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## ELECTRICITY CONSUMPTION AND THE GROWTH OF REGIONAL ECONOMIES

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*The relevance of the research topic is due to the need to determine a scientifically sound approach to the sustainable development of the Russian Federation and its subjects, whose economies are constantly influenced by many different factors, including latent influence on it. One of these factors is electricity, or rather its consumption, which is characterized in linear correlation models by the dependence between variables: electricity consumption and gross regional product. In turn, electricity consumption is influenced by prices set by government authorities, which can both stimulate and reduce electricity consumption in the region, and hence the growth rate of regional economies. Unlike other publications on this topic, the article uses a territorial approach, the grouping method, and correlation and regression analysis to determine whether authorities can make incident decisions to increase or decrease the cost of electricity in a region (typological group of regions), which represents certain elements of novelty. As a result of the study, three main groups of regions were formed: two with a positive correlation between the region's electricity consumption and the gross regional product, and one with a negative one. Conclusions have been drawn for each group and practical recommendations regarding tariff policy have been given. Confidence intervals (with a confidence level of 99%) are used to assess the accuracy of the results obtained and to test them. Theoretically,*

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*the research results make an estimated contribution to the sustainable development of the region, taking into account the use of electricity as one of the factors of economic growth; in practical terms, the conclusions and recommendations can be useful to regional authorities in implementing their tariff policy.*

*Gross regional product, demand for electricity, tariff policy, energy saving, correlation, territorial and sectoral balance, regions of Russia, regression analysis.*

## Introduction

A steady growth in electricity consumption is a pronounced global trend. According to forecasts by the International Energy Agency, global electricity consumption could rise by roughly 4% in 2026, driven by growing demand: in the United States consumption may grow by about 2%, and in European countries by around 2.5%. Expert estimates suggest that electricity demand in Russia could increase by the same 2.5% in 2026. Overall, Rosstat data<sup>1</sup> indicate that electricity consumption in Russia has grown by 13.31% over the past ten years (from 2014 to 2024).

Both in theory and in practice, a certain relationship exists between economic growth and the use of energy resources (including electricity consumption). An analysis of the productive economic activity of Russia's federal subjects shows that, over the period from 2008 to 2022, the gross regional product (GRP) of the Kaluga Region rose by 461.42% (from 150,394.4 million to 693,947.6 million rubles), while electricity consumption increased by 182.5% (from 4,250.5 million to 7,757.2 million kWh); in the Republic of Adygea, GRP grew by 545.1% (from 36,134.4 million to 197,082.0 million rubles), and electricity consumption rose by 199.1% (from 992.5 million to 1,975.2 million kWh); and in the Republic of Ingushetia, GRP expanded by 428.87% (from 19,172.9 million to 82,227.3 million rubles), with electricity consumption up by 189.78% (from 495.1 million to 939.6 million kWh)<sup>2</sup>.

On the other hand, in several regions of the country, growth in GRP over the same period has been accompanied by a decline in electricity consumption. In the Tomsk Region, for instance, a 325.26% increase in GRP was recorded alongside a drop in electricity consumption (to 83.05% of the earlier level); a similar picture is observed in the Kurgan Region, Ulyanovsk Region, and other constituent entities of the Russian Federation: GRP growth (of 319.64 and 390.78%, respectively) went hand in hand with falling electricity consumption (down to 88.46 and 86.77% of the earlier level). This heterogeneity in electricity consumption – characterized by both positive and negative dynamics – gives rise to uneven rates of regional economic growth, which may be attributable to the differing electricity prices that result from each region's energy policy.

Theoretical studies by foreign authors (Escribano, Sucarrat, 2018; Wang et al., 2018; Dong et al., 2019; Yilmaz et al., 2019; Haluzan et al., 2020; He et al., 2020; Richstein, Hosseinioun, 2020; Zhang et al., 2020; Lu et al., 2021; Uniejewski, Weron, 2021) and the multivariate economic-mathematical models built upon them demonstrate that the pricing mechanism does influence economic growth. In developing and transition economies, “the causal relationship between electricity consumption and economic growth manifests

<sup>1</sup> Regions of Russia. Socio-Economic Indicators. 2023. Available at: <https://rosstat.gov.ru/folder/210/document/13204> (accessed: 21.03.2026).

<sup>2</sup> Electricity production and consumption in the Russian Federation. Available at: <https://fedstat.ru/indicator/33942?ysclid=mbkyzl51ja648798770> (accessed: 21.03.2026); Electricity consumption by subjects of the Russian Federation. Available at: [https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Frosstat.gov.ru%2Fstorage%2Fmediabank%2Felbalans\\_2023.xlsx&wdOrigin=BROWSELINK](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Frosstat.gov.ru%2Fstorage%2Fmediabank%2Felbalans_2023.xlsx&wdOrigin=BROWSELINK) (accessed: 21.03.2026).

itself in linear direct-dependence models in which the main argument is energy elasticity: the more energy resources are drawn into productive economic activity, the higher the rate of economic growth” (Belov, 2025).

At the same time, one important fact should be noted: the demand for electricity is inelastic (owing to the vital necessity of this “commodity” and the absence of a full-fledged alternative), whereas the supply of electricity should be regarded as elastic (given the availability of production capacity in many regions of the country), with producers that not only aim to maximize profits but are also capable of responding promptly to changing market conditions and needs. This means that permanent demand will be met by the requisite supply of electricity, a situation which, in principle, contradicts the concept of energy conservation and the relevant documents adopted in the country<sup>3</sup>. Consequently, price regulation in different regions of the country should lead to the necessary territorial-sectoral balance between electricity production and consumption – a balance that, on the one hand, ensures regional economic growth and, on the other, the implementation of energy conservation policy. It follows that electricity consumption – or, more precisely, its price – acts as one of the factors promoting a region’s economic growth. In this connection, an analysis of regional electricity consumption appears essential in order to develop and apply an effective pricing mechanism capable of fostering regional economic growth under conditions of sustainable development.

