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ELECTRIFICATION IN THE UZBEKISTAN RAILWAYS SECTOR AND ITS ECONOMIC SIGNIFICANCE

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Annotation
This article discusses electrification work in the railway sector in the Republic of Uzbekistan and the reforms being implemented in this regard.

Keywords. Electrification of the sector, Uzbekistan Railways, electrification and energy, railway section, electricity supply, diesel fuel, foreign investment.

Introduction

The inefficiency of the old management and economic system inherited from the previous regime became increasingly evident over time. Reforming the system produced positive outcomes for its further development. In a market economy, a financially unprofitable system was inevitably prone to crisis. Therefore, increasing efficiency through railway electrification and gradually phasing out diesel fuel became essential. In line with this, the order of the State Joint-Stock Railway Company O‘zbekiston temir yo‘llari dated January 27, 1995, on the development and improvement of electrification and energy facilities, and the Cabinet of Ministers’ resolution dated June 23, 1993, *“On the General Program for Electrification of the Central Railway for 1993–1995 and up to 2000”*, envisaged commissioning 100–150 kilometers of electrified railway sections annually starting in 1993. Consequently, the adoption of new technologies demanded highly qualified personnel capable of handling critical responsibilities.

The key task of company electricians and electrical fitters was to ensure reliable electricity supply to all consumers. However, significant deficiencies in this area affected train operations and ultimately increased operating costs.

Material and Methods

Inefficient use of electrical energy, imperfect accounting, and the use of outdated or loss-prone supply schemes caused substantial energy losses. The scientific expertise of relevant specialists was effectively employed in practice. Company management issued clear instructions to ensure the construction and commissioning of electrified sections, maintain stable operation of electric traction equipment, support scientific and technical research, develop computerized concepts for energy supply, create automated energy management systems, and enhance the material and moral incentives of energy workers.

Uzbekistan Railways attracted funding from international financial institutions to electrify its lines. Transitioning from diesel to electric traction proved environmentally friendly, cost-effective, and capable of higher traction speeds, demonstrating the necessity of electrification reforms. Electrification of Uzbekistan Railways began in 1983 and continues today. By December 1997, the Keles–Tashkent–Khovos, Begovat–Khovos–Jizzakh, and Jizzakh–Jomboy sections, totaling 580 km, were electrified, representing approximately 6.1% of the total network. Electrified locomotives accounted for 30.1% of total transport volume in 1997, saving 41,700 tons of diesel fuel.

Discussion and Results

However, by 1993, electrification stalled due to insufficient domestic funding. Consequently, foreign investment was directed primarily toward electric locomotives and railway electrification. The economic necessity of electrification

was further reinforced by the aging diesel fleet, whose maintenance and spare parts storage required substantial expenditure. In 1998 alone, nearly 100 diesel locomotives were decommissioned, and electrification of the Samarkand–Bukhara route reduced emissions by 14,000 tons.

To meet operational needs, Uzbekistan Railways, with support from Japan's OECF fund, purchased freight electric locomotives and upgraded repair facilities and technological equipment. Locomotive fleet repairs were estimated at $61 million. Starting in 1999, a $70 million project repaired the 320 km Chingeldi–Samarkand line under OTB assistance. Updating freight locomotives was also critical: 32 in-service freight electric locomotives and 18 electric locomotives manufactured in Russia, all over 30 years old, required replacement. A $40 million memorandum was signed with YETTB for the procurement of freight electric locomotives, covering 13 of 30 required units. In 1998, the unit price of an electric locomotive at the factory was $3,050,000. The majority of locomotives in use were manufactured in Germany (Siemens), Russia (Novocherkassk), and the Czech Republic (Škoda), with Czech units being superior in quality to the Russian ones.

According to Uzbekistan Railways data as of January 24, 2001, the Cabinet of Ministers' resolution of June 23, 1993, *"On the General Program for Electrification of Central Asian Railways for 1993–1995 and up to 2000"*, aimed to ensure stable operation of enterprises, reduce freight costs, minimize environmental impact, and decrease fuel consumption through accelerated electrification. Often, technical specifications did not match the real conditions of existing networks, requiring the company to upgrade and modernize communications networks at its own expense. This was particularly evident in electrification projects for the Jizzakh–Samarkand and Samarkand–Marakand sections. By 1998, major electrification works were completed, including the

Tashkent–Khojikent section. However, at Chirchiq–Khojikent, protective work against interference from Ministry of Communications equipment delayed full electric traction operation.

