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Research on Green Technology Innovation Efficiency of Industrial Enterprises in Qinghai Province

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Abstract: *Incorporating the concept of green innovation into the technical activities of industrial enterprises is the key to breaking through the constraints of the environment and resources and ensuring the sustainable development of the industry. In this paper, the emissions of three industrial wastes and investment in pollution control are included in the research, and the two-stage Super-NSBM model is used to study the green technology innovation efficiency of industrial enterprises in Qinghai Province. The results show that from 2006 to 2020, the overall level of green technology innovation efficiency of industrial enterprises in Qinghai Province is low, the efficiency value fluctuates greatly, and the total efficiency value and sub-stage efficiency value are unstable; the green technology innovation of industrial enterprises in Qinghai Province in 2020, the efficiency is weak and effective. The total efficiency value and the efficiency value of the technological innovation research and development stage are ranked first in the western region, but the efficiency value of the technological innovation achievement transformation stage is lower than that of Guangxi, Chongqing and Shanxi; the green technology innovation investment redundancy phenomenon is prominent, and resources has not been optimally allocated and utilized; the transformation efficiency of knowledge output in the process of marketization is low; the problem of environmental pollution is still severe.*

Keywords: *industrial enterprises; green technology innovation efficiency; Super-NSBM*

1. Introduction

The national "14th Five-Year" Industrial Green Development Plan proposes to implement green technology innovation and research actions to enhance green manufacturing in all aspects, emphasizing the supporting role of science and technology innovation in the green and low-carbon transformation of industry. Green technology innovation is of great significance for industrial enterprises to create economic benefits and fulfill their social responsibility of protecting ecological environment. Qinghai Province is located in the source of the three rivers, known as the "Chinese water tower" reputation, ecological status is extremely important, the development of economic green transformation has become the general consensus. From the perspective of environmental protection, this study uses the two-stage Super-NSBM model to measure the efficiency of green technology innovation of industrial enterprises in Qinghai Province, find out the existing problems and propose countermeasures, with a view to contributing to the implementation of the "four places construction", "one excellent and two high" strategies and innovative provinces in Qinghai Province. The purpose of this study is to contribute to the implementation of "four places construction", "one excellent and two high" strategy and the construction of innovative province in Qinghai Province.

2. Literature Review

With people's increased awareness of environmental protection, green technology innovation research has come into being. As early as 1994, foreign scholars E. Brawn and D. Wield[1] defined the concept of green technology for the first time, pointing out that green technology includes recycling technology, purification technology, pollution control and other contents. The proposal of green technology is of great significance to sustainable development and has triggered extensive attention from relevant researchers in academia. The domestic research on theories related to green technology innovation basically started at the same time with foreign countries, and scholars Lv Yan and Wang Weiqiang[2] took domestic enterprises as the research objects to explore the issue of green technology innovation. After the 18th National Congress, research on green technology innovation has been increasing, and Shen Neng and Zhou Jingjing [3] defined green technology innovation as a new innovation approach to achieve the dual effect of economic development and ecological environmental protection.

Regarding the measurement of green technology innovation efficiency of industrial enterprises, scholars divide green technology innovation activities into R&D and results transformation stages based on input and output perspectives, and more often use SBM and EBM models in data envelopment analysis because of the consideration of non-expected outputs. Zhang Likun et al [4] used the super-efficient network SBM-Malmquist model to analyze the efficiency of green technology innovation in Chinese industrial enterprises; Chen et al [5] evaluated the efficiency of green technology innovation in Chinese industrial enterprises based on SBM model and EBM model; Du et al [6] used a two-stage network DEA with shared inputs to measure the regional enterprise efficiency of green technology innovation; Chen et al [7] studied the efficiency of green innovation in Chinese industrial enterprises based on a three-stage network SBM model.

