



# Energy Outlook

## for Asia and the Pacific

OCTOBER 2009



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

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## III. Subregional Outlook

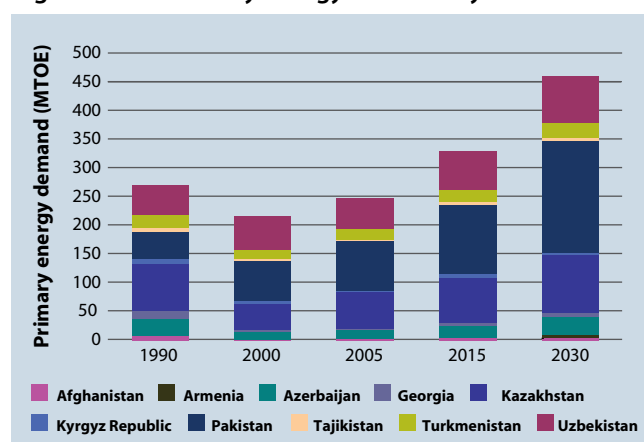
### 3.1 Central and West Asia

- Central and West Asia's total primary energy demand (TPED) is projected to increase from 222.9 million tons of oil equivalent (MTOE) in 2005 to 416.9 MTOE in 2030, growing at an annual rate of 2.5%.
- Pakistan, Kazakhstan, and Uzbekistan will account for more than 80% of TPED in this subregion.
- Diverse economic development levels, industry structure, and climate conditions in Central and West Asia result in a wide variation in per capita energy demand, ranging from Afghanistan's 0.12 tons of oil equivalent (TOE) in 2030 at the lowest to Kazakhstan's 5.19 TOE at the highest.

#### Primary Energy Demand

Central and West Asia's energy demand is projected to increase from 222.9 MTOE in 2005 to 416.9 MTOE in 2030, at an annual growth rate of 2.5%. The growth trend varies by member depending on the economic development level, industry structure, and other factors such as climate conditions and level of energy supply infrastructure development.

Figure 3.1.1: Primary Energy Demand by Member



MTOE = million tons of oil equivalent.

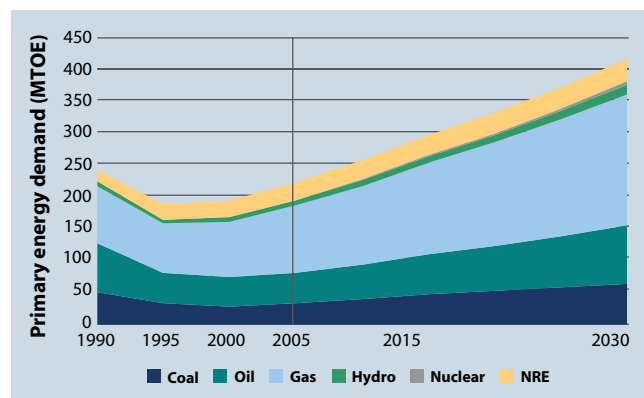
Source: Asia Pacific Energy Research Centre (APERC) analysis (2009).

By member, Afghanistan's energy demand will increase at the fastest annual rate, 9.5%. Afghanistan's primary energy demand accounts for just 1.6% of TPED in this subregion. Pakistan's energy demand will increase at the second-fastest rate, 3.3% annually through 2030. With the fast growth, Pakistan's share of Central and West Asia's TPED will represent the biggest in 2030 at 41.6%, rising from 34.2% in 2005. Kazakhstan's energy demand will represent the second-largest share, at 21.3% in 2030. Uzbekistan's energy demand will account for the third-largest share at 17.4% in 2030, down from 21.1% in 2005. Uzbekistan's reduced share of TPED reflects the member's projected slow growth rate of 1.8% through 2030.

By energy type, natural gas will represent the highest share, at 49.5% in 2030, increasing from 47.7% in 2005.

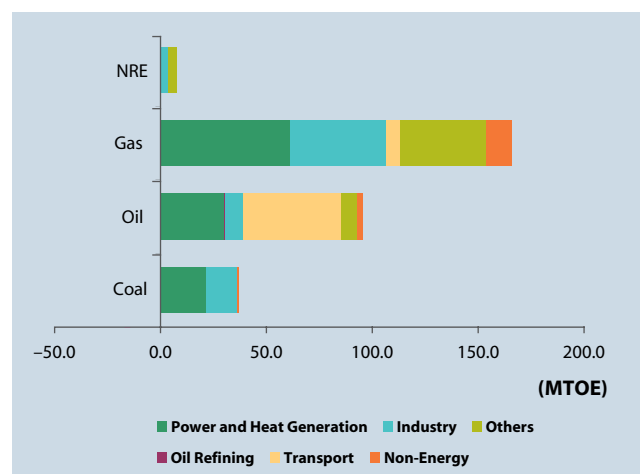
Several members in Central and West Asia with vast natural gas reserves, including Azerbaijan, Kazakhstan, Pakistan, Turkmenistan, and Uzbekistan, are projected to continue to rely on natural gas for power generation, industrial activities, and heating purposes in other sectors. In addition, with the enhanced natural gas pipeline

**Figure 3.1.2: Primary Energy Demand by Type (2005–2030)**



MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 3.1.3: Incremental Energy Demand Growth (2005–2030)**



MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

transport network, natural gas demand is likely to increase in the members without domestic reserves, such as Armenia and Georgia.

Oil will account for the second-largest share of TPED in Central and West Asia at 21.7% in 2030. In terms of volume, oil demand will nearly double from 45.9 MTOE in 2005 to 90.6 MTOE in 2030, growing at an annual rate of 2.8%. The transport sector will lead the oil demand growth. In Central and West Asia, the improvement and expansion of highways connecting the various parts of the member is likely to facilitate the mobility of both passengers and freight, which will translate into an increase in the transport sector's oil demand.

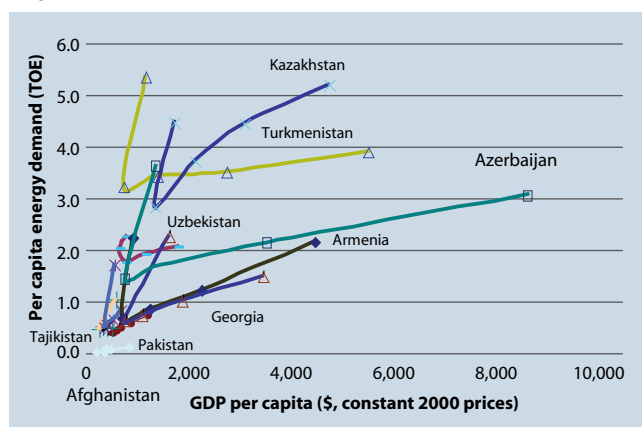
Coal will account for 15.3% of this subregion's TPED in 2030, representing the third-largest share. Demand for coal in Central Asia is concentrated in Kazakhstan, whose share will account for more than 60% of the subregion's coal demand in 2030. Supported by the domestic reserves, coal may continue to be the most important energy source for power generation, while the growth trend may slow in the future due to coal's gradual replacement by natural gas for power generation.

## Per Capita Energy Demand

Central Asia and West Asia's per capita energy demand will average 1.09 TOE in 2030, increasing moderately at an annual rate of 0.9% TOE from 0.87 in 2005—compared with the projected per capita energy demand of Asia and the Pacific at 1.57 TOE and the world's at 2.05 TOE in 2030.<sup>7</sup> Although the average per capita energy demand in this subregion shows moderate growth, both growth trends and levels vary substantially by member. In fact, the projected per capita energy demand ranges from Afghanistan's 0.12 TOE in 2030 to Kazakhstan's 5.19 TOE, reflecting

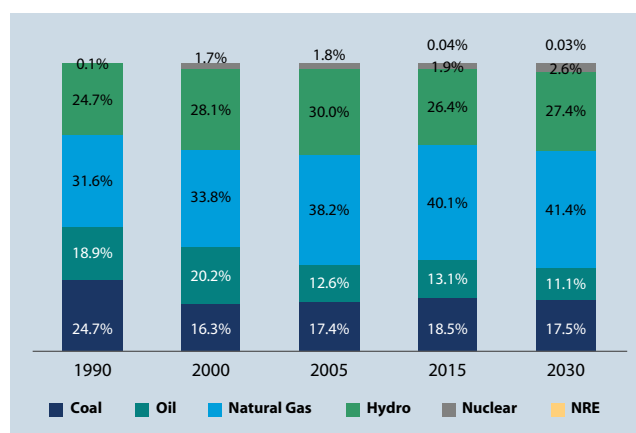
<sup>7</sup> EIA. 2009. *International Energy Outlook's* per capita energy demand of the world in 2030 is referenced here.

**Figure 3.1.4: Energy Demand per Capita and GDP per Capita (1990–2030)**



GDP = gross domestic product, TOE = tons of oil equivalent.  
Source: APERC analysis (2009).

**Figure 3.1.5: Power Generation Mix**



NRE = new and renewable energy.  
Source: APERC analysis (2009).

the diversity in economic development level, industry structure, resource endowments and prices, and climate conditions.

For example, Kazakhstan's relatively high reliance on energy-intensive industries such as iron and steel production, in addition to the cold winter weather, translate into the highest per capita energy requirements within the subregion. Turkmenistan's vast natural gas reserves, and consumers' almost free access to the electricity and natural gas supply, result in the member's per capita energy demand of 3.89 TOE in 2030, the second-highest level in Central and West Asia. Azerbaijan is projected to represent the third-highest per capita energy demand at 3.07 TOE. The member's gross domestic product (GDP) is projected to be led by oil and natural gas exports and increase at the fastest growth rate in Asia and the Pacific (8.6% annually through 2030), which in turn may improve living standards, reduce the poverty level, and nurture the domestic manufacturing sector. These in turn translate into more than a twofold increase in per capita energy demand over the outlook period, from 1.66 TOE in 2005 to 3.07 TOE in 2030.

## Electricity

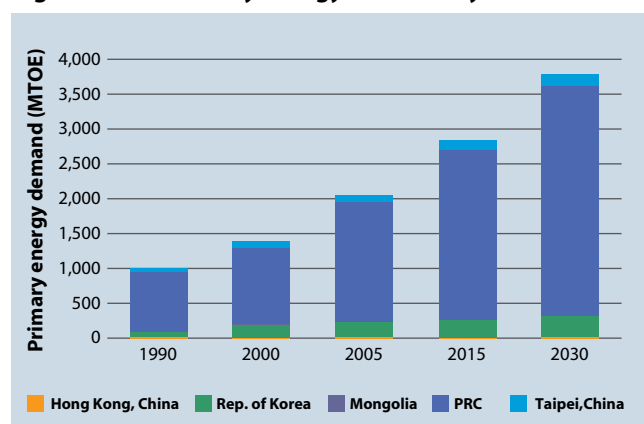
Electricity demand of Central and West Asia is projected to increase at 3.4% through 2030—faster than the final energy demand growth of 2.4% per year over the outlook period.

Power generation will increase from 291.5 terawatt-hours (TWh) in 2005 to 653.6 TWh in 2030, growing at an annual rate of 3.3%. The generation mix varies by member, depending on the resource endowment. In Central and West Asia, energy security means less dependence on energy imports; therefore, each member's generation mix differs substantially based on the resource endowment. In those members with vast hydro reserves and limited fossil fuels, such as the Kyrgyz Republic and Tajikistan, hydro will continue to account for more than 80% and 90% of the total generation mix, respectively. In contrast, backed by vast natural gas reserves, Uzbekistan and Turkmenistan's power generation may rely heavily on natural gas.

## 3.2 East Asia

- East Asia's primary energy demand will increase from 2,058.8 MTOE in 2005 to 3,776.6 MTOE in 2030 at an annual rate of 2.5%. East Asia may dominate the TPED in Asia and the Pacific at 52.3% in 2030.
- The bulk of energy share in East Asia will be taken up by the People's Republic of China (PRC), which may account for 86.9% in 2030, up from 83.5% in 2005. Coal may dominate the energy mix of East Asia, at 49.8% in 2030, although it will be down from 57.5% in 2005.
- The members in East Asia register diverse levels and growth trends in per capita energy demand, ranging from Mongolia's 1.39 TOE in 2030 at the lowest to Taipei,China's 6.86 TOE in 2030 at the highest.

Figure 3.2.1: Primary Energy Demand by Member



MTOE = million tons of oil equivalent, PRC = People's Republic of China.  
Source: APERC analysis (2009).

### Primary Energy Demand

East Asia's primary energy demand is projected to increase from 2,058.8 MTOE in 2005 to 3,776.6 MTOE in 2030 at an annual rate of 2.5%. This subregion's energy demand will continue to dominate the total energy demand in Asia and the Pacific, accounting for 52.3% in 2030, up from 51.1% in 2005. The bulk of energy share will be taken up by the PRC, whose share of TPED in East Asia will reach 86.9% in 2030, from 83.5% in 2005. Likewise, the PRC will account for the biggest portion of incremental growth in primary energy demand of East Asia, at 90.9% between 2005 and 2030.

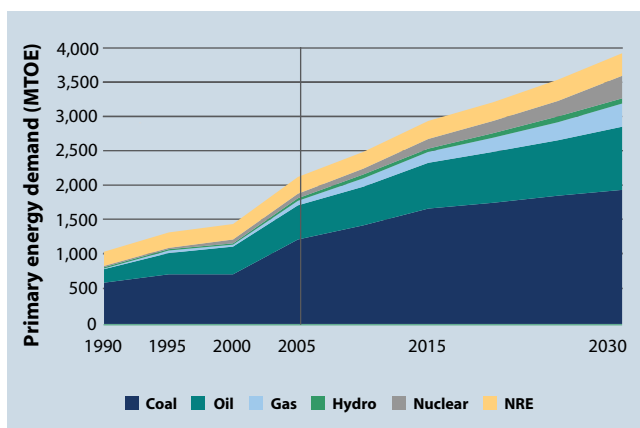
By energy type, coal will account for the biggest share in 2030 at 49.8%, down from 57.5% in 2005. The power sector will drive the growth in coal demand, while the

introduction of efficient technologies and the shift to other energy sources—such as natural gas and nuclear in the power sector—may slow the overall growth trend, resulting in a reduced coal share in 2030. In fact, these factors translate into a slower growth rate in coal demand in the second half of the outlook period, at 1.1% per year in 2015–2030, compared with the annual growth rate of 3.1% during the first half (2005–2015).

Oil will maintain a constant share at 23.0% over the outlook period. Assisted by motorization trends and increased demand from the non-energy sector, oil demand will increase at an annual rate of 2.5% through 2030. An increasing portion of oil demand would have to be met by imports; therefore, East Asia's power sector will continue to shift away from oil, resulting in the power sector's negative growth in oil demand.

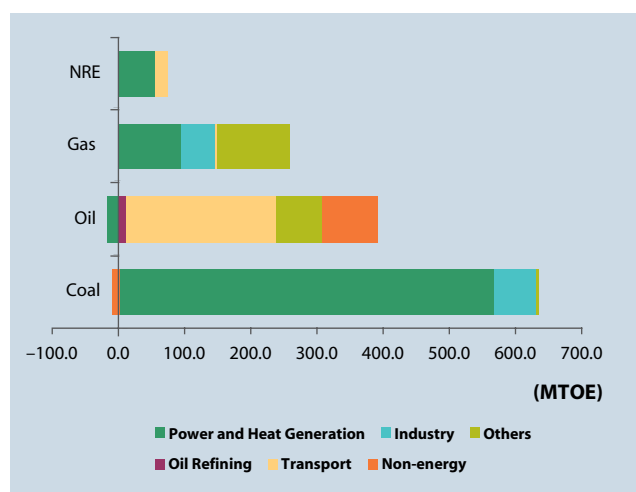
Natural gas demand is projected to grow at 6.0% per year through 2030. This registers the fastest annual growth rate among the fossil fuels. Supported by the development of natural gas supply infrastructure—the pipelines from Central Asia and the Russian Federation and additional liquefied natural gas (LNG) receiving terminals—PRC's natural gas demand will increase more than sixfold, and this affects the projected fast growth in natural gas demand over the outlook period.

**Figure 3.2.2: Primary Energy Demand by Type (2005–2030)**



MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 3.2.3: Incremental Energy Demand Growth (2005–2030)**



MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

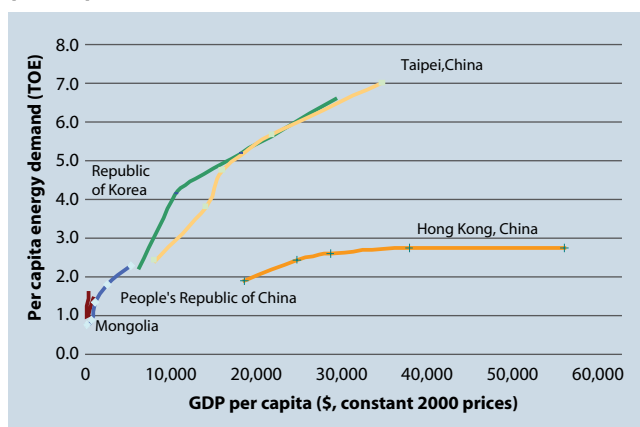
Demand for new and renewable energy (NRE) will increase at a moderate annual pace of 1.1%, from 229.9 MTOE in 2005 to 301.1 MTOE in 2030. Biomass will be the main source of NRE, and will be utilized in rural areas where access to commercial energy sources is limited. Although the incremental portion will be explained by the increased demand for new energy sources—such as wind and solar—due to biomass' dominance in NRE, it is projected to increase at a moderate pace.

## Per Capita Energy Demand

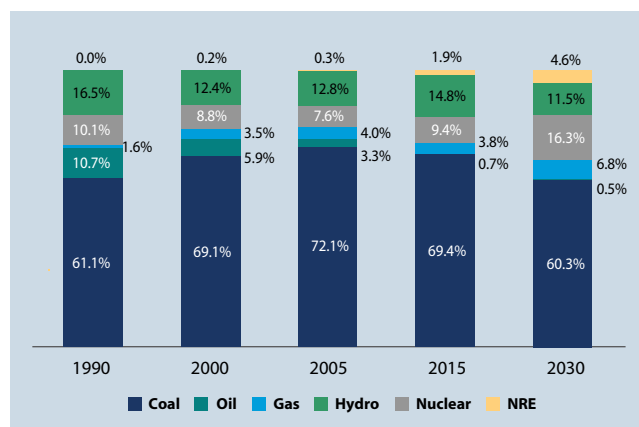
Per capita energy demand in East Asia will average 2.45 TOE in 2030, up from 1.48 TOE in 2005. The projected per capita energy demand of East Asia represents a higher level than that of Asia and the Pacific as a whole (1.57 TOE) and the world (2.05 TOE) in 2030. By member, per capita energy demand represents diverse levels and growth trends. For example, Hong Kong, China's per capita energy demand will not change significantly (from 2.56 TOE in 2005 to 2.71 TOE in 2030), although the member's GDP is projected to increase at an annual rate of 3.7%. The shift toward less energy-intensive industry is the major factor behind this trend. In contrast, per capita energy demand in the Republic of Korea and Taipei, China are projected to reach 6.46 TOE and 6.86 TOE, respectively, in 2030. These members' continued reliance on energy-intensive industry for exports will result in higher per capita energy demand than the average in East Asia.

While maintaining the dominant share in total energy demand in East Asia, the PRC's per capita energy demand may reach 2.25 TOE in 2030, which is less than one-third of Taipei, China's level in the same year. Different development levels, as shown in the differences in per capita GDP, are the factors behind this trend. Mongolia's per capita energy demand will increase relatively slowly, from 1.01 TOE in 2005 to 1.39 TOE in 2030. The demand for commercial energy will be concentrated in the urban areas, while more than 30% of the total population will live in rural areas. This demographic trend explains why the member will maintain a relatively low GDP per capita over the outlook period.



**Figure 3.2.4: Energy Demand per Capita and GDP per Capita (1990–2030)**

GDP = gross domestic product, TOE = tons of oil equivalent.  
Source: APERC analysis (2009).

**Figure 3.2.5: Power Generation Mix**

NRE = new and renewable energy.  
Source: APERC analysis (2009).

## Electricity

East Asia's electricity demand is projected to more than double from 223.1 MTOE in 2005 to 530.3 MTOE in 2030, growing at an annual rate of 3.5%. This projected growth is faster than the growth rate of final energy demand (2.2% through 2030).

To meet the rapid growth in electricity demand, total electricity generation will increase from 3,153.0 TWh in 2005 to 7,427.6 TWh in 2030. East Asia's power generation mix will be dominated by coal-fired generation, reflecting the PRC's continuing reliance on coal-fired generation. However the member's efforts toward reducing dependence on coal for electricity generation is expected to result in a reduced coal share—62.9% in 2030 from 78.9% in 2005.

In contrast, the share of nuclear power in East Asia will more than double, from 7.6% in 2005 to 16.3% in 2030. The share of natural gas-fired generation will likely increase from 4.0% in 2005 to 6.8% in 2030.

