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Research on the Development Status of Natural Gas Power Generation Projects and the Integration Path with Computing Power in Sichuan-Chongqing Region

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Abstract: The Sichuan-Chongqing region is the core bearing area of the Chengdu-Chongqing Computing Power Hub under the national "East Data, West Computing" project, boasting the largest hydropower cluster in China and a complete natural gas industrial chain. However, it is undeniable that natural gas power generation has long been plagued by problems such as lagging installation progress, low unit utilization rate, and difficult project profitability. In contrast, the year-round stable base load demand of AI computing power centers can naturally and efficiently fill the core shortcoming of idle natural gas power generation units during the wet season. Therefore, based on the actual operation data of the natural gas power generation industry in Sichuan-Chongqing from 2021 to 2025 and combined with the value reconstruction theory of integrated energy systems, this paper systematically and rigorously clarifies the development dilemmas of the industry, quantitatively analyzes the profitability effect of the integration model, supplements risk analysis and multi-agent collaboration mechanisms, and accordingly puts forward a development path for the integrated development of natural gas power generation and computing power suitable for the Sichuan-Chongqing region. The most powerful and clear conclusion is that the integrated integration model can increase the utilization hours of natural gas power generation units from 1520 hours to 3200 hours, turning the project from a loss to a profit, thus providing an excellent solution for the sustainable development of natural gas power generation and the energy security of computing power hubs in Sichuan-Chongqing.

Keywords: Sichuan-Chongqing Region; Natural Gas Power Generation; AI Computing Power; Integrated Development; Profit Model; Electricity-Computing Synergy.

1. Introduction

The Sichuan-Chongqing region is the core growth pole of economic development in southwest China, with natural gas output accounting for more than 30% of the national total and hydropower installed capacity accounting for over 80%, forming a unique energy endowment of "abundant natural gas and sufficient hydropower". However, it also faces structural contradictions such as uneven hydropower output between wet and dry seasons and severe seasonal imbalance between power supply and demand. With the implementation of the national "East Data, West Computing" project in the Chengdu-Chongqing Computing Power Hub, a large number of AI intelligent computing centers are accelerating their agglomeration, putting forward extremely high requirements for power supply stability, cleanliness and continuity. At the same time, the completion rate of the "14th Five-Year Plan" for natural gas power generation installation in Sichuan-Chongqing is less than 40%, the unit utilization hours are far below the national average, and most operating projects are generally unprofitable. The traditional development path of solely serving grid peak shaving has fallen into a bottleneck. This paper breaks away from the traditional paradigm of natural gas power generation development, explores the in-depth integration path of natural gas power generation and the computing power industry, and provides decision-making references for the coordinated development of regional energy transformation and digital economy.

2. Domestic and Foreign Research Status

The economic efficiency and development path of natural gas power generation are very clear and mature research topics in the field of energy economics, and there have been quite insightful and logical studies abroad. Joskow et al. (2021) naturally and appropriately demonstrated the increasing flexibility value of natural gas power generation in power systems with a high proportion of renewable energy, as well as the importance of two-part electricity pricing and a perfect auxiliary service market for the profitability of natural gas power generationIto et al [5]. (2023) conducted an excellent empirical test on the technical feasibility and economic rationality of natural gas power generation as the base load power supply and backup power supply for data centers [6].

Domestic academic circles have made a clear and logical analysis of the profitability dilemma of natural gas power generation in Sichuan-Chongqing. Jiang Long et al. (2025) pointed out that insufficient unit utilization is the fundamental cause of project losses [3], and Zhao Yong et al. (2024) made an excellent sorting out of the comprehensive energy supply model of data centers under the background of "East Data [4], West Computing". However, neither of them touched on the theme of in-depth integrated operation of natural gas power generation and the computing power industry. More generally, most existing studies on natural gas power generation start

from its single function of serving grid peak shaving, so there is still a major gap in the research on value reconstruction and collaborative operation of natural gas power generation and the computing power industry. This paper provides a systematic answer to this gap.

3. Development Status and Core Dilemmas of Natural Gas Power Generation in Sichuan-Chongqing

(1) Development Status

During the "14th Five-Year Plan" period, the development progress of natural gas power generation in Sichuan-Chongqing seriously lagged behind the planning goals [1]. By the end of 2025, the cumulative installed capacity of natural gas power generation in Sichuan-Chongqing reached 5.27 million kilowatts, only completing 35.13% of the planned target of 15 million kilowatts. Among them, Sichuan Province planned 12 million kilowatts and actually completed 3.85 million kilowatts, with a completion rate of 32.08%.

From the available data, it can be clearly and accurately seen that Chongqing planned to build 3 million kilowatts and has completed 1.42 million kilowatts, with a completion rate of 47.33%. Therefore, neither region has completed the planning tasks.

