Intelligent Carbon

# 2022

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

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# 1 Research Background and Significance

On September 22, 2020, President Xi Jinping declared, at the General Debate of the 75th Session of the United Nations General Assembly, that China shall scale up its Nationally Determined Contributions (NDCs) by adopting more vigorous policies and measures, and aims to have $CO_2$ emissions peak before 2030 and achieve carbon neutrality before 2060. This remark is an epitome of China's responsible attitude in global climate governance. In October 2021, the Central Committee of the Communist Party of China and the State Council jointly released a document titled *Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy* and *the Action Plan for Reaching Carbon Dioxide Peak Before 2030*, formulating a package of policies centering carbon peaking and carbon neutrality. On November 1, 2021, President Xi Jinping delivered a written speech at the 26th Session of the Conference of the Parties (COP26) to the United Nations Framework Convention on Climate Change (UNFCCC), proposing initiatives to respond to climate change and revive the world economy, with an emphasis on the need to uphold multilateral consensus, focus on concrete actions and accelerate the green transition. On July 16, 2021, China's national carbon market officially started trading, and initially targeted emissions from the power sector. But due to the package of policies centering carbon peaking and carbon neutrality, the coverage of China's national Emissions Trading Scheme (ETS) will gradually expand, eventually covering seven major industries, including petrochemicals, chemicals, building materials, steel, non-ferrous metals, paper making, and domestic civil aviation, with more enterprises involved to bear the economic and environmental cost of excessive emissions. With the advancement of carbon peak and carbon neutrality policy, as well as the establishment of the national carbon trading market, subversive changes will take place in the energy structure and the economic development model of China.

Currently, there are two channels for Chinese listed-companies to actively disclose carbon emission information to the public: some companies mainly disclose emission data in a dedicated chapter in their annual statement, ESG reports or sustainable development reports; while some other enterprises (e.g. Alibaba, Tencent, China Merchants Bank[1], etc.) will release another special report specifically on

[1] Tencent Holdings disclosed the Tencent Carbon Neutrality Target and Roadmap Report in 2022; Alibaba Group disclosed the 2020 Corporate Carbon Neutrality Action Report in 2021; China Merchants Bank disclosed the 2020 Environmental Information Disclosure Report in 2021

carbon emissions in addition to their ESG reports, with all raw data and their respective Greenhouse Gas (GHG) accounting methods adopted. As of 2021, only about 20% of A-share listed companies have disclosed information[2] related to climate change and carbon emissions. However, the quality of data disclosed in ESG reports issued by different companies varied, and so do the types. Most of the listed-companies in China are voluntarily doing the disclosure in a discretionary way, without any uniform information disclosure standards. Therefore, this report hereby researches on the top 100 Chinese listed-companies by market value on the New York Stock Exchange (NYSE), Nasdaq, and Hong Kong Exchanges and Clearing (HKEX), and analyzes their ESG reports or sustainability reports issued in 2019, 2020 and 2021. Based on such factors as the actual emissions, emissions intensity, carbon reduction efforts, the quality of data disclosure, and future emission reduction goals, scores will be given through a quantitative analysis. With the multi-dimensional rating, the Report aims to enhance companies' awareness of self-disclosure of emission-related information, improve the disclosure quality, as well as to make the carbon disclosure of enterprises more professional, standardized and complete.

## 1.1 The Significance of Carbon Disclosure for Enterprises

Facing the goal to have $CO_2$ emissions peak before 2030 and achieve carbon neutrality before 2060, Chinese enterprises not only need to rapidly promote low-carbon business development, but also disclose their emission data and related environmental information in a timely, accurate and comprehensive manner. As carbon emission of enterprises is closely linked to their operating costs under the ETS, in order to better assess the solvency of enterprises and price corporate assets, the capital market has also put forward higher requirements for the quality and comparability of carbon disclosure. On March 21, 2022, the Securities and Exchange Commission (SEC) proposed rule changes that would require registrants to include disclosures about emission and climate-related risks in their registration statements and periodic reports, including its direct GHG emissions that occur from their controlled or owned sources (Scope 1), indirect emissions from purchased electricity or other forms of energy (Scope 2), as well as other emissions from upstream and downstream activities in the supply chain (Scope 3). More and more investors have recognized significant impact climate risks may have on the financial health of listed companies, hence the need for more related and accurate information to make investment decisions. Clear disclosure requirements can help listed companies disclose information more efficiently, which is also in the common interests of both investors and listed companies. There are two practical benefits of high-quality corporate carbon disclosure: Firstly, true and accurate carbon emission is the basis for ETS. The raw data for carbon accounting should be transparent, public and complete; Secondly, the high-quality disclosure of carbon-related information will help guide the flow of capital, enable the public to understand the actual GHG emissions of enterprises, and facilitate enterprises to achieve the vision of carbon peaking and carbon neutrality.

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[2] 2021 Carbon Information Transparency of Listed Companies in China compiled by GoldenBee and JRJ

The global trend of low-carbon business development also encourages Chinese companies to further improve their carbon disclosure and management systems. The Economic and Financial Committee of the European Council reached an agreement on March 22, 2022, to formally launch the Carbon Border Adjustment Mechanism (CBAM) and levy corresponding taxes on five categories of imports with high carbon emissions, namely, cement, fertilizers, iron and steel, aluminum, as well as electricity. CBAM requires importers to declare emissions embedded in their goods and pay the price for carbon emission by purchasing the CBAM certificates for imports. Such a carbon tariff imposed by the EU will have a direct impact on exporters of products with high carbon footprint. And the new competitive landscape will bring challenges to exports in steel, petrochemical and other fields, further stimulating the development of low-carbon production technology, carbon accounting, and carbon disclosure. Chinese enterprises will also be encouraged to the improve the carbon disclosure system as well. Meanwhile, with the development of ESG investment, more stringent requirements have been set in place for the sustainability-related disclosure of financial institutions globally, which will also affect other industries through the investment value chain, urging Chinese financial institutions and their invested enterprises to improve the transparency of emission-related data and environmental information. In addition, Chinese companies with high energy consumption and emissions that are listed both in and abroad, or those with both import and export businesses, also need to disclose detailed carbon emissions in their annual financial statements due to the mandatory requirement for environmental information disclosure (EID) overseas. Faced with such peer pressure, domestic companies in the same industry will be prompted to disclose more emission-related information.

Authorities of environmental supervision in China have formulated preliminary management rules and policies regarding the mandatory carbon disclosure, but there is no unified and clear carbon disclosure standard or mandatory requirement for A-share listed companies. In June 2021, the China Securities Regulatory Commission (CSRC) revised the format guidelines for annual and semi-annual reports of listed companies, adding that "companies are encouraged to voluntarily disclose relevant information about ecological protection, especially the measures and results of reducing their carbon emissions during the reporting period." In October 2021, the Central Committee of the Communist Party of China and the State Council jointly released a document titled Working Guidance for Carbon Dioxide Peaking and Carbon Neutrality in Full and Faithful Implementation of the New Development Philosophy,, clearly proposing to improve the carbon emission reporting and disclosure systems of enterprises and financial institutions. On January 4, 2022, the Ministry of Ecology and Environment (MEE) issued and implemented the Standards for the Format of Mandatory Corporate Environmental Information Disclosure, requiring major GHG emitters in the national carbon market to disclose carbon emission-related information. With the gradual improvement of China's national carbon market, an increasing number of companies will be included in the scope of mandatory disclosure, which will also prompt listed companies to establish systems for carbon management and comprehensive environmental information disclosure.

## 1.2 The Significance of Carbon Disclosure for the Capital Market

As important quantitative information to measure ESG sustainability, corporate carbon emission can be classified into two categories: raw data for carbon accounting and corporate emission mitigation. The raw data for accounting includes such data as energy consumption, fuel consumption, heat purchase, and GHG emissions. In addition, the carbon emissions and carbon intensity of an enterprise are also closely related to several factors, including the industry where they operate, the type of products they produce, the business operation mode, and their operating costs. The announcement of corporate carbon mitigation targets will show the ability and determination of enterprises to face up to the challenges of climate change and assume social responsibilities. It is also conducive to helping financial institutions improve climate risk management. Furthermore, high-quality carbon disclosure is also an important channel for the public to understand and supervise enterprises to achieve their emission reduction goals.

### (1) High-quality carbon disclosure will assist the capital market and investors in assessing climate risks.

With the carbon peak and carbon neutrality policy in place, companies in industries with high energy consumption and carbon emissions may need to bear higher operating costs incurred by excessive emissions. Considering the risks and price fluctuations in the carbon market, if investment was overly concentrated in high-pollution and carbon-intensive industries, the capital market would face greater environmental and climate risks, which may be seen in two aspects: First, changes in environmental policies related to the ETS (e.g. the carbon allowance allocation, disposition, and storage rules) will affect enterprises' emissions and their demand for carbon allowances, while possibly increasing their operating costs. These policy-related risks will affect the business decisions and ROI of investors in the capital market to a certain extent; Second, financial and securities institutions, during their business operations and sustainable development, will face various external pressures, including those brought by regulators at all levels, investors and public opinions. Therefore, the more transparent, comprehensive and detailed the environmental information disclosure made by the enterprises, projects or assets to which funds are invested, it will be much easier to direct the flow of financial resources to low-carbon and environmental protection areas with relatively lower climate risks.

As more and more investors, both in and abroad, conduct climate risk analysis over individual stocks and investment portfolios, the absence of environmental information disclosure by listed companies will prevent them from attracting potential investors. Among them, enterprises in the financial industry are highly sensitive to the risks and opportunities brought by climate change. For example, commercial banks (e.g. Ping An Bank, China Merchants Bank, and China Construction Bank) often adopt scenario analysis and stress testing to analyze climate risks and opportunities in their ESG reports. Carbon emissions and environmental pollution are important factors leading to global climate change. The stress

testing over climate risk carried out by financial institutions needs to cover all typical enterprises in industries with large carbon emission, high energy consumption and heavy pollution, while taking into account the short-, medium- and long-term effects of carbon peaking and carbon neutrality on loans issued to these industries. Considering both the risk transmission among enterprises and in the banking system, relevant researches have been done in mild, moderate and severe scenarios respectively, thus to test the impact of climate-related risks, such as carbon emission costs, on core business indicators of China Merchants Bank, including non-performing loan ratio and capital adequacy ratio.

### (2) The capital market enables green development based on the carbon emissions of enterprises.

The central government calls on the capital market to take the initiative to fully utilize the market mechanism and expand the green financial reform to drive the upgrade of the industrial landscape toward sustainability. On September 12, 2021, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the Opinions on Deepening the Reform of the Ecological Protection Compensation System, putting forward the research and development of financing tools based on resources and environmental rights such as water rights, pollution rights, and carbon emission rights. The document also advocates the launch of Green Stock Indexes, as well as the development of trading mechanism for carbon emission rights futures. The construction of the stock index system relies on companies to disclose complete environmental information to reduce information asymmetry. As of September 26, 2021, seventy-eight environmental stock indexes have been released in China; on January 20, 2022, the Shanghai Stock Exchange and the Shanghai Energy and Environment Exchange jointly launched the CSI Carbon Neutral Index, making Shanghai carbon market accessible for global capital investment. Other world-renowned green stock indexes may include S&P ESG Index, MSCI ESG Indexes, and the Hang Seng Corporate Sustainability Index Series, all focusing on ESG, ecology and environmental protection industries. The carbon neutrality-related indexes have outperformed the market by a large margin. Portfolio with better ESG ratings tend to have higher returns and lower volatility. As the market continues to pay attention to carbon neutrality and sustainable development, ESG ratings will play a more significant role in the risk-return tradeoff of listed companies. Data in March show that the annualized return of Orient Securities Carbon Neutrality Index was 25.22% as of March 28, 2022, higher than that of CSI 300 (4.89%), Shanghai Composite Index (11.23%), and the Hang Seng Composite Index (-5.28%). The ascent of green stock indexes in the financial market will encourage listed companies to undertake more social responsibilities, strengthen environmental information disclosure, thus to facilitate the continuous development and improvement of the environmental information disclosure system. Funds will also be better channeled to green and low-carbon industries such as carbon sequestration technology, energy storage, PV, new energy, and electric vehicles.

### (3) Business microdata affects both the quality of corporate carbon disclosure and the decision-making in the capital market.

For enterprises, the proportion of data disclosed is limited within the current framework of self-disclosure in China, as information disclosure is still in its infancy. However, the quality of carbon disclosure is highly relevant with an enterprise's financial performance, corporate value, and cost of capital. The quality of carbon disclosure has a positive correlation with corporate performance. Under the premise of pursuing the maximal profits of all stakeholders, the development of enterprises should be consistent with their environmental and social responsibilities; In addition, disclosure is conducive to creating a corporate image featuring compliance and environmental protection, which will maximize the corporate value while maintaining economic growth at the same time. As far as the cost of capital is concerned, higher quality of environmental information disclosure will help lower the cost of equity capital and debt capital, which is good for financing due to the following reasons: First, carbon disclosure may show the low energy consumption and high efficiency of corporate production and operation; Second, investors tend to prefer enterprises with high information transparency. And disclosure can improve the information asymmetry between enterprises and investors, avoid irrational external prediction of uncertainties, thus to reduce the investment risk; Finally, it can also improve the creditor's recognition of the company and thus reducing the company's costs of issuing bonds.

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

The Economic and Financial Committee of the European Council reached an agreement on March 22, 2022 to formally launch the Carbon Border Adjustment Mechanism (CBAM) and levy corresponding taxes ( "Carbon Tariffs" ) on five categories of imports with high carbon emissions, namely, cement, fertilizers, iron and steel, aluminum, as well as electricity. CBAM requires importers to declare emissions embedded in their goods and pay the price for carbon emission by purchasing the CBAM certificates for imports. CBAM is an important measure for the EU to achieve the goal of reducing carbon emissions by 55% by 2030. It is expected to be formally implemented from 2026 after a three-year transition period (2022-2025).

Generally speaking, the carbon tariffs of the EU only affects less than 1% of the total exports from China, which may not have a direct impact on market players. However, the policy per se will reconstruct the competition landscape in the EU and even the world in such industries as steel, and petrochemical, driving Chinese companies exporting high-carbon emission products to transform. It also

represents opportunities for some Chinese players to accelerate the development of low-carbon production technology, carbon accounting, and carbon disclosure. In addition, the carbon tariffs will affect the supply chain of related industries, thus guiding upstream and downstream enterprises to upgrade in terms of low-carbon energy conservation.

**The EU carbon tariff will reshape the competitive landscape of high-carbon emission products, and the competitiveness of some of China's exports will be affected.** Since 2005, the EU has launched the Emissions Trading System (EU ETS) to regulate the carbon emissions occurred within its territory and adopted various methods to reduce carbon emissions. Other countries have also gradually strengthened carbon emission control. But the inevitable increase in cost will undermine the competitiveness of local products, so more market share will be lost to cheaper imported alternatives. The main goal of the newly launched carbon tariffs is to increase taxes on imported products with high carbon emissions, equalize the price of carbon between domestic products and imports and better control the total carbon emissions in the EU.

In the steel industry, for example, carbon tariffs will reshape the competitiveness of steel products within and outside the EU. Currently, China's steel is still mainly made in blast furnaces with high emissions, supplemented by arc furnaces with lower emissions but higher costs. The carbon emissions per ton of steel is nearly 2 tons. Turkey and Russia, the main steel exporters to the EU, have significantly higher carbon emissions than those of major EU companies such as ArcelorMittal and Tata Steel. Considering the estimated cost of 5% increase in EU carbon tariffs, the price advantage of imported steel will gradually shrink. The increased transportation costs due to the pandemic and the existing trade protection policies may further highlight the competitiveness of steel products manufactured within the EU.

**Productions of carbon- intensive imports have to start the low-carbon transition considering the EU carbon tariffs.** In order to meet the EU's requirements, Chinese exporters will keep their products competitive by improving the carbon accounting and disclosure mechanisms, speeding up to introduce low-carbon production and operation technologies, and building low-carbon supply chains. CBAM requires exporters, including those from China, to declare the quantity and the corresponding carbon emissions of exports to the EU from 2023 onwards. The move will firstly impose additional requirements on enterprises without sound carbon accounting and disclosure mechanisms. Some domestic enterprises need to work on verifying and disclosing carbon emissions considering their limited verification mechanisms and scope, as well as the inadequate and non-standardized data and information on carbon disclosure. Meanwhile, since steel and aluminum products are among the most affected Chinese products under the initial round of the levies, the relevant Chinese enterprises should reduce Scope 1 and Scope 2 carbon emissions by optimizing their low-carbon production process(e.g. arc furnace steel-making, etc.), developing low-carbon products and carbon capture technologies, thus to avoid high

carbon taxes. As for the broader range of carbon emissions as covered by Scope 3 (emissions from upstream and downstream activities in the value chain), companies with a leading position in the supply chain should respond to the higher carbon emission costs by choosing more energy-efficient and low-carbon raw materials, and guiding high-emission partners into a low-carbon transition, in order to reduce product emissions on a broader scale.

In the short term, the additional costs of low-carbon transition will undermine the price advantage of Chinese exports, and ripple across upstream and downstream enterprises in the supply chain, affecting the overall competitiveness. Carbon emissions of related products cannot be cut over night. At present, among the imports the EU plans to impose carbon tariffs on, steel from China and several others have higher carbon emissions than such countries as the United States, Canada and South Korea due to the limited application of advanced steelmaking technologies. Some petroleum products, fertilizers and others also see a significant increase in the carbon emissions per ton because of the harsh extraction environment. The costs of products will be significantly elevated by more advanced steel, aluminum product making technologies, oil processing equipment, etc. As a result, the extra costs incurred by technology upgrading may be passed on to upstream and downstream enterprises in the supply chain, affecting the price competitiveness of products and services in multiple sectors, including raw materials, transportation, and manufacturing.

In the long run, the low-carbon transition will bring companies sustainable advantages in the domestic and international markets where carbon emission policies are increasingly stringent, and also create new opportunities for some companies. While only the EU has introduced tax-based policies to regulate carbon emissions, other countries are likely to roll out stricter carbon emission controls in different manners in the future. Since Chinese companies, especially export-driven ones and companies on the supply chain, are likely to benefit from their efforts to turn low-carbon, they tend to seize the initiative in the market against the EU's potential coverage expansion of carbon tariffs and the tightening carbon emissions control of other countries, including China per se. In addition to the export-driven enterprises, companies committed to low-carbon technology R&D, energy-saving materials manufacturing, as well as better and more authoritative carbon accounting and disclosure services can ride on the EU carbon tariff policy to secure substantial development. In the international community, controversies over the EU carbon tariffs still exist in terms of the feasibility and implementation, and the policy's direct impacts on Chinese enterprises are relatively limited in the short term. Despite that, on the whole, a more standardized and even unified carbon disclosure mechanism and a shift to a more low-carbon and energy-efficient production will be the inevitable way for Chinese enterprises to transform and upgrade.

# 2 Carbon Disclosure of Listed Companies at Home and Abroad

## 2.1 Policies on Carbon Disclosure of A-share Listed Companies

As a methodology for evaluating the sustainable development of enterprises, ESG (Environment, Social, Governance) is an evaluation system for measuring an enterprise or organization's performance on sustainable development, as well as an important method adopted by investment institutions to evaluate their investment targets. "Environment" involves the quantitative measurement of the GHGs, air pollutants, and energy use of enterprises. For investors, ESG reports are the major source of data on the annual carbon disclosure of listed companies. ESG information disclosure generally falls into two categories, namely mandatory disclosure and voluntary disclosure. Mandatory disclosure generally means that governmental administrative or regulatory departments require enterprises to disclose information to the public. At present, Shanghai Stock Exchange and Shenzhen Stock Exchange haven't developed any comprehensive mandatory requirements on enterprises for the disclosure of ESG carbon emission information. Nevertheless, China's environmental supervision department has mandated enterprises with excessive emissions or priority pollutant discharging entities to disclose their emissions information.

### Environmental supervision departments mandate carbon disclosure:

On November 26, 2021, the Ministry of Ecology and Environment of the People's Republic of China reviewed and approved the Administrative Measures for the Disclosure of Environmental Information of Enterprises (hereinafter referred to as "the Administrative Measures"), which came into force on February 8, 2022. It is stipulated that the following types of enterprises need to disclose their environmental information: (i) priority pollutant discharging entities; (ii) enterprises that are enforced to implement "cleaner production"; (iii) listed companies and subsidiaries at all levels within the scope of consolidated statements that once engaged in illegal activities detrimental to the environment; (iv) issuers of enterprise bonds, corporate bonds, and non-financial enterprise debt financing instruments that once engaged in illegal activities detrimental to the environment; (v) other enterprises that are required by laws and regulations to disclose environmental information. The carbon emission information that such enterprises need to disclose may include emission load, emission facilities and others. Moreover, relying on official government websites, etc., the MEE and local competent departments of

ecology and environment of cities with districts shall establish a system for the disclosure of enterprises' environmental information and provide open access to such information for the public.

Regarding enterprises' carbon disclosure information and standard, the MEE issued the Formats of the Disclosure of Enterprises' Environmental Information on January 4, 2022, requiring priority pollutant discharging entities to disclose information on major air pollutant emissions (including organized emissions and non-organized emissions) in their annual reports. In addition, the priority GHG emitters that are included in the allowance management of the carbon emission rights trading market shall disclose relevant information on carbon emissions, including: 1) the actual carbon emissions of the current year and the previous year; 2) the clearance of carbon allowance according to the accounting and reporting standards or technical specifications of GHG emission; 3) information such as emission facilities and accounting methods.

## Stock exchanges provide guidance and set regulations for enterprises' carbon disclosure:

At present, according to the principles of corporate governance and the content and format requirements for periodical reports, A-share listed companies are encouraged to disclose social responsibility reports and environmental-related information, while the market itself has not issued any rules for carbon emission information disclosure of listed companies, with no comprehensive and unified standard for enterprises' carbon disclosure either.

**(1) Shanghai Stock Exchange:** On May 14, 2008, the Shanghai Stock Exchange issued Guidelines for Environmental Information Disclosure of Listed Companies on the Shanghai Stock Exchange, encouraging listed companies to disclose or separately disclose environmental information in the thee annual corporate social responsibility (CSR) reports. It also specifies the types of environmental information that should be disclosed by companies engaged in thermal power generation, iron and steel, cement, electrolytic aluminum, mineral development and other industries which have a greater impact on the environment. In addition, the procedures of environmental information disclosure were also clarified, such as announcement methods and filing documents. According to Rules Governing the Listing of Stocks on the Science and Technology Innovation Board of Shanghai Stock Exchange issued on March 1, 2019, enterprises listed on the Science and Technology Innovation Board are required to disclose their social responsibility performance in their annual reports, and reports should be prepared and published on their social responsibility, sustainable development, environmental responsibility, etc. On September 25, 2020, the Shanghai Stock Exchange issued Guidelines No. 2 for the Application of Self-regulatory Rules of Companies Listed on the Shanghai Stock Exchange—Voluntary Information Disclosure. According to this document, enterprises listed on the Science and Technology Innovation Board can further disclose personalized information such as their environmental social responsibility and corporate

governance based on characteristics of specific industries, business and the governance structure, after they have disclosed general information on environmental protection, social responsibility performance and corporate governance in accordance with the provisions of laws and regulations.

**(2) Shenzhen Stock Exchange:** In 2015, Shenzhen Stock Exchange issued Guidelines for Standardized Operation of Companies Listed on the Small and Medium-Sized Enterprise Board, which stipulates that when a significant problem of environmental pollution arises, listed companies should disclose the cause and impact of the pollution, the influences on company performance, and the rectification measures to be taken. In 2020, Shenzhen Stock Exchange pointed out in Guidelines for Standardized Operation of Companies Listed on the Growth Enterprise Market of Shenzhen Stock Exchange (revised in 2020) that listed companies should actively implement their social responsibilities, regularly assess their performance on social responsibility, and voluntarily disclose their social responsibility reports. In the same year, Shenzhen Stock Exchange clearly pointed out in Measures of Shenzhen Stock Exchange on the Examination of Information Disclosure of Listed Companies (revised in 2020) that it would pay close attention to the following three aspects: 1) whether a company has actively disclosed CSR reports with substantial and complete content; 2) whether a company has actively disclosed the performance of environmental and social responsibilities and corporate governance (ESG) with substantial and complete content in the according reports; 3) whether a company has actively disclosed information about its active participation in campaigns under major national strategic guidelines;

As of the end of March 2022, only 28.2% of A-share listed companies disclosed their ESG reports. There also exist many other problems, such as inconsistent disclosure standards, incomplete data, and uneven reporting quality. With the ESG information disclosure of A-share listed companies becoming more and more standardized, there will be increasingly strict requirements for the indexation, quantification and substantiation of carbon emission-related information disclosure to ensure quantitative comparability. As a result, all listed companies should ensure the accuracy, completeness, and quantitative comparability of their carbon emissions disclosure.

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

| Time | Document | Content |
|---|---|---|
| Aug. 2016 | Guiding Opinions of a Green Financial System issued by People's Bank and Other Seven Ministries and Commissions | It is proposed to establish and improve a system of mandatory environmental information disclosure for listed companies step by step: 1. Listed companies identified as priority pollutant discharging entities by the MEE (formerly known as the Ministry of Environmental Protection) are forced to disclose environmental information from 2017; 2. "Semi-mandatory" environmental information disclosure will be implemented from 2018. Companies that do not disclose relevant information shall explain the reasons; 3. All listed companies shall disclose environmental information from 2020. |
| Mar. 2021 | Guidelines for the Verification of Corporate Greenhouse Gas Emission Reports (Trial) issued by the MEE | This document specifies the principles, basis, procedures, key points, review methods, and information disclosure of the verification of GHG emission reports of priority emission entities. |
| May 2021 | Plan for the Reform of the Legal Disclosure System of Environmental Information issued by the MEE | In this document, major tasks are presented around "establishing and improving the normative requirements for the compulsory legal disclosure of environmental information", "establishing a collaborative management mechanism for the compulsory legal disclosure of environmental information", "improving the supervision mechanism for the compulsory legal disclosure of environmental information" and "strengthening the legalization of environmental information disclosure". |
| Jun. 2021 | Guidelines for the Standards for the Content and Form of Information Disclosure by Companies Publicly Offering Securities No. 2 - Content and Form of Annual Reports (Revised in 2021) and Guidelines for the Standards for the Content and Form of Information Disclosure by Companies Publicly Offering Securities No. 3 - Content and Form of Semi-Annual Reports (Revised in 2021) | The document requires listed companies to set up a separate "Section 5 Environmental and Social Responsibility", and encourages companies to voluntarily disclose information that is conducive to ecological protection, pollution prevention, and fulfillment of environmental responsibilities; companies are encouraged to disclose the environmental information verified, identified and evaluated by third-party institutions such as verification agencies, certification agencies, evaluation agencies, and index companies; companies are also encouraged to voluntarily disclose the measures and effects they have taken to reduce carbon emissions during the reporting period. |

| Time | Document | Content |
|---|---|---|
| Jul. 2021 | Guidelines for Environmental Information Disclosure of Financial Institutions issued by the People' s Bank of China, which serves as the standard for the financial industry | This document systematically expounds the principles, forms and content requirements for environmental information disclosure of financial institutions. It standardizes the form, frequency, and qualitative and quantitative information that should be disclosed of environmental information disclosure of financial institutions. |
| Dec. 2021 | Administrative Measures for the Legal Disclosure of Environmental Information of Companies issued by the MEE | This document standardizes the legal disclosure activities of corporate environmental information and stipulates that social supervision must be strengthened. |

## 2.2 Policies on Carbon Disclosure of Hong Kong-listed Companies

The Guidelines for ESG Reports issued by Hong Kong Exchanges and Clearing Limited (HKEX) in 2012 provides recommendations on voluntary disclosure for listed companies. In 2016, the Hong Kong Monetary Authority, the Securities and Futures Commission and relevant exchanges decided to include semi-mandatory disclosure in some voluntary disclosure proposals, implementing the rule of "disclose or explain". Issuers on the Main Board of HKEX are required to publish ESG reports within four months after the balance sheet date, and issuers on the Growth Enterprise Market are required to publish ESG reports within three months after the balance sheet date.

Since 2016, the listing rules of the Stock Exchange of Hong Kong (hereinafter referred to as "SEHK") have required listed issuers to publish ESG reports that comply with its Guidelines for Environmental, Social and Governance Report. In May 2019, SEHK revised the Guidelines for Environmental, Social and Governance Report (hereinafter referred to as "the New Guidelines") and related listing rules, and the revised rules took effect in July 2020. The New Guidelines enhances the requirements for ESG information disclosure of listed companies. According to the provisions of the New Guidelines, issuers shall report the environmental information strictly based on the rule of "disclose or explain", or otherwise carefully considered reasons shall be provided in the ESG report.

