# Production and sales

## Key production assets

### Generating facilities

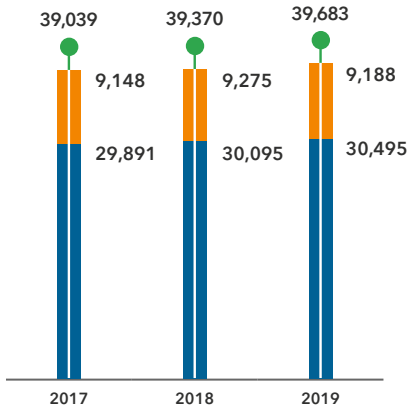
Electricity and heat production is the key business of RusHydro Group. The Group's asset structure includes over 90 renewable energy facilities in Russia, along with some thermal power plants and electrical grid assets in the Far East.

As at January 1, 2020, the installed capacity of RusHydro power plants, including Boguchanskaya HPP, totaled 39,683 MW[1], up 313 MW[2] y-o-y. The installed heat capacity increased to 19,021 Gcal/h, up 97.3 Gcal/h.

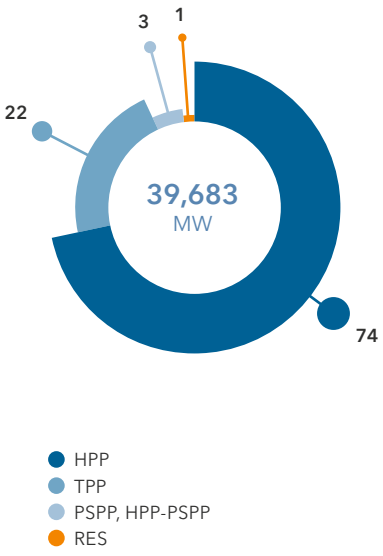
The growth in the installed capacity of the Group's facilities was driven also by the commissioning of Nizhne-Bureyskaya HPP (320 MW) and Sakhalinskaya GRES-2 (120 MW) as well as the implementation of the Comprehensive Modernization Program at Saratovskaya HPP (+12 MW), Novosibirskaya HPP (+10 MW), Votkinskaya HPP (+30 MW) and Zhigulevskaya HPP (+10,5 MW).

The installed capacity structure shows the prevalence of large HPPs generating 29,370 MW[3], or 74.0% of the total installed capacity, while 8,506 MW, or 21.4% of the installed capacity, is generated by the TPPs of RAO ES East Subgroup. The Group's assets also include 1,200 MW Zagorskaya PSPP, 300 MW Zelenchukskaya HPP-PSPP and 16 MW Kubanskaya PSPP. The Group's renewable energy facilities, including SHPP (up to 25 MW), GeoPP, WPP and SPP, account for a total installed capacity of 291 MW.

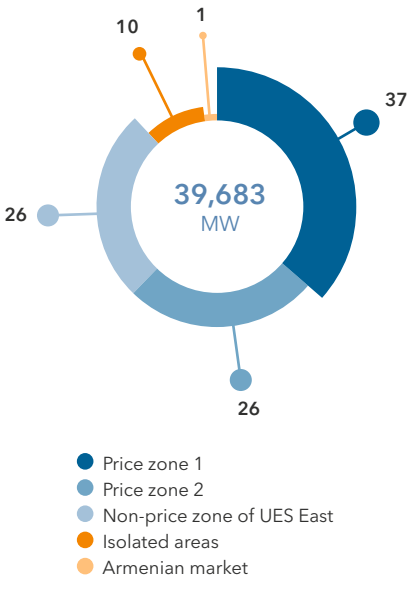
**Installed capacity,** MW




**Installed capacity structure by generation type,** % *[EU1]*




**Installed capacity structure by regulatory treatment,** % *[EU1]*




[1] Including PJSC Boguchanskaya HPP (a joint venture of PJSC RusHydro and RUSAL) and HPP-1, HPP-2 and HPP-3 of PJSC KamGEK, assets held in trust.

[2] Changes related to both commissioning and decommissioning of existing capacities

[3] HPPs with an installed capacity of over 25 MW.

## Electric grid

The businesses of JSC RAO ES East ensure power transmission and distribution both in UES of the East and in isolated energy systems.

As at the end of 2019, the total length of DRSK and PJSC Yakutskenergo transmission power lines in UES East and 35–220 kV isolated energy systems increased by 463 km and reached 35,429 km.

At the end of 2019, the total length of 0.4–10 kV overhead and cable power lines made up 69,592 km, down 190 km y-o-y.

At the end of the reporting period, the total number of transformer substations decreased to 21,953, down 47, with their total capacity hitting 30,514 MVA, up 1,197 MVA. The changes in the length of transmission power lines and in the number and capacity of transformer substations are primarily associated with the housing construction in large cities of the Far East, grid upgrade, and reduction of PJSC Sakhalinenergo grid capacities.

When managed by RusHydro, grid facilities of the Far East, including JSC DRSK, have been demonstrating a robust improvement in both its operating and production performance. Net profit increased from the negative RUB 1 bn in 2012 to RUB 2.7 bn in 2019.

Measures put in place by the Company helped to bring losses down to 7.31% for 2019 (compared to 9.41% in 2007). The target by 2024 is 7.08%, which is considerably below the average across IDGCs that are part of Rosseti Group.

Per unit metrics at JSC DRSK (output per employee of RUB 5,704 thousand per employee and productivity of RUB 3.26 thousand per man-hour) are also significantly above the average Russian levels calculated for IDGCs.

Between 2011 and 2019, JSC DRSK provided utility connections to 92 thousand applicants to the total maximum capacity of 2,716 MW. Since 2016, Far Eastern Hectare, a large-scale program, has been run across the Far Eastern Federal District. As part of the project, JSC DRSK has provided connections to electrical grids for 693 applicants, with another 457 facilities to be connected going forward.

As a result of Yakutskenergo entering the WECM in 2019, RusHydro updated the information on the length of transmission power lines and the number and capacity of transformer substations, provided below.

### Length of overhead and underground transmission power lines by regulatory regime[1], km *[EU4]*

| Grid class | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|
| | WECM | REM | WECM | REM | WECM | REM |
| **Length of transmission power lines** | | | | | | |
| **Overhead power lines** | | | | | | |
| 220 kV | – | 5,179.9 | – | 5,179.9 | 2,041 | 3,241.9 |
| 110 kV | 7,939.7 | 5,903.7 | 7,975.2 | 5,898 | 10,568.8 | 3,482.5 |
| 35 kV | 8,806.9 | 6,997.1 | 8,856 | 6,916.5 | 1,2479 | 3,471.9 |
| **Cable power lines** | | | | | | |
| 110 kV | 40.1 | 1.6 | 40.1 | 4.7 | 41.2 | 4.6 |
| 35 kV | 83.5 | 4.0 | 91.6 | 4.0 | 91.6 | 6.1 |
| **Length of distribution power lines** | | | | | | |
| **Overhead power lines** | | | | | | |
| 6 (10) kV | 20,539.6 | 10,957.3 | 20,621.8 | 11,025.4 | 28,035.4 | 3,596.2 |
| 0.4 kV | 20,531.9 | 11,458.8 | 20,503.1 | 11,677.3 | 28,020.8 | 4,109.2 |
| **Cable power lines** | | | | | | |
| 6 (10) kV | 1,155.7 | 2,040.8 | 1,267.9 | 2,085.8 | 1,880.2 | 1,317.2 |
| 0.4 kV | 1,120.4 | 1,450.7 | 1,119.7 | 1,480.4 | 1,785.6 | 847.2 |
| **Total** | **104,211.7** | | **104,747.4** | | **105,020.4** | |

[1] Measured by chain.

### Number and installed capacity of 6–220 kV transformer substations *[EU4]*

| Metric | Unit | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|---|
| | | WECM | REM | WECM | REM | WECM | REM |
| Number of 220 kV transformer substations | pcs | 1 | 28 | 1 | 27 | 8 | 24 |
| Capacity of 220 kV transformer substations | MVA | 80 | 3,652 | 80 | 3,351 | 1,152 | 3,117 |
| Number of 110 kV transformer substations | pcs | 242 | 140 | 246 | 139 | 317 | 73 |
| Capacity of 110 kV transformer substations | MVA | 7,371 | 4,496 | 7,667 | 4,694 | 10,119 | 2,596 |
| Number of 35 kV transformer substations | pcs | 476 | 383 | 479 | 386 | 656 | 228 |
| Capacity of 35 kV transformer substations | MVA | 4,381 | 1,613 | 4,446 | 1,715 | 4,965 | 1,365 |
| Number of 6 (10) kV transformer substations | pcs | 10,943 | 9,451 | 11,121 | 9,601 | 16,542 | 4,105 |
| Capacity of 6 (10) kV transformer substations | MVA | 3,512 | 3,672 | 3,565 | 3,799 | 5,368 | 1,832 |
| **Total substations** | **pcs** | **21,664** | | **22,000** | | **21,953** | |
| **Total capacity of substations** | **MVA** | **28,777** | | **29,317** | | **30,514** | |

In 2019, total electricity fed to the grids of the Far Eastern Federal District stood at 35,282 mn kWh, up 145 mn kWh y-o-y. The grid losses amounted to 9.8%, up 0,2% y-o-y. The change in relative losses in 2019 was driven by a different operating environment following PJSC Yakutskenergo's accession to WECM – large consumers of Yakutia power grid switched to WECM. This resulted in lower electricity inflow in the Western energy hub of the Republic of Sakha (Yakutia) and PJSC Yakutskenergo, while the absolute losses remained flat y-o-y. *[EU12]*

RusHydro Group regularly implements initiatives to reduce energy losses, including meter testing and replacement, switching to less powerful transformers, installing higher accuracy class equipment, etc.

# Operating performance

## Electricity and heat generation

In 2019, the Group's power generation, including Boguchanskaya HPP, declined by 1.0% y-on-y and amounted to 142.8 bn kWh. According to the System Operator[1] of the Unified Energy System, last year saw the growth in Russia's electricity generation and consumption by 0.9% and 0.4%, respectively. The Group's electricity generation made up 13.0% of the Russian total power generation.

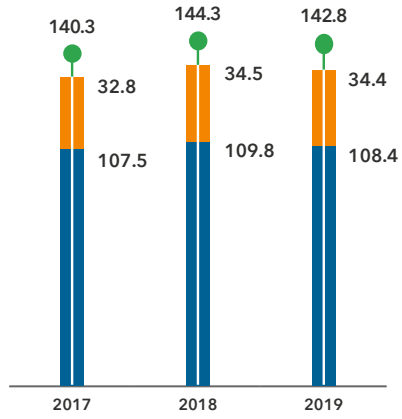
RusHydro Subgroup's electricity generation amounted to 108.4 bn kWh, down 1.3% y-o-y due to a less favorable hydrological situation. In 2019, electricity generation at the Subgroup's Sevan-Hrazdan Cascade HPPs in Armenia grew by 2.9% y-o-y and totaled 0.4 bn kWh.

