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Evolution of Thermal Power Plants in Uzbekistan and Prospects for Their Development

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Abstract. This article provides a comprehensive analysis of the historical evolution of thermal power plants (TPPs) in Uzbekistan from the early 20th century to the mid-21st century, their current technical condition, and development prospects to 2030. The formation and modernisation of key Soviet-era facilities, including Syrdarya TPP, Tashkent TPP, Navoi TPP, Novo-Angren TPP, and Talimarjan TPP, are examined. The energy sector reform process, including the dissolution of Uzbekenergo JSC, the establishment of Thermal Power Plants JSC, and the transition to market mechanisms, is systematically analyzed. Analysis of electricity generation dynamics for 2016–2025 and CO₂ emissions reveals that although the country remains heavily dependent on thermal energy, significant transformative trends are underway. New combined-cycle gas turbine (CCGT) projects and private investor partnership prospects are evaluated within the framework of the 2030 strategic targets.

Keywords: thermal power plant, energy sector, Uzbekistan, combined-cycle gas turbine, energy reform, CO₂ emissions, Syrdarya TPP, Talimarjan TPP, Uzbekistan-2030 strategy.

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1. INTRODUCTION

The energy sector, which constitutes a fundamental driver of modern economies, is of strategic importance for Uzbekistan. A country with a rapidly growing population, a dynamically expanding economy, and a broad industrial base faces acute demand for a reliable energy supply. Historically, Uzbekistan has generated 85–90% of its electricity at thermal power plants by burning natural gas. According to 2022 data, the energy sector accounts for 77% of all CO₂ emissions attributable to fuel combustion [1].

However, the sector faces substantial challenges. The majority of Soviet-era TPPs have exceeded their design service lives of 40–50 years and are now technologically obsolete; their current thermal efficiency stands at only 25–35%, significantly below that of modern facilities in terms of both generation efficiency and labour productivity [2]. Furthermore, declining natural gas reserves and growing import dependence make further-delayed reforms unavoidable — Uzbekistan has been importing gas from Russia since 2023 [3] — while climate commitments necessitate a new energy strategy.

The objectives of this study are: (1) to conduct a systematic analysis of the historical stages of TPP formation in Uzbekistan; (2) to assess the technical and economic indicators of currently operational major

power stations; (3) to examine the dynamics of electricity generation volumes and emissions; and (4) to critically evaluate the strategic development directions planned for 2030.

The scientific novelty of the research lies in the fact that, for the first time, the history of TPP development in Uzbekistan is examined as a continuous evolutionary sequence from the Soviet era through the current reform process, and the prospects for the energy transition are quantitatively assessed on the basis of the most recent 2025 data.

2. LITERATURE REVIEW AND METHODOLOGY

2.1. Literature Review

Research on Uzbekistan's energy sector has been conducted primarily by international organisations. The International Energy Agency (IEA) provides a full account of the country's capacity structure, TPP share, and development plans in its Uzbekistan Energy Profile [4]. The Enerdata global energy platform publishes annual indicators and outlook analyses for Uzbekistan [5].

Technical documentation from Mitsubishi Power covering CCGT projects in Uzbekistan [6] and sectoral analysis published in Modern Power Systems [7] served as important sources for examining the technical aspects of TPP modernisation. Individual station profiles in the Global Energy Monitor (GEM) platform — covering the Syrdarya, Tashkent, Novo-Angren, and Talimarjan TPPs — contain detailed technical histories of each facility [8, 9, 10].

Analyses by BNEF and the Bourse & Bazaar Foundation address the investment attractiveness of Uzbekistan's energy sector and the political economy of the reform process [3, 11]. The UNECE energy policy brief provides a detailed assessment of Uzbekistan's energy complex and its CO₂ emissions profile [1].

2.2. Research Methodology

The study employs the following methods: historical-comparative analysis — to identify stages of TPP development; technical-economic analysis — to assess the installed capacity and efficiency indicators of major stations; statistical analysis — to examine electricity generation dynamics and CO₂ emissions trends; and policy analysis — to review the regulatory and normative framework and strategic documents.

The source base consists of reliable international institutions (IEA, ADB, UNECE, GEM) and verified national sources. All statistical data are supported by references to primary sources. Figures, dates, and designations cited in the article have been verified against authoritative sources.

