

## STATE AND PERSPECTIVES OF THE WORLD FUEL-ENERGY SECTOR OF ECONOMY

Surzhikova O.A.

*Tomsk polytechnical university, Tomsk*

The article presents statistics and analysis of one of the major secondary energy sources – electric power. The state of the world generated power sources, demand, production and supply of electric power to countries and regions has been analyzed. Perspectives of the world power engineering sector for the nearest few years and its relation to primary fuel energy resources have been also considered.

Electrical power industry is a leading part of the power industry producing electricity for countries on the basis of manufacture and distribution of electric power.

Analysis of the state-of-the-art in this sector shows that consumption of electricity in the world is constantly rising (table 1).

**Table 1.** Dynamics of the world electricity consumption (milliard kilowatt-hour) [1]

1995	1996	1997	1998	2000	2001	2002	2003	2004
11742,2	12109,4	12426,6	12751,3	13592,1	13802,4	14285,5	14802,9	15441,3

The world figures of electricity consumption are as follows: the USA (24,1%), China (12,5%), Japan (5,9%), Russia (5,2%), India (3,8%), Germany (3,4%), Canada (3,38%), France (2,9%).

Analysis of Table 1 shows that during 9 years, within the period from 1995 to 2004

consumption increased by 32% which on average makes up 3,5% a year.

If this growth rate of consumption remains at the same level, by 2030 the world consumption of electricity will have made up about 30 milliard kilowatt/hour (Table 2). The bottom line of the table illustrates the forecast [2].

**Table 2.** Forecast for the world consumption of electricity (milliard kilowatt/hour)

	2005	2010	12015	2020	2025	2030
Our forecast	15971	18766	221561	24356	27151	29946
[2]	15766	19045	21699	24371	27133	30116

By 2030 an annual gain of the electricity consumption in countries of Economic Cooperation Organization (ECO) will have made up 1,5% on average. It should be mentioned that rise in consumption by 50% will be mainly stipulated by increasing use of consumer electronics, equipment for offices and telecommunication technology.

One of the most rapid growth rates of electricity consumption (on average 3,9% a year) within the mentioned period is the share of the countries that are not ECO members.

The most rapid growth rate is expected to be in Asia - 4.7% annually, then in the Central and South America - 3.7%, Middle East - 3.0%, Africa 2.9%, Europe and Asia - 2.8%. In 2003 the countries, that are not ECO members, consumed 40% of the world electricity; by 2030 their share is most likely to make up 56%. The forecast of electricity consumption growth by these countries is mainly explained by estimation of gross domestic product, population growth and increase in life level.

Growth of electric power consumption naturally requires increase in a fixed generating supply (Table 3).

**Table 3.** Dynamics of total fixed electric power supply in the world, (million kilowatt/hour) [3]

1995	1996	1997	1998	2000	2001	2002	2003	2004
2929,0	2982, 5	3060,4	3120,9	3279,5	3392,5	3511,6	3631,5	3726,3

The largest production capacities for electric power production are allocated in the USA (24,1% out of the world fixed supply), China (10,5%), Japan (6,5%), Russia (5,8%), India (3,5%), Germany (3,2%), Canada (3,17%), France (3%).

During nine years from 1995 till 2004 an average annual growth of generating power supply made up 2.7% (Table 1.3).

Thus, there is an obvious tendency of decrease in the growth rates of the fixed power supply in the world.

Taking into account this annual growth of generating power supply (2,7%) we can present a forecast of production capacity in electric power industry (Table 4). The bottom graph of the table illustrates the forecast [4].