During the same period, PJSC RAO ES East power plants generated 34.4 bn kWh, down 0.3% y-o-y. The decline was attributable to an increase of generation by PJSC RusHydro HPPs in UES East by 1.2 bn kWh (+10.2%), coupled with a 3.3% total energy consumption increase in the Far Eastern Federal District (to 48.6 bn kWh) and a 0.1 bn kWh decrease in the energy outflow to UES Siberia and China (-2.7%). the heat supply stood at 30.0 mn Gcal.

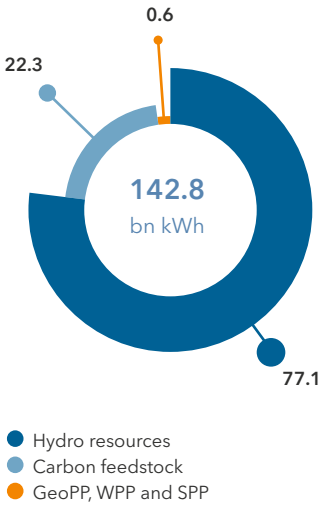
In 2019, the main factors affecting the Group's electricity generation and heat supply included:
- water inflow to reservoirs of Siberia below the previous year's level;
- lower power generation by the TPPs of the Far East due to a higher generation by the PJSC RusHydro HPPs in UES East and higher consumption in the Far East;
- lower energy outflow to UES Siberia and China;
- lower outdoor temperatures.

[1] https://www.so-ups.ru/fileadmin/files/company/reports/disclosure/2020/ups_rep2019.pdf

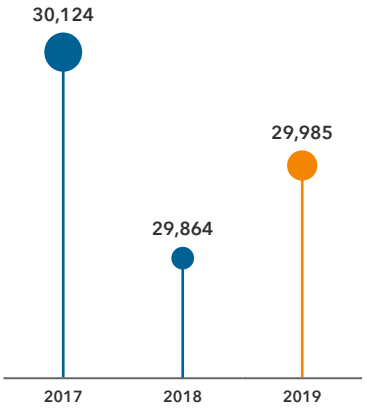
## Electricity generation, bn kWh



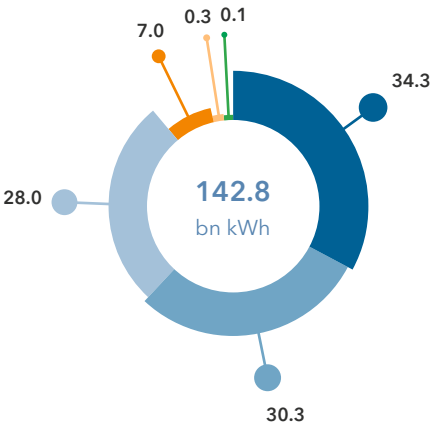

## Generation structure by primary energy source, %



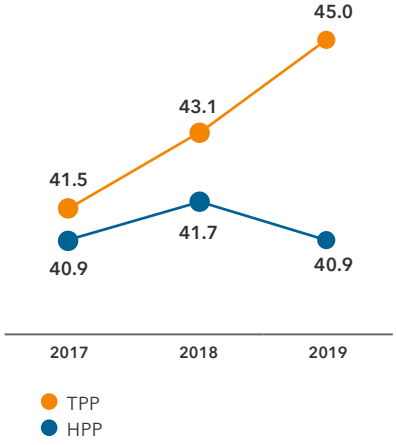

## Heat supply, '000 Gcal




## Generation structure by regulatory regime, % *[EU2]*




## HPP and TPP installed capacity utilization factor (ICUF), %




## Measures for simplifying utility connection to electrical grids *[EU23]*

In 2019, the Group's businesses were involved in implementing the Target Model for "Utility Connection to Electrical Grids" approved by the Russian Government's Decree No. 147-r "On target models for simplifying business procedures and enhancing investment appeal of the Russian regions" dated January 31, 2017 (the "Program").

The project seeks to simplify the procedure for utility connection (the "UC") for legal entities or sole proprietors requesting the power of up to 150 kW with receiver reliability category 2 and 3 (shorter timing, enabling interaction with the grid company via a personal account without a need to visit the client office). The Group's participants in the Program comprise JSC DRSK, PJSC Kamchatskenergo, PJSC Sakhalinenergo, PJSC Magadanenergo, JSC Chukotenergo and PJSC Yakutskenergo.

The Program made it possible to introduce an online service to the energy companies' websites featuring personal accounts for the applicant to interact with the grid company and to make preliminary calculations of the UC cost (UC tariff calculator), apply for a UC, receive a UC contract and sign the necessary UC documents, including their electronic versions.

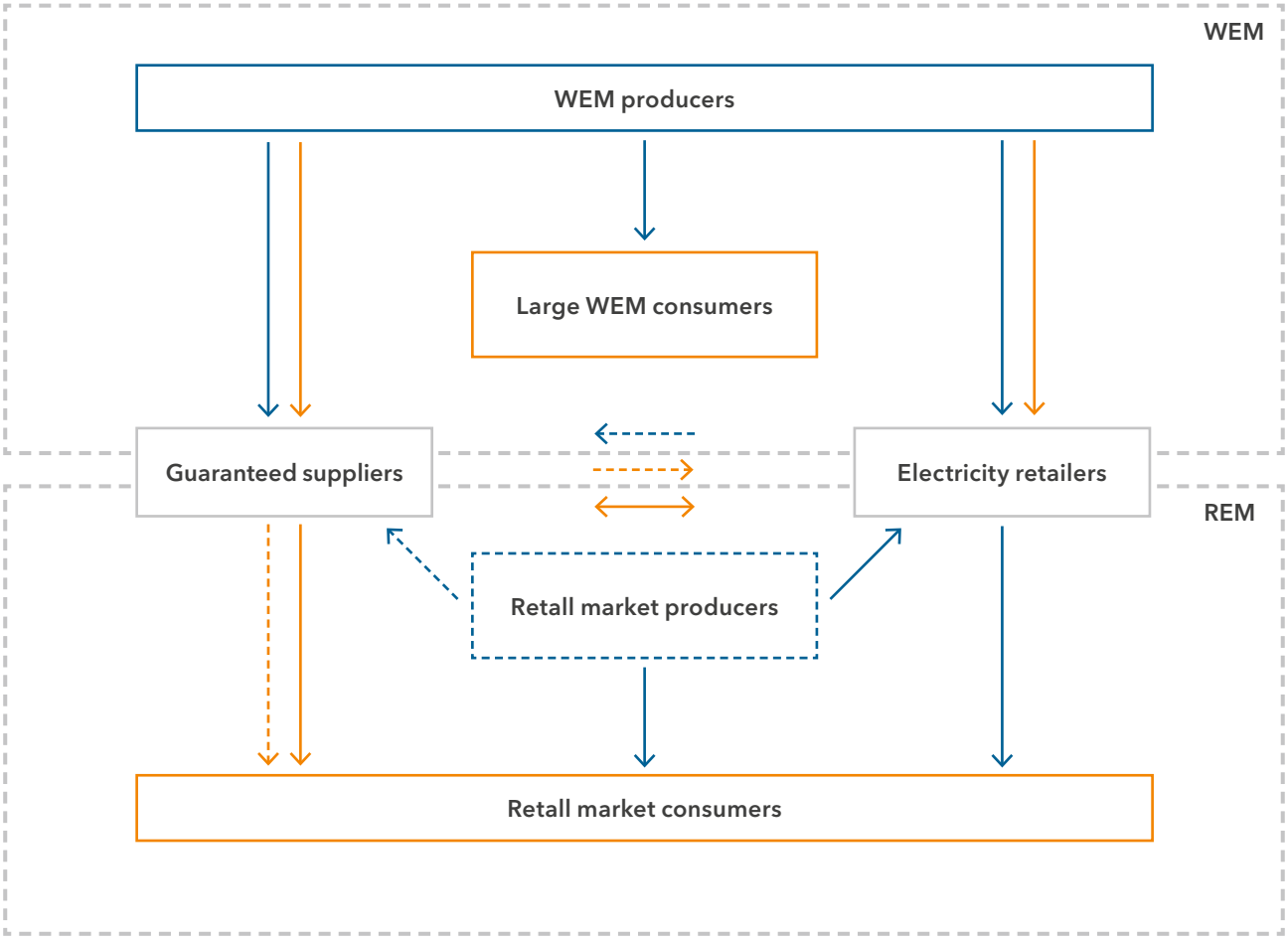
The applications filed by the applicant through the Personal Account differ in their share across regions of the Far Eastern Federal District, with, for example, 1% at JSC Chukotenergo, 22% at JSC DRSK and 48% at PJSC Sakhalinenergo.

# Electricity and heat sales

Efficient electricity and capacity sales in the wholesale market (WEM) and the growing retail business remain among the Group's priorities and have a major impact on its financial performance.

The Group sells electricity in Russia both in the wholesale electricity and capacity market (first and second price zones of the wholesale market and UES East's non-price zone) to major consumers and to retail consumers via its retail companies and guaranteed suppliers.

