CLIMATE DISCLOSURE

DISCLOSURE OF CLIMATE-RELATED EMISSION METRICS: THERMAL POWER GENERATION COMPANIES LISTED IN UK AND CHINA

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PREFACE

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This report, commissioned by the Charitable Trusts of The Institute of Chartered Accountants in England and Wales (ICAEW), analyses the disclosure of climate-related emission metrics by thermal power generation companies listed in the UK and China. It is part of a series of research projects conducted in collaboration with the China Accounting Standards Committee (CASC) and falls within the broader Sustainable Development Goals (SDGs) research workstream of ICAEW.

The research was led by Dr. Zi Wei under the guidance of Academic Advisor Professor Richard Barker of Oxford University. We extend our gratitude to the team and to the ICAEW Research Advisory Board (RAB) for their pivotal role in shaping the project's structure and approach. Their guidance underscores ICAEW's commitment, as outlined in its Royal Charter objectives and overarching strategy, to use research in addressing pressing challenges encountered by the accounting profession.

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Finally, we recognise this project as an integral component of ICAEW's broader research endeavours. Under the guidance of the RAB and with the Trustees' approval, the ICAEW Charitable Trusts allocate research funding aligned with ICAEW's objectives. Presently, this funding sustains eight defined research workstreams addressing critical topics ranging from accounting for intangibles and digital assets to corporate failures, local government reporting, SDGs, regulatory effectiveness, data access, VAT modernisation, AI, and seed corn funding for early career researchers and pilot studies. Additional details on these research initiatives are available at icaew.com/research.

We believe this report offers valuable insights into climate-related disclosure practices and will enrich the ongoing discourse on corporate transparency and sustainability. It is imperative to note that the views expressed herein do not necessarily reflect the official stance of ICAEW. This report provides a comprehensive overview of the research and findings derived from the project.

1 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVES

As climate change risks continue to increase, governments of many jurisdictions have taken active measures to combat them. In the process of responding to climate change, more and more governments have realised that comparable and high-quality climate-related information plays a vital role in corporate carbon emission reduction and achieving national net-zero targets. However, investors around the world report that the information about the impact of climate change on companies is still limited, which has become a big challenge when they make investment decisions. There is a general call in global capital markets to access reliable, consistent and comparable climate-related information which allows investors to price climate-related risks and opportunities and help them make investment decisions (IOSCO, 2023)[1].

To address this issue, many international non-governmental and non-profit organisations have issued recommendations or guidelines to increase and improve the disclosure of climate-related information. In this plethora of initiatives, two main orientations can be distinguished. One strand is impact reporting, which is usually embedded in sustainability or ESG reports. It seeks to promote behavioural change by requiring companies to demonstrate how they contribute to a better world by engaging in environmentally sustainable activities and carbon reduction actions. However, there is another, increasingly influential, strand in climate-related reporting that is more focused on the impact of climate issues on the company itself, rather than on external impact. It seeks to provide investors with information on how climate-related issues might impact the company's future financial performance[2].

Under the influence of these organisations dedicated to the development of climate-related disclosure and sustainability reporting, some of the G20 jurisdictions have begun to take more active actions to promote the disclosure of climate-related information. As a major developed country which advocates more climate-related disclosure, the UK Government has required listed companies to report climate-related information in their Strategic Report and Director's Report since 2013. Moreover, the UK announced plans for mandatory TCFD[3]-aligned disclosures across the economy in 2020. Around 1,600 companies have been required to implement the TCFD recommendations since 6 April 2022. At the same time, the largest developing country in the world, China announced in 2020 that it would strive to peak carbon dioxide emissions by 2030 and achieve carbon neutrality by 2060. In order to achieve this goal, China's national carbon emissions trading market was established in 2020. A series of disclosure policies related to climate change are being developed.

As more jurisdictions began to pay attention to climate-related disclosure, in 2021 the IFRS Foundation Trustees announced the establishment of the International Sustainability Standards Board (ISSB) to provide global high-quality disclosure standards on climate and other sustainability issues. In June 2023, the ISSB issued IFRS S1 General Requirements for Disclosure of Sustainability-related Financial Information and IFRS S2 climate-related disclosures, an important step in developing a set of uniform disclosure standards related to climate issues.

Against this background, it is important to understand the current disclosure practices of the main climate-related metrics of key industries related to climate change in different jurisdictions and to propose corresponding suggestions. This study focuses on disclosure of GHG emission metrics, the core concern of climate change and the most objective climate-related information, in thermal power generation industries. Through investigating the reporting practices of emission metrics of some thermal power generation companies listed in the UK and mainland China, this study seeks to analyse the existing problems and provide further policy suggestions. Specifically, the primary objectives of this study are to:

- Integrate the content elements of climate-related emission metrics of the main guidelines or standards including CDP, CDSB, TCFD, GRI, SASB, IIRC before 3 November 2021[4], and the IFRS S2, forming a complete content element framework on emission metrics of climate-related disclosure.

1 IOSCO's endorsement of the ISSB standards for sustainability-related disclosures was issued on 25 July 2023, which is available at https://www.iosco.org/library/pubdocs/pdf/IOSCOPD741-Endorsement-Decision.pdf

2 IASB Chair speech on what sustainability reporting can and cannot achieve, Hans Hoogervorst, 2019. https://www.ifrs.org/news-and-events/news/2019/04/speech-iasb-chair-on-sustainability-reporting/

3 Task Force on Climate-related Financial Disclosures was created by the Financial Stability Board to develop recommendations on the types of information that companies provide to support investors, lenders and insurance underwriters in assessing and pricing related to climate change.

4 IFRS Foundation announced that ISSB would consolidate with CDSB and VRF (formed by SASB and IIRC in June 2021) on 3 November 2021 at the COP26 climate conference. The reason for focusing on the guidelines before the date is that the standards of these organisations were relatively independent before some of the organisations were merged into IFRS.

- Explore the disclosure practices of climate-related metrics of thermal power generation companies listed in the UK and mainland China based on the element framework of emission metrics, and provide a better understanding on the current status, problems and challenges of emission metrics disclosure in the two countries.

- Shed light on further policy developments on the disclosure of climate-related emission metrics for both the UK and China, and also provide reference for the ISSB Transition Implementation Group founded in September 2023 to address the implementation questions on emission metrics of IFRS S2.

1.2 SCOPE AND METHOD

Scope

First, this study concentrates on the disclosure of climate-related emission metrics, which are the core concern of nearly all the climate-related disclosure guidelines or standards. Although there are other important modules included in climate-related disclosure, such as governance, risks and opportunities, strategy, financial impacts etc., emission metrics are the core concern based on objective numbers and the most important basic information for investors to understand companies' business models, evaluate climate-related risks and opportunities, estimate the financial impacts of climate-related issues, compare the reduction performance among companies and finally make their climate-related investment decisions. In this sense, emission metrics are the foundation of the whole climate-related disclosure system and should be studied first.