From the perspective of operational efficiency, it can be clearly and hierarchically seen that the average utilization hours of natural gas power generation in Sichuan-Chongqing from 2021 to 2025 were only 1625 hours at the highest, less than 70% of the national average (2300 hours). In 2025, the proportion of natural gas power generation in the total regional power generation was only 0.95%, far lower than the national average of 5%. Among them, the utilization hours of natural gas power generation in Sichuan Province were only 1280 hours, and the idle rate of units during the wet season reached more than 70%. In sharp contrast, the utilization hours of natural gas power generation in the Yangtze River Delta region exceeded 2400 hours, and the proportion of power generation reached more than 8%. Compared with Yunnan Province, which is also dominated by hydropower, its natural gas power generation utilization hours have reached 2100 hours [7]. The development gap of natural gas power generation in Sichuan-Chongqing is obvious at a glance (see Figure 1).

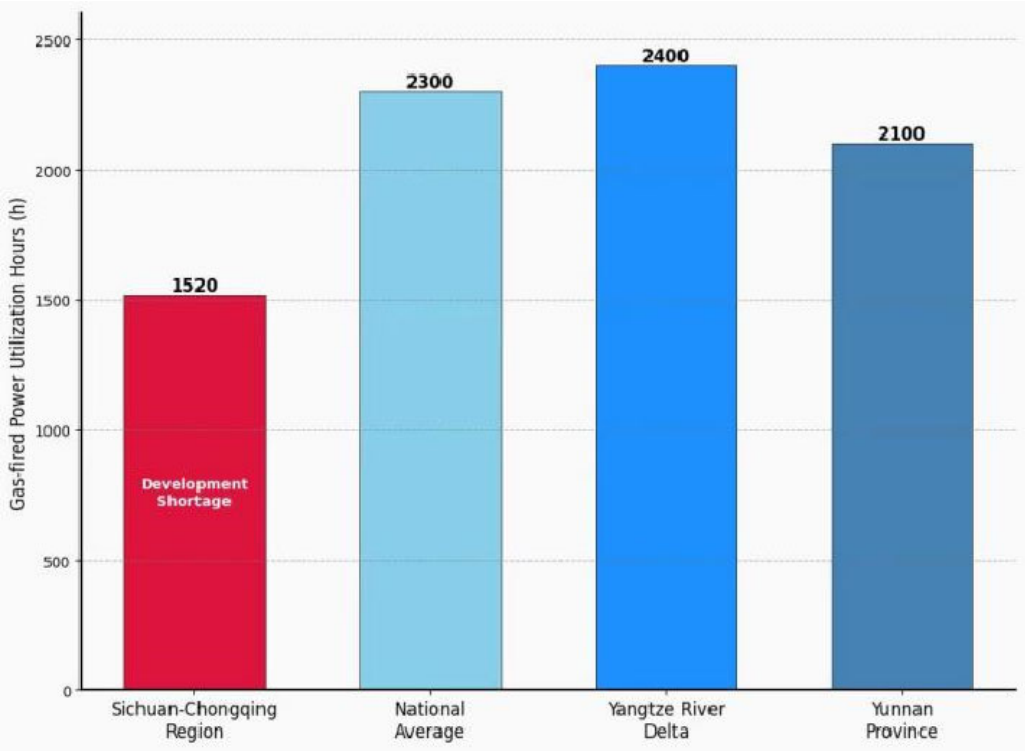


Figure 1. Comparison of Natural Gas Power Generation Utilization Hours in Major Regions

(2) Core Dilemmas

Due to the large installation gap of natural gas power generation in Sichuan-Chongqing, the first core dilemma can be naturally and appropriately summarized as the installation gap restricting the regional power supply capacity: the installation gap of natural gas power generation in Sichuan-Chongqing is 9.73 million kilowatts, and the maximum regional power gap in the extreme dry season reaches 15 million kilowatts. At present, the existing installed capacity can only meet 65% of the conventional gap. The lengthy project approval process is the fundamental reason for the lagging installation.

Second, the economic pressure on projects is very obvious, which can be clearly and directly analyzed: the unit electricity cost of natural gas power generation in Sichuan-Chongqing is 0.55-0.65 yuan/kWh, much higher than the local benchmark coal-fired electricity price (0.403 yuan/kWh) and hydropower electricity price (0.26-0.30 yuan/kWh). Therefore, for a project to break even, it must have more than 2500 utilization hours. However, the current actual operating hours are below the break-even line, resulting in general losses for operating projects.

Third, the marketization mechanism for peak shaving value is not yet sound. It can be naturally and clearly seen that the highest standard of peak shaving compensation in Sichuan-Chongqing is only 0.3 yuan/kWh, less than 40% of that in the Yangtze River Delta region. Therefore, it cannot cover the unit start-stop and peak shaving costs. Moreover, the two-part

electricity pricing mechanism of "capacity electricity price + electricity quantity electricity price" has not been established, so the fixed costs of natural gas power generation cannot be recovered through capacity electricity prices [8], which is extremely mismatched with the functional positioning of "peak shaving first, electricity quantity second".