The main influencing factors of green technology innovation efficiency of industrial enterprises are based on industrial system, enterprise revenue, urbanization level, market environment, technological environment, and policy environment [8-10]. There are few studies in the domestic and international literature that specifically focus on how to improve the efficiency of green technology innovation, and most of them look for problems and propose countermeasures from the perspective of evaluating the efficiency of green technology innovation. The proposed countermeasure suggestions are mostly focused on strengthening environmental supervision, deepening cooperation between industry, academia and research, obtaining foreign research support, accelerating industrial upgrading, improving technology quality, and promoting economies of scale [11-13].

Combing green technology innovation related literature makes this paper more scientific and reasonable in the definition of research concepts and selection of model methods. The efficiency study selects the two-stage Super-NSBM model, divides the green technology innovation into two stages of R&D and transformation of results to establish an evaluation index system, analyzes the green technology innovation efficiency of industrial enterprises in Qinghai Province, and proposes countermeasures.

3. Research Method

3.1 Two-stage Super-NSBM Model

The efficiency measurement methods are based on the non-parametric method represented by DEA (Data Envelopment Analysis) and the parametric method represented by SFA (Stochastic Frontiers Analyst). In order to improve this deficiency, Tone proposed a non-radial and non-angular efficiency measurement method—SBM (Slack-Based Model) model, which comprehensively considers the problems of insufficient desired output and redundancy of non-desired output, making the constructed model more relevant to the real situation and improving the deficiencies of DEA model to a greater extent [14,15]. Based on the SBM (Slack-Based Model) model, Tone further proposed the super-efficient SBM model (Super-SBM), which solves the problem of difficult sorting and comparison when multiple decision units being evaluated reach the effective value of 1 [16]. As the research progressed, it was found that the SBM model and other DEA models usually treat the production behavior of enterprises as a "black box" for single-stage efficiency measurement, and the measurement results and analysis lack realistic guidance [17]. In response to this problem, Tone constructed the network SBM model, a non-radial, non-angle efficiency measurement model based on slack variables, which can measure not only the overall efficiency value of the decision unit, but also the stage efficiency value, which is conducive to researchers to comprehensively analyze the technological innovation efficiency of the research object and make objective accurate judgment [18]. After a comprehensive comparison of technology innovation efficiency-related measurement models, the two-stage Super-efficiency Network SBM model (SBM model) [19] under CRS conditions is selected in this paper to measure the green technology innovation efficiency of industrial enterprises in Qinghai Province, and the specific formula is shown below.

$$\rho_o^* = \min \frac{\sum_{k=1}^{K} w^k \left[1 + \frac{1}{m_k}\sum_{i=1}^{m_k}\frac{s_i^k}{x_{io}^k}\right]}{\sum_{k=1}^{K} w^k \left[1 - \frac{1}{u_{1k}+u_{2k}}\left(\sum_{r=1}^{u_{1k}}\frac{s_i^{dk}}{y_{ro}^{dk}} + \sum_{r=1}^{u_{2k}}\frac{s_i^{bk}}{y_{ro}^{bk}}\right)\right]}$$

$$\text{s.t.}\begin{cases} x_o^k \geq \sum_{j=1,\neq 0}^{n}\lambda_j^k x_j^k + s^{k^-} \\ y_o^{dk} \leq \sum_{j=1,\neq 0}^{n}\lambda_j^k y_j^{dk} + s^{dk} \\ y_o^{bk} \geq \sum_{j=1,\neq 0}^{n}\lambda_j^b y_j^{bk} - s^{bk} \\ \varepsilon \leq 1 - \frac{1}{u_{1k}+u_{2k}}\left(\sum_{r=1}^{v_{1k}}\frac{s_r^{dk}}{y_{ro}^{dk}} + \sum_{r=1}^{v_{2k}}\frac{s_r^{bk}}{y_{ro}^{bk}}\right) \\ z^{(k,h)}\lambda^h = z^{(k,h)}\lambda^k \\ \lambda^k \geq 0, w^k \geq 0, s^{k^-} \geq 0, s^{dk} \geq 0, s^{bk} \geq 0 \end{cases}$$

