Economics & Business Management
ISSN Print: 3079-5214
ISSN Online: 3079-5222
https://doi.org/10.63313/EBM.2011

Research on the Collaborative Path of Low-Carbon Transformation and High-Quality Development of Sichuan Enterprises under the "Dual Carbon" Goals—Taking Kelun Pharmaceutical as an Example

Fuhong He. Jie Fan
School of Economics and Management of Southwest Petroleum University,Southwest Petroleum University, Chengdu 610500, China

How to cite this paper: He, F. H., & Fan, J. (2025). Research on the Collaborative Path of Low-Carbon Transformation and High-Quality Development of Sichuan Enterprises under the "Dual Carbon" Goals—Taking Kelun Pharmaceutical as an Example. Economics & Business Management, 2(1), 29–48. ISSN Print: 3079-5214; ISSN Online: 3079-5222.
https://doi.org/10.63313/EBM.2011
Published: 2025-05-30

Abstract

Under the constraints of the "dual carbon" goals, the research on the collaborative path of enterprises' low-carbon transformation and high-quality development is of great strategic significance for improving the quality and efficiency of regional economy. Taking Sichuan enterprises as samples, this paper focuses on the transformation practices of high-energy-consuming industries, illustrating the importance of enterprise transformation. It analyzes the current situation and challenges of enterprises' low-carbon transformation, and proposes corresponding action plans and implementation schemes. Using qualitative and quantitative research tools, this paper systematically discusses the driving mechanisms and path choices of enterprises' low-carbon transformation by analyzing the carbon emission data of Sichuan enterprises, evaluates their degree of low-carbon transformation, and aims to provide theoretical support and practical guidance for Sichuan enterprises to achieve low-carbon transformation and high-quality development.

Keywords

Dual carbon economy; Low-carbon transformation; High-quality development; Path research

Introduction

Against the backdrop of increasingly severe global climate change, reducing greenhouse gas emissions has become a common responsibility of the international community. As a major global carbon emitter, China has put forward the "dual carbon" goals of "reaching carbon peak before 2030 and carbon neutrality before 2060" in response to the Paris Agreement, demonstrating its responsibility in global

climate governance. This strategic goal not only puts forward new requirements for China's ecological civilization construction but also profoundly affects the development path of regional economy and the transformation logic of enterprises. As a major economic province in western China, Sichuan has an energy structure dominated by hydropower and advantages in renewable resources. However, it also has a strong industrial foundation and a high proportion of resource-based industries, so the pressure of total carbon emissions remains significant. In the green and low-carbon transformation, Sichuan bears the demonstration mission of exploring the dual coordination of "high-quality development and low-carbon path". Especially in the process of new industrialization, how to effectively control carbon emissions, improve resource utilization efficiency, and promote green technological innovation has become an urgent strategic issue to be solved. Enterprises, as the basic units of economic activities, are the key subjects to achieve the "dual carbon" goals. At present, Sichuan enterprises generally face structural obstacles such as insufficient green technology reserves, limited green financing channels, and weak carbon information disclosure and policy adaptability. In particular, during the low-carbon transformation process, medium and large enterprises need to balance regulatory requirements and economic growth. Therefore, systematically sorting out the collaborative path of low-carbon transformation and high-quality development of typical Sichuan enterprises is of important theoretical and practical value. Taking Kelun Pharmaceutical as a case, this paper discusses how Sichuan enterprises achieve synergistic efficiency between low-carbon transformation and high-quality development under the drive of the "dual carbon" goals, aiming to provide scientific basis and practical reference for local governments to formulate differentiated policies and for enterprises to optimize green transformation paths.

1. Conceptual Definition and Theoretical Framework

1.1 Conceptual Definition of Enterprise High-Quality Development

In the report to the 20th National Congress of the Communist Party of China, General Secretary Xi Jinping emphasized that "high-quality development is the primary task of building a modern socialist country in an all-round way" [1] . High-quality development fully reflects the core essence of China's national development strategy, meaning that the focus of China's development has shifted from the past high-speed growth to paying more attention to the quality and efficiency of development. Many scholars have also conducted in-depth research on the connotation and extension of high-quality development from different perspectives. Liang Guodong et al. (2023) [2] argued that the core essence of enterprise high-quality development is to shift from "focusing on scale and efficiency" to "focusing on quality and efficiency". Zhang Changjiang et al. (2022) [3] believed that high-quality development is the most ideal development model for enterprises in the new era, which integrates the advantages of green development, sustainable development, innovation-driven development

and other development models, and is also the ultimate goal of enterprise transformation. Huang Sujian (2018) [3] believed that enterprise high-quality development is a medium and long-term concept, referring to the goal state or development paradigm in which enterprises pursue higher-level, higher-efficiency economic value and social value creation, and shape excellent enterprise sustainable development and sustainable value creation quality and ability. The Research Group of the Economic Research Institute of the National Development and Reform Commission (2019) [4] proposed that high-quality development should reflect quality first and efficiency priority, and its core connotations include high-quality supply system, high efficiency, and high stability. Huang Ying et al. (2022) [5]believed that the key factors of high-quality development are pursuing benefits, improving efficiency, and creating value. This paper believes that the definition of high-quality development should be relative to the reference object. For example, China's previous development strategy was high-speed economic growth, and high-quality development means that the development speed can be appropriately slowed down to pursue higher quality. Here, the development speed is relative to China's previous development speed, but there is no specific standard for which period of China's development speed is used as a reference. The same confusion exists in the high-quality development of enterprises. Therefore, based on the previous research results and the scope of this paper, the high-quality development of enterprises is tentatively equated with the further research of sustainable development, and it is discussed from the environmental dimension, economic dimension, and social dimension.

