5	1.5	1.8	2.1	0.0	0.0	0.1	13.8	15.0	2.3	1.6	5.5
Solar, wind, etc.	-	-	0.0	6.5	17	38	72	-	0.4	2.7	n.a.	12.3	8.7	6.6	9.0
Biomass and waste	27	0.0	2.6	4.2	11	21	38	0.0	0.2	1.4	22.6	12.8	6.4	6.2	8.1

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	1,768	2,167	1,507	2,644	3,223	4,455	5,642	0.9	2.5	3.3	2.4	2.7
Population (million)	320	344	341	341	344	340	333	0.0	0.1	-0.1	-0.2	-0.1
CO_2 emissions[*2] (Mt)	3,497	4,123	2,462	2,859	2,840	2,949	3,021	-1.6	-0.1	0.4	0.2	0.2
GDP per capita ($2010 thousand)	5.5	6.3	4.4	7.7	9.4	13	17	0.9	2.4	3.4	2.6	2.8
Primary energy consump. per capita (toe)	3.9	4.5	2.9	3.5	3.6	3.9	4.3	-1.1	0.2	1.0	0.9	0.7
Primary energy consumption per GDP[*3]	702	709	666	452	380	300	253	-2.0	-2.1	-2.3	-1.7	-2.0
CO_2 emissions per GDP[*2, *4]	1,978	1,903	1,634	1,081	881	662	536	-2.5	-2.5	-2.8	-2.1	-2.5
CO_2 per primary energy consumption[*2, *5]	2.8	2.7	2.5	2.4	2.3	2.2	2.1	-0.5	-0.4	-0.5	-0.4	-0.4
Automobile ownership (million)	22	31	46	88	108	129	138	4.8	2.7	1.7	0.7	1.6
Automobile ownership rates[*6]	67	91	135	258	315	379	413	4.8	2.6	1.9	0.9	1.7

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 39 European Union [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	n.a.	1,645	1,693	1,644	1,716	1,758	1,778	100	100	100	0.0	0.5	0.2	0.1	0.3
Coal	n.a.	456	321	294	274	270	251	28	18	14	-2.0	-0.9	-0.2	-0.7	-0.6
Oil	n.a.	606	623	526	515	505	487	37	32	27	-0.6	-0.3	-0.2	-0.4	-0.3
Natural gas	n.a.	297	396	392	441	479	491	18	24	28	1.3	1.5	0.8	0.2	0.8
Nuclear	n.a.	207	246	230	227	205	217	13	14	12	0.5	-0.2	-1.0	0.6	-0.2
Hydro	n.a.	25	31	29	29	30	30	1.5	1.8	1.7	0.7	0.1	0.2	0.0	0.1
Geothermal	n.a.	3.2	4.6	5.7	7.0	8.0	8.9	0.2	0.3	0.5	2.7	2.6	1.3	1.1	1.6
Solar, wind, etc.	n.a.	0.2	2.4	27	38	49	61	0.0	1.6	3.4	23.7	4.5	2.7	2.0	2.9
Biomass and waste	n.a.	47	66	137	185	212	231	2.8	8.3	13	5.0	3.8	1.4	0.8	1.9

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	n.a.	1,129	1,175	1,139	1,203	1,242	1,257	100	100	100	0.0	0.7	0.3	0.1	0.4
By sector															
Industry	n.a.	343	309	264	279	288	294	30	23	23	-1.2	0.7	0.3	0.2	0.4
Transport	n.a.	259	304	307	317	313	297	23	27	24	0.8	0.4	-0.1	-0.5	-0.1
Buildings, etc.	n.a.	429	453	470	497	526	546	38	41	43	0.4	0.7	0.6	0.4	0.5
Non-energy use	n.a.	99	110	99	110	116	120	8.7	8.7	9.6	0.0	1.4	0.5	0.4	0.7
By energy															
Coal	n.a.	122	52	38	38	36	34	11	3.4	2.7	-5.1	-0.1	-0.6	-0.5	-0.4
Oil	n.a.	503	539	469	465	458	442	45	41	35	-0.3	-0.1	-0.2	-0.4	-0.2
Natural gas	n.a.	226	272	259	284	302	313	20	23	25	0.6	1.2	0.6	0.3	0.7
Electricity	n.a.	186	218	241	261	285	304	16	21	24	1.2	1.0	0.9	0.6	0.8
Heat	n.a.	54	45	48	49	50	51	4.8	4.2	4.1	-0.5	0.1	0.3	0.2	0.2
Renewables	n.a.	39	49	84	107	112	114	3.5	7.4	9.1	3.6	3.0	0.4	0.2	1.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	n.a.	2,576	3,005	3,264	3,571	3,895	4,172	100	100	100	1.1	1.1	0.9	0.7	0.9
Coal	n.a.	1,050	967	935	892	930	897	41	29	21	-0.5	-0.6	0.4	-0.4	-0.1
Oil	n.a.	224	181	73	48	41	35	8.7	2.2	0.8	-5.0	-4.9	-1.7	-1.5	-2.6
Natural gas	n.a.	193	480	582	724	866	929	7.5	18	22	5.2	2.8	1.8	0.7	1.7
Nuclear	n.a.	795	945	882	870	785	832	31	27	20	0.5	-0.2	-1.0	0.6	-0.2
Hydro	n.a.	289	356	335	338	345	346	11	10	8.3	0.7	0.1	0.2	0.0	0.1
Geothermal	n.a.	3.2	4.8	5.8	7.2	8.2	9.2	0.1	0.2	0.2	2.7	2.9	1.3	1.1	1.7
Solar, wind, etc.	n.a.	1.3	24	281	422	556	686	0.1	8.6	16	27.7	5.2	2.8	2.1	3.2
Biomass and waste	n.a.	20	47	170	269	363	436	0.8	5.2	10	10.3	5.9	3.0	1.9	3.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	n.a.	11,433	14,229	16,542	18,848	22,299	25,446	1.7	1.6	1.7	1.3	1.6
Population (million)	n.a.	478	488	506	518	526	529	0.3	0.3	0.2	0.1	0.2
CO_2 emissions[*2] (Mt)	n.a.	4,068	3,786	3,408	3,374	3,398	3,285	-0.8	-0.1	0.1	-0.3	-0.1
GDP per capita ($2010 thousand)	n.a.	24	29	33	36	42	48	1.4	1.3	1.5	1.3	1.4
Primary energy consump. per capita (toe)	n.a.	3.4	3.5	3.3	3.3	3.3	3.4	-0.3	0.2	0.1	0.0	0.1
Primary energy consumption per GDP[*3]	n.a.	144	119	99	91	79	70	-1.7	-1.1	-1.4	-1.2	-1.3
CO_2 emissions per GDP[*2, *4]	n.a.	356	266	206	179	152	129	-2.5	-1.7	-1.6	-1.6	-1.7
CO_2 per primary energy consumption[*2, *5]	n.a.	2.5	2.2	2.1	2.0	1.9	1.8	-0.8	-0.7	-0.2	-0.4	-0.4
Automobile ownership (million)	n.a.	177	235	290	318	347	362	2.3	1.2	0.9	0.4	0.8
Automobile ownership rates[*6]	n.a.	371	482	574	615	660	683	2.0	0.9	0.7	0.4	0.6

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 40 Africa [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	272	391	497	733	895	1,084	1,272	100	100	100	2.9	2.5	1.9	1.6	2.0
Coal	52	74	90	105	123	141	162	19	14	13	1.6	1.9	1.4	1.4	1.6
Oil	61	86	98	160	190	220	249	22	22	20	2.8	2.2	1.5	1.3	1.6
Natural gas	12	30	47	100	144	208	281	7.6	14	22	5.7	4.7	3.8	3.0	3.8
Nuclear	-	2.2	3.4	3.4	3.5	7.5	7.8	0.6	0.5	0.6	2.0	0.5	7.9	0.3	3.0
Hydro	4.1	4.8	6.4	9.7	10	11	12	1.2	1.3	1.0	3.2	0.9	0.9	0.8	0.9
Geothermal	-	0.3	0.4	1.4	6.1	8.9	9.9	0.1	0.2	0.8	7.5	20.3	3.8	1.1	7.3
Solar, wind, etc.	-	0.0	0.0	0.3	1.2	1.8	4.1	0.0	0.0	0.3	34.6	16.3	4.7	8.5	9.3
Biomass and waste	142	194	250	352	417	484	545	50	48	43	2.7	2.1	1.5	1.2	1.6

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	218	292	371	539	655	785	919	100	100	100	2.8	2.5	1.8	1.6	1.9
By sector															
Industry	46	55	58	82	110	140	170	19	15	19	1.9	3.7	2.4	2.0	2.6
Transport	27	38	54	92	112	132	151	13	17	16	4.1	2.5	1.6	1.3	1.8
Buildings, etc.	139	188	243	344	407	486	566	64	64	62	2.8	2.1	1.8	1.5	1.8
Non-energy use	5.4	11	16	20	25	27	33	3.8	3.8	3.6	2.7	2.8	0.9	1.8	1.8
By energy															
Coal	22	20	19	20	24	30	37	6.7	3.6	4.0	0.0	2.7	2.3	2.0	2.3
Oil	54	71	90	143	173	204	235	24	26	26	3.2	2.5	1.6	1.4	1.8
Natural gas	2.8	8.6	14	32	44	57	72	2.9	5.9	7.9	6.2	4.1	2.5	2.5	3.0
Electricity	14	22	31	51	69	97	131	7.6	9.4	14	3.8	3.9	3.5	3.0	3.5
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	126	171	217	294	345	397	444	59	55	48	2.5	2.0	1.4	1.1	1.5

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	184	316	442	720	975	1,374	1,844	100	100	100	3.8	3.9	3.5	3.0	3.4
Coal	100	165	209	259	323	391	471	52	36	26	2.1	2.8	1.9	1.9	2.2
Oil	22	41	51	73	77	81	84	13	10	4.5	2.7	0.6	0.5	0.3	0.5
Natural gas	14	45	92	256	415	702	1,046	14	36	57	8.2	6.2	5.4	4.1	5.2
Nuclear	-	8.4	13	13	14	29	30	2.7	1.8	1.6	2.0	0.5	7.9	0.3	3.0
Hydro	47	56	75	112	121	133	144	18	16	7.8	3.2	0.9	0.9	0.8	0.9
Geothermal	-	0.3	0.4	1.6	7.1	10	12	0.1	0.2	0.6	7.5	20.3	3.8	1.1	7.3
Solar, wind, etc.	-	-	0.2	2.7	12	20	47	-	0.4	2.6	n.a.	21.3	5.0	8.7	10.8
Biomass and waste	0.2	0.5	1.3	1.8	6.3	8.0	11	0.1	0.2	0.6	6.3	17.3	2.4	2.8	6.6

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	648	819	1,075	1,847	2,660	4,102	6,125	3.8	4.7	4.4	4.1	4.4
Population (million)	476	627	806	1,082	1,310	1,632	1,995	2.5	2.4	2.2	2.0	2.2
CO_2 emissions[*2] (Mt)	403	593	719	1,086	1,337	1,648	1,975	2.8	2.6	2.1	1.8	2.2
GDP per capita ($2010 thousand)	1.4	1.3	1.3	1.7	2.0	2.5	3.1	1.2	2.2	2.2	2.0	2.1
Primary energy consump. per capita (toe)	0.6	0.6	0.6	0.7	0.7	0.7	0.6	0.4	0.1	-0.3	-0.4	-0.2
Primary energy consumption per GDP[*3]	419	478	462	397	337	264	208	-0.8	-2.0	-2.4	-2.4	-2.3
CO_2 emissions per GDP[*2, *4]	622	724	668	588	503	402	322	-0.9	-1.9	-2.2	-2.2	-2.1
CO_2 per primary energy consumption[*2, *5]	1.5	1.5	1.4	1.5	1.5	1.5	1.6	-0.1	0.1	0.2	0.2	0.2
Automobile ownership (million)	9.8	14	20	34	46	65	87	3.9	4.0	3.4	2.9	3.4
Automobile ownership rates[*6]	21	23	24	31	35	40	43	1.4	1.6	1.2	0.9	1.2

