POWER BALANCE OF THE SIBERIAN FEDIRAL DISTRICT: DYNAMICS AND PROSPECTS

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ЭЛЕКТРОБАЛАНС СИБИРСКОГО ФЕДЕРАЛЬНОГО ОКРУГА: ДИНАМИКА И ПЕРСПЕКТИВЫ

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Аннотация

Устойчивость системы электроснабжения в СФО требует, прежде всего, точного прогноза и исследования факторов, связанных с электропотреблением. Сибирский федеральный округ (СФО) располагает своей богатой топливно-энергетической и сырьевой базой. Баланс электрической энергии служит своеобразным зеркалом, отражающим социально-экономический уровень развития территории, в том числе и то, насколько эффективно реализуется политика Государства в области энергосбережения. На наш взгляд, политика энергоэффективности может включать не только введение энергосберегающих технологий, но и добиться более точного прогноза электробаланса СФО.

Abstract

The sustainable system of energy supply in the Siberian Federal District requires first of all accurate forecast and research of the factors relating to energy consumption. The Siberian Federal District (SFD) possesses rich fuel, energy and raw material resources, also being a major supplier of resources to other regions [2]. The balance of electrical energy efficiency (EE) is a partial derivative of the composite energy balance in the SFD considered at the socio-economic level of the territory development, as well as an indicator of effectiveness concerning the implementation of the State policy in the field of energy conservation. The most significant factor affecting power consumption is the ***gross regional product*** *(GRP) and capacitance of GRP. Mining and manufacturing industries are characterized by the production of electrical capacitance. Following the scenario of Russia's social and economic development till 2030, some research of changes relating to the dynamics of the GRP has been done by modifying its structure. Also the paper offers approximate forecast concerning electric capacity by 2020 in comparable prices. So with 18% decrease, capacitance will decrease by 13%, not affecting the GRP trend. In our opinion, the policy of energy efficiency may not only include introduction of energy-saving technologies, but bring about a more accurate forecast analysis of the SFD electric balance.*

Introduction

Issues of energy management and energy efficiency are of high importance in the world. Siberian Federal District (SFD) possesses fuel, energy and raw material recourses, satisfying not only own needs for fuel and energy resources (FER), but also being a major supplier to other regions.

The Balance of electrical energy efficiency (EE) is a partial derivative of the composite energy balance in SFD considered in [1, 2] and of the socio-economic level of development of the territory, as well as an indicator of effectiveness concerning the implementation of the State policy in the field of energy conservation [2].

Adoption in 2008 of the Presidential Decree number 889, and in 2009 the Federal Law number 261 was the impetus for the development of long-term programs in the area of energy efficiency. [1] The main indicators of energy efficiency in accordance with the legislation are: the combined energy balance, private energy balances, indicators of socio-economic development, energy and electricity production unit of gross regional product, the consumption of energy resources and energy efficiency per capita.

Despite the fact that all developed the paralysis of energy efficiency compared to 2009, the authors in this paper use statistical data from 2000, as a large selection enables more correct predictions for the future, improving the accuracy of the models and conclusions [1].

Energy Efficiency Indicators

SFD is one of the few districts of Russia, which is almost self-sufficient in energy efficiency of its own production, 96% of which goes to power plants and hydro [3]. During the time, the production of EE at SFD increased by 6%, and consumption by 13%.

The most significant factor affecting power consumption is the gross regional product (GRP), its structure and the possibility of changes in the future. Thus, in the current circumstances manufacture GRP SFD data regarding 2000 increased by 7.3 times. 66% generated GRP accounts for the Krasnoyarsk Territory, Irkutsk, Kemerovo, Novosibirsk region. In the industrial structure it is dominated by the GRP manufacturing (21%), transport and communications (13%), wholesale and retail trade (13%), organizations that work with real estate and public administration (15%), extractive industries (10%).