$$\rho_o^1 = \frac{1 + \frac{1}{m_1}\sum_{i=1}^{m_1}\frac{s_j^{1^-}}{x_{io}^k}}{1 - \frac{1}{\psi}\sum_{r=1}^{\psi}\frac{s_r^{k^+}}{z_{ro}^k}}, \rho_o^2 = \frac{1 + \frac{1}{\psi}\sum_{r=1}^{\psi}\frac{s_r^{1^+}}{z_{ro}}}{1 - \frac{1}{u_{12}+u_{22}}\left(\sum_{r=1}^{u_{12}}\frac{s_r^d}{y_{ro}^d} + \sum_{r=1}^{u_{22}}\frac{s_r^b}{y_{ro}^b}\right)}$$

Suppose there are n decision units,each decision unit consists of k nodes，The number of input and output variables at the kth node is denoted by mk and uk respectively,（k,h）denotes the relationship from the kth node to the hth node，L denotes the number of connecting variables， the number of intermediate output indicators is ψ k,and the input at the kth stage is x_j^k ($x_j^k \in R_+^{m_k}$), $Y^b = \left[y_l^b, L, y_N^b\right] \in R^{S_l \times N}$ and $Y^d = \left[y_l^d, L, y_N^d\right] \in R^{S_l \times N}$ denote undesired and desired outputs respectively, u12, u22denotes the number of desired and non-desired outputs in phase 2； s_i^{1-}、s_r^{1+}、s_r^d、s_r^b denote slack variables for the two-stage input and output indicators; λ^k、w^k denote the weights of the kth stage nodes; $z_j^{(k,h)} \in R_+^{t_{(k,h)}}\left(j = 1,2,```,n;(k,h) \in L\right)$ denote intermediate products between nodes k and h; ρ_o^* denotes the overall efficiency value of the measured decision unit, ρ_o^1 and ρ_o^2 denote the efficiency value of the decisioned unit at the first and second stage respectively.

In this paper, green technology innovation is considered as 2 stages, so k=2, and both stages are regarded as equally important, then the weights are considered the same.

When the efficiency values of both stages are greater than or equal to 1, the corresponding decision unit is judged to be valid.

When the combined efficiency value and the efficiency of one of the two stages is greater than or equal to 1, the decision unit is judged as weak DEA valid. Otherwise, the DEA is judged to be invalid.

3.2 Green Technology Innovation System Structure

According to the innovation value chain theory, the two-stage division of enterprise green technology innovation process is chosen to measure the green technology innovation efficiency issue more comprehensively. The process of green technology innovation activities of industrial enterprises is shown in Figure 1.

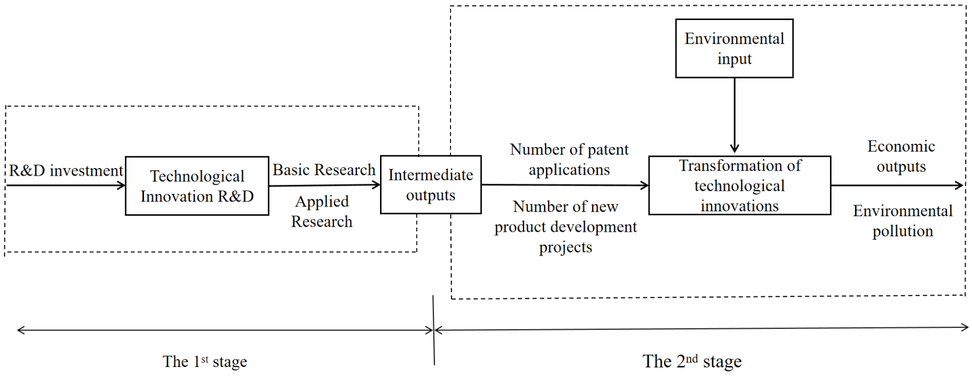

Figure 1: Two-stage process of green technology innovation activities in industrial enterprises

The ultimate purpose of technological innovation activities is to create value, and value creation needs to go through the birth of intermediate products of technology research and development, and the intermediate products can bring economic benefits to industrial enterprises only through the stage of transformation of results, and the research process of green technology innovation efficiency needs to pay attention to the environmental factors to be considered in the stage of transformation of results. Therefore, the research of green technology innovation efficiency of industrial enterprises should fully consider the technology development stage and transformation stage.

