

A Study on Conventional Energy Sources for Power Production

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Abstract

In this modern life we energy is a most important and vital issue. We are so dependent on energy that we can not do without energy. We can not think our normal life with energy. There are many form of energy. Perhaps electricity is the most convenient and desirable form of energy. Everywhere we are using this energy. To run the industry we need electricity. To illuminate the house and street at night we need electricity. To run the compute, mobile phone, smart phone we need electricity. To watch TV, hearing radio and other appliances and machines we need electricity. So the use of electricity knows no bound. Modern life is clearly impossible without electricity. So it is most valuable and most essential source of energy. This study shows the scenario of the fossil fuels (Oil, Gas and Coal) in the world. The findings of the research work are the estimation of the conventional sources of the present world. This work will help to be conscious in the mankind for the use of the fossil fuels in the world.

Keywords: Non Renewable Energy Sources, Oil, Gas, Coal, Nuclear Power, Power.

INTRODUCTION

Energy is the capacity of a physical system to perform work. Energy exists in several forms such as heat, kinetic or mechanical energy, light, potential energy, electrical, or other forms. According to the law of conservation of energy, the total energy of a system remains constant, though energy may transform into another form. Two billiard balls colliding, for example, may come to rest, with the resulting energy becoming sound and perhaps a bit of heat at the point of collision.

The SI unit of energy is the joule (J) or newton-meter (N-m). The joule is also the SI unit of work. Most of the energy, which people are using, is derived directly or indirectly from the sun. Non-renewable energy resources are those, which have been in use since a long time. Availability of petroleum is limited. Petroleum products are nothing but energy-rich components of carbon which have undergone anaerobic degradation with the help of sun's energy. The problem with fossil fuels or petroleum products is that, they release a lot of pollutants, when used. Fuel wood, agricultural waste and cow dung (gobar), form the major sources of energy for rural Bangladesh and most of the urban Bangladeshi population consumes energy from coal, petroleum, natural gas (CNG), hydel power (hydroelectricity), sun, wind and nuclear power. At present, Bangladesh produces 37,000MW of energy from different sources. We are using electricity to run our computer, mobile telephone, various household appliances, toys etc. Everywhere we need electricity [10-15]. Therefore the present global trend is to increase the production of electricity. All over the world the production of electricity is basically depends on non-renewable sources mainly oil, gas and coal. These all are natural resources and not unlimited. The total reserve of these resources is fixed. So it is a great concern what will happen after finishing of these resources. A lot of researches are going to find alternate solution for production of electricity. Now we are using solar energy, wind energy, tidal energy, biogas energy, hydro power, wave energy, OTEC (Ocean Thermal Energy Conversion) etc. These all are the alternative sources of energy and definitely renewable energy. These sources will never run out. All over the world has emphasis on these renewable resources for its improvement. Generation of electricity from Pather Kuchi Leaf (*Briophyllum Pinnatum*) is an addition in the list of renewable energy [11-16]. It is invented in Bangladesh and it has great advantages over other renewable resources. For an example in case of solar energy is not possible to produce electricity during night, in case of wind energy wind must be blow for the production of electricity, in case of tidal energy, wave energy, hydro energy it needs specific requirement. But for the production of electricity from Pather Kuchi Leaf (PKL) it is free from these drawbacks. We can produce it anywhere, anytime, any places without going any complexity. Not only that this technology is so easy to make it possible to make and use it without any previous technical knowledge[17-20]. Moreover it provides electricity directly from the system which is very convenient easy and cheap. Bangladesh is a developing country. For the proper development of the country supply of electricity is a must. But we have a great shortage of electricity. This shortage of electricity is creating a great barrier

in our development. Most of the people in Bangladesh live in rural areas and majority of them are poor. So, to reduce poverty of that majority part of the country it is important to provide energy to them.

