Distribution of Energy Resources in Leningrad during Wartime

Prigodich Nikita*

Social and humanities center, ITMO National Research University, St. Petersburg, Russia

*ndprigodich@itmo.ru

Abstract. This study examines the system of energy resource distribution in besieged Leningrad during 1941–1944 as a unique case of urban energy functioning under extreme conditions. The aim of the research is to identify the mechanisms of allocation and management of scarce fuel and electricity resources and to assess their role in maintaining the operation of urban infrastructure and industry. The methodological basis of the study includes the analysis of archival documents, primarily decisions of the supreme governing bodies, as well as quantitative data on the distribution of gasoline and electricity over time. The results demonstrate that the energy supply system acquired a highly centralized and adaptive character, with strict prioritization of critical consumers such as defense enterprises, municipal services, and administrative institutions; peak allocations of fuel coincided with periods of extreme temperatures, while overall resource volumes remained critically limited. The study also reveals the combined use of administrative measures and infrastructural solutions, including the development of alternative fuel sources and the construction of energy supply routes, which contributed to partial stabilization. It is concluded that the experience of Leningrad reflects a specific model of crisis energy management based on rigid control, resource prioritization, and system adaptability, offering insights relevant to contemporary research on energy resilience and security.

Keywords: energy, distribution, fuel, sources, crisis

1 Introduction

In contemporary energy research, particular attention is devoted to the resilience of energy systems under extreme conditions, including military conflicts, natural disasters, and large-scale infrastructure disruptions. Historical case studies that demonstrate the functioning of energy supply systems under conditions of disrupted logistics and acute resource shortages are of considerable importance for the development of theories of energy security and crisis management. The Siege of Leningrad represents a unique example of the adaptation of an urban energy system under conditions of complete isolation and severe shortages of fuel and electricity. Lasting three years, it was the longest of all battles of this war. Over the course of these years of extraordinary hardship and deprivation, hundreds of thousands of the city's residents and defenders perished

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from starvation, cold, and massive enemy bombardments. The defense of the besieged city, which lasted nearly 900 days and involved several million inhabitants who remained within it, represents a unique phenomenon in the history of warfare. In their struggle against the German army, the city's population and the defending troops endured unimaginable suffering and privation. The immense losses sustained by the defenders of Leningrad, together with the scale of civilian casualties, underscore the tragic nature of the events associated with the city's defense. The total irrecoverable losses of the Soviet armed forces in the battle for the city amounted to approximately 980,000 personnel. As a result of the blockade, no fewer than 800,000 civilians died in the city from starvation and disease [1].

Under siege conditions, particular importance was attached to issues upon which both the defense of Leningrad and life within the city depended-namely, the supply of the front with weapons, ammunition, and uniforms; the functioning of industry; and the provision of fuel, electric power, raw materials, and related resources. The supply of fuel to industrial enterprises, municipal institutions, and residential buildings emerged as one of the decisive factors in the city's struggle for survival under the extreme conditions of the blockade.

The analysis of energy supply challenges in a besieged city makes it possible to move beyond traditional historical inquiry and address issues highly relevant to modern energy studies, including energy source diversification, demand-side management, prioritization of consumers, and the development of decentralized energy solutions. Examining the practices of energy resource distribution during the blockade allows for the identification of mechanisms applicable to modeling resilient energy systems in the context of twenty-first century crises. In this context, particular attention should be paid to the analysis of specific administrative decisions and mechanisms of resource allocation implemented in the besieged city [2].

2 Problem and Methods

Even in the prewar period, supplying Leningrad posed a considerable challenge: both industry and the urban economy required large quantities of fuel of all types. The issue of fuel supply became especially acute on 2 September 1941, when the Mga railway station was definitively captured by the enemy, resulting in the loss of the last railway connection linking Leningrad with the rest of the country. The resolution of the State Defense Committee (GKO) of 30 August 1941, "On the Transportation of Goods for Leningrad", provided for the creation, by early October 1941, of a one-and-a-half-month reserve of food, fuel, and other essential supplies within the besieged city [3]. These were to be delivered via water routes across Lake Ladoga; however, in practice this plan failed. From 1 October, workers and engineering-technical personnel were reduced to a daily ration of 400 grams of bread, while the rest of the population received 200 grams. This constituted the third reduction in bread rations.