4. Empirical Research

4.1 Index Selection

The establishment of the index system in this paper strictly abides by the principles of scientificity, systematicity, feasibility and comparability, reviews and draws on the selection of evaluation indexes in the literature related to green technology innovation research, and constructs a two-stage green technology innovation efficiency index system for industrial enterprises in Qinghai Province from the input-output perspective.

4.1.1 Green technology innovation R&D stage index system

Table 1: Green Technology Innovation R&D Stage Indicator System for Industrial Enterprises in Qinghai Province

First level indicators	Second level indicators	Specific indicators
Inputs	Human input	X11Full-time equivalent of R&D personnel (man-year)
	Financial input	X12Internal expenditure of R&D funds (10000 yuan)
		X13Expenditure on new product development (10000 yuan)
Outputs	R&D results	Y11Number of invention patent applications (piece)
		Y12Number of new product development projects (unit)

The green technology innovation research stage of industrial enterprises focuses on scientific and technological innovation activities, and the most critical and basic inputs are human and financial inputs. The human inputs in this stage are selected from the internationally recognized comparable indicators of industrial enterprises' R&D personnel full-time equivalents to ensure objective and accurate efficiency measurement; the financial inputs are selected from the internal expenditure of industrial enterprises' R&D funds and the expenditure of new product development funds. The output indicators are selected from the number of invention patent applications and new product development projects of industrial enterprises, which are also the input indicators of the transformation stage of technological innovation results, and are used as intermediate variables in the two-stage super-efficiency network SBM model operation. The index system of green technology innovation R&D stage of industrial enterprises in Qinghai Province is shown in Table 1.

4.1.2 Green technology innovation results transformation stage index system

The two output indicators (number of industrial enterprises' invention patent applications and new product development projects) of industrial enterprises' green technology R&D stage are transformed into input indicators of technological innovation results transformation stage, and the amount of completed investment in industrial pollution control is reflected as non-R&D input indicators of environmental protection fund investment. The output indicators are divided into expected output and non-expected output. The expected output indicators are represented by the sales revenue of new products of industrial enterprises, while the non-expected output is selected from three indicators reflecting the degree of environmental pollution: sulfur dioxide emissions, general industrial solid waste generation, and total chemical oxygen demand emissions in wastewater. The indicator system of the transformation stage of green technology innovation results of industrial enterprises in Qinghai Province is shown in Table 2.

Table 2: Indicator system for the transformation stage of green technology innovation results of industrial enterprises in Qinghai Province

First level indicators	Second level indicators	Specific indicators
Inputs	Technical inputs	X21Number of invention patent applications (piece)
		X22Number of new product development projects (unit)
	Financial input	X23Investment completed in the Treatment of industrial pollution (10000 yuan)
Outputs	Desired output	Y21Revenue from new product sales (10000 yuan)
	Undesired outputs	Y22Total Volume of Sulphur Dioxide Emission (ton)
		Y23Common Industrial Solid Wastes Generated (10000 ton)
		Y24Total COD discharge from wastewater (ton)

4.2 Empirical Analysis

The empirical analysis of this study uses a non-oriented non-radial two-stage super-efficiency network SBM model considering non-desired outputs to divide the green technology innovation process of industrial enterprises into two stages: R&D and transformation. On the one hand, the data related to green technology innovation indexes of industrial enterprises above the scale in 11 provinces in the western region of China (Tibet is not considered) are selected from the horizontal perspective to compare and analyze the green technology innovation efficiency of industrial enterprises in Qinghai Province; on the other hand, the green technology innovation data of industrial enterprises above the scale in Qinghai Province from 2006 to 2020 are selected from the vertical perspective. On the other hand, the data of green technology innovation related indexes of industrial enterprises above the scale in Qinghai Province for fifteen years are selected from the vertical perspective to analyze the efficiency of green technology innovation of industrial enterprises in Qinghai Province. Combining the analysis from both longitudinal and horizontal perspectives, we comprehensively evaluate the green technology innovation efficiency of industrial enterprises in Qinghai Province, and continue the advantages and improve the shortcomings.