Second, this study focuses on the thermal power generation companies which are the largest contributor to carbon dioxide emissions according to the Global Energy and CO_2 Status Report 2019 from the International Energy Agency (IEA)[5] . The IEA report (2019) found that CO_2 emitted from coal combustion was responsible for over 0.3°C of the 1°C increase in global average annual surface temperatures. Coal-fired electricity generation accounted for 30% of global CO_2 emissions. In recent years, the traditional thermal power generation industry has accelerated their transition to renewables to avoid CO_2 emissions. The savings from renewables in power generation was led by China and Europe, together contributing two-thirds to the global total. Due to the effects of the thermal power generation industry on climate change, this study analyses the disclosure of climate-related emission metrics of these companies.

Third, this study focuses on the thermal power generation companies[6] listed in the UK and mainland China. The UK is a major developed country and it is also one of the first countries to require listed companies to report climate-related information in annual reports and to make mandatory TCFD aligned disclosure requirements. China, the largest developing country in the world, plays an important role in the global response to climate change. China has announced peaking carbon dioxide emissions by 2030 and achieving carbon neutrality by 2060. Focusing on thermal power generation companies listed in the UK and China could provide status quo analysis for both developed and developing countries on the disclosure of climate-related emission metrics, and thus provide a reference for ISSB which is working on establishing and implementing widely adopted disclosure standard of climate-related information.

Method

Based on the climate-related emission metrics suggested by the main NGOs which address climate-related and environmental disclosure standards, this study analyses the current disclosure practice of these metrics for thermal power generation companies listed in the UK and mainland of China. Specifically, three steps are taken in this study.

First, the research analyses the detailed content elements of current climate-related emission metrics suggested by CDP, CDSB, TCFD, GRI, SASB, IIRC, IFRS S2, then integrates the 18 detailed content elements of climate-related emission metrics into two categories as "GHG emission metrics" and "Emission calculation methodology and reporting". Although non-GHG polluting gases and other emissions could also affect the environment, according to the Kyoto Protocol, emissions related to climate change should be primarily greenhouse gas emissions. Other non-GHG polluting emissions are not included in the climate-related emissions metrics. The details of the integrated element framework of emission metrics are presented in 2.1 of Chapter 2.

5 https://www.iea.org/reports/global-energy-co2-status-report-2019/emissions

6 As thermal power generation keeps decreasing in Europe due to the climate-related consideration, some companies' thermal power generation business is no longer their largest business model although they still have large thermal power generation installed capacity.

Second, this study selects the five companies with the largest thermal power generation capacity listed on the London Stock Exchange and the five companies with the largest installed thermal power generation capacity listed on the Shanghai Stock Exchange as the sample to analyse their disclosure of GHG emissions by reading their annual reports and sustainability (CSR or ESG) reports issued in 2021[7]. Due to Europe's low carbon development strategies and fast development of renewable energy electricity generation, there are not many companies with thermal power generation businesses (eight companies) listed in the UK. Through the sample selection process and in order to keep the numbers of thermal power generation companies listed in China and listed in the UK matched with each other, this study only chooses the top five companies with the largest thermal power generation installed capacities from the London Stock Exchange and Shanghai Stock Exchange respectively. Since this study does not cover all the thermal power generation companies, the conclusions drawn from the findings of this study have certain limitations and cannot represent all the thermal power generation companies of the two markets. The analysis for the sample companies is based on the proposed emission metrics element framework. The sample selection process is shown in 2.2 of Chapter 2, the results and discussions are presented in Chapter 3.

Last, based on the element framework of the GHG emission metrics and the case study of the selected thermal power generation companies listed in the UK and mainland China[8], this study proposes relevant policy suggestions for the UK, China and ISSB. The conclusions and suggestions are set out in Chapter 4.

1.3 KEY FINDINGS AND SUGGESTIONS

Findings of UK-listed companies and suggestions

The mandatory disclosure policies and relatively clear regulations of the UK and EU on climate-related emission metrics have promoted consistency in disclosure of emission metrics among the UK listed sample companies. All the sample companies disclosed most of the climate-related metrics and they all adopted the GHG Protocol as their methodology. However, this study also found considerable differences existed in the disclosed categories of Scope 3 emissions and different approaches adopted to define companies' GHG reporting boundaries. As for the disclosure position of the climate-related emission metrics, it seems that most of the sample companies reported most of their emission metrics in both their annual report[9] and sustainability report.

Particularly, the key findings of the UK-listed sample companies can be summarised in the following points:

- All the five companies disclosed the GHG emission metrics of Scope 1 and Scope 2 as well as the GHG emission intensity. Some companies provided breakdown information for Scope 1 and Scope 2 emissions, while others did not. Although it is not mandatory for Scope 3 emissions to be disclosed by UK-listed companies, all the sample companies disclosed both the total Scope 3 emissions and the detailed subcategories of their Scope 3 emissions[10].
- Considerable differences existed in the disclosed Scope 3 emission subcategories among the five companies, which caused low comparability of Scope 3 emissions and also the total GHG emissions (if Scope 3 emissions are included in calculation).
- All the five companies disclosed that they adopted the GHG Protocol as their methodology to calculate and report GHG emissions. Also, the five companies all disclosed that they had adopted the control approach to define their GHG reporting boundaries.

7 Except SSE, all the other nine companies of the sample have the same fiscal calendar from 1 January to 31 December, this study analysed their annual reports and sustainability (CSR or ESG) reports issued in March or April of 2021, which reported their operation activities in the period between 1 January and 31 December 2020. For SSE, whose fiscal calendar is from 1 April to 31 March, this study analysed its annual report and sustainability report issued in June and July of 2021 respectively, which reported its operation activities in the period between 1 April 2020 and 31 March 2021.

8 "Companies listed in China" in this paper refers to companies listed at the stock market of mainland China. The disclosure requirement of climate-related information at the stock market of mainland China is different to that of the Hong Kong stock market.

9 This study defined the annual report as the report issued each year and disclosed together with the annual financial report in one document. For example, some companies issued a GHG report or ESG report each year, but these reports are not included in the document in which the financial report exists, so these reports are not counted as the annual report although they are issued yearly. On the contrary, some companies issued a non-financial report, strategic report or directors' report, so if these reports are included in the same document in which the financial report exists; they are counted as part of the annual report.

10 According to the GHG Protocol, the Scope 3 emissions include 15 subcategories which are presented in Table 3.2.

However, two companies chose to adopt a "financial control" approach while the other three chose to adopt an "operational control" approach, which causes differences in GHG reporting scopes.

- All the five companies disclosed that their GHG reporting periods were consistent with their financial reporting periods, and they all provided the GHG emissions of previous years. Two companies disclosed the change of the emission reporting scopes when they compared the current emissions with the emissions of previous years, while the other three companies did not.
- The GHG emissions of all five companies had been verified by external professional bodies. Two companies' Scope 1 emissions and one company's Scope 2 emissions were verified as "reasonable assurance", while the other metrics were verified as "limited assurance".
- Most of the companies reported most of their emission metrics in both their annual report and sustainability report. There is only one company which disclosed all its emission metrics in its non-financial report and sustainability report, but not in its annual report.
- The GHG emission intensity, Scope 1, 2 and 3 emissions, comparable GHG emissions of previous years and assurance were disclosed by most of the sample companies in both their annual report and sustainability report, while the other metrics were usually disclosed in their sustainability report only.

