

Primer

**Energy Statistics  
in Asia and the Pacific (1990–2009)**  
and  
**Energy Outlook  
for Asia and the Pacific**



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Note:

In this publication, "\$" refers to US dollars.

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# Abbreviations

ADB	Asian Development Bank
APEC	Asia-Pacific Economic Cooperation
APERC	Asia Pacific Energy Research Centre
BAU	business-as-usual
CO <sub>2</sub>	carbon dioxide
IEA	International Energy Agency
Lao PDR	Lao People's Democratic Republic
LNG	liquefied natural gas
PRC	People's Republic of China
UNSD	United Nations Statistics Division

## Weights and Measures

ktoe	thousand tons of oil equivalent
Mtoe	million tons of oil equivalent
TWh	terawatt-hour

2010

2035

Full versions of the  
**Energy Statistics**  
in Asia and the Pacific (1990–2009)

and  
**Energy Outlook**  
for Asia and the Pacific

are available online at  
[www.adb.org/publications](http://www.adb.org/publications)

Detailed regional and country-specific  
analysis are included in both reports.

This primer introduces key statistics and possible future scenarios for the energy sector of the member economies of the Asian Development Bank (ADB). It serves as a companion and introduction to the full reports *Energy Statistics in Asia and the Pacific (1990–2009)* and *Energy Outlook for Asia and the Pacific* which ADB has created to support policy makers in the Asian energy sector, and its own operations.

# Historical Energy Data (1990–2009) in Asia and the Pacific

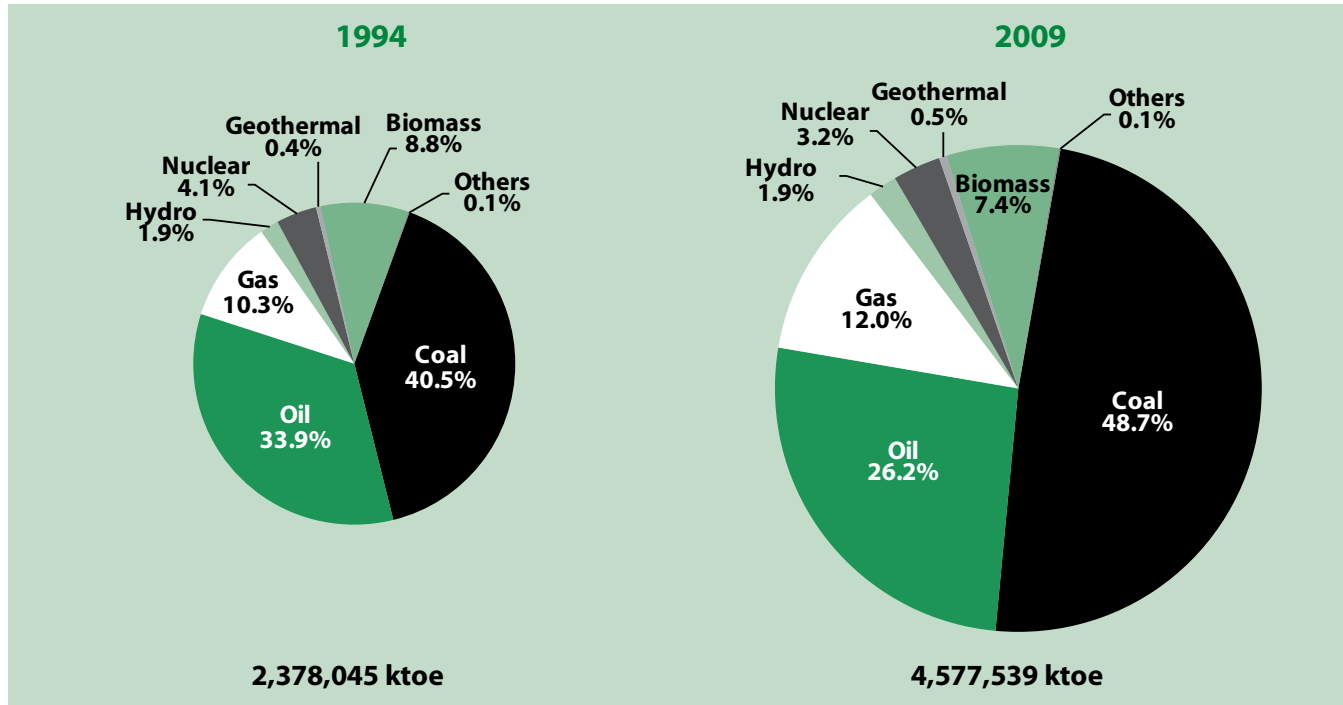
Recent years have seen significant changes for Asia and the Pacific in terms of energy security and sustainable development, with increases in investments in clean energy development, including renewable energy, energy efficiency, and access to modern forms of energy. The data contained here summarizes the current situation, the revealed trends in energy, and offers possible scenarios for what the region's energy situation will be in 2035.

ADB, as the region's multilateral development bank, not only looks at the component regions, the Asian subregions, and their individual countries, but also provides specific statistics and analysis. Each country and region face different challenges going forward, and different responses are to be expected. ADB is prepared, through its Strategy 2020 and current Energy Policy, to support the efforts of its developing member countries towards increased energy security, and sustainable energy development.

