Assessment of technological energy saving potential in the Russian Far East

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In this paper, we assess the technological energy saving potential in the industrial sector of the Russian Far East. The assessment is made by comparing the per-unit energy consumption of various industrial processes with corresponding average and minimum consumption data for other federal districts.

Keywords: **energy saving potential, energy efficiency, Far East**

1. INTRODUCTION

When creating and applying decisions aimed at lowering energy intensity of the economy , an important step is assessment of energy potential. As can be seen from experience of different countries as well as some regions of Russia, consistent and full-scale realization of energy saving potential is not possible without account for regional specifics: climate, structure of energy consumption and supply, etc. The proper assessment of energy saving potential of specific territory is the basis for development of strategies and programs aimed at reduction of energy intensity in all sectors.

The goals of this paper are as follows:

1) Describe the energy intensity indicators for the Russian Far East federal district (FEFD), with comparison to other federal districts and national averages.
2) Give assessment of technological energy saving potential in the industrial sector of the FEFD, based on the intensity data for the most energy-intensive or energy-consuming processes.

2. COMPARATIVE ANALYSIS OF FEFD ENERGY INTENSITY

The FEFD ranks 7th out of 7 federal districts of Russia in GRP (4.5% of GDP of Russia) and in industrial output (4% of national output). The share of industrial energy consumption in the total regional consumption is about 31%.

The FEFD GRP is generally less energy-intensive than other federal districts (table 1), and places 2nd after the Central federal district.

TABLE 1. FEFD GRP ENERGY INTENSITY IN 2005*

Federal District	GRP energy intensity, tce/mln rub	Rank
Central	28.98	1
Far Eastern	39.22	2
Southern	48.15	3
North-Western	53.6	4
Ural	63.45	5
Povolzhsky	76.67	6
Sibir	82.17	7

*the energy intensity calculation implies conversion rates of 0.345 kg ce/kWh for electricity generation and 170 kg ce/Gcal for heat generation
Source: [4]

As for industrial electricity intensity, the FEFD ranks 1st as the least intensive federal district. (table 2). The electricity intensity ofr industrial output in FEFD is about 22.4 kwh, half that of average national intensity.

TABLE 2. ELECTRICITY INTENSITY OF INDUSTRIAL OUTPUT IN RUSSIAN FEDERAL DISTRICTS IN 2006.

Territory	Electricity intensity, kwh/rub	Rank
Russian Federation	43.65	
Central Federal District	22.58	2
North-Western Federal District	31.19	5
Southern Federal District	28.18	4
Privolzhsky Federal District	27.34	3
Ural Federal District	32.58	6
Sibir Federal District	70.55	7
Far Eastern Federal District	22.31	1

Calculated from: [2]

3. ASSESSMENT OF ENERGY SAVING POTENTIAL

2.1. Approaches to assessing the energy saving potential

Depending on the theoretically and practically achievable energy efficiency levels, there are at least three types of energy saving potential described in modern literature: technical (technological) potential, economic potential and market potential [3]. Technological potential can be estimated by theoretical replacing of all equipment with world's best available samples with minimal per-unit energy consumption. This allows to estimate the hypothetical energy saving maximum potential based on real experience. Economic potential is a share of technological potential that is economically profitable to implement when using social criteria for investment decisions. Market potential is a share of economic potential that can be profitably realized by private agents under current market conditions.

In this paper, we estimate the technological energy saving potential in the industrial sector of FEFD, based on the per-unit energy consumption data for various industrial processes. The energy saving potential can be estimated by comparing current energy intensity parameters with corresponding data of other territories. The comparison can be conducted with different types of benchmark data [5],[6]:

- theoretical minimum – minimum possible energy consumption per-unit of output according to laws of thermodynamics;
- practical minimum – world best achieved energy efficiency level, under commercially profitable technologies.
- world average – average energy intensity values in other countries;
- best national intensity values – best achieved energy efficiency levels in the same country;
- average national efficiency level – average per-unit consumption in the country.

2.2. Assessment of technological energy saving potential in the industrial sector of FEFD

The data used for estimation are per-unit energy consumption levels of various industrial processes by federal districts, available in the statistical form 11-TER «Data on fuel, heat and electricity consumption for production of various types of goods and services". The data used for research corresponds to the 2008 year.

For obtaining the results, the 26 energy consumption sectors were chosen. The criteria for choosing these sectors were: high per-unit energy consumption and high share of the sector in the total industry consumption.

The energy saving potential estimation for a federal district was calculated as follows::

$$\Delta = \sum \left(e_i - \tilde{e}_i\right) \times q_i \qquad (1)$$

where e_i –energy consumption kgce per 1 unit of output in sector i.;

$\tilde{e}_i$ - «benchmark» value for per-unit energy показатель consumption in sector i.;

q_i – production output in sector i.

