Assessment of the Formation of the Economic Effect of Cross-Subsidization in the Electric Power Industry

Aleksandra Leschinskaya 1,*, Oksana Kirillova 2 and Maksim Palyanov 2

1 Department of Finance Sustainable, Plekhanov Russian University of Economics, 117997 Moscow, Russia
2 Basic Department of FAS of Russia, Plekhanov Russian University of Economics, 117997 Moscow, Russia; kirillova.oy@rea.ru (O.K.); palyanov.mn@rea.ru (M.P.)

* Correspondence: leschinskaya.af@rea.ru

Abstract: The materials presented in the article reflect changes in the mechanism of cross-subsidization in the electric power industry, where price discrimination of consumers has taken place until recently. Historically, the established practice has been expressed in the redistribution of the burden of paying for electric energy between consumer groups, ensuring the containment of tariff growth. However, the reduction of tariffs for some categories of citizens was achieved by increasing them for others, social justice was violated and, for some buyers, the price is set above marginal costs, and for others—lower, although, in general, it led to prices corresponding to average costs. This policy was considered by the state as a measure of social support for the population but, at the same time, led to some negative consequences. The presented conceptual provisions for the creation of unified energy zones aimed at ensuring a fair redistribution of cross-subsidization between electricity consumers and a gradual reduction in its consumption will make it possible to form a unified energy space of Russia. On a concrete example, the socio-economic effects of the introduction of the author’s approach to the distribution of cross-subsidization between groups of consumers of electric power transmission services are identified and shown. They show the degree of influence of the amount of cross-subsidization paid by the consumer company on the cost of the final products that this company produces. The price of electric energy, which is part of the cost of production, significantly changes the consumer cost of energy-intensive production. The implementation of the proposals contained in the article will create economic incentives for the development of economically lagging regions and will make it possible to form an effective state tariff policy in the process of regulating the socio-economic development of the Russian Federation, defining an effective state tariff policy.

Keywords: electric power industry; cross-subsidization; tariff regulation; social justice; costs; mechanism of state regulation of prices; unified energy zones; prices (tariffs); marginal prices

1. Introduction

Justification of the approach to the distribution of cross-subsidization in the electric power industry is necessary to revise the current system of tariff regulation, which was formed by the middle of the first decade of this century. The considered cross-subsidization is an innovative mechanism for restraining the growth of tariffs, in which, for some buyers, the price is set above marginal costs, and for others it is lower, which in general leads to prices corresponding to an economically reasonable level. A significant number of publications are devoted to the development of a rational system of electricity tariffs [1–5]. The process of cross-subsidization is considered by the state as a measure of social support for the population but, in some cases, leads to some negative consequences; these directions are also reflected in the open press [6–9].

Cross-subsidization does not provide social justice, since, in fact, the amount of the subsidy is directly proportional to electricity consumption. That is, the most affluent household receives significantly more social assistance than a household with a lower income level [10,11].
As a result of the structural reforms carried out and against the background of the state’s policy in the field of electric power industry aimed at curbing the social consequences of rising energy prices for the population, many problems of a socio-economic nature began to form, in particular, in the field of activities of regulated organizations for which the state regulation of prices (tariffs) is carried out. Many of the problems are yet to be solved, and their relevance is only becoming stronger and growing every year [12], especially in the electric grid complex.

So, among the problems of the current tariff regulation system, it is necessary to pay special attention to the following:

- containment of tariffs for electric power transmission services for the population;
- the growth of useful vacation to the population;
- outstripping growth of tariffs for electric power transmission services for other consumers;
- reduction of useful vacation to other consumers;
- uncontrolled growth of cross-subsidization in the electric grid complex, which can be judged by the data provided in Table 1.

Table 1. Changes in the volume of cross-subsidization by the subjects of the Russian Federation with the minimum and maximum of their receipt *.