## Primary Energy Supply

During a 16-year span, energy consumption in the region almost doubled, growing from 2.3 million ktoe in 1994 to 4.5 million ktoe in 2009. The chart to the right shows that coal remains the main source of energy in Asia and the Pacific, and as total energy use increased, coal's usage increased as well. The share of coal in Asia and the Pacific's primary energy supply rose from 40.5% in 1994 to 48.7% in 2009 and the share of oil decreased from 33.9% to 26.2% during the same period. The share of natural gas and hydro slightly increased, while that of nuclear energy slightly decreased. The collective share of other energy, which includes biomass, geothermal, and other renewable energy, decreased from 9.4% to 8.0%.

## Primary Energy Supply by Source, 1994 and 2009



ktoe = thousand tons of oil equivalent.

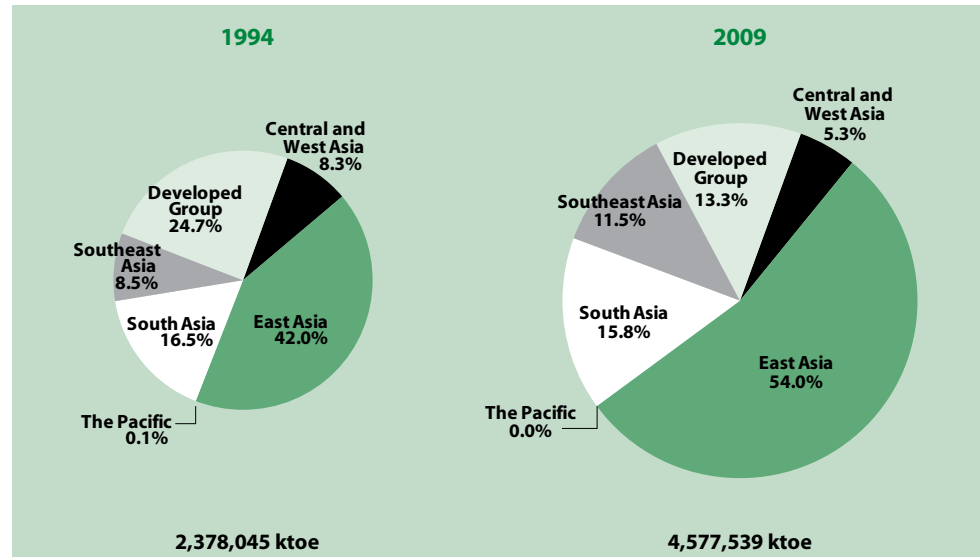
Sources: Asian Development Bank. 2008 Survey on Energy and Energy-Related Information in the Pacific. Unpublished; Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.ieej.or.jp/egeda/database/database-top.html>; Government of the Lao People's Democratic Republic (Lao PDR), Ministry of Energy and Mines. Energy Balances of Lao PDR from 1990 to 2010. Unpublished; International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris. CD-ROM; United Nations Statistics Division. 2011. *2008 Energy Balances and Electricity Profiles*. New York.

# The Regional View of Primary Energy

Of the regions in Asia and the Pacific, Southeast Asia experienced the fastest growth in primary energy supply from 1994 to 2009 at 6.6% per annum, followed by East Asia at 6.2% per annum, South Asia at 4.2% per annum, and Central and West Asia at 1.4% per annum. Primary energy supply of the Pacific grew by 3.8% per annum from 1994 to 2008.

In 2009, East Asia accounted for the largest share (54.0%) of the primary energy supply in Asia and the Pacific, followed by South Asia (15.8%), the Developed Group (13.3%), Southeast Asia (11.5%), Central and West Asia (5.3%), and the Pacific (0.0%).

**Primary Energy Supply by Region, 1994 and 2009**



ktoe = thousand tons of oil equivalent.

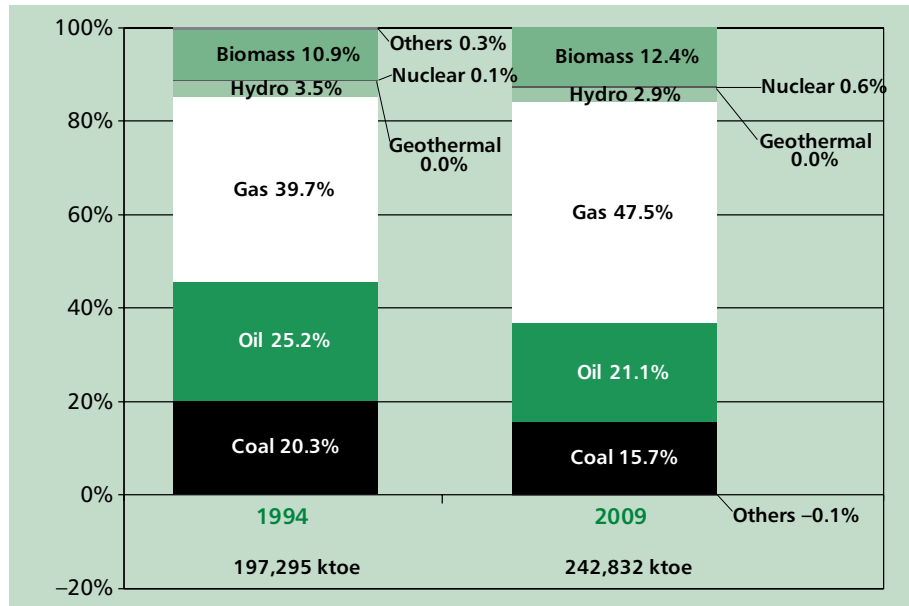
Sources: Asian Development Bank. 2008 Survey on Energy and Energy-Related Information in the Pacific. Unpublished; Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.iecej.or.jp/egeda/database/database-top.html>; Government of the Lao People's Democratic Republic (Lao PDR), Ministry of Energy and Mines. Energy Balances of Lao PDR from 1990 to 2010. Unpublished; International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris. CD-ROM; United Nations Statistics Division. 2011. *2008 Energy Balances and Electricity Profiles*. New York.