In this paper, the two types of intensity benchmarks were chosen for estimation: average national intensity values, and best national intensity levels.

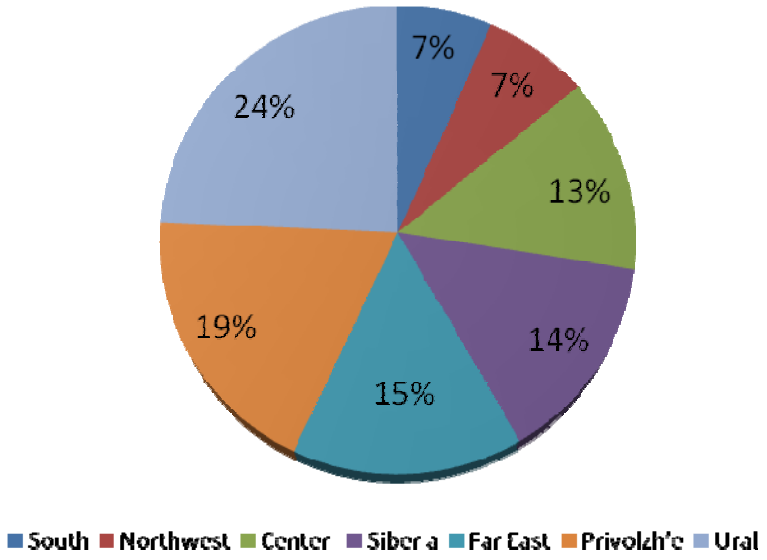

Fig. 1 Distribution of technological energy saving potential of Russian Federation by federal districts, based on average national intensity values (%)

TABLE 3. ESTIMATE OF TECHNOLOGICAL ENERGY SAVING POTENTIAL IN THE INDUSTRIAL SECTOR OF RUSSIAN FEDERAL DISTRICTS

Federal District	**Potential, mln tce**
Central Federal District	3.14
North-Western Federal District	1.72
Southern Federal District	1.57
Privolzhsky Federal District	3.57
Ural Federal District	5.68
Sibir Federal District	3.31
Far Eastern Federal District	3.57

Calculated from:[1]

The biggest energy saving potential seems to be located in the Ural federal district, and the smallest potential belongs to North-Western and Southern federal districts. (table 3).

From the 26 analyzed energy consumption subsectors, in 20 sectors the per-unit energy intensity of FEFD was found to be higher than the national average. Achieving the average national efficiency levels would allow the yearly savings of 0.47 mln tce in the mining and manufacturing sectors (6% from total consumption), 1.9 mln tce in the electricity and heat production sector (9%) and 1.2 mln tce in transport.

Estimation based on the national minimum intensity benchmarks showed the total technological potential of FEFD about 14 mln tce.

In the energy savings potential structure, the biggest shares belong to: railway, electricity generation from fuel, heat generation, fishing fleet. These subsectors add up to 80% of the total energy saving potential. (table 4).

The biggest energy saving potential is in following subsectors: electricity produced by oil generation and Heat produced by boilers.

TABLE 4. ENERGY SAVING POTENTIAL IN THE FEFD SUBSECTORS (TCE)

Subsector	Energy saving potential, tce	Intensity reduction potential, %
Industry (mining and manufacturing)		
Oil production, including gas condensate	36577	22%
Coal conversion (benefication)	26855	96%
Cast iron (excluding thermal processing)	133	21%
Cast steel (excluding thermal processing)	6749	72%
Timber harvesting	53329	51%
Cement	187369	50%
Meat	28510	62%
Bread	27257	44%
Thermal processing of metals	568	71%
Raw sugar processing	30768	50%
Production and distribution of electricity, gas and water		
Electricity produced by oil generation	1015781	11%
Heat produced by power plants	173769	4%
Heat produced by boilers	748136	10%
Electricity generation (diesel power plant)	3463	1%
Water distribution (excluding residential sector)	72674	39%
Sewage water treatment	26119	35%
Transport		
Lifting and construction transport and machinery	71823	23%
Electric Railway	446262	34%
Fishing fleet	615244	82%
Inland water transport	3246	96%

Source: own calculation from [1]

3. ЗАКЛЮЧЕНИЕ

The obtained results lead to the following conclusions.

Russian Far East is not energy intensive region, when compared with other federal districts in terms of GRP intensity and industrial output intensity. For instance, the average per-unit industrial energy consumption in Russia is twice of that in Far East.

Achieving the average national efficiency levels would allow the yearly savings of 0.47 mln tce in the mining and manufacturing sectors (6% from total consumption), 1.9 mln tce in the electricity and heat production sector (9%) and 1.2 mln tce in transport.

4. References

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5. BIOGRAPHY

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