Study On the Impact of Input-Output Ratio of Chinese New Energy Enterprises

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Abstract. This essay will analyze and compare the relevant data of the leading companies in four industries: photovoltaic, wind power, hydrogen energy and new energy automobile. The first part is the brief description of the companies. The author selects two leading companies in each industry and analyzes their contribution to the industry. Next, the author collects the data on the research development investment and total turnover of each company and calculates the input-output ratio of each company by using the formula. Next is the comparison section, where in each industry, the authors compare the data of the net attributable profits of two companies from their annual reports for 2021 and 2022. The results of which can be seen as an increase or decrease in net profit for certain companies in both years and the author explains this result. In the Conclusion section, the authors first summarize the ranking of each industry. Secondly, the author compares the four industries to identify the two most profitable and promising companies in China's future and explains their characteristics and strengths.

Keywords: Photovoltaic; wind power; hydrogen energy.

1. Introduction

The energy issue is becoming more and more serious as a result of China's economy's continued growth and the country's rising reliance on nonrenewable resources like coal, natural gas, and oil. China has started to produce renewable energy to replace non-renewable energy, such as water, electricity, solar energy, and other emerging clean energy to replace oil and coal, in order to resolve the ongoing contradiction between global development and energy demand. China's growing industries have been consuming more non-renewable resources like coal and oil on an annual basis since the start of the twenty-first century. Even though China has a vast territory and is rich in oil and coal resources, the excessive exploitation and utilization of non-renewable resources brought about by industrial development has put enormous pressure on China's sustainable development, and the high level of pollution has caused the ecological environment in China to deteriorate. So China began to actively develop new energy sources, as well as support the development of new energy enterprises [1]. Under this premise, China's support for the new energy industry has led to the birth of many famous companies. For example, SPIC (State Power Investment Corporation) is the first company in China to own all types of power generation and is the world's largest photovoltaic power generation company, new energy power generation company and clean energy power generation company. As of the end of May 2023, State Power invested RMB1.66 trillion in assets. It manages a total installed power capacity of 236 million kilowatts, of which clean energy accounts for nearly 68 percent. 2022 Fortune Global 500 ranked 260th. [2] As well as CHN Energy (CHN Energy Investment Group), was awarded excellence in the comprehensive assessment and evaluation of the tenure of the leadership team of a China-administered enterprise organized by the Ministry of Organization of the People's Republic of China (MOOC). The Fortune 500 ranking improved to 76th, a jump of 9 places from 2022. In 2022, CHN Energy had total assets of RMB1,942.2 billion and total profits of RMB110 billion [3].

Against the backdrop of the rapid development of the new energy industry, this thesis will calculate the ratio formed by China's inputs to the new energy industry in the past as well as its outputs now. The ratio will be used to analyze whether China has a sizable gain in the industry and the impact of the development of new energy companies on the industry as a whole.

In the main part, the author divides new energy into the photovoltaic industry, wind power industry, hydrogen energy industry and new energy automobile industry. This article will mainly through the above four parts of the core enterprise for the industry's investment and the final harvest to do a comparison. From the input part, the first is the investment of each country's government for new energy enterprises, the government encourages the development of a new energy industry. Take the new energy automobile industry as an example, due to the damage to the ecological environment, the government has invested a lot in the development of the new energy automobile industry. The government can support the development of new energy automobiles and promote the popularization of new energy automobiles through both funding and policies. Secondly, there is enterprise investment. Enterprises can introduce investors to obtain the necessary financial support to build power plants and so on to meet the growing demand of users. Thirdly, there are investment institutions, which can invest in a particular industry to obtain a good return and promote the development of the industry. Next is the output section, in which the author will analyze data from various new energy sectors in recent years. In the end, the author will use a formula to calculate the input-output ratio of new energy companies and use the results to determine whether it is worth investing so much money and the impact of the final results on the entire new energy industry.

2. Analysis and Comparison of New Energy Enterprises

2.1. Formula

$$\mathrm{E_i} \div \mathrm{E_o} \times 100\% = \mathrm{R_{i-o}}. \quad (1)$$

All the following input-output ratios are calculated from this formula above. Where E_i represents the total inputs of this enterprise and E_o represents the total outputs of this enterprise. Divide the two and multiply by 100% to get the input-output ratio, or R_{i-o}.