### Literature review

The Russian periodical press contains a substantial number of contemporary publications devoted to the study of energy consumption (including electricity consumption) both in individual regions and across the country as a whole. The pricing mechanism (tariff policy) is regarded by many authors as a key component in regulating economic development. For example, the authors (Temnaya, Agafonov, 2024) investigate the dependence of the electricity intensity of gross regional product on electricity prices and conclude that lowering electricity prices leads to an increase in GRP electricity intensity. This conclusion is drawn on the basis of a calculated linear dependence coefficient that takes a negative value. In another paper (Nekrasov, 2023), by contrast, the author proposes stimulating electricity consumption in lagging regions with low electric power availability as a means of raising the profitability of goods produced and boosting labor productivity. In yet another article, the same author likewise suggests increasing electricity consumption by reducing electricity prices. The author concludes that this should be done for “new non-household electricity consumers in regions where per capita electricity consumption is below the level of developing countries” (Nekrasov, 2022) – that is, for industrial and agricultural production. This, it is argued, would help preserve the “structural resilience” of the Russian economy. One may add here another paper that proposes the same instrument of state regulation – lowering tariffs for electricity transmission services – in order to “enhance

<sup>3</sup> On Certain Measures to Improve the Energy and Environmental Efficiency of the Russian Economy: Decree of the President of the Russian Federation No. 889 of June 4, 2008. Available at: <http://www.kremlin.ru/acts/bank/27565> (accessed: 21.03.2026); On Energy Conservation and Improvement of Energy Efficiency and on Amendments to Certain Legislative Acts of the Russian Federation: Federal Law No. 261-FZ of November 23, 2009 (latest version). Available at: [https://www.consultant.ru/document/cons\\_doc\\_LAW\\_93978/?ysclid=lq5fnxxfr5684472709](https://www.consultant.ru/document/cons_doc_LAW_93978/?ysclid=lq5fnxxfr5684472709) (accessed: 21.03.2026); On Approval of the Comprehensive State Program of the Russian Federation “Energy Conservation and Improvement of Energy Efficiency”: Resolution of the Government of the Russian Federation No. 1473 of September 9, 2023. Available at: <https://docs.cntd.ru/document/1302984058?ysclid=lova6gywsu596227627> (accessed: 21.03.2026); On Approval of the Strategy for the Spatial Development of the Russian Federation for the Period up to 2030, with a Forecast up to 2036: Resolution of the Government of the Russian Federation No. 4146-r of December 28, 2024. Available at: <https://docs.cntd.ru/document/1310767692?section=status> (accessed: 21.03.2026).

the investment attractiveness of depressed and less developed regions” (Afanas’ev et al., 2023). In a further article (Petrov, Serkov, 2024), causal relationships are identified between economic growth and the electricity consumption of industrial enterprises (using the examples of two subjects of the Russian Federation – Sverdlovsk Region and Chelyabinsk Region). The authors conclude that electricity consumption in the Sverdlovsk Region “depends solely on the rate of economic growth”, whereas in the Chelyabinsk Region, which has a similar industrial potential, it depends on the volume of industrial output.

Another study defines the outlook for electricity demand in the country’s regions over the period 2025–2040. The authors note differences in electricity consumption across regions “due to substantial specificities in sectoral specialization and the standard of living of the population” (Mazurova et al., 2022) and conclude that the existing trend will persist – demand will increase by an average of 1.4–1.8% per year, primarily in the Siberian and Far Eastern federal districts. The article by I.G. Akhmetova, E.M. Mainaksky, and A.E. Popov also addresses the dependence of the socio-economic development of territories (municipal formations) on electricity consumption, which is not fully reflected in the “indicative system for assessing the economic development of municipal formations of a subject of the Russian Federation on the basis of electricity consumption” (Akhmetova et al., 2024).

There are other publications on the research topic as well (Gorbacheva, 2020; Ishchuk, 2019; Kareva, 2017; Maslova, Daneev, 2019; Nigmatulin, 2019; Yurkov, 2018; Yashchenko, 2022). However, a number of important considerations prompt further investigation in this area. First, it is apparent that authors frequently adhere to one of two approaches – either a sectoral or a territorial one – whereas the relationship between economic growth and regional electricity consumption calls for

an integrated territorial-sectoral approach. Second, the authors’ studies tend to conclude with recommendations aimed either at entire sectors of the Russian economy or at the classification status of a region, which makes it difficult for regional authorities to arrive at sound decisions, since their actions are confined to a specific territorial unit and a specific sector. In other words, the decisions that can be taken can be implemented only within a territorial-sectoral framework. Third, the partly contradictory nature of the measures proposed regarding electricity consumption (whether to increase or to reduce it) gives rise to the need to group the subjects of the Russian Federation in order to formulate not generic but typological solutions for regions characterized by the application of similar development models. Fourth, any decision taken by regional authorities must rest on data analysis and on the identification of cause-and-effect relationships that can be established empirically. It is precisely for these reasons that systematic additional research is required, and that is what the present article is devoted to.

### **Research aim and methodology**

This study aims to assess the extent to which electricity consumption across Russia’s constituent entities drives regional economic growth, viewed through the lens of sustainable development, and to provide a basis for informed decisions on regional tariff policy.

