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ARGUS RUSSIAN GENERATION FUELS AND POWER

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The most up-to-date Argus Russian Generation Fuels and Power methodology is available on
www.argusmedia.com

Introduction

Russia is one of the largest producers of electricity in the world. Natural gas, together with fuel oil, makes up 51pc of generation fuels. Coal's share is about 19pc, while the hydroelectric and nuclear sectors each account for 15pc of the market.

Argus publishes Russian domestic market prices for generation fuels (coal, natural gas, fuel oil) and power in the weekly Argus Russian Generation Fuels and Power report ("Argus Топливо и энергетика"). The publication also contains detailed analysis of the latest market developments, important industry statistical data and an estimation of coal rail transport costs. It is available to subscribers every Tuesday (except for Russian public holidays) in the Russian language. Argus publishes prices that report and reflect prevailing levels for open-market arms length transactions (please see the Argus Global Compliance Policy for a detailed definition of arms length).

Coal market

Argus publishes price assessments for four commonly used grades of steam coal: low-volatile run-of-mine coal of grade T, high volatile run-of-mine coal of grade D, sorted coal of grade DPK and run-of-mine coal of grade SS, all produced in Kuzbass — Russia's key coal basin in Siberia. Coal specifications (calorific value, ash content, volatility) can differ within the same grade, and depending on the mine. All Kuzbass coal has low sulphur content.

Grade T coal is consumed by several power stations in the European part of Russia. This grade is also used by cement producers and other industrial consumers, such as steel mills.

D-grade coal is most widely used by power generators and the municipal heating sector. DPK grade is consumed by housing and public utilities as well as households. Coal for heating needs is usually purchased by regional administrations, state organizations, military units and other users through open tenders, normally held ahead of the heating season. Coal for heating needs is sold both by the dealers of large coal producers and numerous small traders.

There are no power stations in Russia built specifically to burn high quality SS grade coal but it is often used together with some other grades to improve the efficiency.

Coal prices

Argus assesses prices in the domestic Russian coal market once a month. Assessments may be less frequent in the absence of market activity. Prices are published in Argus Russian Generation Fuels and Power. A publication schedule is available at www.argusmedia.com.

The Argus coal team in Moscow contacts a wide cross section of coal market participants through a telephone survey, instant messenger, and email communication. A balance is maintained in the survey between sellers, utility buyers, power generators, and trading companies. Argus will contact and accept market data from all credible market sources including the front and back office of

market participants and brokers.

Argus analysts ask market participants in the survey whether they have done or heard of any trade in coal, and whether they have made or received any bids or offers. Market participants are asked where they see the level of prices in the spot market for that day. The analysts then assess the price of the coal that conform to the specifications listed in the table below on the basis of transactions and buy/sell estimates.

All information received by the Argus Russian Generation Fuels and Power market reporters/analysts will be used in making the final assessment. Prices are published in Russian roubles per metric tonne, excluding value added tax (VAT, 18pc).

Argus also publishes Argus Russian Coal, Argus Coal Daily International, Argus Coal Daily, Argus Petroleum Coke, and Argus Coal Transportation as well as market and business intelligence reports on a wide range of other energy markets.

Key features of assessed coal				
Characteristics	Grade SS	Grade D	Grade DPK	Grade T
Size of coal, mm	0-300	0-300	50-300	0-300
Typical NCV, kcal/kg	5,700	5,100	5,300	6,000
Basis and location	fca Kuzbass	fca Kuzbass	fca Kuzbass	fca Kuzbass
Delivery period, days	1-90	1-90	1-90	1-90
Volume, '000t	>5	>5	>5	>5

Coal netback price calculation

The netback price is the apparent export value of coal calculated on an fca Kuzbass basis. The netback value is calculated from the coal price in northwest European ports (cif ARA) and South Korean ports (cif South Korea) published daily in Argus Coal Daily International by subtracting the cost of freight from Murmansk, Riga and Ust-Luga to northwest Europe and from Vostochny to South Korea. The netback value implies freight by dry bulk vessels Panamax size.

The cost of Murmansk to ARA freight is taken from Argus Coal Daily International report every Tuesday.

See the [Coal Daily International methodology](#).