**Table 4.** The forecast of the fixed generating power supply of electricity recourses in the world (million kilowatt/hour)

	2005	2010	12015	2020	2025	2030	2035
Our forecast	3819	4335	4850	5366	5881	6397	6912
[4]	3903	4656	4981	5413	5850	6349	7174

Dynamics of electric power production is naturally close to the dynamics of the fixed generating power supply growth [5] (Table 5)

**Table 5.** Dynamics of electric power production (milliard kilowatt/hour) [5]

1995	1996	1997	1998	2000	2001	2002	2003	2004
12624,6	13010,2	13345,6	13681,6	14595,8	14799,8	15342,3	15883,5	16599,1

Leaders in electric power production are the USA (24% of the world production), China (12,5%), Japan (5,9%), Russia (5,3%), India (3,8%), Canada (3,5%), Germany (3,4%), France (3,3%).

**Table 6.** Dynamics of export (a) [6] and import (б) [7] of electricity in the world (milliard kilowatt/hour)

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
a	399,1	418,0	419,6	407,9	446,7	489,5	487,7	516,5	546,6	553,3
б	397,0	420,4	418,6	407,8	445,5	490,0	486,9	519,0	546,0	552,5

Leaders of electric power production are France (12,4% of the world export), Germany (9,2%), Paraguay (8,1%), Canada (6%), Switzerland (5%), Russia (4,9%), Czech Republic (4,4%), the USA(4,1%).

The largest importers of electric power are Germany (8,7%), Italy (8,4%), Brazil (6,8%), the USA (6,2%), Switzerland (5%), Canada (4,1%), the Netherlands (3,9%).

Since a number of primary energy sources is used for electric power produc-

tion, consideration of a certain contribution of each of these sources into the world electric power production is of doubtless interest. Such data are given in Table 7. [8].

**Table 7.** Share of primary resource in milliard kilowatt-hour (A) and in % (B) in the world electric power production

		Oil	Coal	Natural Gas	Renewable Energy Sources	Uranium	Total
2004	A	937,2	6722,8	3230,5	3085,5	2619,2	16595,2
	B	5,7	40,5	19,5	18,6	15,7	100
2010	A	987,9	8073,8	4281,5	3666,2	2722,3	19731,7
	B	5,0	40,9	21,7	18,6	13,8	100
2015	A	1064,8	9378,3	5154,9	3920,6	2972,3	22491,1
	B	4,7	41,7	22,9	17,4	13,3	100
2020	A	1106,2	10711,4	5914,3	4199,4	3255,2	25186,6
	B	4,4	42,5	23,5	16,7	12,9	100
2025	A	1149,1	12101,6	6580,9	4503,8	3472,0	27807,3
	B	4,1	43,5	23,7	16,2	12,5	100
2030	A	1178,3	13649,6	7423,3	4803,9	3618,7	30637,8
	B	3,8	44,5	24,2	15,7	11,8	100

A historical retrospective in the world electric power production is interesting to consider. Combination of primary types of fuel in this sphere during the previous decades changed essentially (even greatly). Coal has always been a dominating fuel. Production of electric power at nuclear stations significantly increased from 1970<sup>th</sup> till the middle of 1980<sup>th</sup>. During 1980<sup>th</sup> and 1990<sup>th</sup> natural gas was a priority for electric power production. From the middle of 1970<sup>th</sup> high world prices for oil stimulated replacement of oil by natural gas and coal at electric power production. Thus, relatively high prices for fossil fuel have recently raised interest to nuclear power and renewable energy sources.

Let us consider a ratio of primary sources at electric power production at present and the forecast for the nearest decades.

It is seen from Table 7 that the oil share in the world electric power production is not large at the moment (less 6%) and is

likely to decrease in the nearest future. It can be easily explained since oil is a too valuable raw material for oil and petrochemical industry to burn it in electric station furnaces and use in diesel-generator sets.

For example, in the Middle East and China electric station power capacity is likely to increase since demand for electric power in these regions surpasses electric power production and industry has to prefer selection of diesel-generator sets to overcome a deficit in energy.

At the moment coal has got the biggest market share in the world electric power production (about 40%) and the situation is likely to remain the same in the future.

Capacity of the world electric power stations used coal is about 30% and increases by 2.2% annually.

