

## **Energy Outlook for Central and West Asia**

### **– Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan♦–**

Naoko Doi\*      Tomoko Matsumoto\*\*

#### **Summary**

The study aims to project energy demand and supply of four countries in Central and West Asia, including Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan (Central and West Asia 4), resulting CO<sub>2</sub> emissions, and investment needs for the energy sector, which may be useful to both policy-makers and energy industries of within and beyond this region for the long-term planning. Below are the findings of the study:

- Energy demand in Central and West Asia 4 is projected to increase from 134.1 MTOE in 2005 to 215.4 MTOE in 2030, growing at an annual rate of 1.9%, in contrast to a decline (at an annual rate of 0.8%) experienced after the breakdown of former Soviet Union.
- By energy type, natural gas will increase from 77.6 MTOE in 2005 to 126.9 MTOE in 2030, growing at 2.0% per year through 2030. The share of natural gas will be the largest in Central and West Asia 4 increasing from 57.9% in 2005 to 58.9% in 2030.
- Coal will increase relatively slowly at an annual rate of 1.6% from 29.2 MTOE in 2005 to 43.5 MTOE in 2030. Kazakhstan is the main consumer of coal in the four countries; meanwhile its use for power generation will gradually be replaced by natural gas.
- Oil will increase from 25.7 MTOE in 2005 to 43.1 MTOE in 2030, growing at 2.1% per year a faster pace than that of total primary energy demand at 1.9% through 2030 in order to fulfill both freight and passenger transport needs as a result of economic development.
- Production of fossil fuels (coal, oil, and natural gas) in Central and West Asia 4 will altogether more than double between 2005 and 2030, with oil accounting for nearly 60% of increases in fossil fuels production, followed by natural gas at 37%, and coal at 3%.
- CO<sub>2</sub> emissions from the energy sector will increase at 2.0% per year – slightly faster pace than that of primary energy demand, reflecting the region's increasing reliance on domestically produced fossil fuels.
- To meet the energy demand and production increases, Central and West Asia 4 will require between \$269 billion and \$384 billion of investment. Much of the investment needs to be dedicated to oil and gas production (about 46% of total investment), followed by the electricity sector from generation to distribution (28% of total investment) through 2030.

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♦ This paper is based on the Asian Development Bank's commissioned study of *Energy Outlook for Asia and the Pacific*. With the updates in some historical data, and additional information, this paper presents the energy outlook for Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan and draw policy implications.

\* Senior Economist, The Energy Data and Modelling Center

\*\* Researcher, Oil Group, Strategy and Industry Research Unit

## 1. Introduction

The countries in Central and West Asia<sup>1</sup> had equally experienced economic downturn as a result of the breakdown of the Former Soviet Union, while the four members - Azerbaijan, Kazakhstan, Turkmenistan, and Uzbekistan – are on a track of rapid recovery in recent years spurred by growth in energy exports – mainly oil and natural gas, and this trend is further assisted by the rise in global energy prices. Although the type of energy resource endowment and the size of energy reserves differ by country, these four countries in Central and West Asia equally consider strategically utilizing the earnings from oil and/or natural gas export revenues for their economic development.

The four countries (hereafter called the Central and West Asia 4) have been increasingly gaining attention in recent years for their prospects toward meeting the global energy demand growth. Much of the vast energy reserves in those countries were untapped during the Soviet era, while an insatiable global appetite for energy resources has spurred interests in these countries after the collapse of the former Soviet Union. Therefore, understanding of the likely future path of energy demand and supply of these countries, resulting CO<sub>2</sub> emissions, and investment needs for the energy sector may be useful to both policy-makers and energy industries within and beyond this region for long-term planning.

In this study, using the outcomes from ADB commissioned study on *Energy Demand and Supply Outlook for Asia and the Pacific*, the energy demand and supply of Azerbaijan, Kazakhstan, Turkmenistan, and Uzbekistan will be presented. The growth trends, and level of projected energy demand of Central and West Asia 4 will be compared with the other countries in Central and West Asia for the purpose of understanding the differences or similarities in level and growth trends. The study also aims to estimate the CO<sub>2</sub> emissions potential associated with the rise in energy demand, and assess future investment requirements of the Central and West Asia 4.

## 2. Macro Economic Assumptions

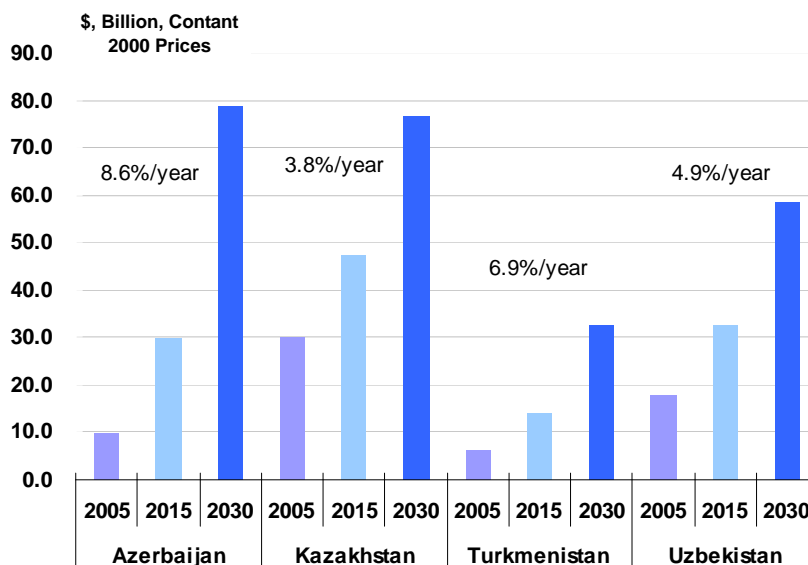
The GDP assumptions for Central and West Asia 4 are presented in Fig. 2-1. Each country will have different growth trends and levels of GDP over the time period between 2005 and 2030. Azerbaijan's economy is projected to increase at the fastest rate of 8.6%, as a result of the expansion of oil export through the Baku-T'blisi-Ceyhan (BTC) pipeline, and natural gas export through the South Caucasus pipeline. This is followed by Turkmenistan's GDP growth at an annual rate of 6.9%, which will be spurred by the growth in natural gas export. Uzbekistan's GDP will follow these at an annual rate of 4.9%, which will likewise be driven by the increased exports of natural gas, in addition to the increased revenue from transit fees for natural gas, along with the development of the service sector. Kazakhstan's GDP is projected to grow at 3.8% per year – a slower rate compared with the other countries, while energy and minerals exports in addition to the

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<sup>1</sup> Central and West Asia comprises Afghanistan, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan and Uzbekistan.

development of the service industry will continue to support the constant growth.