The empirical base includes official data from the Federal State Statistics Service (Rosstat) covering the period 2008–2023 and spanning three indicators: gross regional product, electricity consumption by federal subject, and the electricity balance disaggregated by broad consumer categories. All 85 federal subjects for which Russian statistics provide data are covered in the analysis, with the exception

of four recently incorporated regions – the Lugansk and Donetsk people’s republics and the Kherson and Zaporozhye regions – for which comprehensive statistical data are unavailable.

The study proceeds through several stages. The first stage involves calculating three sets of indicators. The first is Pearson’s pairwise correlation coefficient ( $r$ ), derived from the dynamics of GRP and electricity consumption in each region. The second is the electricity intensity of gross regional product, computed as the ratio of the region’s mean electricity consumption over the period under study to its mean GRP. The third is the share of electricity consumed in the region in 2023 accounted for by the three largest end-users, whose combined consumption exceeds 50% of the total. These end-users are: (a) mining and quarrying; manufacturing; electricity, gas, steam, and air conditioning supply; water supply; sewerage, waste management, and remediation activities (Sections B, C, D, and E are aggregated in the official statistics and cannot be decomposed further); (b) urban and rural households; and (c) losses in electricity networks.

In the second stage, the federal subjects are grouped into unequal intervals, defined in line with the study’s aim and objectives. The first group comprises regions where the correlation coefficient is negative. A second group is formed of regions where  $r$  exceeds 90%, indicating a very high correlation between the two variables (on the Chaddock scale). The remaining regions, where the correlation coefficient falls between 0% and 90%, make up the third group. The fourth stage is designed to verify the precision of the results. Confidence intervals are calculated at a 99% confidence level (left and right bounds), and a typical federal subject is identified within each of the three groups. Beyond their role in precision assessment, the confidence bounds, together with the chosen confidence level, define the band within which the indicator is expected to fluctuate with the specified reliability. A deviation beyond these bounds – to either

the left or the right – is treated as a critical signal and requires heightened attention from government authorities in managerial decision-making. The fifth stage draws conclusions and puts forward policy recommendations.

### Research results

The second stage of the study established that 17 subjects of the Russian Federation (20%) exhibit a negative linear correlation, with the strength of the association between the variables differing quite considerably – by a factor of 12.5 – from  $r = -6.39\%$  in the Sverdlovsk Region to  $r = -80.48\%$  in the Republic of North Ossetia – Alania (*Tab. 1*).

This group of regions is characterized by large outliers and heterogeneity. In addition to the substantial differences in the correlation coefficient, there are also significant differences among the subjects in the following indicators: Sections B, C, D, and E, where the values differ by a factor of 11.5 between the Khanty-Mansi Autonomous Area – Yugra and the Ivanovo Region; urban and rural population, with a 3.3-fold difference between the Khanty-Mansi Autonomous Area – Yugra and the Republic of North Ossetia – Alania; and losses in electricity networks, where a 4.8-fold gap separates the Republic of Khakassia from the Republic of North Ossetia – Alania. All these data point to an abnormal, multimodal distribution with several peaks.

The very presence of a negative correlation, as indicated by the coefficient, allows a definitive conclusion to be drawn for this entire group: to enhance economic growth in the context of sustainable development, electricity consumption in the region must be reduced. This conclusion is further corroborated by the fact that the highest GRP electricity intensity in Russia is observed precisely in the Republic of Karelia, the Republic of Khakassia, and the Kemerovo Region – all of which rank among the top 10 subjects with the highest values. Accordingly, the tariff policy pursued by regional authorities should be “tight” and aim at

**Table 1. Russian Regions with a negative correlation between electricity consumption and GRP (Group 1)**

No.	RF constituent entity	Correlation coefficient, %	GRP electricity intensity, %	Sections B, C, D, E, %	Urban and rural population, %	Losses in electricity networks, %
1	Republic of North Ossetia – Alania	-80.48	1.41	30.03	<b>36.99</b>	13.15
2	Ulyanovsk Region	-77.04	<b>1.77</b>	32.55	<b>22.75</b>	<b>7.50</b>
3	Tomsk Region	-64.58	<b>1.91</b>	<b>57.68</b>	<b>16.01</b>	<b>9.05</b>
4	Ivanovo Region	-61.08	<b>1.86</b>	32.28	<b>26.19</b>	<b>10.32</b>
5	Murmansk Region	-57.63	<b>2.53</b>	<b>71.18</b>	8.13	<b>7.05</b>
6	Kurgan Region	<b>-55.21</b>	<b>2.22</b>	26.48	<b>23.36</b>	12.38
7	Republic of Mari El	<b>-47.47</b>	<b>1.87</b>	31.20	<b>21.70</b>	<b>8.76</b>
8	Bryansk Region	<b>-45.97</b>	1.33	32.47	<b>27.01</b>	11.58
9	Volgograd Region	<b>-44.85</b>	<b>2.25</b>	<b>51.34</b>	<b>18.02</b>	12.25
10	Republic of Karelia	<b>-33.29</b>	<b>3.45</b>	<b>56.91</b>	<b>13.59</b>	4.65
11	Kemerovo Region	<b>-33.14</b>	<b>3.52</b>	<b>72.84</b>	8.80	4.90
12	Republic of Khakassia	<b>-32.16</b>	<b>8.95</b>	<b>86.07</b>	6.41	2.73
13	Saratov Region	-26.85	<b>2.06</b>	<b>43.72</b>	<b>20.79</b>	<b>9.30</b>
14	Khanty-Mansi Autonomous Area – Yugra	-20.96	<b>2.11</b>	<b>88.41</b>	3.20	3.62
15	Altai Territory	-9.67	<b>2.09</b>	33.83	<b>23.48</b>	<b>9.50</b>
16	Nizhny Novgorod Region	-7.49	<b>1.83</b>	<b>53.01</b>	<b>15.02</b>	<b>8.90</b>
17	Sverdlovsk Region	-6.39	<b>2.50</b>	<b>59.20</b>	12.29	<b>6.45</b>
	Left bound of CI	-55.81	1.48	37.97	12.43	6.40
	Right bound of CI	-27.05	3.66	63.11	23.30	10.32