1.2 Conceptual Definition of Enterprise Low-Carbon Transformation

How to measure an enterprise's low-carbon awareness, accurately identify the level of enterprise low-carbon transformation, and how to quantitatively determine whether an enterprise has entered the category of low-carbon transformation? This concept is not clearly defined in today's academic circles and national policies and regulations. From a narrow perspective, enterprise low-carbon transformation refers to the transformation of enterprise economic development from high-carbon dependence to low-carbon. However, Chen Shiyi (2012) [6]believed that low-carbon transformation should be a broader concept, that is, the transformation from relying on high-pollution emissions to low-pollution emissions, where pollution emissions cover various pollutants including carbon dioxide. The Department of Trade and Industry (2003) [7]emphasized the input-output ratio, indicating that the degree of low-carbon transformation can be measured by carbon emission efficiency. Wan Qiuxu and Shi Ying (2022) [8]pointed out that when high-carbon enterprises implement transformation, they can clearly explain the implementation of specific transformation paths through specific KPIs and related performance levels. Luo Jianli, Huang Minmin, and Bai Yanhu (2022) [9]believed that by implementing a low-carbon supply chain (LCSC), enterprises can meet carbon emission standards, achieve market competitiveness, environmental protection, and improve social

welfare. Therefore, to evaluate whether an enterprise has entered low-carbon transformation, it can also consider its practice and contribution in the supply chain or the carbon emissions of other enterprises in the supply chain where the enterprise is located. Wang Fangjun, Sun Junqin, and Dr. Yang Stephanie Liu (2019) [10]found that the carbon emission reduction level of enterprises can be measured by carbon emission reduction reports and performance. Peng Wei and Xiong Langyu (2022) [11]proposed using the number of patent authorizations and citations as proxy variables for the quantity and quality of green transformation levels, respectively. This paper believes that low-carbon transformation refers to the systematic reduction of pollutant emissions by enterprises through technological innovation, energy efficiency improvement, energy structure adjustment, and management model optimization, so as to achieve low-carbon production and operation under the background of global climate change and the national dual carbon strategy.

1.3 Selection of Enterprise Low-Carbon Transformation Indicators

For low-carbon transformation, if we want to fully verify whether an enterprise has entered the category of low-carbon transformation, it may be necessary to establish a comprehensive evaluation system including qualitative and quantitative indicators, but this step requires the joint efforts of more researchers. Based on this, within the scope of this paper in the economic and social background of Sichuan Province, it is assumed that under the condition that the scale, output, and other related factors of the enterprise remain unchanged, the growth rate of the enterprise's apparent carbon emissions is used to measure whether the enterprise has entered the category of low-carbon transformation. China put forward the dual carbon goals in September 2020, so this paper takes 2021 as the boundary. Considering the impact of the three-year global COVID-19 pandemic, the enterprise data sampled is the average value of the latest three years from 2017 to 2022 in which the enterprise has data display, as a reference index to measure whether the enterprise has entered the category of enterprise low-carbon transformation.

2. Analysis of the Current Situation and Problems of Low-Carbon Transformation of Sichuan Enterprises

2.1 Current Situation of Low-Carbon Transformation

According to the Sichuan Statistical Yearbook 2022 of the Sichuan Provincial Bureau of Statistics, the total energy consumption of the province from 2017 to 2021 increased from 192.29 million tons of standard coal to 225.694 million tons of standard coal, with an average annual growth rate of 4.10%. Compared with 2017, the proportion of natural gas consumption in Sichuan increased from 14.96% to 16.96% in 2021, an increase of 2 percentage points. In addition, the consumption of primary electricity increased significantly, from 105.168 million tons of standard coal to 126.068 million tons of standard coal, accounting for 55.86% of the total consump-

tion. Natural gas is a cleaner energy than coal and oil, and electricity belongs to renewable energy. The increase in the proportion of these two energy consumptions indicates that the energy structure transformation in Sichuan Province has achieved remarkable results.

Table 2-1. Energy Consumption in Sichuan Province, 2017–2021

Unit: 10,000 tons of standard coal equivalent (tce)

Energy Type	2017	2018	2019	2020	2021
Coal Products	6085.1	5865.3	5886.1	5728.9	5846.0
Oil Products	3711.6	3680.7	3881.8	3729.6	3840.3
Natural Gas	2876.3	3152.2	3387.7	3486.6	3767.4
Primary Electricity	10516.8	10915.6	11206.1	11996.3	12606.8
Total Consumption	19229.0	19916.2	20790.6	21185.9	22569.

Data source: Sichuan Statistical Yearbook.

Zhou Mi (2008) [12] found through empirical research that there is indeed a correlation between the industrial structure and the energy industry. There is a positive equilibrium relationship between the energy industry structure and the industrial structure. The optimization of the industrial structure is conducive to the decline in the growth rate of energy consumption, the improvement of China's energy utilization efficiency, and the sustainable development of the economy and society. According to the data of the Sichuan Statistical Yearbook 2022 of the Sichuan Provincial Bureau of Statistics, from 2017 to 2021, the proportion of the primary industry in Sichuan Province showed a fluctuating trend, generally remaining at about 10%. Although it suddenly increased in 2020, which may be related to the impact of the COVID-19 pandemic on other industries, it fell back to 10.5% in 2021. This reflects the stability of agriculture in Sichuan Province and also shows that Sichuan Province is making efforts to promote the development of other industries while maintaining basic agricultural development. The proportion of the secondary industry showed a fluctuating downward trend, reflecting that Sichuan Province is gradually reducing its dependence on heavy industry and turning to more environmentally friendly and sustainable industrial development. The proportion of the tertiary industry was relatively large and showed an upward trend, reflecting the transformation of Sichuan's economic structure to a service-oriented one, which is in line with the general trend of global and Chinese economic development. It can be seen that the industrial structure of Sichuan Province is in a process of continuous optimization, reflecting the efforts of Sichuan Province to promote industrial upgrading and the development of environment-friendly industries.

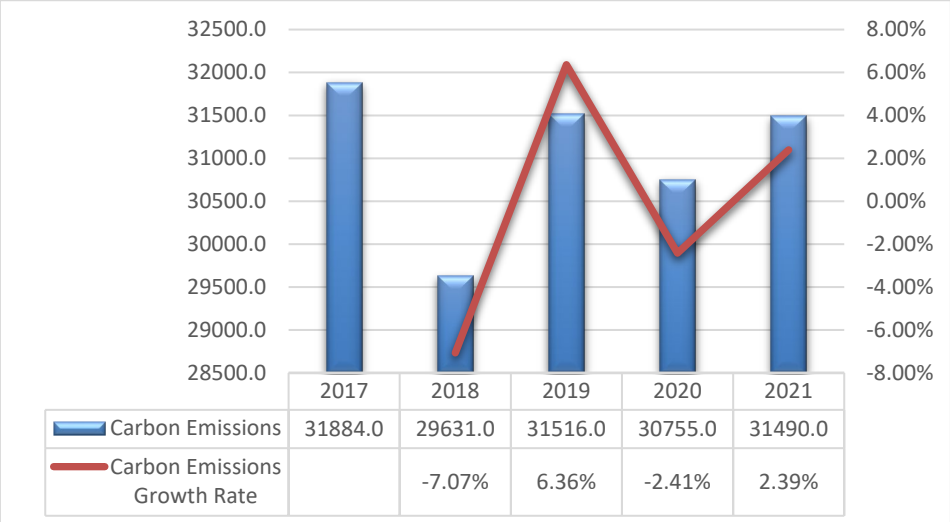
Table 2-2. Industrial Structure Composition of Sichuan Province, 2017–2021

Industry	2017	2018	2019	2020	2021
Primary Industry	11.2%	10.3%	10.4%	11.5%	10.5%
Secondary Industry	38.4%	37.4%	37.1%	36.1%	37.0%
Tertiary Industry	50.4%	52.3%	52.5%	52.4%	52.5%

Data source: Sichuan Statistical Yearbook.

