Intelligent Carbon

# 2023 Carbon Rating Report of China's 100 Overseas Listed Companies

August 2023

香港中文大學(深圳)
The Chinese University of Hong Kong, Shenzhen
深圳数据经济研究院
SHENZHEN INSTITUTE OF DATA ECONOMY
SHENZHEN INSTITUTE of ARTIFICIAL INTELLIGENCE AND ROBOTICS for SOCIETY
深圳市人工智能与机器人研究院
ESG未来基金会
ESG FUTURE FOUNDATION

## Jointly published by

The Chinese University of Hong Kong, Shenzhen

Shenzhen Institute of Data Economy

Shenzhen Institute of Artificial Intelligence and Robotics for Society

ESG Future Foundation

# Preface

Data is, at the same time, the most significant (i) enabler, (ii) inhibitor, (iii) risk and (iv) risk mitigant, in the context of climate action. By focusing on data, we have every opportunity of successfully navigating the road to net zero and building a stronger and sustainable future together.

The 2023 Carbon Rating Report of China's 100 Overseas Listed Companies is important because it helps to develop the foundation for positive change, namely emissions-related data and reporting. The Report discusses the importance of emissions-related disclosure that is reliable and builds awareness and looks at the emissions disclosure policies that affect Chinese listed companies in China, Hong Kong SAR and the United States of America. The Report also looks at the various methodologies and principles that are applied to measure emissions of Chinese listed companies, how this data is used by rating agencies, and how the top 100 Chinese listed companies are scored. The Report goes on to consider the market performance of Chinese companies listed overseas according to their emissions ratings, and the extent to which corporate performance correlates with emissions ratings.

King & Wood Mallesons welcomes publication of the 2023 Carbon Rating Report as a means of helping investors and financial market participants to understand the significance of (reliable, regular and consistent) emissions-related data and reporting to achieve net zero transition.

King & Wood Mallesons is committed to supporting its clients across China, APAC, and around the globe to manage and (as far as possible, mitigate) climate-related risks, and to realise their climate-related objectives for sustainable growth and longevity in a net zero future.

This foreword is prepared by King & Wood Mallesons

# Contents

# 1 Research Background and Significance

On September 22, 2020, President Xi Jinping announced during the United Nations General Assembly that "China will scale up its intended nationally determined contributions and adopt more forceful policies and measures. We aim to have $CO_2$ emissions peak before 2030 and achieve carbon neutrality before 2060." This demonstrated China's responsible stance in global climate governance. In October 2021, the Central Committee of the Communist Party of China and the State Council issued pivotal documents such as the "Opinions on Fully Implementing the New Development Concept and Doing a Good Job in Carbon Peak and Carbon Neutrality" and the "Action Plan for Carbon Peak before 2030," forming a comprehensive policy framework for carbon peak and carbon neutrality, labeled as "1+N." On November 1, 2021, President Xi Jinping delivered a written address during the 26th Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change, proposing initiatives to tackle climate change and stimulate global economic recovery, emphasizing the importance of upholding multilateral consensus, practical action, and expediting green transformation.

On July 16, 2021, China officially launched its national carbon emissions trading market, initially incorporating power generation companies. However, COP26 and the "1+N" dual-carbon policy framework suggest that in the future, seven energy-intensive industries including petrochemicals, chemicals, construction materials, steel, non-ferrous metals, paper, and domestic civil aviation will gradually join the nationwide carbon trading system. More companies will need to bear the economic and environmental costs of excess emissions. As the dual-carbon policy advances and the national carbon emissions market matures, China's energy structure and economic development model are expected to undergo disruptive changes.

Currently, Chinese listed companies proactively disclose carbon emission information through two main channels: some companies primarily reveal emission data in the environmental section of their annual reports, social responsibility ESG reports, or sustainable development reports; another category of companies (e.g., Alibaba, Tencent, China Merchants Bank) issue separate carbon emission disclosure reports in addition to their ESG reports, disclosing greenhouse gas emission calculation data and methodologies. The quality of environmental data disclosure in different companies' ESG reports varies, and the types of disclosed data differ, resulting in most of China's listed company carbon information disclosures falling within the voluntary disclosure category, lacking unified carbon emission information disclosure standards. Given this context, this report focuses on the top 100 Chinese listed companies by market capitalization on the New York Stock Exchange, NASDAQ, and Hong Kong Stock Exchange. It analyzes the companies' 2020, 2021,(1) and 2022 social responsibility ESG or sustainable development reports. Utilizing the enterprise-level emission data from the "intelligent carbon" Chinese listed company carbon database, the report quantitatively analyzes and scores companies' carbon emissions based on actual emission intensity, emission reduction outcomes, data disclosure quality, and future reduction plans. The report aims to enhance companies' awareness of voluntarily disclosing carbon emissions information, improve the quality of carbon emission information disclosure, and promote the professionalization, standardization, and enhancement of carbon emission data disclosure formats from the corporate side through a multi-dimensional rating approach.

(1) In 2022, Tencent Holdings disclosed the "Tencent Carbon Neutrality Goals and Action Roadmap Report." Alibaba Group released the "2020 Corporate Carbon Neutrality Action Report" in 2021. China Merchants Bank disclosed the "2020 Annual Environmental Information Disclosure Report" in 2021.

## 1.1 Significance of Carbon Emission Disclosure for Listed Companies

Given the core objectives of "carbon peak by 2030" and "carbon neutrality by 2060," Chinese listed companies not only need to accelerate low-carbon business development but also promptly, accurately, and comprehensively disclose their emission data and related environmental information. In the carbon market mechanism, a company's carbon emissions are closely linked to its operating costs. This, in turn, requires higher quality and comparable carbon emission information disclosure in order to assess companies' debt-paying abilities and price their assets. Capital markets are placing increased demands on the quality and comparability of companies' carbon emission information disclosure. On March 21, 2022, the U.S. Securities and Exchange Commission (SEC) issued new proposals for climate disclosure by public companies, aiming to mandate the disclosure of carbon emissions and climate-related risks. The rules stipulate that companies disclose their direct emissions (Scope 1 emissions, emissions from owned facilities), indirect emissions (Scope 2 emissions, emissions from purchased electricity and heat), and other emissions (Scope 3 emissions, emissions from the supply chain). More and more investors realize that climate risks will significantly impact listed companies' financial conditions, hence the need for more accurate emission information to aid investment decisions. Clear and specific disclosure requirements can help companies efficiently disclose information to meet investor demands, achieving mutual benefits for both investors and companies.

The actual significance of high-quality carbon disclosure by listed companies lies in two aspects. Firstly, transparent, open, and complete disclosure of foundational data is essential as authentic and accurate carbon emission data forms the basis for trading in the national carbon market. Secondly, high-quality carbon emission information disclosure guides capital flow and empowers the public with a better understanding of companies' real greenhouse gas emissions, facilitating their efforts to achieve carbon peak and carbon neutrality.

The global trend of low-carbon business development is motivating Chinese-listed companies to further improve their carbon emission disclosure and management systems. The Economic and Financial Committee of the European Council reached an agreement on March 22, 2022, to officially launch the Carbon Border Adjustment Mechanism (CBAM). CBAM imposes corresponding taxes on imports of high-carbon goods, including cement, fertilizers, steel, aluminum products, and electricity. The mechanism requires importers to declare the carbon emissions associated with their imported products to the EU starting from 2023 and pay the corresponding carbon emission fees by purchasing CBAM certificates. The EU carbon tariffs will directly impact companies exporting high-carbon emission products, challenging sectors like steel and petrochemicals and further driving the development of low-carbon production technologies, carbon auditing, and emission disclosure. The introduction of EU carbon tariffs will contribute to the improvement of China's listed company carbon information disclosure system. Simultaneously, as ESG investment advances, stricter requirements for sustainable disclosure by financial institutions internationally will transmit down the investment value chain to various sectors, urging Chinese financial institutions and invested companies to enhance the transparency of emission data and environmental information disclosure. Additionally, for high-energy-consuming and high-emission companies with dual listings or import-export businesses, due to mandatory environmental information disclosure overseas, these companies will also be required to detail carbon emission information in their annual reports. Consequently, there will be benchmarking pressure among domestic companies in the same industry, motivating more companies to disclose emission data.

Currently, China's environmental regulatory authorities have established preliminary management rules and policy requirements for mandatory corporate-level carbon emission disclosure. However, there is no unified and clear carbon emission information disclosure standard and mandatory requirement for A-share listed companies. In June 2021, the China Securities Regulatory Commission revised the guidelines for the format of annual and semi-annual reports of listed companies to include "encouraging companies to voluntarily disclose measures and effects taken to reduce their carbon emissions during the reporting period." In October 2021, the Central Committee of the Communist Party of China and the State Council issued the "Opinions on Fully Implementing the New Development Concept and Doing a Good Job in Carbon Peak and Carbon Neutrality," specifically proposing the need to improve the system for corporate and financial institution carbon emission reporting and information disclosure. On January 4, 2022, the Ministry of Ecology and Environment issued the "Guidelines for the Format of Environmental Information Disclosure by Enterprises in accordance with the Law," primarily targeting greenhouse gas key emitting units that are included in the carbon emissions market. The requirement is for them to disclose carbon emission-related information. As the construction of the national carbon market gradually improves, an increasing number of companies will be brought into the scope of mandatory disclosure, which will also drive more listed companies to establish comprehensive carbon emission information disclosure systems.

## 1.2 Significance of Carbon Emission Disclosure for Capital Markets

As a crucial quantitative assessment for ESG sustainable development, company carbon emission information can be categorized into two types: carbon emission accounting foundational data and company emission reduction information. Emission accounting foundational data includes information on the company's energy consumption, fuel consumption, purchased heat and greenhouse gas emissions. Additionally, the company's emission levels and intensity are closely tied to its industry, product types, business operations, and operational costs. On the other hand, the disclosure of company emission reduction information demonstrates the company's capacity and determination to address climate change challenges and fulfill social responsibilities. Listed companies' carbon emission disclosures assist financial institutions in climate risk management and serve as essential channels for the public to understand and monitor companies' emission reduction goals.

### (1.)High-quality carbon emission disclosure aids capital markets and investors in evaluating climate risks.

Amidst the backdrop of the dual-carbon policy, companies within high-energy-consuming and high-emission industries might face higher operating costs due to excess emissions. Considering carbon market risks and price fluctuations, an excessive concentration of market investments in high-pollution and high-carbon industries could expose the capital market to substantial potential environmental and climate risks. These risks manifest at two levels: firstly, changes in relevant environmental policies such as carbon quota allocation, governance, and storage rules, which impact companies' emission levels and carbon quota demands while introducing instability to their operational costs. Such policy risks will to a certain extent influence the business decisions and investment returns of capital market investors. Secondly, financial and securities institutions face various external pressures from regulatory bodies, investors, public opinions, etc., as they operate and strive for sustainability. Therefore, the more transparent, comprehensive, and detailed the disclosure of environmental impact information generated by enterprises, projects, or assets funded, the more advantageous it will be in guiding financial resources towards low-carbon and environmentally friendly sectors, relatively reducing climate risks.

With increasing domestic and foreign investors conducting climate risk analyses on individual stocks and investment portfolios, the absence of relevant environmental information disclosure by listed companies can be detrimental to attracting potential investors. The financial sector, in particular, maintains high sensitivity to the risks and opportunities posed by climate change. Representative commercial banks such as Ping An Bank, China Merchants Bank, and China Construction Bank have conducted climate risk and opportunity analyses using scenario analysis and stress tests. They have incorporated these findings into their ESG reports. Carbon emissions and environmental pollution are significant contributors to global climate change. Climate risk stress tests conducted by financial institutions need to cover typical companies in high-carbon, high-energy consumption, and high-pollution industries. These tests should consider the short-term, medium-term, and long-term impacts of carbon peak and carbon neutrality on the loans extended to high-pollution industries. Such studies examine the influence of climate-related risk factors like carbon emission costs on core operational indicators such as non-performing loan ratios and capital adequacy ratios of commercial banks under mild, moderate, and severe scenarios.

## (2.)Capital markets empower green development based on corporate carbon emissions.

The nation urges capital markets to actively leverage market mechanisms, expanding green financial reforms to drive the green upgrading of the industrial structure. On September 12, 2021, the Central Office of the Communist Party of China and the State Council issued the <Opinions on Deepening the Reform of the Ecological Protection Compensation System>. This called for the study and development of financing tools based on rights to water, emissions, carbon emissions, and other environmental resources. There's a need to establish green stock indexes and develop carbon emission futures trading. The construction of the index system depends on companies disclosing comprehensive environmental information to reduce information asymmetry. As of September 26, 2021, 78 green-related stock indices have been released domestically. On January 20, 2022, the CSI Shanghai Carbon Neutral Index was officially launched, integrating the Shanghai carbon market with the capital market. Representative international green stock indices include the S&P ESG Index, MSCI ESG Index Series, and Hang Seng Sustainable Enterprise Index Series, focusing on ESG, environmental ecology, and environmental protection industries. Carbon-neutral concept indexes outperform the market significantly, and portfolios with high ESG scores have higher returns and lower volatility than those with low scores. As the market's attention to carbon neutrality and sustainable development continues, the impact of ESG evaluations on the risk and return of listed companies will strengthen. The Orient Securities Carbon Neutral Index March performance report showed that as of March 28, 2022, the annualized return of the Orient Securities Carbon Neutral Index was 25.22%, while the CSI 300, Shanghai Composite Index, and Hang Seng Index were 4.89%, 11.23%, and -5.28%, respectively. Developing green stock indices in the financial market benefits listed companies in undertaking social responsibilities, enhancing environmental information disclosure, and continuously advancing and perfecting the system of environmental information disclosure by listed companies. It also promotes capital support for green environmentally friendly industries, raising funds for companies engaged in carbon reduction, energy storage, photovoltaics, new energy, electric vehicles, and other green low-carbon industries.

## (3.) Micro-level company data simultaneously affects the quality of corporate carbon emission disclosures and capital market decisions.

At the corporate level, under China's current voluntary disclosure framework, the carbon emission disclosure rate of some enterprises is low, and information disclosure is still in its infancy. However, there is a broad relationship between carbon emission disclosure levels and a company's financial performance, corporate value, and capital cost. Carbon emission disclosure levels positively correlate with company performance. With the overall interest of stakeholders in mind, a company's development should align with its environmental and social responsibilities. Proactive carbon emission disclosure under the "dual carbon" policy framework is conducive to

creating a compliant, environmentally friendly corporate image, maximizing company value in line with economic trends. Regarding capital costs, the higher the level of a company's environmental information disclosure, the lower the equity and debt capital costs, which is beneficial for financing. This is because carbon disclosure can demonstrate the company's efficient and low-consumption operations; investors prefer transparent companies, and environmental information disclosure can improve asymmetry between companies and investors, reducing the external estimation of the company's uncertain risk, lowering investment risk, and increasing creditors' recognition of the company, thereby saving the company's bond issuance costs.


## 1.3 Impact of EU Carbon Tariffs on Corporate Carbon Emission Disclosure

On March 22, 2022, the European Council's Economic and Financial Affairs Committee reached an agreement to officially introduce the Carbon Border Adjustment Mechanism (CBAM) and released detailed plans. This mechanism imposes corresponding taxes on imported goods with high carbon emissions (hence the term "carbon border tax"). The specific products covered include cement, fertilizers, steel, aluminum products, and electricity, among five categories of imported goods. The CBAM requires importers to declare the carbon emissions of their imported products to the European Union (EU) starting from 2023 and pay the corresponding carbon emission fees through the purchase of CBAM certificates. The CBAM is a significant measure for the EU to achieve its target of reducing carbon emissions by 55% by 2030. It is expected to be formally implemented from 2026 after a 3-year transition period (2022-2025).

Overall, the impact of the EU carbon border tax on China's total exports is less than 1%, so it is not anticipated to directly affect the majority of market participants. However, the carbon border tax policy will reshape the competitive landscape in sectors such as steel and petrochemicals, both within the EU and globally, driving significant transformations within companies producing high carbon emission products. Additionally, the EU carbon border tax policy presents new opportunities for some Chinese companies, accelerating the development of low-carbon production technologies, carbon auditing, and carbon disclosure.

Furthermore, the EU carbon border tax policy will also influence related industry supply chains, encouraging both upstream and downstream enterprises to transition and upgrade towards low-carbon and energy-efficient practices.

The EU carbon border tax will reshape the competitive landscape for high-carbon emission products, impacting the competitiveness of some Chinese export products. Since 2005, the EU has implemented the Emission Trading Scheme (ETS) to regulate carbon emissions produced by EU-based companies. Other countries have also been progressively strengthening carbon emission control measures, and many EU and related countries' enterprises have been adopting various approaches to reduce their carbon emissions. However, the resulting cost increase has made their products less competitive in terms of pricing, often leading to market share being taken by more affordable imported products. The newly introduced carbon border tax primarily aims to impose taxes on imported products with high carbon emissions, adjusting the price differential between EU-produced products and imported products due to differences in carbon reduction costs, thereby better controlling total carbon emissions within the EU.

Taking the steel industry as an example, the carbon border tax will reshape the competitiveness of both EU and non-EU steel products. China's current steel production is primarily based on high-emission blast furnace steelmaking, supplemented by relatively lower emission but higher cost electric arc furnace production, resulting in nearly 2 tons of carbon emissions per ton of steel. Meanwhile, Turkey and Russia, major sources of steel imports for the EU, have significantly higher carbon emissions from their steel production compared to EU-based companies like ArcelorMittal and Tata Steel. Considering the estimated 5% increase in costs due to the EU carbon border tax, the price advantage of imported steel will gradually diminish. Coupled with transportation costs due to the pandemic and existing trade protection policies, the competitiveness of EU-produced steel products may be further emphasized.

The EU carbon border tax will compel high-carbon import products to transition to carbon reduction in production. Chinese export companies are expected to align with EU requirements by enhancing their carbon emission auditing and disclosure mechanisms, adopting low-carbon production technologies, and establishing more carbon-efficient supply chains to maintain their export product competitiveness. CBAM requires exporting companies, including

those from China, to declare the quantity of exported goods and their corresponding carbon emissions to the EU starting from 2023. This introduces new requirements, particularly for enterprises that have not yet established robust carbon auditing and disclosure mechanisms. Some domestic companies still need to strengthen their carbon emission verification and disclosure efforts, addressing issues such as incomplete verification mechanisms, limited scope of verification, and incomplete and non-standardized carbon disclosure data and information.

Furthermore, since the initial scope of CBAM's application significantly impacts steel and aluminum products, Chinese companies will need to optimize low-carbon production processes (such as electric arc furnaces), develop low-carbon products, and implement carbon capture and storage technologies to primarily reduce Scope 1 and Scope 2 carbon emissions to avoid substantial carbon emission taxes. Regarding more extensive Scope 3 emissions (related to supply chains), enterprises occupying a dominant position within the supply chain will need to address the impacts of explicit carbon emission costs by choosing more energy-efficient and low-carbon raw materials, and guiding high-emission cooperating enterprises towards low-carbon transformation, ultimately reducing product-related emissions across a broader range.

In the short term, the additional costs brought about by low-carbon transformation will affect the price advantage of Chinese export products. Additionally, companies may shift the transformation costs to their supply chain partners, potentially affecting the overall competitiveness of the supply chain. Reducing carbon emissions for related products is not an immediate task. Among the imported products that the EU plans to impose carbon taxes on, steel products from China and other countries tend to have higher carbon emissions due to a limited application of advanced steelmaking technologies. Similarly, factors such as refining and extraction processes significantly increase the carbon emissions per ton of products in the petroleum refining and fertilizer sectors. The use of more advanced steel and aluminum production processes, as well as petroleum refining equipment, will notably increase product costs. Consequently, companies might pass on the additional costs to supply chain partners, impacting various aspects like raw materials, transportation, production, and manufacturing, consequently affecting the price competitiveness of related intermediate products and services.

In the long term, the transformation will provide companies with sustainable advantages in both the increasingly strict domestic carbon emission policies and corresponding international markets, creating new opportunities for some enterprises. While the current focus is on the EU's implementation of carbon border taxes, other countries may also raise carbon emission control requirements in different ways in the future. Therefore, Chinese companies, especially export-oriented enterprises and their supply chains, have the opportunity to gain greater benefits from low-carbon transformation efforts. Under the backdrop of the EU potentially expanding the scope of carbon border taxes and more countries, including China, tightening control over carbon emissions, these efforts can help companies seize market opportunities. Not only for export-oriented enterprises, but also for companies focusing on the research and development of low-carbon production technologies, energy-efficient material manufacturing, and having more comprehensive and authoritative carbon auditing and disclosure services, there will be opportunities to thrive under the wind of the EU carbon border tax policy. Although there are still controversies surrounding the implementation difficulty, execution methods, and the direct short-term impact on Chinese enterprises, overall, implementing more standardized and unified carbon disclosure mechanisms and transitioning to more low-carbon and energy-efficient production methods will be the inevitable path for Chinese companies to upgrade and transform.

# 2 Carbon Disclosure Models for Domestic and International Listed Companies

## 2.1 Policy Requirements for Carbon Emission Disclosure of A-Share Listed Companies

ESG (Environment, Social, Governance) is an assessment system that measures the sustainable development performance of companies and organizations. It's also a crucial criterion for investment institutions when evaluating investment targets. Within ESG, the environmental category evaluates indicators covering various quantitative data such as greenhouse gas emissions, air pollutants, and energy consumption. ESG reports serve as the primary channel for investors to understand a listed company's carbon emissions. ESG information disclosure typically falls into two categories: mandatory and voluntary. Mandatory disclosure refers to information that government administrative or regulatory bodies require companies to disclose to the public. Currently, China's environmental regulatory authorities mandate companies exceeding emission limits and totals or classified as key polluters to disclose their emission information. While there is no comprehensive mandatory requirement for ESG carbon emission disclosure on the Shanghai and Shenzhen Stock Exchanges, China's environmental regulatory authorities still mandate companies exceeding emission limits and totals to disclose their emission information. For companies outside of these scopes, the requirements in China are still based on self-regulation, encouragement, and voluntary disclosure. In the A-share market, ESG carbon emission disclosure is semi-mandatory on the Shanghai and Shenzhen Stock Exchanges, while the Beijing Stock Exchange, due to its later establishment, primarily focuses on small and medium-sized enterprises, with disclosure mainly incentivized.

Mandatory Carbon Emission Disclosure by Environmental Regulatory Authorities: The "Administrative Measures for the Disclosure of Enterprise Environmental Information" (referred to as the "Measures") were reviewed and approved by the Ministry of Ecology and Environment on November 26, 2021, and came into effect on February 8, 2022. The Measures stipulate that the following types of enterprises are required to disclose environmental information: (1) Key polluting units; (2) Enterprises subject to mandatory cleaner production audits; (3) Listed companies with ecological and environmental violations, and various subsidiary companies within the scope of consolidated financial statements; (4) Enterprises issuing corporate bonds, company bonds, and non-financial corporate debt financing instruments with ecological and environmental violations; (5) Other enterprises required by laws and regulations to disclose environmental information. Such companies need to disclose carbon emission information including emission volume and emission facilities. Additionally, the Ministry of Ecology and Environment and local ecological and environmental authorities at the city level or above should establish a system for the lawful disclosure of corporate environmental information on government websites, among other means, to centrally publish content disclosed by companies, allowing the public to access the information for free.

Regarding the specific content and standards of corporate carbon emission disclosure, the Ministry of Ecology and Environment released the "Guidelines for the Format of Lawful Disclosure of Enterprise Environmental Information" on January 4, 2022. It stipulates that key polluting units should disclose relevant information on major air pollutants

(including organized and unorganized emissions) in their annual reports. Furthermore, greenhouse gas-emitting units subject to carbon emission quota management in the emissions trading market should disclose carbon-related information, including 1) Actual carbon emissions for the current and previous years; 2) Quota settlement status based on greenhouse gas emission accounting and reporting standards or technical specifications; 3) Information about emission facilities and accounting methods.

Securities exchanges provide guidance and standards for company carbon disclosure: Currently, in China's A-share market, the governance guidelines for listed companies and the guidelines for regular reporting content and format explicitly encourage the disclosure of social responsibility reports and environmental-related information. However, there are no unified, specialized format rules specifically targeting mandatory carbon emission disclosure for listed enterprises and comprehensive, uniform standards for corporate carbon information disclosure have not been established.

(1)Shanghai Stock Exchange: On May 14, 2008, the Shanghai Stock Exchange issued the "Guidelines for Environmental Information Disclosure of Listed Companies on the Shanghai Stock Exchange," which encourages listed companies to disclose environmental information in their annual social responsibility reports or separately based on their needs. It specifies the types of environmental information that companies in industries with significant environmental impacts, such as thermal power generation, steel, cement, electrolytic aluminum, and mineral development, should disclose. It also outlines the scope of information that companies recognized by environmental protection authorities as severe polluters must disclose, along with procedural requirements for environmental information disclosure, such as announcement methods and filing documents. The "Stock Listing Rules for the Science and Technology Innovation Board of the Shanghai Stock Exchange," released on March 1, 2019, require companies listed on the science and technology innovation board to disclose their performance of social responsibility in their annual reports and, when appropriate, prepare and disclose documents such as social responsibility reports, sustainable development reports, and environmental responsibility reports. On January 7, 2022, the Shanghai Stock Exchange further revised its stock listing rules and issued the "Stock Listing Rules of the Shanghai Stock Exchange (Revised in January 2022)," providing clearer content guidance for ESG information disclosure.

(2)Shenzhen Stock Exchange: In 2015, the Shenzhen Stock Exchange issued the "Guidelines for Standardized Operation of SME Board Listed Companies," which stipulated that listed companies should promptly disclose the causes of significant environmental pollution issues, their impact on company performance, their impact on the environment, and the corrective measures to be taken when major environmental pollution issues arise. In 2020, the Shenzhen Stock Exchange pointed out in the "Guidelines for Standardized Operation of ChiNext Listed Companies (Revised in 2020)" that listed companies should actively fulfill social responsibilities, regularly assess the fulfillment of social responsibilities, and voluntarily disclose social responsibility reports. In the same year, the Shenzhen Stock Exchange's "Assessment Method for Information Disclosure Work of Shenzhen Stock Exchange Listed Companies (Revised in 2020)" explicitly indicated that the exchange would focus on the following aspects of listed company information disclosure: 1) Whether social responsibility reports are proactively disclosed, and whether the content is substantial and complete; 2) Whether ESG performance, including environmental and social responsibilities and corporate governance, is proactively disclosed, and whether the content is substantial and complete; 3) Whether information on the company's active participation in matters consistent with major national strategic policies is disclosed.

Compared to the gradual transition of ESG disclosure requirements from voluntary to semi-mandatory by the Shanghai and Shenzhen Stock Exchanges, the Beijing Stock Exchange, due to its later establishment, smaller scale, and more complex and challenging supervision of mainly small and medium-sized enterprises, currently

emphasizes voluntary ESG disclosure. However, there are also certain incentive measures to encourage companies to proactively disclose ESG information. Since its establishment in October 2021, the Beijing Stock Exchange has also issued a series of guidance for ESG information disclosure to guide listed companies in improving the quality of ESG information disclosure. A-share listed companies face issues such as inconsistent environmental information disclosure standards, incomplete data, and varying report quality. With the trend towards standardized ESG information disclosure by listed companies, the requirements for standardized, quantitative, and substantial carbon emission disclosure standards will continue to evolve. All listed companies must ensure the accuracy, completeness, and comparability of carbon emission disclosure.

**Table 1: Regulatory Policies for Environmental Information Disclosure in China**

| Time | Policy document | Policy content |
|---|---|---|
| August,2016 | The People's Bank of China and seven other ministries and commissions issued Guidelines on Building a Green Financial System | Proposing the establishment and enhancement of a mandatory environmental information disclosure system for listed companies. The specific implementation will be carried out in stages as follows:<br>1. For listed companies belonging to the key polluting units announced by the former Ministry of Environmental Protection, mandatory disclosure of environmental information will be required starting from 2017.<br>2. "Semi-mandatory" environmental information disclosure will be implemented from 2018. Companies that have not disclosed relevant information must provide explanations for the reasons.<br>3. All listed companies must disclose environmental information starting from 2020. |
| March,2021 | The Ministry of Ecology and Environment published the "Guidelines for Verification of Corporate Greenhouse Gas Emission Reports (Trial Version)." | This guideline establishes the principles, criteria, procedures, key points, review, and information disclosure for the verification of greenhouse gas emission reports from key emission units. |
| May,2021 | The Ministry of Ecology and Environment has issued the "Reform Plan for the System of Legal Environmental Information Disclosure." | The document outlines several key tasks across four main aspects: "Establishing and improving standardized requirements for mandatory legal environmental information disclosure," "Establishing a coordinated management mechanism for mandatory legal environmental information disclosure," "Enhancing the supervision mechanism for mandatory legal environmental information disclosure," and "Strengthening the legal construction of environmental information disclosure." |
| June,2021 | "Guidelines for the Content and Format of Information Disclosure by Companies Issuing Publicly Traded Securities No. 2 - Annual Report Content and Format (Revised in 2021)" and "Guidelines for the Content and Format of Information Disclosure by Companies Issuing Publicly Traded Securities No. 3 - Semi-Annual Report Content and Format (Revised in 2021)." | The document requires listed companies to include a separate section titled "Section V: Environment and Social Responsibility" and encourages companies to voluntarily disclose relevant information that contributes to ecological protection, pollution prevention, and fulfilling environmental responsibilities. It also encourages companies to disclose third-party organizations such as verification agencies, certification bodies, evaluation organizations, and index companies that have conducted verification, identification, and evaluation of the company's environmental information. Additionally, companies are encouraged to voluntarily disclose the measures taken and their effectiveness in reducing carbon emissions during the reporting period. |
| July,2021 | The People's Bank of China (PBOC) has issued the financial industry standard "Guidelines for Environmental Information Disclosure by Financial Institutions." | The standard comprehensively elaborates on the principles, forms, and content requirements of environmental information disclosure by financial institutions. It outlines requirements regarding the form, frequency, qualitative and quantitative information to be disclosed by financial institutions in terms of environmental information disclosure. |
| December,2021 | The Ministry of Ecology and Environment issued the "Administrative Measures for Corporate Environmental Information Disclosure." | The standardization of corporate environmental information disclosure activities aims to strengthen social oversight. |

## 2.2 Policy Requirements for Carbon Emission Disclosure of Hong Kong-Listed Companies

In 2012, the Stock Exchange of Hong Kong (HKEX) released the "ESG Reporting Guide," providing voluntary environmental information disclosure recommendations for listed companies. In 2016, the Hong Kong Monetary Authority, the Securities and Futures Commission, and relevant exchanges elevated certain voluntary disclosure recommendations to a semi-mandatory level by implementing the "Comply or Explain" rule. Main board issuers in HKEX are required to publish ESG reports within four months after their financial year-end, while GEM board issuers are required to publish ESG reports within three months after their financial year-end.

Starting from 2016, the Stock Exchange of Hong Kong Limited (SEHK) rules stipulated that listed issuers must publish ESG reports that comply with the SEHK's "Guidance on Environmental, Social and Governance (ESG) Reporting." In May 2019, SEHK revised the "Guidance on Environmental, Social and Governance (ESG) Reporting" (referred to as the "New Guidance") and related listing rules. The revised rules officially took effect in July 2020. The provisions of the New Guidance further enhance the requirements for ESG information disclosure by listed companies. According to the detailed rules of the New Guidance, the environmental indicators cover the "Comply or Explain" provisions. If an issuer fails to report on one or more of these provisions, they must provide well-considered reasons in their ESG report.