**The quantitative indicators related to the carbon emissions of enterprises include:**

**1) General disclosure of A1 emissions: emissions of exhaust gas and GHS**

a) KPI A1.1: Scope of emissions and related emission data;
b) KPI A1.2: Total GHG emissions or intensity (if applicable, e.g. carbon emissions per unit of production or per facility) of Scope 1&2 energy (by tons);
c) KPI A1.5: Emissions reduction goals and the steps taken to achieve them.

**2) General disclosure of A2 resource use: Policies for the efficient use of resources (including energy, water, and other raw materials)**

a) KPI A2.1: Total consumption of direct and/or indirect energy (in MWh) by type (e.g. electricity, gas or petrol) and intensity (e.g. per unit of production, per facility).

On December 4, 2015, the Financial Stability Board (FSB) established the Task Force on Climate-related Financial Disclosures (TCFD), with an aim of setting a set of ESG evaluation criteria to evaluate challenges and opportunities brought by the environment and climate to enterprise development. On November 5, 2021, in response to the disclosure of climate information, combined with the recommendations of the TCFD, SEHK issued the Guidelines for Climate Information Disclosure to further refine the disclosure requirements of climate information and help companies effectively assess and respond to the risks of climate change. TCFD recommends that companies use scenario analysis to identify and assess the potential impact of climate-related risks on business performance from a range of possible future scenarios. The Hong Kong Cross-Agency Steering Group on Green and Sustainable Finance has also planned to enforce mandatory climate-related disclosure in line with the recommendations of the TCFD by 2025.

## 2.3 Policies on Carbon Disclosure of US-listed Companies

In 2010, the U.S. Securities and Exchange Commission (SEC) first issued the Commission Guidance Regarding Disclosure Related to Climate Change, which explained SEC's standards for assessing the environmental responsibility of listed companies. This document requires companies to disclose information on sustainable development (corporate governance and related risks) directly in their annual reports (Table 10-K). In April 2021, the U.S. government took an important step towards establishing mandatory ESG disclosure standards: the U.S. House Financial Services Committee passed the ESG Disclosure Simplification Act, which requires all listed companies to regularly disclose ESG reports and information about climate change risks such as GHG emissions and the use of fossil fuels in the course of their operations.

On March 21, 2022, the SEC released a new proposal on corporate climate information disclosure, planning to mandate listed companies to disclose climate-related information. The proposal suggests forcing listed companies to disclose four areas of information:

1) Disclose governance and management processes for climate-related risks;

2) Explain how the relevant risks have or may have a material impact on the company's business and finances, including short-, medium- and long-term impacts;

3) Explain how the relevant risks have or may affect the company's strategy, business model and development prospects;

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

The proposal proposes to compel listed companies to disclose carbon emissions information, including emissions in Scope 1, 2, and 3, among which Scope 1 and 2 shall be applicable to all listed companies. When emissions in Scope 3 have a substantial impact on a listed company, or the carbon reduction target set by the company is included in Scope 3, then the company is required to disclose their emissions in Scope 3. Small companies are exempt from Scope 3 disclosures.

In 2012, the Nasdaq Stock Exchange (hereinafter referred to as "Nasdaq") and the New York Stock Exchange (hereinafter referred to as "NYSE") joined the United Nations Sustainable Stock Exchange Initiative to guide companies listed on these two exchanges to undertake social, economic and environmental responsibilities while making business investments. The NYSE provides some standard guidelines for ESG disclosures by listed companies, but has not issued systematic guidelines on what ESG reports should cover. In March 2017, Nasdaq released ESG Reporting Guide 1.0 based on the principle of voluntary disclosure. In May 2019, it was revised and the Guide 2.0 was released to promote the sustainable development of the securities market. As shown in Table 2, Guide 2.0 delineates the ESG information that listed companies should disclose, including greenhouse gas emissions, emission intensity, energy use and climate risks. Guide 2.0 also provides supplementary explanations on the specific content covered by each indicator, the reasons for disclosure, measurement methods, and disclosure methods. Considering the wide variety of Nasdaq-listed companies and their different development stages, Nasdaq has designed specific regulations for the measurement and disclosure of each ESG matter.

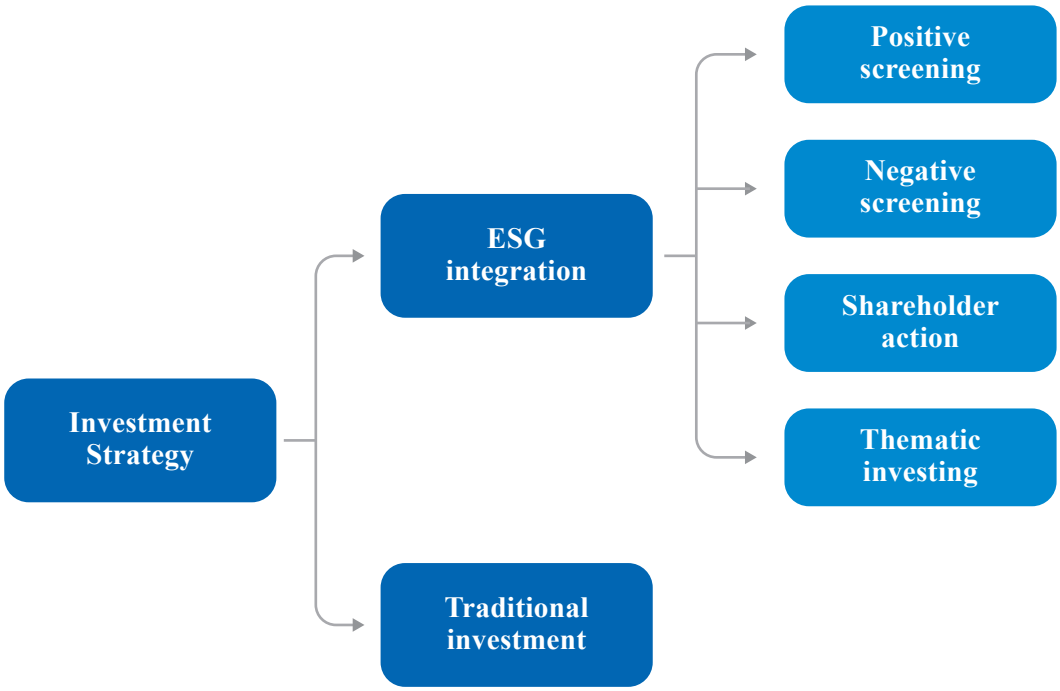
**Table 2: Explanation of Quantitative Indicators for Carbon Disclosure in ESG Reporting Guide 2.0**

| Category | Indicators | Contents to be disclosed |
|---|---|---|
| Environmental indicators | E1. GHG Emissions | Disclosures shall be made numerically and shall be compared to the same period in history and industry average GHG emissions |
| | E2. Emissions Intensity | Disclosures shall be made numerically, and the emissions intensity shall be calculated based on the TCFD framework (carbon emissions per unit of revenue, sales or product) |
| | E3. Energy Usage | Disclosures of energy consumption shall be made numerically |
| Newly-added environmental indicators | E8.Climate Oversight / Board | Answer whether the board oversees/manages climate-related risks |
| | E9. Climate Oversight / Management | Answer whether top management oversees/manages climate-related risks |
| | E10. Climate Risk Mitigation | The annual investment in climate-related infrastructure and product development shall be explained in words to illustrate the company's ability to adapt to climate risks. |

# 3 ESG in Equity Investing

Environmental, social and governance (ESG) investing is a strategy that takes Environmental, Social and Governance factors into investment decision. Besides traditional financial metrics, ESG investing also relies on independent ratings that evaluate company's ESG performance. Nonetheless, ESG investing doesn't mean blindly pursuing sustainability at the cost of financial performance. In fact, company with outstanding ESG performance tends to have better corporate management quality, sustainable profitability and cashflow. That said, ESG investing is aiming to reveal the risk and reward outside of financial information, mitigating tail risk and strengthening investment return, while investing responsibly to make the world a better place.

**Figure 3-0-1: ESG Integration & Traditional Investment**



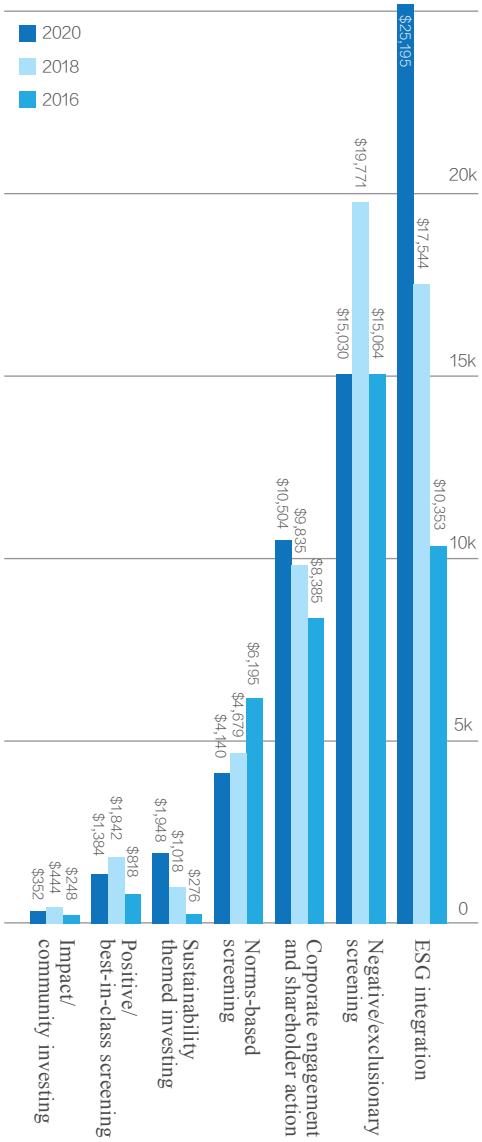
## 3.1 "ESG Integration": the Most Popular ESG Strategy

Environmental, social and governance (ESG) investing is a strategy that takes Environmental, Social and Governance factors into investment decision. Besides traditional financial metrics, ESG investing also relies on independent ratings that evaluate company's ESG performance. Nonetheless, ESG investing doesn't mean blindly pursuing sustainability at the cost of financial performance. In fact, company with outstanding ESG performance tends to have better corporate management quality, sustainable profitability and cashflow. ESG investing is aiming to reveal the risk and reward outside of financial information, mitigating tail risk and strengthening investment return, while investing responsibly to make the world a better place.

**Figure 3-1-1: GSIA ESG Strategy Categories**
Source: GSIA, Global Sustainable Investment Review 2020

| | |
|---|---|
| ESG Integration | Investment project managers systematically and explicitly incorporate environmental, social, and governance factors into financial analysis. |
| Corporate Engagement & Shareholder Action | Employing shareholder power or influencing corporate behavior through direct corporate engagement.<br>Direct corporate engagement: communicating with senior management or boards of companies, submitting or co-submitting proposals, and voting based on ESG guidelines. |
| Norms-based Screening | Screening of investments against minimum business standards or issuer practice based on international norms. |
| Negative/ Exclusionary Screening | Excluding activities that were defined as non-investable in the funds or portfolios of specific sectors, companies, countries, or other issuers. Exclusion criteria can be set with reference to company practices for product categories, such as animal testing, human rights violations, corruption, or controversy. |
| Best-in-class/ Positive Screening | Investing in companies or projects with positive ESG performance and ratings above certain thresholds of industry peers. |
| Sustainability themed/ thematic investing | Investing in themes or assets specifically contributing to sustainable solutions-environmental and social- (e.g.sustainable aariculturearen buildinaslower carbon tilted portfoliogender equitydiversity). |
| Sustainability Themed/ Thematic Investing | Investing in themes or assets that contribute to sustainable solutions, such as sustainable development, agriculture, green buildings, low-carbon development, gender equality, and biodiversity. |
| Impact Investing and Community Investing | Impact Investing: investing with the goal of achieving positive, social and environmental impact. The impacts need to be measured to demonstrate investment intent and targets and investors' ESG contributions<br>Community Funding : funding for traditionally underserved individuals or communities, and for businesses with a clear social or environmental purpose. Some categories of community investments also belong to impact investing, but community investing is broader and includes other forms of investment and targeted lending activities. |

**Figure 3-1-2: Global growth of sustainable investing strategies 2016-2020**
Source: GSIA

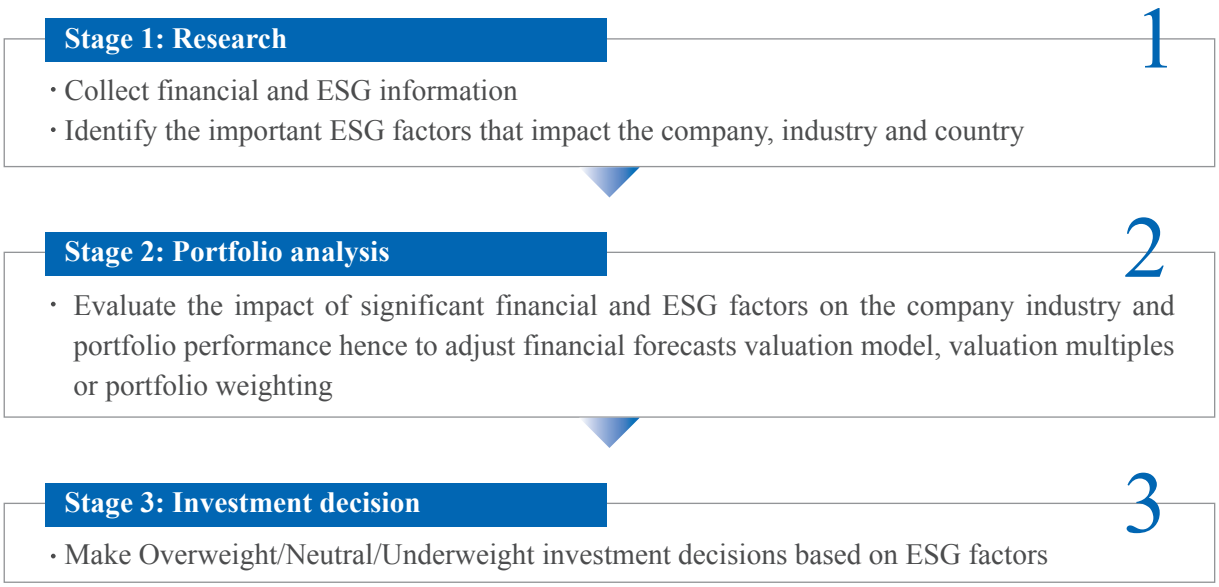



| | GROWTH 2016-2020 | COMPOUND ANNUAL GROWTH RATE |
|---|---|---|
| Impact/ community investing | 42% | 9% |
| Positive/ best-in-class screening | 69% | 14% |
| Sustainability themed investing | 605% | 63% |
| Norms-based screening | -33% | -10% |
| Corporate engagement and shareholder action | -25% | 6% |
| Negative/exclusionary screening | 0% | 0% |
| ESG integration | 143% | 25% |

NOTE: Asset values are expressed in billions of US dollars

ESG integration strategy integrates the ESG factors into traditional investment analysis and decision-making process. ESG integration process basically consists of three stages: research, portfolio analysis, and investment decision.

**Figure 3-1-3: ESG integration process**




## 3.2 ESG Equity Investment Method and Application

Traditional equity investment analysis mainly focuses on macro, fundamental and technical indicators, while ESG strategy pays attention to company's ESG scale ranking. On this basis, ESG strategy introduce additional alternative indicators such as environmental, social, and corporate governance, as these are the factors impacting company's overall performance.

• **Environmental:** Sustainability of company's manufacturing process, and its impact on environment, including carbon footprint, toxic pollutants

• **Social:** company's effort on social impact internally within company and externally to the society, including work safety, gender equality, ethical diversity, human rights

• **Governance:** company's management and broad structure, including transparent management, leadership diversity, management incentive scheme, investor relations

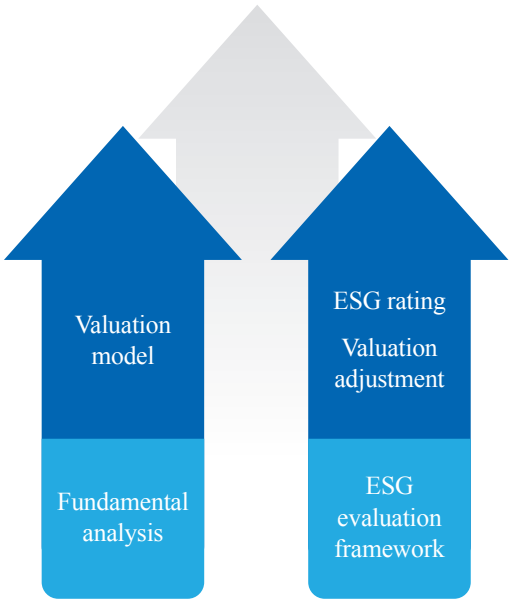
**Fundamental + ESG strategy application process in equity investment include the following steps:**

i) First, formulate a ESG assessment framework based on different industry characteristics. Under such framework, quantify company's ESG performance by rating and score

ii) Then, investors use the ESG rating as a reference to make adjustment on a) financial forecasts and b) target valuation

iii) Lastly, make investment decision based on the ESG-adjusted valuation

**Figure 3-2-1:**
**Fundamentals + ESG strategy application in equity investing**




## 1.Formulate ESG assessment framework

Building an effective ESG assessment framework is the foundation of ESG strategy application. The key is to identify the core ESG factors in different industry, measure the risk exposure of each factor in the industry, and the company's performance regarding the key ESG factors in its industry.

Based on Goldman Sach's ESG investment strategy, there are three key principles in selecting the appropriate ESG metrics: significance, effectiveness and relevance. Firstly, we have to determine the ESG factors that are significant to the company's operation; secondly, whether the company has an effective disclosure of its ESG track record for data collection and comparison; finally whether the ESG factors have correlation to stock price performance and investment return over 3-5 years long term horizon

**Figure 3-2-2: GS SUSTAIN ESG rating metrics principle**

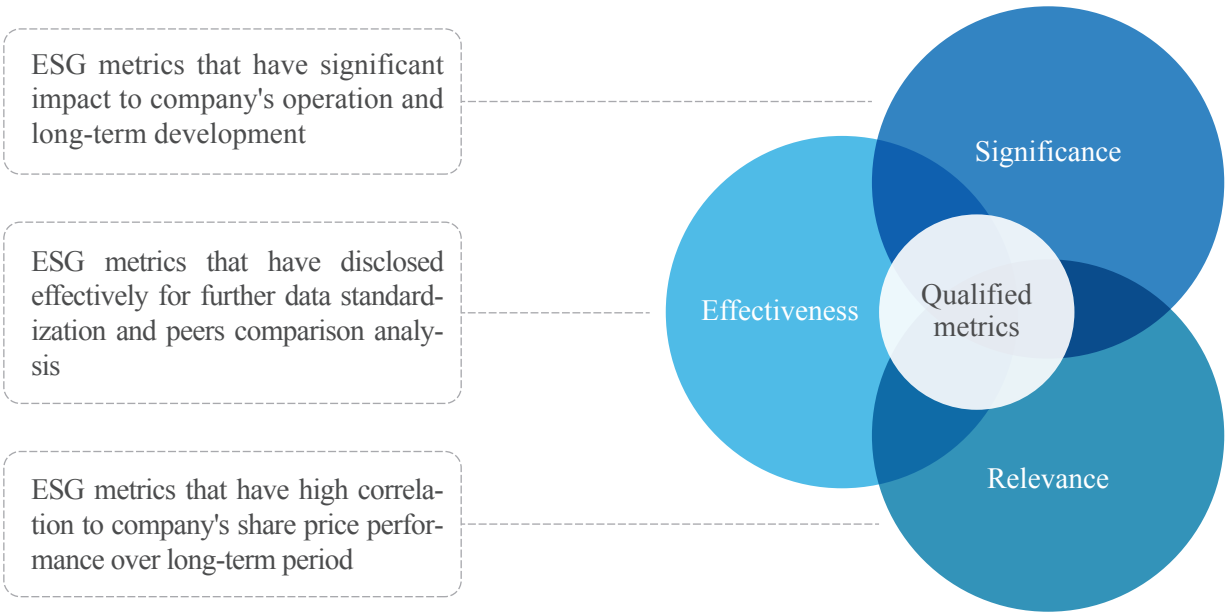


**Table 3: MSCI ESG Key Issue Hierarchy**

| 3 Pillars | 10 Themes | 35 ESG Key Issues | |
|---|---|---|---|
| Environment | Climate Change | Carbon Emissions<br>Product Carbon Footprint | Financing Environmental Impact<br>Climate Change Vulnerability |
| | Natural Capital | Water Stress<br>Biodiversity &Land Use | Raw Material Sourcing |
| | Pollution & Waste | Toxic Emissions &Waste<br>Packaging Material &Waste | Electronic Waste |
| | Environmental Opportunities | Opportunities in Clean Tech<br>Opportunities in Green Building | Opportunities in Renewable Energy |
| Social | Human Capital | Labor Management<br>Health & Safety | Human Capital Development<br>Supply Chain Labor Standards |
| | Product Liability | Product Safety &Quality<br>Chemical Safety<br>Consumer Financial Protection | Privacv &Data Security<br>Responsible Investment<br>Health &Demographic Risk |
| | Stakeholder Opposition | Controversial Sourcing<br>Communitv Relations | |
| | Social Opportunities | Access to Communications<br>Access to Finance | Access to Health Care<br>Opportunities in Nutrition & Health |
| Governance | Corporate Governance | Ownership&Control<br>Board | Pay<br>Accounting |
| | Corporate Behavior | Business Ethics<br>Tax Transparency | |

The table above lists the sub-category metrics under ESG theme. The key issues and degree of risk exposure vary in different industry. For example, food safety and quality is the main ESG issue in F&B industry. For heavy-polluting industries like coal mining, environmental protection is particularly important. ESG assessment frame work for heavy-polluting industry includes: 1) industry-level environmental risk and impact to company; 2) company's contingency plan on environmental risk; 3) company's capex on environmental protection; 4) company's resource utilization efficiency; and 5) company's track record on environmental issues, including negative news and violation record.

Meanwhile, time horizon is also an important metric for ESG factor selection. For instance, some factors (i.e. ESG negative incident) may affect company's short term cashflow. Some other long-term factors (i.e. energy saving and emission reduction policy, donation and charity, business ethics) may affect long-term discounted cashflow model. In general, ESG importance increases over time, the longer the investment horizon, the more ESG factors need to be considered by the ESG assessment framework.

## 2. Incorporate ESG factors into financial forecasts

After building an effective ESG assessment system, the resulted ESG rating and score can be included into fundamental analysis. ESG impact and corresponding financial forecast adjustment include the followings:

**i) Operating cost:** Adjusting future operating costs based on ESG development. Some operating cost can be estimated explicitly, such as staff number changes, while some operating cost isn't disclosed, which requires assumption and adjustment to operating margin. For instance, company with lower ESG score might incur additional operating cost due to fine, labor strike, supply chain disruption issues, hence long-term profitability deteriorates.

**ii) Revenue:** Increasing or decreasing company's revenue growth to reflect ESG opportunities and risks. Company with high ESG risk may incur loss from product recall or license suspension, brining negative impact to future operation; hence, revenue growth forecast shall be revised down accordingly. In contrary, company that follows sustainable development principle and have better ESG performance is more likely to provide high quality product and service, establish a positive brand image, increase customer loyalty, and improve revenue growth through market share gain and pricing power; hence, revenue growth forecast shall be revised up.

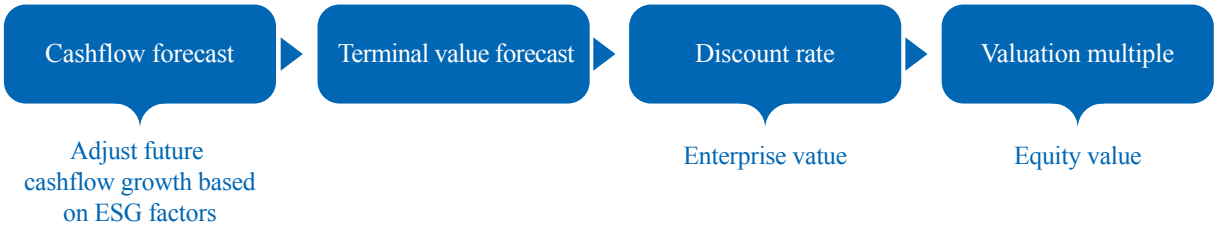
**iii) Capital Expenditure:** ESG factors leads to higher capex. In order to compile with new emission regulation, company might need to increase investment spending in pollution treatment equipment, purchase of CCER, participation in Emission Trading Scheme or factory upgrade etc.

**iv) Book value:** ESG factors affect assets' cashflow expectation. Some unsustainable business segment might be forced to shut down, hence affecting asset's net present value, incurring impairment loss, and book value would decline accordingly. For instance, future cashflow expectation of a mining company's coal asset might be significantly reduced due to weakened demand and regulatory change.

## 3. Integrate ESG factors into valuation model

When a company contains an obvious ESG risk or opportunity, and it is difficult to quantify such into company's financials, we can directly adjust valuation model parameters to reflect such. For instance, DCF model discounts future cashflow (CF) and terminal value (FV) using cost of capital (r), and then obtains company's valuation (P) by summing the discounted cashflows.

**Figure 3-2-3: DCF model and ESG factors**




ESG factors mainly affect valuation in two ways: On one hand, ESG may be transformed into future opportunities, and thus into profitability; on the other hand, ESG may be transformed into a downside risk for the company. Specifically, ESG factors impact to DCF model and corresponding adjustment include the followings:

**i) Cashflow:** ESG factors affect cashflow mainly through the concept of future opportunities. Company with high ESG score tends to have better competitive advantage over peers, and its future cashflow growth rate is also higher. In addition, high ESG score company is usually better at formulating long term business strategy plan and management incentive scheme. Such competitive advantage comes from its more efficient resource utilization, better human capital development and superior innovative management.

**ii) Terminal value:** A company or a business segment might not continue forever due to ESG factors. Under such circumstance, terminal value might need to be adjusted to a lower number or even zero.

**iii) Beta:** High ESG score company usually has above-average risk-control ability and compliance standard on corporate management and supply chain management; hence, lower probability to be affected by negative events. Also, company with good ESG performance is less severely affected by systematic market impact, ultimately reducing company's share price downside risk; hence, its cost of capital is lower, and beta should also be lower.

**iv) Discount rate:** ESG factors affect discount rate mainly through the concept of future downside risk. The magnitude of discount rate adjustment is determined by risk probability and significance of the impact. Discount rate adjustment can be done through industry peers analysis, and ESG ranking. Company with higher ESG score shall have its discount rate adjusted downward, hence increasing company's fair value, vice versa.

**v) Valuation multiple:** Low ESG score company would have its benchmark valuation multiple revised downward, vice versa. If the ESG factors cannot be adjusted by the above methods, we can adjust the valuation multiple by directly calculating "ESG blended valuation multiple". Then use such multiple to multiply company's financial metric to calculate the equity value.

# 4 Methodology of Carbon Accounting

The "three principles" proposed by the Paris Agreement, namely, measurable, reportable, and verifiable, put forward specific requirements for carbon measurement in each country. Measurable means that the response itself and the results of the response are measurable; reportable means that it can be reported in accordance with the UNFCCC or other agreed requirements; verifiable means that it can be verified by consensus, including National and international verification.

Under the Greenhouse Business Accounting System (GHGP) jointly established by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), the Greenhouse Gas Accounting System: Corporate Accounting and Reporting Standards (Revised Edition) (hereinafter referred to as "Corporate Standard") is one of the most influential standards in the GHGP. The Corporate Standard clearly defines three ranges of carbon emissions from the perspective of operational boundaries. Among them, Scope 1 emissions refer to the direct greenhouse GHG of enterprises, such as fuel combustion, fugitive emissions from company-owned vehicles and other direct emissions from emission sources owned or controlled by the company; Scope 2 emissions (Scope 2) refer to indirect emissions, calculating GHG emissions generated by the purchased electricity and purchased heat consumed by the company, as well as the specific emissions based on the heat/power consumption and the corresponding emission factor; Scope 3 emissions refer to other indirect GHG emissions, which is an optional report that takes into account all other indirect emissions from the business, such as the emissions in the supply chain, value chain and industrial chain. Scope 3 GHG accounting and reporting can be carried out with reference to ISO14064-1 or the Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2011).

