

Current Stance of Energy Resources and Potential in OIC Member Countries



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Current Stance of Energy Resources and Potential in OIC Member Countries

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1. Introduction

Energy is a key factor for economic development and, thus, rising living standards. It is required for satisfying all of the basic demands, from agriculture, education, infrastructure to information services (Sopian et al. 2011). Energy is also a key factor in economic growth, which is among the most important factors to be considered in projecting changes in world energy consumption. Despite the consensus regarding the correlation of economic growth and energy consumption, the direction of causality between these two variables is also an interest among economists and policy-makers (Eggoh et al. 2011). To consume energy, the countries should either be able to produce it or import it. It is, therefore, very important to possess energy sources as well as being able to process it.

This special report illustrates the trends in energy resources, including their production and consumption, in the OIC countries. It is clearly illustrated that even though the OIC countries are blessed with the wealth of energy resources, they are lacking the necessary technology and R&D investments to process these resources. As of renewable energy sources, the performance of the OIC countries during the last decade is impressive. However, it is still far below the performance of the developed countries and the OIC member countries are at the beginning of their journey.

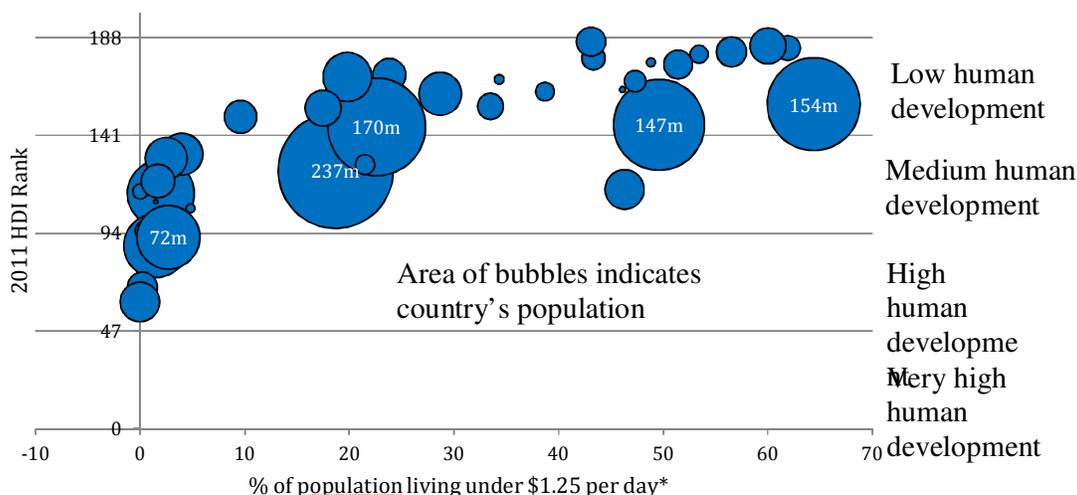
2. Energy and Socio-Economic Development

Four-fifths of total world primary energy is obtained from fossil fuels – with crude oil and natural gas having shares of 32 per cent and 21 per cent, respectively (IEA, 2009). Having said that, the OIC member countries, blessed with the wealth of energy resources – particularly with the crude oil and natural gas, are apparently enjoying a great potential for furthering their stages of socio-economic development and welfare. The OIC member countries, as a group, hold almost two-thirds of the planet’s proven crude oil and natural gas reserves (63 per cent and 62 per cent, respectively).

Yet, despite their geostrategic importance and rich natural resources, a significant portion (according to the World Bank: about 26 per cent) of the OIC population live under income poverty line (PPP \$1.25 a day). As clearly shown in Figure 1, a significant portion of the population is associated with low levels of human development, measured by UN Human Development Index

(HDI), and prevalent poverty. This is, in turn, a clear indication that the aforesaid strategic opportunities from the possession of natural resources are not being used effectively within the OIC group. These resources, if used more effectively, can lead to the elimination of poverty and enhancement of socio-economic development within, and increase in cooperation among, the group of OIC member countries.

Figure 1: Human Development and Poverty



Source: World Bank, UN. * Refers to latest available data between 2000-2009

3. Primary Energy Production and Consumption

3.1 Primary Energy Production

Table 1 summarizes the energy production data by indicating the shares different groups in the world total, and the corresponding growth rates. Share of the OIC countries, as a group, in world energy production was around 21 per cent in 1990; and, it steadily increased in the following years to reach 25.40 per cent in 2009. At the average growth rate level, OIC countries have been far above the world particularly for the first half of the 1990-2009 period. However, during the second half of the twenty-year period, the average growth rate in energy production of the OIC countries showed a declining trend. Even though it decreased from 2.8 per cent during 1990-2000 to 2.4 per cent during 2000-2009, it was still above the world average growth rate during the same period. Or, to put it differently, the share of OIC countries in total energy production of other developing countries increased from 50.20 per cent in 1990 to 55.59 per cent in 2009. Similarly, the corresponding ratio for developed countries increased to 89.63 per cent in 2009 from 61.19 per cent in 1990.

Table 1: Primary Energy Production, (kt of oil equivalent)

	1990	1995	2000	2005	2009	Average Growth Rate (%)	
						1990-2000	2000-2009
OIC	1,893,418	2,131,224	2,508,743	2,953,843	3,108,950	2.8	2.4
Non-OIC Developing	3,771,514	3,740,401	3,937,436	5,014,454	5,592,358	0.4	3.9
Developed	3,094,516	3,324,790	3,482,076	3,474,955	3,468,707	1.1	-0.04
World	8,815,610	9,250,948	9,987,405	11,510,310	12,240,882	1.2	2.2
OIC % of Non-OIC Developing	50.2	56.9	63.7	58.9	55.5		
OIC % of Developed	61.1	64.1	72.0	85.0	89.6		
OIC % of World	1.3	4.1	5.0	5.5	7.3		

Source: World Bank, WDI Online Database

Energy production in the OIC countries concentrated in a few of them. In 2011, Saudi Arabia took the lead with 528,377.1 kt of oil equivalent energy production, accounting for 16.9 per cent of the total energy production of all OIC countries, followed by Indonesia (351,841 kt), Iran (349,781 kt), Nigeria (228,721 kt), United Arab Emirates (169,799 kt), Algeria (152,291 kt), Kazakhstan (145,814 kt), Qatar (139,945 kt), Kuwait (130,240 kt), and Iraq (119,640 kt). These ten countries, together, accounted for 74.4 per cent of the total energy production in all OIC countries.