4. Theoretical Compatibility and Practical Opportunities of Natural Gas Power Generation-Computing Power Integration

(1) Theoretical Compatibility

This paper elaborates on the theoretical compatibility and practical opportunities of natural gas power generation-computing power integration in a very natural and appropriate way: it first systematically and rigorously introduces the value reconstruction theory of integrated energy systems and the energy-digital economy synergy theory adopted in this paper, and thus naturally and smoothly derives the analytical framework of the integration model. Specifically, the integrated energy system theory explains that the collaborative optimization of multiple energy types and multiple load subjects is conducive to breaking the boundaries of energy supply and demand, improving system efficiency and reducing comprehensive costs. The energy-digital economy synergy theory clearly demonstrates the complementary relationship between the rigid energy demand of digital infrastructure and the structural shortcomings on the energy supply side.

The technical characteristics of natural gas power generation, such as flexible start-stop, clean and low-carbon, and the ability to build and supply power nearby, form a natural complement to the energy consumption characteristics of computing power centers, which require high reliability, stable load and strong green electricity demand. Through integrated operation, the value system of natural gas power generation can be reconstructed, fundamentally solving the problem of natural gas power consumption during the wet season, and realizing the coordinated development of energy systems and digital infrastructure (as shown in Figure 2).

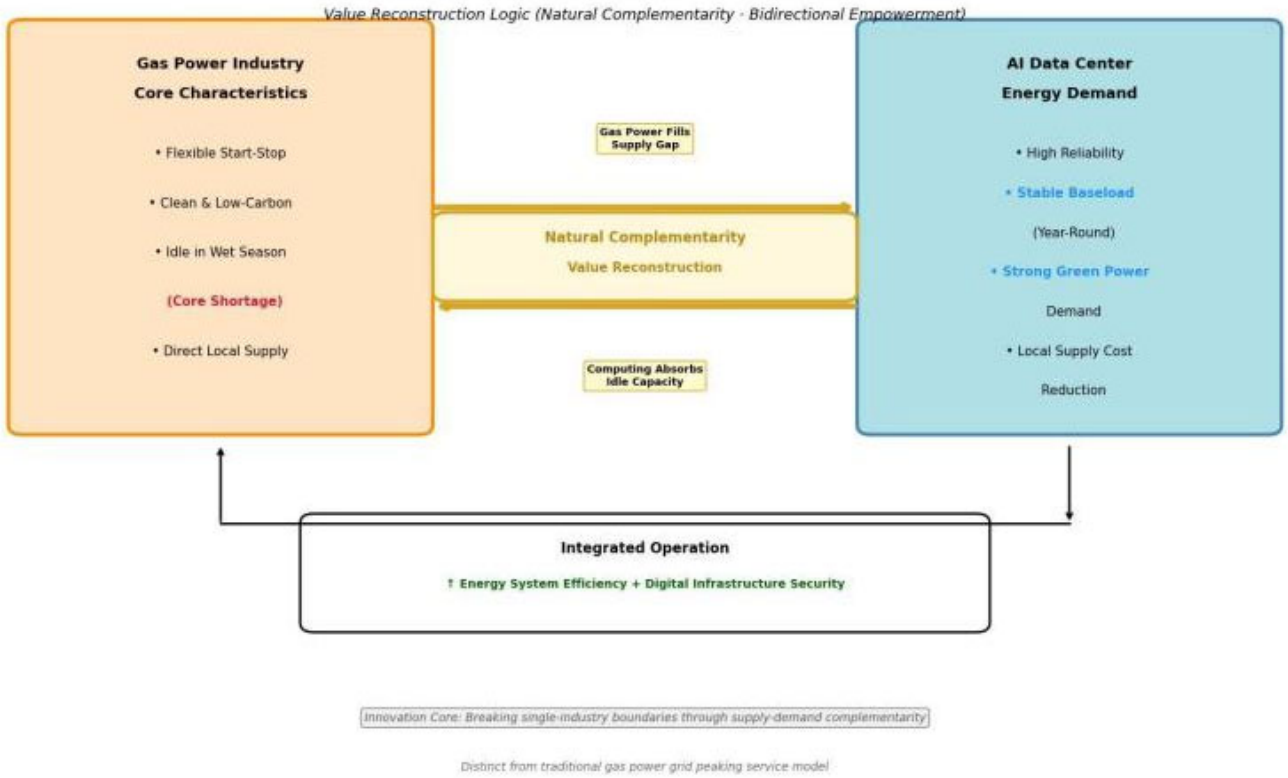


Figure 2. Value Reconstruction Logic of Sichuan-Chongqing Gas Power – AI Computing Integration

(2) Practical Opportunities

Since the Chengdu-Chongqing Computing Power Hub is one of the 8 national computing power hubs under the national "East Data, West Computing" project, its development plan can be clearly and hierarchically seen: by the end of 2025, more than 3 million standard cabinets will be built, with a total computing power scale of 30 EFLOPS, of which AI intelligent computing centers account for more than 60% of the total computing power [2]. From the perspective of electricity demand, the annual electricity consumption of a single 10,000-card AI cluster exceeds 150 million kWh. Among the 12 large intelligent computing centers under construction in Chengdu-Chongqing, the new annual electricity consumption in 2026 has reached 8 billion kWh, which will surely become the most prominent growth point of regional power demand.