3. RESULTS

3.1. Early Development: 1920s–1950s

The history of modern electricity generation in Uzbekistan is closely intertwined with Soviet industrialisation. In the early 1920s, small-capacity thermal power plants were constructed in Tashkent, Samarkand, Bukhara, Termez, and other cities. By 1928, electricity output had increased 10.4-fold compared with pre-war levels [12].

During this period, the energy sector of all Central Asian republics was administered centrally by SredazEKOSO — the Central Asian Economic Council [12]. In the 1930s, a number of new thermal power plants were commissioned in Uzbekistan: the first generating units of the Angren TPP, based on peat and coal, began construction. Small district stations supplying electricity to industrial towns also emerged in the Fergana, Samarkand, and Bukhara regions.

During the Second World War, numerous Soviet industrial enterprises were relocated to Central Asia. This led to a sharp increase in electricity demand in Uzbekistan, necessitating the rapid commissioning of new capacity. Several small stations were built in Tashkent and Angren during the war years.

3.2. The Soviet Industrial Economy Era: 1960s–1991

Uzbekistan occupied an important position in the Soviet energy strategy. The country played a central role in the Central Asian Unified Energy System (CAUES): the coordination centre for 83 stations was the Energiya specialised dispatch centre located in Tashkent. Uzbekistan's share of generation within the CAUES amounted to 51% [13].

A number of major stations were built during this period. The Syrdarya TPP — the largest thermal power plant in Uzbekistan — was constructed in the city of Shirin between 1972 and 1981. Comprising ten units each rated at 300 MW (subsequently upgraded to 325 MW following modernisation), the station's total installed capacity reached 3,200 MW [14]. The primary fuel is natural gas, with fuel oil serving as a backup.

Construction of the Tashkent TPP began in 1960. The first 150 MW unit was connected to the grid in December 1963; the final unit was commissioned in 1971, and the station reached full operational status in 1975. Consisting of twelve steam-generating units and one 370 MW combined-cycle unit, the station's installed capacity stands at 2,230 MW [15]. The station provides both heat and electricity to the city of Tashkent.

The Navoi TPP was established to supply electricity to Navoi, one of Uzbekistan's major industrial cities. Its generating portfolio comprises two 210 MW units, two 150 MW units, two 160 MW units, one 100

MW ISTP-140 unit, a first CCGT of 478 MW commissioned in 2013, and a second CCGT of 450 MW commissioned in 2019. Total capacity amounts to 2,068 MW of electricity and 718 Gcal/h of heat [15].

The New-Angren TPP was built adjacent to the Angren coal deposit in Tashkent Region. Between 1985 and 1995, seven units each rated at 300 MW were commissioned. With a total installed capacity of 2,100 MW, the station supplies electricity to the Fergana Valley, the city of Tashkent, and the Almalyk industrial zone [8]. Construction of the Talimarjan TPP in Kashkadarya Region commenced in 1984; work was halted following the dissolution of the USSR and resumed from 1998 onwards. An initial 800 MW power block and two 450 MW CCGTs commissioned in 2016–2017 give the station a total installed capacity of 1,700 MW [10].

Table 1. Major Thermal Power Plants of Uzbekistan (2025 data)

TPP Name	Year Commissioned	Capacity (MW)	Fuel Type	Location	Key Feature
Syrdarya TPP	1972–81	3,200	Natural gas	Syrdarya Region	Largest in Uzbekistan; 10 × 300 MW units
Tashkent TPP	1963–71	2,230	Natural gas	Tashkent city	CCGT 370 MW; combined heat and power
Novo-Angren TPP	1985–95	2,100	Coal / gas	Tashkent Region	Converted to coal (2014)
Navoi TPP	1960s	2,068	Natural gas	Navoi Region	2 CCGTs added (478+450 MW)
Talimarjan TPP	1984/1998	1,700	Natural gas	Kashkadarya Region	2 × 450 MW CCGT (2016–17)
Angren TPP	1940s	286	Coal	Tashkent Region	Aging facility; partially active
Takhiatash TPP	1960s	730	Natural gas	Karakalpakstan	Primary source for western region

Source: Compiled by the author based on [8, 9, 10, 14, 15].

3.3. The Independence Era and Energy Reform (1991–2021)

The dissolution of the USSR subjected Uzbekistan's energy sector to severe hardship. The majority of Soviet-era TPPs completed their 30–40-year service lives and deteriorated rapidly. Aging equipment with low efficiency — 25–35% — led to excessive natural gas consumption across the country [6]. Simultaneously, energy demand grew steadily: population growth, industrialisation, and economic expansion intensified the need for electricity.