## Pricing principles on the key markets[1]




Unregulated prices

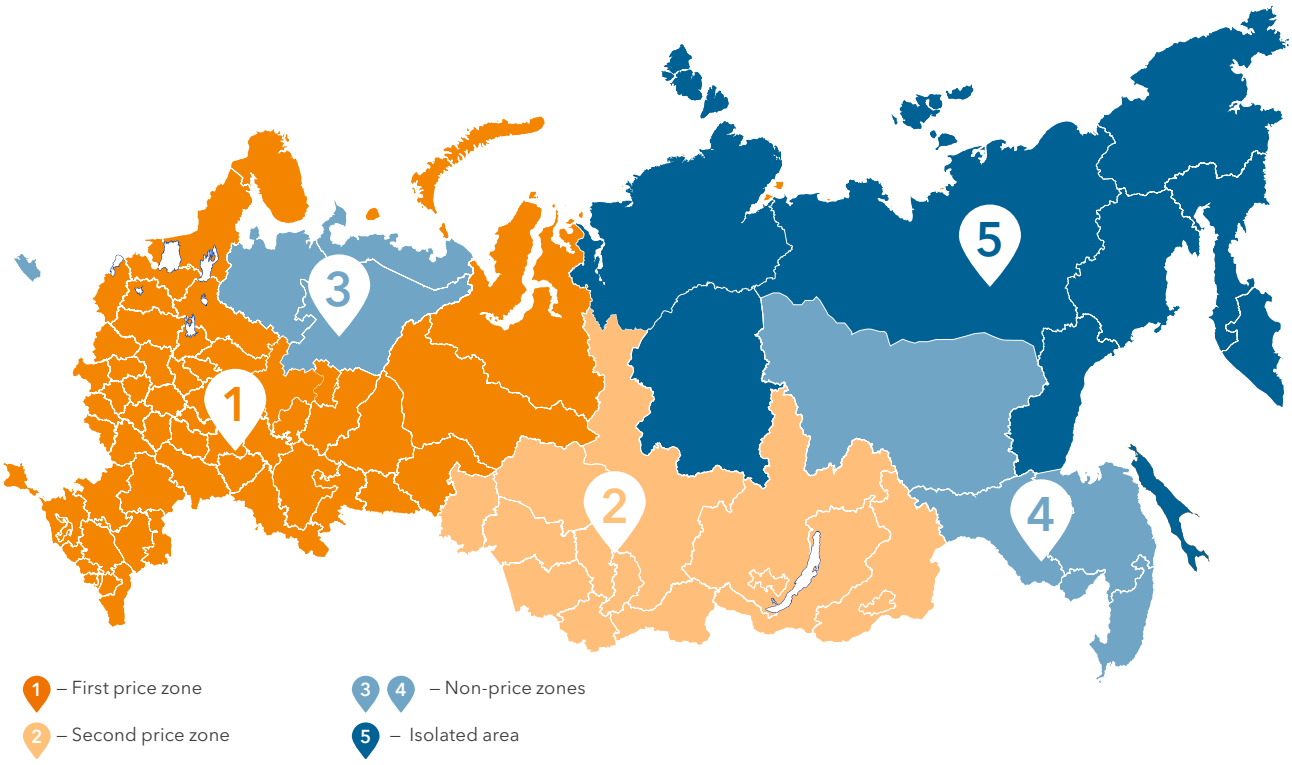
Not higher than WEM prices for GSs

Not higher than maximum unregulated prices[1]

Regulated household prices

[1] Maximum unregulated prices.

## WECM zones




### Performance in the first and second price zones

**WECM sales**
RusHydro directly sells electricity and capacity in the WECM's first and second price zones.

In 2019, total sales dropped y-o-y following a decline in net electricity supply as a result of lower water inflow to the key reservoirs of Siberian HPPs and to the Volga-Kama cascade reservoirs in 1H 2019.

In 2019, the average weighted DAM (day-ahead market) price was RUB 1,287.3 per MWh (+3.2%) for the European part of Russia and RUB 896.4 per MWh (+0.7%) for Siberia.

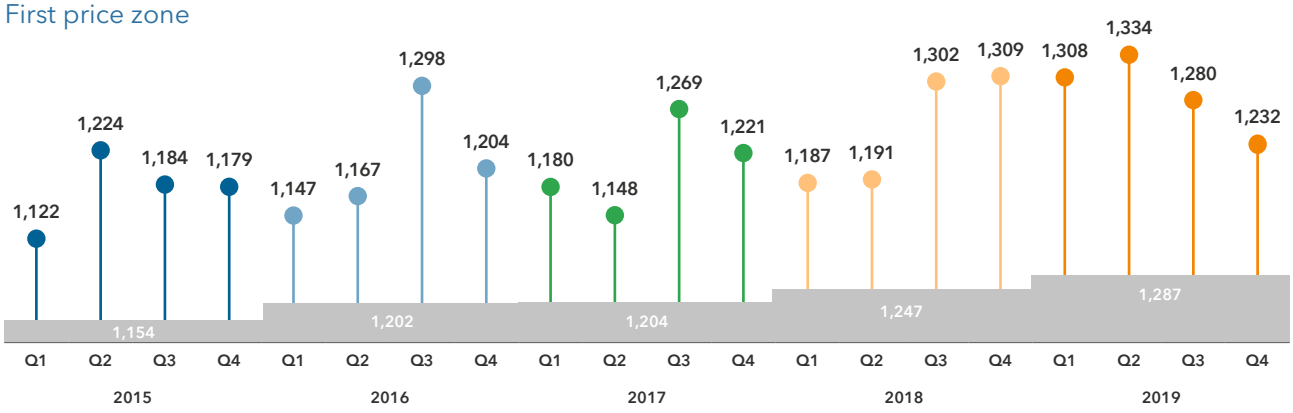
### Net supply of electricity and capacity by RusHydro in the first and second price zones of WECM

| Metric | 2018 | 2019 | 2019/2018, % |
|---|---|---|---|
| Net supply, mn kWh | 91,684 | 87,313 | –4.8 |
| Electricity purchased, mn kWh | 10,116 | 9,716 | –4.0 |
| Total electricity sales, mn kWh | 99,093 | 94,436 | –4.7 |
| Capacity sales, MW[1] | 21,423 | 21,716 | 1.4 |

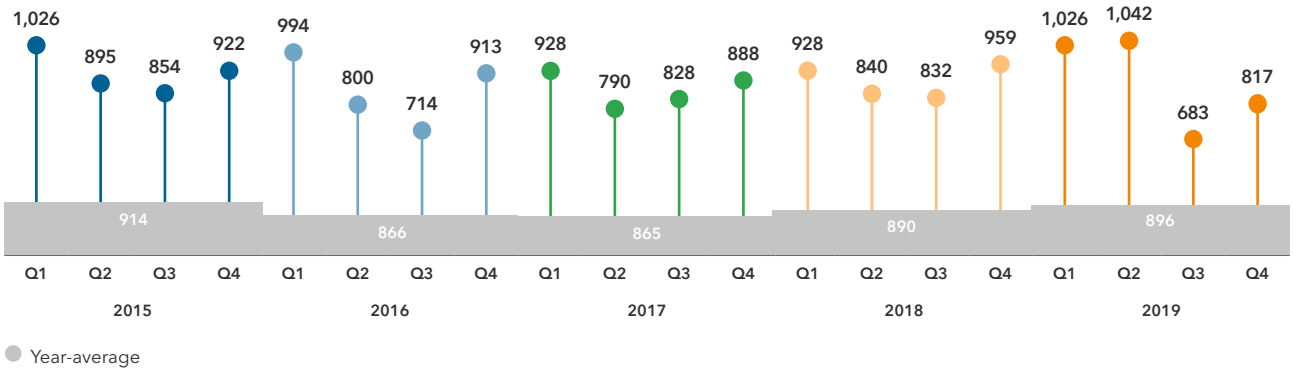
[1] Including Zeyskaya and Bureyskaya HPPs.

## Electricity prices in the first and second price zones, RUB/MWh[1]

### First price zone




### Second price zone




The growth of the DAM price in the first price zone in 2019 (+3.2% y-o-y) was driven by:
- lower HPP output following a decline in hydropower resources;
- higher price bids from suppliers as a result of a 3.4% increase in wholesale gas prices.

The growth of the DAM price in the second price zone in 2019 y-o-y was driven by:
- higher price bids from suppliers as a result of the coal price increase starting 2H 2018;
- lower HPP output (primarily Yenisey cascade HPPs) in May–June 2019;

## RusHydro's electricity and capacity sales prices in the first and second price zones of WECM

| Metric | 2015 | 2016 | 2017 | 2018 | 2019 | 2019/2018, % |
|---|---|---|---|---|---|---|
| Weighted average DAM price, RUB/MWh | 1,096 | 1,080 | 1,094 | 1,114 | 1,107 | -0.6 |
| 1 PZ DAM price, RUB/MWh | 1,207 | 1,267 | 1,224 | 1,285 | 1,298 | 1.0 |
| 2 PZ DAM price, RUB/MWh | 883 | 793 | 824 | 825 | 774 | -6.2 |
| Weighted average KOM price, RUB / MW per month | 127,564 | 139,781 | 580,558 | 783,822 | 725,757 | -7.4 |
| 1 PZ KOM price, RUB / MW per month | 125,524 | 111,628 | 3,212,516 | 4,312,779 | 2,922,353 | -32.2 |
| 2 PZ KOM price, RUB / MW per month | 131,696 | 178,724 | 283,873 | 342,675 | 347,730 | 1.5 |

[1] TSA data.

- restrictions on capacity exchange between parts of the second price zone.

Capacity sales price changes vs 2018 were attributable to the lower surcharge[1] to KOM prices in the WECM price zones.

In 2019, electricity and capacity sales declined y-o-y due to:
- lower capacity price surcharge leading to lower KOM price;
- 4.7% decline in power generation;
- 6.3% decrease in the DAM price in the second price zone.

**REM sales** *[EC]*
REM sales in the first and second price zones are consolidated within ESC RusHydro Subgroup (JSC ESC RusHydro, PJSC Krasnoyarskenergosbyt, PJSC Ryazanenergosbyt, JSC Chuvashskaya Electricity Sales Company). Electricity is supplied both directly by JSC ESC RusHydro and via its retail subsidiaries acting as guaranteed suppliers in three Russian regions.

In 2019, ESC RusHydro Subgroup supplied electricity to 1,952,167 consumers in the retail market, including 1,892,519 households on direct contracts. The number of contracts remains stable across consumer groups, except for households and utility service providers. These groups demonstrate both positive and negative trends. Individual customers grew in number as households started signing direct contracts with RusHydro's subsidiaries under Federal Law No. 59-FZ, while consumers among management companies, condominiums and housing associations shrank as disreputable utility service providers were leaving the market and other management companies were taking over their housing stock. Total sendout of electricity by ESC RusHydro Subgroup amounted to 19,445.8 mn kWh in 2019.

## Performance in non-price and isolated zones of the Far East

Non-price and isolated zones of the Far Eastern Federal District are covered by RAO ES East Subgroup and Bureyskaya and Zeyskaya HPPs.

**Electricity tariffs and supply** *[OS]*
Federal Law No. 35-FZ On Electric Power Industry dated March 26, 2003 outlines the basic principles and methods of state regulation in the electric power industry and the regulators' scope of authority. The basic principles and methods of price (tariff) regulation in the electric power industry and the procedure for setting tariffs are set out in the Russian Government's Resolution No. 1178 On Pricing in the Field of Regulated Prices (Tariffs) for Electric Power dated December 29, 2011.