## 4.1 The Overall Idea of Corporate Carbon Accounting

The Working Group I of the Intergovernmental Panel on Climate Change (hereinafter referred to as "IPCC") has been developing and improving the data and calculation method for greenhouse gas emissions since 1991, and has been encouraging member countries of IPCC to use the method, in order to promote all parties under the United Nations Framework Convention on Climate Change (hereinafter

referred to as "UNFCCC") to achieve the ultimate goal of addressing climate change. In the 12th session of the IPCC, the IPCC Guidelines for National Greenhouse Gas Inventories (revised edition in 1996) was passed (hereinafter referred to as IPCC Guidelines), which officially provides UNFCCC members applicable carbon measurement methods for GHG emissions and removals, ushering in a new era of carbon measurement. The IPCC Guidelines was originally published in 1996, including three documents including the 1996 Revised Guidelines for National Greenhouse Gas Inventories; the "2006 IPCC Guidelines" is the latest version, and the "2019 Revised Guidelines" was released in 2019 as a supplement to the 2006 version. Since then, a number of conferences on international climate change and many international institutions have begun to put forward principles of carbon measurement, which have become the basis for countries to reduce emissions.

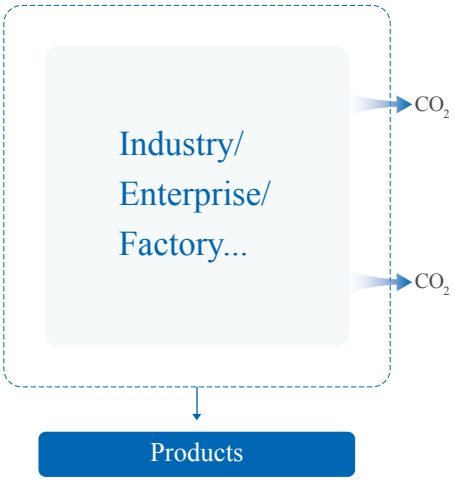
## The product-based measurement:

The IPCC guidelines is based on national/regional carbon-measurement methods, and the basic method for calculating GHG emissions is the default method. The IPCC Guidelines recommends adopting a three-tier approach (Approach 1, 2, and 3) to calculate carbon emissions. Approach 1 is a product-based measurement, calculating GHG emissions by measuring the carbon intensity of the results of the production and service processes, which assumes that the intermediate carbon emissions thereof will be reflected in the final results. The basic formula is:

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

E is the total amount of GHG emissions of the enterprise, calculated by mass (e.g. t, kg); AD (Activity Data) is the product output or activity level of the enterprise, and the unit is the one measuring the product or activity level (e.g. kg/kWh); EF (Emission Factor) is the GHG emission factor based on the product type of the enterprise, representing the carbon intensity of the industry or business, i.e. the GHG emissions per unit of product, in $tCO_2$/activity level unit or $tCO_2$/product unit. Using this method, the total $CO_2$ emissions of all sectors should be the total $CO_2$ emissions of the enterprise.

**Figure 4-1-1: The "Top-down" Corporate Carbon Measurement based on Production**



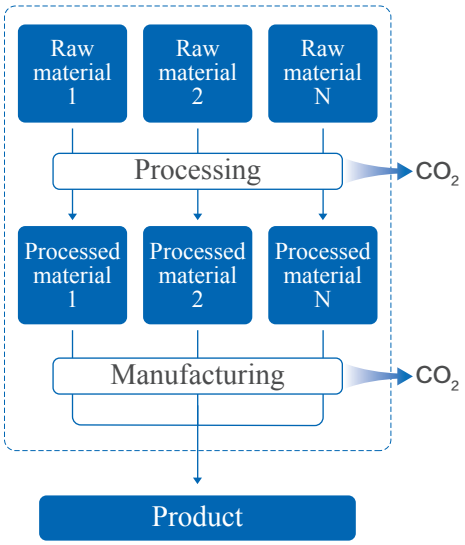
### The process-based measurement:

This approach not only considers all fuel varieties and all corporate sectors, but also combustion technologies (such as stationary and mobile combustion sources). It is a more detailed estimate of emissions, which requires more data as well. This type of approach is a common method used for calculating carbon emissions under the current framework of IPCC Guidelines. This approach is widely used in China to calculate carbon emissions. The formula is as follows

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

$E_{reform}^{N}$ represents the greenhouse gas emissions generated from the processing of the raw materials of the nth product of the industry or other entities. Common processing methods include desulfurization, substitution reaction with HCI etc., and the unit is $tCO_2e$; $E_{fuel}^{N}$ means the GHG emissions generated from the burning of the raw materials of the nth product of the industry or other entities. The unit is $tCO_2e$; $R_d$ represents the GHG emissions absorbed by the decarbonization process in the production of the industry or other entities, and its unit is $tCO_2e$.

**Figure 4-1-2: The Carbon Measurement based on Process of Production or Service**




## 4.2 Carbon Accounting Standards in Different Industries

The development of China's carbon measurement system has been progressing in an orderly manner. According to China's National Climate Change Programme issued by the State Council, Chinee authorities have begun to formulate corresponding methods for the calculation, monitoring and assessment of national carbon emission. At present, China has formulated a series of standards and guidelines for carbon emission calculation. In order to clarify the corporate-level greenhouse gas accounting methods for different industries, as shown in Table 4, the NDRC has compiled and published the corporate GHG emission accounting methods and reporting guidelines for 24 industries (in three batches) from 2013 to 2015 (hereinafter referred to as "Accounting Guidelines for 24 Industries"). The three documents were formulated under the framework of the IPCC Guidelines. In 2015, the National Standardization Administration issued the General Guideline of the Greenhouse Gas Emissions Accounting and Reporting for Industrial Enterprises and the national standards for accounting and reporting of GHG emissions of enterprises in 10 key industries such as power generation, steel, civil aviation, and chemistry. These standards came into force on January 1, 2016, unifying GHG accounting standards nationwide. With the official launch of the carbon market in 2021, the method of quantifying carbon emissions at the enter-

prise level has become more important. From the regulatory perspective, scientific and accurate quantification of corporate GHG emissions is the basis for the efficient operation of the national carbon market, and is also the key to the implementation of the carbon peaking and carbon neutrality policy. From the enterprise perspective, the accounting and disclosure of corporate carbon emissions is an important channel for the public to understand and supervise their realization of carbon emission reduction goals. Enterprises need to regularly collect and truthfully disclose multi-dimensional data on energy consumption, raw material usage and greenhouse gas emissions, pushing the carbon emission accounting system to cover the full chain of management from statistics, monitoring, reporting, verification to disclosure.

**Table 4. Industries covered in the Accounting Guidelines for 24 Industries**

| Batch 1 | Batch 2 | Batch 3 |
|---|---|---|
| Power generation enterprises (official implementation) | Oil and gas production enterprises | Paper and paper product production enterprises |
| Power grid enterprises | Petrochemical enterprises | Other non-ferrous metal smelting and rolling processing enterprises |
| Steel production enterprises | Independent coking enterprises | Electronic equipment manufacturing enterprises |
| Chemical production enterprises | Coal production enterprises | Mining enterprises |
| Electrolytic aluminum production enterprises | | Food, tobacco, wine, beverage and refined tea enterprises |
| Magnesium smelting enterprises | | Public building operating enterprises |
| Flat glass manufacturing enterprises | | Road transportation enterprises |
| Cement production enterprises | | Fluorine chemical enterprises |
| Ceramic production enterprises | | Industrial enterprises in other industries |
| Civil aviation enterprises | | |

At present, the Accounting Guidelines for 24 Industries only cover the GHG accounting standards of high-energy-consuming industrial enterprises. However, the financial industry, of which the investment value chain covers multiple high-emission industries also needs a unified accounting standard. In November 2020, the Partnership for Carbon Accounting Financials (PCAF) launched The Global GHG Accounting and Reporting Standard for the Financial Industry, which is the first document in the world for carbon emissions accounting at the level of portfolios of financial institutions. This document is based on the enterprise value chain emission accounting and reporting as stipulated in the Greenhouse Gas Emissions Agreement, which is applicable to commercial banks, investment banks, development banks, asset companies and insurance companies, etc., covering six types of financial assets including stocks and bonds, commercial loans, unlisted company equity, project financing, commercial real estate, mortgage loans and auto loans. PCAF requires financial institutions to disclose the absolute emissions of borrowers or investees, while allowing disclosure of avoided and removed emissions, which must be disclosed separately.

# 5 Methodology of Carbon Rating

## 5.1 Scope of Carbon Rating

This Report researches on the top 100 Chinese listed-companies by market value on the HKEX, Nasdaq and NYSE, and as of May 1, 2022, analyzes related public documents including annual financial statements, annual ESG reports, sustainability reports or GHG emissions report issued in 2019, 2020 and 2021. Data related to carbon disclosure and the scope of disclosure come from public reports or statements of enterprises, with all financial indicators extracted from the Wind Economic Database. Within our rating scope, a total of 83% of the companies are listed on the HKEX, 9% on the Nasdaq and 15% on the NYSE. Rated companies are operating in the following industries: conglomerate (2 companies), automobile manufacturing (5 companies), consumer staples (5 companies), telecommunications (5 companies),energy and public utilities (8 companies), real estate and construction (9 companies), consumer discretionary (11 companies), healthcare (11 companies), industrial manufacturing (12 companies), information technology (13 companies), finance (19 companies).

As of May 1, 2022, a total of 81% of Chinese overseas listed-companies have publicly disclosed their GHG emissions in 2019, and 94% have publicly disclosed the data in 2020. But the figure for 2021 is only 63%, as some companies have yet to disclose their 2021 ESG/CSR/Sustainability Reports.

**Figure 5-1-1: Industries and the Number of Companies Covered in the Carbon Rating System**

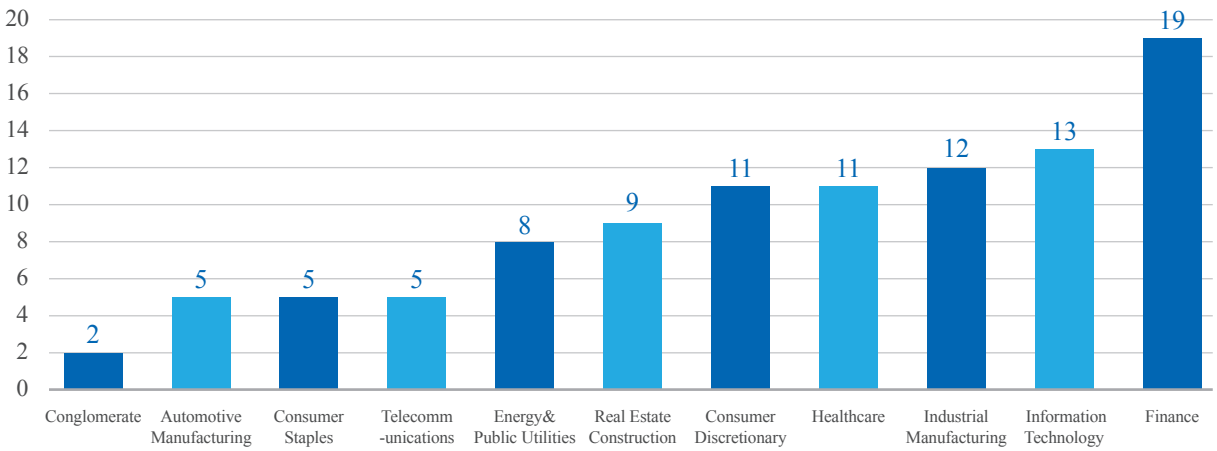


**Figure 5-1-2: Number of Companies in Various Industries that have Disclosed their GHG Emissions, 2019-2021**

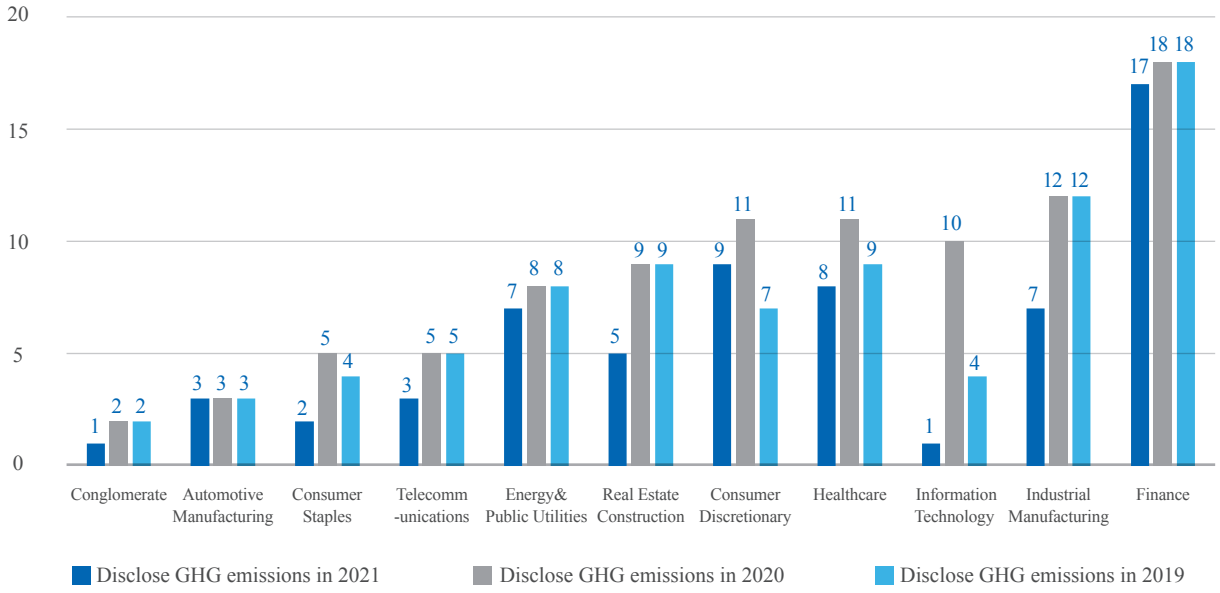
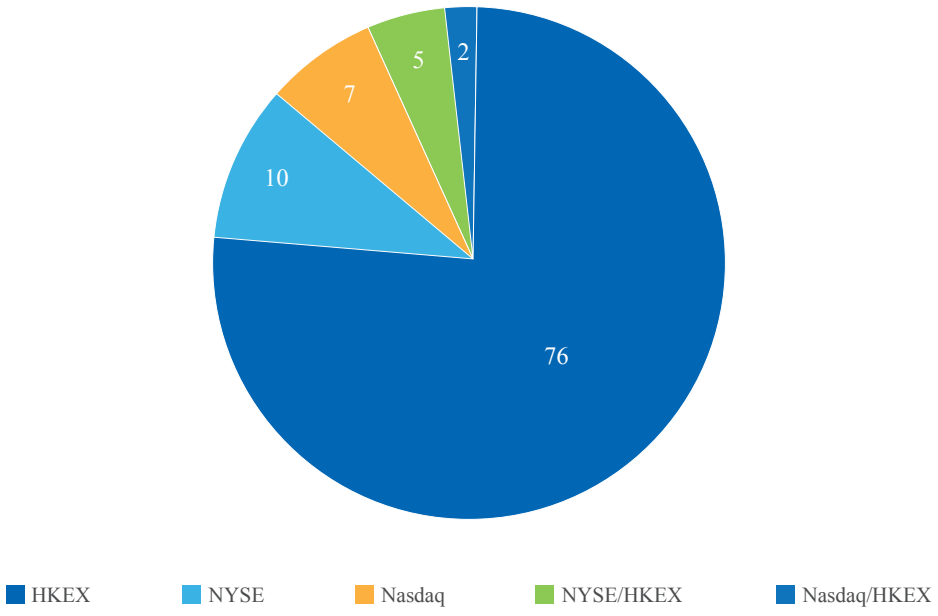



**Figure 5-1-3: Industries and the Number of Companies Covered in the Carbon Rating System**



## Voronoi diagrams of industries where the 100 Listed Companies Operate

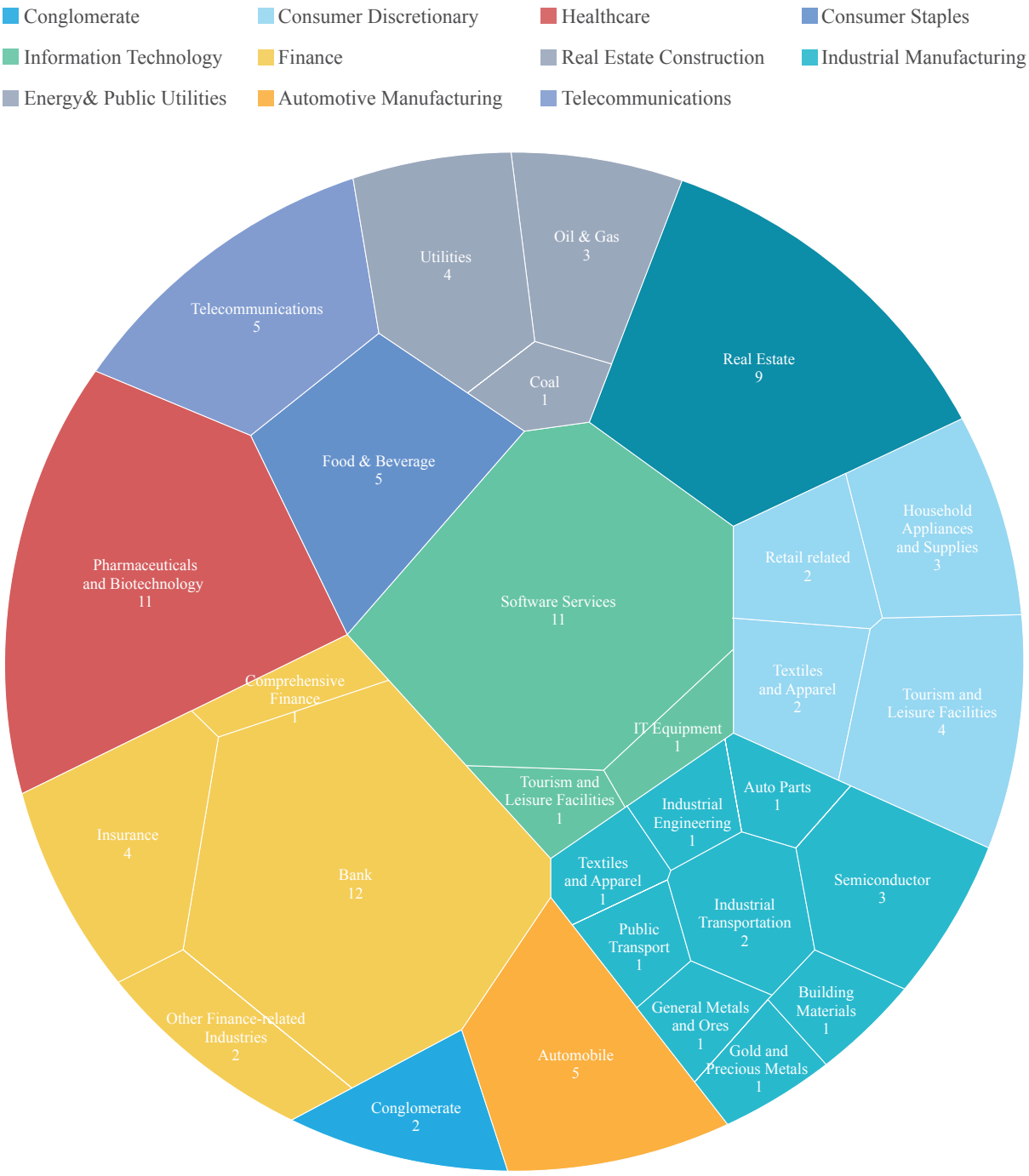



**Figure 5-1-4: Secondary Industries[3] of Companies Covered in the Carbon Rating System**

[3] Blocks of the same color in the Venn diagram represent the same category of primary industries, with all corresponding secondary industries listed within. The numbers represent the volume of rated companies in each secondary industry. The larger of the block, the more rated companies in the industry.

## 5.2 Choice of and Explanation for Indicators for Assessment

The carbon rating system takes the following four dimensions, namely actual carbon emission (Emission), actual carbon mitigation (Mitigation), disclosure quality (Quality), and carbon reduction goal (Goal), as the primary indicator and examines a company's carbon disclosure in multiple dimensions:

### (1) Company's Actual Carbon Emissions:

Examine whether a company discloses its annual carbon emissions to the public or stakeholders through official channels (including annual report CSR Report, ESG Report and Sustainability Report) and assess the company's actual quantified carbon emissions. According to the company's voluntarily disclosed annual GHG emissions and revenues, listed companies' average emission intensity[4] from 2019 to 2021 in the same industry ($tCO_2$/RMB 10k) will be compared. In the Report, a company's carbon emissions of the current year are calculated based on Scope 1 and 2 carbon emissions equivalents. Because companies listed on US or Hong Kong stock exchanges have not been mandated to disclose their Scope 3 emissions, these companies have a relatively low rate of Scope 3 emissions disclosure. Also, different companies have different calculation boundaries of Scope 3 emissions, and thus Scope 3 emissions are not counted in company's actual carbon emissions for the time being.

A company's carbon emissions intensity is calculated by dividing the company's carbon emissions by its main business income ($tCO_2e$/RMB10,000). The unit of the main business income is RMB10,000. If a company reports its income in USD/HKD/AUD/TWD, it needs to be converted into RMB according to the exchange rate during the reporting period. If a company's disclosed emission statistics only cover those generated by its headquarters or a subsidiary, then the carbon emissions intensity will be calculated through dividing carbon emissions by the main business income of the headquarters or the subsidiary.

**Case Analysis** China Construction Bank as a case for analysis to introduce the calculation method of indicators

China Construction Bank Corporation (hereinafter referred as CCB) discloses its GHG emissions of 2019, 2020, and 2021 in the environmental performance section of its 2021 ESG report.

In the 2020 CSR Report, CCB disclosed total GHG emissions (Scope 1 and Scope 2) of 351,076.88 tons, and in 2019, the figure is 272,029.03 tons. Notably speaking, their environment related data adopted a larger statistical scope in 2020, covering the head office, the entire jurisdiction of 10 city branches, as

[4] The annual carbon emissions intensity is calculated as the total carbon emissions divided by main business income in the calculated area.

well as 27 provincial and district head office. Specifically, the business organs within the entire jurisdiction of 10 city branches (Beijing, Tianjin, Shanghai, Chongqing, Dalian, Ningbo, Qingdao, Xiamen, Shenzhen and Suzhou) have been newly taken into account in 2020.

In the latest CSR report of 2021, CCB renews the coverage of environmental performance statistics, including the head office, the whole jurisdiction of 35 branches in China, Northeastern Campus and East China Campus of China Construction Bank University, Beijing Production Base and Wuhan Production Base. GHG emissions between 2019 and 2021 are calculated according to the latest coverage and thus not comparable to statistics in previous reports. CCB discloses its annual revenues in its 2021 annual report according to Chinese accounting standards, where statistics show that CCB's average emissions intensity in the past 3 years is 0.0218t/RMB10,000, meaning that the group emits 0.0218 tons of GHG for every RMB10,000 of revenues.

**Table 5: Disclosed GHG emissions of CCB**

| GHG Emissions | 2021 | 2020 | 2019 |
|---|---|---|---|
| GHG Emissions (Scope 1 and 2) (t) | 1,643,454.48 | 1,481,223.32 | 1,574,914.66 |
| Direct Emissions (Scope 1) (t) | 127,378.31 | 88,906.10 | 115,242.34 |
| Indirect Emissions (Scope 2)(t) | 1,516,076.17 | 1,392,317.22 | 1,459,672.38 |
| Business Income (RMB 1 million) | 764,706 | 714,224 | 678,001 |
| Calculation: Annual Emission Intensity (t/RMB 10,000) | 0.0215 | 0.0207 | 0.0232 |
| Calculation: Average Emission Intensity (t/RMB 10,000) | | 0.0218 | |

## (2) Actual Effect of Company's Carbon Emission Reduction:

Assess whether measures a company took from 2019 to 2021, such as carbon emission reductions and energy saving, have worked. According to the company's voluntarily disclosed annual carbon emissions and its annual revenues from 2019 to 2021, this Report compares the Rate of Change (ROC) in its carbon emissions intensity in the same industry. The ROC of carbon emissions intensity equals the carbon emissions intensity of 2021 divided by that of 2019. (If the company does not disclose its carbon emissions intensity of 2021, then the figure is the carbon emissions intensity of 2020 divided by that of 2019.)

**Case Analysis** China Construction Bank as a case for analysis to introduce the calculation method of indicators

CCB's ROC of carbon emissions intensity is

$$\frac{\text{Carbon Emissions of 2021}}{\text{Carbon Emissions of 2019}} = \frac{0.0215}{0.0232} = 92.67\%$$

Therefore, CCB's carbon emissions intensity declines by 7.33% (=1-92.67%)

## (3) Quality of Company's Carbon Information Disclosure:

Assess the comprehensiveness of a company's carbon emissions information disclosed to the public or stakeholders, and data comparability, accuracy, and temporal continuity. The Report assesses the quality of a company's disclosed statistics, such as emissions, energy use, and carbon accounting (see specific indicators in Table 6) to examine whether companies have clear statistic disclosure coverage and transparent methodologies. Disclosure quality assessment refers the company's latest CSR/Sustainability/ESG Reports released before May 1, 2022.

Regarding the indicator design about the quality of carbon information disclosure, the following aspects are taken into account in the Report: 1) Statistical comparability and standardization: The company should disclose the its Scope 1, 2, and 3 emissions or total GHG emissions according to standardized indicators and with reference to IPCC or other standard carbon accounting methodologies; 2) Clear coverage of disclosure and transparent methodologies: The calculation of all emission-related indicators in the corporate carbon information disclosure framework needs to be consistent with the current carbon accounting methodology, and the authenticity of the data shall be verified by a third-party auditor; 3) Temporal continuity of statistics: Carbon emissions by consecutive time series are built with the same coverage and methodology, so that investors can compare the company's historical statistics of carbon emissions.

**Table 6: Quality of Carbon Information Disclosure**

| Disclosure Types | Specific Disclosure Information | Assessment Dimensions |
|---|---|---|
| Disclosure of emission statistics | Whether the company discloses its Scope 1 and 2 carbon emissions | Statistical comparability and standardization |
| | Whether the company discloses its Scope 3 emissions | |
| | Whether the company disclose the amount of renewable energy purchased / the proportion of renewable energy in its energy mix | |
| | Whether the company discloses its total GHG emissions | |
| | Whether carbon emissions report covers the entire company or its main business organizations | |
| | Whether the company discloses its annual emission reductions[5] | Temporal continuity of statistics |
| Indirect energy use (Scope 2 emissions calculation) | Whether the company discloses the amount of electricity purchased | Statistical comparability and standardization |
| | Whether the company discloses the amount of heat purchased | |
| Direct energy use (Scope 1 emissions calculation) | Whether the company discloses the amount of natural gas use | Statistical comparability and standardization |
| | Whether the company discloses the amount of coal use | |
| | Whether the company discloses the amount of petrol use | |
| | Whether the company discloses the amount of diesel use | |
| Carbon accounting statistics and the accuracy of methodologies | Whether the company discloses its carbon accounting scope and explanation for methodologies of carbon emission factors | Clear coverage of disclosure and transparent methodologies |
| | Whether the company discloses its data audit assurance report | |
| Related emission statistics in the industry | For the finance industry: whether the company discloses its green finance for emission reductions such as debts for carbon emission reduction | Statistical comparability and standardization |
| | For the information technology industry and the finance industry: whether the company discloses emissions of its data center | |

[5] A company's annual emission reductions mean that if the company discloses its annual emission reductions and overall emissions in this year's annual report, or the company discloses historical emissions and this year's overall emissions, and these statistics are comparable, then the company discloses its annual emission reductions.