3.2 Primary Energy Consumption

Table 2 characterizes the energy consumption data by indicating the shares of different groups in the world total, and the corresponding growth rates. The energy consumption of the world has been on the rise. It was growing at an annual average rate of 2.1 per cent during 2000-2009, compared to 1.2 per cent between 1990 and 2000.

Table 2: Primary Energy Consumption, (kt of oil equivalent)

	1990	1995	2000	2005	2009	Average Growth Rate (%)	
						1990-2000	2000-2009
OIC	802,714.4	930,744.9	1,084,665	1,355,687	1,544,515	3.0	4.0
Non-OIC Developing	3,458,610	3,390,564	3,557,289	4,469,917	5,231,082	0.2	4.3
Developed	4,223,711	4,570,292	4,967,308	5,153,829	4,854,514	1.6	-0.2
World	8,573,627	8,997,069	9,739,437	11,125,279	11,786,571	1.2	2.1
OIC % of Non-OIC Developing	23.2	27.4	30.4	30.3	29.5		
OIC % of Developed	19.0	20.3	21.8	26.3	31.8		
OIC % of World	9.3	10.3	11.1	12.1	13.1		

Source: World Bank, WDI Online Database

In 1990, OIC as a group consumed 802,714.4 kt of oil equivalent energy accounting for 9 per cent of the total energy consumed in the world. During 2000-2009, OIC consumption increased by 4.0 per cent per year compared to 3.0 per cent per annum between 1990-2000. Such growth rates are far

above the world average pace of growth. Therefore, the share of OIC in world energy consumption increased to 13.1 per cent in 2009 from 9.3 per cent in 1990. Accordingly, the share of OIC countries in total energy consumption of developed countries has been on the rise since 1990.

As was the case in energy production, energy consumption in the OIC countries concentrated in a few of them. Iran is the largest energy consuming country in 2009 with 215,850 kt of oil equivalent energy production, accounting for 13.9 per cent of the total energy production of all OIC countries, followed by Indonesia (201,998 kt), Saudi Arabia (157,854 kt), Nigeria (108,251 kt), and Turkey (97,660 kt). These five countries, together, accounted for more than half (50.6 per cent) of the total energy production in all OIC countries.

4. Sources of Energy

There are three groups of energy sources: fossil fuels, renewable energy and nuclear power. Fossil fuels are the remains of decomposition of plants and animals which forms in finite supply. There are also three main types of fossil fuels: coal, petroleum and natural gas. Renewable energy is coming from the natural sources such as wind, rain and sunlight. Nuclear power is, on the other hand, obtained through fission and fusion reactions to generate energy from uranium. However, since the data is not widely available for nuclear power, it will not be studied in this report.

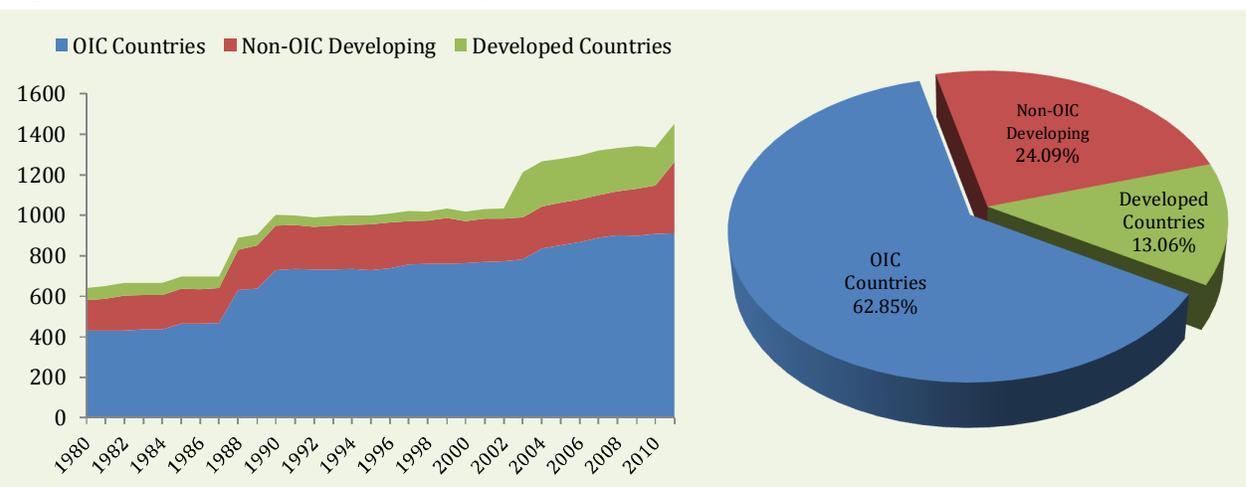
4.1 Fossil Fuels

Oil

Oil is another fossil fuel found in geological formations underneath the Earth’s surface. It is refined and separated through a series of process to produce a large number of refined products from petrol to jet fuel, plastics and pharmaceuticals.

By 2011, world crude oil reserves reached to 1.5 trillion barrels, of which OIC countries represent a share of 63 per cent equivalent to 911 billion barrels (Figure 2). Developed and non-OIC developing countries hold 13 per cent and 24 per cent of the world total, respectively. At the individual country level, Saudi Arabia, alone, with total proved oil reserves of 263 billion barrels, possesses 18 per cent of the world total crude oil reserves and 29 per cent of the OIC total, followed by Iran (137 billion barrels), Iraq (115 billion barrels), Kuwait (104 billion barrels), and United Arab Emirates (97.8 billion barrels). These five countries together accounted for 78.6 per cent of the OIC total crude oil reserves.