<table>
<thead>
<tr>
<th>№</th>
<th>Name of the Subject of the Russian Federation</th>
<th>The Amount of Cross-Subsidization, Thousand Rubles</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Subjects of the Russian Federation with minimal subsidies</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Republic of Crimea</td>
<td>474,698</td>
</tr>
<tr>
<td>2</td>
<td>Baikonur</td>
<td>107,264</td>
</tr>
<tr>
<td>3</td>
<td>Sevastopol</td>
<td>52,720</td>
</tr>
<tr>
<td>4</td>
<td>Jewish Autonomous Region</td>
<td>469,711</td>
</tr>
<tr>
<td>B</td>
<td>Subjects of the Russian Federation with the maximum receipt of subsidies</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tyumen region</td>
<td>6,974,747</td>
</tr>
<tr>
<td>2</td>
<td>Sverdlovsk region</td>
<td>11,878,588</td>
</tr>
<tr>
<td>3</td>
<td>Krasnodarskiy kray</td>
<td>8,904,584</td>
</tr>
<tr>
<td>4</td>
<td>Leningrad Region</td>
<td>5,586,809</td>
</tr>
<tr>
<td>Total for all subjects of the Russian Federation</td>
<td>220,219,951</td>
<td>213,638,177</td>
</tr>
</tbody>
</table>


2. Data and Methods

The specifics of state regulation of prices (tariffs) for electric energy, both for the population and for other consumers, is that the maximum levels of prices (tariffs) are approved at the federal level—by the Federal Antimonopoly Service, prices (tariffs) for consumers at the regional level by the executive authorities of the subjects of the Russian Federation in the field of state regulation of prices (tariffs) [13,14].

one-rate tariff for electric power transmission services in the Republic of Tatarstan is 1.10 rubles/kWh, and in the Ulyanovsk region, 2.66 rubles/kWh.

Table 1 shows the approval of tariffs for electric power transmission services for the period 2018-2021, in addition to the dynamics of changes in cross-subsidization volume, which are considered by the executive authorities of the constituent entities of the Russian Federation in the state regulation of tariffs.

The problem of high tariffs for electric energy transmission services and their significant difference in the adjacent subjects of the Russian Federation can be solved by creating zones with uniform tariff regulation on the territory of several subjects, which has been discussed at the federal level since the mid-2010s.

However, each subject of the Russian Federation independently develops and conducts a tariff policy on its territory.

Regional and regulatory authorities ensured the containment of electricity tariffs for subjects of the Russian Federation, and automatically increased the volume of cross-subsidization, that is, shifted the tariff burden to other consumers, thus increasing their own tariffs. In other regions of the Russian Federation, regional regulatory authorities supported local producers and did not increase the volume of cross-subsidization significantly overstated tariffs.

In the Russian Federation, settlements for electric power transmission services between territorial grid organizations (TSO) are made on the basis of the “boiler” model [15]. In these conditions, mutual settlements of all consumers belonging to the same group pay the “boiler holder” for electricity transmission services at a single (boiler) tariff. Due to this, the “boiler holder” collects the necessary gross revenue of the network organizations included in the “boiler” and distributes it among adjacent network organizations through the use of individual tariffs, thereby ensuring the necessary volume of production, revenue and the corresponding share of profit of each of the network organizations required to cover their production costs [16,17].

The “boiler” model of mutual settlements through three variations is shown in Figure 1 (TSO (1, 2, 3) is a territorial network organization).

Figure 1. Variants of the “boiler” model of mutual settlements for electric power transmission services between grid organizations (TSO).
Where CK 1, CK 2, CK 3, CK 4 are TSO providing services for the transmission of electric energy to consumers within one subject of the Russian Federation.

When the subjects of the Russian Federation are united in terms of setting uniform tariffs for electric energy transmission services, the effect of “smoothing” cross-subsidization is created for territories where it is high, thus achieving the effect of tariff reduction for the region [18,19].

In Russia, in 2018, the issue of combining unified (boiler) tariffs for electricity transmission services on the territory of several subjects of the Russian Federation was worked out. As a result, regulatory documents were adopted that provide the necessary organizational and legal basis for the creation of a unified tariff regulation zone in the electric grid complex on the territory of several subjects of the Russian Federation.

Using the theory of price enables price regulation (tariffs) and marginal (minimum and (or) maximum) price levels (tariffs) for electric energy (capacity) in retail markets and for services rendered in retail markets that use electric energy (capacity) [20–22].

These prices can be set by:

- authorities and executive authorities of the subjects of the Russian Federation in the field of state regulation of tariffs;
- federal executive authorities in the field of tariff regulation in order to ensure equality of the specified regulated prices (tariffs) and the maximum (minimum and (or) maximum) levels of prices (tariffs) in the territories of two or more subjects of the Russian Federation, dependent on an agreement between the highest officials of the subjects.

