

# Monitoring and Assessment of the Level of Economic Security of Natural Monopolies in Commodity Markets of Basic Industries

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## ABSTRACT

*Commodity markets of basic industries: thermal energy, water supply and sanitation, are key for the economy of any region and the country as a whole. In this regard, an assessment of the state of their economic security level is necessary for making operational decisions on their management. This article is devoted to the assessment of the current state of the level of threat to the economic security of subjects of the tariff regulation system of commodity markets of basic industries within the geographical boundaries of the city of Yoshkar-Ola, the Republic of Mari El, as well as improving the assessment methodology.*

**Key words:** economic security, assessment, commodity markets of basic industries; monopoly; government regulation; thermal energy, water supply, sanitation, tariffs, monitoring.

## INTRODUCTION

In tariff regulation, it is necessary to maintain a balance of economic interests between consumers and regulated organizations. In this regard, two imbalance options are possible. The first is in favor of regulated organizations, then the consequences will be an unjustified increase in tariffs and a burden on the consumer, the second is in favor of consumers, a long stay in such a situation can lead to the bankruptcy of natural monopolies, which is an external threat to the economic security of commodity markets in basic industries: thermal energy, water supply and sanitation.

Tariff regulation does not stand still, so according to the draft Report on the state of competition for 2023, the FAS Russia has carried out work to improve the control procedure in the field of state regulation of tariffs, in particular, the stages, actions carried out by inspectors during control activities are disclosed, the need for collegial decisions on the results of control by a specialized commission of the FAS Russia is introduced, the possibility of carrying out unscheduled inspections by territorial bodies of the FAS Russia on behalf of the FAS Russia has been added. All these actions certainly lead to a decrease in the level of threat to economic security. However, they are still not enough. According to the Report on law enforcement practice in the framework of the implementation of state control (supervision) over the implementation of powers in the field of price (tariff) regulation by executive bodies of the constituent entities of the Russian Federation in 2023 in the Republic of Mari El, the FAS Russia issued an order dated 07.11.2023 No. SP / 92416/23. In particular, the Ministry of Industry, Economic Development and Trade of the Republic of Mari El, when setting tariffs in the heat supply sector, "expenses attributable to the production of the coolant were taken into account as part of the required gross revenue (hereinafter referred to as RGR) for the production of thermal energy in order not to exceed the maximum index of growth of citizens' payments for utilities from July 1, 2022." However, according to the current regulatory legal acts in this area, RGR is determined separately for regulated activities. There is a violation of the balance of interests, since in an open water supply system, the tariff for hot water consists of two components: a component for heating (thermal energy) and a component for the coolant. The actions of the regulator led to an increase in the tariff for thermal energy, which also contributed to an increase in the tariff for hot water. According to the FAS Russia order dated 07.11.2023 No. SP/92477/23 and No. SP/92452/23, the audit results revealed that regulated organizations failed to implement production programs, i.e., did not use previously declared repair expenses.

A reduction in these expenses can only be justified if the monopolist's performance efficiency increases; otherwise, such expenses cannot be recognized as savings and are subject to exclusion from the required gross revenue. Consequently, illegal actions by regulators lead to a high level of threat to economic security for both regulated organizations and consumers.

Thus, the purpose of this article is to assess the level of threat to the economic security of subjects of the

tariff regulation system of commodity markets of basic industries: thermal energy, water supply and sanitation within the geographical boundaries of the city of Yoshkar-Ola in the Republic of Mari El.

Depending on the object of study, the following scientists consider various issues of tariff regulation: Ahmed T., Sipra H., Zahir M., Ahmad A., & Ahmed M. [1]; Amador M., Bagwell K. [2]; Baron D., Myerson R. [4]; Whittington D. & Nauges C. [10]. For example, A. Pigou considered government regulation of prices and profits to be a huge waste [9]. Tariff formation in the district heating sector of European countries was studied by Delgado A., Charles MM, Evans M., Kholod N., Kuznetsov A., Pinchuk S. & Kutsman V. [6].