One of the quantifiable indicators related to corporate carbon emissions under the new SEHK Guidance is:

**1) General Disclosure A1 Emissions: Pertaining to emissions of gases and greenhouse gases**

a) Key Performance Indicator A1.1: Categories of emitted substances and corresponding emission data.

b) Key Performance Indicator A1.2: Total direct (Scope 1) and indirect energy-related (Scope 2) greenhouse gas emissions (in metric tons) and, if applicable, intensity (calculated per production unit, per facility).

c) Key Performance Indicator A1.5: Describe established emission reduction targets and the measures taken to achieve these targets.

**2)General Disclosure A2 Resource Usage: Policy for Efficient Resource Utilization (including energy, water, and other raw materials)**

a) Key Performance Indicator A2.1: Total direct and/or indirect energy (such as electricity, gas, or oil) consumption categorized by type (measured in kilowatt-hours) and intensity (calculated per production unit, per facility).

On December 4, 2015, the Financial Stability Board (FSB) established the Task Force on Climate-related Financial Disclosures (TCFD) to develop a set of ESG evaluation standards for assessing the challenges and opportunities posed by the environment and climate to corporate development. On November 5, 2021, in conjunction with TCFD recommendations, the Hong Kong Exchanges and Clearing Limited (HKEX) issued the "Climate Disclosures Guidance," further refining disclosure requirements for climate information. This guidance helps companies effectively assess and address the risks posed by climate change. TCFD recommends the use of scenario analysis by companies to identify and assess the potential impacts of climate-related risks on business performance, considering a range of future scenarios. The Hong Kong Green and Sustainable Finance Cross-Agency Steering Group also plans to mandate climate-related information disclosures in line with TCFD recommendations by 2025 or earlier.

## 2.3 Policy Requirements for Carbon Emission Disclosure of U.S. Listed Companies

In 2010, the U.S. Securities and Exchange Commission (SEC) first issued the "Commission Guidance Regarding Disclosure Related to Climate Change," outlining standards for assessing environmental responsibility of listed companies at the SEC level. The guidance requires companies to disclose sustainability information (corporate governance and relevant risks) directly in their annual reports (Form 10-K).In April 2021, an important step was taken by the U.S. government towards establishing mandatory ESG disclosure standards. The House Financial Services Committee passed the "ESG Disclosure Simplification Act," requiring all listed companies to regularly disclose specific details of their environmental, social, and corporate governance performance. This includes disclosing information related to climate change risks, such as greenhouse gas emissions and fossil fuel usage, throughout their business operations.

On March 21, 2022, the SEC released a new proposal for corporate climate disclosure, intending to mandate the disclosure of climate-related information by listed companies. This proposal suggests compelling listed companies to disclose information in four areas:

**1) Disclose the governance structure and management processes for climate-related risks.**

**2) Explain how the identified risks have already or may materially affect the company's operations and finances, including short-term, medium-term, and long-term impacts.**

**3) Describe how the identified risks have already or may impact the company's strategy, business model, and long-term development prospects.**

**4) Explain the impact of climate-related events, such as extreme weather events and other natural disasters, as well as transition activities, on the financial statements, estimation methods, and underlying assumptions of the financial statements.**

The proposal suggests mandatory disclosure of carbon emissions information by listed companies, including Scope 1, Scope 2, and Scope 3 emissions. Scope 1 and Scope 2 emissions apply to all listed companies. When Scope 3 emissions have a material impact on a listed company or when a company's carbon reduction goals include Scope 3 emissions, disclosure of Scope 3 emissions becomes mandatory (smaller companies may be exempt from Scope 3 disclosure).

In 2012, both the NASDAQ Stock Market ("NASDAQ") and the New York Stock Exchange ("NYSE") joined the United Nations Sustainable Stock Exchanges initiative, guiding listed companies within their exchanges to simultaneously undertake social, economic, and environmental responsibilities while making business investments. The NYSE has provided some standard guidelines for ESG disclosure by listed companies, but it hasn't issued comprehensive guidelines on the scope of information that ESG reports should cover.

In March 2017, NASDAQ published its first "ESG Reporting Guide 1.0" based on voluntary disclosure principles. This guide was revised in May 2019, leading to the release of the updated "ESG Reporting Guide 2.0" to promote sustainable development in the securities market. As shown in Table 2, the "ESG Reporting Guide 2.0" lists and explains the environmental, social, and governance aspects that listed companies should disclose. Information that companies should disclose includes greenhouse gas emissions, emission intensity, energy usage, and climate risks,

among others. The "ESG Reporting Guide 2.0" provides supplementary explanations for each indicator's coverage, reasons for disclosure, accounting methods, and disclosure methods. Based on the type and developmental stage of listed companies, NASDAQ has designed specific provisions for measuring ESG disclosure information and disclosure methods tailored to each case.

**Table 2: Explanation of Quantitative Indicators for Carbon Emission Disclosure in "ESG Reporting Guide 2.0"**

| index | Disclosure Content |
|---|---|
| GHG Emissions | The disclosure is in the form of figures and should be compared with the historical period and industry average GHG emissions |
| Emissions Intensity | Disclosure in the form of figures, based on the TCFD framework, calculating the emissions intensity of the business (carbon emissions per unit of revenue, sales or product) |
| Energy Usage | Disclosure of corporate energy consumption in digital form |
| Climate Oversight/Board | Answer whether the Board monitors/manages climate-related risks |
| Climate Oversight/Management | Answer whether top management monitors/manages climate-related risks |
| Climate Risk Mitigation | Provide an annual breakdown of investments in climate-related infrastructure and product development, along with an explanation of the company's capacity to address climate risks. |

# 3 ESG in China – Solid 2022, Promising 2023

## Highlights:

### A.ESG market in China is active, and ESG performance of listed companies continues to improve

In 2022, the number of A-share listed companies publishing ESG report exceeded 1,400, surpassing 30% of total companies for the first time, reaching historical high. However, the ESG disclosure level varies significantly among industries, in which financial industry topping the list with 89.5% ESG disclosure rate. On the rating side, A-share listed companies' ESG performance is improving rapidly. In 2022, the SynTao Green Finance (' 商 道 融 绿 ') ESG rating upgrade of all A-share listed companies from Grade C to Grade B has accelerated, the number of companies with Grade B or above rating is 1,711, accounting 35.31% of total, which is around 1.25 times of 2021' s. There is a correlation between ESG rating and listed company' s future profit and cashflow, high-score company' s future ROE and dividend yield is relatively higher. Also, the number of ESG fund is growing rapidly, in which the number of ESG public offering fund has jumped to 606 in 2022, with a significantly increased market share in the fund market.

### B.Intensive ESG policies roll out, strengthening standardization

During 2021-2022, the integration of international ESG rating standards has been significant. SASB and IIRC merged to form VRF, which then merged with CDP to enter IFRS. Thereafter, IFS established ISSB (which is based on GRI and TCFD standards), which became a milestone for ESG international standardization, and continued actively promoting global unified ESG disclosure standard in 2022. In China, institutions, including Shenzhen Stock Exchange, Shanghai Stock Exchange, Hong Kong Stock Exchange and National Energy Administration, have been issuing ESG indicators, supervision mechanism and related standards, to supervise ESG development. Among them, at the beginning of 2022, Shanghai Stock Exchange issued a document encouraging listed companies to disclose ESG information, and also requiring STAR50 companies to disclose ESG report separately, a key step to mandatory ESG information disclosure. At end 2022, Central State-Owned Enterprises ESG Alliance (' 央 企 ESG 联 盟 ') was established to lay the foundation for ESG development of leading companies in 2023.

### C.Promising ESG development in 2023, localization and strong regulation to be mainstream trend in China

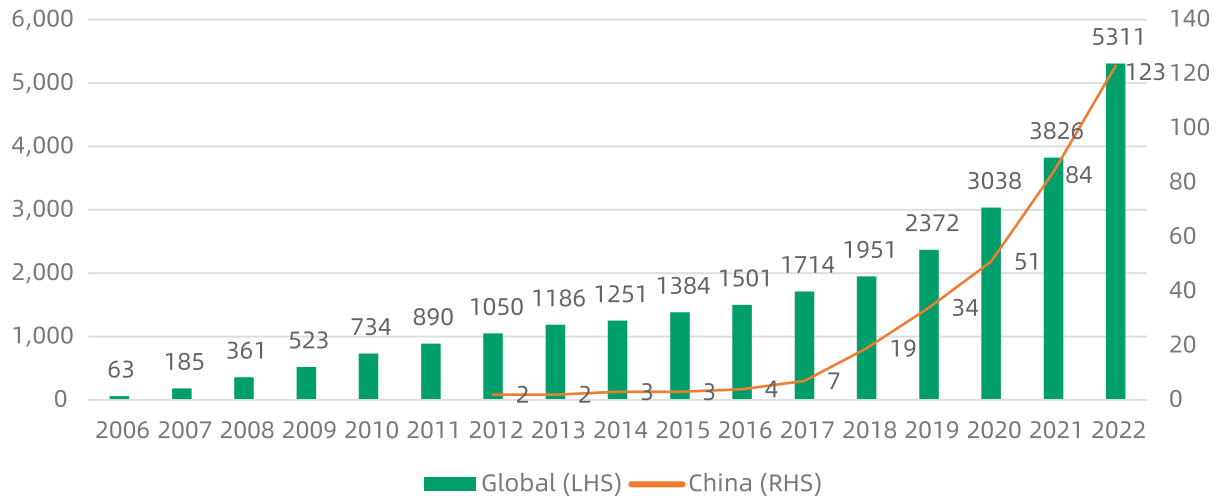
PwC predicts global ESG fund market size to reach US$34 trillion by 2026, with global ESG-related asset size proportion to increase to 21.5%. Based on Morningstar data, as of third quarter of 2022, global ESG fund market had recorded capital net inflow for two consecutive years, showing resilience of ESG investment. With the continuous improvement of overseas ESG maturity and increasing perfection of domestic regulation and implementation system, it is expected that the attention to ESG investment in Chinese market will maintain at high level in 2023. In term of development trend, compared with international institutions focusing on the frontier and timeliness of ESG, China pays more attention to ESG development investment and system construction. In the context of continuous improvement of domestic policies, 2023 will show a trend of accelerated localization and stricter supervision. At the same time, after years of development, ESG application scenarios will further expand.

## 3.1 Data Review and Analysis of China's ESG Development in 2022

### 3.1.1 PRI Signing Status

In recent years, the number of institutions participating in responsible investment through the Principles for Responsible Investment (PRI) has continued to grow globally. As of the end of 2022, the number of institutional signatories to the PRI, which is supported by the United Nations, reached 5,311, an increase of 38.8% from the end of 2021. The number of domestic PRI signatories has surged rapidly since 2018, with over 120 institutions signed up by end of 2022. PRI has gained widespread recognition worldwide, and institutions signing up to PRI need to comply with a minimum required amount of responsible investment. The increase in the number of signatories represents the continuous expansion of the global responsible investment scale, reflecting the positive response of the international market to ESG investment concepts.

**Figure 1: Number of Global and China PRI Institutional Signatories (2006 - 2022)**

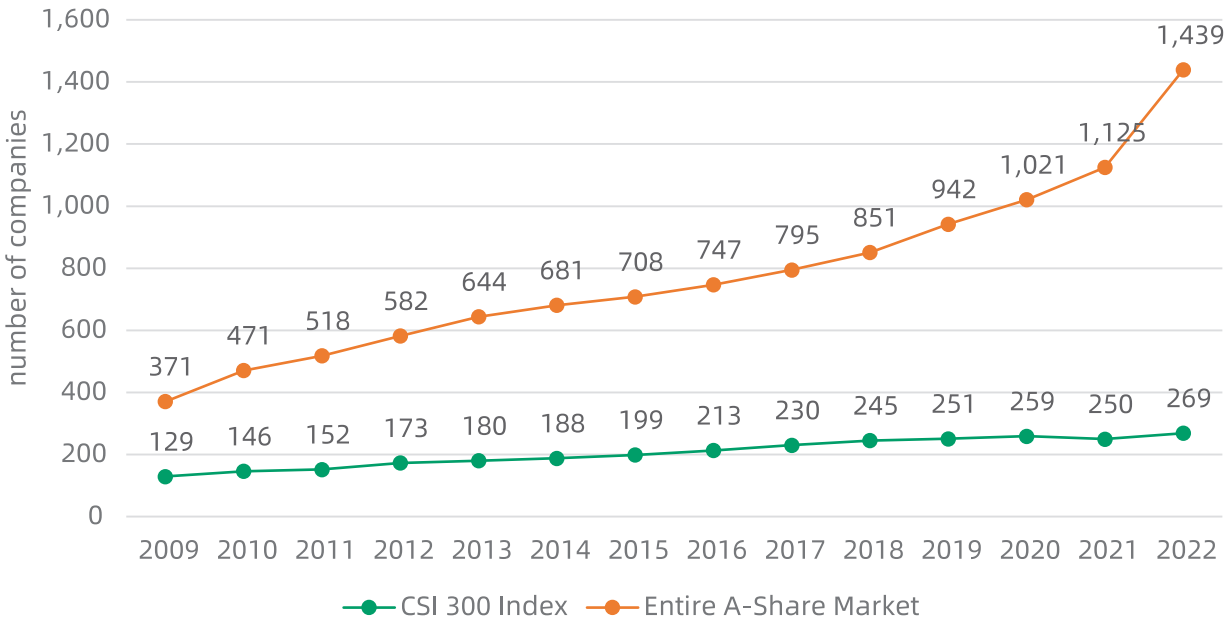



Source: 2022 China Sustainable Investment Review, UN PRI

### 3.1.2 A-Shares ESG Report Publication Status

In 2022, over 1,400 A-share listed companies published ESG reports, a significant increase year over year. The number of listed companies publishing ESG reports reached 1,439 in 2022, nearly fourfold of 2009' s 371. Among the constituents of the CSI 300 index in 2022, 269 companies published ESG reports, a 7.6% increase from 2021. The publication rates of ESG report for both entire A-share market and the CSI 300 Index have reached a historical high.

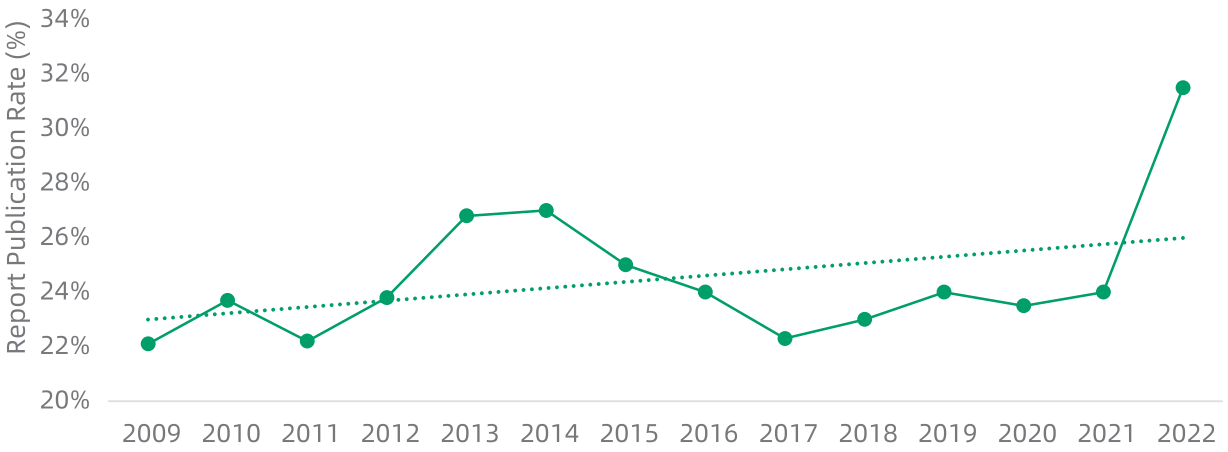
**Figure 2: Statistics on ESG Report Publication of A-Share Listed Companies (2009-2022)**




Source: SynTao Green Finance

In 2022, the proportion of A-share listed companies publishing ESG reports exceeded 30% for the first time. From 2009 to 2021, the proportion of listed companies publishing ESG reports had been fluctuating between 22% and 27%. In 2022, it leaped and broke through to 31.5%, up 6.2 percentage point year over year. Since 2021, the China Securities Regulatory Commission ( 'CSRC' ) has continuously released stringent signals to market on ESG information disclosure requirements. Into 2022, the trend of international information disclosure standards unification accelerated, domestic information disclosure policies transitioned from voluntary to semi-mandatory, plus the increased awareness of corporate ESG concepts, these multiple factors have contributed to the significant improvement in the ESG report publication rate in 2022.

**Figure 3: Statistics on ESG Report Publication Rate of A-share Listed Companies (2009-2022)**

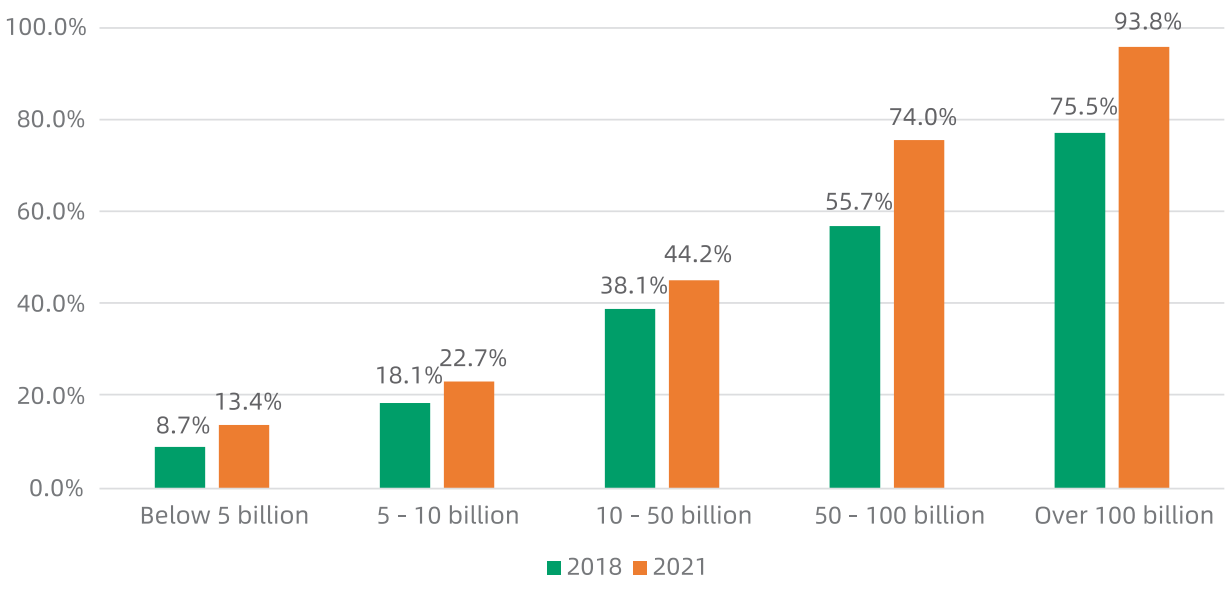



Source: SynTao Green Finance

The ESG-related report disclosure rate is highest among listed companies with a market capitalization over 100 billion yuan, exceeding 90% in 2021. The proportion of ESG-related report disclosures for listed companies with a market value of over 100 billion yuan was 93.8% in 2021, an increase of 24% compared to 2018, while the disclosure rates among listed companies with a market capitalization of 50-100 billion yuan, 10-50 billion yuan and less than 10 billion yuan were 74.0%, less than 50% and less than 25% respectively. Compared to Corporate Social Responsibility reports, independent ESG reports have stricter disclosure compliance and more diverse information requirements. Big-cap companies have relatively better maturity in non-financial segment development, and the information and non-financial performance available for disclosure is of higher quality, therefore big-cap companies have a stronger willingness and ability to disclose independent ESG reports.

Moreover, SOEs have a relatively larger proportion among the large enterprises with a market capitalization exceeding 100 billion yuan. In May 2022, the State-owned Assets Supervision and Administration Commission of the State Council encouraged state-owned enterprises to increase ESG information disclosure, aiming to achieve full scale of ESG disclosure among state-owned enterprises by 2023. Therefore, it is expected that the ESG disclosure number among large enterprises will further increase from 2022 to 2023.

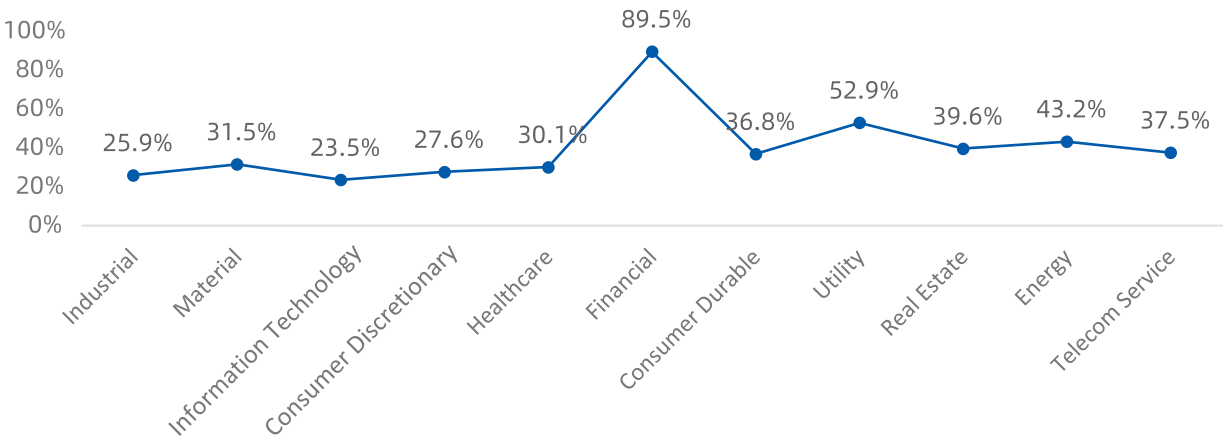
**Figure 4: ESG-related Report Disclosure Rate among Listed Companies with Different Market Capitalization (%)**




Source: China Bond Centre

There are significant differences in ESG information disclosure levels among industries, with the financial industry having the highest ESG-related report disclosure rate. The industrial sector has the highest absolute number of companies that disclose independent ESG reports, with a total of 326 companies, but the disclosure rate is only 25.9%. The financial industry has the highest information disclosure rate at 89.5%, mainly due to the continuous promotion of a green finance system through top-level design and the financial institution' s ESG pilot responsibilities under strengthened financial regulations.

Figure 5: ESG Report Disclosure Rate by Industry (%)

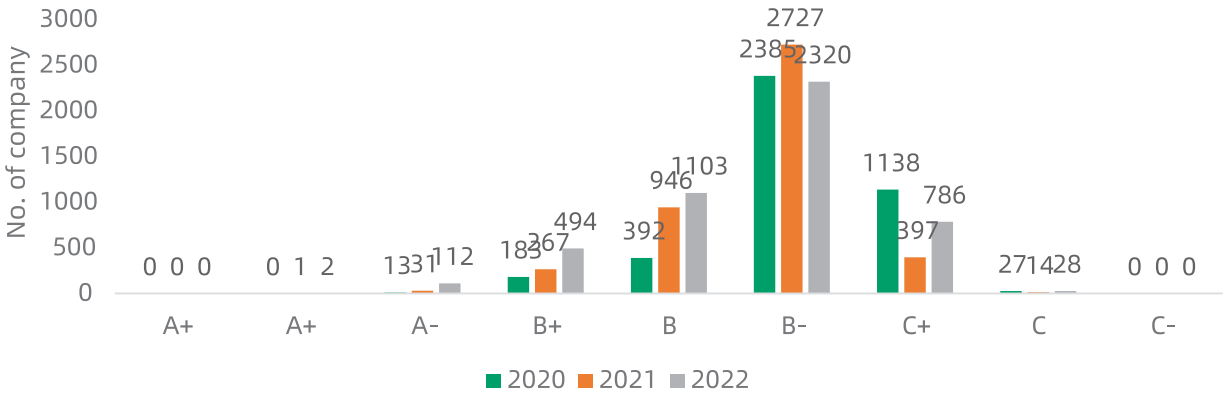



Source: iFinD

## 3.2 ESG Rating Status

In 2022, A-share companies' ESG rating upgrade from Grade C to Grade B has accelerated. According to ESG rating data of A-share listed companies by SynTao Green Finance, there were 4,845 A-share listed companies in 2022, of which 1,711 companies were rated Grade B or above, accounting for 35.31% of total, approximately 1.25 times of 2021. There were 3,134 listed companies rated below Grade B, accounting for 64.69% of total. The transition of A-share listed companies' ESG rating from Grade C to Grade B is accelerating, and ESG performance is also showing an accelerating improvement trend.

Figure 6: A-share ESG Rating Distribution Comparison (2020-2022)




Source: SynTao Green Finance

According to SynTao Green Finance' s comprehensive ESG evaluation framework, the classification and meaning of ESG ratings for individual company are shown in below table.

Table 1: SynTao Green Finance ESG Rating Result and Meaning

| Grade | Meaning |
|---|---|
| A+ | The company has excellent ESG integrated management capabilities, and there have been almost no negative ESG events or rarely minor negative events over the past three years |
| A | |
| A- | The company has relatively good ESG integrated management capabilities, and there have been a few minor negative ESG events over the past three years |
| B+ | |
| B+ | The company has average ESG integrated management capabilities, and there have been some moderate or a few serious negative ESG events over the past three years |
| B- | |
| C+ | |
| C | The company has weak ESG integrated management capabilities, and there have been many or quite serious negative ESG events over the past three years |
| C- | |
| D | The company recently experienced a significant negative ESG event, which has major negative impact on the company |

Source: SynTao Green Finance

## 3.3 Correlation between ESG and Share Price

There is a correlation between ESG scores and the listed companies' future profitability and cash flow. Companies with high ESG scores tend to have higher ROE and dividend yield in the future, with positive excess return and incentive effect. (In Table 2, EPS is selected as an indicator of the company's profitability level, revenue and net profit attributable to shareholders growth rates are selected as indicators of the company's growth level, and ROE is selected as an indicator of the company's long-term value.)

Table 2: ESG and Corporate Earnings Performance

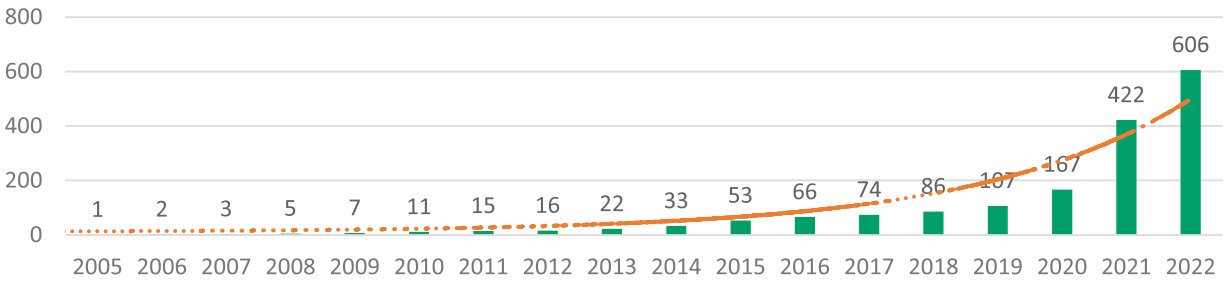
| Segment | ESG Report Disclosure? (Yes/No) | EPS (rmb) | Revenue yoy% | Net Profit Attr. To Shareholder yoy% | ROE (%) |
|---|---|---|---|---|---|
| Entire A-shares | No | 0.34 | 18.72 | 10.60 | 6.93 |
| | Yes | 0.49 | 19.27 | 17.44 | 8.53 |
| Entire A-shares (excluding Financials) | No | 0.51 | 19.06 | 14.33 | 8.84 |
| | Yes | 0.56 | 20.21 | 17.10 | 9.13 |

Source: Miotech, iFinD

## 3.4 ESG Funds Status

In 2022, the number of Chinese ESG public funds increased to 606, a year-over-year increase of 43.6%. The first Chinese ESG public fund was launched in 2005. By the end of 2014, there were only 33 ESG public funds. From 2014 to 2019, the issuance of ESG public funds accelerated, and the total number of funds exceeded 100 in 2019. In 2020, ESG public funds entered a three-year period of rapid development, with an annual increase of 60 funds in 2020. The number of ESG funds grew exponentially in 2021 and 2022, reaching 422 and 606 respectively, of which the ESG funds size increased by 100% year-over-year in 2021, exceeding 630 billion yuan. Despite the impact of market volatility, the number of ESG funds still grew rapidly in 2022, but the total ESG fund size has fallen to about 500 billion yuan.

**Figure 7: Number of ESG Funds**




Source: 2022 China Sustainable Investment Review

The market share of ESG funds in the fund market has significantly increased. As of September 30th, 2022, there is a total of 555 ESG equity funds and hybrid funds. According to the public funds market data of Asset Management Association of China, as of September 30th, 2022, there is a total of 6,404 equity and hybrid funds, and the market share of ESG public funds has increased from 5.9% in 2021 to 8.7% in 2022, approximately 1.47 times of 2021.

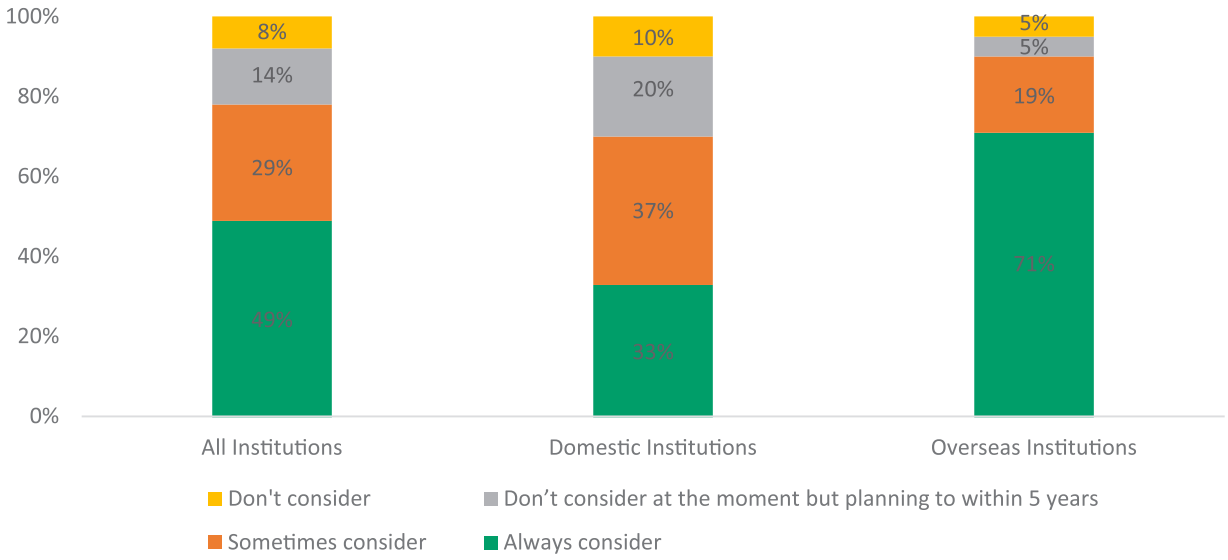
**Table 3: ESG Funds Number and Size**

| Fund Category | 2020 /9/30 | | 2021/9/30 | | 2022/9/30 | |
|---|---|---|---|---|---|---|
| | Number | Size (rmb bn) | Number | Size (rmb bn) | Number | Size (rmb bn) |
| ESG Equity | 61 | 67.9 | 156 | 223.9 | 224 | 203.7 |
| ESG Hybrid | 57 | 48.3 | 166 | 278.8 | 331 | 270.7 |
| Total ESG Funds | 118 | 116.2 | 322 | 502.7 | 555 | 474.4 |
| Total Equity and Hybrid Funds | 4,365 | 5,374.8 | 5,436 | 8,014.0 | 6,404 | 7,155.1 |
| Market share of ESG Equity and Hybrid Funds | 2.7% | 2.2% | 5.9% | 6.3% | 8.7% | 6.6% |

Source: 2022 China Sustainable Investment Review, Asset Management Association of China

Regarding funds selection, about 80% of the surveyed institutions, when selecting a fund manager, would consider the fund managers' ability on evaluating ESG performance of investment targets. According to ESG Survey Report for Asset Owners (2022), 90% of overseas surveyed institutions and 70% of domestic surveyed institutions consider the fund manager's ESG evaluation ability. Among them, 71% of overseas surveyed institutions would always consider this factor, which is 2.15 times of domestic institutions. Overseas institutions generally attach more importance to ESG than domestic institutions, which may be due to the earlier exposure of overseas institutions to ESG-related policy and practice. It is expected that more and more domestic fund investors will incorporate ESG factors into investment selection decisions in the future.