**Case Analysis** Tencent Holdings as a case for indicator introduction

Tencent disclosed its corporate environmental performance in its 2021 ESG report, with carbon emissions-related information shown in the table below:

**Table 7: Tencent Carbon Information Disclosure, 2021**

| Specific Disclosure Information | Content |
|---|---|
| Whether the company discloses its Scope 1 and 2 carbon emissions (by million metric tons of CO2) | Scope 1: 0.019, Scope 2: 2.349 |
| Whether the company discloses its Scope 3 emissions (by million metric tons of CO2) | Scope 3: 2.743 |
| Whether to disclose the amount of renewable energy purchased / the proportion of renewable energy in its energy mix (MWh) | Renewable energy purchased: 63,000<br>Self-generated renewable energy: 2334 |
| Whether the company discloses its total GHG emissions（million metric tons） | Total GHG Emissions (Scopes 1, 2 and 3): 5.111 |
| Whether carbon emissions report covers the entire company or its main business organizations | Yes, in 2021, the company expanded the reporting scope of environmental performance to cover all office buildings and data centers in mainland China and Hong Kong within the company's operational control, while leased data centers without actual operational control are not included in the report. |
| Whether the company discloses its annual emission reductions | Yes, although the 2020 corporate environmental performance reporting scope only covers major office buildings and major data centers in mainland China, with Scope 2 emissions registering 1.71 million tons of CO2. In the revised version, it's still comparable to the data in 2021 as the revised reporting scope is the same as that in 2021. |
| Whether the company discloses the amount of electricity purchased | Indirect energy consumption (electricity purchased): 4308960 MWh |
| Whether the company discloses the amount of heat purchased | No relevant data |
| Whether the company discloses the amount of natural gas use | 3,111,654 $m^3$ |
| Whether the company discloses the amount of coal use | No relevant data |
| Whether the company discloses the amount of petrol use | 34,160 L |
| Whether the company discloses the amount of diesel use | 3,261,448 L |

| Specific Disclosure Information | Content |
| --- | --- |
| Whether the company discloses its carbon accounting scope and explanation for methodologies of carbon emission factors | Accounting scope: the disclosure covers all office buildings and data centers in mainland China and Hong Kong within the company's operational control, while leased data centers without actual operational control are not included in the reporting scope; Method and emission factor description: 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Report , IPCC Fifth Assessment Report, as well as the average CO2 emission coefficient of provincial power grids issued by the MEE. |
| Whether the company discloses its data audit assurance report | A third-party agency (PWC) is entrusted to conduct data authentication audits |

**Figure 5-2-1: Average Disclosure Rate of Various Emissions of the 100 Listed Companies**

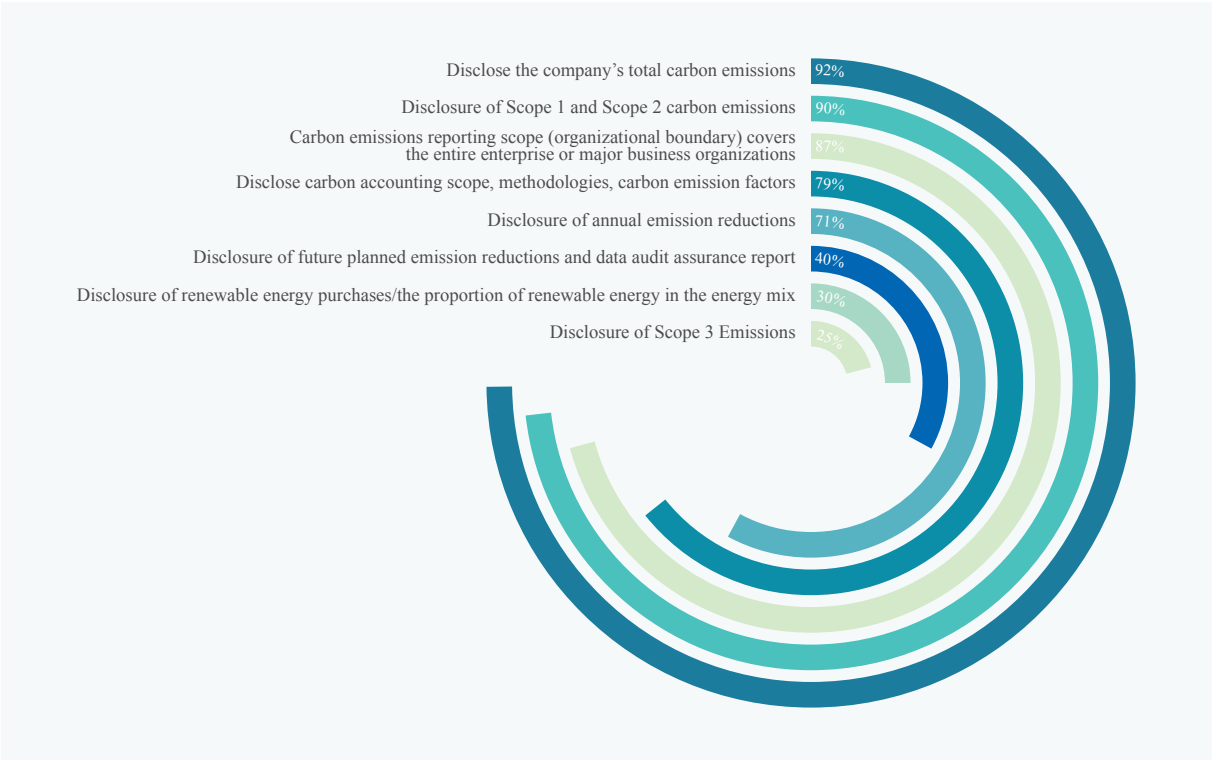
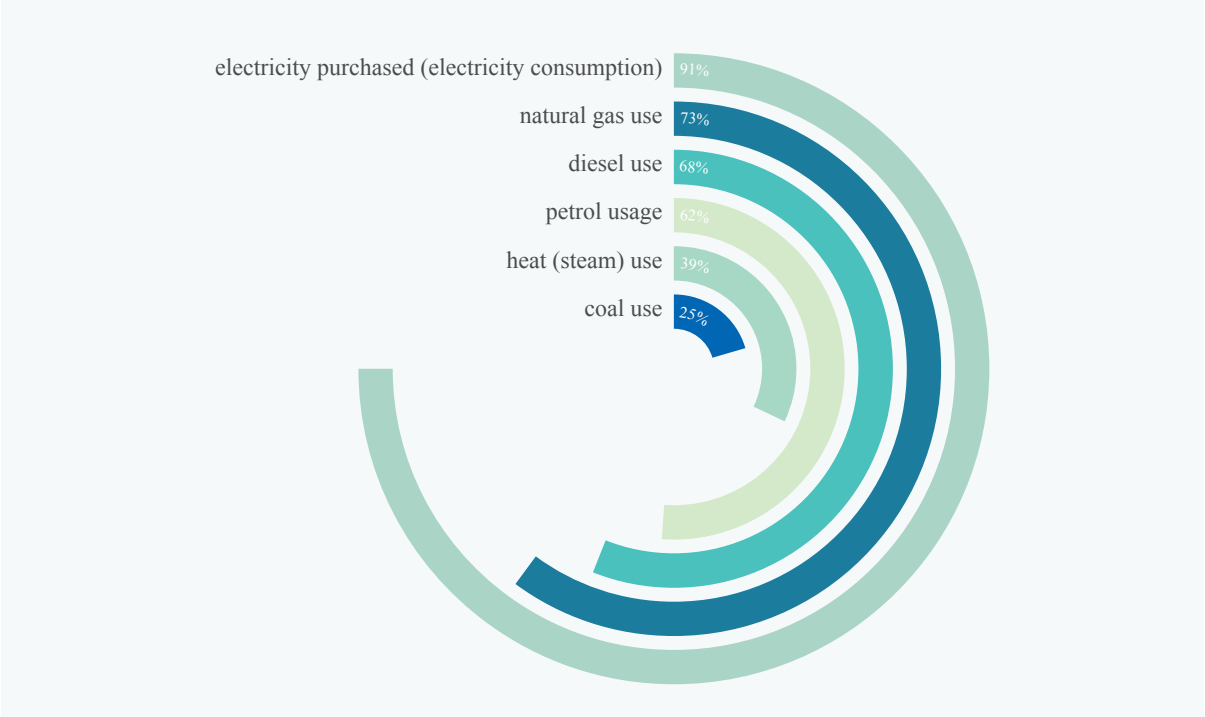


**Figure 5-2-2: Average Disclosure Rate of Energy-related Data of the 100 Listed Companies**




## (4) Quality of emission reduction plan by companies:

The report uses quantitative measures to assess whether companies have set emission reduction targets and whether they have announced exhaustive pathways to carbon neutrality, carbon peaking, or emission reduction plan (such as future emission reductions and emissions-reduction timeline); whereas, the report also adopts qualitative analysis to see whether companies disclose specific emissions-reduction technologies (such as investment in carbon emission reduction projects, purchase of eco-friendly equipment and development of low-carbon technologies).

**Case Analysis** Tencent Holdings Ltd.

1) Carbon neutrality and carbon peaking roadmap and target (timeline for carbon mitigation goal): Tencent unveiled in its 2021 ESG Report that it would use 2021 as the base year to develop the carbon neutrality roadmap and decarbonization pathways, and pledged to achieve carbon neutrality (covering Scope 1, 2, and 3) across its operations and supply chain. Please refer to Tencent Carbon Neutrality Target and Roadmap Report for more details.

2) Future planned emission reductions (quantified goal): The annual GHG emission projections for 2021-2030 under the carbon neutrality roadmap (million tons of $CO_2e$) has been provided, with a commitment to achieve 100% green power use no later than 2030.

3) Specific future emissions-reduction technologies: through energy-saving transformation, Tencent regularly assessed the energy consumption of office buildings, and conducted online emission monitoring for Binhai Tower, Shenzhen, and Beijing headquarters. Tencent's Beijing Headquarters integrated the low-carbon, environmentally friendly and energy-saving designs, such as the intelligent lighting system and building automation system. Besides, Tencent has also built green data centers and actively explored market-oriented green power trading. Tencent has started to develop and build distributed new energy projects for the data centers in 2020 and planned to employ energy storage power stations in the park in the future.

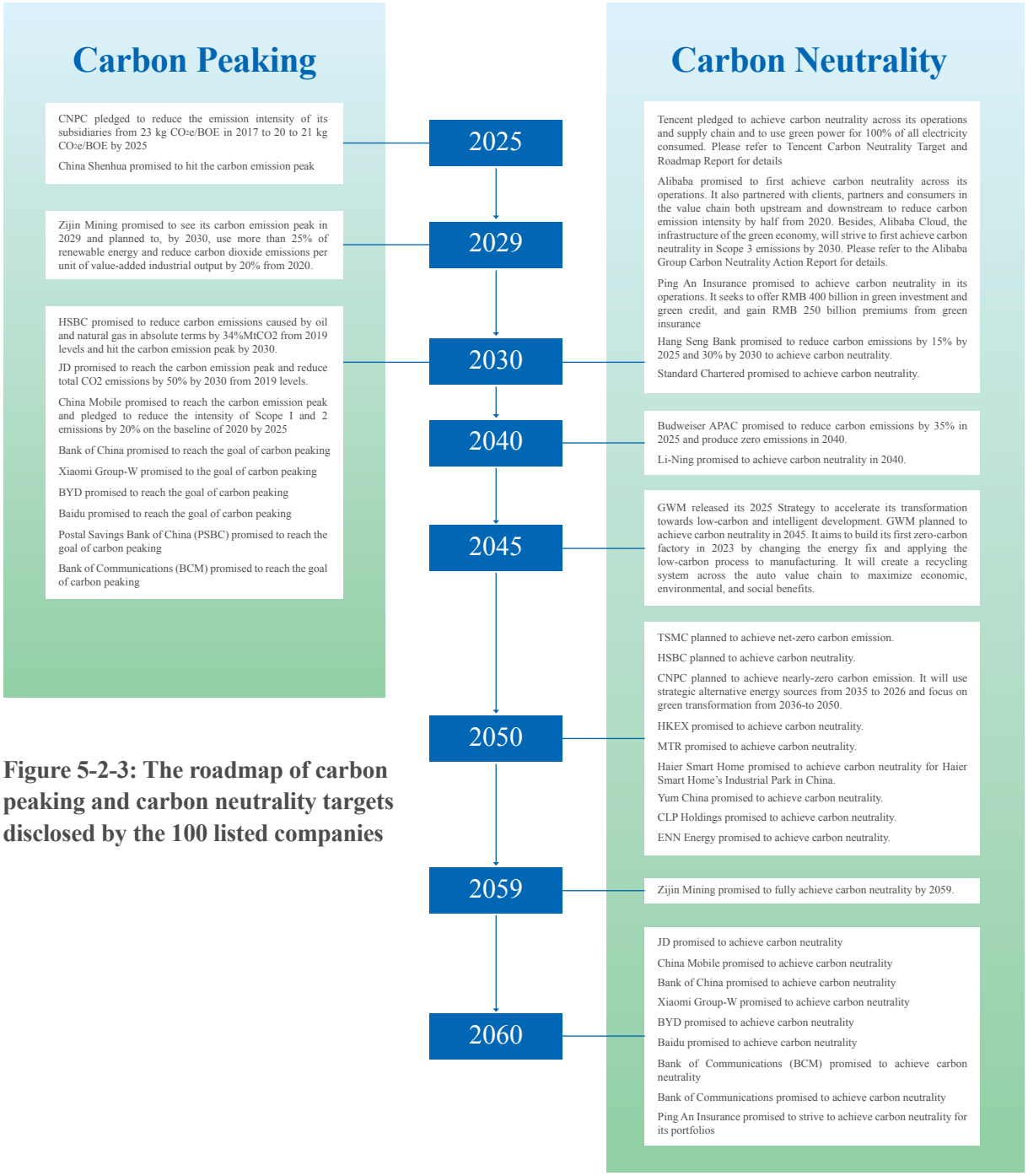



**Figure 5-2-3: The roadmap of carbon peaking and carbon neutrality targets disclosed by the 100 listed companies**

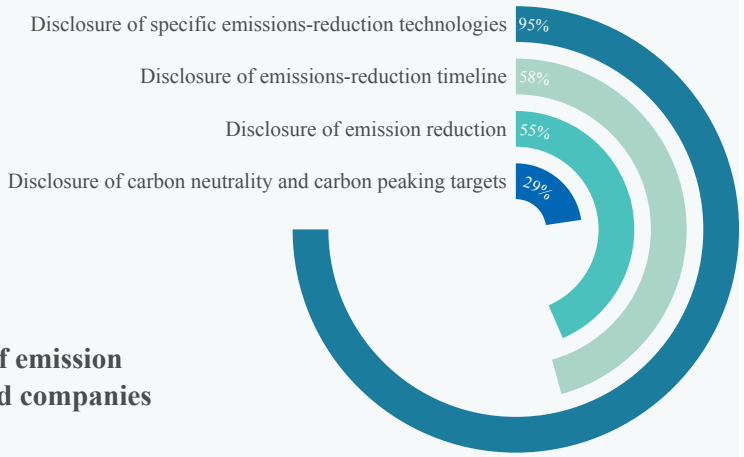



**Figure 5-2-4: Disclosure rate of emission reduction goals in the 100 listed companies**

**Table 8: Indicators of Carbon Ranting System**

| Primary | Secondary | Tertiary | Methodology |
|---|---|---|---|
| Emission | E1 Actual carbon emission intensity | E1.1Average carbon emission intensity in 2019, 2020 and 2021 (in $tCO_2$ / RMB 10000) | Score by industry-specific median and 0 points for nondisclosure during the past 3 years |
| Mitigation | M1 Actual emission mitigation | M1.12019-2021: rate of change in emission reduction intensity | Score by industry-specific median; 0 points for nondisclosure during the past 3 years or with no comparable historical data |
| Quality | Q1 Quality of emission disclosure | Q1.1 Whether Scope 1 and 2 emissions are disclosed | 50 points for disclosure and 0 points for nondisclosure |
| | | Q1.2 Whether Scope 3 emissions is disclosed | 50 points for disclosure and 0 points for nondisclosure |
| | | Q1.3 Whether the purchase of renewable energy or proportion of renewable energy in the energy mix is disclosed | 50 points for disclosure and 0 points for nondisclosure |
| | | Q1.4 Whether the total carbon emissions are disclosed | 50 points for disclosure and 0 points for nondisclosure |
| | | Q1.5 Whether the carbon emission report covers the company or major business organizations | 50 points for disclosure and 0 points for nondisclosure |
| | Q2 Disclosure of indirect energy use (calculated by Scope 2 emissions) | Q2.1 Whether purchased electricity is disclosed (calculated by Scope 2 emissions) | 50 points for disclosure and 0 points for nondisclosure |
| | | Q2.2 Whether purchased heat is disclosed (calculated by Scope 2 emissions ) | 50 points for disclosure and 0 points for nondisclosure |

| Primary | Secondary | Tertiary | Methodology |
|---|---|---|---|
| | Q3 Disclosure of direct energy use (calculated by Scope 1 emissions ) | Q3.1. Whether the direct energy use is disclosed (e.g. natural gas, coal, petrol, diesel[6], etc.) | 50 points for disclosure and 0 points for nondisclosure |
| | Q4 Quality of disclosure of carbon audits and methodology | Q4.1 Whether the scope, methodology and carbon emission factors of carbon calculation are disclosed | 50 points for disclosure and 0 points for nondisclosure |
| | | Q4.2 Whether the data audit assurance report is disclosed | 50 points for disclosure and 0 points for nondisclosure |
| Goal | G1 Quality of quantitative data disclosure in emission reduction plan | G1.1 Whether the "carbon neutrality and carbon peaking" targets (e.g. the time for reaching "carbon neutrality" and "carbon peaking") or the timeline of future emission reduction planned are disclosed | 50 points for disclosure and 0 points for nondisclosure |
| | | G1.2 Whether the planned emission reductions are disclosed | 50 points for disclosure and 0 points for nondisclosure |
| | G2 Quality of qualitative data disclosure in emission reduction plan | G2.1 Whether the specific emissions-reduction technologies are disclosed (investment of carbon emission reduction project, carbon emission reduction equipment purchase, low-carbon technology development, etc.) | 50 points for disclosure and 0 points for nondisclosure |

## 5.3 Scoring Methodology in Carbon Rating

As shown in Figure 8, in the rating system, the indicator in the dimension of Emission and Mitigation are scored by using the industry-specific median. Each company by industry is scored on the average carbon emission intensity and the ROC in carbon emission; the resultant industry-specific median is viewed as the baseline on a 100-points scale. In addition, the Report also analyses the Quality and the Goal of the CSR report. Companies are scored on a 500-points scale in the dimension of Quality (with a score of 50 for each tertiary indicator) and on a 150-points scale in the dimension of Goal (with a score of 50 for each tertiary indicator)

[6] Since different industries require different types of direct energy, listed companies are considered to have disclosed their direct energy use if any of natural gas, coal, gasoline, diesel or other direct energy use is disclosed.

## Convert data into scores:

Under the rating system, the data collected for each rating indicator fall into two categories: the numeric value data and the Boolean data points. The numeric value data includes annual carbon emission, annual carbon emission intensity, actual emission reductions, etc.; the Boolean data points are those whose value is either True or False, such as "whether Scope 1 and 2 carbon emissions are disclosed", "whether the total carbon emissions are disclosed", etc. Consequently, the methodology varies with the data types.

### (1) Boolean Data

We directly convert Boolean data (True or False) into rating points according to the score scale of the tertiary indicators which it falls under. The indicator of "whether Scope 1 and 2 carbon emissions are disclosed", for instance, indicates 50 points on the score scale of tertiary indicators. Then, any company which has disclosed Scope 1 and 2 carbon emissions from 2019 to 2020 will gain the full score of 50 points; otherwise, it will get 0 points. The same principle applies when scoring the tertiary indicators under the dimensions of Quality and Goal.

### (2) Numeric Value Data

If all companies by industry have quantified their data, the industry-specific median is used to score the corresponding indicators, that is, the score is determined by the ranking in their industry in relative terms. The methodology converts the values of the indicators for all companies based on the median of the indicators in that industry, with the industry-specific median being 100 points. In the rating system hereof, the carbon intensity and its trend both are numeric value data.

## Industry-specific weighting:

Since the median carbon intensity of companies in some high carbon emission industries (e.g. energy and public utilities, industrial manufacturing, etc.) is much higher than that of other industries, industry scaling factors based on the median carbon intensity data of all companies in each industry have been designed to make the comparison fairer: The median carbon intensity of high carbon emission industry A (=100× scaling factor of industry A), should be lower than the corresponding median carbon intensity score of low carbon emission industry B (= 100 × scaling factor of industry B). We assign a scaling of 1 to the mean of the median carbon intensity of all industries, and calculate the scaling factor for each industry according to the Cumulative Distribution Function (CDF), which is shown in the following table.

**Table 9: Scaling Factors by Industry**

| Industry | Mean of the median carbon intensity (t $CO_2e$/RMB 10, 000) | Z-score under standard normal distribution | Scaling factor |
|---|---|---|---|
| Consumer staples | 0.1840 | -0.1589 | 1.1263 |
| Real estate and construction | 0.0431 | -0.8547 | 1.6073 |
| Telecommunications | 0.3540 | 0.6797 | 0.4967 |
| Consumer discretionary | 0.0268 | -0.9348 | 1.6501 |
| Industrial manufacturing | 0.5233 | 1.5152 | 0.1297 |
| Finance | 0.0075 | -1.0301 | 1.6970 |
| Energy and public utilities | 0.5731 | 1.7609 | 0.0782 |
| Automobile manufacturing | 0.1170 | -0.4898 | 1.3757 |
| Healthcare | 0.2020 | -0.0705 | 1.0562 |
| Information technology | 0.0224 | -0.9564 | 1.6612 |
| Conglomerate | 0.3255 | 0.5393 | 0.5897 |
| Mean of the median carbon intensity of all industries | | 0.2135 | |

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:

$$\text{Company A's score in the dimension of Emission} = 100 \times \frac{\text{The median carbon emission intensity of all companies in the industry}}{\text{Company A's average carbon emission intensity}} \quad (1)$$

$$\text{Company A's in the dimension of Mitigation} = 100 \times \frac{\text{The median rate of change in carbon emission of all companies in the industry}}{\text{Company A's average rate of change in carbon emission}} \quad (2)$$

Since some companies have never published the CSR or ESG report and accordingly did not disclose the carbon emission data from 2019 to 2021, they have not unveiled the numeric data corresponding to the tertiary indicator, so their score on this indicator is 0 points.

# 6 Analysis of Carbon Rating Results

Based on the above experience and the Scope 1&2 $CO_2$ emission equivalents, the Report has scored and ranked listed companies with a thorough examination over corporate financial information and industry information in a multi-dimensional manner.

## 6.1 Analysis of Carbon Rating in Different Industries

Through comparative analysis of four dimensions, namely, actual carbon emissions (Emission), the actual mitigation efforts (Mitigation), the quality of carbon information disclosure (Quality), and the future emission reduction plan (Goal), we have completed the carbon rating for the top 100 listed companies in China with the largest market capitalization (see Appendix 1). Figure 6-1-1 compares the average scores of the primary indicators of 11 industries, among which real estate and construction, consumer discretionary and financial industry ranked among the TOP 3.

**Figure 6-1-1 Carbon Rating by Industry**

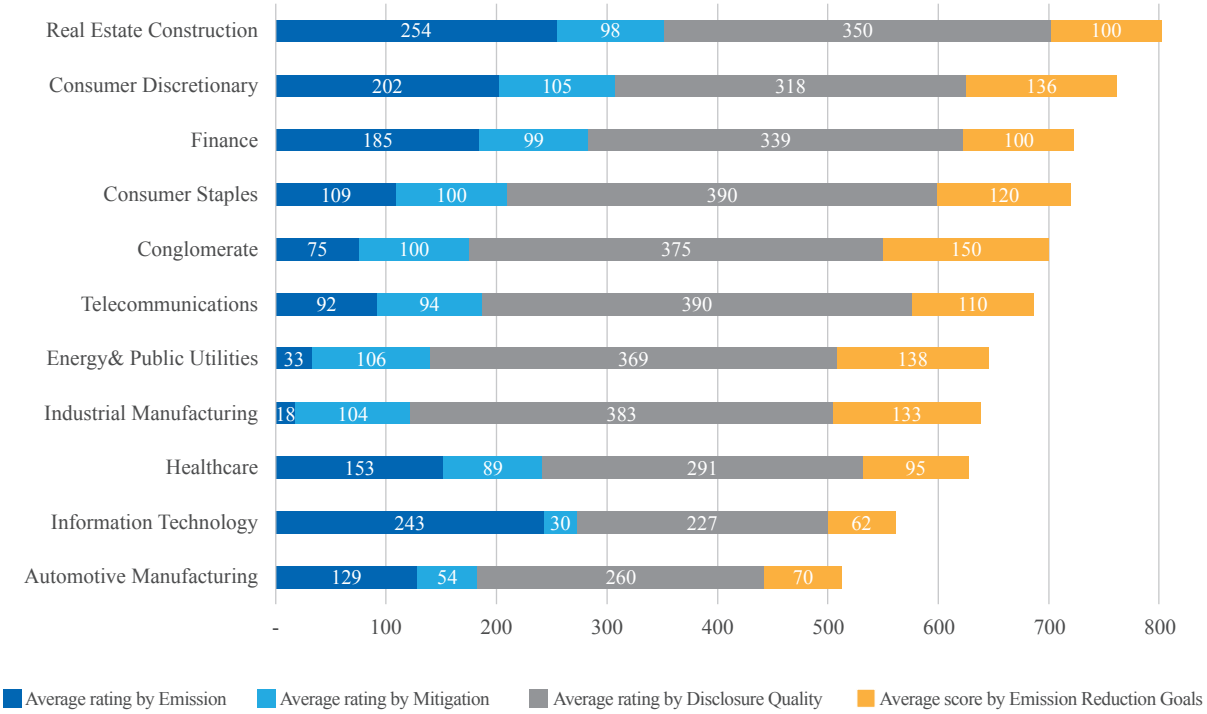
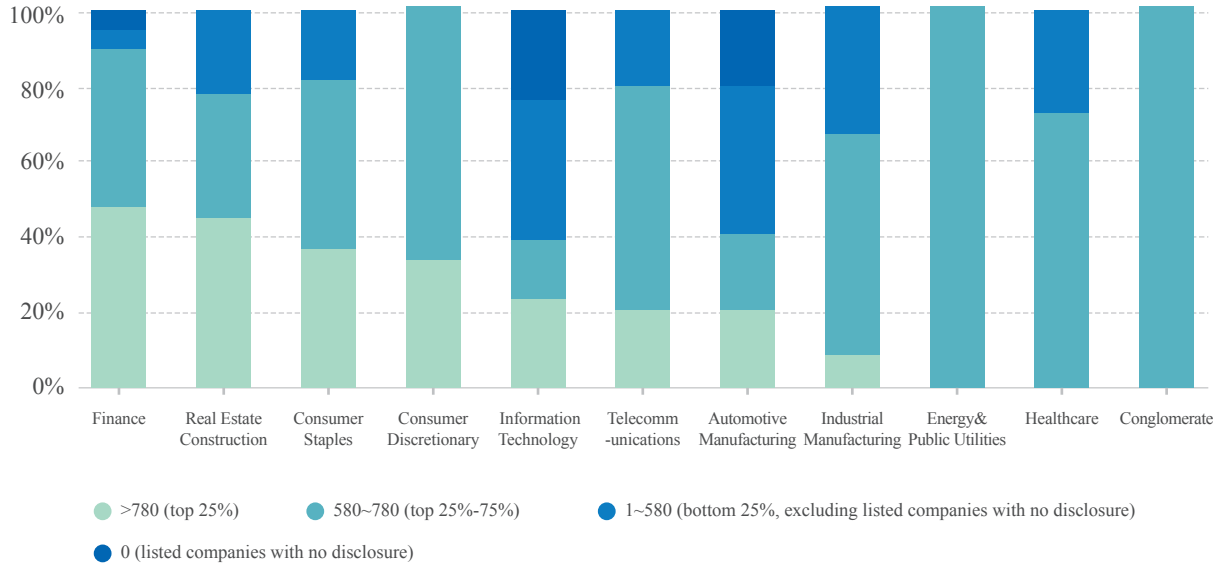


Figure 6-1-2 analyzes carbon ratings in different industries, in which 47% financial companies and 44% of companies in the real estate and construction industry score higher than 780 (i.e., ranked among the top 25% of all researched companies); while all energy, public utilities, conglomerates, and healthcare companies score below 780 (i.e., ranked among the bottom 75% of all listed companies). In addition, the total score for companies in the finance, IT, and auto manufacturing industries was 0 as some players in these aforementioned trades did not disclose any ESG reports and carbon emissions-related information during 2019 and 2021.

**Figure 6-1-2 Distribution of Carbon Rating by Industry**




Figures 6-1-3 and 6-1-4 compare the median of carbon intensity in various industries as well as their annual carbon emissions. The three industries with the highest carbon intensity are: energy and public utilities, industrial manufacturing, and telecommunications. And the TOP 3 sectors with the highest average emissions are: energy and public utilities, conglomerates, and industrial manufacturing. Among them, telecommunications (disclosure quality score: 390), industrial manufacturing (disclosure quality score: 383), energy and public utilities (disclosure quality score: 369), although as high-emitting industries, have all achieved relatively high score in terms of the disclosure quality. The quality of a company's emissions disclosure is related to the type of industry where it operates. At present, China's heavy-chemical industry can be further classified into six high-emission and high-energy-consuming segments, namely, ferrous metal smelting, steel and non-ferrous metal, building materials, cement, and petrochemicals, while our rating system also covers industries with high carbon emission, including telecommunications, energy and public utilities (coal, gas and oil producers, power suppliers), as well as industrial manufacturing, which tend to have large energy consumption, heavy pollution, and high carbon intensity, hence the greater room for emission reduction. On the one hand, the market has a great

demand for the products of these companies, while the task of low-carbon transformation facing them is also very arduous. Therefore, higher carbon emission intensity brings more stringent requirements on the quality and quantity of carbon disclosure of such companies, which, in turn, have to disclose carbon-related information with higher quality, thus to improve the corporate image and avoid negative market reaction. This is a reason why these companies tend to have haver higher scores in disclosure quality.