## VI. Country/Economy Energy Outlook

### Energy Outlook of DMCs in *Central and West Asia*

#### 6.1 Afghanistan

- *Afghanistan's primary energy demand is expected to grow at a rapid pace of 9.5% annually, from 0.7 million tons of oil equivalent (MTOE) in 2005 to 6.5 MTOE in 2030. Despite the rapid growth, per capita energy demand will remain one of the lowest among ADB member countries.*
- *Coal- and natural gas-fired power generation will be increased through 2030 in order to diversify energy sources and to reduce dependence on oil.*
- *Infrastructure rehabilitation and development are essential to pave the way for the country's economic development.*

#### Recent Energy Trends and Energy Policy

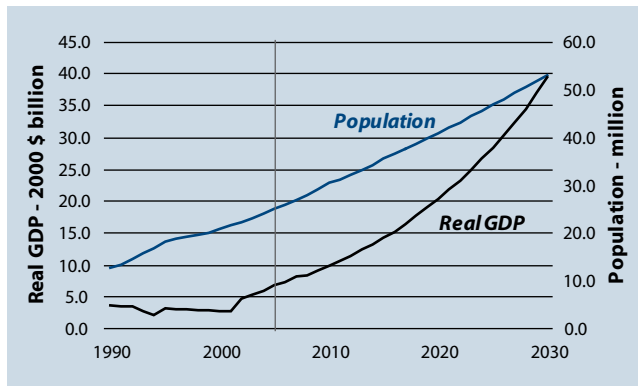
Afghanistan's total primary energy demand in 2006 was 0.7 MTOE, much smaller than the 1990 level of 1.2 MTOE. Since Afghanistan's economy was severely damaged by civil war and political instability in the early 1990s, total energy demand plunged to 0.8 MTOE in 1992. The repercussions of internal strife hindered the country's economic development in the 1990s. With attempts at political reconstruction supported by the international community starting in late 2001, Afghanistan's economy started to recover substantially with a double-digit annual growth rate, from \$2.7 billion of gross domestic product (GDP) in 2000 to \$7.3 billion in 2006. However, the negative impacts of political instability lingered over energy growth trends: total energy demand decreased slightly, by 0.3% per year between 2000 and 2006.

Afghanistan is endowed with abundant natural resources: recoverable coal reserves of 66 million tons and proven natural gas reserves of 1.8 trillion cubic feet. Notwithstanding, access to these energy sources has been limited because the country's infrastructure was destroyed or deteriorated as a consequence of the civil war. Hence, the country relies on imported petroleum products and hydropower.

To use the energy resources available domestically, the Government of Afghanistan has put priority on natural gas development by expanding the supply network and increasing production, which would lead to reduced dependence on oil.<sup>35</sup> In addition, the government is aware of the importance of improving power supply capacity for the country's development as it is addressed in its power sector strategy for the power sector.<sup>36</sup> Rehabilitation of power

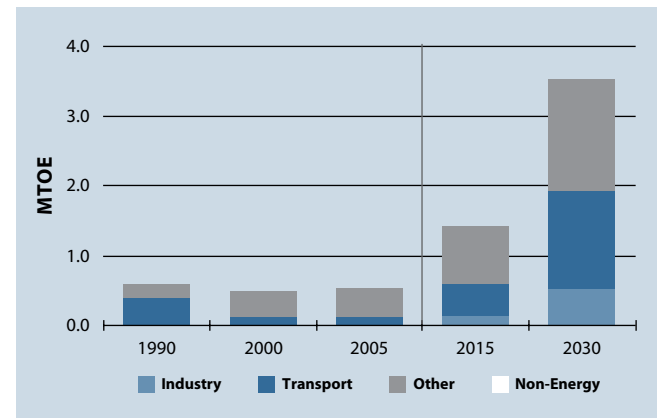
<sup>35</sup> Asian Development Bank. 2003b. *Master Plan to Realize Potential of Afghanistan's Energy Sector*. Available: [www.adb.org/Media/Articles/2003/2179\\_Afghanistan\\_Master\\_Plan\\_to\\_Realize\\_Potential\\_of\\_Energy\\_Sector/](http://www.adb.org/Media/Articles/2003/2179_Afghanistan_Master_Plan_to_Realize_Potential_of_Energy_Sector/)

<sup>36</sup> Islamic Republic of Afghanistan, Ministry of Energy & Water. 2007. *Power Sector Strategy for the Afghanistan National Development Strategy (with Focus on Prioritization)*. Available: [www.and.gov.af/ands/final\\_ands/src/final/ministry\\_strategies/English/Power%20Sector%20Strategy-English.pdf](http://www.and.gov.af/ands/final_ands/src/final/ministry_strategies/English/Power%20Sector%20Strategy-English.pdf)

**Figure 6.1.1: GDP and Population—Afghanistan**

GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

**Figure 6.1.2: Final Energy Demand—Afghanistan**

MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

infrastructure damaged by the war and expansion of installed capacity and the distribution network are considered urgent needs.

## Energy Demand Drivers

Afghanistan's GDP is projected to grow at an average of 7.3% per year over the outlook period (2005–2030). Although the agriculture sector, in which wheat is the major product, is likely to be the main source of income, the construction industry is expanding as the country takes on reconstruction efforts. GDP growth in 2008—driven by construction and service industries—was offset by the decline in agricultural production caused by drought in the same year. Furthermore, industries that were shut down during the civil war are beginning to resume operations, and this is expected to drive industrial growth in the future.

Afghanistan's total population is projected to increase at an average rate of 3.1% per year, more than doubling the population from 25.1 million in 2005 to 53.3 million in 2030. Although the rural population accounts for approximately 75% of the total in 2005, its ratio is likely to decline to 63.8% in 2030 (Figure 6.1.1).

## Final Energy Demand

The average growth rate of total final energy demand is projected to be 7.8% per year, producing a robust increase from 0.5 MTOE in 2005 to 3.5 MTOE in 2030. Demand from industry will grow at a healthy annual rate of 13.1% from 2005 to 2030, followed by the transport sector at 11.8%. However, in 2030, demand from industry will remain the smallest at 15.0%. Other sectors<sup>37</sup> are likely to remain the dominant energy consumers until 2030 despite only moderate annual growth of 5.4% (Figure 6.1.2).

<sup>37</sup> The other sectors include the agriculture, commercial, and residential sectors.

## Industry Sector

Annual growth in industrial energy demand will average 13.1% over the outlook period. Faster growth is expected in the near term (18.4% from 2005 to 2015) compared with the longer term (9.6% from 2015 to 2030). Restoration of industries that were closed during conflicts will boost this growth. Most increase in industrial energy demand will be met by electricity because the main manufacturers in Afghanistan are likely to be smaller-scale companies, such as those producing textiles and furniture.

## Transport Sector

Similar to that of industry, energy demand from transport will grow rapidly at an average annual rate of 11.8%, increasing MTOE from 0.1 in 2005 to 1.4 in 2030. Although energy demand has stayed around 0.1 MTOE after a sudden drop in 1992, it is expected to reach the 1990 level of 0.4 MTOE again by 2015. Although a landlocked country like Afghanistan relies on land transport, the country has some of the worst road networks and conditions in the region.<sup>38</sup> The government and multilateral aid agencies recognize that improvement of road infrastructure is the foundation for encouraging regional trade and enhancing the country's economic development. Given this focus, road traffic is likely to increase through 2030, leading to robust growth in energy demand from the transport sector.

## Other Sectors

In the other sectors, energy demand is projected to quadruple from 0.4 MTOE in 2005 to 1.6 in 2030. With the increased energy demand by industry and transport, the other sectors' share in final energy demand is likely to dwindle substantially through 2030.

The residential sector relies heavily on biomass fuel such as wood, animal dung, and agricultural waste for cooking and heating. The share of biomass used by the other sectors will decline significantly, from 90.3% in 2005 to 51.2% in 2030. In rural areas, where access to electricity is very limited, candles, solar lanterns, and hurricane lamps are used for lighting.<sup>39</sup> As electrification is expected to improve in the future, demand for electricity in the other sectors is likely to account for higher shares in 2030.

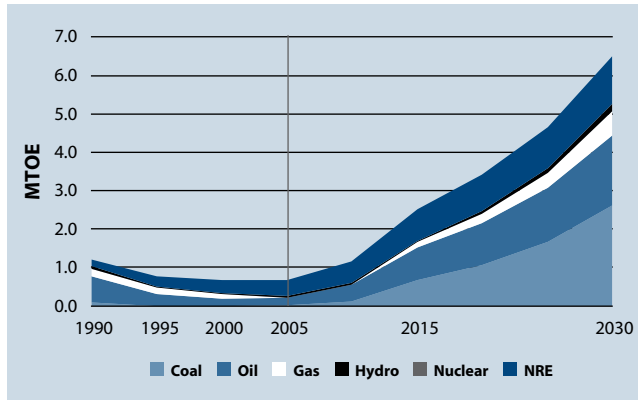
## Primary Energy Demand

Driven by robust economic growth, Afghanistan's primary energy demand is projected to increase substantially, from 0.7 MTOE in 2005 to 6.5 in 2030, with an average annual growth rate of 9.5%. Specifically, the annual growth rate will register at 14.1% in the near term (2005–2015) and slow down to 6.5% in the longer term (2015–2030). Primary energy demand per capita will increase from 0.03 TOE in 2005 to 0.12 in 2030. Despite this annual growth rate of 6.2% between 2005 and 2030, the projected per capita energy demand in 2030 will represent one of the lowest levels among Asian Development Bank member.

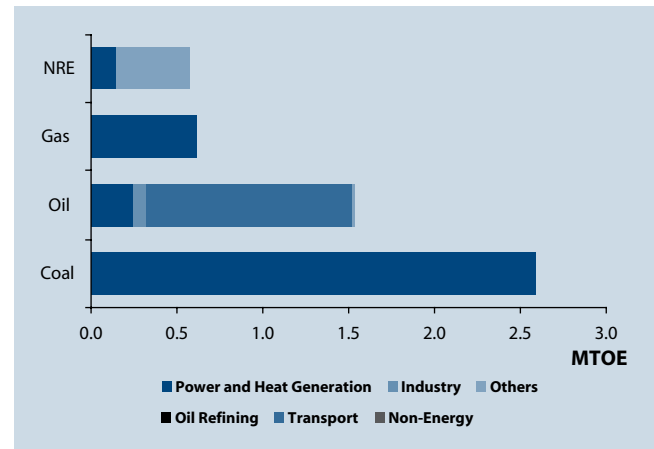
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<sup>38</sup> World Bank. 2008. *Afghanistan: Transport At A Glance, 2007*. Available: [siteresources.worldbank.org/INTSARRREGTOPTRANSPORT/1812598-1130163691879/21879646/AF\\_Transport\\_At\\_Glance\\_update\\_2008.pdf](http://siteresources.worldbank.org/INTSARRREGTOPTRANSPORT/1812598-1130163691879/21879646/AF_Transport_At_Glance_update_2008.pdf) Currently the share of paved roads is 23.7%.

<sup>39</sup> Islamic Republic of Afghanistan, Ministry of Energy & Water. 2007. *Power Sector Strategy for the Afghanistan National Development Strategy (with Focus on Prioritization)*. Available: [www.and.gov.af/ands/final\\_ands/src/final/ministry\\_strategies/English/Power%20Sector%20Strategy-English.pdf](http://www.and.gov.af/ands/final_ands/src/final/ministry_strategies/English/Power%20Sector%20Strategy-English.pdf)

**Figure 6.1.3: Primary Energy Demand—Afghanistan**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.1.4: Incremental Energy Demand Growth—Afghanistan (2005-2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

Natural gas is projected to register the fastest annual growth at a rate of 24.8% between 2005 and 2030, followed by coal at 20.8%, oil at 9.2%, and hydro at 5.6%. Although it will increase through 2030 as a result of the government's priority on its development, the share of natural gas will be still smaller than other fossil fuels, 9.4%. In contrast, coal is likely to expand its share to 40.2% by 2030, a substantial increase from 3.4% in 2005. Oil is projected to maintain its current share, around 30%, with an annual average growth rate of 9.2%.

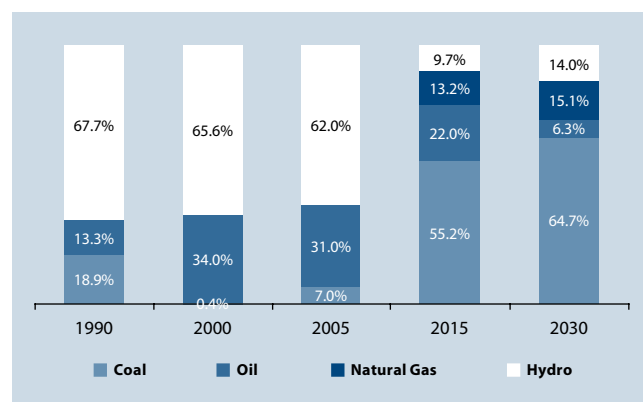
The government's plan to diversify power resources and to reduce dependence on diesel will be reflected in incremental energy demand growth. As Figure 6.1.4 shows, the power sector will contribute all of the incremental demand growth of coal and natural gas between 2005 and 2030. Additionally, the number of solar-based off-grid power systems is expected to increase, which primarily explains the demand growth of 25.3% of incremental new and renewable energy (NRE) over the outlook period.

## Electricity

With a rapid annual average growth rate of 12.0% over the outlook period, electricity generation will reach 16.5 terawatt-hours (TWh) in 2030, a substantial increase from 1.0 TWh in 2005. Coal-fired generation is projected to have the fastest growth rate, 22.5%, increasing production from 0.1 TWh in 2005 to 10.6 TWh in 2030. Accordingly, its share will increase from 7.0% in 2005 to 64.7% in 2030.

Assuming that natural gas-fired power plants will be rehabilitated, natural gas will be reintroduced and increasingly utilized to generate electricity with an average growth rate of 9.4% between 2015 and 2030. The government's emphasis on diversification of energy sources for power generation will boost coal- and natural gas-fired power generation, resulting in changes to the power generation mix by 2030.

In contrast, moderate growth is expected from oil-fired (5.1%) and hydro (5.6%) power plants over the outlook period. Their shares will be replaced by coal and natural gas in the future. In rural areas, small hydro plants and private diesel generation may continue to be the main sources of power generation.

**Figure 6.1.5: Power Generation Mix—Afghanistan**

Source: APERC analysis (2009).

## Energy Policy Issues and Implications

Energy infrastructure development is the key policy agenda for economic development. For example, Afghanistan's electrification rate stands at only 7.0%; further expansion is necessary for economic development and improvement in living standards. Acknowledging the benefits of rebuilding infrastructure, the government plans to expand electricity capacity and distribution network by using domestic resources like coal and natural gas.

However, Afghanistan's financial base is still too fragile to invest in such infrastructure development independently. Financial support from abroad, including

the development banks and the private sector, is necessary for infrastructure rehabilitation and development. A strong government commitment is essential for improvement of the investment climate—such as through a stabilized political situation and development of legal framework—to facilitate infrastructure development.

The major concern is ongoing political instability. Afghanistan has been afflicted with terrorist attacks that often destroy the infrastructure supporting economic activities, such as electricity supply and roads. Such unstable situations make it difficult for investors to participate in the country's reconstruction. Ensuring political stability and security is as fundamentally critical as the country's infrastructure development.

## References

- Asian Development Bank (ADB). 2003a. *Better Roads and Energy Infrastructure Would Help Move Afghanistan's Economy*. Available: [www.adb.org/media/Articles/2003/3792\\_Afghanistan\\_Roads\\_and\\_Energy/](http://www.adb.org/media/Articles/2003/3792_Afghanistan_Roads_and_Energy/)
- . 2003b. *Master Plan to Realize Potential of Afghanistan's Energy Sector*. Available: [www.adb.org/Media/Articles/2003/2179\\_Afghanistan\\_Master\\_Plan\\_to\\_Realize\\_Potential\\_of\\_Energy\\_Sector/](http://www.adb.org/Media/Articles/2003/2179_Afghanistan_Master_Plan_to_Realize_Potential_of_Energy_Sector/)
- . 2008. *Key Indicators for Asia and the Pacific 2008*. Available: [www.adb.org/Statistics](http://www.adb.org/Statistics)
- . 2009. *Asian Development Outlook 2009: Islamic Republic of Afghanistan*. Available: [www.adb.org/Documents/Books/ADO/2009/AFG.pdf](http://www.adb.org/Documents/Books/ADO/2009/AFG.pdf)
- Central Intelligence Agency (CIA). 2009. *The World Factbook - Afghanistan*. Available: [www.cia.gov/library/publications/the-world-factbook/geos/af.html](http://www.cia.gov/library/publications/the-world-factbook/geos/af.html)
- Islamic Republic of Afghanistan, Ministry of Energy & Water. 2007. *Power Sector Strategy for the Afghanistan National Development Strategy (with Focus on Prioritization)*. Available: [www.ands.gov.af/ands/final\\_ands/src/final/ministry\\_strategies/English/Power%20Sector%20Strategy-English.pdf](http://www.ands.gov.af/ands/final_ands/src/final/ministry_strategies/English/Power%20Sector%20Strategy-English.pdf)
- World Bank. 2008. *Afghanistan: Transport at a Glance, 2007*. Available: [siteresources.worldbank.org/INTSARREGTOPTRANSPORT/1812598-1130163691879/21879646/AF\\_Transport\\_At\\_Glance\\_update\\_2008.pdf](http://siteresources.worldbank.org/INTSARREGTOPTRANSPORT/1812598-1130163691879/21879646/AF_Transport_At_Glance_update_2008.pdf)

## 6.3 Azerbaijan

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- *Primary energy demand is projected to increase from 13.9 million tons of equivalent (MTOE) in 2005 to 29.5 MTOE in 2030, growing at an average rate of 3.1% per year. At this rate, per capita energy demand will reach 3.07 tons of oil equivalent (TOE) per person in 2030, a nearly twofold increase from the 2005 level of 1.66 TOE per person.*
- *Final energy demand is projected to double from 8.6 MTOE in 2005 to 17.3 MTOE in 2030 growing at an annual rate of 2.8%. By 2030, the transport sector will account for the largest share of final energy demand at 40.2%, followed by the other sectors at 37.3% and the industry sector at 17.1%.*

### Recent Energy Trends and Energy Policy

Azerbaijan's primary energy demand experienced a downward trend since the collapse of the Soviet Union in 1991 until it reached its bottom of 11.2 MTOE in 1999. With the economy's recovery—driven by the growth in oil exports in 2000—energy demand accordingly began to increase at an annual rate of 3.7% between 2000 and 2005. As a result of the positive growth, Azerbaijan's per capita energy demand reached 1.67 TOE in 2006 from 1.42 TOE in 2000. Despite the increase in per capita energy demand, the 2006 level represented only about the half of the 1990 TOE level of 3.62.

Energy demand registered positive average annual growth between 2000 and 2006 (3.3%), but increased at a much slower pace than that of gross domestic product (GDP) during the same time period (16.7%). This decoupling of energy demand growth from that of GDP results from different growth trends by sector. For example, the industry sector grew relatively slowly at only 1.4% per year, and the commercial sector declined at 15.3% per year.<sup>52</sup> In contrast, energy demand from 2000 to 2006 increased substantially in the transport (16.9%) and residential (7.2%) sectors. The impressive growth of the transport and residential sectors were driven by the income growth and infrastructure development assisted by the reinvestment from the State Oil Fund (SOFAZ). Therefore, these sector variations in terms of energy demand growth resulted in a relatively slow growth in overall energy demand.

Given its sizeable oil and natural gas reserves—7 billion barrels of oil and 30 trillion cubic feet of natural gas<sup>53</sup>—Azerbaijan is one of the region's largest oil and natural gas producers, and one of the largest oil exporters. In 2006, Azerbaijan produced 32.4 MTOE of oil compared with 9.1 MTOE in 1997. The Azeri-Chirag-Guneshli field in the Caspian Sea accounted for about 65% of the country's oil production in 2006, and is exclusively responsible for the growth in the

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<sup>52</sup> The country's GDP growth from 2000 to 2006 was driven mostly by the 59% increase in the oil sector. Manufacturing was responsible for 6% and services for 11% of the growth in GDP during the same time period.

<sup>53</sup> Sandrea, Rafael. 2009. An In-Depth View of Future World Oil and Gas Supply: A Quantitative Model Analysis. *Oil and Gas Journal*. (January). Houston: Pennwell Editors.



country's oil production.<sup>54</sup> With the completion of the Baku-Tbilisi-Ceyhan (BTC) oil pipeline<sup>55</sup> in 2005, oil export expanded from 14.4 MTOE in 2005 to 24.9 MTOE in 2006. Azerbaijan is a net importer of natural gas despite being endowed with a sizeable reserve, importing about 42% of its total natural gas demand in 2006.

Diversifying the economic structure has been the key element of economic and energy policy for Azerbaijan. The oil sector accounted for 20% of GDP in 2006, and the oil sector is responsible for nearly 60% of incremental growth in GDP between 2000 and 2006. To increase its sustainable economic development, in 1999 the Azerbaijan government established SOFAZ, where earnings from oil sales are saved to reinvest in the development of residential buildings, improvement of social conditions (such as poverty eradication), enhancements to irrigation and water supply systems, and development of oil supply infrastructure, while some portions are transferred to the state budget.<sup>56</sup>

Additionally, improvement of the overall energy supply infrastructure and the energy sector's operational efficiency are considered of paramount importance in the country's sustainable economic development. Therefore, the government promulgated the State Program on Poverty Reduction and Economic Development in 2005, and included the energy policy in this program. The focus areas for Azerbaijan's energy policy are improving energy supply to the population through strengthening financial discipline in the fuel-energy sector; implementing structural reforms; introducing efficient price policy; and improving the energy supply system. Implementation of projects in the focused areas may continue to affect the balance between energy demand and supply of Azerbaijan.

## Energy Demand Drivers

Azerbaijan's GDP is projected to increase at an annual rate of 8.6% through 2030, representing the fastest growth rate among the ADB regional member countries. Spurred by the oil exports from the BTC pipeline and related repercussions on the industry and service sectors, near-term annual growth is projected to be faster (11.7% from 2005 to 2015) compared with longer-term growth (6.7% from 2015 to 2030). The economy will primarily rely on the revenues from oil sales, which may account for a substantial part of GDP through 2030. Meanwhile, the effective management of public spending for poverty eradication, infrastructure development, and improvements in the business environment may support the country's sustainable economic development.

Over the outlook period, the population of Azerbaijan is projected to increase from 8.4 million in 2005 to 9.6 million in 2030, growing at a slow annual rate of 0.6%.