**Fig. 2-1 GDP in Central and West Asia 4 (2005-2030)**

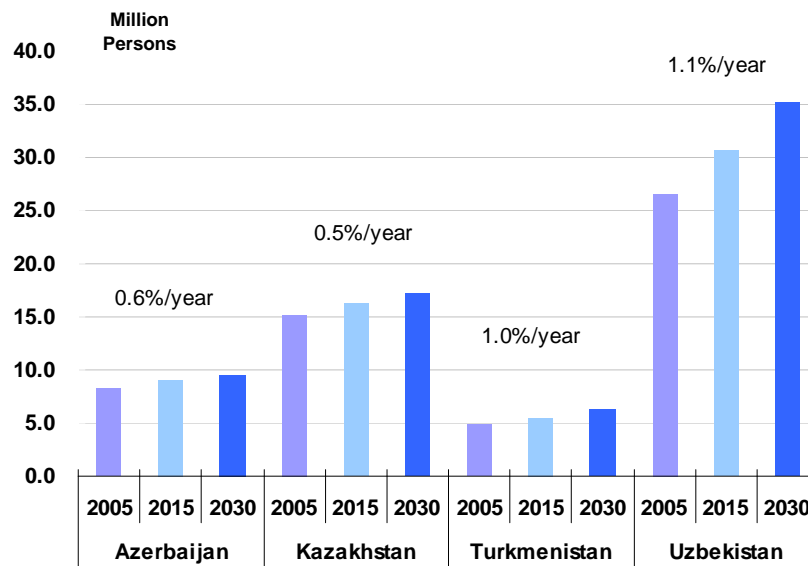


Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

The assumed population growth rates are obtained from the United Nations’ World Urbanization Prospects (2007) for both the historical data and projections. Growth rates as well as the level of population among Central and West Asia 4 vary substantially. Uzbekistan’s population is projected to maintain the highest level among the four countries increasing from 26.6 million in 2005 to 35.2 million at 1.1% per year. Kazakhstan’s population will stay at the second highest level from 15.2 million in 2005 to 17.1 million in 2030, which is followed by Azerbaijan increasing from 8.4 million in 2005 to 9.6 million in 2030 at 0.6% per year. Turkmenistan’s population will represent the lowest level among the four countries, increasing from 4.8 million in 2005 to 6.3 million in 2030.

Different growth trends and levels of GDP and population will result in diverse levels of GDP per capita for those four countries analyzed. With the fast GDP growth, Azerbaijan’s per capita GDP will reach the highest level at \$8,210 in 2030 which is about a seven-fold increase from the 2005 level at \$1,186. Turkmenistan’s per capita GDP will reach the second highest level in Central and West Asia 4 at \$5,220 in 2030 – which represents a four-fold increase from the 2005 level at \$1,271 in 2005. Kazakhstan’s per capita GDP will more than double from the 2005 level at \$1,969 in 2005 to \$4,477 in 2030. Despite the assumed constant growth, Uzbekistan’s per capita GDP will represent the lowest level in the four countries at \$1,666 in 2030 from \$673 in 2005.

**Fig. 2-2 Population in Asia and the Pacific by Subregion (2005-2030)**

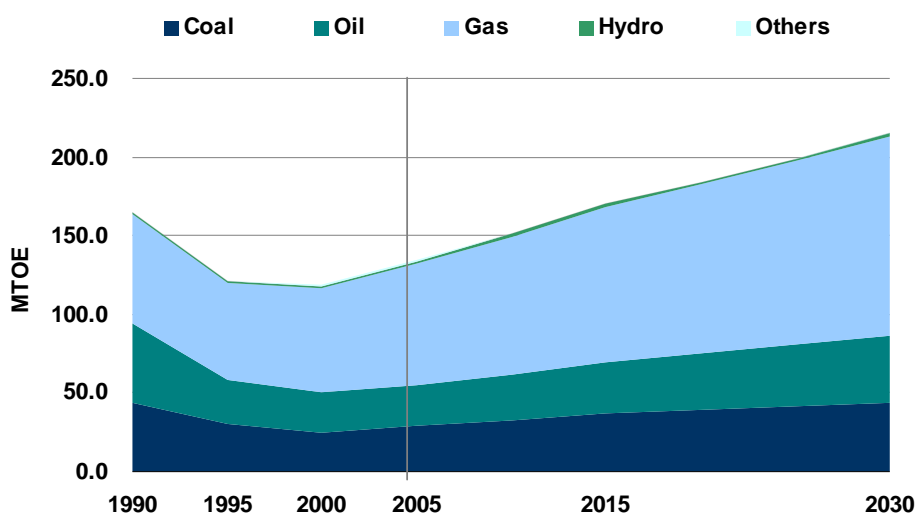


Source : United Nations. (2007). *World Urbanization Prospects*.

### 3. Primary Energy Demand Outlook

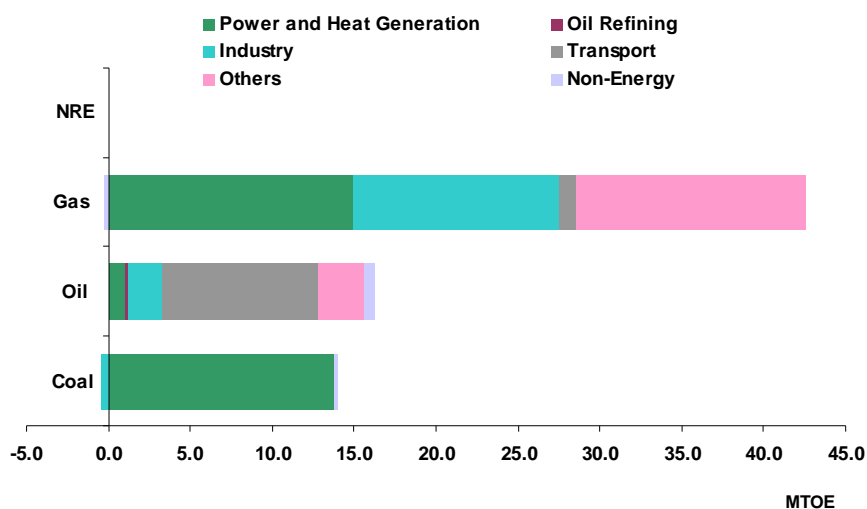
Primary energy demand in Central and West Asia 4 is projected to increase from 134.1 MTOE in 2005 to 215.4 MTOE in 2030, growing at an annual rate of 1.9%. With the breakdown of the former Soviet Union, the primary energy demand of the four countries declined at an annual rate of 0.8%, while over the outlook period, energy demand will grow positively corresponding to the economic recovery. With this growth, the per capita energy demand of Central and West Asia 4 will reach 3.17 TOE—nearly 30% higher than the 2005 level.