Realizing their functions, the heads of the supreme executive bodies of state power of the subjects of the Russian Federation have the right to regulate tariffs and prices for electric (thermal) energy in the retail (consumer) market for the population and equivalent categories of consumers, as well as tariffs for services for the transmission of electric energy supplied to the population and equivalent categories of consumers. In addition to the above, the federal executive authority has the right to regulate tariffs for services for the transmission of electric energy supplied to consumers who are not related to the population and categories of consumers equated to it [23–25].

The approved, valid and provided in the “Fundamentals of Pricing” norms allow setting uniform prices (tariffs) on the territory of several subjects of the Russian Federation.

3. Results

In order to implement the legislative norms, it is proposed to switch to the specified mechanism of state regulation of prices (tariffs) for electric power transmission services in accordance with the following stages.

Stage I. Establishment of unified network tariffs in the territories of the subjects of the Russian Federation with a low level of socio-economic development. This initiative will contribute to the support of the subjects of the Russian Federation with a low level of socio-economic development, in order to create a single economic space on the territory of the Russian Federation.

The calculation of tariff consequences indicates a significant positive effect in the form of tariff reductions in the subjects of the Russian Federation with a low level of socio-economic development and a slight increase in tariffs in the adjacent subjects of the Russian Federation (due to their greater share in the energy balance in the combined energy zone) (https://fas.gov.ru/news/31542 (accessed on 10 May 2023), https://fas.gov.ru/publications/23401 (accessed on 10 May 2023)).

So, in 2021, a regulatory project was developed in Russia in which it was envisaged to provide:

- revision of the maximum–minimum (maximum) tariff levels for electric power transmission services for other consumers by 1 June 2021;
- revision by regional regulatory authorities of unified (boiler) tariffs for electric power transmission services and individual tariffs until 1 July 2021.
In accordance with which, in 2021, three new zones were created with a single tariff regulation of electric power transmission services in the following regions:

1. Kurgan Region, Tyumen Region, Khanty-Mansi Autonomous Okrug—Yugra and Yamalo-Nenets Autonomous Okrug;
2. The Republic of Kalmykia and the Rostov region;
3. The Altai Republic and the Altai Territory.

As a result, the corresponding tariffs were reduced:
- in the Republic of Kalmykia by 8%;
- in the Kurgan region on 28%;
- in the Altai Republic by 48%.

The formed common economic space makes it possible to reduce cross-subsidization, which contributes to increasing the investment attractiveness and development of regions with a low level of socio-economic development, which in turn leads to a reduction in electricity costs by large industrial consumers and has a positive effect on the cost of their products.

Stage II. At the second stage of the implementation of this initiative, it is proposed to establish uniform tariffs for electric power transmission services on the territory of the subjects of the Russian Federation that are part of one federal district.

The transition to a unified tariff regulation of electric power transmission services within the federal districts will be implemented on the basis of the current powers of the Government of the Russian Federation, executive authorities of the constituent entities of the Russian Federation and will not require a redistribution of powers between the federal and regional levels.

The Federal Antimonopoly Service, within the framework of its current powers, will approve the maximum levels of tariffs for electric energy for the subjects of the Russian Federation, and the relevant executive authorities of the subjects of the Russian Federation will have the authority to analyze expenses, implement repair and investment programs of regulated organizations.

After the unification of tariff regulation of electric power transmission services within individual federal districts, it is proposed to proceed to the unification of tariffs for electric power transmission services in the whole country. As a “pilot project”, calculations on subsidiary payments for 2022 were made taking into account the proposed methodology.

Stage III. The third stage provides for the establishment of uniform tariffs for electric power transmission services in the price zones of the wholesale electricity and capacity market.

The method of comparing analogues used in the Russian Federation for the purpose of calculating the sale allowances of guaranteeing suppliers (GS) is based on a direct dependence of the size of the reference revenue of the GP, which determines the value of the organization’s OPEX for the estimated period of regulation on the scale of its activities and fixed values of the “standards” of costs determined at the federal level.