Since computing power centers operate at a stable base load 24 hours a day throughout the year, they naturally fill the load gap of natural gas power generation during the wet season, thus opening up a new consumption market for the development of natural gas power generation and providing high-reliability clean power guarantee for the computing power centers themselves. It can be said that they promote each other and complement each other.

5. Development Paths and Multi-agent Collaboration Mechanisms of Natural Gas Power Generation-Computing Power Integration

(1) Core Development Paths

Starting from the development paths and multi-agent collaboration mechanisms of natural gas power generation-computing power integration, the core development paths can be naturally and appropriately summarized: adopting the bundled construction model of "natural gas power plant + intelligent computing center", and supporting the construction of a dedicated distributed power grid to realize direct power supply. This can avoid the cost of power transmission and distribution of the grid and effectively reduce the comprehensive electricity cost, while intelligent computing centers are preferentially located in the Chengdu-Chongqing Computing Power Hub clusters.

In terms of operation and dispatching, a dispatching mechanism of "wet-dry coordination and peak shaving priority" is formulated. During the dry season, 70% of the natural gas power generation capacity participates in grid power supply and peak shaving, and 30% guarantees the base load of computing power centers; during the wet season, 70% of the capacity operates at full capacity to guarantee the computing power load, and 30% participates in new energy peak shaving. This completely solves the problem of idle units during the wet season and realizes the annual utilization hours exceeding 3000 hours (as shown in Figure 3).

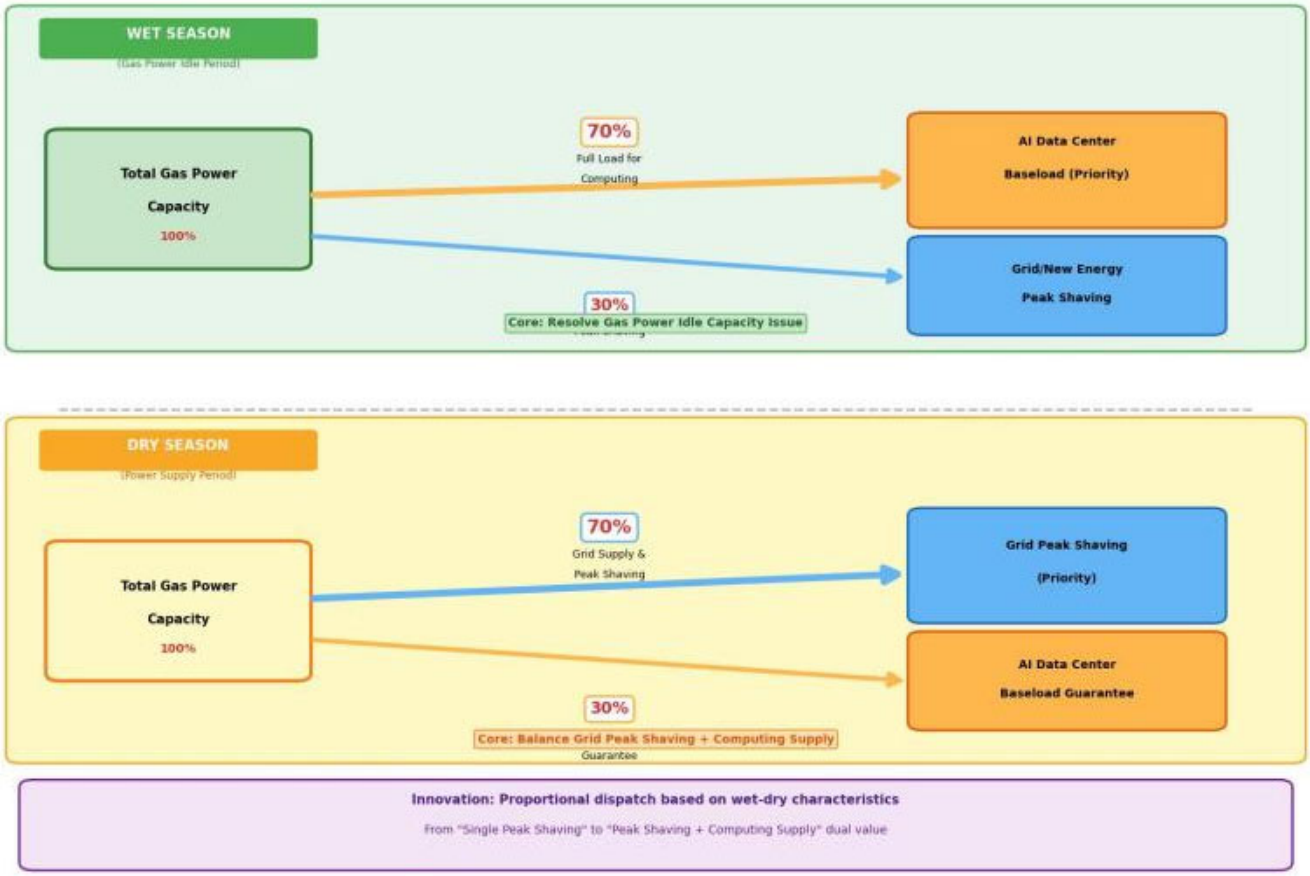


Figure 3. "Wet-Dry Synergy, Peak Shaving Priority" Dispatch Mechanism

Since the revenue model is designed as a diversified profit system of "power generation revenue + computing power service revenue + carbon asset revenue", natural gas power generation enterprises can share the benefits of the computing power industry through joint ventures and equity investment in electricity, and develop carbon emission reductions based on the green electricity attribute of natural gas power generation, naturally opening up revenue channels in the carbon market.