The Riga to ARA, Ust-Luga to ARA and Vostochny to South Korea freight cost is determined by a survey of market participants. To assess the freight rate, Argus contacts shipping companies, producers and traders and calculates the current freight rate for Panamax vessels, which is used for the netback calculation. The cost of port cargo handling and related expenses are also determined through a survey of market participants and are extracted from the fob Murmansk, fob Riga, fob Ust-Luga and fob Vostochny prices. The cost of port cargo handling is usually set for one year.

The related expenses include the forwarding agent's commission and an independent cargo inspection at the port. The fob Riga cargo handling cost includes expenses for railway transportation in Latvia. The costs nominated in euros are converted into US dollars

using the Central Bank's rate.

The cost of coal transportation by rail from Kuzbass stations to Murmansk, Ust-Luga, Vostochny or the Latvian border in case of Riga-destined coal (there is a united rate for Latvia that includes handling and railway transportation costs) is subtracted from the resulting balance. The cost of transportation in Russia is calculated as an average cost from three different Kuzbass stations used for shipping major volumes of coal to Russian ports.

Cost of gondola cars rent

Gondola cars daily rent is assessed on a monthly basis by contacting the key cars owners, operators and their customers — energy and coal companies.

Respondents give an estimate of the cost of daily gondola car rent to transport coal within Russia (RUR/d, excluding VAT) for short-term (up to 1 year) agreements. The rate is published in Argus Russian Generating Fuels and Power no later than the 15th of each month.

The following basic assumptions are used in the assessment:

- gondola car load 69 t
- full train
- speed of loaded gondola car – 550 km/d within Russia
- speed of empty railway gondola car return – 330km/d
- Rate includes the cost of car maintenance

Fuel oil market

Argus assesses domestic fuel oil markets in Russia daily and publishes price assessments in the Argus Russian Fuel Oil report. Argus Russian Generation Fuels and Power analyses the fuel oil market for power generation weekly and publishes average prices for the week before publication for the following basis/locations:

- M-100 fca Moscow refinery
- M-100 fca Ukhta refinery
- M-100 fca Ufa refineries
- M-100 fca Samara refineries
- M-100 fca Omsk refinery
- M-100 fca Khabarovsk refinery

See the [Argus Russian Fuel Oil Methodology](#).

Natural gas market

Gas prices

In absence of liquidity in the over-the-counter natural gas market Argus publishes current regulated tariffs set up by the Federal Tariff Service of the Russian Federation for industrial users and power generators. Separate tariffs are set quarterly for each region of Russia.

Power market

Argus publishes weekly analysis of Russian power market every Tuesday in Argus Russian Generation Fuels and Power. The market

commentary covers price movements, changes in supply and demand, power plant and grids outages, fuel price changes, fluctuations of hydrological resources and other fundamental factors.

Power prices

Argus Russian Generation Fuels and Power publishes the following price series:

Weekly results of ATS marketplace power trades (the week from Tuesday through Monday) for both Russian market zones (Europe-Urals and Siberia) and for 27 free flow zones:

- Weighted average price in the day-ahead market, Rbs/MWh
- Weekly sales volume in the day-ahead market, MWh
- Weekly sales volume in the regulated segment, MWh
- Weekly total sales volume in each market zone, MWh

Results of power trading on the ATS platform on Monday:

- Monday average-weighted day-ahead power price (Rbs/MWh) for each power grid system in the market: Center, North-West, Middle Volga, Urals, South, Siberia

Monthly results of power and capacity trading on the Arena exchange:

- Average prices for power and capacity for every one of the six power grid systems in the market: Centre, North-West, Middle Volga, Urals, South, Siberia, Rbs per lot.
- Volumes of power and capacity sales (in lots)

Power and capacity are sold at Arena in lots for the particular calendar month. Every lot comprises 0.25 MW of generating capacity and the equivalent amount of power, which depends on the type of contract (base-load, half peak or peak) and the calendar month.

Power prices are published in Russian roubles, power volumes in MWh and generation capacity volumes in MW.

Price zones

The wholesale market for electricity and capacity functions in regions consolidated into two price zones Europe - Ural (Price zone 1) and Siberia (Price zone 2).

Electric grids in several regions are not connected to the united national power grid. These isolated regions constitute non-price zones where electricity and capacity are sold at regulated tariffs.