**Figure 6-1-3 Average carbon intensity in different industries, 2019-2021**

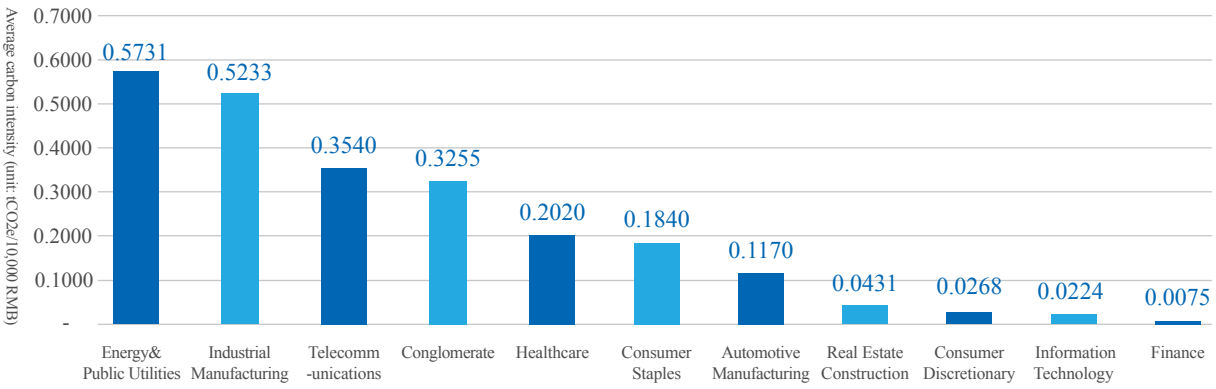
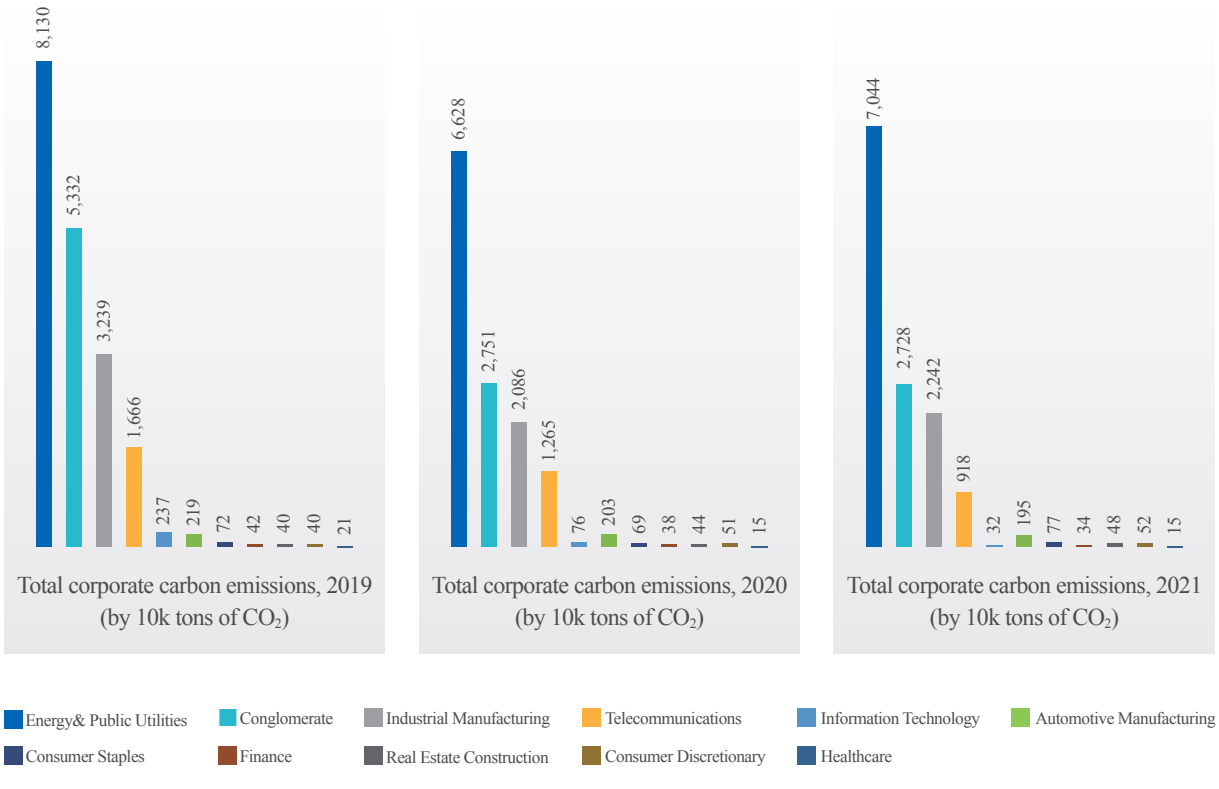


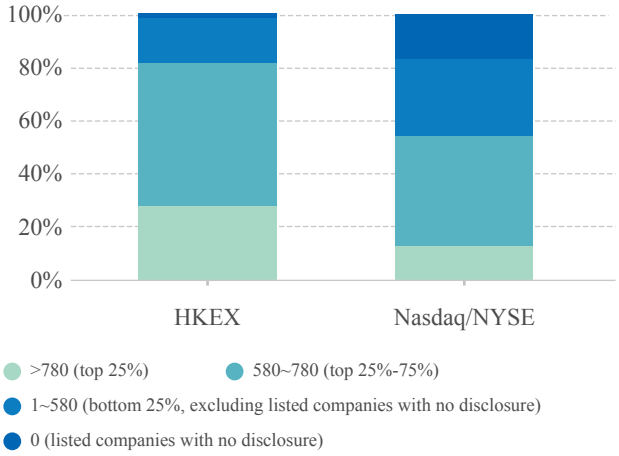

**Figure 6-1-4 Average carbon emissions of companies in different industries, 2019-2021**



## 6.2 Policy Impact of Environmental Information Disclosure on Carbon Rating

Figure 6-2-1 compares the carbon ratings of companies listed on different stock exchanges. Among them, 27% of companies listed on the HKEX and 12.5% on the NYSE/NASDAQ scored higher than 780 (top 25%). As of May 1, 2022, 16.67% of NYSE/NASDAQ-listed companies had never publicly disclosed emissions data. But the proportion was only less than 1% for HKEX-listed companies.

**Figure 6-2-1 The carbon rating of companies listed on different stock exchanges**




Both the Nasdaq and the NYSE have provided some standard guidelines of ESG disclosures for listed companies, while the NYSE have yet to systematically clarify the scope and content to be included in the report. Nasdaq released the ESG Reporting Guide 2.0 based on the principle of voluntary disclosure, encouraging companies to disclose GHG emissions and energy consumption as a number trended over time, which should also be compared against historical and industry averages, if possible. At the same time, Nasdaq recommends that companies disclose their emissions intensity (carbon emissions per unit of revenues, sales and production) in numerical form.

The SEHK stipulates that the environmental indicators of listed companies shall be based on the principle of "disclose or explain", or otherwise carefully considered reasons shall be provided in the ESG report. Quantitative indicators related to corporate carbon emissions shall also been clarified in detail, including: the scope of emission types and relevant data, total GHG emissions or intensity (if applicable, e.g. carbon emissions per unit of production or per facility) of Scope 1&2 energy (by tons). The enterprise shall also describe the emission reduction goals and the steps taken to achieve them, policies for the efficient use of resources (including energy, water and other raw materials), as well as the total consumption of direct and/or indirect energy (in MWh) by type (e.g. electricity, gas or petrol) and intensity (e.g. per unit of production, per facility).

Compared with the NYSE and Nasdaq, the HKEX-listed companies need to disclose more environmental indicators, in line with all detailed rules and standards for corporate disclosure. These higher requirements will facilitate HKEX-listed companies to improve their carbon emission disclosure system, thus to better promote the low-carbon development of enterprises.

## 6.3 The Impact of Corporate Profits on Carbon Rating

Figure 6-3-1 compares the average annual operating profit margin in groups with different carbon rating. The average annual operating profit margin of listed companies with the high rating (>780 points, top 25%), mid rating (580~780 points, top 25%-75%) and low rating (<580 points, bottom 25%) is 22.86%, 21.63% and 3.95% respectively, showing a decreasing trend, which indicates that within the carbon rating system, the profitability of listed companies with high rating is much higher than those with lower rating. Carbon information disclosure is conducive to enhancing corporate value and promoting corporate financing. In addition to corporate scale, profitability and management, carbon disclosure is also positively correlated with stock prices. Corporate profitability can absorb the cost of environmental reporting and help companies formulate carbon reduction strategies. Being the focus of stakeholders, its well-proved rationality and legitimacy based on environmental disclosure will create an attractive corporate image to increase investor confidence, laying a solid foundation for the company's future revenue growth. In addition, in the context of the continuous development of the national carbon market, the tightening supply of carbon allowance may drive up carbon prices, and the effective use of carbon allowance will help reduce corporate costs and increase profits.

**Figure 6-3-1 Carbon rating and annual operating profit margin**

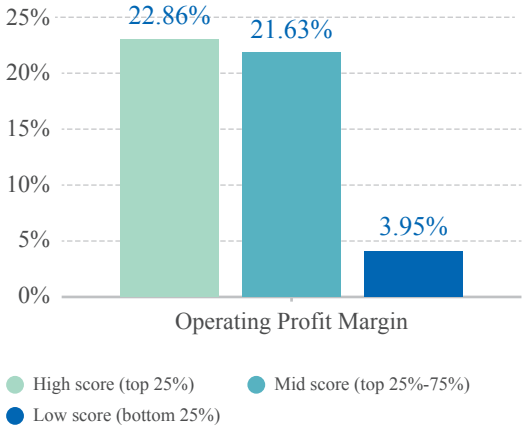
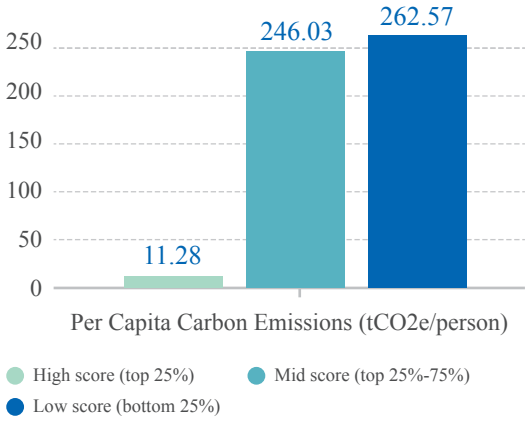



**Figure 6-4-1 Carbon rating and annual per capita carbon emissions in companies**




## 6.4 The Impact of Employee's Per Capita Energy Use on Carbon Rating

Figure 6-4-1 compares the per capita carbon emissions in groups with different carbon rating. The per capita carbon emissions of listed companies with the high rating (>780 points, top 25%), mid rating (580~780 points, top 25%-75%) and low rating (<580 points, bottom 25%) is 11.28t, 246.03t, 262.57t CO2 respectively, showing a monotonic increase. Among them, the per capita carbon emission of companies with high scores is significantly lower than that with mid or low scores, which shows the former are significantly better than the latter in terms of environmental-friendly operation and emission reduction.

## 6.5 The Impact of Corporate Stock Turnover Rate on Carbon Rating

Figure 6-5-1 compares the annual corporate stock turnover rate in groups with different carbon rating. The annual corporate stock turnover rate of listed companies with the high rating (>780 points, top 25%), mid rating (580~780 points, top 25%-75%) and low rating (<580 points, bottom 25%) is 96.11%, 109.39% and 300.14% respectively, showing a monotonic increase. The turnover rate is used to measure the liquidity of a stock. And the result shows companies with lower rating tend to have higher stock turnover rate, indicating that investors are more willing to hold the share of companies with higher scores for a long time, while flexibly trading those with lower scores, as investors believe that high-scoring companies will have greater prospects and potential as they tend to be more consistent with the carbon peak and carbon neutrality policy in China. As a result, investors are more willing to hold the shares of high-scoring companies expect greater profits thereby. On the contrary, enterprises with lower scores may need to undergo energy transition or improve their disclosure quality, hence the lower predictability of their future low carbon development. As a result, most investors will not hold the shares in a long term. Instead, they tend to focus more on the short-term financial information, thus to make frequent transactions to gain more profits. With the carbon peak and carbon neutrality policy in place, companies in industries with lower carbon rating may need to bear additional cost for carbon reduction, which will influence their profitability. These data show that investors have been keenly aware of the possible impact of carbon disclosure on the future development of enterprises under the carbon peak and carbon neutrality policy. As a result, enterprises should be more active in information disclosure and emission reduction.

**Figure 6-5-1 Carbon rating and annual corporate stock turnover rate**

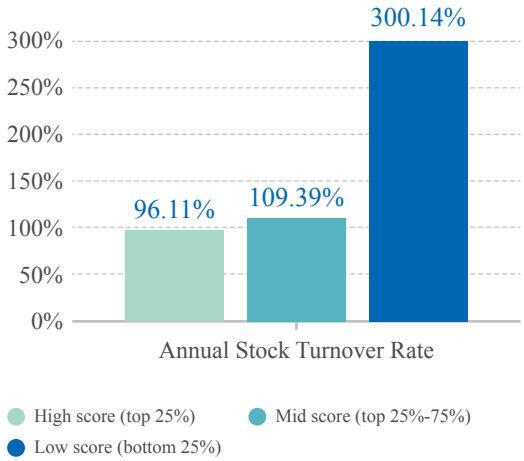
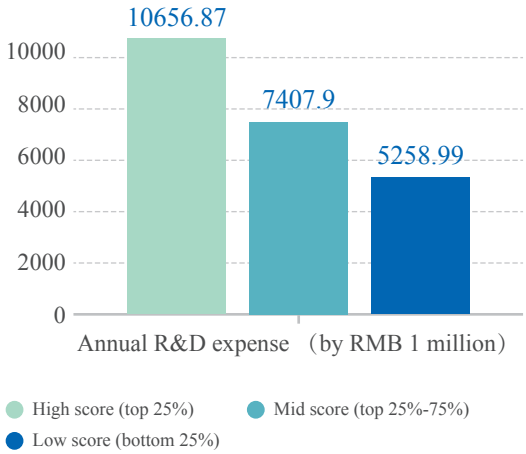



**Figure 6-6-1 Carbon rating and annual corporate R&D expense**



## 6.6 The Impact of Annual Corporate R&D Expense on Carbon Rating

R&D investment can not only be used to enhance corporate innovation capabilities, but also to support the green and sustainable development of listed companies, improve consumption efficiency of natural resource while reducing emissions. Therefore, Figure 6-6-1 compares the average annual R&D expenses in companies with different carbon rating. The annual R&D expense of listed companies with the high rating (>780 points, top 25%), mid rating (580~780 points, top 25%-75%) and low rating (<580 points, bottom 25%) is RMB 10.657 billion, 7.4 billion and 5.259 billion respectively, showing the trend of decrease. The results show that listed companies with higher scores spend more on R&D and pay more attention to the company's R&D initiatives and innovation.

## 6.7 Analysis of Carbon Information Disclosure Quality

The section compares the disclosure rate of various types of carbon information and energy use among listed companies that have released ESG or sustainability reports from 2019 to 2021.

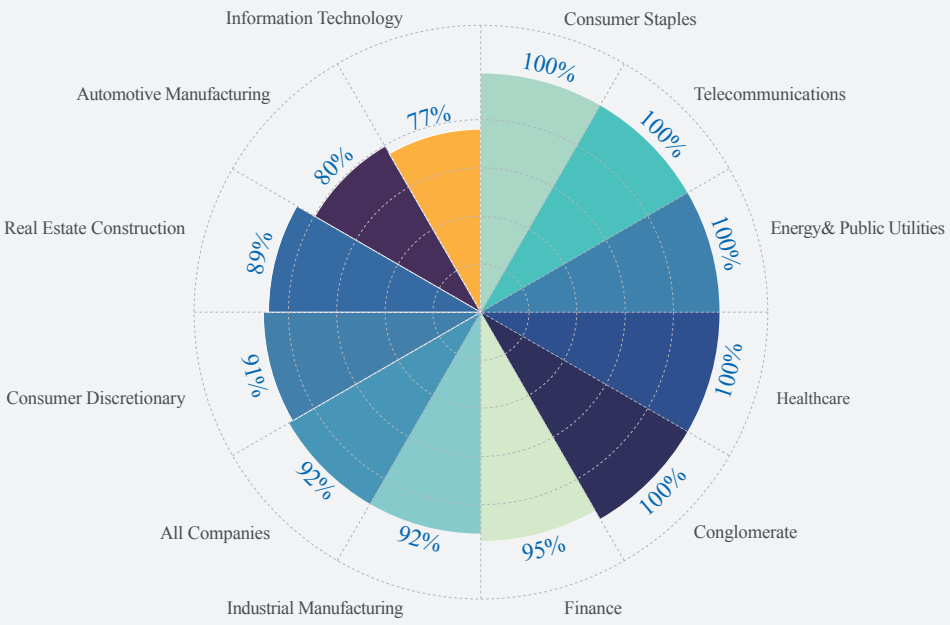



**Figure 6-7-1 Disclosure rate of total emissions in different industries**

Figure 6-7-1 compares the total carbon emission disclosure rate of different industries. Overall, the disclosure rate of total carbon emissions in all 11 industries is relatively high, with an average disclosure rate of 92%. Among them, 5 industries have achieved 100% disclosure, including consumer staples, telecommunications, energy and public utilities, healthcare and conglomerate.

Figure 6-7-2 compares Scope 1&2 emissions disclosed by different industries. The average disclosure rate of Scope 1 and Scope 2 emissions reaches 90%, among which, industries namely consumer staples, telecommunications, consumer discretionary, industrial manufacturing, energy and public utilities, as well as conglomerate have reached 100% disclosure rate. And the figure for the finance industry also reaches 95%.

At present, only a few companies disclosed their Scope 3 emissions, with the average disclosure rate registering 25%, and there is a large performance gap between different industries. Among them, the industry with the highest Scope 3 disclosure rate is real estate and construction, with an average disclosure rate of 44%. Neither the auto manufacturing nor the conglomerates disclosed any Scope 3 emissions. Meanwhile, statistics and analysis has been done on the scope of emissions disclosure of all companies. It's found that 87% of listed companies have already achieved the scope of carbon emissions disclosure to the whole company or its major business organs, while 13% of companies only disclosed the emissions in headquarters or some business organs.

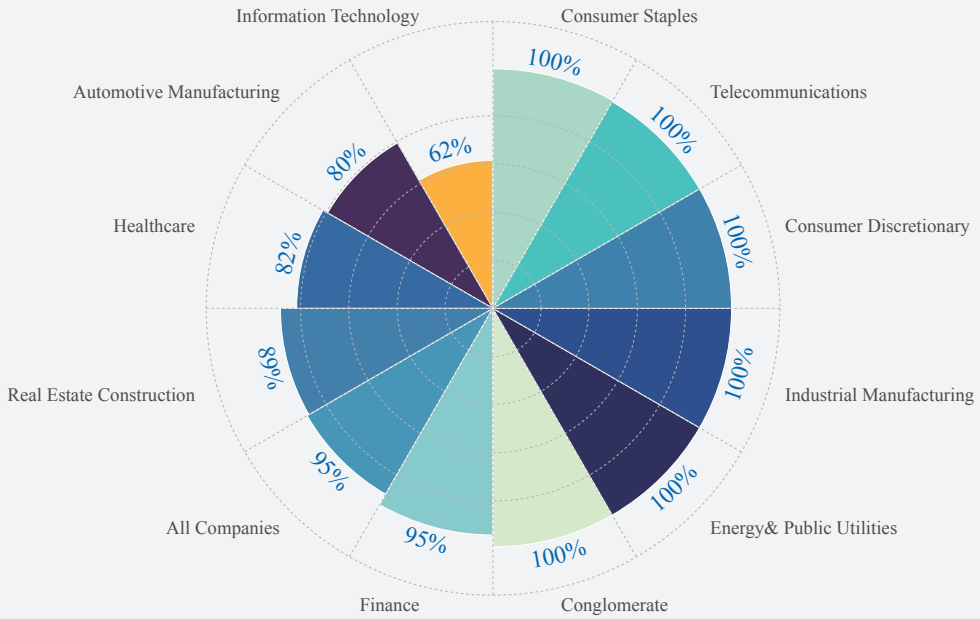



**Figure 6-7-2 Scope 1 & 2 emission disclosure rates by industry**

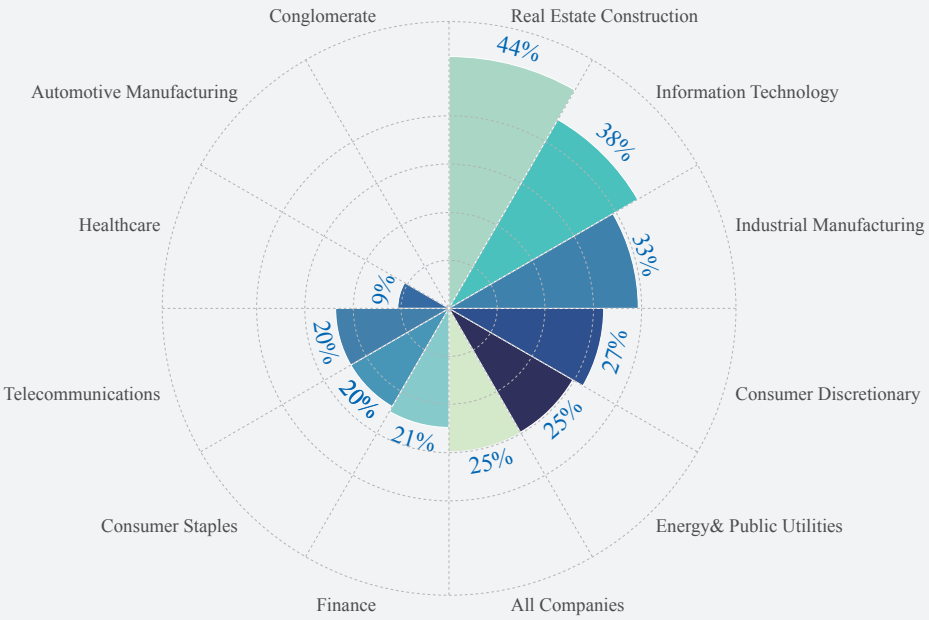



**Figure 6-7-3 Scope 3 emission disclosure rates by industry**

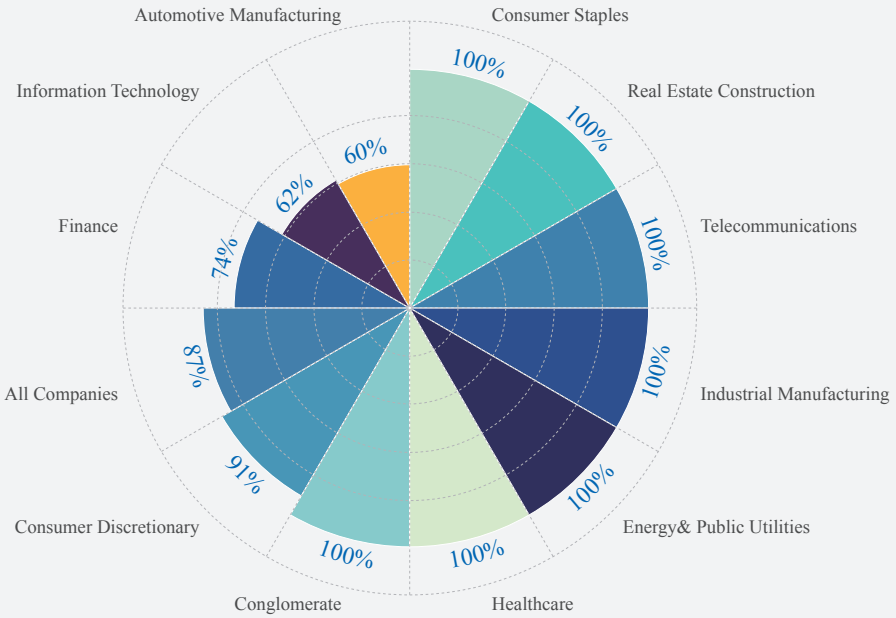



**Figure 6-7-4 Companies that disclose carbon emissions covering the entire organization**

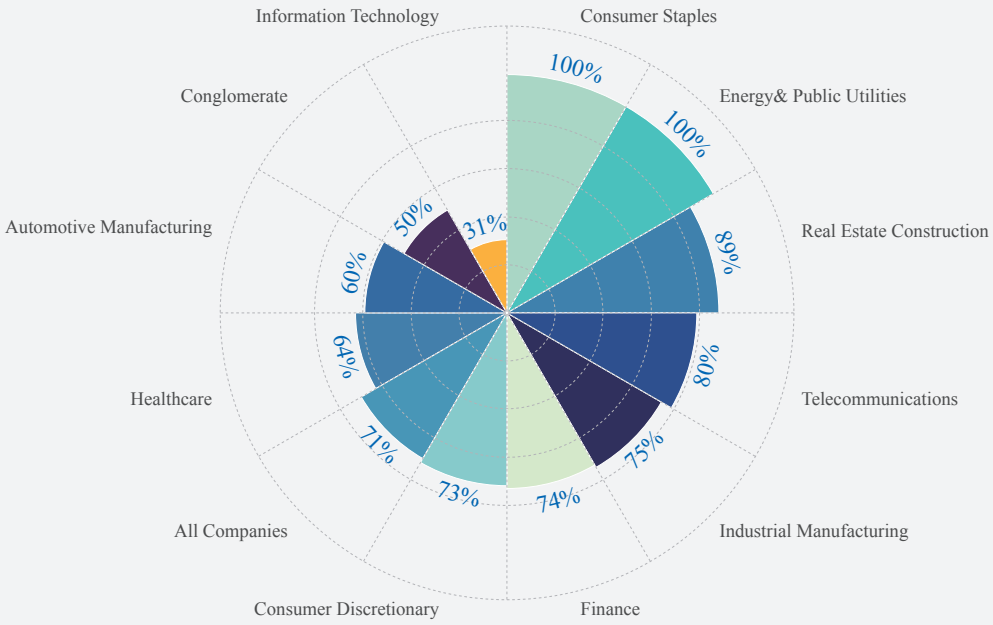



**Figure 6-7-5 Disclosure rate of total emission reductions by industry**

Figure 6-7-5 compares the annual disclosure rate of emission reduction in different industries. The average total emission reduction disclosure rate of the 100 researched companies is 71%, among which, energy and public utilities and consumer staples have achieved a 100% disclosure rate, and the real estate and construction, as well as telecommunications industry have also achieved a disclosure rate of no less than 80%. However, in the information technology industry, only 31% of companies disclosed annual emission reductions or historical emissions data. Companies that did not disclose annual emission reductions lacked the temporal stability of emission data, so investors were unable to compare companies' carbon emissions against any historical data.