**Fig. 3-1 Primary Energy Demand in Central and West Asia 4 (1990-2030)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Fig. 3-2 Incremental Energy Demand Growth by Energy and by Sector in Central and West Asia 4 (2005-2030)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Table 3-1 Primary Energy Demand in Central and West Asia 4 by Energy (1990-2030)**

	Primary Energy Demand (MTOE)					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
<b>Total</b>	165.7	118.6	134.1	170.1	215.4	-0.8%	1.9%
Coal	43.7	24.6	29.2	36.7	43.5	-1.6%	1.6%
Oil	50.2	26.0	25.7	33.1	43.1	-2.6%	2.1%
Natural Gas	69.7	66.3	77.6	98.6	126.9	0.4%	2.0%
Hydro	1.3	1.3	1.5	1.6	1.8	0.4%	0.8%
Nuclear	-	-	-	-	-	-	-
Electricity Import/Export	0.86	0.42	0.11	0.10	0.14	-7.8%	0.8%

Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

By energy type, **natural gas** will increase from 77.6 MTOE in 2005 to 126.9 MTOE in 2030, growing at an annual rate of 2.0% through 2030. The share of natural gas will represent the largest in Central and West Asia 4 increasing from 57.9% in 2005 to 58.9% in 2030. Supported by resources availability and infrastructure development, natural gas will be increasingly utilized across the sectors. In terms of incremental growth, the power sector will account for about 35.3% of total incremental growth of natural gas between 2005 and 2030, followed by the other sectors at 33.0% and the industry sector at 29.8%.

**Coal** will increase relatively slowly at an annual rate of 1.6% from 29.2 MTOE in 2005 to 43.5 MTOE in 2030. In Central and West Asia 4, Kazakhstan is the main consumer of coal, backed by its vast reserves, meanwhile its use for power generation will gradually be replaced by natural gas; therefore, it will affect a slight decline in its share. In 2030, the power sector will account for more than 80% of entire coal demand in Central and West Asia 4, and the industry sector will follow this, accounting for 17%.

**Oil** will increase at an annual rate of 2.1% from 25.7 MTOE in 2005 to 43.1 MTOE in 2030.

In fact, oil's projected growth rate represents a faster pace compared with that of total primary energy demand at 1.9% through 2030. Given the landlocked location, Central and West Asia 4 would have to rely heavily on road transport for fulfilling their freight needs. In addition, the four countries' projected fast economic development will drive the motorization trend, which will in turn contribute to the growth in oil demand. Out of the total incremental growth in oil demand, the transport sector will account for 58.5%, followed by the other sector at 17.4%, the industry sector at 12.8%.

**Nuclear** is not projected to be installed during the outlook period. Kazakhstan has a plan to introduce one or two units; however, realization may hinge upon the cost competitiveness against the fossil fuel based generation, progress in international cooperation in construction and uptake of safety measures in terms of operation.

**Hydro** will increase at an annual rate of 0.8% through 2030, which represents the slowest growth rate among the energy sources. In Central and West Asia 4, hydro may play a small role in the total energy mix, the share of which is projected to decrease from 1.1% to 0.8% in 2030.

#### 4. Primary Energy Demand by Country in Central and West Asia 4

By country, the projected primary energy demand varies substantially both by growth trends and by level.

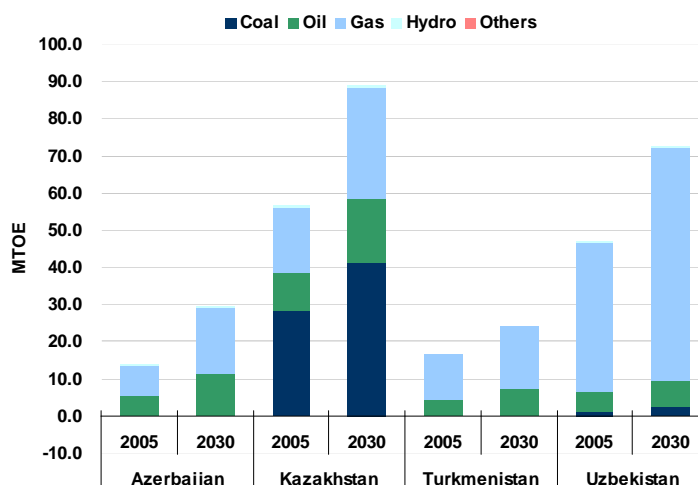
**Azerbaijan's** primary energy demand is projected to increase from 13.9 MTOE in 2005 to 29.5 MTOE, growing at 3.1% per year – representing the fastest pace among the Central and West Asia 4. Nearly 60% of the energy mix will be dominated by natural gas (mainly used for the power generation and other sectors), and the remainder is taken by oil (mainly used by the transport sector). Over the outlook period, Azerbaijan's energy elasticity to GDP represents a relatively low level of 0.35.<sup>2</sup> Aside from the energy extraction industry, the development of Azerbaijan will be led by the service sector which results in relatively slow growth in energy demand compared with the GDP growth. In terms of per capita energy demand, Azerbaijan will reach 3.07 TOE in 2030 increasing from 1.66 TOE in 2005.

Growing at an annual rate of 1.8%, **Kazakhstan's** primary energy demand is projected to reach 88.9 MTOE in 2030, up from 56.7 MTOE in 2005. Despite the relatively slow growth, Kazakhstan's energy demand maintains the highest in Central and West Asia 4. Coal (for the power and industry sectors) will maintain the largest share in primary energy demand, while it will decline slightly from 49.7% in 2005 to 46.1% in 2030 as a result of reduced share in the power sector. By contrast, natural gas's share will increase from 30.7% in 2005 to 33.3% in 2030. Despite a relatively slow growth rate, Kazakhstan's energy elasticity to GDP at 0.47 over the outlook period represents a higher level than that of the average of Central and West Asia at 0.34 – as its economic development is accompanied by the energy intensive industries such as iron and steel, and manufacturing industries. The per capita energy demand of Kazakhstan will reach 5.19 TOE in 2030 increasing from 3.73, which is also the highest level among Central and West Asia 4.

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<sup>2</sup> According to the *Energy Outlook for Asia and the Pacific*, developing members of Asia and the Pacific on average will have a higher energy elasticity to GDP at 0.50 between 2005 and 2030.