### Number of households and corporates in service in the first and second price zones *[EU3]*

| Consumer | 2017 | 2018 | 2019 |
|---|---|---|---|
| Manufacturing industry | 2 714 | 2 680 | 2 653 |
| Transport and communications | 1,226 | 1,232 | 1,282 |
| Agriculture | 2,053 | 2,168 | 2,300 |
| State-financed | 7,903 | 7,654 | 6,880 |
| Management companies, condominiums, housing associations, etc. | 2,042 | 1,997 | 2,529 |
| Wholesalers-resellers | 74 | 83 | 98 |
| Housing and utilities | 456 | 456 | 419 |
| Heat suppliers | 124 | 132 | 137 |
| Other | 41,683 | 42,513 | 43,350 |
| Households | 1,779,929 | 1,808,857 | 1,892,519 |
| **Total** | **1,838,204** | **1,867,772[2]** | **1,952,167** |

[1] For more details, see the Tariff adjustment mechanism in the Far East section.

[2] Total accounts were updated from the 2018 annual report to include direct contracts signed in early 2019 with effect from December 2018.

Tariffs for electricity (capacity) supplies in the WECM are set by the FAS in line with a methodology developed by the Federal Tariff Service (FTS)[1].

The primary tariff calculation methodology for generating facilities located in the WECM non-price zone is the one based on indexation. It was approved by FTS Order No. 210-e/1 dated August 28, 2014. The base tariff calculated in 2007 is annually adjusted to factor in the index of changes in semi-fixed costs as determined by the Russian Ministry of Economic Development. The 4.3% deflator index in the 2019 tariff was in line with the PPI (excluding contribution from the energy sector). This methodology is also used for new generating facilities starting from the second year of their operation.

During the first year in the wholesale market, the tariff for generating facilities located in non-price zones is set in line with the guidelines approved by FTS Oder No. 199-e/6 dated September 15, 2006. This methodology determines the economically justified amount of financial resources a company needs to operate at regulated tariffs within a specific regulation period (the return on investments, which is accrued through amortization, is not taken into consideration).

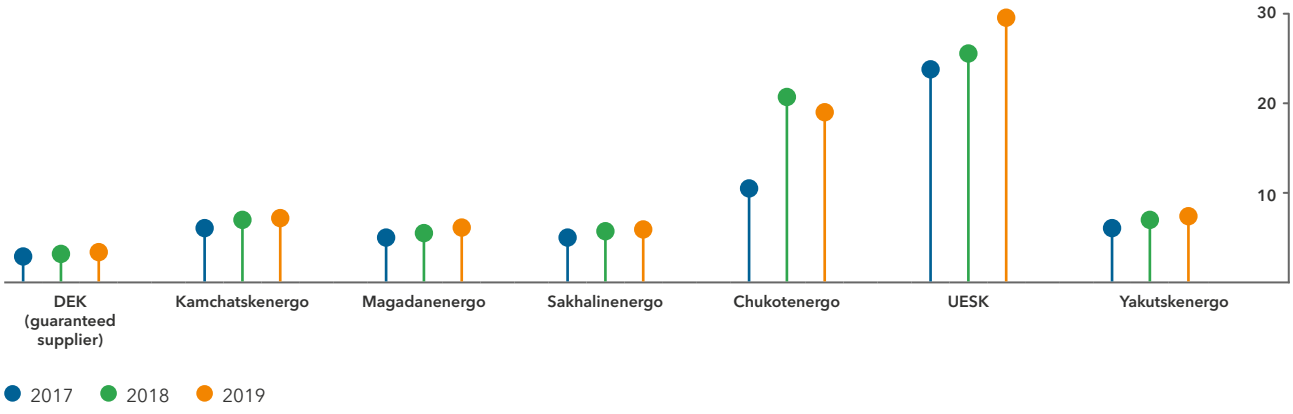
Key WECM tariff drivers in 2019:
- tariff indexation, with the deflator index standing at 4.3%;
- increase in the fees paid for using federal water bodies for the purpose of hydropower generation with no water withdrawal operations in accordance with the Russian Government's Resolution No. 876 dated December 30, 2006[2].

REM sales in isolated zones are covered by RusHydro's subsidiaries which are 100% regulated since there is no free electricity (capacity) market in the region. The REM tariffs for generating facilities operating in isolated zones are set by the regional authorities in charge of tariff regulation based on economically justified expenses approved by FTS Order No. 20-e/2 dated August 6, 2004.

For the purpose of tariff determination in 2019, regulators used the following regulation methods:
- tariffs for DGK electricity (capacity) supplies in the WECM non-price zones (as approved by FAS Order No. 1565/18 dated November 16, 2018) were calculated using the indexation methodology;
- DRSK electricity transmission tariffs for services provided by branches of DRSK – Amur Power System were determined based on the regulatory asset base method (RAB), while tariffs for services provided by Primorsky Krai, Khabarovsk and South-Yakutsk Power Systems as well as Electric Networks of the Jewish Autonomous Region were set using long-term indexation of required gross revenue;
- sales surcharge for PJSC DEK was determined using the comparative method;
- electricity tariffs for end consumers in isolated zones were determined using the method of economically justified expenses.

Since July 1, 2016, numerical tariff values are no longer set for other consumers in the WECM non-price zone. In accordance with the estimated tariff values determined based on indicative prices, the uniform transmission tariff and the sales surcharge approved by the regulator, the tariff increase in the WECM non-price zone ranged from 0.46% to 3.24%.

**Average electricity tariffs in the Far Eastern Federal District,** RUB/MWh




[1] Abolished in 2015 to be succeeded by the Federal Antimonopoly Service of Russia (FAS).

[2] As revised by the Russian Government's Resolution No. 1690 dated December 29, 2017.

In 2019, the overall increase in average electricity tariffs for consumers in isolated energy hubs of the Far Eastern Federal District amounted to 7.6% y-o-y. The smallest increase was registered by Kamchatskenergo (2.8%), while the largest one (16.0%) was delivered by UESK. Chukotenergo reported a tariff decline by 7.8% due to the exclusion of RUB 1,063.0 mn from the required gross revenue in 2019 used to offset the cost of electricity purchased from Bilibino NPP in 2017.

DGK's weighted average electricity prices in the wholesale market rose by 9.6% in 2H 2019 over 1H 2019, while its average annual energy prices in 2019 remained flat at 0.028% y-o-y.

The weighted average energy rate for all of the DGK stations was: RUB 1,315.94 per MWh in 1H 2019 and RUB 1,366.11 per MWh in 2H 2019 (an increase of 3.8% in 2H 2019 over 1H 2019).

The key factors behind changes in the DGK electricity tariff rates in 2H 2019 compared to the rates approved for 2H 2018 included:
- 2019 gas prices under the Consortium-1 project;
- application of growth indices for coal and fuel oil in 2019.

The average DGK capacity tariff rate was RUB 272,829 / MW per month in 1H 2019 and RUB 294,717 / MW per month in 2H 2019 (an increase of 8% over 1H 2019).

**Power transmission tariffs**

In 2019, the branches of JSC DRSK (Primorye Power System, Amur Power System, Khabarovsk Power System, and Electric Networks of the Jewish Autonomous Region (ES EAO)) entered into the second year of the second long-term regulation period. During this period (2018–2022), electricity transmission tariffs for Amur Power System will be regulated using the ROIC method, while tariffs for Primorye Power System, Khabarovsk Power System and Electric Networks of the Jewish Autonomous Region will be set using long-term indexation of required gross revenue.

For South-Yakutsk Power System, 2019 was the first year of the long-term regulation period, with tariffs for 2019–2023 set using the long-term indexation method.

In 2019, DRSK's required gross revenue in power transmission rose by 0.9% y-o-y.

**Tariff subsidization in the Far East**

*[103-2] [EU23] [OS]*

Federal Laws No. 508-FZ dated December 28, 2016 and No. 129-FZ dated June 30, 2017 On Amendments to the Federal Law On Electric Power Industry introduced a surcharge to the capacity price in the first and second price zones, helping to bring tariffs in the Far East down to the Russian base (average) rate.

These amendments provide for a surcharge to be applied to the capacity price in the WECM price zones, with proceeds from the surcharge transferred to the regional budgets of the Far Eastern Federal District in the form of target non-repayable contributions.

As part of the effort to bring electricity (capacity) prices (tariffs) for the Far Eastern consumers other than households to the base rate, the Government issued Decree No. 2739-r dated December 10, 2018 to set the base electricity (capacity) price (tariff) for 2019 at RUB 4.69 per kWh.

As part of the effort to align prices in the Far East with the Russian base rate, the surcharge amount for 2019 was approved by the Russian Government at RUB 32,076.56 mn.

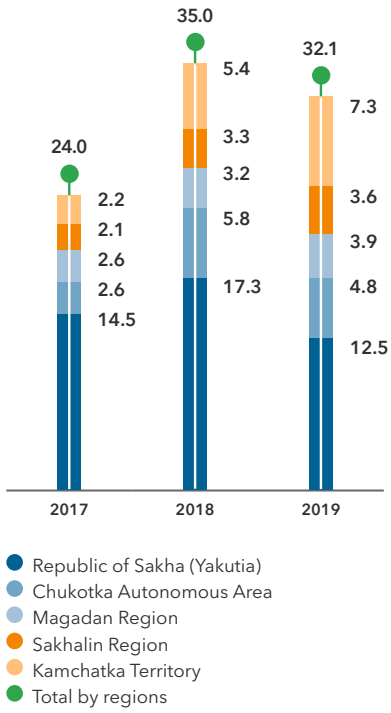
RusHydro and System Operator of the Unified Energy System have successfully partnered for many years, primarily on ensuring that the country's energy system continues stable operation. Our constructive business relationship has also become the foundation for joint work on improving the industry's regulatory framework, developing standardization, and putting in place a youth policy and a number of other activities.

RusHydro employs real professionals whose knowledge, experience, skills, and responsibility help guarantee the reliable and safe operation of existing hydropower plants, as well as the development of hydropower and renewable energy in Russia overall. The RusHydro team's success is the most crucial factor in ensuring a reliable energy supply to Russian consumers and the country's sustainable industrial growth.

**Boris Ayuev,**

*Chairman of the Management Board of JSC SO UES*

### Amount of the surcharge with a breakdown by regions of the Far Eastern Federal District, RUB bn




In 2019, the alignment mechanism was used in five out of nine regions of the Far Eastern Federal District. In all of those regions, the average electricity tariff for consumers was higher than RUB 4.69 per kWh. Tariff reduction does not result in lower revenue, as it is fully offset by government subsidies paid from the budget funds generated by surcharge to the capacity auction rate.

As a result of changes made in tariff regulation, the electricity (capacity) prices (tariffs):
- in the WECM non-price zones are set using the annual indexation method until July 1, 2020 (commencement date of the long-term indexation of required gross revenue, as provided for by the Russian Government's Resolution No. 837 dated June 29, 2019);
- in isolated energy systems are set using the method of economically justified expenses (for 2020 and beyond as provided for by the FAS Order No. 686/19 On Approval of Guidelines for Calculation of Regulated Electricity (Capacity) Prices (Tariffs) in Technologically Isolated Local Energy Systems as well as Areas not Linked to the Unified Energy System of Russia and Technologically Isolated Local Energy Systems except for Electricity (Capacity) Generated by Qualified Generating Facilities dated May 29, 2019, which was developed in pursuance of the Russian Government's Resolution No. 64 dated January 30, 2019; the long-term indexation of required gross revenue to be introduced going forward).