II. Methodology

A. Coal production, consumption and reserves

Lately, there’s nothing new in coal’s consumption. That is understandable because exploiting technologies have reached its peak, so there’s no big possibility of progress. According to the rough predictions, there’s still enough coal for the next 200 years if we continue today’s tempo of its exploitation. That means that in our close future won’t be problems with coal’s supply, but could be problems because of economical and ecological aspects of this energy’s use. In 2011 total global coal production was 7678 Metric Ton whereas in 2010 it was 7201 Metric Ton¹. Total world coal production increasing by 6.6% over 2010. The average annual growth rate of coal since 1999 was 4.4%.

As per the statistics of 2011, Table 1 shows the top five coal producer in the world¹.

Table 1: Top five coal producer in the world

Sl. No.	Country	Total Production
1	PR China	3471Mt
2	USA	1004Mt
3	India	585Mt
4	Australia	414Mt
5	Indonesia	376Mt

The graphical representation of the above top coal producer in the world is shown in figure 1.

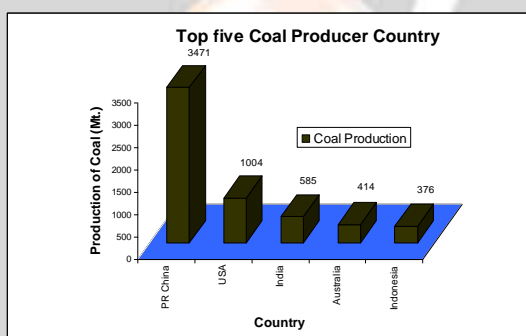


Figure 1: Top five coal producer of the world.

B. Coal consumption

Coal is the major fuel used for generating electricity worldwide. Table 2 shows the top 5 countries heavily dependent on coal for electricity¹.

Table 2: Top five heavily coal dependent countries for electricity.

Sl. No.	Country	Total Production
1	South Africa	93%
2	Poland	90%
3	PR China	79%
4	Australia	76%
5	Kazakhstan	70%

The graphical representation of the above five countries that are heavily depend on coal for production of electricity is shown in figure 2.4.

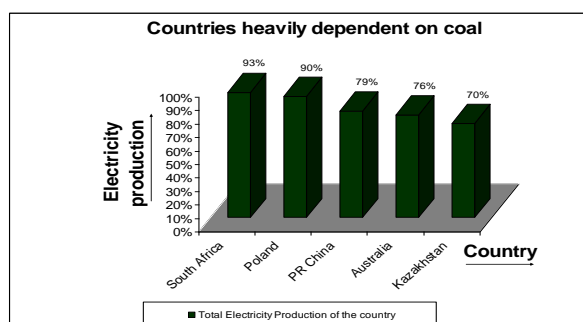


Figure 2: Top five heavily coal dependent country for producing electricity.

C. Coal Reserve

Coal is a valuable energy resource. Many electrical power plan run on coal. Many countries has a large reserve of coal. Table 3 shows the list of top ten countries of the world has largest proven coal reserve.

Table 3: Top ten countries who has largest coal reserve.

Sl. No.	Country	Total Reserve
1	United States	237,295 Mt
2	Russia	157,010 Mt
3	China	114,500 Mt
4	Australia	76,400 Mt
5	India	60,600 Mt
6	Germany	40,699 Mt
7	Ukraine	33,873 Mt
8	Kazakhstan	33,600 Mt
9	South Africa	30,156 Mt
10	Serbia	13,770 Mt

The graphical representation of the top ten countries who has largest coal reserve is shown in figure 3

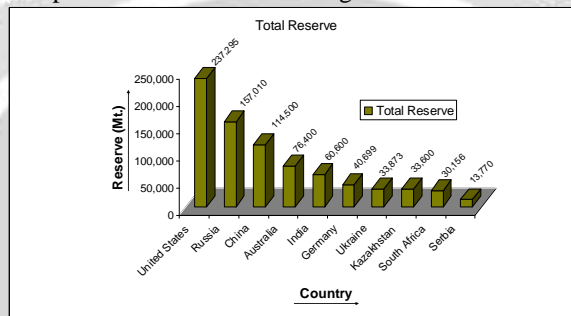


Figure 3: Top ten countries of the world has largest proven coal reserve.