2.2. Photovoltaic Industry

The No. 1 company in China's photovoltaic business and No. 168 on the Fortune China 500 list is LONGi Green Energy Technology Co., Ltd., which was founded in 2000. LONGi Green Energy has developed five business categories with a focus on scientific and technological innovation: monocrystalline silicon wafers, battery modules, distributed photovoltaic systems, terrestrial photovoltaic solutions, and hydrogen energy equipment. In order to assist worldwide zero-carbon development, LONGi Green Energy has created "Green Power" + "Green Hydrogen" goods and solutions. LONGi Green Energy's cumulative revenue is RMB128.998 billion, with 60,601 employees worldwide. LONGi Green Energy's R&D investment is RMB7.141 billion, and its input-output ratio is 1,806.44% [4].

A well-known and highly creative provider of solar energy technology, JinkoSolar Solar Co., Ltd. A well-known and extremely creative manufacturer of solar energy technology is JinkoSolar Solar. The company is a key player in the worldwide mainstream PV market, lays out the key links in the photovoltaic industrial chain strategically, concentrates on integrated R&D and production of photovoltaic products, and offers comprehensive solutions for clean energy. JinkoSolar's products serve more than 3,000 customers in more than 160 countries and regions around the world, and the Company has been ranked as the world's largest module shipper for many years. As of the first quarter of 2023, JinkoSolar's module shipments totaled more than 150GW. As of 2022, the Company's cumulative investment in research and development amounted to NT$5.615 billion, and its cumulative turnover amounted to NT$82.676 billion. Its input-output ratio is calculated to be 1,472.41% [5]. The comparison can be concluded that the input-output ratio of LONGi Green Energy is 334.03% higher than that of JinkoSolar.

Next, comparing the annual reports of these two companies, the author selected the annual reports for 2021 and 2022. Starting from the 2021 annual report, LONGi's total net profit for the four quarters of 2021 is RMB40,928,248,868.97.[6] JinkoSolar's total net profit for the four quarters of 2021 is

RMB361,0139,000.[7] By comparison, LONGi's net profit in 2021 is higher than JinkoSolar's net profit in 2021 by RMB482,685,868.97. Next is the annual report of 2022, the total net profit of LONGi for four quarters in 2022 is RMB14811576797.86.[8] JinkoSolar's total net profit for the four quarters of 2022 is RMB209248386.27.[9] In comparison, LONGi's net profit in 2022 is higher than JinkoSolar's net profit in 2022 by RMB14,602,328,411.59. There are several reasons why LONGi's net profit is so much higher than JinkoSolar's net profit: Firstly, JinkoSolar continued to decline in performance for three years and was affected by the combined effect of the company's PV power station development, operation and transfer business gross profit decline, power station asset trading and government subsidy reduction, JinkoSolar's net profit loss in the first and fourth quarter was close to 150 million yuan. Secondly, in 2022, component prices continued to be high, the company continued to promote the "fine engineering" strategy, and EPC business output value was reduced, resulting in such a loss.

2.3. Wind Power Industry

With a strong focus on the four areas of energy development, equipment, services, and applications, Goldwind Science and Technology Co., Ltd. raises the bar for renewable energy efficiency via solid scientific research and innovation. At present, Goldwind has achieved a global cumulative installed capacity of more than 100GW, with more than 47,000 operational wind turbines all over the world. The company's total market capitalization is RMB44.828 billion, and it has invested RMB12 billion in scientific research expenses, creating a total revenue of RMB332.178 billion. The calculation shows that the company's input-output ratio is 2768.15%.[10] Mingyang Smart Energy Group Co., Ltd. was founded in 2006, the company is committed to building a clean energy full life cycle value chain management and system solutions provider. It will be first in the world for innovation in offshore wind power and 15th among the top 500 global new energy firms by 2022. It has now grown into a globally influential group of intelligent energy enterprises. The primary competencies of Ming Yang Intelligent Energy include high-end new energy equipment R&D and design, production of products, operation and maintenance services, and new energy investment and operation. The company has obtained more than 1,800 technology patents and more than 30 types of wind turbine designs. Mingyang Smart's total R&D capital reached RMB15.5 billion, generating a total turnover of RMB124.568 billion. The calculation shows that the company's input-output ratio is 803.66%. [11] The comparison can be concluded that the input-output ratio of Goldwind is 1964.49% higher than that of Mingyang Smart. Next, comparing the annual reports of these two companies, the author selected the annual reports for 2021 and 2022. Starting from the 2021 annual report, Goldwind 's total net profit for the four quarters of 2021 is RMB3,731,392,377.62.[12] Mingyang Smart's total net profit for the four quarters of 2021 is RMB3,517,783,753.61.[13] By comparison, Goldwind's net profit in 2021 is higher than Mingyang Smart's net profit in 2021 by RMB213,608,624.01. Next is the annual report of 2022, the total net profit of Goldwind for four quarters in 2022 is RMB2,383,342,917.68. [14] Mingyang Smart's total net profit for the four quarters of 2022 is RMB3,454,607,512.89. [15] In comparison, Mingyang Smart's net profit in 2022 is higher than Goldwind's net profit in 2022 by RMB1,017,264,595.21. As can be seen from the annual reports for the two years 2021 as well as 2022, Mingyang Smart's net profit has improved greatly in 2022 compared to 2021. His net profit has exceeded Goldwind. There are three reasons for this First, the company's offshore project delivery scale and proportion of the rise, driving revenue growth; second, the company's interest in holding power stations with grid-connected installed capacity increased compared with the same period of the previous year, resulting in an increase in power generation revenue; third, due to the sale of wind farms projects, the investment income has increased.