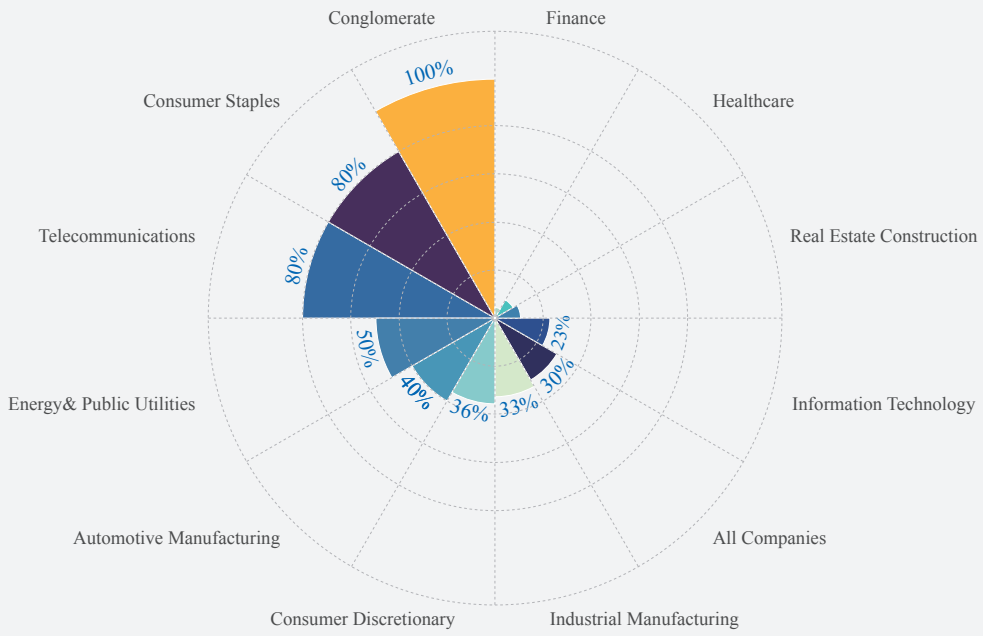



**Figure 6-7-6 Disclosure rate of the proportion of renewable energy procurement by industry**

With the carbon neutrality goals, it is fundamental for companies to use renewable energy with higher energy efficiency, so as to support its sustainable economic development. Figure 6-7-6 shows the disclosure rate of renewable energy procurement (or proportion) in different industries. At present, the average disclosure rate for renewable energy procurement (or proportion) of 100 researched companies is only 30%, and there is a large performance gap between industries. Among them, the disclosure rate in conglomerates, consumer staples and telecommunications has reached 80% and above. The industries with the lowest disclosure rate include real estate and construction, healthcare, as well as finance, with their disclosure rates registering 11%, 9% and 5%, respectively.

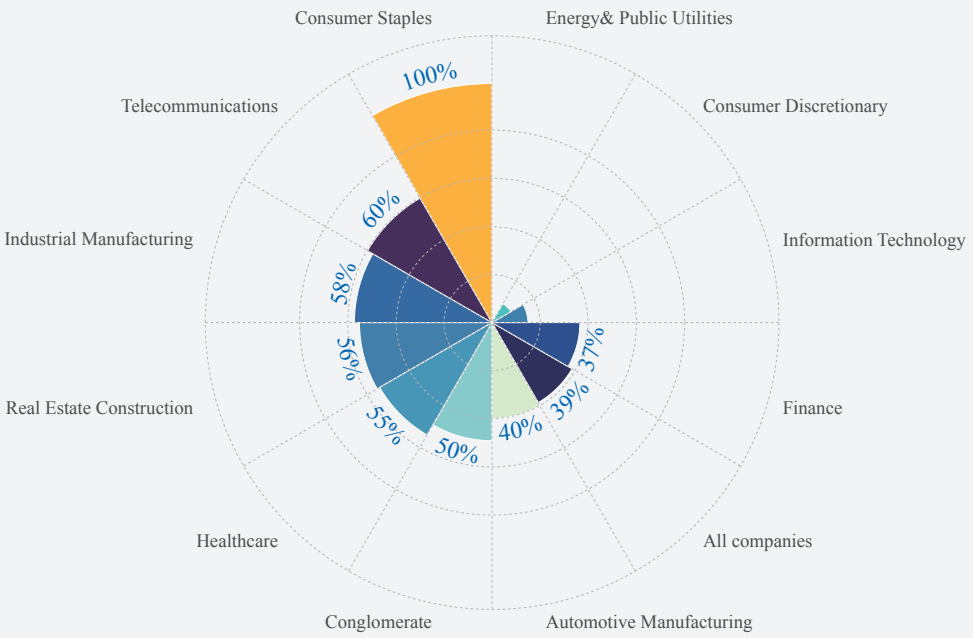



**Figure 6-7-7 Disclosure rate of heat purchased in different industries**

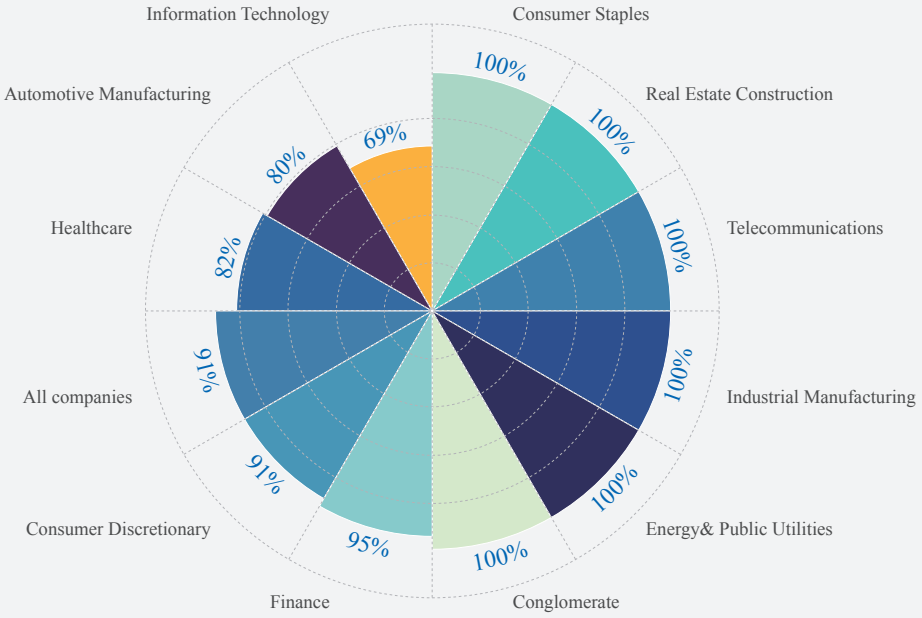
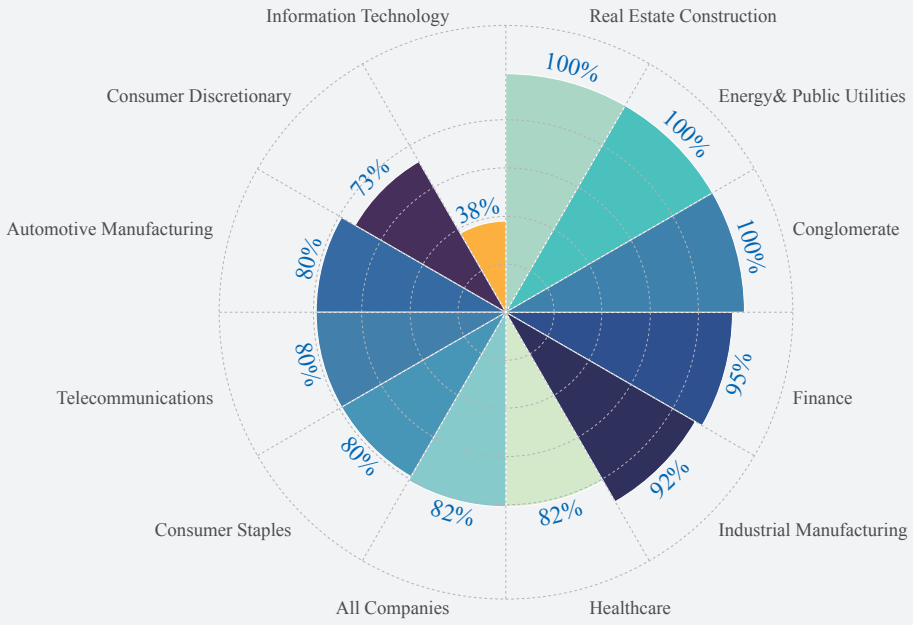


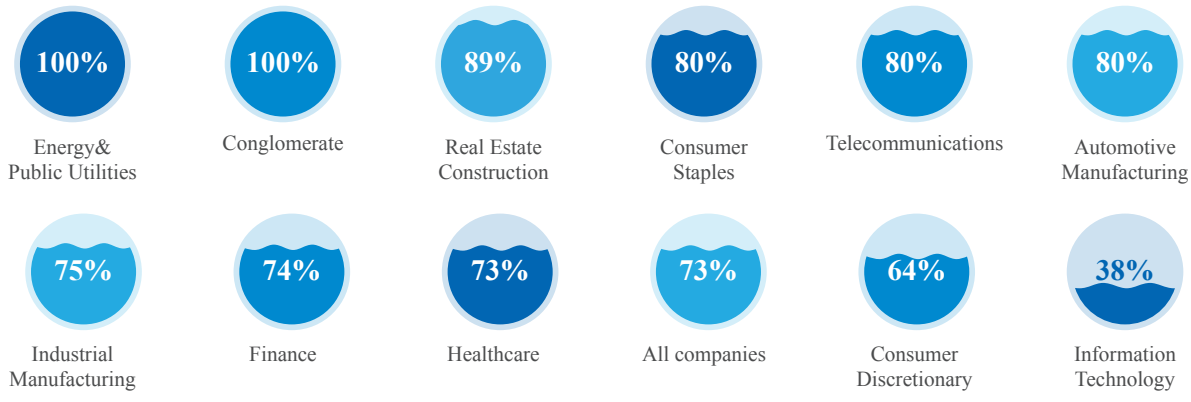

**Figure 6-7-8 Disclosure rate of electricity purchased in different industries**

According to China's Guidelines for Accounting and Reporting for Emissions from 24 Industries, the calculation of the total carbon emissions of enterprises needs to be based on the emissions from fuel combustion within the accounting boundary (Scope 1 emissions) and the emissions from purchased electricity and heat (Scope 2 emissions). Therefore, the data disclosure of both direct and indirect energy by listed companies is very important, which can provide investors with basic information to estimate or verify the raw data for carbon accounting of direct/indirect emissions. Figure 6-7-7 and 6-7-8 compare the disclosure rates of heat purchased and electricity purchased. Currently, the average disclosure rate for heat purchased in the 100 companies is only 39%, but the figure for electricity satisfyingly reaches 91%. The disclosure of electricity purchased in all industries is relatively good, among which, industries namely consumer staples, real estate and construction, telecommunications, energy and public utilities, conglomerate have reached 100% disclosure rate.

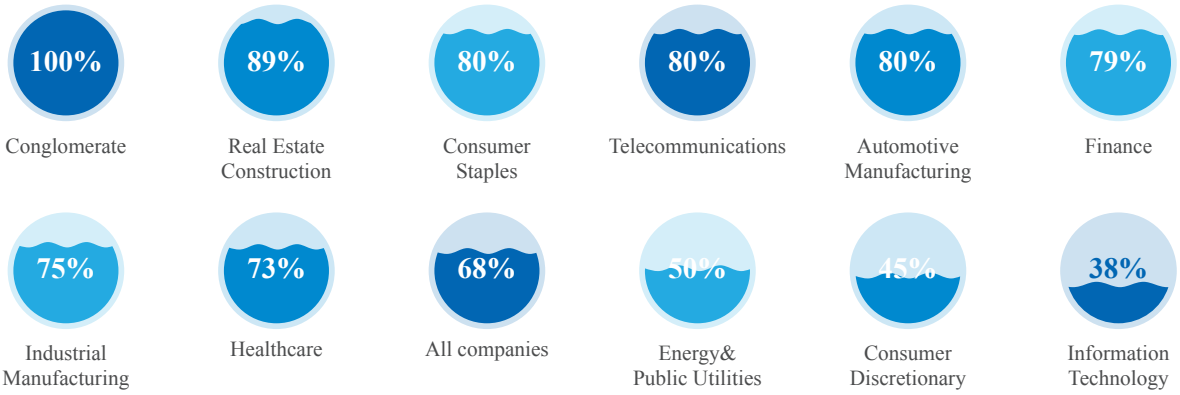



**Disclosure rate of direct energy use by industry**

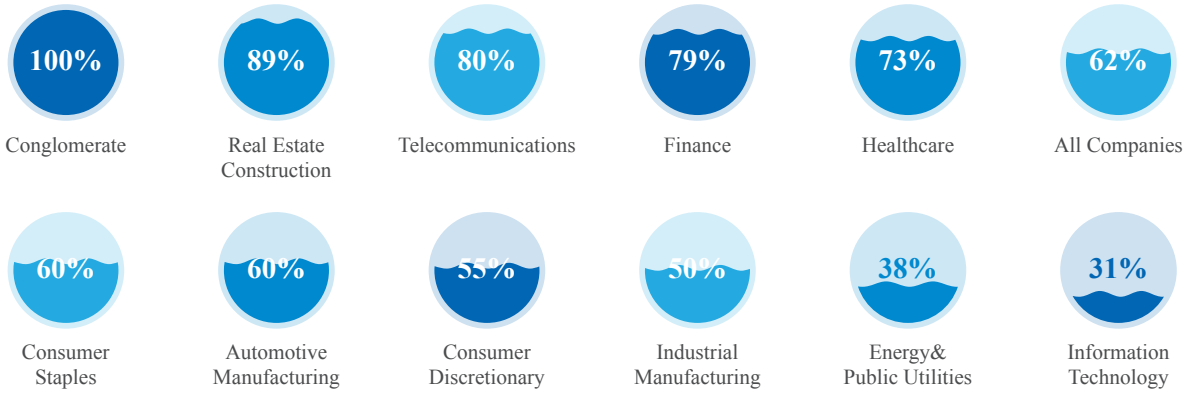
## Disclosure rate of natural gas use by industry



## Disclosure rate of diesel use by industry




## Disclosure rate of petrol use by industry




## Disclosure rate of coal use by industry

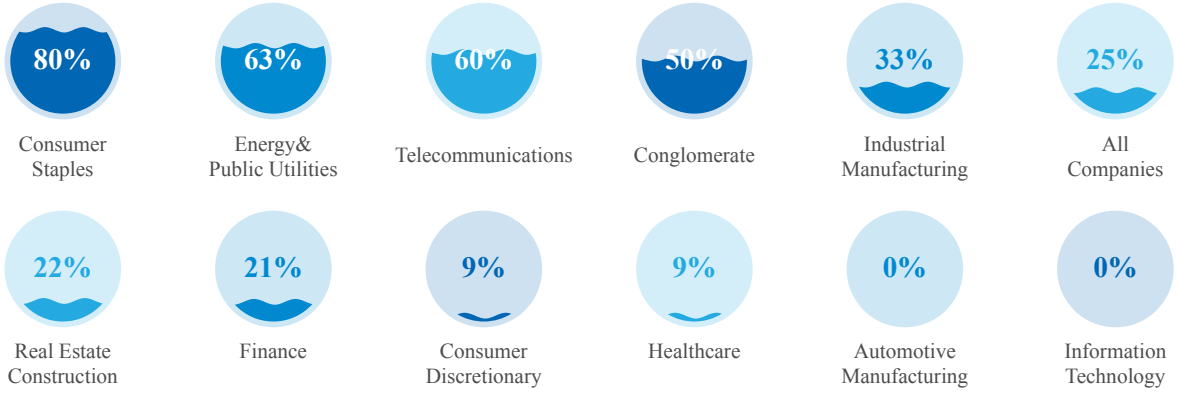



**Figure 6-7-9 Disclosure rate of direct energy use by industry**

Figure 6-7-9 compares the disclosure rates of direct consumption of natural gas, diesel, petrol and coal in different industries. Among the 100 researched companies, the average disclosure rate of direct energy use reached 82%. Among them, the real estate and construction industry, energy and public utilities, and conglomerates performed the best, all achieving 100% disclosure of direct energy use.

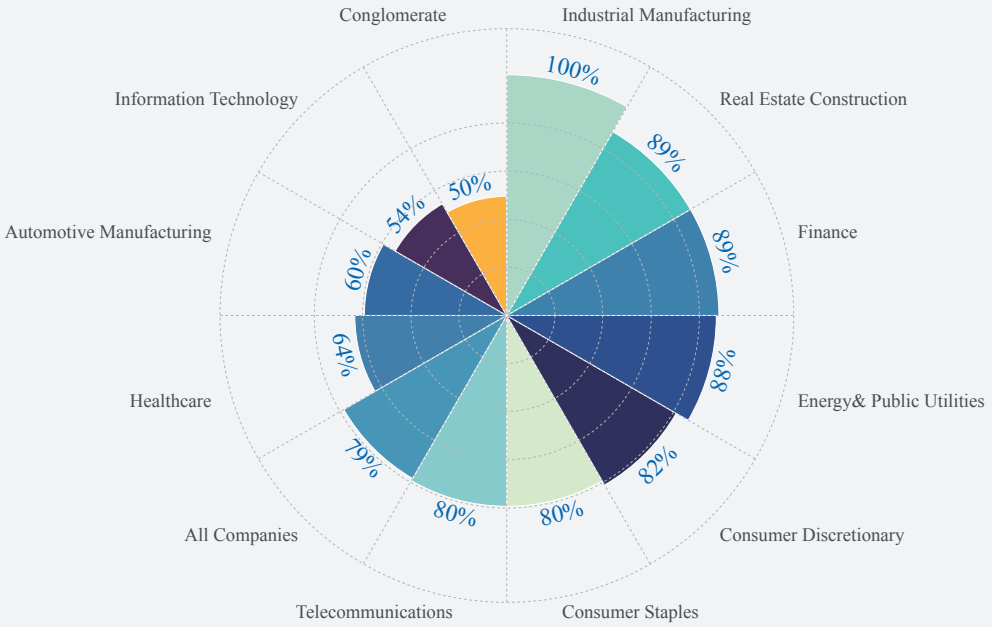



**Figure 6-7-10 The disclosure of scope, methodology and carbon emission factors of carbon accounting in different industries**

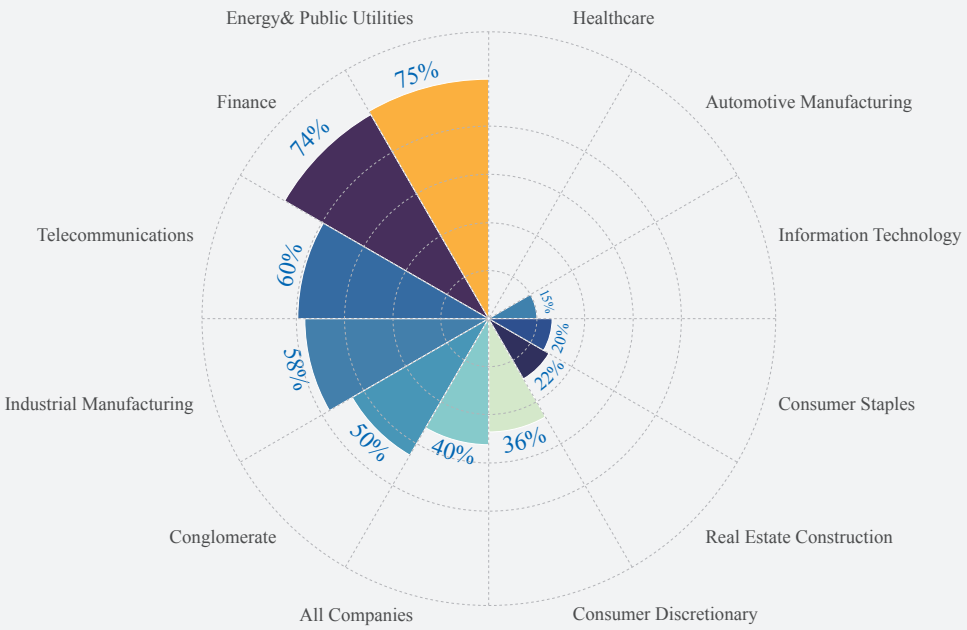
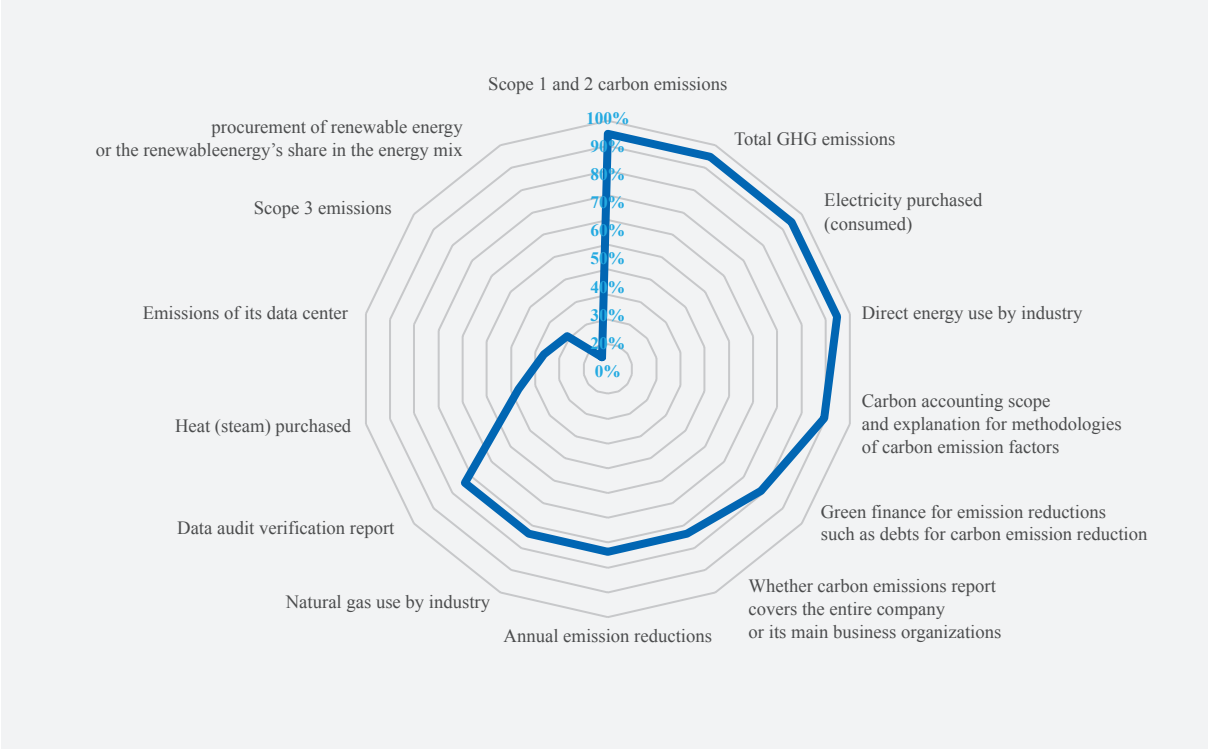



**Figure 6-7-11 Disclosure rate of data audit assurance reports by industry**

Companies need to define a clear scope of disclosure and transparent accounting methodologies for emissions data. The calculation of all emission-related indicators in the corporate carbon information disclosure framework needs to be consistent with the current carbon accounting methodology, and the authenticity of the data shall be verified by a third-party auditor, thus to make the data public and transparent. Figure 6-7-10 compares the disclosure of scope, methodology and carbon emission factors of carbon accounting in different industries. Currently, the average disclosure rate of scope, methodology and carbon emission factors of carbon accounting of the 100 listed companies reaches 79%. Among them, industrial manufacturing industry has achieved 100% disclosure in this regard, followed by real estate and construction (89%), financial industry (89%), as well as energy and public utilities (88%). Figure 6-7-11 compares the disclosure rate of data audit assurance reports in different industries. The average data audit assurance report disclosure rate among the 100 companies is only 40%, with a large gap between industries. Among them, 75% of energy and public utilities companies and 74% of financial companies have disclosed their audit assurance reports, while no companies in the healthcare industry and automobile manufacturing industry have done so.

Currently, the industries covered by the Task Force on Climate-related Financial Disclosures (TCFD) mainly include the finance, manufacturing, associations/professional services/NGOs, materials, and information technology. As a result, these industries tend to have high quality and standard disclosure of environmental information. Carbon emission information related to some industries, such as green finance and data center, have been collected in the report according to 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 Ecology and Environment (formerly known as the Ministry of Environmental Protection), the China Banking Regulatory Commission, the China Securities Regulatory Commission, and the China Insurance Regulatory Commission jointly issued the Guidelines for Establishing the Green Financial System (hereinafter referred to as the "Guidelines"). The Guidelines defines green finance as an economic activity that supports environmental improvement, countermeasures against climate change, as well as the efficient use of resources. Under the Guidelines, financial services will be provided to the investment and financing, project operation, risk management of projects in such field as environmental protection, energy conservation, clean energy, green transportation, and green buildings. The green financial system includes all major financial instruments such as green bonds, green stock indexes and derivatives, green development funds, green insurance, and carbon finance. Figure 6-7-12 compares the disclosure rate of various carbon information in the financial industry. Currently, 79% of companies in the financial industry disclose their emission reductions from green finance-related projects in their annual statements or ESG reports.

**Figure 6-7-12 Disclosure rates of various carbon information in the financial industry**




With the accelerated development of China's IT application process, the data center, as the carrier of the digital economy, has been continuously expanded, both in volume and scale. At the same time, data centers also need a lot of power to maintain the operation of servers, storage equipment, backup devices, cooling systems and other infrastructure. Therefore, the low-carbon and high-quality development of data centers also deserve our attention. Figure 6-7-13 compares the disclosure of data center emissions or energy use by industry. At present, the carbon disclosure rates of data centers are 46%, 26%, 20% and 18% respectively in information technology, finance, telecommunications and healthcare industry.

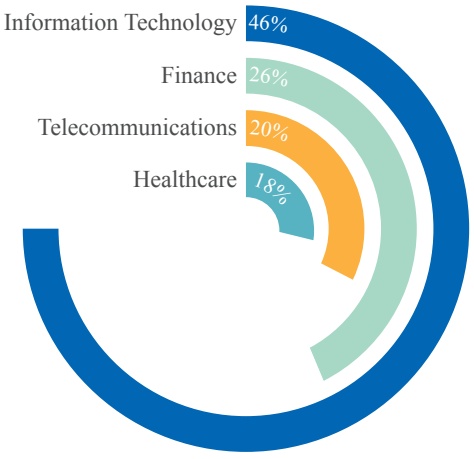



**Figure 6-7-13 Disclosure of data center emissions (or energy use) by industry**

From the perspective of disclosure quality, consumer staples (390/500) and telecommunications companies (390/500) are doing the best in this regard, as they are the focus of regulatory authorities due to their high relevance to daily production and life. The disclosure rate of Scope 1, 2 and 3 emissions and the total emission in consumer staples and telecommunications industry reached 100%, with data collected from the entire enterprise.

Industrial manufacturing (383/500), conglomerates (375/500), energy and public utilities (369/500), real estate and construction (350/500) and financial (339/500) companies are also doing well. The first three are all secondary industries, which are more subject to the carbon peak and carbon neutrality policy as well as environmental regulation, due to the high energy consumption. Therefore, companies in these industries need to disclose more environmental information, as relatively complete data disclosure can fully demonstrate their actual actions in energy transition and environmental-friendly operation to investors. The real estate and construction industry (mainly real estate developers) and the financial industry both belong to tertiary industry. Most of these companies have relatively high profitability, hence sufficient funds to implement comprehensive ESG disclosure. With an insight into the future trend of the market, the financial industry tend to have greater awareness of high-quality ESG disclosure. They're also sensitive to industrial changes brought by carbon peaking and carbon neutrality policies.

Disclosures were modest in consumer discretionary (318/500), and healthcare industry (291/500), with an average performance on detail disclosure, such as direct/indirect energy use. And the disclosure rate of data audit assurance reports is lower than that of the previous industries, further lowering their scores in terms of disclosure quality.

Less well-disclosed were information technology (227/500) and automobile manufacturing (260/500) companies. As of May 1, 2022, total carbon emissions disclosure rate was 7.7% and 60% respectively in information technology and automobile manufacturing industry in 2021. Despite relatively low carbon intensity, the quality of carbon emission disclosure is not satisfying, with relative low disclosure rate for direct/indirect energy use. Among them, 3 listed companies in the information technology industry and 1 in the automotive manufacturing industry did not disclose ESG reports in 2019, 2020, and 2021. However, with the accelerated low carbon development in China, some IT companies have gradually paid more attention to environmental disclosure in recent years. For example, Alibaba and Tencent both released related reports, with an aim to integrate energy transition and technological innovation, thus to achieve economic development and environmental conservation at the same time.

## 6.8 Analysis of Emission Reduction Goals

Figure 6-8-1 compares the disclosure of the carbon peaking and carbon neutral goal by industry. In general, the disclosure rate of the carbon peaking and carbon neutral goal among all industries is relatively low, with a large gap between different industries. The average disclosure rate only reached 29%. But conglomerates, energy and utilities tend to have higher disclosure rates, at 100% and 75%, respectively.