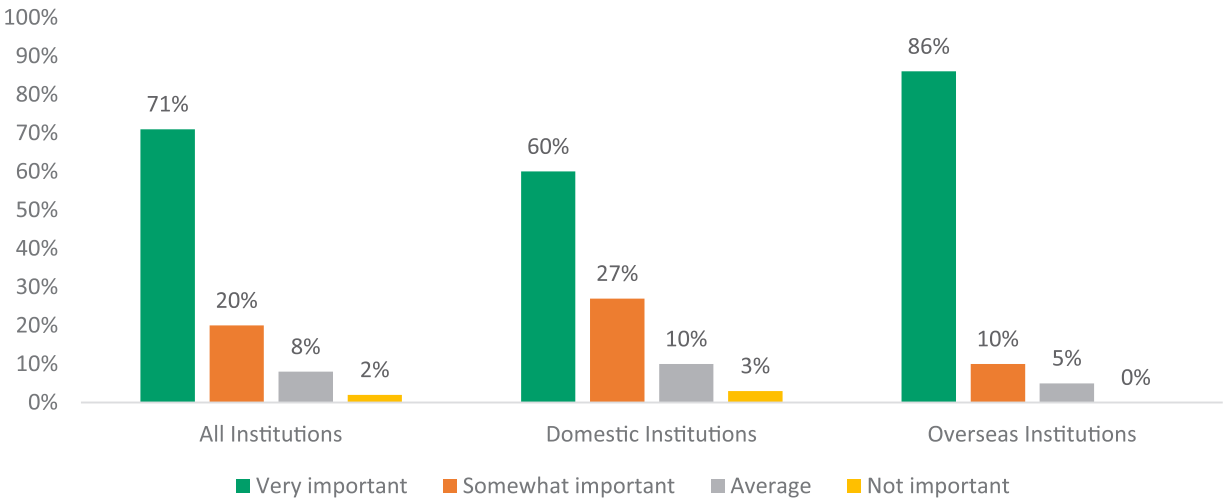
**Figure 8: Whether to Consider the Ability of Fund Managers to Evaluate the ESG Performance of Investment Targets when Selecting a Fund Manager**




Source: ESG Survey Report for Asset Owners (2022)

More than 90% of surveyed institutions recognize the importance of responsible investment in China. According to the data, 60% of domestic respondents and 86% of overseas respondents believe that responsible investment in China is very important, and 27% of domestic surveyed institutions and 10% of overseas surveyed institutions believe that responsible investment in China is somewhat important, totalling approximately 90% of surveyed institutions acknowledging the importance of responsible investment. Among them, overseas surveyed institutions attach more importance to the implementation and application of responsible investment in China.

Figure 9: Importance of Responsible Investment in China




Source: ESG Survey Report for Asset Owners (2022)

## 3.5 Review and Summary of China’ s ESG-related Policy History

### 3.5.1 Review of Mainland China's ESG-related Policies

In 2006, the government issued the "Guidelines for Social Responsibility of Listed Companies", encouraging listed companies to actively fulfil their social responsibilities and voluntarily disclose relevant information. In 2008, the Shanghai Stock Exchange issued the "Guidelines for Environmental Information Disclosure of Listed Companies on the Shanghai Stock Exchange", requiring listed companies to disclose environmental information. In 2018, the "Code of Corporate Governance for Listed Companies" established the basic framework for disclosure of environmental, social responsibility, and corporate governance information. In 2021, the "Guidelines for the Content and Format of Information Disclosure of Securities Issuing and Listing Companies No.2 - Annual Report Content and Format (Revised in 2021)" further completed the ESG information disclosure policy for listed companies, adding a section on environmental and social responsibility and requiring all listed companies to disclose environmental-related administrative penalties in their reports. In 2022, the "Guidelines for Investor Relations Management of Listed Companies" explicitly requires the addition of environmental, social, and governance (ESG) information in communication between listed companies and investors. In the “Action Plan to Achieve Carbon Peaking and Carbon Neutrality During the 14th Five-Year Plan of Shanghai Stock Exchange” released in 2022, it is pointed out that environmental information disclosure of listed companies should be strengthened, disclosure system should be further improved, disclosure content and regulatory requirements should be standardized, a comprehensive information disclosure framework should be established, and listed companies should be encouraged to disclose carbon reduction measures and their effectiveness, as well as social responsibility practices.

# 4 Methodology of Corporate Carbon Accounting

The "Paris Agreement" sets forth the "Three Principles" for carbon accounting among countries: Measurability, Reportability, and Verifiability. Measurability refers to the ability to measure both the methods used and the results obtained in carbon accounting. Reportability means being able to report in accordance with the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) or other agreed-upon standards. Verifiability entails being able to verify through mutually agreed-upon methods, including domestic and international verification.

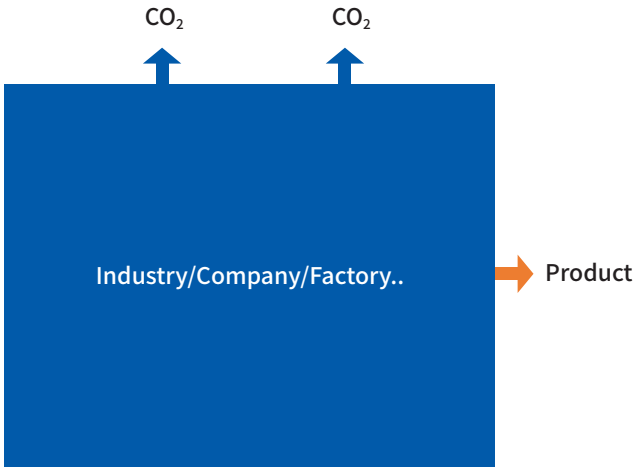
Under the Greenhouse Gas Protocol (GHGP), a collaborative effort between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), the "Corporate Standard for Accounting and Reporting of Greenhouse Gas Emissions (Revised Edition)" (hereinafter referred to as the "Corporate Standard") is one of the most influential standards. This standard defines the calculation of carbon emissions from an operational perspective and categorizes carbon emissions into three scopes. Scope 1 emissions refer to direct greenhouse gas emissions, such as emissions from fuel combustion and fugitive emissions from company-owned or controlled sources. Scope 2 emissions pertain to indirect greenhouse gas emissions associated with purchased electricity and heat and are calculated based on energy consumption and corresponding emission factors. Scope 3 emissions represent other indirect greenhouse gas emissions and are reported selectively, encompassing emissions across a company's entire value chain, including supply chain and industry-related emissions. The greenhouse gas accounting and reporting for Scope 3 emissions can be conducted in accordance with ISO14064-1 or the "Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011)."

## 4.1 Overall Approach to Corporate Carbon Accounting

The Intergovernmental Panel on Climate Change (IPCC), established to address climate change on a global level, initiated the development and refinement of data and calculation methods for greenhouse gas emissions since 1991 through its Working Group I. The IPCC encourages nations participating in its efforts to adopt these methods. In pursuit of the ultimate goal of addressing climate change as outlined by the United Nations Framework Convention on Climate Change (UNFCCC), the 12th session of the IPCC in 1996 approved a revised version of the "IPCC Guidelines for National Greenhouse Gas Inventories" (referred to as the "IPCC Guidelines").

The 1996 version of the IPCC Guidelines marked the official commencement of providing UNFCCC member

**Table 4-1-1:Carbon accounting for companies based on final products and services**



countries with methodologies for measuring greenhouse gas emissions and removals, marking a new era for carbon accounting. The initial release of the IPCC Guidelines occurred in 1996 and consisted of three documents, including the "Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories." The 2006 version of the IPCC Guidelines is the latest version, supplemented by the "2019 Refinement to the 2006 IPCC Guidelines" to provide updated guidance. Subsequently, various international climate change conferences and institutions began to introduce principles related to carbon accounting, forming the foundation for emission reduction efforts in different countries.

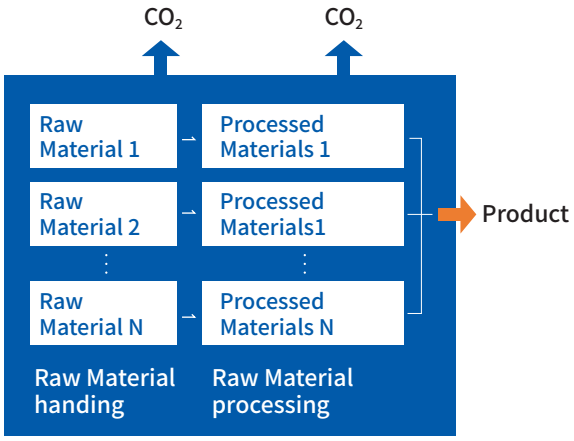
Based on the concept of enterprise carbon accounting centered around final product or service, the IPCC Guidelines offer fundamental methodologies for calculating greenhouse gas emissions based on national or regional contexts. The Guidelines recommend the comprehensive use of three methods (Method 1, Method 2, Method 3) to compute carbon emissions, with Method 1 employing a perspective centered around final product or service.

The approach based on final product or service entails calculating the carbon emission intensity by analyzing the outcomes of production and service processes. This method assumes that the intermediate carbon emissions during production and service processes are ultimately reflected in the final outcomes. Its core formula is as follows:

$$E = AD \times EF \quad (1)$$

In this formula, where E stands for calculated enterprise greenhouse gas emissions, measured in mass units (e.g., tons, kilograms); AD represents the activity data of the enterprise, indicating the final product output or service activity level, measured in corresponding units to the final product or service activity (e.g., t/MWh, kg/kWh); EF denotes the emission factor, determined based on the product type of the enterprise, signifying the carbon intensity of the industry or enterprise, expressed as greenhouse gas emissions per unit of product or service, with units such as $tCO_2e$/activity unit or $tCO_2e$/product unit. The cumulative carbon dioxide emissions from all sectors amount to the total carbon dioxide emissions of the enterprise.

**Table 4-1-2:Carbon accounting for companies based on production process and services.**




Based on the production and service process, the enterprise carbon quantification approach considers not only all types of fuels and enterprise sectors but also combustion technologies (such as stationary and mobile combustion sources). This approach provides a more detailed estimation of emission quantities but requires more data support. Such methods are commonly used for calculating carbon emissions within the framework of the IPCC guidelines and are primarily followed in China for carbon emission calculations. The formula is as follows:

$$E = \sum_{n=1}^{N} E_{reform}^{n} + \sum_{n=1}^{N} E_{fuel}^{n} - R_{d} \quad (2)$$

## In the equation:

- "En fuel( 公式中) " represents the greenhouse gas emissions associated with the treatment of the nth unit of raw material in the industry or other entities, often involving processes like desulfurization, carbonate displacement reactions, etc., measured in $tCO_2e$.

- "En fuel (公式中) " represents the greenhouse gas emissions associated with the combustion of the nth unit of raw material in the industry or other entities, measured in $tCO_2e$.

- "Rd" stands for the greenhouse gas emissions absorbed by the decarbonization process of the industry or other entities' production, measured in $tCO_2e$.

## 4.2 Carbon Accounting Standards for Different Industries

The construction of China's carbon accounting system is currently progressing in an orderly manner. According to the "National Plan on Climate Change" issued by the State Council, relevant departments in China began formulating national carbon emission statistical, monitoring, and assessment methods in 2007. Currently, a series of standards and guidelines for carbon emissions accounting have been developed in China. To clarify greenhouse gas accounting methods at the enterprise level across different industries, as shown in Table 4, the National Development and Reform Commission (NDRC) released, in three batches between 2013 and 2015, the "Guidelines for Corporate Greenhouse Gas Emissions Accounting and Reporting for 24 Industries" (referred to as the "24 Industries Guidelines"), all of which adhere to IPCC guidelines. In 2015, the National Standardization Management Committee issued the "General Principles for Greenhouse Gas Emissions Accounting and Reporting in Industrial Enterprises," as well as national standards for greenhouse gas emissions accounting and reporting requirements for key industries such as power generation, steel, civil aviation, and chemical industry. These standards were implemented starting from June 1, 2016, addressing the issue of inconsistent greenhouse gas accounting standards. With the formal launch of the carbon market in 2020, the accuracy and scientific nature of enterprise-level carbon emissions accounting methods have become especially important. From a regulatory perspective, accurate and scientific quantification of enterprise greenhouse gas emissions forms the basis for the efficient operation of the national carbon market and is a key element in implementing policies such as "carbon neutrality" and "carbon peak." From an enterprise perspective, corporate carbon accounting and emission disclosure serve as crucial channels for public oversight of companies' carbon reduction goals. Enterprises need to regularly calculate and truthfully disclose energy consumption and greenhouse gas emissions data, completing the entire chain of management from accounting, monitoring, reporting, verification to disclosure.

Table 4.24 industry accounting guidelines cover industry types

| The first batch of pilot industries | The second batch of pilot industries | The third batch of pilot industries |
|---|---|---|
| Power generation enterprises (has officially issued a document) | Oil and gas production enterprises | paper and paper products production enterprises |
| Power grid enterprises | petrochemical enterprises | Other non-ferrous metal smelting and rolling processing industrial enterprises |
| Steel production enterprise | independent coking enterprise | electronic equipment manufacturing enterprise |
| Chemical production enterprises | Coal production enterprises | machinery and equipment manufacturing enterprises |
| Electrolytic aluminum production enterprise | | mining enterprise |
| Magnesium smelting enterprise | | food, tobacco and wine, beverage and refined tea enterprises |
| Flat glass production enterprise | | public building operation enterprise |
| Cement production enterprises | | road transportation enterprises |
| Ceramic production enterprises | | fluorine chemical enterprises |
| Civil aviation enterprises | | Industrial enterprises in other industries |

Currently, China's "Guidelines for Corporate Greenhouse Gas Emissions Accounting and Reporting for 24 Industries" only cover greenhouse gas accounting standards for high-energy-consuming industrial enterprises. However, for the financial industry, which encompasses various high-emission industries across the investment value chain, there is also a need to establish unified enterprise-level carbon emission accounting standards. In November 2020, the Partnership for Carbon Accounting Financials (PCAF) introduced "The Global GHG Accounting and Reporting Standard for the Financial Industry," the world's first carbon emissions accounting document at the investment portfolio level for financial institutions.

This standard is based on the Corporate Value Chain (Scope 3) Accounting and Reporting Standard developed by the Greenhouse Gas Protocol, and its scope includes commercial banks, investment banks, development banks, asset management companies, and insurance companies. It covers six categories of financial assets, including stocks and bonds, commercial loans, equity in non-listed companies, project financing, commercial real estate, and mortgage and auto loans. PCAF requires financial institutions to disclose the absolute emissions of their loans or invested entities, and also allows for disclosure of avoided emissions and removal emissions, which must be disclosed separately.

# 5 Carbon Rating and Rating Methods

## 5.1 Scope of Carbon Rating

We conducted our research on the top 100 Chinese companies listed on the Hong Kong Stock Exchange, NASDAQ, and New York Stock Exchange. We analyzed publicly available reports including the annual financial reports, annual social responsibility / ESG reports, and sustainable development reports for the years 2020, 2021, and 2022. The carbon emission disclosure data was sourced from the Intelligent Carbon China database, which provides enterprise-level emission data. The database comprises three main data sources: voluntary environmental disclosure data from Chinese listed companies, national electricity emission data, and regional high-precision emission data from multiple satellite sources. By integrating and cross-validating data from voluntary disclosures and other sources, the accuracy and granularity of enterprise-level emission data are improved.

Within our rating scope, 83% of the companies are listed on the Hong Kong Stock Exchange, 9% on NASDAQ, and 15% on the New York Stock Exchange. The companies cover various industries including integrated enterprise(2 companies), automobile manufacturing industry(5 companies), consumer staples(5 companies), telecommunications (5 companies), energy and utilities (8 companies), real estate construction industry(9 companies), consumer discretionary industry (11 companies), healthcare industry(11 companies), information technology (12 companies), industrial manufacturing (13 companies), and banking industry(19 companies). As of August 1, 2023, 94% of the Chinese overseas-listed companies publicly disclosed their greenhouse gas emissions for the year 2020, 93% for the year 2021, and 93% for the year 2022.

**Table 5-1-1: The carbon Rating scoring system covers the type of industry and the number of companies**

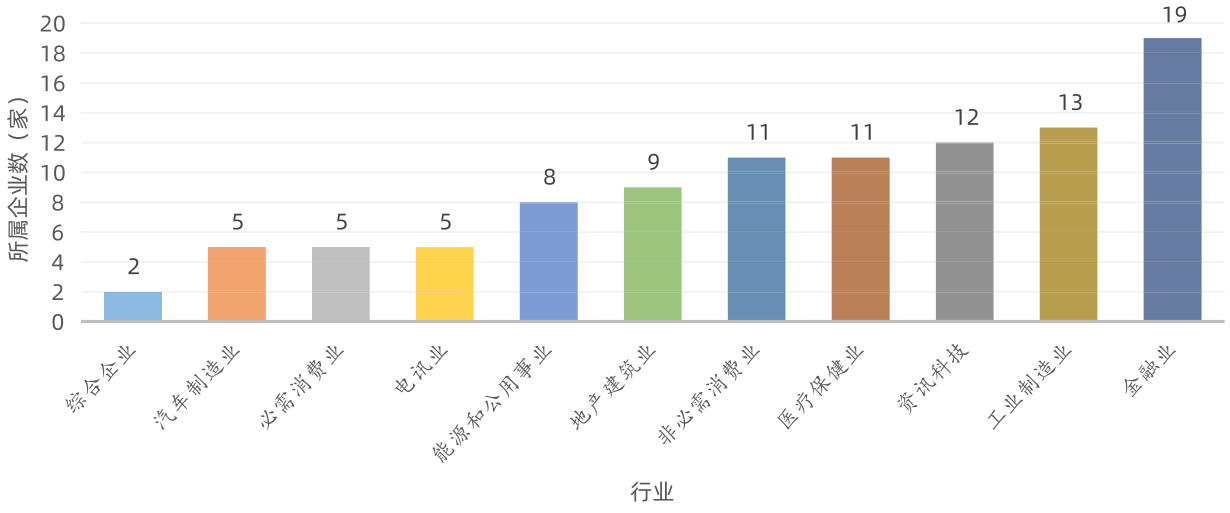
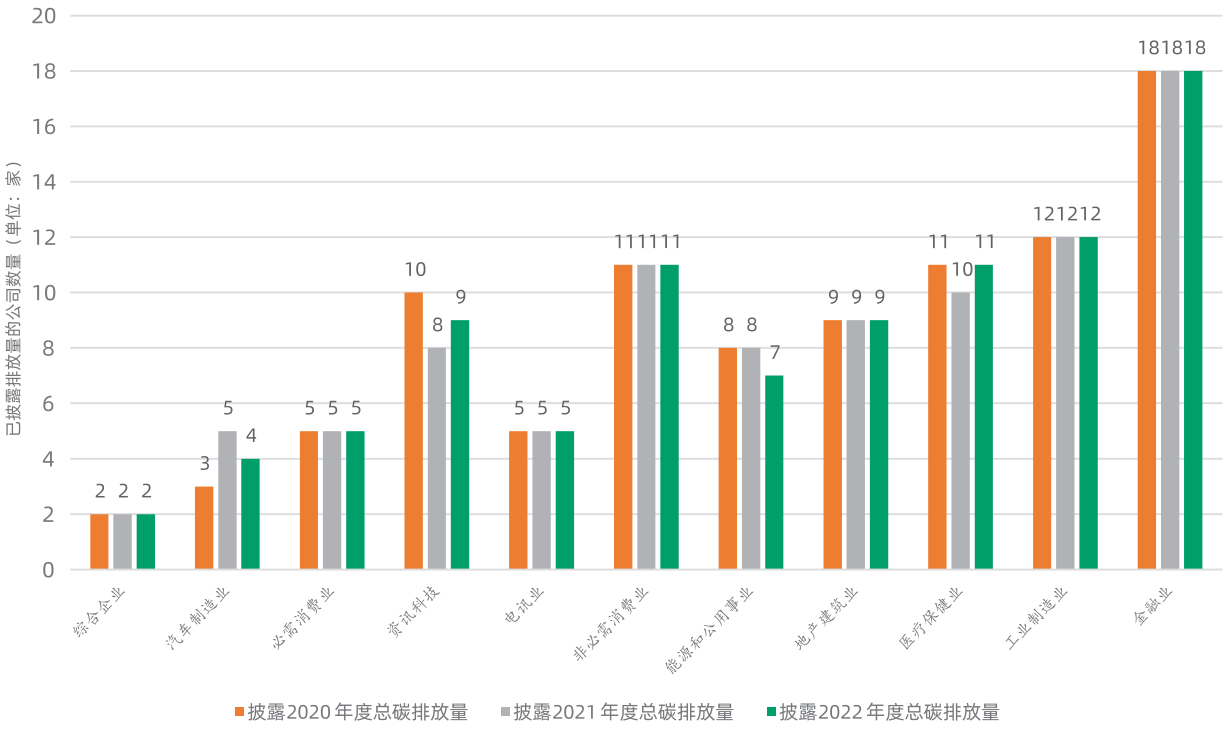
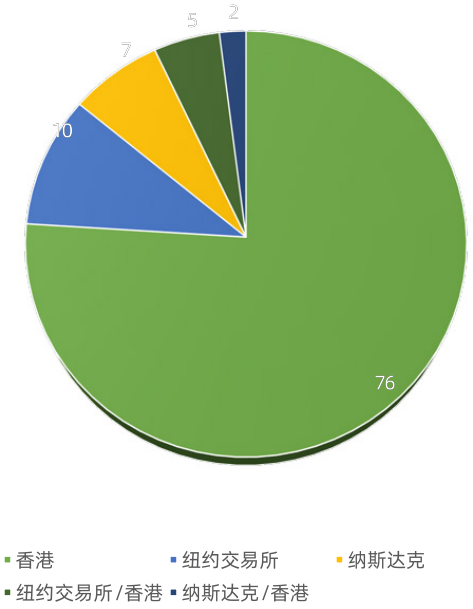


Table 5-1-2: Number of companies by industry that have disclosed their greenhouse gas emissions for 2020-2022




Picture 5-1-3: Carbon rating scoring system Covering the distribution of listed companies




Picture 5-1-4: Carbon Rating scoring system Covering the company's secondary industry distribution (Unit: home)

## 5.2 Selection and Explanation of Assessment Variables

The company's carbon rating considers four dimensions as primary indicators for scoring: actual carbon emissions, actual carbon reduction, carbon emission disclosure quality, and company emission reduction plans. These dimensions are examined to assess the company's carbon disclosure:

1. **Actual Carbon Emissions:** This evaluates whether the company discloses its annual total carbon emissions to the public or stakeholders through official channels such as annual reports, social responsibility reports, ESG reports, and sustainable development reports. The actual quantified value of carbon emissions is assessed. Based on the company's self-disclosed annual greenhouse gas emissions and its operating revenue, the average emission intensity ($tCO_2e$/ RMB 10,000) is compared within the industry for the years 2020 to 2022. The report calculates the company's annual total carbon emissions based on the self-disclosed Scope 1 and Scope 2 emissions. Due to the lack of mandatory disclosure of Scope 3 emissions for companies listed on the U.S. stock exchanges and Hong Kong Stock Exchange, and variations in calculation methods and boundaries for Scope 3 emissions, these emissions are not currently included.

2. **Carbon Emission Intensity:** The carbon emission intensity is calculated by assessing the proportion of the company's carbon emissions to its main operating revenue ($tCO_2e$/ RMB 10,000). If the company reports its emissions in currencies other than RMB (such as USD, HKD, AUD, or TWD), it needs to be converted to RMB using the exchange rate provided in the company's financial report. If the company's emission data only covers the company's headquarters or subsidiaries, the emission intensity will be calculated for those specific entities.

### *Example: Using China Construction Bank as an analytical case to explain the calculation method*

China Construction Bank Corporation ("Construction Bank") disclosed its greenhouse gas emissions in its social responsibility reports for the years 2020, 2021, and 2022. The scope of environmental performance data was adjusted over these years. In 2020, the reporting scope included the head office, offices of 10 city branches, and offices of 27 provincial branches. The scope expanded in subsequent years. The greenhouse gas emissions for 2020-2022 were recalculated based on the updated scope. The average emission intensity for Construction Bank over these three years was calculated as 0.0209 tons of $CO_2e$ per RMB 10,000 of revenue. This indicates that the company emits an average of 0.0209 tons of greenhouse gases to generate RMB 10,000 in revenue.

Table 5: China Construction Bank disclosed greenhouse gas emission data

| Greenhouse gas emissions | 2022 | 2021 | 2020 |
|---|---|---|---|
| Greenhouse gas emissions (ranges 1 and 2) (tons) | 1682812.2 | 1,643,454.48 | 1,481,223.32 |
| Direct discharge (Range 1) (tons) | 69497.11 | 127378.31 | 88906.10 |
| Indirect emissions (Range 2) (tons) | 1,613,315.09 | 1,516,076.17 | 1,392,317.22 |
| Operating income (RMB million) | 822473 | 764706 | 714224 |
| Calculation: Annual emission intensity (tons/RMB million) | 0.0205 | 0.0215 | 0.0207 |
| Calculation: Average emission intensity (tons/RMB 10,000) | 0.0209 | | |

(2) The actual emission reduction effect of the company: evaluate whether the measures taken by the company to reduce carbon emissions and save energy will achieve certain emission reduction effect in 2020-2022.
According to the total annual carbon emission and annual operating income of the company from 2020 to 2022 independently disclosed by the company, the company's carbon emission is stronger in the same industry
Degree change rate. The value of the change rate of carbon emission intensity is equal to the carbon emission intensity of 2022 / carbon emission intensity of 2020 (if the listed company does not disclose 2022
Annual emissions data, then the value is equal to 2021 carbon intensity /2020 carbon intensity).

## * Example: Take China Construction Bank as an analysis case to introduce the index calculation method

The change rate of carbon emission intensity of China Construction Bank is

**Annual emissions data 2022 / Carbon intensity 2020**

Therefore, CCB's carbon emission intensity decreased by 1.34% (=1-98.66%) in four years.

(3) Company Carbon Emission Disclosure Quality: This dimension evaluates the quality of the company's carbon emission information disclosed to the public or stakeholders. The assessment considers the comprehensiveness, comparability, accuracy, and temporal stability of the data. The report assesses the quality of disclosed data related to emissions, energy use, carbon audits, and other relevant data (specific indicators are listed in Table 6). The evaluation examines whether each listed company has a clear scope of data disclosure and a transparent methodology. The assessment of disclosure quality is based on the most recent annual social responsibility report, sustainable development report, or ESG report published by each company before August 1, 2023.

When designing evaluation indicators for assessing the quality of carbon emission disclosure, the report considers the following aspects:

1. Data Comparability and Standardization: Companies should adopt standardized indicators, with reference to IPCC or other internationally recognized carbon accounting methodologies, to disclose emissions data for Scope 1, Scope 2, Scope 3 emissions, or total greenhouse gas emissions.

2. Clear Disclosure Scope and Transparent Methodology: All emission indicators in the disclosure framework should be utilized, and the calculation methodology must align with existing carbon auditing methodologies. Data authenticity should be verified through audit and certification by third-party organizations.

3. Temporal Stability of Data: Establishing a continuous time series of carbon emission data using consistent scopes and methodologies allows investors to compare the company's historical emission data.