The methodology of multi-institutional analysis for establishing tariff benchmarks was developed by Ziemele J., Vigants G., Vitolins V., Blumberga D. & Veidenbergs I. [12].

Djørup S., Sperling K., Nielsen S., Østergaard P. A., Zinck Thellufsen J., Sorknæs P. & Drysdale D. developed an algorithm for studying and reforming the heat supply tariff scheme using the example of Aalborg [7].

In the field of water supply, issues of tariff regulation were dealt with by Caravaggio A., De Cesare L. & Di Liddo A. [5].

Mathematical models in tariff regulation were used by Macchiaroli M., Dolores L. & De Mare G. The model is based on the division of the tariff into a fixed part (QF), which does not depend on consumption, and a variable part (QV), proportional to consumption [8].

The need to take into account the affordability of payment for this service by low-income populations in tariff regulation of water supply was studied by Xenarios S., Edwards EY & Buurman J. [11]. The establishment of social tariffs for low-income citizens was considered by Amorim D., Resende M. & Miranda RJS [3].

## MATERIALS AND METHODS

Theoretical sources are used as research materials - publications on issues of ensuring economic security. The information basis is tariff decisions of the regional body setting tariffs, data from the tax service information system, orders of the Federal Antimonopoly Service, as well as information posted on the website of the Supreme Court of the Republic of Mari El.

## RESULTS AND DISCUSSION

Having examined the methods of monitoring economic security and the indicators used at the level of countries, regions (cities), government agencies, and enterprises, it can be concluded that they are not applicable for monitoring economic security both in general on commodity markets and taking into account the system of antimonopoly regulation of commodity markets. In this regard, Kudryavtsev K.A. previously developed a universal monitoring methodology for assessing the level of economic security for subjects of the system of tariff regulation of commodity markets in basic industries, which consists of the following stages:

- 1) selection and justification of the most informative indicators reflecting the level of tariff regulation in the commodity markets of basic industries in accordance with the regulatory legal acts in force in this area;
- 2) determination of the rating characterizing the level of economic security in commodity markets for each indicator. Class A – low level of threat to economic security in commodity markets; class B – medium level of threat to economic security;

class C – high level of threat to economic security (Table 1);

**Table 1.** Economic security rating taking into account the tariff regulation system in commodity markets of basic industries

Rating	A	B	C
<b>1. Tariff for goods</b>			
Measurement, in %	less than 5%	5-10%	more than 10%
<b>2. Composition of economic entities operating in the commodity market</b>			

Measurement, quantity pcs.	It is growing, entry to the market is free	Remains unchanged	It's decreasing
<b>3. Shares of economic entities in the commodity market</b>			
Measurement, in %	< 35%	∑ shares of no more than 3 subjects >50%. ∑ shares of no more than 5 subjects >70%.	> 35% ∑ shares >20%, with the share of each >8%.
<b>4. Level of concentration of the commodity market</b>			
Herfindahl-Hirschman Index	Short HHI<1000	Moderate 1000≤HHI<2000	High 2000≤HHI≤10000
<b>5. Disagreements in the calculation of tariffs, compliance with the pricing procedure (natural monopolies and regulators)</b>			
Measurement, quantity pcs.	Not found	The disagreements were considered within the framework of the tariff case, or in court in favor of the regulator. A violation of the pricing procedure was identified, a warning was issued. The regulator has been issued an order by the FAS of Russia	The disputes were resolved in court in favor of the natural monopoly. The warning was not carried out, a case was opened
<b>6. Liquidation (bankruptcy) of business entities</b>			
Measurement, quantity pcs.	No	Liquidation by decision of the founders (participants), withdrawal from the commodity market, or lack of entry into the commodity market	Bankruptcy (claim filed)

3) "assigning a point to each rating class in accordance with paragraph 2 of the methodology and determining the significance coefficients of the rating indicators;

4) calculation of the integral indicator of the point-rating system.