**Fig. 4-1 Primary Energy Demand Growth by Country and by Energy (2005-2030)**



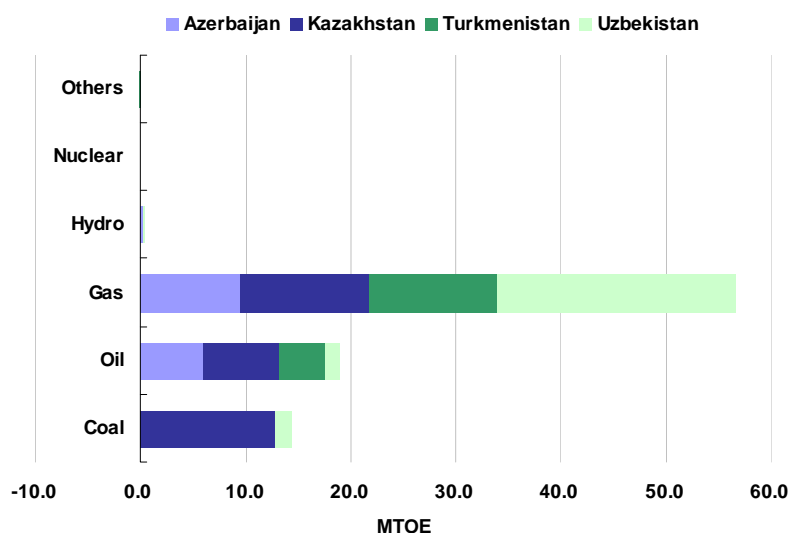
Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Table 4-1 Primary Energy Demand in Central and West Asia (1990-2030)**

	Primary Energy Demand (MTOE)					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
<b>Central and West Asia</b>	243.7	193.5	222.9	297.1	416.9	-0.4%	2.5%
Azerbaijan	26.1	11.6	13.9	19.3	29.5	-2.5%	3.1%
Kazakhstan	73.6	42.2	56.7	72.3	88.9	-1.0%	1.8%
Turkmenistan	19.6	14.5	16.5	19.3	24.4	-0.7%	1.6%
Uzbekistan	46.4	50.4	47.0	59.2	72.6	0.1%	1.8%
Central and West Asia 4	165.7	118.6	134.1	170.1	215.4	-0.8%	1.9%
Other Central and West Asia	78.0	74.9	88.9	127.0	201.5	0.5%	3.3%

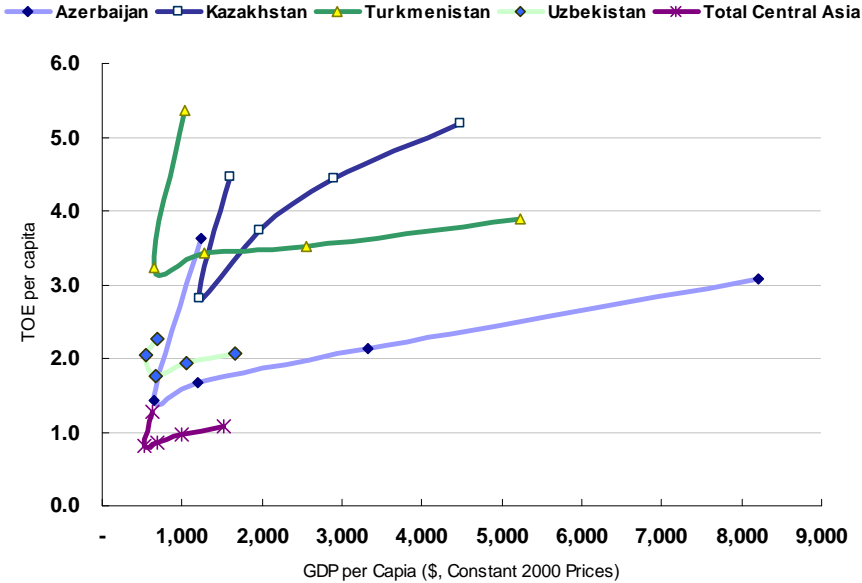
“Other Central and West Asia” includes Afghanistan, Armenia, Georgia, Kyrgyz Republic, Pakistan, and Tajikistan.  
Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Fig. 4-2 Incremental Primary Energy Demand Growth by Country and by Energy (2005-2030)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Fig. 4-3 Primary Energy Demand by Subregion (1990-2030)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Turkmenistan’s** primary energy demand is projected to increase at 1.6% per year through 2030. This is the slowest annual growth rate among the four countries analyzed. Given the limited prospects toward industrial development, the other sectors – including agriculture, residential, and commercial sectors – will dominate the final energy demand. Despite the economic development, the other sectors will not significantly increase their energy demand as almost free access to electricity and gas is already allowed for residential customers supported by vast natural gas reserves (which are utilized as the input fuel for power generation and city gas). The per capita energy demand of Turkmenistan will reach 3.89 TOE in 2030 – a moderate increase from the 2005 level at 3.42 TOE.

**Uzbekistan’s** primary energy demand is projected to increase at 1.8% per year through 2030. The country’s energy demand will reach 72.6 MTOE in 2030 which is the second highest level after Kazakhstan at 88.9 in the same year. Because of the large size of the population at 35.2 million in 2030 (the largest in Central and West Asia 4), the per capita energy demand of Uzbekistan will represent 1.7 TOE in 2030 – the lowest level in the four countries analyzed. In terms of energy elasticity to GDP, Uzbekistan represents 0.36 over the outlook period – a slightly higher level compared with the average of Central and West Asia 4 at 0.34.



## 5. Electricity Outlook

### 5-1 Electricity Demand

Electricity demand of Central and West Asia 4 is projected to increase from 111.1 terawatt-hours (TWh) in 2005 to 200.8 TWh in 2030 with an annual rate of 2.4% (Table 5-1). Although the four countries' electricity demand is likely to trend upward on the whole over the outlook period, a different growth trend is expected by country. Azerbaijan's electricity demand is projected to record the highest annual growth rate of 4.0% between 2005 and 2030. In Azerbaijan, the service sector's expansion and improvement in access to electricity in the residential sector will contribute to the increasing electricity demand. Kazakhstan follows this with an annual growth rate of 2.5% over the outlook period but its electricity demand in 2030 is not likely to reach the 1990 level yet. In Turkmenistan, approximately 90% of the residential sector already has access to electricity and electricity is supplied for free to residential customers; therefore, despite the increase in income level at 5.8% per year, it will result in a moderate growth of electricity demand at 2.4% per year. Compared with the other countries in Central and West Asia 4, Uzbekistan's electricity demand is projected to increase at a slower pace of 1.1% per year through 2030 due to an increased tariff derived from the ongoing price reform.