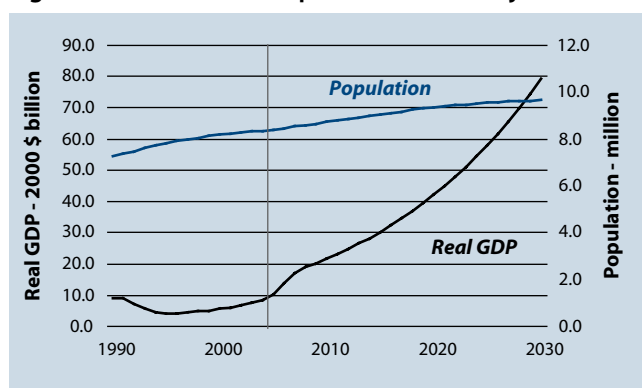
As a result of the fast growth of GDP compared with that of population, Azerbaijan's GDP per capita will expand from \$1,180 in 2005 to \$8,200 in 2030.

<sup>54</sup> Energy Information Administration, United States Department of Energy. 2009. *Country Analysis Briefs: Azerbaijan*. Washington, DC.

<sup>55</sup> BTC pipeline allows oil export from the landlocked Caspian Sea to the Mediterranean Sea by surpassing Georgia and Turkey.

<sup>56</sup> Center for Economic and Social Development (CESD), Azerbaijan. 2007. *Strategy for State Oil Fund of Azerbaijan Republic*. Baku.

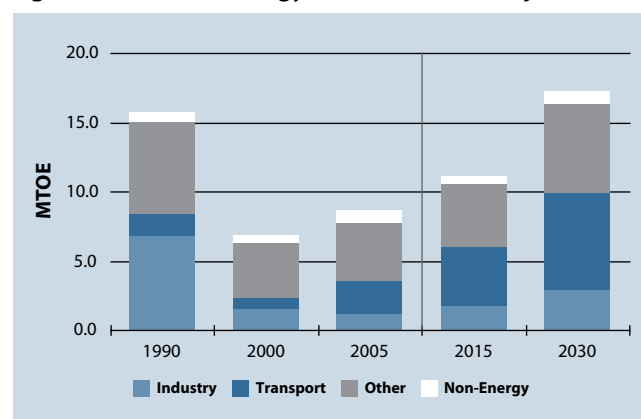
Figure 6.3.1: GDP and Population—Azerbaijan



GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

Figure 6.3.2: Final Energy Demand—Azerbaijan



MTOE = million tons of equivalent.

Source: APERC analysis (2009).

## Final Energy Demand

Final energy demand is projected to double from 8.6 MTOE in 2005 to 17.3 MTOE in 2030, an annual growth rate of 2.8%. By 2030, the transport sector will account for the largest share at 40.2% of final energy demand, followed by the other sectors at 37.3% and the industry sector at 17.1% (Figure 6.3.2).

### Industry Sector

Azerbaijan's industry sector is dominated by the oil sector, accounting for more than 60% of industry's total GDP in 2006. Following the government's plan to diversify the economic structure, manufacturing—focusing on electro-technical industry, metallurgy, and aluminium—is likely to develop over the outlook period, with its added value growing an annual rate of 6.5% through 2030.

Despite the growth in the manufacturing sector, industrial energy demand is projected to increase at a moderate annual rate of 3.6% through 2030. The replacement of old inefficient technologies with new ones would improve both overall production efficiency and energy efficiency, and thus register relatively slow growth in energy demand.

By energy source, electricity will register the fastest annual growth, 5.4%, driven mostly by the aluminium and electro-technical industries. This is followed by heat (3.9%) and natural gas (2.5%) over the outlook period.

### Transport Sector

Azerbaijan's development hinges on expanded and upgraded transport infrastructure. Because of the country's important location at the crossroads of Europe, Central Asia, and the People's Republic of China (PRC), enhanced transport infrastructure may assist the internationally commodity trade. It will also serve as a useful means to facilitate the transport of goods and services domestically to reduce the economic disparity among the rapidly growing Baku area, townships, and rural areas.

During the outlook period, transport energy demand is projected to increase at 4.5% per year, representing the fastest annual growth rate by sector. At this growth rate, the sector's energy demand will triple from 2.3 MTOE in 2005 to 7.0 MTOE in 2030.

By energy type, diesel for freight trucks will register the fastest annual growth rate of 5.1% through 2030. Enhanced road transport networks such as the Transport Corridor Europe–Caucasus–Asia (the TRACECA corridor), and North–South corridor—along with the domestic development of non-oil industry—may facilitate the movement of freight goods by trucks both internationally and domestically. These factors will create a shift from railway to roads for freight transport and drive the substantial growth in diesel demand.

Gasoline for passenger transport will grow at the second fastest annual growth rate of 4.8%. The increase in vehicle stocks is currently concentrated in the Baku area, accounting for nearly 90% of the incremental growth in the number of vehicle stocks between 2001 and 2007. In contrast, the socioeconomic development in the other areas of Azerbaijan may increasingly contribute to the growth in vehicle stocks, and this translates into the robust growth in gasoline demand.<sup>57</sup>

Jet kerosene for air transport is projected to increase at a relatively slower rate of 2.7% per year. Azerbaijan has three international airports—in Baku, Ganjya, and Nakhchivan. The Baku international airport reopened in 1999 with upgrades and expansion being conducted. Ganjya airport also has been upgraded to cope with the expected rise in international air transport demand. These factors will double the jet kerosene demand from 0.49 MTOE in 2005 to 0.94 MTOE in 2030.

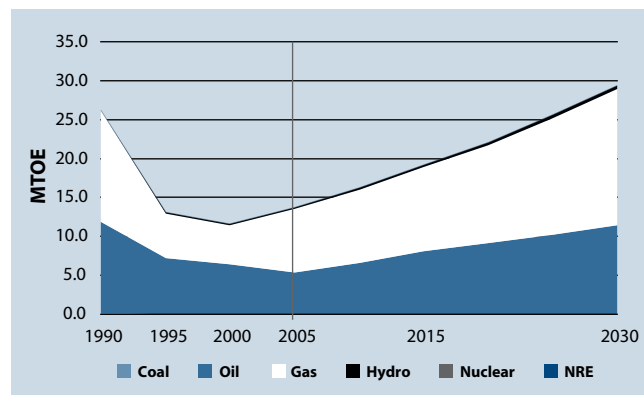
## Other Sectors

The other sectors' energy demand will grow at a relatively slow annual rate of 1.7% through 2030, compared with the rapid per capita GDP growth of 8.0% over the outlook period. Electricity demand is projected to increase the fastest over the outlook period, at an annual rate of 4.0%. Through mobilizing SOFAZ, Azerbaijan is investing in the construction of residential buildings, and cities and townships will have improved access to the electricity supply. These factors, along with a sixfold increase in income, will translate into rapid growth in residential electricity demand. In addition, with the government's efforts toward economic diversification, the service sector will expand, which will drive growth in the service sector's electricity demand. Meanwhile, the recent efforts toward meter installation, tariff increases, and bill collection will temper the increase in electricity demand, resulting in a relatively moderate growth of 4.0% per year compared with the rate of income growth.

Demand for natural gas will grow 1.9% annually between 2005 and 2030, the second-fastest rate. Similar to the factors creating the increased demand for electricity, growth in natural gas demand will be driven by the newly installed commercial and residential buildings. Natural gas will increasingly be used to replace the obsolete technology currently used for heat.

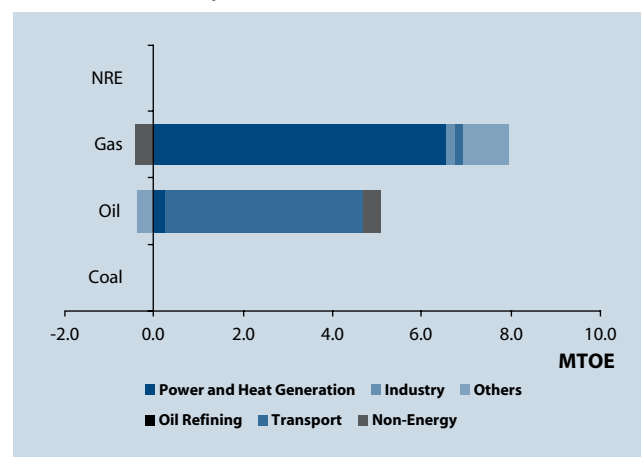
In contrast, heat demand will decline at an annual rate of 3.3% through 2030. Currently, heat is supplied with old inefficient technology built during the Soviet era, and this will be replaced by a more efficient system using natural gas.

<sup>57</sup> Azerbaijan's vehicle stocks are projected to more than double from 72.9 per 1,000 in 2005 to 148.7 in 2030.

**Figure 6.3.3: Primary Energy Demand—Azerbaijan**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.

Source: APERC analysis (2009).

**Figure 6.3.4: Incremental Energy Demand Growth—Azerbaijan (2005–2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.

Source: APERC analysis (2009).

Azerbaijan's other sectors use relatively small amounts of petroleum products (LPG, kerosene, and diesel), only 0.42 MTOE in 2005. These are mostly used in rural areas with low-income households and in old commercial buildings. As a result of the improved energy supply infrastructure, electricity and natural gas will increasingly replace petroleum products, dropping by nearly 70% to reach 0.13 MTOE in 2030.

## Primary Energy Demand

Primary energy demand is projected to increase from 13.9 MTOE in 2005 to 29.5 MTOE in 2030, growing at 3.1% per year. Per capita energy demand will reach 3.07 TOE in 2030, a nearly twofold increase from the 2005 level of 1.66 TOE. Despite the increase, per capita energy demand in 2030 will still be lower than the 1990 level of 3.62 TOE.

By energy source, demand for natural gas will grow at the fastest annual rate, 3.1%, driven mostly by the power sector. Natural gas will dominate the mix of primary energy demand, reaching 17.6 MTOE or 59.7% of primary energy demand in 2030.

Reflecting the substantial increase in the transport sector, demand for oil is projected to more than double from 5.4 MTOE in 2005 to 11.3 MTOE in 2030. Hydro is projected to increase at 2.5% per year during the same time period (Figure 6.3.3).

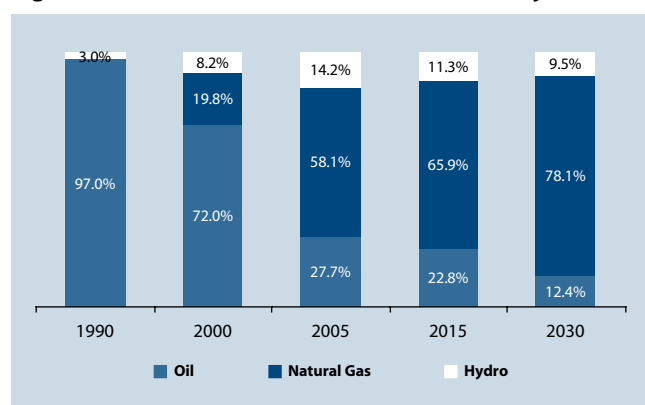
## Electricity

Azerbaijan's electricity demand is projected to increase at 4.0% per year between 2005 and 2030. Industry is expected to register the fastest growth rate in electricity demand at 5.4% per year, followed by the other sectors at 4.2% per year and the transport sector at 4.0% per year. In terms of the overall incremental growth of electricity demand over the outlook period, the other sectors will account for the major proportion at 67%, followed by the industry sector at 30%, and the transport sector at 3%.

Similar to the other countries in the Central and West subregion, the power generation units currently available in Azerbaijan were built during the Soviet era and are obsolete. Of the reported total installed capacity of 5,500 megawatts (MW), actual operational capacity stands at 4,500 MW. The government is engaged in building new facilities and upgrading the old ones, with primary focus on thermal generation units.

In terms of fuel choice for power generation, natural gas is projected to increasingly replace fuel oil, with natural gas reaching a 78.1% share of the total power generation mix by 2030. The government has a policy to rely more heavily on domestically available natural gas for power generation. Generation from oil will increase from 5.9 terawatt-hours (TWh) in 2005 to 7.4 TWh in 2030, reflecting an average annual growth rate of 0.9% (Figure 6.3.5).

**Figure 6.3.5: Power Generation Mix—Azerbaijan**



Source: APERC analysis (2009).

## Energy Policy Issues and Implications

Azerbaijan's GDP is projected to grow at 8.6% per year through 2030, while the country's energy demand is expected to increase at a relatively slow pace of 3.1 % over the same period. The country's implementation of energy price reform (trying to raise prices to the cost recovery level) and somewhat slower growth trends in the industry sector explain the decoupling of energy demand from economic growth. In addition, more than 40% of the total population is below the poverty level, and therefore has minimal ability to purchase energy. For the purpose of nationwide development, effective use of SOFAZ for infrastructure development is essential.

## References

- Center for Economic and Social Development (CESD), Azerbaijan. 2007. *Strategy for State Oil Fund of Azerbaijan Republic*. Baku.
- European Bank for Reconstruction and Development. 2007. *Strategy for Azerbaijan*. London.
- Energy Information Administration. 2008. *Country Analysis Briefs: Azerbaijan*. Available: [www.eia.doe.gov/emeu/cabs/Azerbaijan/Profile.html](http://www.eia.doe.gov/emeu/cabs/Azerbaijan/Profile.html)
- Sandrea, Rafael. 2009. An In-Depth View of Future World Oil and Gas Supply: A Quantitative Model Analysis. *Oil and Gas Journal*. (January). Houston: Pennwell Editors.
- World Bank. 2009. *Azerbaijan Country Brief*. Available: [web.worldbank.org](http://web.worldbank.org)

## 6.5 Kazakhstan

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- *Kazakhstan's primary energy demand is projected to increase at 1.8% per year between 2005 and 2030. Coal is expected to maintain the dominant share in primary energy demand at 46.1% in 2030 from 49.7% in 2005.*
- *Final energy demand is projected to increase at 1.2% per year in contrast to the 2.8% per year decline observed between 1990 and 2005.*

### Recent Energy Trends and Energy Policy

Primary energy demand in Kazakhstan has been growing positively from 1999, in contrast to the previous trend, where the country's energy demand nearly halved from 1991 to 1999. The economic recovery that was spurred by increased revenues from exports of oil, natural gas, and other mineral resources has translated into increased energy demand, from 36.0 million tons of equivalent (MTOE) in 1999 to 61.4 MTOE in 2006, an annual growth rate of 7.9%.

The country's primary energy demand has recently grown at a relatively slow annual rate (4.3% in 2007–2008) as a result of the slowdown in economic growth—3.2% in 2008 compared with the double-digit growth registered between 1999 and 2006. The impact of global recession and fall in oil prices from the second half of 2008 have reduced investor and consumer confidence, and slowed both overall economic growth and energy demand.

Kazakhstan's economy presently relies on earnings from the energy and minerals industries. For example, in 2006, the combined total of the energy and mineral sectors accounted for nearly 60% of the country's industrial value added. Given the vast reserves of oil (30 billion barrels), natural gas (85 trillion cubic feet), and coal (31.3 billion tons), it is inevitable that the economy will rely on the exports of these products in the period of transition, while it is necessary for the country to diversify its economic structure for long-term growth and prosperity.

*The Kazakhstan 2030*, released by the government in 1997, outlined the country's energy policy through 2030.<sup>59</sup> One of the policy's main elements is to develop the country's economy through the export of energy resources, mainly oil and natural gas.<sup>60</sup>

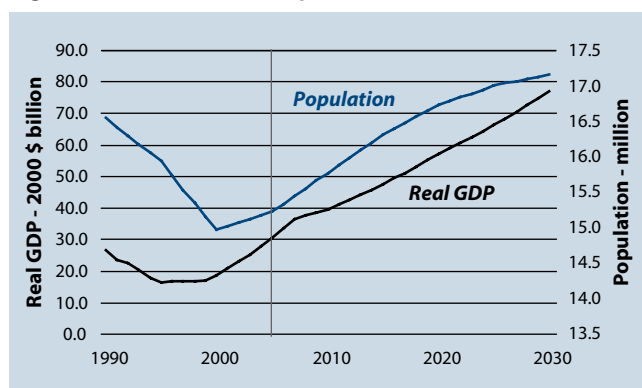
The country's economic development, led by heavy dependence on exports from the energy and mineral sectors, has created social disparities such as a widening income gap between rich and poor and development gap between regions. To strengthen the overall economy, in 2003,

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<sup>59</sup> *The Kazakhstan 2030* outlines the country's overall socioeconomic policy including (1) enhancement of national security, (2) political stability and unification of the society, (3) economic development through prompting foreign investment and national savings, (4) health security and promotion of education, (5) efficient use of energy resources for economic development, (6) transport and telecommunication infrastructure development, and (7) re-establishment of efficient government service.

<sup>60</sup> In fact, between 1998 and 2000, a program was developed to support the policy implementation, and this highlighted the importance of opening the upstream segment to foreign investors. Subsequent plans set for 2001–2005 also called for economic development through increases in oil exports.

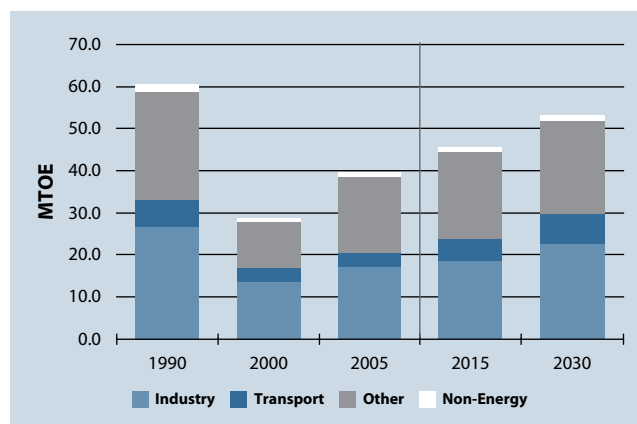
Figure 6.5.1: GDP and Population—Kazakhstan



GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

Figure 6.5.2: Final Energy Demand—Kazakhstan



MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

the Kazakhstan government promulgated the Innovative Industrial Development Strategy for 2003–2015, which tries to diversify the economic structure. At the same time, Kazakhstan is encouraging foreign investment in the oil and gas sector and strengthening government ownership.

## Energy Demand Drivers

Kazakhstan's gross domestic product (GDP) is projected to grow at an annual rate of 3.8% between 2005 and 2030. Assisted by pipeline infrastructure development, oil and gas exports will continue to drive steady economic development. Following the current practice, surplus revenues from oil and gas sales will be channelled to the National Fund, which will support the country's efforts to diversify the economic structure through development of the agriculture and manufacturing industries.

The economic downturn in the early 1990s resulted in increased emigration, causing the population to decline at an annual rate of 1% between 1990 and 1999. In contrast, as the economy started to strengthen in 1999, immigration increased and the country's population grew at a moderate rate of 0.1% per year from 1999 to 2005. During the outlook period, the overall population is expected to continue growing at 0.5% per year through 2030, while the urban population will grow at a faster rate, 1.1% annually through 2030, with its share of the total population reaching 66.8% in 2030 from 57.1% in 2005 (Figure 6.5.1).

## Final Energy Demand

Final energy demand is projected to grow at 1.2% per year in contrast to the 2.8% per year decline observed between 1990 and 2005. The transport sector is expected to increase at the fastest rate, 2.7%, followed by industry at 1.2% and the other sectors at 0.8% (Figure 6.5.2).

## ***Industry Sector***

The industry sector's energy demand is projected to increase at an annual rate of 1.2% between 2005 and 2030, a decline from the 4.5% annual growth registered between 2000 and 2005. Presently, coal is the main energy source in Kazakhstan's industry sector, accounting for 41.7% of total industry's energy demand. Coal is mainly used in the steel and manufacturing subsector, which is located close to the coal mines in the northern part of Kazakhstan. Over the outlook period, although iron and steel production will continue to drive the steady growth in coal demand, other manufacturing subsectors will shift from coal to other energy types—mainly electricity and natural gas due to the development of expanded transmission networks. As a result, industry's coal demand is projected to decline at an annual rate of 0.8% through 2030, compared with the annual growth rate of 1.4% between 2000 and 2005.

Natural gas is projected to increase the fastest, at an annual rate of 5.1% over the outlook period. The development of a natural gas pipeline that connects the production deposits in the western region to the eastern demand center for the light and food industries may increase natural gas demand. At the same time, following the government's strategy to diversify economic structure, the manufacturing industry is expected to increase its investment in the western region and utilize natural gas for on-site generation. The rapid growth in demand for natural gas will increase its share of industry energy demand from 4.8% in 2005 to 12.2% in 2030.

Electricity demand is projected to grow at an annual rate of 2.5% between 2005 and 2030—more than double the projected growth of industry's total energy demand (1.2%) during the same time period. Electricity will increasingly substitute for coal, and as a result, electricity's share of total industry energy demand will increase from 14% in 2005 to 18.9% in 2030.

Demand for petroleum products is projected to increase at an annual rate of 3.5% through 2030. In Kazakhstan, the mining subsector is currently the main consumer of petroleum products (diesel), and with steady growth in mining, this sector is expected to continue driving the increase in diesel demand.

## ***Transport Sector***

Given Kazakhstan's distinctive geographical characteristics—vast land area, landlocked location, and long distance between the mineral resource deposits and demand center—the country's economic activities inevitably rely on efficient transport operations.

Over the outlook period, transport energy demand will nearly double from 3.6 MTOE in 2005 to 7.0 MTOE in 2030, an annual growth rate of 2.7%. As a result of income growth, demand for gasoline for both passenger and freight vehicles will grow 2.1% per year through 2030 and maintain the largest share of total transport energy demand at 60.7% in 2030—although this still represents a decline from 69% in 2005. Diesel for buses and freight trucks will grow at an annual rate of 3.1% through 2030, faster than the projected total growth in transport energy demand. The Kazakhstan government plans to modernize the road infrastructure and expand the road network to facilitate connectivity within the country and to allow smooth transit to other countries. Investment in road infrastructure and economic development both within and outside the country may increase the freight transport needs, which will in turn translate into the relatively fast growth of diesel demand through 2030.