C. Oil: An Introduction

Most people think that oil is located in some underground pools, but this is not the case. Oil is located compendious in small pores between the rocks under the very big pressure² as shown in figure 4.



Figure 4: Oil is captured under huge pressure in pores between the rocks.

When we make a drill till the depth in which pores containing oil are located, that small drops are rushing to oil well because of the huge pressure. First of all, the natural pressure bursts the oil outside through the well, and after that oil companies are deciding to pump the oil out of the well. These two fazes of exploitation are called primary production. After that about 75 % of oil’s starting amount is still in the well. That’s the reason why are oil companies deciding to flood oil wells with water. Through some other well they’re pumping water in to a well and are “washing” one part of the remaining oil with it. Thanks to this 15 % more of oil’s starting amount is gained. Finally, there’s about 60 % of oil still in the well, which we for time being still don’t know how to pump out.

D. Oil production

According to International Energy Agency (IEA) top ten countries produced over 63 % of the world oil production in 2011. As per IEA table 4 shows the list of top ten oil producing countries.

Table 4: Top ten oil producing countries in the world³.

Sl. No.	Country	Daily Production (Million Barrel)
1	Saudi Arabia	11.15
2	Russia	10.21
3	United States of America	9.02

4	Iran	4.23
5	China	4.07
6	Canada	3.59
7	Iraq	3.40
8	United Arab Emirates	3.09
9	Mexico	2.93
10	Kuwait	2.68

A graphical representation of the world top ten countries production is shown in figure 2.7.

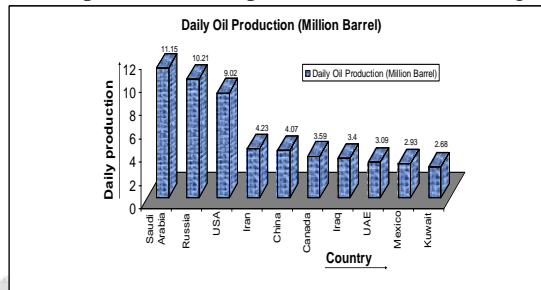


Figure 5: Production of top ten oil producing country.

E. Oil Consumption

In 2010, world energy consumption of refined products increased 3.8%. This trend was supported by fast-growing demand for road and air transport, particularly in developing countries. In China, demand for refined products surged by 12% due to increasing needs. Asia accounted for more than 40% of the overall increase in consumption. As per the World Fact Book, table 2.4 shows the top 10 oil consumption countries in the world for the year 2010.

Table 4: top ten oil consuming countries⁴.

Sl. No.	Countries	Daily Consumption (Million Barrel)
1	United States of America	19.15
2	China	9.40
3	Japan	4.45
4	India	3.18
5	Saudi Arabia	2.64
6	Germany	2.50
7	Canada	2.21
8	Russia	2.20
9	South Korea	2.20
10	Mexico	2.07

A graphical representation of the world’s top ten oil consumer’s country is shown in figure 2.8.

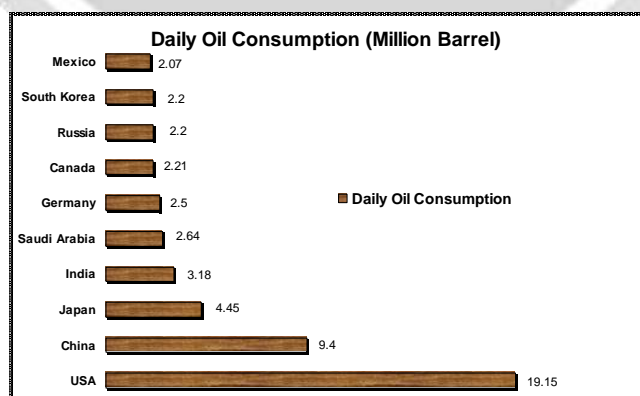


Figure 6: Top ten oil consuming country.

Table 4 is a list of top ten countries by proven oil reserves. Proved reserves are those quantities of petroleum which, by analysis of geological and engineering data, can be estimated with a high degree of confidence to be commercially recoverable from a given date forward, from known reservoirs and under current economic conditions.