The data in the empirical analysis were obtained from China Statistical Yearbook, China SStatistical Yearbook On Science And Technology, China Statistical Yearbook On Environment, Qinghai Statistical Yearbook, Statistics Yearbook On Science And Technology Activities Of Industrial Enterprises and the official website of Qinghai Provincial Bureau of Statistics. The specific analysis assumes the CRS condition, and uses MaxDEA software to measure the green technology innovation efficiency value with the input perspective as the entry point.

4.2.1 Cross-sectional Analysis of Green Technology Innovation Efficiency Measurements

After measuring the data of green technology innovation indicators of industrial enterprises above the scale in 11 provinces in the western region of China (excluding Tibet) in 2020, the efficiency values were obtained as shown in Table 3.

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Table 3: Green technology innovation efficiency value of industrial enterprises in the western region (except Tibet) in 2020

Province	Total efficiency	The 1st stage efficiency	The 2nd stage efficiency
Inner Mongolia	0.284	0.430	0.554
Guangxi	0.849	0.697	1.000
Chongqing	0.817	0.634	1.000
Sichuan	0.970	0.878	0.567
Guizhou	0.239	0.935	0.118
Yunnan	0.224	0.725	0.357
Shanxi	0.856	0.712	1.000
Gansu	0.166	0.705	0.263
Qinghai	1.028	1.303	0.906
Ningxia	0.148	0.913	0.197
Xinjiang	0.529	1.000	0.656

According to the calculation results in Table 3, the total efficiency value of green technology innovation efficiency of industrial enterprises in Qinghai Province in 2020 is 1.028, which is higher than the average value of total efficiency in western region 0.555; the efficiency value of R&D stage of technology innovation is 1.303, which is higher than the average value of R&D stage efficiency in western region 0.812; the total efficiency value and R&D stage efficiency value of green technology innovation of industrial enterprises in Qinghai Province are ranked first in western provinces This fully indicates that Qinghai Province has been effective in strengthening ecological environmental protection and promoting green development in 2020. However, it should still be noted that the efficiency value of the transformation stage of industrial enterprises' technological innovation in Qinghai Province is lower than that of Guangxi, Chongqing and Shaanxi, and the efficiency value of the transformation stage has not reached the effective value of 1. Overall, the efficiency of industrial enterprises' green technological innovation in Qinghai Province in 2020 is weakly effective.

4.2.2 Longitudinal Measurement Analysis of Green Technology Innovation Efficiency

After measuring the data of green technology innovation related indicators of industrial enterprises above the scale in Qinghai Province for fifteen years from 2006 to 2020, the efficiency values are obtained as shown in Table 4.

Table 4: Green technology innovation efficiency value of industrial enterprises in Qinghai Province from 2006 to 2020

Year	Total efficiency	The 1st stage efficiency	The 2nd stage efficiency
2006	0.257	0.914	0.316
2007	0.149	0.872	0.198
2008	0.353	0.855	0.464
2009	0.735	0.470	1.000
2010	0.686	0.372	1.000
2011	0.716	0.432	1.000
2012	0.498	0.380	0.721
2013	0.443	0.405	0.647
2014	0.664	0.328	1.000
2015	0.458	0.498	0.674
2016	1.164	1.452	0.923
2017	0.453	0.505	0.453
2018	0.960	1.287	0.969
2019	1.188	0.784	1.188
2020	1.028	1.303	0.906

As can be seen from Table 4, the average value of the total efficiency of green technology innovation of industrial enterprises in Qinghai Province in the past fifteen years is 0.65, which has not reached the effective state. According to the time change, the line graph of the trend change of total efficiency of green technology innovation of industrial enterprises in Qinghai Province from 2006 to 2020 is drawn, as shown in Figure 2. The change of the line graph shows that the value of total efficiency of green technology innovation of industrial enterprises in Qinghai Province is fluctuating, the level of green technology innovation is unstable, and there is more room for improvement. In 2019 and 2020, the efficiency value will exceed 1 for two consecutive years.