Non-price zones are assigned to the following regions: Kaliningrad region, Komi Republic, Arkhangelsk region, Amur region, Primorye territory, Khabarovsk territory, Republic of Sakha (Yakutia), Jewish autonomous region, Magadan region, Sakhalin region, Chukotka autonomous area, Taimyr district of Krasnoyarsk territory, Kamchatka territory.

Free flow zones

Price zones consists of 27 free flow zones. Electricity in a free flow zone can be transferred to any customer without restrictions on grid. Electricity and capacity produced by any generator in a free flow zone can be easily replaced by electricity and capacity of other generator situated in the same zone (see list of free flow zones in table on page 4).

Free flow zones

Power system/Free flow zone	Region
Europe – Ural	
Middle Volga	
Balakovo	Balakovsko-Saratovskiy district of Saratov region
Volga	Penza, Samara, Ulyanovsk regions, Saratov region (excluding Balakovsko-Saratovskiy district), Mordovia, Tatarstan (excluding Kazanskiy district)
Kinderi	Mari El, Chuvash Republic, Kazanskiy district of Tatarstan
North-West	
West	Novgorod, Pskov, Leningrad regions, Karelia, Saint-Petersburg
Kolskaya	Murmansk region
Ural	
Vyatka	Kirov region, Udmurtian republic, South district of Perm territory
Perm	Permsko-Zakamskiy district of Perm territory
North Tyumen	North district of Tyumen region including Yamal-Nenets autonomous area and Nenets autonomous area
Tyumen	Tyumen region and Khanty-Mansi autonomous area – Yugra (excluding North district of Tyumen region), North district of Tomsk region
Ural	Perm Territory (excluding Permsko-Zakamskiy district), Kirov, Kurgan, Orenburg, Chelyabinsk regions, Sverdlovsk region, Bashkortostan
Center	
Vologda	Vologda region
Moscow	Moscow and moscow region
Center	Belgorod, Bryansk, Vladimir, Voronezh, Ivanovo, Kaluga, Kostroma, Kursk, Lipetsk, Moscow, Nizhny Novgorod, Orel, Ryazan, Smolensk, Tambov, Tver, Tula, Yaroslavl regions
South	
Volgograd	Volgograd Region
Gelendzhik	South-West district of Krasnodar territory
Mahachkala	Daghestan
Kavkaz	Stavropol territory, Adygeya, Ingushetia, Kabardino-Balkarian republic, Karachayevo-Circassian republic, North Ossetia–Alania, Chechen Republic
Kaspiy	Astrakhan region
Kuban	Krasnodar territory (excluding South and South-West district)
Rostov	Rostov region, Kalmykia
Sochi	South district of Krasnodar territory
Siberia	
Siberia	
Altai	Barnaulsko-Byiskiy district of Altai and Altai territory
Buryatia	Buryatia
Omsk	Omsk region
Siberia	Altai and Altai territory (excluding Barnaulsko-Byiskiy district), Irkutsk, Novosibirsk regions, Tomsk region (excluding North district), Kemerovo region (excluding South district), Krasnoyarsk territory, Khakassia, Tuva
Chita	Trans-Baikal territory
Yuzhnyi Kuzbass	South district of Kemerovo region

Generation economics

Argus spark and dark spreads provide illustrative information about generation economics. They are derived from ATS day-ahead power prices, regulated natural gas tariffs and Argus' fuel oil and coal price assessments.

Argus calculates power generation costs for different types of fuel in several regions of Russia. The calculations of spark and dark spreads for each Monday are published weekly in the Argus Russian Generation Fuels and Power report. Spark (gas) and dark (coal) spreads show the difference between the price of power and fuel costs for its generation. Argus does not take into account other generation costs not related to fuel such as maintenance or modernization of power plants. Spreads are calculated according to the formula:

$$\text{Spread} = \text{Power price} - (\text{Fuel Price} / \text{Power plant efficiency})$$

Spreads are calculated for five regions of the Europe-Urals zone of the Russian power market (Moscow, Leningrad, Ryazan, Smolensk, Sverdlovsk regions) and for three regions of Siberia (Kemerovo, Novosibirsk and Tomsk regions)

Depending on the region, spreads are calculated for different types of fuel: natural gas, various grades of coal or fuel oil (see table below for details). Gas, coal and fuel oil have different calorific values. The calorific value of natural gas is assumed at 7,900 kcal/m³ and 9,800 kcal/kg for fuel oil. The calorific value of coal depends on the grade of coal.