Regional differences in coal use for electric power production are mainly stipulated by differences in coal resources of the region. Regions with rich coal resources

have to use coal for electric power production since coal has got a lower energy density and in comparison with oil and natural gas is more rarely used for other purposes.

No wonder that such countries as the USA, China, India and Australia with the largest world coal supply widely use this source (50-80% of electric power).

The share of natural gas in electric power production made 19.5% in 2004 in the world, and it is likely to increase by 24.2% in 2030.

Today capacity of electric power stations used natural gas makes about 20% and in the nearest 20 years will increase by about 2.7% annually. The share of the fixed capacity of the world electric power stations used natural gas will make up 33% in 2030 as compared to 27% in 2004.

Almost half of the total growth of generating power capacity of electric stations used natural gas is the share of European countries. The share of natural gas in this region in electric power production will double and over (from 15% to 39%) from 2004 till 2030. Because of the planned step-by-step cease of nuclear generator use in Belgium, Germany and Sweden and ecological limitation of building of new coal electric power stations, natural gas has got the biggest share on the electricity market in the countries of Economic Cooperation Organization (ECO).

In the USA the share of electric power produced at electric power stations used natural gas is gradually reducing. These electric power stations providing about 50% of the total electric power supply in the USA, will increase its share up to 20% in 2015, and then will decrease it again up to 15% in 2030. This increase is stipulated by construction of new and more efficient electric power stations, while the further decrease is a consequence of a constant rise of the gas price. A similar situation is likely to take place in Asia. In Canada and Mexico capacity of electric power stations used natural gas and electric power production have a stable growth (4.5% annually in Canada and 6.9% annually in Mexico).

Capacity of electric power stations used natural gas is growing most rapidly in Asia (especially in China and India). Natural gas consumption in electric power sector is now growing and will grow on average by 7% annually in China and 7.1% annually in India.

In Asia production of electric power based on the use of natural gas will on average increase by 7.2% annually in comparison with 4.7% annually in the world.

Nuclear power is an important source of electric power in the majority of the world countries. In 2005 16 countries depended on nuclear power since 25% of electric production was provided by nuclear power stations.

In December of 2005 443 nuclear reactors were in operation and 24 were in the process of construction. Construction of a few new electric power stations is planned in Finland, France, Japan, South Korea and the USA. Despite an obvious tendency of reduction of the nuclear energy share in electricity production, it will remain an important electric power source. Production of electric power at nuclear power stations all over the world made 2619.2 milliard kilowatt/hour in 2004 and is likely to increase up to 3618 milliard kilowatt/hour in 2030.

Recently perspectives in nuclear power have grown. Rising prices for fossil fuels, issues of energy supply safety and opportunity of construction of new, cheaper nuclear reactors might foster new capacity of nuclear power as well.

However, perspectives in nuclear power can be limited due to various political and social reasons. This causes a certain doubt concerning its application forecast.

#### References:

1. <http://www.eia.doe.gov/pub/international/iealf/table62.xls>.
2. Energy Information Administration/International Energy Outlook 2006, P. 63. [www.eia.gov/oiaf/ieo/index.html](http://www.eia.gov/oiaf/ieo/index.html).
3. <http://www.eia.doe.gov/pub/international/iealf/table64.xls>.
4. Energy information Administration/International Energy Outlook 2006, P. 163. [www.eia.gov/oiaf/ieo/index.html](http://www.eia.gov/oiaf/ieo/index.html).

5. <http://www.eia.doe.gov/pub/international/iealf/table63.xls>.  
6. <http://www.eia.doe.gov/pub/international/iealf/table3.xls>.

7. <http://www.eia.doe.gov/pub/international/iealf/table1.xls>.  
8. [www.eia.doe.gov/oiaf/ieo/graphic\\_data\\_highlights/html](http://www.eia.doe.gov/oiaf/ieo/graphic_data_highlights/html)