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 41 Middle East [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	121	222	375	705	841	1,014	1,165	100	100	100	5.4	2.2	1.9	1.4	1.8
Coal	1.2	3.0	8.1	12	16	22	28	1.3	1.6	2.4	6.3	4.5	2.9	2.4	3.2
Oil	90	146	217	349	402	474	532	66	49	46	4.0	1.8	1.7	1.2	1.5
Natural gas	29	72	148	340	413	493	568	32	48	49	7.3	2.5	1.8	1.4	1.8
Nuclear	-	-	-	0.5	4.4	19	29	-	0.1	2.5	n.a.	31.8	15.9	4.4	15.8
Hydro	0.8	1.0	0.7	1.9	1.8	1.8	1.8	0.5	0.3	0.2	2.9	-0.7	0.0	0.0	-0.2
Geothermal	-	-	-	-	0.0	0.0	0.0	-	-	0.0	n.a.	n.a.	8.3	5.6	n.a.
Solar, wind, etc.	-	0.4	0.7	1.3	2.0	3.1	4.7	0.2	0.2	0.4	5.4	5.6	4.4	4.2	4.7
Biomass and waste	0.3	0.4	0.4	0.9	1.0	1.1	1.2	0.2	0.1	0.1	3.2	0.9	1.1	1.0	1.0

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	84	157	254	468	561	692	807	100	100	100	5.1	2.3	2.1	1.6	2.0
By sector															
Industry	30	42	64	127	154	195	233	27	27	29	5.2	2.4	2.4	1.8	2.2
Transport	26	50	74	131	150	188	217	32	28	27	4.5	1.7	2.3	1.5	1.8
Buildings, etc.	22	40	76	121	149	183	219	26	26	27	5.1	2.7	2.1	1.8	2.1
Non-energy use	5.6	25	40	89	109	126	139	16	19	17	6.0	2.6	1.5	1.0	1.6
By energy															
Coal	0.3	0.2	0.5	2.2	2.5	3.8	5.2	0.1	0.5	0.6	11.7	2.0	4.3	3.1	3.2
Oil	67	108	152	228	267	325	375	69	49	46	3.5	2.0	2.0	1.4	1.8
Natural gas	9.8	31	68	168	201	243	278	20	36	34	7.9	2.3	1.9	1.3	1.8
Electricity	6.5	17	33	68	89	117	145	11	14	18	6.4	3.5	2.8	2.2	2.8
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	0.2	0.7	1.0	2.0	2.5	3.3	4.4	0.5	0.4	0.5	4.7	2.5	2.9	2.9	2.8

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	95	244	472	968	1,268	1,647	2,028	100	100	100	6.5	3.4	2.7	2.1	2.7
Coal	0.1	11	30	39	60	80	102	4.3	4.0	5.0	6.2	5.5	2.9	2.5	3.5
Oil	47	108	188	341	406	476	531	44	35	26	5.4	2.2	1.6	1.1	1.6
Natural gas	39	114	246	563	760	988	1,247	47	58	61	7.5	3.8	2.7	2.4	2.9
Nuclear	-	-	-	1.8	17	74	113	-	0.2	5.6	n.a.	31.8	15.9	4.4	15.8
Hydro	9.7	12	8.0	22	21	21	21	4.9	2.3	1.0	2.9	-0.7	0.0	0.0	-0.2
Geothermal	-	-	-	-	0.0	0.0	0.0	-	-	0.0	n.a.	n.a.	8.3	5.6	n.a.
Solar, wind, etc.	-	0.0	0.0	0.6	4.2	8.3	15	0.0	0.1	0.7	33.6	28.1	6.9	6.2	12.3
Biomass and waste	-	-	-	0.1	0.2	0.3	0.4	-	0.0	0.0	n.a.	5.4	4.8	2.8	4.3

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	833	919	1,393	2,449	3,328	4,506	5,717	4.6	3.9	3.1	2.4	3.1
Population (million)	92	132	166	221	256	293	325	2.4	1.8	1.4	1.1	1.4
CO_2 emissions[*2] (Mt)	332	559	936	1,675	1,975	2,358	2,701	5.1	2.1	1.8	1.4	1.7
GDP per capita ($2010 thousand)	9.0	7.0	8.4	11	13	15	18	2.1	2.0	1.7	1.3	1.7
Primary energy consump. per capita (toe)	1.3	1.7	2.3	3.2	3.3	3.5	3.6	2.9	0.4	0.5	0.3	0.4
Primary energy consumption per GDP[*3]	146	242	269	288	253	225	204	0.8	-1.6	-1.2	-1.0	-1.2
CO_2 emissions per GDP[*2, *4]	399	609	672	684	594	523	472	0.5	-1.8	-1.3	-1.0	-1.3
CO_2 per primary energy consumption[*2, *5]	2.7	2.5	2.5	2.4	2.3	2.3	2.3	-0.3	-0.1	-0.1	0.0	-0.1
Automobile ownership (million)	5.8	10	14	35	44	61	75	5.8	3.0	3.2	2.1	2.8
Automobile ownership rates[*6]	63	78	85	158	173	208	230	3.3	1.1	1.8	1.0	1.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 42 Oceania [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	79	99	125	147	156	162	165	100	100	100	1.8	0.7	0.4	0.2	0.4
Coal	28	36	49	48	51	48	43	37	33	26	1.3	0.6	-0.5	-1.1	-0.4
Oil	34	35	40	51	47	50	53	35	34	32	1.7	-1.0	0.7	0.5	0.1
Natural gas	8.3	19	24	34	37	40	42	19	23	25	2.7	1.3	0.7	0.5	0.8
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	2.7	3.2	3.5	3.2	3.3	3.5	3.7	3.2	2.2	2.2	-0.1	0.5	0.5	0.5	0.5
Geothermal	1.0	1.5	1.9	3.9	7.8	8.1	8.5	1.5	2.6	5.2	4.5	9.2	0.4	0.5	2.9
Solar, wind, etc.	0.0	0.1	0.1	1.1	2.5	4.5	7.1	0.1	0.8	4.3	12.6	10.9	5.8	4.7	6.8
Biomass and waste	4.1	4.7	6.1	6.3	7.1	7.3	7.8	4.8	4.3	4.7	1.3	1.5	0.3	0.7	0.8

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	54	66	83	92	101	109	116	100	100	100	1.5	1.1	0.8	0.6	0.8
By sector															
Industry	20	23	28	28	30	32	33	35	30	29	0.9	1.1	0.5	0.4	0.7
Transport	19	24	30	36	37	40	43	36	39	37	1.8	0.5	0.8	0.6	0.6
Buildings, etc.	11	15	19	23	26	29	31	22	25	27	2.0	1.5	1.1	0.7	1.1
Non-energy use	3.1	4.6	6.1	5.8	7.4	8.4	9.1	6.9	6.2	7.8	1.1	3.2	1.2	0.8	1.6
By energy															
Coal	5.3	5.2	4.7	3.9	4.1	3.9	3.6	7.9	4.2	3.1	-1.3	0.7	-0.7	-0.6	-0.2
Oil	31	33	40	47	49	54	57	50	51	49	1.6	0.7	0.9	0.6	0.7
Natural gas	5.4	10	14	14	16	17	17	16	16	15	1.4	1.3	0.6	0.1	0.6
Electricity	8.5	14	18	21	25	28	31	20	23	26	2.1	1.9	1.1	0.9	1.3
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	4.0	4.1	5.6	5.9	6.6	7.0	7.6	6.2	6.4	6.5	1.7	1.4	0.5	0.8	0.9

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	118	187	249	293	345	387	425	100	100	100	2.1	2.1	1.2	0.9	1.3
Coal	70	122	176	175	191	193	181	65	60	43	1.6	1.1	0.1	-0.6	0.1
Oil	5.2	3.6	1.8	4.1	4.6	6.2	8.2	1.9	1.4	1.9	0.6	1.6	2.9	2.9	2.5
Natural gas	8.7	20	26	59	70	88	110	11	20	26	5.0	2.3	2.3	2.2	2.3
Nuclear	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Hydro	32	37	41	37	38	40	43	20	13	10	-0.1	0.5	0.5	0.5	0.5
Geothermal	1.2	2.1	2.9	6.2	13	13	14	1.1	2.1	3.3	5.0	9.6	0.3	0.5	3.0
Solar, wind, etc.	-	-	0.2	9.7	24	42	64	-	3.3	15	n.a.	12.2	5.6	4.4	7.0
Biomass and waste	0.7	1.3	1.7	3.0	3.7	4.7	5.8	0.7	1.0	1.4	4.0	2.9	2.2	2.1	2.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	520	715	989	1,407	1,765	2,243	2,704	3.1	2.9	2.4	1.9	2.4
Population (million)	18	20	23	27	30	33	36	1.3	1.2	1.0	0.9	1.0
CO_2 emissions[*2] (Mt)	227	281	357	410	411	415	407	1.7	0.0	0.1	-0.2	0.0
GDP per capita ($2010 thousand)	29	35	43	52	59	68	75	1.8	1.7	1.4	1.0	1.3
Primary energy consump. per capita (toe)	4.4	4.9	5.4	5.4	5.2	4.9	4.6	0.5	-0.5	-0.6	-0.6	-0.6
Primary energy consumption per GDP[*3]	151	139	127	105	88	72	61	-1.3	-2.1	-2.0	-1.6	-1.9
CO_2 emissions per GDP[*2, *4]	437	392	361	291	233	185	150	-1.3	-2.8	-2.3	-2.1	-2.3
CO_2 per primary energy consumption[*2, *5]	2.9	2.8	2.9	2.8	2.6	2.6	2.5	-0.1	-0.7	-0.3	-0.4	-0.4
Automobile ownership (million)	8.8	12	15	19	22	24	27	2.4	1.3	1.2	0.9	1.1
Automobile ownership rates[*6]	495	567	650	714	722	734	738	1.0	0.1	0.2	0.1	0.1

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 43 OECD [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	4,060	4,511	5,273	5,225	5,481	5,646	5,670	100	100	100	0.7	0.6	0.3	0.0	0.3
Coal	966	1,078	1,094	1,011	954	918	845	24	19	15	-0.3	-0.7	-0.4	-0.8	-0.6
Oil	1,938	1,861	2,103	1,888	1,823	1,793	1,749	41	36	31	0.1	-0.4	-0.2	-0.2	-0.3
Natural gas	778	843	1,156	1,343	1,504	1,645	1,689	19	26	30	2.1	1.4	0.9	0.3	0.8
Nuclear	162	451	586	509	582	566	581	10	9.7	10	0.5	1.7	-0.3	0.3	0.5
Hydro	94	102	115	119	125	130	133	2.3	2.3	2.3	0.7	0.6	0.4	0.2	0.4
Geothermal	10	26	30	32	57	74	94	0.6	0.6	1.7	0.9	7.4	2.6	2.5	3.9
Solar, wind, etc.	0.1	1.9	5.8	47	73	106	138	0.0	0.9	2.4	15.7	5.7	3.8	2.7	3.9
Biomass and waste	111	147	182	276	365	417	444	3.3	5.3	7.8	2.9	3.6	1.3	0.6	1.7