Coal prices used in the spread calculation are Argus Russian domestic coal assessments, published in the Argus Russian Generation Fuels and Power report. Gas prices used in the spread calculation are state-regulated tariffs for particular regions of Russia (for industrial consumers). Gas tariffs are published in the Argus Russian Generation Fuels and Power report.

Fuel oil prices used in the spread calculation are Argus Russian fuel oil assessments for Monday, published in the Argus Russian Fuel Oil daily report. The methodology for fuel oil price assessments is available at <http://www.argusmedia.com/methodology-and-reference/>

Key data for dark spreads calculation

Region	Coal			Fuel oil		Electricity	
	Grade	NCV, kcal/kg	Transportation route	Basis	Transportation route	Key station	Price zone
Moscow	D	6000	Belovo – Krivandino	fca Moscow refinery	Yanichkino – Krivandino	Shatura GRES	Europe-Urals
	T	5100	Tyrgan – Ozherelye			Kashira GRES	
Leningrad	–	–	–	fca Salavat refinery	Allugavat – Avtovo	Avtovo TETs-15	Europe-Urals
Ryazan	D	5100	Meret – Voslebovo	fca Ryazan refinery	Stenkinno – Voslebovo	Ryazan GRES	Europe-Urals
Smolensk	D	5100	Erunakovo – Valutino	fca Ryazan refinery	Stenkinno – Valutino	Smolensk GRES	Europe-Urals
Sverdlovsk	SS	5,700	Bochaty – Maloreftinskaya	fca Omsk refinery	Kombinatnaya – Maloreftinskaya	Reftinskaya GRES, Novosverdlovskaya TETs	Europe-Urals
Kemerovo	T	6000	Kiyzak – Kaltan	fca Omsk refinery	Kombinatnaya – Kaltan	Yuzhnyi Kuzbass GRES	Siberia
	SS	5,700	Zaboischik – Kemerovo			Kemerovo GRES	
Novosibirsk	D	5100	Meret – Zherebtsovo	fca Omsk refinery	Kombinatnaya – Zherebtsovo	Novosibirsk TETs-5	Siberia
Tomsk	D	5100	Erunakovo – Tomsk-1	fca Omsk refinery	Kombinatnaya – Tomsk-1	Tomsk GRES-2	Siberia

Electricity prices used in spread calculations are Monday average-weighted day-ahead power prices for particular power grid systems, in which the regions chosen for calculation are located (Centre, North-West, Urals, Siberia power grid systems). Electricity prices are measured in Rbs/MWh excluding value-added tax. Fuel prices used in spread calculation are measured in Rbs/MWh and include transport costs and value-added tax.

Prices for natural gas in Russia are traditionally measured in Rbs/1,000m³, for coal in Rbs/t and for fuel oil in Rbs/t. Argus uses the following formula to convert traditional fuel prices to Rbs/MWh:

Calculated fuel price = Initial fuel price / Conversion factor

The conversion factor shows the amount of power which may be produced from a particular fuel in ideal conditions, i.e. at 100pc power plant efficiency. The calculation of the conversion factor is based on the calorific value of the particular fuel and its comparison to the calorific value of conventional fuel, which is 7000 kcal/kg. 1 kcal of conventional fuel allows to produce 1.163Wh or (1.163 / 1,000,000) MWh of power. Consequently, different types of fuel correspond to the following conversion factors:

- Natural gas – 9.1877 MWh/1,000m³
- Coal D-grade – 5.9313 MWh/t
- Coal T-grade – 6.9780 MWh/t
- Coal SS-grade – 6.6291 MWh/t
- Fuel oil M-100 – 11.3974 MWh/t

Most Russian power plants have a generation efficiency in the range from 30pc to 50pc, although the most modern gas turbines may have an efficiency of up to 56-58pc. During the spread calculation, Argus divides calculated fuel price by the power plant efficiency factor (see formula above). For the calculation of generation economics, Argus uses the following common power plant efficiency factors: 30pc, 35pc, 40pc, 50pc, 55pc.