The introduction of electric trains significantly reduced the environmental impact of diesel locomotives, increased train speeds up to 140 km/h, and reduced annual diesel consumption by 1,224 tons.

To implement these projects, working groups comprising various experts were formed, and the technical and financial aspects of each project were thoroughly discussed. Foreign funds attracted for the projects were carefully monitored to ensure they were spent for their intended purposes.

According to data submitted by the company to the Cabinet of Ministers of the Republic of Uzbekistan on March 23, 2001, pursuant to the Cabinet's March 20, 2001 decree, information was provided regarding the implementation of the project *"Improving Transport Connectivity of the Fergana Valley with Other Regions of the Republic"*. Following the project presentation on February 1, 2001, a working group meeting on transport and logistics was held on February 2, where the project was discussed in detail.

Based on a letter from Germany's KfW Bank dated January 31, 2001, technical parameters, solutions, and operational and financial-economic indicators of the project were reviewed. Dornier System Consult provided data on the volume of transport-economic connections of the Fergana Valley provinces through the Bekobod–Konibodom section in Northern Tajikistan for 1996, 1997, and 1998. The technical-economic basis of the project underwent expert evaluation, with the total construction cost increasing to 1,568.4 million soums (1991 prices). During the June 20, 2000 session of the Uzbekistan–Germany Economic Forum's Transport and Logistics Working Group, company specialists provided explanations on the project. Following the discussions, the working group

forwarded the experts' conclusions to the Cabinet of Ministers' Investment Programs Department per instructions from the Presidential Administration.

On November 27, 2001, according to company data, ongoing efforts were being made to identify potential creditors to implement the December 12, 2000 decree of the Cabinet of Ministers. Considering that electrification of railway lines was a priority, the U.S.-based company *Lemna International Inc.* offered its services for the electrification of the Maroqand–Navoiy (project value: $300 million) and Navoiy–Bukhara (project value: $200 million) lines. Expert evaluation of the companies confirmed their good global reputation and experience in handling investment projects, increasing confidence in achieving positive results. In recent years, the company had restored Romania's railways with $2.5 billion, including electrification, tunnel construction, replacement of rolling stock, and construction of new railways. The Cabinet's Department for Foreign Economic Relations and Foreign Investments confirmed the feasibility of negotiating with *Lemna* for financing the electrification project. The company also expressed its readiness to discuss the project's technical and financial aspects with the Cabinet.

Electrification requires precise technical work and uninterrupted electricity supply. Accordingly, on August 2, 2002, the company commissioned external electrical supply facilities for the new Uchquduq–Miskin–Qorao'zak railway line: the *Buzaubay* power station and the *Miskin* substation. Per the Ministry of Energy's technical specifications dated November 2, 1999, the company was obliged to manage and maintain these facilities. However, due to insufficient specialized lifting equipment, experience, and trained personnel, the company could not provide these services independently. Consequently, the company requested the Ministry of Energy to consider transferring the *Miskin* substation (owned by *O'zbekenergo* JSC) to its balance.

Within environmental protection measures, the company signed contracts to purchase new electric locomotives for railway electrification. By the end of 2003, two locomotives were delivered, followed by eight more in 2004. Twelve locomotives purchased from a Chinese company met the expectations of both Uzbek railway workers and passengers. According to the Presidential Decree of November 5, 2008, regarding the renewal of the passenger locomotive fleet and procurement of passenger electric trains, the company agreed with the Chjuchjou company to supply 15 new high-speed electric trains with a maximum speed of 160 km/h.

