

**POWER SECTOR DEVELOPMENT IS AN INDICATOR FOR ECONOMIC DEVELOPMENT**

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The economic development of any country irrespective of its size mainly depends upon the development of the power sector, which in fact is a key indicator of the nation's overall economic development. Power is vital input not only to all household activities, but to economic development as well. In fact it is the fuel of the economic progress in all sectors, not only agricultural and industrial but all allied areas. Economic progress depends very much upon how successfully and profitably a country manages its power sector. Agriculture, industry and other core areas of economy ultimately depend for their development and success on the availability of adequate power constantly and uninterruptedly throughout the year. How important is power sector in the economic development of a country, apart from other factors, may be known by taking into consideration its power consumption. If power consumption by all sectors is seen to increase, then the index of economic development as a measure of its progress is also found to increase. Usually the correlation between consumption of power and the growth of economy is taken as a measure of progress.

The production of electricity is a basic indicator of a country's size and level of development in all spheres. Some countries are exporting electricity on a massive scale and others are importing it on a large scale. In India most of the power consumption is by the agricultural sector, where the rate of revenue is very low. Expanding the supply of electricity to meet the growing demand of ever increasing urbanised Indian economy without incurring unacceptable costs is a major challenge to it. People's standard of living depends on their use of energy in general and access to electricity in particular. It is a major factor on which the policy-makers have to seriously focus their attention

and direct their efforts. Compared with several other countries of the world, India is lagging behind many in terms of production as well as per capita consumption of energy.

### **Origin of Electricity**

Electricity occurs naturally in the form of lightning and is highly versatile, because it can be carried over long distances and converted easily into many other forms of energy. Almost any form of energy can be converted into electricity. The most common methods of producing electricity are those used in batteries or generators. Converting chemical energy into electric energy<sup>1</sup> generates power from batteries. Most generators convert heat energy into electric energy. Some generators exploit such natural resources as sunlight or wind or water to obtain electrical energy<sup>1</sup>. The year 1800 is significant because of origin of electricity, as Alessandro Volta of Italy, starting a marvelous phase of convenient, reliable, secure and happy life style, invented the electric battery. Volt, a unit of electromotive force (difference of potential that would carry one ampere of current against one ohm resistance) is named after him.

James Watt's improved design of steam engine in 1765, brought to light the use of steam energy to move a heavy vehicle. Watt, a unit of power to rate output of electrical devices, is named after him. William Sturgeon of Britain designed electro-magnet in 1824, followed by the first major step in the generation of electricity in the Royal Institute of London in the year 1831. When Michael Faraday discovered that if a bar magnet was moved near a coil of wire, electric current was produced in the coil. William Siemens of Britain invented Electric Furnace in 1861. Zenobe Gramme of Belgium in 1873 and AC motor by Nikola Tesla of United States of America invented D.C. motor in 1888. All these inventions revolutionised the industry. Thomas Alva Edison of United States of America (U.S.A) invented Electric lamp in 1879, starting a new phase of activity in all spheres. With this invention, human being could work round the clock, thereby improved his standard of living and quality of life.

Electricity is the form of energy that enables charged particles such as electrons to move. Moving charge is current electricity, either DC or AC. Direct Current (D.C) flows in one direction only, while Alternate Current (A.C) changes direction many times every second. Transfer of energy brought about transformation in the well being of man. Windmills convert wind energy into electricity through generator. Solar cells convert Sun's rays (light) into electricity and Light Emitting Diodes (LED's) and bulbs do the opposite by converting electricity into light. Battery and solar power can be stored in very minute quantum for short periods with limited efficiency.

### **Historical Background**

Men of pre-historic times did not know about electric power<sup>2</sup>. They are dependent on wood for cooking, lighting and for heating purpose, and were consuming limited fuel. Now the scenario is different. Coal, oil, natural gas etc. and conventional energy sources dominate the present energy scene. Traditional power included motive power and heat such as the muscular energy of humans, and work of draught animals. Albert Einstein in his equation  $E = mc^2$  proved that energy (Energy released = mass decomposed x square of velocity of light) and matter are interchangeable. Every thing that exists on earth can directly or indirectly be attributed to solar energy. Scientists believe that the first living cell was formed. When energy from lighting combined with other elements on earth. Naturally, man also owes his existence to that cell<sup>3</sup>.

Subsequently, man discovered the technical to control fire. This made him God's special creation, and led to his supremacy over all other living things. Animate (living beings) energy, the source of 18<sup>th</sup> century was gradually replaced by inanimate energy. Coal replaced wood and formed the basis of industrial revolution in late 19<sup>th</sup> century and early 20<sup>th</sup> century. Sources of energy can be sub-classified as commercial and non-commercial energy. Coal, lignite coke, oil, gasoline (petrol), kerosene and natural gas as thermal power and Hydel power are made available on commercial scale i.e., in huge quantum required by large population. Firewood, charcoal, lumber mill waste, cowdung, straw, agricultural waste, wind power, sunlight (to dry agricultural products) and streams available

locally at no cost are used as non-commercial energy sources. As the demand of energy outstripped the supplies from conventional sources, more and more non-conventional forms of energy are being harnessed.