Note: the first 10 subjects of the Russian Federation with the lowest values in the entire set of regions are highlighted in green; the last 10 subjects with the highest values are highlighted in yellow.  
Calculated from: Rosstat data.

raising the cost of electricity. In other words, it can be concluded that, for this group of regions, electricity consumption is not the main factor driving their sustainable development.

The reason is that the above-mentioned regions of the country continue to follow a development model typical of the past – a “brown” economy – in which economic growth is underpinned by rising energy consumption. The old, unsustainable development model is thus being reproduced, whereas current regulatory documents call for precisely the opposite: reducing energy consumption and improving energy efficiency. Moreover, a substantial share of enterprises in this group of regions still rely on outdated, energy-intensive equipment in need of modernization

or complete replacement. To achieve these goals, the authorities have a sufficient “arsenal” of instruments at their disposal. One such instrument within the framework of tariff policy is raising the cost of electricity. This measure can produce different outcomes. On the one hand, it may lead to a contraction in output volumes as production costs and prices rise, which is unacceptable. On the other, it may spur the adoption of modern, advanced, and less energy-intensive equipment, which is simply indispensable. In order to sustain the required output volumes and provide support to economic entities, regional authorities can stimulate the uptake of more energy-efficient equipment at energy-intensive enterprises by lowering regional and local tax rates. In this

scenario, the expected consequences are a reduction in the amount of energy resources drawn into productive activity and, at the same time, an increase in the quantity of output through the deployment of new equipment. Further growth of the regional economies could thus be ensured.

The second group of regions consists of 23 RF subjects that are homogeneous in terms of the correlation coefficient. Differences in

the other indicators persist, however. Thus, for the “Sections B, C, D, and E” indicator, the gap between the Chechen Republic and the Chukotka Autonomous Area is 9.3-fold; for “urban and rural population”, there is a 5.9-fold difference between the Republic of Tyva and the Chukotka Autonomous Area; and for “losses in electricity networks”, a 12.4-fold gap separates the Belgorod Region from the Republic of Ingushetia (Tab. 2).

**Table 2. Russian regions with a positive correlation between electricity consumption and GRP ( $r > 90\%$ ) (Group 2)**

No.	RF constituent entity	Correlation coefficient, %	GRP electricity intensity, %	Sections B, C, D, E, %	Urban and rural population, %	Losses in electricity networks, %
1	Krasnodar Territory	99.11	1.11	25.53	28.23	11.10
2	Kamchatka Territory	97.82	0.91	28.34	26.51	10.74
3	Voronezh Region	97.79	1.45	46.44	19.80	9.02
4	Republic of Sakha (Yakutia)	97.78	0.94	49.29	10.14	12.24
5	Kabardino-Balkarian Republic	97.62	1.15	21.34	27.24	20.91
6	Republic of Tyva	97.22	1.37	20.96	37.16	17.98
7	Chechen Republic	97.16	1.53	8.14	34.21	34.07
8	Primorye Territory	96.45	1.61	26.26	29.55	10.42
9	Republic of Tatarstan	96.29	1.38	61.36	12.19	5.34
10	Rostov Region	95.82	1.47	42.11	21.70	11.57
11	Smolensk Region	94.91	2.31	63.68	13.91	8.12
12	Ryazan Region	94.67	1.92	40.56	15.30	6.16
13	Amur Region	93.88	2.60	28.23	13.71	7.73
14	Magadan Region	93.85	1.57	70.64	6.68	10.21
15	Republic of Ingushetia	93.70	1.38	10.33	18.06	48.58
16	Republic of Altai	91.85	1.32	8.35	30.30	13.83
17	Jewish Autonomous Region	91.62	2.64	38.77	15.72	7.11
18	Republic of Adygea	91.52	1.48	29.54	25.91	10.35
19	Republic of Crimea	91.12	1.43	17.56	36.96	12.40
20	Chukotka Autonomous Area	90.94	0.89	76.00	6.29	10.39
21	Belgorod Region	90.84	2.07	63.78	8.46	3.93
22	Leningrad Region	90.60	2.26	46.95	12.54	8.65
23	Novgorod Region	90.49	1.90	49.52	14.85	9.54
	Left bound	92.94	1.32	27.19	15.06	7.74
	Right bound	96.02	1.87	48.78	25.41	18.38

Note: the first 10 subjects of the Russian Federation with the lowest values in the entire set of regions are highlighted in green; the last 10 subjects with the highest values are highlighted in yellow. Calculated from: Rosstat data.

A direct correlation between electricity consumption and GRP suggests a conclusion opposite to that for Group 1: growth in electricity consumption in the region should lead to growth in GRP. This conclusion holds true, however, under only one condition: that electricity consumption cannot be increased in those sectors and branches of the regional economy that have already reached a critical level – in our case, those highlighted in yellow in Table 2. This condition rests on the regulatory documents on energy conservation and energy efficiency improvement adopted in the Russian Federation. Only if this condition is met can the sustainable development of the subject be ensured. Consequently, the tariff policy pursued by regional authorities with respect to this group of regions should be “soft”, stimulating electricity consumption by lowering electricity tariffs in those sectors and spheres where it is needed.