Taking into account the requirements of the legislation of Russia on maintaining separate cost accounting, when calculating tariffs provided to various categories of consumers, when using this method, the formula for calculating the HBB (HBB<sub>i</sub>) of the guaranteeing supplier (GP), attributed to a separate category of consumers for the next period of regulation, can be written as follows:

\[
HBB_i = RV_{i}^{\text{cat}} + NC_{i}^{\text{cat}} + Res_{i-2}^{\text{cat}},
\]

where:
- \(NC_{i}^{\text{cat}}\) — non-controllable expenses taken into account when setting the selling allowances of guaranteeing suppliers, attributable to the relevant category of consumers;
- \(RV_{i}^{\text{cat}}\) — reference revenue GP, attributed to the corresponding category of consumers, which is calculated as follows:
\[ RV_{i}^{\text{cat}} = \sum_{j=1}^{n} CE_{j}^{\text{cat}} \cdot q_{j}^{\text{cat}} \cdot CPI_{i} + EGP_{i}^{\text{cat}} + ER_{i}^{\text{cat}} + EP_{i}^{\text{cat}}, \]  

(2)

where:

- \( CE_{j}^{\text{cat}} \) — the value of the constant \( j \) of the “standard” of costs for one point of supply of electric energy (capacity), approved by the Government of the Russian Federation for the corresponding category of GP consumers;
- \( q_{j}^{\text{cat}} \) — the number of supply points of the guaranteeing supplier accepted for calculation by the regulatory body for the next period of regulation for the corresponding category of GP consumers;
- \( CPI_{i} \) — consumer price index determined by the Forecast of socio-economic development of the Russian Federation for the next period of regulation;
- \( EGP_{i}^{\text{cat}} \) — GP expenses accepted for calculation by the regulator for the next period of regulation related to servicing interest on credit funds, attributed to the appropriate category of consumers, which are calculated using variable “standards” of costs;
- \( ER_{i}^{\text{cat}} \) — expenses accepted by the regulator for the settlement period of regulation for the formation of a reserve for doubtful debts, attributed to the appropriate category of consumers;
- \( EP_{i}^{\text{cat}} \) — the estimated value of the business profit of the guaranteeing supplier, attributed to the corresponding category of consumers accepted by the regulator for the next period of regulation.

The results of the analysis of the proposed method for calculating sale surcharges to guaranteeing suppliers is based on the method of comparing analogues currently used in Russia by regulatory authorities, ensuring the rationalization of the system of electricity payment rates and reducing the cost of subsidizing tariffs for the state.

It should be noted that the principle of forming uniform prices has already been considered in the wholesale market of electric energy and capacity within the framework of “free flow zones”. Further consolidation of free flow zones to federal districts, and then within price zones, will contribute to the formation of a single tariff space.

Thus, the proposed concept of regulation of tariffs for electric energy in combination with long-term tariff regulation (for up to 10 years) will ensure the creation of a single economic space on the territory of the Russian Federation.

The schedule can be drawn up for 10 years (from 2022 to 2032), taking into account the annual reduction of cross-subsidization by 1%. If this initiative is implemented, cross-subsidization over 10 years will decrease by 9.56% in relative terms, or by 23.1 billion rubles in absolute terms: from 241.3 billion rubles in 2022 to 218.2 billion rubles in 2032. The reduction in the volume of cross-subsidization as a result of the implementation of this initiative will not lead to negative socio-economic consequences in the subjects of the Russian Federation, which is also confirmed by the results of the analysis conducted by the Federal Antimonopoly Service of Russia of changes in the payment of citizens in the event of changes in tariffs for electric energy for the population with a decrease in the volume of cross-subsidization by 1% per year (Explanations of the Federal Antimonopoly Service of Russia on the issue of the procedure for compliance with the maximum (maximum) indices of changes in the amount of utility fees paid by citizens in municipalities of the subjects of the Russian Federation.—Text: electronic//Federal Antimonopoly Service: [official website].—2021.—Access mode: https://fas.gov.ru/documents/686820 (accessed on 10 June 2021)).

In addition, the implementation of this measure will reduce the risks of negative economic consequences for the budgets of the constituent entities of the Russian Federation arising from the need to compensate for exceeding the limits of cross-subsidization from the regional budget (Decree of the Government of the Russian Federation No. 1450 dated 13 November 2019 “On Amendments to Paragraph 81 (5) of the Pricing Principles in the Field of Regulated Prices (Tariffs) in the Electric Power Industry” introduced budgetary responsibility of the subjects of the Russian Federation for non-compliance with the limits of cross-subsidization).
The main task of regulating economic relations between producers and consumers of electricity is to approve economically justified tariffs for consumers that would contribute to the economic development of enterprises in market conditions.