F. Oil Reserves

Though different sources (OPEC, CIA World Factbook, oil companies) give different figures and there are different types of oil, ranging from cheap and easy to recover oils to shale oil or oil sands, which are very expensive and difficult to recover but it is believed that those reserves are relevant. It is estimated that at least 70% of the proven oil reserves are currently held by OPEC countries.

Table 5: Oil reserve of top ten countries⁵.

Sl. No.	Countries	Reserve (Million Barrel)
1	Venezuela	211,169 - 297,571
2	Saudi Arabia	265,405 - 267,017
3	Canada	173,625 - 175,200
4	Iran	151,167 - 154,580
5	Iraq	115,350 - 143,103
6	Kuwait	103,998 - 111,500
7	United Arab Emirates	97,800
8	Russia	60,003 - 116,000
9	Libya	47,102 - 48,014
10	Kazakhstan	30,002 - 39,800

A graphical representation of top ten oil reserve country is shown in figure 2.9.

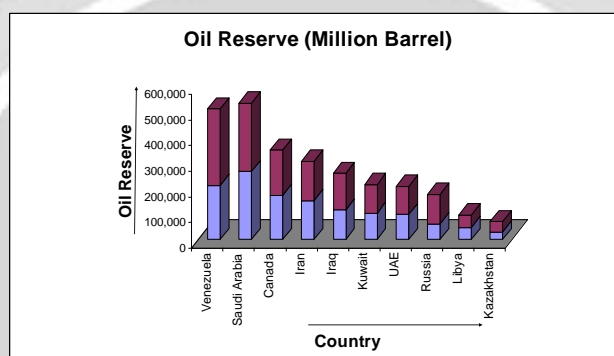


Figure 6: Top ten oil reserve country.

G. Natural Gas: An Introduction

For many years common belief was that natural gas is useless. Even today in some countries, people are trying to get rid of this gas by burning it in large torches. This gas is mainly made out of the methane, a simple union that consists of one carbon atom and four hydrogen atoms. Methane is highly flammable with almost full combustion. After combustion, there are no ashes, and air pollution is almost negligible. Natural gas has no color, taste, smell or shape in its natural form, so it's indiscernible to people. Because of this reason companies are adding chemical to it which has smell of rotten egg. That smell enables people easy detection of potential gas leaking in house².

Natural gas is found in different underground formations. Some formations are heavier and more expensive for exploit, but are also leaving the place for the improvement in future gas supply

H. Gas Production

According to International Energy Agency (IEA) in 2011 world total gas production was 3388 Billion Cubic Meter (bcm) and the top ten gas producing country produced around 66.7 % of the world total. As per IEA table 2.7 shows the list of top ten gas producing countries along with their production.

Table 6: Gas production of top ten countries.

Sl. No.	Country	Annual natural Gas production (bcm)
1	Russia	669.60
2	United States of America	651.30
3	Canada	160.10
4	Iran	146.10
5	Qatar	116.70
6	Norway	103.10
7	China	102.70
8	Saudi Arabia	99.23
9	Algeria	84.61
10	Indonesia	82.80

A graphical representation of top ten gas producer country is shown in figure 2.10.

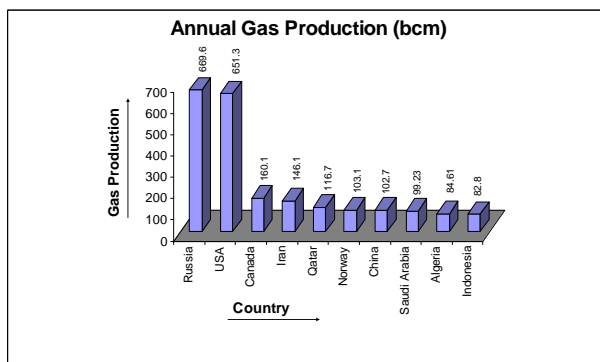


Figure 7 : Top ten gas producer in the world.