Figure 2: Crude Oil Reserves (billion barrels) and Shares



Source: Energy Information Administration Online Database

World crude oil production grew by 1.1 per cent per year between 2000 and 2011, compared to 1.6 per cent per year in the period 1990-2000 (Table 3). In 2011, the crude oil production of the OIC countries constituted 44 per cent of the world total, which was 5 percentage points higher than the share observed in 1990.

Table 3: Crude Oil Production (thousand barrels/day)

	1990	1995	2000	2005	2011	Average Growth Rate (%)	
						1990-2000	2000-2011
OIC	25,915.2	30,119.2	33,993.7	37,888	38,364.4	2.8	1.2
Non-OIC Developing	23,773.4	23,774.1	26,521.0	30,356.2	31,275.8	1.1	1.7
Developed	16,747.1	16,411.4	17,193.9	16,173.6	17,372.6	0.3	0.1
World	66,435.7	70,304.6	77,708.7	84,417.8	87,012.8	1.6	1.1
OIC % of World	39.0	42.8	42.9	44.8	44.0		

Source: Energy Information Administration Online Database

On the other hand, world oil consumption grew by an annual average growth rate of 1.2 per cent in the period 2000-2011 compared to 1.4 per cent in the period 1990-2000 (Table 4). The main reason for the slight decline in consumption of oil is the sharp increase in the price level of oil from 2000 to 2008. Throughout the period under consideration, consumption of the OIC member countries remained far above the world average. The same is true for the non-OIC developing countries during 1990-2000 and for the developed countries between 2000 and 2011.

Table 4: Crude Oil Consumption (thousand barrels/day)

	1990	1995	2000	2005	2011	Average Growth Rate (%)	
						1990-2000	2000-2011
OIC	6,448.1	8,408.2	9,484.6	11,200.5	13,722	3.9	3.4
Non-OIC Developing	23,374.7	18,498.9	21,241.8	24,777	29,539	-1.0	3.0
Developed	36,326.8	42,770.3	45,596.2	47,572.6	43,396	2.3	-0.5
World	66,149.7	69,677.5	76,322.6	83,550.1	86,557	1.4	1.1
OIC % of World	9.7	12.0	12.4	13.4	15.8		

Source: Energy Information Administration Online Database

In 2008, OIC countries had a trade surplus of 23 million barrels of crude oil per day, compared to 16.9 million barrels per day in 1990 which simply implies the significant increase in oil export of the OIC member countries (Table 5). During the same period, non-OIC developing countries could only increase their trade surplus of crude oil by 1.1 million barrels/day. The crude oil trade deficit of developed countries, on the other hand, increased to 26.1 million barrels/day in 2008 from 17 million barrels/day in 1990.

However, as shown in Table 5, in 2008, the OIC countries could only produce 11.4 million barrels of refined oil even though they amounted to 38.3 million barrels of crude oil per day. This is simply due to the low capacity of the OIC countries to refine crude oil. In 2008, refined oil trade surplus of OIC countries, as a whole, decelerated to 1.5 million barrels per day from 2.6 million

barrels per day in 1990. On the other hand, non-OIC developing countries and developed countries represented a different trend. Both of the country groups had better refining capacity. The refining capacity of developed countries is impressive. In 2008, their crude oil production per day was only 17.7 million barrels. It seems from Table 6.7 that developed countries refined more than they produced. Non-OIC developing countries, on the other hand, had a production of 26.1 million barrels of refined oil per day despite the production of 29.3 million barrels of crude oil in 2008.

Table 5: Output and Trade of Crude Oil and Refined Products (million barrels/day)

			1990	1995	2000	2005	2008
Crude Oil	OIC	Supply	25.9	30.1	34.0	37.9	38.3
		Trade Balance	16.9	18.6	21.3	22.6	23.0
	Non-OIC Developing	Supply	23.3	23.7	26.5	30.3	31.2
		Trade Balance	0.0	2.7	2.3	3.2	1.1
	Developed	Supply	16.7	16.4	17.1	16.1	17.3
		Trade Balance	-17.0	-21.4	-23.7	-26.5	-26.1
Refined Oil	OIC	Supply	7.8	9.5	10.4	11.9	11.4
		Trade Balance	2.6	2.7	2.9	2.4	1.5
	Non-OIC Developing	Supply	23.6	18.1	21.2	25.8	26.1
		Trade Balance	0.9	0.2	0.8	2.0	1.3
	Developed	Supply	34.2	40.9	43.5	44.9	37.0
		Trade Balance	-2.0	-1.5	-2.4	-2.4	0.0

Source: Energy Information Administration Online Database

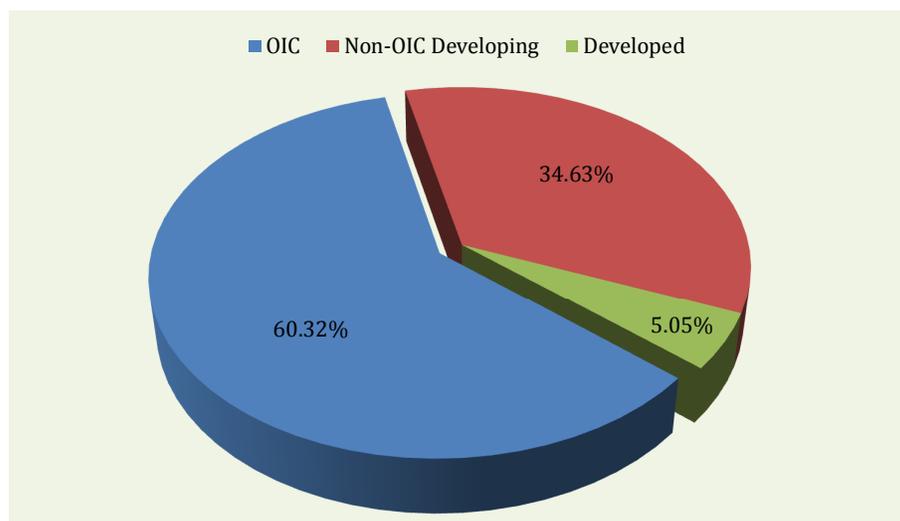
To sum, even though the OIC countries are major suppliers of primary oil and run large crude oil trade surpluses, this does not translate into a strong presence in the production and trade of refined oil products due to insufficient refinery capacity.