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	2,937	3,099	3,631	3,568	3,747	3,873	3,903	100	100	100	0.6	0.6	0.3	0.1	0.3
By sector															
Industry	940	826	909	791	841	867	876	27	22	22	-0.2	0.8	0.3	0.1	0.4
Transport	781	938	1,142	1,180	1,196	1,192	1,156	30	33	30	1.0	0.2	0.0	-0.3	-0.1
Buildings, etc.	972	1,045	1,210	1,266	1,349	1,423	1,459	34	35	37	0.9	0.8	0.5	0.3	0.5
Non-energy use	243	290	370	330	361	391	412	9.3	9.3	11	0.6	1.1	0.8	0.5	0.8
By energy															
Coal	259	234	140	121	119	113	106	7.5	3.4	2.7	-3.0	-0.2	-0.5	-0.6	-0.5
Oil	1,570	1,586	1,841	1,695	1,663	1,645	1,608	51	48	41	0.3	-0.2	-0.1	-0.2	-0.2
Natural gas	559	589	746	709	785	819	829	19	20	21	0.8	1.3	0.4	0.1	0.6
Electricity	408	550	714	795	881	975	1,034	18	22	26	1.7	1.3	1.0	0.6	0.9
Heat	36	43	49	59	61	64	65	1.4	1.7	1.7	1.5	0.4	0.5	0.2	0.3
Renewables	105	97	141	189	239	257	261	3.1	5.3	6.7	3.1	3.0	0.7	0.2	1.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	5,656	7,608	9,685	10,722	11,810	13,051	13,834	100	100	100	1.6	1.2	1.0	0.6	0.9
Coal	2,319	3,082	3,759	3,439	3,296	3,272	3,087	41	32	22	0.5	-0.5	-0.1	-0.6	-0.4
Oil	980	676	580	374	243	204	194	8.9	3.5	1.4	-2.6	-5.3	-1.7	-0.5	-2.3
Natural gas	618	782	1,543	2,735	3,253	4,019	4,419	10	26	32	5.9	2.2	2.1	1.0	1.7
Nuclear	621	1,729	2,249	1,952	2,232	2,173	2,228	23	18	16	0.6	1.7	-0.3	0.3	0.5
Hydro	1,093	1,181	1,341	1,389	1,454	1,516	1,549	16	13	11	0.7	0.6	0.4	0.2	0.4
Geothermal	11	29	33	45	86	111	142	0.4	0.4	1.0	2.0	8.6	2.6	2.5	4.2
Solar, wind, etc.	0.5	5.1	31	476	776	1,140	1,478	0.1	4.4	11	22.9	6.3	3.9	2.6	4.1
Biomass and waste	13	124	149	312	470	616	736	1.6	2.9	5.3	4.3	5.3	2.7	1.8	3.1

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	20,997	28,548	37,129	44,727	53,245	65,257	76,636	2.1	2.2	2.1	1.6	1.9
Population (million)	982	1,062	1,150	1,246	1,300	1,353	1,388	0.7	0.5	0.4	0.3	0.4
CO_2 emissions[*2] (Mt)	10,863	11,095	12,398	11,965	11,823	11,830	11,456	0.3	-0.1	0.0	-0.3	-0.2
GDP per capita ($2010 thousand)	21	27	32	36	41	48	55	1.3	1.7	1.6	1.4	1.6
Primary energy consump. per capita (toe)	4.1	4.2	4.6	4.2	4.2	4.2	4.1	-0.1	0.1	-0.1	-0.2	-0.1
Primary energy consumption per GDP[*3]	193	158	142	117	103	87	74	-1.4	-1.6	-1.7	-1.6	-1.6
CO_2 emissions per GDP[*2, *4]	517	389	334	268	222	181	149	-1.7	-2.3	-2.0	-1.9	-2.1
CO_2 per primary energy consumption[*2, *5]	2.7	2.5	2.4	2.3	2.2	2.1	2.0	-0.3	-0.7	-0.3	-0.4	-0.4
Automobile ownership (million)	347	469	594	721	795	875	929	2.0	1.2	1.0	0.6	0.9
Automobile ownership rates[*6]	354	441	516	578	612	647	669	1.2	0.7	0.6	0.3	0.5

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 44 Non-OECD [Reference Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	2,974	4,068	4,534	7,795	9,361	11,263	13,030	100	100	100	3.0	2.3	1.9	1.5	1.9
Coal	822	1,152	1,264	2,867	3,157	3,516	3,860	28	37	30	4.2	1.2	1.1	0.9	1.1
Oil	986	1,169	1,283	1,966	2,377	2,891	3,349	29	25	26	2.4	2.4	2.0	1.5	1.9
Natural gas	456	824	917	1,501	1,932	2,539	3,130	20	19	24	2.8	3.2	2.8	2.1	2.7
Nuclear	24	74	89	133	268	429	573	1.8	1.7	4.4	2.7	9.1	4.8	2.9	5.3
Hydro	54	83	110	196	240	265	288	2.0	2.5	2.2	4.0	2.5	1.0	0.8	1.4
Geothermal	2.2	7.6	22	34	88	100	105	0.2	0.4	0.8	7.1	12.5	1.3	0.4	4.1
Solar, wind, etc.	-	0.5	2.1	29	55	85	121	0.0	0.4	0.9	20.4	8.5	4.5	3.6	5.3
Biomass and waste	630	758	846	1,067	1,241	1,433	1,598	19	14	12	1.6	1.9	1.5	1.1	1.5

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	2,266	2,988	3,185	5,061	6,148	7,492	8,775	100	100	100	2.4	2.5	2.0	1.6	2.0
By sector															
Industry	835	979	980	1,749	2,089	2,497	2,906	33	35	33	2.7	2.2	1.8	1.5	1.8
Transport	289	436	549	977	1,265	1,619	1,942	15	19	22	3.7	3.3	2.5	1.8	2.5
Buildings, etc.	1,031	1,380	1,400	1,857	2,214	2,669	3,097	46	37	35	1.4	2.2	1.9	1.5	1.8
Non-energy use	111	192	256	478	580	706	830	6.4	9.5	9.5	4.2	2.4	2.0	1.6	2.0
By energy															
Coal	453	535	437	789	846	863	885	18	16	10	1.8	0.9	0.2	0.3	0.4
Oil	698	818	1,011	1,607	1,993	2,482	2,928	27	32	33	3.1	2.7	2.2	1.7	2.2
Natural gas	257	357	377	657	873	1,162	1,448	12	13	17	2.8	3.6	2.9	2.2	2.9
Electricity	178	283	377	832	1,116	1,508	1,908	9.5	16	22	5.0	3.7	3.1	2.4	3.0
Heat	85	293	198	227	243	268	286	9.8	4.5	3.3	-1.1	0.8	1.0	0.7	0.8
Renewables	596	702	785	949	1,076	1,209	1,319	24	19	15	1.4	1.6	1.2	0.9	1.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	2,628	4,218	5,741	11,946	15,737	20,993	26,382	100	100	100	4.8	3.5	2.9	2.3	2.9
Coal	822	1,343	2,244	5,729	6,970	9,087	11,228	32	48	43	6.8	2.5	2.7	2.1	2.4
Oil	674	634	623	754	824	922	979	15	6.3	3.7	0.8	1.1	1.1	0.6	0.9
Natural gas	381	979	1,210	2,365	3,439	5,150	7,028	23	20	27	4.1	4.8	4.1	3.2	4.0
Nuclear	93	283	341	510	1,027	1,654	2,223	6.7	4.3	8.4	2.7	9.2	4.9	3.0	5.4
Hydro	624	963	1,279	2,283	2,787	3,078	3,346	23	19	13	4.0	2.5	1.0	0.8	1.4
Geothermal	2.6	7.8	19	26	70	91	104	0.2	0.2	0.4	5.6	13.5	2.6	1.4	5.1
Solar, wind, etc.	-	0.0	3.1	153	387	652	1,004	0.0	1.3	3.8	46.0	12.3	5.3	4.4	7.0
Biomass and waste	31	7.7	22	127	232	358	470	0.2	1.1	1.8	13.6	7.8	4.4	2.7	4.8

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	6,316	8,391	11,503	23,177	34,494	54,169	77,654	4.7	5.1	4.6	3.7	4.4
Population (million)	3,454	4,209	4,943	5,787	6,367	7,019	7,594	1.5	1.2	1.0	0.8	1.0
CO_2 emissions[*2] (Mt)	7,026	9,521	10,342	19,523	22,657	26,724	30,536	3.3	1.9	1.7	1.3	1.6
GDP per capita ($2010 thousand)	1.8	2.0	2.3	4.0	5.4	7.7	10	3.2	3.8	3.6	2.9	3.4
Primary energy consump. per capita (toe)	0.9	1.0	0.9	1.3	1.5	1.6	1.7	1.5	1.1	0.9	0.7	0.9
Primary energy consumption per GDP[*3]	471	485	394	336	271	208	168	-1.6	-2.6	-2.6	-2.1	-2.5
CO_2 emissions per GDP[*2, *4]	1,112	1,135	899	842	657	493	393	-1.3	-3.1	-2.8	-2.2	-2.7
CO_2 per primary energy consumption[*2, *5]	2.4	2.3	2.3	2.5	2.4	2.4	2.3	0.3	-0.4	-0.2	-0.1	-0.2
Automobile ownership (million)	68	108	173	429	628	883	1,161	6.4	4.9	3.5	2.8	3.6
Automobile ownership rates[*6]	20	26	35	74	99	126	153	4.9	3.6	2.5	2.0	2.6

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 45 China [Low Growth Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	598	871	1,161	2,894	3,358	3,591	3,797	100	100	100	5.6	1.9	0.7	0.6	1.0
Coal	313	528	691	1,969	2,029	1,922	1,840	61	68	48	6.2	0.4	-0.5	-0.4	-0.2
Oil	89	119	221	464	599	695	765	14	16	20	6.4	3.2	1.5	1.0	1.8
Natural gas	12	13	21	121	245	380	492	1.5	4.2	13	10.7	9.3	4.5	2.6	5.2
Nuclear	-	-	4.4	25	118	186	253	-	0.9	6.7	n.a.	21.2	4.6	3.1	8.6
Hydro	5.0	11	19	74	100	106	110	1.3	2.6	2.9	9.1	3.8	0.5	0.4	1.4
Geothermal	-	-	1.6	4.3	4.6	5.3	5.9	-	0.1	0.2	n.a.	0.9	1.5	1.1	1.2
Solar, wind, etc.	-	0.0	1.0	22	39	57	76	0.0	0.7	2.0	34.3	7.8	3.8	2.8	4.6
Biomass and waste	180	200	204	216	223	241	255	23	7.5	6.7	0.3	0.4	0.8	0.6	0.6

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	494	664	816	1,702	2,026	2,227	2,404	100	100	100	4.4	2.2	0.9	0.8	1.2
By sector															
Industry	188	244	329	810	897	896	906	37	48	38	5.6	1.3	0.0	0.1	0.4
Transport	24	34	88	238	342	422	485	5.1	14	20	9.3	4.6	2.1	1.4	2.6
Buildings, etc.	272	344	337	518	616	706	781	52	30	32	1.9	2.2	1.4	1.0	1.5
Non-energy use	10	43	62	136	171	202	232	6.5	8.0	9.7	5.4	2.9	1.7	1.4	1.9
By energy															
Coal	220	318	304	558	566	509	465	48	33	19	2.6	0.2	-1.1	-0.9	-0.6
Oil	59	85	180	422	550	641	708	13	25	29	7.6	3.4	1.5	1.0	1.9
Natural gas	6.4	8.9	12	81	147	218	293	1.3	4.7	12	10.6	7.8	4.0	3.0	4.7
Electricity	21	39	89	355	464	547	618	5.9	21	26	10.6	3.4	1.7	1.2	2.0
Heat	7.4	13	25	71	85	90	92	2.0	4.2	3.8	7.9	2.3	0.7	0.2	1.0
Renewables	180	200	205	216	215	222	227	30	13	9.5	0.3	-0.1	0.3	0.3	0.2