**Table 5-1 Electricity Demand in Central and West Asia (1990-2030)**

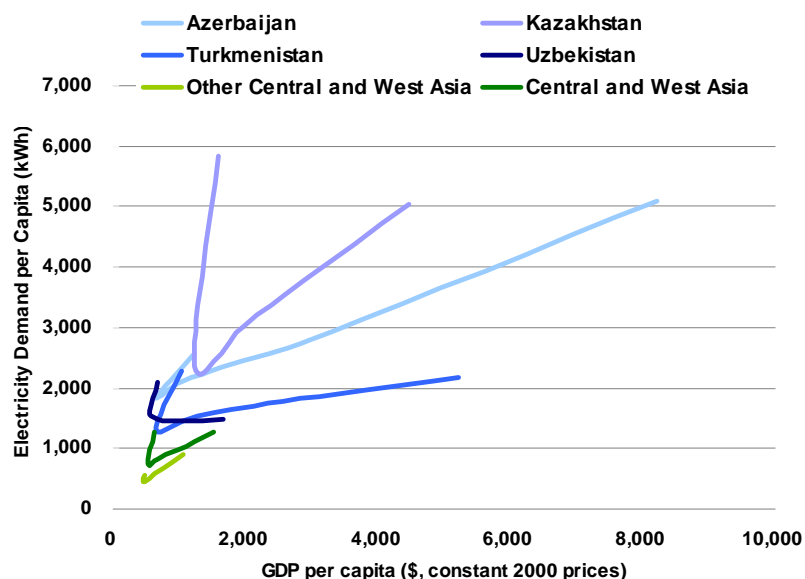
	Electricity Demand (TWh)					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
<b>Central and West Asia</b>	245.8	176.9	213.6	304.0	487.1	-0.9%	3.4%
Azerbaijan	18.5	14.9	18.2	26.5	48.9	-0.1%	4.0%
Kazakhstan	96.6	35.2	46.0	61.7	86.1	-4.8%	2.5%
Turkmenistan	8.4	5.8	7.5	9.7	13.6	-0.8%	2.4%
Uzbekistan	42.9	39.8	39.4	45.1	52.2	-0.6%	1.1%
Central and West Asia 4	166.4	95.7	111.1	143.0	200.8	-1.6%	2.4%
Other Central and West Asia	79.4	81.2	102.6	161.0	286.3	1.7%	4.2%

Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

Electricity demand may correspondingly increase along with economic development and improvement in living standards. Fig. 5-1 is shown to trace patterns between electricity demand per capita and GDP per capita between 1990 and 2030. Azerbaijan and Kazakhstan are projected to reach almost the same electricity demand per capita in 2030. Yet there will be a gap in GDP per capita between the two countries through 2030, which may be caused by a difference in the main electricity user. In Azerbaijan, the other sectors (including the agriculture, residential and commercial sectors) are the major electricity consumer. They will account for 67% of the overall incremental growth of electricity demand over the outlook period. Higher living standards will translate into a higher electricity requirement per capita. By contrast, in Kazakhstan, the industry sector represents more than half of the total electricity demand, and its share in the sector's energy demand will increase from 14% in 2005 to 18.9% in 2030. In the case of Turkmenistan, despite an increasing income, electricity demand per capita is not expected to grow as high as Azerbaijan and

Kazakhstan because of the current high electrification rate and accessibility, and as free electricity is already provided as mentioned above so that there would be little room for electricity demand growth. For Uzbekistan, electricity demand per capita is projected to stay at almost the same level over the outlook period since the income level will remain low through 2030.

**Fig. 5-1 Electricity Demand per Capita and GDP per Capita (1990-2030)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

## 5-2 Electricity Supply

Total electricity generation in Central and West Asia 4 will grow annually at 2.2% on average, reaching 260.7 TWh in 2030 (Table 5-2). Azerbaijan’s electricity generation is likely to increase at the highest annual growth rate of 4.2% between 2005 and 2030, followed by Kazakhstan at 2.3%, Turkmenistan at 1.9%, and Uzbekistan at 1.0%.

**Table 5-2 Electricity Generation in Central and West Asia (1990-2030)**

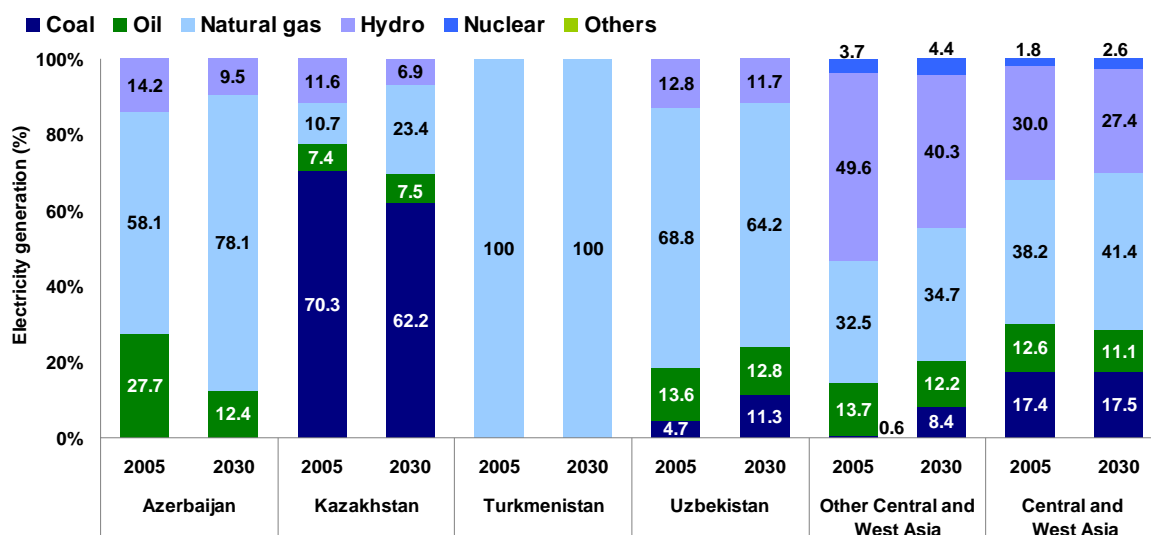
	Electricity Generation (TWh)					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
<b>Central and West Asia</b>	278.3	238.9	291.5	410.7	653.6	0.3%	3.3%
Azerbaijan	23.2	18.7	21.2	31.7	59.1	-0.6%	4.2%
Kazakhstan	87.4	51.3	67.9	88.7	119.9	-1.7%	2.3%
Turkmenistan	14.6	9.8	12.8	15.8	20.6	-0.9%	1.9%
Uzbekistan	56.3	46.8	47.7	53.9	61.2	-1.1%	1.0%
Central and West Asia 4	181.5	126.7	149.7	190.1	260.7	-0.8%	2.2%
Other Central and West Asia	96.8	112.2	141.9	220.7	392.9	2.6%	4.2%

Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

### 5-3 Electricity Generation Mix

Electricity generation mix varies substantially by country, depending on the resource endowment (Fig. 5-2). The countries in Central and West Asia will continue to rely on domestically available energy sources for electricity generation to reduce dependence on imports. In Turkmenistan, natural gas will account for 100% of electricity generation over the outlook period. Similarly, natural gas is expected to be a dominant fuel for power generation in Azerbaijan, replacing fuel oil and reaching a 78.1% share in 2030. In Uzbekistan, the share of natural gas will gradually contract through 2030 since reduction of natural gas use is taken into consideration in the power sector to allocate more natural gas for export, and coal for power generation is encouraged by government. Different from these three countries, Kazakhstan’s power generation is projected to be dominated by coal. Construction of natural gas-fired power plants which are undertaken near the western deposits is expected to contribute, increasing its share from 10.7% in 2005 to 23.4% in 2030. As the four countries are backed by vast energy resources, new and renewable energy in electricity generation is likely to remain insignificant through 2030.