To improve the relevance, comparability and the financial materiality of the disclosure of climate-related emissions, further policy suggestions for the UK can be summarised as follows:

- Scope 3 emissions provided by companies still lack comparability and accuracy at this stage, incorporating Scope 3 emissions into the mandatory disclosure requirement list and the calculation of the total GHG emissions still needs caution. Further study could focus on whether it is necessary and feasible to require companies of all the industries or all sizes to disclose Scope 3 emissions mandatorily. A voluntary disclosure requirement of Scope 3 emissions could be retained for non-financial industries until the conditions become mature for companies to provide comparable and accurate information of Scope 3 emissions.
- For climate-related emissions metrics, although most companies adopt the GHG Protocol as their calculation and reporting methodology, there is more than one option provided by the GHG Protocol in reporting boundary and measurement units, which causes this information to be less comparable among companies. Determining one more suitable method from these options and removing others is suggested.
- The current policies of climate-related disclosure in the UK have defined what information should be disclosed. Future policies should provide guidance on where climate-related information should be disclosed; especially what kind of climate-related information should be disclosed in the annual report mandatorily due to its materiality for investors, while others should not. In addition to the mandatorily disclosed information, if companies want to disclose other climate-related information voluntarily, linking to sustainability reports through indexing is recommended to prevent the unnecessary overload of the annual report.
- The UK has required listed companies to disclose climate-related information based on TCFD since 2022. Most of the information suggested by TCFD is required to be disclosed in the strategic report and directors' report which are included in the annual report. How to organise and integrate TCFD within the current disclosure framework of the annual report and sustainability report needs to be studied.

Findings of China-listed companies and suggestions

Although it is voluntary to disclose GHG emissions in the annual report and CSR (or ESG) report in mainland China, three of the five sample companies disclosed GHG emissions (Scope 1, Scope 2 and emission intensity) in their ESG reports. This study found that the companies which voluntarily disclosed their GHG emissions in ESG reports all claimed that they referred to GRI's Sustainability Reporting Standards and they are all listed at the Hong Kong Stock Exchange which requires listed companies to disclose Scope 1, Scope 2 emissions and emission intensity mandatorily and Scope 3 emissions voluntarily. None of the five companies disclosed Scope 3 emissions. One company disclosed the methodology adopted to calculate and report GHG emissions, and there are several differences existing between the methodology adopted and the GHG Protocol. As for the disclosure position of the climate-related emission metrics, it seems that the companies which voluntarily disclose GHG emissions preferred to disclose the information of GHG emissions in their ESG report only. Little GHG emission information was disclosed in the annual report.

Although the two companies did not disclose GHG emissions in their annual report or ESG report, it does not mean they don't need to calculate and report GHG emissions. As the key GHG emitting entities in the key GHG emission industries, companies are required to calculate the Scope 1 and 2 emissions based on the designated methodology, have the emissions verified by a third party and then report to the Ministry of Ecology and Environment each year. However, the Ministry of Ecology and Environment will not release these companies' GHG emission data to the public.

Specifically, the key findings of the China-listed sample companies can be summarised as follows:

- Three of the five companies disclosed the metrics of "Scope 1 emissions", "Scope 2 emissions" and "GHG emission intensity". No companies disclosed Scope 3 emissions. The three companies which voluntarily disclosed their GHG emissions in their ESG report all claimed that they referred to GRI Standards and they are also cross-listed at the Hong Kong Stock Exchange which required listed companies to disclose Scope 1 and 2 emissions in their ESG reports.
- One company disclosed that its GHG emissions were calculated with reference to the "Guidelines for Accounting Methods and Reporting of GHG emissions for Chinese Power Generation Enterprises (Trial)", which has some differences in detail from the GHG Protocol issued by WRI and WBCSD.
- All the three companies which reported GHG emissions disclosed their emission reporting boundaries indirectly. The reporting boundaries they disclosed were not clear and consistent, and they did not disclose how they consolidated the GHG emissions for the whole group.
- All the three companies reporting GHG emissions disclosed that the reporting periods of the GHG emissions metrics were consistent with their fiscal calendars. Two companies provided comparable GHG emissions for previous years.
- All the three companies disclosing GHG emissions reported that they had completed third-party verification on GHG emissions to meet the requirements of the national carbon emission verification program by the Ministry of Ecology and Environment.
- Different from the UK-listed sample companies, which disclosed most of the GHG emission metrics in both their annual financial report and sustainability report, all the China sample companies which voluntarily disclosed GHG emissions reported their GHG emission metrics only in the ESG report. Little GHG emission information was reported in the annual report.
- Although some companies did not disclose GHG emissions in their annual report or ESG report, they were required to report GHG emissions to the Ministry of Ecology and Environment each year as the key GHG emitting entities (GHG emission is more than 26,000 tons of CO_2 equivalents) in the key GHG emission industries (thermal power generation industry is one of the key GHG industries).
- Different from the voluntary disclosure requirements for GHG emissions in the annual report, some environmental pollution metrics such as the emission of air pollutants (including NOx, SOx and dust), water and waste discharge have for a long time been required to be disclosed mandatorily in the annual report.

Disclosure of climate-related emission metrics can greatly improve the market efficiency of green investment and finance, which is crucial to achieving the targets of peaking carbon dioxide emissions by 2030 and carbon neutrality by 2060. Specifically, the policy suggestions for disclosure of GHG emissions in mainland China are summarised as follows:

- Establish a set of GHG emissions calculation and reporting standards in line with the internationally accepted GHG accounting and reporting methodology as soon as possible.
- Considering the targets of peaking carbon dioxide emissions in 2030 and achieving carbon neutrality in 2060, as well as the mandatory reporting system of GHG emissions in the key emitting industries are becoming mature, mandatory disclosure policies of GHG emissions in mainstream reports could be trialled in the key GHG emitting industries first and then expanded to all other industries. How to distribute the GHG emission disclosures between the annual report and CSR (or ESG) report should also be considered during the process.
- Given that mandatory disclosure of pollutant gases, water and solid waste in the annual report has been in place for a long time, it seems that there is no reason for GHG emissions to remain a voluntarily rather than a mandatory disclosure, when the conditions of measurement and reporting of GHG emissions become mature. The emphasis of environmental information

disclosure in the annual report or ESG report should be extended from pollutant discharge to GHG emissions. Embedding GHG emissions into the current mandatory environmental disclosure requirements of pollutant gases, wastewater and solid waste in the annual report would be a shortcut for mandatory GHG emission disclosure.

- The distribution of climate-related emission metrics or the whole climate-related information between the annual report and ESG report, especially what kind of climate-related metrics should be disclosed in the annual report due to their materiality for investors are also necessary to consider when a mandatory disclosure policy of GHG emissions is determined.