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	301	621	1,356	4,985	6,393	7,464	8,374	100	100	100	9.9	3.2	1.6	1.2	1.9
Coal	164	443	1,062	3,785	4,140	4,436	4,648	71	76	56	10.2	1.1	0.7	0.5	0.7
Oil	78	49	46	6.8	7.6	7.5	7.4	7.9	0.1	0.1	-8.6	1.5	-0.2	-0.2	0.3
Natural gas	0.7	2.8	5.8	86	277	508	680	0.4	1.7	8.1	16.9	15.8	6.3	3.0	7.7
Nuclear	-	-	17	97	454	713	973	-	2.0	12	n.a.	21.2	4.6	3.1	8.6
Hydro	58	127	222	863	1,167	1,228	1,280	20	17	15	9.1	3.8	0.5	0.4	1.4
Geothermal	-	-	-	0.2	0.3	0.3	0.3	-	0.0	0.0	n.a.	6.8	1.5	1.4	2.9
Solar, wind, etc.	-	0.0	0.6	102	271	450	630	0.0	2.1	7.5	58.6	12.9	5.2	3.4	6.7
Biomass and waste	-	-	2.4	45	77	120	155	-	0.9	1.8	n.a.	7.0	4.5	2.6	4.5

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	334	812	2,190	6,988	11,139	15,711	20,210	10.3	6.0	3.5	2.5	3.9
Population (million)	981	1,135	1,263	1,351	1,405	1,425	1,408	0.8	0.5	0.1	-0.1	0.1
CO_2 emissions[*2] (Mt)	1,506	2,339	3,258	9,067	9,906	9,999	10,065	6.4	1.1	0.1	0.1	0.4
GDP per capita ($2010 thousand)	0.3	0.7	1.7	5.2	7.9	11	14	9.4	5.5	3.4	2.7	3.7
Primary energy consump. per capita (toe)	0.6	0.8	0.9	2.1	2.4	2.5	2.7	4.8	1.4	0.5	0.7	0.8
Primary energy consumption per GDP[*3]	1,790	1,072	530	414	301	229	188	-4.2	-3.9	-2.7	-1.9	-2.8
CO_2 emissions per GDP[*2, *4]	4,507	2,879	1,488	1,298	889	636	498	-3.6	-4.6	-3.3	-2.4	-3.4
CO_2 per primary energy consumption[*2, *5]	2.5	2.7	2.8	3.1	3.0	2.8	2.7	0.7	-0.7	-0.6	-0.5	-0.6
Automobile ownership (million)	1.2	5.3	16	109	192	244	284	14.7	7.3	2.4	1.5	3.5
Automobile ownership rates[*6]	1.2	4.7	12	81	137	171	202	13.8	6.8	2.3	1.6	3.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 46 India [Low Growth Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	205	316	456	788	953	1,209	1,543	100	100	100	4.2	2.4	2.4	2.5	2.4
Coal	49	103	161	354	389	470	589	33	45	38	5.8	1.2	1.9	2.3	1.8
Oil	33	61	112	177	232	314	402	19	22	26	5.0	3.5	3.1	2.5	3.0
Natural gas	1.3	11	23	49	75	119	187	3.3	6.2	12	7.2	5.5	4.8	4.6	4.9
Nuclear	0.8	1.6	4.4	8.6	29	52	79	0.5	1.1	5.1	7.9	16.5	5.9	4.3	8.2
Hydro	4.0	6.2	6.4	11	14	18	22	1.9	1.4	1.4	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	0.2	3.1	5.6	8.3	14	0.0	0.4	0.9	29.5	7.7	4.0	5.2	5.5
Biomass and waste	116	133	149	185	207	227	249	42	23	16	1.5	1.4	0.9	0.9	1.1

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	179	250	318	512	631	798	1,013	100	100	100	3.3	2.6	2.4	2.4	2.5
By sector															
Industry	43	69	83	168	214	276	355	28	33	35	4.1	3.1	2.6	2.5	2.7
Transport	17	21	32	74	98	143	197	8.4	14	19	5.9	3.7	3.8	3.3	3.6
Buildings, etc.	113	146	176	234	272	319	382	59	46	38	2.2	1.9	1.6	1.8	1.8
Non-energy use	5.7	13	27	36	46	61	79	5.3	7.0	7.8	4.6	3.1	2.9	2.6	2.9
By energy															
Coal	28	42	33	88	97	103	116	17	17	11	3.5	1.2	0.6	1.2	1.0
Oil	27	50	94	148	206	288	376	20	29	37	5.1	4.2	3.4	2.7	3.4
Natural gas	0.7	5.6	9.7	26	36	52	74	2.3	5.1	7.3	7.2	4.0	3.8	3.6	3.8
Electricity	7.8	18	32	75	106	162	242	7.4	15	24	6.6	4.5	4.3	4.1	4.3
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	116	133	148	174	186	194	205	53	34	20	1.2	0.8	0.4	0.6	0.6

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	120	293	570	1,128	1,547	2,308	3,426	100	100	100	6.3	4.0	4.1	4.0	4.0
Coal	61	192	390	801	983	1,407	2,035	65	71	59	6.7	2.6	3.7	3.8	3.4
Oil	8.8	13	29	23	13	9.0	8.3	4.5	2.0	0.2	2.5	-7.1	-3.3	-0.9	-3.5
Natural gas	0.6	10.0	56	94	175	328	589	3.4	8.3	17	10.7	8.1	6.5	6.0	6.8
Nuclear	3.0	6.1	17	33	112	198	302	2.1	2.9	8.8	7.9	16.5	5.9	4.3	8.2
Hydro	47	72	74	126	167	213	256	24	11	7.5	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	1.7	30	60	91	155	0.0	2.7	4.5	36.6	8.9	4.3	5.4	6.0
Biomass and waste	-	-	1.3	21	37	60	80	-	1.8	2.3	n.a.	7.8	4.9	2.9	5.0

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	279	479	825	1,901	2,788	4,939	8,166	6.5	4.9	5.9	5.2	5.3
Population (million)	699	869	1,042	1,237	1,353	1,476	1,566	1.6	1.1	0.9	0.6	0.8
CO_2 emissions[*2] (Mt)	284	585	961	1,961	2,302	2,932	3,781	5.7	2.0	2.5	2.6	2.4
GDP per capita ($2010 thousand)	0.4	0.6	0.8	1.5	2.1	3.3	5.2	4.8	3.7	5.0	4.5	4.5
Primary energy consump. per capita (toe)	0.3	0.4	0.4	0.6	0.7	0.8	1.0	2.6	1.3	1.5	1.9	1.6
Primary energy consumption per GDP[*3]	735	660	553	415	342	245	189	-2.1	-2.4	-3.3	-2.6	-2.8
CO_2 emissions per GDP[*2, *4]	1,016	1,219	1,164	1,032	826	594	463	-0.8	-2.7	-3.2	-2.5	-2.8
CO_2 per primary energy consumption[*2, *5]	1.4	1.8	2.1	2.5	2.4	2.4	2.5	1.4	-0.4	0.0	0.1	-0.1
Automobile ownership (million)	1.7	4.3	9.4	29	47	92	175	9.1	6.2	6.8	6.7	6.6
Automobile ownership rates[*6]	2.4	5.0	9.0	24	35	62	112	7.4	5.0	5.9	6.1	5.7

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 47 China [Low Growth and Reform Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	598	871	1,161	2,894	3,202	3,199	3,137	100	100	100	5.6	1.3	0.0	-0.2	0.3
Coal	313	528	691	1,969	1,864	1,538	1,224	61	68	39	6.2	-0.7	-1.9	-2.3	-1.7
Oil	89	119	221	464	574	615	624	14	16	20	6.4	2.7	0.7	0.1	1.1
Natural gas	12	13	21	121	239	353	432	1.5	4.2	14	10.7	9.0	4.0	2.0	4.7
Nuclear	-	-	4.4	25	143	259	374	-	0.9	12	n.a.	24.2	6.1	3.8	10.1
Hydro	5.0	11	19	74	107	115	122	1.3	2.6	3.9	9.1	4.7	0.7	0.6	1.8
Geothermal	-	-	1.6	4.3	6.2	8.3	9.6	-	0.1	0.3	n.a.	4.7	3.0	1.5	3.0
Solar, wind, etc.	-	0.0	1.0	22	46	75	109	0.0	0.7	3.5	34.3	9.8	5.1	3.8	5.9
Biomass and waste	180	200	204	216	223	237	244	23	7.5	7.8	0.3	0.4	0.6	0.3	0.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	494	664	816	1,702	1,960	2,047	2,093	100	100	100	4.4	1.8	0.4	0.2	0.7
By sector															
Industry	188	244	329	810	866	819	777	37	48	37	5.6	0.8	-0.6	-0.5	-0.1
Transport	24	34	88	238	330	383	415	5.1	14	20	9.3	4.2	1.5	0.8	2.0
Buildings, etc.	272	344	337	518	594	643	673	52	30	32	1.9	1.7	0.8	0.5	0.9
Non-energy use	10	43	62	136	170	201	227	6.5	8.0	11	5.4	2.9	1.7	1.3	1.9
By energy															
Coal	220	318	304	558	544	463	400	48	33	19	2.6	-0.3	-1.6	-1.4	-1.2
Oil	59	85	180	422	527	569	579	13	25	28	7.6	2.8	0.8	0.2	1.1
Natural gas	6.4	8.9	12	81	142	211	285	1.3	4.7	14	10.6	7.4	4.0	3.0	4.6
Electricity	21	39	89	355	453	508	539	5.9	21	26	10.6	3.1	1.2	0.6	1.5
Heat	7.4	13	25	71	82	83	81	2.0	4.2	3.9	7.9	1.9	0.1	-0.3	0.5
Renewables	180	200	205	216	211	213	210	30	13	10	0.3	-0.3	0.1	-0.1	-0.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	301	621	1,356	4,985	6,232	6,905	7,217	100	100	100	9.9	2.8	1.0	0.4	1.3
Coal	164	443	1,062	3,785	3,727	3,354	2,705	71	76	37	10.2	-0.2	-1.0	-2.1	-1.2
Oil	78	49	46	6.8	7.6	7.5	7.4	7.9	0.1	0.1	-8.6	1.5	-0.2	-0.2	0.3
Natural gas	0.7	2.8	5.8	86	268	424	449	0.4	1.7	6.2	16.9	15.3	4.7	0.6	6.1
Nuclear	-	-	17	97	551	992	1,434	-	2.0	20	n.a.	24.2	6.1	3.8	10.1
Hydro	58	127	222	863	1,247	1,337	1,418	20	17	20	9.1	4.7	0.7	0.6	1.8
Geothermal	-	-	-	0.2	0.3	0.3	0.4	-	0.0	0.0	n.a.	7.1	2.3	2.5	3.7
Solar, wind, etc.	-	0.0	0.6	102	335	645	1,025	0.0	2.1	14	58.6	16.0	6.8	4.7	8.6
Biomass and waste	-	-	2.4	45	96	144	179	-	0.9	2.5	n.a.	10.1	4.1	2.1	5.1