Fig. 5-2 Electricity Generation Mix in 2005 and 2030



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

## 6. Energy Production Outlook

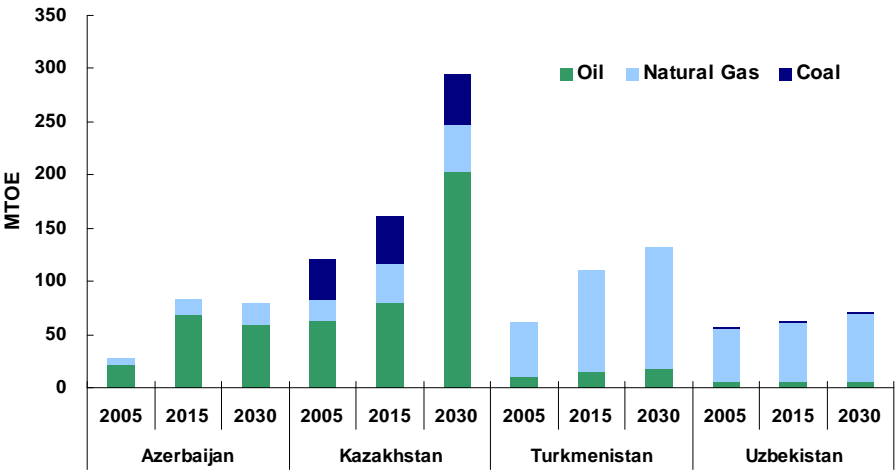
Central and West Asia 4 is projected to substantially increase energy production over the outlook period. Meanwhile, the level of production and energy type differs by country as it reflects the diversity in energy resources endowment, size of reserves, and progress in infrastructure to deliver those to the market.

**Azerbaijan** will see a substantial increase in oil production, mainly from the Azeri-Chirag-Guanashli (ACG) oil field in the Caspian sea, reaching 1.4 million barrels per day (b/d) in 2015. Meanwhile, the production will moderately decline thereafter; reaching 1.26 million

b/d in 2030. Through the Baku-T’blisi-Ceyhan (BTC) pipeline, much of the produced oil (at the peak in 2015 more than 5 times bigger than the domestic demand) will be dedicated to exports. Natural gas production will increase over the outlook period with the second phase of the Shah Deniz gas field start production. By 2015, natural gas production will reach 15 bcm, and further it will increase to 22 bcm.

**Kazakhstan’s** fossil fuel productions will more than double from 2005 to 2030. Much of the increase will come from oil, increasing from 1.24 million b/d in 2005 to 4.3 million b/d in 2030, reflecting the steady increase in production from the five fields – including Tengiz, Karachaganak, Kashagan, Uzen, and Aktobe. Out of these, Tengiz, Karachaganak, Kashagan will lead the production. In 2030, about 83.7% of the entire production (or 3.6 million b/d) will be dedicated for export. While moderate growth in coal production (at an annual rate of 0.8% over the outlook period) is expected, production of natural gas will more than double from 23.3 bcm in 2005 to 48 bcm in 2030, driven largely by the increased production of the Karachaganak gas field in the Western deposit.

**Fig. 6-1 Energy Production by Source (2005-2030)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Table 6-1 Ratio of Net Export to Primary Energy Demand (2005, 2015, and 2030)**

	2005	2015	2030
Azerbaijan	95%	329%	172%
Kazakhstan	115%	107%	220%
Turkmenistan	268%	464%	438%
Uzbekistan	20%	10%	2%

Source: Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

Endowed with vast natural gas reserves at 8.1 tcm, (representing the second highest level in the former Soviet Union after Russia) **Turkmenistan’s** natural gas production will more than double from 56.9 bcm in 2005 to 128 bcm in 2030. Turkmenistan is a landlocked country, and the

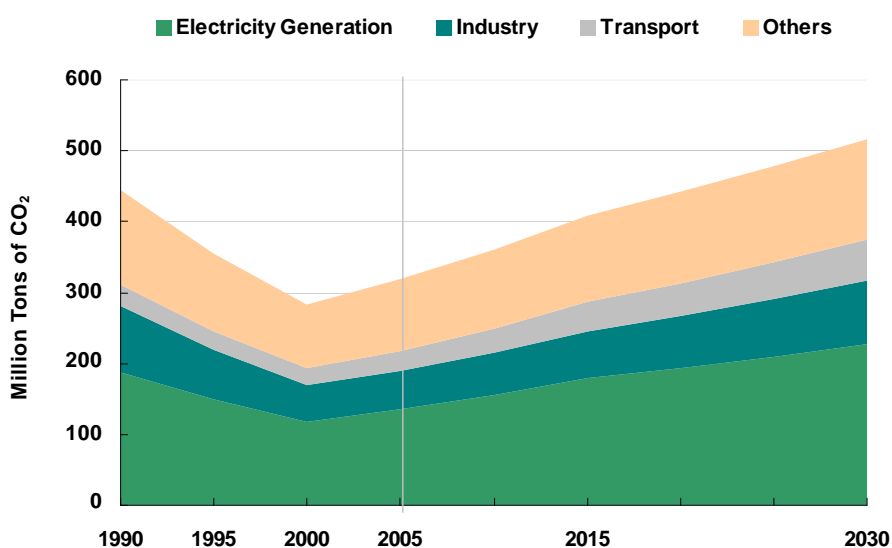
Central Asia Center (CAC) pipeline had been the only overseas natural gas export route until 1997 when the Korpezhen-Kurt Kul pipeline for export to Iran started operation. Meanwhile, over the outlook period, the country will diversify export routes with approximately 30 bcm dedicated to China, 70 bcm to CAC, and 9 bcm to Iran. In addition, construction of international pipelines has been under planning including the Trans-Caspian Gas pipeline and the Trans-Afghan pipeline.

Compared with other countries in Central and West Asia 4, **Uzbekistan's** fossil fuel productions will moderately increase from 56 MTOE in 2005 to 71.7 MTOE in 2030 at 1.0% per year. Out of this total production, natural gas will account for 88%, followed by oil at 9%, and coal at 4% in 2030. With its large-scale natural gas reserves representing 1.68 TCM, its production will reach 70 bcm in 2030 – up from 54.4 bcm in 2005. Despite the growth, more than 98% of total natural gas production would have to be supplied to the domestic market. Export route diversification as well as improvement in investment conditions – which can allow foreign companies participation – has been under consideration for the purpose of production increases to be dedicated to export.