**Table 6: Information collected on the quality of corporate carbon emission disclosure**

| Disclosure type | Specific disclosure information | Evaluation dimension |
|---|---|---|
| Emission data disclosure | Whether to disclose Scope I and Scope II carbon emissions | Data comparability and standardization |
| | Whether to disclose Scope 3 emissions | |
| | Whether to disclose the amount of renewable energy purchased/the proportion of renewable energy | |
| | Whether to disclose the company's total greenhouse gas emissions | |
| | Whether carbon emissions reporting covers the entire company or major business organization | |
| | Whether to disclose annual emission reductions[5] | Time stability of data |
| Indirect energy use Disclosure (Scope 2 emissions calculation | Whether to disclose the company's purchase of electricity | Data comparability and standardization |
| | Whether to disclose the company's purchasing power | |
| Direct energy Use Disclosure (Scope 1 emission calculation) | Whether to disclose the company's gas usage | Data comparability and standardization |
| | Whether to disclose the company's coal use | |
| | Whether to disclose the company's gasoline usage | |
| | Whether to disclose the company's diesel usage | |

(5) The disclosure of annual emission reduction means that if the enterprise directly discloses the annual emission reduction and the total emission data of the year in this annual report, or the enterprise simultaneously discloses the historical emission data and the total emission data of the year and can compare the data, that is, the disclosure of the annual emission reduction of the enterprise is considered.

| | | |
|---|---|---|
| Carbon audit data and methodology accuracy | Whether to disclose the scope of carbon accounting, description of methods and description of carbon emission factors | Clear scope of disclosure and transparent methodology |
| | Whether to disclose the data audit report | |
| Industry-related emissions data | Financial industry: whether to disclose the emission reduction of green finance such as carbon emission reduction loans | Data comparability and standardization |
| | Information Technology, finance: whether to disclose corporate data center emissions | |

## * Take Tencent Holdings as an analysis case to introduce indicators:

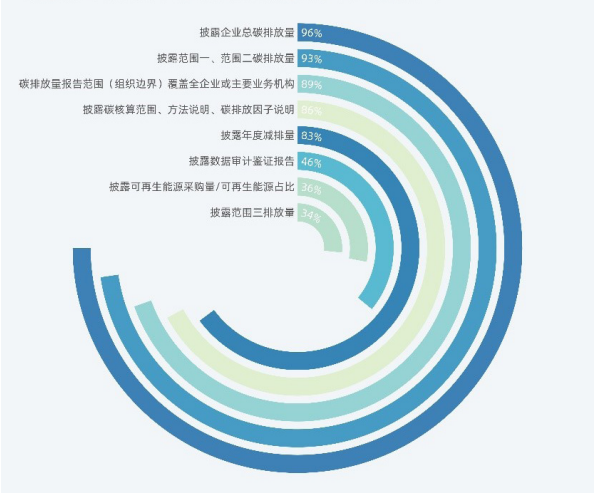
Tencent disclosed the company's environmental performance in the 2022 ESG report, among which the carbon emission-related information is shown in the following table:

**Table 7: Tencent's carbon emission disclosure information for 2021**

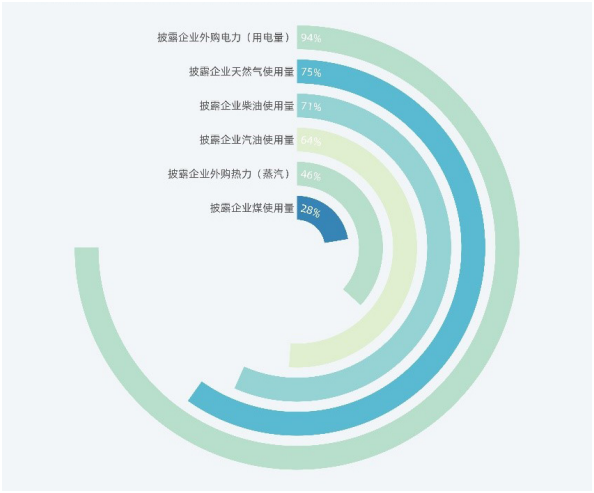
| Specific disclosure information | content |
|---|---|
| Whether to disclose Scope I and Scope II carbon emissions(million metric tons of carbon dioxide) | Range 1 emissions: 0.17, Range 2 emissions: 2.65 |
| Whether to disclose Scope 3 emissions (million metric tons of carbon dioxide) | Range 3 Emissions: 2.918 |
| Whether to disclose renewable energy purchases Renewable energy share (MWH) | Renewable energy purchased: 336,419.5 MWH; |
| Spontaneous renewable energy: 21,870 MWH | 温室气体排放总量（范围一、二、三）： 5.74 |
| Whether to disclose the company's total greenhouse gas emissions (million metric tons of carbon dioxide) | Total greenhouse gas emissions (Scope I, II and III) : 5.74 |
| Whether carbon emissions reporting covers the entire company or major business organization | Yes, in 2021, the Company expanded its reporting of environmental performance to cover all office buildings and data centers in Mainland China and Hong Kong under the company's operational control, excluding leased data centers without operational control. |
| Whether to disclose annual emission reductions | Yes, the 2021 report scope is the same as 2022 and can be compared. |
| Whether to disclose the company's purchase of electricity | Indirect energy consumption (purchased electricity) :4,638,840.1 MWH |
| Whether to disclose the company's purchasing power | No relevant data |
| Whether to disclose the company's gas usage | 1,867,442.0 cubic meters |
| Whether to disclose the company's coal use | No relevant data |
| Whether to disclose the company's gasoline usage | 44,623.7 L |

| | |
|---|---|
| Whether to disclose the company's diesel usage | 1,458,596.4 L |
| Whether to disclose the scope of carbon accounting, description of methods and carbon emission factors | Accounting scope: covers all office buildings and data centers in Mainland China and Hong Kong within the scope of the company's operational control, and leased data centers without operational control are excluded from the scope of the report; Description of methods and emission factors: Starting from 2022, the company will comply with the "Greenhouse Gas Accounting System Enterprise Accounting and Reporting Standards" and the SBTi "Information and Communication Technology Industry Scientific Carbon Purpose. The Standard Setting Guidelines and the ISO 14064-1:2018 Greenhouse Gas Inventory Standard calculate greenhouse gas emissions. |
| Whether to disclose the data audit report | Entrust third-party agency SGS to conduct carbon emission data verification audit |

**Picture5-2-1：Average emission data disclosure rate of 100 listed**




**Picture5-2-2：The average disclosure rate of energy data of 100 listed companies**




(4) Company Emission Reduction Plan Quality: From a quantitative analysis perspective, the report evaluates whether companies have established future emission reduction goals and announced detailed carbon neutrality, peak carbon emissions, or reduction plans (including future emission reduction amounts and coverage periods). Additionally, from a qualitative analysis perspective, it examines whether companies disclose specific technologies for future emission reduction (such as carbon reduction project investments, purchase of emission reduction equipment, development of low-carbon technologies, etc.).

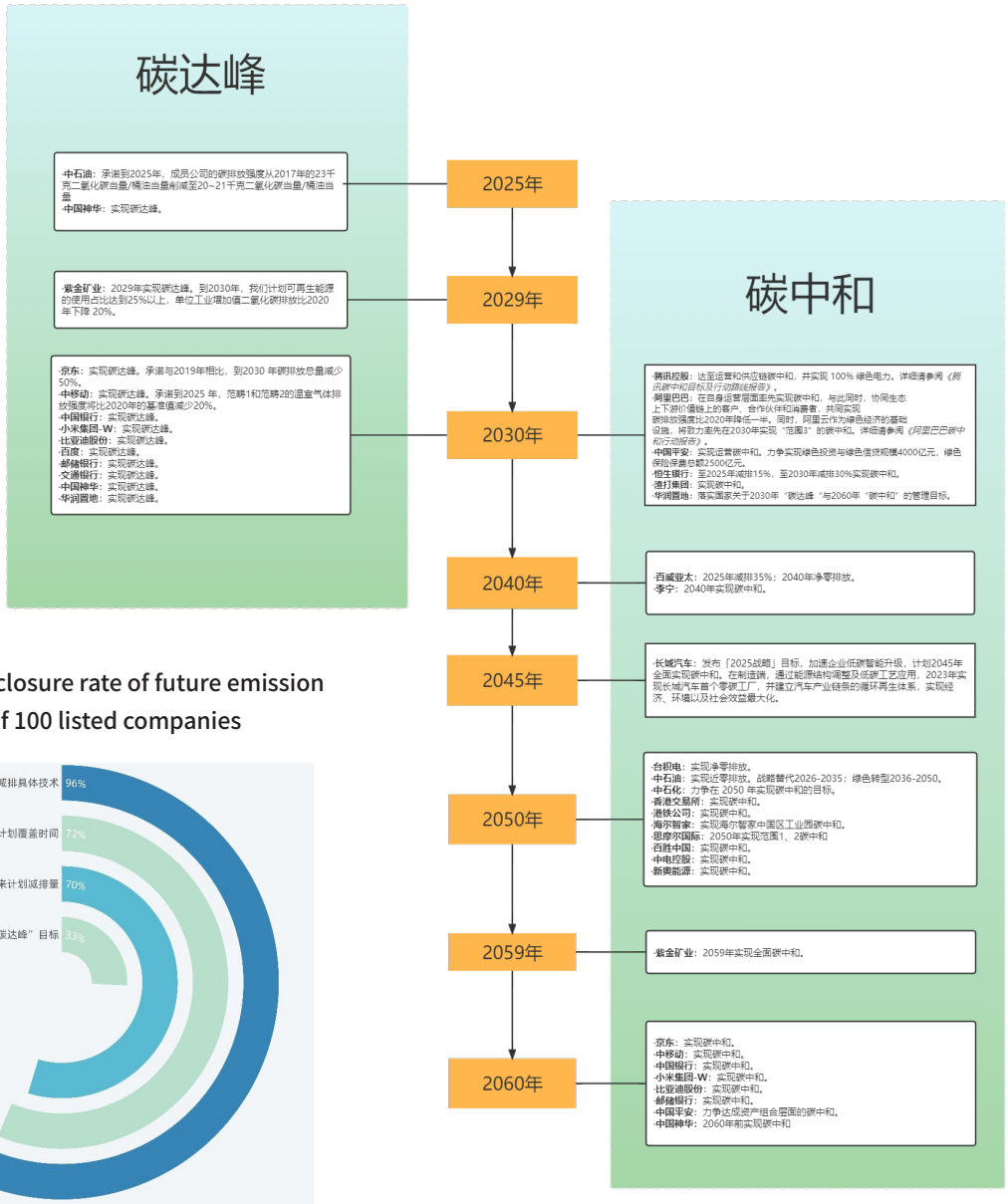
## * Using Tencent Holdings as an Analytical Case Study:

1) Carbon Neutrality and Peak Carbon Emission Goals (Coverage Period): In its 2021 ESG report, Tencent announced that it designates the year 2021 as the base year for establishing its carbon neutrality and decarbonization roadmap, committing to achieve comprehensive carbon neutrality for its operations and supply chain (covering Scope 1, Scope 2, and Scope 3 emissions) no later than 2030. Details of the carbon neutrality roadmap can be found in the "Tencent Carbon Neutrality Goals and Action Roadmap Report."

2) Future Emission Reduction Amount (Quantitative Target): Tencent provides forecasts for its annual greenhouse gas emissions (in metric tons of $CO_2e$) from 2021 to 2030 under its carbon neutrality roadmap, committing to achieve 100% use of renewable energy no later than 2030.

3) Specific Future Emission Reduction Technologies: Tencent regularly assesses the energy consumption levels of its office buildings through energy-saving renovations and conducts online emission monitoring for the Shenzhen Bin Hai Building and its Beijing headquarters. The headquarters building incorporates energy-saving and consumption reduction designs, including smart lighting systems and building automation systems. Tencent is also building green data centers, actively exploring transactions in the green electricity market, and initiated the development of distributed new energy projects for data centers in 2020. The company plans to introduce energy storage stations on its campuses in the future.

**Picture5-2-3：100 listed companies disclosed the "carbon peak, carbon neutral" target path**




**Picture 5-2-4：Disclosure rate of future emission reduction plans of 100 listed companies**

Table 8: Carbon rating system score quantification index description

| Primary index | Two-level index | Three-level index | Scoring method |
|---|---|---|---|
| Emission | E1 Actual carbon emission intensity of the company | E1.1<br>The company's average carbon emissions in 2020, 2021 and 2022 intensity<br>(Unit: $tCO_2$ / RMB 10,000) | Industry median scoring method; If no release data is disclosed within three years, no points are awarded. |
| Mitigation | M1 Actual emission reduction effect | M1.1<br>2020-2022: Change rate of the company's carbon emission intensity | Industry median scoring method; If the platoon is not disclosed in three years No points will be awarded if data is included or no comparable historical emissions data is available. |
| Quality | Q1 Quality of emission data disclosure | Q1.1 Whether to disclose Scope I and Scope II carbon emissions | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | | Q1.2 Whether to disclose the scope of three carbon emissions | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | | Q1.3 Whether to disclose the amount of renewable energy purchased/the proportion of renewable energy | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | | Q1.4 Whether to disclose total carbon emissions | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | | Q1.5Whether carbon emissions reporting covers the entire company or major business organization | If it covers the whole company or major business organizations, 50 points will be awarded;<br>If not covered, no points are scored. |
| | Q2 Indirect energy use Disclosure (Scope 2 emissions calculation) | Q2.1Whether to disclose the company's purchase of electricity (range of two-row discharge calculation) | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | | Q2.2 Whether to disclose the company's purchased heat (range of second discharge calculation) | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | Q3 Direct energy use exposure (range-emissions calculation) | Q3.1 Whether to disclose the company's direct energy usage (natural gas, coal, gasoline, diesel, etc.) | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | Q4 Carbon audit data and methodological disclosure quality | Q4.1 Whether to disclose the scope of carbon accounting, description of methods and description of carbon emission factors | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |
| | | Q4.2 Whether to disclose the data audit report | If this indicator is disclosed, 50 points will be awarded;<br>If not disclosed, no points will be awarded. |

(6)Since different industries require different types of direct energy, listed companies are considered to have disclosed direct energy usage as long as they disclose any natural gas, coal, gasoline, diesel or other direct energy sources.

| | | | |
|---|---|---|---|
| Goal | G1 Quantitative disclosure of quality of future emission reduction plans | G1.1 Whether to disclose the "carbon neutral, carbon peak" target(" Carbon neutral "time point," carbon peak "time point) Or future emissions reduction plan coverage time | If this indicator is disclosed, 50 points will be awarded; If not disclosed, no points will be awarded. |
| | | G1.2 Whether to disclose future planned emission reductions | If this indicator is disclosed, 50 points will be awarded; If not disclosed, no points will be awarded. |
| | G2 Qualitative disclosure quality of future emission reduction plans | G2.1 Whether to disclose specific technologies for future emission reductions (carbon reduction Investment in emission projects, purchase of carbon emission reduction equipment, | If this indicator is disclosed, 50 points will be awarded; If not disclosed, no points will be awarded |

## 5.3 Scoring Method for Carbon Rating

As shown in Table 8, the scoring system for the evaluation consists of the following dimensions: actual carbon emissions of the company and the effectiveness of the company's emission reduction efforts. The scoring within each industry category employs the industry median scoring method, where companies' average carbon intensity and carbon intensity change rate are scored. The benchmark value for the industry's median carbon intensity and carbon intensity change rate is set as 100 points.

Additionally, the scoring system incorporates an analysis of the carbon emission disclosure quality in the company's social responsibility ESG reports and the evaluation of the company's emission reduction plans. The assessment of data disclosure quality contributes a maximum of 500 points (with each tertiary indicator corresponding to 50 points), while the assessment of the company's future emission reduction plans contributes a maximum of 150 points (with each tertiary indicator corresponding to 50 points).

### In the scoring system outlined in the report, the various scoring indicators correspond to collected data points that can be categorized into two types.

First, there are numeric value data points, such as annual carbon emissions, annual carbon intensity, actual emission reduction by the company, etc.

Second, there are Boolean data points, where the values are either True or False. Examples include "Disclosure of Scope 1 and Scope 2 carbon emissions," "Disclosure of total carbon emissions," etc.

Consequently, the scoring system employs different methods for scoring based on the data type.

### (1)Boolean data

For Boolean data points (values are "Yes" or "No"), we convert them into scores based on the corresponding third-

level indicator's score. Let's take the example of the indicator "Disclosure of Scope 1 and Scope 2 carbon emissions." The maximum score for this third-level indicator is 50 points. If a company discloses Scope 1 and Scope 2 carbon emissions for the years 2020 to 2022, they would receive the full 50 points. If not, they would receive 0 points. This method is used for scoring all three-level indicators under both the data disclosure quality and future emission reduction plan evaluation dimensions.

## (2)Numeric data

For numeric data points, when all companies within an industry group report quantified data, the industry median score method is applied to assign scores. This means that the score setting is based on a company's relative rating within its industry. The industry median score method uses the industry's median value for the quantified indicator as a benchmark to convert the reported values into scores. The score corresponding to the industry median is set as 100 points. In our scoring system, both company carbon emission intensity and carbon emission intensity change rate fall into this category of numeric data points.

Industry Weighting Score Method: Due to the fact that certain high-carbon industries (such as Energy and Utilities, Industrial Manufacturing, etc.) have significantly higher median carbon emission intensities compared to other industries, in order to ensure fair industry comparisons and ratings, we design industry scaling factors based on the median carbon emission intensities of all companies within each industry. These scaling factors are designed to create a more balanced comparison among industries.

Specifically, we calculate industry scaling factors in a way that the median carbon emission intensity of a high-carbon industry A, represented by 100 times the scaling factor of industry A, is expected to be lower than the median carbon emission intensity of a low-carbon industry B, represented by 100 times the scaling factor of industry B. We assign a scaling factor of 1 to the average of the median carbon emission intensity values across all industries. The cumulative distribution function is utilized to compute the scaling factors for each industry. The calculation of these factors is illustrated in the table below:

**Table 9: Scaling Factors by Industry**

| Industry | Median carbon intensity ($tCO_2e$/ RMB 10,000) | z-score under standard normal distribution | Industry scaling factor |
|---|---|---|---|
| Consumer staples | 0.1584 | -0.2982 | 1.2345 |
| Real Estate & Construction | 0.0399 | -0.8203 | 1.5880 |
| Telecommunications | 0.3430 | 0.5143 | 0.6070 |
| Consumer discretionary | 0.0297 | -0.8651 | 1.6130 |
| Industrial manufacturing | 0.5151 | 1.2719 | 0.2034 |
| Finance | 0.0076 | -0.9625 | 1.6642 |
| Energy & Public Utilities | 0.5598 | 1.4688 | 0.1419 |
| Automobile Manufacturing | 0.0980 | -0.5645 | 1.4276 |
| Healthcare | 0.1345 | -0.4035 | 1.3134 |
| Information technology | 0.0311 | -0.8590 | 1.6097 |
| Conglomerate | 0.5710 | 1.5181 | 0.1290 |
| Mean of the median carbon intensity of all industries | 0.2345 | | |

In addition, before measuring different data, it is necessary to define its polarity, namely, to define whether the data with a higher value will cause a proportional increase or decrease in the final score. A higher value of emission reduction is a positive contribution, for example, while a higher value of total emissions produces more negative environmental impacts. As a result, the report also takes into consideration the polarity of each indicator (i.e. judging whether a higher value represents a “better” or “worse” environmental influence) and converts the numeric data into scores. The formulas are:

Company A^' s actual carbon emission dimension score

$$= \text{Industry scaling factor} \times 100 \times \frac{\text{Median carbon emission intensity of all companies in the industry}}{\text{Average carbon emission intensity of company A}}$$

Company A’ s actual emission reduction effectiveness dimension score

$$= 100 \times \frac{\text{Median rate of change in carbon emissions intensity for all companies in the industry concerned}}{\text{Rate of change in average carbon intensity of Company A}}$$

Since some companies have never disclosed the carbon emission data in the social responsibility ESG report from 2020-2022, the company has not disclosed the floating point data corresponding to the third-level indicator, and the corresponding score of the indicator is 0.
Since some companies have never disclosed their social responsibility ESG reports in 2020-2022 and have not disclosed carbon emissions data, the companies have not disclosed the floating-point data corresponding to the tertiary indicator, and the corresponding score for this indicator is zero.

# 6 Analysis of results

## 6.1. Industry Carbon Rating Analysis

By comparing and analyzing the four dimensions of a companies' actual carbon emissions, actual emission reduction effect, carbon information disclosure quality, and future emission reduction plans, we arrive at the results of the total carbon score ranking of China's top 100 listed companies by market capitalization (see Appendix 1). Figure 6-1-1 compares the average scores of each primary indicator for 11 industries, with the Real Estate & Construction, Non-essential Consumption and Finance industries having the highest average total carbon rating scores.

Figure 6-1-2 analyzes the industry distribution of companies' carbon scores, with 44% of companies in the Real Estate & Construction industry scoring higher than 820 (i.e., scoring in the top 25% of all listed companies), and 38% of companies in the information technology industry scoring higher than 820 (i.e., scoring in the top 25% of all listed companies). In addition, some companies in the Finance and IT sectors did not disclose their 2020-2022 ESG reports and carbon emissions information, resulting in a total score of 0 for these companies.

Figures 6-1-3 and 6-1-4 compare the median carbon intensity and annual carbon emissions by industry. The three industries with the highest carbon intensity are Energy & Public Utilities, Industrial Manufacturing, and Telecommunications, and the three industries with the highest average emissions are Energy & Public Utilities, Conglomerates, and Industrial Manufacturing. Among them, Telecommunications (Carbon Disclosure Quality Score: 390), Industrial Manufacturing (Carbon Disclosure Quality Score: 383), and Energy & Public Utilities (Carbon Disclosure Quality Score: 369), as high-emission industries, are also industries with high scores on the disclosure quality dimension. The quality of a company's emissions disclosure is somewhat related to the type of industry it belongs to. Currently, China's heavy chemical industry includes six major high-emission and high-energy-consumption industries such as ferrous metal smelting, iron and steel, and non-ferrous metal,, construction materials, cement, and petrochemicals, and our scoring system likewise covers companies in high-carbon-emission industries, including telecommunication, energy and utilities (coal, gas, oil and gas producers, and electricity suppliers), and industrial manufacturing. Due to the characteristics of the production activities of the industries they belong to, such listed companies have high energy consumption, heavy pollution, high carbon emission intensity, and more room for emission reduction. On the one hand, there is a high market demand for the products of these companies, and on the other hand, such companies are faced with the arduous task of promoting low-carbon transformation. Therefore, the higher the carbon emission intensity of a company, the higher the demand from investors for the quality and level of carbon disclosure of such companies, urging high carbon emission and high energy consumption companies to make higher quality disclosure of their emissions, with a view to improving the image of the company and avoiding negative market reactions. As a result, the quality of carbon disclosure by such companies is relatively high.

Figure 6-1-1 Carbon Score Performance by Sector

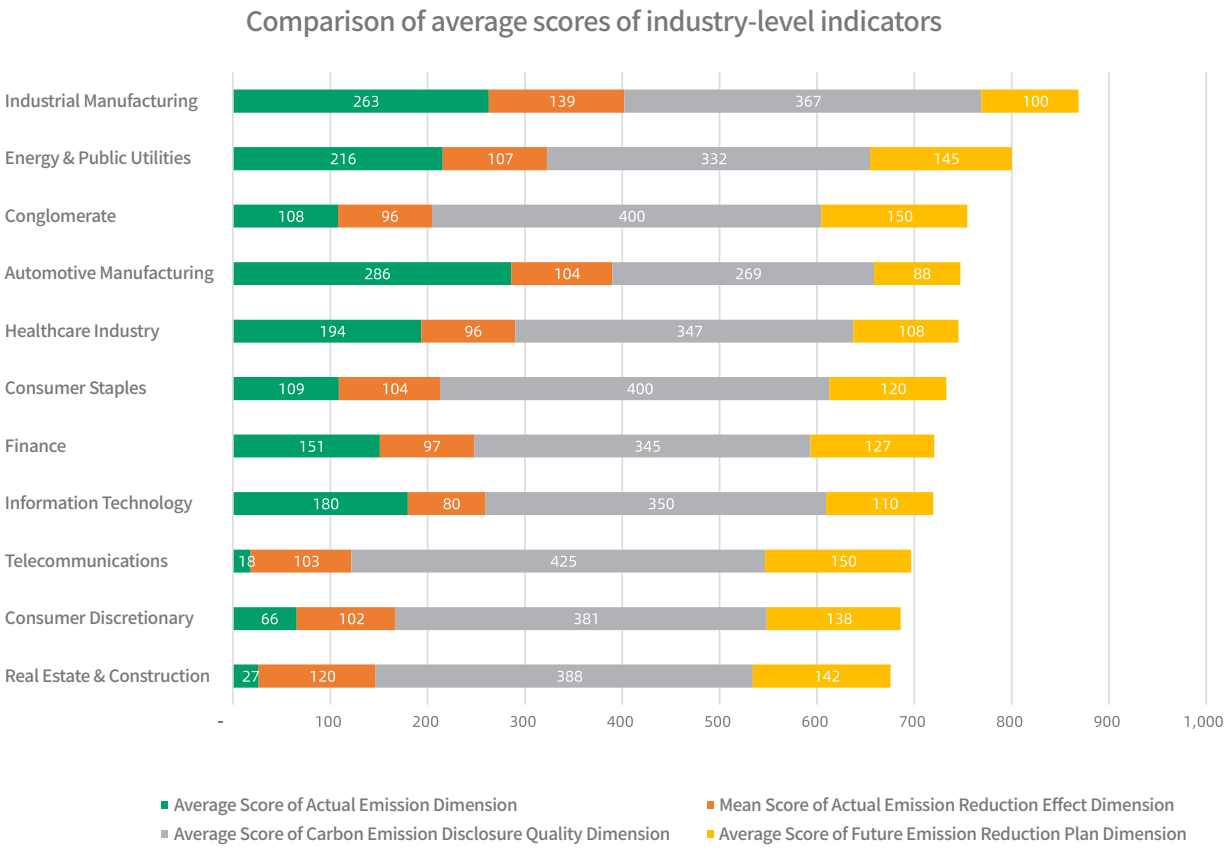



Figure 6-1-2 Distribution of Carbon Scores by Industry

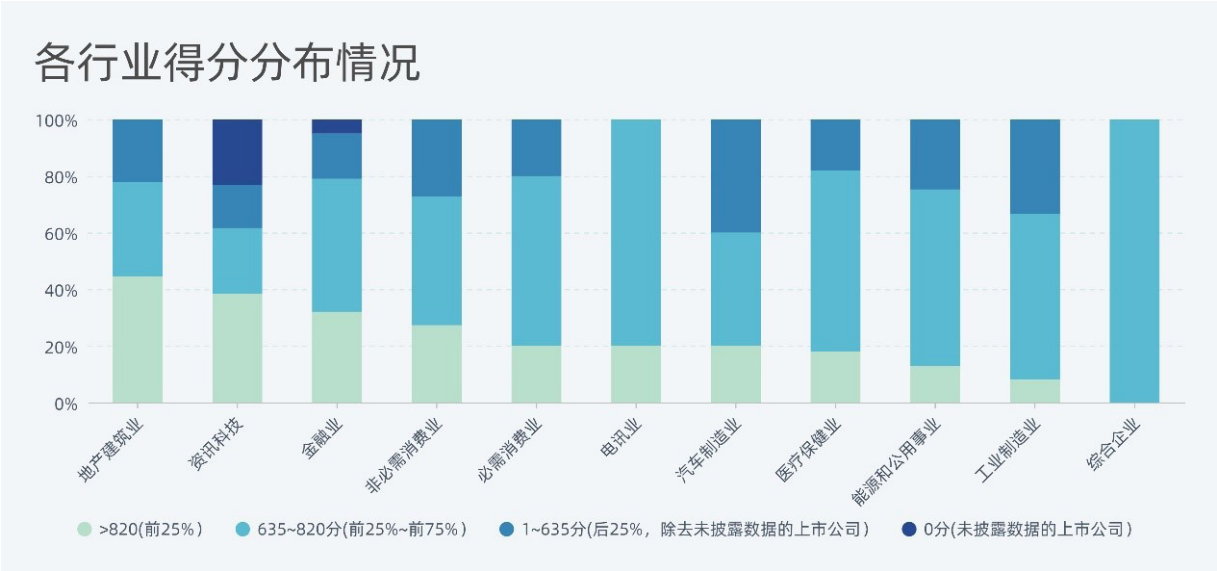


Figure 6-1-3 Comparison of Median Carbon Emission Intensity by Industry

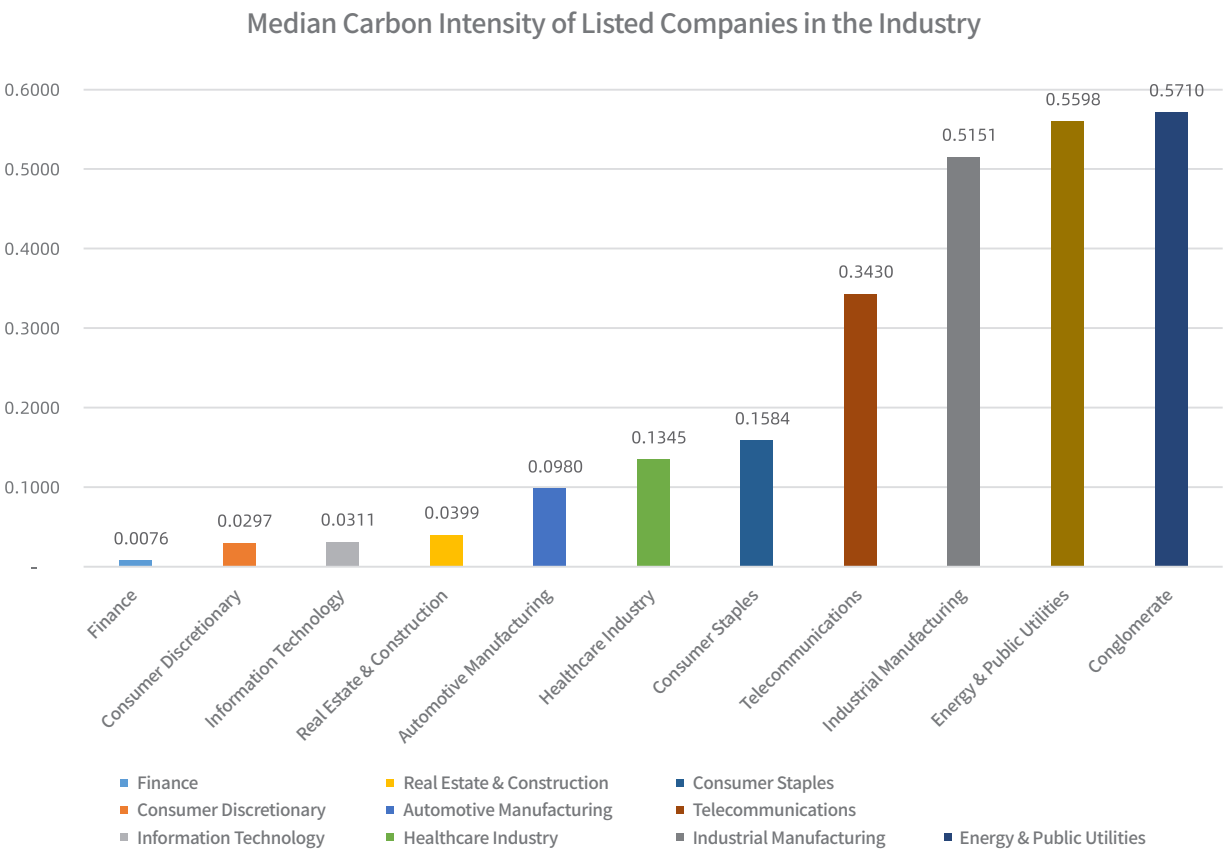
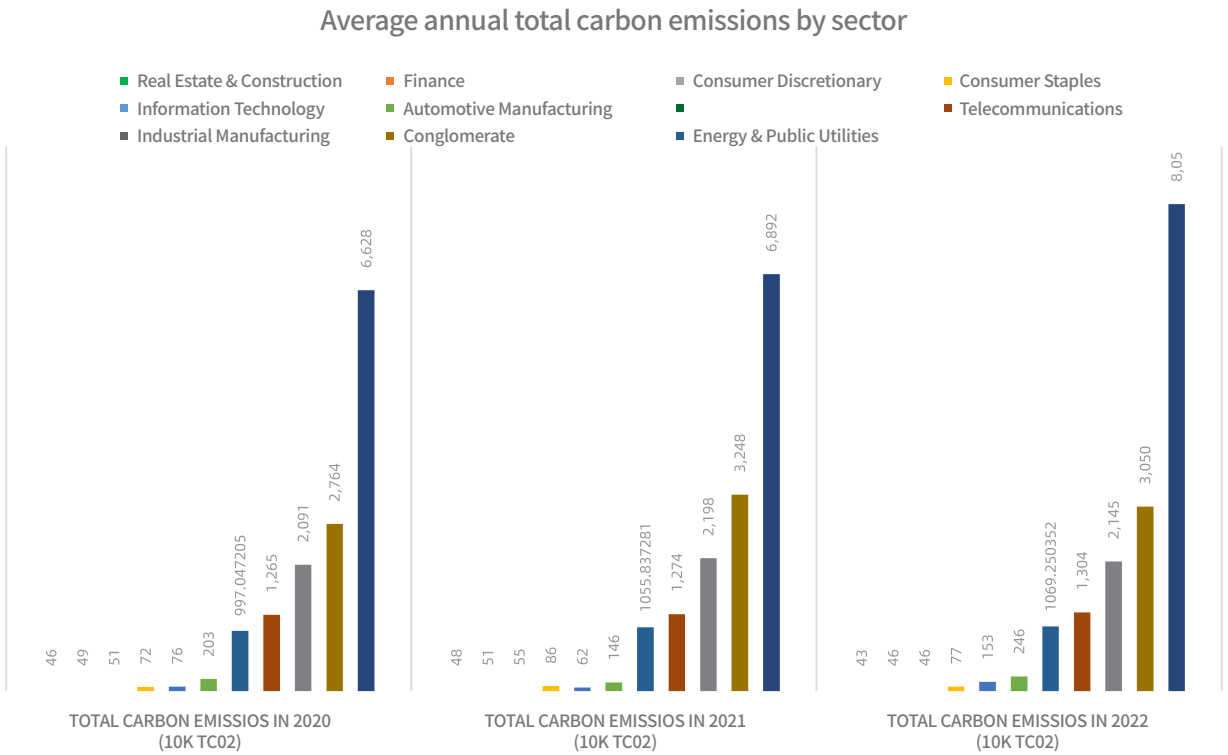



Figure 6-1-4 Comparison of Average Carbon Emissions by Industry, 2020-2022



## 6.2 Impact of Environmental Disclosure Requirements on Carbon Rating

Figure 6-2-1 Carbon Rating Score Performance by Listed Exchange

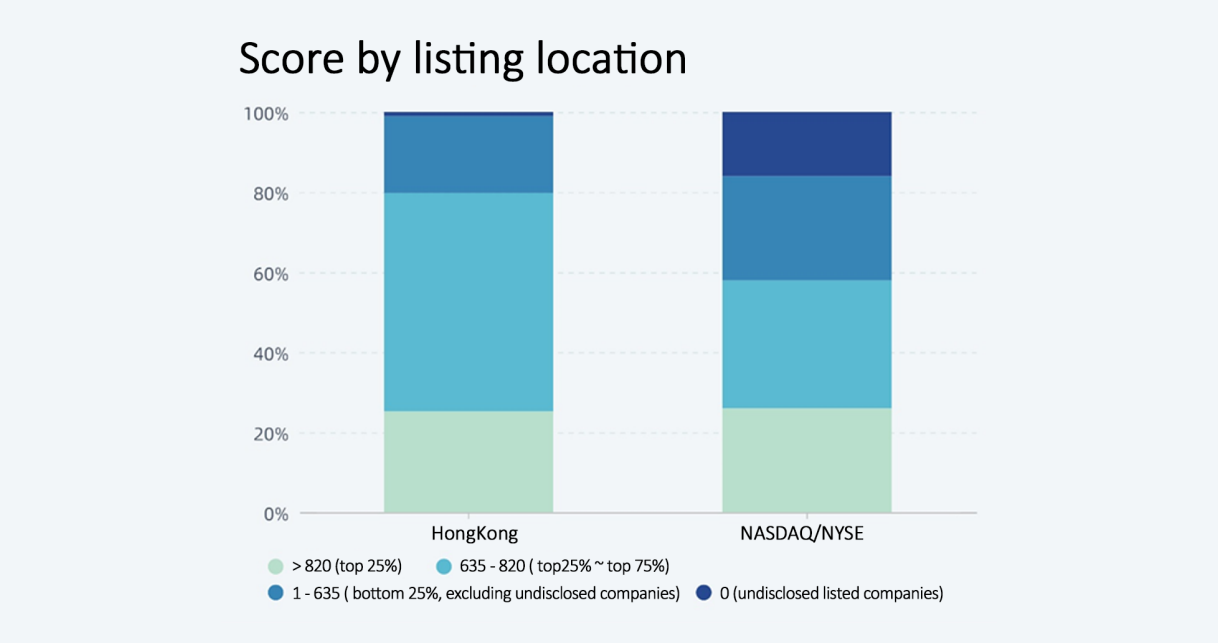



Figure 6-2-1 compares the carbon rating scores of companies listed on different exchanges. Of the companies listed in Hong Kong, 25% have a score Hong Kong-listed companies have a score higher than 820 (top 25% carbon rating), and 26% of NYSE/Nasdaq-listed companies have a score higher than 820 (top 25% carbon rating). (top 25% carbon rating). As of August 1, 2023, 16% of NYSE/Nasdaq-listed companies have never publicly disclosed emissions data. Less than 1% of companies listed in Hong Kong have never publicly disclosed emissions data.