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	334	812	2,190	6,988	11,139	15,711	20,210	10.3	6.0	3.5	2.5	3.9
Population (million)	981	1,135	1,263	1,351	1,405	1,425	1,408	0.8	0.5	0.1	-0.1	0.1
CO_2 emissions[*2] (Mt)	1,506	2,339	3,258	9,067	9,163	8,175	7,067	6.4	0.1	-1.1	-1.4	-0.9
GDP per capita ($2010 thousand)	0.3	0.7	1.7	5.2	7.9	11	14	9.4	5.5	3.4	2.7	3.7
Primary energy consump. per capita (toe)	0.6	0.8	0.9	2.1	2.3	2.2	2.2	4.8	0.8	-0.2	-0.1	0.1
Primary energy consumption per GDP[*3]	1,790	1,072	530	414	287	204	155	-4.2	-4.5	-3.4	-2.7	-3.4
CO_2 emissions per GDP[*2, *4]	4,507	2,879	1,488	1,298	823	520	350	-3.6	-5.5	-4.5	-3.9	-4.6
CO_2 per primary energy consumption[*2, *5]	2.5	2.7	2.8	3.1	2.9	2.6	2.3	0.7	-1.1	-1.1	-1.3	-1.2
Automobile ownership (million)	1.2	5.3	16	109	192	244	284	14.7	7.3	2.4	1.5	3.5
Automobile ownership rates[*6]	1.2	4.7	12	81	137	171	202	13.8	6.8	2.3	1.6	3.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 48 India [Low Growth and Reform Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	205	316	456	788	938	1,100	1,314	100	100	100	4.2	2.2	1.6	1.8	1.8
Coal	49	103	161	354	359	324	334	33	45	25	5.8	0.2	-1.0	0.3	-0.2
Oil	33	61	112	177	228	296	366	19	22	28	5.0	3.2	2.7	2.1	2.6
Natural gas	1.3	11	23	49	74	112	165	3.3	6.2	13	7.2	5.3	4.2	3.9	4.4
Nuclear	0.8	1.6	4.4	8.6	39	83	121	0.5	1.1	9.2	7.9	20.8	8.0	3.8	9.9
Hydro	4.0	6.2	6.4	11	14	18	22	1.9	1.4	1.7	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	0.2	3.1	10	29	42	0.0	0.4	3.2	29.5	16.4	10.7	4.0	9.8
Biomass and waste	116	133	149	185	213	237	262	42	23	20	1.5	1.8	1.1	1.0	1.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	179	250	318	512	625	757	910	100	100	100	3.3	2.5	1.9	1.9	2.1
By sector															
Industry	43	69	83	168	212	255	300	28	33	33	4.1	2.9	1.9	1.6	2.1
Transport	17	21	32	74	98	138	189	8.4	14	21	5.9	3.6	3.5	3.2	3.4
Buildings, etc.	113	146	176	234	270	303	342	59	46	38	2.2	1.8	1.2	1.2	1.4
Non-energy use	5.7	13	27	36	46	61	79	5.3	7.0	8.7	4.6	3.1	2.9	2.6	2.9
By energy															
Coal	28	42	33	88	94	88	83	17	17	9.1	3.5	0.8	-0.6	-0.6	-0.2
Oil	27	50	94	148	201	271	340	20	29	37	5.1	3.9	3.0	2.3	3.0
Natural gas	0.7	5.6	9.7	26	36	51	72	2.3	5.1	7.9	7.2	3.9	3.7	3.5	3.7
Electricity	7.8	18	32	75	106	149	202	7.4	15	22	6.6	4.5	3.5	3.1	3.6
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	116	133	148	174	188	197	213	53	34	23	1.2	1.0	0.5	0.7	0.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	120	293	570	1,128	1,548	2,125	2,860	100	100	100	6.3	4.0	3.2	3.0	3.4
Coal	61	192	390	801	886	887	1,070	65	71	37	6.7	1.3	0.0	1.9	1.0
Oil	8.8	13	29	23	11	5.4	4.1	4.5	2.0	0.1	2.5	-8.8	-6.7	-2.7	-5.9
Natural gas	0.6	10.0	56	94	174	300	488	3.4	8.3	17	10.7	8.0	5.6	5.0	6.1
Nuclear	3.0	6.1	17	33	149	320	466	2.1	2.9	16	7.9	20.8	8.0	3.8	9.9
Hydro	47	72	74	126	167	213	256	24	11	9.0	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	1.7	30	115	328	487	0.0	2.7	17	36.6	18.1	11.0	4.0	10.4
Biomass and waste	-	-	1.3	21	46	71	90	-	1.8	3.1	n.a.	10.6	4.4	2.4	5.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	279	479	825	1,901	2,788	4,939	8,166	6.5	4.9	5.9	5.2	5.3
Population (million)	699	869	1,042	1,237	1,353	1,476	1,566	1.6	1.1	0.9	0.6	0.8
CO_2 emissions[*2] (Mt)	284	585	961	1,961	2,166	2,283	2,607	5.7	1.3	0.5	1.3	1.0
GDP per capita ($2010 thousand)	0.4	0.6	0.8	1.5	2.1	3.3	5.2	4.8	3.7	5.0	4.5	4.5
Primary energy consump. per capita (toe)	0.3	0.4	0.4	0.6	0.7	0.7	0.8	2.6	1.1	0.7	1.2	1.0
Primary energy consumption per GDP[*3]	735	660	553	415	336	223	161	-2.1	-2.6	-4.0	-3.2	-3.3
CO_2 emissions per GDP[*2, *4]	1,016	1,219	1,164	1,032	777	462	319	-0.8	-3.5	-5.1	-3.6	-4.1
CO_2 per primary energy consumption[*2, *5]	1.4	1.8	2.1	2.5	2.3	2.1	2.0	1.4	-0.9	-1.1	-0.4	-0.8
Automobile ownership (million)	1.7	4.3	9.4	29	47	92	175	9.1	6.2	6.8	6.7	6.6
Automobile ownership rates[*6]	2.4	5.0	9.0	24	35	62	112	7.4	5.0	5.9	6.1	5.7

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 49 World [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	7,211	8,780	10,079	13,371	14,520	15,645	16,374	100	100	100	1.9	1.0	0.7	0.5	0.7
Coal	1,788	2,231	2,358	3,879	3,686	3,433	3,150	25	29	19	2.5	-0.6	-0.7	-0.9	-0.7
Oil	3,101	3,231	3,658	4,205	4,425	4,593	4,657	37	31	28	1.2	0.6	0.4	0.1	0.4
Natural gas	1,234	1,667	2,073	2,844	3,166	3,557	3,817	19	21	23	2.5	1.4	1.2	0.7	1.1
Nuclear	186	526	676	642	950	1,282	1,599	6.0	4.8	9.8	0.9	5.0	3.0	2.2	3.3
Hydro	148	184	225	316	375	410	438	2.1	2.4	2.7	2.5	2.2	0.9	0.7	1.2
Geothermal	12	34	52	67	156	265	336	0.4	0.5	2.1	3.1	11.2	5.4	2.4	6.0
Solar, wind, etc.	0.1	2.4	7.9	75	155	284	432	0.0	0.6	2.6	17.0	9.4	6.3	4.3	6.4
Biomass and waste	741	905	1,029	1,343	1,608	1,821	1,946	10	10	12	1.8	2.3	1.3	0.7	1.3

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	5,381	6,288	7,088	8,979	9,891	10,748	11,354	100	100	100	1.6	1.2	0.8	0.5	0.8
By sector															
Industry	1,775	1,805	1,889	2,541	2,822	3,088	3,313	29	28	29	1.6	1.3	0.9	0.7	1.0
Transport	1,247	1,575	1,964	2,507	2,796	3,025	3,135	25	28	28	2.1	1.4	0.8	0.4	0.8
Buildings, etc.	2,004	2,425	2,610	3,123	3,330	3,538	3,664	39	35	32	1.2	0.8	0.6	0.4	0.6
Non-energy use	354	482	626	809	942	1,098	1,241	7.7	9.0	11	2.4	1.9	1.5	1.2	1.5
By energy															
Coal	712	768	577	909	929	885	846	12	10	7.5	0.8	0.3	-0.5	-0.5	-0.3
Oil	2,445	2,605	3,124	3,652	3,920	4,110	4,197	41	41	37	1.5	0.9	0.5	0.2	0.5
Natural gas	816	946	1,123	1,366	1,584	1,802	1,995	15	15	18	1.7	1.9	1.3	1.0	1.4
Electricity	586	834	1,091	1,626	1,890	2,256	2,562	13	18	23	3.1	1.9	1.8	1.3	1.6
Heat	121	335	247	287	290	298	299	5.3	3.2	2.6	-0.7	0.2	0.3	0.0	0.2
Renewables	701	800	926	1,138	1,277	1,396	1,454	13	13	13	1.6	1.5	0.9	0.4	0.9

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	8,283	11,825	15,426	22,668	26,108	30,964	35,025	100	100	100	3.0	1.8	1.7	1.2	1.6
Coal	3,142	4,425	6,002	9,168	8,893	9,031	8,836	37	40	25	3.4	-0.4	0.2	-0.2	-0.1
Oil	1,654	1,310	1,203	1,128	917	863	823	11	5.0	2.3	-0.7	-2.6	-0.6	-0.5	-1.1
Natural gas	999	1,760	2,753	5,100	5,774	6,945	7,649	15	22	22	5.0	1.6	1.9	1.0	1.5
Nuclear	713	2,013	2,591	2,461	3,643	4,948	6,210	17	11	18	0.9	5.0	3.1	2.3	3.4
Hydro	1,717	2,144	2,620	3,672	4,359	4,764	5,089	18	16	15	2.5	2.2	0.9	0.7	1.2
Geothermal	14	36	52	70	170	319	429	0.3	0.3	1.2	3.0	11.7	6.5	3.0	6.7
Solar, wind, etc.	0.5	5.2	35	628	1,498	2,938	4,617	0.0	2.8	13	24.4	11.5	7.0	4.6	7.4
Biomass and waste	44	132	170	439	853	1,155	1,372	1.1	1.9	3.9	5.6	8.7	3.1	1.7	4.2

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	27,314	36,939	48,631	67,904	87,739	119,426	154,291	2.8	3.3	3.1	2.6	3.0
Population (million)	4,436	5,272	6,093	7,033	7,667	8,372	8,983	1.3	1.1	0.9	0.7	0.9
CO_2 emissions[*2] (Mt)	18,432	21,233	23,575	32,562	32,852	32,839	32,124	2.0	0.1	0.0	-0.2	0.0
GDP per capita ($2010 thousand)	6.2	7.0	8.0	9.7	11	14	17	1.5	2.1	2.2	1.9	2.1
Primary energy consump. per capita (toe)	1.6	1.7	1.7	1.9	1.9	1.9	1.8	0.6	0.0	-0.1	-0.2	-0.2
Primary energy consumption per GDP[*3]	264	238	207	197	165	131	106	-0.9	-2.1	-2.3	-2.1	-2.2
CO_2 emissions per GDP[*2, *4]	675	575	485	480	374	275	208	-0.8	-3.0	-3.0	-2.7	-2.9
CO_2 per primary energy consumption[*2, *5]	2.6	2.4	2.3	2.4	2.3	2.1	2.0	0.0	-0.9	-0.7	-0.7	-0.8
Automobile ownership (million)	416	577	767	1,150	1,424	1,758	2,089	3.2	2.7	2.1	1.7	2.2
Automobile ownership rates[*6]	94	109	126	163	186	210	233	1.8	1.6	1.2	1.0	1.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 50 Asia [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	1,445	2,119	2,936	5,268	6,099	6,833	7,398	100	100	100	4.2	1.8	1.1	0.8	1.2
Coal	471	796	1,078	2,669	2,663	2,549	2,383	38	51	32	5.7	0.0	-0.4	-0.7	-0.4
Oil	478	618	917	1,243	1,434	1,622	1,748	29	24	24	3.2	1.8	1.2	0.8	1.2
Natural gas	51	116	232	507	682	938	1,152	5.5	9.6	16	6.9	3.8	3.2	2.1	3.0
Nuclear	25	77	132	89	345	549	769	3.6	1.7	10	0.7	18.4	4.8	3.4	8.0
Hydro	20	32	41	107	153	172	188	1.5	2.0	2.5	5.7	4.6	1.2	0.9	2.0
Geothermal	2.6	8.2	23	32	81	122	143	0.4	0.6	1.9	6.3	12.4	4.2	1.6	5.5
Solar, wind, etc.	-	1.2	2.1	27	65	127	193	0.1	0.5	2.6	15.0	11.8	6.9	4.3	7.3
Biomass and waste	397	472	510	594	673	750	816	22	11	11	1.0	1.6	1.1	0.9	1.1