2.4. Hydrogen Energy Industry

In an effort to strategically restructure the petroleum and petrochemical sector, the central government created China Petroleum & Chemical Corporation (Sinopec) on the foundation of the former China Petrochemical Corporation in July 1998. The Chairman of the Board of the Sinopec

Group is the Company's legal representative. The Company is a very significant petroleum and petrochemical group with a registered capital of RMB326.5 billion. With its main office in Beijing, it represents the investor's interests in the relevant state assets that are owned by its fully owned subsidiaries. It is charged with maintaining and enhancing the value of state assets by managing, operating, and supervising them in accordance with applicable legislation. The Company is currently the largest supplier of refined oil products and petrochemicals, the second-largest producer of oil and gas in China, the world's No. 1 oil refiner, No. 2 chemical producer, and owner of the second-largest number of gas stations globally. In 2021, the Company will be ranked No. 5 among the Fortune Global 500 companies. The company owns 63,149 patents, and 106 registered trademarks and has a total market capitalization of 730,169 million dollars. The company's total revenue is RMB2,611,913.31 billion. Taking the data of 2022 as an example, Sinopec's total R&D investment in 2022 is RMB28.718 billion, and its total revenue is RMB3.32 trillion. The calculation gives Sinopec an input-output ratio of 115,606.94% in 2022 [16].

Since the author has introduced the CHN Energy Investment Group (CHN Energy) in the Introduction section, in this section, the author will only add the CHN Energy Investment Group's establishment in hydrogen energy. In 2022, CHN Energy Investment Group has total assets of 19,422.2 billion yuan, a total profit of 110 billion yuan, and a new energy installed capacity of 70.14 million kilowatts. The company has the whole industry chain business of coal, electricity, transportation and chemical industry, and the industry is distributed in 31 provinces, autonomous regions and municipalities across the country, as well as in more than 10 countries and regions such as the United States, Canada, etc. The company is the world's largest coal production company, thermal power generation company, wind power generation company, and coal-to-liquid coal chemical company. The chemical industry produced 27.91 million tons of oleochemicals and sold 16.695 million tons of oleochemicals, realizing a profit of RMB 6.71 billion for the year, the highest level in history. The company's total revenue was 466.8983 billion yuan, the company invested 3.25 billion yuan in research and development in 2022, and the revenue was 817.865 billion yuan. The calculation shows that the company's input-output ratio in 2022 is 25,165.08%. [3] The comparison can be concluded that the input-output ratio of Sinopec is 90,441.86% higher than that of CHN Energy. Next, comparing the annual reports of these two companies, the author selected the annual reports for 2021 and 2022. Starting from the 2021 annual report, Sinopec's total net profit for the four quarters of 2021 is RMB71,208 million.[17] CHN Energy's total net profit for the four quarters of 2021 is RMB50,084 million.[18] By comparison, Sinopec's net profit in 2021 is higher than CHN Energy's net profit in 2021 by RMB21,124 million. Next is the annual report of 2022, the total net profit of Sinopec for four quarters in 2022 is RMB66,302 million.[19] CHN Energy's total net profit for the four quarters of 2022 is RMB69,626 million.[20] In comparison, Sinopec's net profit in 2022 is less than CHN Energy's net profit in 2022 by RMB3,324 million. Comparing the two sets of data above, it can be seen that Sinopec's net profit is lower by RMB4906 million compared to 2021. There are two reasons for such a situation, one is that the international oil prices in 2022 will rise and then fall and oscillate broadly. The demand for natural gas, petrochemicals and refined oil products in the territory is weak due to a number of factors. In 2022, international crude oil prices will rise and then fall, with a wide range of oscillations. Platts Brent crude oil spot price averaged US$101.2 per barrel for the year, up 43.1% year-on-year. In addition, according to the NDRC, China's apparent consumption of natural gas within its territory reached 366.3 billion cubic meters for the year 2022, a year-on-year decline of 1.7%. Secondly, in terms of the performance of specific businesses, benefiting from the overall upward movement of oil prices, Sinopec's profit from the upstream oil and gas exploration business increased significantly. However, due to the downturn in domestic macroeconomic growth, the refining segment, on the other hand, cut its profit sharply, and the chemical segment posted an operating loss of more than 10 billion yuan. Specifically, on the chemical side, ethylene production in 2022 was 13.44 million tons, achieving an increase of only 60,000 tons year-on-year. The division's operating income in 2022 was RMB540.2 billion, up 6.9% year-on-year; its operating loss was RMB14.1 billion, a year-on-year profit reduction of RMB25.2 billion.