(2) Multi-agent Collaboration Mechanisms

This paper elaborates on the multi-agent collaboration mechanism of the integration model in a very clear and hierarchical way: this model takes five main bodies, namely natural gas power generation enterprises, computing power operators, grid companies, local governments and gas source suppliers, as the basic framework. Therefore, it is first necessary to establish a collaboration mechanism with clear rights and responsibilities, shared benefits and shared risks. Specifically, natural gas power generation enterprises undertake the functions of power supply construction and power supply to ensure power supply reliability; computing power operators are engaged in the construction and operation of intelligent computing centers to provide stable computing power service revenue; grid companies are responsible for bottom-line power supply guarantee and dispatching connection, so it is natural to clarify the grid access and dispatching rules for direct power supply; local governments introduce supporting policies, optimize project approval processes, and actively promote the implementation of pilot demonstrations; gas source suppliers sign medium and long-term gas supply agreements with natural gas power generation enterprises to determine gas prices and gas supply

volumes, and effectively ensure stable gas sources. What is more valuable is that long-term contracts are used to clarify the benefit distribution ratio and risk sharing boundaries of each subject.

6. Profitability Calculation and Robustness Test of the Integration Model

(1) Benchmark Model Calculation

This paper deals with the profitability calculation and robustness test of the integration model in a clear and hierarchical way: first, taking a 2×350MW gas-fired power station as the benchmark model, the profitability levels of the traditional model and the integration model are calculated respectively, and then a sensitivity analysis is carried out.

Basic assumptions of the traditional model: installed capacity of 700MW, annual utilization hours of 1520 hours; benchmark on-grid electricity price of 0.45 yuan/kWh, peak shaving auxiliary service compensation of 0.3 yuan/kWh, peak shaving power generation accounting for 32%; benchmark gate price of natural gas of 2.0 yuan/cubic meter, unit power generation gas consumption rate of 0.2 cubic meters/kWh.

Since the annual fixed cost amortization is 120 million yuan and the annual operation, maintenance and start-stop cost is 30 million yuan, the following calculation can be made naturally and appropriately: the total annual operating income is 428 million yuan, the total annual operating cost is 576 million yuan, the annual total profit is -148 million yuan, the return on investment is -3.7%, and the minimum utilization hours for project break-even is 2489 hours. The current actual operating level is below the break-even line.

Basic assumptions of the integration model: with the supporting 100,000-card AI intelligent computing cluster, the annual utilization hours are increased to 3200 hours, and the direct supply model reduces the electricity cost by 15%, thus naturally and reasonably increasing the computing power service revenue. From this, it can be clearly and reliably calculated: the annual power generation is 2.24 billion kWh, the total annual operating income is 1.61 billion yuan (962 million yuan from power generation revenue and 650 million yuan from computing power service revenue), the total annual operating cost is 1.03 billion yuan, the annual total profit is 563 million yuan, and the return on investment is 14.1%. The project has been fully profitable (as shown in Figure 4).