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,142	1,579	2,042	3,323	3,913	4,480	4,957	100	100	100	3.4	2.1	1.4	1.0	1.4
By sector															
Industry	391	520	672	1,284	1,483	1,625	1,750	33	39	35	4.2	1.8	0.9	0.7	1.1
Transport	127	191	326	559	711	874	1,010	12	17	20	5.0	3.0	2.1	1.5	2.1
Buildings, etc.	570	752	855	1,151	1,324	1,509	1,650	48	35	33	2.0	1.8	1.3	0.9	1.3
Non-energy use	54	116	190	329	396	472	547	7.3	9.9	11	4.9	2.3	1.8	1.5	1.8
By energy															
Coal	310	438	407	735	765	724	686	28	22	14	2.4	0.5	-0.5	-0.5	-0.2
Oil	327	464	741	1,073	1,281	1,476	1,606	29	32	32	3.9	2.2	1.4	0.8	1.5
Natural gas	21	47	89	232	336	475	623	3.0	7.0	13	7.5	4.8	3.5	2.7	3.6
Electricity	88	156	278	647	838	1,064	1,259	9.9	19	25	6.7	3.3	2.4	1.7	2.4
Heat	7.5	14	30	77	91	96	96	0.9	2.3	1.9	8.0	2.2	0.5	0.0	0.8
Renewables	388	459	498	559	602	645	687	29	17	14	0.9	0.9	0.7	0.6	0.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,196	2,215	3,974	8,921	11,365	14,286	16,795	100	100	100	6.5	3.1	2.3	1.6	2.3
Coal	302	863	1,991	5,529	5,785	6,349	6,541	39	62	39	8.8	0.6	0.9	0.3	0.6
Oil	472	421	385	352	216	167	147	19	3.9	0.9	-0.8	-5.9	-2.5	-1.3	-3.1
Natural gas	90	247	567	1,167	1,431	1,996	2,411	11	13	14	7.3	2.6	3.4	1.9	2.6
Nuclear	97	294	505	342	1,323	2,124	3,006	13	3.8	18	0.7	18.4	4.9	3.5	8.1
Hydro	232	370	481	1,243	1,775	2,002	2,190	17	14	13	5.7	4.6	1.2	0.9	2.0
Geothermal	3.0	8.3	20	22	60	106	142	0.4	0.3	0.8	4.6	13.0	5.9	3.0	6.8
Solar, wind, etc.	-	0.0	3.0	150	540	1,199	1,938	0.0	1.7	12	45.7	17.4	8.3	4.9	9.6
Biomass and waste	0.0	11	22	116	236	342	420	0.5	1.3	2.5	11.1	9.3	3.8	2.1	4.7

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	4,347	7,398	10,658	18,808	28,042	43,252	61,633	4.3	5.1	4.4	3.6	4.3
Population (million)	2,442	2,931	3,401	3,854	4,129	4,382	4,531	1.3	0.9	0.6	0.3	0.6
CO_2 emissions[*2] (Mt)	3,289	4,959	7,048	14,564	15,342	15,840	15,856	5.0	0.7	0.3	0.0	0.3
GDP per capita ($2010 thousand)	1.8	2.5	3.1	4.9	6.8	9.9	14	3.0	4.2	3.8	3.3	3.7
Primary energy consump. per capita (toe)	0.6	0.7	0.9	1.4	1.5	1.6	1.6	2.9	1.0	0.5	0.5	0.6
Primary energy consumption per GDP[*3]	332	286	275	280	218	158	120	-0.1	-3.1	-3.1	-2.7	-3.0
CO_2 emissions per GDP[*2, *4]	757	670	661	774	547	366	257	0.7	-4.3	-3.9	-3.5	-3.9
CO_2 per primary energy consumption[*2, *5]	2.3	2.3	2.4	2.8	2.5	2.3	2.1	0.8	-1.2	-0.8	-0.8	-0.9
Automobile ownership (million)	48	86	139	295	433	598	807	5.8	4.9	3.3	3.0	3.7
Automobile ownership rates[*6]	19	29	41	76	105	137	178	4.5	4.0	2.7	2.7	3.1

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 51 China [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	598	871	1,161	2,894	3,301	3,580	3,684	100	100	100	5.6	1.7	0.8	0.3	0.9
Coal	313	528	691	1,969	1,930	1,775	1,543	61	68	42	6.2	-0.3	-0.8	-1.4	-0.9
Oil	89	119	221	464	597	701	752	14	16	20	6.4	3.2	1.6	0.7	1.7
Natural gas	12	13	21	121	250	411	531	1.5	4.2	14	10.7	9.6	5.1	2.6	5.4
Nuclear	-	-	4.4	25	143	259	374	-	0.9	10	n.a.	24.2	6.1	3.8	10.1
Hydro	5.0	11	19	74	107	115	122	1.3	2.6	3.3	9.1	4.7	0.7	0.6	1.8
Geothermal	-	-	1.6	4.3	6.2	8.4	9.9	-	0.1	0.3	n.a.	4.8	3.1	1.5	3.0
Solar, wind, etc.	-	0.0	1.0	22	46	78	112	0.0	0.7	3.0	34.3	10.0	5.3	3.8	6.0
Biomass and waste	180	200	204	216	222	234	240	23	7.5	6.5	0.3	0.3	0.5	0.3	0.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	494	664	816	1,702	2,018	2,263	2,412	100	100	100	4.4	2.2	1.2	0.6	1.3
By sector															
Industry	188	244	329	810	892	902	898	37	48	37	5.6	1.2	0.1	0.0	0.4
Transport	24	34	88	238	344	444	507	5.1	14	21	9.3	4.7	2.6	1.3	2.7
Buildings, etc.	272	344	337	518	611	710	764	52	30	32	1.9	2.1	1.5	0.7	1.4
Non-energy use	10	43	62	136	172	208	242	6.5	8.0	10	5.4	2.9	1.9	1.5	2.1
By energy															
Coal	220	318	304	558	555	489	426	48	33	18	2.6	0.0	-1.3	-1.4	-1.0
Oil	59	85	180	422	548	647	696	13	25	29	7.6	3.3	1.7	0.7	1.8
Natural gas	6.4	8.9	12	81	149	240	330	1.3	4.7	14	10.6	8.0	4.9	3.3	5.2
Electricity	21	39	89	355	472	589	665	5.9	21	28	10.6	3.6	2.2	1.2	2.3
Heat	7.4	13	25	71	83	86	84	2.0	4.2	3.5	7.9	2.1	0.3	-0.2	0.6
Renewables	180	200	205	216	210	213	211	30	13	8.7	0.3	-0.3	0.1	-0.1	-0.1

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	301	621	1,356	4,985	6,488	7,999	8,907	100	100	100	9.9	3.4	2.1	1.1	2.1
Coal	164	443	1,062	3,785	3,966	4,326	4,155	71	76	47	10.2	0.6	0.9	-0.4	0.3
Oil	78	49	46	6.8	7.6	7.5	7.4	7.9	0.1	0.1	-8.6	1.5	-0.2	-0.2	0.3
Natural gas	0.7	2.8	5.8	86	285	547	689	0.4	1.7	7.7	16.9	16.2	6.7	2.3	7.7
Nuclear	-	-	17	97	551	992	1,434	-	2.0	16	n.a.	24.2	6.1	3.8	10.1
Hydro	58	127	222	863	1,247	1,337	1,418	20	17	16	9.1	4.7	0.7	0.6	1.8
Geothermal	-	-	-	0.2	0.3	0.3	0.4	-	0.0	0.0	n.a.	7.1	2.3	2.5	3.7
Solar, wind, etc.	-	0.0	0.6	102	335	645	1,025	0.0	2.1	12	58.6	16.0	6.8	4.7	8.6
Biomass and waste	-	-	2.4	45	96	144	179	-	0.9	2.0	n.a.	10.1	4.1	2.1	5.1

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	334	812	2,190	6,988	12,175	20,797	30,784	10.3	7.2	5.5	4.0	5.4
Population (million)	981	1,135	1,263	1,351	1,405	1,425	1,408	0.8	0.5	0.1	-0.1	0.1
CO_2 emissions[*2] (Mt)	1,506	2,339	3,258	9,067	9,515	9,493	8,913	6.4	0.6	0.0	-0.6	-0.1
GDP per capita ($2010 thousand)	0.3	0.7	1.7	5.2	8.7	15	22	9.4	6.7	5.4	4.1	5.3
Primary energy consump. per capita (toe)	0.6	0.8	0.9	2.1	2.3	2.5	2.6	4.8	1.2	0.7	0.4	0.7
Primary energy consumption per GDP[*3]	1,790	1,072	530	414	271	172	120	-4.2	-5.2	-4.4	-3.6	-4.3
CO_2 emissions per GDP[*2, *4]	4,507	2,879	1,488	1,298	782	456	290	-3.6	-6.1	-5.2	-4.5	-5.2
CO_2 per primary energy consumption[*2, *5]	2.5	2.7	2.8	3.1	2.9	2.7	2.4	0.7	-1.0	-0.8	-0.9	-0.9
Automobile ownership (million)	1.2	5.3	16	109	205	293	374	14.7	8.2	3.6	2.5	4.5
Automobile ownership rates[*6]	1.2	4.7	12	81	146	205	266	13.8	7.6	3.5	2.6	4.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 52 India [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	205	316	456	788	984	1,209	1,519	100	100	100	4.2	2.8	2.1	2.3	2.4
Coal	49	103	161	354	386	388	448	33	45	29	5.8	1.1	0.1	1.4	0.8
Oil	33	61	112	177	234	303	377	19	22	25	5.0	3.5	2.6	2.2	2.7
Natural gas	1.3	11	23	49	77	125	195	3.3	6.2	13	7.2	5.9	4.9	4.6	5.1
Nuclear	0.8	1.6	4.4	8.6	42	97	152	0.5	1.1	10	7.9	21.9	8.8	4.6	10.8
Hydro	4.0	6.2	6.4	11	14	18	22	1.9	1.4	1.5	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	0.2	3.1	11	33	53	0.0	0.4	3.5	29.5	17.4	11.6	4.8	10.7
Biomass and waste	116	133	149	185	219	244	272	42	23	18	1.5	2.1	1.1	1.1	1.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	179	250	318	512	651	814	1,021	100	100	100	3.3	3.1	2.3	2.3	2.5
By sector															
Industry	43	69	83	168	224	285	357	28	33	35	4.1	3.6	2.4	2.3	2.7
Transport	17	21	32	74	98	134	182	8.4	14	18	5.9	3.7	3.2	3.1	3.3
Buildings, etc.	113	146	176	234	282	328	389	59	46	38	2.2	2.3	1.5	1.7	1.8
Non-energy use	5.7	13	27	36	47	67	92	5.3	7.0	9.0	4.6	3.6	3.6	3.2	3.5
By energy															
Coal	28	42	33	88	100	103	111	17	17	11	3.5	1.6	0.3	0.7	0.8
Oil	27	50	94	148	207	278	351	20	29	34	5.1	4.3	3.0	2.4	3.1
Natural gas	0.7	5.6	9.7	26	36	53	78	2.3	5.1	7.6	7.2	4.1	4.0	3.9	4.0
Electricity	7.8	18	32	75	114	175	258	7.4	15	25	6.6	5.4	4.4	4.0	4.5
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	116	133	148	174	193	205	223	53	34	22	1.2	1.3	0.6	0.9	0.9