## 7. CO<sub>2</sub> Emissions Outlook

The CO<sub>2</sub> emissions in Central and West Asia 4 will increase from 318.3 million tons of CO<sub>2</sub> in 2005 to 517.3 million tons of CO<sub>2</sub> in 2030 at an annual rate of 2.0%. The projected growth rate of CO<sub>2</sub> emissions is slightly faster than the projected energy demand at 1.9%. This results from the slight increases in overall CO<sub>2</sub> intensity (or CO<sub>2</sub> emissions per unit of TPED) in some countries in Central and West Asia 4 as they may increase the use of domestically available fossil fuels, while hydro use will remain almost constant. As a result of this growth, per capita CO<sub>2</sub> emissions of Central and West Asia 4 will reach 7.58 tons of CO<sub>2</sub> in 2030, up from 5.79 tons in 2005.

**Fig. 7-1 CO<sub>2</sub> Emissions in Central and West Asia 4 (1990-2030)**

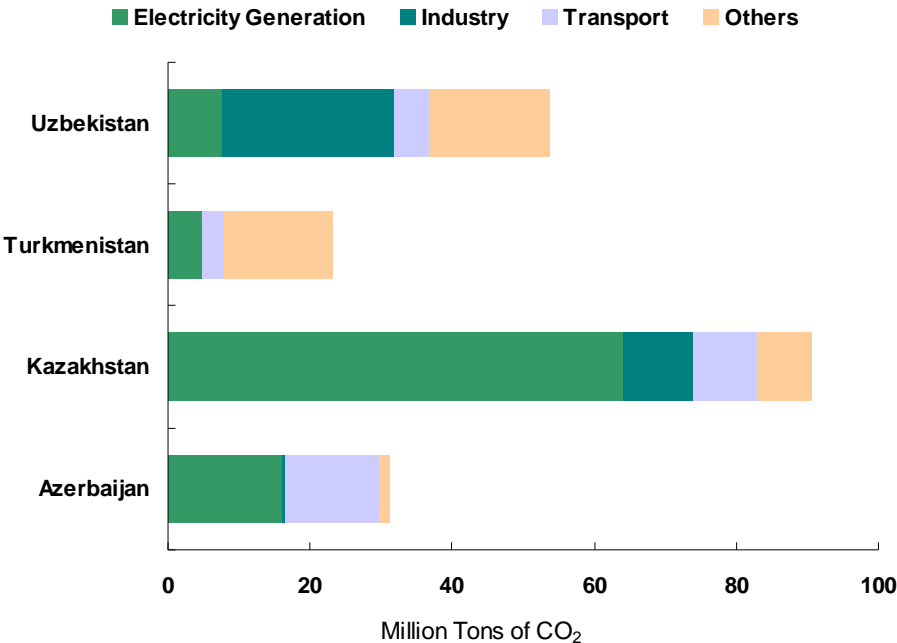


Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

By sector, the CO<sub>2</sub> emissions from the transport sector in Central and West Asia will increase the fastest, at an annual growth rate of 3.0% through 2030. Despite this growth, the transport sector’s share of total CO<sub>2</sub> emissions will remain the smallest at 11% in 2030. This is followed by the power sector, where CO<sub>2</sub> emissions are expected to increase at an annual rate of 2.1% through 2030. This sector’s share may increase from 42% in 2005 to 44% in 2030. The industry sector’s CO<sub>2</sub> emissions are expected to grow at an annual rate of 2.0% through 2030, and the sector’s share of total CO<sub>2</sub> emissions will remain almost constant at 17% through 2030. The emissions of the others sectors will increase moderately at an annual rate of 1.4%. The share of this sector to total CO<sub>2</sub> emissions will reach 28% in 2030, down from 32% in 2005.

By country, different sector will differently affect the growth trends in CO<sub>2</sub> emissions as shown in Fig. 7-2 that presents the CO<sub>2</sub> emissions increment by country and by sector. Kazakhstan’s contributions to the overall increments in the CO<sub>2</sub> emissions of Central and West Asia 4 will account for the largest, due to its continued reliance on domestically produced coal for power generation. This will be followed by Uzbekistan, of which industry’s energy demand is expected to grow at a relatively fast pace of 3.6% per year, and this results in substantial increases in CO<sub>2</sub> emissions. Azerbaijan takes the third position in terms of the increments in CO<sub>2</sub> emissions among the four countries analyzed because of the expected improvement in electrification and motorization. Turkmenistan’s contributions to the overall increments in CO<sub>2</sub> emissions of four countries will represent the lowest level given the projected slow growth in energy demand.

**Fig. 7-2 CO<sub>2</sub> Emissions Increment by Country and by Sector (2005-2030)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Table 7-1 CO<sub>2</sub> Emissions by Country (1990-2030)**

	Million Tons of CO <sub>2</sub>					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
<b>Central and West Asia</b>	581.3	397.4	454.7	625.0	890.7	-1.0%	2.7%
Azerbaijan	59.5	26.5	28.5	39.4	59.8	-2.9%	3.0%
Kazakhstan	233.2	123.5	158.3	203.0	249.0	-1.5%	1.8%
Turkmenistan	42.2	31.3	35.5	45.7	58.7	-0.7%	2.0%
Uzbekistan	110.6	101.6	96.1	120.4	149.8	-0.6%	1.8%
Central and West Asia 4	445.5	282.9	318.3	408.5	517.3	-1.3%	2.0%
Other Central and West Asia	135.8	114.5	136.4	216.5	373.5	0.0%	4.1%

Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

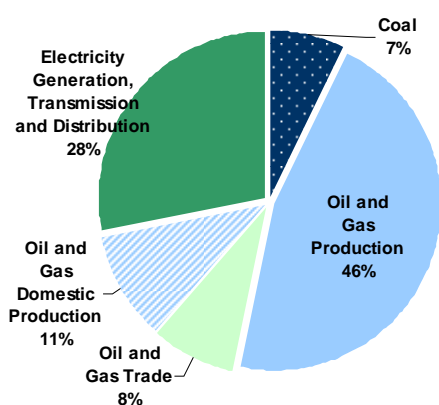
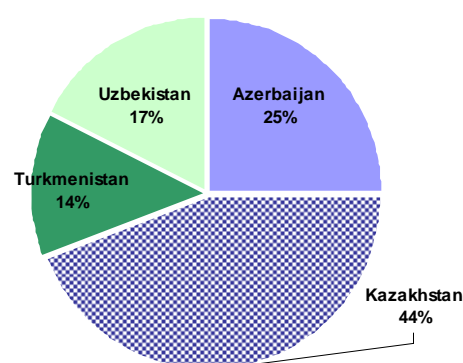
**Table 7-2 CO<sub>2</sub> per Total Primary Energy by Country (1990-2030)**