The financing included a total credit of $75.53 million, with $70.11 million as loan and $5.42 million in company funds. The project involved Uzbek engineers collaborating with Chinese counterparts during production. In August 2010, three new electric trains were delivered from Chjuchjou Electric Train Manufacturing Company. This project exemplifies long-term financial and technical cooperation between Uzbekistan and China, supported by preferential credit arrangements. Furthermore, per the Cabinet's April 10, 2008 decree, a contract worth $73.8 million was signed between the company and Chjuchjou to supply 15 high-speed electric trains.

In 2010, it was planned to complete the electrification of the 389-kilometer "Samarkand – Qarshi" and "Toshguzar – Boysun – Qumqo'rg'on" railway lines. A notable feature of this comprehensive program was that it included 18 projects. In 2010, the "Jizzah – Yangiyer" double-track and "Yangiyer – Farxod" single-track electrified railway lines were constructed, and an agreement was reached with Spain's "Talgo" company to purchase electric trains with a speed of 250 km/h. The total value of the contract amounted to 38 million euros, financed by both the Uzbekistan Recovery and Development Fund and the company's own funds.

According to the resolution "On the Comprehensive Program for the Development and Modernization of the Railway Sector for 2009–2013", adopted on March 16, 2009, modernization and improvement of production in the sector continued steadily. Specifically, in the electrification of the "To'qimachi – Angren" railway section (2002), funding was provided by the German Development Bank (KfW), the Arab Fund for Economic Development of Kuwait, as well as company funds. The total cost of construction amounted to 65.4 million USD. The purpose of this project was to replace diesel locomotives with electric locomotives operating on alternating current. As a result, all railway lines in the Tashkent region were converted to electric traction.

For this purpose, the company purchased 13 of the newest high-speed express trains. The electrification project involved significant contributions from the company's Electricity Supply Center, Tashkent Electricity Supply District, Signal and Communication Center, Road Management Department, and Tashkent Railway District. Consequently, the remaining 114 km section of the Tashkent regional railway hub was fully electrified. The implementation of this project reduced operating costs by 1.8 times, improved environmental conditions in the region, and created an additional 50 jobs. The total length of the country's railway network exceeded 6,020 km, with 4,230 km of usable tracks.

On the eve of the 2010 Independence Day, the "Tashkent–Angren" railway was electrified. Approximately 70 Chinese specialists were involved alongside local railway workers. The total project cost amounted to 85.39 million USD, and the work was completed on time with high quality. Modern microprocessor-based centralized control, telecommunication tools, and up-to-date communication systems were introduced. As a result, transportation costs along this section decreased by 1.8%, and travel times for passengers and cargo were significantly reduced.

Currently, significant work has been carried out on the 222 km section to transfer control to the MPS system. A total of 125 railway workers were employed at the control center, 91 of whom were directly managing train operations. They were equipped with modern Siemens information technologies, allowing for real-time monitoring of train consist and wagon movements.

It should also be noted that YADM personnel actively participated in the electrification of the "Marokand – Qarshi – Toshguzar – Boysun – Termiz" railway. With company investments, loans from the German Development Bank (KfW), and the Arab Fund for Economic Development of Kuwait, the electrification of the "Tashkent (To'qimachi) – Angren" railway line was completed.

In 2011, electrification works were planned for the "Qarshi – Termiz" railway, bringing the total length of electrified railways in the country to 674.3 km. According to the March 18, 2009 resolution "On the Comprehensive Program for the Development and Modernization of the Railway System for 2009–2013", the project was designed to facilitate the low-cost transportation of key cargoes, such as petroleum products and coal, from the Surkhandaryo and Qashqadaryo regions. The "Qarshi – Termiz" railway passes through the Qashqadaryo and Surkhandaryo regions and is 325 km long.

Following official visits by the First President of Uzbekistan, Islam Karimov, to Spain and by Spain's Foreign Minister Miguel Ángel Moratinos to Uzbekistan, an agreement was reached with Spain's "Patentes Talgo S.L." for the procurement of passenger electric trains.

The total length of 140.8 km for the "Marokand – Qarshi" and 325.7 km for the "Qarshi – Termiz" railway sections was electrified, and rolling stock modernization was implemented as part of 16 investment projects in this direction. These projects involved the company's "No.1 Energy Installation

Train", "Uztemiryo'l Construction and Installation", "Bridge Construction" trusts, "Mexmost" joint-stock company, "Qarshi Electricity Supply", and "Special Mechanized Railway Station", with hundreds of engineers and machinery employed.