According to the goals of the "14th Five-Year Plan" of Sichuan Province and relevant calculations, the carbon emission target values of Sichuan Province in 2030 and

2060 are 336 million tons and 72 million tons, respectively. It can be seen from Figure 2-1 that the total carbon emissions of Sichuan Province showed an obvious fluctuating downward trend from 2017 to 2021, which can reflect that Sichuan Province has made significant contributions to energy transformation and low-carbon environmental protection.



	2017	2018	2019	2020	2021
Carbon Emissions	31884.0	29631.0	31516.0	30755.0	31490.0
Carbon Emissions Growth Rate		-7.07%	6.36%	-2.41%	2.39%

Figure 2-1. Trends in Total Carbon Emissions and Growth Rate in Sichuan Province, 2017–2021

Data source: China Carbon Accounting Database.

"Carbon Benefit Tianfu" Completes First Batch of Public Welfare Action Subscriptions; Comprehensive Launch of Climate Change Cooperation in Sichuan-Chongqing Region; World's First Ultra-High-Altitude Photovoltaic Demonstration Base Begins Construction

The Tianfu Yongxing Laboratory, a research platform focused on core green and low-carbon technologies under the theme of "carbon neutrality," was officially inaugurated. Additionally, the first carbon market compliance cycle clearing was completed. Over the past two years, guided by the goals of carbon peak and carbon neutrality, Sichuan has steadfastly pursued a green and low-carbon development path that aligns with national strategic priorities and supports the province's future growth. Significant progress has been made in the comprehensive green transformation of economic and social development.

According to the Sichuan Private Enterprise Green Development Report (2022), in 2022, Sichuan established 100 provincial-level green factories, 93 of which were private enterprises, accounting for 93% of the total [13] . This reflects the increasing proactive engagement of Sichuan's private enterprises in green development, effectively contributing to the province's green manufacturing system. Private enterprises in Sichuan have strengthened their green development awareness, optimized green development factors, accelerated green transformation, and upgraded green product certification. These enterprises actively promote comprehensive pollution control and management of wastewater, exhaust gases, and solid waste, advance

demonstration projects for resource utilization, and widely adopt new technologies such as online monitoring for quality and environmental protection, as well as data transmission. They have explored innovative lifecycle green management models.

To achieve carbon neutrality, enterprises must rely on three key pillars: the energy system, economic system, and ecosystem. Based on decarbonization measures adopted by 100 enterprises nationwide, this paper outlines six pathways: (1) decarbonization of electricity; (2) electrification of energy use; (3) decarbonization of fuels; (4) decarbonization of raw materials; (5) efficient utilization of energy resources; and (6) negative carbonization of environmental impact.

In terms of electricity decarbonization, Sichuan has made remarkable progress in renewable energy, including hydropower, wind power, and solar power projects. Large-scale hydropower stations such as the Gezhouba Dam in Yibin and the Baihetan Dam in Ganzi have been constructed. Leshan Electric Power Co., Ltd. has leveraged local resources to integrate high-quality electricity, water, and gas supplies, accelerating the establishment of a modern, clean, low-carbon, safe, and efficient energy system. The company has improved its clean energy supply network, mitigated the instability of renewable energy output, maximized the efficiency of clean power sources, and actively participated in electricity market trading to enhance clean energy consumption and drive energy transition. Through clean energy substitution, the company has reduced coal emissions by approximately 55,309.42 tons. Sichuan Road & Bridge Co., Ltd. has adopted the electrification of energy use pathway, actively promoting the shift from fuel-powered to electric construction machinery. The company has upgraded traditional fuel-based equipment, pioneering the use of electric loaders, excavators, dump trucks, intelligent variable-frequency fans, electric self-unloading trucks, and electric concrete mixer trucks in the industry. By integrating intelligent construction technologies, it has fostered optimized energy application structures and developed low-carbon, green projects.

According to the 2021 Environmental Information Report of Sichuan Changhong Group Finance Co., Ltd., to support China's "carbon peak and carbon neutrality" strategy, the company has actively responded to central bank monetary policies by implementing "carbon reduction bill rediscount" services. Using financial instruments, it supports the production and use of high-efficiency energy-saving household appliances, reducing CO_2 emissions. Building on its successful carbon reduction quantitative testing model, the company steadily expanded its carbon reduction bill rediscount business in 2021, processing ¥518 million (a ¥442 million increase from 2020), helping enterprises cut CO_2 emissions by 6,359.94 tons. It continues to explore and enrich green financial products and services, employing diverse financial tools to deepen low-carbon and environmentally friendly investments and guide capital toward sustainable sectors [14] .

An analysis of carbon emission reports from select enterprises disclosed on Sichuan’s carbon disclosure platform reveals that most companies either did not pub-

lish reports or provided incomplete data. This study examines four power generation enterprises from 2018 to 2019. Three of these enterprises showed an overall decline in carbon emissions over three years: China Energy Fuxi Power Development Co., Ltd. reduced emissions by an average of 253,000 tons annually; Huadian Gongxian Power Generation Co., Ltd. cut emissions by 201,000 tons per year; and Yibin Huimei Thread Co., Ltd. decreased emissions by 45,000 tons annually. In contrast, Bashu Jiangyou Coal-Fired Power Plant experienced fluctuating increases, with an average annual rise of 319,000 tons. These trends demonstrate that power enterprises have effectively reduced fossil fuel consumption in electricity generation by phasing out outdated machinery, optimizing filler materials, and improving equipment operations. Controlling the sulfur content of raw coal has also significantly reduced carbon emissions from desulfurization. However, a few enterprises still struggle to improve their decarbonization efforts.