Natural Gas

Natural gas is one of the cleanest and safest burning fossil fuels which emits 50 per cent less carbon dioxide than that released by coal and 25 per cent less carbon dioxide than oil, for the same amount of energy produced (Haktanir, 2004). Therefore, its usage has been increasing in the world to satisfy the environmental concerns.

Figure 3 provides information on the share of various country groups in natural gas reserves worldwide. By 2011, recoverable natural gas reserves worldwide were approximately 6,216.6 trillion cubic feet (Tcf). As seen from the figure, the OIC countries held 62.1 per cent of the world total in 2011. Developed and non-OIC developing countries, on the other hand, represented shares of 5.2 per cent and 35.7 per cent, respectively.

At the individual country level, with total proved natural reserves of 1045.7 Tcf, Iran, alone, possesses 27 per cent of the OIC total natural gas reserves followed by Qatar (895.8 Tcf), Saudi Arabia (275.7 Tcf), Turkmenistan (265 Tcf), and United Arab Emirates (227.9 Tcf). These five countries together accounted for almost 70.0 per cent of the OIC total.

Figure 3: Share of Natural Gas Proven Reserves, 2011

Source: Energy Information Administration Online Database

Natural gas production has been increasing to satisfy the demand for the last twenty years (Table 6). In 2010, the OIC countries produced 35,862 billion cubic feet (Bcf) of natural gas compared to 9493 Bcf in 1990 which is equivalent to an annual average growth rate of 5.6 per cent between 2000-2010 compared to 8.5 per cent between 1990-2000. Such growth rates simply imply that the pace of growth in natural gas production of the OIC member countries remained far above the world average throughout the period under consideration.

Table 6: Dry Natural Gas Production (billion cubic feet)

	1990	1995	2000	2005	2010	Average Growth Rate (%)	
						1990-2000	2000-2010
OIC	9,493.08	15,651.1	21,495.9	28,092.7	35,862.9	8.5	5.3
Non-OIC Developing	3,527.4	28,246.3	28,428.7	33,381.7	37,170.6	-2.1	2.7
Developed	29,020.8	34,207.4	37,175.3	36,918.7	39,057.2	2.5	0.5
World	73,787.9	78,104.7	87,099.9	98,393.1	112,090	1.7	2.6
OIC % of World	12.8	20.0	24.6	28.5	1.9		

Source: Energy Information Administration Online Database

Natural gas production in the OIC countries concentrated in a few of them. In 2010, Iran took the lead with 5,161 Bcf, accounting for 14.3 per cent of the total natural gas production of all OIC countries, followed by Qatar (4,121 Bcf), Saudi Arabia (3,095 Bcf), Algeria (2,988 Bcf), and Indonesia (2,917 Bcf). These five countries, together, accounted for 51 per cent of the total gas production in OIC countries.

The growth in natural gas consumption of the OIC countries also remained above the average for the period under consideration. In 2010, the consumption increased to 25,563 (Bcf) which is almost

71.5 per cent higher than the level in 2000 (Table 7). The annual average growth rate of natural gas consumption was 8.2 per cent in 1990s, and 5.5 per cent in 2000s. OIC countries' consumption formed 22.6 per cent of the world total in 2010 compared to 9.2 per cent in 1990. At the individual country level, Iran consumed 5,105 Bcf of natural gas, accounting for 19.9 per cent of total OIC consumption, followed by Saudi Arabia (3,095 Bcf), United Arab Emirates (2,137 Bcf), Egypt (1,630 Bcf), and Uzbekistan (1,614 Bcf).

Table 7: Dry Natural Gas Consumption (billion cubic feet)

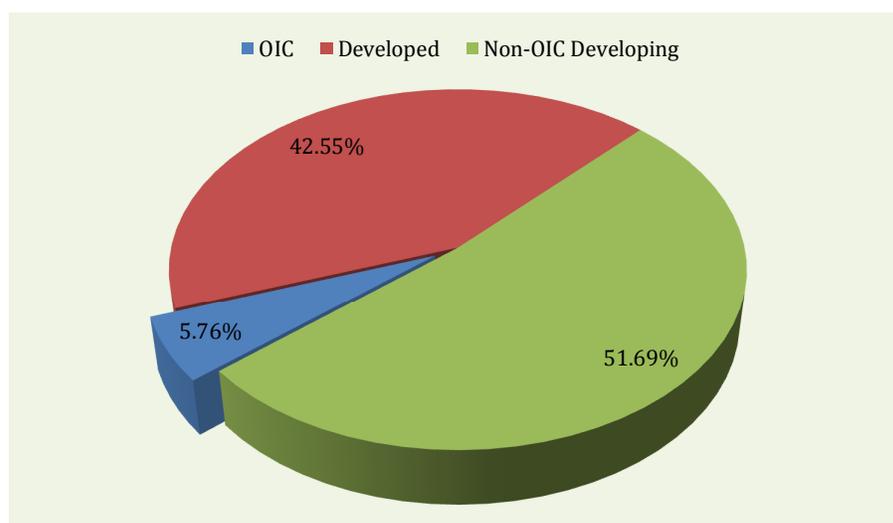
	1990	1995	2000	2005	2010	Average Growth Rate (%)	
						1990-2000	2000-2010
OIC	6,762.7	11,357.1	14,903.2	20,153.9	25,563.2	8.2	5.5
Non-OIC Developing	35,083.2	26,023.9	26,354.8	31,604.7	35,754.8	-2.8	3.1
Developed	31,783.4	41,544.5	46,001.3	48,250.7	51,601.7	3.8	1.7
World	73,629.4	78,925.5	87,259.3	100,009.2	112,919.7	1.7	2.6
OIC % of World	9.18	14.39	17.08	20.15	22.6		

Source: Energy Information Administration Online Database

Coal

Coal is a fossil fuel which is widely used in generating energy since the 18th century. Coal can be found in different forms, with some being more common and more useful than others. As of 2008, world's current recoverable coal reserves are approximately 948 billion tons (Figure 4). Coal reserves are very limited in OIC countries. Only 5.75 per cent of the world's recoverable coal is hold by OIC member states. At the country level, Kazakhstan possesses 67 per cent of the total coal reserves of the OIC member countries, followed by Indonesia (11.1%) and Turkey (4.7%).

