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Kazakhstan Oil Consumption and Energy Efficiency in a Global comparison

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Жаһандық салыстырудағы Қазақстанның мұнай тұтыну мен энергетикалық тиімділігі

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Потребление нефти и энергетическая эффективность Казахстана в Мировом сравнении Energy is inevitable for human life and a secure and accessible supply of energy is crucial for the sustainability of modern societies. This article presents the major global findings of the use Global energy and oil consumption and provides an overview of the current and projected energy scene. Five countries have been studied in this work. These include China, Japan, Germany, USA and Kazakhstan. Together the present energy budget of these countries is roughly half that of the globe. Four of the above five countries that are discussed in this work are all net importers of energy and are heavily dependent on imports of fuel to sustain their energy demands. Their respective local oil reserves will only last 9, 6, 7 and 4 years, respectively. The demand for energy is also presented and have been analyzed by daily consumption of oil and energy.

Key words: Oil, Energy, Global oil production, oil consumption, energy efficiency.

Энергия көзі қоғамның өмір сүруіне қажет, сонымен қатар қауіпсіз және қолжетімді энергиямен жабдықтау қазіргі заманғы қоғамның тұрақтылығы үшін маңызды болып табылады. Мақалада жаһандық ауқымдағы энергетикалық және мұнай тұтынудың негізгі нәтижелері ұсынылған, энергетика секторының ағымдағы жағдайына шолу көрсетілген. Осы жұмыста бес ел қарастырылған. Олардың ішінде Қытай, Жапония, Германия, АҚШ және Қазақстан. Әлем энергия көздерінің ағымдағы бюджетінің жартысына жуығы осы елдерге тиесілі. Аталған бес елдің төртеуі энергияның неттоимпорттаушылары болып табылады және көбінесе олардың энергия қажеттіліктерінің қамтамасыздығы отын импортына тәуелді болып табылады. Олардың жергілікті отын қорлары тек 9, 6, 7 және 4 жылға ғана жетеді. Энергияға сұраныс күнделікті мұнай және энергия тұтынуы арқылы талданған.

Түйін сөздер: Мұнай, энергия, жаһандық мұнай өндіру, мұнай тұтыну, энергия тиімділігі.

Энергия неизбежна для человеческой жизни, и безопасная и доступная поставка энергии крайне важна для устойчивости современных обществ. Эта статья представляет основные глобальные результаты использования энергии и потребления нефти в мировых масштабах и предоставляет обзор текущей ситуации в энергетическом секторе. Пять стран были рассмотрены в данной работе, такие как Китай, Япония, Германия, США и Казахстан. Текущий бюджет этих стран составляет примерно половину мирового. Четыре из вышеупомянутых пяти стран, которые рассмотрены в этой работе, являются нетто-импортерами энергии и в значительной степени зависят от импорта топлива для поддержания своих энергетических потребностей. Их соответствующие местные запасы нефти хватят только на 9, 6, 7 и 4 года, соответственно. Представленный спрос на энергию.

Ключевые слова: нефть, энергия, глобальная нефтедобыча, потребление нефти, эффективность использования энергии.

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KAZAKHSTAN OIL CONSUMPTION AND ENERGY EFFICIENCY IN A GLOBAL COMPARISON

Introduction

Global oil consumption grew by 0.8 million barrels per day (b/d), or 0.8% – a little below its recent historical average and significantly weaker than the increase of 1.4 million b/d seen in 2013. Countries outside the OECD once again accounted for all of the net growth in global consumption. OECD consumption declined by 1.2%, the eighth decrease in the past nine years. Chinese consumption growth was below average but still recorded the largest increment to global oil consumption (+390,000 b/d); Japan recorded the largest decline (-220,000 \hat{b}/d), with Japanese oil consumption falling to its lowest level since 1971. Light distillates were the fastestgrowing refined product category for a second consecutive year. Global oil production growth was more than double that of global consumption, rising by 2.1 million b/d or 2.3%. Production outside OPEC grew by 2.1 million b/d, the largest increase in our dataset. The US (+1.6 million b/d) recorded the largest growth in the world, becoming the first country ever to increase production by at least 1 million b/d for three consecutive years, and taking over from Saudi Arabia as the world's largest oil producer. Along with the US, production in Canada (+310,000 b/d) and Brazil (+230,000 b/d) also reached record levels in 2014. OPEC output was flat, and the group's share of global production fell to 41%, it's lowest since 2003. Declines in Libya (-490,000 b/d) and Angola (-90,000 b/d) were offset by gains in Iraq (+140,000 b/d), Saudi Arabia (+110,000 b/d) and Iran (+90,000 b/d).