The third group of regions is the most numerous, comprising 45 subjects of the Russian Federation. Like Group 2, it is characterized by a positive correlation between electricity consumption and GRP, but it is the most heterogeneous of all, with substantial differentiation across every indicator. Thus, the correlation coefficients calculated for the Arkhangelsk Region (excluding the autonomous area) and for the Kaluga Region differ by a factor of more than 180. GRP electricity intensity shows an 8.3-fold difference between Moscow and the Chelyabinsk Region. For the “Sections B, C, D, and E” indicator, the gap between the Republic of Kalmykia and the Nenets Autonomous Area is 15.6-fold; for “urban and rural population”, a 17.8-fold difference separates the Pskov Region from the Nenets Autonomous Area; and for “losses in electricity networks”, a staggering 2524-fold gap exists between the Nenets Autonomous Area and the Republic of Kalmykia (*Tab. 3*).

The conclusion and recommendations drawn for Group 2 are, on the whole, also relevant for Group 3. For Group 3, however, one qualification applies, and it is this that distinguishes Group 2 from Group 3. According to the Chaddock scale,

for regions with a weak, moderate, or noticeable correlation between electricity consumption and GRP – that is, regions where  $r \leq 70\%$  – an increase in electricity consumption in sectors and spheres with high or critical electricity consumption is permissible, but only on condition that the GRP electricity intensity is not at a critical level. In the Komi Republic, for instance, it is permissible to ramp up electricity consumption in the industries that correspond to Sections B, C, D, and E, whereas in the Perm Territory it is not, owing to the high GRP electricity intensity, which has reached a critical level.

In this group, tariff policy does not lend itself to one-size-fits-all solutions and requires further subdivision of the regions in order to adopt typological decisions on electricity pricing. For example, an additional subgroup could be distinguished comprising regions where electricity consumption under the “urban and rural population” indicator is high or critical (Kaliningrad Region, Pskov Region, and others). For these regions, in order to improve energy efficiency and ensure economic growth, electricity tariffs should be raised, thereby encouraging energy conservation. It is assumed that a price increase for the population, in the case of elastic demand, could be an effective instrument for implementing energy conservation policy in the region.

A similar subgroup could be formed of regions where network losses are high (Karachayev-Circassian Republic, Republic of Kalmykia, and others). Here, however, the pricing mechanism is hardly applicable: raising the cost of electricity would be passed on to the end consumer, as is common in everyday economic practice, while lowering it would lead to even greater waste, which is unacceptable. In this case, therefore, other instruments of state regulation are needed to compel electricity producers and distributors to close the gap represented by unjustifiable power losses.

At the fourth stage, the confidence intervals were calculated (left and right bounds) at a 99% confidence level. It is worth noting that

**Table 3. Russian regions with a positive correlation between electricity consumption and GRP (0% < r < 90%) (Group 3)**

No.	RF constituent entity	Correlation coefficient, %	GRP electricity intensity, %	Sections B, C, D, E, %	Urban and rural population, %	Losses in electricity networks, %
1	Arkhangelsk Region (excluding the autonomous area)	0.49	<b>1.69</b>	53.14	14.72	<b>8.40</b>
2	Perm Territory	0.72	2.28	<b>63.71</b>	11.66	<b>7.18</b>
3	Chuvash Republic	11.82	<b>1.89</b>	34.96	21.41	<b>9.03</b>
4	Karachayevo-Circassian Republic	15.70	<b>1.87</b>	<b>40.99</b>	25.97	<b>17.36</b>
5	Komi Republic	19.64	<b>1.60</b>	<b>67.71</b>	<b>9.38</b>	<b>6.98</b>
6	Republic of Buryatia	33.78	<b>2.48</b>	30.65	<b>18.22</b>	<b>9.62</b>
7	Pskov Region	47.54	1.43	25.88	<b>31.15</b>	<b>10.79</b>
...	...					
16	Samara Region	<b>60.98</b>	<b>1.94</b>	<b>43.45</b>	<b>20.26</b>	<b>7.27</b>
17	City of Saint Petersburg	<b>64.43</b>	<b>0.61</b>	<b>22.83</b>	<b>18.85</b>	<b>10.65</b>
18	Astrakhan Region	<b>65.50</b>	1.12	<b>46.91</b>	21.37	<b>11.81</b>
19	Irkutsk Region	<b>65.72</b>	<b>5.01</b>	61.06	<b>15.88</b>	<b>10.46</b>
20	Kursk Region	<b>71.53</b>	<b>2.31</b>	61.52	13.02	<b>8.09</b>
21	Omsk Region	<b>71.66</b>	<b>1.75</b>	<b>43.83</b>	<b>16.79</b>	<b>7.80</b>
22	Republic of Mordovia	<b>74.59</b>	<b>1.69</b>	<b>41.07</b>	<b>19.13</b>	<b>8.23</b>
...	...					
32	Republic of Kalmykia	81.05	<b>0.92</b>	<b>6.08</b>	21.69	<b>25.24</b>
33	Moscow Region	81.63	1.22	36.46	21.44	<b>15.01</b>
34	Nenets Autonomous Area	84.58	<b>0.83</b>	<b>94.76</b>	<b>1.75</b>	<b>0.01</b>
35	Krasnoyarsk Territory	84.68	<b>2.95</b>	<b>75.66</b>	<b>6.13</b>	<b>5.05</b>
36	Chelyabinsk Region	84.88	<b>2.98</b>	<b>70.50</b>	<b>10.55</b>	<b>5.09</b>
37	Tula Region	85.13	<b>1.97</b>	<b>64.89</b>	13.68	<b>8.20</b>
38	Lipetsk Region	85.29	<b>2.57</b>	<b>67.87</b>	<b>8.93</b>	<b>6.42</b>
39	Novosibirsk Region	85.43	<b>1.58</b>	26.40	23.91	<b>9.29</b>
40	Tyumen Region (excluding the autonomous areas)	85.51	<b>1.07</b>	<b>51.64</b>	<b>16.81</b>	<b>8.06</b>
41	Trans-Baikal Territory	85.90	<b>2.71</b>	28.01	<b>11.55</b>	<b>9.15</b>
42	Kaliningrad Region	86.08	<b>1.12</b>	26.53	<b>30.35</b>	<b>10.23</b>
43	City of Sevastopol	86.29	<b>1.55</b>	25.75	25.93	<b>8.14</b>
44	City of Moscow	86.41	<b>0.36</b>	<b>19.54</b>	21.06	<b>5.10</b>
45	Kaluga Region	88.85	<b>1.69</b>	<b>41.09</b>	22.26	<b>6.91</b>
	left bound	56.28	1.45	37.65	15.56	7.14
	right bound	74.65	2.08	52.55	20.95	12.44