Suggestions for ISSB

The findings of this study could also be of interest to ISSB, which has issued IFRS S2 for climate-related disclosures in 2023. Different from the TCFD and GHG Protocol, which don't require but encourage companies to disclose Scope 3 emissions, IFRS S2 suggested that Scope 3 emissions need to be disclosed along with Scope 1 and Scope 2. According to the definition of the GHG Protocol, Scope 3 encompasses the emissions which are not produced by the company itself, but by other companies which are up and down its value chain, such as suppliers and customers. The attribute of Scope 3 emissions makes it the hardest to tackle.

This study shows that Scope 3 emissions reported by the listed companies still lack accuracy and comparability in the UK, which has a highly developed economy, advanced policy and practice of measurement and disclosure on climate-related GHG emissions. Developing economies, most of which haven't established complete GHG measurement and reporting systems for Scope 1 and 2 emissions, have more difficulties in reporting emissions of Scope 3. Although incorporating Scope 3 emissions into companies' disclosure lists could provide motivation for companies to choose suppliers with lower GHG emissions and push customers to reduce their Scope 1 emissions to some extent, the promotion effect of GHG reduction is very indirect and limited, compared with the huge disclosure cost and the damage of the comparability of GHG emissions. All these difficulties and the cost and benefit trade off of reporting Scope 3 emissions at this stage should be fully considered. Whether to put Scope 3 emissions into the mandatory disclosure list for all companies, all industries and all economies needs to be studied.

Moreover, this study finds that although most of the UK-listed companies claimed that they adopted the GHG Protocol to define their GHG reporting boundaries, there are three different approaches provided by the GHG Protocol and companies chose one or two approaches as they saw fit. The difference in the GHG reporting scopes among the three approaches are significant, which make their GHG emission data incomparable. For the listed sample companies in mainland China, the approaches adopted by companies to define their GHG reporting boundaries are not disclosed and the suggested approach specified by the policy document seems different to the approaches provided by the GHG Protocol. It is important and necessary for the ISSB to determine a sole and consistent approach of GHG reporting boundaries to avoid different scopes of GHG emissions among companies and across countries.

This study also shows that most of the UK-listed sample companies disclosed the climate-related emissions metrics in both the annual report and sustainability report, while most of the China-listed sample companies disclosed (if they did) the climate-related emissions only in the ESG report. This addresses a question of what kind of climate-related information should be disclosed in the annual report and what information should not be; and how to distribute the climate-related information between the annual report and sustainability report. Although IFRS S2 climate-related disclosure has suggested what kind of climate-related information should be disclosed, there is no clear and specific suggestion for where they should be disclosed. Management commentary or similar reports such as the strategic report and the operating and financial review in general purpose financial reports, or other reports required by regulators by cross-reference are all allowed. Future research should look at what kind of climate-related metrics should be disclosed in the annual report due to their materiality for investors and how to distribute climate-related metrics among different reports, because companies' different positioning of climate-related disclosure could bring different influence on investors' decisions.

2 RESEARCH APPROACH

To address the research objectives, this study first builds a content element framework for climate-related emission metrics based on the guidelines of the main NGOs related to climate-related disclosure. Then, this study selects some thermal power generation companies listed in the UK and mainland China to analyse their disclosure practices for climate-related emission metrics based on the element framework.

2.1 METHOD OF ANALYSIS

As climate-related uncertainty has increased, a number of guidelines or standards have been developed by international NGOs to encourage companies to disclose more climate-related or environmental information. These main NGOs include, but are not limited to, CDP, CDSB, TCFD, IIRC, GRI, and SASB. In 2021, the IFRS Foundation also announced the creation of the International Sustainability Standards Board (ISSB) to meet the increasing disclosure requirement of climate-related and other ESG matters. Although some of these NGOs have merged with others[11], and the ISSB have issued IFRS S2 on climate-related disclosure, a unified global climate-related disclosure standard hasn't been adopted widely until now. Companies usually adopt one or several guidelines as they see fit or they are required when they disclose climate-related information in their reports.

Although the scope, structure and focus of these climate-related disclosure guidelines or standards are different, some content elements overlap. This study finds that "emission metrics" is the module suggested by nearly all the standards. This prompts us to focus on the emission metrics which are the core focus of climate change and the only objective numerical information in the whole climate-related disclosure framework.

Specifically, three steps were taken to construct a content framework of emission metrics. First, this study extracted all the climate-related emission metrics from CDP, CDSB, TCFD, IIRC, GRI, SASB and the IFRS Foundation[12]. Second, we combined the same or similar climate-related metrics from different guidelines as one element code. If a content element code is listed in one guideline but not in the others, this code will be listed separately. Third, this study marked each content element code with a superscript to indicate which guideline it comes from. Last, all the content element codes were placed in logical order. The content element framework of climate-related emission metrics is shown in Table 2.1.

Table 2.1 Content element framework of climate-related emission metrics

ELEMENT	CATEGORIES	DETAILED CODES
EMISSION METRICS	GHG EMISSIONS	Scope 1 emissions[1,2,3,4,7,8]
		Scope 1 breakdown (GHG/Region/Business)[1,4]
		Scope 2 emissions[1,2,3,4,7,8]
		Scope 2 breakdown (GHG/Region/Business)[1,4]
		Scope 3 emissions[1,3,4,7,8]
		Scope 3 breakdown (Category)[1,3,4,7,8]
		Scope 1 and 2 emissions[2]
		Total GHG emissions (Scope 1+2+ 3)[1]
	CALCULATION METHOD AND REPORTING	GHG emission intensity[1,4,7,8]
		Emissions calculation methodology[1,2,4,8]
		Reporting boundary[2,4,5,7,8]
		Reporting period[2,4,5,7,8]
		Comparable emissions of previous years[1,3,4,8]
		Assurance[1,2,4]

Note: the superscript 1,2,3,4,5,6,7 and 8 indicate the content element code is recommended by CDP, CDSB, TCFD, GRI, SASB, IR, TRWG of IFRS Foundation and IFRS S2 respectively.

11 The IIRC and SASB merged into the Value Reporting Foundation (VRF) in 2021. The IFRS Foundation will complete consolidation of CDSB (an initiative of CDP) and the VRF by June 2022.

12 IFRS Foundation issued the Climate Disclosure Prototype, Exposure Draft of IFRS S2 and IFRS S2 Climate-related Disclosure in 2021, 2022 and 2023 respectively, while all the sample companies of this study issued their reports before August 2021, that means IFRS Foundation hadn't issued the two documents yet when this study collected the data from the samples. However, considering this study could also be of interest to ISSB, this study analyses the content elements of the two documents issued by the IFRS Foundation and adopts the red superscript 7 and 8 to indicate them. This study did not find any content element of emission metrics proposed by Climate Disclosure Prototype and ED of IFRS S2 only but by the other guidelines, which means there is no difference for the content element framework whether the two documents of IFRS Foundation are included in the integration analysis or not.