Domestic product of oil has peaked in China, and half of consumption was imported each year. Reliance on imported oil is unlikely to change. Nevertheless, the global demand for oil has eased due to shale gas revolution. What will worry global oil market is not insatiable China demand, but possible overcapacity when OECD demands decline. China's vast shale gas reserve is entirely untapped. With renewable and nuclear buildup, domestic electricity consumption can be met with efforts. Nuclear power is the answer to provide energy supplies for centuries. Forecast long-term demand for critical resources, iron ore and copper, based on economic projections.

Today Kazakhstan is among the top 15 countries in the world when it comes to essential oil reserves, having 3% of the world's to-

tal oil reserves. 62% of the country is occupied by oil and gas areas, and there are 172 oil fields, of which more than 80 are under development. More than 90% of oil reserves are concentrated in the 15 largest oil fields – Tengiz, Kashagan, Karachaganak, Uzen, Zhetybai, Zhanazhol, Kalamkas, Kenkiyak, Karazhanbas, Kumkol, North Buzachi, Alibekmola, Central and Eastern Prorva, Kenbai, Korolevskoye. Oil fields can be found in six of the fourteen provinces of Kazakhstan. They are the Aktobe, Atyrau, West Kazakhstan, Karaganda, Kyzylorda and Mangystau provinces. About 70% of the hydrocarbon reserves are concentrated in western Kazakhstan.

Current trend in energy and oil sector

Domestic product of oil has peaked in China, and half of consumption was imported each year. Reliance on imported oil is unlikely to change. Nevertheless, the global demand for oil has eased due to shale gas revolution. What will worry global oil market is not insatiable China demand, but possible overcapacity when OECD demands decline. China's vast shale gas reserve is entirely untapped. With renewable and nuclear buildup, domestic electricity consumption can be met with efforts. Nuclear power is the answer to provide energy supplies for centuries.Forecast long – term demand for critical resources, iron ore and copper, based on economic projections [1, p. 139].

No matter China grows its economy at 8% or 4%, its demand for oil and energy will continue climbing. China became the world's number one consumer of primary energy since 2009. Except oil, natural gas, and nuclear power, China has exceeded US in consumption of near all other energy forms. While energy consumption may be viewed as industrial prowess in old days, China is increasingly concerned by it long – term energy supply and security.

Thanks to its vast coal reserves, China can meet its own needs for primary energy, but oil and gas have been to be imported in large quantities, until shale gas can make an impact in the future. China is aggressively building its renewable capacities, which ranked number one already, and its nuclear power plans. Although nuclear is not renewable strictly speaking, its long reserve years (> 1500 years) make it a near forever energy source [2, p. 96].

 Table 1 – Comparison of Energy Efficiency (tons of oil equivalent / per \$ 10.000 GDP)

YearCountry	2000	2003	2004	2005	2006	2007					
China	9.1	8.6	9.1	8.9	8.6	8.0					
Japan	1.1	1.1	1.1	1.0	1.0	1.0					
USA	2.3	2.2	2.2	2.1	2.1	2.0					
Germany	1.8	1.8	1.8	1.7	1.7	1.6					
World Average	3.0	3.0	3.1	3.0	3.0	2.9					
Source: World bar	Source: World bank WDI database [3]										

While China energy demand may continue climbing, OECD countries energy demands are flattening out. Between 2011 and 2030, primary energy demand in USA barely rises, although there is a pronounced shift away from oil, coal, towards natural gas and renewables. By around 2020, USA is projected to become the largest oil producer, overtaking Saudi Arabia, and starts to see the impact of new fuel – efficiency improvement in transportation. The net result is a continued decline of US oil imports, to the extent that USA becomes a net oil exporter around 2030 [4, p. 69].

China, India and the Middle East will account for 60% of global increase in primary energy consumption. China alone will increase its energy consumption by 72% in next 20 years, while its domestic production will rise by only 46% (including all energy forms). China will continue ramp-up importing of oil and natural gas. Luckily, while USA imports 500 million ton of oil, USA may not need those oil entirely after 2020 when USA becomes self sufficient because of quick climb of shale gas production and biofuel supply. China and India demand can be met by those spare capacities without adding pressure on global supply and pushing up oil price, which happened between 2000 and 2008.