## Central and West Asia

The supply of nuclear energy had the fastest growth rate that averaged 17.0% from 1994 to 2009. This double digit growth easily surpasses the roughly 2% growth in natural gas and biomass.

**Primary Energy Mix in Central and West Asia, 1994 and 2009**



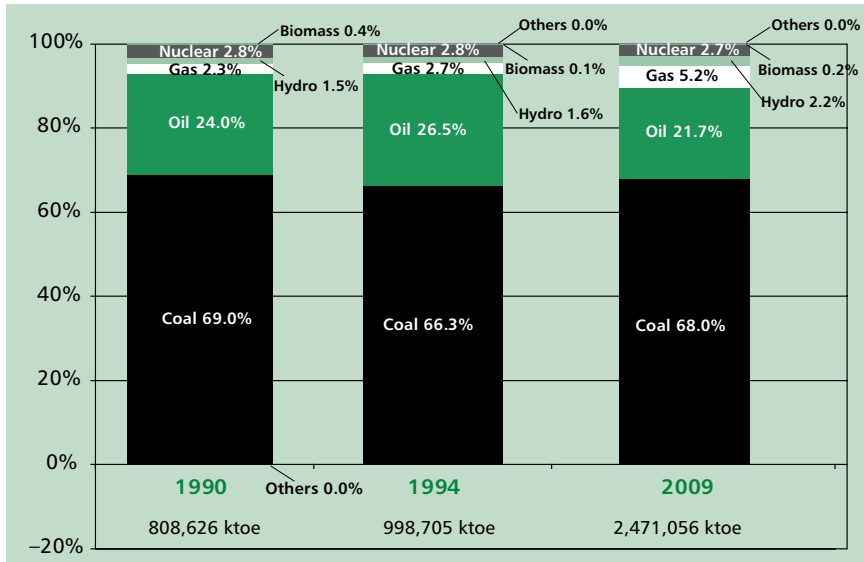
ktoe = thousand tons of oil equivalent.

Sources: Asian Development Bank. 2008 Survey on Energy and Energy-Related Information in the Pacific. Unpublished; Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.iej.or.jp/egeda/database/database-top.html>; Government of the Lao People's Democratic Republic (Lao PDR), Ministry of Energy and Mines. Energy Balances of Lao PDR from 1990 to 2010. Unpublished; International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris, CD-ROM; United Nations Statistics Division. 2011. *2008 Energy Balances and Electricity Profiles*. New York.

## East Asia

The total primary energy supply of East Asia more than doubled, from 999 million tons of oil equivalent (Mtoe) in 1994 to 2,471 Mtoe in 2009, growing at an average rate of 6.2% annually. Though natural gas was the fastest-growing fuel, coal represents the largest share of the energy supply.

**Primary Energy Mix in East Asia, 1990, 1994, and 2009**



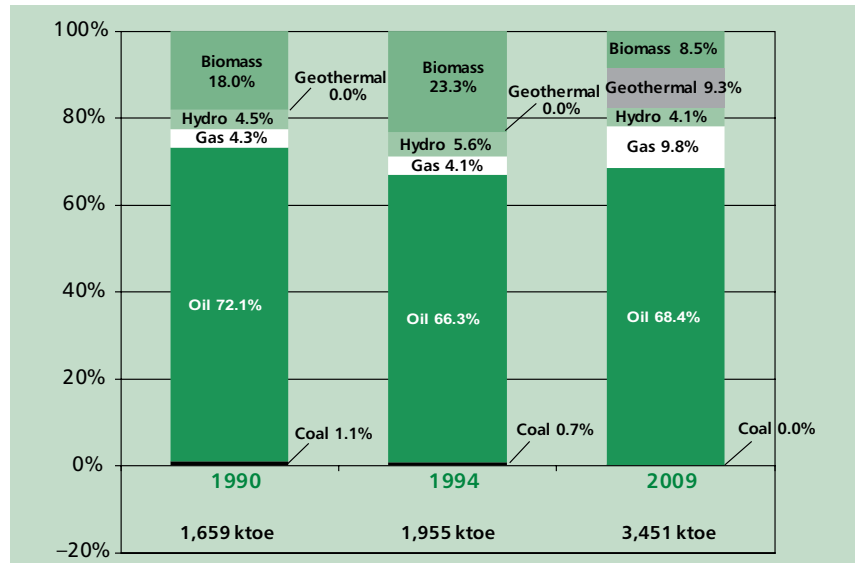
ktoe = thousand tons of oil equivalent.

Sources: Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.iecej.or.jp/egeda/database/database-top.html>; International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris, CD-ROM.

## The Pacific

Among the energy types in the Pacific's primary energy supply, natural gas grew the fastest, with an annual growth rate of 10.9%, although the product is used only in Papua New Guinea. Oil had the second-fastest growth rate, as the majority of countries in the Pacific import petroleum products. Oil power plants are used in place of coal in the Pacific, which leaves the use of coal at almost zero.