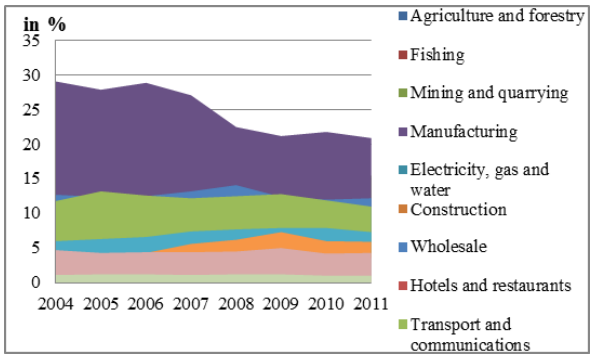

Fig.1 Structural Dynamics of GRP under comparable conditions relative to 2000

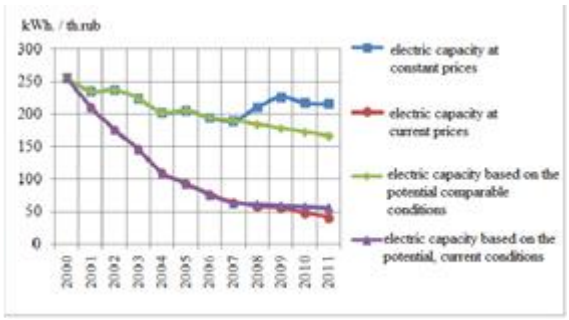

Fig.3. GRP electricity intensity in current and comparable conditions with and without the energy saving potential

Fig. 1 shows that the share of economic activity is really creating products in values of 66-69%. Depending Graphs shown in Fig. 2 show the natural decline of electrical capacity in the current environment.

Fig. 3 shows us that in comparable prices GRP electricity intensity in 2011 were 216 kWh / thousand rubles, which are 40 kWh / thousand rubles less than 2000. Reduction occurs mainly due to changes in the structure of GRP toward non-energy activities. If you save electricity consumption trends observed in the SFD in the near future can be estimated using the equation obtained in the program STATISTICA (1).

$$W'_{GRP} = 2230{,}1409 \cdot x - 4{,}2868 \cdot 10^6 \text{, mln. kWh} \quad (1)$$

Taking into account the implementation of energy-saving electric capacity assigned by 2020 it should reach 114 kWh / thousand rubles. In accordance with the state program of energy saving potential it is supposed to achieve this by raising extra budgetary sources and further reduce the proportion of non-energy activities in GRP. Equation takes the form (2):

$$W_{GRP}^{'} = -2604,9007 \cdot x + 5,3973 \cdot 10^{6} \text{, mln. kWh.} \quad (2)$$

What changes in the pattern of capacitance by type of economic activity will occur in the future, we cannot say now, because there is no forecast of socio-economic development of the SFO until 2020. In 2011 values of electric capacity FEA have reached the following rates (Table 1) [4].

Table 1.

Electric capacity production by economic activity

Economic activities	kWh / thousand rub.
Extractive industries	59.1
Manufacturing industries	79.7
Production, distribution, energy efficiency, gas, water	17.2
Construction	2.2
Agriculture and forestry	3.3
Transport and communications	18.4
Others	17

Mining and manufacturing industries (Table 1) are characterized by the production of electrical capacitance; therefore, search for the major reserves of energy savings should start with them [4].

Conventionally, all economic activities can be divided into creating the means of production and creating consumer goods. [3] That is, the end user of direct and indirect products of economic activities is the population. Purchasing consumer goods, the population pays electrical component in the cost of production at unregulated prices for industrial consumers. Consuming energy in households, the population pays its regulated prices approved by the Departments of tariff regulation or the Regional Energy Commissions [5].

Table 2

Population

	2000	……	2010	2011
Per capita income, thousand	1933	…	15007	16568
Per capita consumption of EE kWh	958	…	1174	1282
Abundance, thousand	20333	…	19252	19261

In Siberia there is a stable trend of decrease of population alongside with rising consumption of electric energy (EE) (Table 2). To explain the increase in per capita consumption of energy efficiency on the background of ever-increasing rates is possible only against the background of the welfare of citizens.

In terms of implementation of energy saving policy population - the most severe category of consumers and the state is looking for incentives, for example - the social norm of consumption of electricity for the population. On the other hand, it is a hidden increase in tariffs for the population.