China has installed the world's most electricity generation capacity, although nuclear and gas capacities are behind US, capacities of coal, hydro, wind are well ahead of other countries. Renewable energy is on nation's priority list to secure energy supplies, and clean up environment. With those cleantech efforts, renewable energy is expected to account for 35% of total electricity generation in 2030. Along with nuclear, reliance on coal will be meaningfully reduced [5, p. 256].

Even more challenging for China is how to improve its energy efficiency and hence to reduce energy consumption per unit of GDP. The solution is not just finding energy that is more primary and generate ever more electricity, but to grow GDP with less energy consumption. The pressure of energy supply is really caused by China's economic structure and generation efficiency [6, p. 178].

Because the heavy investments made in the past years, construction and heavy industries consumed disproportionately high electricity versus service industries. Also contributing to high – energy consumption in China was heavy manufacturing of goods that are exported overseas. Hence, when compare energy consumption per \$ 10,000 GDP, in tons of oil equivalent, China consumed the most energy among major economies. For example, to produce \$ 10,000 worth of GDP, China consumed 9.1 tons of oil (or equivalent), while Japan burned 1.1 tons of oil and USA 2.0 tons [7, p.101].

China's transition to a consumption economy is mandatory because of not only financial and political situations, but also energy consumption and environmental concerns. China economy is overly reliant on heavy consumption of energy and resource, a path that is unsustainable and environment damaging. Following table shows that for each dollar of GDP, China consumed 0.6 KWH of electricity in 2012, while Japan needed 0.2 KWH, Germany 0.2 KWH, and USA 0.3 KWH [8, p. 39].

AREA	Transpor- tation- Road	Transpor- tation Non-road	Industrial	Residential/ commercial/ agriculture	Power	Air flight	Total
North America	52%	10%	23%	7%	5%	3%	100%
Western Europe	41%	9%	25%	14%	5%	7%	100%
Asia	32%	9%	33%	15%	9%	4%	100%
OECD	45%	9%	26%	11%	6%	4%	100%
Latin America	45%	5%	24%	16%	8%	3%	100%
Mid east/ Africa	38%	7%	21%	17%	14%	3%	100%
South Asia	29%	7%	36%	19%	10%	0	100%
SE Asia	33%	9%	30%	7%	5%	16%	100%
China	23%	10%	40%	20%	4%	3%	100%
OPEC	38%	4%	26%	13%	16%	4%	100%
Emerging markets	33%	7%	30%	15%	10%	5%	100%
FSU	31%	11%	31%	17%	9%	0	100%
EU eastern	43%	0%	29%	14%	14%	0	100%
Other Emerging	33%	10%	31%	17%	10%	0	100%
Global	40%	9%	28%	13%	7%	4%	100%
Source: World	Energy Outlook	, 2008 [9].					

 Table 2 – Oil consumption by country and industry

According to IEA's annual World Energy Outlook, 49% of global oil were consume, as fuels for cars and airplanes, 28% for industrial, and 7% for electricity. Comparing OECD and emerging economies, higher percent-age of oil are used as fuels for transportation in OECD and lower% of fuel are used for industrial use. For example, in US, 65% oil is used as fuels, and in China, 36%. In US, industrial use accounts for 26% of oil, and in China, 40% [10, p. 369].



Picture 1 – Global Shale Gas Reserve = 6600 trillion feet Source: EIA 2012 [12].

Table 3 – Oil total proved reserves

Global shale gas reserves have been estimated by large scale test drills and geological surveys. EIS published following estimates in 2009. Global reserves were estimate to be 6600 trillion cubic feet, or 188 trillion cubic meter. Shale gas increase technically recoverable natural gas resources by almost 50%. China has the largest shale gas reserves, estimated to be 36 trillion cubic meter, 20% of global reserves, although shale gas can not turn China to an oil exporting country [11, p. 127].

However, China should not aim to consume equal amount of oil on individual basis. Its vast population already renders huge pressure on energy supplies and pollution. Given its low energy efficiency on GDP basis, the emphasis should be how to improve efficiency. The efficiency can be improved on two fronts, transforming the economy to a consumption and service economy running on less energy intensity, and increasing utilization efficiency, such as car's fuel efficiency, steel industry's coal efficiency, and electricity generation efficiency.