2.2 Problem Analysis

(1) Energy Consumption Pressure

With the rapid advancement of industrialization and urbanization in Sichuan Province, energy demand has grown substantially. Key sectors, regions, and seasonal fluctuations continue to face significant challenges in securing stable supplies of coal, electricity, oil, and natural gas. While corporate energy needs escalate, most enterprises still predominantly rely on fossil fuels under high-demand and high-consumption models. Despite large-scale integration of renewable energy into the grid, the current energy supply and consumption structure remains heavily dependent on fossil fuel combustion.

(2) Core Technology Constraints in Renewable Energy

The accelerated development of green and low-carbon industries—such as new materials, renewable energy, energy storage, electric vehicles, and high-efficiency power equipment—has driven profound transformations in energy systems. The increasing adoption of digitalization, informatization, and intelligent technologies has further reshaped the sector. However, critical bottlenecks persist in core energy technologies. Commercialization pathways for advanced energy storage, hydrogen energy, and integrated energy services require deeper exploration. Additionally, the economic viability, safety, and regulatory frameworks for emerging business models and industries demand resolution.

(3) Lagging Carbon Reduction Technologies and Talent Shortages

Current CO_2 emission reduction technologies primarily include carbon capture, oxygen-assisted storage, CO_2 resource utilization, and energy recovery from CO_2. However, CO_2 storage technology faces unresolved technical challenges, such as viscosity enhancement, gas channeling prevention, and wellbore sealing, limiting its industrial adoption. Globally, only 26 commercial facilities currently operate in this field, with few countries or sectors possessing the expertise for implementation. The

shortage of specialized professionals further slows technological progress.

(4) Inadequate Corporate Carbon Disclosure Mechanisms

Sichuan's carbon emission disclosure platform requires significant improvements. Nationally, mandatory disclosure policies have yet to be strictly enforced, allowing enterprises to voluntarily report emissions based on self-assessments. This lack of oversight often leads to selective or biased disclosures, where companies highlight achievements while omitting shortcomings. Such practices compromise data authenticity and increase regulatory difficulties for governments.

3. Analysis of the Correlation between Low-Carbon Transformation and High-Quality Development

Green and low-carbon development is the firm pursuit of today's development philosophy, aiming to achieve high-quality growth while simultaneously promoting environmental protection. Recently, PwC, in collaboration with the United Nations Development Programme (UNDP) and the China Chamber of International Commerce, jointly released a noteworthy research report at the 2023 China International Fair for Trade in Services, titled "The Path of Corporate Low-Carbon Transformation — Sustainable Development Actions of Enterprises in China 2022/2023." The report revealed the perspectives of surveyed enterprises, among which 86.7% stated that the "dual carbon" goals have impacted their operations and revenue, and 44.5% considered this impact to be quite significant [15] .

Under the broader context of the dual carbon economy, enterprises are regarded as the core to achieving the "dual carbon" goals, and low-carbon transformation is seen as the only feasible path forward. The main actions enterprises take in implementing low-carbon transformation include reducing carbon emissions, providing green products and services, and actively innovating low-carbon technologies. This innovation in low-carbon technology not only helps companies meet their low-carbon targets but also creates a virtuous cycle. Ultimately, these efforts are expected to shape a high-level socialist market economic system, build a modern green industrial system, and promote coordinated progress between ecological environment and economic development. This comprehensive drive is anticipated to achieve comprehensive, high-quality development. As shown in Figure 3.1.

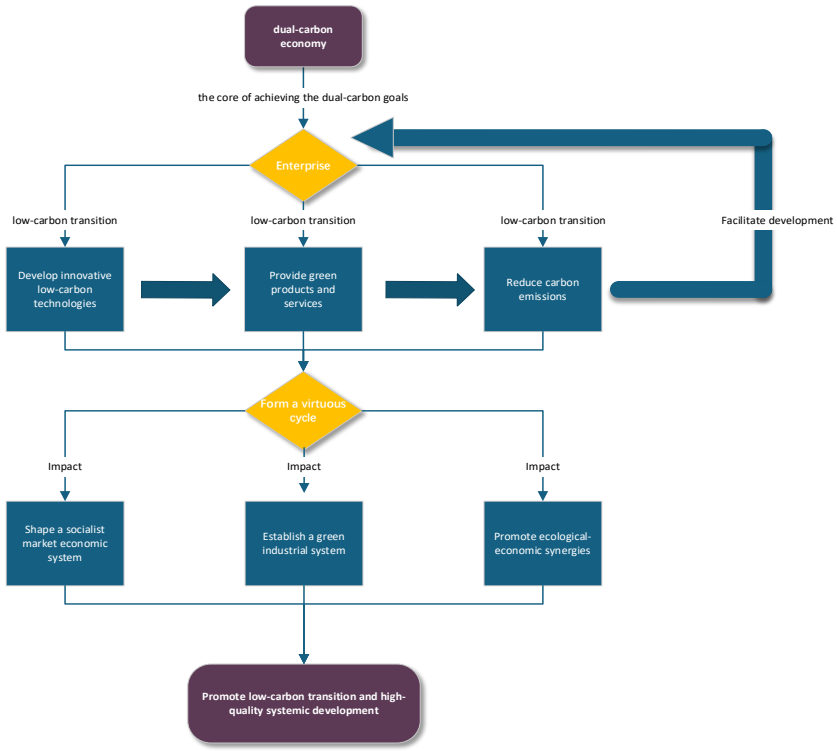


Figure 3.1 Transformation Diagram

Taking Sichuan Kelun Pharmaceutical Co., Ltd., an A-share listed company in Sichuan Province, as an example. Founded in 1996, Kelun Pharmaceutical is one of the largest pharmaceutical enterprise groups in China with the most complete industrial ecosystem, covering multiple fields such as pharmaceutical research and development, drug manufacturing, and commercial distribution. By the end of 2022, the company's revenue reached 18.913 billion RMB, net profit was 1.709 billion RMB, R&D investment amounted to 1.815 billion RMB, net assets totaled 15.751 billion RMB, and the number of employees was 18,400. Its pharmaceutical products include 616 varieties, with a sales network covering more than 50 countries and regions.