While maintaining the existing trends we obtain the following equation forecast relating to electricity consumption for this group (3)

$$W_P = 68,3287 \cdot x^2 - 2,7362 \cdot 10^5 \cdot x + 2,7394 \cdot 10^8 \text{,mln. kWh} \quad (3)$$

On average, the increase in SFD equal to 1500 rubles per capita income will increase consumption of electric energy corresponding to 100 kWh per year.

Consumer power balance part will consist of the sum of two units

$$W = W_{GRP} + W_P, \ mln\ kWh. \quad (4)$$

In the current situation, when frequent accidents occur at electric power facilities, there is a growing need to replace power equipment. The cost of production of fossil energy resources dominates in the share of the

energy balance, as a result, the importance of planning and forecasting electric balance on territories is on par with the state policy to improve energy efficiency of the country.

So, following the scenario of social and economic development of the 2030 Russia:

1. Production of the GRP should increase to 45% the year; (2007 = 100%)
2. Electric capacity should decrease in 2020 by 18%; (2010 = 100%)
3. The share of consumption EE should decrease by 20% by 2020; (2010 = 100%)

The authors study changes relating to the dynamics of the GRP, by changing its structure.

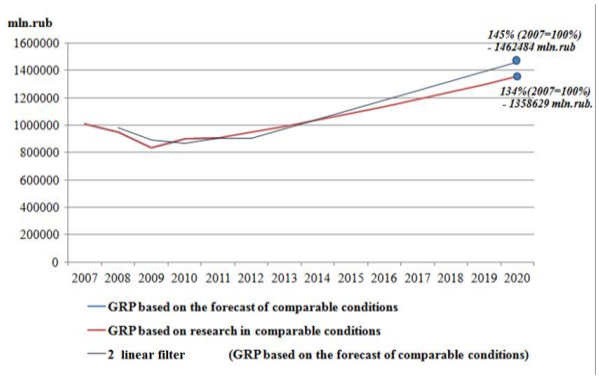

Fig.4. Study dynamics GRP SFD in the future from 2011 to 2020

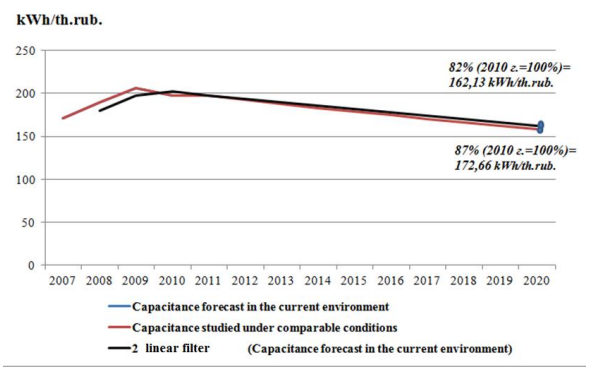

Fig.5. Study the dynamics of electric capacity (EC) GRP SFD in the future from 2011 to 2020

We can see that there is no effect on the GRP value. Thus: with the increase of non-energy sectors (Agriculture and forestry, Transport and Communications, Building) from 2011 to 2020 and decreasing share of energy from 2018-2020 (mining, manufacturing, production quantity and distribution of EE), the share of GRP SFD continues to grow and the final year in comparable terms increased by 34%.

Also approximate electric capacity forecast 2020 has been implemented in comparable prices. With proper decrease of 18%, capacitance decreased of 13%.

Conclusion

The plan may include energy efficiency:

1. Introduction of energy-saving technologies that will reduce the burden on the economy due to lower energy consumption and reduce the cost of production
2. Qualitative and accurate planning and forecasting, power balances;
3. Implementation of innovative programs, as well as the introduction of new energy facilities and replacement of the existing outdated equipment.

References

1. G.N. Klimova, V.V. Litvak, Seven and seven key issues of energy conservation, Publishing Red flag, Tomsk, 2013.

2. G.N. Klimova, The role of energy balance in the energy efficiency program Tomsk region, Bulletin of the Tomsk Polytechnic University. 308 (2005) 232-236.

3. G.N. Klimova, V.V. Litvak, M. Y. Jaworski, An estimate of the energy needs of the region's population, Resources regions of Russia. 5 (2004) 20-24.

4. Information on http://gks.ru.

5. Information on Siberian Federal District http://loi.sscc.ru/bdm/nso/attr/sfo/sfo.htm4.