Nevertheless, water transport remained of enormous importance for Leningrad under blockade: over two months of the autumn navigation period, approximately 60,000 tons of various cargoes were delivered to the western shore of Lake Ladoga, including 45,000

tons of foodstuffs, nearly 7,000 tons of fuel and lubricants, as well as ammunition, weapons, and other military supplies. German forces sought to destroy food and fuel reserves, power stations, water supply systems, and other critical infrastructure whose loss would have paralyzed life in the city, primarily through aerial bombardment. On 8 September 1941, 6,327 incendiary bombs and 48 high-explosive bombs were dropped on the city, resulting in 183 fires across various districts. The largest of these fires occurred at the food warehouses named after Alexey Badayev, which also had significant psychological consequences. Leningrad thus faced an increasingly dire situation not only with respect to food supplies but also fuel: even under the strictest economy, reserves of coal and petroleum products were sufficient only until November [4].

Thus, the energy crisis in Leningrad assumed a systemic character, simultaneously affecting supply chains, distribution mechanisms, and end-use consumption.

3 Results and Discussion

Under these circumstances, administrative decisions regarding the redistribution of scarce resources became a determining factor shaping the subsequent functioning of the urban economy and infrastructure. As of 1 October 1941, firewood reserves amounted to approximately 120,000 cubic meters – an amount that, under peacetime conditions, would not have met even two weeks of the city's demand. On 8 October 1941, the executive committees of the Leningrad City Soviet and the Regional Soviet adopted a resolution to begin logging operations in the Pargolovo and Vsevolozhsk districts. Women and adolescents dispatched to timber harvesting lacked both work experience and adequate equipment, including protective clothing and tools. Approximately 2,000 members of the Komsomol – predominantly young women from Leningrad – were sent to assist them; however, despite their selfless efforts, they were unable to supply the city with sufficient firewood [5].

In addition to logging, Leningrad residents were also mobilized for peat extraction. For instance, workers from Plant No. 371 were repeatedly sent to the Shuválovo peat workings. The shortage of electricity and fuel for power generation was acutely felt by all inhabitants of Leningrad. Deliveries of imported coal to storage depots ceased, and in September the Volkhov, Dubrovka, Svir, and Raukhiala power stations went out of operation. As a result, Leningrad received nearly three times less electricity than in June 1941. Electricity was now supplied primarily by Thermal Power Plant No. 5, converted to peat fuel and located near the front line, where it was under constant enemy artillery and aerial bombardment.

Urban thermal power plants and industrial enterprises continued operating for some time on the basis of coal reserves remaining in Havana district of Leningrad and Avtovo; however, these reserves were not replenished and were rapidly depleted. By December 1941, the city was consuming the last remnants of its emergency fuel supplies. On 17 November, Leningrad was plunged into darkness as electricity was cut off. From that date onward, the use of electric power within established limits was permitted only in a restricted number of facilities, including the Smolny Institute, the Main Headquarters,

Lenenergo, police administration and precinct offices, district party committees, district executive committees, military commissariats, civil defense headquarters, the Central Post Office, telegraph and telephone exchanges, the municipal fire administration, judicial institutions, and hospitals [6].

By December, daily electricity generation had decreased sevenfold compared to September levels. On 9 December, in an effort to reduce electricity consumption, eight transport routes were eliminated and 90 tramcars were withdrawn from service. Soon thereafter, trams and trolleybuses came to a complete halt on the city's streets, becoming an integral feature of the besieged urban landscape during the winter of 1941–1942. On 2 December 1941, the executive committee of the Leningrad City Soviet established monthly coal consumption limits for municipal enterprises and institutions. Medical institutions were allocated approximately 6 tons, bathhouses and laundries 4.55 tons, the city water supply system 0.7 tons, the tram and trolleybus administration 0.65 tons, and the City Department of Public Education (including kindergartens and nurseries) only 0.05 tons [4]. These extremely low figures can be explained by the fact that only 325 tons of coal remained in reserve for municipal consumers under the jurisdiction of the city executive committee.