**Electricity sales in non-price and isolated zones**

In 2019, PJSC DEK, acting as the single purchaser in the non-price zone of the Far East's wholesale electricity and capacity market, purchased 36.3 bn kWh. Its commercial purchases of electricity and capacity in the WECM amounted to RUB 62.4 bn in 2019.

Electricity sales stood at 15.9 bn kWh. DEK's commercial sales of electricity and capacity in the WECM came in at RUB 28.6 bn in 2019.

On a y-o-y basis, DEK achieved considerable gains in terms of volumes and cost of electricity (capacity) purchases and sales following the integration of the Central and Western energy hubs of the Republic of Sakha (Yakutia) into the UES of East effective from January 1, 2019. In 2019, local guaranteed suppliers Yakutskenergo and Viluyskaya HPP-3, which used to service isolated energy hubs on their own, started selling electricity in the WECM via DEK as the single purchaser. In 2019, Yakutskenergo and Viluyskaya HPP-3 sold 2,988.4 mn kWh and 685.7 mn kWh, respectively, in the WECM via DEK. Transneftenergo increased consumption by 921.0 mn kWh, also contributing to DEK's higher sales.

### DEK's electricity purchases and sales in the WECM non-price zone

| Metric | 2018 | 2019 | 2019/2018, % |
|---|---|---|---|
| WECM electricity purchases, bn kWh | 31.0 | 36.3 | 17.0 |
| Cost of WECM electricity (capacity) purchases, RUB bn | 51.6 | 62.4 | 20.8 |
| WECM electricity sales, bn kWh | 11.2 | 15.9 | 42.8 |
| Cost of WECM electricity (capacity) sales, RUB bn | 20.2 | 28.6 | 41.7 |

### Number of households and corporates in service in non-price and isolated zones of the Far Eastern Federal District *[EU3]*

| Consumer | 2017 | 2018 | 2019 |
|---|---|---|---|
| Manufacturing industry | 3,494 | 3,230 | 3,274 |
| Transport and communications | 2,219 | 2,295 | 2,292 |
| Agriculture | 1,725 | 1,712 | 1,783 |
| State-financed | 11,969 | 12,142 | 12,274 |
| Management companies, condominiums, housing associations, etc. | 9,287 | 12,154 | 12,960 |
| Wholesalers-resellers | 24 | 28 | 32 |
| Housing and utilities | 1,852 | 957 | 1,019 |
| Other | 56,616 | 56,592 | 56,843 |
| Households | 2,464,149 | 2,478,200 | 2,504,738 |
| **Total** | **2,551,335** | **2,567,310** | **2,595,215** |

In accordance with the Russian Government's Resolution No. 1496 dated December 8, 2018, the Western and Central energy hubs of the Republic of Sakha (Yakutia) are included in the non-price zone of the Far Eastern WECM effective from January 1, 2019.

In 2019, JSC DGK supplied 21.5 bn kWh in the non-price zone of the Far East's wholesale electricity (capacity) market. Its commercial sales of electricity and capacity in the WECM amounted to 49.4 bn kWh in 2019.

The volumes of electricity (capacity) supply declined by 4% y-o-y, mainly due to the rising electricity sales volumes by Zeyskaya and Byreyskaya HPPs.

Total sendout of electricity under RAO ES East Subgroup's retail contracts amounted to 30.1 bn kWh in 2019. In 2019, RAO ES East Subgroup served retail market consumers under 2,595,215 electricity supply contracts, including 2,504,738 households.

### Heat market in the Far East

RAO ES East Subgroup generates and distributes heat in the Far Eastern Federal District.

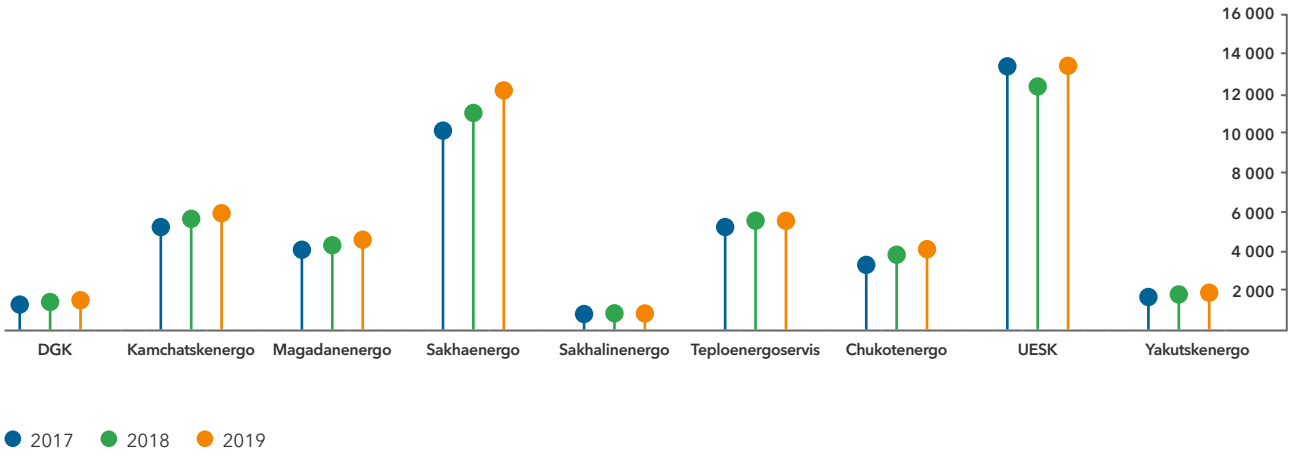
Heat is supplied on a centralized basis from thermal power plants and boiler stations operated by energy companies. Some energy companies engage in both heat production and distribution, while others do not go beyond production operations.

Heat sales are fully regulated under the Russian law.

Federal Law No. 190-FZ On Heat Supply dated July 27, 2010 sets out the basic price (tariff) regulation principles for heat supply and the scope of authority of regulators in charge of heat supply price (tariff) regulation. The Russian Government's Resolution No. 1075 On Pricing in the Field of Heat Supply dated October 22, 2012 outlines the main regulation principles and procedures for calculating and approving heat tariffs.

In the Far East, heat tariffs in 2019 were set using the long-term indexation method in line with the Guidelines for Calculation of Regulated Prices (Tariffs) for Heat Supplies approved by FTS Order No 760-e dated June 13, 2013.

## Consumer tariffs for heat supplies in the Far Eastern Federal District, RUB/Gcal[1]




The average tariff in DGK zones of operation rose by 4.4%, with the smallest increase (1.9%) registered by the LuTEK branch in the Primorsky Krai and the largest increase (9.4%) recorded by Neryungrinskaya GRES in the Republic of Sakha (Yakutia).

In isolated energy hubs, average consumer tariffs for heat supplies added 4.4%, with the smallest increase (0.2%) reported by Teploenergoservis and the largest increase (9.6%) delivered by JSC UESK. Sakhalinenergo reported an average tariff decline of 0.4% compared to the rate approved for 2018 due to the exclusion of Sakhalinskaya GRES operating costs from the required gross revenue after Sakhalinskaya GRES-2 was commissioned in 2019.

Total sendout of heat under RAO ES East Subgroup's retail contracts amounted to 23.601.9 mn Gcal in 2019. In 2019, RAO ES East Subgroup served retail market consumers under 886,960 heat supply contracts, including 865,952 households.

## Number of households and corporates in service in non-price and isolated zones of the Far Eastern Federal District *[EU3]*

| Consumer | 2017 | 2018 | 2019 |
|---|---|---|---|
| Manufacturing industry | 445 | 443 | 406 |
| Agriculture | 33 | 33 | 30 |
| State-financed | 3,493 | 3,378 | 3,293 |
| Management companies, condominiums, housing associations, etc. | 2,334 | 2,516 | 2,463 |
| Heat suppliers | 7 | 10 | 11 |
| Other | 13,926 | 14,164 | 14,805 |
| Households | 848,529 | 874,030 | 865,952 |
| **Total** | **868,767** | **894,574** | **886,960** |

[1] Sakhalinenergo and Chukotenergo supply heat from power plants and boiling stations to the wholesale reselling consumers.

# Consumer interaction *[103-2]*

## Reduction in the accounts receivable is one of RusHydro Group's top priorities across its footprint.

To prevent receivables from growing any further, RusHydro Group relies on all remedies legally available to it to recover debts and make sure current bills are paid as they fall due.

As at December 31, 2019, RusHydro Group's receivables from buyers and consumers grew by 0.3% to RUB 65.4 bn.

RusHydro and ESC RusHydro Subgroup sell electricity and/or capacity in the first and second price zones, while RAO ES East Subgroup covers the non-price and isolated zones.

The principal debt owed to RusHydro for electricity and capacity supplies stood at RUB 7.7 bn. Total payments received by RusHydro for electricity and capacity supplies to the wholesale and retail markets amounted to 99.8% in 2019 vs 99.1% in 2018.

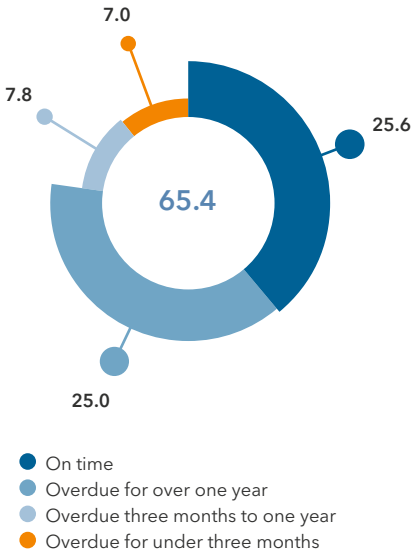
Debt reduction in 2019 y-o-y was driven by:
- the exclusion of Chelyabenergosbyt, Roskommunenergo and Novouralskaya Electricity Sales Company from the list of market participants and payment of their debt in full to RusHydro by successful bidders to become guaranteed suppliers in their stead;
- voluntary debt payment;
- out-of-court settlement and debt recovery through court, including enforcement proceedings.

As at December 31, 2019, ESC RusHydro Subgroup's receivables stood at RUB 9,699.2 mn, thus adding RUB 222 mn, or 2.3%, in 2019 y-o-y. 99.9% at Krasnoyarskenergosbyt (RUB 41,033 mn), 98.1% at Chuvashskaya Electricity Sales Company (RUB 14,160 mn), 99.1% at Ryazanenergosbyt (RUB 12,731 mn), and 99.1% at ESC RusHydro (RUB 6,669 mn).