I: Gas Consumption

As per The World Factbook the world total natural gas consumption was 3319 bcm. Table 7 shows the top ten gas consumer countries in the world.

Table 7: Top ten gas consumer countries in the world.

Sl. No.	Country	Annual natural Gas consumption (bcm)
1	United States of America	689.90
2	Russia	506.70
3	Iran	144.60
4	China	130.90
5	Japan	112.60
6	Canada	103.30
7	Saudi Arabia	99.230
8	United Kingdom	82.210
9	Germany	78.99
10	Italy	77.83

A graphical representation of top ten gas consuming country is shown in figure 2.11.

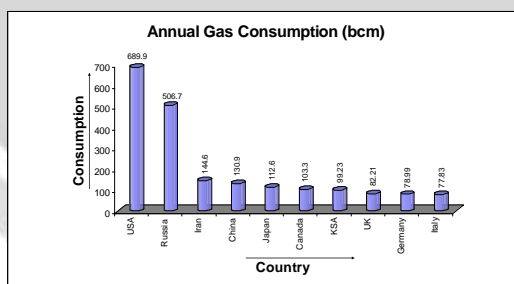


Figure 8: Top ten gas consumer.

J: Gas Reserve

AS per The World Fact book it was estimated that the total gas reserve of the world is 300000 bcm (1st January, 2012). Based on data from British Petroleum (BP) at the end of 2009 proved gas reserves are dominated by three countries: Russia (24%), Iran (16%) and Qatar (14%). Table 9 shows the list of top ten countries by natural gas proven reserves.

Table 9: Top ten countries by natural gas proven reserves.

Sl. No.	Country	Natural Gas Proven Reserve (bcm)
1	Russia	55,000
2	Iran	33,500
3	Turkmenistan	26,200
4	Qatar	25,470
5	United States of America	9,000
6	Saudi Arabia	8,200

7	Venezuela	5,525
8	Nigeria	5,246
9	Algeria	4,502
10	Australia	3,825

A graphical representation of top ten gas reserve country is shown in figure 8.

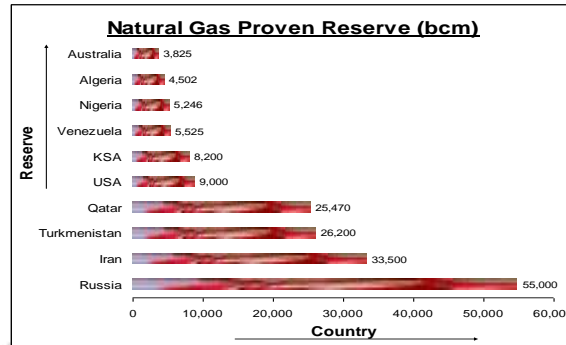


Figure 8: Top ten gas reserve countries.

Liquefied natural gas (LNG): An Introduction:

Liquefied natural gas (LNG) is natural gas under the big pressure that is refrigerated to a very low temperature so it acquires liquid aggregate state. When natural gas is cooled all the way to 161 degrees of Celsius below zero, it becomes clear liquid without color, taste and smell. Since LNG takes only 1/600 of natural gas volume when in gaseous state, that state is suitable for tanker transportation across the world. Terminal for LNG is installation for filling and emptying tankers. Tankers that transport LNG can be longer than 300 meters², and minimal water depth must be more than 12 meters, when they're being completely full. These tankers must also have double lining and are specially designed to withstand low LNG temperatures².



Figure 9: Ships that are transporting LNG.

The production of LNG is going high day by day as the demand is going rise. The total production of LNG was 50 Million Tonnes Per Annum (Mtpa) in 1990. But in 2007 it grows to 160 Million Tonnes Per Annum (Mtpa).

K: LNG exports by country

By the end of 2011, 18 countries were exporting their gas resources as LNG. In addition, five countries, namely Belgium, Brazil, Mexico, Spain and the United States, were re-exporting LNG previously imported from another source.⁶ Qatar is by far the largest LNG exporter. In 2011, the country supplied 75.5 Metric Ton (MT) of LNG to the market –nearly one third (31%) of global supply.