NASDAQ and NYSE provide some standardized guidance on ESG disclosure for listed companies, but the NYSE has not issued any guidelines on what should be covered in an ESG report. However, the NYSE does not have systematic guidelines on what should be covered in an ESG report. NASDAQ has published ESG Reporting Guidance 2.0, based on voluntary disclosure, which recommends that companies Disclosure of GHG emissions and energy consumption should be in the form of figures, and should be compared with historical and industry average GHG emissions for the same period. At the same time Nasdaq also recommends that companies disclose the company's emissions intensity (carbon emissions per unit of revenue, sales or product) in numerical terms.

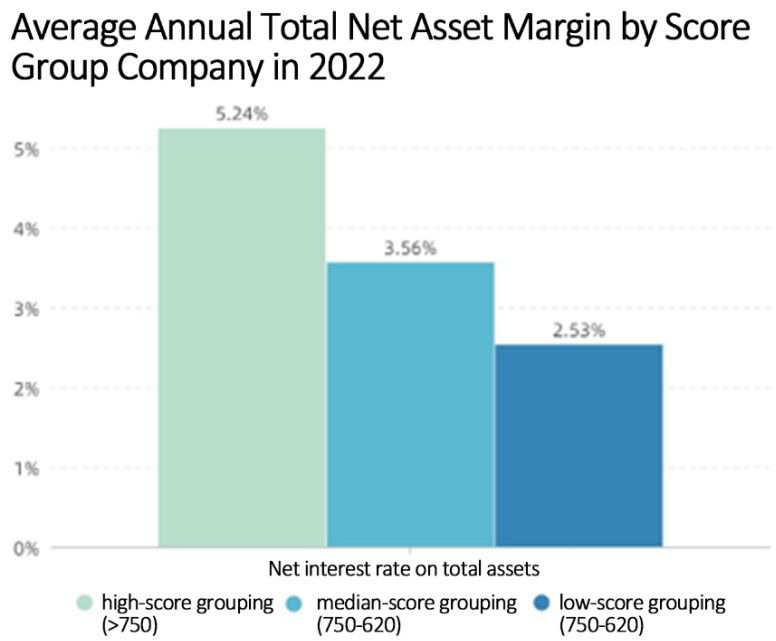
The Hong Kong Stock Exchange requires listed companies to report on one or more of the environmental indicators covered by the "disclose or explain" provisions, if the issuer fails to report on one or more of these provisions. If an issuer fails to report on one or more of these provisions, the issuer is required to provide carefully considered reasons in the ESG report. It also sets out in detail the quantitative indicators of a company's carbon emissions, including: Scope of emissions species and related emissions data, total direct (Scope 1) and indirect energy (Scope 2) greenhouse gas emissions in tons and, if applicable, intensity (e.g., per unit of production). applicable) intensity (e.g., per unit of production, per facility), a description of the emissions targets set and the steps taken to meet those targets. Policies for the efficient use of resources (including energy, water and other raw materials), total direct and/or indirect energy (e.g. electricity, gas or oil) consumption by type (in thousands of kWh) (e.g., electricity, gas or oil) by type (in thousands of kilowatt-hours) and intensity (e.g., per unit of production, per facility).

Compared to NYSE and NASDAQ, HKEX requires companies to disclose a greater number of metrics and has more detailed disclosure standards in its rules, which are more stringent on the exchanges. Under the stricter disclosure requirements of the Exchange, listed companies need to continuously improve their carbon emission disclosure system so as to have stronger motivation to promote the development of low-carbonization. The listed companies need to continuously improve their carbon emission disclosure system under the stricter disclosure requirements of the exchanges, so as to have stronger motivation to promote the development of low-carbonization.

## 6.3 Impact of Company Profitability on Carbon Rating

Figure 6-3-1 compares the average annual operating profit margins of different carbon rating score groups. The average annual operating profit margin of listed companies in the high scoring group (>750 points) is 22.86%, the average annual operating profit margin of companies in the medium scoring group (620-750 points) is 21.63%, and the average annual operating profit margin of companies in the low scoring group (<620 points) is 3.95%, which shows a decreasing trend, indicating that the profitability of listed companies in the high scoring group is much higher than the profitability of listed companies in the low scoring group under the carbon rating system. listed companies in the low-scoring group. Carbon emission disclosure is conducive to enhancing company value and facilitating company financing, in which company size, profitability, and management factors are positively correlated with stock price, and carbon emission disclosure also interacts with such factors. The company's profitability is conducive to absorbing the cost of environmental reporting and formulating carbon reduction strategies; at the same time, stakeholders are concerned about the company's profitability pathway, and environmental disclosure can corroborate the reasonableness and legitimacy of the company's benefits, which in turn shapes a good company image, increases investor confidence, and facilitates the company's future revenue growth. In addition, in the context of the continuous development of the national carbon market, the accelerated tightening of quotas in the future is likely to drive the price of carbon upward, and the company's effective use of carbon quotas will also help to reduce the company's costs and increase profitability.

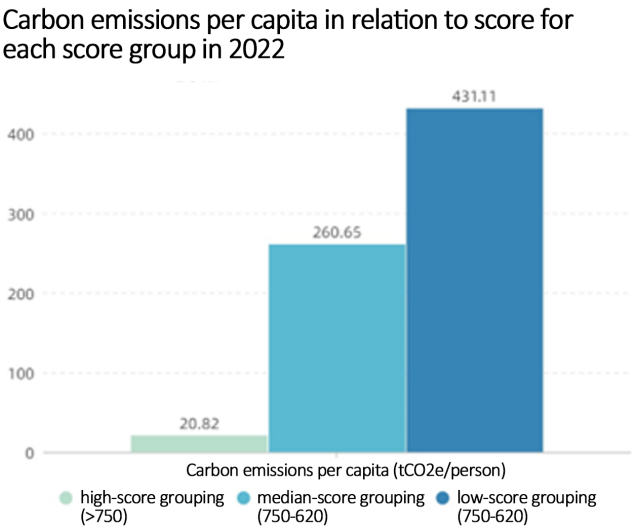
Figure 6-3-1 Company Annual Operating Margin vs. Score



## 6.4 Impact of Company's Employee Energy Consumption on Carbon Rating

**Figure 6-4-1 Relationship between Annual Per Capita Carbon Emissions of Companies and Scores**

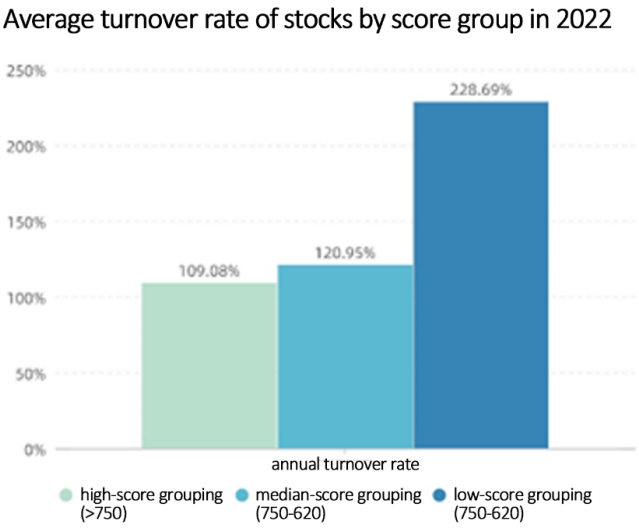
Figure 6-4-1 compares the per capita carbon emissions of different carbon rating score groups. The per capita carbon emission of companies in the high score group (>750 points) is 20.82 tons of carbon dioxide per person, the per capita carbon emission of companies in the medium score group (750~620 points) is 260.65 tons of carbon dioxide per person, and the per capita carbon emission of companies in the low score group (<620 points) is 431.11 tons of carbon dioxide per person. This shows a monotonically increasing trend. Among them, the per capita carbon emissions of the high-achievement group are significantly smaller than those of the medium-achievement group and the low-achievement group, which indicates that the companies in the high-achievement group are significantly better than those in the medium- and low-achievement groups in terms of green operation and optimization of energy emission reduction.




## 6.5 Impact of Company Turnover Ratio on Carbon Rating

**Figure 6-5-1 Relationship between the Annual Turnover Rate of companies' stocks and scores**

Figure 6-5-1 compares the annual stock turnover rate for different carbon rating score groups. The average annual turnover rate of listed companies' stocks in the high score group (>750 points) is 109.08%, the average annual turnover rate of listed companies' stocks in the medium score group (620-750 points) is 120.95%, and the average annual turnover rate of listed companies' stocks in the low score group (<620 points) is 228.69%, which is characterized by the incremental increase. The turnover rate is a measure of the strength of stock liquidity, and the scoring results indicate that the lower the score of the corporate carbon rating, the higher the turnover rate of the company's stock, and investors are more willing to hold the companies in the high scoring group for a long time and trade flexibly in the



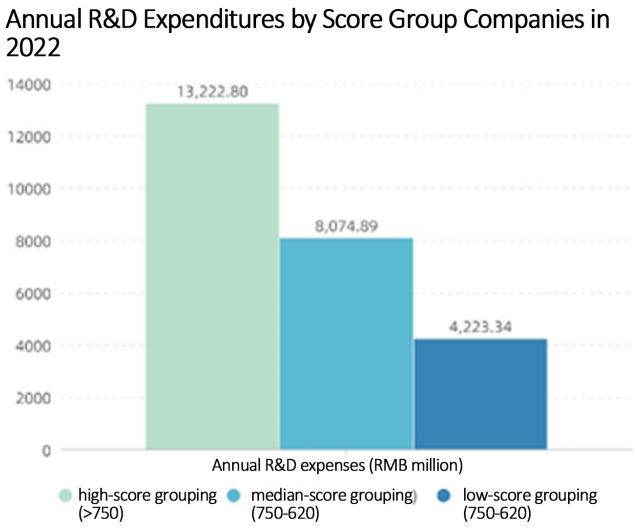
companies in the low scoring group. The reason for this phenomenon is that the sustainable development model of companies in the high scoring group tends to be more in line with the requirements of China's dual-carbon policy, and has a greater advantage in future carbon market transactions, so investors are more willing to hold the shares of companies in the high scoring group for a long period of time in anticipation of the continued growth of earnings of such companies in the future. On the other hand, companies in the low-scoring group need to undergo an energy transition or make higher quality carbon disclosures, and it is more difficult for investors to predict the potential for low-carbon development in the future. Therefore, investors do not consider holding shares of such companies in the long term, and place more emphasis on other financial information of such companies in the short term, and engage in short-term trades in order to gain profits. Meanwhile, in the context of dual-carbon policy, companies in the low-scoring group may bear additional abatement costs, which may affect the company's profitability effect. Therefore, we find that under the dual-carbon policy investors can keenly perceive the impact of carbon emissions on the future development of the company, and thus listed companies are more likely to go for active disclosure of carbon emissions data and active emission reduction to attract more investors.

## 6.6 Impact of Company R&D Expenses on Carbon Rating

**Figure 6-6-1 Relationship between Annual R&D Expenses of Companies and their scores**

R&D investment can not only be used to improve the innovation capability of companies, but also to support the green and sustainable development of listed companies, improve the efficiency of natural resources and reduce pollutant emissions. Therefore, Figure 6-6-1 compares the average annual R&D expenses of different carbon rating score groups. Among them, the average annual R&D expenses of listed companies in the high scoring group (top 25%) is $13.22 billion, the average annual R&D expenses of listed companies in the medium scoring group (top 25%-75%) is $8.074 billion, and the average annual R&D expenses of listed companies in the low scoring group (bottom 25%) is $4.223 billion, which shows a decreasing trend. The results show that listed companies with higher scores invest higher R&D expenses and place more emphasis on the company's R&D activities and innovativeness.

**Figure 6-6-1 Relationship between Annual R&D Expenses of Companies and their scores**



## 6.7 Quality Analysis of Carbon Emissions Data Disclosure

This section compares the disclosure rate of various types of emission information and energy consumption information of listed companies that have published social responsibility ESG reports or sustainability reports from FY2020 to FY2022. This section compares the disclosure rates of listed companies that have published social responsibility ESG reports or sustainability reports from 2020 to 2022.

Figure 6-7-1 compares the disclosure rate of total carbon emissions of different industries. Overall, the average disclosure rate of total carbon emissions of all industries is high, with an average disclosure rate of 96% for 11 industries, and 9 industries have achieved 100% disclosure of total carbon emissions, including the Consumer Staples, Real Estate & Construction, Telecommunications, Consumer Discretionary, Industrial Manufacturing, Energy & Public Utilities, Automotive Manufacturing, Healthcare Industry, and Conglomerate.

Figure 6-7-2 compares the disclosure rate of Scope 1 and Scope 2 carbon emissions of different industries. The average disclosure rate of Scope 1 and Scope 2 carbon emissions by industry is 93%. Consumer Staples, Telecommunications, Consumer Discretionary, Industrial Manufacturing, Energy & Public Utilities, Automotive Manufacturing, and Conglomerates achieved 100% Scope 1 and Scope 2 disclosure, and the Finance also achieved 95% disclosure.

Currently, fewer companies disclose Scope 3 carbon emissions, with an average Scope 3 emissions disclosure rate of 34% across all industries and a wide disparity in disclosure rates between industries. The industry with the highest Scope 3 disclosure rate is the health insurance industry, with an average disclosure rate of 55%. Meanwhile, we have also conducted statistics and analysis on the scope of disclosure of emissions of all companies. 89% of listed companies have achieved the scope of disclosure of carbon emissions to cover the whole company or major business organizations, while 11% of companies only disclose the annual carbon emissions of the company headquarters or part of the business organizations.

**Figure 6-7-1 Total Emissions Disclosure Rates by Sector**

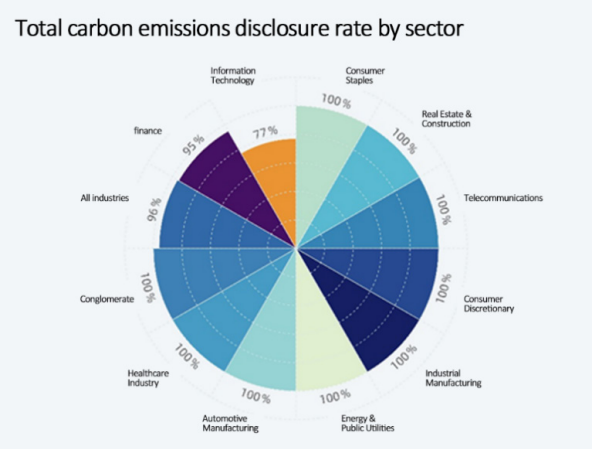



**Figure 6-7-2 Scope 1 and Scope 2 Emission Disclosure Rates by Sector**

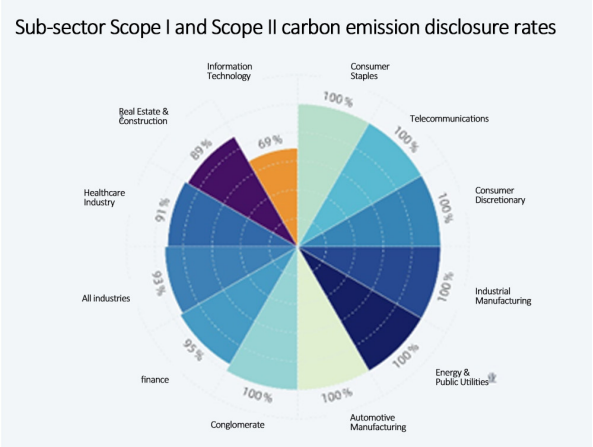


Figure 6-7-3 Sectoral Scope 3 Emission Disclosure Rates

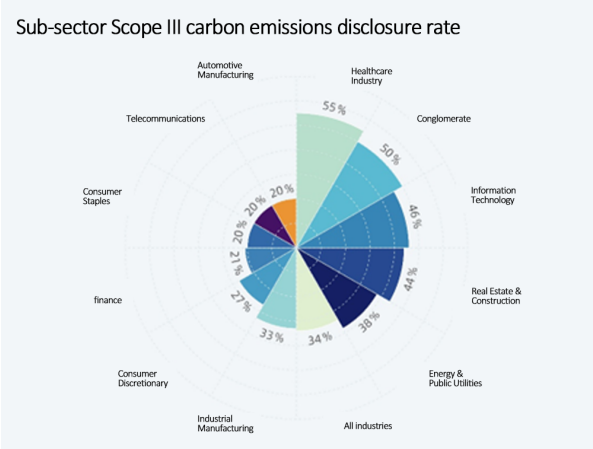



Figure 6-7-4 Ratio of Companies Disclosing Carbon Emissions Covering the Entire Organization

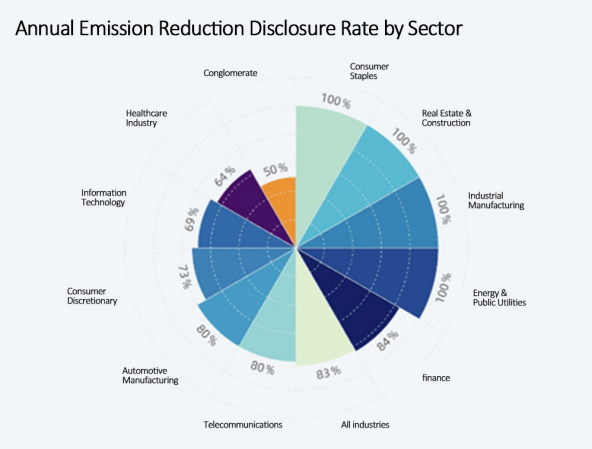
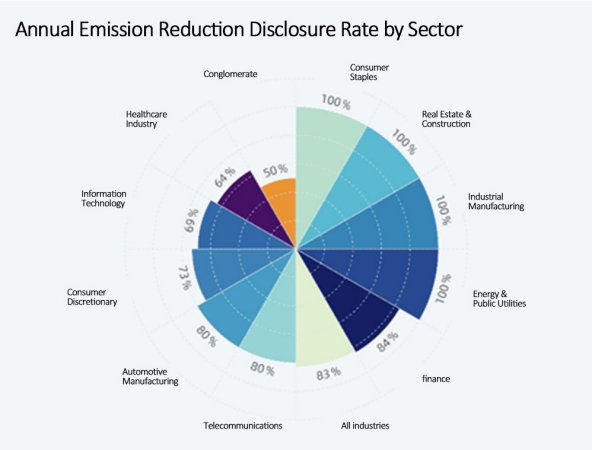



Figure 6-7-5 compares the annual emission reduction disclosure rates of different industries, and the average total emission reduction disclosure rate of 100 listed companies reaches 83%. Among them, Industrial Manufacturing, Real Estate & Construction, and Consumer Staples all achieved 100% disclosure of emission reductions. Companies that do not disclose annual emissions reductions Companies that do not disclose their annual emissions reductions lack temporal stability of their emissions data, making it impossible for investors to compare the historical data of the company's carbon emissions.

Figure 6-7-5 Disclosure Rate of Total Emission Reduction by Sector




In the context of carbon neutral targets, it is fundamental for companies to develop renewable energy sources, and there is a need to improve energy efficiency and support economic development with the development of renewable energy sources. Figure 6-7-6 compares the disclosure rate of renewable energy procurement volume (or percentage) of different industries. At present, the average disclosure rate of renewable energy purchasing volume (or percentage) of 100 listed companies is only 36%, and there is a big difference in the disclosure rate among industries. Among them, the disclosure rate of renewable energy purchases (or percentage) of general enterprises, consumer necessities and telecommunication all reached 80% and above. The least disclosed sectors are Real Estate & Construction, Healthcare Industry and finance, with disclosure rates of 22%, 18% and 5% respectively.

Figure 6-7-6 Renewable Energy Procurement (%) Disclosure Rate by Sector

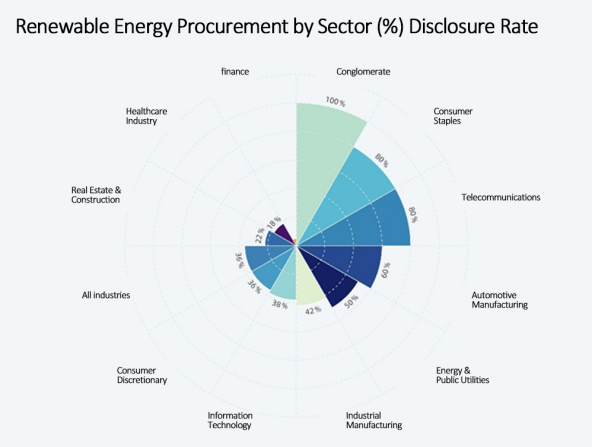


Figure 6-7-7 Purchased Heat Disclosure Rate by Sector

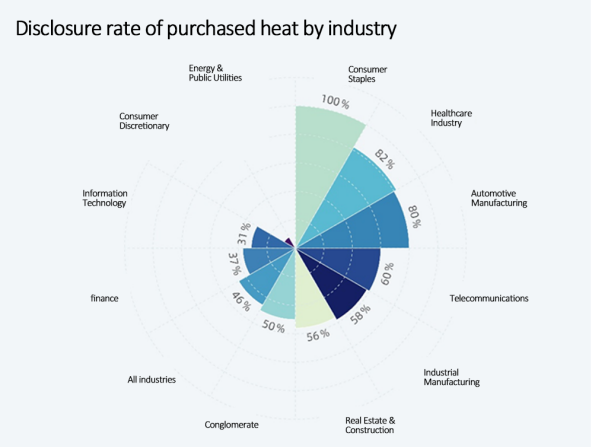
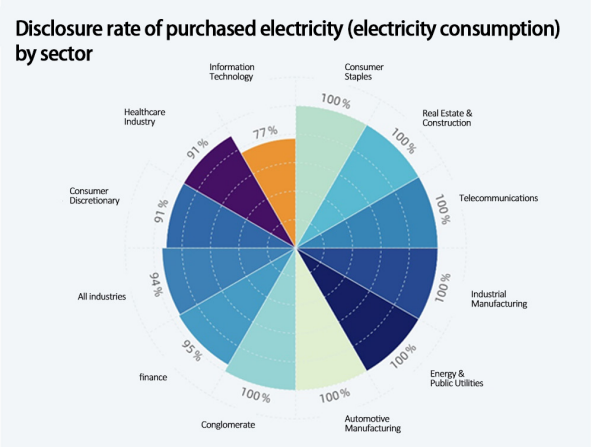


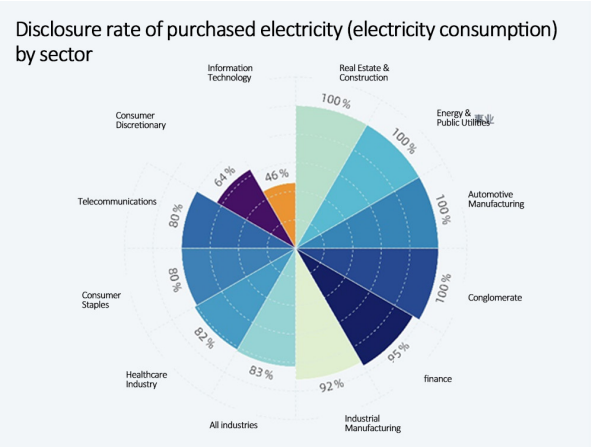

Figure 6-7-8 Disclosure Rate of Purchased Electricity by Sector




According to China's 24 Industry Accounting Guidelines, the calculation of a company's total carbon emissions generally needs to take into account emissions from fuel combustion within the accounting boundary (Scope 1 emissions) and emissions corresponding to purchased electricity and heat (Scope 2 emissions). Therefore, data disclosure by listed companies on direct and indirect energy sources is critical, and such disclosure can provide investors with basic accounting data for estimating or verifying a company's direct and indirect emissions. Figures 6-7-7 and 6-7-8 compare the disclosure rates of purchased heat and purchased electricity across industries. Currently, the average purchased heat disclosure rate of the 100 listed companies is only 46%, but the average purchased electricity disclosure rate reaches 94%. The disclosure of purchased electricity is better for all industries. Consumer Staples, Real Estate & Construction, Telecommunications, Industrial Manufacturing, Energy & Public Utilities, Automobile Manufacturing, and Conglomerate have all achieved 100% disclosure of electricity consumption data.

Figure 6-7-9 compares the disclosure rates of natural gas, diesel fuel, gasoline, and coal usage for direct energy sources by industry. The average disclosure rate of direct energy usage among the 100 companies reached 83%. Among them, Real Estate & Construction, Energy & Public Utilities, Automotive Manufacturing, and Conglomerate performed the best, all achieving 100% disclosure of direct energy use.

Figure 6-7-9 Comparison of Direct Energy Use Disclosure Rates by Sector



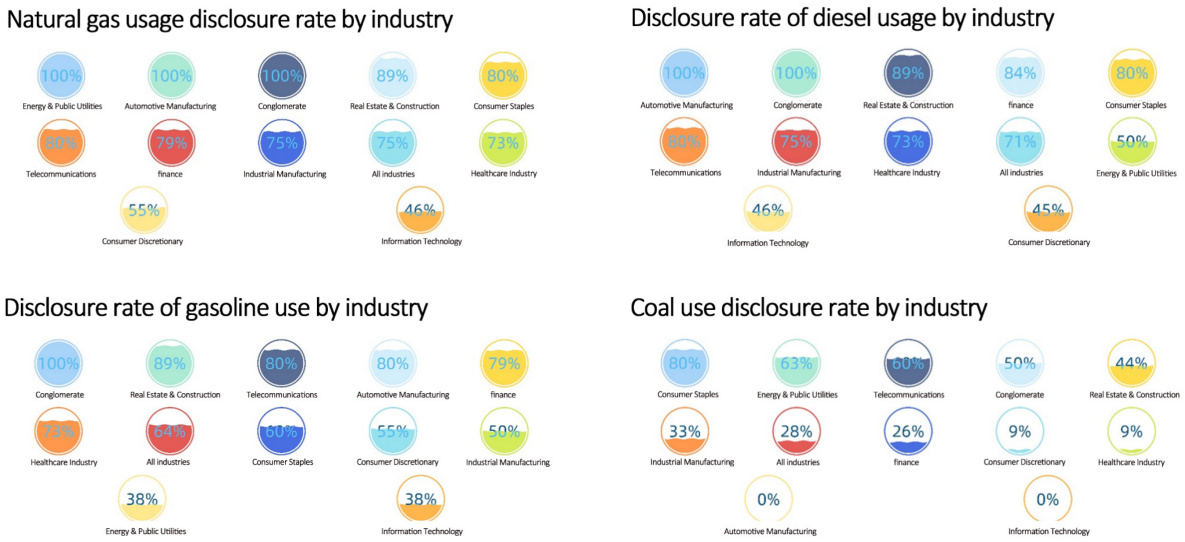



Figure 6-7-10 Scope of Carbon Accounting, Description of Methodology, and Disclosure Rate of Carbon Emission Factors by Sector

Companies need to define a clear scope of disclosure and a transparent calculation methodology for emissions data. The calculation methodology of all emission indicators in the company's carbon disclosure framework needs to be consistent with the current carbon audit methodology, and the authenticity of the data needs to be authenticated through the audit of a third-party organization, which can better ensure the openness and transparency of the data. Figure 6-7-10 compares the scope of carbon accounting, methodology description, and disclosure rate of carbon emission factor description in different industries. At present, the average disclosure rate of carbon accounting scope, methodology description and carbon emission factor description of 100 listed companies is 100%. Figure 6-7-11 compares the disclosure rate of data audit and assurance reports of different industries. The average disclosure rate of data audit and assurance reports of 100 companies is only 40%, and there is a big gap between industries. Among them, the disclosure rate of data audit assurance report of Energy & Public Utilities and finance reached 75% and 74%, while no company disclosed data audit assurance report in Healthcare Industry and Automotive Manufacturing.