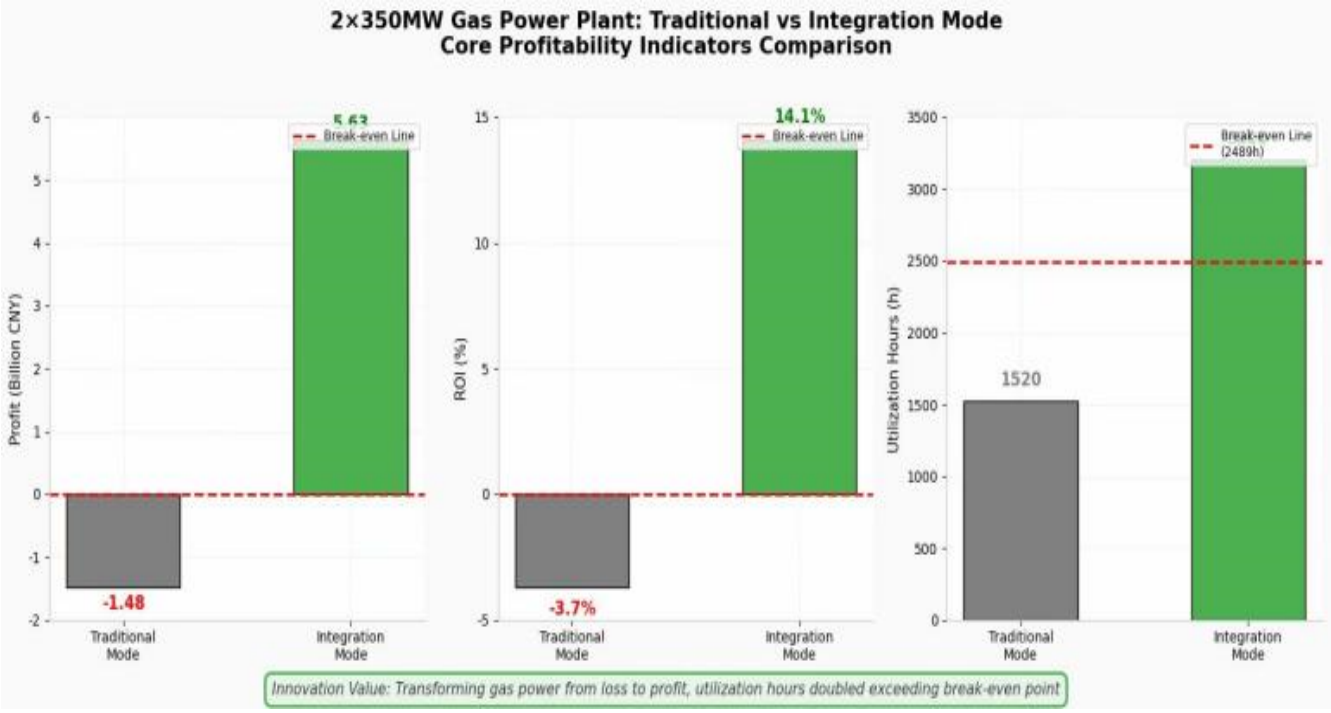


Figure 4. Profitability Comparison between Traditional Model and Integration Model Sensitivity Analysis

Since the purpose of sensitivity analysis is to test the robustness of the calculation results, this paper naturally and reasonably selects three parameters, namely natural gas price, annual utilization hours and computing power service revenue, to conduct single-factor sensitivity analysis. The results obtained are very clear and definite: ① For every ±0.2 yuan/cubic meter fluctuation in natural gas price, the project's total profit fluctuates by ±112 million yuan, and the return on investment fluctuates by ±2.8 percentage points; ② For every ±200 hours fluctuation in annual utilization hours, the total profit fluctuates by ±78 million yuan, and the return on investment fluctuates by ±1.95 percentage points; ③ For every ±10% fluctuation in computing power service revenue, the total profit fluctuates by ±65 million yuan, and the return on investment fluctuates by ±1.63 percentage points.

In the pessimistic scenario where the natural gas price rises to 2.4 yuan/cubic meter, the annual utilization hours drop to 2800 hours, and the computing power service revenue decreases by 20%, the project can still achieve an annual total profit of 85 million yuan and a return on investment of 2.1%. Therefore, it can be seen that its anti-risk ability is extremely strong (as shown in Figure 5).

