STATE OF ENERGY SECTOR IN D-8 COUNTRIES

ORGANISATION OF ISLAMIC COOPERATION

STATISTICAL ECONOMIC AND SOCIAL RESEARCH
AND TRAINING CENTRE FOR ISLAMIC COUNTRIES

SESRIC

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ORGANISATION OF ISLAMIC COOPERATION
STATISTICAL, ECONOMIC AND SOCIAL RESEARCH AND
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ABBREVIATIONS AND ACRONYMS

BASEIND:	SESRIC Basic Social and Economic Indicators Database
COMCEC:	Commercial Cooperation of the Organization of Islamic Cooperation
D-8:	Developing-8 Organization
EIA:	Energy Information Administration
GCI:	Global Competitiveness Index
LPI:	Logistics Performance Index
LSCI:	Linear Shipping Connectivity Index
IEA:	International Energy Agency
OIC:	Organisation of Islamic Cooperation
SESRIC:	Statistical, Economic and Social Research and Training Center for Islamic Countries
UNCTAD:	United Nations Conference on Trade and Development

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FOREWORD

Energy, which is defined as the capacity to do work, is clearly of enormous significance to human existence. It is a significant driving force for sustainable development with critical economic, social and environmental impacts. Energy is both a cause and a condition to economic growth of the economy. Given the finite nature of carbon-based energy and the eventuality of the post-oil era, effective strategies and policies are needed to deal with the future of the energy sector at both the national and regional levels. As global populations around the world witness increasing growth, the demand for less volatile and more clean and diverse energy portfolios is now becoming more critical than ever before.

Like many other developing countries, the member countries of the Organization for Economic Development Cooperation (D-8) continued to experience rapid economic growth rates over the last two decades. In order to sustain these rates, adequate and coherent policies regarding the energy sector in these countries become critically important. Energy is a priority sector for D-8 countries. In fact, adequate financing mechanisms for improving energy infrastructure, energy-use efficiency, and sustainability of energy supply have been recently given special attention in D-8 countries. To this end, four Working Groups on Energy have been established within the D-8 Organization to address and deal with a wide range of energy-related issues.

This report sheds light on the state of energy sector in D-8 countries with a view to reflecting the current situation and identifying major challenges, obstacles, and opportunities with respect to the other countries. The report also highlights a number of related socio-economic factors such as economic growth, energy use, energy supply, pollution levels, and energy intensity. The report then concludes with a set of broad policy recommendations at both the national and the D-8 cooperation levels.

We hope that this report will be a useful contribution to expanding the knowledge related to the energy sector in the D-8 countries, particularly to the decision making process in the domain of energy through enacting appropriate policies and strategies that will enable the D-8 countries to successfully address the challenges they face.

Amb. Musa Kulaklıkaya
Director General
S E S R I C

EXECUTIVE SUMMARY

Energy and Economic Growth

Energy use and economic growth are positively correlated. In the last 40 years, GDP per capita has grown by 2 percent per year on average, and energy use per capita has grown by 1 percent per year on average. This can be explained by an increased demand for energy, serving as both a driving force and product of economic growth. This motivates policymakers to look for a clearer understanding of energy growth on different levels of supply, demand and its overall effects on the economy.

Energy Resources and Supply

On average, more than 80 percent of total primary energy production in the world comes from fossil fuel sources with oil having the biggest share, 34 percent. Fossil fuel energy sources make up 95 percent of the total primary energy production of D-8 countries, a significant amount. Also, unlike the world trend, with 35 percent, natural gas is leading in D-8 countries. In contrast, while renewable energy sources make 13 percent of the world total primary energy production, it only makes 3 percent in D-8 countries.

Albeit with a slight decrease over the last five years, oil production of D-8 countries has been kept steady. In fact, more than 80 percent of total oil production of D-8 countries originates from Iran and Nigeria. Surprisingly, the ratio of total production in D-8 countries contrasted with the total production of the remainder of developing countries has been less than the aggregate of other developing countries, as the ratio of their reserves was well over half.

Regarding coal production, the total production of D-8 countries has increased more than 50 percent in the last five years. This rate was higher than that in the remaining OIC countries and other developing countries. The production levels of coal in D-8 countries, however, is lower compared to the production levels in other developing countries and developed countries. It should also be noted that around 85 percent of the total coal production in D-8 countries is from Indonesia.

As for natural gas production, the total production level of D-8 countries is below that of the rest of the developing countries and developed countries. This is the opposite of what it would have been expected comparing differences in reserves. In fact, total production of dry natural gas in developed countries is more than the double of the total production level of D-8 countries even though total reserves was less than the half of the reserves in D-8 countries.

Regarding nuclear energy production, it seems that this is not the most preferred source for energy production in D-8 countries even though it has its advantages over fossil fuels. Among the D-8 countries, Pakistan and Iran are the only two countries with nuclear energy production. Although Iran has the most capacity for nuclear energy production, Pakistan is leading in total production.

On the other hand, the total production of renewable energy in the D-8 countries has been increasing in the recent years. Although the rest of the developing countries are improving a lot faster in this type of energy production, D-8 countries are showing a promising future.

As a secondary energy production, the installed electricity capacity of the D-8 countries has been growing steady over the past five years. As is the case in other country groups, fossil sources are the most preferred sources for generating electricity in D-8 countries. Overall, the use of renewables and nuclear energy in D-8 countries seem to be at a very low level (15 percent, compared to 29 percent in the rest of the developing countries).

Energy Demand

The analysis of energy demand for different end-use sectors shows that, with 96.1 quadrillion BTU, the transportation sector has the highest demand for oil and this covers almost all the energy demand of this sector. Unlike transportation sector, industrial sector has a diversified demand for energy. Oil is still the most commonly used energy source, 57.2 quadrillion BTU, but it is closely followed by the demand for coal, 52.9 quadrillion BTU, and natural gas, 45.5 quadrillion BTU. The demand for renewables and electricity is also at significant levels for industrial sector, 15.2 quadrillion BTU and 29.2 quadrillion BTU, respectively. Energy demand in commercial and residential sectors are at lower levels compared to the first two sectors. Commercial sector mostly relies on electricity consumption, 14.8 quadrillion BTU. Yet, natural gas, oil, and coal are also demanded at moderate levels by this sector. In addition, the demand for electricity in residential sector is higher than that in commercial sector but it is not the most popular energy source in residential sector. Natural gas leads in demand for energy in residential sector with 19.9 quadrillion BTU.

On the other hand, the analysis displays different patterns of total primary energy consumption in D-8 countries when compared to other country groups. Around half of energy demand in D-8 countries is met by natural gas consumption compared to only 12.7 percent in non-D-8 developing countries. In contrast, while almost half of energy demand in non-D-8 developing countries is met by consuming coal, coal makes only 11.3 percent of the total energy consumption in D-8 countries.

Regarding total secondary energy consumption, net electricity consumption levels for D-8 countries are stable over the years and show similar characteristics compared to primary energy consumption.

Energy Balances

As a group, the D-8 countries appear to be a net exporter of each of the energy sources. In 2012, the most exported energy product was coal (8.41 quadrillion BTU), followed by oil (7.01 quadrillion BTU).

Energy Environment

Total world carbon dioxide emissions have increased by 75.3 percent, 2.2 percent per year on average, between 1980 and 2012. Moreover, this dramatic increase was not only on the aggregate level but also on the country-group level. During the same period, the D-8 countries have recorded a 10.8 percent per year increase on average Compared to 9.5 percent and 9.6 percent recorded by non-D-8 OIC and non-D-8 developing countries, respectively. With 62.4 percent, oil accounted for the bulk of carbon dioxide emissions in D-8 countries in 2012 compared with only 26.7 percent in the case of non D-8 developing countries. In contrast, with 63.3 percent, coal was the biggest provider for emissions in developing countries in the same year compared to only 10.7 percent in

D-8 countries. In 2011, the level of carbon intensity in D-8 countries was recorded at 1.12 MMT of carbon dioxide/2005 U.S Dollars; a level which is significantly higher than that of both non-D-8 OIC countries (0.97 MMT of carbon dioxide/2005 U.S. Dollars) and non-D-8 developing countries (0.89 MMT of carbon dioxide/2005 U.S. Dollars).

In terms of environmental policies and energy intensity, policymakers in D-8 countries have been recently working on switching towards consuming more of low-carbon options. According to the International Energy Agency reports, renewable energy subsidies reached $88 billion in 2011. In fact, D-8 countries recorded a 20 percent higher than non-D-8 developing countries in terms of energy consumption for generating the same level of GDP increase (energy intensity).

Energy Affordability and Sustainability

Energy consumption appears to be more affordable in D-8 countries compared to the rest of the world. This becomes clear when the differences in the pump price of gasoline are considered where the average pump price for one liter of gasoline was recorded at 0.97 dollars in 2014 compared to 1.48 dollars in developed countries.

Regarding energy sustainability, Energy Trilemma Index suggests that D-8 countries seem to perform very similar to other developing countries but their performance is considerably below that of developed countries. In fact, the highest score among developed countries was recorded in Switzerland with 9.48 while the highest score among D-8 countries was recorded in Malaysia with 6.79. On the other hand, the lowest score among developed countries was recorded in Estonia with 4.57 while the lowest score among D-8 countries was recorded in Bangladesh with 1.99.

1 INTRODUCTION

The importance of energy to economic development is critical, and for this reason the consumption of energy at the global level has been increasing steadily. Over the last 40 years, global GDP per capita has experienced a 2 percent growth rate on average and which was matched by a 1 percent average growth rate in energy consumption per capita. There is however a number of other factors contributing to such an increase in energy consumption, the most significant of which is population growth all around the world. According to the United Nations Population Fund, the world population has reached 7.3 billion as of June, 2015. This has become a challenge due to limited supply of traditional energy resources. Thus, the state of energy sector has been the topic of much discussion in the recent years.

Developing countries continue to experience rapid economic growth rates and social developments, reshaping the global system for the better. In order to sustain this, policies regarding energy sectors in these countries have become of critically significant. In light of the understanding that sustainable development should meet the needs of the present without compromising the ability of future generations, a number of policy changes were effected in developing countries to promote the use of renewable energy resources. However, performance of developing countries still falls short of developed countries in this area.

Energy is a priority sector for D-8 countries. Adequate financing mechanisms for improving energy infrastructure, energy-use efficiency, and sustainability of energy supply have been recently given special attention in D-8 countries. To this end, four Working Groups on Energy have been established within the D-8 Organization to address and deal with a wide range of energy-related issues.

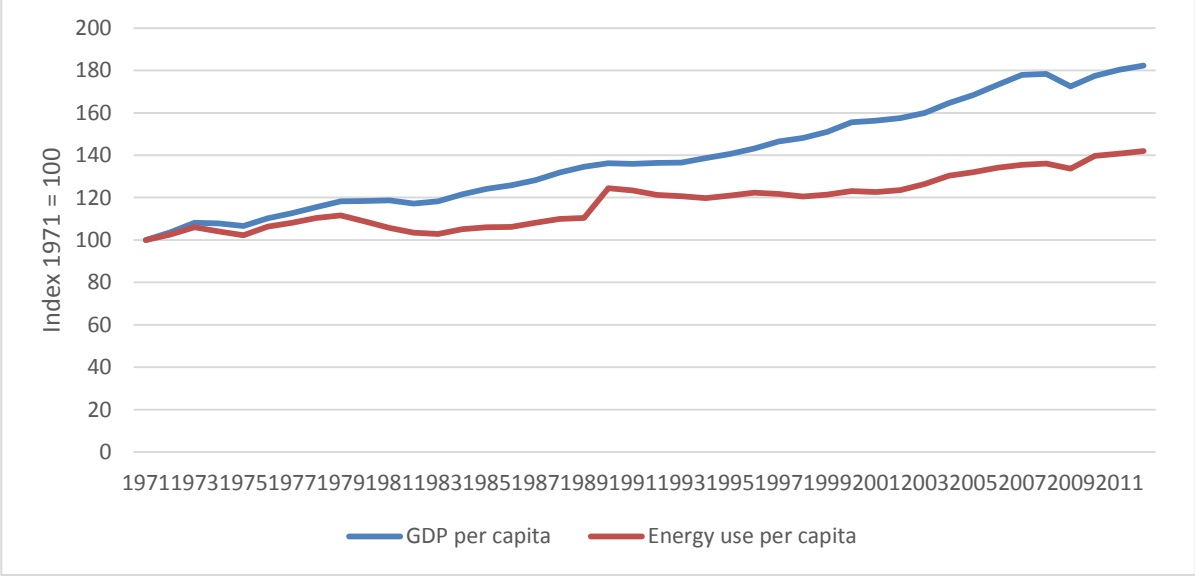
Against this background, this report looks at the state of the energy sector in D-8 countries. The report begins with an analysis of the relationship between energy and economic growth. In Section 3 the report introduces the different types of energy resources by grouping them under three broad categories: fossil energy, nuclear energy, and renewable resources. Using the latest available data, the report compares the supply of these types of energy resources in D-8 countries to the world. Section 4 addresses the state of energy demand in D-8 countries, which is contrasted to other country groups. Section 5 focuses on the international flow of energy for each type of energy. Section 6 highlights the negative impacts of energy use on the environment and levels of energy efficiency in D-8 countries versus that of other country groups. Section 7 studies energy affordability and sustainability in D-8 countries. The report concludes with a number of policy recommendations aiming to improve the state of energy sectors in D-8 countries.

2 ENERGY AND ECONOMIC GROWTH

Given that energy is necessary for production, the role of energy in economic growth is vital where higher levels of energy use foster economic growth (Stern, 2010). Similarly, the growth of an economy determines its energy consumption. Countries with higher growth rates achieve lower costs of energy production through endogenous technological development and increases in efficiency, which consequently raises the bar for further growth capacity. In other words, the relation between energy use and economic growth is intrinsically linked. On one hand, increased production, and as a result the consumption of energy eventually leads to an increased capacity for economic growth in countries. On the other hand, rapidly growing, stable economies must contend with high consumption of energy as a price for higher levels of production.