Equation for assessing the level of threat to economic security subjects of the tariff regulation system of commodity markets of basic industries, took the following form (1):

$$I1 = 0.17 \times r1 + 0.17 \times r2 + 0.2 \times r3 + 0.1 \times r4 + 0.23 \times r5 + 0.13 \times r6 \quad (1)$$

I1 - integral indicator of the level of threat to economic security;

r1 - rating for the product tariff indicator;

r2 - rating for the indicator of the composition of economic entities operating in the commodity market;

r3 - rating for the indicator of the share of economic entities in the commodity market;

r4 - rating for the indicator of the level of concentration of the commodity market;

r5 - rating for the indicator related to disagreements in tariff calculations, compliance with pricing procedures (natural monopolies and regulators);

r6 - rating for the indicator characterizing the liquidation (bankruptcy) of business entities.

Integral indicator the level of threat to the economic security of subjects of the tariff regulation system of commodity markets of basic industries will range from 0 to 1, where 0 corresponds to a low level of threat to economic security in the commodity market (class AAAAAA), and 1 corresponds to a high level of threat to economic security (class CCCCCC).

Let's test the universal onemethodology for assessing the level of threat to economic security, using the example of subjects of the tariff regulation system of commodity markets in basic industries: thermal energy, water supply and sanitation

**Table 2.** Dynamics of changes in tariffs for thermal energy in the city of Yoshkar-Ola, Republic of Mari

El from 01.07.2023 to 01.07.2024.

No.	Name of the organization	Rate07/01/2023, rub./Gcal (excluding VAT)	Rate07/01/2024, rub./Gcal (excluding VAT)	Change, %
1	Municipal Unitary Enterprise "Yoshkar-Olinskaya CHPP-1"	1,912.73	1,912.73	0,00
2	JSC "Marbiopharm"	1 647,10	1,742.60	5.80
3	Federal State Budgetary Institution "Central Housing and Communal Services Administration" of the Ministry of Defense of Russia (boiler room No. 124, military unit 20, village of Semenovka)	3 199,02	3 665,14	14.57
4	Federal State Budgetary Institution "Aviation Base"	1,752.72	1 807,80	3.14
5	LLC "Marikommunenergo"	3 585,55	3 599,88	0.40
6	Federal State Budgetary Institution "Military Unit 95504"	1,585.66	2,593.49	63.56
7	PJSC "T Plus"	1 105,26	1 199,07	8.49
8	PJSC "T Plus" on the networks of MUP "Yoshkar-Ola TPP-1"	1,612.48	1,678.51	4.09
9	PJSC "T Plus" for networks LLC Scientific and Production Firm "Energetik"	1 208,56	1,307.69	8.20
10	PJSC "T Plus" on the networks of MUP "Yoshkar-Ola TPP-1" and LLC Scientific and Production Firm "Energetik"	1,715.78	1,787.13	4.16
11	Federal Penitentiary Institution "Correctional Colony No. 6 of the Federal Penitentiary Service of Russia for the Republic of Mari El"	1 850,95	2 172,57	17.38
12	Research and Production Firm "Energetik" LLC	103.30	108.62	5.15
	On average for the market for the period			11.24

According to the table, there was no increase in the tariff for thermal energy during the period under review at MUP Yoshkar-Ola CHPP-1, the smallest increase was at OOO Marikommunenergo - 0.40%, the largest at FKU Correctional Colony No. 6 of the Federal Penitentiary Service of Russia in the Republic of Mari El - 17.38%, the average increase in the tariff for thermal energy in the city of Yoshkar-Ola was 11.24%. The volumes of resource release are not disclosed in the section on state regulation of tariffs on the official portal of the Republic of Mari El, therefore, the calculation of the average value of tariff growth here and below can only be calculated based on the actual figures given in the table without taking into account the volumes. Thus, according to Table 1, class C is assigned for the first indicator.