Kelun Pharmaceutical demonstrates a certain representativeness among many low-carbon transformation enterprises in Sichuan Province. By the end of 2022, the company had released 11 reports reflecting its performance in Environmental, Social, and Governance (ESG) aspects. Moreover, Kelun Pharmaceutical ranks among the top in carbon emissions within Sichuan Province. As shown in Figure 3.2, since China proposed the "dual carbon" goals in 2020, the company's average carbon emissions have been significantly lower than the average before 2020, successfully achieving low-carbon transformation. Meanwhile, Kelun Pharmaceutical's efforts in environmental protection also have certain representative significance, as illustrated in Figure 3.3.

This series of data and achievements highlights Kelun Pharmaceutical's outstanding position among Sichuan enterprises and its leadership in sustainable operations and low-carbon transformation. This makes Kelun Pharmaceutical a remarkable case

worthy of in-depth study of its successful experience, aiming to provide valuable insights for other enterprises in their low-carbon transformation and high-quality development.

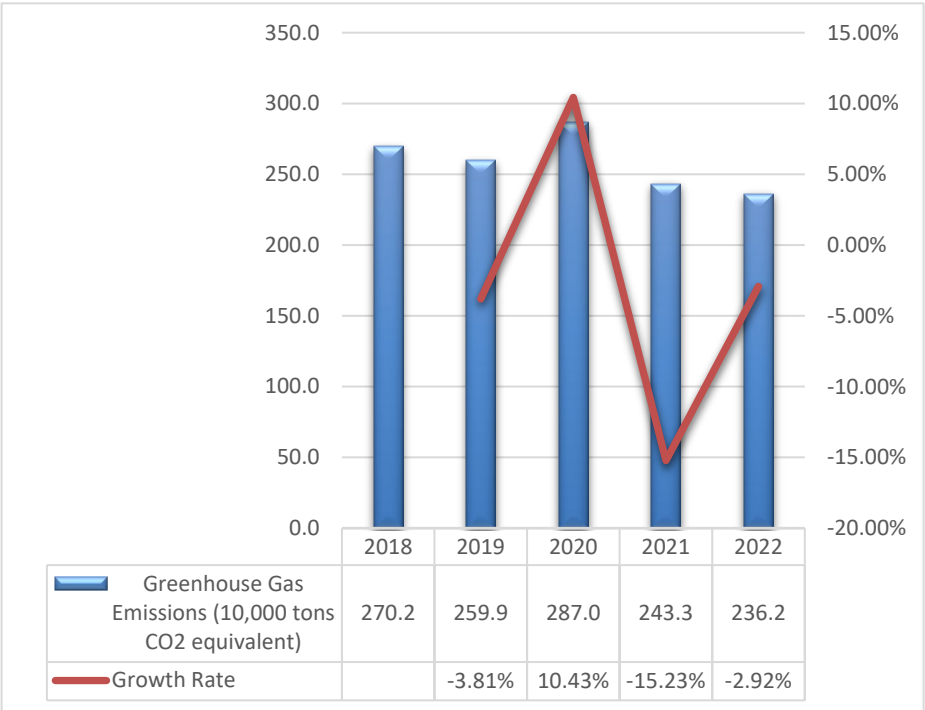


Figure 3.2 Kelun Pharmaceutical Greenhouse Gas Emissions Data, 2018–2022

Data Source: Kelun Pharmaceutical Environmental, Social and Governance (ESG) Report

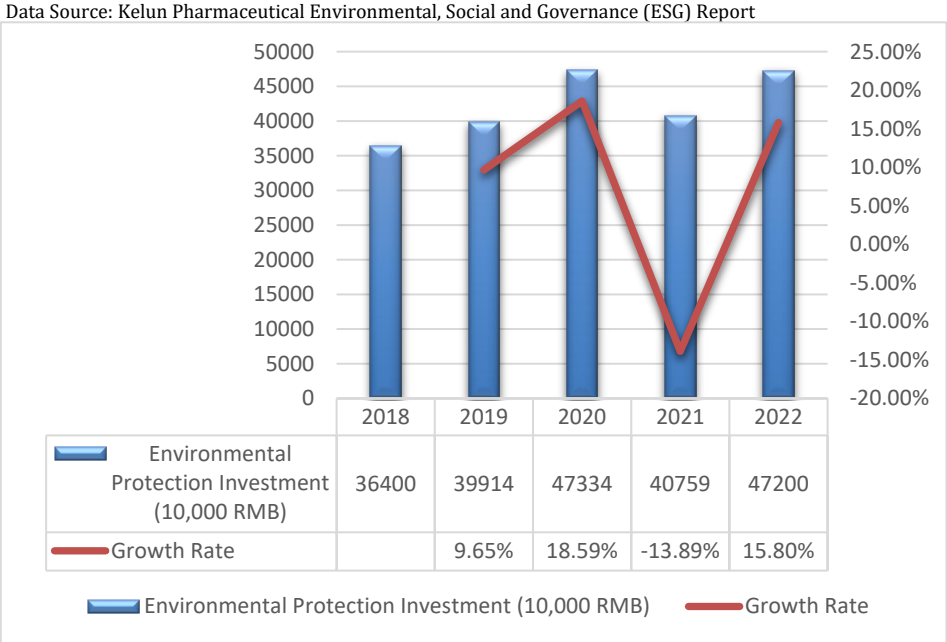


Figure 3.3 Kelun Pharmaceutical's Recent Environmental Protection Investment, 2018–2022

Data Source: Kelun Pharmaceutical Environmental, Social and Governance (ESG) Report

3.1 Economic Benefit Impact Assessment

From the perspective of economic benefits, Kelun Pharmaceutical achieved steady growth in operating revenue during the period from 2017 to 2020, increasing from 11.18 billion RMB in 2017 to 15.39 billion RMB in 2020, with an average annual growth rate of 11.2%. Net profit also maintained a high level, rising from 2.36 billion RMB in 2017 to 3.28 billion RMB in 2020, with an average annual growth rate of 11.6%. R&D investment continuously increased as well, growing from 510 million RMB in 2017 to 840 million RMB in 2020, at an average annual growth rate of 18.1%, and its proportion of operating revenue rose from 4.6% to 5.5%.