Fig 1 demonstrates aggregate trends in energy use per capita and GDP per capita between 1971 and 2014. GDP per capita is measured according to (constant US$) and energy use refers to use of primary energy before transformation to other end-use fuels (kg of oil equivalent per capital). In order to observe the correlation between these two variables, they are both reported with 1971 being the base year. This figure suggests that both GDP per capita and energy use per capita in the world have increased consistently while the growth in GDP per capita is greater than the growth in energy use per capita. This indicates that the nature of the relationship between economic growth and energy use is positive regardless of the direction of causation.

Figure 1: The overall change in GDP per capita and energy use per capita, 1971-2011



Source: World Bank and World Economic Forum

3 ENERGY RESOURCES AND SUPPLY

Energy can be classified into two main types; namely primary and secondary energy. Primary energy is extracted or captured directly from the environment and has not been subjected to any conversion or transformation process. In contrast, secondary energy is converted from primary energy in the forms of electrical energy, refined fuels, or synthetic fuels. This process of energy transformation is important in order to be able to deliver more convenient and ready-to-use forms of energy, such as electricity, to society. At the end, this is to provide energy services that improve quality of life (e.g. health, life expectancy and comfort) and productivity (Hall *et al.,* 2004).

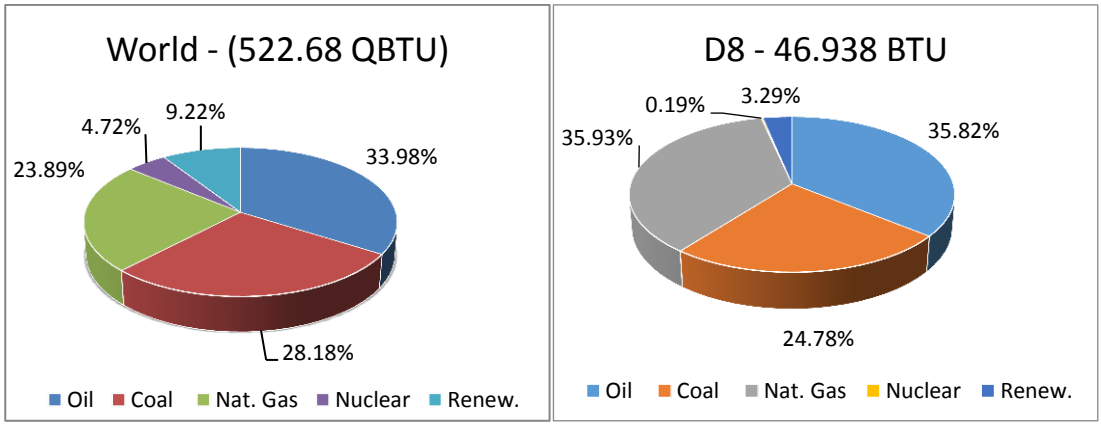
In light of this classification of energy sources, this section briefly highlights the trends in supply of different types of energy sources in D-8 countries.

3.1 Primary Energy Sources

Primary energy sources take on many forms including fossil fuel energy (oil, coal and natural gas), nuclear energy and renewable resources (wind, solar, hydropower, biomass and geothermal). Figure 2 summarizes the primary energy production data for 2012 by indicating the shares of different sources in total production throughout the world and in D-8 countries.

Figure 2 (left) indicates that more than 85 percent of total primary energy production in the world comes from fossil energy sources (oil, coal and natural gas) with oil holding the biggest share, at 34 percent. This situation is more dramatic when we compare shares for D-8 countries which produce 9 percent of the world's total primary energy production. Fossil fuel energy sources constitute more than 95 percent of primary energy production in D-8 countries. Unlike production trends in the world, natural gas production is the most produced in the case of D-8 countries with a 35 percent share in total primary energy production. On the other hand, while renewable sources

Figure 2: Shares of primary energy sources in total primary energy production, 2013



Source: Energy Information Administration Online Database

make up 9 percent of the world's total primary energy production, they account for only 3 percent in D-8 countries. This could be a challenging issue for D-8 countries as renewable energy sources are known to be among the most efficient and effective solutions for reaching sustainable development (Dincer 2000).

3.1.1 Fossil Fuels

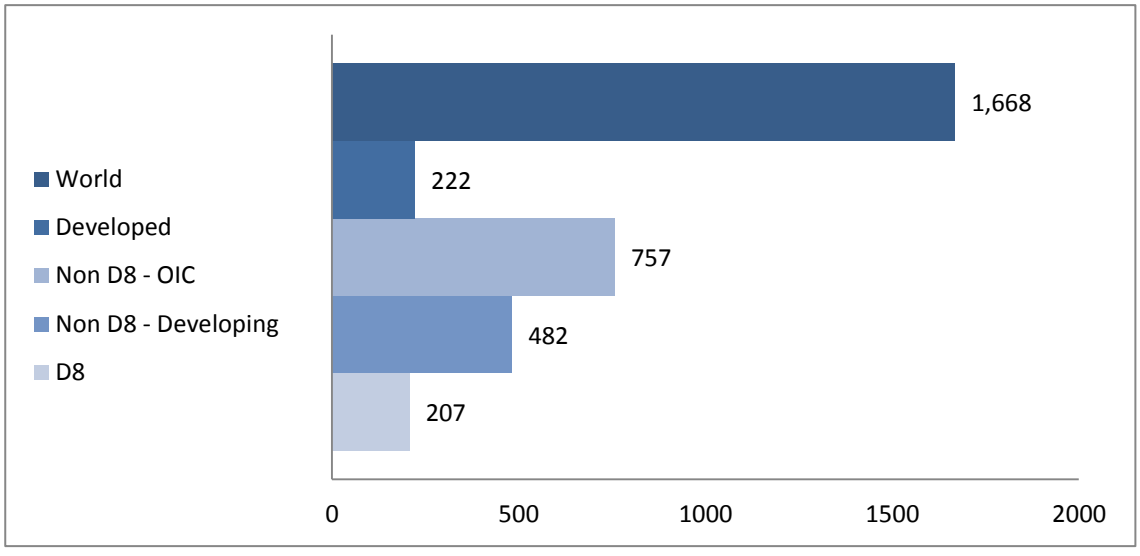
Among primary energy resources, fossil fuel energy is the most dominant in total world production. Different types of fossil fuel energy are formed by natural process of buried dead organisms. They consist of carbon and hydrogen bonds. There are three different types of fossil energy; oil, coal and natural gas.

3.1.1.1 Oil

Oil is the most widely used fossil fuel. Crude oil consists of many different organic compounds which are transformed to products through refining. These products include petrol and diesel. As such, it is by far the most important transport fuel.

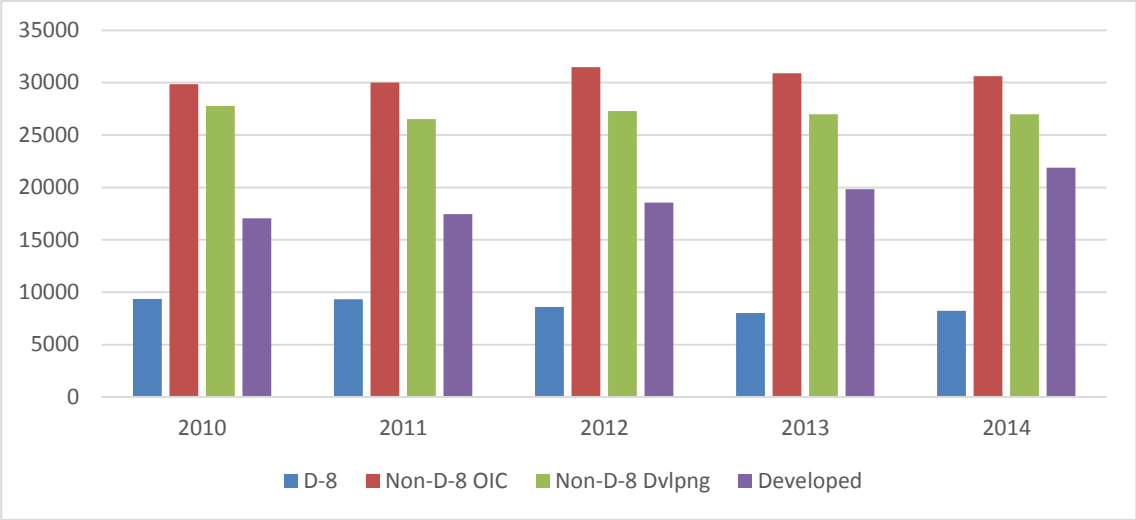
Oil reserves are the amount of technically and economically recoverable oil. As of 2014, world crude oil reserves have exceeded 1.6 trillion barrels. Figure 3 presents the amount of oil reserves for selected country groups in 2014. D-8 countries have 12.4 percent of the world oil reserves, with the biggest part of D-8 oil reserves is coming from Iran, at 75.96 percent. In other words, Iran has 9.48 percent of world oil reserves on its own. Secondly, OIC countries not including the D-8 group have a total of 757 billion barrels of oil reserves. This makes up 45 percent of the world's total oil reserves. In addition, oil reserves of D-8 countries are nearly equivalent to that of developed countries, and are equivalent to around 43 percent of total non-OIC developing countries reserves. In conclusion, oil reserves of D-8 countries are considerably significant.

Figure 3: Proved crude oil reserves for selected country groups, 2014 (billion barrels)



Source: Energy Information Administration Online Database

Figure 4: Total oil supply for selected country groups, 2010-2014 (thousand barrels per day)



Source: Energy Information Administration Online Database

The level of crude oil production is not only affected by the amount of proved reserves where the relationship is not one-to-one. Therefore, production levels should be also investigated to reach a better understanding of the state of this type of energy resource. Figure 4 displays levels of production for the same country groups in the period 2010-2014.

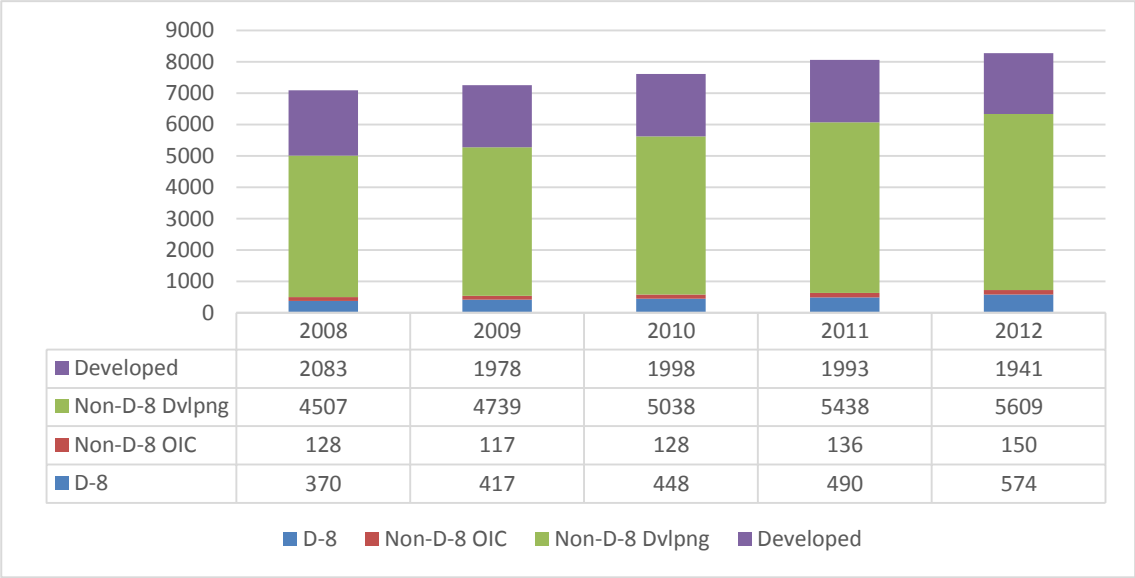
It appears that the aggregate level of crude oil production in D-8 countries has been steady with a slight decrease over the last five years. Almost half of this production derives from Iran which has the highest levels of reserves among the D-8. Iran is followed by Nigeria with a 30 percent share of the total production of crude oil in D-8 countries. It is also observed that the ratio of the total production in D-8 countries to total production in remaining developing countries has been less than half on a consistent basis over the last five years. This is surprising as the ratio of reserves was well over half. Thus, it would seem that in overall, D-8 countries have not utilized oil reserves to the extent of the rest of the developing countries group.

3.1.1.2 Coal

Coal is the only fossil fuel that takes on a solid state. It is formed through millions of years by decay of land vegetation. Coal is quite abundant compared to other fossil fuels. Coal is extracted by means of mining, and is the largest source of energy for the generation of electricity worldwide.

The production levels of coal are displayed in Figure 5. Aggregate production levels are plotted for selected country groups during the period of 2008-2012. During this period, total coal production in D-8 countries increased by more than 50 percent. This rate of increase however, was higher than that achieved by other OIC countries or other developing countries. However, when absolute levels of production are compared, the production in D-8 countries was significantly smaller than that of other developing countries. It should also be noted that around 85 percent of coal production in D-8 countries derives from Indonesia. In fact, according to the Statistical Review of World Energy, Indonesia the third largest primary coal producer in the world after China, India and Australia.