Important methods of illumination were developed in 20<sup>th</sup> century, replacing old methods and improved the quality of life. After two world wars, liquid fuels recorded phenomenal growth. This was followed by electrification on a big scale. Many western countries have developed their power generation systems using liquid fuels, coal, hydel storage capacities and also nuclear energy. Rapid progress in industrialisation was achieved through distribution of power that was generated. Agriculture and allied activities, transport vehicles and related tools also got the necessary support from developed power systems.

Generation is the power produced by natural or artificial method. Energy is generated by the natural force of water (hydel) pressure of wind (wind) solar energy (solar), tidal waves and also deep soil (geo-thermal). Heat energy (thermal) is obtained by burning coal, lignite, oil, natural gas, naphtha, biogases etc. Energy is also generated from atomic fusion and fission (nuclear) simple rural technology oriented biogas/biomass and other non-conventional sources.

### **Importance of Power**

Power is one of the most critical inputs in modern society and finds its right place in the list of core sector industries, Government of India, through industrial Policy Resolution 1956, included Power generation, transmission and distribution under category one, in the concurrent list allowing only Central or State Governments to operate in power sector. Thus private sector has no entry into vital sector. The exceptions were only a handful like Bombay Suburban Electric Supply Company (BSES) an enterprise of Tata group, which was already in the field of generation and distribution of power of Mumbai metropolitan area and Calcutta Electric Supply Company Limited (C.E.S.L). After 35 years this sector is opened upto private sector in 1991.

## **Role of Power in Economic Development**

Nowadays, power plays a vital role in every sphere of activity. Innumerable gadgets are run on electricity, which are indicators etc., of the quality of life. In domestic sector, power is used for lighting, cooking, ceiling and table fans, water heaters, room heaters, air coolers, air-conditioners, refrigerators, ovens, electric irons, electric cookers, washing machines, vacuum cleaners motors for water supply, wet and dry grinders, audio-visual equipment like radio, tape recorder, television, video cassette recorder, video cassette player, and now the personal computers with or without internet and e-mail facilities. In commercial complexes, especially multistoried structures, lifts are vital to reach higher floors. Modern comforts are fixed in them. Agricultural pump sets, electric trains, life-saving equipment in hospitals like scanner, laser equipment etc. need electricity. The list of power consuming equipment is un-ending. With the passage of time, more and more new equipment is entering the market, increasing power consumption by 10% per annum.

## **Utilisation of Power**

Power is utilised by many categories of consumers. Industrial application of power has no bounds. Different kinds of machinery are in use in large, medium and small-scale industries. Industries have been the major consumers of power to run computers to robots. It is now possible to contact and communicate from one point in the universe, through telephone, Internet, e-mail, e-commerce, video conferences etc. Distance between places has a little significance now, due to the development of modern communication systems. Satellites supporting all these channels of communication are controlled from earth stations, with the help of both conventional and non-conventional power systems.

## **Power Development in the World**

The Power situation in the world is giving a unique picture in the power development scenario. Because of varied geographical, national situations. The power situation in the world is not same

among all the countries, different picture and it prevails for various reasons. The world per capita use of energy is 1.9 times whole equivalent (TCE). Developed countries like USA, UK and Japan have their respective per capita consumption at a much higher level of 11.1 T.C.E., 5.4 T.C.E and 3.2 T.C.E respectively, while developing countries like China and India have a per capita energy consumption of 0.5, T.C.E. and 0.2 T.C.E respectively<sup>4</sup>. A lot of change has been taking place the world over in the consumption of energy. High-income countries consume energy 31/2 times that of Europe and Central Asia. The total energy use by South Asia and Middle East and North Africa is countries use more energy than South Asia. But the Sub-sabaran Africa consumers less power than half of South Asia. The U.S is the biggest consumer of commercial the erstwhile Russian federation was a large consumer of commercial energy. But India, Canada and the U.K. consume almost the same quantities of energy, which indicate the stage of economic development of each of the countries. It is clearly noticed that rapidly industrialised countries have been increasing their consumption of energy considerably. India has registered a high average growth of 4.4 percent<sup>5</sup> The world development report 2000 world development report 2000 world development indicators-1988 clearly specify the world position of power is terms of per capita use. It points out that the use of electrical energy is very high in the developed and some of the Gulf countries<sup>6</sup>. The percapita use of the U.S was only one half of that of Norway, Japan, Belgium and Switzerland consumed 7000 KWh percapita each in the year 1997.