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	120	293	570	1,128	1,664	2,498	3,652	100	100	100	6.3	5.0	4.1	3.9	4.3
Coal	61	192	390	801	968	1,100	1,480	65	71	41	6.7	2.4	1.3	3.0	2.2
Oil	8.8	13	29	23	12	7.3	6.3	4.5	2.0	0.2	2.5	-7.3	-5.2	-1.5	-4.5
Natural gas	0.6	10.0	56	94	188	354	627	3.4	8.3	17	10.7	9.0	6.6	5.9	7.0
Nuclear	3.0	6.1	17	33	160	372	583	2.1	2.9	16	7.9	21.9	8.8	4.6	10.8
Hydro	47	72	74	126	167	213	256	24	11	7.0	2.6	3.6	2.5	1.8	2.6
Geothermal	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Solar, wind, etc.	-	0.0	1.7	30	124	380	609	0.0	2.7	17	36.6	19.2	11.9	4.8	11.3
Biomass and waste	-	-	1.3	21	46	71	90	-	1.8	2.5	n.a.	10.6	4.4	2.4	5.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	279	479	825	1,901	3,079	5,854	10,148	6.5	6.2	6.6	5.7	6.2
Population (million)	699	869	1,042	1,237	1,353	1,476	1,566	1.6	1.1	0.9	0.6	0.8
CO_2 emissions[*2] (Mt)	284	585	961	1,961	2,295	2,569	3,121	5.7	2.0	1.1	2.0	1.7
GDP per capita ($2010 thousand)	0.4	0.6	0.8	1.5	2.3	4.0	6.5	4.8	5.0	5.7	5.0	5.3
Primary energy consump. per capita (toe)	0.3	0.4	0.4	0.6	0.7	0.8	1.0	2.6	1.7	1.2	1.7	1.5
Primary energy consumption per GDP[*3]	735	660	553	415	320	207	150	-2.1	-3.2	-4.3	-3.2	-3.6
CO_2 emissions per GDP[*2, *4]	1,016	1,219	1,164	1,032	746	439	308	-0.8	-4.0	-5.2	-3.5	-4.2
CO_2 per primary energy consumption[*2, *5]	1.4	1.8	2.1	2.5	2.3	2.1	2.1	1.4	-0.8	-0.9	-0.3	-0.7
Automobile ownership (million)	1.7	4.3	9.4	29	49	97	190	9.1	6.6	7.1	6.9	6.9
Automobile ownership rates[*6]	2.4	5.0	9.0	24	36	66	121	7.4	5.4	6.2	6.3	6.0

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 53 Japan [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	345	439	519	452	441	397	362	100	100	100	0.1	-0.3	-1.0	-0.9	-0.8
Coal	60	77	97	112	88	80	69	17	25	19	1.7	-3.0	-1.0	-1.4	-1.7
Oil	234	250	255	210	167	135	113	57	46	31	-0.8	-2.8	-2.1	-1.8	-2.2
Natural gas	21	44	66	105	76	69	59	10	23	16	4.0	-4.0	-0.9	-1.6	-2.0
Nuclear	22	53	84	4.2	77	66	64	12	0.9	18	-10.9	44.2	-1.6	-0.3	10.3
Hydro	7.6	7.7	7.5	6.5	11	13	13	1.7	1.4	3.6	-0.8	6.7	1.6	0.2	2.5
Geothermal	0.8	1.6	3.1	2.4	3.7	9.8	15	0.4	0.5	4.1	2.0	5.5	10.3	4.2	6.7
Solar, wind, etc.	-	1.2	0.8	1.4	4.7	9.1	14	0.3	0.3	3.8	0.7	16.7	6.9	4.0	8.6
Biomass and waste	-	4.9	5.6	10	13	14	15	1.1	2.3	4.2	3.4	3.3	0.9	0.5	1.4

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	232	298	341	309	291	260	234	100	100	100	0.2	-0.8	-1.1	-1.1	-1.0
By sector															
Industry	91	101	96	82	84	78	74	34	26	31	-0.9	0.3	-0.7	-0.6	-0.4
Transport	54	72	88	75	64	52	43	24	24	18	0.2	-1.9	-2.1	-1.8	-1.9
Buildings, etc.	58	91	116	115	107	96	85	31	37	36	1.1	-0.8	-1.1	-1.2	-1.1
Non-energy use	28	34	41	38	35	34	33	12	12	14	0.4	-0.9	-0.4	-0.4	-0.5
By energy															
Coal	25	32	25	27	26	25	23	11	8.7	9.9	-0.7	-0.3	-0.6	-0.8	-0.6
Oil	157	182	208	164	141	114	94	61	53	40	-0.5	-1.9	-2.1	-2.0	-2.0
Natural gas	5.8	15	23	35	35	32	29	5.1	11	12	3.8	0.0	-1.0	-1.0	-0.7
Electricity	44	64	81	79	82	80	78	22	26	33	0.9	0.4	-0.2	-0.3	-0.1
Heat	0.1	0.2	0.5	0.5	2.9	5.1	7.2	0.1	0.2	3.1	4.6	23.7	5.6	3.5	9.7
Renewables	-	3.9	3.7	3.3	3.5	3.7	3.7	1.3	1.1	1.6	-0.7	0.4	0.7	0.0	0.3

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	573	836	1,049	1,026	1,055	1,037	1,006	100	100	100	0.9	0.3	-0.2	-0.3	-0.1
Coal	55	116	229	303	190	160	118	14	30	12	4.5	-5.7	-1.7	-3.0	-3.3
Oil	265	237	135	181	81	56	48	28	18	4.7	-1.2	-9.6	-3.6	-1.7	-4.7
Natural gas	81	179	256	397	251	244	206	21	39	20	3.7	-5.6	-0.3	-1.7	-2.3
Nuclear	83	202	322	16	297	254	245	24	1.6	24	-10.9	44.2	-1.6	-0.3	10.3
Hydro	88	89	87	75	127	149	153	11	7.4	15	-0.8	6.7	1.6	0.2	2.5
Geothermal	0.9	1.7	3.3	2.6	4.1	11	17	0.2	0.3	1.7	1.9	5.8	10.6	4.2	6.9
Solar, wind, etc.	-	0.0	0.5	12	48	96	145	0.0	1.2	14	53.1	19.1	7.2	4.3	9.4
Biomass and waste	-	11	16	39	57	67	75	1.3	3.8	7.5	6.0	5.0	1.6	1.1	2.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	2,894	4,553	5,093	5,571	6,501	7,422	8,278	0.9	1.9	1.3	1.1	1.4
Population (million)	117	124	127	128	126	121	115	0.1	-0.2	-0.4	-0.5	-0.4
CO_2 emissions[*2] (Mt)	916	1,070	1,196	1,220	931	790	659	0.6	-3.3	-1.6	-1.8	-2.2
GDP per capita ($2010 thousand)	25	37	40	44	52	61	72	0.8	2.1	1.7	1.6	1.8
Primary energy consump. per capita (toe)	3.0	3.6	4.1	3.5	3.5	3.3	3.2	0.0	-0.1	-0.7	-0.4	-0.4
Primary energy consumption per GDP[*3]	119	96	102	81	68	53	44	-0.8	-2.2	-2.4	-2.0	-2.2
CO_2 emissions per GDP[*2, *4]	317	235	235	219	143	106	80	-0.3	-5.2	-2.9	-2.9	-3.6
CO_2 per primary energy consumption[*2, *5]	2.7	2.4	2.3	2.7	2.1	2.0	1.8	0.5	-3.0	-0.6	-0.9	-1.4
Automobile ownership (million)	38	58	72	76	77	74	71	1.3	0.2	-0.4	-0.4	-0.2
Automobile ownership rates[*6]	325	467	570	595	615	612	619	1.1	0.4	0.0	0.1	0.1

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 54 ASEAN [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	142	233	380	573	750	960	1,118	100	100	100	4.2	3.4	2.5	1.5	2.4
Coal	3.6	13	32	89	119	163	191	5.4	16	17	9.3	3.7	3.2	1.6	2.8
Oil	58	88	153	209	253	299	327	38	37	29	4.0	2.4	1.7	0.9	1.6
Natural gas	8.6	30	74	126	159	198	225	13	22	20	6.7	3.0	2.3	1.3	2.1
Nuclear	-	-	-	-	2.0	22	59	-	-	5.3	n.a.	n.a.	27.2	10.2	n.a.
Hydro	0.8	2.3	4.1	8.8	11	15	17	1.0	1.5	1.5	6.2	3.4	2.6	1.5	2.4
Geothermal	1.8	6.6	18	25	70	102	117	2.8	4.4	10	6.2	13.8	3.9	1.3	5.7
Solar, wind, etc.	-	-	-	0.1	0.5	1.2	3.0	-	0.0	0.3	n.a.	26.0	10.1	9.3	14.1
Biomass and waste	70	93	99	114	133	153	174	40	20	16	0.9	1.9	1.5	1.3	1.5

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	112	173	271	412	512	648	761	100	100	100	4.0	2.8	2.4	1.6	2.2
By sector															
Industry	22	43	76	115	155	214	263	25	28	35	4.6	3.9	3.3	2.1	3.0
Transport	17	32	62	104	131	164	194	19	25	26	5.5	2.9	2.3	1.7	2.2
Buildings, etc.	71	87	113	141	164	194	217	50	34	29	2.2	1.9	1.7	1.1	1.5
Non-energy use	2.4	11	21	52	62	75	87	6.3	13	11	7.3	2.4	1.8	1.5	1.9
By energy															
Coal	2.1	6.0	13	28	39	56	69	3.4	6.9	9.1	7.3	4.1	3.7	2.1	3.3
Oil	41	67	123	187	222	268	297	38	45	39	4.8	2.2	1.9	1.0	1.7
Natural gas	2.5	7.5	17	37	52	69	86	4.4	9.0	11	7.5	4.5	2.8	2.2	3.1
Electricity	4.7	11	28	59	83	123	160	6.4	14	21	7.8	4.4	4.0	2.7	3.6
Heat	-	-	-	-	-	-	-	-	-	-	n.a.	n.a.	n.a.	n.a.	n.a.
Renewables	62	82	90	101	116	132	149	47	25	20	1.0	1.7	1.3	1.3	1.4

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	62	154	370	754	1,032	1,511	1,967	100	100	100	7.5	4.0	3.9	2.7	3.5
Coal	3.0	28	79	236	322	460	556	18	31	28	10.2	4.0	3.6	1.9	3.1
Oil	47	66	72	55	62	68	73	43	7.3	3.7	-0.8	1.6	0.8	0.8	1.0
Natural gas	0.7	26	154	334	423	565	656	17	44	33	12.3	3.0	2.9	1.5	2.4
Nuclear	-	-	-	-	7.7	104	280	-	-	14	n.a.	n.a.	29.7	10.5	n.a.
Hydro	9.8	27	47	102	133	172	200	18	14	10	6.2	3.4	2.6	1.5	2.4
Geothermal	2.1	6.6	16	20	55	93	123	4.3	2.6	6.3	5.1	13.6	5.5	2.8	6.8
Solar, wind, etc.	-	-	-	0.9	5.6	15	36	-	0.1	1.8	n.a.	26.3	10.1	9.4	14.2
Biomass and waste	-	0.6	1.0	6.9	22	34	42	0.4	0.9	2.1	11.7	15.8	4.4	2.1	6.7

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	405	702	1,137	2,074	3,124	4,901	7,101	5.0	5.3	4.6	3.8	4.5
Population (million)	345	427	503	587	638	691	729	1.5	1.1	0.8	0.5	0.8
CO_2 emissions[*2] (Mt)	205	362	709	1,139	1,440	1,814	2,039	5.4	3.0	2.3	1.2	2.1
GDP per capita ($2010 thousand)	1.2	1.6	2.3	3.5	4.9	7.1	9.7	3.5	4.2	3.8	3.2	3.7
Primary energy consump. per capita (toe)	0.4	0.5	0.8	1.0	1.2	1.4	1.5	2.7	2.4	1.7	1.0	1.6
Primary energy consumption per GDP[*3]	352	332	334	276	240	196	158	-0.8	-1.7	-2.0	-2.2	-2.0
CO_2 emissions per GDP[*2, *4]	507	515	624	549	461	370	287	0.3	-2.2	-2.2	-2.5	-2.3
CO_2 per primary energy consumption[*2, *5]	1.4	1.6	1.9	2.0	1.9	1.9	1.8	1.1	-0.4	-0.2	-0.4	-0.3
Automobile ownership (million)	4.4	10	21	48	62	85	114	7.3	3.4	3.2	2.9	3.2
Automobile ownership rates[*6]	13	24	41	82	98	124	156	5.8	2.3	2.3	2.4	2.4