Figure 5: Total primary coal production for selected country groups, 2008-2012 (million short tons)



	2008	2009	2010	2011	2012
Developed	2083	1978	1998	1993	1941
Non-D-8 Dvlpng	4507	4739	5038	5438	5609
Non-D-8 OIC	128	117	128	136	150
D-8	370	417	448	490	574

Source: Energy Information Administration Online Database

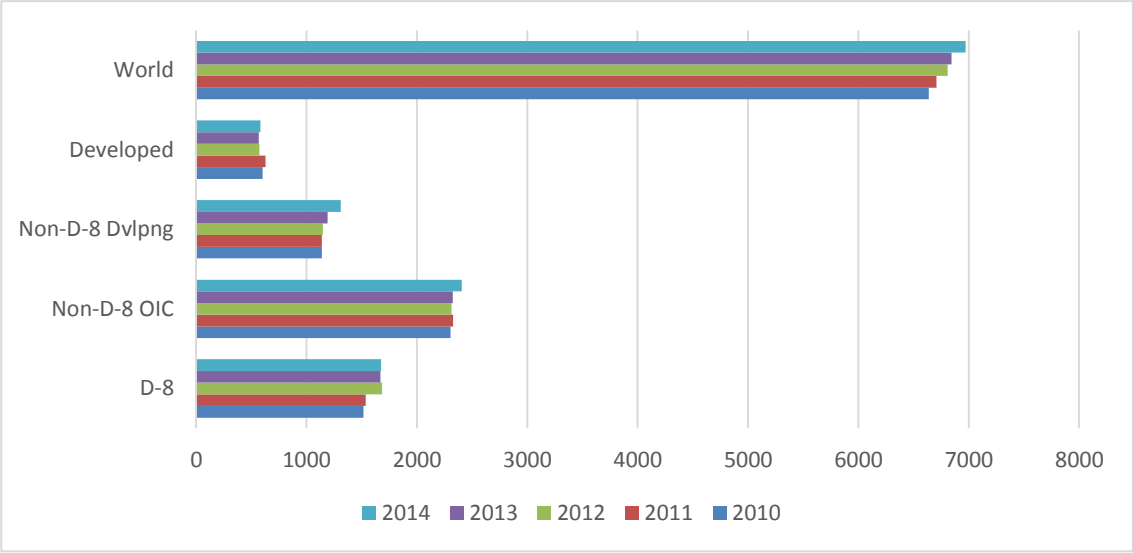
To sum up, while coal production in D-8 countries is at low levels when compared to developing countries or developed countries, the production growth of coal is notably faster when compared to the same country groups.

3.1.1.3 Natural Gas

Natural gas is a fossil fuel with a cleaner burn when compared to coal or oil. According to Haktanir (2004), for the same amount of produced energy, natural gas emits 50 percent less carbon dioxide than that which is released by coal and 25 percent less than oil. It is a relatively new type of energy source. Even though the share of natural gas in total primary energy production in the world is below that of oil and coal, its share in total primary energy production in D-8 countries is higher than oil and coal. Overall, natural gas is becoming increasingly popular as an alternative to oil and coal.

In terms of natural gas reserves, Figure 6 highlights the changes in proved natural gas reserves in the period between 2010 and 2014. Globally, proved reserves of natural gas have increased over the last five years. Likewise, total reserves of D-8 countries have increased in the same time period. Among D-8 countries, Iran has the most proved reserves of natural gas with a 70 percent share of total reserves of D-8 countries. Additionally, total reserves of D-8 countries are higher than reserves of developed countries and other developing countries. Given that natural gas is less harmful to the environment compared to oil and coal; this positively affects the health and well-being of D-8 countries.

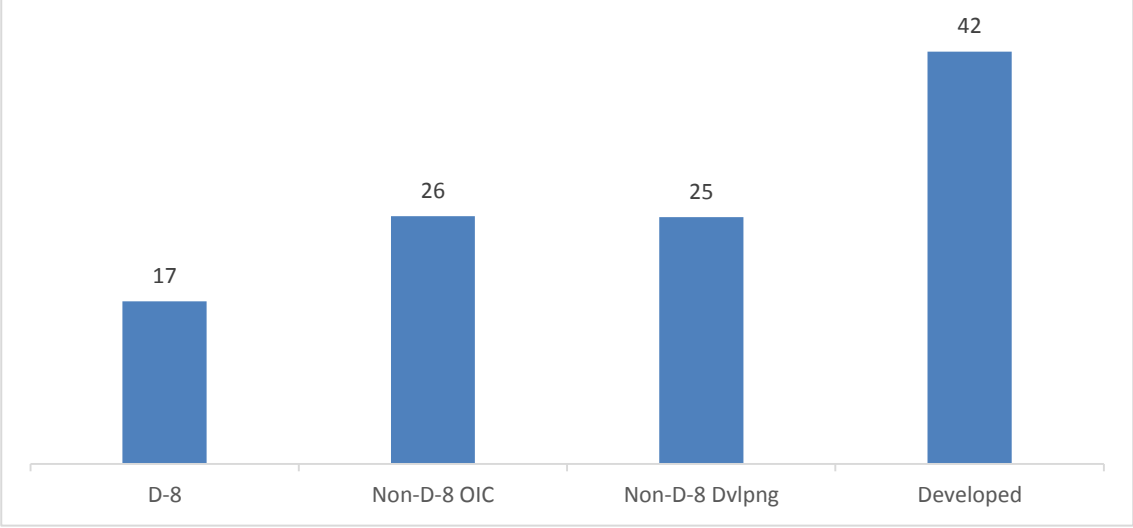
Figure 6: Total proved reserves of natural gas for selected country groups, 2010-2014 (trillion cubic feet)



Source: Energy Information Administration Online Database

However, when production levels of dry natural gas are compared between country groups, Figure 7 reflects a different situation when contrasted to reserves. It is observed that production levels have not changed significantly in the last few years when data is aggregated for the selected country groups. Thus, Figure 7 reports production levels only for the latest year for which they are available.

Figure 7: Total dry natural gas production for selected country groups, 2013 (quadrillion BTU)



Source: Energy Information Administration Online Database

As a result, it is clear that total gas production level of D-8 countries is below that of the developing and developed country groups. This is at odds with the larger reserves found in D-8 countries, and may be attributed to a lack of extraction capacity. Rather critically, the difference in production levels between D-8 countries and developed countries is large. Total production of dry natural gas in developed countries is more than double the total production levels of D-8 countries, in spite their total reserves at less than the half of the reserves found in D-8 countries. This is a point of contention in need of attention. Possible measures to engage further extraction may include temporary subsidization of technology used for extraction, investment in extraction R&D, and encourage gas enterprises to conduct technical and exploratory cooperation with institutes or groups with advanced extraction and production technology.

3.1.2 Nuclear energy

Nuclear energy is generated in nuclear power plants when an atom of a uranium isotope is split and results in a thermal chain reaction. The resulting heat converts water into steam, which turns a turbine, generating electricity. This is similar to most coal, oil, and gas-fired power plants with exception to the fact that there no harmful gases are released into the air through the process. In other words, nuclear power is essentially carbon-free. However, nuclear energy faces a number of obstacles, specifically the problem of disposing of radioactive waste, potential for catastrophic nuclear accidents, damaging radiation and environmental harm through uranium mining.

Nuclear energy supplies around 5 percent of the world's total primary energy production. According to the International Atomic Energy Agency's reports, as of July 2015, 30 countries operate 438 nuclear reactors for electricity generation, with 67 new nuclear plants under construction in 15 countries. Among D-8 countries, Iran and Pakistan are the only two countries with active nuclear power reactors. Iran's only nuclear power reactor has been active since 2011. It has a capacity of 915 MW and produces 3.7 billion kW·h electricity in 2014. This generates nearly 1.5 percent of Iran's total electricity production. On the other hand, Pakistan has a total of three nuclear power reactors. Pakistan's first reactor went operational in 1971. Since then, two more reactors were built in Pakistan, in 2010 and 2011 respectively. Currently, Pakistan's total reactor output capacity is at 690 MW, which produces 4.6 billion kW·h electricity in 2014 or around 4 percent of Pakistan's total electricity generation. Future nuclear energy plans for Pakistan involve the construction of two more reactors that are set to increase total capacity by 630 MW.

In light of this, it would seem that nuclear energy is not the most preferred method for energy production in D-8 countries or around the world for that matter. As much as nuclear energy has advantages over fossil fuel based energy, the problems regarding waste disposal and environmental concerns make this method the least used among all the other alternatives. Among the D-8 countries, Pakistan and Iran are the only two with nuclear energy production. Although Iran has the most capacity for nuclear energy production, Pakistan is in the lead for total production.

3.1.3 Renewable Energy Resources

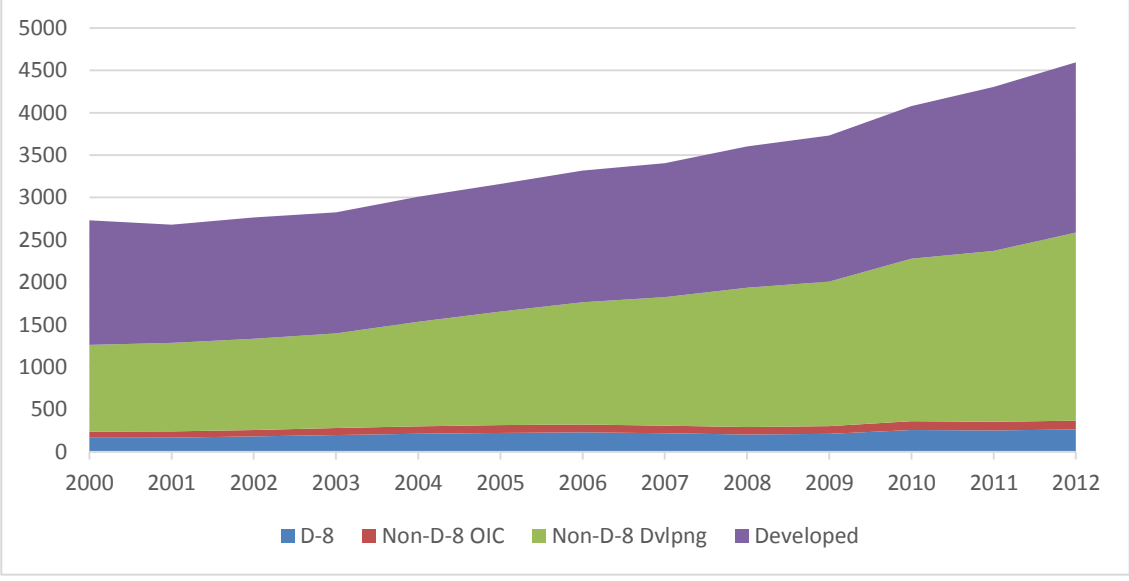
Renewable energy is generally defined as energy that comes from resources which are naturally replenished on a human timescale. Taking many forms, it can come directly from the sun, or from heat generated deep within the earth. In contrast to other energy sources, renewable energy resources are found through a broad range of geographical areas. Renewable energy production

does not involve utilizing irreplaceable resources, and as such is directly connected to the sustainable development of economies. Currently, renewable energy production constitutes 13.5 percent of total primary energy production of the world and only 3 percent of D-8 countries.

According to the United Nations Environment Programme, global investment in renewable energy reached $270 billion in 2014, mainly driven by investments in solar and wind energy. A key feature of this result was the rapid expansion of renewables into new markets in developing countries including Turkey and Indonesia. This increase in global investment in renewable energy in 2014 is a part of an upwards trend observed in the last 15 years. As a result, the amount of energy supplied by means of renewable resources has been increasing since then. Specifically, this increase has been very sharp. In the last few years, Figure 8 plots total renewable electricity generation between 2000 and 2012. It is therefore clear that total renewable energy supply of D-8 countries has been at lower levels when compared to remaining developing countries and developed countries. However, the total production levels of D-8 countries have been higher than the total of remaining OIC countries. In addition, following the general global trends in renewable energy production, the production of D-8 countries has also been increasing in recent years. Overall, although the remainder of the developing countries group is improving faster in renewable energy production, D-8 countries show promise for the future.

There are many different renewable energy sources, chiefly biomass, hydropower, wind, solar, and geothermal sources. These different sources are used at different intensities by different countries. However, on the aggregate level, most renewable energy comes from biomass and hydropower.

Figure 8: Total renewable electricity net generation for selected country groups, 2000-2012 (billion kW·h)



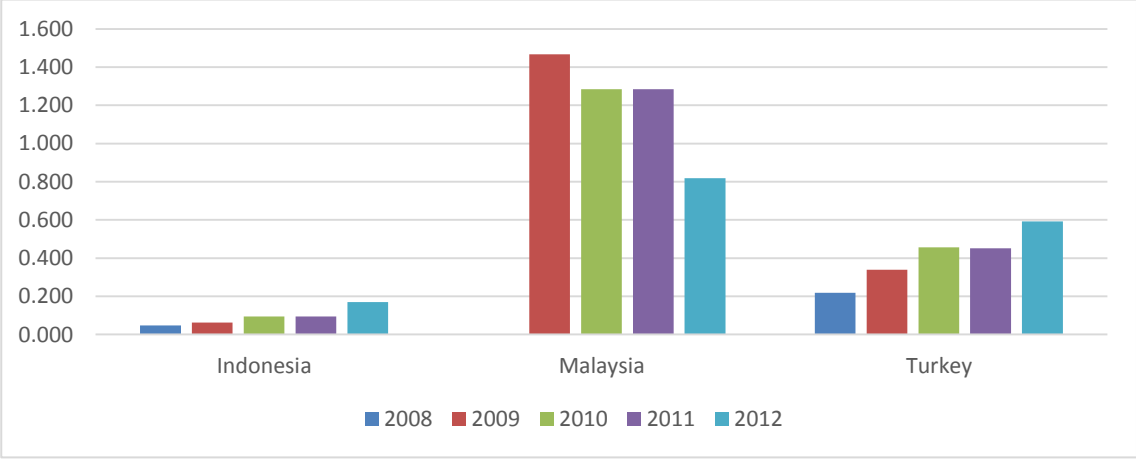
Source: Energy Information Administration Online Database

3.1.3.1 Biomass

Biomass is an organic material regenerated over time, usually in the form of wood, municipal waste, and alcohol fuels derived from agricultural crops. Landfill gas is currently the largest source of biomass generation in most countries. Other biomass sources include forest, agricultural and livestock residues, short-rotation forest plantations, and organic waste streams. As an energy source, biomass can either be used directly via combustion to produce heat, or indirectly after converting it to various forms of biofuel. Currently, around 10 percent of the total primary energy supply of the world is met by biofuels and waste. On the contrary, the share of biomass and waste sourced energy supply in D-8 countries is as low as 1 percent. Countries such as Bangladesh, Egypt, Iran, Nigeria, and Pakistan do not use biomass or use it very little in electricity generation. Figure 9 displays biomass and waste electricity net generation levels for remaining three D-8 countries during the last five-year period for which the data is available.