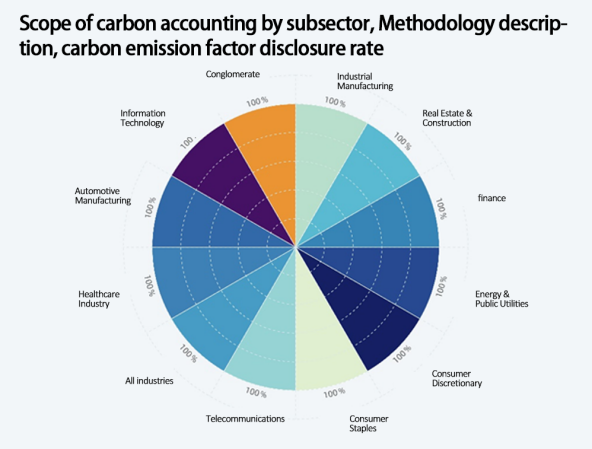
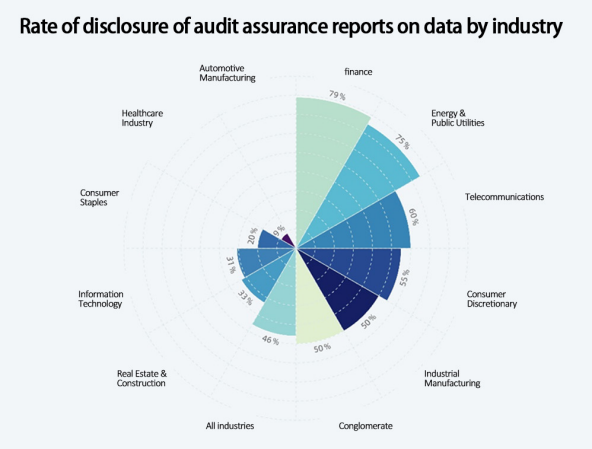



Figure 6-7-11 Rate of disclosure of audit and certification reports of data by sector



Currently, the industries of the Task Force on Climate-Related Financial Disclosure (TCFD) supporting organizations mainly include finance, industry, associations/professional services/non-governmental organizations (NGOs), materials, and information technology, and the quality of environmental information disclosure in such industries is higher and the disclosure standards are more consistent. The report also organizes and collects other carbon emission information related to some industries, including green finance and data center emission disclosure information, based on the operational characteristics of different industries. On August 31, 2016, the People's Bank of China, the Ministry of Finance, the National Development and Reform Commission, the Ministry of Environmental Protection, the China Banking Regulatory Commission, the China Securities Regulatory Commission, and the China Insurance Regulatory Commission jointly issued the Guiding Opinions on Building a Green Financial System ("Guiding Opinions"). The Guiding Opinions define green finance as economic activities that support environmental improvement, climate change response and the economical and efficient use of resources, i.e. financial services provided for project investment and financing, project operation and risk management in the fields of environmental protection, energy conservation, clean energy, green transportation and green building. The green financial system includes all major financial instruments such as green bonds, green stock indexes and related products, green development funds, green insurance, and carbon finance. Figure 6-7-12 compares the disclosure rate of various data of listed companies in the financial industry. Currently, 79% of the companies in the financial industry disclose the emission reductions of green finance-related projects in their annual reports or ESG reports.

**Figure 6-7-12 Disclosure Rates for Various Information in the Financial Sector**

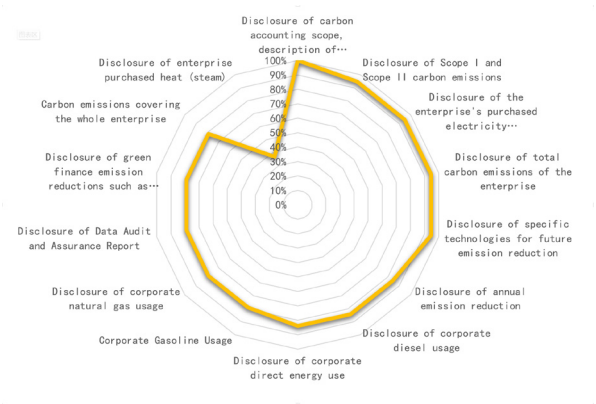
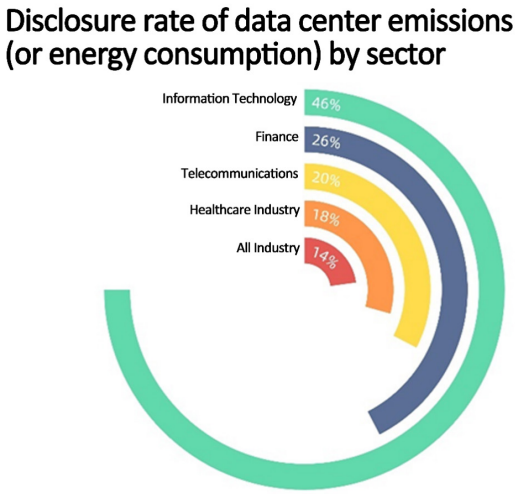



**Figure 6-7-13 Disclosure of Data Center Emissions (or Energy Consumption) by Sector**




With the accelerated development of China's informatization process and digital economy, the construction volume and scale of data centers, as the carrier of the digital economy, are constantly expanding. At the same time, data centers require a large amount of power to maintain the operation of servers, storage equipment, backup devices, cooling systems and other infrastructure. The low-carbon and high-quality development of data centers is also worthy of attention. Figure 6-7-13 compares the disclosure rates of data center emissions or energy consumption of listed companies in different industries. Currently, companies in the information technology, finance, telecommunications and healthcare industries have disclosed their data center emissions or energy consumption, with industry average disclosure rates of 46%, 26%, 20% and 18% respectively.

The industries with better disclosure are Conglomerates (425/500), Telecommunications (400/500), Industrial Manufacturing (388/500), Energy & Public Utilities (381/500), Real Estate & Construction (367/500), Automotive

Manufacturing (350/500), and Finance (347/500). Among them, Industrial Manufacturing, Telecommunications, Conglomerates, Energy and Utilities, and Automotive Manufacturing are all part of the secondary industry, which is more affected by the dual-carbon policy and the regulation of the environmental sector due to its high energy-consuming nature. Therefore, such listed companies need to disclose more environmental information, and the content of the disclosed data is relatively complete, which can show investors a complete picture of the company's actual actions in energy transition and green operations. The real estate & construction industry (mainly real estate developers) and the finance are tertiary industries, and most of these listed companies have higher profit margins and sufficient funds to make comprehensive ESG disclosures. At the same time, the financial industry is aware of the future direction of the market, and has a higher awareness of ESG quality disclosure within the industry, As well as a higher sensitivity to the changes in the industry brought about by the dual-carbon policy..

Industries with more average disclosure are consumer discretionary (332/500), and healthcare industries (345/500). These industries perform more generally on detailed disclosure items, such as direct energy and indirect energy use disclosures, and both disclose a lower percentage of data audit attestation reports than the preceding industries. As a result, the final disclosure quality dimension scores are lower.

The sector with poor disclosure is Information Technology (269/500). Although the carbon intensity of this industry is small, the quality of carbon disclosure is poor, with a low rate of direct and indirect energy disclosure. Among them, three listed companies in the information technology industry have not disclosed ESG reports in 2019, 2020, 2021 and 2022. With the accelerated development of China's low-carbonization, some information technology companies have gradually paid attention to environmental disclosure in recent years, and Alibaba and Tencent have released carbon-neutral related reports, and plan to combine the company's energy transformation and technological innovation to achieve the common growth of the economy and environmental effects.

## 6.7 Quality Analysis of Carbon Emissions Data Disclosure

Figure 6-8-1 compares the disclosure rate of "peak carbon and carbon neutral" targets of different industries. Generally speaking, the disclosure rate of total carbon emissions of all industries is low, and there is a big difference in the disclosure rate of different industries. 100 listed companies' average disclosure rate of "peak carbon compliance and carbon neutrality" reaches 33%. The average disclosure rate of the "peak carbon and carbon neutral" targets of the 100 listed companies reached 33%, among which the disclosure rates of general enterprises, energy and utilities were higher, at 100% and 75% respectively.

**Figure 6-8-1 Disclosure Rate of "Peak Carbon and Carbon Neutral" Targets by Sector**

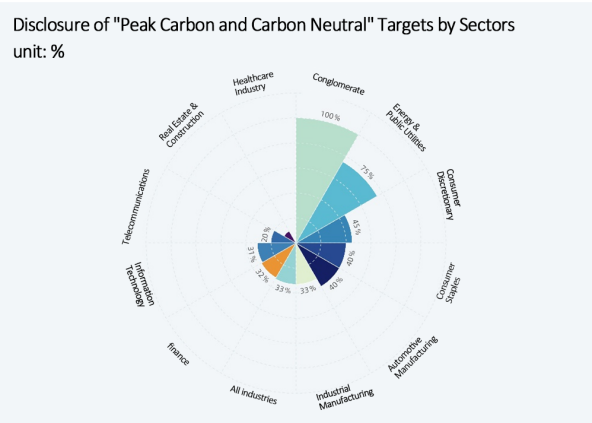


Figure 6-8-2 compares the disclosure rate of future planned emission reductions by industry. 100 listed companies have an average disclosure rate of 70% for future emission reductions, and there is a large difference in the disclosure rate among industries. The best performing industries are Telecommunications and Consolidated Enterprises, both of which have achieved 100% disclosure rate of future emission reductions. The industries with the lowest disclosure rates of planned future emission reductions are information technology and real estate and construction, with disclosure rates of 46% and 44% respectively.

**Figure 6-8-2 Disclosure Rate of Future Planned Emission Reductions (Quantitative Emission Reduction Targets) by Sector**

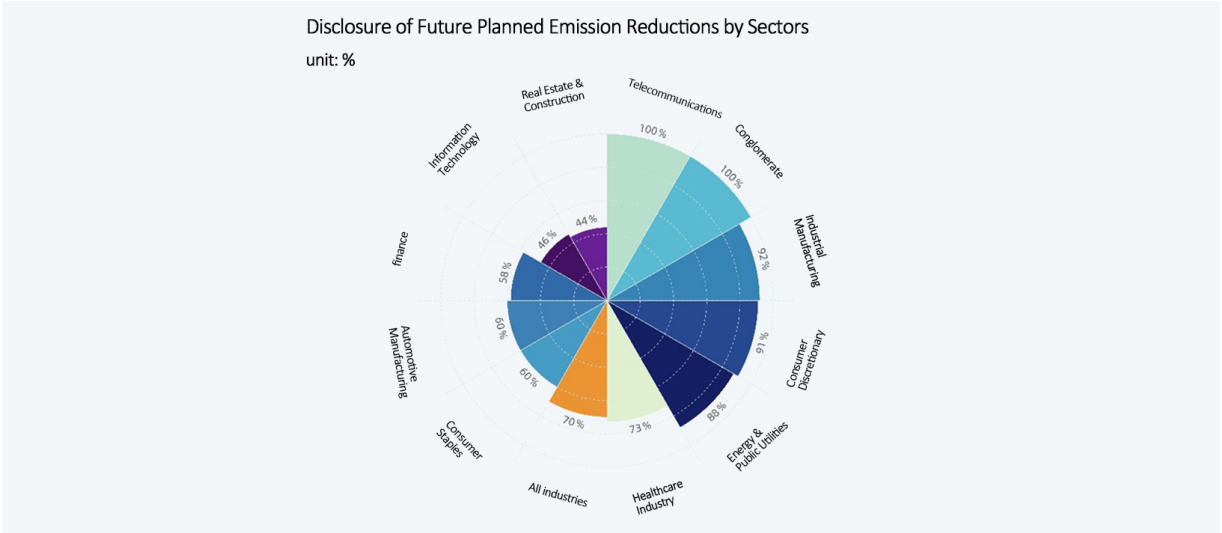
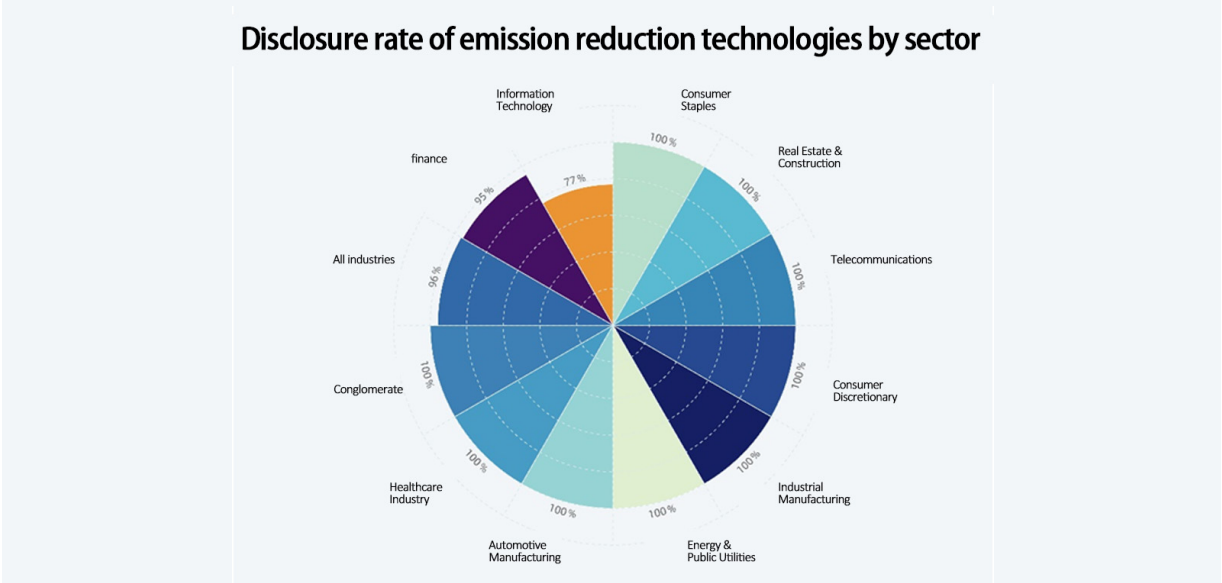



Figure 6-8-3 compares the disclosure rates of future emission reduction technologies in different industries. The average disclosure rate of the 100 listed companies' future emission reduction technologies is as high as 96%. Basically, listed companies in all industries have made detailed introductions on their own emission reduction technologies and green operation models. Among them, the industry with a relatively low disclosure rate of future emission reduction technologies is the information technology industry, with a disclosure rate of 77%.

**Figure 6-8-3 Disclosure Rate of Specific Technologies for Future Emission Reduction by Sector**



# 7 Analysis of Companies' Investment Performance Based on Carbon Rating

This chapter aims to analyze the market performance of Chinese overseas-listed companies in the report according to the carbon rating as an investment factor. Atz et al. (2021) conduct a meta-analysis of more than 1,000 research papers and find that the vast majority of these studies report a positive relationship between ESG and measures of financial performance, including stock returns. Nollet et al. (2016) used a nonlinear model to study the relationship between corporate social performance and financial performance based on indicators such as ROA (Return on Assets), and found that good corporate social responsibility performance can improve its financial performance in the long run. Sabbaghi (2019) argued that good ethical practices are an important part of risk management, thus good ESG performance prevents future negative events involving the company and mitigates the risk of market investment. Therefore, a high-quality portfolio can effectively prevent risks and reduce volatility. In the following, we will analyze whether Chinese overseas-listed companies have the same performance.

We selected the 5 stocks with top carbon rating scores (hereinafter referred to as the "Top 5 ") : Xiaomi-W, NetEase, Coocks with untry Garden, Zhongsheng Group Holdings Limited and Chow Tai Fook, and the bottom5 carbon rating scores (hereinafter referred to as the "Bottom 5 ") , Namely: Ctrip, Meituan-W, PDD, tencent Music and Futu Holdings Limited. Then we invested in two stock portfolios with equal weighting and calculated their net values. Compared with the 2022 carbon rating, NetEase has been added to the top 5 stocks, while Vanke has fallen out of the top 5 ranks to rank 10 this year. Among the last 5 stocks, Ctrip was added, and NIO rose to 77th place from the last year. At the same time, the scope is expanded to establish the Top 10 carbon rating (hereinafter referred to as the "Top 10") stock portfolios and the Bottom 10 carbon rating (hereinafter referred to as the "Bottom 10") stock portfolios, and the same operation is used to compare them with the trend of the FTSE China A50 Index from July 1, 2022 to June 30, 2023 as shown in Figure 7-1-1. FTSE China A50 Index is a common securities index used by overseas investors to measure China' s A-share market. The index, which contains 50 A-share companies listed on the Shanghai or Shenzhen stock exchanges with the highest market values, has a strong market relevance. The sample carbon-ranking companies in the report are homegrown Chinese companies listed overseas. The CSI 300 Index mainly represents homegrown Chinese companies listed domestically, while the Hong Kong stock index (e.g. Hang Seng Index) and the US stock index (e.g. NASDAQ Composite Index) mainly represent local companies in Hong Kong and the US, neither of which are compatible with the sample portfolios. Thus, the A50 Index is selected as a standard.

In the report, we used the stock trading data from July 1, 2022 to June 30, 2023 and from January 1, 2023 to June 30, 2023, and select Top 5 and Top 10 stocks and Bottom 5 and Bottom 10 stocks as sample data. Additionally, the stock mix of long Top 5 and short Bottom 5 will be called portfolio 1, and the stock mix of long Top 10 and short Bottom 10 will be called portfolio 2, and its return rate, standard deviation and Sharpe ratio will be calculated.

## 7.1 Analysis of A50 Index and Stock Portfolios Performance

Figure 7-1-1 shows the portfolio for the one-year holding period of 2022 (July 2022 to June 2023), and the trend shows that the top 5 and top 10 carbon emitters in 2022 appeared fluctuated around the A50 index (the market), but ultimately lower than the A50 index. This may cause by two property stocks (Country Garden and Vanke) in the top 5 and top 10. In early 2022, real estate enterprises are affected by the regulation of housing and loan policies in some cities, and the enthusiasm for real estate sales has declined. In the later period, although the policy was relaxed, the real estate sales were still weak due to the adverse impact of the epidemic and the downward economic cycle. In addition, affected by unexpected events such as bank thunderstorms and unfinished buildings, people's lack of confidence in real estate consumption has led to the generally poor performance of real estate enterprises in 2022, which has dragged down the stock performance of the entire top 5 and top 10 carbon enterprises to a certain extent. Relatively speaking, Chow Tai Fook and China Pacific Insurance, the top 10 performers, are more welcome as protection assets in the economic downturn cycle.

The most noteworthy is the China Pacific Insurance, which is in the new enterprise appears in top 10 carbon rating this year, China Pacific Insurance increasingly pay attention to corporate ESG performance and disclosure. Since 2021, China Pacific Insurance has released the ESG Sustainable Development Report and the 2022 Climate Change Report for two consecutive years. According to the G20 Financial Stability Board Task Force on Climate-related Financial Disclosure, The proposed framework of TCFD and the People's Bank of China's Environmental Information Disclosure Guidelines for Financial Institutions for ESG risk management disclosure. In addition, China Pacific Insurance also formulated its own Environmental, Social and Governance Plan (2023-202 5 ) in 2022, which provides a systematic implementation strategy and action plan for the company's future ESG development. Although China Pacific Insurance entered the top 10 carbon rating for the first time in 2022, and has not entered the top 5 series for the time being, under a series of efforts focusing on ESG practice, China Pacific Insurance's performance achieved a high growth in 2022, and even drove the stock performance of the top 10 enterprises to outperform the top 5 enterprises. This shows that although external factors such as the economic cycle will have a certain impact on the enterprise operations, enterprises that pay attention to ESG performance can make a smoother transition and better prevent risks and negative impacts brought by the external environment due to good governance, higher reputation and more scientific operation.

Unlike most of the top 5 and top 10 enterprises that suffered setbacks, many of those ranked in the bottom 5 and bottom 10 enterprises performed more prominently during the epidemic. For example, Ctrip, which ranked in the bottom 5 in terms of carbon last year, actively developed other businesses such as online ride-hailing, car charter, and food online purchase when its main business was frustrated in terms of tourism. At the same time, according to different user habits, customized content such as similar fan evaluations, travel guides and route planning of attractions of interest were introduced in the platform recommendation, which saved some business performance to a certain extent. Subsequently, with the recovery period of the epidemic at the end of 2022, the number of tourism consumption skyrocketed, and its performance was further rebounded. In the period from July 2022 to June 2023, its return reached 23.4%, which is already higher than many of the top 5 or top 10 companies. Similarly, the rapid development of all aspects of Internet business due to the inconvenience of travel has given internet companies a valuable opportunity for rapid development. Other carbon rating in the bottom 5 and 10 internet companies such as PDD, Tencent Music, etc., have also achieved rapid development. These Internet have greatly boosted the performance of the bottom 5 and top 10 enterprises, so the bottom 5 and top 10 enterprises have achieved higher returns than the top 5 and top 10 enterprises in 2022-2023.

In order to reduce the impact of such objective economic cycle fluctuations, we removed Country Garden from the top 5 and top 10 enterprises and drew a net value chart again. Figure 7-1-2 shows that after the removal of Country Garden, although the overall return rate of the top 5 top 10 enterprises is still lower than that of the bottom 5 and top 10 enterprises, the difference has been significantly reduced. It can be seen that the poor performance of the top 5 and top 10 carbon emission enterprises in 2022-2023 is mainly caused by the economic cycle changes in the industry in which the enterprises are located.

Figure 7-1-1 A50 Index and Net Values of Portfolios in 2022.7-2023

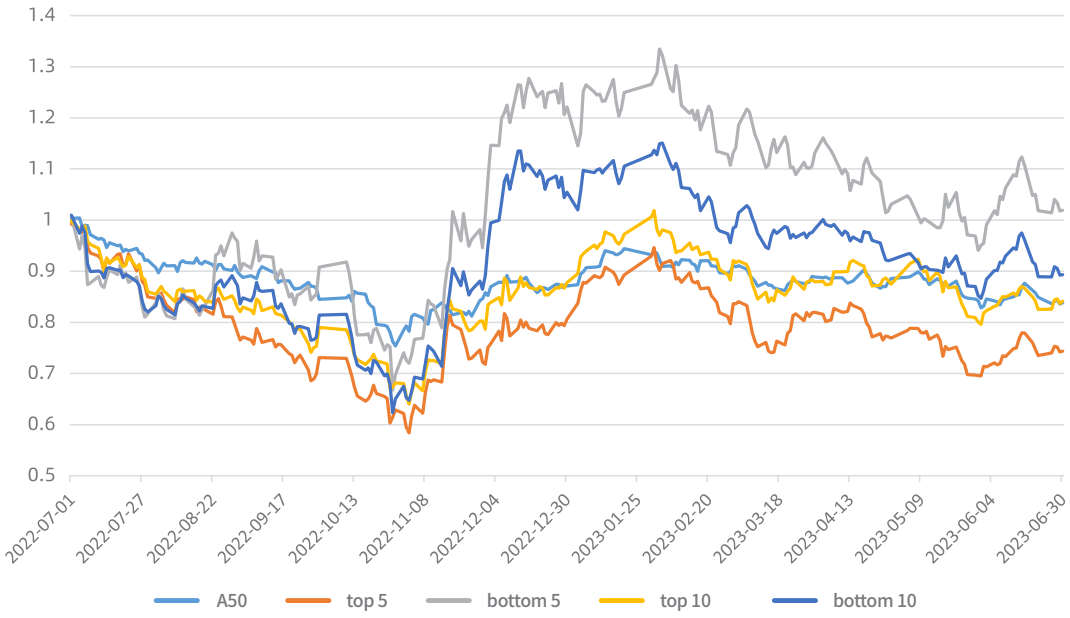



Figure 7-1-2 A50 Index and Net Values of Portfolios in 2022.7-2023 (excluding real estate)

In order to further analyze the correlation between A50 index and stock portfolios, we continue to measure the correlation coefficients between various stock portfolios and A50 index, as shown in Table 10:

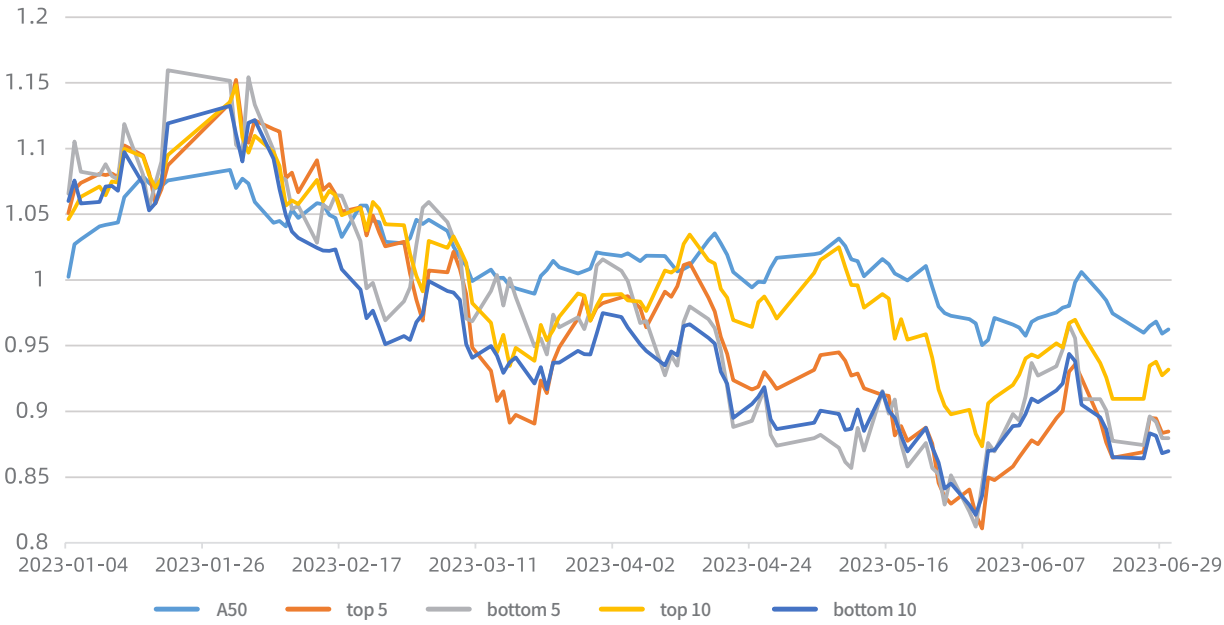
**Table 10 Correlation coefficients between A50 Index and each portfolio in 2022**

| | A50 Index and Top 5 stock portfolio | A50 Index and Bottom 5 stock portfolio | A50 Index and Top 10 stock portfolio | A50 Index and Bottom 10 stock portfolio |
|---|---|---|---|---|
| Correlation coefficient β | 0.878 | -0.354 | 0.527 | -0.0288 |
| α | -0.0125 | 1.330 | 0.367 | 0.984 |

As shown in Table 10, the correlation coefficient (β) between A50 index and the Top 5 and top 10 portfolios are all less than 1, and the absolute value of correlation coefficient between A50 index and Top 10 stock portfolios is greater. This shows that the stock performance of enterprises that focus on ESG performance has the similar trend as that of the market, but its volatility is less than that of the market, that is, these stocks have lower risk of change. This indicates that companies focusing on ESG performance have a lower stock volatility risk than the market average risk, especially in the economic downturn, they have a better ability to reduce risks and losses (Albuquerque, R., 2019). Next, according to the α, we can infer that the α value of the top 10 companies is greater than 0, which indicates that investing in the top 10 carbon rating companies can get higher returns than the market. As for the top 5 enterprises, it may due to the two of the 5 enterprises are real estate enterprises, and the overall performance has been dragged down. In general, however, companies with better ESG performance are more likely to achieve higher ROI (Serafeim, G., & Yoon, A., 2022).

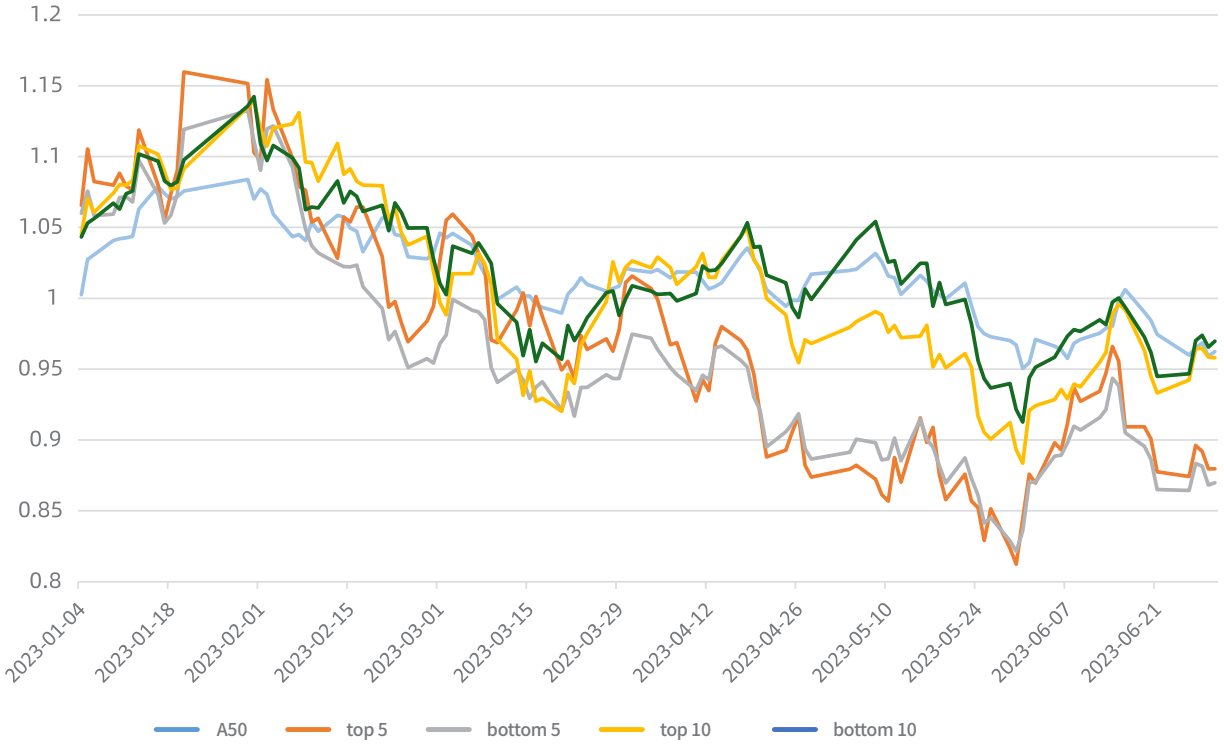
Next, from the half-year investment period from January 2023 to the end of June 2023, which shows (Figure 7-1-2) that the trend of the net value of stock portfolios, the net value of the top 5 and top 10 stock portfolios is higher than that of the bottom 5 and bottom 10 stock portfolios, which is conformed to our expectation. Higher carbon rating is particularly important for institutional investors seeking to screen the most social-responsible stocks. An increase (decrease) in rating will quickly lead to an increase (decrease) in investment in companies with improved rating (decrease). In turn, it will affect the overall return on investment of enterprises (Shanaev, S., & Ghimire, B., 2022). Although the first two groups of companies are less than the A50 curve, this may still because of the unrecovered of real estate companies.