#### **Thermal energy commodity market of Yoshkar-Ola city, Mari El Republic:**

1. Tariffs for thermal energy are presented in (table 2).
2. The composition of economic entities operating in the commodity market, which is in a state of natural monopolies, remains unchanged for consumers, class B is assigned.
3. The share of each of the economic entities operating in the commodity market, which is in a state of natural monopoly, is 100%. Class C is assigned.
4. The level of concentration of the thermal energy commodity market is high, the Herfindahl-Hirschman index is 10000. The indicator should be assigned class C.

5. No disagreements related to the calculation of tariffs from 2023 to 04/07/2024 were found in the search for information on cases on the website of the Supreme Court of the Republic of Mari El. No information on violations of the pricing procedure was found on the website of the Mari UFAS of Russia either. However, The Ministry of Industry, Economic Development and Trade of the Republic of Mari El was issued an order by the FAS Russia, which allows assigning class B to this indicator. This also allows for improving the definition of the rating characterizing the level of economic security in commodity markets for this indicator.
6. According to information in open sources, there were no liquidations (bankruptcies) of business entities in this period; class A is assigned.

Let us calculate the integral indicator of the point-rating system using the example of subjects of the tariff regulation system in the heat energy commodity market:

$$I1 = 0.17 \times C + 0.17 \times B + 0.2 \times C + 0.1 \times C + 0.23 \times B + 0.13 \times A = 0.17 \times 1 + 0.17 \times 0.5 + 0.2 \times 1 + 0.1 \times 1 + 0.23 \times 0.5 + 0.13 \times 1 = 0.17 + 0.085 + 0.2 + 0.1 + 0.115 + 0 = 0.67$$

It was previously established that "the average level of economic security threat is in the range from 0.385 to less than 0.745. At a value of 0.385 or less, the economic security threat is low, 0.745 or more is high, and a revision of tariffs is required." [1, p. 276]. The value of 0.67 corresponds to the average level of threat to economic security, it is necessary to continue monitoring the commodity market. If the natural monopolist files a lawsuit and wins the case, then the integral indicator will take a value equal to 0.785, which will indicate a high level of threat to economic security in the commodity market of thermal energy.

#### Commodity market for cold water supply in Yoshkar-Ola, Republic of Mari El:

1. Tariffs for cold water supply are presented in (table 3).

Table 3. Dynamics of changes in tariffs for cold water supply in the city of Yoshkar-Ola, Republic of Mari El from 01.01.2023 to 01.07.2024.

No.	Name of the organization	Rate 01.01.2023, RUB/cubic meter. (excluding VAT)	Rate 01.07.2024, RUB/cubic meter. (excluding VAT)	Change, %
1	MUP "Vodokanal"	18.36	18.49	0.71
2	JSC "Stroykeramika"	24.06	26.42	9.81
3	Federal State Budgetary Institution "Military Unit 95504"	6.61	8.87	34.19
4	PJSC "T Plus"	5.29	5.99	13.23
5	Federal State Budgetary Institution of the Central Housing and Utilities Department (State Housing and Utilities Department)	38,44	42.18	9.73
	On average for the market for the period			13.53

According to the table, the lowest tariff increase was at MUP Vodokanal - 0.71%, the highest at FGKU Voyskovaya Chast 95504 - 34.19%, the average increase in the tariff for cold water supply in Yoshkar-Ola was 13.53%. Thus, according to Table 1, class C is assigned for the first indicator.

2. The composition of economic entities operating in the commodity market, which is in a state of natural monopolies, remains unchanged for consumers, class B is assigned.
3. The share of each of the economic entities operating in the commodity market, which is in a state of natural monopoly, is 100%. Class C is assigned.
4. The level of concentration of the thermal energy commodity market is high, the Herfindahl-Hirschman index is 10000. The indicator should be assigned class C.
5. No disagreements related to the calculation of tariffs from 2023 to 04/07/2024 were found in the search for information on cases on the website of the Supreme Court of the Republic of Mari El. No

information on violations of the pricing procedure was found on the website of the Mari UFAS of Russia either. The FAS Russia has not issued any orders for this market, which allows us to assign class A to this indicator.

