

Expenses for repair works, TR&M programme, RUB mn

	2015	2016	2017	2018 (Plan)
PJSC RusHydro and PJSC RusHydro's controlled companies except RAO ES East Subgroup				
Repair works	3,081	2,748	2,737	2,898
Technical rehabilitation and modernisation	28,560	27,258	27,622	23,008
RAO ES East Subgroup				
Repair works	11,227	11,568	12,693	12,993
Technical rehabilitation and modernisation	6,218	7,142	7,729	12,523

In 2018, Rushydro Group planned the increase of installed capacity of PJSC RusHydro by 46.5 MW with help of technical rehabilitation of hydropower facilities:

- Changing hydroturbines - 7 pcs;
- Changing hydrogenerators - 5 pcs;
- Constructing gas-insulated 500 kV switchgear.

ENERGY EFFICIENCY AND ENERGY SAVING

The main shareholder PJSC RusHydro, Russian Federation, challenges energy companies to increase energy security and reduce power consumption. In accordance with the state programme "Energy efficiency and power development", approved by the Decree of the Government of the Russian Federation of April 15, 2014 No. 321, there are three main directions for improving energy efficiency in the use of all types of energy resources:

- energy efficiency;
- development and modernization of electrical power;
- development of the use of renewable energy sources.

Energy efficiency of hydropower

Hydropower is one of the main branches of the electrical power industry, providing a significant contribution to energy production. At the same time, hydropower is the most economically efficient and environmentally safe industry. Hydropower plants have their own peculiar features that require a special approach to the assessment

of energy efficiency and finding ways increase of energy efficiency. Hydropower plants, in addition to power generation, carry out a number of functions, which are critically necessary both for the energy industry and for the life of large groups of the population. These include the hydrotechnical problems of river flow regulation, flood prevention, irrigation of agricultural lands, automobile and railroad transportation across rivers as well as shipping.

In this connection, the hydroelectric power plants may be subject to requirements, sometimes diametrically opposed, which significantly complicates the analysis of their functioning. For example, a discharge of water reduces the overall energy efficiency of the HPP, but it provides a vital drainage of the river, and the operation of the hydrogenerator in the synchronous compensator mode reduces the overall efficiency of the HPP, but ensures the stability of the energy system as a whole.

Due to the lack of consumption of any fuel for the production of electricity, the analysis of energy efficiency of hydropower plants excluded this main cost item, inherent in other types of power plants, with the exception of renewable energy sources. Therefore, the main subject of analysis is its own consumption of power plants.

The main directions of energy efficiency improvement in PJSC RusHydro:

- modernization of internal and external, working and emergency lighting systems (partially with automated control);
- modernization of ventilation and air conditioning systems of main and auxiliary buildings of HPP (including the introduction of weather regulation);
- reconstruction of heated buildings and structures, elimination of leaks of warm air, reduction of the degree of infiltration of premises;
- reconstruction of heating and hot water supply systems, electro-boiler houses, modernization of pumping stations, elevators (with the replacement of mechanisms, with the use of variable frequency drives);
- replacement of hydraulic units with higher output coefficient; modernization of automatic control systems of hydraulic units and excitation systems of generators;
- modernization and reconstruction of hydraulic structures, including working and emergency-repair shutters, phased reconstruction of knots and sections of water intakes, and industrial water disposal;
- replacement of power transformers with energy-saving analogues, replacement of air circuit breakers with transition to gas-insulated circuit breakers (considering the withdrawal from compressor operations).

Energy saving and efficiency programme

In 2015 PJSC RusHydro approved the Programme of energy saving and increased energy efficiency (hereinafter, - ESEEP) for the period of up to 2020, which contains a list of the main works on increasing the efficiency of energy and water resources use, as well as a number of priority energy-saving solutions. In 2017, the programme was updated on the results of the review in Ministry of Energy of Russia in connection with the changed requirements of legal acts. The updated programme was compiled according to the results of an energy audit, held in the period of 2010-2016. [103-2], [103-3]

The overall effect of the energy efficiency measures of PJSC RusHydro in 2017 was 114.6 mn kWh, equivalent to 38,964 tonnes of reference fuel

For the year of 2017 the implementation of ESEEP contributed to energy savings on consumption for own needs of 40,816 kWh, additional output from the implementation of measures was 73,785 thousand kWh.