Figure 4: Share of Total Recoverable Coal Reserves, 2008



Source: Energy Information Administration Online Database

Accordingly, the coal production of the OIC countries in 2010 only constituted only 7.3 per cent of the world total production (Table 8). However, it seems from the table that coal production of the OIC countries has been significantly increasing over time. It increased to 585 million tons in 2010 from only 72 million tons in 1990. The annual average growth rate is 13.1 per cent during the 1990s compared to 8.9 per cent in 2000s. Notably, the annual average growth rate of coal production of the OIC countries remained far above the world average for this period. In 2010, Indonesia was the leading country among OIC in terms of coal production. Indonesia produced 370 million tons of coal, accounting for 63.2 per cent of the total coal production of the OIC member countries, followed by Kazakhstan (122 million tons), Turkey (79 million tons), Pakistan (3.7 million tons), and Uzbekistan (3.6 million tons).

Table 8: Coal Production, (million short tons)

	1990	1995	2000	2005	2010	Average Growth Rate (%)	
						1990-2000	2000-2010
World	5,347	5,077	4,894	6,554	7,985	-0.8	5.0
Non-OIC Developing	3,693	2,943	2,706	4,156	5,411	-3.6	7.1
Developed	1,582	1,923	1,939	2,037	1,989	2.0	0.2
OIC	72	210	249	361	585	13.1	8.9
OIC % of World	1.3	4.1	5.0	5.5	7.3		

Source: Energy Information Administration Online Database

The growth in coal consumption of the OIC countries also remained above the world average for the period under consideration. In 2010, the consumption increased to 297.9 million tons which is almost 61 per cent higher than the level in 2000 (Table 9). The average annual growth rate of consumption was recorded at 8.1 per cent in 1990s, and 4.9 per cent in 2000s. OIC countries' coal consumption formed 3.7 per cent of the world total consumption in 2010 compared to 1.5 per cent in 1990. At the individual country level, Turkey consumed 109.1 million tons of coal, accounting for 36.6 per cent of total OIC consumption, followed by Kazakhstan (86.8 million tons), Indonesia (54.2 million tons), Malaysia (21.3 million tons), and Pakistan (11.5 million tons).

Table 9: Coal Consumption, (million short tons)

	1990	1995	2000	2005	2010	Average Growth Rate (%)	
						1990-2000	2000-2010
OIC	84.06	173.01	184.58	239.40	297.94	8.1	4.9
Non-OIC Developing	3,561.43	2,864.11	2,654.95	3,956.76	5,541.61	-2.8	7.6
Developed	1,618.04	2,042.18	2,202.83	2,302.42	2,155.15	3.1	-0.2
World	5,263.53	5,079.30	5,042.36	6,498.57	7,994.70	-0.4	4.7
OIC % of World	1.5	3.4	3.6	3.6	3.7		

Source: Energy Information Administration Online Database

4.2 Renewable Energy Sources

Although most of the energy demand is met by fossil fuels, combustion of fossil fuels has negative impacts on planet such as acid precipitation, stratospheric ozone depletion, and, as a result,

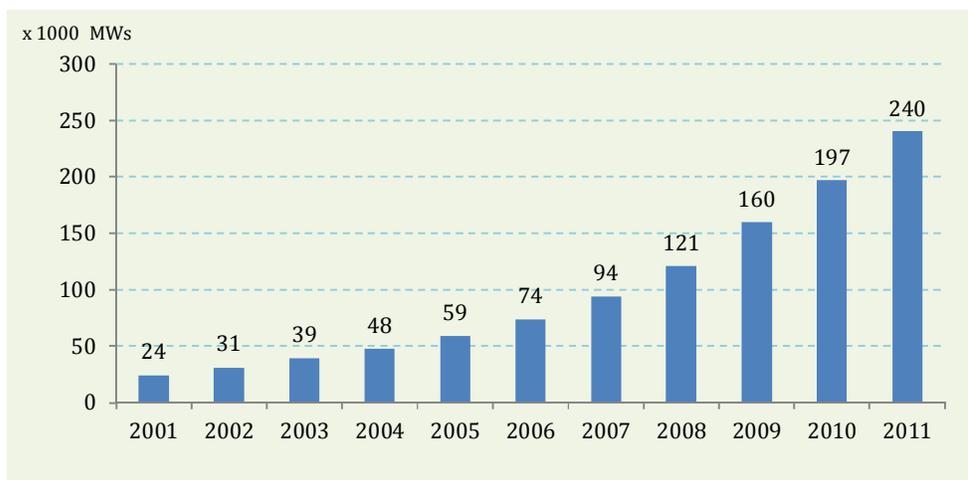
global climate change. To overcome these issues, safe energy policies have to be implemented. Renewable energy sources appear to be the most efficient option among the others. There is also high correlation between renewable energy and sustainable development. In other words, sustainable development requires a sustainable supply of energy resources. Notably, supplies of energy resources such as fossil fuels are finite; other sources such as solar, wind and hydro are renewable and sustainable in the long-run.

In 2011, global investment in renewable energy reached a record high of \$257 billion, of which developed countries made 65 per cent (Bloomberg, 2011). According to the Energy Information Administration, 21 per cent of all R&D expenditures in energy go to the development of renewable energy sources. The most important renewable energy sources are wind and hydro energy.

Wind Energy

Despite global economic crisis, investment in new wind turbines exceeded all previous years. As shown in Figure 4, the wind capacity worldwide increased to 240,000 MWe in 2011 out of which 43,000 MWe were added in the same year. Wind power showed a growth rate of 22 per cent in 2011.