6. According to information in open sources, there were no liquidations (bankruptcies) of business entities in this period; class A is assigned.

Let us calculate the integral indicator of the point-rating system using the example of subjects of the tariff regulation system in the cold water supply commodity market:

$$I1 = 0.17 \times C + 0.17 \times B + 0.2 \times C + 0.1 \times C + 0.23 \times A + 0.13 \times A = 0.17 \times 1 + 0.17 \times 0.5 + 0.2 \times 1 + 0.1 \times 1 + 0.23 \times 0 + 0.13 \times 0 = 0.17 + 0.085 + 0.2 + 0.1 + 0 + 0 = 0.555$$

The integral indicator of 0.555 corresponds to the average level of threat to economic security, it is necessary to continue monitoring the commodity market. If the natural monopolist files a lawsuit and wins the case, the integral indicator will take the value equal to 0.785, which will indicate a high level of threat to economic security in the commodity market of cold water supply.

#### Product market for water disposal in Yoshkar-Ola, Republic of Mari El:

1. Water disposal tariffs are presented in (table 4).

**Table 4.** Dynamics of changes in tariffs for water disposal in the city of Yoshkar-Ola, Republic of Mari El from 01.01.2023 to 01.07.2024.

No.	Name of the organization	Rate 01.01.2023, RUB/cubic meter. (excluding VAT)	Rate 01.07.2024, RUB/cubic meter. (excluding VAT)	Change, %
1	MUP "Vodokanal"	21.72	22.91	5.48
2	Federal State Budgetary Institution of the Central Housing and Utilities Department (State Housing and Utilities Department)	31.23	32.70	4.71
	On average for the market for the period			5.09

According to the table, the average increase in the water disposal tariff in Yoshkar-Ola was 5.09%. Thus, according to table 1, class B is assigned for the first indicator.

2. The composition of economic entities operating in the commodity market, which is in a state of natural monopolies, remains unchanged for consumers, class B is assigned.
3. The share of each of the economic entities operating in the commodity market, which is in a state of natural monopoly, is 100%. Class C is assigned.
4. The level of concentration of the thermal energy commodity market is high, the Herfindahl-Hirschman index is 10000. The indicator should be assigned class C.
5. No disagreements related to the calculation of tariffs from 2023 to 04/07/2024 were found in the search for information on cases on the website of the Supreme Court of the Republic of Mari El. No information on violations of the pricing procedure was found on the website of the Mari UFAS of Russia either. The FAS Russia has not issued any orders for this market, which allows us to assign class A to this indicator.
6. According to information in open sources, there were no liquidations (bankruptcies) of business entities in this period; class A is assigned.

Let us calculate the integral indicator of the point-rating system using the example of subjects of the tariff regulation system in the cold water supply commodity market:

$$I1 = 0.17 \times B + 0.17 \times B + 0.2 \times C + 0.1 \times C + 0.23 \times A + 0.13 \times A = 0.17 \times 0.5 + 0.17 \times 0.5 + 0.2 \times 1 + 0.1 \times 1 + 0.23 \times 0 + 0.13 \times 0 = 0.085 + 0.085 + 0.2 + 0.1 + 0 + 0 = 0.47$$

The integral indicator of 0.47 corresponds to the average level of threat to economic security; it is necessary to continue monitoring the commodity market. If the natural monopolist files a lawsuit and wins the case, the integral indicator will take the value equal to 0.7, which will indicate approaching a high level of threat to economic security in the commodity market of water disposal.

## CONCLUSION

Based on the results of the conducted assessment of the level of economic security of subjects of the tariff regulation system of commodity markets of basic industries: thermal energy, water supply and sanitation within the geographical boundaries of the city of Yoshkar-Ola of the Republic of Mari El, for all commodity markets of basic industries received an average level of threat to economic security. It is necessary to further monitor the commodity markets of basic industries and in the event of an increase in the level of threat to economic security, a timely response from the authorities in whose department these areas of activity of subjects of natural monopolies are located. Based on the results of the study, the monitoring methodology for assessing the level of economic security of natural monopolies was also improved through the development of a procedure for determining a rating characterizing the level of economic security in commodity markets for the indicator disagreements in calculating tariffs, compliance with the pricing procedure. The proposed methodology can be further applied to research commodity markets of basic industries throughout the country, and the information processing process can be automated through the use of digital twins.