The implementation of these projects enabled full electrification of the railways, produced significant economic benefits, and facilitated the introduction of energy-saving technologies, improving the ecological situation in the region.

Electrification works on the 140 km "Marokand – Qarshi" section began in 2012. With concessional loans from OTB and company funds, the railway was electrified and equipped with communication and technology systems meeting international standards. More than 1,500 km of railway lines have been electrified by the company, including the "Toshguzar – Boysun – Qumqo'rg'on" line, a critical part of the national railway system.

By 2012, the company had electrified 691 kilometers of railway, bringing the total length of electrified lines in the country to over 1,500 kilometers. At the beginning of 2012, the company initiated works on the electrification projects for the "Marokand – Qarshi – Termiz" route, utilizing credit funds from the OTB and the Japan International Cooperation Agency (JICA). In 2012, the initial phase of the project focused on construction and design works on the "Marokand – Qarshi" section. A notable outcome of these projects was a 23% reduction in train operating costs.

Additionally, annual diesel fuel savings reached 15,000 tons, freight transport time decreased by 1.2 hours, and passenger travel time was reduced by 40 minutes. Most importantly, the railway's train handling capacity increased by 35%.

The electrification of the "To'qimachi – Angren" railway also laid the foundation for a new project: the construction of the "Angren – Pop" electrified railway.

Currently, the company has involved specialists from China Railway Tunnel Group and Germany's DB International.

Conclusion: Due to the systematic nature and international significance of these works, they have always been of state importance and closely monitored under the investment program. The company rehabilitated 600 kilometers of existing railway and constructed 150 kilometers of new electrified railway. Five new bridges, with a total length of 193 meters, capable of supporting train speeds of 200 km/h, were built and commissioned.

From 2011 to 2015, under the program to accelerate the development of infrastructure, transport, and communications, and with support from Japan's Official Development Assistance (ODA) program, the Marokand – Qarshi and Qarshi – Termiz lines were completed. As a result, operating costs fell by 40%, and the speed of passenger and freight delivery increased by at least 1.3 times. This, in turn, increased railway capacity and contributed not only to Uzbekistan's socio-economic development but also to the overall advancement of neighboring countries and the region.

Starting from August 22, 2015, high-speed "Afrosiyob" passenger trains began operations on the "Tashkent – Samarkand – Qarshi" route. Over 208 million USD was invested in the project, of which 108.3 million USD came from the company and 100 million USD from OTB. During electrification, 9 kilometers of steel tracks at eleven station areas were restored. Over 2,100 cubic meters of earthworks were carried out along 166 kilometers, and 3,216 cantilever supports and 259 durable metal structures were installed at section stations, along with 140.8 kilometers of overhead electric wires.

To accelerate the development of the tourism industry, increase its share in the economy, improve service quality, and enhance infrastructure, the "Qarshi – Kitob" line was electrified. The total length of this line is 124 kilometers, with

three stations, eight stops, 46 bridges, and 107 other artificial structures. The project included the construction of one traction substation and a 94-kilometer transmission network, as well as external electricity supply facilities. The total cost of the project amounted to 58.87 million USD.

During the visit of President Shavkat Mirziyoyev to the Fergana region on June 22–23, 2017, instructions were issued to establish electric train services between Qo‘qon, Marg‘ilon, and Andijon. Starting August 8, 2017, electric train service began on this route, operating at a speed of 120 km/h. The travel time was 2 hours and 50 minutes, which is 40 minutes faster than by car. Each train consisted of six carriages, serving up to 350 passengers in one direction.

In 2017, according to the company’s plan, 58 projects were scheduled for implementation. The plan involved allocating 770.11 million USD to the network and attracting 651.12 million USD in additional funding. By the end of September 2017, a total of 616.13 million USD had been fully utilized. Of this, 329.58 million USD came from the company’s own funds, 74.70 million USD from the state budget, 86.80 million USD from the Recovery and Development Fund, and 123.52 million USD from state-guaranteed foreign investments.

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