### Primary Energy Mix in the Pacific, 1990, 1994, and 2009



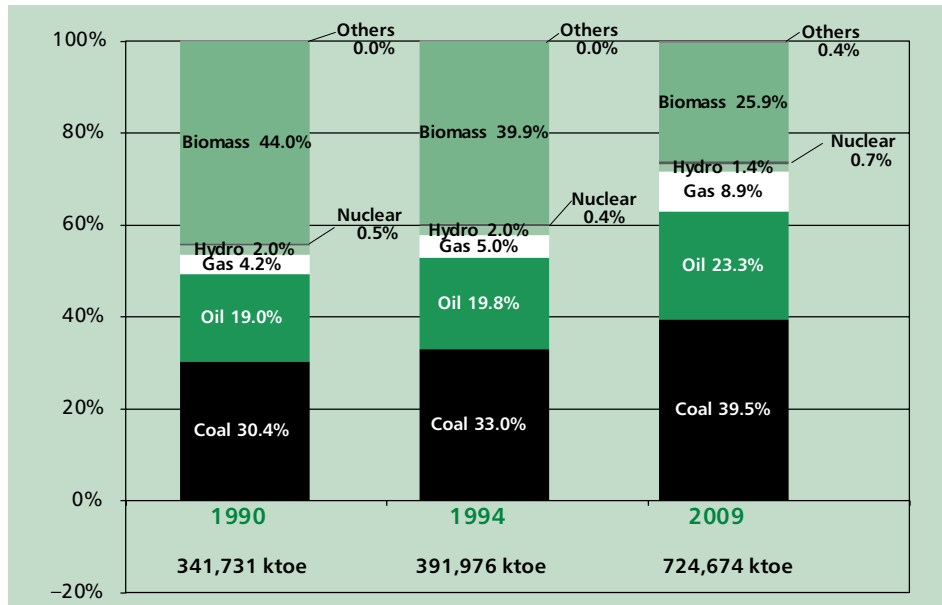
ktoe = thousand tons of oil equivalent.

Sources: Asian Development Bank. 2008 Survey on Energy and Energy-Related Information in the Pacific. Unpublished; Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.iecej.or.jp/egeda/database/database-top.html>; United Nations Statistics Division. 2011. *2008 Energy Balances and Electricity Profiles*. New York.

## South Asia

Notably, other energy, which constitutes solar, wind, and liquid biofuels, increased at an average annual rate of 29.9%, although its share to the total primary energy supply constituted a mere 0.2% in 2009. Nuclear energy's growth can be traced to the increase in the nuclear electricity-generating capacity in India. .

**Primary Energy Mix in South Asia, 1990, 1994, and 2009**



ktoe = thousand tons of oil equivalent.

Sources: International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris. CD-ROM; United Nations Statistics Division. 2011. *2008 Energy Balances and Electricity Profiles*. New York.

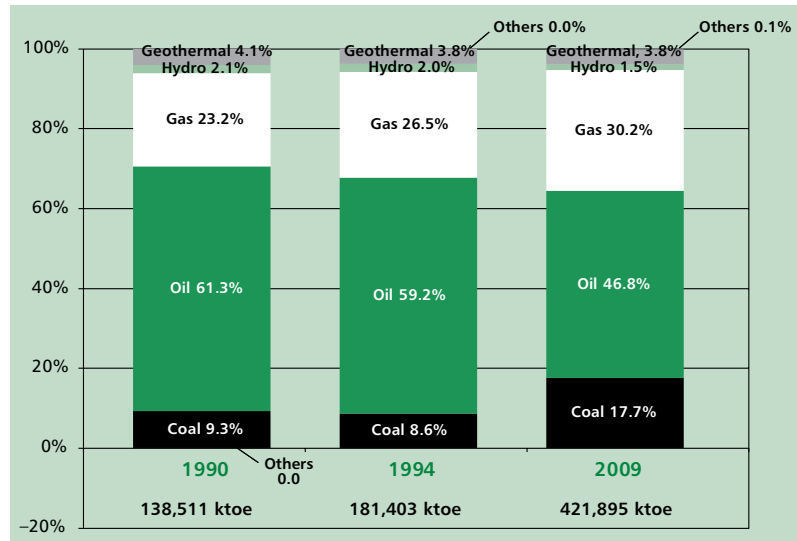
## Southeast Asia

The primary energy type that experienced the fastest growth during this period was coal, with an average annual growth rate of 11.0%. This is due to the construction of coal-fired power plants in Indonesia, Malaysia, Philippines, Thailand, and Viet Nam that began in the 1990s.

The fast growth rate of natural gas is attributable to the installation of natural gas-fired power plants in the same five countries as well as Singapore during the same period. Geothermal energy's growth is attributable to geothermal developments in the Philippines and Indonesia.

The sudden jump in biomass numbers can be explained due to increased biomass reporting during the time period - data collection for this type of energy in three (i.e., Indonesia, Thailand, and Viet Nam) of the 10 Southeast Asian countries started only after 2003.

## Primary Energy Mix in Southeast Asia, 1990, 1994, and 2009



ktoe = thousand tons of oil equivalent.

Note: The big jump in primary supply of biomass is due to the unavailability of biomass data in three of the 10 Southeast Asian countries before 2004. From 2004 onwards, these countries had been reporting consumption of biomass. There was also a sizable jump in the data from 1994 to 1995 due to unavailability of data in Cambodia before 1995.