Note: the first 10 subjects of the Russian Federation with the lowest values in the entire set of regions are highlighted in green; the last 10 subjects with the highest values are highlighted in yellow.  
 Calculated from: Rosstat data.

in Group 1, not a single subject of the Russian Federation fell within the bounds of the confidence interval, for the reasons outlined above – large outliers, heterogeneity of the

sample, multimodality, and so forth. For this reason, when selecting a typical region, we will be guided by the mean correlation coefficient for this group (–41.43%). The subject closest

in value for this parameter is the Volgograd Region. Using the method of regression analysis, we can construct a regression equation and form a model for the Volgograd Region (Fig. 1).

In contrast to Group 1, in Group 2 the bounds of the confidence interval (highlighted in bold in the tables) fully “envelope” one subject of the Russian Federation, which can unconditionally

be regarded as the typical representative of Group 2 (Fig. 2).

A notable fact here is that both regions (Volgograd and Rostov regions) not only belong to the same federal district, the Southern Federal District, but are also neighboring subjects in which, in order to ensure sustainable development, the regional energy policies should be diametrically opposed.

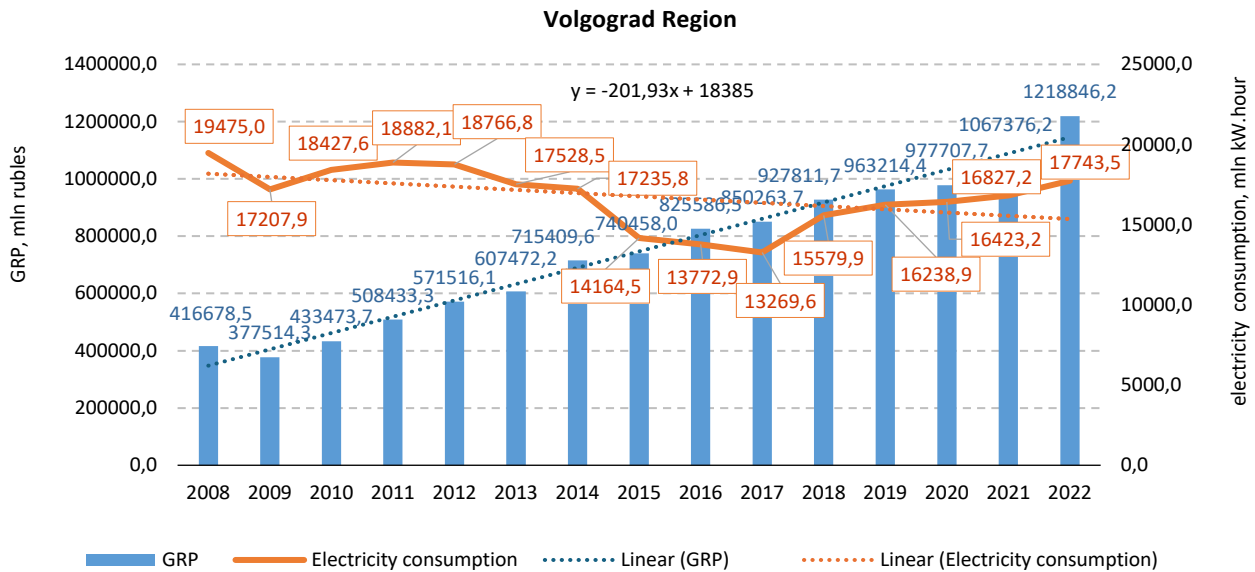


Figure 1. Regression model of electricity consumption for the Volgograd Region  
Compiled from: Rosstat data.