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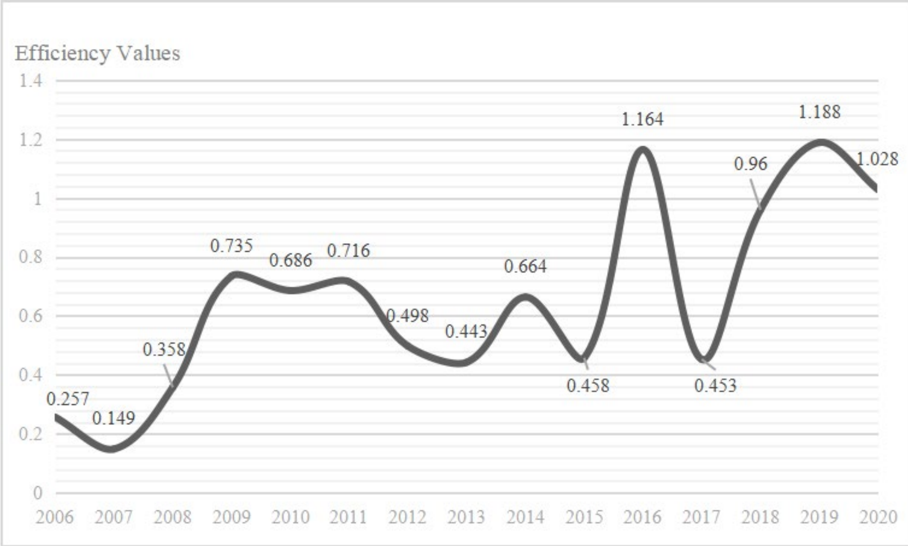

Figure 2: Trends in the total efficiency of green technology innovation in industrial enterprises in Qinghai Province from 2006 to 2020

The efficiency value of green technology innovation sub-stage of industrial enterprises in Qinghai Province fluctuates greatly, as shown in Figure 3, the efficiency value of technology innovation stage decreases year by year from 2006 to 2009, the efficiency value is low and stable from 2009 to 2015, the efficiency value increases faster from 2016 to 2020, and reaches the effective state in 2016, 2018 and 2020; the efficiency value of transformation of technology innovation results The efficiency value of the transformation phase gradually increased from 2006 to 2011, and the efficiency value was 1 for three consecutive years in 2009, 2010 and 2011, while the efficiency value of the transformation phase fluctuated greatly from 2012 to 2020 and did not reach the effective state.