	At end 1994	At end 2004	At end 2013		At en	d 2014	
	Thousand million barrels	Thousand million barrels	Thousand million barrels	Thousand million tones	Thousand million barrels	Share Of total	R/P ratio
Kazakhstan	5.3	9.0	30.0	3.9	30.0	1.8%	48.3
China	16.3	15.5	18.5	2.5	18.5	1.1%	11.9
Total North America	127.6	223.7	232.5	35.3	232.5	13.7%	34.0
Total S. & Cent. America	81.5	103.4	329.8	51.2	330.2	19.4%	*
Total Europe & Eurasia	141.2	140.8	157.2	20.9	154.8	9.1%	24.7
Total Middle East	663.6	750.1	808.7	109.7	810.7	47.7%	77.8
Total Africa	65.0	107.6	130.1	17.1	129.2	7.6%	42.8
Total Asia Pacific	39.2	40.6	42.7	5.7	42.7	2.5%	14.1
Total World	1118.0	1366.2	1701.0	239.8	1700.1	100.0%	52.5
Source: BP Sta	tistical Review of	ofWorld Energy .	June 2015 [13].				

Table 4 - Oil production

Thousand barrels daily	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Kazakhstan	1248	1294	1368	1413	1485	1609	1672	1684	1662	1720	1701
China	3486	3642	3711	3742	3814	3805	4077	4074	4155	4216	4246

Продолжение таблицы 4

Thousand barrels daily	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total North America	14160	13704	13724	13629	13156	13441	13847	14316	15555	16921	18721
Total S. & Cent. America	7166	7339	7479	7322	7398	7326	7350	7379	7317	7335	7613
Total Europe & Eurasia	17572	17524	17587	17799	17576	17757	17692	17385	17119	17155	17198
Total Middle East	24873	25518	25734	25305	26417	24727	25777	28088	28502	28198	28555
Total Africa	9313	9891	9945	10194	10203	9849	10095	8524	9275	8684	8263
Total Asia Pacific	7854	7988	7947	7970	8097	8049	8428	8288	8382	8286	8324
Total World	80938	81963	82417	82220	82847	81149	83190	83980	86150	86579	88673
Source: BP Statistical	Review of	ofWorld E	nergy Jun	e 2015 [1	3].						

$Table \ 5-Oil \ consumption$

Thousand barrels daily	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Kazakhstan	196	204	210	233	229	188	196	255	273	273	276
China	6740	6923	7437	7817	7937	8212	9266	9791	10231	10664	11056
Total North America	25023	25119	25002	25109	23860	22957	23511	23330	22926	23364	23347
Total S. & Cent. America	5058	5214	5384	5672	5911	5930	6220	6454	6599	6913	7125
Total Europe & Eurasia	20076	20199	20366	20098	20017	19210	19125	19007	18551	18450	18252
Total Middle East	5940	6346	6469	6764	7212	7530	7766	7985	8296	8450	8706
Total Africa	2777	2919	2923	3062	3229	3301	3479	3390	3561	3650	3800
Total Asia Pacific	24232	24614	25184	26035	25887	26138	27766	28808	29914	30415	30856
Total World	83107	84411	85328	86741	86115	85066	87867	88974	89846	91243	92086
Source: BP Statistical	Review of	ofWorld E	nergy Jun	e 2015 [1	3].						

Table 6 – Oil production

Million tones	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Kazakhstan	59.5	61.5	65.0	67.1	70.7	76.5	79.5	80.0	79.2	81.8	80.8
China	174.1	181.4	184.8	186.3	190.4	189.5	203.0	202.9	207.5	210.0	211.4
Total North America	660.2	637.6	637.8	632.7	612.0	621.7	639.0	659.7	721.2	784.7	866.8
Total S. & Cent. America	368.0	375.3	382.0	374.1	379.8	375.4	376.9	379.0	376.7	376.4	391.0
Total Europe & Eurasia	853.7	849.0	852.4	863.8	855.0	861.3	859.0	844.2	833.2	832.6	834.3
Total Middle East	1199.4	1226.0	1235.6	1213.0	1268.3	1176.0	1218.1	1324.6	1343.2	1325.2	1339.5
Total Africa	444.6	470.6	472.2	483.0	484.9	466.8	479.6	405.3	441.7	412.8	392.2
Total Asia Pacific	378.9	383.0	381.1	382.0	388.6	384.5	402.7	395.3	400.4	394.9	396.7
Total World	3904.7	3941.5	3961.2	3948.6	3988.6	3885.8	3975.4	4008.1	4116.4	4126.6	4220.6
Source: BP Statistical R	eview of V	Vorld Ene	rgy June 2	2015 [13]	•						



Picture 2 – The dynamic of daily production and consumption of oil in barrels [12]