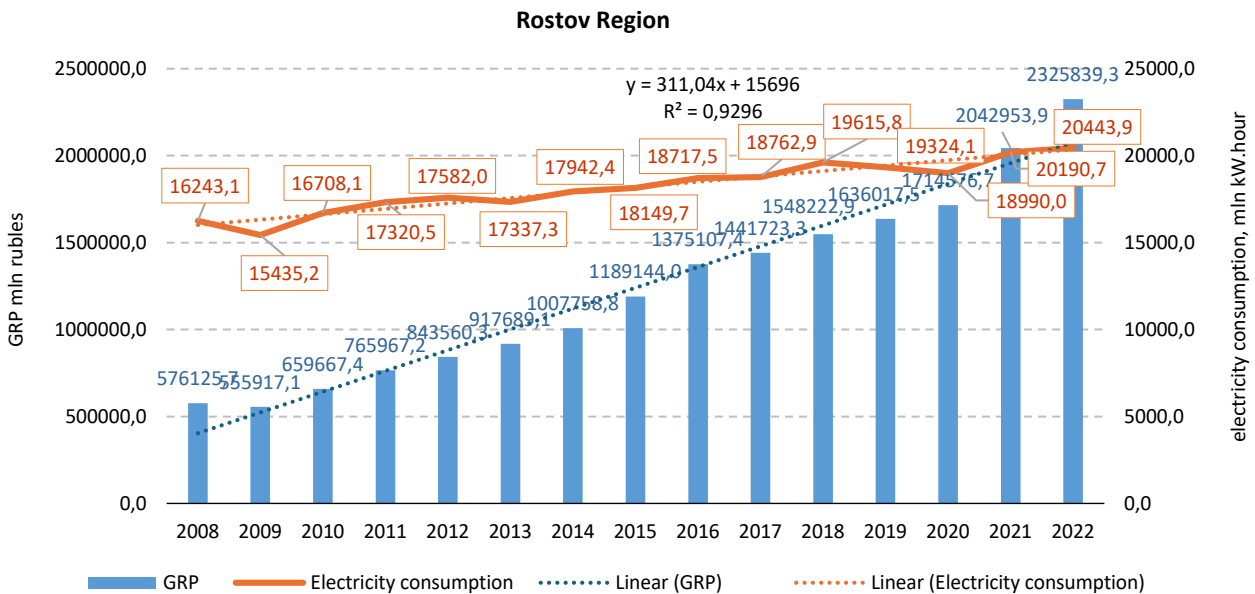


Figure 2. Regression model of electricity consumption for the Rostov Region  
Compiled from: Rosstat data.

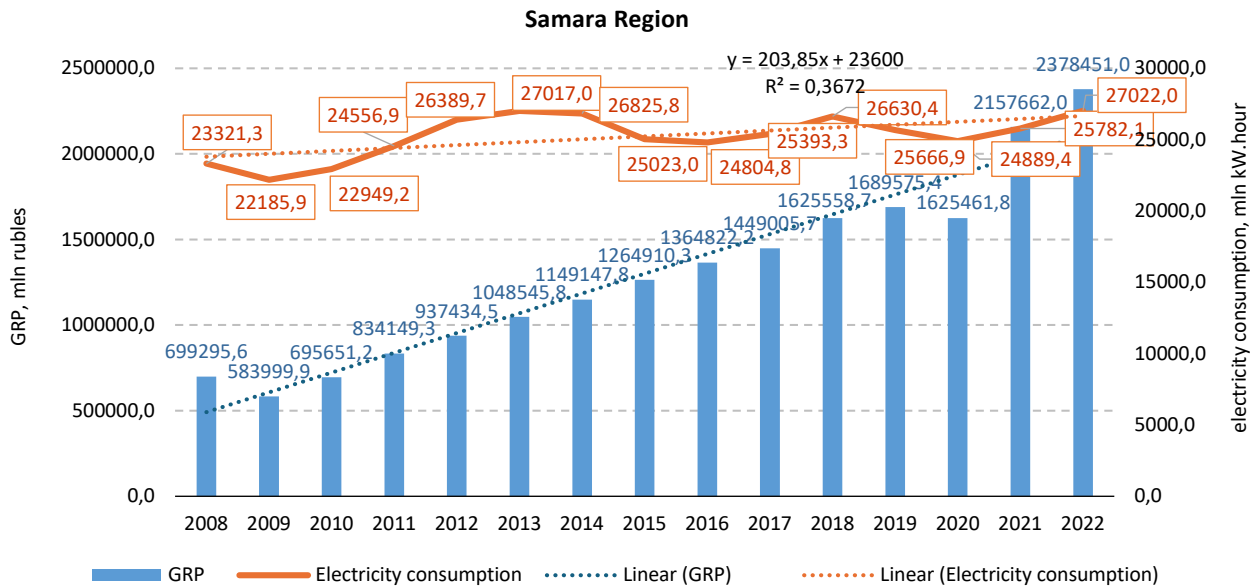


Figure 3. Regression model of electricity consumption for the Samara Region

Compiled from: Rosstat data.

In the third group of regions, the confidence interval “envelopes” three subjects of the Russian Federation simultaneously – the Samara Region, the Omsk Region, and the Republic of Mordovia. The choice of the typical region was made in favor of the Samara Region for the same reasons as in the case of Group 1: the mean value for the set (the correlation coefficient) stands at 65.74%, whereas the Samara Region’s figure is 60.98%. The regression model for the Samara Region is presented in *Figure 3*.

**Findings and discussion**

The conclusions drawn for Group 1 (see above) find confirmation in the practical activity of the authorities: the regional authorities raise the cost of electricity for consumers each year (see, for example, the documents relating to the Volgograd Region<sup>4</sup>). However, the stated objectives of such actions are different – above all, to compensate the energy companies for the costs they have borne when investing in the

sector using the RAB method – and this is not linked to the established dependence between electricity consumption and economic growth in the context of the region’s sustainable development. Yet tariff policy can, and should, be an effective instrument for regulating the development of the regional economy. Consequently, for Group 1, it is both feasible and necessary to raise the cost of electricity substantially in order to encourage industrial consumers to incorporate less energy-intensive and more productive equipment into their production processes, thereby fostering the growth of regional economies.