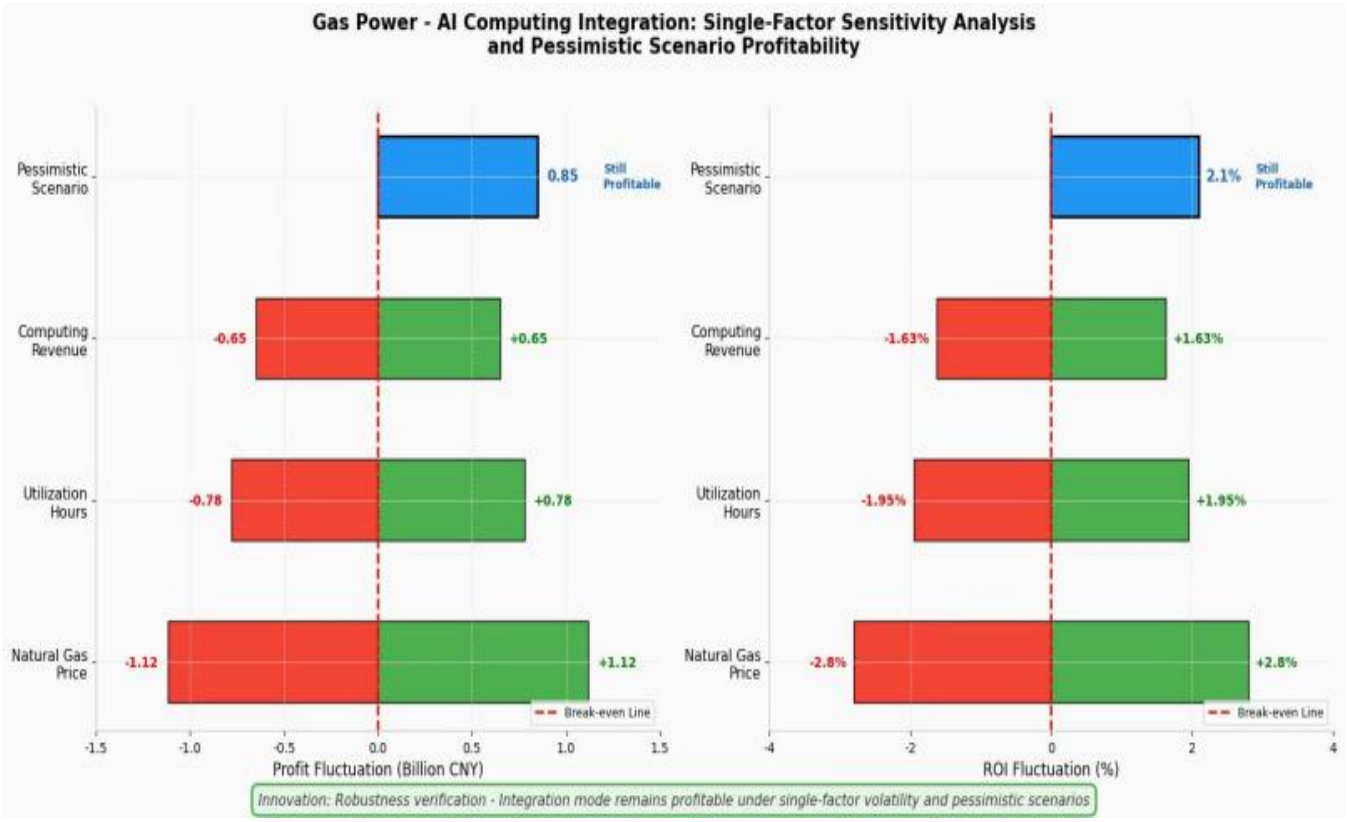


Figure 5. Single-Factor Sensitivity Analysis and Pessimistic Scenario Profitability

7. Core Risks and Hedging Mechanisms of the Integration Model

(1) Core Risks

There are very clear and hierarchically sortable core risks and corresponding hedging mechanisms under the integration model: The first is the fuel price fluctuation risk. Since natural gas costs account for 70%-80% of the unit electricity cost of natural gas power generation, the rise in gas prices will inevitably increase power generation costs and directly erode project profits. The second is the computing power market demand fluctuation risk. The AI computing power industry is greatly affected by factors such as technological iteration, market demand and policy supervision. If the computing power demand fails to meet expectations, it will directly lead to a decline in computing power service revenue and a reduction in unit utilization hours. The third is the policy and regulatory risk. Policies such as direct power supply policies, grid dispatching rules, capacity electricity price mechanisms and carbon market policies may be adjusted, and their changes will have a substantial impact on the project operation model and revenue. The fourth is the gas source supply guarantee risk. In extreme weather or peak gas consumption periods, the priority of natural gas supply guarantee is generally given to people's livelihood, which may affect the normal operation of natural gas power generation units.

(2) Risk Hedging Mechanisms

The risk hedging mechanism makes a very systematic and logical arrangement for the gas price fluctuation risk: signing medium and long-term gas supply agreements of more than 5 years with gas source suppliers to agree on a fixed benchmark gas price and peak shaving gas price, and then supporting the construction of gas storage facilities to directly suppress gas price fluctuations. A very clear hedging design is also made for the computing power demand risk, that is, signing long-term computing power service agreements with leading Internet enterprises and AI enterprises to lock in the basic computing power load and revenue. For policy risks, take the initiative to fully communicate with local governments and energy regulatory authorities, participate in integrated pilot demonstration projects, and strive for special policy support, thus naturally and reasonably solidifying the compliant operation model. Finally, effective protection is provided for the gas source supply guarantee risk (as shown in Figure 6).