In the content element framework, the climate-related emission metrics are shown in two categories: "GHG emissions" and "calculation method and reporting". The GHG emissions refer to the emissions of the seven GHG gases covered by the Kyoto Protocol, which are the core drivers of climate change. The category of "GHG emissions" includes Scope 1, 2 and 3 emissions and breakdowns, emission intensity and GHG emission totals. The category of "calculation method and reporting" includes "emission calculation methodology", "reporting boundary", "reporting period", "comparable emissions of previous years" and "assurance".

2.2 SAMPLE SELECTION

Due to the purpose and scope of this study, sample selection starts with identifying thermal power generation companies listed on the London Stock Exchange and Shanghai Stock Exchange.

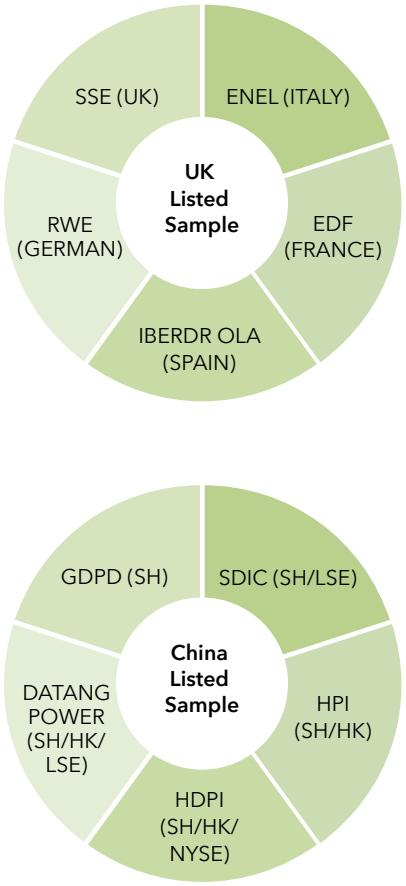
According to the Wind database, there are 10 listed companies with thermal power generation business among the 25 listed companies of electricity generation, distribution, and sales on the London Stock Exchange. Due to Europe's low carbon development strategies and fast development of renewable energy electricity generation, thermal power generation in Europe has shrunk in recent years. For some of these companies listed on the London stock market, thermal power generation is not their dominant power generation mode although they still have relatively large thermal power generation installed capacity. This study chose five listed companies on the London Stock Exchange, which have the largest thermal power generation installed capacity. The five companies are from France, Italy, UK, Spain and Germany respectively[13].

For China, there are 27 listed companies with thermal power generation as their main business among the 38 listed companies of electricity generation, distribution and sales. The percentage of the thermal power generation companies reflects that thermal power generation remains dominant in China. This study chose five companies listed on the Shanghai Stock Exchange, with the largest thermal power generation installed capacity. Three of the five companies are also listed on other international capital markets.

Specifically, one company is listed on both Shanghai and Hong Kong Stock Exchanges, one is listed on Shanghai, Hong Kong and London Stock Exchanges, and the other one is listed on Shanghai, Hong Kong and New York Stock Exchanges. For companies with a cross-listed background, this study focuses on their reports issued on the Shanghai stock market only.

The details of the sample companies are listed in Appendix 1. The characteristics of these samples are shown in Figure 2.1. The thermal power generation installed capacity and the percentage of thermal power generation installed capacity over the whole power generation installed capacity for the sample companies are presented in Table 2.2. This study collects the information of climate-related emission metrics from the annual reports and sustainability (CSR or ESG) reports issued in 2021[14] by these sample companies.

Figure 2.1 Characteristics of the UK and China sample



13 There are 2 companies from China among the 10 UK-listed companies. Considering separate analysis will be taken for companies listed in China, the two LSE-listed companies from China are not included in the UK-listed sample companies.

14 Except SSE, all the other 9 companies of the sample have the same fiscal calendar from 1 January to 31 December. This study analysed their annual reports and sustainability (CSR or ESG) reports issued in March or April 2021, which reported their operation activities in the period between 1 January and 31 December 2020. For SSE, whose fiscal calendar is from 1 April to 31 March, this study analysed its annual report and sustainability report issued in June and July 2021 respectively, which reported its operation activities in the period between 1 April 2020 and 31 March 2021.

Table 2.2 thermal power generation installed capacity and the percentage of thermal power generation over the whole generation

MARKET	UK-LISTED COMPANIES				
Companies	SSE	IBELL ROLA	EDF	ENEL	RWE
Thermal power generation installed Capacity (MW)	5,284	17,011	19,280	35,616	25,106
Thermal power generation installed capacity/whole installed capacity (Percentage)	57.43%	30.87%	16.00%	42.40%	61.68%

MARKET	CHINA-LISTED COMPANIES				
Companies	SDIC POWER	GDPD	DATANG POWER	HPI	HDPI
Thermal power generation installed Capacity (MW)	11,880	67,077	52,826	90,005	50,500
Thermal power generation installed capacity/whole installed capacity (Percentage)	37.33%	76.23%	77.37%	79.40%	86.40%

3 FINDINGS AND DISCUSSIONS

3.1 FINDINGS

Based on the content element framework of emission metrics shown in Table 2.1, this study selects five listed companies with the largest thermal power generation installed capacity on the London Stock Exchange and five listed companies with the largest thermal power generation installed capacity on the Shanghai Stock Exchange respectively. The results of their disclosure of climate-related emissions metrics are listed in this chapter.

Besides focusing on whether the sample companies did disclose these climate-related emission metrics or not, this study also focuses on where these companies disclosed these emission metrics and how they disclosed them. Some abbreviations are adopted to label which report the content element information comes from. Specifically, AR indicates this information is disclosed in the annual report or integrated report which is defined as "the yearly disclosed document in which the financial report is included"[15]; SR, NFR, CSR and ESG indicate the content element is disclosed in the sustainability, non-financial report, CSR report and ESG report respectively. To simplify the labelling, if a company's non-financial report is included in its annual report, the label is AR; if a company combines its sustainability report with a non-financial report into one document, the label is SR; if a company combines its CSR report with ESG report into one document, the label is ESG.

3.11 UK-LISTED SAMPLE COMPANIES

Table 3.1 Disclosure of climate-related emissions metrics of UK's sample companies

ELEMENT	CATEGORIES	DETAILED CODES	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
EMISSION	GHG EMISSIONS	Scope 1 emissions	AR ESG[16]	AR SR	AR SR	SR	AR SR
		Scope 1 breakdown (GHG/Region/ Business)	ESG	SR	SR		SR
		Scope 2 emissions	AR ESG	AR SR	AR SR	SR	AR SR
		Scope 2 breakdown (GHG/Region/ Business)		AR SR	SR		SR
		Scope 3 emissions	AR ESG	AR SR	SR	SR	AR SR
		Scope 3 breakdown	AR	SR	SR	SR	SR

15 For example, some companies issue a GHG report, ESG or sustainability report each year, but usually these reports are not included in the same document in which the financial report exists, so these reports will not be labelled as the annual report although they are issued yearly. On the contrary, some companies issue a non-financial report, strategic report or directors' report, if these reports are included in the same document in which its financial report exists, these reports are labelled as annual report.