Jet kerosene demand for international air transport will grow at an annual rate of 4.4% over the projected period. Integration into the subregional economy as well as increased tourism may attract international passengers to drive this growth. In anticipation of increased air transport demand, the Kazakhstan government plans a two-stage upgrade to the service in 2010 and 2015.

The railway system is likely to continue its importance as a mode of transport for passenger traffic and mineral and steel products for export. By energy source, currently diesel represents more than 75% of total rail transport energy demand, while the remainder is taken up by electricity.

### **Other Sectors**

The other sectors' energy demand is projected to increase at an annual rate of 0.8% through 2030, slower than the growth of final energy demand (1.2%) during the same time period.

By energy, natural gas for heating and cooking is the dominant energy source, accounting for 61.7% of total energy demand in this sector. Over the outlook period, natural gas will continue to have the dominant share in this sector, while its demand is projected to grow relatively slowly at an annual rate of 1.0% through 2030. This reflects both the efficiency improvements in gas supply and an expected price increase to offset the cost of those improvements.

In contrast, heat—which currently accounts for the second-largest share at 22.7% of the sector's energy demand—is projected to decline at an annual rate of 0.2% over the outlook period. Heat for space and hot water heating may increasingly be replaced by natural gas, and heat supply efficiency may improve in newly installed residential and commercial buildings. These factors will result in a decline in heat demand over the outlook period, with the share of heat decreasing to 17.7% in 2030.

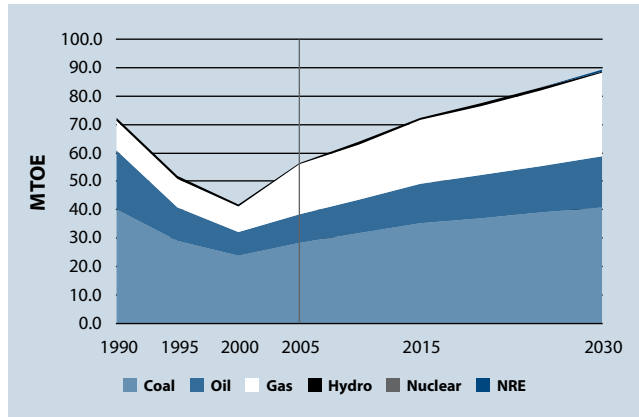
Electricity is projected to increase at an annual rate of 2.3%, representing the fastest growth among all types of energy in the other sectors. With the economic development of Kazakhstan, the service sector's share is likely to increase and this will drive the growth in electricity demand.

## **Primary Energy Demand**

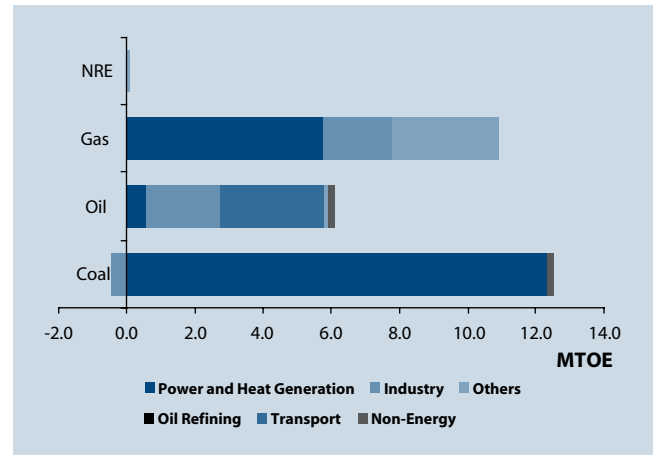
Kazakhstan's primary energy demand is projected to increase 1.8% per year between 2005 and 2030. Although the country's primary energy demand registered a 1.7% annual decline between 1990 and 2005, a positive increase is projected over the outlook period (Figure 6.5.3). Primary energy demand is projected to increase faster in the near term (2005–2015) at 2.5% annually, driven by the economic growth, in contrast to a slower growth rate of 1.4% per year for the longer term (2015–2030).

By energy type, coal is expected to maintain its dominant share over the outlook period (46.1% in 2030 from 49.7% in 2005). However, its growth is likely to be relatively slow, at 1.5% annually through 2030, as coal may be replaced by natural gas for the industry sector, and will be more efficiently utilized for heat production and power.

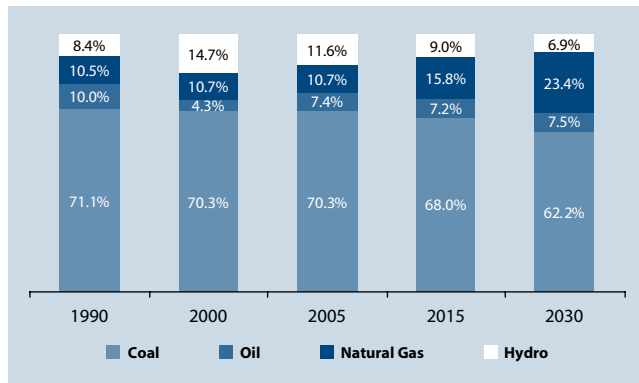
Natural gas demand will increase 2.2% per year, reaching 29.7 MTOE in 2030 from 17.4 MTOE in 2005. Increased production in the western part of Kazakhstan may spur the growth in demand

**Figure 6.5.3: Primary Energy Demand—Kazakhstan**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.5.4: Incremental Energy Demand Growth—Kazakhstan (2005–2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.5.5: Power Generation Mix—Kazakhstan**

Source: APERC analysis (2009).

in the power sector and in other sectors for space and water heating. The expanding manufacturing sector near the western natural gas deposit may also increase the use of natural gas for on-site generation.

Oil demand is projected to increase at 2.1% annually, in contrast to the 4.6% annual decline observed between 1990 and 2005. As a result of upgrades and development of the road infrastructure, the transport sector's growth will lead to an overall increase in oil demand, accounting for more than 50% of total incremental growth in oil demand.

## Electricity

Electricity demand is projected to increase 2.5% per year between 2005 and 2030. The increase in overall electricity demand may be driven largely by the industry sector, which accounts for 60% of incremental demand growth between 2005 and 2030, followed by the other sectors at 31% and the transport sector at 9% during the same time period.

Similar to other countries in Central and West Asia, most of Kazakhstan's power generation facilities were built during the Soviet era and are obsolete. Currently, the country's total installed capacity is 18,602 megawatts (MW), of which only 14,410 MW of generation capacity is operational. To meet the expected 2.5% annual growth in demand, replacement of the old generation units and introduction of additional units will be necessary. Kazakhstan's power generation mix is dominated by coal, accounting for 70.3% in 2005. Along with the additional capacity increase in coal-fired generation close to the northern part of the country, construction of natural gas-fired generation facilities are being undertaken near the western deposits and hydrogeneration capacity is being expanded in the south. As a result, coal's share will drop to 62.2% in 2030, while natural gas-fired generation will double from the current 10.7% to 23.4% in the same time period (Figure 6.5.5).

The geographical disparity of resources (coal in the north, natural gas in the west, and hydro in the south) means that enhanced transmission capacity is necessary to secure electricity from domestic supply sources. Due to the vast land area, Kazakhstan's electricity system is not unified. Currently it consists of three systems: two in the north that are connected to Russia, and one in the south that is connected to the Unified Energy System of Central Asia.<sup>61</sup> Over the outlook period, a second transmission line will be developed to connect the systems, enhancing the transmission of electricity generated in the north to the south. This network expansion will reduce the amount of imported electricity, gradually turning the country into a net exporter of 0.05 MTOE in 2030.

## Energy Policy Issues and Implications

Although Kazakhstan is endowed with vast energy reserves of coal, oil, and natural gas, it does not have a well-developed nationwide energy supply infrastructure. This results from the legacy of the former Soviet Union and distance between the energy deposits and demand centers. The country recognizes that an enhanced energy supply infrastructure will create the foundation for Kazakhstan's economic development.

## References

- Energy Information Administration, US Department of Energy. 2008. *Country Analysis Briefs: Kazakhstan*. Available: [www.eia.doe.gov/emeu/cabs/kazak.html](http://www.eia.doe.gov/emeu/cabs/kazak.html)
- Japan Association for Trade with Russia & NIS. 2007. *Transport Infrastructure Development and Demand in Central Asia*. Tokyo (In Japanese).
- Japan Electric Power Information Center, Inc. 2007. *Study on Power Sector in Central Asia*. Tokyo (In Japanese).
- World Bank. 2004. *Central Asia Regional Electricity Exports Potential Study*. Available: [siteresources.worldbank.org/INTUZBEKISTAN/Resources/REEPS\\_Main\\_Report\\_Final\\_English.pdf](http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/REEPS_Main_Report_Final_English.pdf)

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<sup>61</sup> Energy Information Administration. 2008. *Country Analysis Briefs: Kazakhstan*. Available: [www.eia.doe.gov/emeu/cabs/kazak.html](http://www.eia.doe.gov/emeu/cabs/kazak.html)

## 6.6 Kyrgyz Republic

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- *The Kyrgyz Republic's primary energy demand is expected to grow annually at 2.6%, from 2.8 million tons of oil equivalent (MTOE) in 2005 to 5.3 MTOE in 2030, driven primarily by economic and population growth.*
- *Hydroelectricity is likely to continue dominating the Kyrgyz Republic's energy mix. However, the country's energy security would be enhanced through energy source diversification.*

### Recent Energy Trends and Energy Policy

Following the economic downturn caused by the collapse of the Soviet Union, the Kyrgyz Republic's energy demand has declined by 68% since 1990, to 2.3 million tons of oil equivalent (MTOE) in 2006. The country's economy started to recover in 1996, with its energy demand gradually increasing at an average annual rate of 0.8% from 1996 to 2006. However, this still represented the third lowest level among Central Asian countries, after Afghanistan and Armenia. Of its total final energy demand in 2006, about 29.7% was consumed by industry, 17.0% by transport, and 51.7% by the residential and agriculture/forestry/fishing sectors.

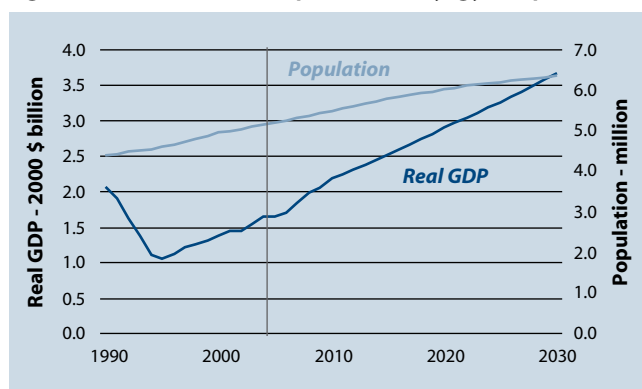
In terms of demand by fuel type, the country's three main energy sources in 2006 were electricity (39.3%), oil (25.8%, half of which was motor gasoline), and coal (16.3%). Coal demand had the highest annual average growth rate, 10.1% from 1995 to 2006. Meanwhile, driven by the demand for residential heating and gas-fired power generation during the same period, natural gas demand increased at an average annual rate of 6.2%. Oil demand grew by 3.1% per year, driven by increased demand from the transport sector of 9.4% per year during the same period. However, the demand of heavy fuel shrank, largely because of the slump in industrial activity. Electricity demand increased an average of 2.0% annually and is presently the Kyrgyz Republic's dominant energy source.

In terms of primary energy supply, hydro garnered the largest share in 2006—about 45.5% of the total—reflecting average growth of 3.0% per year from 1995 to 2006. Natural gas continued to be the second highest source, with a share of 22.9% of the total and average annual growth of 4.2% during the period. On the other hand, declines were seen in the shares of coal (18.3%) and oil (20.8%).

Although the Kyrgyz Republic produces certain amount of coal, oil, and natural gas, its supply of fossil fuels depends heavily on imports. Therefore, the government has been pushing for increased use of its most plentiful domestic resource, hydroelectric power.<sup>62</sup> The Kyrgyz Republic's energy policy is heavily weighted toward hydroelectric power. The country exports about 15%–20% of its hydroelectricity to neighboring countries such as the Peoples Republic of China, Kazakhstan, Russia, and Uzbekistan in summer, and imports electricity from these countries in winter. Policies such as the implementation of privatization have been introduced

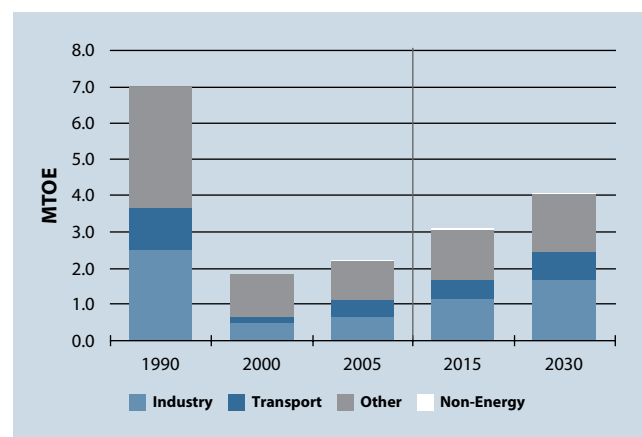
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<sup>62</sup> GlobalSecurity.org. 2009. *Kyrgyzstan-energy*. Available: [www.globalsecurity.org/militaryworld/centralasia/Kyrgyz-energy.htm](http://www.globalsecurity.org/militaryworld/centralasia/Kyrgyz-energy.htm)

**Figure 6.6.1: GDP and Population—Kyrgyz Republic**

GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

**Figure 6.6.2: Final Energy Demand—Kyrgyz Republic**

MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

to further develop the power generation and transmission sectors, as the government aims for increased electricity supplies for both domestic use and export revenues.

## Energy Demand Drivers

The Kyrgyz Republic's population grew from 4.4 million in 1990 to 5.2 million in 2005, with an annual growth rate of 1.1%. Total population is projected to grow at an annual rate of 0.8% from 2005 to 2030, reaching 6.3 million by 2030 (Figure 6.6.1).

The country's gross domestic product (GDP) declined dramatically by an average of 12.7% per year from 1990 to 1995, but turned to a growth trend of 4.5% annually until 2006. Its GDP from 2005 to 2030 is expected to increase at an average annual rate of 3.2%. The economy is currently dominated by the services sector (about 50% of GDP), agriculture (30%), and industry (20%).

## Final Energy Demand

Final energy demand is projected to grow at 2.4% per year from 2005 and 2030, faster than the annual growth rate of 1.9% registered between 1995 and 2005; however, the projected demand in 2030, 4.1 MTOE, is only 58.6% of the 1990's level.

Energy demand from industry is expected to overtake the other sectors (including agriculture, commercial, and residential) and become the largest one with a share of around 41.4%. The share of the other sectors is projected to decline from 48.9% in 2005 to 38.6% in 2030, with the transport sector maintaining a range of 17%–20% over the outlook period (Figure 6.6.2).

## Industry Sector

The energy demand from industry is projected to grow at an average annual rate of 3.8% between 2005 and 2030, faster than the average growth rate of 3.4% observed between 1995 and 2005. Major industries in the Kyrgyz Republic include oil, gas, natural gas, nonferrous metal (gold, mercury, antimony, lead, and tin), mining, manufacturing, and construction. The industry

sector and its energy demand are expected to grow at a faster rate than the transport and other sectors given factors such as the country's natural resources endowment; government policies of promoting privatization of industry; and introduction of foreign investment to develop light industry, the food producing industry, and natural resources exploration.

Industry's demand for coal is projected to grow 4.3% per year and expand its share from 59% in 1995 to 67% in 2030. The remaining energy demand from industry is expected to be met by electricity, which is projected to grow by 2.8% annually. About 39% of the country's total electricity demand in 2030 is expected to come from industry.

### Transport Sector

Over the outlook period, petroleum demand from the transport sector is projected to increase at an annual rate of 2.4%.

In terms of petroleum subtypes, gasoline for passenger vehicles is expected to grow 1.9% per year, and jet kerosene at a higher annual rate of 3.5%. By 2030, the demand for gasoline (all from this sector) is expected to take a share of 46% of the total demand of petroleum products, with jet kerosene's share projected to be 29%.

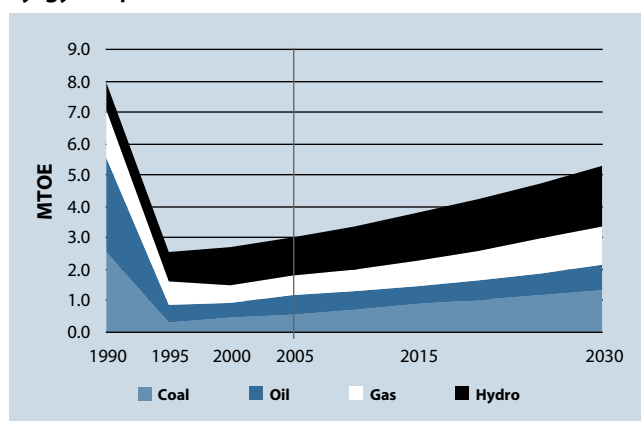
### Other Sectors

Over the outlook period, the energy demand of other sectors is projected to increase at an annual rate of 1.5%, compared with a decline of 7.2% per year during the period from 1995 to 2005, driven by demand from the commercial sectors.

Electricity is expected to remain the biggest energy source for this sector, with its share of the total demand enlarging from 48% in 2005 to 55% in 2030. This sector is projected to account for 61% of the total electricity demand in 2030.

Oil is expected to grow by 1.5% per annum, with diesel increasing by 2.1% and heavy fuel decreasing by 1.1%. All the demand for diesel is expected to come from this sector. Its share of the total demand for petroleum products is projected to be 18% by 2030.

**Figure 6.6.3: Primary Energy Demand—Kyrgyz Republic**



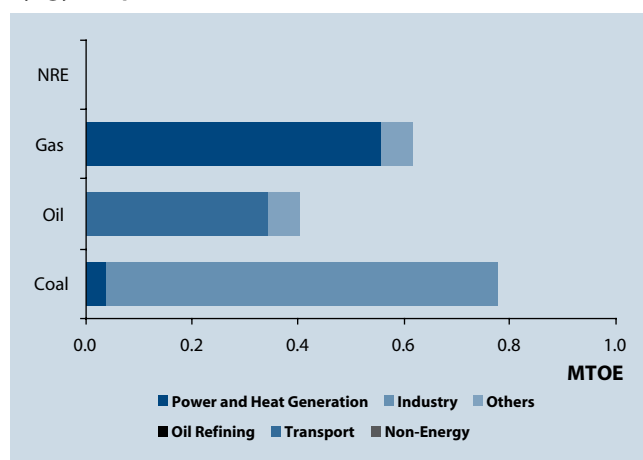
MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

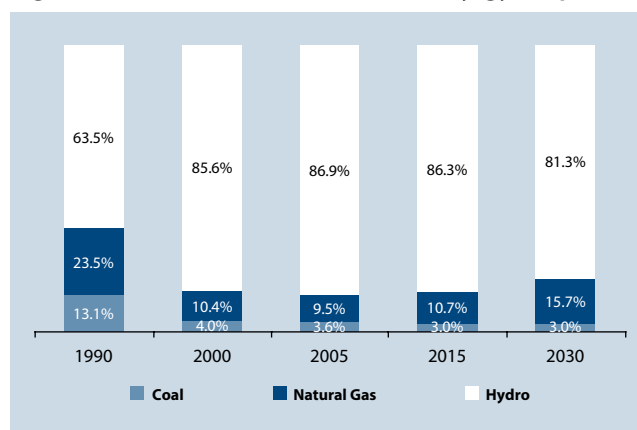
### Primary Energy Demand

The Kyrgyz Republic's primary energy demand is projected to grow at 2.6% annually through 2030, in contrast to the decline of 6.4% per year observed between 1990 and 2005. However, the amount is expected to stand at 5.3 MTOE, a mere 70% of that in 1990 (Figure 6.6.3).

By energy type, coal is expected to grow 3.6% per year along with the development of industry, especially mining, manufacturing, and construction. Coal's share of the total primary energy demand is expected to grow from 19.8% in 2005 to 25.1% in 2030. Coal

**Figure 6.6.4: Incremental Energy Demand Growth—Kyrgyz Republic (2005–2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.6.5: Power Generation Mix—Kyrgyz Republic**

Source: APERC analysis (2009).

demand is expected to be 1.3 MTOE in 2030, with 95% for the industry sector and the rest for power generation.

Oil is projected to grow at 1.1% per annum due to motorization, development of the aviation infrastructure, and its expanded use by the agriculture/forestry/fishing sector. Demand is expected to be 0.8 MTOE in 2030, with 85% of the incremental growth coming from transport and 15% from the residential sector.

Natural gas demand is expected to grow at an annual rate of 2.8% over the projected period, driven by the need for power generation (0.5 MTOE) and residential heating (0.1 MTOE).

Hydro demand is projected to increase 1.8% per year and retain the largest share during the outlook period, reaching 36.1% in 2030.

## Electricity

Electricity demand is projected to grow by 2.3% per annum. To meet this demand, total electricity generation will increase by 67.1% over the projected period, from 16.4 terawatt-hours (TWh) in 2005 to 27.4 TWh in 2030. The Kyrgyz Republic is endowed with abundant water resources. While most of its demand for fossil fuels will be met by imports, hydro is expected to dominate power generation by 2030 with a share of 81.3%.

Meanwhile, gas-fired power generation is projected to increase from a 9.5% share in 2005 to 15.7% in 2030, producing 4.3 TWh by the end of the project period. In contrast, the share of coal-fired power generation is expected to decline from 3.6% in 2005 to 3.0% in 2030, although its production is expected to grow from 0.6 TWh to 0.8 TWh (Figure 6.6.4).

In terms of growth, hydropower generation is expected to grow at an average annual rate of 1.8% over the projected period, followed by natural gas-fired (4.1%) and coal-fired (1.3%) power generation.