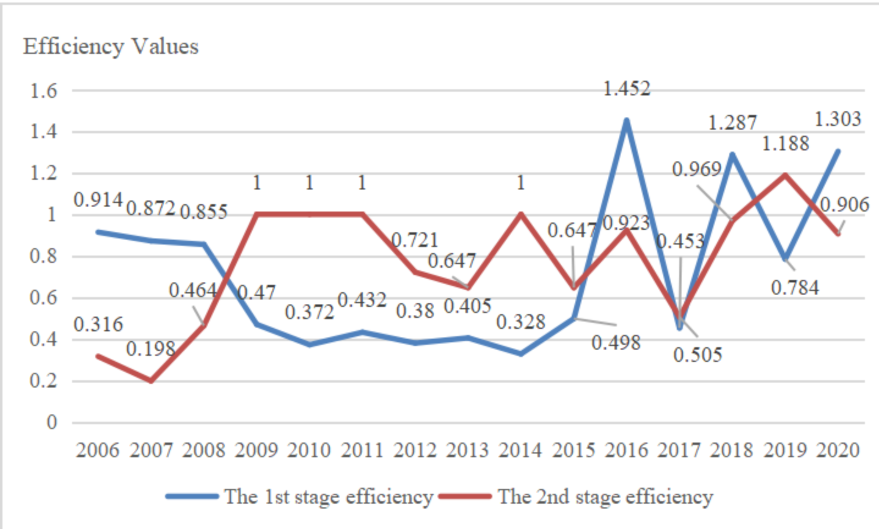

Figure 3: Trends in efficiency of green technology innovation sub-stages in industrial enterprises in Qinghai Province from 2006 to 2020

4.2.3 Slack improvement analysis

In addition to the above results, the measurement results also provide the gap between the actual and projected values of each input and output variable, i.e. the slack improvement values of each variable. As can be seen from Table 4, the efficiency of green technology innovation of industrial enterprises in Qinghai Province during the evaluation period reached a weakly effective state in 2016, 2019 and 2020, while the other years were invalid decision units, and the improvements of input and output variables are shown in Tables 5 and 6.

In the network SBM super-efficiency model, a negative slack improvement in inputs represents the need to reduce inputs and a positive slack improvement in inputs represents the possibility of

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increasing inputs; a positive slack improvement in outputs represents the possibility of increasing outputs and a negative slack improvement in outputs represents the possibility of reducing outputs; a negative slack improvement in intermediate goods represents the need to reduce intermediate goods and a positive slack improvement in intermediate goods represents the possibility of increasing intermediate output. From the data in Table 5, it can be seen that Qinghai Province has input redundancy except for 2016, and input resources have not been rationally allocated and effectively used. Combined with the data presented in Tables 4 and 6, it can be seen that the number of invention patent applications and new product development projects, as intermediate variables, are waste-free only in the relatively scattered five years of 2009, 2010, 2011, 2014 and 2019, corresponding to the efficiency value of 1 or greater than 1 in the results transformation stage of Table 4, meeting the requirements of the effective state, while the rest of the years have intermediate output waste In the rest of the years, there is waste of intermediate outputs, and the knowledge-based outputs are inefficiently transformed and under-utilised in the marketisation process. The slack variables reflecting environmental pollution are all negative, indicating that the task of environmental protection remains serious and measures need to be taken to address it.

Table 5: Input variable slack improvement

Variables / Year	Full-time equivalent of R&D personnel	Internal expenditure of R&D funds	Expenditure on new product development	Investment completed in the Treatment of industrial pollution
2006	-175.93	-2902.20	-2344.06	-250183.03
2007	-319.25	-2939.20	-3225.10	-287602.00
2008	0.00	-6534.01	-8914.86	-339112.86
2009	-689.49	-23518.10	-15301.75	0.00
2010	-1026.51	-41417.25	-30290.97	0.00
2011	-987.13	-60693.24	-14791.29	0.00
2012	-1221.95	-60907.80	-51727.47	-15024.67
2013	-1327.37	-64464.06	-62642.20	-36756.04
2014	-1430.99	-61207.43	-66017.79	0.00
2015	-673.13	-37457.97	-69854.19	-92305.03
2016	0.00	0.00	0.00	0.00
2017	0.00	0.00	0.00	-758871.46
2018	-206.31	-23708.36	-40298.17	-1035681.06
2019	-1116.29	-35260.82	-30289.88	-972255.91
2020	-55.40	-34189.49	-49969.34	-1870762.67