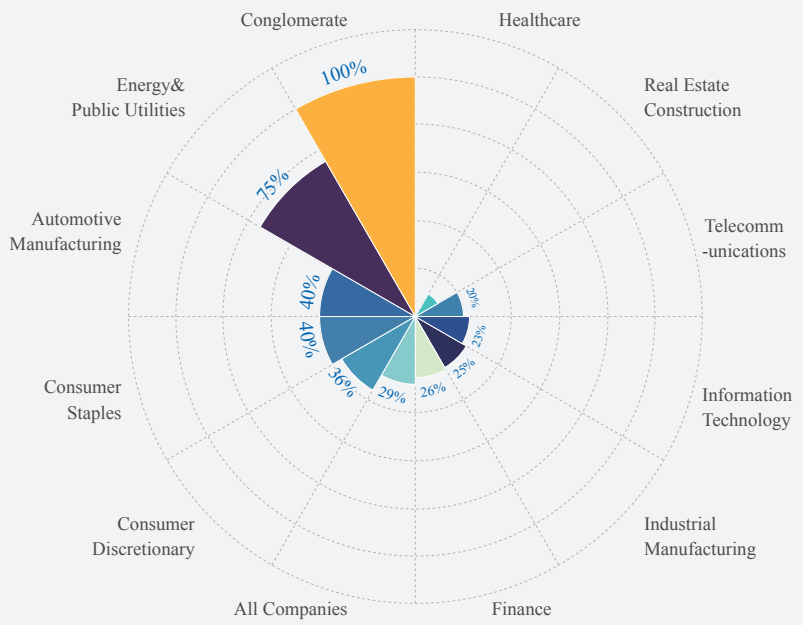



**Figure 6-8-1: Disclosure of the carbon peaking and carbon neutral goal by industry**

Figure 6-8-2 compares the disclosure rate of emission reduction goal by industry. The average disclosure rate of emission reduction goal of the 100 researched companies is 55%, with a large performance gap between industries. among which, the disclosure rate in consumer discretionary, industrial manufacturing, energy and public utilities, as well as conglomerates all reached 80% and above. The industries with the lowest disclosure rate in this regard are IT (23%) and automobile manufacturing (20%).

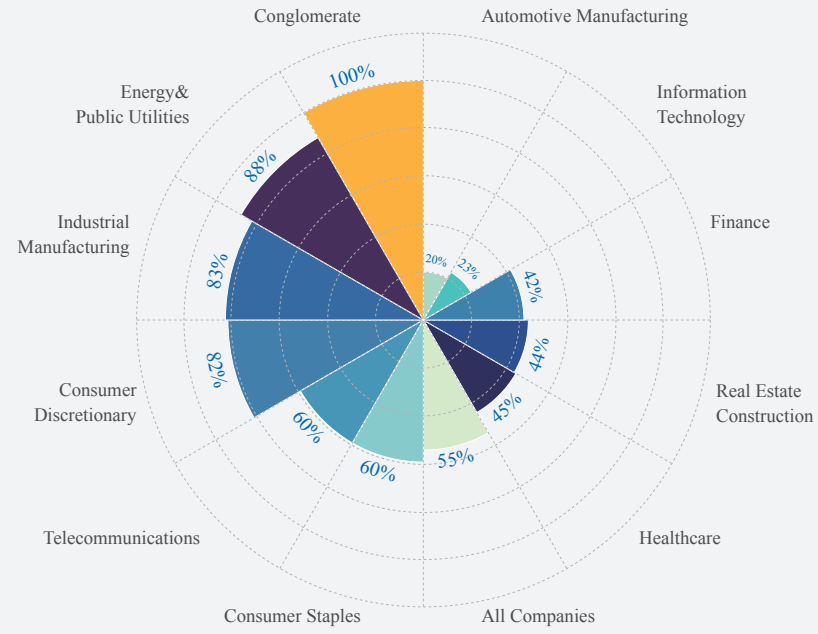



**Figure 6-8-2 Disclosure rate of emission reduction goal (quantified targets) by industry**

Figure 6-8-3 compares the disclosure rates of future carbon reduction technologies by industry, with the average disclosure rate registering as high as 94%. Listed companies in basically all industries have introduced their emission reduction technologies and environmental-friendly operation models in detail. The industries with the relatively disclosure rate in this regard are IT (77%) and automobile manufacturing (80%).

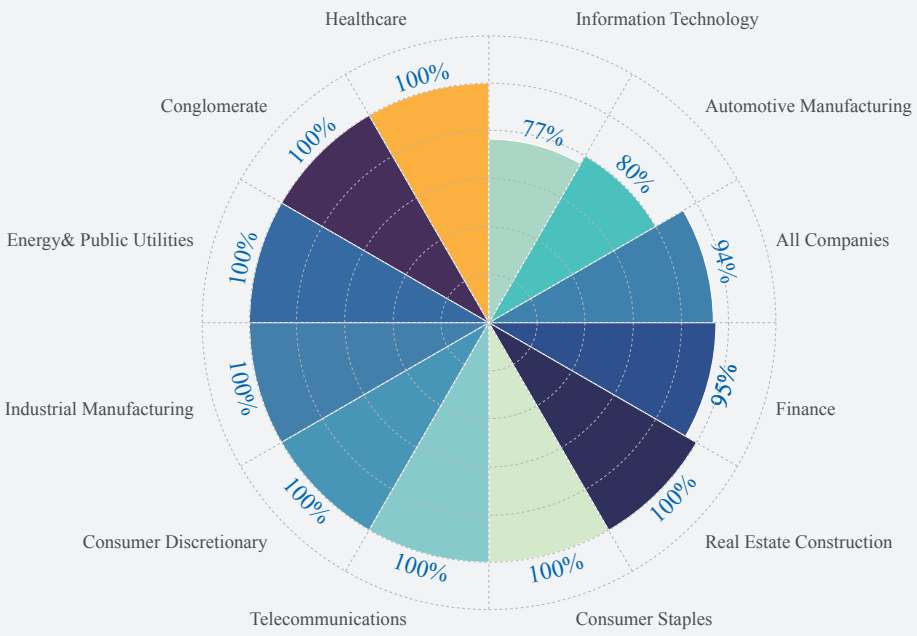



**Figure 6-8-3 Disclosure rate of future carbon reduction technologies by industry**

# 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 based on an investment factor, i.e. carbon rating. A study by BlackRock Consulting on market index during major global headwinds over the last decade shows that it has become increasingly common for companies with better ESG practice to outperform the general market. This point is proved by the downswing in the energy sector of emerging markets from 2015 to 2016, the Federal Reserve's massive policy campaign in 2018, and the impact of the Covid-19 pandemic since 2020. Empirical studies also suggest that positive screening portfolio increases investment returns (Barnett and Salomon, 2006). Nowadays, investment portfolios have emerged as a powerful tool to drive the social and ecological transition of economic model (Fabian, 2015). Positive screening portfolios can effectively prevent risks and reduce volatility. We will analyze whether Chinese overseas-listed companies deliver the same performance.

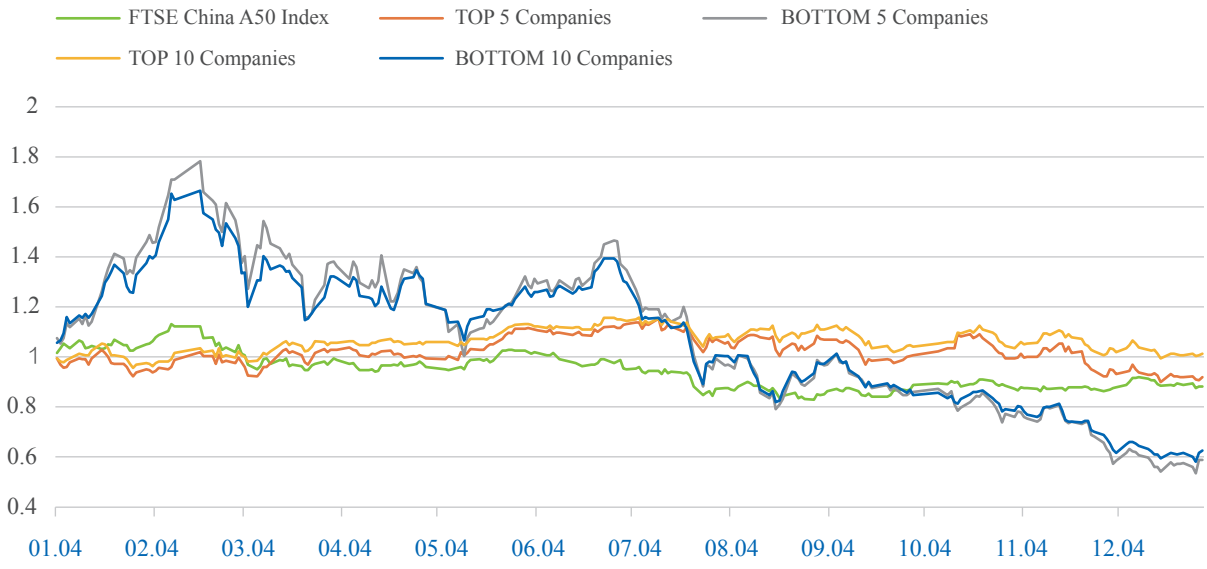
We selected five stocks with top carbon rating (hereinafter referred to as "Top 5"), namely, XIAOMI-W, Country Garden, Zhongsheng Group Holdings Limited, Chow Tai Fook, and China Vanke Co., Ltd.; and five stocks with bottom carbon rating (hereinafter referred to as "Bottom 5"), namely, Meituan-W, Pinduoduo, NIO, Tencent Music, and Futu Holdings Limited. Then we invested in two stock portfolios with equal weighting and calculated their net values. Meanwhile, the range was extended to include one portfolio of ten stocks with the top carbon rating (hereinafter referred to as "Top 10") and another ten with the bottom carbon rating (hereinafter referred to as "Bottom 10"), both of which were subject to the same calculating process. The results are compared with the FTSE China A50 Index 2021 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 stock trading data during the year of 2021 and the period from November 1, 2021 to April 30, 2022 to select Top 5 and Top 10 stocks as well as the Bottom 5 and Bottom 10 stocks as sample data. Among the samples, Ctrip and Kuaishou went public in April 2021 and February 2021 respectively, so their previous stock prices were missing. We filled in the gap with stock prices on the same dates of KE Holdings Inc. and Country Garden Services, whose carbon ratings were the bottom 12 and bottom 11 respectively, and calculated the Return on Investment (ROI) of the portfolio.

## 7.1 Analysis of A50 Index and Stock Portfolios Performance

Figure 7-1-1 shows portfolios with a 2021 one-year holding period. The net values of Top 5 and Top 10 stocks gradually show a more robust upward trend than the A50 Index, while the net values of Bottom 5 and Bottom 10 stocks registered a downward trend, especially in the later period when they were significantly lower than the A50 Index. This indicated that the stock portfolios with high carbon ratings had better prospect than the market.

**Figure 7-1-1 A50 Index and Net Values of Portfolios in 2021**




To further analyze the correlations between the A50 Index and each stock portfolio, we measured the correlation coefficients between each stock portfolio and the A50 Index, as shown in Table 10.

**Table 10 Correlation coefficients between A50 Index and each portfolio in 2021**

| | 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 | -0.0348 | 0.8099 | -0.2692 | 0.8230 |

As shown in Table 10, the correlation coefficients of the A50 index with both Top 5 and Top 10 stock portfolios were negative. Besides, the absolute value of the correlation coefficient between the A50 index and Top 10 stock portfolios was greater, indicating a stronger negative correlation. This demonstrated that companies focusing on ESG performance had stronger risk defenses in the face of economic downturns and that these green portfolios were more capable of diversifying financial risks (Yoo & Managi, 2021; Albuquerque et al., 2019). As a result, Top 5 and Top 10 stock portfolios perform better in balancing investment risks and returns.

Based on the semiannual investment period from November 2021 to the end of April 2022 (Figure 7-1-2), the net value of Top 10 stock portfolio gradually surpassed the A50 Index, and the net values of Top 5 and Top 10 stock portfolios were higher than the Bottom 5 and Bottom 10 throughout the period, which indicated that companies' carbon rating was positively correlated with investment returns. Thus, positive screening portfolios are more recognized and competitive in the market. Our findings are highly consistent with the studies of the international financial ESG investment theory. For example, Raimo, Caragnano (2021) et al. analyzed 919 companies included in the S&P Global 1200 Index, verifying that there was a negative correlation between corporate ESG disclosure and the cost of debt financing, and that companies with better ESG practices yielded lower financing costs and less binding financing terms. The study showed that these companies spent a lot in R&D. Companies that valued environmental sustainability tended to be more innovative and willing to invest more in R&D (Switzer, 1984), which contributed to the companies' value increase in the long run. The stocks of these companies were therefore highly recognized by the market as potential quality shares worth investing.

**Figure 7-1-2 A50 Index and Net Values of Portfolios from November 2021 to April 2022**

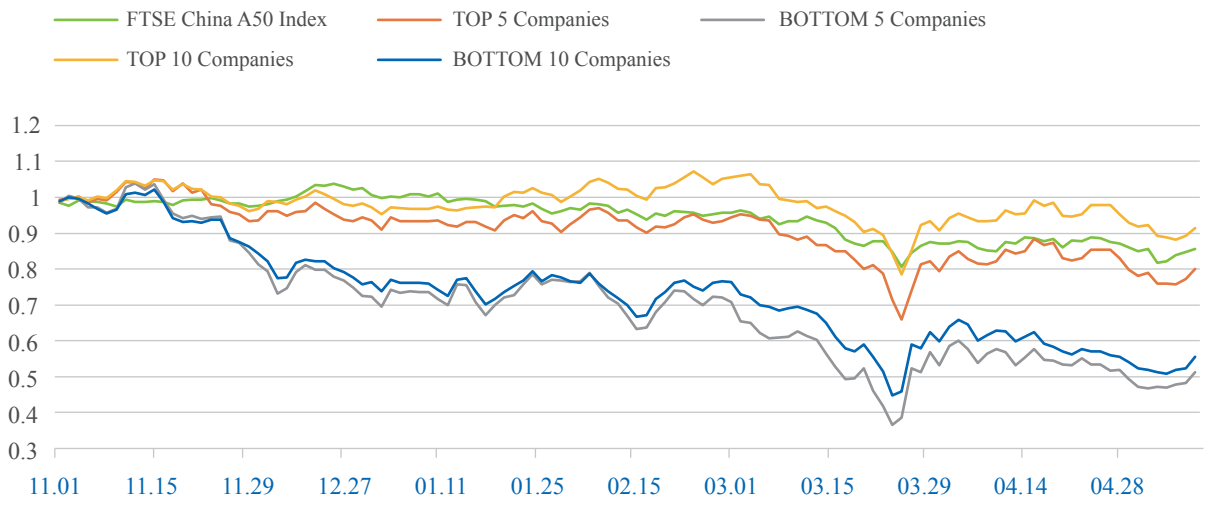


**Table 11 Correlation coefficients between A50 Index and each portfolio from November 2021 to April 2022**

| | 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 | 0.8872 | 0.8091 | 0.6830 | 0.8174 |

Analysis of the correlation coefficients between the A50 Index and each stock portfolio from November 2021 to April 2022 revealed that both the net values of stock portfolios and the A50 Index saw a downward trend. The general downturn in the market was due to the recurring pandemic and overall macroeconomic volatility since 2021. Meanwhile, since the beginning of 2022, international financial markets have been volatile, as the Federal Reserve planned to further increase the interest rate and the Russia-Ukraine conflict triggered general risk aversion. Emerging economies have been under the pressure of capital outflow. Business performance and market sentiment have been harmed, resulting in significant falls in companies' share prices. Under the influence of the mentioned external environment, the net values of Top 5, Top 10, Bottom 5, and Bottom 10 stock portfolios moved in line with the A50 index, but the returns of Top 5 and Top 10 were still higher than those of Bottom 5 and Bottom 10, proving that companies with better ESG performance are more competitive.

## 7.2 Analysis of A50 Index and Long/short Stock Portfolio Performance

Next, based on carbon rating, we bought the top five stocks and sold the bottom five as the first portfolio (hereinafter referred to as "Portfolio I"), and bought the top ten stocks while selling the bottom ten as the second portfolio (hereinafter referred to as "Portfolio II"). We analyzed their investment returns and volatilities throughout the year of 2021 and from the beginning of November 2021 to the end of April 2022, plotting the A50 Index and the net value of the long/short portfolios on Figure 7-2-1 and Figure 7-2-2.

In 2021, the net values of Portfolio I and Portfolio II gradually outperformed the A50, and the trend continued well into the end of April 2022, revealing that long stocks with high carbon rating and short the low-ranking ones can outperform the general market and steadily generate excess returns.

**Figure 7-2-1 A50 Index and the net values of the long/short portfolios in 2021**

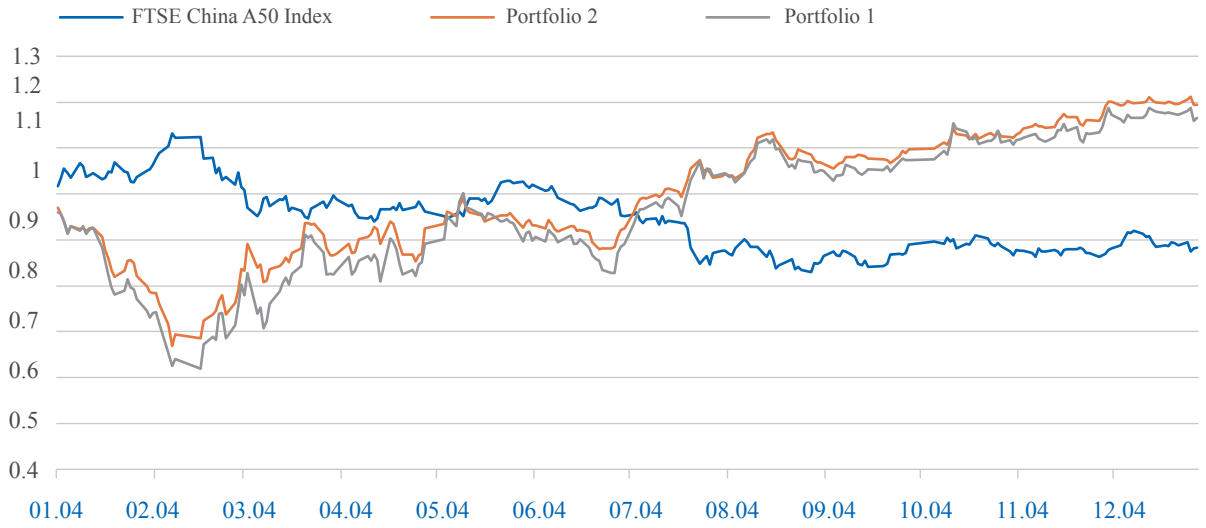
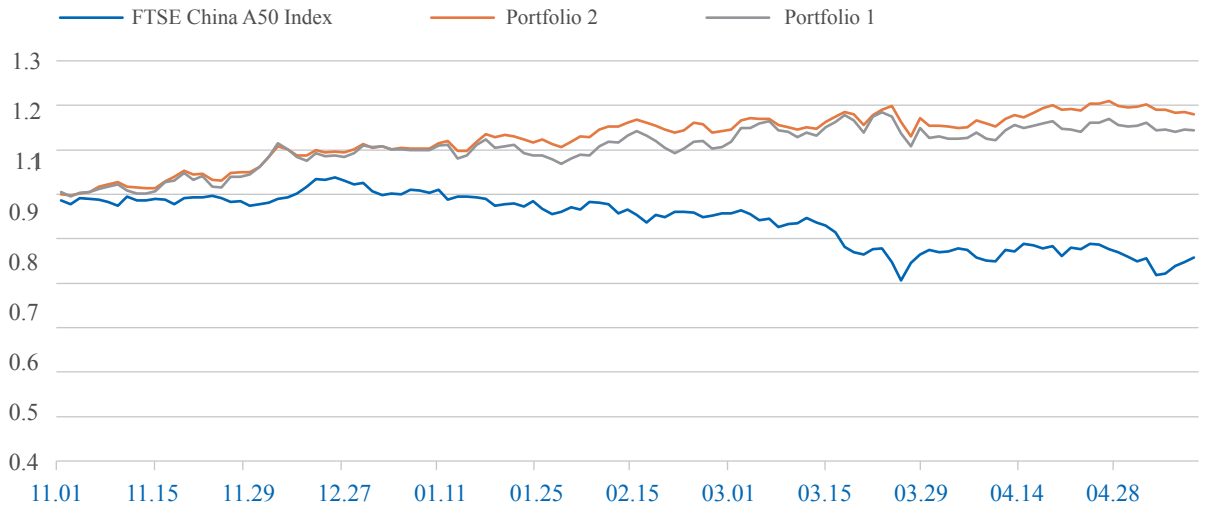



**Figure 7-2-2 A50 Index and the net values of the long/short portfolios from November 2021 to April 2022**




Next, we calculated the correlation coefficients between the A50 index and the long/short stock portfolios as shown in Table 12 and 13. Both coefficients are negative and close to -1, which suggests that longing high-carbon-ranking stock portfolio and shorting one with low carbon rating are an approach to buffer the systemic risks of economic downturn. Thus, the practice (hedge) of using carbon rating as an investment factor is advantageous.

**Table 12 Correlation coefficients between A50 index and the long/short stock portfolios in 2021**

| 2021 | A50 Index and Portfolio II | A50 Index and Portfolio I |
|---|---|---|
| Correlation coefficient | -0.8567 | -0.8385 |

**Table 13 Correlation coefficients between A50 index and the long/short stock portfolios from November 2021 to April 2022**

| 2021.11-2022.4 | A50 Index and Portfolio II | A50 Index and Portfolio I |
|---|---|---|
| Correlation coefficient | -0.7135 | -0.6556 |

## 7.3 Analysis of Risk-return and Sharpe Ratios of Stock Portfolios

According to the daily ROI of Top 5, Top 10, Bottom 5, and Bottom 10 stocks, we calculated the ROI, volatility and Sharpe Index of the long/short portfolios in the year of 2021 and from the beginning of November 2021 to the end of April 2022 as shown in Table 14 and Table 16. When volatility indicators are compared, companies topping the carbon rating have markedly smaller volatility than companies at the bottom of the carbon rating, meaning that the former stock portfolio carries a smaller risk.

When FTSE China A50 Index's ROI is taken as a benchmark to calculate the Sharpe Index, Portfolio I's Sharpe Index is 0.69, lower than Portfolio II's 1.08, suggesting that under the same risk, Portfolio II's expected excess returns surpass Portfolio I's. Meanwhile, Portfolio II registers a higher portfolio return and a smaller standard deviation than Portfolio I, meaning that Portfolio II is less volatile and thus more attractive to long-term capital for low-risk investment.

Moreover, in 2021, the Top 5 portfolio's ROI is -7.995%, lower than the Top 10 portfolio's ROI of 1.325%. The semiannual result from the beginning of November 2021 to the end of April 2022 follows the same pattern (Table 14). Compared with the Top 5 portfolio, the Top 10 portfolio contains quality companies among the top 10 of carbon rating which better cushion and diversify investment risks. According to the stakeholder theory, voluntary disclosure of environmental information has a positive influence on an enterprise's economic benefits (Cormier and Magnan, 2003; Ho and Taylor, 2007). Incorporating these companies into the Top 10 portfolio boosts its ROI to some extent. For example, in Table 15, Li-Ning's Return on Equity (ROE) of 27.20% and its Return on Asset (ROA) of 18.10% are notably higher than the figures of other companies in the Top 10 portfolio. According to Dongxing Securities, Li-Ning's net profit reached RMB 4.011 billion in 2021, up by 136% year on year. During the same period, China Overseas Land and Investment's ROE and ROA of 11.9% and 4.80% also excelled among Top 5 and Top 10 companies.

**Table 14 The ROI and Sharpe Index of Several Portfolios in 2021**

| Carbon Rating | Portfolio Return | Portfolio's annualized standard deviation | Long/Short portfolio return | Long/Short portfolio standard deviation | Sharpe Ratio |
|---|---|---|---|---|---|
| Top 5 | -7.995% | 25.788% | 16.497% (Portfolio I) | 40.671% (Portfolio I) | 0.69 |
| Bottom 5 | -40.989 | 62.233% | | | |
| Top 10 | 1.325% | 20.218% | 19.367% (Portfolio II) | 28.838% (Portfolio II) | 1.08 |
| Bottom 10 | -37.409% | 48.061% | | | |
| The A50 Index in 2021 | | -11.767% | | | |

**Table 15 Top 10 ROE, ROA, and profit margin**[7]

| Top 10 companies | Return on equity (ROE) | Return on assets (ROA) | Profit margin |
|---|---|---|---|
| XIAOMI-W | 15.00% | 7.20% | 5.90% |
| Country Garden | 9.80% | 1.40% | 5.10% |
| Zhongsheng Group Holdings Limited | 25.00% | 11% | 4.80% |
| Chow Tai Fook | 20.60% | 9.30% | 8.60% |
| Vanke Co., Ltd. | 6.20% | 1.20% | 5.00% |
| Ping An Insurance | 10.00% | 1.00% | 9.60% |
| Hang Seng Bank | 7.60% | 0.80% | 28.20% |
| Agricultural Bank of China | 10.60% | 0.90% | 33.50% |
| China Overseas Land and Investment | 11.90% | 4.80% | 16.60% |
| Li-Ning | 27.20% | 18.10% | 17.80% |

**Table 16 Semiannual portfolio ROI and Sharpe Index from November 2021 to April 2022**

| Carbon Rating | Portfolio Return | Portfolio's annualized standard deviation | Long/Short portfolio return | Long/Short portfolio standard deviation | Sharpe Ratio |
|---|---|---|---|---|---|
| Top 5 | -20.069% | 29.162% | 14.296% (Portfolio I) | 13.722% (Portfolio I) | 2.08 |
| Bottom 5 | -48.661% | 57.965% | | | |
| Top 10 | -8.663% | 22.590% | 17.928% (Portfolio II) | 10.964% (Portfolio II) | 2.94 |
| Bottom 10 | -44.520% | 45.829% | | | |
| 2022 semiannual A50 Index | | -14.281% | | | |

[7] Source: caibaoshuo.com

## 7.4 Analysis of Industry's Portfolios Performance based on Carbon Rating

As shown in Figure 7-4-1, we categorized the 100 companies in this carbon rating into 11 industries and plotted the net portfolio values of different industries in 2021. Judging from the trends of net portfolio values in the Figure, "conglomerate companies" and "energy and utilities" outperform other industries, with upward trends and higher returns of 20.821% and 17.34% respectively (Table 17), while "information technology", "medical care", and "non-discretionary spending" have weak portfolio return. From the beginning of November 2021 to the end of April 2022, "conglomerate companies" have a remarkable performance and a higher portfolio return, while "medical care", "automobile manufacturing", and "information technology" have lower trend lines and investment return.

It is certain that every industry contains different amounts of companies, which influences their stock value trend and volatility to various degrees. For example, as there are only two conglomerate companies among the 100 companies in the Report, each stock carries a heavy weight. Thus, each stock's price and change greatly affect the return and volatility of "conglomerate companies" during the sample period, leading to varying deviations of investment trends and ROIs of different industries. "Finance", on the other hand, includes 19 listed companies in the Report, with each stock taking up a lighter weight. Thus, the industry's portfolio return and volatility are only slightly influenced by individual company.