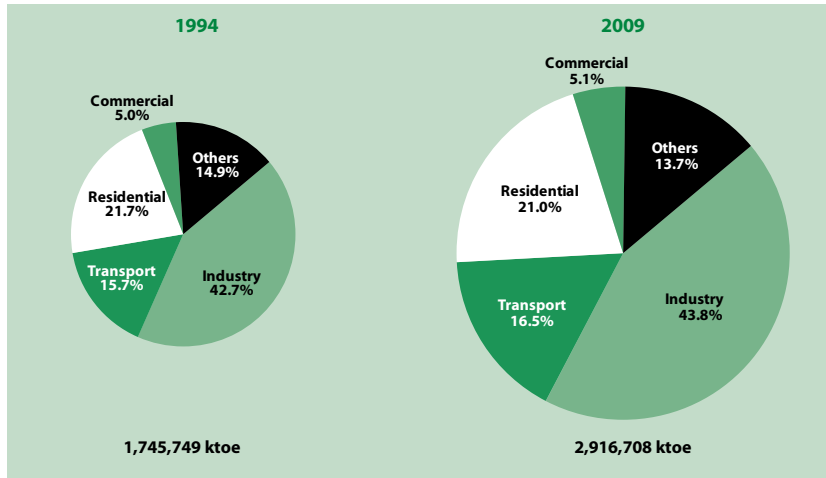
Sources: Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.ieej.or.jp/egeda/database/database-top.html>; Government of the Lao People's Democratic Republic (Lao PDR), Ministry of Energy and Mines. *Energy Balances of Lao PDR from 1990 to 2010*. Unpublished; International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris. CD-ROM; .

# Final Energy Consumption by Sector and by Type

The level of final energy consumption in 2009 of 2,917 Mtoe grew by 3.5% annually on average from 1,746 Mtoe in 1994. This growth rate from 1994 was lower than that of primary energy supply (4.5%), indicating that net energy consumption growth in the transformation sector surpassed that of the final energy consumption sector. The faster increase in the consumption of the transformation sector could be attributed to the faster growth of thermal electricity generation than hydroelectricity generation.

The total final energy of the residential and commercial sector increased by 3.3% per annum on average. Consumption growth was also seen in the transport sector (3.8% per annum) and the industry sector (3.6% per annum). Industry remains the most energy consuming sector by far, with a share of 43.8%. In comparison, the residential and commercial sectors combined represented 26.1%.

**Final Energy Consumption by Sector in Asia and the Pacific, 1994 and 2009**

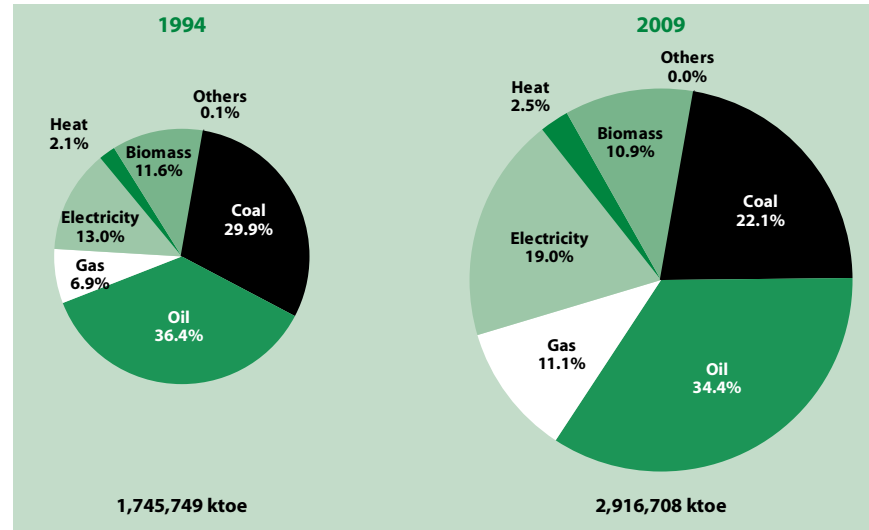


ktoe = thousand tons of oil equivalent.

Sources: Asian Development Bank. 2008 Survey on Energy and Energy-Related Information in the Pacific. Unpublished; Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.ieej.or.jp/egeda/database/database-top.html>; Government of the Lao People's Democratic Republic (Lao PDR), Ministry of Energy and Mines. Energy Balances of Lao PDR from 1990 to 2010. Unpublished; International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris. CD-ROM; United Nations Statistics Division. 2011. *2008 Energy Balances and Electricity Profiles*. New York.

All types of fuel saw growing use, with the largest growth seen in gas consumption (6.9% per annum), followed by electricity consumption (6.1% per annum). Coal's growth was the lowest, with consumption only growing by 1.4%, from 523 Mtoe in 1994 to 643 Mtoe in 2009.

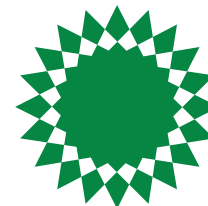
### Final Energy Consumption by Type in Asia and the Pacific, 1994 and 2009



ktoe = thousand tons of oil equivalent.

Sources: Asian Development Bank. 2008 Survey on Energy and Energy-Related Information in the Pacific. Unpublished; Asia Pacific Energy Research Centre. *APEC Energy Database*. Available at <http://www.iieej.or.jp/egeda/database/database-top.html>; Government of the Lao People's Democratic Republic (Lao PDR), Ministry of Energy and Mines. Energy Balances of Lao PDR from 1990 to 2010. Unpublished; International Energy Agency. 2011. *Energy Balances of Non-OECD Countries*. Paris. CD-ROM; United Nations Statistics Division. 2011. *2008 Energy Balances and Electricity Profiles*. New York.