	Ton of CO <sub>2</sub> per TOE					Annual Growth Rates	
	1990	2000	2005	2015	2030	1990-2005	2005-2030
<b>Central and West Asia</b>	2.38	2.05	2.04	2.10	2.14	-0.6%	0.2%
Azerbaijan	2.28	2.29	2.05	2.04	2.03	-0.4%	0.0%
Kazakhstan	3.17	2.93	2.79	2.81	2.80	-0.5%	0.0%
Turkmenistan	2.15	2.16	2.15	2.36	2.41	0.0%	0.5%
Uzbekistan	2.38	2.02	2.04	2.03	2.06	-0.6%	0.0%
Central and West Asia 4	2.69	2.38	2.37	2.40	2.40	-0.5%	0.0%
Other Central and West Asia	1.74	1.53	1.54	1.70	1.85	-0.5%	0.8%

Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

## 8. Energy Investment Outlook

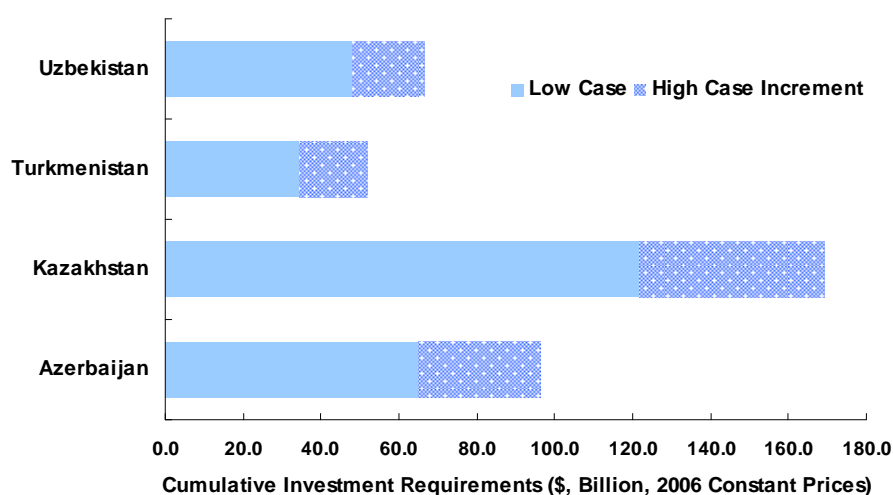
To meet the increases in energy demand and production, Central and West Asia 4 will require between \$269 billion and \$384 billion in investment. Much of the investment needs to be dedicated to oil and gas production, which represent \$177.7 billion (high case) or 46% of total investment in the energy sector. This is followed by investment in the electricity sector – from generation to

**Fig. 8-1 Energy Investment Outlook by Sector (High Case, 2005-2030)****Fig. 8-2 Energy Investment Outlook by Country (High Case, 2005-2030)**

Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

distribution at \$108.2 billion (high case). Development of domestic oil and gas supply infrastructure may require substantial investment at \$40.4 billion (high case) to meet demand growth and to retrofit the obsolete infrastructure which was built during the Soviet era. Infrastructure necessary for oil and gas trade may likewise require substantial investment at \$30.2 billion (high case), and this is followed by investment in coal at \$27.6 billion (high case).

**Fig. 8-3 Energy Investment Outlook by Subregion  
(Low Case and High Case Increments)**



Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

**Table. 8-1 Energy Investment Outlook by Country (Low Case and High Case)**

	Coal		Oil and Gas Production		Oil and Gas Trade		Oil and Gas Domestic Supply		Electricity Generation, Transmission and Distribution		Total	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
<b>Total Central and West Asia</b>	24.2	36.1	112.7	189.4	38.0	47.1	66.2	76.1	192.1	254.1	433.2	602.8
<b>Azerbaijan</b>	0.0	0.0	34.5	58.4	5.2	6.9	11.6	13.1	13.6	18.0	64.9	96.3
<b>Kazakhstan</b>	17.7	26.4	37.3	60.2	12.8	17.9	13.0	14.4	40.6	50.3	121.4	169.2
<b>Turkmenistan</b>	0.0	0.0	20.2	35.0	4.3	4.8	1.0	1.1	9.1	11.0	34.6	51.8
<b>Uzbekistan</b>	0.8	1.1	13.9	24.1	0.5	0.6	10.7	11.9	22.2	29.0	48.1	66.7
<b>Central and West Asia 4</b>	18.5	27.6	105.9	177.7	22.8	30.2	36.3	40.4	85.5	108.2	269.0	384.0
<b>Other Central and West Asia</b>	5.8	8.6	6.8	11.7	15.2	16.9	29.8	35.7	106.6	145.9	164.2	218.7

Source : Asian Development Bank. (2009). *Energy Outlook for Asia and the Pacific*.

By country, **Kazakhstan's** projected investment will represent the largest level at \$169.2 billion, of which investment in oil and gas production will account for the largest at \$60.2 billion. Projected increases in oil and natural gas production from giant fields such as Tengiz, Karachagnaka, and Kashagan are the underlying factors that affect large-scale investment requirements. Following the oil and gas production, investment in the electricity sector – from generation to distribution – requires large-scale investment at \$50.3 billion in Kazakhstan. Similar to the other countries in Central and West Asia, in addition to the investment in new infrastructure,



retrofitting and replacement of obsolete infrastructure translates into investment needs.

Despite maintaining a relatively low level of energy demand (about 32% of that of Kazakhstan in 2030), **Azerbaijan**'s needs for energy investment represent the second largest level at \$96.3 billion among the four countries analyzed due to the projected expansion in oil and natural gas production. Production increases from the ACG oil field, along with the projected start production of the Shah Deniz natural gas field, will translate into about \$58 billion in investment needs.

**Uzbekistan**'s investment needs at \$66.7 billion represent a relatively high level compared with the projected moderate growth in energy demand due to the expected natural gas production increases. Similarly, the energy sector of **Turkmenistan** will require substantial investment at \$51.8 billion, of which \$35 billion (or 68% of total investment) would have to be dedicated to the production of natural gas.

## 9. Implications

Energy demand of Central and West Asia 4 is projected to increase steadily over the outlook period; while the energy supply infrastructure of Central and West Asia 4 – such as electricity and gas supply infrastructure – was built mostly during the Soviet era, and there is great need for retrofitting and refurbishment. Each country would have to create conditions that can promote investment in such infrastructure with the formulation of a long-term energy policy including energy efficiency, and pricing.

Fossil fuel exports from Central and West Asia 4 may contribute greatly to meet the growing energy needs of both Asia and Europe. Large-scale investment is needed to explore, develop, and produce those energy sources, which may not be met by the four countries alone. Financial assistance from both importing countries and other developed countries will be critical for facilitating such investment. Additionally, cooperation among Central and West Asia 4 – along with neighboring countries as transit of energy exports – is and will be critical for the purpose of energy security across the region.

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Contact: report@tky.ieej.or.jp