16 This study did not find the sustainability report or ESG report for the company; instead this study found there was an ESG dataset on the company's website to disclose all the ESG related data.

ELEMENT	CATEGORIES	DETAILED CODES	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
METRICS		(Category)	ESG				
		Scopes 1 and 2 emissions	ESG				AR SR
		Total Carbon emission (Scope 1+2+3)	ESG	SR			AR SR
		GHG emission intensity	AR ESG	AR SR	AR SR	NFR SR	AR SR
	EMISSION CALCULATION METHOD AND REPORTING	Methodology of emissions calculation	AR	SR	SR	NFR SR	AR SR
		Reporting boundary	AR ESG	SR	SR	(SR)*	(SR)*
		Reporting period	AR ESG	SR	SR	NFR SR	SR
		Comparable data of previous years	AR ESG	AR SR	AR SR	SR	AR SR
		Assurance	AR ESG	SR	SR	NFR SR	AR SR

Note: (SR)* indicates that the company did not disclose the information directly in its sustainability report; instead they provided a link to GHG emission reports (published on their websites) which disclosed the reporting boundary of GHG emissions.

1. GHG EMISSIONS

(1) Emission intensity, Scope 1, Scope 2 and the breakdown information

All five companies disclosed the GHG emission metrics of Scope 1, Scope 2 as well as the GHG emission intensity. Four companies disclosed the breakdown information of Scope 1 and three companies disclosed the breakdown information of Scope 2.

Among the four companies which disclosed the breakdown information of Scope 1, one company disclosed the breakdown by GHG category; two companies disclosed the breakdown by business activities and source, and the other company disclosed by business activities, GHG category and business region.

Among the three companies which disclosed the breakdown information of Scope 2 emissions, two companies disclosed the breakdown by the source of emissions such as purchased electricity (market based and location based) and energy losses from distribution and transmission; one company disclosed by both the source of emission and the country of business located.

Because the breakdown information of Scope 1 and Scope 2 emissions disclosed by companies were based on different classifications, they are less comparable among companies.

(2) Scope 3 emissions and the subcategories

All the five companies disclosed their Scope 3 emissions although disclosure in the UK is not mandatory. According to the GHG Protocol, the Scope 3 emissions allow for the treatment of all the other indirect emissions including the upstream and downstream GHG emissions. There are 15 subcategories to measure Scope 3 emissions altogether. Although all the five companies disclosed the Scope 3 emissions and the detailed categories, considerable differences are found in the subcategories disclosed by the companies, which is presented in Table 3.2.

Table 3.2 Categories of Scope 3 emissions

CATEGORY[17]	CODE	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5	NUMBER OF COMPANIES DISCLOSE IT
1	Purchased goods and services			5.2 8.8%	0.7 3.7%	0.009 0.2 %	3
2	Capital goods				0.6 3.1%		1
3	Fuel and energy related activities		1.0 2.0%	40.5 68.7%	5.5 29.1%	0.9 27.1%	4
4	Upstream transportation and distribution		0.1 0.2%		0.3 1.5%		2
5	Waste generated in operations				0.1 0.5%		1
6	Business travel			0.02 N <0.1%	<0.1 –	0.001 <0.1%	3
7	Employee commuting			0.007 <0.1%	<0.1 –		2
8	Upstream leased assets						0
9	Downstream transportation and distribution				<0.1 –	0.1 3.2%	2
10	Processing of sold products				0.1 0.4%		1
11	Use of sold products	82.3 77.2%	46.0 96.4%	13.0 22.1%	11.7 61.9%	2.3 69.3%	5
12	End-of-life treatment of sold products						0
13	Downstream leased assets						0
14	Franchises						0
15	Investments	9.6					1

17 The number and the code of the categories are consistent with those in the GHG Protocol.

	9.0%					
Total categories disclosed	2	3	6	10	5	11
Scope 3 emissions (MtCO2e)	107.0	47.7	58.9	18.9	3.3	
Total GHG emissions (MtCO2e)	135.3	100.8	61.5	94.5	10.6	
Scope 3 / Total GHG emissions (Percentage)	79.0%	48.7%	95.7%	20.0%	31.0%	

Note: Blank means the company did NOT disclose the information of the category of Scope 3 emissions. The numbers in a darker shade of green represent the emission amounts of each category by million tons of CO_2 equivalents (MtCO2e) and how much the emission amount of each category accounts for the whole Scope 3 emissions (GHG emission of the category/ Scope 3 emissions) by percentage respectively.

For the disclosed categories of Scope 3 emissions, a minimum of 2 and a maximum of 10 categories of Scope 3 emissions were disclosed by the five UK-listed companies. Specifically, "Use of sold products" was disclosed by all five companies, "Fuel and energy-related activities" was disclosed by four companies, "Purchased goods and services" and "Business travel" was disclosed by three companies. "Capital goods", "Upstream transportation and distribution", "Employee commuting" and "Downstream transportation and distribution" were disclosed by two companies, "Waste generated in operations", "Processing of sold products" and "Investments" were disclosed by one company and other categories were not disclosed by the five companies at all. The categories disclosed by the five companies are various and inconsistent.

Even for the only category "Use of sold products" disclosed by all the five companies, both the emission amount of the category (from 2.3 to 82.3 MtCO2e) and its percentage of the whole Scope 3 emissions (from 22.1% to 96.4%) for the five companies are various and incomparable. According to GHG Protocol, "Use of sold products" (category 11) includes emissions from the use of goods and services sold by the reporting company in the reporting year. A reporting company's Scope 3 emissions from use of sold products include the Scope 1 and Scope 2 emissions of end users which include both consumers and business customers that use final products. The five companies disclosed this category in different ways. Three companies disclosed their "Use of sold products" include gas and electricity sold to final customers, one company disclosed that the value of its category 11 included sold gas to end customers, and one company just disclosed the value of category 11 without explaining the content. None of the companies disclosed the amount of gas or electricity sold to customers and the emission factor used, which makes it unclear why there is variation across companies.

All these various and unclear disclosures of the categories of Scope 3 emissions bring significant differences in companies' Scope 3 emission amounts (from 3.3 to 107 MtCO2e) and the percentage of the Scope 3 emissions of the total GHG emissions (from 20% to 79%). All the results indicate that the current data of Scope 3 emissions provided by the sample companies are not comparable, which further reduces the comparability of companies' total GHG emissions when Scope 3 emissions are included in the total GHG emissions. Different reporting boundaries also lead to incomparable GHG emission across companies.

(3) GHG Totals

Three companies summed up Scope 1, Scope 2 and Scope 3 as their total GHG emissions while the other two did not. Among the three companies which summed up Scope 1, Scope 2 and Scope 3, two of them also provided the sum of Scope 1 and Scope 2 as another total GHG emissions. The result shows that there is different understanding between companies on whether to put Scope 3 emissions into the total GHG emissions. Different scopes for the total GHG emissions among companies also make the GHG totals less comparable.