Figure 9 presents electricity generation from biomass and waste sources for Indonesia, Malaysia, and Turkey between 2008 and 2012. It appears that both Indonesia and Turkey are increasing their production levels in this time period. This is despite the fact that their production levels are lower compared to Malaysia. However, Malaysia seems to be decreasing its electricity generation levels from biomass and waste sources, while investing further into higher-yield power plant development. , which while not negative, is worthy of note.

Figure 9: Total biomass and waste electricity net generation for selected D-8 countries, 2008-2012 (billion kW·h)

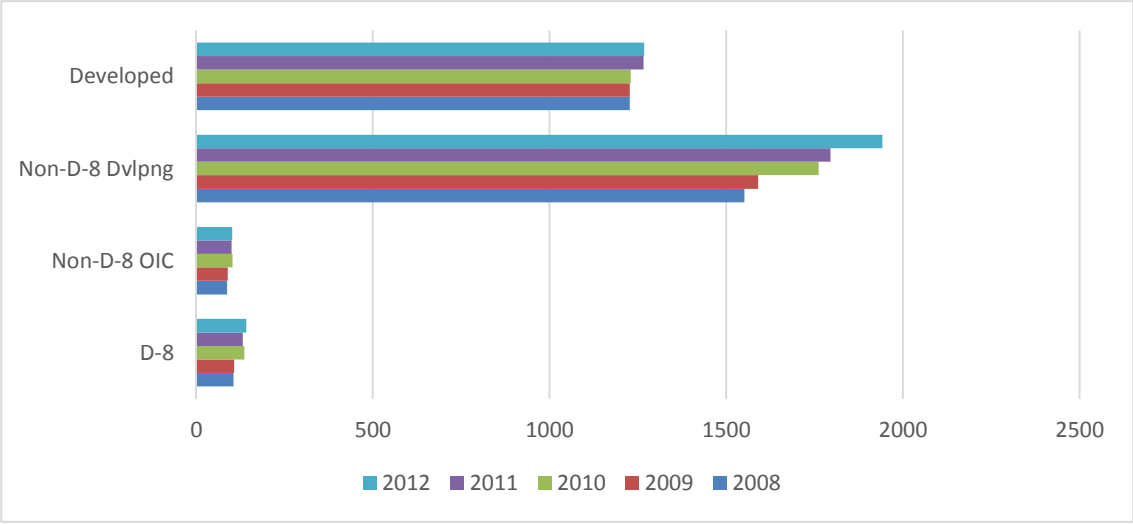


Source: Energy Information Administration Online Database

3.1.3.2 Hydropower

Hydropower is derived from the force or energy of moving water. Dammed water passes through a turbine that rotates a generator to create electrical power. A major advantage of this production process is the elimination of fuel. As there is no fuel combustion, there is little air pollution when compared to fossil fuel plants, and limited thermal pollution when compared to nuclear plants. This form of energy is relatively inexpensive and the environmental impact is dependent on the facility size.

Figure 10: Total hydroelectricity net generation for selected country groups, 2008-2012 (billion kW·h)



Source: Energy Information Administration Online Database

The World Energy Council reports that at the end of 2011 over 160 countries around the world had hydropower resource capacity, for a total output capacity of 936 GW across 11,000 hydropower stations. Turkey is one of the top 10 hydropower producing countries in the world. D-8 countries in total accounted for approximately 7 percent of the world's total hydropower supply in 2012.

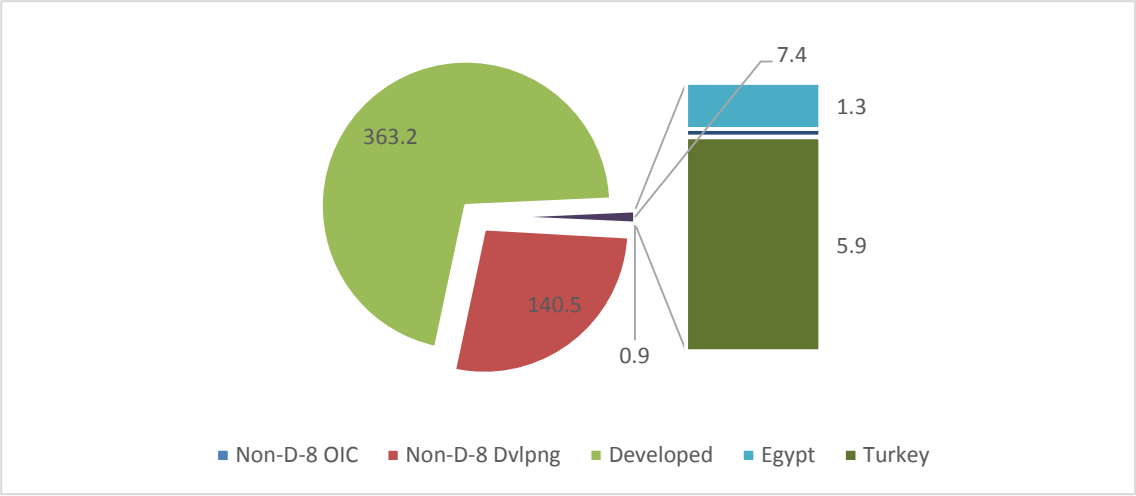
As shown in Figure 10, more than half of global hydroelectricity production is generated by non-D-8 developing countries. The aggregate production levels of this group are considerably higher than that of developed countries. Moreover, during the period under consideration, the supply of hydroelectricity from non-D-8 developing countries is growing faster than that of the developed countries and OIC countries. The D-8 countries have also experienced an impressive increase in the production of hydroelectricity, with a growth rate of around 30 percent between 2008 and 2012. It is worth mentioning here that around 40 percent of the hydroelectric supply of D-8 countries originates from Turkey. If we compare the production levels of hydroelectricity between D-8 countries and remaining OIC countries, it is clear that D-8 countries have a higher total than the non-D-8 OIC countries in each year during the period under consideration.

3.1.3.3 Wind

Energy can be created from the wind. When wind is caught in windmill propellers, the propeller shaft is forced to rotate and turn a generator creating electricity. This process of supplying energy is emission free and constantly available with a continuous wind flow. Recent estimates show that less than 1 percent of the world's total primary energy production comes from wind energy, but projections show that this share is expected to grow in the near future.

Figure 11 shows the total wind electricity generation for 2012. In 2012, over 60 percent of the world's wind energy was generated in developed countries with 363.2 billion kW·h, while developing countries generated 140.5 billion kW·h, more than 25 percent of total wind energy production.

Figure 11: Total wind electricity net generation for selected country groups, 2012 (billion kW·h)



Source: Energy Information Administration Online Database

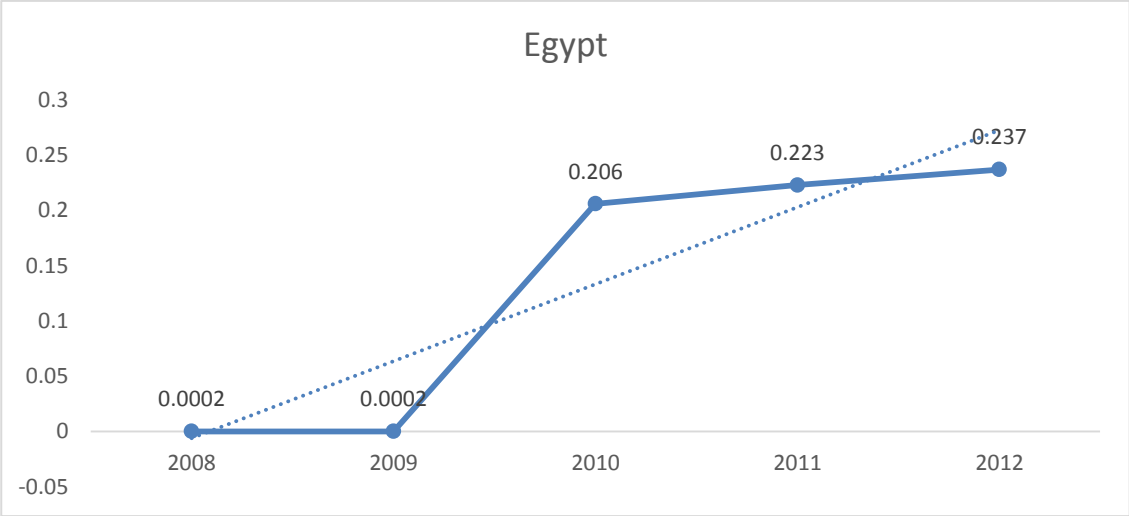
However, the state of wind energy production in D-8 countries falls on the lower production level brackets even though it has reflected significant growth over the last decade. D-8 countries accounted for 1.5 percent (7.4 billion kW·h) in total wind energy production of the world. In fact, with 5.9 billion kW·h, Turkey alone accounted for 80 percent of total wind electricity of D-8 countries. Egypt has the second most wind energy production among D-8 countries with a 17 percent share of the group's total production. Malaysia and Nigeria are the only two D-8 countries with no wind energy production. Nevertheless, the performance of D-8 countries in wind energy production is far better than the remainder of the OIC countries which is at 0.9 billion kW·h.

3.1.3.4 Solar

Solar energy is derived from the sun's rays. It is collected and stored as electricity through photovoltaic panels. Solar rays, if collected off reflective surfaces, may also heat an object and in the process creating solar thermal energy. Solar energy as a whole has grown in popularity since the oil crisis of the 1970s. Despite the fact that consumers continue to rely on solar panels for various purposes, solar generation remains more costly than most forms of renewable generation (Subhashini, 2015). However, according to the International Energy Agency (source, 2014), solar energy is projected to be the world's largest source of electricity by 2050.

Total output production of solar energy on the aggregate level appears to be somewhat similar to production levels of wind energy. Total solar energy production capacity was 178 GW in 2014. When shares of production from different country groups are analyzed, it is observed that less than 1 percent comes from OIC countries, while more than 90 percent are produced in D-8 countries. However, the production level of D-8 countries is significantly lower than that of the rest of developing countries. At the individual country level, Egypt takes the lead with 0.24 billion kW·h, followed by Bangladesh with 0.06 billion kW·h, Malaysia with 0.05 billion kW·h and Indonesia at 0.01 billion kW·h in 2012. It is clear that, unlike the other D-8 countries, Egypt has increased its solar energy production significantly in the last few years (see Figure 12).

Figure 12: Total solar electricity net generation of Egypt, 2008-2012 (billion kW·h)



Source: Energy Information Administration Online Database

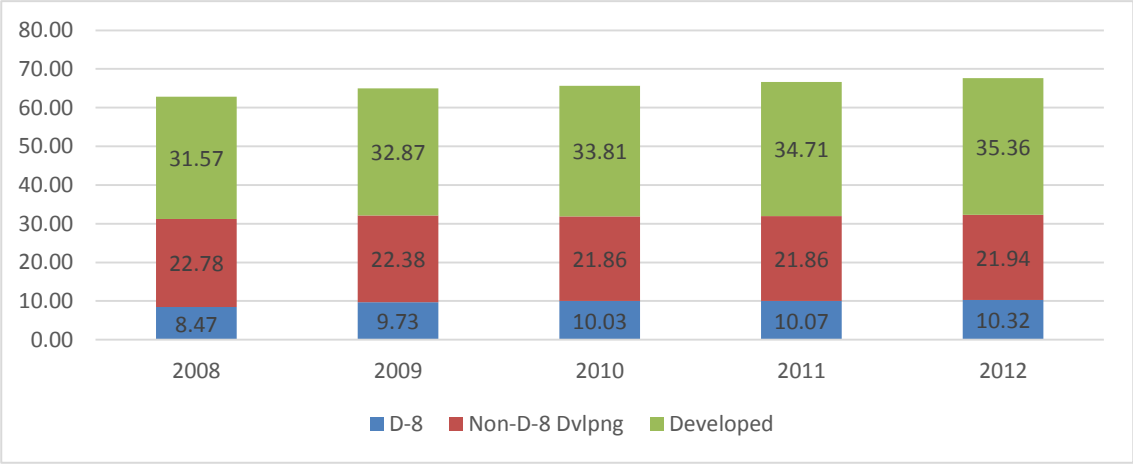
In 2010, Egypt has increased its production tenfold. In 2011, the first solar-thermal power plant of Egypt has started operating, and since then, Egypt is the leading country in solar energy production among D-8 countries.

3.1.3.5 Geothermal

Geothermal energy is derived from heat within the earth. Energy is found deep in the earth in the form of steam, naturally heated water, and rocks that touch magma deep in the earth's crust. This form of energy has no known harmful emissions and it widely used across the world.