In an effort to alleviate the fuel crisis, the city authorities authorized in December the dismantling of wooden houses and other wooden structures-primarily those already damaged for use as firewood. The stands of the Lenin Stadium, summer park structures, and various wooden constructions, including so-called "roller coasters" were dismantled. These measures provided the besieged city with approximately 150,000 cubic meters of firewood. In addition, a further 300,000 cubic meters were harvested in the Pargolovo and Vsevolozhsk districts. As noted by Sergey Yarov, firewood became one of the most frequently stolen commodities during the first winter of the blockade.

The situation with transport, which was essential for fuel distribution, was also крайне difficult. Following the mobilization of 2,177 trucks and 1,333 passenger vehicles into the Red Army, only 1,137 trucks suitable for use remained in the city [7]. For a city such as Leningrad, this was an extremely small number of vehicles; however, even this limited fleet required substantial quantities of gasoline, which, under blockade conditions, were simply unavailable. By November, the situation had become catastrophic: the remaining transport in the city risked coming to a complete halt due to the lack of fuel. It was precisely during this period that issues concerning the distribution of petroleum products began to be addressed at the level of the city committee of the All-Union Communist Party (Bolsheviks) and the Executive Committee of the Leningrad City Soviet of Workers' Deputies.

A resolution of the executive committee of the Leningrad City Soviet and the bureau of the city committee of the All-Union Communist Party (Bolsheviks), "On the Distribution of Automobile Gasoline from 2 to 7 January 1942" published in the document collection Leningrad in the Siege, provided for the allocation of 100 tons of fuel mixture (composed of gasoline, diesel oil, and alcohols) among the following recipients: the Bread-Baking Trust – 21 tons; the Administration of Food Trade – 3.5 tons; Glavrestoran – 1 ton; coal transportation – 16 tons; logging operations – 3 tons; the Headquarters of Local Air Defense – 1.5 tons; the NKVD – 2 tons; the NKVD Fire Protection Directorate – 5 tons; the NKVD Department of Military Construction – 0.5

tons; the Executive Committee of the Leningrad City Soviet – 30 tons; and industry, as directed by Comrade Volodarsky – 16.5 tons [4]. The resolution mandated the strictest economy in fuel consumption: directors and managers of enterprises and institutions were required to exercise rigorous control over the use of petroleum products and to prevent their allocation to secondary needs.

Nevertheless, despite all measures adopted at the highest administrative levels, it proved impossible to eliminate shortages; a significant portion of machinery remained idle due to the absence of fuel. Owing to the shortage of electricity, defense plants began to shut down one after another. By the summer of 1942, according to a decision of the Leningrad City Party Committee, only 175 enterprises remained partially operational, with limited numbers of workers and engineering personnel; all others were placed in conservation. The stagnation of industrial life had a severe impact on public morale. Physical exhaustion, cold, and the absence of electricity, heating, water supply, sewage, and other basic amenities further diminished people's ability to resist starvation.

During the winter of 1941–1942, 40% of operating industrial enterprises were completely unheated, another 40% were only partially heated, and only about 20% maintained temperatures close to normal. In an attempt to protect themselves from the cold, workers boarded up windows with plywood, cardboard, planks, or even bricks, plunging interiors into darkness. At the same time, 63% of industrial premises lacked both electric lighting and kerosene lamps; work had to be carried out by the light of makeshift oil lamps and torches [8]. After the city was left almost entirely without electricity, enterprises began installing gas generators, internal combustion engines, and their own local power stations, which nevertheless also required fuel – peat, coal, or at least firewood [8].

In the period from late autumn 1941 to January 1944, the bureaus of the Leningrad city and regional committees of the All-Union Communist Party (Bolsheviks) carried out the distribution of energy resources among enterprises and institutions in Leningrad. Under blockade conditions, the value of every kilowatt of electricity, kilogram of fuel oil, and liter of gasoline was extraordinarily high – not only for maintaining industrial production but also for the survival of the city's population. Such decisions were typically adopted for periods of ten days and included data on the allocation of gasoline, electricity, fuel oil, diesel fuel, coal, firewood, and kerosene among consumers.