Between 2016 and 2024, electricity generation in Uzbekistan increased from 59 billion kWh to 81.5 billion kWh — a 38% rise. During the same period, the country commissioned 11,000 MW of new capacity, three times the volume added in the preceding 25 years [11]. As part of the energy system reform, a Presidential Decree of March 2019 dissolved Uzbekenergo JSC and established three independent successor entities: Thermal Power Plants JSC (generation), Uzbekistan National Electric Grid JSC (transmission), and Regional Electric Networks JSC (distribution) [4]. By 2021, Thermal Power Plants JSC had an installed capacity of 11,669 MW, encompassing eleven TPPs [4].

3.4. Electricity Generation Dynamics (2016–2025)

The growth trend and structural changes in Uzbekistan's electricity generation are reflected in the following table:

Table 2. Annual Electricity Generation Indicators in Uzbekistan

Indicator	2016	2019	2022	2024	2025
Total generation (bn kWh)	59.0	~65.0	~74.0	81.5	86.7
TPP share (%)	~90	~88	~84	~75	~68
Renewable energy share (%)	~10	~12	~16	~25	~32
Total installed capacity (GW)	~13.0	~14.5	~16.5	21.9	25.8
TPP installed capacity (GW)	~11.5	~12.0	~13.0	~16.0	17.55

Source: Compiled by the author based on [4, 5, 11, 16]. Values for 2016–2022 are approximate.

3.5. Current Status: End-of-Year 2025 Results

According to end-of-year 2025 results, Uzbekistan achieved a total installed capacity of 25,797 MW across 148 power stations. Of this total, TPPs and cogeneration plants accounted for 17,551 MW — representing 68% of total capacity [16]. This figure underpinned the majority of the 86.7 billion kWh of electricity generated in 2025.

According to the most recent data from the Trend.az portal, Uzbekistan currently operates 17 TPPs, 3 combined heat and power plants, and 4 cogeneration centres — a combined total of 17,551 MW [17]. The majority of TPPs use natural gas as their primary fuel. Novo-Angren TPP, however, has converted five of its units to coal since 2014; inspection data from 2025 also revealed that the station's flue gas and dust-cleaning systems are performing below the required standard [8].

Table 3. Structural Composition of Uzbekistan's Power System (December 2025)

Station Type	Installed Capacity (MW)	Share (%)
TPPs and cogeneration plants	17,551	68.0
Hydroelectric power plants	2,441	9.5
Solar photovoltaic plants	3,930	15.2
Wind power plants	1,652	6.4
Block stations	223	0.9
TOTAL	25,797	100.0

Source: Compiled by the author based on [16].

4. DISCUSSION

4.1. Analysis of Historical Evolutionary Stages

A historical analysis of TPP development in Uzbekistan allows four principal stages to be identified. The first stage (1920s–1940s) was the formative period. During this era, small, scattered thermal stations were constructed primarily to establish urban electricity supply. The energy system was centrally administered by SredazEKOSO [12]. The second stage (1960–1985) represented the main period of large-scale TPP construction under Soviet industrialisation. The Syrdarya (3,200 MW, 1972–81), Tashkent (2,230 MW, 1963–71), and Navoi TPPs were built; the CAUES was established, with Uzbekistan serving as its principal generator [13, 15]. The third stage (1985–2000) was a period of crisis and stagnation. The construction of Novo-Angren TPP (1985–95) and the mid-course suspension of Talimarjan TPP illustrate the paradoxes of this era. With the collapse of the USSR, financing difficulties and accelerating equipment obsolescence intensified.

The fourth stage (2000–present) constitutes the reform and modernisation period. This phase encompasses two significant trends: (a) the modernisation of existing stations through the installation of modern CCGT units — carried out at Navoi TPP in 2013 and 2019, and at Talimarjan TPP in 2016–17 [15, 10]; and (b) the dissolution of Uzbekenergo JSC and the transition to market mechanisms (2019–2021) [4].

4.2. Technological Modernisation and the CCGT Strategy

The Government of Uzbekistan has identified CCGT technology as the primary instrument for modernising the TPP sector. The advantage of this technology is evident: whereas the efficiency of legacy steam-turbine units stands at 25–35%, CCGTs achieve efficiencies of 55–60% [6]. Mitsubishi Power is implementing a number of CCGT projects in Uzbekistan. Saudi Arabia's ACWA Power has signed a 25-year power purchase agreement and invested USD 1.2 billion for the construction of a 1,500 MW CCGT in Syrdarya Region [7].