In 2019, ESC RusHydro Subgroup's receivables generally saw a decline in current bills and debts overdue for 1 month to 2.5 years and an increase in moratorium debt. The latter was expanded to include 83% of the debt of Concern Tractor Plants (consumer of Chuvashskaya Electricity Sales Company) after its subsidiaries were placed under bankruptcy management, supervision or receivership.

At RAO ES East Subgroup, as at December 31, 2019, total payments received for electricity and heat totaled 98.4%, with receivables of RUB 35,102.7 mn. The company received 99.2% of payments for electricity and 96.7% for heat in retail markets. The receivables for electricity and heat amounted to RUB 15,518.0 mn and RUB 19,584.7 mn, respectively.

**Receivables from buyers and consumers,** RUB bn




RusHydro Group's retail companies use the following three approaches to improve debt recovery:
- interacting with consumers and executive authorities and introducing outreach measures aimed at improving payment discipline;
- recovering debt through court;
- disconnecting the electricity supply for non-payment.

### Improvement of payment discipline through outreach measures

Drawing attention to systemic non-payment of energy bills is an effective way to improve payment discipline among households, businesses and public sector.

The prompt payment culture is created through measures encouraging regular and timely payment. Given that utility service providers are among the biggest debtors, these initiatives seek to incentivize those management companies, condominiums and housing associations that fulfil their payment obligations promptly.

Other actions include regular posting of "black lists" of persistent non-payers featuring organizations with the worst payment discipline and the highest debt levels.

With a view to strenghthen the payment discipline and motivate consumers to fulfil their debt obligtions (legal entities), Subgroup ESC RusHydro has been actively participating in the arrangement of the regional stage of the annual federal event "Reliable Partner" for a number of years. The regional stage is meant to encourage the most diligent and responsible consumers, to set a high status for reliable consumers of power resources, as well as to support and to maintain the partnership between suppliers and consumers. The contest winners across Russian regions help to sum up the results of the event, which is arranged annualy on the basis of the Federation Council. *[OS]*

### Debt recovery through court

As part of its efforts to reduce receivables under contracts related to electricity (capacity) sales, RusHydro Group works to enforce debt recovery through court action.

In 2019, RusHydro's debt recovery actions for non-payments translated into court awards for a total of RUB 1,586.9 mn, including arbitration awards of RUB 693.9 mn. Based on the arbitration awards, 29 writs of execution were issued in 2019 for RUB 1,249 7 mn. Of those, debt outstanding in the amount of RUB 638.105 mn was repaid in the reporting period.

In 2019, ESC RusHydro Subgroup filed 48,704 claims as part of its debt collection efforts to recover debt on electricity bills for a total of RUB 3,706 mn, of which 4,313 claims were against legal entities, including grid companies purchasing electricity to offset grid losses (76 claims of RUB 499.4 mn). Most of the non-payment cases that resulted in court action were in the utilities sector, represented in particular by utility service providers, which had 1,421 claims filed against them; a total of 609 claims were lodged against utilities companies. The combined debt of these two groups came in at RUB 1,381.9 mn. Compared to 2018, the number of claims filed against state-funded organizations dropped two-fold, reflecting improved payment discipline in this consumer group. The Group's subsidiaries lodged claims with magistrates courts against 44,391 individuals for RUB 252 mn in 2019. Courts of different instances satisfied 43,820 claims for RUB 2,493.7 mn, and issued 40,348 writs of execution for over RUB 2,470 mn. The measures that bailiffs may use for non-payment include direct debiting, freezing injunction, travel restriction, and restriction on disposal (sale, transfer by gift, etc.) of cars and real estate.

In 2019, RAO ES East Subgroup filed 227,571,000 claims to recover debt on electricity and heat bills for a total of RUB 11,454 mn, including 7,419 claims of RUB 7,464 mn against legal entities, of which 1,166 claims of RUB 1,430 mn were against state-funded organizations, and 220,152 claims of RUB 3,990 mn against individuals. Courts of different instances satisfied 204,357 claims for RUB 9,387 mn.

### Limitations on energy supplies to consumers for failure to pay for electricity and heat

Limitation of electricity and heat consumption for non-payment is an effective measure, but a last resort in ensuring debt recovery.

The procedures of notifying consumers in arrears of any limitations in consumption and actual implementation of the same are in full compliance with applicable laws (Procedure for Consumption Limitations in Circumstances Other Than Power Facility Repairs or (Risk of) Emergency Operating Modes as per the Russian Government's Decree No. 624 dated May 24, 2017).

Electricity supply can be recovered in full only after the debt is fully settled (or a restructuring agreement is signed), the penalties and reconnection charges are paid.

In 2019, 581,150 notices for RUB 23,455 mn were sent to consumers of ESC RusHydro Subgroup. RUB 16,825 mn of debt was repaid by 345,119 consumers after receiving notices, and RUB 478 mn by 27,613 consumers after limitation of consumption, including RUB 88 mn by households. The total number of consumers affected by the sanctions for non-payment amounted to 90,685 in 2019, including 88,335 consumers from the Households group.

RAO ES East Subgroup saw a total of 265,069 disconnections for non-payments in 2019, including 259,357 consumers from the Households group.

# Comprehensive modernization, rehabilitation, and upgrade programs *[103-2]*

### Comprehensive Modernization Program

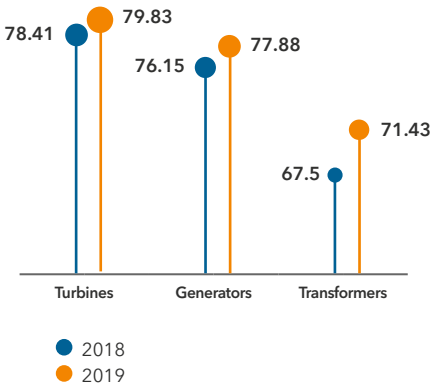
As many large HPPs were commissioned in the 1950s and 1960s, the need arose in the early 2000s to upgrade or replace the existing equipment. Tough economic conditions prevented HPPs from replacing obsolete and worn-out equipment and forced it to focus on maintenance and partial replacements instead.

Since mid-2000s, a number of RusHydro's HPPs began replacing equipment on a case-by-case basis, but the overall trend of ageing prevailed.

This was true until December 2011, when the Board of Directors approved the Comprehensive Modernization Program to upgrade the Company's power generation facilities by 2025. Its key priority is to ensure that no core generation equipment with expired safe operation life remains in place by then.

In 2019, Votkinskaya HPP's hydropower unit No. 5 was upgraded as part of RusHydro's

### Health of RusHydro's core equipment




### Key results of RusHydro's Comprehensive Modernization Program in 2019

| Equipment type and HPP | 2019 | 2020 E |
|---|---|---|
| **Units of equipment replaced or modernized** | | |
| Turbines | 11 | 6 |
| Generators | 9 | 5 |
| Transformers | 4 | 7 |
| **Additions to installed capacity, MW** | | |
| Zhigulevskaya HPP | 10.5 | 0.0 |
| Saratovskaya HPP | 12.0 | 0.0 |
| Novosibirskaya HPP | 10.0 | 0.0 |
| Votkinskaya HPP | 30.0 | 0.0 |
| Cascade of Verkhnevolzhskiye HPPs | 0.0 | 10.0 |
| **Total installed capacity** | **62.5** | **10.0** |

Comprehensive Modernization Program, becoming the third fully modernized hydropower unit at the plant.

At Volzhskaya HPP, new hydropower units No. 3 and 7 were launched. In addition, the plant saw Russia's first ever commissioning of unprecedented innovation: a phase angle regulator, designed to support power transmission from Volzhskaya HPP. The phase angle regulator will enable redistribution of output between 200 kV and 500 kV and increase transmission via a 500 kV power line.

Kamskaya HPP celebrated the completion of a turbine upgrade at hydropower units No. 3 and 6, and Saratovskaya HPP had turbines at hydropower units No. 1 and 9 successfully replaced.

At Novosibirskaya HPP, the turbine replacement was followed by commissioning of the hydropower unit No. 2. A new main control board was also put into operation at the plant, boasting the latest digital technologies. The original main control board of Novosibirskaya HPP was commissioned back in 1957 for the plant's personnel to operate all of the HPP's equipment. After more than 60 years of operation, the board's equipment, which had still relied on electro-mechanical switches and relays, became worn-out and obsolete and needed to be replaced. The new board consists of seven sections with a total length of 14 m and two video panels, providing personnel with all the information they require. In addition, a new control desk with automated workplaces was installed and the control room was repaired to replace power supply and HVAC systems.

Cheboksarskaya HPP put into operation hydropower units No. 3 and 11 following their upgrade, which included the recovery of the adjustable blade pitch, the replacement of the iron piece of the rotor rim, tachogenerator and stator of generator No. 3, as well as tachogenerator and stator of generator No. 11. On top of that, obsolete oil circuit breakers of the plant's 220 kV outdoor switchgear equipment were replaced with the latest gas-insulated ones.

At Rybinskaya HPP, an upgrade of hydropower unit No. 3 was completed, with a turbine and a generator replaced.

RusHydro's efforts also focused on modernizing electrical equipment at other plants. One example is the commissioning of modern switchgear at Zagorskaya PSPP.

Following the upgrade, the hydropower units underwent the re-labeling procedure to formally document their new capacities. This added 62.5 MW to the capacity of RusHydro Group's existing HPPs: 30 MW at Votkinskaya HPP, 12 MW at Saratovskaya HPP, 10.5 MW at Zhigulevskaya HPP, and 10 MW at Novosibirskaya HPP.

## Rehabilitation and modernization program

The rehabilitation and modernization program of RusHydro's branches draws upon the Comprehensive Modernization Program and focuses on extending the lifespan of the core generation equipment, reducing production costs and enhancing the overall economic efficiency of hydroelectric power plants.

Driven by the need to ensure long-term reliability throughout its technological complex, JSC RAO ES East Subgroup runs its own rehabilitation and modernization program (as part of its investment program). The development and implementation of this initiative is regulated by RusHydro Group's Technical Policy.