2.5. New Energy Automobile Industry

A high-tech business called BYD is dedicated to advancing science and technology in order to improve life. BYD was founded in February 1995 and has had more than 20 years of explosive growth. It now operates more than 30 industrial parks globally and is a significant player in sectors like electronics, transportation, automotive, and new energy. BYD is dedicated to providing zero-emission energy solutions across the board, including power generation, energy storage, and applications. The market capitalization and revenue of BYD, which is listed on the Hong Kong and Shenzhen stock markets, exceed RMB 100 billion. Automotive, rail transportation, batteries, and electronics are the four industries where BYD Auto has made advancements. Given that this section is about new energy vehicles, the author will focus primarily on advancements in the automotive industry. BYD Auto's new energy vehicles use three main technologies: batteries, motors, and computerized control. BYD is the first automaker in the world to simultaneously hold the three key technologies for new energy cars, including the battery, motor, and electronic control. The battery capacity among them reached 28GWh in 2018, making it the world's top producer of power batteries. In addition, BYD owns BYD Dual-Mode Technology and BYD Bi-directional Charging/Discharging Technology, both of which achieve Easing Charging, Environment-friendly and Energy Efficient and Low Running Cost. BYD Auto has innovations in four areas: automotive, rail transportation, battery and electronics. Since this section deals with the part of new energy vehicles, the author will mainly elaborate on the innovations regarding automobiles. The three core technologies of new energy vehicles owned by BYD Auto are batteries, motors and electronic control. BYD is the first car company in the world to own the three core technologies of new energy vehicles: battery, motor and electronic control at the same time. Among them, the battery capacity reached 28GWh in 2018, making it the world's leading power battery producer. In addition, In addition, BYD's BYD Dual-Mode Technology and BYD Bi-directional Charging/Discharging Technology have achieved the advantages of convenient charging, environmental protection and energy saving, and low operating costs. BYD's total turnover is RMB1,575,222 million. Using the data for 2022 for comparison, the total input capital of BYD in 2022 is RMB20.223 billion and the total turnover is RMB424.061 billion. The calculation shows that BYD's input-output ratio in 2022 is 2096.92%. [21] In a large Sino-foreign joint venture, SAIC-GM-Wuling Automobile Co., Ltd. was founded on November 18, 2002, by Shanghai Automotive Group Corporation, General Motors (China) Company, and Liuzhou Wuling Automobile Company Limited. Its predecessor was the Liuzhou Automobile Power Machinery Factory, which was founded in 1958. Additionally, SAIC-GM-Wuling established a subsidiary in Indonesia, SAIC-GM-Wuling Indonesia Automotive Ltd., and laid the foundation stone on August 20, 2015, in order to expand the Southeast Asian market and further respond to the national "One Belt, One Road" strategy. For nine years running, SGMW has sold the most single vehicles in China and has amassed a customer base of over 13 million. Four further branches have been established by SGMW: the Qingdao, Chongqing, Liuzhou Hexi, and Liuzhou Baojun bases. With the help of these four divisions, SGMW has evolved into a modern, learning company with "multi-point manufacturing, commercial and passenger transportation, and trans-oceanic and sea-going" capabilities. Over time, it has become a major automobile manufacturer in China and a contender on the global stage. The company currently has four major manufacturing bases, including the Liuzhou Hexi Headquarters, Liuzhou Baojun Base, Qingdao Branch, and Chongqing Branch. These bases form a new development pattern with an east-west echo and a north-south linkage, which will give the company a strong guarantee that it will achieve the production capacity scale of 2 million at the conclusion of the "Twelfth Five-Year Plan" and subsequent development. In parallel, SAIC-GM-Wuling established a subsidiary in Indonesia, SAIC-GM-Wuling Indonesia Automotive Ltd., and laid the foundation stone on August 20, 2015, in order to further respond to the national "One Belt, One Road" strategy and further capture the overseas market. For nine years running, SGMW has sold the most single vehicles in China, accumulating more than 13 million consumers. SGMW has also set up four branches: Qingdao Branch, Chongqing Branch, Liuzhou Hexi Headquarters, and Liuzhou Baojun Base. These four branches have made SGMW a learning and innovative modernized enterprise with