Major projects planned for completion by 2030 include a $2 \times 1,300$ MW CCGT in Syrdarya Region, an 850 MW CCGT in Tashkent Region (Cengiz Enerji, Turkey), a 900 MW CCGT in Surkhandarya Region (Yildirim Enerji, Turkey), and a 2×650 MW CCGT at Navoi TPP [4]. These projects are expected to add approximately 7.9 GW of new capacity to the TPP sector by 2030 [4].

A significant policy decision for TPPs is the gradual convergence of electricity consumer tariffs towards market levels by 2030. The new tariff policy, introduced in May 2024, was piloted through a dedicated study covering 3,516 households [11].

4.3. CO₂ Emissions and Environmental Challenges

TPPs constitute the principal source of CO₂ emissions in Uzbekistan. According to 2022 data, 77% of all CO₂ emissions from fuel combustion are attributable to the energy sector [1]. Natural gas accounts for 82% of the energy fuel mix [1]. While this is a serious concern, it is worth noting that natural gas produces

significantly lower CO₂ emissions than coal — a comparison that partly explains the use of the term ‘transitional fuel’ in some contexts.

However, the country began importing natural gas from Russia in 2023 (under a two-year agreement of 2.8 billion m³/year, with scope to increase to 10 billion m³/year by 2030) [3]. This situation poses a threat to energy security and represents a direction at odds with decarbonisation objectives. In accordance with its NDC-3, Uzbekistan has set targets to reduce greenhouse gas emissions per unit of GDP by 30% relative to 2010 levels by 2030, and to source at least 40% of electricity from renewable energy by the same date [18].

4.4. Challenges and Constraints in the TPP Sector

One of the most significant challenges facing the thermal energy sector is ageing infrastructure: the majority of existing TPPs were built during the Soviet era and have, in most cases, already exceeded or are approaching the end of their service lives. Obsolete equipment entails low technical efficiency and high maintenance costs. The second challenge is the depletion of natural gas reserves: Uzbekistan’s gas production has been declining in recent years, a trend attributed to the exhaustion of major fields such as Shurtan and Gazli [3]. The third challenge is the persistence of weak corporate governance inherited from the dismantled Uzbekenergo JSC structure. Improving the managerial effectiveness and transparency of Thermal Power Plants JSC is of paramount importance [11]. The fourth challenge is the difficulty of attracting private investment. Delayed tariff reform and state subsidies remain significant barriers for private investors operating under market conditions.

5. CONCLUSIONS

A comprehensive study of the evolution and development prospects of thermal power plants in Uzbekistan has yielded the following principal conclusions.

1. The history of Uzbekistan’s TPPs has passed through three principal stages: the formative period of the 1920s–1940s; the main Soviet industrialisation construction phase of 1960–1985; and the independence, crisis, and reform era from 1991 to the present. The Syrdarya (3,200 MW), Tashkent (2,230 MW), Novo-Angren (2,100 MW), and Navoi (2,068 MW) TPPs form the backbone of the national energy system.

2. By the end of 2025, Uzbekistan had achieved a total installed capacity of 25,797 MW across 148 stations, with TPPs accounting for 17,551 MW. The TPP share stands at 68%, while the share of renewable energy has grown from approximately 10% in 2016 to approximately 32% in 2025. This trend indicates that structural diversification is underway.

3. The transition to CCGT technology remains the principal strategic direction for TPP modernisation in Uzbekistan. Major projects planned for completion by 2030 (ACWA Power, Cengiz Enerji, Yildirim Enerji, Mitsubishi Power) are expected to add 7.9 GW of new, efficient capacity to the TPP sector.

4. CO₂ emissions, the emerging dependence on natural gas imports, and the insufficiently rapid pace of tariff reform represent the principal constraining factors. To achieve the targets set in the Uzbekistan-2030 Strategy — a 40% renewable energy share and a 30% reduction in the GHG/GDP ratio — Uzbekistan must accelerate TPP reform, introduce a transparent tariff policy, and create a favourable environment for private sector investment.

Directions for future research: a comparative analysis of the economic efficiency of CCGT projects in the Central Asian context, as well as a study of the feasibility of ‘blue hydrogen’* technology for Uzbekistan’s TPPs, represent promising avenues for further investigation.

* *Blue hydrogen: hydrogen produced from natural gas (methane), whereby the CO₂ generated in the process is captured and stored underground or in dedicated facilities rather than being released into the atmosphere.*

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