In 2019, the rehabilitation and modernization program of RAO ES East Subgroup saw completion of several important projects, including:

- second stage of the Anadyrskaya CHPP gasification project focusing on the conversion of BKZ-160-100-20 boiler No. 1 at Anadyrskaya CHPP to combined combustion of coal and natural gas (completion of construction and installation works at boiler No. 1 in 2020 as per the contract; conversion of boiler No. 2 to gas combustion completed in 2018);

In October 2019, results of the comprehensive modernization, technical re-equipment and HPP and PSPP reconstruction programs were presented by PJSC RusHydro at the International Forum "Russian Energy Week" (REW-2019), arranged by the Ministry of Energy of the Russian Federation and the Moscow Government as part of the meeting dedicated to "Energy Efficiency and Energy Safety of Hydropower Faciliets regarding Modernization of the Energy Equipment and Digital Transformation." *[OS]*

- rehabilitation of Khabarovskaya CHPP-3 with PTVM-180 boiler No. 1 of the hot-water peaking boiler plant converted to natural gas combustion (completion of construction and installation works in 2020 as per the contract);
- expansion of ash dump No. 2 (stage 1) at Khabarovskaya CHPP-3 by 1,800,000 m$^3$ (completion of construction and installation works in 2021 as per the contract);
- modernization of power unit No. 2 at Neryungrinskaya GRES;
- modernization of the fuel supply system at Magadanskaya CHPP (completion of construction and installation works in 2022).

The Company also paid close attention to the rehabilitation of heat supply networks and the modernization of substations and transmission lines to ensure stable power supply for existing consumers and new customers.

# Reliability and safety of production facilities *[103-2]*

### RusHydro Group's reliability and safety policy

One of RusHydro Group's strategic goals is to provide a reliable power supply and ensure safe operation of equipment, hydraulic structures, and production facilities. RusHydro's Technical Policy[1] plays a crucial role in this process.

The document aims to identify key operations of RusHydro Group suitable for developing and applying technical solutions and technologies designed to boost reliability, safety and efficiency of production facilities in the short and long term.

The Technical Policy comprises a range of mandatory technical solutions enabling planned changes in production facilities in line with laws and regulations in the power industry, goals of RusHydro Group's Development Strategy, and latest developments in technology.

Key objectives of RusHydro's Technical Policy are as follows:
- upgrade of production facilities and their effective operation as a way to ensure reliability and safety;
- fulfilment of presidential and government instructions focusing on the development of energy infrastructure and envisaging the creation of economically and environmentally efficient, reliable and safe production facilities;
- development of the energy sector in the Russian Far East, including by tapping into the potential of renewables.

RusHydro Group's Technical Policy defines requirements imposed on the reliability and safety management system for equipment and structures (RSMSES) governed by the Regulations on the Reliability and Safety Management System for Hydraulic Structures and Hydroelectric Power Plants[2]. As part of the RSMSES, dedicated operating procedures have been put in place for the Analytical Center, one of the key elements in the system assessing the state of equipment and structures, to liaise with the Company's Headquarters, branches and subsidiaries[3].

RusHydro Group's Technical Policy defines requirements for the integrated process safety management system, including the industrial safety management subsystem.

The following documents were developed and adopted as part of the industrial safety management system:
- Standard Regulations on In-Process Monitoring of Compliance with Industrial Safety Requirements at Subsidiary's Hazardous Production Facilities[4];
- RusHydro's In-Process Monitoring Information System[5] (fully implemented across the Company's branches).

To oversee preparation of RusHydro's facilities for special operating conditions and control corrective actions designed to eliminate gaps identified by government, institutional and internal supervisory bodies, the Company has implemented the following information systems:
- the supervisory information system put into operation by Order of the Company No. 451 of May 28, 2019 and Decree of the Company No. 358r On Supporting the Operation of the Supervisory Information System dated August 26, 2019 (the system has been rolled out across the Company's branches);
- the integrated recorder for the analytical database of supervisory activities (KRAB-3) put into operation by Decree of the Company No. 467r On Using a Data Reporting Form – Integrated

[1] RusHydro's Technical Policy was approved by the Board of Directors of PJSC RusHydro (Minutes of the Board of Directors No. 307 of April 9, 2020).

[2] Approved by RusHydro's Order No. 515 of August 8, 2017.

[3] Approved by RusHydro's Orders No. 430 of June 20, 2018 and No. 862 of November 9, 2018.

[4] Approved by RusHydro's Order No. 190 of March 11, 2015.

[5] Commissioned by RusHydro's Order No. 1170 of November 27, 2013.

Recorder for the Analytical Database of Supervisory Activities dated December 8, 2015 as amended by Decree No. 157r On Using a Data Reporting Form – Integrated Recorder for the Analytical Database of Supervisory Activities dated May 14, 2018 (KRAB-3 has been rolled out across the Company's subsidiaries).

The Company's industrial safety priorities are:
- to continuously enhance and improve industrial safety of the Company's hazardous production facilities in line with the global best practices by ensuring timely upgrades of process equipment and its safe, reliable and trouble-free operation;
- to establish and maintain an efficient on-site safety monitoring system to enable industrial safety planning and tackling major challenges faced by the Company.

Meeting the above industrial safety goals helps reduce industrial risks associated with hazardous production facilities as a result of better process control, quality of repairs and industrial safety audits.

Ways of ensuring reliable and safe facility operation include:
- quality assurance at design and construction phase;
- external regulatory supervision;
- internal process monitoring;
- compliance with industry and corporate operating standards and procedures;
- implementation of the Technical Policy and engineering system controls.

In pursuance of RusHydro's Decree No. 42r On the Approval of Target Audit Schedule dated February 1, 2019, the Production Unit departments performed target audits of RusHydro's branches and subsidiaries to improve the effectiveness and control of production process compliance with applicable safety requirements.

The dual control and monitoring of compliance with industrial safety requirements at hazardous production facilities – both internally and externally (by state supervisory bodies) – secures efficient control over safety and reliability of existing assets.

All of RusHydro Group's production facilities have put in place regulations on in-process monitoring of compliance with industrial safety requirements at hazardous production facilities. RusHydro Group has 517 hazardous production facilities registered in the State Register of Hazardous Production Facilities, including 174 facilities owned by PJSC RusHydro and 343 facilities owned by its subsidiaries.

## Allocation of industrial safety responsibilities

| Responsible | Functions |
|---|---|
| Member of the Management Board, First Deputy General Director – Chief Engineer | - General control of compliance with industrial safety requirements at hazardous production facilities of RusHydro and production subsidiaries;<br>- Methodological support and coordination of industrial safety efforts at the Company's hydropower facilities, including recording of violations, emergency prevention and response. |
| Industrial and Fire Safety Office of the Industrial and Occupational Safety Department | - Setting up and running internal controls of compliance with industrial safety requirements at hazardous production facilities and hydropower facilities of RusHydro and its production subsidiaries;<br>- Coordination and control of HQ units, branches and subsidiaries as regards in-process monitoring and compliance with industrial safety requirements;<br>- Methodological support of the Company's branches and subsidiaries as regards in-process monitoring of compliance with industrial safety requirements and industrial safety management system operating procedures;<br>- Control over the efforts of the Company's branches and subsidiaries to develop and implement annual industrial safety action plans and action plans eliminating industrial safety gaps identified by supervisory bodies. |

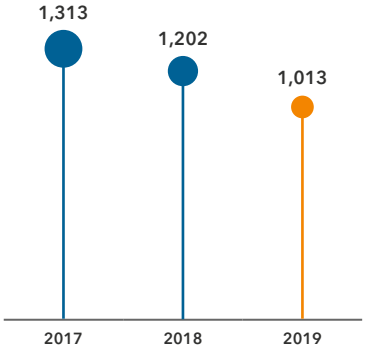
| Responsible | Functions |
|---|---|
| Directors of RusHydro's branches and subsidiaries | – General management of in-process monitoring and financing procedures;<br>– Management of the development team working on initiatives to improve industrial safety and prevent environmental damage;<br>– Coordination of efforts to prevent and manage emergencies and accidents at hazardous production facilities and to deal with their consequences;<br>– Maintenance of buildings, structures and technical devices at hazardous production facilities to ensure their operability and safety, enforcement of occupational safety as required by the Russian Labor Code. |
| First Deputy General Directors – Chief Engineers of RusHydro's branches and subsidiaries | – Management of the in-process monitoring function and commission;<br>– Control over experts and employees working at hazardous production facilities to make sure they promote compliance of production technologies, equipment, buildings and structures with the applicable legal requirements, standards, regulations and rules, and fulfil improvement orders issued by supervisory bodies with respect to industrial safety;<br>– Management of the efforts to identify hazardous production facilities and include them in the relevant State Register, develop an industrial safety statement with respect to class I and II hazardous production facilities, and draft a fire safety statement and emergency response plans;<br>– Arrangement of technical inspections, tests and expert reviews to confirm industrial safety of technical devices, buildings and structures and examine the technical documentation of hazardous production facilities;<br>– Staff training to ensure accident and emergency preparedness at hazardous production facilities;<br>– Implementation of action plans to eliminate industrial safety gaps at hazardous production facilities identified by the Federal Environmental, Industrial and Nuclear Supervision Service of Russia, assessment of industrial safety, control of compliance with the technical safety requirements at hazardous production facilities. |
| Industrial and occupational safety functions in RusHydro's branches and subsidiaries | – Organization and enforcement of in-process monitoring to ensure compliance with the industrial safety requirements at hazardous production facilities;<br>– Development and implementation of industrial safety action plans;<br>– Methodological stewardship of in-process monitoring;<br>– Assessment of industrial safety at hazardous production facilities and analysis of accident causes;<br>– Staff training and certification in industrial safety;<br>– Organization of expert reviews for technical devices, buildings and structures at hazardous production facilities to ascertain their industrial safety;<br>– Control over:<br>• compliance with license requirements for operators of hazardous production facilities;<br>• fulfilment of improvement orders issued by supervisory bodies with respect to industrial safety;<br>• elimination of causes for emergencies, accidents and incidents at hazardous production facilities;<br>• timely testing and inspection of technical devices, buildings and structures at hazardous production facilities, equipment maintenance and validation of check measurement units;<br>• certification of technical devices used at hazardous production facilities for compliance with the industrial safety requirements;<br>• availability and accuracy of operating and technical documentation for hazardous production facilities;<br>• employee compliance with industrial safety requirements. |

# Accident rate at RusHydro Group's facilities *[103-2] [OS]*

## In 2019, RusHydro Group's accident rate was down 16% y-o-y.

Most accidents (61%) were caused by recurrent natural hazards, third parties not engaged in operations, and animal or bird activity.