Table 6: Improvements in output variable slack

Variables / Year	Number of invention patent applications	Number of new product development projects	Revenue from new product sales	Total Volume of Sulphur Dioxide Emission	Common Industrial Solid Wastes Generated	Total COD discharge from wastewater
2006	0.00	-12.78	6638.50	0.00	-3808.55	-4910.88
2007	0.00	-12.86	16945.48	0.00	-9159.61	-2564.50
2008	0.00	-12.18	2070.59	0.00	-2577.11	-4602.51
2009	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.00	0.00	0.00	0.00	0.00	0.00
2011	0.00	0.00	0.00	0.00	0.00	0.00
2012	-20.81	0.00	15047.98	-6032.35	-119.85	0.00
2013	-64.57	0.00	16716.46	-13922.94	-148.32	0.00
2014	0.00	0.00	0.00	0.00	0.00	0.00
2015	-57.90	0.00	0.00	-29152.27	0.00	-3515.45
2016	-177.42	0.00	24033.55	0.00	-5519.25	0.00
2017	-247.79	0.00	169700.34	-15338831.75	-22271.07	-125486.02
2018	-177.79	0.00	40669.21	-215036.47	-9713.30	-77265.20
2019	0.00	0.00	35415.67	-301622.15	-16510.73	-103902.60
2020	-267.80	0.00	151508.11	-282623.39	-16288.86	-105472.70

5. Conclusions and Suggestions

5.1 Conclusions

This study incorporates environmental factors into the technological innovation efficiency evaluation model, considers the phenomenon of undesirable output, and introduces negative environmental pollution indicators affecting the activities of industrial enterprises into the research index system. Using the SBM model of non-oriented non-radial two-stage super-efficiency network with non-desired outputs, a comparative analysis is carried out horizontally with industrial enterprises in other provinces in the western region (except Tibet), and a comparative analysis is carried out vertically with the measured values of green efficiency of industrial enterprises in Qinghai Province in the past 15 years, and the following conclusions are drawn from the combined analysis of the above measurements.

(1) In 2020, the green technology innovation efficiency of industrial enterprises in Qinghai Province was weakly effective, with the total efficiency value and the efficiency value of the R&D stage of technology innovation ranking first in the western region, but the efficiency value of the transformation stage of technology innovation results was lower than that of Guangxi, Chongqing and Shanxi.

(2) Green technology innovation efficiency values of industrial enterprises in Qinghai Province fluctuate greatly, and the total efficiency values and sub-stage efficiency values are unstable, and the level of green technology innovation needs to be improved.

(3) The redundancy of technological innovation inputs is prominent and resources are not optimally allocated and utilised; knowledge-based outputs are inefficiently transformed in the marketisation process and are not fully utilised; pollution in the production process of industrial enterprises is still a serious problem and further measures are needed to combat it.

5.2 Suggestions

Based on the findings of the study, the following countermeasures are proposed.

First, optimise the allocation of green technology innovation input resources to avoid wasting resources. While ensuring the welfare treatment and humanistic care of scientific researchers, attention should also be paid to improving the work assessment mechanism of scientific researchers, stimulating their motivation to innovate and avoiding the waste of talent resources; optimizing the investment structure of science and technology funds, attaching importance to the arrangement of environmental governance funds and strengthening the supervision of scientific research funds.

Second, improve the level of green technology innovation and promote the transformation of scientific and technological achievements. Put into practice the in-depth cooperation between government, enterprises, industry, academia and research institutes to effectively improve the level of green technological innovation and lay a solid foundation for the green transformation of scientific and technological achievements; look for intermediaries with strong executive power to start cooperation and improve the efficiency of the transformation of green technological innovation results; the Qinghai Provincial Science and Technology Department should further improve the patent law and the law on the transformation of results in line with the provincial situation to provide guidance and guarantee for the transformation of science and technology in Qinghai Province.

Third, accelerate the full completion of the green industrial system and realise new industrialisation. Qinghai Province should accelerate the construction work of the green industrial system, promote industrial transformation and upgrading, and realise the positive interaction with the efficiency enhancement of green technological innovation by realising the advanced industrial structure and the rationalisation of industrial structure. In addition, it strives to achieve a new type of industrialisation, accelerating the transformation and innovation of existing production technologies, making production methods more environmentally friendly and intelligent, and ensuring the green development of the industrial system.

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