# Energy Outlook for Asia and the Pacific



**A** DB's outlook is one that analyzes the energy demand and supply for Asia and the Pacific using a business-as-usual (BAU) case and an alternative case up to 2035. The implications arising from the analysis focusing on energy security enhancement, the environment, energy efficiency, and financing energy projects are also included, in brief. Detailed, country-specific analyses are available in the full version of the report.

## Overall

Asia and the Pacific's primary energy demand is projected to increase at 2.1% per year over the outlook period (2010–2035)—faster than the projected world average growth rate of 1.5% per year during the same period. With this growth, the primary energy demand of Asia and the Pacific will reach 8,358.3 Mtoe by 2035, up from 4,985.2 Mtoe in 2010.

Fossil fuels will dominate the primary energy mix in Asia and the Pacific through 2035, increasing their share from 82.4% in 2010 to 83.2% by 2035. However growth trends will differ among fossil fuel types. Demand for coal will

increase by 1.7% yearly through 2035, slower than the growth in overall primary energy demand (2.1%), and coal's share of overall energy demand will be reduced to 42.1% by 2035 from 46.2% in 2010. Demand for oil will also increase more slowly, at 1.9% per year, and have a lower share of overall primary energy demand, at 26.3%, compared with 24.8% in 2010. By contrast, demand for natural gas will increase at a brisk 3.9% per year because of increased use for power generation, and its share in primary energy demand will increase to 17.5% by 2035 from 11.4% in 2010.



## Business As Usual: The Use of Fossil Fuels

### *Coal*

Demand for coal in Asia and the Pacific will increase by 52.8% from 2010 to 2035, reaching 3,516.3 Mtoe by 2035. The People's Republic of China (PRC), with its 63.7% share, will continue to dominate the demand for coal in Asia and the Pacific, but its growth in demand is projected to slow through 2035 because of the combined impact of improvements in energy efficiency and the shift toward other sources of energy, mainly in the industry and power sectors. India, on the other hand, will see a steady increase in demand for coal, at 3.1% per year until 2035, and maintain the second-largest share of demand in Asia and the Pacific (17.5%) through continued growth driven by the power sector.

Some members in Southeast Asia (such as Indonesia, the Philippines, and Viet Nam) will encourage the use of coal, particularly in the power sector, to diversify the energy supply structure and to enhance energy security. Southeast Asia will outpace the other regions in growth of coal demand, at 4.8% per year through 2035.

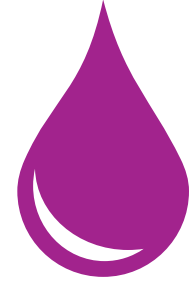
Despite its energy security benefits, the use of coal produces carbon dioxide (CO<sub>2</sub>) emissions and other adverse effects on the environment. Therefore, advanced coal-fired generation technologies (ultra-supercritical and supercritical power generation technologies) that are commercially available will have to be deployed, hand in hand with innovations in clean coal technologies.



## Oil

Oil demand in Asia and the Pacific is projected to increase by 1.9% yearly over the outlook period and reach 1,973.0 Mtoe by 2035, 59.3% higher than the 1,238.2 Mtoe utilized in 2010. The demand will be driven by the transport sector, which will account for 60.5% of incremental growth in oil demand between 2010 and 2035. Among the members, the PRC, India, Indonesia, Japan, the Republic of Korea, and Thailand will dominate the demand for oil in Asia and the Pacific; while these countries will differ in the rate of demand growth, as a group they will account for 81% of the demand for oil in Asia and the Pacific in 2035.

Among the fossil fuels, oil imports will have the biggest share through 2035. In the BAU case, 64.9% of the demand for oil in 2035 in Asia and the Pacific will have to be met by imports. Central and West Asia will remain a net exporter of crude oil as the region includes major exporters such as Azerbaijan, Kazakhstan, and Turkmenistan. All the other



regions will become net oil importers by 2035. East Asia will be the biggest importer (14.8 million barrels per day [mb/d] in 2035), followed by South Asia (6.3 mb/d), Southeast Asia (4.4 mb/d), and the Developed Group (3.4 mb/d).

This dependence on imported oil represents a major challenge for the members of Asia and the Pacific to find and secure stable and affordable supply sources outside the region.

A variety of options on the supply and the demand sides will have to be pursued. On the supply side, the continued involvement of Asia and the Pacific members in upstream development outside the region should be encouraged. Joint efforts among the ADB members to explore and produce oil within the region will be highly beneficial to Asia and the Pacific as a whole. Demand-side efforts should focus on the transport sector by encouraging the use of fuel-efficient vehicles and modal shifts in transport.



## Natural Gas

Demand for natural gas is projected to increase at 3.9% per year, reaching 1,463.2 Mtoe in 2035, 2.6 times the 2010 level of 566.7 Mtoe. This projected growth will be the fastest among the fossil fuels because of the lower environmental burden and ease of use.

Nearly half (51.7%) of the entire growth in natural gas demand between 2010 and 2035 in Asia and the Pacific will come from the PRC, followed by India (13.0%), Indonesia (6.0%), and Japan (4.8%).

Asia and the Pacific includes natural gas resource-rich members such as Australia, Azerbaijan, Turkmenistan, and Uzbekistan. The regional members' interdependence will enhance the security of energy supplies in Asia and the Pacific.

However, bringing the natural gas supply from landlocked locations to the demand centers via pipeline

may present difficulties, particularly in Central and West Asia. Financing such supply projects will require strong commitment from both exporters and importers to guarantee long-term demand for, and supply of, natural gas.