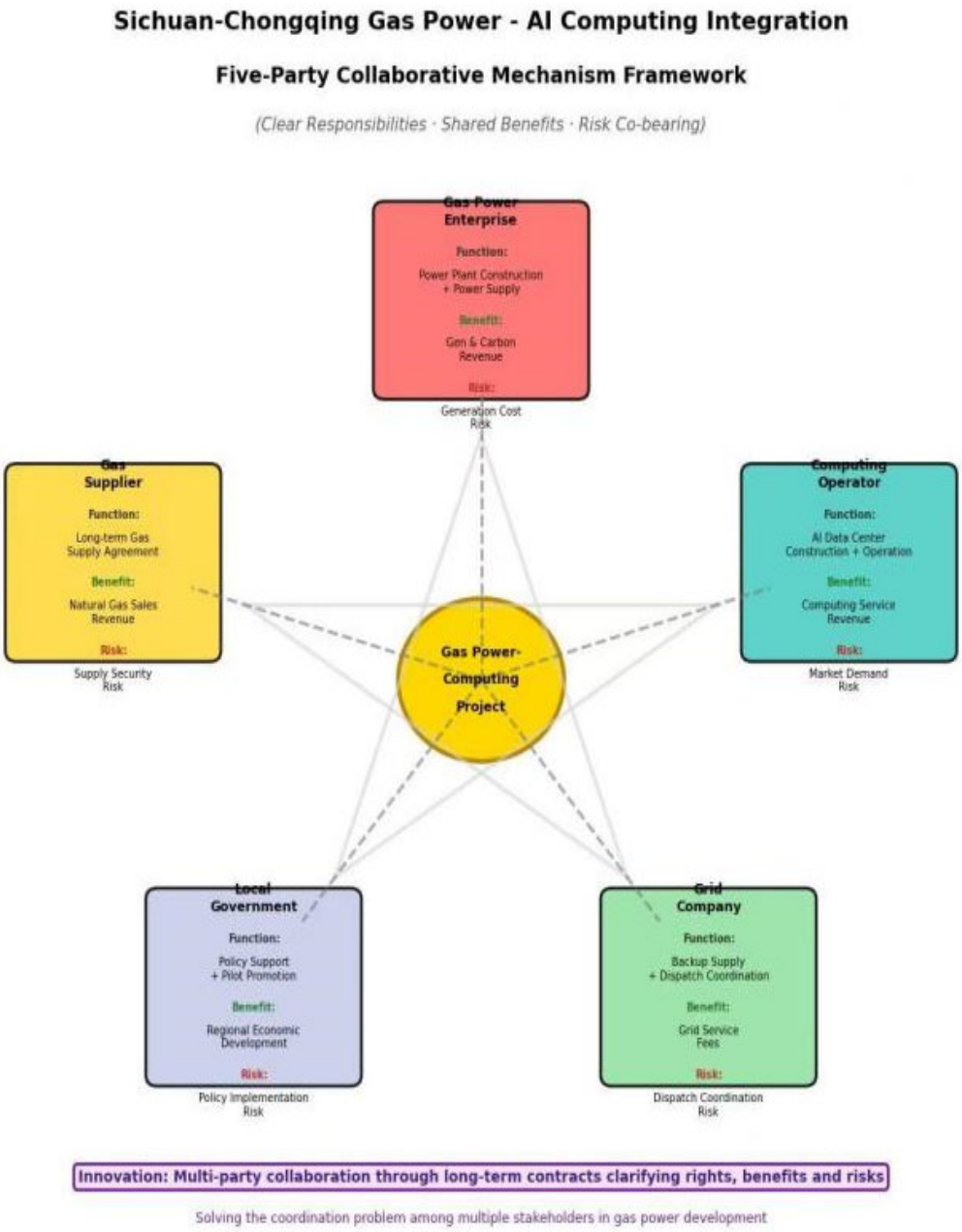


Figure 6. Core Risks and Hedging Mechanisms of the Integration Model

8. Countermeasures and Suggestions

Clear and hierarchical countermeasures are put forward from the aspects of improving policies and market mechanisms: First, introduce the capacity electricity price policy for natural gas power generation in Sichuan-Chongqing, improve the peak shaving auxiliary service market, raise the peak shaving compensation standard, and then formally incorporate natural gas power generation as a supporting power source for computing power hubs into regional energy and industrial plans, thus naturally leading to the idea of bundled construction of "natural gas power generation + computing power".

Second, start with strengthening the gas source guarantee system, actively promote the construction of gas storage facilities, improve the medium and long-term gas supply agreement mechanism, determine gas prices and annual gas supply volumes, thus naturally and reasonably suppressing the seasonal fluctuations of natural gas prices.

Third, innovate in both technology and model: first, promote H-class high-efficiency gas turbines and localized core components to effectively reduce project investment and operation and maintenance costs; then carry out integrated pilot demonstrations of "natural gas power generation + computing power" to systematically and steadily explore the benefit distribution and dispatching coordination mechanisms.

Fourth, arrange from the perspective of optimizing regional spatial layout: arrange large-scale natural gas power generation projects in natural gas resource-rich areas such as Luzhou and Yibin to directly supply power to the Intelligent Computing Center of Western Science City in Chongqing, and support the layout of natural gas power generation projects at the computing power hub nodes in western and southern Sichuan to achieve nearby power consumption.

9. Conclusion

The development of natural gas power generation in Sichuan-Chongqing has long been plagued by the fundamental problems of lagging installation, low utilization rate and difficult profitability, and the traditional development path of solely serving grid peak shaving is extremely difficult to adapt to the regional power structure dominated by hydropower. Therefore, the construction of the Chengdu-Chongqing Computing Power Hub has brought a new major opportunity for the development of natural gas power generation: the in-depth integration of natural gas power generation and the computing power industry can enable natural gas power generation to play the dual values of "grid peak shaving + computing power supply guarantee", thus fundamentally solving the long-standing problem of idle units during the wet season. What is more valuable is that quantitative analysis clearly and rigorously proves that the integration model can turn the project from a loss to a profit and significantly enhance its anti-risk ability. Therefore, the Sichuan-Chongqing region should seize the policy opportunity of "East Data, West Computing", systematically and actively promote the in-depth coordination of natural gas power generation and the computing power industry, so as to support the simultaneous advancement of regional energy transformation and high-quality development of the digital economy.

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