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 55 United States [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	1,805	1,915	2,273	2,141	2,082	1,962	1,766	100	100	100	0.5	-0.3	-0.6	-1.0	-0.7
Coal	376	460	534	425	338	250	170	24	20	9.6	-0.4	-2.8	-3.0	-3.8	-3.2
Oil	797	757	871	771	699	608	514	40	36	29	0.1	-1.2	-1.4	-1.7	-1.4
Natural gas	477	438	548	596	610	572	485	23	28	27	1.4	0.3	-0.6	-1.6	-0.7
Nuclear	69	159	208	209	223	244	257	8.3	9.8	15	1.2	0.8	0.9	0.5	0.7
Hydro	24	23	22	24	25	26	26	1.2	1.1	1.5	0.1	0.6	0.2	0.1	0.3
Geothermal	4.6	14	13	8.7	21	43	55	0.7	0.4	3.1	-2.2	11.7	7.4	2.4	6.8
Solar, wind, etc.	-	0.3	2.1	15	31	66	104	0.0	0.7	5.9	19.0	9.7	7.9	4.7	7.2
Biomass and waste	54	62	73	89	132	150	154	3.3	4.1	8.7	1.6	5.1	1.3	0.2	2.0

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	1,311	1,294	1,546	1,433	1,410	1,327	1,196	100	100	100	0.5	-0.2	-0.6	-1.0	-0.6
By sector															
Industry	387	284	332	248	245	231	207	22	17	17	-0.6	-0.2	-0.6	-1.1	-0.7
Transport	425	488	588	597	569	518	451	38	42	38	0.9	-0.6	-0.9	-1.4	-1.0
Buildings, etc.	397	403	473	483	480	446	393	31	34	33	0.8	-0.1	-0.7	-1.3	-0.7
Non-energy use	102	119	153	104	117	133	145	9.2	7.3	12	-0.6	1.4	1.3	0.9	1.2
By energy															
Coal	56	56	33	22	19	17	15	4.3	1.5	1.3	-4.1	-1.6	-1.1	-1.2	-1.3
Oil	689	683	793	719	646	560	471	53	50	39	0.2	-1.3	-1.4	-1.7	-1.5
Natural gas	337	303	360	296	311	284	246	23	21	21	-0.1	0.6	-0.9	-1.4	-0.7
Electricity	174	226	301	321	329	350	349	18	22	29	1.6	0.3	0.6	0.0	0.3
Heat	-	2.2	5.3	6.5	6.4	5.6	4.7	0.2	0.5	0.4	5.2	-0.3	-1.3	-1.8	-1.2
Renewables	54	23	54	68	99	111	111	1.8	4.8	9.2	5.1	4.7	1.2	0.0	1.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	2,427	3,203	4,026	4,271	4,356	4,612	4,597	100	100	100	1.3	0.2	0.6	0.0	0.3
Coal	1,243	1,700	2,129	1,643	1,329	986	651	53	38	14	-0.2	-2.6	-2.9	-4.1	-3.3
Oil	263	131	118	33	30	27	20	4.1	0.8	0.4	-6.1	-1.1	-1.2	-2.7	-1.7
Natural gas	370	382	634	1,265	1,332	1,361	1,136	12	30	25	5.6	0.7	0.2	-1.8	-0.4
Nuclear	266	612	798	801	855	936	985	19	19	21	1.2	0.8	0.9	0.5	0.7
Hydro	279	273	253	279	292	299	302	8.5	6.5	6.6	0.1	0.6	0.2	0.1	0.3
Geothermal	5.4	16	15	18	45	92	117	0.5	0.4	2.5	0.6	12.0	7.5	2.4	6.9
Solar, wind, etc.	-	3.7	6.4	153	334	737	1,185	0.1	3.6	26	18.4	10.3	8.2	4.9	7.6
Biomass and waste	0.5	86	72	79	138	174	200	2.7	1.8	4.4	-0.4	7.2	2.3	1.4	3.4

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	6,521	9,054	12,717	15,658	19,280	24,593	29,621	2.5	2.6	2.5	1.9	2.3
Population (million)	227	250	282	314	334	359	379	1.0	0.8	0.7	0.6	0.7
CO_2 emissions[*2] (Mt)	4,743	4,820	5,617	5,139	4,573	3,811	2,970	0.3	-1.4	-1.8	-2.5	-1.9
GDP per capita ($2010 thousand)	29	36	45	50	58	69	78	1.5	1.8	1.7	1.3	1.6
Primary energy consump. per capita (toe)	7.9	7.7	8.1	6.8	6.2	5.5	4.7	-0.5	-1.1	-1.3	-1.6	-1.3
Primary energy consumption per GDP[*3]	277	212	179	137	108	80	60	-2.0	-2.9	-3.0	-2.9	-2.9
CO_2 emissions per GDP[*2, *4]	727	532	442	328	237	155	100	-2.2	-4.0	-4.2	-4.3	-4.1
CO_2 per primary energy consumption[*2, *5]	2.6	2.5	2.5	2.4	2.2	1.9	1.7	-0.2	-1.1	-1.2	-1.4	-1.3
Automobile ownership (million)	156	189	221	251	274	305	329	1.3	1.1	1.1	0.8	1.0
Automobile ownership rates[*6]	686	756	785	801	821	850	868	0.3	0.3	0.3	0.2	0.3

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million, *4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people

Table 56 European Union [Advanced Technologies Scenario]

Primary energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total[*1]	n.a.	1,645	1,693	1,644	1,636	1,587	1,492	100	100	100	0.0	-0.1	-0.3	-0.6	-0.3
Coal	n.a.	456	321	294	232	191	163	28	18	11	-2.0	-2.9	-1.9	-1.6	-2.1
Oil	n.a.	606	623	526	493	420	355	37	32	24	-0.6	-0.8	-1.6	-1.7	-1.4
Natural gas	n.a.	297	396	392	395	379	347	18	24	23	1.3	0.1	-0.4	-0.9	-0.4
Nuclear	n.a.	207	246	230	241	264	272	13	14	18	0.5	0.6	0.9	0.3	0.6
Hydro	n.a.	25	31	29	29	30	30	1.5	1.8	2.0	0.7	0.1	0.2	0.0	0.1
Geothermal	n.a.	3.2	4.6	5.7	7.1	10	12	0.2	0.3	0.8	2.7	2.8	3.6	1.4	2.6
Solar, wind, etc.	n.a.	0.2	2.4	27	44	63	84	0.0	1.6	5.6	23.7	6.3	3.7	3.0	4.2
Biomass and waste	n.a.	47	66	137	195	230	230	2.8	8.3	15	5.0	4.5	1.7	0.0	1.9

Final energy consumption

	Mtoe							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	n.a.	1,129	1,175	1,139	1,145	1,098	1,017	100	100	100	0.0	0.1	-0.4	-0.8	-0.4
By sector															
Industry	n.a.	343	309	264	269	265	258	30	23	25	-1.2	0.3	-0.2	-0.3	-0.1
Transport	n.a.	259	304	307	305	272	218	23	27	21	0.8	-0.1	-1.1	-2.2	-1.2
Buildings, etc.	n.a.	429	453	470	461	445	420	38	41	41	0.4	-0.2	-0.3	-0.6	-0.4
Non-energy use	n.a.	99	110	99	110	116	120	8.7	8.7	12	0.0	1.4	0.5	0.4	0.7
By energy															
Coal	n.a.	122	52	38	36	31	28	11	3.4	2.7	-5.1	-0.8	-1.3	-1.3	-1.2
Oil	n.a.	503	539	469	446	380	321	45	41	32	-0.3	-0.6	-1.6	-1.7	-1.3
Natural gas	n.a.	226	272	259	266	261	247	20	23	24	0.6	0.4	-0.2	-0.6	-0.2
Electricity	n.a.	186	218	241	249	266	278	16	21	27	1.2	0.4	0.7	0.4	0.5
Heat	n.a.	54	45	48	46	44	41	4.8	4.2	4.0	-0.5	-0.7	-0.5	-0.7	-0.6
Renewables	n.a.	39	49	84	103	116	102	3.5	7.4	10	3.6	2.5	1.2	-1.2	0.7

Electricity generation

	(TWh)							Shares (%)			CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990	2012	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
Total	n.a.	2,576	3,005	3,264	3,422	3,684	3,881	100	100	100	1.1	0.6	0.7	0.5	0.6
Coal	n.a.	1,050	967	935	716	592	510	41	29	13	-0.5	-3.3	-1.9	-1.5	-2.1
Oil	n.a.	224	181	73	39	26	20	8.7	2.2	0.5	-5.0	-7.6	-3.8	-2.5	-4.4
Natural gas	n.a.	193	480	582	580	554	491	7.5	18	13	5.2	0.0	-0.5	-1.2	-0.6
Nuclear	n.a.	795	945	882	925	1,014	1,042	31	27	27	0.5	0.6	0.9	0.3	0.6
Hydro	n.a.	289	356	335	338	345	346	11	10	8.9	0.7	0.1	0.2	0.0	0.1
Geothermal	n.a.	3.2	4.8	5.8	7.4	11	12	0.1	0.2	0.3	2.7	3.1	3.7	1.3	2.7
Solar, wind, etc.	n.a.	1.3	24	281	493	722	976	0.1	8.6	25	27.7	7.3	3.9	3.1	4.5
Biomass and waste	n.a.	20	47	170	324	419	482	0.8	5.2	12	10.3	8.4	2.6	1.4	3.8

Energy and economic indicators

								CAGR (%)				
	1980	1990	2000	2012	2020	2030	2040	1990/ 2012	2012/ 2020	2020/ 2030	2030/ 2040	2012/ 2040
GDP ($2010 billion)	n.a.	11,433	14,229	16,542	18,848	22,299	25,446	1.7	1.6	1.7	1.3	1.6
Population (million)	n.a.	478	488	506	518	526	529	0.3	0.3	0.2	0.1	0.2
CO_2 emissions[*2] (Mt)	n.a.	4,068	3,786	3,408	3,031	2,590	2,192	-0.8	-1.5	-1.6	-1.7	-1.6
GDP per capita ($2010 thousand)	n.a.	24	29	33	36	42	48	1.4	1.3	1.5	1.3	1.4
Primary energy consump. per capita (toe)	n.a.	3.4	3.5	3.3	3.2	3.0	2.8	-0.3	-0.4	-0.5	-0.7	-0.5
Primary energy consumption per GDP[*3]	n.a.	144	119	99	87	71	59	-1.7	-1.7	-2.0	-1.9	-1.9
CO_2 emissions per GDP[*2, *4]	n.a.	356	266	206	161	116	86	-2.5	-3.0	-3.2	-2.9	-3.1
CO_2 per primary energy consumption[*2, *5]	n.a.	2.5	2.2	2.1	1.9	1.6	1.5	-0.8	-1.4	-1.3	-1.0	-1.2
Automobile ownership (million)	n.a.	177	235	290	318	347	362	2.3	1.2	0.9	0.4	0.8
Automobile ownership rates[*6]	n.a.	371	482	574	615	660	683	2.0	0.9	0.7	0.4	0.6

*1 Trade of electricity and heat are not shown, *2 Excludes emission reduction by CCS, *3 toe/$2010 million,
*4 t/$2010 million, *5 t/toe, *6 Vehicles per 1,000 people