The earth's geothermal resources are theoretically more than adequate to supply humanity's energy needs, but only a very small fraction may be profitably exploited. Drilling and exploration for deep resources is very expensive. Forecasts for the future of geothermal power are dependent on assumptions regarding technology, energy prices, subsidies, and interest rates. Due to these high costs, not many countries are heavily investing in geothermal energy generation process. In fact, non-D-8 OIC countries seem to be benefiting from either no or very small amounts of geothermal energy. Figure 13 demonstrates total geothermal net electricity generation for selected country groups between 2008 and 2012. It is clear from the figure that half of all geothermal electricity generation originates from developed countries. As was the case with other renewable energy production methods, developed countries are responsible for at least half of the world's total geothermal net electricity production. Non-D-8 developing countries provide around one-third of the world's total solar generation, while D-8 countries supply around 10.3 percent of total generation. Overall, the performance of D-8 countries in geothermal electricity production is highly influenced by Indonesia's high production levels. Indonesia is ranked among the world's top three most developed geothermal electric capacity countries, generates more than 90 percent of the D-8 countries' output total, and around 10 percent of the world's total geothermal electric output.

Figure 13: Total geothermal net electricity generation for selected country groups, 2008-2012 (billion kW·h)



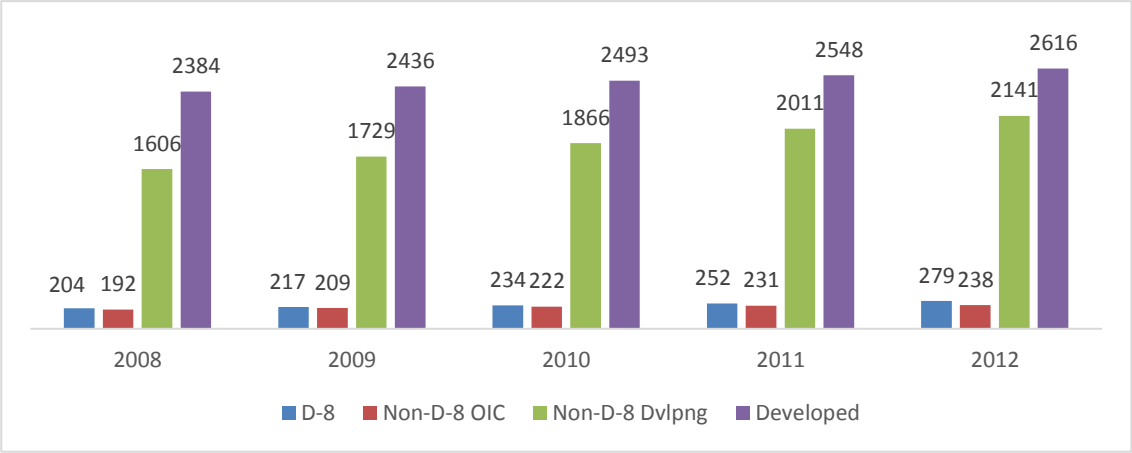
Source: Energy Information Administration Online Database

3.2 Secondary Energy Sources

Secondary energy refers to more convenient forms of energy which are transformed from primary energy sources through energy conversion processes. Secondary energy sources are also referred to as energy carriers, because they move energy in a useable form from one place to another. Thus, they are also referred to as useful energy. They can be in the form of electrical energy or fuel; such as gasoline, fuel oil, methanol, ethanol, and hydrogen. Electricity is the flow of electrical power or charge and, is one of the most widely used forms of secondary energy. Hence, this sub-section will focus only on electricity while analyzing secondary energy sources.

Electricity is of great importance in our every-day lives. There is a high demand on electricity for a wide-range of purposes ranging from lighting, heating, cooling to powering all appliances and electronics. This high demand necessitates its own supply. Electricity may be generated from different sources; the most common of which are coal, nuclear energy and natural gas, followed by hydroelectric, wind generators, and petroleum based sources, with a small amount derived from solar energy and geothermal sources. Figure 14 summarizes total electricity installed capacity between 2008 and 2012. It is observed that developed countries have access to almost half of the world's total installed capacity. This is closely followed by non-D8 developing countries. On the other hand, D-8 countries have access to around 5 percent of the world's total installed capacity and this remains higher than non-D8 OIC countries. These figures represent averages over five years. Moreover, it seems that total installed electricity capacity has increased in the period under consideration in all country groups with the highest increase taking place in non-D8 developing countries. In contrast, the growth of installed electricity capacity in D-8 countries has been steady and consistent during the same period.

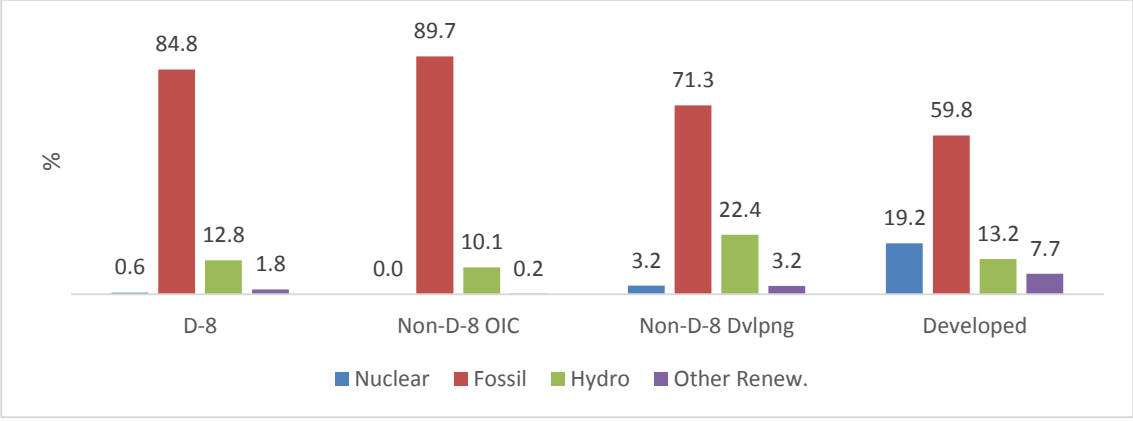
Figure 14: Total electricity installed capacity for selected country groups, 2008-2012 (million kilowatts)



Source: Energy Information Administration Online Database

Electricity can be generated from different sources and each source has its own advantages and disadvantages, countries have different preferences in generating electricity. Figure 15 shows the shares of energy sources in electricity generation in selected country groups in 2012. It is clear that the most common used sources for in all the groups are fossil fuels. The use of renewables and nuclear sources for generating electricity in D-8 countries and OIC countries seem to be at low levels, around 15 percent and 10 percent, respectively. However, this may be contrasted with relative disuse in developed countries, at around 26.9 percent. The least preferred way of generating electricity in D-8 countries, nuclear energy, is second on the list with 19.2 percent in developed countries. In contrast the use of fossil fuel sources is at much lower levels in developed countries compared to D-8 countries.

Figure 15: The shares of energy sources in electricity generation for selected country groups, 2012



Source: Energy Information Administration Online Database

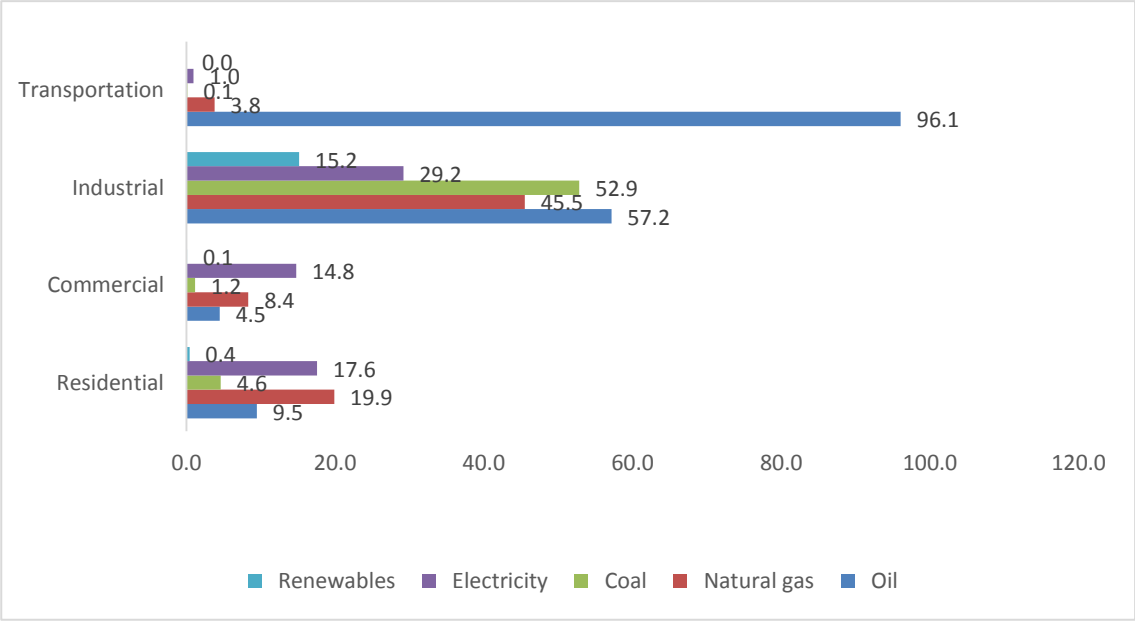
4 ENERGY DEMAND

Total demand for energy is witnessing an increase all over the world. In 2011, the Energy Information Administration estimated that world energy consumption was 520 quadrillion BTU. This involves all energy harnessed from all energy sources applied towards humanity's endeavors throughout every single industrial and technological sector, across every country. Given that most of energy production is done using non-renewable resources, this high level of consumption becomes a potential problem. Thus, many countries have been implementing policies that aim to control energy consumption.

This section highlights trends in total energy consumption in D-8 countries in a comparative manner to other country groups. In this context, consumption will be differentiated according to its source; primary or secondary in order to have a better understanding of energy demand.

The section begin with a brief highlight of differences in energy demand for different end-use sectors, such as residential, commercial, industrial, and transport. Figure 16 shows total world energy consumption by end-use sector in 2010. It is clear that the transportation sector has the most demand for oil with 96.1 quadrillion BTU, and realistically this covers nearly all the energy demands of this sector. Unlike the transportation sector, the industrial sector has a diversified demand for energy, where oil is still the most commonly used energy source at 57.2 quadrillion BTU, followed by coal at 52.9 quadrillion BTU, and natural gas at 45.5 quadrillion BTU. It should be noted here that the industrial sector is the biggest consumer of coal and natural gas. The demand for renewables and electricity is also at significant levels for the industrial sector, at 15.2 quadrillion BTU and 29.2 quadrillion BTU, respectively. Energy demand in commercial and residential sectors are at lower levels compared to the first two sectors. The commercial sector relies mostly on electricity consumption, at 14.8 quadrillion BTU. Moreover, natural gas, oil, and coal are in moderate demand by the sector. In addition, the demand for electricity in residential sector is found to be higher than the demand in the commercial sector, but it is not the most popular energy source in the residential sector. Natural gas leads in meeting demand for energy in the residential sector by 19.9 quadrillion BTU. The remainder is met by electricity, oil, coal and renewable sources in a decreasing order.

Figure 16: Total world delivered energy consumption by end-use sector, 2010 (quadrillion BTU)



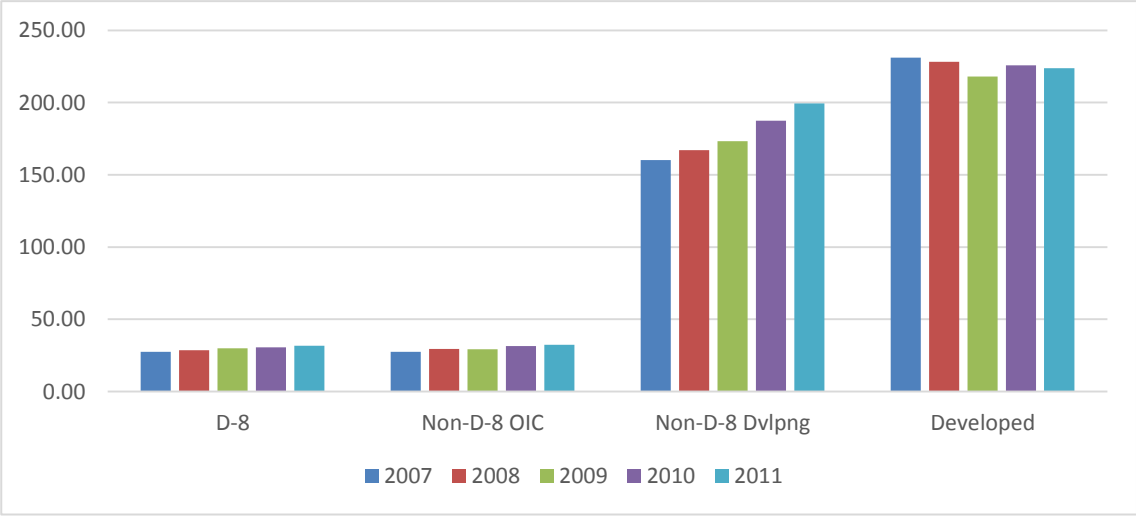
Source: Energy Information Administration Online Database

4.1 Primary Energy Consumption

Primary energy sources are transformed into more convenient forms of energy, such as electrical energy, refined fuels and or synthetic fuels. In this section, the demand for each of these sources will be analyzed. First, total primary energy consumption between 2007 and 2011 is shown in Figure 17. It is clear that consumption levels of D-8 countries are lower than developed and non-D-8 developing countries. However, compared to the remainder of OIC countries, the demand for primary energy in D-8 countries has been at comparable levels. Moreover, it appears that with the exception of developed countries group, primary energy consumption has been steadily increasing in other groups.

On the other hand, as reflected in Figure 18, there are differences in energy consumption patterns of primary energy by sources. While more than 40 percent of energy consumption in D-8 countries and the rest of the OIC countries are fulfilled through natural gas consumption, this share was only found to be 12.7 percent in the non-D-8 developing countries.