The conclusions drawn for Group 2 envisage reducing electricity tariffs, but Russian economic practice provides no evidence of such a move. The analysis we have conducted shows that this needs to be done for industrial consumers (Sections B, C, D, and E), especially in regions such as the Kabardino-Balkarian Republic, the Chechen Republic, the republics

<sup>4</sup> On Amendments to the Order of the Tariff Regulation Committee of the Volgograd Region No. 47/1 of December 10, 2024, “On Setting Prices (Tariffs) for Electric Energy for the Population and Equivalent Categories of Consumers in the Volgograd Region” and Order of the Tariff Regulation Committee of the Volgograd Region No. 47/1 of December 10, 2024, “On Setting Prices (Tariffs) for Electric Energy for the Population and Equivalent Categories of Consumers in the Volgograd Region” for 2025: Order of the Tariff Regulation Committee of the Volgograd Region No. 7 of February 28, 2025. Available at: <https://energosal34.ru/fizperson/tarify/deystvuyushchie-tarify/> (accessed: 21.03.2026).

of Tyva, Ingushetia, and Altai, in order to stimulate direct investment, raise the volume of industrial output (thanks to cheaper electricity and consequently lower production costs), and thus ensure the growth of regional economies in the context of sustainable development. In addition, in certain subjects of the Russian Federation – the Kamchatka Krai, the Republic of Sakha (Yakutia), and the Chukotka Autonomous Area – the creation of energy-intensive production facilities is deemed permissible, since at present the GRP electricity intensity of these regions is the lowest in the country.

The conclusions drawn for Group 3, as already set out above, correspond to those drawn and the recommendations made for Group 2, subject to the conditions and qualifications identified. A synthesis of these allows us to conclude that state regulation of electricity prices – whether stimulating or curbing electricity consumption – depends on the GRP electricity intensity: if the GRP electricity intensity is high, electricity tariffs should be high and should be raised; if the GRP electricity intensity is low, lowering tariffs should lead to regional economic growth and sustainable development of the region.

### Conclusion

Current trends in the electric power industry are characterized by a steady growth in the consumption of electrical energy, both throughout the world and in Russia. Each constituent entity of the Russian Federation, having its own distinct structure of electricity consumers, differs in the volumes of electricity it produces and consumes,

and this is reflected in its economic growth. At the same time, the regional authorities, in implementing their tariff policy, do not fully take into account the specific features of sustainable development of the territory.

The correlation coefficient between electricity consumption and GRP, which we have calculated and analyzed, establishes the existence of a relationship between the two, while its value determines the degree to which electricity consumption (the regressor) influences GRP (the regressand). The price of electricity is here viewed as one of the important factors that can either reduce or boost electricity consumption. In other words, the authorities' tariff policy represents an instrument for regulating the rate of growth both of individual sectors and branches of the economy and of the regional economy as a whole:

a) where a negative correlation exists (Group 1), raising the price of electricity should lead to the sustainable development of the regional economy, while lowering it would appear inadvisable, since the effect of such a step is unlikely to be positive.

b) where a positive correlation exists (Groups 2 and 3), lowering the price of electricity – accompanied by a rise in energy consumption – should lead to the sustainable development of the regional economy. For the regions belonging to Group 3, it should be noted that increasing electricity consumption is possible even in energy-intensive sectors and spheres, but only on condition that the GRP electricity intensity is not at a critical level. Raising prices, on the contrary, would most probably fail to yield a positive effect.

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## ЭЛЕКТРОПОТРЕБЛЕНИЕ И РОСТ РЕГИОНАЛЬНЫХ ЭКОНОМИК

*Актуальность темы исследования обусловлена необходимостью определения научно обоснованного подхода к устойчивому развитию Российской Федерации и ее субъектов, экономика которых находится под постоянным воздействием множества различных факторов, оказывающих на нее в том числе и латентное влияние. Одним из таких факторов является электроэнергия, точнее ее потребление, характеризующееся в корреляционных моделях линейной связи зависимостью между переменными: электропотреблением и валовым региональным продуктом. В свою очередь на потребление электроэнергии оказывают влияние устанавливаемые органами власти цены, которые могут как стимулировать, так и снижать электропотребление в регионе, а значит, и темп роста региональных экономик. В статье в отличие от иных публикаций по данной теме посредством территориального подхода, метода группировок и корреляционно-регрессионного анализа определяется возможность принятия органами власти инцидентных решений в части повышения или снижения стоимости электроэнергии в регионе (типологической группе регионов), что представляет собой определенные элементы новизны. В результате проведенного исследования были сформированы три основные группы регионов: две – с положительной корреляционной связью между электропотреблением в регионе и валовым региональным продуктом и одна – с отрицательной. По каждой группе сделаны выводы и даны практические рекомендации в отношении тарифной политики. Для оценки точности полученных результатов и их апробации используются доверительные интервалы (с уровнем доверия 99%). Результаты исследования в теоретическом плане вносят свой оценочный вклад в устойчивое развитие региона с учетом использования электроэнергии как одного из факторов экономического роста, в практическом плане выводы и рекомендации могут быть полезны органам региональной власти при осуществлении ими тарифной политики.*

*Валовой региональный продукт, спрос на электроэнергию, тарифная политика, энергосбережение, корреляционная связь, территориально-отраслевой баланс, регионы России, регрессионный анализ.*

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## ИНФОРМАЦИЯ ОБ АВТОРЕ

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