From 2021 to 2022, Kelun Pharmaceutical's operating revenue grew from 17.2 billion RMB to 18.9 billion RMB, a year-on-year increase of 9.46%. During the period from 2020 to 2022, the company's revenue showed stable and continuous growth. According to data, Kelun Pharmaceutical's operating revenue was 16.464 billion RMB in 2020, increased to 17.277 billion RMB in 2021, and finally reached 18.913 billion RMB in 2022. The compound annual growth rate (CAGR) over these three years was 7.18%. Meanwhile, the company's net profit attributable to shareholders also saw significant growth, rising from 829 million RMB to 1.103 billion RMB, and finally reaching 1.709 billion RMB. This shows that Kelun Pharmaceutical has achieved positive development in both operating revenue and net profit over the past three years.

Based on an analysis of its financial statements and comparing periods before and after 2020, the overall revenue trend is upward (except for the special impact of the pandemic in 2020). The long-term benefits brought by its carbon-neutral transformation and the green optimization of its product structure have continuously optimized the infusion product mix, which is one of the important reasons affecting changes in the company's operating performance. With continuous technological progress in low-carbon and energy-saving practices and changing market demands, the company has continually adjusted and optimized its infusion product structure and increased the promotion of closed infusion systems. Closed infusion systems have better safety and stability, effectively reducing infection risks, and thus have been widely recognized and accepted by the market. According to statistics, the proportion of closed infusion volume increased by 1.91% in the past year. This indicates that the company's market share in the infusion sector has further expanded, bringing more sales revenue and profit growth.

At the same time, newly approved products have also achieved good sales growth, contributing positively to the company's performance improvement. With increased market demand and supply chain pressures, the prices of active pharmaceutical ingredients (APIs) have gradually rebounded. This price recovery has brought significant positive effects for the company. First, higher API prices mean increased sales revenue per product, thereby driving overall revenue growth. Second, the rebound

in API prices has also improved product gross profit margins, resulting in a year-on-year increase in the company's profits. This profit growth not only supports the company's sustainable development but also provides more financial resources for R&D investment and creates a virtuous development opportunity for green and low-carbon innovation, achieving a spiraling upward trend in innovative low-carbon revenue.

In summary, during its low-carbon transformation process, Kelun Pharmaceutical has not sacrificed economic benefits; on the contrary, it has driven innovation to improve product competitiveness and market share, thereby promoting high-quality development.

3.2 Environmental Benefit Impact Assessment

From the perspective of environmental protection, Kelun Pharmaceutical actively responded to the national "dual carbon" goals during the period from 2017 to 2020 by implementing a series of low-carbon measures, including improving energy efficiency to reduce energy consumption per unit of output value; using clean energy to reduce greenhouse gas emissions; implementing clean production to reduce wastewater, waste gas, and solid waste generation; promoting a circular economy through the resource utilization and harmless treatment of waste; increasing environmental protection investments; and establishing environmental management systems and pollution control facilities.

These measures have achieved remarkable results. For example, from 2017 to 2020, Kelun Pharmaceutical's energy consumption per unit of output value was 0.19, 0.17, 0.16, and 0.15 tons of standard coal per 10,000 RMB, respectively, showing a year-on-year downward trend. From 2017 to 2020, its carbon dioxide emissions were 221,000 tons, 236,000 tons, 242,000 tons, and 251,000 tons, while the carbon dioxide emissions per unit of output value were 0.20, 0.18, 0.17, and 0.16 tons per 10,000 RMB, also showing a steady decline each year.

From 2020 to 2022, Kelun Pharmaceutical actively built itself into a low-carbon and green enterprise by driving green manufacturing, based on the GMP quality management system and using the environmental management system as a platform. It integrated the requirements of environment, energy, occupational health and safety, and risk standards, gradually establishing an integrated management system that is compatible, complementary, and organically unified. For example, in 2022, the company audited more than 20 production bases, achieving the annual goals of 100% compliance in "three wastes" treatment (wastewater, waste gas, and solid waste) and zero major safety accidents. During the reporting period, the company did not receive any major environmental penalties nor experienced any external environmental pollution incidents. The results were significant, with solid waste recycling reaching 15,370 tons in 2022, a year-on-year increase of 160.5%. Environmental protection investment amounted to 472 million RMB, a year-on-year increase of

15.8%.

Thus, it is evident that during its low-carbon transformation, Kelun Pharmaceutical has effectively reduced its environmental impact and contributed to achieving carbon neutrality and carbon peak goals.

3.3 Social Benefit Impact Assessment

From the perspective of social benefits, during the period from 2017 to 2020, Kelun Pharmaceutical not only focused on its own economic and environmental benefits but also paid attention to social needs and expectations, fulfilling its social responsibilities well. These responsibilities included improving product quality to ensure public medication safety; providing high-quality customer service to meet public medication demands; establishing stable supply chain management to guarantee medication supply; participating in social welfare activities supporting education, healthcare, poverty alleviation, and more; and improving employee welfare to protect their rights and development.

These measures also achieved positive results. For example, from 2017 to 2020, Kelun Pharmaceutical's product qualification rate reached 100% every year, with no quality incidents; its customer satisfaction rates were 97.8%, 98.2%, 98.6%, and 99.0% respectively, showing an increasing trend year by year; and its social welfare investments were 120 million RMB, 150 million RMB, 180 million RMB, and 210 million RMB respectively, also showing a steady increase annually.

From 2020 to 2022, the company continued to innovate based on its existing protection systems, gradually expanding its social influence. These included a 100% labor contract signing rate, no occurrences of child labor, forced labor, or employment disputes; and no monetary losses caused by lawsuits related to employment discrimination. Kelun Pharmaceutical established reliable quality control and testing systems to ensure the safety and effectiveness of pharmaceuticals produced by all member enterprises, effectively addressing people's medical and health needs. The company maintained a strong corporate culture during 2020-2022, offering fair and reasonable compensation and welfare systems; it established transparent performance evaluation mechanisms to motivate employee effort and performance, as well as promotion pathways and career development plans to encourage employees to pursue higher professional achievements and actively improve social benefits.

Thus, it is evident that during its low-carbon transformation, Kelun Pharmaceutical not only enhanced its brand image and social reputation but also promoted social harmony and progress. There is a close relationship between Kelun Pharmaceutical's low-carbon transformation and its high-quality development. The low-carbon transformation has not hindered the company's high-quality development; rather, it has become a driving force and guarantee for such development. Kelun Pharmaceutical's low-carbon transformation practices provide a valuable example for other enterprises and offer strong support for China's realization of its "dual carbon" goals

and high-quality development.