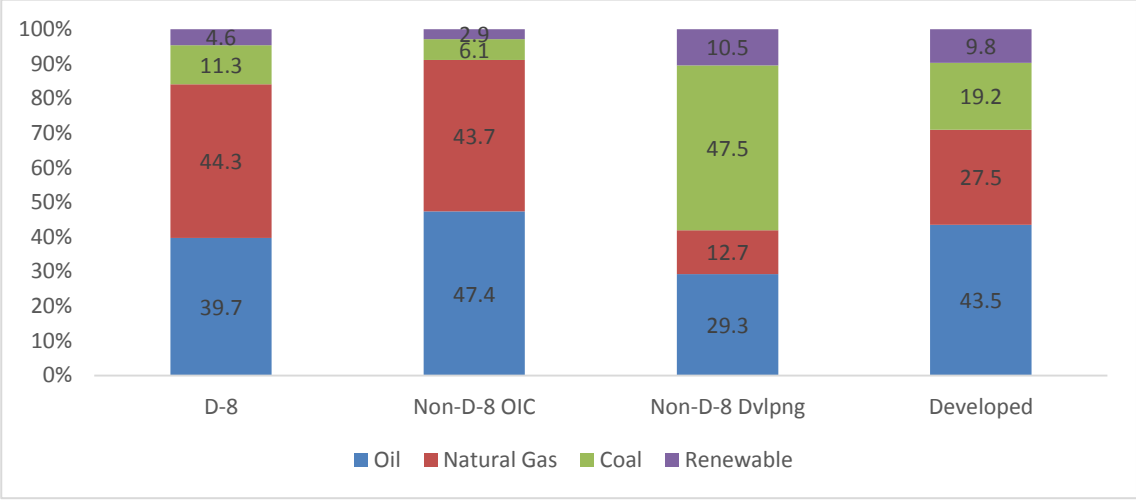
Figure 17: Total primary energy consumption for selected country groups, 2007-2011 (quadrillion BTU)



Source: Energy Information Administration Online Database

While coal accounted for 47.5 percent of total energy consumption of non-D-8 developing countries, it accounted for only11.3 percent in the case of D-8 countries. It is also observed that the share of renewables in total energy consumption of all country groups is 10 percent or less with D-8 countries recorded 4.6 percent energy consumption from renewables. Also, the share of oil in total energy consumption is significant level in all groups, with 39.7 percent in D-8 countries, which is more than in non-D-8 developing countries at 29.3 percent, but less than that of non-D-8 OIC countries at 47.4 percent.

Figure 18: Shares of primary energy sources in energy consumption for selected country groups, 2012

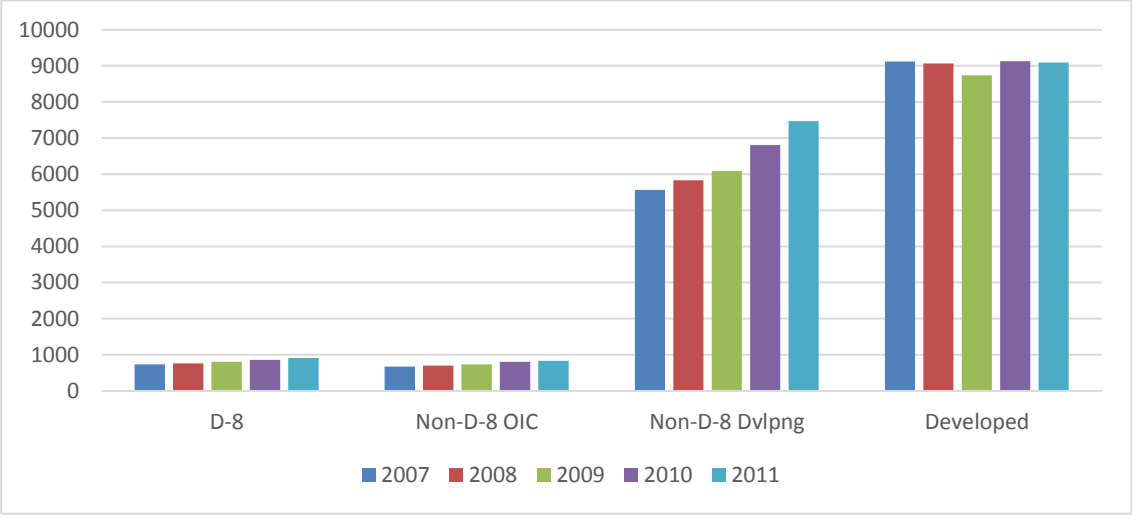


Source: Energy Information Administration Online Database

4.2 Secondary Energy Consumption

While there are different forms of secondary energy sources, the analysis presented in this section is only limited to highlighting total electricity net consumption. Electrical energy is used as electricity and is mostly consumed in industrial, residential, and commercial sectors. Figure 19 displays total electricity net consumption between 2007 and 2011. Overall, similar trends to those of primary energy consumption have been observed. The trend in net electricity consumption in D-8 countries has increased slightly during said period. Similar trends have been also observed in non-D-8 OIC countries. However, the level of net electricity consumption in these two groups was significantly lower than recorded in non-D-8 developing countries and developed countries. Thus, we can conclude that the demand for primary and secondary energy shows similar characteristics.

Figure 19: Total electricity net consumption for selected country groups, 2007-2011 (billion kW h)



Source: Energy Information Administration Online Database

5 ENERGY BALANCES

The majority of energy used today is derived from finite resources, and these finite resources are distributed unevenly. In addition, the demand for energy is known to be volatile in the short-term and on the country level. As a result, energy trade exists between countries. Almost every country in the world takes part in international energy trade regardless of its region, and in spite of different levels of government involvement in the energy trade. Energy trade between countries is done in terms of various energy commodities such as coal, natural gas, electricity, and most importantly oil. Oil has been the most important world trade commodity in the 20th century. However, the demand for energy types (commodities) in energy consumption is due to the fact that each of these commodities is demanded at various levels by different end–use sectors.

Table 1 summarizes net exports of energy sources between 2008 and 2012. It is clear that, as a group, D-8 countries are net exporters of each of the energy sources, with coal ranked first, followed by oil. This is not the case for other country groups. For example, in 2012, non-D-8 OIC countries had an aggregate trade deficit of oil and electricity while non-D-8 developing countries yielded an aggregate trade deficit of all energy sources. The situation is different for the two country groups in other years; however none have been a net exporter of every product in a single year. The same may be said for developed countries. In this matter, D-8 countries have been consistent in yielding a trade surplus in energy sources. There may be two reasons for this. First, the numbers imply that D-8 countries perform better in terms of supply of energy as opposed to the remainder of the OIC and the remainder of developing countries. Alternatively, it may be inferred that the consumption of energy has been consistently below supply in D-8 countries, and this is reversed or not the case for developing countries. The latter argument can be supported by comparing energy consumption for the two groups as summarized by Figures 17 and 19. In this context, it is observed that energy consumption of non-D-8 developing groups witnessed an increase between 2007 and 2011, but was stable in D-8 countries. This difference in growth in consumption could be a reason for trade deficit recorded in non-D-8 developing countries.

Table 1: Total net exports of energy sources for selected country groups, 2008-2012 (Quadrillion BTU)

Groups	2008	2009	2010	2011	2012
Oil					
D-8	8.288	8.856	9.202	8.840	7.056
Non-D-8 OIC	-8.422	-5.770	-5.181	-4.679	-4.583
Non-D-8 Dvlpng	-53.695	-48.732	-49.160	-47.949	-47.117
Developed	1.823	2.310	1.155	0.687	-1.187
Natural Gas					
D-8	2.278	2.268	2.657	2.239	2.119
Non-D-8 OIC	7.362	6.442	7.806	9.017	9.578
Non-D-8 Dvlpng	-0.035	0.244	-0.306	-1.042	-1.185
Developed	-11.851	-11.449	-12.381	-12.573	-11.116
Electricity					
D-8	0.013	0.019	0.020	0.017	0.013
Non-D-8 OIC	-0.037	-0.038	-0.042	-0.061	-0.073
Non-D-8 Dvlpng	0.024	0.011	0.034	0.013	-0.022
Developed	-0.098	-0.092	-0.102	-0.104	-0.112
Coal					
D-8	4.080	4.943	5.640	6.419	8.408
Non-D-8 OIC	0.258	0.389	0.332	0.353	0.340
Non-D-8 Dvlpng	2.026	1.647	-1.086	-1.585	-1.541
Developed	-12.453	-11.912	-10.629	-10.680	-10.089

Source: Energy Information Administration Online Database

6 ENERGY AND ENVIRONMENT

All energy sources are known have an impact on the environment. Fossil fuels do more harm to the environment compared to renewable energy sources. However, it is also important to acknowledge the environmental impacts associated with producing power from renewable sources even though these are comparably lower compared to other alternatives. The magnitudes of these impacts are not uniform across the countries and energy generation processes. There is no a universally accepted approach for minimizing the environmental impact of producing energy from each energy source. Therefore, varying degrees of environmental impact across countries and different regulatory policies to decrease these impacts have been observed.

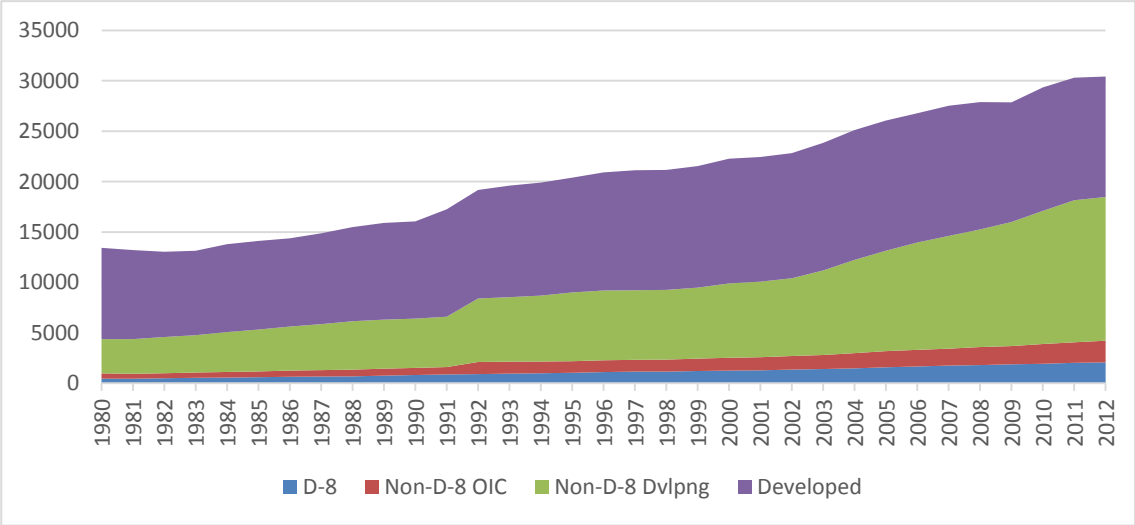
This section highlights the negative environmental impacts of the energy sector and the policies that have been employed by D-8 countries to diminish these impacts. It investigates in a comparison manner the magnitude of these impacts with respect to the source of the energy supply.

6.1 Carbon Dioxide Emissions

Carbon dioxide is a greenhouse gas emitted through human activities. Although there are both natural and human sources of carbon dioxide emissions, only the human-sourced variant raises in carbon dioxide levels damage the existing carbon cycle. Human sources come from activities like cement production, deforestation as well as the burning of fossil fuels like coal, oil and natural gas.

Figure 20 shows carbon dioxide emissions for selected country groups between 1980 and 2012. It can be observed that carbon dioxide emissions have, overall, increased sharply in all country groups during this period. Total world emissions have increased by 75.3 percent; corresponding to an average increase of 2.2 percent per year. While D-8 countries recorded an average increase of 10.8 percent per year, non-D-8 OIC and non-D-8 developing countries recorded 9.5 percent and 9.6 percent per year, respectively. Unlike developing countries, developed countries have had smaller increases in this time period, 1 percent per year on average. However, the situation becomes different when the absolute levels of carbon dioxide emissions are considered, where D-8 countries recorded the lowest increase (1610 MMT) among all other groups. This is very similar to the increase in the remaining OIC countries but the increase in the remaining developing countries is 10,859 MMT, and given that consumption has increased at higher rates in developed countries, this result is expected.

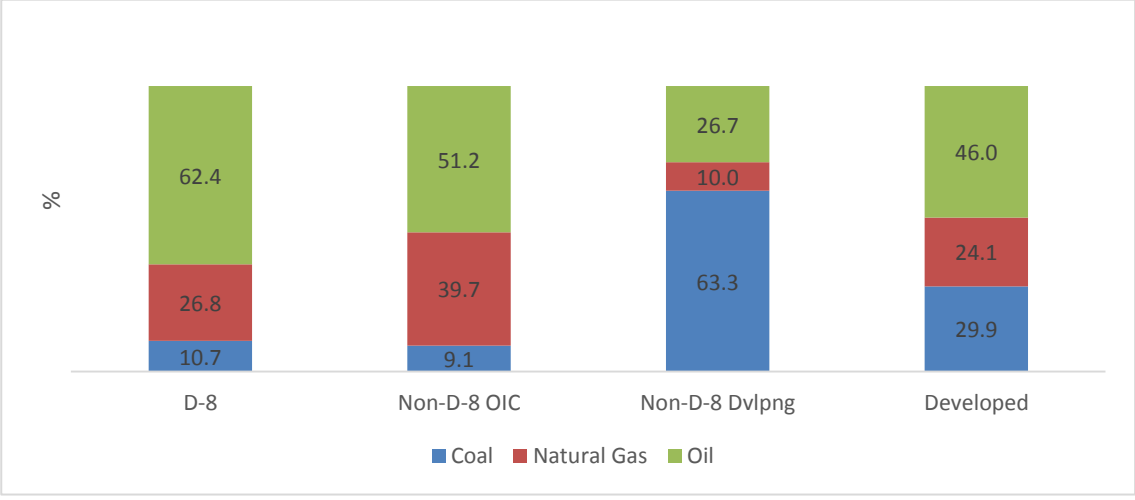
Figure 20: Total carbon dioxide emissions from the consumption of energy for selected country groups, 1980-2012 (million metric tons)



Source: Energy Information Administration Online Database

In terms of the source of carbon dioxide emissions, according to Energy Information Administration, coal emits the most amount of carbon dioxide, followed by oil and natural gas which is the least harmful source of energy to the environment among fossil fuels. Figure 21 reflects shares of different kind of fossil fuels in total carbon dioxide emissions. It can be observed that oil constitutes the biggest part of carbon dioxide emissions in D-8 countries (62.4 percent).

