POWER BALANCE RESEARCH: FORECAST BASED ON THE STRATEGIK INDICATORS OF SOCIO-ECONOMIC DEVELOPMENT OF SIBERIA UNTIL 2020

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ИССЛЕДОВАНИЕ ЭЛЕКТРОБАЛАНСА СФО: ПРОГНОЗ НА ОСНОВЕ СТРАТЕГИЧЕСКИХ ПОКАЗАТЕЛЕЙ СОЦИАЛЬНО-ЭКОНОМИЧЕСКОГО РАЗВИТИЯ СИБИРИ ДО 2020г.

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Аннотация

Произведен прогноз потребления электроэнергии (ЭЭ) населением, видами экономической деятельности и в целом по территории с целью планирования развития территории и прогноза социально-экономических показателей методом регрессионного анализа данных. Оценка проделана на основе среднесрочного прогноза статистических показателей при помощи прикладного пакета STATISTICA в текущих и сопоставимых условиях до 2020г. методами линейной регрессии.

Siberia Federal District (SFD) electric balance research and electric consumer forecasting allows you not only to identify energy saving potential and energy efficiency, but to identify the main directions of increasing efficiency.

Following this, regional planning and forecasting is necessary to ensure an integrated and more effective socio-economic development of the region.

The implementation of the energy saving potential is impossible without considering the territorial specificity: the climatic conditions, the energy consumption structure, sociodemographic factors, etc.

The aim is power consumption (PC) forecasting of the population and economic activities (EA) using of regression analysis methods in the STATISTICA program.

The correlation coefficient allows to make a quantitative characterization of communication degree. It is impossible to predict what the average is equal to the value of one sign for a given value of another sign. Regression analysis allows to solve this problem. As dependent variables we use the following indicators of electricity:

The basic equation for further transformations is (1):

Table 1

№ (N_D)	**Dependent variables N_D, mln.kWh**	**Independent variables (N_{ind})**	
1	Power consumption areas (in general)	$t_{time} = \{2000 - 2020\}$	
	Including:		
2	PC of the population, **mln.kWh**	Population (th.people)	$t_{time} = \{2000 - 2020\}$
3	PC of economic activities (EA) , **mln.kWh**	(Gross regional product in the SFD, **mln.rub**.)	$t_{time} = \{2000 - 2020\}$
4	Specific PC of the population (**kWh / person. in year***)*	Incomes average per capita (**rub.)**	$t_{time} = \{2000 - 2020\}$

The basic equation for further change is given by (1):

$$W_{EA} = W_{\sum} + W_P \ , \tag{1}$$

where (kWh) - power consumption of all kinds of economic activities.

In recent years, much attention is given to the per capita electric consumption research.

This interest is connected with looking for new people motivate ways to increase electric consumption energy efficiency in the home, approach developing to an objective social electric consumption norms assessment, etc.

For this case, when the variables show the nonlinear nature of the relationship, the program offers the raw data transformation ($log\ y = b\ log\ x + log\ a$), which allows you to transfer them to another scale of measurement and thus "equalize" the non-linear relationship between the signs. High dependence guarantee of variables and data accurate forecast can be provide by the following parameters of regression analysis methods.

Regression Summary for Dependent Variable: млн.кВтч.Население (Spreadsheet1)
R= ,89588589 R?= ,80261153 Adjusted R?= ,78616249
F(1,12)=48,794 p<,00001 Std.Error of estimate: 1259,4

N=14	Beta	Std.Err. of Beta	B	Std.Err. of B	t(12)	p-level
Intercept			-1149152	167542,9	-6,85885	0,000018
Var1	0,895886	0,128254	583	83,5	6,98526	0,000015

Fig.1. Regression analysis of population electric consumption results.

1) Dependent: the name of the dependent variable;

2) the number of observations;

3) Intercept: the value of the constant term of the regression equation;

4) Std. Err. Of Beta = 0,1: the constant term standard error of the regression equation;

5): The determination coefficient, which determines the rate in the regression analysis, which reflects the quality of the calculated regression, showing the proportion (%) of the total spread of sample points. It turns out that 80% of the variance of the dependent variable (population, thousand people) is due to the variation of the independent variable (EP population, kWh), which is insufficient at this stage.

6) standardized regression coefficient; We see that 89% of the dependent variable value determined by the values of the independent variable (Fig. 1).

7) One of the most important columns in the table because it contains exactly the desired values of the regression equation constant term (2):

$$W_{Pop} = 583 \cdot N_{time} - 1149152 \tag{2}$$

8) $p - leve\ l = 0,000015$ - the probability of error for the null hypothesis of zero coefficients equality (to be P << 0,001).

As a result, two significant coefficients $R^2 = 80\%$ и $p - level = 0,000015$ are also statistically differ from 0.

The built regression model describes the relationship between population and consumption. Linear regression analysis is applied.