Figure 7-1-3 A50 Index and Net Values of Portfolios from January 2023 to June 2023




In order to further verify that the poor performance of the top carbon emission enterprises is caused by the objective economic cycle and the drag of real estate stocks, we remove the real estate stock enterprises in the ranking and compare the stock price performance of the remaining enterprises with A50. The net value of the comparison chart is as follows:

Figure 7-1-4 A50 Index and Net Value of Portfolios (Excluding Real Estate)



As shown in Figure 7-1-2, what is more obvious than the performance of the year 2022-2023 is that when the real estate stocks are removed, the performance of the top 5 and top 10 net worth enterprises in the half year of 2023 grows rapidly, higher than the bottom 5 and bottom 10 enterprises, and the trend is similar to the A50. It can be seen that the performance of the top 5 and top 10 enterprises in the carbon rating is higher than those in bottom 5 and bottom 10 enterprises, and are more in line with the performance of the mainstream industry. That means, regardless of other objective economic conditions that may have a greater impact, carbon rating still has a strong impact on the performance fluctuations and excess returns of enterprises.

Our conclusions are also supported by many academic literatures: Dyck, A et al. (2019) selected a sample of 3,277 non-US companies from 41 countries during 2004-2013 to test whether the equity owned by institutional investors with a one-stage lag is related to the E&S (Environmental and social) performance of the companies. They found a significant positive correlation between higher institutional ownership and higher corporate E&S scores.

Secondly, from the perspective of the relationship between ESG disclosure and corporate risk, El Ghoul et al. (2016) confirmed that good ESG governance can effectively reduce systematic risk by studying the relationship between corporate social responsibility performance and corporate governance. Stellner, C. et al. (2015) measured the impact of excellent CSR performance on corporate credit rating and z-spreads, found that in rudimentary business environment, excellent CSR can effectively reduce the credit risk of enterprises. And help companies get better credit risk ratings; Thirdly, Schiller, C.(2018) studied the effect of supply chain relations on the dissemination of E&S policies. He found that the litigation and reputation risks of enterprises with high E&S governance will be reduced, and at the same time, these enterprises can drive their upstream and downstream enterprises to jointly reduce pollution emissions and avoid unsustainable behaviors. Therefore, enterprises that attach importance to ESG can also effectively reduce the risk of legal proceedings that enterprises may face. Finally, Ilhan, E. et al. (2021), by analyzing the relationship between the uncertainty of future climate policies and the product performance of carbon-intensive enterprises in the option market, find that for enterprises with carbon-intensive business models, Downside risk entails greater costs. Therefore, focusing on carbon emissions and ESG performance can effectively reduce the downside risks that enterprises may face in the future.

Finally, from the perspective of the impact of ESG disclosure on corporate performance, Fatemi, A et al. (2015) established an enterprise valuation model and simulated and tested the impact of enterprise resource expenditure on community, social or environmental causes on enterprise value. They found that CSR expenditure will create returns for enterprises in a way that increases enterprise value. On the other hand, Hong et al. (2012) studied the impact of CSR performance on shareholder wealth from the perspective of shareholder income, and found a positive correlation between corporate ESG/CSR performance and shareholder wealth. According to the summary of Gillan, S. L et al. (2021), they found that 90% of the more than 2000 empirical academic studies on whether and how ESG/CSR is related to corporate performance and value found that there is a non-negative correlation between ESG/CSR and corporate financial performance. And the vast majority of studies have come to the conclusion of a positive correlation. This is also similar to our statistical results.

Next, similar to 2022, we also conducted correlation coefficient analysis for the A50 index and various stock portfolios in the first half of 2023 (2023.1-2023.6). The results are as follows (Table 11):

**Table 11 2023.1-2023.6 Correlation Coefficients between the A50 Index and Each Equity Portfolio for the Half-year Period**

| | A50 Index and Top 5 stock portfolio | A50 Index and Bottom 5 stock portfolio | A50 Index and Top 10 stock portfolio | A50 Index and Bottom 10 stock portfolio |
|---|---|---|---|---|
| Correlation coefficient β | 0.434 | -0.595 | 0.372 | -0.368 |
| α | -0.0002 | 0.0010 | -0.0001 | 0.0013 |

Here, we can observe that, , similar to the results for the full year 2022, the correlation coefficients(β)of the top 5 and top 10 stock portfolios are positive and less than one, indicating that the stock performance of the top ESG performers is on a par with the market, but their volatility is less than that of the market, i.e., the risk of change in these stocks is lower. This shows that the risk of stock volatility is lower than the average risk of the market for companies that emphasize ESG performance. On the other hand, the stock portfolios of the bottom 5 and 10 companies show that their correlation coefficients(β) are all negative, which indicates that companies with low ESG performance are exposed to more unpredictable factors, and that their investment risks are contrary to the direction of the market, with more uncertainty. This further validates that those companies with top carbon ratings and ESG performance will present and disclose their corporate governance practices and results more comprehensively (Van Duuren, E., 2016), and that investing in these companies will allow for a more timely grasp of changes in the company's operations and better risk aversion (Giese, G., 2019).

## 7.2 A50 Index and Long/Short Portfolio Analysis

In this section, in order to verify the investment performance obtained after investing according to the carbon rating, we long the first 5 stocks according to the carbon rating score, short the last 5 stocks as portfolio 1, long the first 10 stocks and short the last 10 stocks as portfolio 2. Analyzing their investment returns and volatility from July 1, 2022 to June 30, 2023 and January 1, 2023 to June 30, 2023, the A50 index vs. long-short equity portfolio is plotted as follows (Figures 7-2-1 and 7-2-2):

As can be seen from Figure 7-2-1, Portfolio 1 of the top 5 and bottom 5 in 2022-2023 significantly underperforms Portfolio 2 (top 10 and bottom 10), which on one hand is similar to the previous reason: the two real estate stocks in the top 5have a certain drag on the performance of the investment, whereas China Taipao in the top 10 has a better pulling effect as an emerging company in terms of ESG. On the other hand, it is also possible that the bottom 5 companies in the corporate carbon ratings also have a strong negative impact on the overall portfolio performance, in which the top 5 are weak and the bottom 5 are a strong drag, the top 5 and bottom 5 portfolios are significantly weaker than the top 10 and bottom 10 portfolios. This reflects the strong negative impact that ignoring carbon governance can have. Similarly, the above conclusion is further validated by the fact that in the first half of 2023, a higher Portfolio 2 than Portfolio 1 is also recorded.

Therefore, these portfolio results show that corporate carbon governance is not only a bonus for companies, but also a necessity. Lack of effective carbon governance will have a serious drag effect on the performance of the firms and pull down their business results.

Figure 7-2-1 2022.7-2023.6 Net A50 Index and Long-Short Portfolios

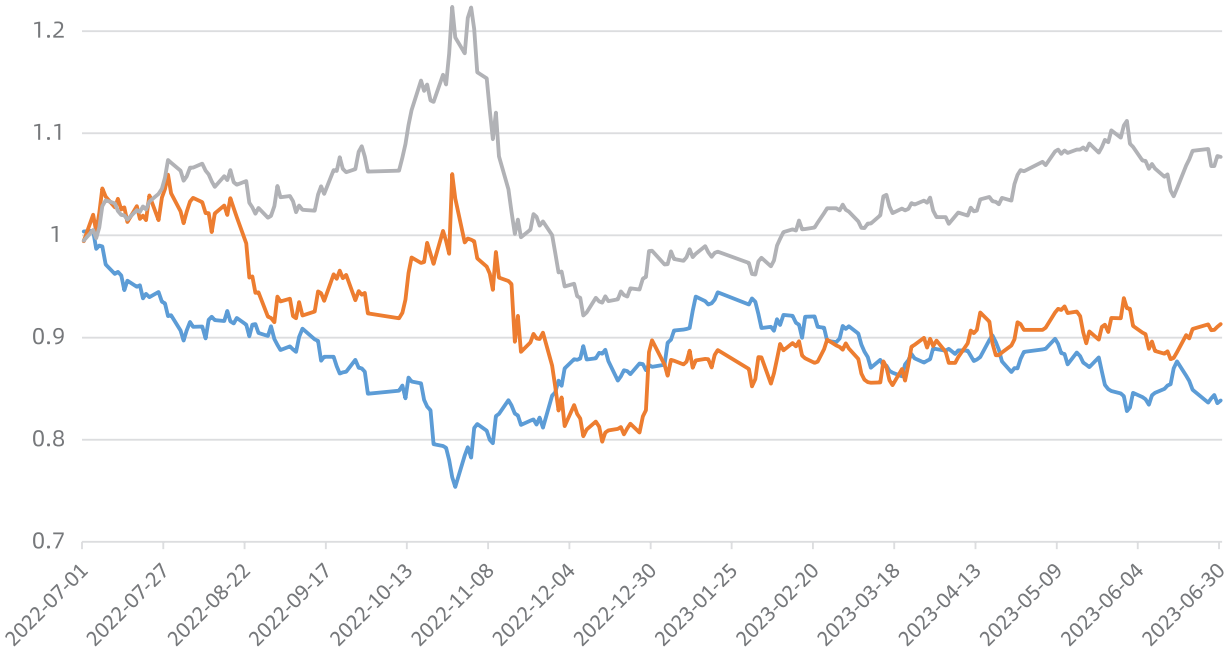
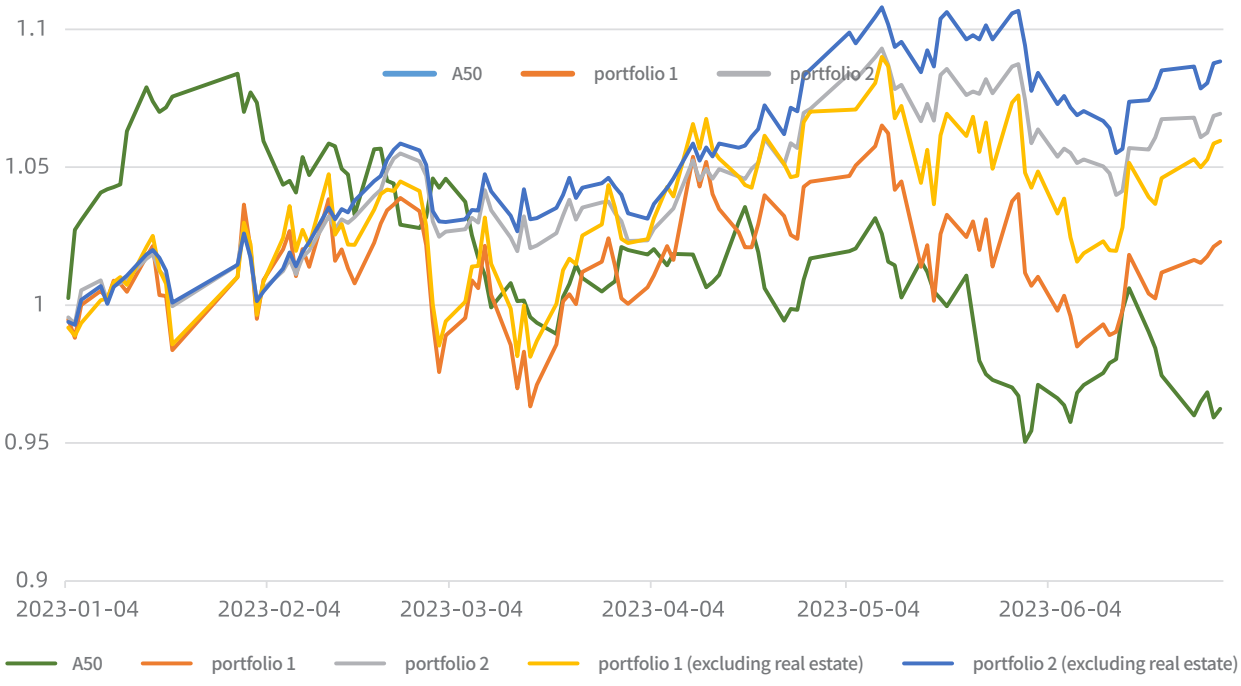



Figure 7-2-2 2023.1-2023.6 A50 Index and Long Short Portfolio NAVs



Next, we calculate the correlation coefficients between the A50 Index and the long-short stock portfolios, as shown in Tables 12, 13 and 14, which show that the correlation coefficients of Portfolio 1 are positive and Portfolio 2 are negative in the year 2022.The half-year of 2023 is similar to the one-year of 2022, although the correlation coefficients of Portfolio 1 (the top and bottom 5 companies) are positive when real estate stocks are not removed, which may be due to the influence of real estate stocks. Although the correlation coefficient of Portfolio 1 (top and bottom 5 firms) is positive when real estate stocks are not removed, this is also probably due to the influence of real estate stocks; in contrast, the correlation coefficient of Portfolio 2 (top and bottom 10 firms) is negative due to other firms' pulls. Therefore, we calculate the correlation coefficients again after removing the real estate companies.

After removing the real estate firms, we can see that the coefficients of portfolios one and two are both negative, which suggests that long portfolios of stocks with high carbon ratings and short portfolios of stocks with low carbon ratings can cope with systematic risks of economic downturns, and that the practical (hedging) performance of using carbon ratings as an investment factor strategy possesses superiority.

**Table 12 Correlation Coefficients of A50 Index and Long-Short Equity Portfolio for the Year 2022.7-2023.6**

| 2022.7.1-2023.6.30 | A50 with portfolio 1 | A50 with portfolio 2 |
|---|---|---|
| correlation coefficient | -0.5119 | 0.1481 |

**Table 13 Correlation Coefficients of the A50 Index and Long-Short Equity Portfolios, 2023.1-2023.6 (Excluding Real Estate)**

| 2023 semi-annual | A50 with portfolio 1 | A50 with portfolio 2 |
|---|---|---|
| correlation coefficient | -0.6934 | -0.3745 |

**Table 14 Correlation Coefficients of the A50 Index and Long-Short Equity Portfolios, 2023.1-2023.6**

| 2023 semi-annual | A50 with portfolio 1 | A50 with portfolio 2 |
|---|---|---|
| correlation coefficient | -0.6306 | 0.0394 |

## 7.3 Returns and Sharpe Indices for Several Equity Portfolios

Based on the daily returns of the top 5, top 10, bottom 5, and bottom 10 stocks, the buy/short portfolio returns, long/short volatility, and Sharpe ratios for July 2022 to June 2023 and for the beginning of January 2023 to the end of June 2023 were calculated as shown in Tables 16 and 17. When comparing the volatility indicators, the volatility of the top carbon rated companies is significantly less than that of the bottom carbon rated companies, implying that the portfolio is less risky.

From the table for the year 2022-2023, it can be seen that due to the poor performance of the top and bottom 5 firms, especially the top 5 firms, the return of Portfolio 1 is -8.67% and the Sharpe Ratio is -0.3, which indicates that for the same level of risk, the expected return to be obtained is negative, consistent with the reasons that we have stated above. Returning to Portfolio 2, it returned 7.7% for the year with a Sharpe ratio of 1.41, suggesting that Portfolio 2 was able to earn a positive excess return over Portfolio 1, which is also related to the better performance of China Taipao in the top 10 and internet firms in the bottom 10, as discussed above. Similar to the previous section, we next proceed to recalculate the returns, standard deviations, and Sharpe ratios by removing BIG from the portfolios. Table 16 shows that the return of Portfolio 1 after removing the real estate is -3.61% and the Sharpe ratio is 0.53 over the period 2022-2023, with both losses reduced and the same-risk excess return turning positive, which validates our idea that the entire portfolio is dragged down by the underperformance of individual real estate firms.

Table 15 Top 10 ROE, ROA and Net Profit Margin Chart

| Top 10 Enterprises | Return on Equity (ROE) | Return on Assets (ROA) | Net Interest Rate |
|---|---|---|---|
| Xiaomi Group-W | 1.76% | 0.87% | 0.89% |
| NetEase | 20.33% | 12.46% | 20.56% |
| Cinnamon Garden | 5.44% | 0.74% | 2.97% |
| Zhongsheng Holdings | 15.86% | 7.53% | 3.60% |
| Chow Tai Fook | 20.85% | 8.83% | 6.93% |
| Hang Seng Bank | 5.52% | 0.55% | 22.27% |
| Ping An of China | 10.03% | 1.01% | 9.67% |
| China Taipao | 10.81% | 1.22% | 5.54% |
| Agricultural Bank of China | 10.20% | 0.82% | 35.69% |
| Vanke Enterprises | 9.45% | 2.03% | 7.45% |

Table 16 Returns and Sharpe Ratios for Several Equity Portfolios in 2022.7-2023.6

| Carbon Rating | Portfolio Returns | Portfolio Annual Standard Deviation | Long/short Portfolio Returns | Long/short portfolio standard deviation | Sharpe Ratio |
|---|---|---|---|---|---|
| Top 5 Enterprises | -25.62% | 33.81% | -8.67% | 24.73% | -0.30 |
| Bottom 5 Enterprises | 1.91% | 47.26% | | | |
| Top 10 Enterprises | -15.87% | 29.35% | 7.70% | 16.87% | 1.41 |
| Bottom 10 Enterprises | -10.66% | 36.18% | | | |
| A50 index for 2022-2023 | | -16.14% | | | |

Table 17 Returns and Sharpe Ratio of Several Equity Portfolios for 2022.7-2023.6 (Excluding Real Estate)

| Carbon Rating | Portfolio Returns | Portfolio Annual Standard Deviation | Long/short Portfolio Returns | Long/short portfolio standard deviation | Sharpe Ratio |
|---|---|---|---|---|---|
| Top 5 Enterprises | -15.50% | 30.54% | -3.61% | 23.86% | 0.53 |
| Bottom 5 Enterprises | 1.91% | 47.26% | | | |
| Top 10 Enterprises | -10.29% | 27.02% | 10.49% | 17.05% | 1.56 |
| Bottom 10 Enterprises | -10.66% | 36.18% | | | |
| A50 index for 2022-2023 | | -16.14% | | | |

Table 18 Returns and Sharpe Ratio of Several Equity Portfolios for 2023.1-2023.6

| Carbon Rating | Portfolio Returns | Portfolio Annual Standard Deviation | Long/short Portfolio Returns | Long/short portfolio standard deviation | Sharpe Ratio |
|---|---|---|---|---|---|
| Top 5 Enterprises | -11.53% | 19.51% | 2.29%<br>(投资组合一) | 13.26%<br>(投资组合一) | 0.46 |
| Bottom 5 Enterprises | -12.03% | 25.98% | | | |
| Top 10 Enterprises | -6.81% | 17.37% | 6.94%<br>(投资组合二) | 7.43%<br>(投资组合二) | 1.44 |
| Bottom 10 Enterprises | -13.02% | 18.19% | | | |
| 2023 Half-yearly A50 index | | -3.757% | | | |

Table 19 Returns and Sharpe Ratio of Several Equity Portfolios for 2023.1-2023.6 (Excluding Real Estate)

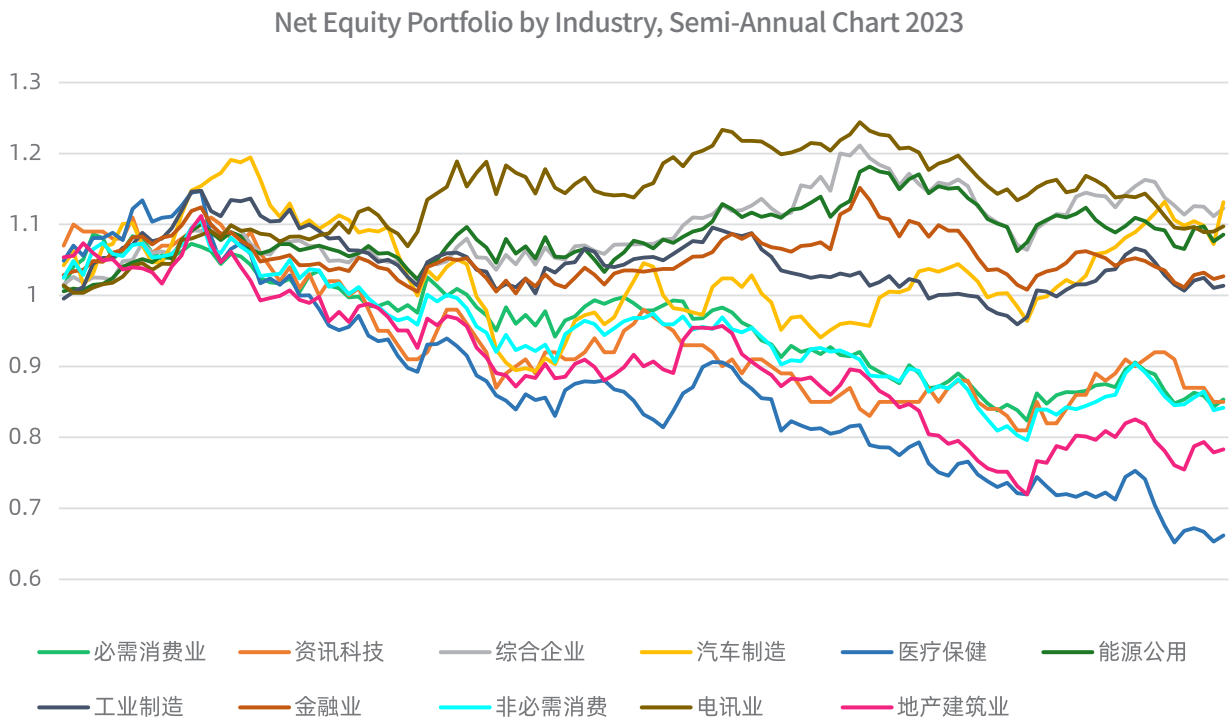
| Carbon Rating | Portfolio Returns | Portfolio Annual Standard Deviation | Long/short Portfolio Returns | Long/short portfolio standard deviation | Sharpe Ratio |
|---|---|---|---|---|---|
| Top 5 Enterprises | -4.19% | 17.75% | 5.96%<br>(投资组合一) | 12.78%<br>(投资组合一) | 0.46 |
| Bottom 5 Enterprises | -12.03% | 25.98% | | | |
| Top 10 Enterprises | -3.02% | 16.20% | 8.83%<br>(投资组合二) | 7.39%<br>(投资组合二) | 1.20 |
| Bottom 10 Enterprises | -13.02% | 18.19% | | | |
| 2023 Half-yearly A50 index | | -3.757% | | | |

## 7.4 Carbon Rating and Industry Return on Investment Analysis

As shown in Figure 7-4-1, the 100 enterprises entered into this carbon rating are categorized into 11 industries to make a net value graph of the stock portfolio of each industry for the six months of 2023. From the net value trend of each industry in the graph, it can be seen that the Automotive Manufacturing and Conglomerate have the highest investment returns of 13.16% and 12.28% respectively in 2023 (see Table 17), with a volatility of 13.45% and 18.37%, while Healthcare Industry and Real Estate & Construction have the worst industry returns of -33.83% and -21.69% respectively, with volatility of more than 22% in both cases.

Naturally, the number of companies included in each industry also affects their stock movements and volatility to varying degrees. For example, the Conglomerate include only two of the 100 enterprises in the report, with a high proportion of individual equity weighting, and their return and volatility within the sample are greatly affected by the high and low prices and changes of individual stocks, thus leading to different degrees of bias in the results of the investment trend and return rate of different industries, such as the financial industry includes 19 listed enterprises in the report, with a small proportion of individual equity weighting, and the industry's return and volatility are less affected by individual enterprises. The investment return and fluctuation rate of the industry are less affected by individual enterprises.

**Chart 7-4-1 2023 Half Year Equity Portfolio Net Value by Industry**

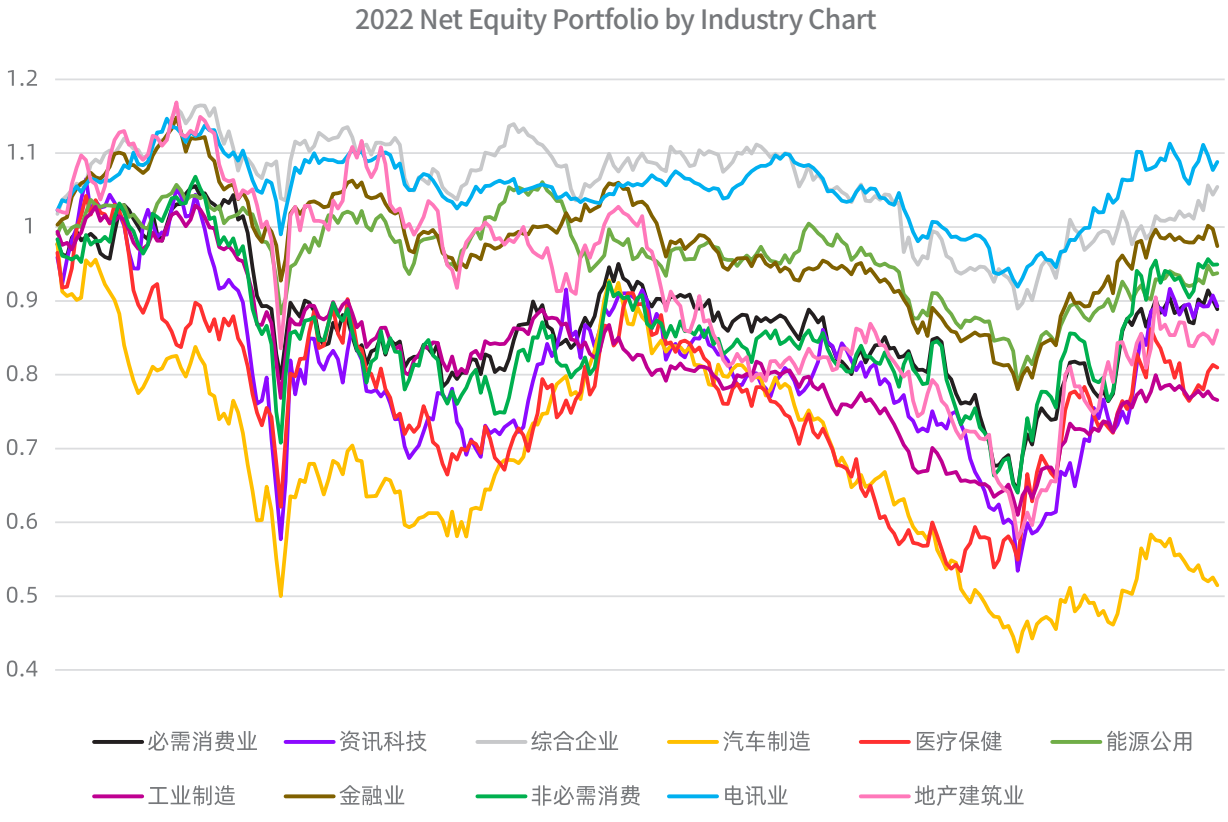



As shown in Figure 6-1-1 industry carbon rating performance and the investment performance metrics in Table 17, Finance, which ranked first in industry carbon, was in the upper mid-range with a return of 2.71%, while the second-ranked Non-Essential Consumer Discretionary had an underperforming equity portfolio with a return of -15.8%. While Energy & Public Utilities and Conglomerate ranked at the bottom of the list, both had higher investment

returns than the previous two, at 8.38% and 12.28% respectively. The reasons for this phenomenon are not only the inconsistency in the number of stocks mentioned before, but also the performance of individual stocks, which further illustrates the problem that the top ranking of the industry does not mean that the carbon rating of the enterprises belonging to the industry is top, for example, the financial industry is ranked first, but three out of nine of them have low carbon ratings (carbon rating of 75 or later), which to a certain extent pulls down the industry's ROI. In addition, in the just-past In 2022, China Merchants Bank stock price by the management change, its "signature" retail business overall non-performing rate rose and the real estate industry downturn and other reasons led to a sharp decline in the return on investment, and the direction of the increasingly challenged and pressured to invest in the direction of the loan. The healthcare industry, ranked 6th in carbon, has the weakest ROI performance, which is related to its low number of public companies in 2023, lower-than-expected number of financings, and the instability and lack of new technologies. In addition, the Fed's interest rate hike, the 2022 pandemic embargo, and the deteriorating employment environment have made the ESG positives outweighed by the broader market environment, thus weakening the carbon rating's predicted ROI performance for the financial industry as a whole.

In addition, the rate of return of the Automotive Manufacturing industry in the middle of the ranking is superior, but it has relatively high volatility, which is as high as 22.46%. This is mainly due to the positive impact of the dominant stock ideal automobile, and its half-year growth rate is as high as 67.3%. We guess that the reasons for its good performance in 2023 are the rich experience of the founding team members and the emphasis on user experience. It is committed to focusing on products, intelligent AI self-research, sales and service system. As shown in Figure 7-4-2, the automotive manufacturing industry has the weakest return on investment in 2022. It is the change of its business strategy and the emphasis on user groups that expand the audience to the masses in third - and fourth-tier cities and promote the development of enterprises from the aspects of user experience, staff quality,

**Figure 7-4-2 2022 Equity Portfolio by Industry Net Value Chart**



corporate governance and other ESG aspects. So that the return on investment in 2023 has significantly increased. In addition, the tenth ranked Energy & Public Utilities also had a better performance in the first half of 2023, which may be related to the "three barrels of oil" (Sinopec, petrochina, CNOOC) insisting on adjusting and optimizing the investment direction, optimizing the terminal network layout and infrastructure. The significant increase in the return on investment of these companies in 2023 is related to the concept of ESG, which further proves that good ESG practices can enable enterprises to have good prospects and excellent return on investment in the future.

Besides, we find that the telecommunications has an advantageous ROI both in 2022 and in the first half of 2023, which we suspect may be related to the faster growth of telecom business volume, further optimization of the business structure, and the continued decline in the price of integrated services. The telecommunications has continued to enhance its network infrastructure in the past two years, improving the breadth of its "double gigabit" network coverage and its data collection capabilities, and is committed to improving customer service experience. The Sharpe ratio of 0.95 implies that the telecommunications industry has a better return for the same risk, which makes it a more stable industry with a more pronounced bias in the investment market.

The above phenomenon and analysis suggests that financial indicators such as ROI and industry carbon ratings do not correlate well, and that portfolio screening based on industry rankings is not effective. Therefore, it is not convincing to screen portfolios based on industry carbon ratings, and the carbon rating scores of individual stocks within the industry should be considered for further analysis.