Figure 21: Shares of fossil fuels in total carbon dioxide emissions for selected country groups, 2012

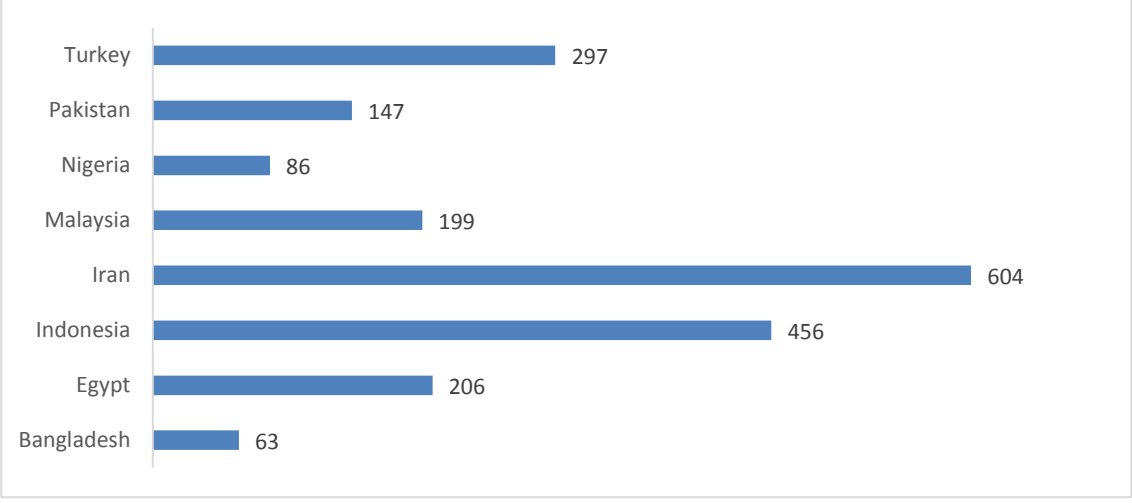


Source: Energy Information Administration Online Database

This is not very different when compared to non-D-8 OIC countries but is significantly different from non-D-8 developing countries where this percentage is recorded at only 26.7 percent. In contrast, while coal accounted for 63.3 percent of total carbon dioxide emissions in non D-8 developing countries, this share was only at 10.7 percent D-8 countries. The share of natural gas in total carbon monoxide emissions in D-8 countries was recorded at 26.8 percent. This share was 39.7 percent in non D-8 OIC countries. Overall, the shares of fossil fuels in total carbon monoxide emissions in D-8 countries were very similar to those of non-D-8 OIC countries but significantly different from those of non-D-8 developing countries.

At the individual D-8 country level, Figure 22 displays the total carbon dioxide emissions from the consumption of energy in selected D-8 member countries in 2012. It is clear that Iran has the biggest amount of carbon dioxide emissions with 604 MMT in 2012, which corresponded to one-third of the total emissions in D-8 countries. Iran is followed by Indonesia with 456 MMT (20 percent of total emissions in D-8 countries). On the other hand, Bangladesh and Nigeria recorded the lowest amount of carbon dioxide emissions with 63 MMT and 86 MMT, respectively.

Figure 22: Total carbon dioxide emissions from the consumption of energy in selected D-8 Member Countries, 2012 (million metric tons)

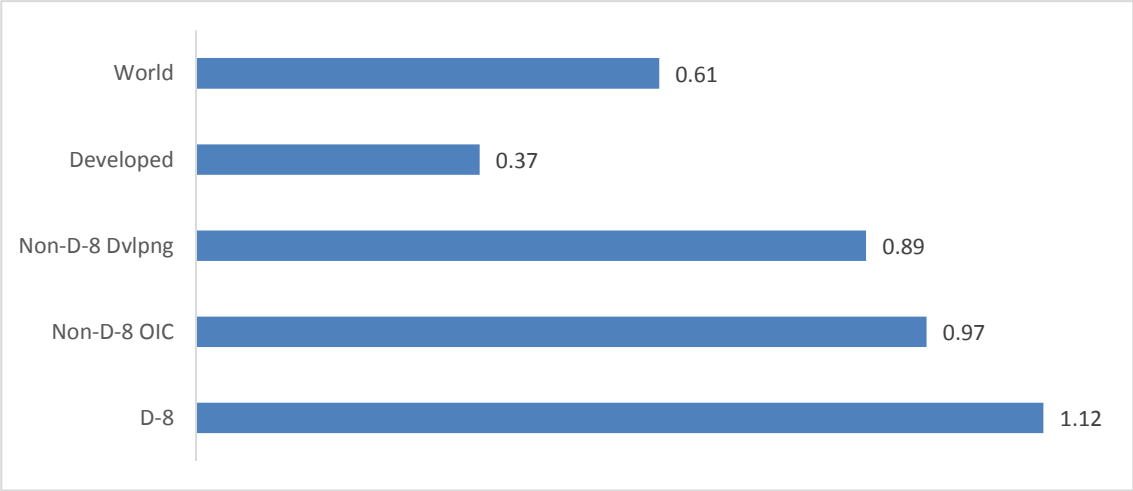


Source: Energy Information Administration Online Database

6.2 Carbon Intensity

Carbon intensity is a measure of how efficiently countries use their polluting energy resources, such as coal, oil and gas. It is calculated by dividing annual emissions by GDP for a given country. So as long as a country's energy sector emissions grow at a slower rate than its aggregate production, the carbon intensity of its economy falls. Thus, comparing carbon intensity across countries can be also an indicator of the differences in the growth rates of their economies.

Figure 23: Carbon intensity levels using market exchange rates for selected country groups, 2011 (MMT of carbon dioxide/2005 U.S. Dollars)



Source: Energy Information Administration Online Database

Figure 23 demonstrates carbon intensity levels for selected country groups in 2011. The lowest carbon intensity level (0.37) is recorded in the group of developed countries, which is lower than the world average of 0.61. With an average of 1.12, the carbon intensity level in D-8 countries was almost double that of the world average and higher than that of both non-D-8 OIC countries and non-D-8 developing countries. The reason for this may be that GDP levels of D-8 countries are relatively lower compared to that of developed countries. However, further analysis indicates that this may be a direct result of differences in GDP levels. This can be explained by a lower performance by D-8 countries in controlling environmental impacts of their growing energy sector.

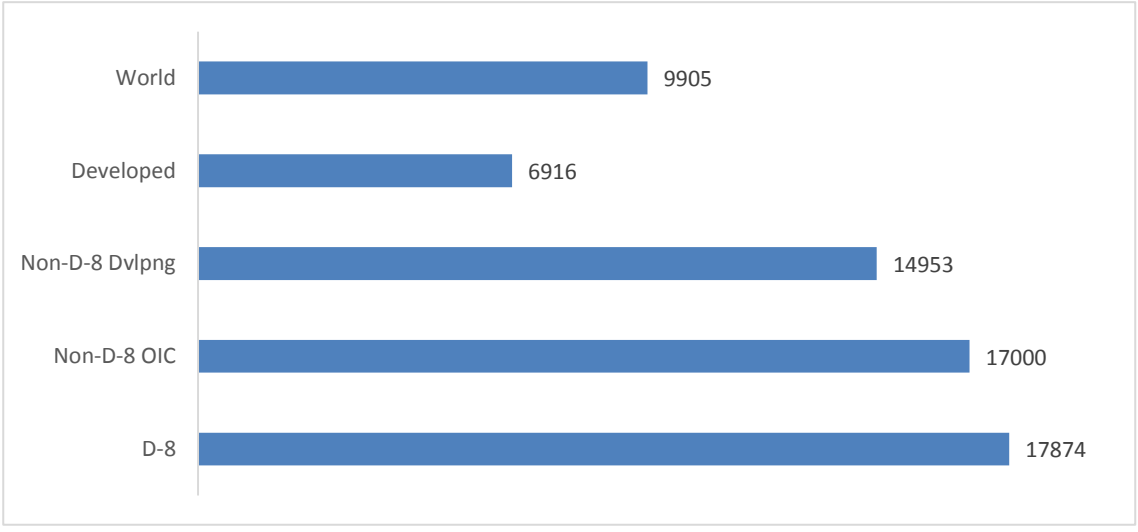
6.3 Environmental Policies and Energy Intensity

There are three primary methods for reducing the amount of carbon dioxide in the atmosphere. These employ reduced-carbon energy resources, switching to practices that are more focused on energy efficiency and energy conservation, and capturing and storing carbon either from fossil fuels or from the atmosphere.

Reduced-carbon energy resources are mostly renewable resources such as hydro, wind, solar, geothermal, and biomass. They also include nuclear energy. Policymakers in D-8 countries have been recently applying policies for switching towards the consumption of more of these low-carbon options. In fact, renewable energy subsidies worldwide reached $88 billion in 2011 according to International Energy Agency reports. Despite the fact that renewable resources and nuclear energy are not the most popular energy generating options in D-8 countries, there has been an increasing trend of growth in the use of such resources. On the negative side, the options of such energy resources have some negative environmental impacts. For example, wind farms have an impact on the landscape, and also emit noise. Likewise, hydropower plants have a significant effect on the landscape and impact river ecosystems. In addition, the management of high-level waste that is a by-product of nuclear energy generation requires storage in secure facilities for a very long time.

Increasing energy efficiency and energy conservation is the quickest and least costly way of decreasing the environmental impacts of energy consumption. Energy efficiency refers to the saving energy while aiming to retain the same level of service. A significant portion of consumed energy is wasted through transmission, heat loss and inefficient technology. On the other hand, energy conservation is the act of saving energy while maintaining efficacy of function. In this manner, policymakers can have direct effects on energy efficiency, while they can have only indirect effects on energy conservation. For example, policymakers can introduce higher energy taxes or lower energy subsidies in order to promote the more efficient use of energy. Figure 24 displays the levels of energy efficiency in selected country groups in 2011. Energy intensity is calculated by dividing total primary energy consumption per dollar of GDP. Total primary energy consumption is in BTU units and GDP is reported for 2005 dollars after adjusting for current market exchange rates. As shown in Figure 24, the average energy intensity worldwide was calculated at 9905 BTU per 2005 dollars in 2011. Compared to the world average, developed countries perform better in terms energy intensity with 6916 BTU, meaning that developed countries on average are consuming 6916 BTU units of energy to increase their GDP by one dollar, as opposed to the higher world average of 9905 BTU units. On the other hand, developing countries are well above the world average while D-8 countries reflect the highest level of energy intensity at 17874 in 2011. Specifically, D-8 countries are 20 percent higher than non-D-8 developing countries in terms of their energy consumption for generating the same levels of increase in GDP. This would result in an increase in size of negative environment impacts in D-8 countries.

Figure 24: The level of energy intensity for selected country groups, 2011 (BTU/2005 dollars)



Source: Energy Information Administration Online Database

7 TRANSPORTATION AND ENVIRONMENT

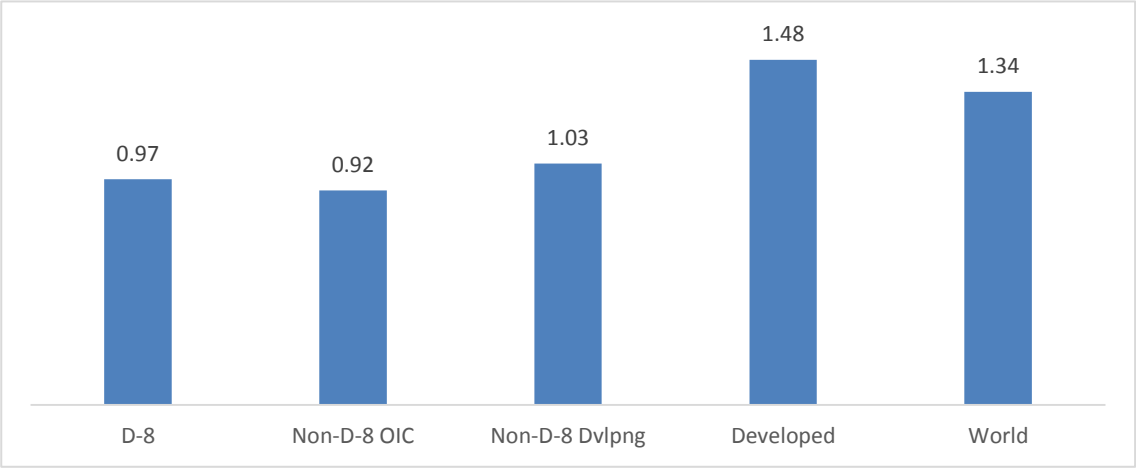
In today's modern world, it is still a challenge to ensure access to affordable and sustainable energy for all. This is mostly because of uneven distribution of different natural resources and purchasing power around the world. International Energy Agency reports that about 40 percent of the world's population relies on traditional biomass fuels for cooking. This is a serious problem as these low quality fuels can be a major source of indoor air pollution and eventually lead to high annual death toll. Affordability itself would not be enough to solve this problem if energy provision is unsustainable in the long run. This is for the reason that the most basic economic activity depends on a steady supply, robust governance, and an efficient and stable distribution system of energy.

This section provides an outlook on the current state of energy affordability and energy sustainability in the D-8 countries compared to the rest of the world through examining the level of energy prices and energy trilemma index.