Table 10 shows the LNG exporters by country, 2011.

Table 10: LNG exporters by country, 2011⁶.

Sl. No.	Exporting Country	Quantity (MT)
1	Qatar	75.5
2	Malaysia	25.0
3	Indonesia	21.4
4	Australia	19.2
5	Nigeria	18.7
6	Trinidad	13.9
7	Algeria	12.6

8	Russia	10.5
9	Oman	7.9
10	Brunei	6.8
11	Yemen	6.7
12	Egypt	6.4
13	UAE	5.9
14	Equatorial Guinea	4.0
15	Peru	3.8
16	Norway	2.9
17	US	0.3
18	Libya	0.1
Total Export		241.5

A graphical representation of top ten gas exporting country is shown in figure 10.

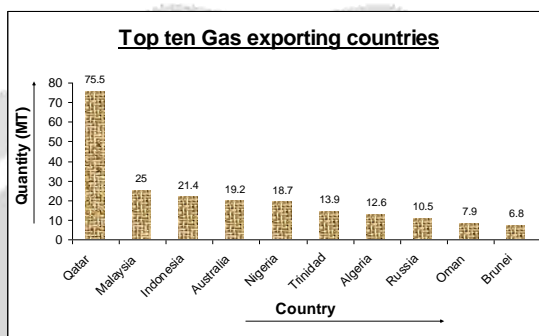


Figure 11: Top ten gas exporting countries.

L: LNG Importers by Country

Many countries import LNG for their country. Japan is the highest importer of LNG in the world. Next the Korea is in second position. Table 2.11 shows the LNG importer country by 2011.

Table 11: LNG importers by country, 2011⁶.

Sl. No.	Exporting Country	Quantity (MT)
1	Japan	78.8
2	Korea	35.8
3	UK	18.6
4	Spain	17.1
5	China	12.8
6	India	12.7
7	Taiwan	12.2
8	France	10.7
9	Italy	6.4
10	USA	5.9
11	Turkey	4.6
12	Belgium	4.5
13	Argentina	3.2
14	Mexico	2.9
15	Chile	2.8
16	Canada	2.4
17	Kuwait	2.4
18	Portugal	2.2
19	UAE	1.2
20	Greece	1.0
21	Dom. Rep	0.7
22	Thailand	0.7
23	Brazil	0.6
24	Netherlands	0.6
25	Puerto Rico	0.5

Total Imports	241.5
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A graphical representation of top ten gas exporting country is shown in figure 2.15.

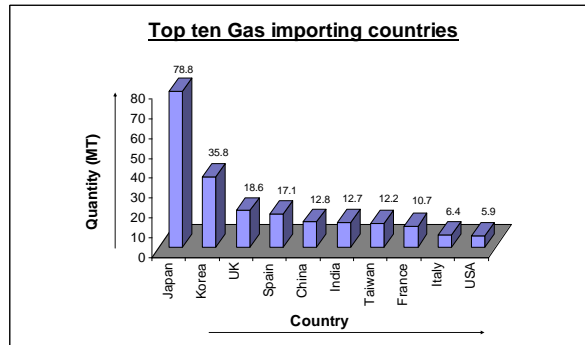


Figure 12: Top ten gas importing countries.

M: Nuclear Energy: An Introduction

Nuclear energy originates from the splitting of uranium atoms in a process called fission. At the power plant, the fission process is used to generate heat for producing steam, which is used by a turbine to generate electricity. Almost two billions of people across the globe don't have access to electrical energy and this problem will become even worse since Earth's population is growing. Global relying on fossil fuels and huge hydro-electrics will remain trend at least to year 2020, but that won't be enough to satisfy constant and ever-growing humanity needs. As one of the possible solutions of this problem, nuclear energy isolates itself. In the last three decades nuclear energy has significant part in electrical energy production. Momentarily with the help of the nuclear energy, 16% of total world's electrical energy production is generated. Strong burst of nuclear energy can be related with its purity and almost non greenhouse gases emission. Well constructed nuclear power plants showed to be reliable, safe, economically acceptable and ecologically benign. Till this date more than 9000 reactor-year work was accumulated, so necessary experience in using the nuclear energy was also summoned.