The main instrument of control in the interaction of the main participants in the process of state regulation of prices (tariffs) in the electric power industry are the Methodological Guidelines developed by the author for calculating the amount and rates of cross-subsidization, taking into account the prices (tariffs) for electric power transmission services for consumers who are not related to the population and equivalent categories of consumers, as approved by the order of the FAS of Russia dated 22 February 2022 No. 141/22 (hereinafter—Guidelines).

The authors conducted a comprehensive analysis and developed Methodological Guidelines for calculating the amount and rate of cross-subsidization, taking into account the prices (tariffs) for electric power transmission services for consumers who do not belong to the population or equivalent categories of consumers (Approved by Order of the Federal Antimonopoly Service No. 141/22 dated 22 February 2022), which provide a transition period for a new payment system until 2025.

With the adoption of Methodological Guidelines, the organizational and managerial mechanism of interaction between participants in the process has changed. There are new administrative procedures that are carried out by the regional regulatory body:

- calculates electricity tariffs and cross-subsidization rates in accordance with the Methodological Guidelines;
- if necessary, coordinates and ensures that the Head of the subject of the Russian Federation signs a schedule (up to 5 years) of a phased transition to cross-subsidization rates calculated in accordance with the Methodological Guidelines;
- ensures coordination of the schedule with the FAS of Russia;
- monitors the application of tariffs and rates of cross-subsidization by regulated organizations.

The FAS of Russia has new control powers regarding the analysis of tariff decisions of the regional regulatory body for compliance with their Guidelines, and any cancellation of tariff decisions which violate the approaches described in those Guidelines can be assessed.

The average cross-subsidiation rate, taking into account the two-part prices (tariffs) for electric power transmission services in the p half of the i-period of regulation at voltage levels (VN, CH1, CH2, NN), is calculated by the executive authorities of the subjects of the Russian Federation in the field of state regulation of tariffs, according to the following formula:

$$ S_{CS, 2cT,i,p} = \frac{CS_{i,p} - \sum_n S_{VN1,i,p} EE_{VN1,i,p}^{PV,n}}{(N_{VN,i,p}^{PV} + N_{CH1,i,p}^{PV} + N_{CH2,i,p}^{PV} + N_{NN,i,p}^{PV}) \cdot 6}, \quad \text{p./MWh · Mec.} \quad (3) $$

where:

- $CS_{i,p}$—the amount of cross-subsidization in the p-half of the i-regulation period, taking into account the tariffs for electric power transmission services by voltage levels (HH, CH1, CH2, NN) for 2023 and subsequent years;
- $S_{VN1,i,p}^{CS}$—the rate of cross-subsidization for the relevant subject of the Russian Federation in the p-half of the i-regulatory period, determined in accordance with paragraph 81 (3) of the Pricing Framework, p./MWh;
- $EE_{VN1,i,p}^{PV,n}$—the planned volume of useful supply of electric energy to the consumer (n) at the voltage level (VN1) in the p-half of the i-period of regulation, MWh;
- $N_{VN,i,p}^{PV}$, $N_{CH1,i,p}^{PV}$, $N_{CH2,i,p}^{PV}$, $N_{NN,i,p}^{PV}$—the declared capacity of other consumers of the subject of the Russian Federation connected to networks at voltage levels (VN, CH1, CH2, NN), including indirectly.

Table 2 shows the actual values of cross-subsidization for the period 2021–2023 for Moscow and the Republic of Sakha (Yakutia).
Table 2. The actual values of cross-subsidization for the period 2021–2023 for Moscow and Republic of Sakha (Yakutia).

<table>
<thead>
<tr>
<th>Name of the Subject of the Russian Federation</th>
<th>2021 Fact</th>
<th>2022 Fact</th>
<th>2023 Fact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moscow</td>
<td>3,348,048</td>
<td>3,240,486</td>
<td>1,695,642</td>
</tr>
<tr>
<td>Republic of Sakha (Yakutia)</td>
<td>3,356,854</td>
<td>3,065,134</td>
<td>3,915,452</td>
</tr>
</tbody>
</table>

These examples are indicative, as they illustrate the different tariff policies pursued by the subjects of the Russian Federation.