Million tones	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Kazakhstan	9.5	9.8	10.3	11.3	11.0	8.9	9.3	12.3	13.0	12.9	13.0
China	318.9	326.8	351.2	369.3	376.0	388.2	437.7	460.0	482.7	503.5	520.3
Total North America	1125.9	1130.5	1119.7	1123.1	1068.2	1016.7	1040.0	1030.2	1012.6	1025.3	1024.4
Total S. & Cent. America	236.5	242.7	251.1	262.6	274.3	273.2	286.3	297.2	304.3	317.8	326.5
Total Europe & Eurasia	961.8	964.5	974.6	957.7	956.7	913.3	907.7	901.6	880.4	869.3	858.9
Total Middle East	279.5	293.3	299.6	314.1	336.3	348.1	354.2	360.2	374.8	382.5	393.0
Total Africa	132.3	138.9	138.5	145.0	153.1	155.9	164.3	159.3	168.3	172.2	179.4
Total Asia Pacific	1134.8	1149.3	1175.4	1214.8	1210.5	1215.8	1289.5	1336.9	1392.9	1412.1	1428.9
Total World	3870.8	3919.3	3958.9	4017.3	3999.0	3922.9	4041.8	4085.4	4133.2	4179.1	4211.1
Source: BP Statistical	Review o	ofWorld Er	ergy June	2015 [13]							

Table 7 – Oil consumption

Conclusion

With domestic production peaking and reserve declining, China's dependence on foreign oil is likely to worsen in coming years. How should China develop its oil strategy and security for 2030 and beyond?

Based on forecasts (made in 2003) from major energy research agencies, China will need 430-540million tons of oil in 2020. China Energy Research Institute's estimates were at the low end of 430-475 million tons, and estimate by US Dept. of Energy was 540 million tons. (in2011 China consumed 460 million tons of oil) Historically, all those agencies had under – estimated Chinese demand. For example, they forecast in 2003 that China oil demand in 2010 to be in a range 250 – 350 million tons. Actually, China consumed 438 million tons in 2010. Demand will most likely exceed the high – end estimate by major agencies.

Historically, oil demand growth rate was 0.7 x of GDP growth rate from 1978 to 2008. Following is a scenario analysis based on elasticity of 0.5 to 0.7 for oil growth / GDP growth. If energy intensity is reduced, which is possible given that China has gone through 20 years of industrialization and urbanization, China demand for oil will look like following table. Implied in oil demand model are following assumptions: China GDP grows at 7% from 2010 – 2020, and 4% from 2020 to 2030. China oil demand will be around 600 million tons in 2020, and 750 million tons in 2030. Assuming domestic production to stay at 200 million tons, China has import about 400 million tons annually.

Based on several research institutes, China domestic production will peak at 180 - 200 million tons and stay at that level from years. Two estimates of domestic productions in 2020, from Zhou etc. and China Commerce Ministry, were very close and pointed to same declining trend. Domestic productions to be maintain ta 200 million tons through 2010 - 2020. Zhou estimated that domestic supply to be 100 million tons in 2050. It is reasonable to forecast that domestic production around 2030 is 150 million tons.

Kazakhstan has an export oriented economy, highly dependent on shipments of oil and related products (73 percent of total exports). Other exports include: ferrous metals, copper, aluminum, zinc and uranium. Main export partners are: China (19 percent of total exports), Italy (17 percent), Russia (8.4 percent) and Netherlands (8 percent). Others include: France, Switzerland, Ukraine and Canada. This page provides – Kazakhstan Exports – actual values, historical data, forecast, chart, statistics, economic calendar and news. Kazakhstan Exports – actual data, historical chart and calendar of releases – was last updated on January of 2016.

Exports in Kazakhstan decreased to 3553.70 USD Million in October from 3714.30 USD Million in September of 2015. Exports in Kazakhstan averaged 3420.67 USD Million from 1998 until 2015, reaching an all time high of 9788.50 USD Million in June of 2011 and a record low of 286.50 USD Million in January of 1999. Exports in Kazakhstan is reported by the Agency of Statistics of the Republic of Kazakhstan.

In future, the volume of oil and gas in Kazakhstan is expected to grow significantly. The growth of oil and gas production in Kazakh can be linked to the following three factors. First, it is due to a significant influx of investment. Second, due to favorable world market conditions for crude production. Finally, a large-scale study of the subsoil areas in the Caspian and Aral Seas will contribute to further addition of resources.

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