7.1 Energy Affordability

There are various degrees of energy affordability as a result of varying prices of energy throughout the world. Figure 25 demonstrates the differences in pump price for gasoline in dollars per liter for selected country groups in 2014. The world average pump price for one liter of gasoline was recorded at 1.34 dollars in 2014, while this price was at 1.48 in developed countries in the same year. This higher price in developed countries can be associated with higher price of living in those countries. On the other hand, the average pump price of gasoline is relatively cheaper in developing countries. It is the lowest in non-D-8 OIC countries with 0.92 dollars per liter and in D-8 countries with 0.97 dollars per liter. In non-D-8 developing countries, the average pump price of gasoline was 1.03 dollars per liter in the same year. Thus, it can be concluded that energy consumption appears to be more affordable in D-8 countries compared to the rest of the world by looking at the differences in the pump price of gasoline.

Figure 25: Pump price for gasoline per liter in dollars for selected country groups, 2014

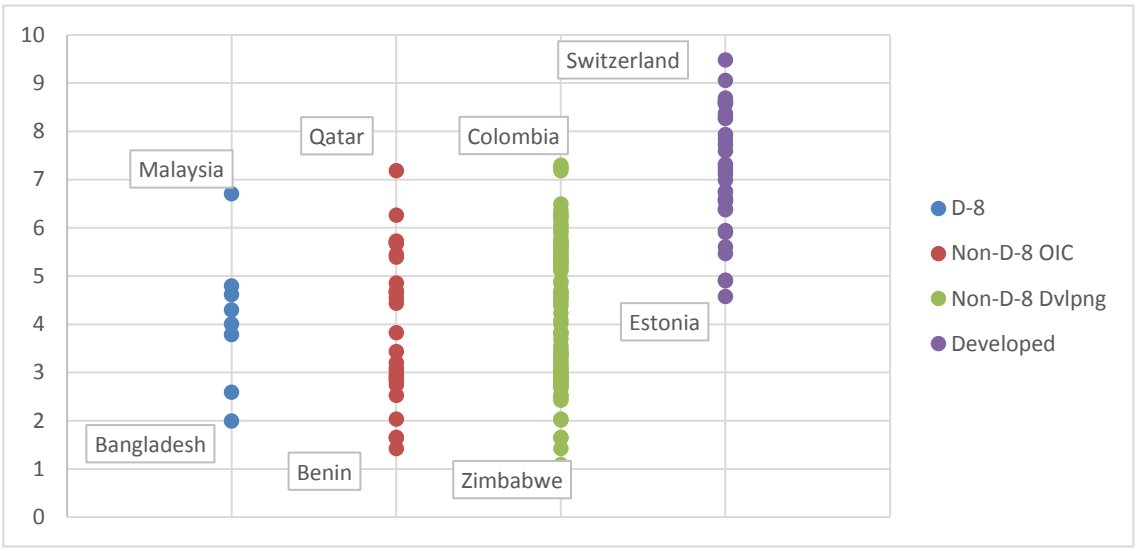


Source: World Bank

7.2 Energy Sustainability

This sub-section attempts to highlight energy sustainability in D-8 countries when compared to other country groups by comparing the relative position of their Energy Trilemma Index. The Energy Trilemma Index is calculated by World Energy Council and it ranks countries in terms of their ability to provide sustainable energy policies through the 3 dimensions of the energy trilemma such as energy security, energy equity, and environmental sustainability. A higher score in this index would show how well a country manages the trade-offs between three competing dimensions. Figure 26 shows the Energy Trilemma Index for selected country groups in 2014. It is clear that developed countries recorded in the highest Energy Trilemma Index compared to developing countries. Among developing countries, it appears that the D-8 and other developing countries recorded a similar Energy Trilemma Index. However, D-8 countries seem to be more focused around their average, while non-D-8 OIC and non-D-8 developing countries seem to be more dispersed. In other words, non-D-8 developing countries have a lower minimum and a higher maximum score in the Energy Trilemma Index. At the individual country level, Switzerland has the best worldwide score with 9.48 while the best score among D-8 countries is recorded by Malaysia at 6.79. On the other hand, the lowest score among developed countries is Estonia with 4.57 while the lowest score among D-8 countries is Bangladesh with 1.99. Overall, D-8 countries seem to performing similar to other developing countries, but their performance is considerably below that of developed countries.

Figure 26: Energy Trilemma Index for selected country groups, 2014



Source: World Energy Council

8 CONCLUSION AND POLICY RECOMMENDATIONS

This report analyses the state of energy sector in D-8 countries to reflect the current situation and identify major challenges, obstacles, and opportunities with respect to other countries. The report also highlights a number of related socio-economic factors such as economic growth, energy use, energy supply, pollution levels, and energy intensity.

While the D-8 member countries have rich natural resources that serve as primary energy sources, particularly crude oil and gas, they fall behind in terms of both energy consumption and energy supply compared to other geographical groupings consisting of developed countries. Different trends have been witnessed in D-8 energy supply, which indicate varying capacities among D-8 countries and the rest of the world. The high levels of oil and natural gas reserves in D-8 countries are not fully utilized in production where the total production per unit of reserves in remaining developing countries is higher than that of the D-8 country group. For example, even though developed countries have considerably less natural gas reserves than D-8 countries, the total production of natural gas in developed countries is much higher than total production in D-8 countries. This problem needs to be addressed, inter alia, through improving production processing of crude oil and natural gas.

On the other hand, total carbon dioxide emissions in D-8 countries have been increasing faster than the rest of the world. The most recent data on emissions show that D-8 countries are leading in total carbon dioxide emissions compared to the other developing countries and developed countries. Furthermore, oil constitutes the biggest part of carbon dioxide emissions in D-8 countries. These high levels of emissions are directly connected with serious health problems. This necessitates an immediate solution. In addition, the average carbon intensity of D-8 countries is almost double the world average. This presents a worrying trend, given human security concerns linked to global warming such as rising water-levels, water scarcity, erratic weather and the like. There is a necessity for developing and supporting renewable energy sectors and R&D, that will serve as strategic sources of energy in the future, and are found to be intimately linked to sustainable development.

However, D-8 countries are benefiting less from renewable energy production compared to the rest of the world. The share of renewables in electricity production is very low in D-8 countries when compared to other developing countries. Renewable energy production is key to sustainable development and has minimal negative impact on the environment. Thus, there is a need for more efforts towards using more renewable energy resources in D-8 countries. To that end, governments may consider increasing the size of the subsidies for renewable energy and allocate more financial resources to develop required infrastructure for renewable energy production.

As global demand for more competitive energy sources increases, it will be increasingly difficult to be energy efficient without making additional investments in energy and energy-related areas. Investments at the national level of D-8 countries should be encouraged to improve the performance of these countries in this important sector. Thus, expanding public-private partnerships in the energy sector and improving the business climate in these countries will lead to

more investments and job creation. In return, this will increase their potential for producing more energy sources and opening new channels in energy trade.

Strong economic growth, particularly coming from the developing countries, will increase the demand for energy efficient technologies. Notably, growth engines such as China and India will climb the energy ladder; demanding considerably more energy than today. In this context, D-8 member countries are lacking the necessary technology and R&D investments to process crude oil and natural gas 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. For example, there is an intimate connection between renewable energy and sustainable development. Renewable energy resources appear to be the one of the most efficient and effective solutions, therefore be key energy sources for the future. Yet, although the existing business potential for renewable energy in D-8 member countries is promising, it needs to be supported with efficient strategies to strengthen the industry, consumers and R&D activities.

Increasing cooperation among D-8 member countries and the rest of the OIC member countries in the field of energy could also contribute to the improvement of the current situation. D-8 countries should prepare for the future challenges in energy by formulating modalities of cooperation, both among themselves and with the leading energy producing countries, based on their own potentials and projections of growing energy demand from their local markets. The oil and gas producing countries will survive in world energy markets as long as they can respond to the energy needs of these markets. In this context, it is important for D-8 countries to expand their participation in international, regional and bilateral energy agreements and arrangements for large-scale energy projects, including cross-border gas and oil pipelines and onshore/offshore exploration activities.

Policy Recommendations

At the National Level

- Diversifying national energy investment portfolios, away from finite carbon-based energy sources as a long-term strategy.
- Increasing awareness of the importance of energy efficiency.
- Developing effective energy policy and regulatory instruments, within specialized commissions.
- Increasing capacity for enforcing regulatory policies
- Increasing funding for energy efficiency development and investment, while selectively and gradually reducing harmful subsidies for energy prices, instead reinvesting in R&D and efficiency measures.
- Creating an electricity market regulator.
- Increasing public-private partnerships in energy sectors, and enhanced investment environments to encourage R&D and job creation.
- Mapping geographical distribution of renewable energy resource to achieve cost-effective deployment of energy infrastructure, generation projects and grids; made available to developers.
- Targeting incentives to sustainable energy developers, as commercial banking sectors are often skeptical of clean energy sector project financing.
- Communicating clear, credible long-term policy signals to encourage energy growth and portfolio diversification.
- Developing renewable energy capacity and technology, given strategic vitality to future of energy sectors and link to sustainability.
- Anticipating emerging energy markets by developing secondary value-added energy by-products sectors.
- Engaging in bilateral energy agreements, joint-offshore and onshore exploration and extraction ventures, cross-border pipelines and technical cooperation.

At the D-8 Cooperation Level

- Jointly addressing energy price volatility
- Jointly addressing low private sector capacity for identifying, prioritizing, and developing energy efficiency projects
- Fostering institutional cooperation on manufacturing, servicing, and testing for energy-efficient products and on sharing good practices
- Fostering institutional cooperation on sharing of good practices for extraction, refinement and storage technologies and procedures.
- Increasing regional cooperation between the D-8 member states with other OIC member-states on points of cooperation, taking into account projected energy demand trends and national capacities.

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APPENDIX

Country Classifications:

D-8 Countries:

Bangladesh	Iran	Pakistan
Egypt	Malaysia	Turkey
Indonesia	Nigeria	

Non-D-8 OIC Countries:

Afghanistan	Gabon	Morocco	Tunisia
Albania	Gambia	Mozambique	Turkmenistan
Algeria	Guinea	Niger	Uganda
Azerbaijan	Guinea-Bissau	Oman	United Arab Emirates
Bahrain	Guyana	Palestine	Uzbekistan
Benin	Iraq	Qatar	Yemen
Brunei Darussalam	Jordan	Saudi Arabia	
Burkina Faso	Kazakhstan	Senegal	
Cameroon	Kuwait	Sierra Leone	
Chad	Kyrgyz Republic	Somalia	
Comoros	Lebanon	Sudan	
Cote d'Ivoire	Libya	Suriname	
Djibouti	Maldives	Syrian Arab Republic	
Gabon	Mali	Tajikistan	
Gambia	Mauritania	Togo	

Non-D-8 Developing Countries:

Afghanistan
Albania
Algeria
American Samoa
Andorra
Angola
Antigua and Barbuda
Argentina
Armenia
Aruba
Azerbaijan
Bahamas
Bahrain
Barbados
Gabon
Gambia
Georgia
Ghana
Greenland
Grenada
Guam
Guatemala
Guinea
Guinea-Bissau
Guyana
Haiti
Honduras
Hungary
India
Iraq
Isle of Man
Jamaica
Jordan
Kazakhstan
Kenya
Kiribati
Korea, Dem. Rep.
Kosovo
Kuwait
Kyrgyz Republic
Lao PDR
Lebanon
Lesotho

Belarus
Belize
Benin
Bermuda
Bhutan
Bolivia
Bosnia and Herz.
Botswana
Brazil
Brunei Darussalam
Bulgaria
Burkina Faso
Burundi
Cabo Verde
Liberia
Libya
Liechtenstein
Lithuania
Macao SAR, China
Macedonia, FYR
Madagascar
Malawi
Maldives
Mali
Marshall Islands
Mauritania
Mauritius
Mexico
Micronesia
Moldova
Monaco
Mongolia
Montenegro
Morocco
Mozambique
Myanmar
Namibia
Nepal
New Caledonia
Nicaragua
Niger
North. Mariana Islands
Oman

Cambodia
Cameroon
Cayman Islands
Cent. African Republic
Chad
Channel Islands
Chile
China
Colombia
Comoros
Congo, Dem. Rep.
Congo, Rep.
Costa Rica
Cote d'Ivoire
Palau
Palestine
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Puerto Rico
Qatar
Romania
Russian Federation
Rwanda
Samoa
Sao Tome and Principe
Saudi Arabia
Senegal
Serbia
Seychelles
Sierra Leone
Somalia
South Africa
South Sudan
Sri Lanka
St. Kitts and Nevis
St. Lucia
St. Maarten Solomon Islands
St. Martin
St. Vincent and the Grenadines

Croatia
Cuba
Curacao
Djibouti
Dominica
Dominican Republic
Ecuador
El Salvador
Equatorial Guinea
Eritrea
Ethiopia
Faeroe Islands
Fiji
French Polynesia
Sudan
Suriname
Swaziland
Syrian Arab Republic
Tajikistan
Tanzania
Thailand
Timor-Leste
Togo
Tonga
Trinidad and Tobago
Tunisia
Turkmenistan
Turks and Caicos Islands
Tuvalu
Uganda
Ukraine
United Arab Emirates
Uruguay
Uzbekistan
Vanuatu
Venezuela
Vietnam
Virgin Islands Zambia
Yemen
Zimbabwe

Developed Countries:

Australia	France	Korea, Rep.	Singapore
Austria	Germany	Latvia	Slovak Republic
Belgium	Greece	Luxembourg	Slovenia
Canada	Hong Kong	Malta	Spain
Cyprus	Iceland	Netherlands	Sweden
Czech Republic	Ireland	New Zealand	Switzerland
Denmark	Israel	Norway	United Kingdom
Estonia	Italy	Portugal	United States
Finland	Japan	San Marino	