Table 17 Industry Equity Portfolio Returns and Sharpe Ratio, 2022

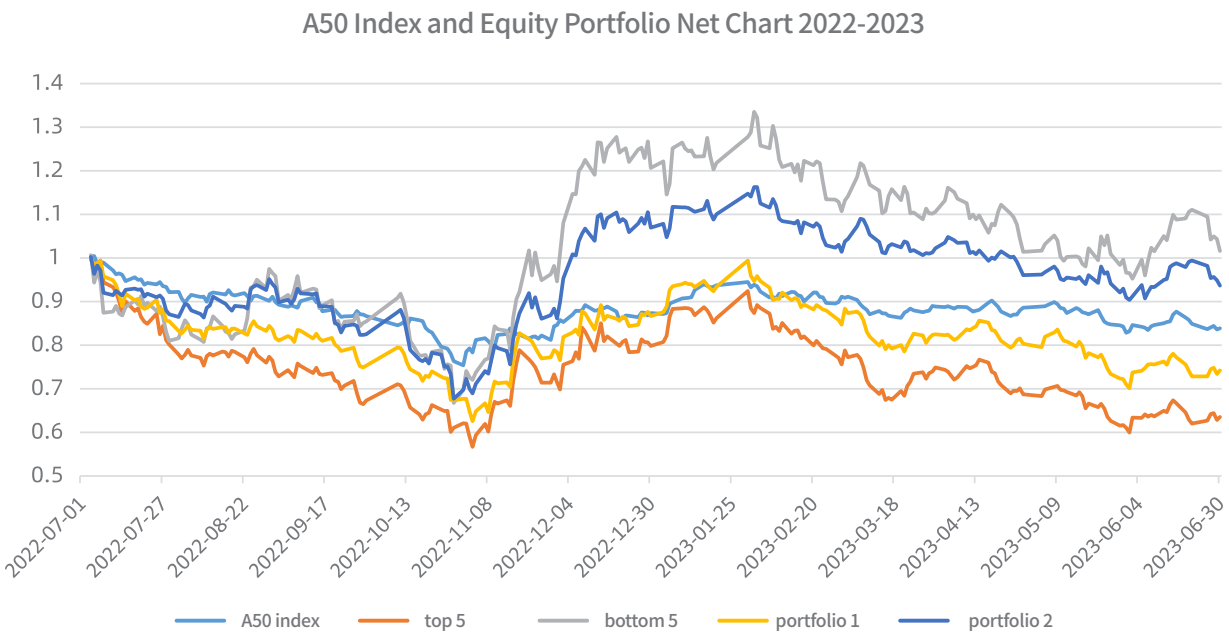
| Industry Name | Portfolio Returns | Portfolio Annual Standard Deviation | Market Risk Premium | Sharpe Ratio | Industry Rank |
|---|---|---|---|---|---|
| Consumer Staples | -14.67% | 17.04% | -0.10913 | -0.640434272 | 7 |
| Healthcare Industry | -15.28% | 21.63% | -0.11523 | -0.532732316 | 3 |
| Information Technology | 12.28% | 14.27% | 0.16037 | 1.123826209 | 11 |
| Automotive Manufacturing | 13.16% | 22.46% | 0.16917 | 0.753205699 | 5 |
| Healthcare Industry | -33.83% | 22.25% | -0.30073 | -1.351595506 | 6 |
| Energy & Public Utilities | 8.58% | 13.77% | 0.12337 | 0.895933188 | 10 |
| Industrial Manufacturing | 1.37% | 13.84% | 0.05127 | 0.370447977 | 9 |
| Finance | 2.71% | 13.45% | 0.06467 | 0.480817844 | 1 |
| Consumer Discretionary | -15.80% | 18.47% | -0.12043 | -0.652030319 | 2 |
| Telecommunications | 9.76% | 14.17% | 0.13517 | 0.953916725 | 8 |
| Real Estate & Construction | -21.69% | 21.02% | -0.17933 | -0.853139867 | 4 |
| FTSE China A50 Index | -3.76% | | | | |

# 8 Review of Carbon Rating Stock Portfolios in 2022

In order to further observe the relationship between the carbon rating situation and the return on investment of enterprises, and also to track the Carbon Rating Analysis Report of China's 100 Overseas Listed Companies in 2022 (hereinafter referred to as: After the release of the 2022 Carbon Rating Report, we selected the top 5, top 10, bottom 5 and bottom 10 stocks in last year's (2022) carbon rating. Based on the stock price data from July 1, 2022 to June 30, 2023. The net value trend is also compared with the FTSE China A50 index, as shown in Figure 8-1-1. During this period, the return of the FTSE China A50 index was -16.14%, which was significantly lower than the return of -3.76% in the half year of 2023, indicating that the market has been significantly lower since the second half of 2022.

## 8.1 A50 Index and Equity Portfolio Analysis 2022-2023

Figure 8-1-1 2022.7.1-2023.6.30 FTSE China A50 Index vs. Equity Portfolio Net Value Chart




As can be seen from the chart, the top 5 and 10 stocks in the Carbon Ratings have moved lower than the bottom 5 and 10 stock combinations, similar to the eventual trend in Figure 7-1-1 above. Combined with the stock price charts of the 2022 Carbon Rating Report, we find that the top 5 and 10 stocks have been significantly weaker than the market since mid-2022, while the bottom 5 and 10 stocks have been significantly better and outperformed the broader market. In addition to the economic downturn and declining real estate industry mentioned above, we note that Li Ning, the tenth-ranked carbon company, has seen its stock price go down in 2022. We guess it is due to the fierce competition in domestic sportswear in recent years, the brand is more concerned about brand image and long-term development in the market competition, rather than lowering its selling price in pursuit of short-term

profitability. In addition, the shift of its distributor model to direct retailing has led to uncertainty in its performance in the short term. The third-ranked company, Zhongsheng Holdings, saw its return drop by 43.4%. As a leading automobile dealership group in China, Zhongsheng Holdings' main sources of revenue include new car sales and after-sales services. This may be due to the slowdown in China's passenger car sales growth, and auto dealership companies are generally facing rising inventories and falling performance.

On the flip side of the share price movement of the bottom 10 companies, Ctrip stock, ranked in the bottom 5, returned 23.4% during the said period. With the liberalization of the domestic epidemic policy at the end of 2022, international and domestic exchanges are no longer restricted, and the tourism industry is beginning to recover, Ctrip, as a major digital travel platform, can be predicted to see a rebound in its share price. In addition, 99th-ranked Tencent Music returned a whopping 42.2%, with its innovative online music business model delivering significant short-term business growth, as well as the completion of its secondary listing on the Hong Kong Stock Exchange in 2022 also driving up the share price. The high returns of these two stocks significantly boosted the overall returns of the bottom 5 and 10 portfolios.

## 8.2 A50 Index and Long-Short Equity Portfolio Analysis 2022-2023

Next, to verify the performance of the portfolios of the carbon rated companies in 2022, we still try to buy the top 5 stocks and sell the bottom 5 stocks, and buy the top 10 stocks and sell the bottom 10 stocks to become two portfolios. Analyzing their investment return and volatility metrics between July 1, 2022 and June 30, 2023, Figure 8-1-2 reflects the net value movements of the A50 Index and the two long/short stock portfolios.

**Figure 8-1-2 2022.7.1-2023.6.30 FTSE China A50 Index vs. Long/Short Equity Portfolio NAVs**

Similar to Figure 7-2-1, the top 10 and bottom 10 portfolios outperformed the top 5 and bottom 5 portfolios and consistently outperformed the market. It shows that the net performance of the stock portfolio with good carbon rating and the stock portfolio with low carbon ranking can outperform the market and generate excess returns stably. At the same time, we should also note that during the period after December 2022, the net performance of the portfolio of long the first 5 stocks and short the last 5 stocks changed from better than the A50 index to lower than the market, which should be due to the severe downward impact of the real estate industry mentioned above. However, through comparison, it can be found that, whether it is the portfolio 1 or portfolio 2, the trend of long and short stock portfolios is better than that of the corresponding stock portfolios in Figure 8-1-1, indicating that long high-quality stock portfolios and short inferior stock portfolios can produce better investment returns.

In addition, the top 5 and bottom 5 portfolios and the top 10 and bottom 10 portfolios showed upward net value movements during the June 2023 year-end period, which would be even more compelling if the period were longer. We believe that these two portfolios will continue to outperform the market and demonstrate their portfolio strengths against the downside of the economic cycle.

Finally, similar findings were obtained by calculating the returns, standard deviations, long/short portfolio returns, and Sharpe ratios for the four equity portfolios in Table 17 below.

**Table 17 Equity Portfolio Returns, Volatility and Sharpe Ratio, 2022 – 2023**

| 2022.7.1 — 2023.6.30 | | | | | |
|---|---|---|---|---|---|
| Carbon rating | Portfolio Returns | Portfolio Annual Standard Deviation | Long/Short Portfolio Returns | Long/Short portfolio standard deviation | Sharp ratio |
| Top 5 enterprises | -36.52% | 38.71% | -13.85 | 25.98% | 0.09 |
| Bottom 5 enterprises | 1.58% | 47.75% | | | |
| Top 10 enterprises | -25.78% | 31.93% | -5.8% | 15.20% | 0.68 |
| Bottom 10 enterprises | -6.36% | 33.75% | | | |
| A50 Index for 2022-2023 | | -16.14% | | | |

The top 5 stock portfolios are significantly pulled down by the two real estate stocks, which only pull down the returns of the top 5 and top 10 stock portfolios by -36.52% and -25.78% respectively. However, the annual standard deviation of the top 5 portfolios is smaller than that of the bottom 5 portfolios, and that of the top 10 portfolios is smaller than that of the bottom 10 portfolios. Overall, the volatility of the portfolios of the carbon rated companies is smaller than that of the portfolios of the carbon rated companies, which suggests that the volatility of the stock prices of the companies with good ESG performance is lower than that of the companies with poorer performance. Especially in the case of COVID-19, which increases the volatility of firms' stock prices, the increase in stock price volatility of firms focusing on ESG performance is smaller, and they have the advantage of being more "resilient" and stabilizing their stock prices (Zhou, 2022). The volatility of the portfolio of long-five-short-five is higher than that of long-ten-short-ten, which indicates that the volatility of the portfolio of long-ten-short-ten is smaller, and it is more attractive to long-term capitals pursuing low-risk investment, and the portfolio of long-ten-short-ten includes some high-quality companies in the carbon rating, which is able to better bear and diversify the investment risk.

When using the FTSE China A50 Index's investment return over the same period as a benchmark to calculate the Sharpe ratio, the Sharpe ratio for the long-first-short-last-five portfolio is 0.09, which is lower than that of the long-first-short-last-five portfolio, which is 0.68. This means that the latter portfolio is expected to earn more than the former portfolio given the same level of risk.

Overall, a similar pattern emerges when we look at the stock price movements of carbon ranked companies in 2022 and 2023 in Chapter 7 of this report.That is, the top carbon ranked companies tend to have better investment return performance due to their greater focus on ESG practices and better disclosure of ESG-related information. Although some of the ESG-performing stocks have weakened, resulting in lower portfolio returns, suggesting that the positive impact of ESG is not as strong as changes in the general environment, such as epidemics and general economic downturns, we also find that companies with good ESG practices tend to be more resilient and dominant in recessionary environments.

# 9 Summary and perspectives

Nowadays, carbon disclosure is of great practical significance to the development of companies, and the advantageous companies in the capital market generally have higher disclosure levels, while the stock market positively incentivizes companies with high disclosure levels, forming a positive cycle.At the same time, under the dual-carbon policy system, carbon disclosure, a social and environmental element, will continue to receive attention from the capital market, and will have a greater impact on the company's share price, profits and other financial performance. Therefore, it is all the more necessary for all companies to improve the optimization of their own carbon emission management and disclosure system, so as to reduce their carbon emission intensity and improve the quality of carbon disclosure while accomplishing their own emission reduction targets.

**Appendix 1: Summary Table of Company Carbon Ratings**

| Company Name | Industry | Carbon Rating | Actual Carbon Emission Scores | Actual Carbon Emission Reduction Score | Carbon Disclosure Quality Score | Future Emission Reduction Plan Score | Total Score |
|---|---|---|---|---|---|---|---|
| Xiaomi Group-W | Information Technology | 1 | 1367.6610 | 274.0036 | 350 | 150 | 2,141.66 |
| NetEase | Information Technology | 2 | 1177.5817 | 78.5367 | 400 | 50 | 1,706.12 |
| Cinnamon Garden | Real Estate & Construction | 3 | 852.8147 | 328.2808 | 350 | 50 | 1,581.10 |
| Zhongsheng Holdings | Consumer Discretionary | 4 | 734.6255 | 98.1233 | 300 | 150 | 1,282.75 |
| Chow Tai Fook | Consumer Staples | 5 | 496.5916 | 119.4920 | 400 | 150 | 1,166.08 |
| Hang Seng Bank | Finance | 6 | 346.0436 | 126.3951 | 450 | 150 | 1,072.44 |
| Ping An of China | Finance | 7 | 385.8782 | 131.4262 | 400 | 150 | 1,067.30 |
| China Taipao | Finance | 8 | 559.1392 | 120.6099 | 300 | 50 | 1,029.75 |
| Agricultural Bank of China | Finance | 9 | 373.6170 | 97.7038 | 400 | 150 | 1,021.32 |
| Vanke Enterprises | Real Estate & Construction | 10 | 463.7982 | 98.1062 | 400 | 50 | 1,011.90 |
| Li Ning | Consumer Staples | 11 | 389.9320 | 116.1820 | 350 | 150 | 1,006.11 |
| Geely Automobile | Automative Manufacturing | 12 | 231.7754 | 119.3982 | 450 | 150 | 951.17 |
| China Overseas Development | Real Estate & Construction | 13 | 332.3751 | 65.3820 | 400 | 150 | 947.76 |
| Xinao Energy | Energy & Public Utilities | 14 | 302.2487 | 118.9538 | 350 | 150 | 921.20 |

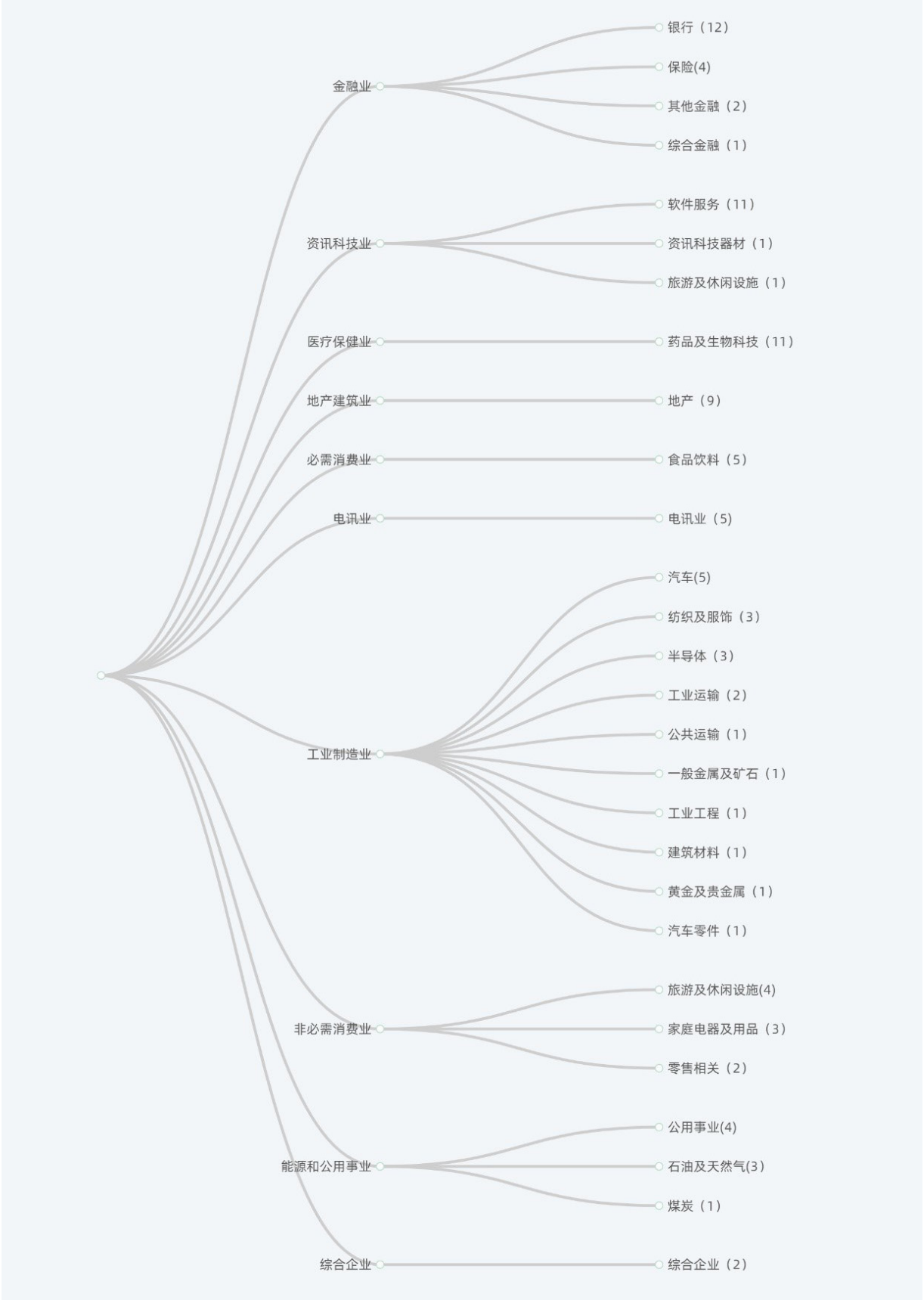
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| BOCOM | Information Technology | 15 | 209.1197 | 60.9174 | 500 | 150 | 920.04 |
| Sun Hung Kai Properties | Real Estate & Construction | 16 | 158.7950 | 95.1221 | 500 | 150 | 903.92 |
| WuXi AppTec | Healthcare | 17 | 114.6189 | 120.7452 | 500 | 150 | 885.36 |
| Alibaba | Information Technology | 18 | 68.6068 | 204.8662 | 450 | 150 | 873.47 |
| China Tower | Telecommunications | 19 | 241.9223 | 74.9172 | 400 | 150 | 866.84 |
| Budweiser Asia Pacific | Consumer Staples | 20 | 138.7949 | 127.4457 | 450 | 150 | 866.24 |
| China Everbright Bank | Finance | 21 | 285.7316 | 111.8665 | 350 | 100 | 847.60 |
| Baidu | Information Technology | 22 | 93.5045 | 103.8019 | 500 | 150 | 847.31 |
| Ganfeng Lithium | Industrial Manufacturing | 23 | 19.2854 | 323.4531 | 350 | 150 | 842.74 |
| Baiji Shenzhou | Healthcare | 24 | 204.2602 | 174.6575 | 350 | 100 | 828.92 |
| Hong Kong Stock Exchange | Finance | 25 | 113.2157 | 112.5973 | 450 | 150 | 825.81 |
| CITIC Securities | Finance | 26 | 239.7357 | 121.0416 | 300 | 150 | 810.78 |
| WuXi Biotechnology | Healthcare | 27 | 131.3446 | 124.6133 | 400 | 150 | 805.96 |
| Great Wall Motor | Automative Manufacturing | 28 | 142.7593 | 107.3159 | 400 | 150 | 800.08 |
| BOC Hong Kong | Finance | 29 | 140.9329 | 102.4067 | 400 | 150 | 793.34 |
| Tencent Holdings | Information Technology | 30 | 130.8375 | 59.1190 | 450 | 150 | 789.96 |
| China Post Bank | Finance | 31 | 226.3297 | 63.2439 | 350 | 150 | 789.57 |
| UMC | Industrial Manufacturing | 32 | 21.5209 | 117.7295 | 500 | 150 | 789.25 |
| Chunghwa Telecom | Telecommunications | 33 | 135.6200 | 100.0000 | 400 | 150 | 785.62 |
| Mengniu Dairy | Consumer Staples | 34 | 123.4463 | 100.0000 | 400 | 150 | 773.45 |
| Tiger Pharmaceuticals | Healthcare | 35 | 204.2602 | 68.6060 | 350 | 150 | 772.87 |
| China Biopharmaceutical | Healthcare | 36 | 173.0785 | 87.7481 | 350 | 150 | 760.83 |
| China Resources Land | Real Estate & Construction | 37 | 147.6359 | 211.0799 | 300 | 100 | 758.72 |
| China Mobile | Telecommunications | 38 | 51.5789 | 104.6641 | 450 | 150 | 756.24 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| TSMC | Industrial Manufacturing | 39 | 38.7333 | 111.9344 | 450 | 150 | 750.67 |
| COSCO Sea Controls | Industrial Manufacturing | 40 | 12.6221 | 186.3480 | 400 | 150 | 748.97 |
| Sands China Ltd. | Consumer Discretionary | 41 | 14.3265 | 125.6763 | 450 | 150 | 740.00 |
| Racer | Information Technology | 42 | 43.7159 | 195.1684 | 350 | 150 | 738.88 |
| Fosun Pharmaceuticals | Healthcare | 43 | 73.4053 | 115.3020 | 400 | 150 | 738.71 |
| Changshi Group | Real Estate & Construction | 44 | 89.4556 | 98.2425 | 400 | 150 | 737.70 |
| Anta Sports | Consumer Discretionary | 45 | 161.2990 | 71.3597 | 350 | 150 | 732.66 |
| Zijin Mining | Industrial Manufacturing | 46 | 32.5168 | 100.0948 | 450 | 150 | 732.61 |
| Nongfushanquan | Consumer Staples | 47 | 66.9095 | 106.0484 | 400 | 150 | 722.96 |
| Chuangke Industry | Consumer Staples | 48 | 220.3369 | 100.0000 | 250 | 150 | 720.34 |
| Henderson Real Estate | Real Estate & Construction | 49 | 61.4100 | 100.0000 | 400 | 150 | 711.41 |
| Ideal Automobile | Automative Manufacturing | 50 | 231.7754 | 78.7679 | 300 | 100 | 710.54 |
| China Merchants Bank | Finance | 51 | 169.8474 | 87.2164 | 400 | 50 | 707.06 |
| China Telecom | Telecommunications | 52 | 60.7041 | 95.2749 | 400 | 150 | 705.98 |
| Shenzhou International | Industrial Manufacturing | 53 | 21.8226 | 81.3868 | 450 | 150 | 703.21 |
| China Gas | Energy & Public Utilities | 54 | 159.5375 | 91.2839 | 400 | 50 | 700.82 |
| Changhe | Conglomerate | 55 | 28.2596 | 122.3782 | 400 | 150 | 700.64 |
| China Construction Bank | Finance | 56 | 60.2156 | 87.8262 | 400 | 150 | 698.04 |
| CITIC | Conglomerate | 57 | 8.3574 | 84.5408 | 450 | 150 | 692.90 |
| Bank of China | Finance | 58 | 49.0524 | 93.1480 | 400 | 150 | 692.20 |
| Kanglonghua | Healthcare | 59 | 100.4582 | 90.0317 | 350 | 150 | 690.49 |
| Galaxy Entertainment | Consumer Discretionary | 60 | 5.0065 | 234.0751 | 300 | 150 | 689.08 |
| CLP Holdings | Energy & Public Utilities | 61 | 1.2462 | 83.7735 | 450 | 150 | 685.02 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Henson Pharmaceuticals | Healthcare | 62 | 157.7442 | 118.6399 | 250 | 150 | 676.38 |
| CNOOC | Energy & Public Utilities | 63 | 18.6461 | 154.9407 | 350 | 150 | 673.59 |
| PetroChina | Energy & Public Utilities | 64 | 11.9550 | 111.1764 | 400 | 150 | 673.13 |
| Sinopec | Energy & Public Utilities | 65 | 12.3495 | 110.5564 | 400 | 150 | 672.91 |
| China Resources Breweries | Consumer Staples | 66 | 76.0616 | 96.0712 | 400 | 100 | 672.13 |
| Haier Zhijia | Consumer Discretionary | 67 | 238.9756 | 26.3847 | 250 | 150 | 665.36 |
| Fuyao Glass | Industrial Manufacturing | 68 | 13.8123 | 99.8591 | 400 | 150 | 663.67 |
| Minsheng Bank | Finance | 69 | 246.5813 | 62.7618 | 300 | 50 | 659.34 |
| Industrial and Commercial Bank of China | Finance | 70 | 43.2712 | 115.0864 | 350 | 150 | 658.36 |
| China Unicom (Hong Kong) | Telecommunications | 71 | 50.3123 | 107.3677 | 350 | 150 | 657.68 |
| CITIC Bank | Finance | 72 | 163.1255 | 87.9088 | 350 | 50 | 651.03 |
| Jingdong Health | Healthcare | 73 | 204.2602 | 39.0060 | 350 | 50 | 643.27 |
| SMIC | Industrial Manufacturing | 74 | 15.4683 | 122.5991 | 350 | 150 | 638.07 |
| Shell | Information Technology | 75 | 239.3461 | 96.4668 | 200 | 100 | 635.81 |
| Longfor Group | Real Estate & Construction | 76 | 229.5096 | 103.7694 | 250 | 50 | 633.28 |
| Azure | Automative Manufacturing | 77 | 231.7754 | 0.0000 | 350 | 50 | 631.78 |
| China Feihe | Consumer Staples | 78 | 139.0536 | 89.9216 | 350 | 50 | 628.98 |
| Bank of Communications | Finance | 79 | 56.4066 | 120.8391 | 300 | 150 | 627.25 |
| BeiliBeili | Information Technology | 80 | 277.5750 | 195.6532 | 100 | 50 | 623.23 |
| Yum China | Consumer Discretionary | 81 | 13.6328 | 108.1298 | 350 | 150 | 621.76 |
| Consenol Bio-B | Healthcare | 82 | 93.5393 | 25.1643 | 350 | 150 | 618.70 |
| China Property & Casualty | Finance | 83 | 122.4620 | 95.6491 | 350 | 50 | 618.11 |
| Simcoe International | Consumer Staples | 84 | 76.9778 | 86.2670 | 350 | 100 | 613.24 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sunny Optical Technology | Industrial Manufacturing | 85 | 101.5182 | 58.3675 | 300 | 150 | 609.89 |
| China Life | Finance | 86 | 97.6604 | 93.7389 | 350 | 50 | 591.40 |
| Hong Kong and China Gas | Energy & Public Utilities | 87 | 16.6693 | 67.4888 | 350 | 150 | 584.16 |
| China Shenhua | Energy & Public Utilities | 88 | 1.5240 | 74.9717 | 350 | 150 | 576.50 |
| Haiyan International Holdings | Consumer Discretionary | 89 | 19.3867 | 93.8829 | 300 | 150 | 563.27 |
| Conch Cement | Industrial Manufacturing | 90 | 0.7951 | 60.1869 | 350 | 150 | 560.98 |
| MTR Corporation | Industrial Manufacturing | 91 | 17.7527 | 78.0022 | 300 | 150 | 545.75 |
| Cinnamon Services | Real Estate & Construction | 92 | 29.8325 | 154.1310 | 300 | 50 | 533.96 |
| Zhongtong | Industrial Manufacturing | 93 | 22.2984 | 99.9053 | 350 | 50 | 522.20 |
| Ali Health | Healthcare | 94 | 204.2602 | 100.0000 | 150 | 50 | 504.26 |
| BYD | Automative Manufacturing | 95 | 60.2487 | 93.6179 | 250 | 100 | 503.87 |
| Ctrip | Information Technology | 96 | 109.6820 | 77.1527 | 200 | 50 | 436.83 |
| Meituan-W | Information Technology | 97 | 0.0000 | 0.0000 | 0 | 0 | - |
| Pinduoduo | Information Technology | 98 | 0.0000 | 0.0000 | 0 | 0 | - |
| Tencent Music | Information Technology | 99 | 0.0000 | 0.0000 | 0 | 0 | - |
| FUTURE HOLDINGS | Finance | 100 | 0.0000 | 0.0000 | 0 | 0 | - |

## Appendix 2: Sectoral Tier 1 and Tier 2 Indicator Classification



# References

Nollet, J., Filis, G., & Mitrokostas, E. （2016）. Corporate social responsibility and financial performance: A non-linear and disaggregated approach. Economic Modelling, 52, 400-407. doi:10.1016/j.econmod.2015.09.019

Sabbaghi, O. (2022). The impact of news on the volatility of ESG firms. Global Finance Journal, 51, 100570.

中国太平洋保险 (Ed.). (2022). 中国太保可持续发展报告 .《中国太平洋 (3.640, 0.33, 9.97%) 保险 (集团) 股份有限公司环境、社会及治理规划》（2023-2025）. https://www.cpic.com.cn/upload/resources/file/2023/04/21/70630.pdf

Atz, U., Van Holt, T. and Liu, Z. (2021) “Do corporate sustainability and sustainable finance generate better financial performance? A review and meta-analysis.” SSRN

Albuquerque, R., Koskinen, Y., & Zhang, C. (2019). Corporate social responsibility and firm risk: Theory and empirical evidence. Management Science, 65(10), 4451-4469.

Serafeim, G., & Yoon, A. (2022). Stock price reactions to ESG news: The role of ESG ratings and disagreement. Review of accounting studies, 1-31.

Shanaev, S., & Ghimire, B. (2022). When ESG meets AAA: The effect of ESG rating changes on stock returns. Finance Research Letters, 46, 102302.

Dyck, A., Lins, K. V., Roth, L., & Wagner, H. F. (2019). Do institutional investors drive corporate social responsibility? International evidence. Journal of financial economics, 131(3), 693-714.

El Ghoul, S., Guedhami, O., Wang, H., & Kwok, C. C. (2016). Family control and corporate social responsibility. Journal of Banking & Finance, 73, 131-146.

Stellner, C., Klein, C., & Zwergel, B. (2015). Corporate social responsibility and Eurozone corporate bonds: The moderating role of country sustainability. Journal of Banking & Finance, 59, 538-549.

Schiller, C. (2018, April). Global supply-chain networks and corporate social responsibility. In 13th Annual Mid-Atlantic Research Conference in Finance (MARC) Paper.

Ilhan, E., Sautner, Z., & Vilkov, G. (2021). Carbon tail risk. The Review of Financial Studies, 34(3), 1540-1571.
Fatemi, A., Fooladi, I., & Tehranian, H. (2015). Valuation effects of corporate social responsibility. Journal of Banking & Finance, 59, 182-192.

Hong, H., Kubik, J. D., & Scheinkman, J. A. (2012). Financial constraints on corporate goodness (No. w18476). National Bureau of Economic Research.

Gillan, S. L., Koch, A., & Starks, L. T. (2021). Firms and social responsibility: A review of ESG and CSR research in corporate finance. Journal of Corporate Finance, 66, 101889.

Van Duuren, E., Plantinga, A., & Scholtens, B. (2016). ESG integration and the investment management process: Fundamental investing reinvented. Journal of Business Ethics, 138, 525-533.

Giese, G., Lee, L. E., Melas, D., Nagy, Z., & Nishikawa, L. (2019). Foundations of ESG investing: How ESG affects equity valuation, risk, and performance. The Journal of Portfolio Management, 45(5), 69-83.

Int. J. Environ. Res. Public Health 2022, 19(1), 202; https://doi.org/10.3390/ijerph19010202

香港中文大學（深圳）
The Chinese University of Hong Kong, Shenzhen

深圳数据经济研究院
SHENZHEN INSTITUTE OF DATA ECONOMY

SHENZHEN INSTITUTE of ARTIFICIAL INTELLIGENCE AND ROBOTICS for SOCIETY
深圳市人工智能与机器人研究院

ESG未来基金会
ESG FUTURE FOUNDATION

Intelligent Carbon