## Energy Policy Issues and Implications

### *Development of Hydroelectric Generation and Power Supply*

Because most of the Kyrgyz Republic's power generation and transmission facilities were built during the Soviet era, aging infrastructure is largely to blame for unreliable and insufficient electricity production and supply. Meanwhile, the country has the third-largest amount of hydroelectric resources in the Commonwealth of Independent States region, surpassed only by Russia and Tajikistan. The potential of its mountain water resources is estimated to be 142 billion kWh a year, but less than 10% of this is utilized.<sup>63</sup> Therefore, key energy policy issues for the Kyrgyz Republic are the development of hydroelectric power generation and the expansion and upgrade of the electricity grid to strengthen the power supply network.

In terms of hydroelectric power generation development, the government is actively pursuing the Kambarata I and II hydroelectric projects. These two power facilities are designed to be a storage type of 1,900 megawatts (MW) and a run-of-the-river type of 360 MW. They are expected to be commissioned around 2010–2012 and cost more than \$2.2 billion.<sup>64</sup> On the other hand, because the Kyrgyz Republic currently depends on its neighbor countries for electricity import in winter, it is also important to strengthen fossil fuel-fired thermal power generation to improve its supply stability.

With its abundant water resources, the Kyrgyz Republic is expected to rely on hydroelectric energy over the outlook period. At the same time, because its natural resources also include coal, oil, and natural gas, policies for further exploration and development of its fossil fuel resources would rationalize a more diversified energy mix and reduce dependence on energy import, therefore improving the country's energy security.

However, lack of capital and technology are major constraints for the Kyrgyz Republic's energy development. Support from its neighbor countries (such as the Peoples Republic of China, Kazakhstan, Russia, and Uzbekistan), developed countries, and international organizations and institutions would be of great value to develop the Kyrgyz Republic's energy resources and increase prosperity in the subregion as a whole.

## References

- GlobalSecurity.org. 2009. *Kyrgyzstan-energy*. Available: [www.globalsecurity.org/military/world/centralasia/kyrgyz-energy.htm](http://www.globalsecurity.org/military/world/centralasia/kyrgyz-energy.htm)
- World Bank. 2004. *Central Asia Regional Electricity Export Potential Study*. Washington DC. Available: [www.adb.org/Documents/Reports/CAREC/Energy/CA-REEPS.pdf](http://www.adb.org/Documents/Reports/CAREC/Energy/CA-REEPS.pdf)

<sup>63</sup> Interfax Information Services. 2007.

<sup>64</sup> World Bank. 2004. *Central Asia Regional Electricity Export Potential Study*. Washington, DC.



## 6.8 Tajikistan

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- *Primary energy demand is projected to increase from 3.4 million tons of equivalent (MTOE) in 2005 to 4.6 MTOE in 2030, growing at an annual rate of 1.2%. Despite the projected growth, per capita energy demand will decline from 0.52 tons of oil equivalent (TOE) in 2005 to 0.48 TOE in 2030.*
- *By energy type, oil will account for the biggest share of primary energy demand at 46.1% in 2030, followed by hydro at 40.5% and natural gas at 12.3%.*

### Recent Energy Trends and Energy Policy

Parallel with the economic recovery in 2000, the primary energy demand of Tajikistan increased at an annual rate of 4.2% through 2006. Despite overall growth in energy demand, the trend varies by source. For example, demand for petroleum products increased at a robust annual rate of 10.6% to meet the increased demand for passenger transport. With this growth, oil accounted for the biggest share of primary energy demand in 2006 at 44.7%. In contrast, hydro—which had the largest share in 2000—grew relatively slowly at an annual rate of 2.9% from 2000 to 2006, and its share reached the second highest one at 39.1% in 2006.

Although primary energy demand registered positive growth from 2000 to 2006, the per capita energy demand of 0.55 TOE in 2006 represented one of the lowest levels in Central and West Asia. This is caused by a relatively low per capita gross domestic product (GDP) (around \$250 per person) and inadequate energy supply infrastructure.

Tajikistan has limited fossil energy reserves. It holds 0.2 trillion cubic feet of natural gas reserves and 10 million barrels of oil reserves.<sup>69</sup> Tajikistan is the smallest oil reserve holder in Central Asia. Therefore, almost all of its needs for fossil fuels are met by imports.

In contrast, the country's hydro resources are among the largest in the world and are evenly located throughout the territory.<sup>70</sup> Using its hydro reserves, Tajikistan exports electricity to neighboring countries such as Russia and Uzbekistan during the summer. However, Tajikistan imports electricity from Uzbekistan and Russia in the winter. As a result, Tajikistan has been a net importer of electricity since 1995. Securing financial sources to develop Tajikistan's unexploited hydro potential is critical for enhancing the country's energy supply security.

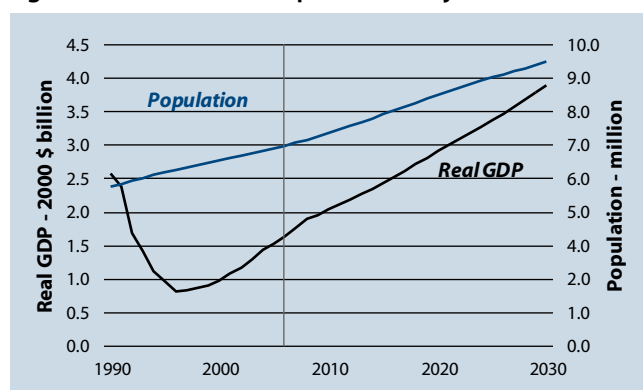
### Energy Demand Drivers

Tajikistan's GDP is projected to increase at an annual rate of 3.8% over the outlook period. This is much slower than the recent robust growth of 8.4% per year between 2000 and 2005. In addition, the projected economic growth rate is the slowest among the countries of Central

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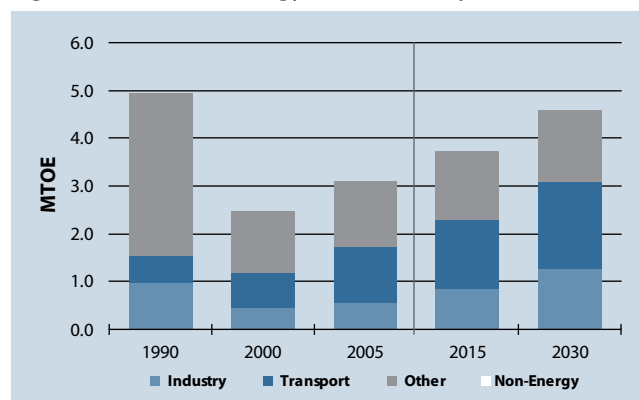
<sup>69</sup> World Energy Council. 2007. *2007 Survey of Energy Resources*. London.

<sup>70</sup> Research Laboratory for Natural Protection of Tajikistan. 2002. Only 5% of the country's hydro potential is being exploited currently.

**Figure 6.8.1: GDP and Population—Tajikistan**

GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

**Figure 6.8.2: Final Energy Demand—Tajikistan**

MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

and West Asia. The recent growth was led largely by the remittances from Russia; however, the contribution from those remittances will be reduced over the outlook period, and Tajikistan will be sustained by exports of cotton and aluminium.

Tajikistan's population is projected to increase 1.5% per year over the outlook period. At this rate of growth the population will reach 9.4 million in 2030, compared with 6.6 million in 2005 (Figure 6.8.1).

About 26% of the total population currently lives in urban areas, and with the projected economic development, it is estimated that 34% of the total population will live in urban areas by 2030 (Figure 6.8.2).

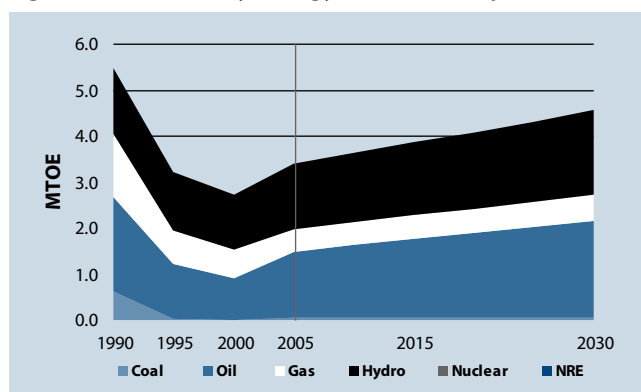
## Final Energy Demand

Final energy demand is projected to increase at an annual rate of 1.6% between 2005 and 2030, producing a final energy demand of 4.6 MTOE in 2030, which is still lower than the 1990 level of 4.9 MTOE. The projected 1.6% growth in final energy demand during the outlook period is also slower than the 4.5% experienced from 2000 to 2005. These figures assume a GDP growth rate of 3.8% (Figure 6.8.2).

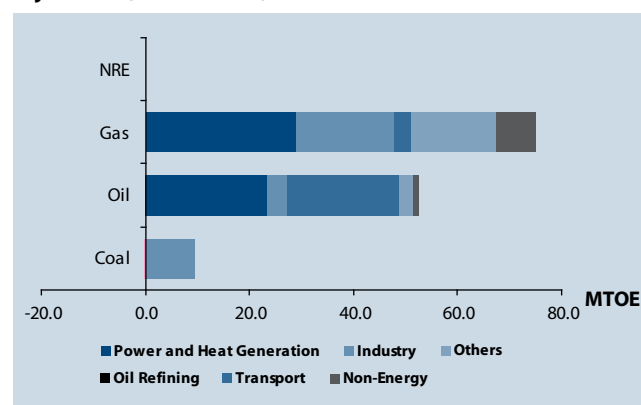
### Industry Sector

Industry energy demand is projected to increase at 3.3% annually through 2030—the fastest growth rate of any sector. Despite the growth, industry will continue to hold the lowest share of final energy demand, with 27.6% expected in 2030. The aluminum industry is the sector's biggest energy consumer, representing more than 90% of industry's total energy demand in 2005, a trend that projected to continue through 2030.

By energy type, electricity is the most important input for the industry sector and is projected to continue dominating the industry sector's energy demand during the outlook period.

**Figure 6.8.3: Primary Energy Demand—Tajikistan**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.8.4: Incremental Energy Demand Growth—Tajikistan (2005–2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

## Transport Sector

Transport energy demand is projected to increase slowly, from 1.2 MTOE in 2005 to 1.8 MTOE in 2030 with an annual growth rate of 1.8%. This is primarily due to the slow growth in urban population and sustained low income level (\$410 in 2030). Petroleum products will continue to represent the bulk of total transport energy demand, accounting for 99% by 2030.

## Other Sectors

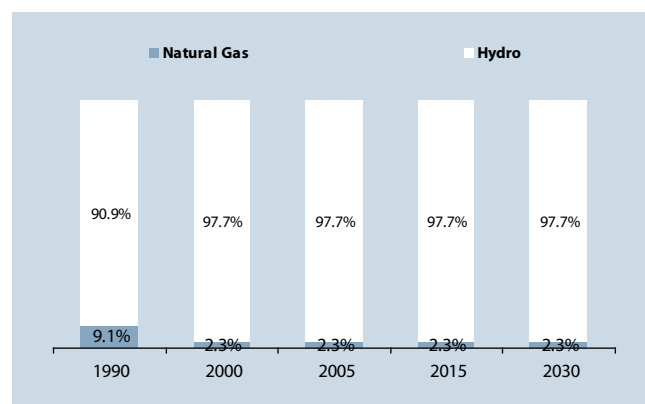
Energy demand in other sectors is projected to increase from 1.3 MTOE in 2005 to 1.5 MTOE in 2030, growing at 0.4% per year, the slowest rate of any sector. As with transport, the relatively small urban population (around 30% of the total) and the projected low income level are the major contributing factors in this sector's sluggish growth.

By energy type, electricity will account for the largest share at 48.7% in 2030. However, this sector's demand for electricity will increase only 0.2% per year through 2030, a result of the expected rise in tariff that may impede growth. The share of natural gas will represent the second-largest level, 23% by 2030. Again, despite maintaining a relatively large share, the projected growth of natural gas may register a slow rate at 0.9% per year.

## Primary Energy Demand

Tajikistan's primary energy demand is projected to increase from 3.4 MTOE in 2005 to 4.6 MTOE in 2030, growing at an annual rate of 1.2%. Reflecting the growth of primary energy demand, per capita energy demand will decline from 0.52 MTOE in 2005 to 0.48 MTOE in 2030, reflecting a yearly increase of only 0.3% (Figure 6.5.3).

By energy type, oil will account for the biggest share of primary energy demand at 46.1% in 2030, followed by hydro at 40.5% and natural gas at 12.3%.

**Figure 6.8.5: Power Generation Mix—Tajikistan**

Source: APERC analysis (2009).

Oil will represent the largest incremental growth of fossil fuels at 0.7 MTOE between 2005 and 2030, followed by natural gas at 0.1 MTOE. This will be led by increased demand from the transport sector, while the growth in natural gas demand will be led by the “others” sector.

## Electricity

Tajikistan’s electricity demand is projected to increase at an annual rate of 1.9%. Industry will have the largest share of total electricity demand at 63.5% in 2030, followed by the other sectors at 36.4% in the same year.

Electricity generation will increase from 17.1 TWh in 2005 to 22.1 TWh in 2030, with an annual growth rate of 1.0%. The power generation mix will be dominated by hydro, which will account for 97.7% of total generation in 2030.

Tajikistan has a vast hydro resource potential of about 40,000 MW, of which only 10% is currently used. As a result, hydro is projected to maintain the largest share of the total power generation mix (Figure 6.8.5).

## Energy Policy Issues and Implications

Tajikistan’s extensive hydro resources can be effectively tapped for the country’s economic development. Despite the potential gains from the export of electricity using hydroelectric power, the progress in implementation is somewhat slow. Forming strategic partnerships with neighboring countries and establishing a long-term energy policy are essential, and may be facilitated by financial assistance from development banks.

## References

- Japan Electric Power Information Center, Inc. 2007. *Study on Power Sector in Central Asia*. Tokyo (In Japanese).
- United Nations Development Programme–Tajikistan. Available: [www.undp.tj](http://www.undp.tj)
- World Bank. 2004. *Central Asia Regional Electricity Exports Potential Study*. Available: [siteresources.worldbank.org/INTUZBEKISTAN/Resources/REEPS\\_Main\\_Report\\_Final\\_English.pdf](http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/REEPS_Main_Report_Final_English.pdf)
- . 2005. *The Energy Loss Reduction Project in Tajikistan*. Available: [web.worldbank.org/external/projects](http://web.worldbank.org/external/projects)

## 6.10 Uzbekistan

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- *Uzbekistan's primary energy demand is expected to grow annually at 1.8%, from 47.0 million tons of equivalent (MTOE) in 2005 to 72.6 MTOE in 2030. It is driven primarily by the high demand for natural gas in the industry sector and the other sectors.*
- *Coal is expected to increase its share of the power generation mix through 2030, while natural gas is likely to reduce its share, although it will continue to be the dominant fuel for power generation.*
- *Creating a sound investment climate is critical for encouraging private investment in the energy sector and modernizing obsolete facilities and equipment.*

### Recent Energy Trends and Energy Policy

Uzbekistan's primary energy demand barely changed between 1990 and 2006, increasing from 46.4 MTOE in 1990 to 48.5 MTOE in 2006. Demand fluctuated during the period, reaching a peak of 52.9 MTOE in 2002. Economic activity in Uzbekistan was not as severely damaged as the most of Commonwealth of Independent States countries after its independence from the former Soviet Union. The country took a gradual approach to economic and social reform, which successfully maintained the final energy demand at a steady level.<sup>74</sup>

Uzbekistan is rich in natural resources. Being a major world producer of minerals such as gold and uranium, the country also possesses 3,000 million tons of recoverable coal reserves, 65 trillion cubic feet of proven natural gas reserves, and 0.59 billion barrels of proven oil reserves. Energy independence was achieved in 1995 by making increased petroleum and natural gas output one of the country's major strategic goals in its initial years of independence. In contrast, coal production declined in spite of substantial coal reserves due to economic inefficiency and lack of investment.<sup>75</sup>

The energy sector has substantial export potential and is regarded as the foundation for the country's economic development. As part of its energy policy, the Uzbekistan government continuously seeks ways to augment its petroleum and natural gas output, to increase natural gas exports, and to draw direct foreign investment to the energy sector. Uzbekistan has increased its natural gas production and succeeded in expanding its contribution to total exports. Natural gas export in 2006 accounted for 10.2 MTOE, or 20.2% of production, and is 3.5 times larger than the 1990 level.<sup>76</sup> The Uzbekistan government opts for a production sharing agreement (PSA) to expand its natural gas production because the country lagged behind in

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<sup>74</sup> World Bank. 2009. *Uzbekistan—Country Brief 2009*. Available: [www.worldbank.org/uz/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/UZBEKISTANEXTN/0,,menuPK:294197~pagePK:141132~piPK:141107~theSitePK:294188,00.html](http://www.worldbank.org/uz/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/UZBEKISTANEXTN/0,,menuPK:294197~pagePK:141132~piPK:141107~theSitePK:294188,00.html) After gaining independence from the former Soviet Union, the Uzbekistan government adopted the use of state controls, planning, and direct interventions in economic activity, restricted foreign exchange and trade, and made a large public investment.

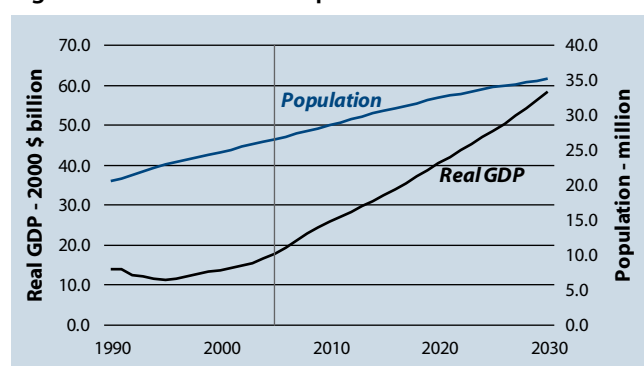
<sup>75</sup> United Nations Development Programme (UNDP). 2007a. *Options for Continuing Energy Reforms in Uzbekistan*. Policy Brief. No. 1(8), 2007. Available: [www.undp.uz](http://www.undp.uz)

<sup>76</sup> International Energy Agency. 2008. *Energy Balances of Non- OECD Countries*. Paris.

advanced technology for exploration.<sup>77</sup> For example, a joint work with Russia's LUKoil and Gazprom has been conducted under a PSA.<sup>78</sup>

In Uzbekistan, the energy sector is significantly influenced by the national government, which owns enterprises in all the energy sectors.<sup>79</sup> This situation has hindered effective development of the energy sector. For example, because energy prices are regulated by the government, they are artificially lower than the level required to recover costs, making it difficult to draw investors' interest. Lack of investment means that one of the energy sector's major problems—obsolete infrastructure systems left from the former Soviet Union era—cannot be fixed.

**Figure 6.10.1: GDP and Population—Uzbekistan**



GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

## Energy Demand Drivers

In Uzbekistan, gross domestic product (GDP) is projected to grow annually at 4.9% on average between 2005 and 2030. During the near term (2005–2015) GDP growth is projected to grow at 6.2% per year, slowing to 4.0% in the longer term (2015–2030). The service sector's share of GDP will gradually increase from 49.0% in 2005 to 53.4% in 2030, with the fastest annual growth rate of 5.2% per year. In addition to a developing financial market, receipts from gas transit are expected to bolster the service sector's growth.

In contrast, shares of total GDP will be likely to decrease for industry (from 23.0% in 2005 to 22.3% in 2030) and agriculture (28.0% to 24.3%). These sectors play a critical role in producing export commodities such as cotton, gold, energy products, ferrous and nonferrous

metals, and automobiles.<sup>80</sup> In 2008, half of all export revenue stemmed from energy, cotton, and metals.<sup>81</sup> Uzbekistan aims to increase value-added industry such as production of fuel, machinery, and metals, while gradually reducing its dependence on agriculture. Industrialization in Uzbekistan will be influenced by the degree to which the country can create favorable conditions for investment.

Uzbekistan's population will moderately increase from 26.6 million in 2005 to 35.2 million in 2030 with an average annual growth rate of 1.1%. The ratio of people living in urban areas is currently 36.7% and projected to increase to 46.1% in 2030 (Figure 6.10.1).

<sup>77</sup> UNDP. 2007a. *Options for Continuing Energy Reforms in Uzbekistan*. Policy Brief. No. 1(8), 2007. Available: [www.undp.uz](http://www.undp.uz)

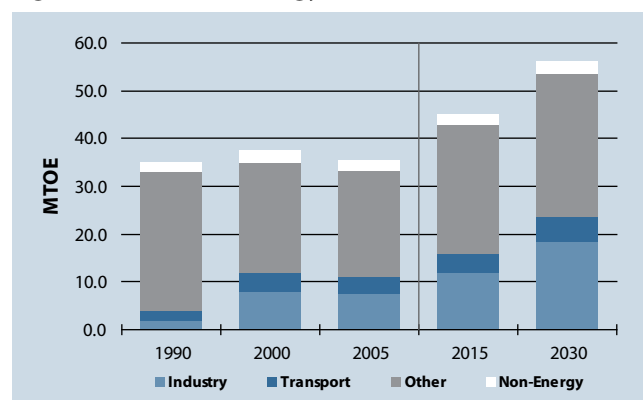
<sup>78</sup> UNDP. 2007a. *Options for Continuing Energy Reforms in Uzbekistan*. Policy Brief. No. 1(8), 2007. Available: [www.undp.uz](http://www.undp.uz)

<sup>79</sup> UNDP. 2007a. *Options for Continuing Energy Reforms in Uzbekistan*. Policy Brief. No. 1(8), 2007. Available: [www.undp.uz](http://www.undp.uz)  
The state-owned company Uzbekneftgaz is in charge of exploration, production, refining/processing, and distribution of petroleum and natural gas. Similarly, Uzbekenergo State Joint-Stock Company is responsible for the power industry, putting Uzbekugol (coal) and Uzelektroset (transmission) under its umbrella.