Figure 5. Total Wind Installations



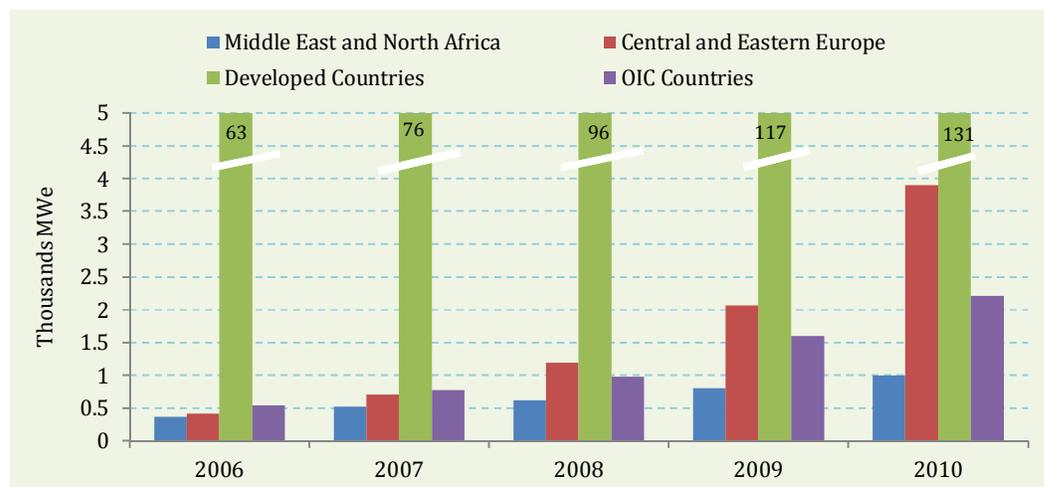
Source: World Wind Energy Association Annual Report 2010

Figure 6 shows that developed countries are still accounting for the bulk of the world's total installation, with a total capacity of 131 gigawatt (GW) in 2011, followed by the Central and Eastern Europe (3.8 GW), and the OIC countries (2.2 GW).

Investment in wind energy has shown impressive growth rates in OIC member countries since 2006. It increased to 2.2 GW in 2011 from only 0.53 GW in 2006 which is almost quadrupled. According to Sopian et al. (2006), investments in wind energy farms in OIC countries will continue to grow at an average growth rate of 25 per cent per year in parallel to global wind markets. This is due to foreseen improvement in world financial markets, development in wind power generation technologies, additional financial and tax incentives, worldwide adoption of Feed-in-Tariff (FiT) by respective countries and improved community power ownership models as developed and applied in

Scotland, Canada, Australia and many other parts of the world. Yet, it is worth mentioning that the percentage of total wind generation capacity in OIC countries constitutes only 1 per cent of the worldwide wind capacity by 2010. This ratio is expected to be 2 per cent in 2020.

Figure 6: Total Wind Installations by Regions (Thousand MWe)



Source: World Wind Energy Association Annual Report 2010

At the individual country level, Turkey stood first in 2010 with wind tribunes installed capacity of 1274 MWe (58 per cent of the OIC capacity) out of which 477.5 MWe were added in 2009. Turkey is followed by Egypt with a capacity of 550 MWe, Morocco (286 MWe), Iran (47.4 MWe), and Tunisia (20.7 MWe) in 2010.

Hydro Energy

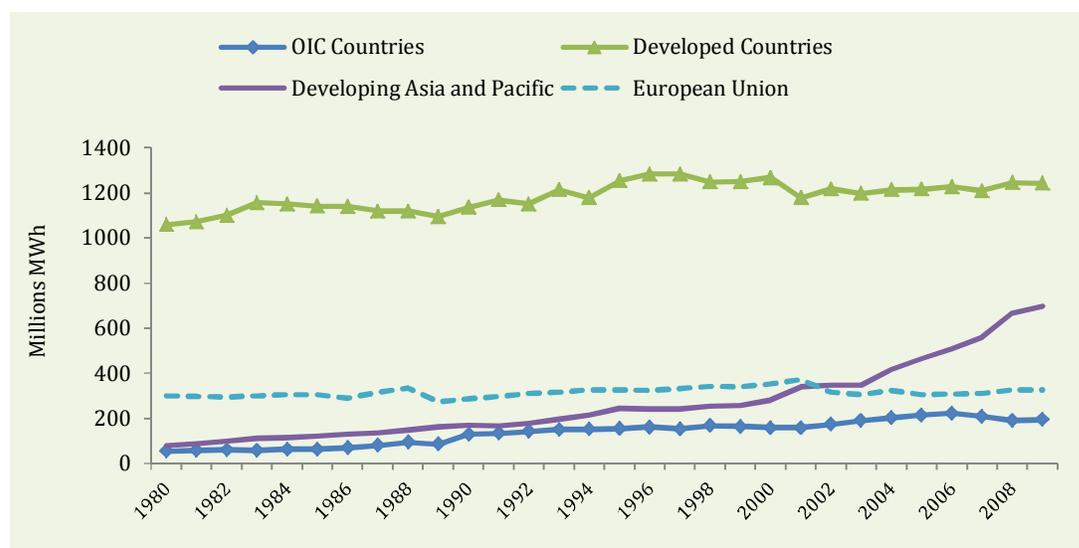
Being one of the oldest yet efficient methods of producing power, hydro energy is the production of electrical power through the kinetic energy of falling water. There are two important advantages of hydro energy. First, it is unceasingly renewable because of the recurring nature of the hydrologic cycle. Second, it has no direct waste in the sense that it does not particulate pollution.

In 2009, the world as a whole generated 3.23 million gigawatt hours of hydroelectric power, approximately 30 per cent higher than the amount generated in 1990. Developed countries continued to be the leading group in electricity generation from hydroelectric sources in 2009 where 38.4 per cent of the world total hydroelectric energy is produced in these countries. In the year 2010, European Union countries lost their position as the second most dynamic region. Developing Asia and Pacific countries took the second rank and increased their capacity by 24 per cent between 2000 and 2002, adding 0.06 million gigawatt hours, to a total of 0.28 million GWh. 2002 was, therefore, a kind of milestone for developing Asia and Pacific countries in terms of hydro energy which lead an important trend to start. By 2009, the total capacity of these countries increased to 0.7 million GWh which was 2.5 times greater than the amount generated in 2002.

The OIC countries, as a group, generated 0.19 million GWh of hydroelectric power, approximately 50 per cent higher than the amount generated in 1990, with an annual average growth

rate of 2 per cent which is higher than the EU average (0.6 per cent) in the same period. Yet, the OIC countries were able to generate only 6.0 per cent of the world hydroelectric power generation in 2009.