Due to the selection of the optimal equipment, the optimization of the repair company, the operation of hydroelectric power plants at heads higher than average annual values and the reduction of idle water discharges by redistributing the reserves of automatic secondary regulation to other hydroelectric power stations of the cascade, additional generation of electric power of 750 million kWh is ensured.

As part of the implementation of the system of planning of regimes at HPP, tests and acceptance tests of all modules (medium and short-term planning) of the IS Dispatch Center-2 were carried out. As a result, it was decided the system was fully ready for the procedure for acceptance of IS and its launch into commercial operation.

According to the results of 2017, RusHydro Group (without RAO ES East Subgroup) spent 503 million rubles on energy saving, and 7,017 million rubles on power efficiency.

In accordance with the schedule of energy inspections of branches in PJSC RusHydro in 2017, energy audits of twenty sites of Dagestan, Kabardino-Balkaria, Karachaevo-Cherkesiya branches and three facilities of PJSC Kolymaenergo were carried out. For all branches and controlled companies on which the energy audit was conducted, energy passports (specifications), energy saving and energy efficiency programmes were developed, reports with recommendations were prepared.

Own consumption

Volume of own consumption by the types of energy resources of RusHydro Group without RAO ES East Subgroup

Type of energy resource	2015	2016	2017	
			thousand rubles	
Heat, Gcal	429,026	426,100	419,260	71,659
Electrical energy, MWh	1,396,343	1,503,246	1,457,409	1,049,511
Gasoline for automobiles, l	424,143	389,018	447,458	16,027
Diesel fuel, l	1,762,854	1,249,619	1,559,797	57,702
Natural gas, m ³	58,716	40,241	39,700	186

Specific energy consumption by RusHydro Group without RAO ES East Subgroup

Company Name	Power generation, thousand kWh	Own consumption, thousand kWh	Specific weight of own consumption in annual output, %
2015	93,100,233.74	1,396,343.08	1.5
PJSC RusHydro	77,406,430.00	1,207,480.83	1.6
JSC Geotherm	409,672.00	33,267.00	8.1
JSC Pauzhetskaya GeoPP	42,262.74	7,484.48	17.7
PJSC Kolymaenergo	1,672,764.00	53,916.00	3.2
PJSC KamGEK	38,954.00	1,172.00	3.0
CJSC MEK	453,375.00	10,108.85	2.2
PJSC Boguchanskaya HPP	13,076,766.00	82,913.92	0.6
2016	106,800,700.86	1,493,944.32	1.4
PJSC RusHydro	90,279,428.08	1,292,184.31	1.4
JSC Geotherm	400,199.00	33,748.00	8.4
JSC Pauzhetskaya GeoPP	43,109.31	7,506.21	17.4
PJSC Kolymaenergo	1,663,482.00	50,672.00	3.0
PJSC KamGEK	39,405.00	1,531.00	3.9
CJSC MEK	405,464.00	10,548.59	2.6
PJSC Boguchanskaya HPP	13,969,613.47	97,754.21	0.7
2017	107,121,497.65	1,449,155.15	1.35
PJSC RusHydro	91,146,260.29	1,258,712.39	1.4
JSC Geotherm	392,056.00	32,601.00	8.3
JSC Pauzhetskaya GeoPP	43,920.05	7,874.49	17.9
PJSC Kolymaenergo	1,747,610.00	50,344.00	2.9
PJSC KamGEK	38,225.00	1,282.00	3.4
CJSC MEK	466,021.00	10,284.47	2.2
PJSC Boguchanskaya HPP	13,287,405.31	88,056.81	0.7

Results of Activities

Volume of own consumption by types of energy resources by RAO ES East Subgroup [302-1]