"multi-point manufacturing, commercial and passenger transportation, and trans-oceanic and sea-going", and it has gradually grown into a leading domestic and internationally competitive automobile company. SGMW's total R&D investment in 2022 is $18 billion and the total turnover is $720,988 million. This calculation gives SGMW an input-output ratio of 4005.49% in 2022.[22] The comparison can be concluded that the input-output ratio of BYD is 1908.57% less than that of SGMW. Next, comparing the annual reports of these two companies, the author selected the annual reports for 2021 and 2022. Starting from the 2021 annual report, BYD's total net profit for the four quarters of 2021 is RMB 3,045,188,000.00.[23] SGMW's total net profit for the four quarters of 2021 is RMB24,533,097,943.83.[24] By comparison, BYD's net profit in 2021 is less than SGMW's net profit in 2021 by RMB21,487,909,943.83. Next is the annual report of 2022, the total net profit of BYD for four quarters in 2022 is RMB16,622,448,000.00.[25] SGMW's total net profit for the four quarters of 2022 is RMB16,117,549,650.39.[26] In comparison, BYD's net profit in 2022 is higher than SGMW's net profit in 2022 by RMB504,839,349.61. As can be seen from the data above, the company's sales decreased due to the impact of the rebound of the epidemic on the automotive industry chain supply chain. At the same time, the tight supply of chips, power batteries and other raw material prices rose sharply on the product gross margin adversely affected in recent years, resulting in a gradual intensification of the decline in sales of SAIC Motor, with sales of 1.17 million units during the reporting period, a year-on-year decline of 12.13%. In addition, the sales of SAIC Wuling, SAIC Datsun and other products also declined to different degrees in the reporting period. Therefore, in the face of the superimposed effects of such over-expected factors as the obstruction of the operation of the industrial chain supply chain, the emergence of significant fluctuations in the market, and the high price of raw materials. Seizing the opportunity to expand the market and combining with the national and local automobile consumption promotion policies, the Company endeavored to activate the market demand through a series of methods such as insurance cost reduction, preferential financial programs and after-sale rights and benefits, etc. and made efforts to grasp the sales of new energy vehicles as the best way out.

3. Conclusion

The authors have divided the main part of this article into four sections, and in each section the authors have selected two leading companies in this industry in China to compare and analyze. By analyzing the data, the top industry in terms of input-output ratio is hydrogen energy companies. Two of them, Sinopec and CHN Energy, have input-output ratios of more than 100,000%. The second place is the new energy automobile industry, in which two companies, BYD and SGMW, have outstanding net profit and total turnover. Last are the wind energy industry and the photovoltaic industry. The authors came to the conclusion that the hydrogen energy business and the new energy automotive sector are the most lucrative and promising industries in China's future by analyzing the net profits of the two corporations in each area. In terms of hydrogen production, transportation, and storage as well as its use as an energy source, the hydrogen energy sector is still in its infancy. In China, there exists a "hydrogen industry" that produces hydrogen from fossil energy sources and recycles industrial by-products for production and non-energy use, and this industry has already reached a considerable scale. Compared with the "hydrogen" industry, the development of China's "hydrogen energy" industry is still in its infancy. The current 25 million tons of hydrogen production is only about 1% of energy use. But China's hydrogen production and hydrogen storage materials production and sales of the world's first, for China's hydrogen energy technology development and utilization and hydrogen energy industry development, have created favorable conditions. The new energy automotive sector comes next. The new energy automotive sector has a number of benefits. First, carbon dioxide emissions can be decreased through new energy vehicles. Since batteries are the primary power source for new energy vehicles, their zero-emission features aid in lowering carbon dioxide emissions. Secondly, the new energy automotive industry chain is extensive and involves numerous sectors, therefore it might increase the employment problem by creating more job

possibilities in the linked fields. Government support for the new energy vehicle sector can also help it grow. On China's current course of ongoing growth, let me conclude. There is less space for improvement in some fields because they have already reached their maximum potential. However, China's future development still has a chance with regards to hydrogen energy and new energy vehicles.

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