<sup>80</sup> Central Intelligence Agency. 2009. *The World Factbook - Uzbekistan*. Available: [www.cia.gov/library/publications/the-world-factbook/geos/UZ.html](http://www.cia.gov/library/publications/the-world-factbook/geos/UZ.html)

Uzbekistan is ranked 2nd as cotton exporter and 5th as producer.

<sup>81</sup> Asian Development Bank. 2009. *Asian Development Outlook 2009: Uzbekistan*. Manila.

**Figure 6.10.2: Final Energy Demand—Uzbekistan**

MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

## Final Energy Demand

Final energy demand is projected to grow annually at 1.9% on average, from 35.4 MTOE in 2005 to 56.2 MTOE in 2030. After declining from 2000 to 2005, the final energy demand is likely to rebound with a faster annual growth rate of 2.4% in the near term (2005–2015) and a slower pace of 1.5% in the longer term (2015–2030). The other sectors is likely to maintain the largest share at 53.8% in 2030, followed by industry at 32.7% and transport at 9.3% (Figure 6.10.2).

## Industry Sector

Energy demand from industry is expected to increase from 7.6 MTOE in 2005 to 18.4 MTOE in 2030. Although

its projected growth rate of 3.6% per year is the fastest among all the sectors, this is still much slower than the 9.8% annual growth exhibited between 1990 and 2005. A policy shift from reliance on agriculture to the development of industries such as energy products, ferrous and nonferrous metals, and automobiles is supposed to drive energy demand upward in the outlook period.

Natural gas, primarily used for boilers and furnaces, is projected to remain a dominant fuel, with average annual growth of 4.1% and an expanded share of the sector's total, reaching 89.4% in 2030 from 79.1% in 2005. Natural gas will account for 96.7% of industry's total incremental demand. Electricity is likely to grow annually at 1.1% while its share dwindles from 17.0% in 2005 to 9.2% in 2030. Electricity and natural gas will be generally used across the sector which includes fuel resources production. In contrast, slight negative growth is projected for coal and petroleum products.

## Transport Sector

Energy demand from the transport sector will moderately increase from 3.4 MTOE in 2005 to 5.2 MTOE in 2030, with a growth rate of 1.7% per year. The share of each fuel will not change over the outlook period: petroleum products will account for about 57%–58%, followed by natural gas at 39%–41%, and electricity at 2%–3%.

Petroleum products are expected to grow slowly at 1.6% per year between 2005 and 2030. An increase in freight shipments will be shared between trucks and railways, and opportunities for vehicle ownership is likely to remain limited to a relatively small high-income population. These factors all contribute to the slow projected growth of petroleum products.<sup>82</sup>

Uzbekistan's distinctive feature in the transport sector is a relatively large share of natural gas use, reflecting its transport of natural gas through pipelines. In Uzbekistan, the total length of

<sup>82</sup> Japan Association for Trade with Russia & NIS. 2007. *Transport Infrastructure Development and Demand in Central Asia*. Tokyo: Japan Association for Trade with Russia & NIS. (In Japanese). In 2005, the road segment represented the highest share at 59.5% of total person-km. By contrast, the pipeline transport represented the highest share in total ton-km in 2005 at 53.5% supported by the country's extensive pipeline network and substantial production. This was followed by rail transport at 26.2%, and road transport at 20.4% in the same year.

natural gas pipelines amounts to 12,260 kilometers. They are connected to neighboring countries such as Kazakhstan, the Kyrgyz Republic, Tajikistan, Russia, and Ukraine.<sup>83</sup> The natural gas pipeline system is operated by about 250 units of compressor stations, using electric and gas turbines.<sup>84</sup>

## Other Sectors

The growth in energy demand from other sectors will average 1.2% per year between 2005 and 2030. Natural gas, used for heating and cooking, is likely to dominate this sector's energy use through 2030, with its share of the total increasing from 74.5% in 2005 to 79.0% in 2030. This is because gasification was extensively pursued in Uzbekistan in the 1990s; 81% of the total population has access to natural gas with 95% of urban residents and 74% in rural areas.<sup>85</sup>

In spite of 100% electrification, electricity's share of energy demand of the other sectors was relatively small in 2005 at 8.9% and is likely to remain flat until 2030, while electricity demand in this sector will likely grow at 1.2% annually on average. This modest growth is due to the extensive gasification and an increased tariff as a result of price reform.

Demand for heat, used for hot water and space heating, is unlikely to change over the outlook period, seeing a gradual decline in its share from 11.6% in 2005 to 8.5% in 2030. Although the heating system is well developed in the major cities, it is inefficient due to obsolete facilities that need modernization to improve their efficiency.

## Non-Energy

Energy demand from the non-energy sector is projected to marginally increase with an average annual growth rate of 0.4% over the outlook period. Natural gas is likely to maintain the largest share through 2030, reaching 74.7% in 2030. This reflects the use of natural gas as feedstock for petrochemical manufacturing plants to produce propylene and polyethylene.<sup>86</sup>

## Primary Energy Demand

Uzbekistan's primary energy demand is projected to increase from 47.0 MTOE in 2005 to 72.6 MTOE in 2030, growing at 1.8% per year. Similarly, the growth rate of primary energy demand per capita will be moderate at 0.60%, a slight increase from 1.77 TOE in 2005 to 2.06 TOE in 2030 (Figure 6.10.3).

Natural gas is likely to remain a dominant fuel through 2030, with a share of approximately 86.0% and growth of 1.8% per year. Natural gas is projected to account for 88.5% of incre-

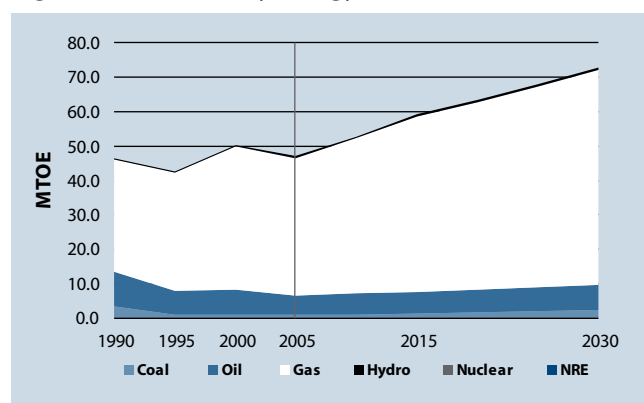
<sup>83</sup> Japan External Trade Organization (JETRO). 2006. *Feasibility Study on Modernization Plan of Angren Power Plant in Uzbekistan*. Tokyo; JETRO. (In Japanese).

<sup>84</sup> UNDP. 2007b. *The Outlook for Development of Renewable Energy in Uzbekistan*. Tashkent; United Nations Development Programme. Available: [www.undp.uz](http://www.undp.uz)

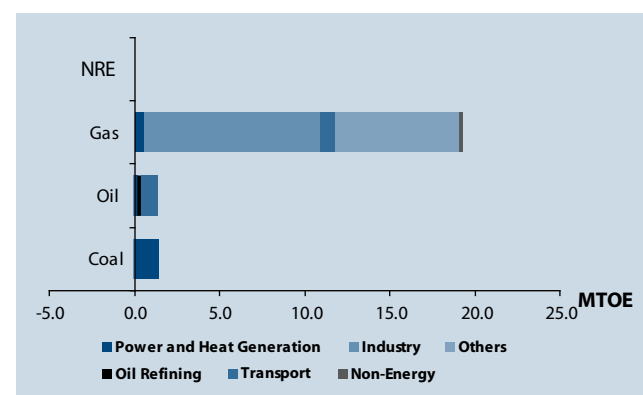
<sup>85</sup> UNDP. 2007a. *Options for Continuing Energy Reforms in Uzbekistan*. Policy Brief. No. 1(8), 2007. Available: [www.undp.uz](http://www.undp.uz)

<sup>86</sup> *Oil and Gas Journal*. 2008. Ethylene report. July 28. As of 1 January 2008, Uzbekistan has installed capacity of 140,000 tons per year for ethylene production.



**Figure 6.10.3: Primary Energy Demand—Uzbekistan**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.10.4: Incremental Energy Demand Growth—Uzbekistan (2005–2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

mental growth of the total primary energy demand between 2005 and 2030. Although coal is expected to have a small share in 2030, 3.4%, it will have the fastest growth rate, 3.6% per year from 2005 to 2030. Slight increases will be seen in the growth of oil (0.9% per year) and hydro (0.6%), but their shares will gradually decline through 2030.

Demand for natural gas is likely to increase across all sectors. Industry will account for 53.8% of the overall incremental growth in gas demand, as further development in energy production, ferrous and non-ferrous products, and automobiles are expected in this sector. The other sectors will follow, accounting for 37.9% of the incremental growth. In Uzbekistan, natural gas—supported by vast reserves—is more affordable because the price for gas is set relatively lower than coal.<sup>87</sup>

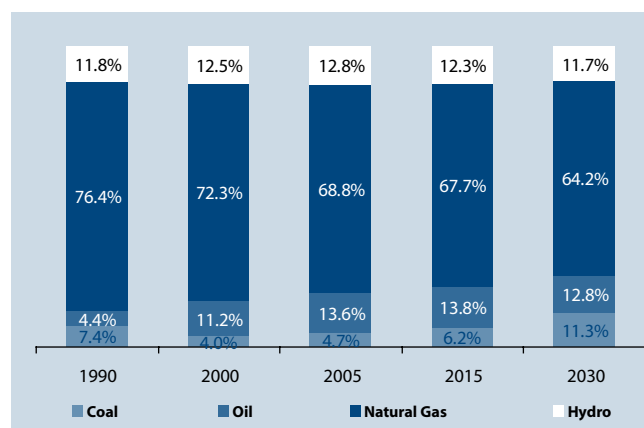
Coal (brown coal or lignite) is mostly used in the power sector. In fact, the power sector is responsible for the total incremental demand growth for coal. This is a consequence of the national plan that promotes the use of coal for power generation while reducing use of natural gas.

## Electricity

Electricity demand will grow at 1.1% per year through 2030. Its average annual growth rate will slowdown from 1.4% in the near term (2005–2015) to 1.0% in the longer term (2015–2030), mainly because population growth is expected to be moderate.

In accordance with the electricity demand, total electricity generation is also likely to show moderate growth of 1.0%, increasing from 47.7 terawatt-hours (TWh) in 2005 to 61.2 TWh in 2030. Over the outlook period, the annual average growth rate of all energy sources used for power generation, except coal, will be slow: 0.8% for petroleum products, 0.7% for natural gas, and 0.6% for hydro. In contrast, coal will stand out with the fastest growth rate, 4.6% per year through 2030, a result of the strategy to increase coal use for power generation. (Figure 6.10.5).

<sup>87</sup> UNDP. 2007a. *Options for Continuing Energy Reforms in Uzbekistan*. Policy Brief. No. 1(8), 2007. Available: [www.undp.uz](http://www.undp.uz)  
The tariff ratio for coal, natural gas, and oil is set at 1.0/0.8/0.7.

**Figure 6.10.5: Power Generation Mix—Uzbekistan**

Source: APERC analysis (2009).

Natural gas-fired power is projected to increase from 32.8 TWh in 2005 to 39.3 TWh in 2030, while its share will gradually contract from 68.8% to 64.2%. Although natural gas will be the dominant fuel in power generation through 2030, Uzbekneftegaz plans to reduce natural gas use in the power sector in order to allocate more natural gas for export.<sup>88</sup> At present, thermal efficiency of natural gas-fired power generation is not necessarily high—29.2% in 2005. However, improved thermal efficacy is expected as five natural gas-fired power plants, using combined cycle gas turbine technology with total installed capacity of 1,346 megawatts (MW), are planned to be constructed between 2011 and 2019.<sup>89</sup>

Coal use for power generation is projected to rise substantially to meet the increase in electricity demand.

Coal-fired generation will increase from 2.2 TWh in 2005 to 6.9 TWh in 2030. The Uzbekistan government plans to expand the share of coal used for power generation from 4.7% in 2005 to 13% by 2010 and 15% by 2020.<sup>90</sup>

Hydropower generation will increase slowly at 0.6 % per year from 2005 to 2030.<sup>91</sup> Uzbekenergo plans to construct a new hydropower plant in Pskem with a capacity of 404 MW, which is expected to start operations in 2018.<sup>92</sup>

## Energy Policy Issues

The major shift in energy policy in Uzbekistan is to increase coal for power generation and to dedicate more natural gas to export. The government will use natural gas as a means to acquire foreign currency for economic development. Increased coal production will have to be pursued first after many years of sluggish activity in the coal industry. In 2002, the government set a production target of 10 million tons by 2010, nearly three times the 3.3 million tons produced in 2006.<sup>93</sup> The Uzbekistan government is encouraging modernization and retrofit of facilities in the coal industry to achieve both expanded coal production and reduced production costs.

<sup>88</sup> JETRO. 2006. *Feasibility Study on Modernization Plan of Angren Power Plant in Uzbekistan*. Tokyo; JETRO. (In Japanese).

<sup>89</sup> In total, installed capacity of 3,100 MW is planned to be added between 2011 and 2019 (Footnote 88).

<sup>90</sup> Japan Electric Power Information Center, Inc. 2007. *Study on Power Sector in Central Asia*. Tokyo; Japan Electric Power Information Center, Inc. (In Japanese) p.3-37.

<sup>91</sup> UNDP. 2007b. *The Outlook for Development of Renewable Energy in Uzbekistan*. Tashkent; United Nations Development Programme. Available: [www.undp.uz](http://www.undp.uz)

The specific case supported by the government to promote the renewable energy sector is seen in the Development of Small Hydropower in Uzbekistan Program, approved by 28 December 1995 by Resolution #476 of the Cabinet of Ministers of the Republic of Uzbekistan, on the Development of Small Hydropower in the Republic of Uzbekistan.

<sup>92</sup> JETRO. 2006. *Feasibility Study on Modernization Plan of Angren Power Plant in Uzbekistan*. Tokyo; JETRO. (In Japanese).

<sup>93</sup> Japan Electric Power Information Center, Inc. 2007. *Study on Power Sector in Central Asia*. Tokyo; Japan Electric Power Information Center, Inc. (In Japanese).

Similarly, modernization of facilities and equipment for oil and natural gas production are necessary to increase their output levels because most of them are also obsolete, inherited from the former Soviet Union era. In addition, it is important to renovate the natural gas pipeline systems. Uzbekneftegaz plans to modernize the gas pipeline systems, which is expected to enable 16 billion cubic meters of natural gas to be exported by 2014.<sup>94</sup>

The Uzbekistan government has paid attention to renewable energy sources for the purpose of reducing greenhouse gas emissions and saving natural gas. Given the technology currently available, solar energy is found to have the most potential for Uzbekistan.<sup>95</sup> However, renewable energy development has made minimal progress due to the existence of abundant energy resources such as natural gas and oil, current low prices for traditional energy, and well developed electricity and heat supply systems.<sup>96</sup>

## Policy Implications

Although the Uzbekistan government has emphasized the development of energy, conditions are not necessarily favourable for investors. Since the energy sector is largely controlled by the government, foreign companies face restrictions and obstacles to entering the market. However, it is crucial to encourage the participation of foreign companies for technology development, investment in new facilities, and maintenance of existing equipment.

## References

- Asian Development Bank. 2009. *Asian Development Outlook 2009: Uzbekistan*. Available: [www.adb.org/Documents/Books/ADO/2009/UZB.pdf](http://www.adb.org/Documents/Books/ADO/2009/UZB.pdf)
- Central Intelligence Agency. 2009. *The World Factbook - Uzbekistan*. Available: [www.cia.gov/library/publications/the-world-factbook/geos/UZ.html](http://www.cia.gov/library/publications/the-world-factbook/geos/UZ.html)
- European Commission. 2008. *The Economic Aspects of the Energy Sector in CIS Countries*. Economic Papers 327. Available: [ec.europa.eu/economy\\_finance/publications/publication12678\\_en.pdf](http://ec.europa.eu/economy_finance/publications/publication12678_en.pdf)
- Japan Association for Trade with Russia & NIS. 2007. *Transport Infrastructure Development and Demand in Central Asia*. Tokyo: Japan Association for Trade with Russia & NIS. (In Japanese).
- Japan Electric Power Information Center, Inc. 2007. *Study on Power Sector in Central Asia*. Tokyo: Japan Electric Power Information Center, Inc. (In Japanese).
- Japan External Trade Organization. 2006. *Feasibility Study on Modernization Plan of Angren Power Plant in Uzbekistan*. Tokyo: JETRO. (In Japanese).

<sup>94</sup> JETRO. 2006. *Feasibility Study on Modernization Plan of Angren Power Plant in Uzbekistan*. Tokyo: JETRO. (In Japanese).

<sup>95</sup> UNDP. 2007b. *The Outlook for Development of Renewable Energy in Uzbekistan*. Tashkent: United Nations Development Programme. Available: [www.undp.uz](http://www.undp.uz)

<sup>96</sup> Japan Electric Power Information Center, Inc. 2007. *Study on Power Sector in Central Asia*. Tokyo: Japan Electric Power Information Center, Inc. (In Japanese).

- Oil and Gas Journal*. 2008. Ethylene report. July 28.
- United Nations Development Programme. 2007a. *Options for Continuing Energy Reforms in Uzbekistan. Policy Brief. No. 1(8), 2007*. Available: [www.undp.uz](http://www.undp.uz)
- . 2007b. *The Outlook for Development of Renewable Energy in Uzbekistan*. Tashkent; United Nations Development Programme. Available: [www.undp.uz](http://www.undp.uz)
- World Bank. 2004. *Central Asia Regional Electricity Exports Potential Study*. Available: [siteresources.worldbank.org/INTUZBEKISTAN/Resources/REEPS\\_Main\\_Report\\_Final\\_English.pdf](http://siteresources.worldbank.org/INTUZBEKISTAN/Resources/REEPS_Main_Report_Final_English.pdf)
- . 2006. *Transport – Uzbekistan*. Updated on March 15, 2006. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/EXTECAREGTOPTRANSPORT/0,,contentMDK:20649613~pagePK:34004173~piPK:34003707~theSitePK:571121,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/EXTECAREGTOPTRANSPORT/0,,contentMDK:20649613~pagePK:34004173~piPK:34003707~theSitePK:571121,00.html)
- . 2009. *Uzbekistan - Country Brief 2009*. Available: [www.worldbank.org/uz/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/UZBEKISTANEXTN/0,,menuPK:294197~pagePK:141132~piPK:141107~theSitePK:294188,00.html](http://www.worldbank.org/uz/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/UZBEKISTANEXTN/0,,menuPK:294197~pagePK:141132~piPK:141107~theSitePK:294188,00.html)

## 6.13 Mongolia

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- *Mongolia's primary energy demand is expected to grow annually at 2.2%, from 2.6 million tons of oil equivalent (MTOE) in 2005 to 4.5 MTOE in 2030, driven primarily by the high demand for oil in the industrial and transport sectors and coal for power generation.*
- *The member's increasing reliance on the mining industry and the government's promotion for coal use raise environmental concerns on air pollution and CO<sub>2</sub> emissions during the outlook period.*
- *Although crude oil extraction has steadily increased, there was no domestic oil refinery plant until recently, and the country will likely continue to rely on imports to meet the domestic oil demand.*

### Recent Energy Trends and Energy Policy

Mongolia's primary energy demand has declined sharply from 3.4 MTOE in 1990 to 2.4 MTOE in 2000 as a result of the collapse of the Soviet Union in the early 1990s. However, driven largely by the development of industry sector, especially mining, and the transport sector, Mongolia's energy demand rebounded to 2.8 MTOE in 2006 at an annual rate of 2.6%. During the same period, per capita energy demand dropped to 0.96 tons of oil equivalent (TOE) in 2000 from 1.54 TOE in 1990 and then recovered to 1.07 TOE in 2006.

Mongolia is endowed with a large amount of energy reserves, including a vast coal reserve (210 billion tons). Crude oil is being extracted, but the country has no domestic downstream oil industry,<sup>106</sup> so all petroleum products are imported. Mongolia's commercial energy sources consumed domestically are limited to indigenous coal and imported petroleum products. Coal is used to generate electricity and heat; petroleum products are used mainly for transport and electricity generation in isolated systems.

In 2001, the Great Khural (Parliament) adopted a new energy law that replaced the previous law enacted in 1995. The purpose of this law is to regulate energy generation, transmission, and distribution; dispatching and supply activities; energy facilities construction; and energy demand that involves utilization of energy resources.<sup>107</sup>

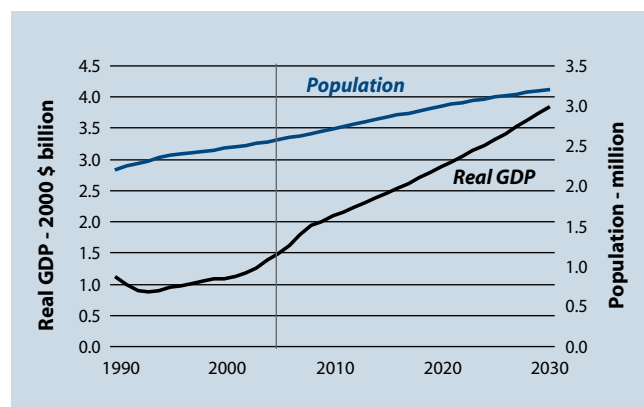
### Energy Demand Drivers

Mongolia has seen dramatic changes over the last 10 years since the collapse of the Soviet Union. From a system of state planning, the country has moved toward a market-based economy. Over the outlook period, the economy is expected to continue growing steadily. Mongolia's gross domestic product (GDP) is projected to grow at an annual rate of 3.9% (2005–2030). The performance of the industrial sector, which includes mining, manufacturing, construction,

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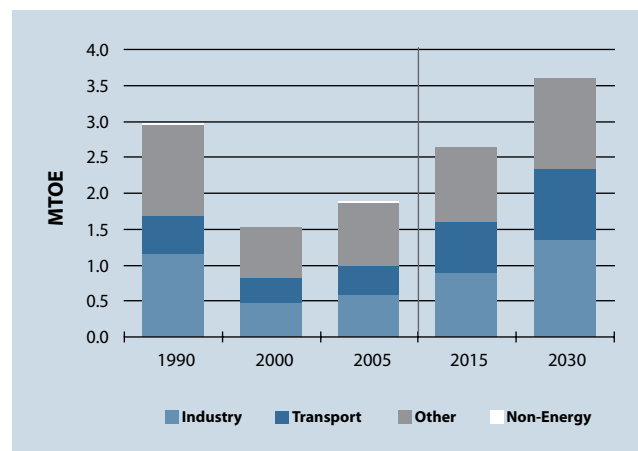
<sup>106</sup> Nearly all the crude oil is exported to the People's Republic of China (PRC).