Data on the distribution of gasoline from autumn 1941 to January 1944, as well as on electricity distribution from January 1943 to January 1944, make it possible to visualize the overall volume of energy resources across specific time intervals. A notable feature of energy allocation policy was the reservation of a significant share of resources for subsequent redistribution among consumers. This could involve grouping enterprises according to their affiliation with particular commissariats (less frequently), administrative bodies, or delegating distribution authority to the Plenipotentiary of the USSR State Planning Committee (Gosplan) for the city of Leningrad.

For a more comprehensive understanding of the scale and logic of energy resource distribution, it is necessary to turn to aggregated quantitative data. The Figure 1 presented below provides information on the quantities of gasoline (in tons) allocated during the period from late November 1941 to January 1944. These data allow us to conclude that peaks in distribution occurred in February 1942 and February 1943,

corresponding to periods of the lowest temperatures. During the summer months, by contrast, fuel allocations were reduced for reasons of economy. At the same time, certain atypical fluctuations in the statistics indicate periods marked by the emergence of additional demands, associated with industrial tasks, the regulation of urban life, and preparations for military operations at the front.

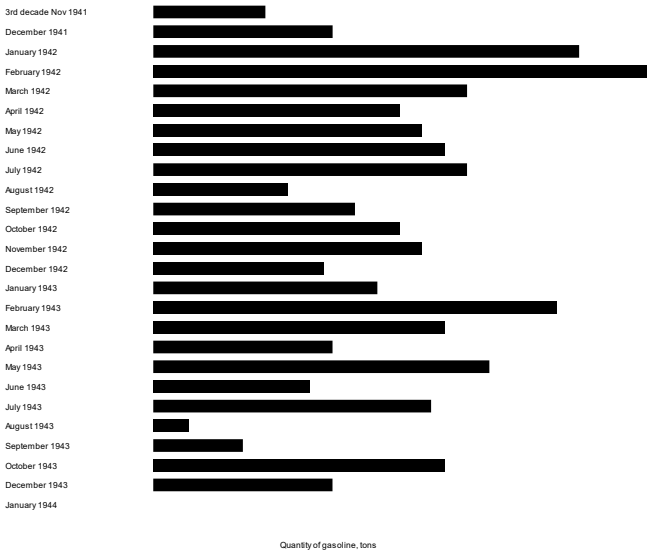

Fig. 1. Distribution of gasoline 1941-1944.

Similarly, as shown in Figure 2, the data on the volume of electricity distributed during the period from January 1943 to January 1944 (measured in millions of kWh) may be interpreted in much the same way. This type of aggregated statistical representation overlaps, in definitional terms, with the dataset presented in the preceding table.

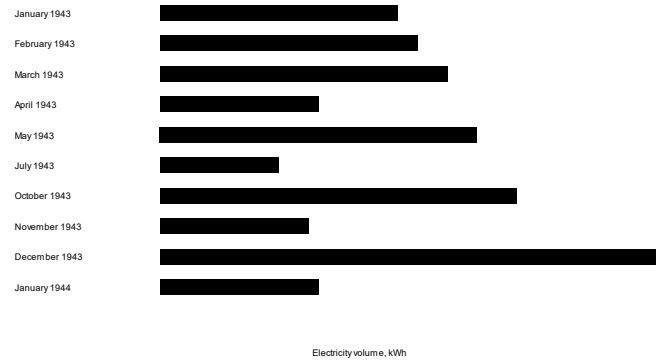

Fig. 2. Distribution of electricity in 1943, in million kWh.

At a number of enterprises, in order to avoid halting the production of military goods, a shift to manual labor was implemented. During the winter of 1941–1942, "32,000 tons of ammunition and explosives, approximately 35,000 tons of fuel and lubricants (including 10,700 tons of motor gasoline, about 7,700 tons of aviation gasoline, more than 5,000 tons of fuel oil, and over 5,200 tons of kerosene), and 22,800 tons of coal were delivered to Leningrad" [7].

April 1942 marked a partial revival of the city's economic life, largely attributable to the availability of fuel: "The revival of economic activity in the spring of 1942 was, to a considerable extent, associated with fuel supplies. Although gasoline and hard coal were delivered to Leningrad from the 'Mainland,' the principal sources of fuel within the city were peat and firewood, which were procured by Leningrad residents in suburban areas. If in March 75 wagonloads of peat were dispatched daily to Leningrad, in April this figure rose to 99 wagons. In addition, 45 wagonloads of firewood were delivered daily. In April, 12,922 thousand kilowatt-hours of electricity were generated in Leningrad. The increase in energy resources made it possible to resume passenger tram service on 15 April. On that day, 320 tramcars, organized into 108 trains, were put into operation across five routes". The presented data indicate a high degree of adaptability in the resource distribution system despite the extreme limitations in available supplies.