4. Design of Low-Carbon and High-Quality Development Transformation Path

4.1 Low-Carbon Transformation Planning for Sichuan Enterprises

In response to rapid market changes, the national push for new energy industry development, and the strengthening of corporate competitiveness, achieving low-carbon transformation has become a key strategy for enterprises in Sichuan Province to sustain high-quality development. This paper aims to formulate scientific and practical low-carbon transformation strategies for Sichuan enterprises, helping them adapt to environmental changes while maintaining economic growth. The following are key strategic plans for corporate low-carbon transformation:

1. Market Positioning and Analysis

At the initial stage of formulating a low-carbon transformation strategy, enterprises need to conduct in-depth market analysis, which is a critical step to ensure the effectiveness of the strategy. First, enterprises should comprehensively evaluate the development trends of the low-carbon market nationwide and within Sichuan Province. This includes understanding the latest national and regional policies related to the low-carbon economy, new energy, and environmental protection. Furthermore, analyzing customer demand is equally essential; enterprises need to investigate the market demand for low-carbon products and services, and understand consumer preferences and expectations regarding energy efficiency and sustainability. At the same time, enterprises must conduct a thorough competitor analysis, identifying key domestic and international competitors and analyzing their market strategies, product lines, technological advantages, and market shares. Through this competitive analysis, enterprises can better understand their relative position in the market, identifying strengths and weaknesses. Based on a deep understanding of market trends, customer demands, and competitive landscape, enterprises need to determine their specific positioning within the low-carbon economy. This includes identifying opportunities the enterprise can leverage, such as market gaps in specific industries or the application potential of emerging technologies. Potential market challenges should not be overlooked, such as technological barriers, financial constraints, or impacts caused by policy changes.

2. Technological Innovation and R&D

In the formulation of low-carbon transformation strategies, the importance of technological innovation and research and development (R&D) cannot be ignored. To effectively achieve low-carbon goals and maintain competitiveness in the market, enterprises need to actively invest in R&D related to low-carbon technologies and clean energy. This includes developing new energy-saving products, improving the energy efficiency of existing products, and exploring new clean energy solutions. Through these efforts, enterprises can not only enhance the environmental attrib-

utes of their products and services but also make substantial progress in energy saving and emission reduction. Moreover, enterprises are not isolated in the path of technological innovation. Establishing partnerships with research institutions and universities is crucial for promoting technological innovation and R&D. Such collaboration allows enterprises direct access to cutting-edge scientific results and innovative ideas, while also providing research institutions with opportunities to apply their findings in practice. Through this synergy, enterprises can gain technical support and guidance, accelerate the development and market application of new technologies, and maintain a leading position in the innovation race. Increasing investment in low-carbon technology R&D is also an important investment for the future development of the enterprise. Through continuous technological innovation, enterprises can develop new products and services that meet market demands, enhancing their market appeal and competitiveness. Additionally, innovation helps improve production efficiency and reduce operating costs, thereby boosting overall economic benefits. Therefore, making technological innovation and R&D a core part of the low-carbon transformation strategy not only drives the achievement of environmental goals but also brings long-term economic and competitive advantages. This requires enterprises to constantly pursue technological breakthroughs and make forward-looking investments and resource allocations to ensure smooth innovation processes and tangible results.

3. Setting Sustainable Development Goals

During the low-carbon transformation process, clear and specific sustainable development goals are essential to guide corporate strategic actions. These goals need to be challenging enough to drive efforts in environmental protection and resource utilization, but also realistic and achievable to ensure enterprises can meet them under practical conditions. First, goal setting should include specific targets for reducing greenhouse gas emissions, for example, aiming to reduce carbon emissions by 10% within the next five years. Such targets can be achieved through adopting more efficient production technologies, improving energy management systems, or shifting to more environmentally friendly raw materials and energy sources. Improving energy efficiency is another important goal, involving optimizing energy use, reducing waste, and enhancing overall operational efficiency. Additionally, increasing the proportion of renewable energy usage, such as solar and wind power, is a key part of sustainable development goals. When setting these goals, enterprises need to consider their specific circumstances, such as industry characteristics, existing resources and technological capabilities, market conditions, and financial capacity. Through this personalized and realistic goal setting, enterprises can contribute to environmental protection while ensuring these changes generate economic benefits, such as cost savings, improved operational efficiency, and the development of new market opportunities.

4.2 Policy Recommendations and System Optimization

According to new policies and regulations in Sichuan Province, enterprises on the path toward a low-carbon future can leverage these measures to reduce risks, alleviate the financial burden of green projects, and simultaneously enhance investment attractiveness and profit potential. This enables them to rapidly establish a green brand image in the market. However, the transformation journey is not without challenges. New environmental regulations and standards require enterprises to allocate additional resources to comply, which may lead to increased operating costs. Although tax reductions and subsidies support the transition, technological upgrades and transformation efforts can still impose financial pressure, especially for projects with longer investment payback periods. Additionally, to meet higher environmental standards and efficiency requirements, enterprises need to upgrade their management systems and technologies, which may require specialized expertise and further investment.

Tax Incentive Policies: In May 2023, the Sichuan Provincial Taxation Bureau issued tax and fee preferential policies aimed at supporting environmental protection, promoting energy conservation and environmental protection, encouraging comprehensive resource utilization, and advancing the development of low-carbon industries. This policy includes 66 specific tax and fee incentive measures, focusing on the green development of the manufacturing sector.

Environmental Protection Standards: In December 2022, the Sichuan Provincial Department of Ecology and Environment issued the "Enterprise Greenhouse Gas Emission Management Specification." This specification aims to promote coordinated improvements in pollution reduction, carbon emission reduction, and environmental quality, strengthen enterprises' green competitiveness in the market, and enhance corporate social responsibility awareness.

Subsidy Policies: In 2017, the Sichuan provincial government issued the "Implementation Measures for Energy Conservation Review of Fixed Asset Investment Projects," providing subsidies for technological renovation and energy-saving production. Additionally, in recent years, the Chengdu municipal government has released a series of subsidy policies supporting power grid construction, phasing out outdated production capacities, optimizing the energy structure, and supporting renewable energy projects. These initiatives aim to promote green and low-carbon transformation and high-quality development in the industrial sector.