India has now low energy consumption but high-energy intensity. The energy consumption percapita (toe/persons) in India was 0.112 while it was 0.336 in Asia and 7.67 in USA. In 1991 there is lot of variation in terms of energy consumption between developing and developed countries. In term of electricity intensity it was 462 in India, 385 in Asia and 503 in USA during the year 1991 and it shot up to 597 in India 406 in Asia 384 in USA during the year 1996<sup>7</sup>. It is clear that while the energy intensity has been increasing year after year in India and it is considerably getting reduced in USA over a period of time. But in other Asian countries it exhibits a mixed trend. It indicates that through there is a considerable growth of rate power generation in India over a

period of time, its energy requirements have been so enormously increasing that there is no match between power generation and the demand for power. Unless adequate power is generated to meet the requirements of all sectors of the economy, the economic progress will be invariably declining.

**Table - 1.1****Electricity Generation in the World\***

	<b>Billion KWh</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
1.	USA	3991 (25.85)	3924 (25.11)	4051 (25.02)	4039 (24.24)
2.	Canada	605 (3.92)	582 (3.72)	581 (3.59)	560 (3.36)
3.	Mexico	204 (1.32)	210 (1.34)	215 (1.33)	190 (1.14)
4.	Argentina	89 (0.58)	90 (0.58)	84 (0.52)	91 (0.55)
5.	Brazil	349 (2.26)	329 (2.11)	345 (2.13)	365 (2.19)
6.	Chile	40 (0.26)	43 (0.28)	44 (0.27)	47 (0.28)
7.	Colombia	42 (0.27)	43 (0.28)	46 (0.28)	47 (0.28)
8.	Venezuela	89 (0.58)	95 (0.61)	96 (0.59)	97 (0.58)
9.	Other S & Luxembourg	200 (1.30)	207 (1.32)	218 (1.35)	227 (1.36)
10.	Austria	62 (0.40)	64 (0.41)	62 (0.38)	60 (0.36)
11.	Azerbaijan	19 (0.12)	19 (0.12)	19 (0.12)	21 (0.13)
12.	Belarus	26 (0.17)	25 (0.16)	26 (0.16)	27 (0.16)
13.	Belgium & Luxembourg	85 (0.55)	81 (0.52)	86 (0.53)	88 (0.53)
14.	Bulgaria	41 (0.27)	44 (0.28)	43 (0.27)	44 (0.26)
15.	Czech Republic	73 (0.47)	75 (0.48)	76 (0.47)	83 (0.50)
16.	Denmark	36 (0.23)	38 (0.24)	39 (0.24)	46 (0.28)
17.	Finland	70 (0.45)	74 (0.47)	75 (0.46)	84 (0.50)
18.	France	541 (3.50)	550 (3.52)	559 (3.45)	567 (3.40)
19.	Germany	564 (3.65)	582 (3.72)	581 (3.59)	597 (3.58)
20.	Greece	54 (0.35)	54 (0.35)	51 (0.32)	55 (0.33)
21.	Hungary	35 (0.23)	36 (0.23)	36 (0.22)	34 (0.20)
22.	Iceland	8 (0.05)	8 (0.05)	8 (0.04)	8 (0.04)
23.	Republic of Ireland	24 (0.16)	25 (0.16)	25 (0.15)	25 (0.15)
24.	Italy	277 (1.79)	279 (1.79)	284 (1.75)	293 (1.76)
25.	Kazakhstan	52 (0.34)	56 (0.36)	59 (0.36)	64 (0.38)
26.	Lithuania	11 (0.07)	15 (0.09)	18 (0.11)	19 (0.11)
27.	Netherlands	89 (0.58)	94 (0.60)	96 (0.59)	96 (0.58)