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## REFERENCES

1. Pigou, A. C. (1920) *The Economics of Welfare*. London: Macmillan. URL: <http://pombo.free.fr/pigou1920.pdf>
2. Ahmed, T., Sipra, H., Zahir, M., Ahmad, A., & Ahmed, M. (2022) Consumer perception and behavior toward water supply, demand, water tariff, water quality, and willingness-to-pay: A cross-sectional study. *Water Resources Management*, 36(4), 1339-1354. DOI: [10.1007/s11269-022-03085-5](https://doi.org/10.1007/s11269-022-03085-5).
3. Amador M., Bagwell K. (2022) Regulating a monopolist with uncertain costs without transfers // *Theoretical Economics*. Vol. 17. P. 1719-1760. DOI: <https://doi.org/10.3982/TE4691>
4. Amorim, D., Resende, M., & Miranda, R. J. S. (2023). The effect of economic regulation on the implementation of the social tariff in the water sector. DOI: <http://dx.doi.org/10.2139/ssrn.4314048>.
5. Baron D., Myerson R. (1982) Regulating a monopolist with unknown costs // *Econometrica*. Vol. 50. P. 911-930. DOI: <https://doi.org/10.2307/1912769>
6. Caravaggio, A., De Cesare, L., & Di Liddo, A. (2024) Socio-economic determinants of pricing water for domestic use: A comparison of blocks and linear tariffs. *Socio-Economic Planning Sciences*, 93, 101876. DOI: <https://doi.org/10.1016/j.seps.2024.101876>.
7. Delgado, A., Charles, M.M., Evans, M., Kholod, N., Kuznetsov, A., Pinchuk, S., & Kutsman, V. (2021) *Tariff Setting in the District Heating Sector: Recommendations Based on International Experience* (No. PNNL-30956). Pacific Northwest National Lab. (PNNL), Richland, WA (United States). P. 47. URL: [https://www.pnnl.gov/main/publications/external/technical\\_reports/PNNL-30956.pdf](https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-30956.pdf)
8. Djørup, S., Sperling, K., Nielsen, S., Østergaard, PA, Zinck Thellufsen, J., Sorknæs, P., ... & Drysdale, D. (2020) District heating tariffs, economic optimization and local strategies during radical technological change. *Energies*, 13(5), 1172. DOI: <https://doi.org/10.3390/en13051172>
9. Macchiaroli, M., Dolores, L., & De Mare, G. (2023) Design the Water Tariff Structure: Application and Assessment of a Model to Balance Sustainability, Cost Recovery and Wise Use. *Water*, 15(7), 1309. DOI: <https://doi.org/10.3390/w15071309> <https://doi.org/10.3390/w15071309>.
10. Whittington, D., & Nauges, C. (2020) An assessment of the widespread use of increasing block tariffs in the municipal water supply sector. In *Oxford Research Encyclopedia of Global Public Health*. DOI: <https://doi.org/10.1093/acrefore/9780190632366.013.243>.
11. Xenarios, S., Edwards, E.Y., & Buurman, J. (2023) *Water Tariffs and Affordability in Urban Water Supply and Wastewater Systems*. Available at SSRN 4401666. DOI: [10.5194/egusphere-egu22-13391](https://doi.org/10.5194/egusphere-egu22-13391).

12. Ziemele, J., Vigants, G., Vitolins, V., Blumberga, D., & Veidenbergs, I. (2014) District heating systems performance analyses. Heat energy tariff. *Environmental and climate technologies*, 13(1), 32-43. DOI:<https://doi.org/10.2478/rtuct-2014-0005>.