4.2.1 Policy Recommendations

（1）Tax Incentive Policies:

Firstly, it is recommended to further clarify and refine the standards and scope of application for tax and fee incentives related to green development, enabling enterprises to better understand and utilize these benefits. Additionally, efforts should be strengthened to promote awareness of relevant incentive policies, thereby increas-

ing enterprises' understanding and enthusiasm for low-carbon transformation. At the same time, it is suggested to provide more efficient policy implementation channels for enterprises actively responding to low-carbon transformation, such as establishing dedicated green service channels to facilitate the practical application of these policies.

（2）Environmental Regulations and Standards:

To help enterprises better comply with the "Enterprise Greenhouse Gas Emission Management Specification," it is proposed to develop detailed implementation guidelines. Considering that enterprises may need time to adapt to new standards, it is recommended to set a reasonable transition period, allowing companies sufficient time for necessary adjustments and upgrades.

（3）Subsidy Policies:

It is advised to regularly evaluate current subsidy policies to ensure they meet the evolving needs of market development and technological progress. Meanwhile, attention should be paid to the fairness and transparency of fund allocation, ensuring that subsidies effectively and equitably promote enterprises' green development.

4.2.2 System Optimization

(1) Clean Production and Energy Efficiency Improvement:

In addition to adopting energy-saving equipment, enterprises should explore integrating advanced production technologies, such as automation and intelligent manufacturing systems, to further enhance production efficiency and reduce energy consumption. Moreover, by implementing energy management systems and conducting regular energy audits, enterprises can more accurately monitor and manage energy usage, thereby identifying and implementing opportunities for energy conservation and emission reduction.

(2) Green Supply Chain Management:

It is recommended that enterprises consider environmental factors not only in material procurement but also during the product design phase by applying sustainable design principles. At the same time, through collaboration with suppliers, enterprises should promote green standards throughout the entire supply chain, including encouraging suppliers to adopt environmentally friendly practices to ensure sustainability from the source.

(3) Technological Innovation and R&D:

Enterprises should establish or strengthen cooperation with research institutions and universities to jointly develop new low-carbon technologies and products. Additionally, enterprises should consider setting up internal R&D funds to support innovation projects and encourage employees to propose and implement energy-saving and emission-reduction innovations.

5. Conclusion

This thesis focuses on the low-carbon transformation of enterprises in Sichuan Province under the dual-carbon economy framework and its driving effect on high-quality development. In the face of global climate change challenges, China, as a major carbon emitter, has committed to achieving carbon peaking and carbon neutrality goals. Taking Kelun Pharmaceutical as a representative case study, this research provides valuable insights but acknowledges that it cannot comprehensively capture the diverse low-carbon practices across various industries. Future studies are encouraged to broaden the sample scope to multiple sectors to generate more generalizable policy recommendations.

Through conceptual clarification and theoretical framework analysis, this thesis explores the low-carbon transformation strategies adopted by enterprises in Sichuan Province within this context, while assessing the impact of these strategies on the quality of enterprise development. By quantitatively analyzing carbon emission data of Sichuan enterprises, the study offers concrete strategies and recommendations to assist companies in effectively implementing low-carbon transformation while promoting sustainable, high-quality growth.

References

[1] Xi Jinping: Hold High the Great Banner of Socialism with Chinese Characteristics and Strive in Unity to Build a Modern Socialist Country in an All-Round Way——Report to the 20th National Congress of the Communist Party of China [EB/OL]. [2023-11-15].

[2] Liang Guodong, Yu Xuejun, Zhan Linxi. Research on the Construction of Evaluation Index System for Quality and Efficiency Improvement of Power Central Enterprises Based on the Concept of High-Quality Development [J]. Commercial Accounting, 2023(17): 39-43.

[3] Zhang Changjiang, Zhang Sihan, Hou Mengxiao. Enterprise High-Quality Development: Connotation,Measurement, and Path Selection [J/OL]. Accounting Monthly, 2022(13): 137-144.

[4] Huang Sujian, Xiao Hongjun, Wang Xin. On the High-Quality Development of State-Owned Enterprises [J/OL]. China Industrial Economy, 2018(10): 19-41.

[5] Research Group of the Economic Research Institute of the National Development and Reform Commission. Research on Promoting High-Quality Economic Development [J/OL]. Macroeconomic Research, 2019(2): 5-17+91.

[6] Huang Ying, Lin Chunhong, Peng Fei, et al. Innovative Practice of Value Management of Power Grid Enterprises Based on the Concept of High-Quality Development [J]. Commercial Accounting, 2022(14): 81-85.

[7] Chen Shiyi. Evaluation of the Low-Carbon Economic Transformation Process in Various Regions of China [J]. Economic Research Journal, 2012, 47(8): 32-44.

[8] Department of Trade and Industry. Energy White Paper: Our Energy Future- creating a low carbon economy [R][M/OL]. London：DTI, 2003.

[9] IIGF Viewpoint | Research on Countermeasures for Transformational Finance to Support the Low-Carbon Transformation of High-Carbon Industries - Green Finance International Research Institute of Central University of Finance and Economics [EB/OL]. [2023-11-09].

[10] LUO J, HUANG M, BAI Y. Visual analysis of low-carbon supply chain: Development, hot-spots, and trend directions [J/OL]. Frontiers in Environmental Science, 2022, 10[2023-11-10].

[11] WANG F, SUN J, LIU Y S. Institutional pressure, ultimate ownership, and corporate carbon reduction engagement: Evidence from China [J/OL]. Journal of Business Research,

2019, 104: 14-26.

[12] PENG W, XIONG L. Managing financing costs and fostering green transition: The role of green financial policy in China [J/OL]. Economic Analysis and Policy, 2022, 76: 820-836.

[13] Zhou Mi, Liu Wei. Discussion on the Correlation between China's Energy Industry and Industrial Structure [J/OL]. Reform and Strategy, 2008(11): 159-164.

[14] Report on the Green Development of Private Enterprises in Sichuan Released, and Private Enterprises Account for More than 90% of Provincial Green Factories - Sichuan Circular Economy Association [EB/OL]. [2023-11-15].

[15] 2021 Environmental Information Disclosure Report of Sichuan Changhong Group Finance Co., Ltd. [EB/OL]. [2023-11-15].

[16] The Path of Enterprise Low-Carbon Transformation——Sustainable Development Actions of Enterprises in China 2022/2023 | United Nations Development Programme [EB/OL]//UNDP. [2023-11-15].