<sup>107</sup> Law of Mongolia on Energy.

**Figure 6.13.1: GDP and Population—Mongolia**

GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

**Figure 6.13.2: Final Energy Demand—Mongolia**

MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

and utilities, saw ups and downs during the early years of transition, yet took off from 2000.<sup>108</sup> The strong performance is expected to continue over the outlook period. The fastest growing economic sector has been the tertiary/services sector in Mongolia, especially retail and wholesale trade, transport, communications, and financial services.<sup>109</sup> However, the share of the service sector's GDP to total was smaller at 34%, compared with the industry sector (41% of total GDP). Both sectors are expected to be the major drivers of the country's economy during the outlook period.<sup>110</sup>

Between 1990 and 2005, Mongolia's total population grew from 2.2 million to 2.6 million. Over the outlook period, total population is projected to grow at an annual rate of 0.9%, reaching 3.2 million by 2030 (Figure 6.13.1).

## Final Energy Demand

Final energy demand is projected to grow at 2.7% per year. Energy demand in the industry sector will replace the other sectors (including agriculture, commercial, and residential), account-

<sup>108</sup> World Bank. 2007a. *Mongolia Sources of Growth*. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html)

Much of this overall positive performance has been due to the rapidly expanding mining sector, which posted increases of 34.3 % and 11.3 %, respectively, during 2001–2004 and 2005. The increase in mining value added is a result of new activities and projects coming on stream as well as the recent increase in global commodity prices.

<sup>109</sup> World Bank. 2007a. *Mongolia Sources of Growth*. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html)

<sup>110</sup> World Bank. 2007a. *Mongolia Sources of Growth*. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html)

The GDP growth that occurred in the first decade since 1993 was driven by the husbandry and agriculture sector but severe weather thereafter blocked the growth path.

ing for the largest share at around 37.8%, followed by the other sectors at 35.0%, transport at 27.1%, and non-energy at 0.1% in 2030 (Figure 6.13.2).

## Industry Sector

Industry energy demand is projected to grow at an average annual rate of 3.4% between 2005 and 2030 in contrast to a 4.4% annual decline observed between 1990 and 2005. Mining is inevitably a priority subsector. Although value added from the mining sector as a share of GDP has only recently started to grow and still accounts for only a small part of the total GDP, the situation is likely to change in the near future as newly discovered deposits come onstream. The progress of urbanization, focused around the capital, Ulaanbaatar, and mining areas will lead to more construction activities. Also, machinery manufacturing will speed up along with an increase in mining operations.

By energy type, oil is expected to grow at the fastest rate of 5.5% through 2030. Oil is the dominant fuel and its increasing demand in the industry sector is mainly due to expected new mining projects (diesel for trucks in the mining subsector is counted under the industry energy demand). Industrial oil demand will reach 41.5% in 2030, from 25.5% in 2005.

Demand for coal is expected to grow at 4.9% per year, a little slower than oil. Following oil and coal, electricity demand is projected to grow at an annual rate of 3.7% over the outlook period. Similarly, the future industrial demand for electricity will be inevitably influenced by new projects within the mining and construction subsectors. The mining subsector is a central consumer, and mining projects in the South Gobi region will require substantial amounts of electricity.<sup>111</sup> Demand for heat is mainly from the manufacturing subsectors, led by food and textiles, which are livestock-related. The heat demand is expected to decline at a mild rate of –0.1% from 2005 to 2030, with its share down to 16.1% in 2030 from 39% in 2005.

## Transport Sector

Over the outlook period, transport energy demand is projected to increase substantially at an annual rate of 3.5%, driven by the government's increasing support. According to the World Bank, the Mongolian government has proposed a total investment in transport infrastructure of \$2.9 billion between 2008 and 2015.<sup>112</sup> As a natural transit country for trade between Russia and the People's Republic of China (PRC), and with its heavy dependence on exports for GDP growth, Mongolia needs to develop transport for future economic development. Because of the currently insufficient transport capability, the government puts a high priority on transport development. The Transit Mongolia Programme was drafted to improve the nation's transport network.<sup>113</sup>

By energy type, diesel for trucks and buses is expected to grow at the highest rate of 5.3% over the outlook period. The rapidly rising demand for diesel is mainly driven by the increasing

<sup>111</sup> World Bank. 2007b. *Foundation for Sustainable Development: Rethinking the Delivery of Infrastructure Services in Mongolia*. [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21394791~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21394791~pagePK:141137~piPK:141127~theSitePK:327708,00.html)

<sup>112</sup> Swedish Trade Council Beijing Office. 2008. *Private Sector Opportunities in the Oil, Gas and Coal Sectors in Mongolia*. Available: [www.swedishtrade.se/PageFiles/138252/Private%20sector%20opportunities%20in%20the%20oil,%20gas%20and%20coal%20sectors%20in%20Mongolia.pdf](http://www.swedishtrade.se/PageFiles/138252/Private%20sector%20opportunities%20in%20the%20oil,%20gas%20and%20coal%20sectors%20in%20Mongolia.pdf)

<sup>113</sup> The program was drafted by the Mongolian National Transport and Trade Facilitation Committee, which was established in 2007 and chaired by the minister responsible for roads transport and tourism.

freight transport by road. Mongolia's transport sector was recently privatized, and most freight and passenger transport companies are now privately owned. Today, even bulky items such as mining commodities, are carried on the road network. Construction of several Asian highway routes in Mongolia is included in the Transit Mongolia Program. The projects include a road from Ulaanbaatar to the PRC and four additional north-south roads linking Russia to the PRC.

Gasoline for passenger vehicles will grow at an annual rate of 3.2% over the outlook period. The number of passenger vehicles in Mongolia has been increasing quickly—by an annual rate of 14% from 2001 to 2007.<sup>114</sup> With urban progress around Ulaanbaatar and improving road conditions, the increase of passenger vehicles will continue in the future.

Electricity is projected to increase substantially at a rate of 3.8% per year. This demand comes from the railway subsector. Rail transport has become the main mode of moving heavy and bulky freight in Mongolia.<sup>115,116</sup> Most of the proposed investments in the transport infrastructure are aimed at improving the country's railways, focusing mainly on maintaining and upgrading the existing railways. There are also proposals to construct new rail lines, including a new north-south railway beside the existing one and a railway network in the south to aid the promising mining industry in the South Gobi area.

Jet kerosene for international air transport is expected to grow at an annual growth rate of 2.9% through 2030. The government plans to improve air navigation safety by upgrading existing airport conditions, expanding international destinations, and increasing the number of aircraft.

## Other Sectors

Over the outlook period, the energy demand of the other sectors is projected to increase at an annual rate of 1.5% (2005–2030). Electricity is projected to grow at the fastest annual rate of 3.8%, and the residential subsector is the major consumer. Between 67% and 75% of Mongolia's population has access to electricity, but the vast majority of the households are found in urban areas, and many connections provide enough current for only a bulb, leaving nearly nothing for heating or cooking.<sup>117</sup> The growing demand for electricity will be driven by expanding generation and distribution capacity, as well as by improving existing networks.

Over the same period, demand for heat is expected to grow at an annual rate of 1.3%. Because of long periods of cold weather and fierce winters, Mongolians already spend a large part of their income on heating. In urban areas, households that have access to the electricity network also have access to heat distribution systems because most of the country's coal-fired power plants are combined heat and power (CHP) plants that generate electricity and heat at the same time. In other areas, people use coal-fired stoves for heating. Although the increasing household demand for heat is mainly driven by population growth, commercial demand for heat, which is the second largest among the other sectors, is influenced mainly by GDP growth.

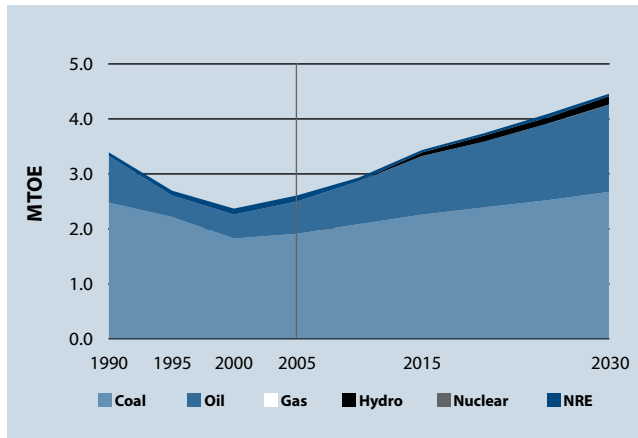
<sup>114</sup> Calculated based on the data from National Statistical Office Mongolia (NSOM).

<sup>115</sup> Freight transported by rail decreased somewhat in recent years due to rapid growth in road transport.

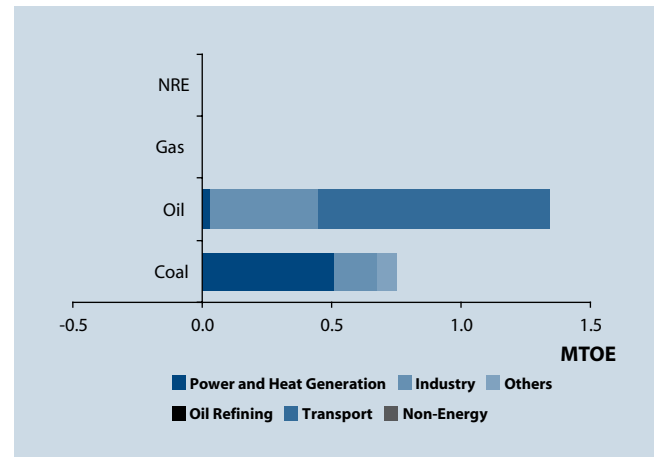
<sup>116</sup> Most rail freight consists of coal transports to the power stations in Ulaanbaatar. Others include oil and timber transports from Russia to the PRC. (Footnote 115).

<sup>117</sup> World Bank/Public–Private Infrastructure Advisory Facility. 2007.



**Figure 6.13.3: Primary Energy Demand—Mongolia**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.13.4: Incremental Energy Demand Growth—Mongolia (2005–2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

Coal demand is projected to increase at an annual rate of 1.2% through 2030. Coal is mainly consumed in the residential subsector and has already been a major fuel for cooking and heating for rural families (as well as urban families that cannot get enough electricity or heat supply). As long as they are noncompetitive and not subsidized by the government, imported fuel demand is unlikely to spread, and coal will remain the dominant fuel for household use.<sup>118</sup>

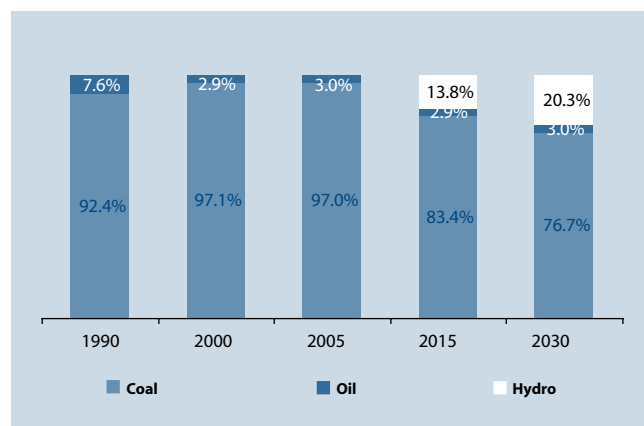
## Primary Energy Demand

Mongolia's primary energy demand is projected to grow at an annual rate of 2.2% through 2030, from 2.6 MTOE in 2005 to 4.5 MTOE in 2030. Over the outlook period, GDP elasticity of energy will account for 0.55. Oil is projected to grow at the fastest pace of 4.1% per year, followed by coal at 1.3% per year. In contrast, biomass is projected to decline at a rate of 2.9% per year (Figure 6.13.3).

By energy type, oil is expected to grow at the fastest rate of 4.1% per year (2005–2030). Oil demand growth is dominated by the transport sector, which will be responsible for more than 66.5% of overall incremental demand growth between 2005 and 2030. Although the industry sector accounts for 31% of overall incremental demand growth, power generation will represent substantial growth as well—accounting for 2.5% of incremental oil demand growth during the same time period.

Coal demand is projected to grow at an annual rate of 1.3% (2005–2030). The power sector will be responsible for more than 67.6% of incremental coal demand growth between 2005 and 2030. The remaining incremental growth in coal demand will come from the industry sector, accounting for 22.2%, and the others sectors will represent 10.2% (Figure 6.13.4).

<sup>118</sup> Because of current import dependency on gas and petroleum products, the distribution of pipes for liquefied petroleum gas or natural gas is not included in the government program (such as the "40,000 apartments") for new constructed apartments. (Action Plan of the Government of Mongolia for 2004–2008).

**Figure 6.13.5: Power Generation Mix—Mongolia**

Source: APERC analysis (2009).

## Electricity

Electricity demand is projected to grow by a yearly rate of 3.8%. Forces behind the increasing demand include rising urbanization, increased mining and construction, and transport and communication usage.

To meet the growth in demand, total electricity generation will more than double, from 3.5 terawatt-hours (TWh) in 2005 to 9.0 TWh in 2030. In terms of generation by energy type, oil is expected to increase at the fastest rate of 3.9% over the outlook period, followed by coal at a rate of 2.9% per year. Though there was no hydropower generation until 2005, hydropower is expected to grow at a rate of 5.9% per year from 2015 to 2030 (Figure 6.13.5).

The existing system also needs to be improved to decrease transmission and distribution loss and internal use by power stations. In 2007, losses in transmission and distribution, as well as the stations' internal usage, accounted for nearly 30% of total gross generation.<sup>119</sup>

Growing at an annual rate of 3.9%, oil-fired generation will more than double, from 0.1 TWh in 2005 to 0.3 TWh in 2030 (almost the same as the 1990's generation of 0.3 TWh). In Mongolia, oil (mainly diesel) is used for power generation in isolated areas without access to the grid and is heavily subsidized. However, because of the high operation cost and diesel fuel cost, a large-scale oil power plant is unlikely to be developed. Its share is also very small—expected to be 3.0% in 2030, unchanged from 2005.

Coal-fired generation is projected to increase at 2.9% per year (2005–2030). Because of the country's large coal reserves, more than 90% of electricity generation in 2005 was from coal-fired power plants. Coal-fired power generation is expected to reach 6.9 TWh in 2030, almost doubling the 2005 level at 3.4 TWh. However, because it will be increasingly replaced by hydropower, its share will shrink to 76.7% in 2030 from 97.0% in 2005.

Hydrogeneration is expected to grow at a rate of 5.9% from 2015 to 2030. The hydroenergy potential is estimated at 6,200 megawatts (MW), and several hydropower sites have been identified in Mongolia. The government is also positive about hydropower projects. By 2030, around 20% of the country's electricity demand is expected to be met by hydropower.

The Mongolian Parliament adopted the National Renewable Energy Law in 2005 (enacted in January 2007) to regulate generation and delivery of renewable energy resources.<sup>120</sup> In the National Renewable Energy Program, passed by the Parliament in 2005, the target of renewable energy use was set at 3%–5% of total electricity generation by 2010 and 20%–25% by 2020. However, by 2008 there were only 60,000 independent solar power systems for households and 4,000 portable small wind generators with capacity ranging from 50 windpower (Wp) to 150 Wp.<sup>121</sup>

<sup>119</sup> National Statistical Office Mongolia (NSOM).

<sup>120</sup> According to the law, the tariffs on power generation from renewable energies are set at 8.0–9.5 US cents/kWh for wind, 4.5–6.0 US cents/kWh for hydro (with no more than 5 MW), and 15.0–18.0 US cents/kWh for solar power.

<sup>121</sup> Ganjuur, Rarii. 2008. *Renewable Energy Resources and the Utilization in Mongolia*.

## Energy Policy Issues and Implications

Urbanization, the expanding mining sector, and continued growth in Russia and the PRC trade all provide hope for rapid economic advances. Infrastructure is the key to unlocking these prospects.<sup>122</sup> Unfortunately, Mongolia's infrastructure sector is seriously underdeveloped. In fact, the infrastructure has become one of the impediments to development. For example, the costs of rail transport, both in terms of unit cost of freight forwarding per kilometer and the cost of border crossings to neighboring countries, are much higher than those of other landlocked countries in Asia and the Central Asian Republics.<sup>123</sup>

To address the urgent infrastructure barriers, the Mongolian government has proposed several programs and investments: the Transit Mongolia Program, the Millennium Road Project, investments in railway construction, the Program on Integrated Power Energy System of Mongolia, and so forth. According to the World Bank study, there are three solutions: more closely aligning prices with costs, improving efficiency and governance, and incorporating better planning. The government's ability to finance the promised investments to infrastructures is also a concern.

## References

- Enebish, N. et al. 2004. *Renewable Energy Application in Mongolia*. Paper presentation at the Second Regional Training and Planning Workshop of PREGA<sup>124</sup>, ADB, Manila, 5-8 October.
- Ganjuur, Radii. 2008. *Renewable Energy Resources and the Utilization in Mongolia*. Paper Presented at the Fourth Annual Meeting of CAREC Electricity Regulators Forum, ADB, Karven Issyk-Kul, 15-19 September.
- Government of Mongolia. 2001. *Law of Mongolia on Energy*.
- Swedish Trade Council Beijing Office. 2008. *Private Sector Opportunities in the Oil, Gas and Coal Sectors in Mongolia*. Available: [www.swedishtrade.se/PageFiles/138252/Private%20sector%20opportunities%20in%20the%20oil,%20gas%20and%20coal%20sectors%20in%20Mongolia.pdf](http://www.swedishtrade.se/PageFiles/138252/Private%20sector%20opportunities%20in%20the%20oil,%20gas%20and%20coal%20sectors%20in%20Mongolia.pdf)
- United Nations Centre for Regional Development. 2009. *Sustainable Transport Challenges, Strategy of Mongolia*. Presented at Fourth Regional Environmentally Sustainable Transport (EST) Forum, Seoul, 24-26 February. Available: [www.uncrd.or.jp/env/4th-regional-est-forum/Presentations/04\\_BS1\\_Mongolia.pdf](http://www.uncrd.or.jp/env/4th-regional-est-forum/Presentations/04_BS1_Mongolia.pdf).
- World Bank. 2007a. *Mongolia Sources of Growth*. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html)
- . 2007b. *Foundation for Sustainable Development: Rethinking the Delivery of Infrastructure Services in Mongolia*. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21394791~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21394791~pagePK:141137~piPK:141127~theSitePK:327708,00.html)

<sup>122</sup> World Bank. 2007b. *Foundation for Sustainable Development: Rethinking the Delivery of Infrastructure Services in Mongolia*. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21394791~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21394791~pagePK:141137~piPK:141127~theSitePK:327708,00.html)

<sup>123</sup> World Bank. 2007a. *Mongolia Sources of Growth*. Available: [web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html](http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/MONGOLIAEXTN/0,,contentMDK:21487082~pagePK:141137~piPK:141127~theSitePK:327708,00.html)

<sup>124</sup> TA 5972-REG: Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement.

## 6.14 People's Republic of China

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- *Rapid economic growth in the People's Republic of China will drive an annual growth rate of 2.4% in final energy demand (2005–2030).*
- *Total primary energy demand is projected to grow at 2.6% annually. Coal will account for the bulk of the primary energy mix, at 53.4% in 2030, although it represents a reduced share compared with the 2005 level of 63.2%.*
- *The increasing amount of oil demand will have to be met by imports, with oil import dependency increasing from 43.6% in 2005 to 71.9% in 2030.*
- *Nuclear power will play a key role to slow carbon dioxide emissions; its growth rate will be about 11.9% (2005–2030).*

### Recent Energy Trends and Energy Policy

The People's Republic of China's (PRC) energy demand rose gradually from 1990 to 1996, moderated for a few years, and then accelerated rapidly from 2000 with sustained and very fast economic expansion. Over this period, total primary energy demand grew from 863.2 million tons of oil equivalent (MTOE) in 1990 to 1,878.7 MTOE in 2006, an average annual rate of 5.0%. The total final energy demand growth was slower at 3.8%. Per capita primary energy demand grew rapidly from 0.75 tons of oil equivalent (TOE) to 1.42 TOE, still well below its neighbors and the East Asia group's 2006 average of 1.59 TOE per capita. Primary energy intensity, conversely, fell from 1,942 TOE/\$ million to 896 TOE/\$ million, an average annual rate of –4.7%. This rate was a much faster decline than the East Asia group's rate of –2.7%, but as a developing country, the PRC's absolute economic energy intensity was still quite high for the region.

The PRC is geographically the largest among Asian Development Bank members in Asia and the Pacific. It has the world's largest population, one that is rapidly urbanizing and concentrated mostly along its eastern coastline, and it is among the top global producers and consumers of energy. A robustly developing major global manufacturing and production base, the PRC's industry sector currently dominates energy demand; despite sustained growth, however, it is gradually yielding share to the "others" sector, including transport. From 1990 to 2006, the share of final energy demand attributed to the industry sector rose from 36.3% to 43.8%. The "others" sector, which includes residential, commercial, agricultural, and other energy uses, fell from 51.7% to 37.4% in the same period. The transport sector's share grew quickly, from 5.6% to 10.5%, driven by demand for freight and personal road transport as well as air travel.