Figure 7: Electricity Generations from Hydroelectric Sources



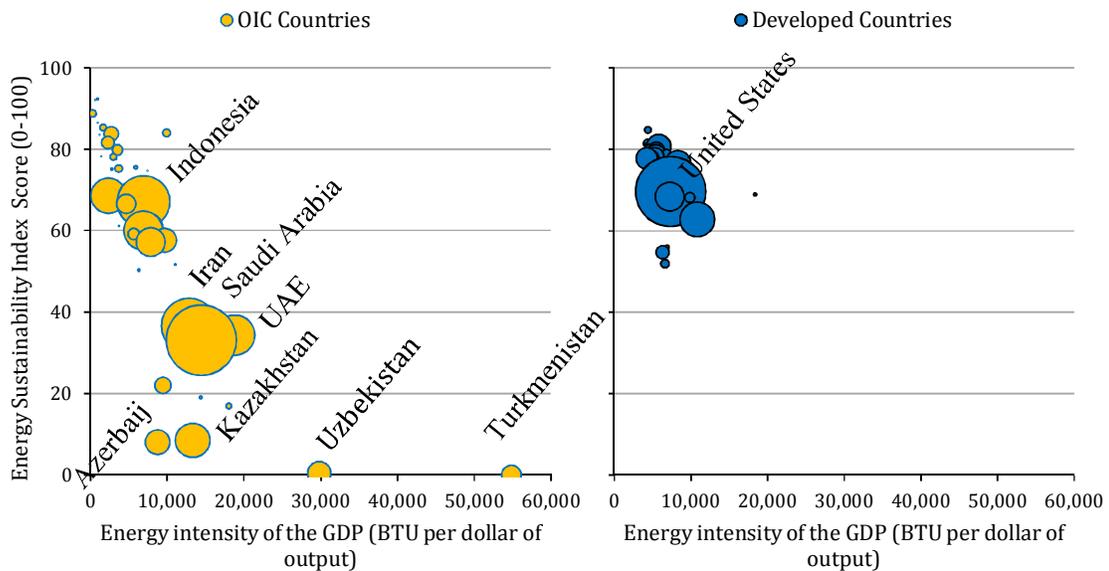
Source: World Bank, WDI Online Database

At the individual country level, Turkey was the leading OIC country in hydroelectric power generation since 1990s. According to Haktanir (2004), much of this can be attributed to the country's Southeastern Anatolia Project, which includes the construction of a system of 21 dams and 19 hydroelectric power plants on the Euphrates and Tigris rivers and their tributaries. Turkey is followed by Pakistan, Mozambique, Tajikistan, and Egypt with a production of 0.028, 0.017, 0.016, and 0.013 million GWh of hydroelectric power, respectively.

5. Energy Sustainability and Energy Intensity

Energy sustainability means that the energy is provided in a way that it meets the needs of the present without compromising those of future generations. Technologies that promote sustainable energy include renewable energy sources (as discussed in Section 4.2), such as hydro power, solar and wind energy, and also some other technologies that are designed to improve energy efficiency. In this connection, the Energy Sustainability Index (ESI), as a sub-index of the Environmental Performance Index developed by Yale University, ranks the countries according to their scores in three areas that are directly linked to the sustainability of energy. Namely, these areas are energy efficiency, renewable energy, and carbon emissions. Figure 8 depicts the ESI scores versus energy intensity of the GDP in some selected OIC countries and compares them to developed countries. It is clear from the figure that there is a strong positive (negative) relationship between energy efficiency (intensity) and energy sustainability. In addition to that, major energy producers within the group of OIC countries, such as Saudi Arabia, Iran, UAE, Algeria, Kazakhstan, Azerbaijan and Uzbekistan are characterized by low levels of Energy Sustainability Index and high degrees of energy inefficiency. Developed countries, on the other hand, maintain high levels of energy efficiency and sustainability. Overall, these figures are a clear indication that energy resources-rich OIC countries should develop policies to promote sustainability of their energy use and resources by investing in more energy efficient technologies.

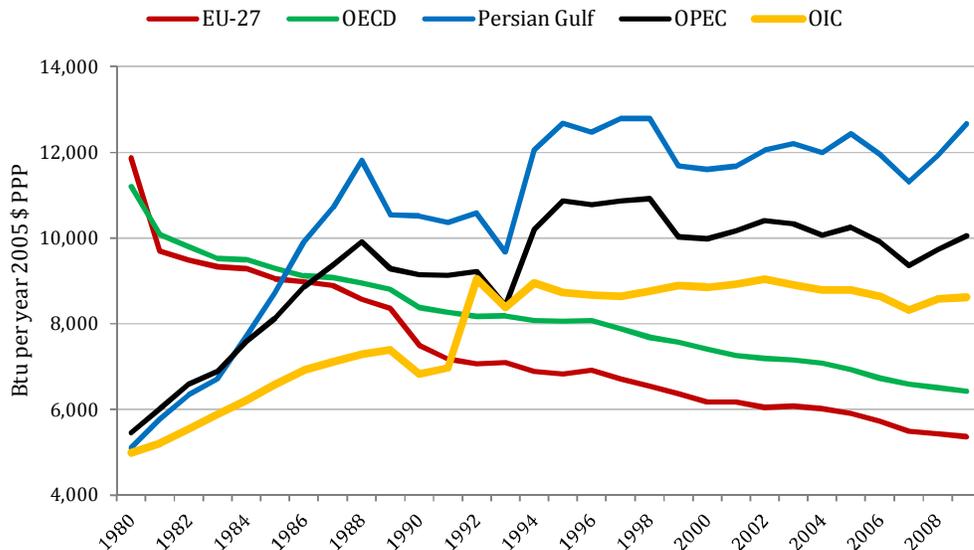
Figure 8: The Relationship between Energy Sustainability and Energy Intensity



Source: Yale University, Energy Information Administration

Figure 9 depicts the evolution of the level of energy intensity of the economic output in OIC member countries. Since 1980s, OIC countries have become less energy-efficient as the amount of energy consumed per dollar of output has increased significantly. Particularly during the 1990s, with the participation of Central Asian countries into the OIC, the average energy intensity of the economic output has seen a substantial increase. On the contrary, EU-27 and OECD economies have converged to very low levels of energy intensity and become more energy efficient over the same period.