N: Nuclear Energy Facts

Nuclear energy is non-renewable energy source. Some interesting facts about nuclear energy are as below: Nuclear energy is energy that is released either by splitting atomic nuclei or by forcing the nuclei of atoms together. Nuclear energy comes from mass-to-energy conversions that occur in the splitting of atoms. Albert Einstein's, famous mathematical formula $E = mc^2$ explains this. The equation says: E [energy] equals m [mass] times c^2 [c stands for the speed or velocity of light]. This means that it is mass multiplied by the square of the velocity of light. Nuclear energy is produced by a controlled nuclear chain reaction and creates heat which is used to boil water, produce steam, and drive a steam turbine. Nuclear power can come from the fission of uranium, plutonium or thorium or the fusion of hydrogen into helium. Today it is almost all uranium. The basic energy fact is that the fission of an atom of uranium produces 10 million times the energy produced by the combustion of an atom of carbon from coal. Nuclear power plants need less fuel than ones which burn fossil fuels. One ton of uranium produces more energy than is produced by several million tons of coal or several million barrels of oil.



Figure 13: The Cattenom Nuclear Power Plant in France.

III. Countries' Use of Nuclear Energy

Nuclear power stations operate in thirty countries. Of these thirty countries only France, Belgium and Slovakia use them as its primary source of electricity, although many of them have a significant nuclear power generation capacity. According to the nuclear power advocacy association World Nuclear Association, over 45 countries are giving "serious consideration" to introducing a nuclear power capability. Association say that China, South Korea and India are pursuing ambitious expansions of their nuclear power capacities, with China aiming to increase capacity to at least 60

GWe by 2020, 200 GWe by 2030 and 400 GWe by 2050. South Korea, they say, is planning to expand its nuclear capacity from 20.7 GWe in 2012 to 27.3 GWe in 2020 and to 43 GWe by 2030. They say that India aims to have 20 GWe nuclear capacity by 2020 and 63 GWe by 2032. Table 12 shows the list of top ten nuclear electricity generated country.

Table 12: Top ten nuclear electricity generated country.

Sl. No.	Country	Capacity, 2010 (MW)	Share of Electricity production
1	United States	101,409	19.3%
2	France	63,130	77.1%
3	Japan	44,215	18.1%
4	Russia	23,643	17.6%
5	South Korea	20,671	34.6%
6	Ukraine	13,107	47.2%
7	Canada	12,604	15.3%
8	Germany	12,003	17.8%
9	China	11,816	1.9%
10	United Kingdom	9,703	15.7%

A graphical representation of top ten nuclear electricity generated country with their country’s share of electricity production is shown in figure 14.

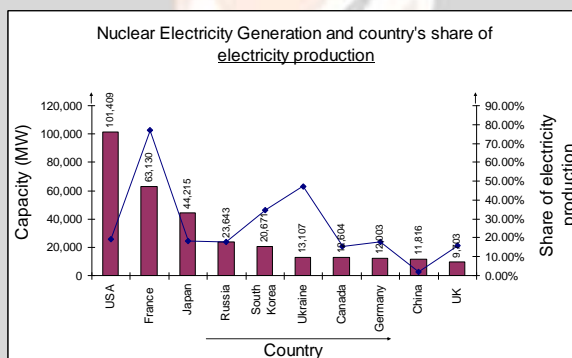


Figure 14: Top ten nuclear electricity generated country with their country’s share of electricity production.

IV. Conclusion

Energy specially the electric energy is an important issue of modern life. We can not think the civilization without electricity. We depend on mainly coal, oil and gas for the production of electric energy. There is another source of producing electricity. That is nuclear energy. Energy is also the symbol of civilization. The developed countries are using these sources of energy for producing more and more electricity. They have the large reserve of these sources.

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