Moreover, some economies—the PRC, Republic of Korea, and Taipei, China in East Asia; Japan; and Singapore and Thailand in Southeast Asia—may increasingly depend on liquefied natural gas (LNG) imports. As the construction of LNG facilities (terminals, etc.) requires large amounts of capital, LNG will continue to be traded under long-term contracts, which often involve arduous contract negotiation. Member governments in Asia and the Pacific could work together to facilitate upstream investment and ensure the long-term commitment of exporters and importers.

# The Alternative Case



The alternative case considers potential for energy savings and CO<sub>2</sub> emissions reduction. In the alternative case, with the deployment of advanced technologies, primary energy demand of Asia and the Pacific will increase at an annual rate of 1.4% through 2035—a slower rate compared with the growth rate of BAU at 2.1% per year. Given the projected growth, the primary energy demand of Asia and the Pacific in the alternative case will be 1,295.2 Mtoe lower than that in the BAU case in 2035. This estimated reduction in primary energy demand exceeds the total industry demand in Asia and the Pacific in 2010, which is equal to 1,216.5 Mtoe.

The assumed shift toward low-carbon-emitting sources in the alternative case will reduce the share of fossil fuels in total primary energy demand to 74.3% by 2035, from 83.2% in the BAU case. Nevertheless, fossil fuel will still have the majority share even in the alternative case.

The regions' potential for primary energy savings (that is, the difference between the primary energy demand in the BAU and alternative cases) corresponds to the size of primary energy demand in 2035. East Asia will have the biggest savings potential (853.8 Mtoe), followed by

South Asia (214.7 Mtoe), Southeast Asia (114.6 Mtoe), Central and West Asia (37.6 Mtoe), and the Pacific region (0.5 Mtoe).

Energy transformation (including power generation and other transformation processes such as oil refining and gas processing) will represent the biggest energy savings potential. Demand-side electricity savings account for nearly half of the reduction in energy inputs to energy transformation. The rest will come from thermal efficiency improvements resulting from the use of advanced

coal-fired and natural gas-fired generation units. This finding stresses the importance of introducing both energy saving efforts on the demand side and the use of high efficiency technologies on the supply side. Policies and measures encouraging demand-side savings could improve energy security in Asia and the Pacific.

Priority should be placed on the industry sector as it offers cost-effective energy savings options. Reducing final energy demand of the industry sector by shifting from the BAU case to the alternative case (estimated to amount to 234.7 Mtoe in 2035) will require a relatively small investment.

The energy savings potential in the residential and commercial sectors (216.5 Mtoe in 2035) will follow that of the industry sector. Member countries in Asia and the Pacific, particularly developing member countries whose electricity demand is driven by the residential and commercial sectors, must implement policies and measures that can handle such demand growth. Effective policy options include setting standards, appliance labeling, and enhancing laboratory capacities in testing the energy efficiencies of appliances sold in the market. Based on the energy savings estimates,

lighting offers the greatest savings potential for some members; this could be a starting point for energy efficiency policies in the developing member countries.

The alternative case analysis shows smaller energy savings in the transport sector (109.4 Mtoe in 2035) than in the other final energy demand sectors, despite the assumed introduction of fuel-efficient vehicles, including hybrid, plug-in hybrid, and electric vehicles. The diffusion of these vehicle technologies will be constrained by the infrastructure requirements for fuel charging stations; therefore, more widespread use of these technologies is assumed to take place in the developed member countries or emerging economies whose policy and plans encourage their introduction. This result suggests that the member countries need to undergo a modal shift toward public transport such as buses and mass rapid transit (including rail and subway). Such efforts should focus on the urban areas of Asia and the Pacific, where vehicle dependence will grow faster than the country average. Nevertheless, it is important to note that an effective modal shift toward public transport can be realized only when the full-fledged infrastructure is in place to integrate the residential suburbs and the city center.

# Electricity

**D**riven by economic and industrial development and higher living standards, electricity demand in Asia and the Pacific is projected to more than double between 2010 and 2035, reaching 16,169.2 terawatt-hours (TWh) in 2035. Coal will continue to dominate the electricity generation mix, followed by natural gas, which is likely to expand its share moderately. New and renewable energy will also increase its share in electricity generation to 7.1% in 2035, up from 1.9% in 2010.

In the alternative case, total electricity generation will be reduced by 3,103.3 TWh to 15,428.6 TWh in 2035 compared with the BAU case. These potential savings can be realized as a result of energy savings in the final energy demand sectors (mainly in the industry, residential, and commercial sectors).

In the alternative case, there will be a significant addition to the installed generating capacity of new and renewable energy, a reduction in the capacity of coal-fired power plants, and expanded nuclear

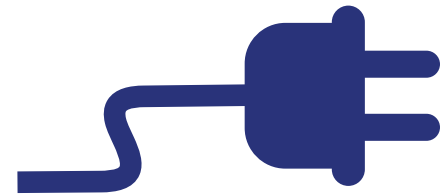
power capacity in 2035. The expected increase in nuclear power capacity in some members, such as the PRC and India, will be offset by substantial capacity reductions in Japan. In the alternative case, the installed capacity of new and renewable energy, such as wind and solar power, could be further increased in Asia and the Pacific, especially in East Asia, South Asia, and the Developed Group.