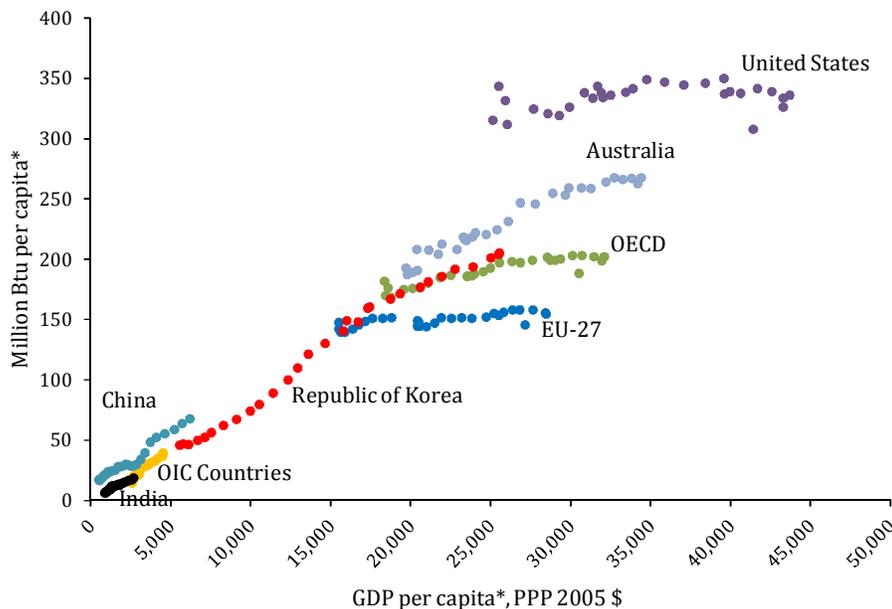
Figure 9: Energy Intensity of the Output (1980-2009)



Source: Energy Information Administration Online Database

Energy is essential for economic development and rising living standards of the community. Changes in countries' energy consumption attitudes mark transitions in the economic and social development of these countries and societies. Energy ladder, in this context, shows the improvement of per capita energy use corresponding to an increase in per capita income over time. Basically, as per capita income increases, the energy types used by economies would be cleaner and more efficient, but more expensive as moving from traditional biomasses to electricity. As it can be noted from Figure 10, where the positions of different countries and country groups on the energy ladder is indicated for the period 1980-2009, there are important differences between economic and energy performances of these countries and country groups. Developing countries, such as China, India and OIC countries, scramble to produce the energy sufficient to climb the ladder, whereas wealthy nations, such as the Republic of Korea, Australia, the US, and EU-27 countries, struggle to adapt their energy consumption patterns to maintain their existing lifestyles. Per capita energy consumption grows with income in a similar pattern across countries and time. Around \$15,000 per capita the relationship shifts as less energy-intensive services dominate economic growth. There are signs of saturation beyond \$25,000 and evidence that later developers require less energy. The figure also implies that many OIC countries still lack access to commercial energy as they are on average characterised by poor per capita primary energy consumption and low levels of per capita income. In other words, OIC countries are still at the beginning of their journey on the energy ladder.

Figure 10: Relationship between Income and Energy Consumption (Energy Ladder)



Source: World Bank, EIA, Shell International. * Data covers the period 1980-2009

6. Conclusion

OIC member countries are blessed with the wealth of energy resources, particularly with the crude oil and natural gas. They, as a group, hold almost two-thirds (63 per cent and 62 per cent) of the planet's proven crude oil and natural gas reserves, respectively. Notwithstanding this fact, for many member countries, poverty is still a prevalent issue: a considerable portion of the OIC population lives beneath poverty threshold.

It is well known that strong economic growth, particularly coming from the developing countries, will increase the demand for energy for the upcoming years—exceeding the reductions with the help of the energy-efficient technologies. It is, therefore, very important to possess energy sources as well as being able to process it. However, it is illustrated that OIC member countries are lacking the necessary technology and R&D investments to process crude oil to produce more value-added energy products. This leads to an inability to take the full advantage of their leading position in primary energy supply.

On the other hand, it should also be noted that supplies of energy resources such as fossil fuels are finite. Moreover, the combustion of fossil fuels has negative impacts on planet such as acid precipitation, stratospheric ozone depletion and, as a result, global climate change. Therefore, as the world faces an unsustainable energy future, with OIC countries being no exceptions, renewable energy sources (wind, hydro and others) appear to be the most efficient alternative to overcome these challenges. OIC countries, however, show heterogeneous structure in terms of renewable energy production from alternative sources.

There are several strategies exist in order to enhance the widespread application of renewable energy technology among OIC countries (Sopian et al. 2006). For instance, establishing education and capacity building programs will lead to understanding of renewable energy technology. Creating a renewable energy market and financing mechanism, on the other hand will let the countries import high skill labor which may be needed for high-tech RE investments. Moreover, such a market will allow host countries to implement appropriate taxes and incentives to attract international manufacturers utilizing the RE technology. Another strategy can be implementing efficient energy policy provide a healthy business environment for manufacturers. Finally, enhancing industrial collaboration and R&D activities among OIC members would help member countries to not only capture knowledge spillovers but also reduce duplication. It will also support the exploitation of scale economies in R&D and accelerate the commercialization of new technologies and the transfer of research outcomes from universities to industry.

The member countries are just starting their journey on the energy ladder. The member countries are characterised by on average relatively low per capita income and per capita energy consumption levels. In terms of the energy intensity of the output, the majority of the OIC countries, particularly those blessed with rich energy resources, are economically energy-inefficient and lacking necessary technologies to be able to produce and export higher value-added energy products. This state of affairs, in turn, offers a significant potential for developing the energy industry in OIC member countries, which could be achieved through, inter alia, investing in more energy-efficient technologies and increasing R&D and technology investments in the energy sector.

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