Thus, the Moscow Government adopted the approaches approved in the Guidelines even before their approval. The use of these approaches shows an annual decrease in cross-subsidization in the region, in 2022 relative to 2021 by 3%, in 2023 relative to 2021 by 48%.

The reverse dynamics are observed in the Republic of Sakha (Yakutia), where the regional government has not bothered with the problem of reducing cross-subsidization and lowering tariffs for consumers. Thus, for the period 2022–2023, the volume of cross-subsidization increased by 28%.

Using a concrete example, this article presents the socio-economic effects of the approach proposed by the authors, aimed at reducing and fairly distributing cross-subsidization between consumers of electric power transmission services. The effects consist in a monthly reduction in electric energy costs in the cost of products manufactured by manufacturers and, as a result, a decrease in the cost of products, which makes manufacturers more competitive both in domestic and foreign markets, allows growth in their financial indicators, and their anti-crisis state is ensured [26,27]. The article proves the relationship between the amount of cross-subsidization, which is paid by the consumer in the price of electric energy and the cost of production by the enterprise.

The calculation of tariffs for electric power transmission services obtained by the method presented by the authors, taking into account the cross-subsidization rates recalculated in accordance with the proposed approach, is presented in Table 3.

Table 3. Calculation of tariffs for electric power transmission services, taking into account cross-subsidization rates.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Ed. ed.</th>
<th>Total</th>
<th>Voltage Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Economically justified one-rate tariff for electric power transmission</td>
<td>rub/MWh</td>
<td>781 956 2003</td>
<td></td>
</tr>
<tr>
<td>2. Single-rate tariff for electric power transmission services, taking into</td>
<td>rub/MWh</td>
<td>1155 1553 2074</td>
<td></td>
</tr>
<tr>
<td>account cross-subsidization</td>
<td>rub/MWh</td>
<td>374 597 71</td>
<td></td>
</tr>
<tr>
<td>3. The current cross-subsidization rate</td>
<td>thousand</td>
<td>1,129,823</td>
<td></td>
</tr>
<tr>
<td>4. The volume of cross-subsidization by region</td>
<td>rub/MWh</td>
<td>15,685</td>
<td></td>
</tr>
<tr>
<td>5. Useful vacation by territorial network organizations in the region</td>
<td>rub/MWh</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>6. The cross-subsidization rate calculated in accordance with the author’s</td>
<td>rub/MWh</td>
<td>853 1028 2075</td>
<td></td>
</tr>
<tr>
<td>approach to the distribution of cross-subsidization between groups of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>consumers of services in the electric grid complex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. One-rate tariff for electric power transmission services, taking into</td>
<td>rub/MWh</td>
<td>−26% −34% 0%</td>
<td></td>
</tr>
<tr>
<td>account cross-subsidization, calculated in accordance with the author’s</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>approach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. The effect in the form of a reduction in the one-rate tariff for electric</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>power transmission services, taking into account cross-subsidization</td>
<td>%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: calculated by the authors.

The calculation of the final tariff recalculated in accordance with the proposed approach is presented in Table 4.
Table 4. The values of final tariffs recalculated in accordance with the author’s approach.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit of Measurement</th>
<th>Price (Current)</th>
<th>Price (In Accordance with the Author’s Approach)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>The final price for electric energy in Moscow for June 2022 (supplier of Mosenergosbyt JSC)</td>
<td>RUB/MWh, without VAT</td>
<td>3985.63</td>
<td>3684.06</td>
<td>−8%</td>
</tr>
<tr>
<td>Weighted average cost of electricity for OREM</td>
<td>RUB/MWh, without VAT</td>
<td>2631.67</td>
<td>2631.67</td>
<td>0%</td>
</tr>
<tr>
<td>Electric power transmission services (single-rate tariff)</td>
<td>RUB/MWh, without VAT</td>
<td>1154.77</td>
<td>853.20</td>
<td>−26%</td>
</tr>
<tr>
<td>GP sales allowance</td>
<td>RUB/MWh, without VAT</td>
<td>193.31</td>
<td>193.31</td>
<td>0%</td>
</tr>
<tr>
<td>Infrastructure payments</td>
<td>RUB/MWh, without VAT</td>
<td>5.88</td>
<td>5.88</td>
<td>0%</td>
</tr>
</tbody>
</table>

Source: calculated by the authors.