(4) Emission calculation method and reporting

a) Methodology of calculation

All the five UK-listed companies claimed that they adopted the GHG Protocol to calculate their GHG emissions. Specifically, all the companies claimed that they covered all or some of the seven key greenhouse gases (CO_2, CH_4, N_2O, HFC, PFC, SF_6 and NF_3) and expressed GHG emissions in CO_2 equivalents as the GHG Protocol suggested. The units of CO_2 equivalents and GHG emission intensity used by the four companies were "millions of tonnes" and "gCO_2/kWh", while the other company used "tones" and "kgCO_2/kWh" for GHG emission amounts and emission intensity.

(b) Reporting boundary

Defining the organisational boundary is a key step in corporate GHG accounting. This step determines which operations are included in the company's organisational scope and how emissions from each operation are consolidated by the reporting company. There are two methods allowed in the UK Government Environmental Reporting guidelines (March 2019), the equity share and control (financial or operational) approaches, which are also suggested by GHG Protocol and ISO14064-1 standards.

Three of the five companies disclosed their emission calculation boundaries in their annual report or sustainability report. The other two companies did not disclose the boundary information in their annual report or sustainability report directly; instead, they provided a link to the GHG report, usually published on their website, in which they defined their reporting boundary.

One company adopted the equity share method, under which a company accounts for GHG emissions according to its percentage ownership of the equity. Three companies adopted the control approach under which a company accounts for 100% of the GHG emissions over the equity it has control of, but it does not account for GHG emissions from companies which it owns an interest in but has no control over. One company provided two sets of GHG emission data under both the equity share method and the control method. Among the four companies which adopted the control method, two companies chose to adopt the "financial control" approach while the other two adopted the "operational control" approach. According to the GHG Protocol[18], the difference between the two control approaches would also cause different scopes of GHG emission calculation.

For the two companies which adopted financial control as their approach, one of them disclosed that for the companies which the group does not have financial control, their Scope 1 and Scope 2 emissions were consolidated into the group's GHG emission as the investment item (category 15) of the group's Scope 3 emissions based on the equity method.

The GHG Protocol Standard provides three approaches to define the boundary of GHG reporting. However, it makes no recommendation as to whether public GHG emissions reporting should be based on the equity share or any of the two control approaches. Companies need to decide on the approach best suited to their business activities and GHG accounting and reporting requirements. More than one option for defining the reporting boundary of GHG emissions was provided by the GHG Protocol, which resulted in companies adopting different approaches to define GHG reporting boundaries; although they all claimed that their GHG reporting boundaries were based on the GHG Protocol. Different reporting boundaries lead to incomparable GHG emissions across companies.

(c) Reporting period and comparative GHG emissions of previous years

Although the five companies did not disclose the reporting period for GHG emissions specifically, they all disclosed the reporting period of their non-financial or sustainability reporting in which the GHG emission was included. The reporting periods of their non-financial or sustainability report of the five companies were all consistent with their fiscal reporting periods.

Disclosure of the comparative GHG emissions of previous years could provide better understanding of the trend of GHG emissions. All five companies provided comparative GHG emissions of previous years. Two companies disclosed the GHG emission data of the previous two years and the other three companies provided the emission data of the previous one year. All the five companies' GHG emissions decreased compared with their previous GHG emissions and all the companies explained the reason for their emission reduction.

It is worth mentioning that companies should also disclose the change of the reporting boundary between different years when they compare the previous GHG emissions with the emissions of the current year. Only two companies provided information about the change of boundary when they compared the GHG emissions with previous years.

(d) Assurance

All five companies disclosed that their GHG emissions had been verified by external professional bodies. Two companies attached the assurance documents to their sustainability reports. The assurance level of Scope 1, 2 and 3 emissions of the five companies are shown in Table 3.3.

18 According to the GHG Protocol, a company has operational control over an operation if the former or one of its subsidiaries has the full authority to introduce and implement its operating policies at the operation. A group may own less than 50% of a venture's equity capital but have operational control over the venture. On the other hand, in some situations, a group may hold a majority interest in a venture without being able to exert operational control.

Table 3.3 Assurance level of Scope 1, 2 and 3 emissions

GHG EMISSION SCOPES	REASONABLE ASSURANCE (COMPANIES)	LIMITED ASSURANCE (COMPANIES)
Scope 1 emissions	2	3
Scope 2 emissions	1	4
Scope 3 emissions	0	5

From Table 3.3, two companies' Scope 1 emissions and one company's Scope 2 (restricted to natural gas sales activities) were verified as reasonable assurance, while others were verified as limited assurance. All the Scope 3 emissions of these companies were verified to a limited assurance level.

Table 3.4 Emission metrics disclosed in both annual report and sustainability report

RANKING	NAME OF EMISSION METRICS	NUMBER OF COMPANIES DISCLOSE IT IN BOTH AR AND SR
1	GHG emission intensity	5
2	Scope 1 emissions	4
2	Scope 2 emissions	4
2	Comparable data of previous years	4
3	Scope 3 emissions	3
3	Assurance	3
4	Methodology of emission calculation	2
4	Reporting period	2
5	Reporting boundary	1
5	Scope 2 breakdown	1
5	Scope 3 breakdown	1
5	Scope 1 breakdown	0

(5) Where is the information disclosed

In Table 3.1, there are 70 possible information parameters in total and 62 of them (88.6%) were given, which means most of the GHG emission metrics were disclosed by the five companies. Among these 62 parameters, 32 (51.6%) metrics were disclosed in both the annual report and sustainability report. The ranking results of the frequency of the emission metrics disclosed in both the annual report and sustainability report is listed in Table 3.4.

There are still many differences among companies' choices. Generally speaking, three out of five of the UK sample companies disclosed GHG emission intensity, Scope 1, 2 and 3 emissions, comparable data of previous years and assurance received in both the annual report and sustainability report. The method of emission calculation, reporting period, reporting boundary and breakdown information for Scope 1, 2 and 3 were usually disclosed in the sustainability reports only.

Different from the other four companies, sample 4 disclosed the Scope 1, 2 and 3 emissions as well as the breakdown information only in its sustainability report. They disclosed GHG emission intensity, methodology, reporting period and assurance in both the non-financial report and sustainability report. The non-financial report was issued separately from its annual report. Nothing about the climate-related emissions was disclosed in its annual report.

3.12 CHINA-LISTED SAMPLE COMPANIES

Table 3.5 Disclosure of climate-related emissions metrics for China's sample

ELEMENT	CATEGORIES	DETAILED CODES	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
		Scope 1 emissions			ESG	ESG	ESG
EMISSION METRICS	GHG EMISSIONS	Scope 1 breakdown (GHG/Region/ Business)				AR[19] ESG	
		Scope 2 emissions			ESG	ESG	ESG
		Scope 2 breakdown (GHG/Region/ Business)					
		Scope 3 emissions					
		Scope 3 breakdown (Category)					
		Scope 1+2			ESG		ESG
		Total Carbon Emission (Scope 1+2+3)					
		GHG emission intensity			ESG	AR ESG	ESG
	EMISSION CALCULATION METHOD AND REPORTING	Methodology of emission calculation					ESG
		Reporting boundary			ESG	ESG	ESG
		Comparable data of previous years				ESG	ESG
		Assurance			(ESG)*	(ESG)*	(ESG)*

Note: (ESG)* means the company disclosed that its GHG emissions had been verified by the third party professional organisations in the ESG report, but it did not disclose the result or the assurance level.