### Number of accidents involving RusHydro Group's generating facilities, electrical equipment and 110+ kV power lines




### Stable Power Grid Operation in the Sakhalin Region

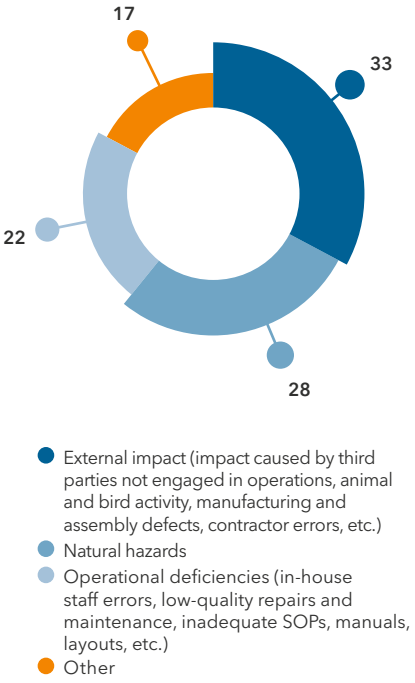
The electricity system is the backbone of the Sakhalin Region's economy. Given the island's isolated location, the electricity system is key to ensuring its sustainable social and economic development, as well as the adequate living conditions for its population.

Its stability is affected by local climatic conditions, including strong cyclonic activity, hurricanes with a speed of up to 56 m/s, high seismicity (magnitude 8–9), aggressive salt deposits, off-season icing of power lines, and frost heave. Coupled with high wear and tear of the grid infrastructure, these factors lead to frequent power failures.

As instructed by the Russian Government's Decree No. YUT-P9-13pr dated March 18, 2016, the Government of the Sakhalin Region and RusHydro Group developed the Program of Stable Power Grid Operation in the Sakhalin Region[1].

In 2019, Sakhalinenergo launched a number of initiatives funded from the available sources, including design works at eight facilities and construction and installation works at three facilities.

### Cause of accidents in 2019, %




### System Average Interruption Frequency Index (SAIFI)[2] *[EU28]*

| Subsidiary | 2017 | 2018 | 2019 |
|---|---|---|---|
| JSC DRSK | 1.18 | 0.87 | 1.64 |
| PJSC Yakutskenergo | 2.34 | 2.97 | 0.10 |
| JSC Sakhaenergo | 0.15 | 0.51 | 0.19 |
| PJSC Magadanenergo | 1.02 | 0.73 | 1.71 |
| PJSC Sakhalinenergo | 5.76 | 2.34 | 2.83 |
| PJSC Kamchatskenergo | 2.04 | 1.32 | 1.37 |
| JSC UESK | 0.20 | 0.18 | 0.05 |
| JSC Chukotenergo | 1.82 | 1.03 | 0.51 |

[1] The Program's priority initiatives falling within PJSC Sakhalinenergo's area of responsibility and operations are approved by the Ministry of Energy's Letter No. AT-2669/09 dated March 15, 2019, Minutes No. AN-114pr of April 2, 2019).

[2] The System Average Interruption Frequency Index (SAIFI) is calculated using the formula (∑li*Ni)/NT, where li is the total number of interruptions per annum for a group of customers Ni, and NT is the total number of customers served. The index is calculated for the entire location served.

### System Average Interruption Duration Index (SAIDI), h[1] *[EU29]*

| Subsidiary | 2017 | 2018 | 2019 |
|---|---|---|---|
| JSC DRSK | 1.34 | 1.08 | 2.04 |
| PJSC Yakutskenergo | 4.24 | 6.02 | 0.14 |
| JSC Sakhaenergo | 1.67 | 0.57 | 0.34 |
| PJSC Magadanenergo | 1.10 | 1.44 | 1.13 |
| PJSC Sakhalinenergo | 13.22 | 4.93 | 3.85 |
| PJSC Kamchatskenergo | 5.08 | 1.86 | 2.14 |
| JSC UESK | 2.14 | 0.36 | 0.94 |
| JSC Chukotenergo | 10.14 | 8.16 | 7.45 |

# Emergencies

## Preparedness for natural disasters and emergencies

RusHydro Group is responsible for reliable and uninterrupted operation of its facilities. To this end, a dedicated system was implemented at the Company's production sites to prevent and respond to natural disasters and emergencies. In particular, efforts are made to prevent process upsets and accidents, and if an interruption occurs, the Company does its best to bring the facility operation back to normal as soon as reasonably possible. Furthermore, employees of RusHydro have regular trainings in civil defense and emergency response.

Key potential sources of natural disasters and industrial emergencies at RusHydro Group's production facilities:
- high magnitude low-frequency (once every 100 years) flood may result in boosting the headrace, overflowing hydraulic structures, waterfront destruction in junction areas, and a hydrodynamic accident followed by the flooding of adjacent areas, including flooding of power line pylons and transformer substations;
- during natural disaster alerts, there is a risk of electrical grid accidents caused by wire breaks or overlapping and short circuits at transformer stations followed by power outages for electricity consumers;
- technological emergencies affecting the equipment of power plants and grid infrastructure, which may cause interruptions or failures of power and heat generation or supply to households and economic assets;
- accidental oil spill affecting economic assets and people.

In RusHydro Group, the following functions and officials are responsible for the protection of population and territories from emergencies:
- the Situation Analysis Center and Industrial and Occupational Safety Department (as regards fire safety) at the Headquarters. They report to member of the Management Board, First Deputy Director General – Chief Engineer of the Company;
- first deputy directors – chief engineers with the direct involvement of civil defense and emergency response engineers reporting to them – at the Group's branches;
- employees authorized to deal with the issues of civil defense and protection of population from natural and industrial emergencies – at RusHydro's subsidiaries.

RusHydro Group prevents and responds to emergencies in full accordance with applicable Russian laws on hydraulic structures and hazardous production facilities. For the purpose of rescue and emergency recovery operations, the Company has established a back-up fund of documentation on RusHydro Group's hazardous facilities, which is maintained by the government.

All RusHydro Group's facilities have:
- action plans for natural and industrial emergency prevention and response, as well as action plans for oil and petrochemicals spill prevention and response approved by local bodies of the Russian Ministry for Civil Defense, Emergencies and Elimination of Consequences of Natural Disasters (EMERCOM);
- hydraulic structures safety statements updated (revised) at least once in every five years

[1] The System Average Interruption Duration Index (SAIDI) is calculated using the formula (∑ti*Ni)/NT where ti is the total duration of interruptions per annum for a group of customers Ni, and NT is the total number of customers served. The index is calculated for the entire location served.

subject to obligatory audit of such hydraulic structures by ad hoc commissions in collaboration with design and R&D institutions;
- facility safety certificates;
- special machinery for prompt response to potential damage or accidents (for facilities with own (or contractor's) fire stations);
- emergency and rescue equipment.

Volunteer emergency response teams, local warning systems and contracts for professional emergency response services have been put in place across RusHydro Group's facilities operating extremely dangerous and highly dangerous hydraulic structures or hazard class II and class III facilities duly assigned to respective civil defense categories.

To fulfil the requirements of HTS safety legislation, the Company provides for the mandatory insurance of public liability of those who own hazardous facilities, in respect of their harmful impact as a result of emergency (the insurance limit under the mandatory insurance contract on the HTS owner's public liability is stated by legislation in the amount of RUB 6.5 billion), as well as for the voluntary insurance of public liability, increasing the insurance amount up to RUB 35.5 billion, which corresponds to the public liability insurance level of leading Russian power companies. *[OS]*

## Functional subsystem of the National Emergency Management System

In pursuance of the Order of the Russian Ministry of Energy[1], RusHydro Group established a functional subsystem of the National Emergency Management System (NEMS).

The Company's emergency prevention and response and fire safety commission (the "Commission") is the supervisory body of the subsystem responsible for the timely situation assessment and decision-making on emergency prevention. The Commission's annual action plans stipulate efforts to facilitate the safe passage of flood water during the spring and summer period, prepare for the fall and winter peak loads, and secure the stable operation during the fire and storm seasons. The Commission manages and coordinates the operations of standing bodies and management bodies responsible for the day-to-day operation of the functional subsystem.

Permanent management bodies of the Company's functional subsystem – the Emergency Management Unit of the Situation Analysis Center's team specializing in civil defense, emergency prevention and response, and civil defense and emergency engineers at RusHydro's generating branches and subsidiaries – are responsible for the planning of emergency prevention and response, coordination of emergency prevention and response activities in accordance with laws and regulations of the Russian Federation and internal documents of the Company.

Management bodies responsible for the day-to-day operation of the Company's functional subsystem – the Emergency Management Unit's duty shift and duty shifts at RusHydro's generating branches and subsidiaries – conduct 24/7 situation monitoring at facilities, give warnings of identified equipment failures, and carry out priority emergency prevention activities.

For the purpose of emergency prevention and response, RusHydro put in place resource stockpiles at its branches operating hydraulic structures and a dedicated financial reserve at RusHydro. The dedicated financial reserve for emergencies was established on a centralized basis in the interests of RusHydro's branches by transferring 1% of the average monthly revenue from electricity and capacity sales. All subsidiaries have established

[1] Order No. 792 On the Functional Emergency Management Subsystem at Organizations (Facilities) of the Energy Industry and Organizations (Facilities) Subordinate to the Russian Ministry of Energy dated September 24, 2018.

the required financial reserves and resource stockpiles for emergency prevention and response.

### Emergency recovery exercises

Employees are trained in emergency recovery as part of the corporate civil defense and emergency response training program. The list of persons to be trained was made in accordance with Russian laws and regulations.

In line with the schedule for 2019, RusHydro Group conducted:
- 5 comprehensive exercises;
- 527 facility-based exercises;
- 109 table top exercises and training sessions;
- 37 tactical training exercises.

In 2019, 66 people took training or advanced professional training at training centers and as part of civil defense courses, including one civil defense manager and 22 chairmen and members of emergency prevention and response and fire safety commissions (with nine such members coming from the Headquarters).

### Prevention of injuries and fatalities involving RusHydro Group's assets *[EU25] [OS]*

A special emphasis in occupational safety is placed on the prevention of injuries among local residents arising from contact with the Group's facilities.

This issue is primarily covered through mass media (articles published in printed and online media) and school safety lessons on hazardous and harmful health impact of various power installations in the event of exposure within a hazardous distance.

In 2019, there were 16 accidents, including 11 third-party fatalities involving RusHydro Group assets. Of this number, nine fatalities resulted from approaching energized parts of power installations or overhead power lines closer than the minimum approach distance. Another two were due to traffic accidents involving vehicles of the Olekminsky electricity distribution zone (Sakhaenergo) and DRSK's branch Primorye Power System. The accidents were caused by driving under the influence and a third-party traffic violation, respectively.

Additionally, legal proceedings were launched in connection with injuries at RusHydro Group facilities. There were no legal actions lodged in response to fatalities.

As a leader among Russian energy companies, RusHydro Group is one of the world's largest organizations operating in hydropower and maintains the smooth, reliable operation of the Russian Federation's power systems.

**Yevgeny Zinichev,**

*Ministry of Civil Defense, Emergencies and Disaster Relief of the Russian Federation*