The delivery of liquid fuel to Leningrad from the "Mainland" by rail and road transport was, of course, highly inefficient and was undertaken only out of necessity. On 25 April 1942, the State Defense Committee issued a resolution on the construction of a fuel pipeline along the bed of Lake Ladoga. Construction and installation were completed in a record time of 50 days, by 16 June 1942.

On 23 September, the laying of the power transmission line from the Volkhov Hydroelectric Station to Leningrad was completed; 23 kilometers of this line ran along the bed of Lake Ladoga. Under peacetime norms, such a project would have required six months; even under wartime planning schedules, 56 days were allocated, yet the builders completed it in just 47 days. By the end of the month, electric current from the Volkhov Hydroelectric Station began flowing into the besieged city via the third cable laid along the bottom of Lake Ladoga, significantly improving the city's electricity supply.

Beginning on 1 September, a month-long campaign of firewood procurement was launched. Participation was compulsory for the population: men aged 16 to 55 and women aged 16 to 45. Each participant was required to procure no less than four cubic meters of firewood – two for personal use, with the remainder allocated to the general fuel fund. Among city residents, firewood became a highly demanded commodity and, moreover, a kind of exchange currency [8].

Following the partial lifting of the blockade of Leningrad in the winter of 1942–1943, a new task emerged: the restoration and expansion of industrial activity. However, reinstalling dismantled equipment alone was insufficient – the revival of Leningrad's industry depended to a significant extent on resolving the fuel supply problem. Within the city, fuel reserves had long been exhausted, and the possibilities for peat and timber extraction within the blockade ring were diminishing.

In March 1942, both the automobile route and the railway line Shlisselburg–Polyany were in operation simultaneously; nevertheless, fuel and materials remained insufficient to revive Leningrad's industry. Even the most marginal and economically inefficient

sources of fuel had to be utilized. Initiative was shown by workers in the Krasnogvardeysky and Volodarsky districts, who began peat extraction within the city itself. In the Nevsky district, small peat deposits were found in Steklyanny Gorodok and Klochki; in the Krasnogvardeysky district, near Revolyutsii Highway; and in the Vyborgsky district, on the northern outskirts of Sosnovka. Even in the Moskovsky district, 14 small peat enterprises were established and объединены into a special trust, “Lentorph” Over the course of a year, these enterprises produced approximately 50,000 tons of peat for the city’s power stations and industry.

4 Conclusion

Gradually, the situation with fuel supply in Leningrad stabilized. Opportunities emerged to procure fuel in the northeastern districts of the region, and significantly larger volumes of fuel began to be delivered from the “Mainland” These and many other factors gradually, yet steadily, contributed to the normalization of conditions in the city and to the beginning of the full-scale restoration of industry and the urban economy after the devastation and losses of the wartime period.

The analysis conducted demonstrates that the system of energy resource distribution in besieged Leningrad constituted a complex mechanism combining centralized governance with elements of adaptive local practices. Under conditions of acute resource scarcity, priority was consistently assigned to critical sectors, including defense industries, essential urban services, and administrative institutions. This reflects the emergence of a distinct model of crisis energy management based on a strict hierarchy of consumers and rigorous control over resource allocation.

The historical practices examined in this study hold significant relevance for contemporary energy systems, particularly in the context of resilience and security. The experience of Leningrad highlights the importance of energy diversification, the development of localized energy systems, and flexible mechanisms of resource redistribution. Of particular importance is the capacity of an energy system to rapidly transition to alternative fuel sources and decentralized modes of generation.

In this regard, the study of energy supply in besieged Leningrad contributes not only to a deeper understanding of historical processes but also to the formulation of principles applicable to modern energy strategies. These include the prioritization of critical infrastructure, the integration of multiple energy sources, and the enhancement of system resilience to external shocks. Further research in this field may support the development of advanced models for energy resource management under crisis and emergency conditions.

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