**Figure 7-4-1 Net portfolio values of industries in 2021**

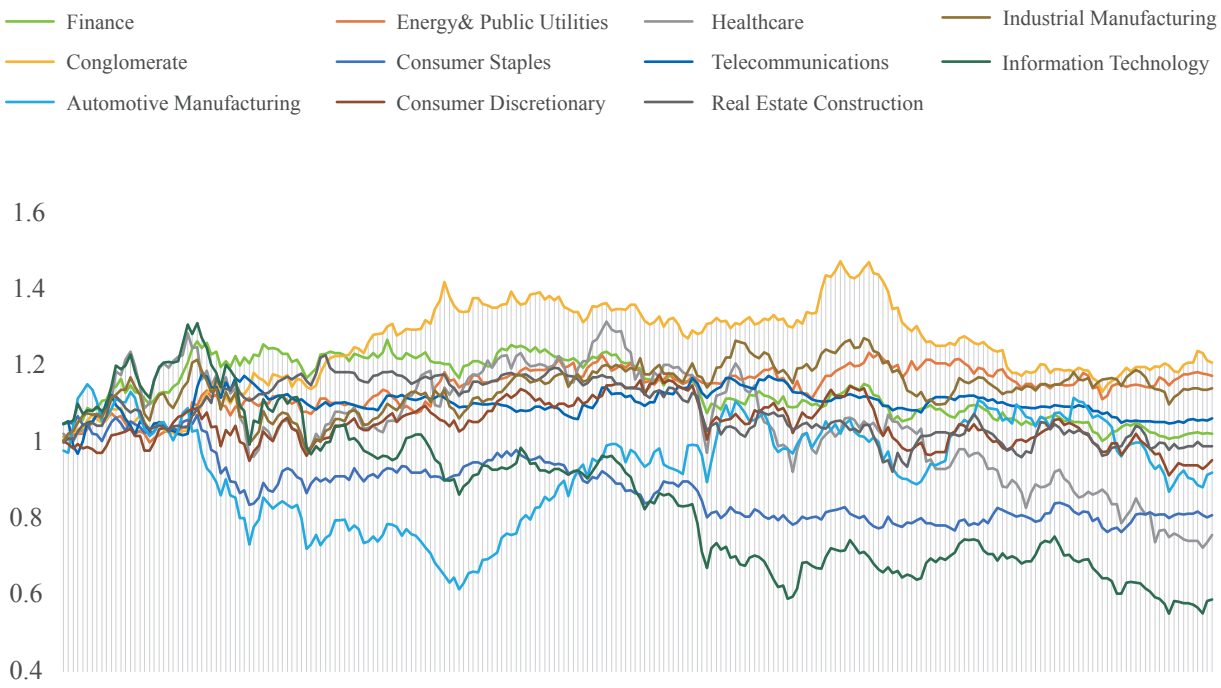
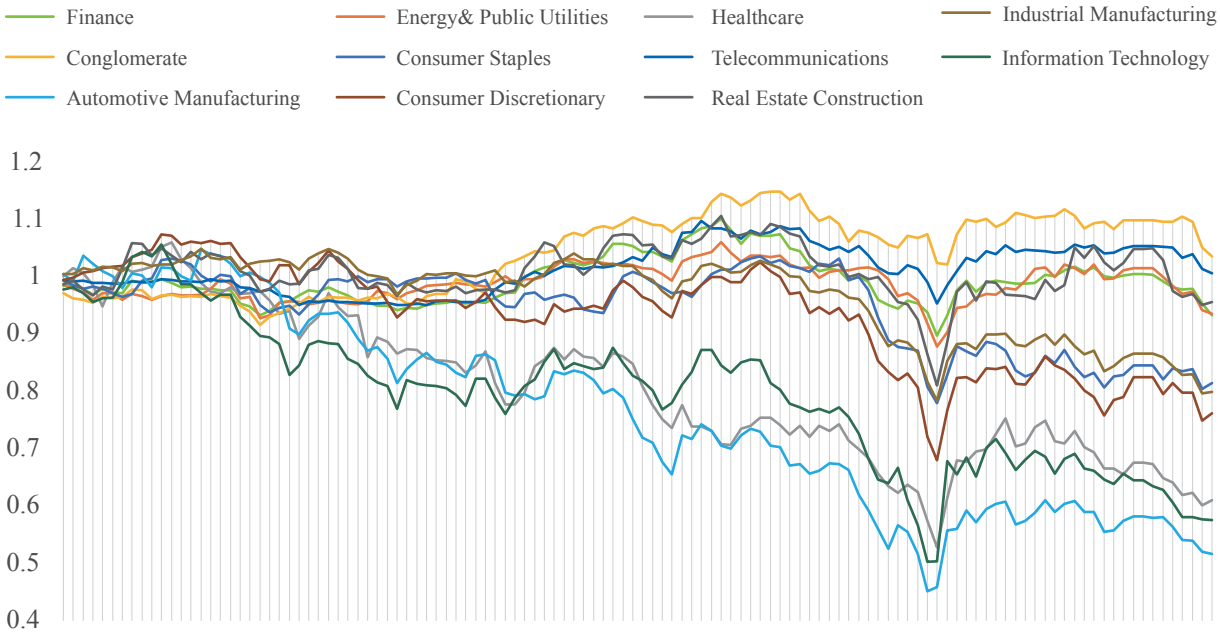


**Figure 7-4-2 Semiannual net portfolio values of industries from November 2021 to April 2022**




As the carbon scores of different industries in Figure 6-1-1 and investment performance indicators in Table 17 show, the top three industries in carbon rating, namely, "real estate and engineering", "discretionary spending", and "finance", have lower portfolio returns of only -1.034%, -4.631% and 2.28% respectively. In contrast, "information technology" and "automobile manufacturing" have the lowest carbon scores, with lower return and higher volatility of -41.094% and -7.978% respectively. Based on this phenomenon, we conclude that companies in high-carbon-ranking industries does not necessarily top the carbon rating. For example, "real estate and engineering" has the top industry ranking, but three out of nine companies in this industry have low carbon rating (after 75), dragging down the industry portfolio return. Also, influenced by the Federal Reserve's raised interest rate and the Covid-19 pandemic, the emerging countries face downward economy in general. When carbon rating is taken as a benchmark for comparison, the positive influence brought by ESG fails to offset the negative influence brought by the worsening market.

In addition, middle-ranking "conglomerate companies" and "energy and utilities" have remarkable returns of 20.82% and 17.34% respectively. If the time period is extended to the end of April 2022, the phenomenon remains basically consistent. Meanwhile, if the Sharpe Ratios in Table 17 and Table 18 are taken as a benchmark, "conglomerate companies" and "energy and utilities" have incredible performance in 2021, meaning that these two industries yield higher excess returns in face of risks. In the semiannual Sharpe Index of 2022, despite the best performance of "telecommunications" and "conglomerate companies", these industries only rank the middle in carbon scores. We believe that the reason why these industries have sound market indicators yet mediocre carbon ratings is that factors, including inflation last year and the Russia-Ukraine conflict this year, have significantly raised the prices of commodities and resources. Thus, relevant industries can benefit from these factors and have outstanding ROIs.

The phenomenon and analysis above suggest that ROI and other financial indicators have weak correlations with the industry carbon rating. Building portfolio based on industrial ranking cannot produce impressive results. Instead, Chow Tai Fook and Li-Ning in the discretionary spending industry with high carbon rating and CITIC Limited in conglomerate companies generate high portfolio return and excellent corporate financial performance. Thus, industry carbon rating is not convincing enough to be used as the benchmark for building investment portfolios. Individual stock's carbon rating deserves consideration for further analysis.

**Table 17 Portfolio ROI and Sharpe Index of industries in 2021**

| Industry name | Portfolio Return | Portfolio annualized standard deviation | Market risk premium | Sharpe Ratio | Industry ranking |
|---|---|---|---|---|---|
| Conglomerate | 20.821% | 21.10% | 32.588% | 1.54 | 5 |
| Energy and public utilities | 17.34% | 19.41% | 29.107% | 1.50 | 7 |
| Industrial manufacturing | 14.201% | 26.53% | 25.968% | 0.98 | 8 |
| Telecommunications | 6.191% | 20.14% | 17.958% | 0.89 | 6 |
| Finance | 2.28% | 19.47% | 14.046% | 0.72 | 3 |
| Real estate and construction | -1.034% | 23.69% | 10.733% | 0.45 | 1 |
| Consumer discretionary | -4.631% | 26.91% | 7.136% | 0.27 | 2 |
| Automobile manufacturing | -7.978% | 45.30% | 3.789% | 0.08 | 11 |
| Consumer staples | -19.106% | 25.423% | -7.339% | -0.29 | 4 |
| Medical care | -24.161% | 43.64% | -12.394% | -0.28 | 9 |
| Information technology | -41.094% | 41.707% | -29.327% | -0.70 | 10 |
| FTSE China A50 Index | -11.767% | | | | |

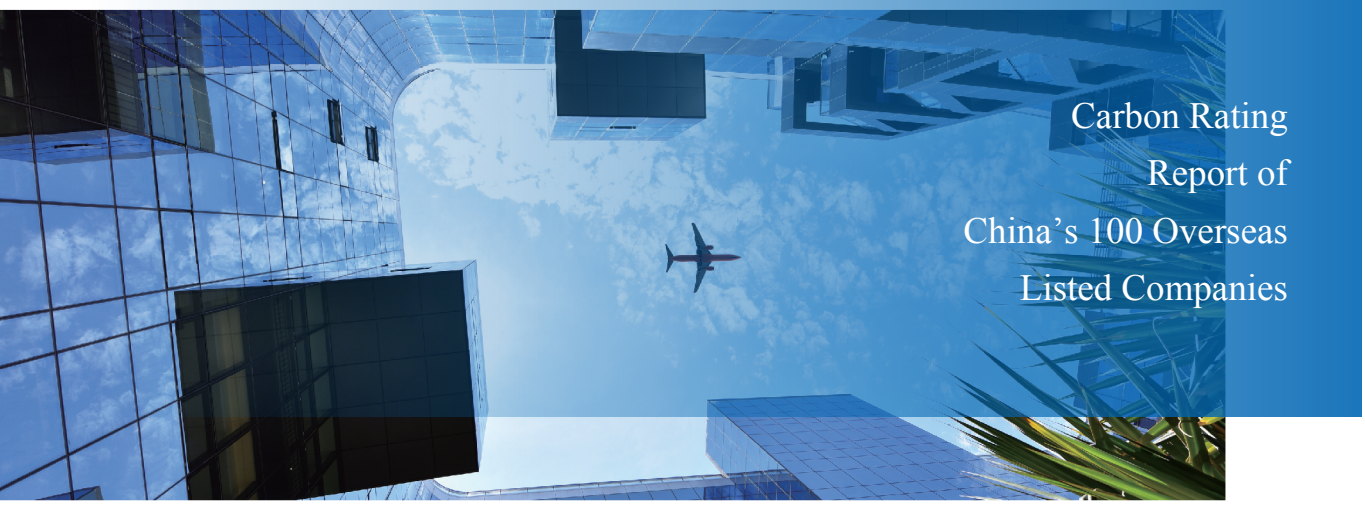
**Table 18 Semiannual portfolio ROI and Sharpe Index of industries from November 2021 to April 2022**

| Industry name | Portfolio Return | Portfolio annualized standard deviation | Market risk premium | Sharpe Ratio | Industry ranking |
|---|---|---|---|---|---|
| Conglomerates | 3.57% | 14.56% | 17.85% | 1.23 | 5 |
| Telecommunications | 0.540% | 11.75% | 14.82% | 1.26 | 6 |
| Real estate and construction | -4.39% | 25.85% | 9.89% | 0.38 | 1 |
| Energy and public utilities | -6.49% | 14.89% | 7.79% | 0.52 | 7 |
| Finance | -6.71% | 14.21% | 7.57% | 0.53 | 3 |
| Consumer staples | -18.54% | 21.72% | -4.26% | -0.20 | 4 |
| Industrial manufacturing | -20.16% | 18.63% | -5.88% | -0.32 | 8 |
| Consumer discretionary | -23.77% | 28.67% | -9.49% | -0.33 | 2 |
| Healthcare | -38.94% | 36.82% | -24.66% | -0.67 | 9 |
| Information technology | -42.39% | 48.56% | -28.11% | -0.58 | 10 |
| Automobile manufacturing | -48.40% | 41.37% | -34.12% | -0.82 | 11 |
| FTSE China A50 Index | -14.281% | | | | |

# 8 Summary and Outlook

At present, there is no unified definition of the organizational boundary, scope and management for corporate carbon emission information disclosure in China. China-based Stock Exchanges have no mandatory disclosure requirements for carbon emission information of listed companies either. In the absence of uniform standards, there may be inconsistencies in the statistical methodologies of corporate carbon information disclosure, resulting in the lack of comparability among different emission data. Domestic regulatory authorities need to establish a unified corporate carbon information disclosure standard to supervise the carbon information disclosure of listed companies and assist companies, thus to carry out standardized disclosure.

Carbon disclosure is now of great practical significance to the development of enterprises. The leading enterprises in the capital market generally have higher disclosure levels, which will be in turn incentivized by the stock market, thus forming a positive cycle. At the same time, with the national carbon peaking and carbon neutrality policy in place, carbon disclosure, as a social and environmental factor, will continuously be the focus of the capital market. It will also have a greater impact on a company's stock price, profits and other financial performances. Therefore, it is even more imperative for all companies to improve their own carbon emission management and disclosure systems. While achieving emission reduction targets, they should also reduce the carbon emission intensity and improve the quality of carbon information disclosure.



# **Appendix 1:** Summary of Corporate Carbon Rating-1

| Company | Industry | Rank | Emission | Mitigation | Quality | Goal | Total |
|---|---|---|---|---|---|---|---|
| XIAOMI-W | Information Technology | 1 | 1646.04 | 114.66 | 250.00 | 50.00 | 2060.69 |
| Country Garden | Real Estate and Construction | 2 | 746.16 | 111.42 | 350.00 | 50.00 | 1257.58 |
| Zhongsheng Holdings | Consumer Discretionary | 3 | 659.38 | 94.47 | 300.00 | 150.00 | 1203.85 |
| Chow Tai Fook | Consumer Discretionary | 4 | 423.77 | 101.94 | 400.00 | 150.00 | 1075.72 |
| China Vanke | Real Estate and Construction | 5 | 455.72 | 137.70 | 400.00 | 50.00 | 1043.41 |
| Ping An Insurance | Finance | 6 | 284.84 | 178.92 | 400.00 | 150.00 | 1013.77 |
| Hang Seng Bank | Finance | 7 | 314.45 | 77.64 | 450.00 | 150.00 | 992.09 |
| Agricultural Bank of China | Finance | 8 | 355.90 | 85.90 | 400.00 | 150.00 | 991.80 |
| China Overseas Land and Investment Ltd. | Real Estate and Construction | 9 | 340.65 | 100.03 | 400.00 | 150.00 | 990.68 |
| Li-Ning | Consumer Discretionary | 10 | 300.95 | 160.89 | 350.00 | 150.00 | 961.84 |
| China Pacific Insurance | Finance | 11 | 433.29 | 150.34 | 300.00 | 50.00 | 933.62 |
| Haier Smart Home | Consumer Discretionary | 12 | 353.68 | 66.47 | 300.00 | 150.00 | 870.15 |
| Sun Hung Kai Properties | Real Estate and Construction | 13 | 160.73 | 99.15 | 450.00 | 150.00 | 859.87 |
| Budweiser APAC | Consumer Staples | 14 | 133.30 | 107.08 | 450.00 | 150.00 | 840.38 |
| Tencent Holdings | Information Technology | 15 | 132.58 | 106.59 | 450.00 | 150.00 | 839.17 |
| NetEase | Information Technology | 16 | 388.53 | 0.00 | 400.00 | 50.00 | 838.53 |
| China Everbright Bank | Finance | 17 | 265.61 | 102.36 | 350.00 | 100.00 | 817.97 |
| United Microelectronics Corporation | Industrial Manufacturing | 18 | 15.90 | 149.73 | 500.00 | 150.00 | 815.63 |
| Mengniu Dairy | Consumer Staples | 19 | 153.79 | 108.93 | 400.00 | 150.00 | 812.71 |
| CITIC Securities | Finance | 20 | 213.70 | 143.82 | 300.00 | 150.00 | 807.52 |
| HKEx | Finance | 21 | 97.81 | 159.21 | 450.00 | 100.00 | 807.03 |
| Great Wall Motor | Automotive Manufacturing | 22 | 137.57 | 110.24 | 400.00 | 150.00 | 797.81 |
| Bank of China (Hong Kong) | Finance | 23 | 138.72 | 99.57 | 450.00 | 100.00 | 788.29 |
| China Tower | Telecommunications | 24 | 220.15 | 117.44 | 400.00 | 50.00 | 787.59 |
| Postal Savings Bank of China | Finance | 25 | 258.98 | 73.79 | 350.00 | 100.00 | 782.77 |
| JD | Information Technology | 26 | 277.16 | 0.00 | 350.00 | 150.00 | 777.16 |
| WuXi AppTec | Healthcare Industry | 27 | 132.11 | 78.56 | 400.00 | 150.00 | 760.67 |

# **Appendix 1:** Summary of Corporate Carbon Rating-2

| Company | Industry | Rank | Emission | Mitigation | Quality | Goal | Total |
|---|---|---|---|---|---|---|---|
| Chunghwa Telecom | Telecommunications | 28 | 104.01 | 101.70 | 400.00 | 150.00 | 755.71 |
| Techtronic Industries | Consumer Discretionary | 29 | 199.00 | 102.06 | 300.00 | 150.00 | 751.06 |
| WuXi Biologics | Healthcare Industry | 30 | 130.49 | 115.10 | 350.00 | 150.00 | 745.58 |
| CITIC Limited | Conglomerate | 31 | 40.22 | 100.56 | 450.00 | 150.00 | 740.78 |
| Tigermed | Healthcare Industry | 32 | 248.14 | 88.41 | 250.00 | 150.00 | 736.54 |
| Geely Auto | Automotive Manufacturing | 33 | 223.10 | 61.32 | 400.00 | 50.00 | 734.42 |
| ENN Energy | Energy and Public Utilities | 34 | 141.03 | 137.57 | 300.00 | 150.00 | 728.60 |
| Ali Health | Healthcare Industry | 35 | 248.14 | 279.98 | 150.00 | 50.00 | 728.12 |
| Zijin Mining | Industrial Manufacturing | 36 | 19.00 | 107.56 | 450.00 | 150.00 | 726.55 |
| Henderson Land | Real Estate and Construction | 37 | 156.13 | 63.49 | 350.00 | 150.00 | 719.62 |
| TSMC | Industrial Manufacturing | 38 | 20.02 | 97.74 | 450.00 | 150.00 | 717.76 |
| China Merchants Bank | Finance | 39 | 173.68 | 90.55 | 400.00 | 50.00 | 714.23 |
| Minsheng Bank | Finance | 40 | 269.61 | 94.07 | 300.00 | 50.00 | 713.68 |
| Cheung Kong Group | Real Estate and Construction | 41 | 109.38 | 52.69 | 400.00 | 150.00 | 712.07 |
| China Mobile | Telecommunications | 42 | 48.88 | 57.69 | 450.00 | 150.00 | 706.56 |
| Bank of China | Finance | 43 | 47.17 | 106.22 | 400.00 | 150.00 | 703.39 |
| China Telecom | Telecommunications | 44 | 49.67 | 100.00 | 400.00 | 150.00 | 699.67 |
| CLP Holdings | Energy and Public Utilities | 45 | 0.66 | 98.56 | 450.00 | 150.00 | 699.22 |
| China Resources Beer | Consumer Staples | 46 | 78.82 | 97.88 | 400.00 | 100.00 | 676.69 |
| PetroChina | Energy and Public Utilities | 47 | 6.21 | 119.24 | 400.00 | 150.00 | 675.44 |
| Fuyao Group | Industrial Manufacturing | 48 | 7.86 | 112.19 | 400.00 | 150.00 | 670.05 |
| Nongfu Spring | Consumer Staples | 49 | 68.96 | 100.00 | 350.00 | 150.00 | 668.96 |
| SMIC | Industrial Manufacturing | 50 | 8.96 | 108.58 | 400.00 | 150.00 | 667.53 |
| Jiangxi Ganfeng Lithium Co. Ltd. | Industrial Manufacturing | 51 | 9.59 | 154.65 | 350.00 | 150.00 | 664.24 |
| Pharmaron | Healthcare Industry | 52 | 88.71 | 175.31 | 350.00 | 50.00 | 664.02 |
| CHEUNG KONG Hutchison | Conglomerate | 53 | 110.47 | 99.45 | 300.00 | 150.00 | 659.91 |
| Construction Bank of China | Finance | 54 | 58.35 | 100.63 | 350.00 | 150.00 | 658.98 |

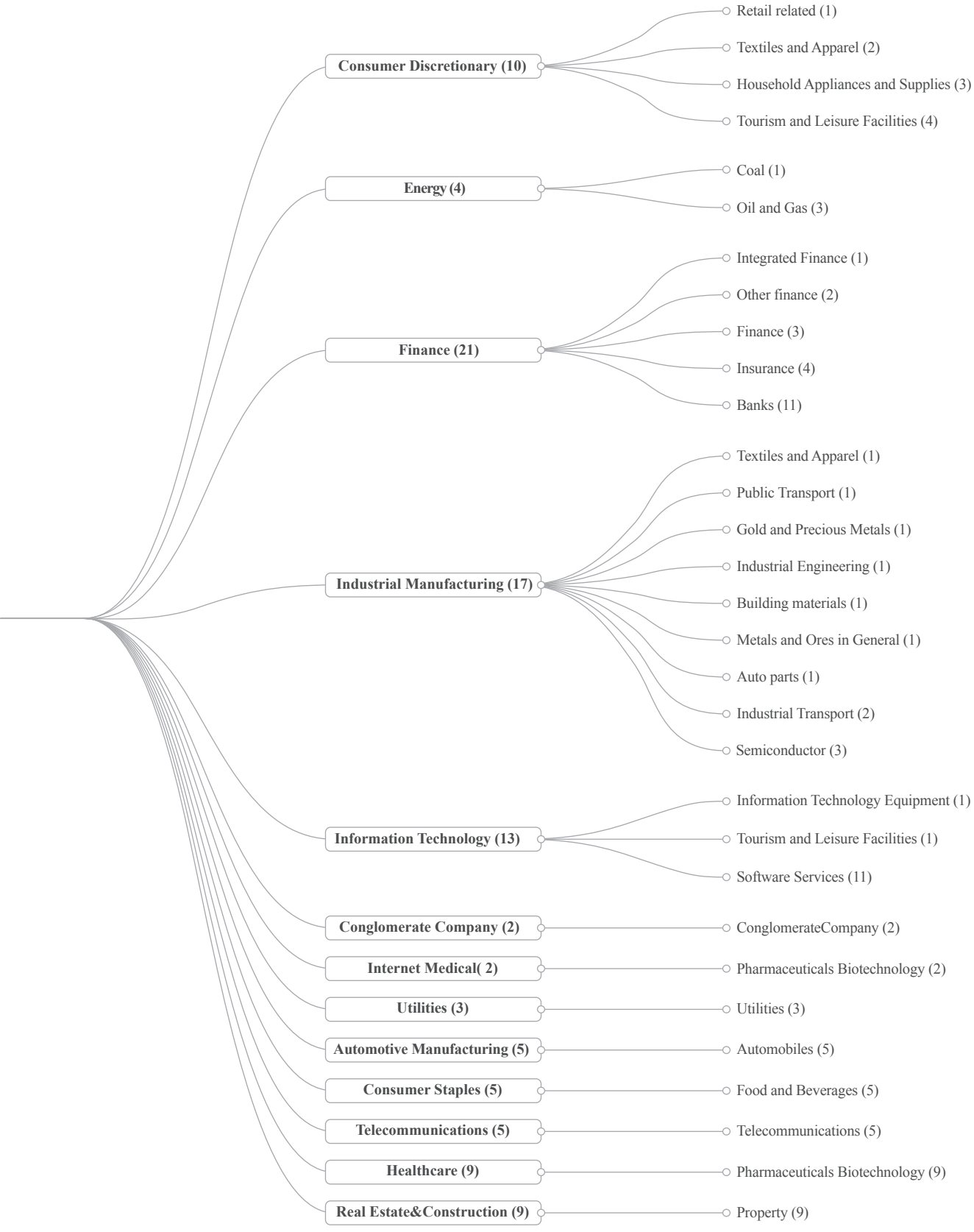
# **Appendix 1:** Summary of Corporate Carbon Rating-3

| Company | Industry | Rank | Emission | Mitigation | Quality | Goal | Total |
|---|---|---|---|---|---|---|---|
| Sands China Ltd. | Consumer Discretionary | 55 | 16.18 | 41.93 | 450.00 | 150.00 | 658.10 |
| COSCO SHIPPING Holdings | Industrial Manufacturing | 56 | 4.99 | 102.36 | 400.00 | 150.00 | 657.36 |
| Shenzhou International | Industrial Manufacturing | 57 | 13.52 | 88.01 | 400.00 | 150.00 | 651.53 |
| Fosun Pharma | Healthcare Industry | 58 | 74.75 | 123.02 | 300.00 | 150.00 | 647.77 |
| Baidu | Information Technology | 59 | 102.38 | 94.18 | 400.00 | 50.00 | 646.56 |
| Smoore International | Consumer Discretionary | 60 | 74.46 | 114.54 | 350.00 | 100.00 | 639.01 |
| China Shenhua Energy | Energy and Public Utilities | 61 | 0.77 | 129.92 | 350.00 | 150.00 | 630.69 |
| Industrial and Commercial Bank of China | Finance | 62 | 165.91 | 60.20 | 250.00 | 150.00 | 626.11 |
| Hansen Pharmaceuticals | Healthcare Industry | 63 | 175.17 | 0.00 | 300.00 | 150.00 | 625.17 |
| Sino Biopharmaceuticals | Healthcare Industry | 64 | 248.14 | 67.92 | 250.00 | 50.00 | 616.06 |
| Anta Sports | Consumer Discretionary | 65 | 165.01 | 100.00 | 300.00 | 50.00 | 615.01 |
| China Gas | Energy and Public Utilities | 66 | 92.67 | 71.42 | 400.00 | 50.00 | 614.08 |
| Hong Kong and China Gas | Energy and Public Utilities | 67 | 9.48 | 101.48 | 350.00 | 150.00 | 610.96 |
| CITIC Bank | Finance | 68 | 157.13 | 100.43 | 300.00 | 50.00 | 607.56 |
| China Property & Casualty Insurance | Finance | 69 | 121.60 | 85.21 | 350.00 | 50.00 | 606.81 |
| Galaxy Entertainment Group | Consumer Discretionary | 70 | 3.89 | 201.51 | 250.00 | 150.00 | 605.40 |
| CNOOC | Energy and Public Utilities | 71 | 9.63 | 94.63 | 350.00 | 150.00 | 604.26 |
| Sinopec | Energy and Public Utilities | 72 | 6.66 | 96.43 | 350.00 | 150.00 | 603.09 |
| China Life Insurance | Finance | 73 | 98.81 | 100.73 | 350.00 | 50.00 | 599.54 |
| Feihe | Consumer Staples | 74 | 112.63 | 86.75 | 350.00 | 50.00 | 599.38 |
| Longfor Group | Real Estate and Construction | 75 | 171.13 | 121.93 | 250.00 | 50.00 | 593.06 |
| China Resources Land | Real Estate and Construction | 76 | 128.07 | 94.76 | 250.00 | 100.00 | 572.83 |
| Bank of Communications | Finance | 77 | 55.70 | 61.97 | 300.00 | 150.00 | 567.67 |
| Haidilao International Holding Ltd. | Consumer Discretionary | 78 | 18.20 | 80.74 | 300.00 | 150.00 | 548.94 |
| JD Health | Healthcare Industry | 79 | 248.14 | 0.00 | 250.00 | 50.00 | 548.14 |
| Alibaba | Information Technology | 80 | 45.00 | 0.00 | 350.00 | 150.00 | 545.00 |
| Conch Cement | Industrial Manufacturing | 81 | 0.55 | 89.46 | 300.00 | 150.00 | 540.02 |

# **Appendix 1:** Summary of Corporate Carbon Rating-4

| Company | Industry | Rank | Emission | Mitigation | Quality | Goal | Total |
|---|---|---|---|---|---|---|---|
| MTR Corporation | Industrial Manufacturing | 82 | 12.46 | 67.20 | 300.00 | 150.00 | 529.66 |
| Li Auto | Automotive Manufacturing | 83 | 223.10 | 0.00 | 250.00 | 50.00 | 523.10 |
| Sunny Optical Technology | Industrial Manufacturing | 84 | 82.28 | 79.87 | 300.00 | 50.00 | 512.15 |
| BYD | Automotive Manufacturing | 85 | 58.91 | 100.00 | 250.00 | 100.00 | 508.91 |
| ZTO Express | Industrial Manufacturing | 86 | 17.99 | 89.78 | 350.00 | 50.00 | 507.78 |
| China Unicom (Hong Kong) | Telecommunications | 87 | 38.11 | 94.62 | 300.00 | 50.00 | 482.73 |
| BeiGene | Healthcare Industry | 88 | 82.81 | 48.46 | 300.00 | 50.00 | 481.27 |
| KE Holdings | Information Technology | 89 | 222.35 | 0.00 | 200.00 | 50.00 | 472.35 |
| Country Garden Services | Real Estate and Construction | 90 | 20.37 | 100.00 | 300.00 | 50.00 | 470.37 |
| Yum China | Consumer Discretionary | 91 | 12.44 | 87.14 | 200.00 | 150.00 | 449.57 |
| Ctrip | Information Technology | 92 | 107.98 | 75.19 | 200.00 | 50.00 | 433.17 |
| Bilibili | Information Technology | 93 | 206.80 | 0.00 | 100.00 | 50.00 | 356.80 |
| CanSino Bio-B | Healthcare Industry | 94 | 2.28 | 0.00 | 300.00 | 50.00 | 352.28 |
| Kuaishou | Information Technology | 95 | 31.53 | 0.00 | 250.00 | 50.00 | 331.53 |
| Meituan-W | Information Technology | 96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Pinduoduo | Information Technology | 96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| NIO | Automotive Manufacturing | 96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Tencent Music | Information Technology | 96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Futu Holdings | Finance | 96 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# **Appendix 2:** Primary and Secondary Indicators of Industrial Segments



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