The proposed approach to the distribution of cross-subsidization between groups of consumers of services in the electric grid complex, on the example of Moscow, led to a decrease in the final tariff for electric energy by 8%, and services for the transmission of electric energy by 26%.

An example of calculating the socio-economic effect of the implementation of the proposed scientific approach to the distribution of cross-subsidization between groups of consumers of services in the electric grid complex is presented in Tables 5–7 on the example of the greenhouse plant of Leon JSC (Leon LLC is a Leon Limited Liability Company. An organization engaged in entrepreneurial activity).

Table 5. Performance indicators of Leon JSC.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit of Measurement</th>
<th>Price (Current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The cost of production for 1 piece, including: direct costs</td>
<td>rub.</td>
<td>15.0</td>
</tr>
<tr>
<td>including: electrical energy</td>
<td>rub.</td>
<td>13.0</td>
</tr>
<tr>
<td>indirect costs</td>
<td>rub.</td>
<td>9.0</td>
</tr>
<tr>
<td>Output volume</td>
<td>pc.</td>
<td>356,256</td>
</tr>
<tr>
<td>Total expenses</td>
<td>rub.</td>
<td>5,343,840</td>
</tr>
</tbody>
</table>

Source: calculated by the authors.

Table 6. Breakdown of electric energy costs of Leon JSC per unit of production.

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit of Measurement</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of electrical energy</td>
<td>kWh</td>
<td>2.26</td>
</tr>
<tr>
<td>Price of electric energy (current)</td>
<td>RUB/MWh, without VAT</td>
<td>3.99</td>
</tr>
<tr>
<td>The cost of electric energy</td>
<td>rub.</td>
<td>9.00</td>
</tr>
</tbody>
</table>

Source: calculated by the authors.

Table 7. Breakdown of electric energy costs of Leon JSC per unit of production (taking into account the author’s approach).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit of Measurement</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume of electrical energy</td>
<td>kWh</td>
<td>2.26</td>
</tr>
<tr>
<td>The price of electric energy (taking into account the author’s approach)</td>
<td>RUB/MWh, without VAT</td>
<td>3.68</td>
</tr>
<tr>
<td>The cost of electric energy</td>
<td>rub.</td>
<td>8.32</td>
</tr>
<tr>
<td>The cost of production per piece</td>
<td>rub.</td>
<td>14.3</td>
</tr>
<tr>
<td>Output volume</td>
<td>pc.</td>
<td>356,256</td>
</tr>
<tr>
<td>Total expenses</td>
<td>rub.</td>
<td>5,101,237</td>
</tr>
</tbody>
</table>

Source: calculated by the authors.

The presented calculations show that the monthly reduction in electric energy costs in the cost of production will be: (15 rubles—14.3 rub.) × 356,256 = 242,603 rub./month,
which, in percentage terms, will reduce the cost of production by 4.5%. The total amount of subsidiary receipts of electric energy for 2022 amounted to 255,223,029 thousand rubles. for all subjects of the Russian Federation. The range of subsidies received by subjects is very wide; Table 8 shows the amounts of subsidies received by subjects of the Russian Federation with the minimum receipt of subsidies and with the maximum receipt of subsidies (https://fas.gov.ru/news/31816 (accessed on 10 June 2021), https://fas.gov.ru/news/26987 (accessed on 10 June 2021)).

Table 8. The amount of cross-subsidization taken into account by the executive authorities of the subjects of the Russian Federation in the field of state regulation of tariffs when approving tariffs for electric power transmission services for 2022.

<table>
<thead>
<tr>
<th>№</th>
<th>Name of the Subject of the Russian Federation</th>
<th>Volume of Cross-Subsidization (Thousand Rubles) 2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>And the subjects of the Russian Federation with minimal subsidies</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>The Republic of Crimea</td>
<td>74,312</td>
</tr>
<tr>
<td>2.</td>
<td>The city of Baikonur</td>
<td>106,191</td>
</tr>
<tr>
<td>3.</td>
<td>Sevastopol</td>
<td>153,274</td>
</tr>
<tr>
<td>4.</td>
<td>Jewish Autonomous Region</td>
<td>503,506</td>
</tr>
<tr>
<td>B</td>
<td>Subjects of the Russian Federation with the maximum receipt of subsidies</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Tyumen region</td>
<td>12,373,422</td>
</tr>
<tr>
<td>2.</td>
<td>Sverdlovsk region</td>
<td>12,752,758</td>
</tr>
<tr>
<td>3.</td>
<td>Krasnodarskiy kray</td>
<td>10,633,622</td>
</tr>
<tr>
<td>4.</td>
<td>Leningrad Region</td>
<td>8,074,182</td>
</tr>
<tr>
<td></td>
<td>The total amount of subsidiary receipts by subjects of the Russian Federation</td>
<td>255,223,029</td>
</tr>
</tbody>
</table>

Source: calculated by the authors.