Fuel consumption	Volume of consumption in natural terms			Volume of specific consumption per unit of generated energy		
	2015	2016	2017	2015	2016	2017
non-renewable sources						
Power consumption, mn kWh	4,647.66	4,543.87	4,553.48	0.137	0.143	0.139
Consumption of thermal energy, thousand Gcal	646.55	627.56	623.43	0.021	0.020	0.021
Coal, thousand tonnes	17,341.65	16,284.68	16,765.01			
Fuel oil, thousand tonnes	102.01	101.86	107.95			
Other fuel, thousand tonnes, including diesel fuel, kerosene, firewood	126.60	128.74	126.74	385.39 ^{1/} 160.748 ²	385.319 ^{1/} 161.216 ²	385.174 ^{1/} 159.867 ²
Natural gas, mn m ³	5,300.74	5,068.09	5,125.38			
renewable sources						
Hydropower	15 448 155	16 153 632	16 204 595	6,89	7,03	7,12
Cascade of Viluyskiye HPPs named after E.N. Batenchuk	15 210 000	15 893 000	15 948 000	6,80	6,94	7,03
SHPP on r. Bistraya	238 155	260 632	256 595	45,71	45,09	44,82

Specific costs of conditional fuel by companies on RAO ES East Subgroup [302-3]

Indicator name	2015	2016	2017
Specific consumption of conventional fuel for the release of electrical energy, g/kWh	385.390	385.319	385.174
Specific consumption of conditional fuel for the release of thermal energy, kg/Gcal	160.748	161.216	159.867

In order to increase the level of automation of energy saving activities and increase the power efficiency by the order of PJSC RusHydro from December 13, 2017 No. 872 the chart and roadmap for the replication of typical software on the basis of information management system of energy administration was approved.

In 2017, the energy management system of JSC SENK was implemented in accordance with the requirements of ISO 50001:2011 (GOST R ISO 50001-2012) "Energy management system. Application requirements and guidelines". By order of JSC SENK from April 26, 2017 No. 127 "A" approved 9 system local normative acts.

Indicators of specific consumption of fuel per unit of produced energy include:

¹ Specific consumption of conventional fuel for the release of electrical energy, g/kWh;

² Specific consumption of conditional fuel for the release of thermal energy, kg/Gcal.

The Programme of Energy Saving and Increased Energy Efficiency Activities

Total reduction of energy consumption as a result of the implementation of measures on approved programmes of power saving and increase of energy efficiency of companies of RAO ES East Subgroup in 2017 year was 41,549.8 tonnes of reference fuel.

Main directions of ESEP activities on RAO ES East Subgroup

Main directions of energy conservation measures	Results (effects) in 2017	
	RUB mn	Tonnes of reference fuel
Improvement of technological processes	83.7	18,286.89
Optimization of energy consumption regimes	30.86	5,279.04
Improvement of power supply schemes	1.54	141.78
Reconstruction and modernisation of power plants	46.43	10,842.23
Introduction of new technologies and equipment	4.84	669.09
Improving energy accounting tools and systems	21.11	241.14
Other activities	248.37	6,089.63
Total	436.85	41,549.80

Expenses on measures in accordance with the approved programmes of energy saving and the increase of power efficiency of companies of RAO ES East Subgroup in 2017 were RUB 1,433.6 mn, and the annual economic effect of their implementation was RUB 436.85 mn.

Energy savings by RAO ES East Subgroup [302-4]

Types of energy savings	2015	2016	2017
Gas saving, thou. m ³	752.33	445.60	270.13
Economy of diesel fueltonnes	188.75	6.97	44.79
Economy of different fuels, tonnes of reference fuel	31,848.90	18,045.00	27,466.75
Economy of heat energy, Gcal	39,454.08	19,482.00	27,867.67
Energy saving, thou. kWh	65,307.19	70,610.00	87,150.56

Building a consumer behavior model

All the branches of the company joined the festival of Energy Saving #Togetherbrighter, the main purpose of which was to popularise the culture of careful attitude to nature and demonstrate modern energy-efficient technologies among citizens and different sectors of the Russian economy. Special attention was paid to activities for children and young people: in the framework of the festival, there were excursions to hydro power stations, lessons of ecology and economical attitude to energy resources, contests, and quizzes.

Energy efficiency plans for 2018

In accordance with the decree of PJSC RusHydro of December 13, 2017 No. 873 developed and approved ESEP for the period of 2018-2023, in the framework of which in 2018 it is planned to implement measures to increase efficiency worth RUB 2,518.2 mn, the realization of which will allow to get an annual effect worth RUB 386.85 mn.