Coal remains the major fuel, although oil and electricity are increasingly important. From 1990 to 2006, coal's share of primary energy demand grew from 61.2% to a dominant 64.2%. Used primarily in the power and industry sectors, oil grew from 12.8% to 18.3%, and natural gas grew from 1.5% to 2.5%. The PRC also has significant hydropower production, and nuclear power was introduced in the 1990s. However, overall shares for both remain small; hydropower rose from 1.3% to 2.0% from 1990 to 2006, and nuclear power reached 0.8% in 2006. Over the same period, coal's share of final energy demand fell dramatically, from 47.5% to 32.7%, whereas the share for oil rose from 12.6% to 24.6% with electricity's rise. Gas rose from 1.5% to 3.1%. PRC electricity production grew 10.0% annually between 1990 and 2006 and an even higher 13.3% between 2000 and 2006, driven largely by industrial demand. Generation continues to rely

heavily on coal, an abundant and cheap domestic resource, followed by hydropower.

In more recent years, the PRC's overall energy demand growth accelerated significantly, following a 1996–2000 slowdown. Average annual primary energy demand growth increased from 2.5% in 1990–2000 to 9.2% in 2000–2006. Recent total economic growth was similar to that of the 1990s, actually having fallen slightly from 10.4% annual growth in 1990–2000 to 9.8% growth in 2000–2006. Much of the dramatic increase in primary energy demand can be attributed to a resurgence of energy-intensive heavy industries such as the iron and steel, aluminium, and cement subsectors.

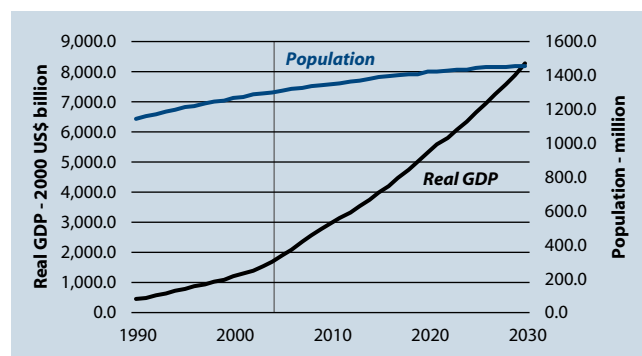
The PRC energy resources are abundant, but rapid growth in energy demand outpaces growth in energy production. Estimates put recoverable coal reserves at 115 billion tons,<sup>125</sup> proven gas reserves at 80.0 trillion cubic feet, and proven oil reserves at 16 billion barrels.<sup>126</sup> From 1990 to 2006 energy import dependency gradually grew from –4.1% to 7.2%, reflecting the PRC's 1997 shift from net energy exporter to importer. Despite significant domestic production of oil, marginal growth in demand for crude and petroleum products destined for the transport and industry sectors drives increasing energy imports. Non-fossil natural energy resources in the PRC are plentiful as well; hydropower resource potential is estimated to be among the highest globally, and renewable resources, particularly those for wind, hold extremely good potential for continued rapid development such as that experienced in recent years.

Energy policy in the PRC was historically guided by successive 5-year plans that emphasized the role of energy security given continually rising demand alongside supply limits. With the philosophy that the energy sector should not impinge on overall economic growth, the PRC energy policy has identified the shared importance of expanding and strengthening energy supply while prioritizing energy efficiency and conservation across all sectors. The most recent *Eleventh 5-year guidelines*, issued in 2006, gave special attention to the role of efficiency, setting targets to improve subsector and technology-specific efficiency metrics with an overarching goal of 20% reduction in economic energy intensity by 2010 (about 4.4% annual reduction). Supporting energy legislation and policies were broad-based and sophisticated, with key measures including the closure of small coal mines to address safety and efficiency concerns; the closure of small, old, and inefficient power generators and deployment of advanced thermal generator technologies; the broad deployment of flue gas desulphurization equipment on coal-fired power generators to help meet sulphur dioxide emission reduction targets; the accelerated development and strengthening of energy infrastructure, including electric grids, gas pipelines, and rail networks; and the promotion of new and clean energy such as natural gas, nuclear, and renewable sources.

In addition to measures that guide energy infrastructure development, recent energy sector reforms also addressed structural reforms. For example, energy policy coordination and strategy was strengthened with the establishment of the National Energy Administration, electricity market reform, and liberalization continued under the State Electricity Regulatory Commission, and tax and pricing reforms were implemented or considered for a variety of fuels. Because the PRC's energy development is heavily influenced by the form of overall economic development, structural characteristics continue to be an important part of government dialogues on energy policy.

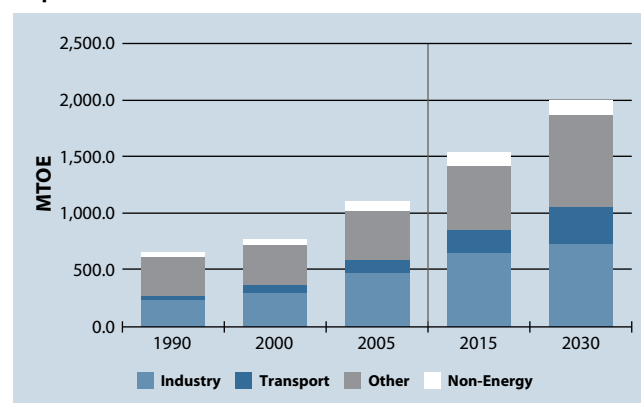
<sup>125</sup> World Energy Council. 2007. *2007 Survey of Energy Resources*. London.

<sup>126</sup> Sandrea, Rafael. 2009. An In-Depth View of Future World Oil and Gas Supply: A Quantitative Model Analysis. *Oil and Gas Journal*. (January). Houston: Pennwell Editors.

**Figure 6.14.1: GDP and Population—People's Republic of China**

GDP = gross domestic product.

Source: Asia Pacific Energy Research Centre (APERC) (2009).

**Figure 6.14.2: Final Energy Demand—People's Republic of China**

MTOE = million tons of oil equivalent.

Source: APERC analysis (2009).

## Energy Demand Drivers

The PRC per capita gross domestic product (GDP) in 2006 was approximately \$1,600 (constant 2000 dollars), lower than ADB East Asia group's average of \$2,400, but having grown quickly at 9.2% annually from 1990 to 2006. Electrification rate was 99% as a result of successful rural electrification programs despite a population urbanization level of only 43.9%. Average annual economic growth from 1990 to 2006 was generally stable and very high at 10.1%, although GDP growth is projected to slow to a still-robust annual rate of 6.1% over the 2005 to 2030 outlook period. Economy-wide primary energy intensity is projected to continue to fall over the outlook period (although the rate of decline will likely fall behind its historically fast trend), given expected cross-sector improvements in energy efficiency, a continued transition to higher quality fuels, and a gradual economic structural shift away from the most energy-intensive heavy industries.

Between 1990 and 2006, the PRC population grew from 1.14 billion to 1.32 billion, an average annual rate of only 0.9%. Population growth is projected to slow to 0.4% over the outlook period, reaching 1.45 billion in 2030 and reaching its peak soon after as the average age rises. Over the outlook period, this population will become increasingly wealthy, urban, and mobile. This will be reflected in an increased demand for energy services and fuel, switching away from direct use of coal and biomass and toward clean and refined fuels such as electricity and gasoline in the residential, commercial, and transport sectors. Drawing from the developmental experiences of the PRC's East Asia group neighbors, this large demographic shift will over time change the broader structure of the economy itself as domestic demand of goods and services grows (Figure 6.14.1).

## Final Energy Demand

Over the forecast period, final energy demand is projected to grow at 2.4% per year, much lower compared with the annual growth rate of 3.5% from 1990 to 2005. In 2030, the other sectors will maintain the largest share at 40.4%, followed by the industry sector at 36.4%, and transport at 16.8% (Figure 6.14.2).

## Industry Sector

The PRC's industrial energy demand is projected to grow at an average annual rate of 1.7% until 2030, lower than its average annual growth of 4.7% from 1990 to 2005. More than two-thirds of the energy required in the industrial sector will be used by heavy industry such as chemicals, metals, non-metallic minerals, mining, and quarrying. Coal has been the major source of energy in China's industrial sector, although other fuels, such as oil and electricity, have nibbled at its share.<sup>127</sup> Over the outlook period, coal's share to total industrial energy demand is expected to decline and will reach 46% by 2030 (from 59% in 2005). Coal is mainly used in the production of crude steel, cement, and chemicals.

The share of total industrial energy from petroleum products is projected to decrease to 6% of the total industrial energy demand in 2030 from 8% in 2005. Natural gas is projected to grow fast at 6.1% per year, compared with 3.5% from 1990 to 2005. Despite its relatively fast growth, the share of natural gas to total industrial energy demand will reach only 7% in 2030 in comparison with 3% in 2005.

Over the outlook period, electricity is projected to represent the fastest growth at an annual rate of 2.8%. Its demand will account for 32% of industrial energy demand in 2030. Manufacturing would account for the large proportion of growth for electricity demand.

## Transport Sector

Over the outlook period, the PRC's transport energy demand will grow by 4.4% annually (2005–2030). By fuel type, gasoline (the main fuel for passenger vehicles) will see a 4.3% growth rate, and diesel for trucks and farm vehicles is expected to grow by 4.5%. Continued income growth would boost the number of passenger vehicles owned. Following the commitment to the World Trade Organization (WTO), the PRC gradually lowered the tariffs on imported cars and parts, and completely removed them in 2007, thereby making cars more affordable for the general public.

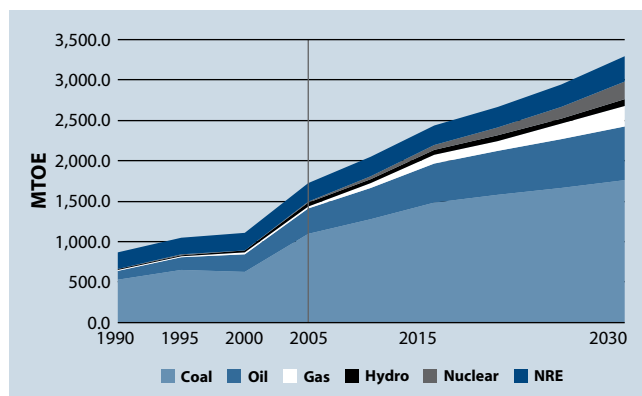
## Other Sectors

Energy demand in the other sectors, which includes residential, commercial, agricultural, and construction demand, is expected to grow at 2.5% per year over the outlook period. Electricity and biomass are expected to continue to dominate the fuel mix in this sector, accounting for 26% and 28% in 2030, respectively, compared with 7% and 61%, respectively, in 2005. This increase in electricity over biomass can be accounted for by higher living standards and availability of electricity.

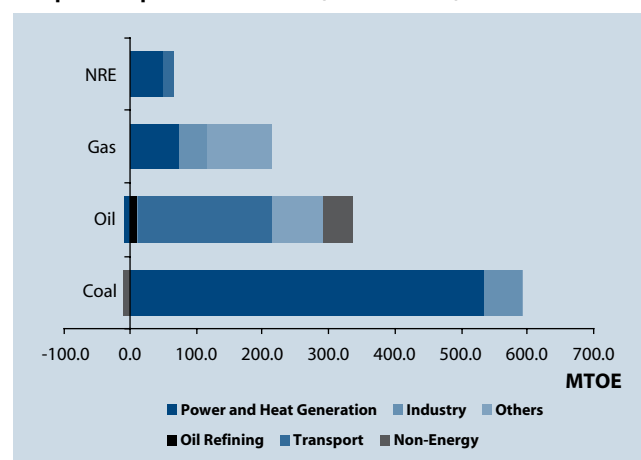
## Primary Energy Demand

The PRC's total primary energy demand is projected to grow at an annual rate of 2.6%—a slower pace than the 4.7% per annum from 1990 to 2005. Among the fossil fuels, natural gas will grow at the fastest pace of 7.7% per year, followed by oil at 3.1% and coal at 1.9%. Nuclear will play a key role to reduce carbon dioxide emissions, its growth rate will be 11.9%, and new and renewable energy (NRE) will be about 1.0% (from 2005–2030).

<sup>127</sup> Share of coal in the industrial sector stood at 71% in 1990, 59% in 2000, and 59% in 2005.

**Figure 6.14.3: Primary Energy Demand—People's Republic of China**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

**Figure 6.14.4: Incremental Energy Demand Growth—People's Republic of China (2005–2030)**

MTOE = million tons of oil equivalent, NRE = new and renewable energy.  
Source: APERC analysis (2009).

Coal demand will be largely driven by the power sector, accounting for about 80% of coal's incremental growth between 2005 and 2030. To meet the rising electricity demand, the PRC will continue to rely on coal because it is the most cost-competitive option among all fuel types, considering that it has significant coal reserves. The installed capacity of coal-fired generation may increase from 381 gigawatts (GW) in 2005 to 762 GW in 2030.

The transport sector will boost demand for oil, accounting for 61.7% of the incremental oil demand growth between 2005 and 2030. With rising demands and inadequate supply increases, the PRC's net oil import dependency is projected to increase from 43.6% in 2005 to 71.9% in 2030.

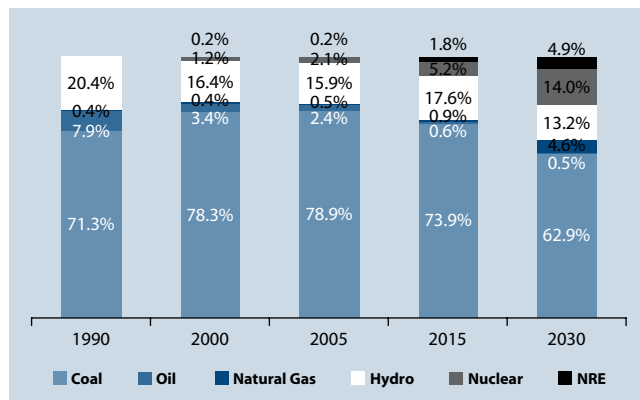
The share of natural gas in total primary energy demand will increase from 2.3% in 2005 to 7.9% in 2030. Although the share represents less than half of the current natural gas proportion in Europe and the United States, there are some impediments for achieving it. The first West-East Gas Pipeline started commercial operation on 30 December 2004, with the pipeline network covering more than 70 cities, 3,000 large and medium-sized enterprises, 42 billion cubic meters of natural gas sales, and nearly 2 billion people benefiting from its use. The pipeline has also become the main gas source for the PRC's Bohai Sea and the Yangtze River Delta economic circle. On 22 February 2008, the second line of the West-East Gas Pipeline began construction. This gas line, which passes through 14 provinces and municipalities, is a main energy artery with a total length of 9,139 km. Its west point starts in Horgos in Xinjiang, southeast to Guangzhou, and east to Shanghai, connecting the Central Asia Gas Pipeline across three source countries: Kazakhstan, Turkmenistan, and Uzbekistan.<sup>128</sup> The amount of natural gas will be 30 billion cubic meters, and the gas supply will last for more than 30 years. With all these factors taken into account, the share of natural gas in total primary energy supply (TPES) will reach 2.3% in 2015 and 7.7% in 2030.<sup>129</sup>

<sup>128</sup> China Internet Information Center. 2008. *Kazakhstan Starts Work to Send Gas to China*. Available: [www.china.org.cn/business/2008-07/10/content\\_15985103.htm](http://www.china.org.cn/business/2008-07/10/content_15985103.htm)

<sup>129</sup> China Internet Information Center. 2008. *China Lays 2nd West-East Natural Gas Pipeline*. Available: [www.china.org.cn/china/photos/2008-07/14/content\\_16004226.htm](http://www.china.org.cn/china/photos/2008-07/14/content_16004226.htm)



**Figure 6.14.5: Power Generation Mix—People's Republic of China**



NRE = new and renewable energy.

Source: APERC analysis (2009).

## Electricity

Electricity demand in the PRC will increase by 3.9% per year (2005–2030) to an amount that is more than two times higher than the 2005 level. With this fast growth, the PRC's total electricity demand will surpass that of the United States sometime in 2025.

Throughout the outlook period, coal will maintain its dominant share in the generation mix at around 62.9% in 2030. Natural gas-fired generation will take about 4.6% share in total generation mix. In coastal areas, gas-fired generation will replace coal-fired generation to improve air quality. Nuclear installed capacity will increase substantially from the current 8 gigawatts (GW) to 70 GW in 2020, and will further increase to 120 GW in 2030. Despite the increase in installed

capacity, the nuclear share in the generation mix will be only 14.0% in 2030. Hydro will see a major expansion in the near term with the opening of Three Gorges Dam in 2009. By 2030, hydro capacity is expected to expand to 320 GW from 117 GW in 2005, and renewable capacity will expand to 139 GW from 3 GW in 2005, mostly from wind.

## Energy Policy Issues

### *Energy Efficiency and Intensity Improvement*

Efficient and rational energy use has long been a keystone of the PRC's energy policy goals. And in recent years, as the scale of energy demand and economic activity took on increasingly global proportions, the prioritization of economic energy efficiency has carried a new sense of urgency.

As a developing country, the PRC's absolute efficiency levels in many of the most energy-intensive subsectors, such as aluminium and glass production, still lag behind demonstrated "international advanced level" potentials. At the same time, many of these inefficient industries in recent years have also been the fastest growing. To address this, policy responses, both national and subnational, have been broad and strong. More importantly, they have helped achieve significant progress. For example, the 2007 *Top 1,000 Enterprise Energy Efficiency Action Plan*, which targeted industries responsible for about 30% of total PRC energy demand, anticipated 50 MTOE in total energy savings by 2010. Similarly, the 2004 *Medium-and Long-Term Energy Conservation Plan* developed targets and strategies so that energy demand in the production and operation of major industrial, commercial, and residential products in 2010 will reach the international level of the early 1990s and approach the advanced international level by 2020 or sooner.<sup>130</sup>

Similar continued policy efforts that can build on these successes will help ensure that the PRC's economic energy efficiency performance becomes an asset to future energy security global competitiveness.

<sup>130</sup> APERC. 2008b. *Understanding Energy in China*. Tokyo.

## ***Energy Supply Security and Investment***

With rising energy demand, continued aggressive energy sector investment will help reduce the likelihood and severity of energy supply disruptions. For example, ongoing infrastructure improvements such as strengthening and optimizing the operation of domestic rail networks and electricity grids are expected to relieve pressure on the balance of supply and demand often experienced during periods of stress such as natural disasters or severe market fluctuations. Concerted upstream efforts by major PRC petroleum companies to extend the life of mature domestic oil fields, to invest and improve expertise in the production of clean domestic fossil resources such as natural gas, and to engage in broadening exploration and development with overseas partners all contribute to energy security by improving diversity in the fuel supply mix, markets, and geography. Over the outlook period, an attractive investment environment in the PRC's energy sector will encourage continued progress in these and other key areas.

## ***Global Energy Cooperation***

As its energy sector evolves and matures over the outlook period, the PRC will strengthen its role as a key international energy economy. Regional and global exchange on issues of energy production and demand, trade, technology, investment, conservation, efficiency, and environmental impact will become increasingly important. On some issues, such as minimization of local air and water pollution from energy production and demand, or power generation technology, the PRC will likely benefit from considerable international experience. But other issues—such as climate change, new and renewable energies, and global energy trade and investment—present novel challenges for all parties and will define an evolving shared international experience. Moreover, although the PRC has historically been engaged in international energy cooperation with many of the most developed global economies—relationships that will continue to strengthen—it will increasingly become a valuable partner for other developing countries that want to learn from the considerable and unprecedented energy development experience being created in the PRC today.

## ***Policy Implications***

Throughout the outlook period, the growth in the PRC's energy demand and its energy supply choice will affect the dynamics of global energy demand and supply. In particular, the PRC's expected oil import dependency at 72% in 2030 may imply the PRC's further need to find overseas resources and make efforts toward energy efficiency improvements across the sector. In this regard, the PRC's implementation of the vehicle efficiency standards, promotion of small vehicles, and development of urban transport systems in the major cities may be further strengthened in the future. Cooperation with the ADB regional member countries in sharing the policy information and know-how will benefit the implementation. And cooperation within the regional member countries on oil resources development may bring mutually beneficial outcomes for the PRC's energy security enhancement and host countries' economic development.

The projected carbon dioxide emissions growth trends offer a slower rate during the second half of the outlook period. This results from the combination of slower energy demand growth, mainly in the productivity improvement of the industry sector, efficiency improvement in coal-fired generation, and application of zero emissions power generation technologies such as

wind and nuclear. The pathway to reach this trend has to be supported by policy making and implementation at central and local levels. Clear direction and practical ways to integrate the long-term policy direction to support a low-carbon economy with the PRC's economic development goals will lead to further success in the PRC's development as well as region-wide prosperity.

## References

- Asia Pacific Energy Research Centre. 2008a. *APEC Energy Overview 2008*. Tokyo.
- . 2008b. *Understanding Energy in China*. Tokyo.
- China Energy Statistical Yearbook. 2008. *China Statistics Press*.
- PRC Government Official Web Portal. Available: [www.gov.cn](http://www.gov.cn)
- Energy Data and Modelling Center. 2007. *APEC Energy Database. Energy Data and Modelling Center, Institute of Energy Economics, Japan*. Available: [www.ieej.or.jp/apec](http://www.ieej.or.jp/apec)
- National Development and Reform Commission. Available: [www.sdpc.gov.cn](http://www.sdpc.gov.cn)
- Liu, Xiaoli. 2009. *Overview of Energy Development in China*. A Paper presented at the APERC Annual Conference 2009, Tokyo, Japan, February, 2009.
- Sandrea, Rafael. 2009. An In-Depth View of Future World Oil and Gas Supply: A Quantitative Model Analysis. *Oil and Gas Journal*. (January). Houston: Pennwell Editors.