In general, the total amount of subsidized receipts for the subjects of the Russian Federation in 2022 increased by 5.5% compared to 2021; the decrease mostly affected the subjects of the Russian Federation with the maximum receipt of subsidies, while in the subjects of the Russian Federation with the minimum receipt of subsidies, their growth was outlined. The maximum increase in subsidies occurred in the Republic of Crimea 6.4 times.

According to the authors, the creation of territories with a single level of tariffs for electric power transmission services seems appropriate to create an impulse for the development of subjects of the Russian Federation with a low level of socio-economic development. A systematic solution to this problem is possible due to the establishment of unified network tariffs for large territories consisting of several subjects of the Russian Federation.

In addition, the Government of the Russian Federation proposes to provide large energy-intensive consumers a special status as “basic consumers”, in order to protect them from a sharp change in the price of electric energy, by presenting budget preferences.

Thus, the dependence between the amount of cross-subsidization paid by the consumer in the price of electric energy and the cost of products produced by the enterprise is proved.

4. Discussion

The concept of subsidizing individual entities by energy industry enterprises is quite conservative, as is the adoption of intelligent decisions on the construction of new electricity consumers in the regions, which indicates the sustainable nature of the decisions taken on the amount of subsidies, in terms of securing donors to recipients of energy resources, which is reflected in the Development Strategy of the Russian Federation’s electric grid complex [28,29]. Cross-subsidization is considered by the state as a measure of social support for the population but, at the same time, leads to some negative consequences,
including the distribution of most of the subsidies to households with high incomes and an increase in business costs, which are embedded in the cost of goods and services [30–32]. Simultaneous elimination of cross-subsidization will have a worse impact on the economic performance of the participants of the energy market than its gradual decline, which is confirmed by the research of Trachuk A.V., Linder N.V. “Cross-subsidization in the electric power industry: approaches to modeling the reduction of its volumes” [33]. According to the authors, the creation of territories with a single level of tariffs for electric power transmission services seems appropriate to create an impulse for the development of subjects of the Russian Federation with a low level of socio-economic development. A systematic solution to this problem is possibly due to the establishment of unified network tariffs for large territories consisting of several subjects of the Russian Federation [34]. With regard to the impact on communities, the following approaches can be distinguished: approaches to economic assessment, such as cost–benefit analysis or multi-criteria assessments [35,36]. In addition, the Government of the Russian Federation proposes to provide large energy-intensive consumers a special status as “basic consumers”, in order to protect them from a sharp change in the price of electric energy by presenting budget preferences. Thus, the dependence between the amount of cross-subsidization paid by the consumer in the price of electric energy and the cost of products produced by the enterprise is proved.

Our article is focused on the Russian economy, but for greater interest, we can consider continuing this research in the economy of charging electric vehicles, where Europe is very interested. The energy price is contractual and depends on the request and the energy management system for both cost containment and energy demand, which may not be enough, for example, in Europe [37,38].

5. Conclusions

The presented conceptual provisions for the creation of unified energy zones based on a scientific approach to the fair redistribution of cross-subsidization between electricity consumers and a plan to gradually reduce its value over the years will ultimately ensure the optimization of subsidizing regions and sustainable growth of the Russian economy.

1. The identified and shown, on a concrete example, the socio-economic effects of the introduction of the author’s approach to the distribution of cross-subsidization between groups of consumers of electric power transmission services, proves the relationship between the volume of cross-subsidization, the price of electric energy paid by the consumer company and the cost of production by enterprises of the region.

2. The created economic incentives for the socio-economic development of the Russian Federation, thanks to the implementation of the author’s proposals, in the process of regulating economically lagging regions, will make it possible to form an effective state electricity tariff policy for them.

3. The proposed concept of regulation of tariffs for electric energy in conjunction with long-term tariff regulation (for up to 10 years) will ensure the creation of a single economic space on the territory of the Russian Federation.

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