	Billion KWh	2000	2001	2002	2003
28.	Norway	143 (0.93)	122 (0.78)	131 (0.81)	107 (0.64)
29.	Poland	145 (0.93)	146 (0.93)	144 (0.89)	152 (0.91)
30.	Portugal	44 (0.28)	47 (0.30)	45 (0.28)	46 (0.28)
31.	Romania	52 (0.34)	54 (0.35)	55 (0.34)	57 (0.34)
32.	Russian Federation	878 (5.69)	891 (5.70)	891 (5.50)	912 (5.47)
33.	Portugal	31 (0.20)	32 (0.20)	32 (0.20)	31 (0.19)
34.	Spain	225 (1.46)	237 (1.51)	246 (1.52)	262 (1.57)
35.	Sweden	146 (0.95)	162 (0.04)	147 (0.91)	137 (0.82)
36.	Switzerland	67 (0.43)	72 (0.46)	67 (0.41)	67 (0.40)
37.	Turkey	125 (0.81)	123 (0.79)	132 (0.82)	141 (0.85)
38.	Turkmenistan	10 (0.06)	11 (0.07)	12 (0.07)	13 (0.07)
39.	Ukraine	169 (1.09)	171 (1.09)	174 (1.07)	180 (1.08)
40.	United Kingdom	377 (2.44)	385 (2.46)	387 (2.39)	395 (2.37)
41.	Uzbekistan	47 (0.30)	47 (0.30)	49 (0.30)	49 (0.29)
42.	Other Europe & Eurasia	146 (0.95)	147 (0.93)	150 (0.93)	154 (0.92)
43.	Iran	119 (0.77)	128 (0.82)	138 (0.85)	149 (0.89)
44.	Kuwait	33 (0.21)	34 (0.22)	35 (0.22)	36 (0.22)
45.	Qatar	9 (0.06)	10 (0.06)	10 (0.06)	11 (0.07)
46.	Saudi Arabia	128 (0.83)	137 (0.88)	143 (0.88)	151 (0.91)
47.	United Arab Emirates	39 (0.25)	40 (0.26)	42 (0.26)	43 (0.26)
48.	Other Middle East	140 (0.91)	147 (0.94)	153 (0.94)	153 (0.92)
49.	Algeria	25 (0.16)	26 (0.17)	27 (0.17)	29 (0.17)
50.	Egypt	76 (0.49)	80 (0.51)	86 (0.59)	92 (0.55)
51.	South Africa	211 (1.37)	210 (1.34)	218 (1.35)	232 (1.39)
52.	Other Africa	124 (0.80)	127 (0.81)	130 (0.80)	133 (0.80)
53.	Australia	213 (1.38)	221 (1.41)	226 (1.40)	227 (1.36)
54.	Bangladesh	16 (0.10)	17 (0.11)	19 (0.12)	20 (0.12)
55.	China	1368 (8.86)	1435 (9.18)	1654 (10.22)	1911 (11.47)
56.	China Hong Kong SAR	31 (0.20)	32 (0.20)	34 (0.21)	36 (0.22)
57.	India	548 (3.55)	561 (3.59)	583 (3.60)	597 (3.58)
58.	Indonesia	100 (0.65)	105 (0.67)	110 (0.68)	115 (0.69)
59.	Japan	1082 (7.00)	1083 (6.93)	1085 (6.70)	1085 (6.51)
60.	Malaysia	67 (0.43)	72 (0.27)	75 (0.46)	84 (0.50)
61.	New Zealand	38 (0.25)	38 (0.24)	39 (0.24)	40 (0.24)
62.	Pakistan	65 (0.42)	75 (0.48)	82 (0.51)	86 (0.52)



	Billion KWh	2000	2001	2002	2003
63.	Philippines	45 (0.29)	47 (0.31)	49 (0.30)	51 (0.31)
64.	Singapore	32 (0.21)	33 (0.21)	35 (0.22)	36 (0.22)
65.	South Korea	295 (1.91)	315 (2.01)	338 (2.09)	355 (2.13)
66.	Taiwan	185 (1.20)	189 (1.21)	199 (1.23)	209 (1.25)
67.	Thailand	96 (0.62)	102 (0.65)	109 (0.67)	115 (0.69)
68.	Other Asia Pacific	74 (0.48)	78 (0.49)	85 (0.53)	92 (0.55)
	<b>TOTAL WORLD</b>	<b>15440 (100)</b>	<b>15629 (100)</b>	<b>16189 (100)</b>	<b>16663 (100)</b>

\* : Based on gross output.  
Bracket figure shows total share of the country in percentage.

**Source:** BP Statistical review of World Energy 200 (bp.com)

The power generation situation in the world is presented in Table No.1.1. It is observed that different countries are having different power situation during the years 2000 - 2003. It is also observed a mixed trend in electricity generation in various countries.

Table - 1.2

## World Total Net Electricity Consumption, 2002

Sl.No.	Country Name	Billion KWh
1.	United States	3659.99
2.	China	1456.60
3.	Japan	970.96
4.	Russia	779.99
5.	Germany	512.91
6.	India	510.09
7.	Canada	487.30
8.	France	414.70
9.	Brazil	351.89
10.	United Kingdom	343.94
11.	Italy	293.90
12.	Korea, South	267.44
13.	Spain	218.37
14.	Australia	195.59
15.	Mexico	189.66
16.	South Africa	189.36
17.	Ukraine	154.35
18.	Taiwan	147.44
19.	Sweden	138.07
20.	Saudi Arabia	128.51

**Source:** World Factbook, 2002.

The details about the total net electricity consumption in the world are furnished in Table No.1.2. It can be observed from the table that India is having a net electricity consumption of 510.09 billion KWh whereas USA is having the recorded consumption 3659.99 followed by China, 1456.60 billion KWh. According to world fact book 2002 India ranked 6th position in terms of total net electricity consumption in the year 2002.