New and renewable energy will have an increasingly important role in meeting the rising electricity

needs in Asia and the Pacific. The share of new and renewable energy in the power generation mix will reach 7.1% (BAU case) or 15.8% (alternative case) in 2035, up from 1.9% in 2010. The substantial new and renewable energy capacity expansion will have to be accompanied by the introduction of systems that can enhance grid stability, and by additional investments.

Dwindling domestic fossil fuel production in some members in Asia and the Pacific will become the primary driver—alongside climate change mitigation—for nuclear power generation. Substantial expansion is expected to take place mainly in the PRC and India, whose nuclear capacity may reach 95.0 gigawatts and 34.9 gigawatts, respectively, even in the BAU case. Enhancing the security of nuclear operation will continue to be an important agenda, and international cooperation is encouraged.

Since heavy reliance on fossil fuels for power generation is likely to continue over the outlook period, it is necessary to diversify fuel input for power generation. Reducing dependence on fossil fuels will help improve energy security for energy-importing members and curb CO<sub>2</sub> emissions. For instance, new and renewable energy such as wind and solar power could be an alternative. However, cost competitiveness and technology availability will affect the deployment level for new and renewable energy.



# Carbon Dioxide Emissions



Carbon Dioxide emissions in Asia and the Pacific, which accounted for about 42.8% of world CO<sub>2</sub> emissions in 2010, are projected to reach more than half of world CO<sub>2</sub> emissions in 2035.

East Asia will contribute the largest share of the increase because of strong economic growth. Its CO<sub>2</sub> intensity (CO<sub>2</sub> emissions per total primary energy demand) will decrease at 0.3% per year, mainly as a result of the shift to less carbon-intensive energy, such as nuclear, natural gas, and renewable energy. In contrast, CO<sub>2</sub> intensities in South Asia and Southeast Asia are projected to increase at annual rates of 0.4% and 0.8%, respectively, as a result of the expected increase in coal demand, especially for power generation.

CO<sub>2</sub> emissions in Asia and the Pacific in the alternative case will be 27.6% lower than in the BAU case. This reduction can be achieved through (i) improvements in energy efficiency (52.6%) and (ii) a shift toward

lower-carbon-emitting energy sources (47.4%). Specifically, energy efficiency improvements on both the supply and demand sides will contribute significantly to the overall reduction in CO<sub>2</sub> emissions in Asia and the Pacific.

This finding suggests the importance of improving energy efficiency not only to cope with the challenges to energy security within the region, but also to manage the global challenges of climate change. In other words, Asia and the Pacific has the greatest potential to contribute to global efforts to mitigate the challenges of climate change by reinforcing its policies and measures on energy efficiency.



# Energy Investment



To meet energy demand in the BAU, Asia and the Pacific as a whole will need a cumulative investment of about \$11.7 trillion in the energy sector (2010–2035), from upstream energy extraction and production to midstream energy transformation and transportation to downstream energy distribution.

By type of energy source, electricity and heat will account for the biggest share of total investment requirements in the BAU case (72.5%), followed by natural gas (including its extraction, production, and the construction of infrastructure for international trading) (10.9%), oil (8.5%), and coal (8.1%).

The estimated regional investments in the energy sector in the BAU case depend on the amount of new infrastructure that needs to be built. Driven primarily by the energy needs in the PRC, East Asia's estimated energy sector investments will amount to the biggest share in Asia and the Pacific, at \$5.8 trillion (2010–2035). This will be followed by South Asia at \$2.4 trillion, which is driven by the energy

needs in India. Meanwhile, despite the projected decline in its primary energy demand, the Developed Group is expected to have the third-largest share of investments, at \$1.7 trillion, as a result of the investment needs for the assumed deployment of new natural gas-fired and new and renewable power plants in Japan, in addition to assumed expansion in Australia's LNG export capacity.

Diversity in the energy demand and energy exports and imports in Asia and the Pacific will translate into diverse levels of energy investments by members. The estimated burden of energy investments in the BAU case tends to be high for rapidly developing members. These members will have to introduce new

infrastructure and energy transformation facilities, and upgrade existing ones.

Nevertheless, the governments of rapidly developing members or their energy utilities tend to suffer from financial constraints and cannot allocate enough investments into energy infrastructure development and renovation. Many of the ADB members have undertaken market reform to increase the energy supply tariffs for electricity, gas, and petroleum products to cover the cost of investment, although sometimes such efforts face political difficulties. Steady progress in this regard is necessary to improve the financial balance of utilities and to enable them to cope with future investment requirements.

Additionally, in view of the higher burden of investments needed for developing member countries to develop and upgrade infrastructure and save energy, cooperation among members—particularly the developed members—will be encouraged for financing and technology transfer. Lending institutions will continue to have an important role in guaranteeing such financing

to developing member countries for the region's sustainable development and mutual prosperity.

The alternative case will require about \$19.9 trillion in investments for both the supply and the demand sides. The demand-side investments (additional to the BAU case) will amount to \$7.3 trillion that will be needed to deploy advanced energy-efficient technologies for the transport, residential, commercial, and industry sectors. The supply-side investments will amount to \$12.6 trillion—higher than the BAU investment needs. This is a result of the additional investments required to deploy advanced coal- and natural gas-fired power generation technologies for improved thermal efficiency as well as for low-carbon-emitting power generation (nuclear, wind, and photovoltaic). The estimated additional investments outweigh the estimated benefits arising from the savings from fossil fuels. This finding suggests that members in Asia and the Pacific should place priority on investments for energy savings, starting with cost-effective options for maximizing energy savings benefits at minimal cost.