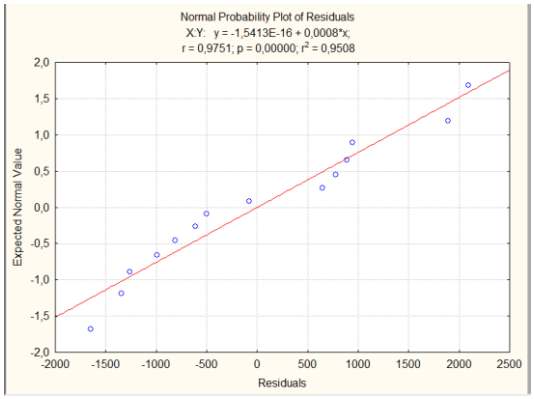

Fig.2. Check result of normality residues distribution

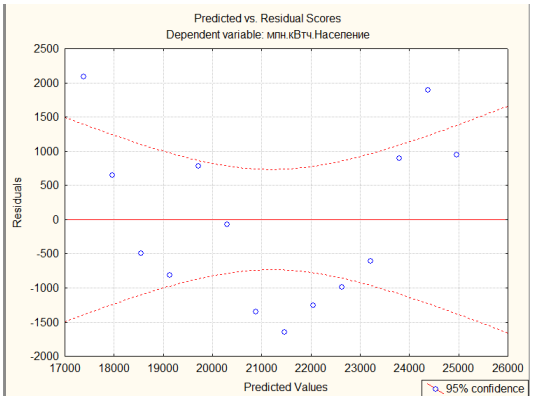

Fig.3. Check result dispersion residues uniformity

Second method: residues regression analysis shows a more precise dependence estimate. *Residues* is difference between the observed values of dependent variable and the values predicted by the regression model.

Points stacked along the theoretically expected straight line quite closely (Fig. 2), the *residues* normally distributed. Linear regression analysis is applied

On the second main condition residues dispersion immutability point on the graph (Fig. 3) are arranged randomly, without showing any regularity. This confirms the linear regression application accuracy.

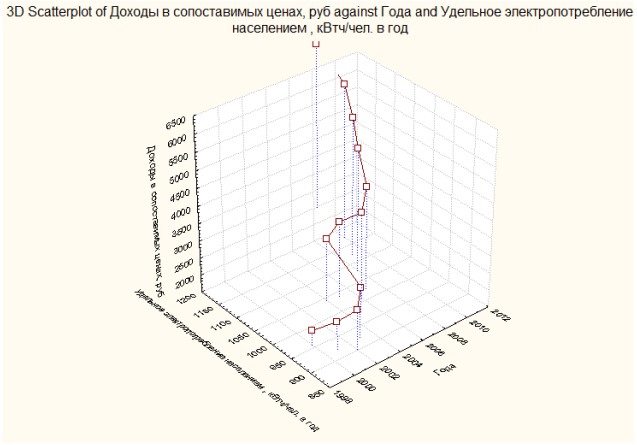

Fig. 4. Schedule 3D-dependence of the scattering of energy consumption (kWh / person. Per year) and per capita income (rub.), 2000 - 2011. In comparable conditions

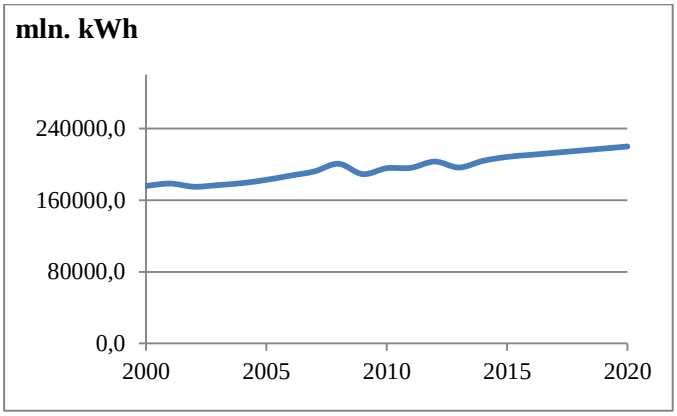

Fig.5. Population electric consumption forecasting of SFD , mln. KWh

Figure 4. shows us real dependence of the variables: p-level = 0,0001. Constructed regression model perfectly describes relationship between the specific population power consumption (kWh / person. per year) and average per capita income (rubles.) (R2 = 83%).

At this stage it is planned medium-term forecasting up to 2020.

The resulting forecasting equation to 2020 provides a deviation in the data retrospective calculation from 2001 in the normally permissible limits (Fig. 5) and it satisfies the condition verification of normal probability and variance of homogeneity remains condition.

Prediction equation population specific energy consumption is given by:

$$N_D = \mathbf{0,0591} N_{inD} - \mathbf{1149152} \quad (3)$$

где N_D – specific population power consumption, N_{inD} – time in years..

Next we will assess the relationship between economic activities energy consumption and gross regional product.

Prediction equation for each variable using with help free coefficients and regression coefficients (B) are have the form:

1. Prediction equation of economic activities energy consumption from 2020 (4):

$$N_D = 2127N_{inD} - 4079845, \quad (4)$$

2. Gross regional product prediction equation in the current prices to 2020 (5):

$$N_D = 385292N_{inD} - 770302606 \quad (5)$$

A high correlation coefficient ($P = 0,88$) allows to make a forecasting with minimum error.

GRP electric capacity is an important energy efficiency indicator of the territory.

Electric capacity will be in 2020 (27.5 and 192 kWh. \ rubles) in current and comparable conditions and in accordance with received electric consumption forecasting.

Conclusion

The level of socio-economic development indication of the territories is per capita income and electricity consumption in per capita terms.

Thus, per capita electric consumption per person for 2013 is 1343.22 kWh / person., and the level of income, in accordance with the planned program of socio-economic development of the Siberian Federal District is 16568 per month. rub. / person.

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