19 Although the company disclosed the breakdown information both in the annual report and CSR report, the breakdown information disclosed in the two reports were not the same. The Scope 1 breakdown disclosed in the annual report was by regions, while the Scope 1 breakdown disclosed in the ESG report was by business activities. As the two breakdowns of Scope 1 are not the same, the grid is not coloured in the darker green.

1. GHG EMISSIONS

(1) Scope 1, 2 and 3 emissions and GHG emission intensity

Although it is not mandatory to disclose GHG emissions in the annual report or ESG report for the stock market of mainland China, three of the five sample companies disclosed the metrics of "Scope 1 emissions", "Scope 2 emissions" and "GHG emission intensity". No company disclosed Scope 3 emissions. One company disclosed breakdown information for Scope 1 emissions by business regions in the annual report and by source in their ESG report. No companies disclosed breakdown information for Scope 2 emissions. Two companies disclosed the sum of Scope 1 and 2 emissions as the total GHG emissions.

2. EMISSION CALCULATION METHOD AND REPORTING

(1) Methodology of emission calculation

Among the three companies which disclosed GHG emissions, one company disclosed that its GHG emissions were calculated with reference to the "Guidelines for Accounting Methods and Reporting of GHG emissions for Chinese Power Generation Enterprises (Trial)" issued by the China National Development and Reform Commission in 2013.

The measurement units of Scope 1 and Scope 2 emissions for the three companies which disclosed GHG emissions were all "millions of tons". One company disclosed its GHG measurement unit as CO_2 equivalents, while the other two companies disclosed the measurement unit as CO_2 only. No information was provided about what kind of GHG was included in the calculation of GHG emission.

The unit of "GHG emission intensity" of the three companies is "kg/kWh". One company also adopted "g/degree" as the measurement unit for the breakdown information of Scope 1 emissions disclosed in its annual report.

(2) Reporting boundary

Among the three companies reporting GHG emissions, one company disclosed its reporting boundary as "the company and its domestic subsidiaries", one company disclosed its boundary as "the company and its subsidiaries", and the other company reported its reporting boundary as "the whole company covering the fields of power generation, coal, transportation, and circular economy and electricity sales". The different descriptions of reporting boundaries of these companies made it unclear about how the group's GHG emissions are consolidated and made it less comparable across companies.

(3) Reporting period and comparative GHG of previous years

All the three companies reporting GHG emissions disclosed that their reporting periods were from 1 January to 31 December, which was consistent with the reporting period of their financial reports.

As for the comparative GHG of previous years, one company reported the GHG emissions of the previous two years, one company provided GHG emissions of the last year, and the other one did not provide GHG emissions for previous years. For the two companies which disclosed GHG emissions for previous years, the total emissions of Scope 1 and Scope 2 decreased compared with their previous GHG emissions, but they did not specify any reason for their emission reductions. Also, they did not disclose whether there was a change of reporting boundary when they compared with previous GHG emissions.

(4) Assurance

All three companies which disclosed GHG emissions reported in their ESG reports that all the thermal power enterprises affiliated to the company had completed third-party verification on GHG emissions in accordance with the requirement of the national carbon emission verification and reporting program organised by the Ministry of Ecology and Environment. However, they did not disclose the detailed results of third-party verification in their annual report or ESG report.

According to the Carbon Emissions Reporting, Verification and Monitoring Program by the Ministry, power generation enterprises with more than 26,000 tons of CO_2 equivalents each year are required to account for and report GHG emissions to the Ministry of Ecology and Environment every year. Competent authorities should organise and review the third-party verification on companies' GHG emissions.

3. WHERE ARE THE GHG EMISSION METRICS DISCLOSED

Different from the sample companies listed in the UK, which disclosed most of the GHG emission metrics in both the annual financial report and sustainability report, all the sample companies listed in China disclosed most of their GHG emission metrics in their CSR or ESG report. Only one company disclosed its GHG emission intensity and the breakdown information of Scope 1 emissions in its annual report.

The possible reason would be that there is no requirement for GHG emissions to be disclosed in the annual report and some sample companies are also listed on the Hong Kong Stock Exchange, which requires listed companies to disclose GHG emissions in their ESG report.

3.2 DISCUSSIONS

3.21 UK-LISTED SAMPLE COMPANIES

(1) Mandatory disclosure policies of GHG emissions and relatively clear detailed regulations have prompted companies to disclose their GHG emissions with similar methods.

All the five UK-listed companies disclosed most of the GHG emission metrics in their annual report and sustainability report. An indispensable factor that leads to this result is that the EU and the UK have promulgated and implemented a series of mandatory disclosure policies on GHG emissions and the corresponding methodology, reporting scope and measurement units.

First, the five UK-listed sample companies are from France, Germany, Italy, Spain and the UK, which were all members of the EU before 2021. The EU issued a Non-Financial Reporting Directive (NFRD) in 2014 and required all members to translate the NFRD into legislation. According to the NFRD, GHG emissions and air pollution emissions should be disclosed in the Non-Financial Report (NFR).

Second, in the UK, the government provided legislative infrastructure for corporate reporting on GHG information. According to the Companies Act 2006 (Strategic Report and Directors' Report) Regulations[20] 2013, all the UK incorporated companies whose equity share capital are listed on the main market of the London Stock Exchange, a European Economic Area, or been dealt on the New York Stock Exchange or NASDAQ must report their annual GHG emissions in their directors' report. In order to assist companies in complying with the regulations, the Defra Environmental Reporting Guidelines[21] were released in 2013 to help companies measure and report their GHG emissions and environmental impacts.

With the transposition of EU Directive 2014/95/EU on the NFRD, the UK Government issued a series of regulations such as the Companies, Partnerships and Groups (Accounts and non-financial reporting) Regulations (2016) and the Guidance on the Strategic Report (2018) to improve the disclosure quality of non-financial reports. Both of these two regulations also required companies to disclose GHG emissions in their strategic report or non-financial report.

The UK Government's Streamlined Energy and Carbon Reporting (SECR) policy, implemented in 2019, required quoted companies[22] of all sizes to continue to report their global GHG emissions and an intensity ratio through their annual reports. Specifically, quoted companies must continue to report their global Scope 1 and 2 GHG emissions (seven greenhouse gases defined by the Kyoto Protocol) in tons of carbon dioxide equivalents, and emission intensity ratio in their directors' reports for the current and previous reporting periods. Reporting Scope 3 emissions remains voluntary, but it is strongly recommended by the UK Government.

Additionally, SECR also required that quoted companies must disclose the methodology, boundaries and period of their reporting of emissions. Two methods were suggested: the GHG Protocol and ISO14064–1:2018 standards. Although no particular methodology was prescribed, the method must be robust, transparent and widely accepted. According to SECR, companies should provide information to enable a clear understanding of what emissions have been reported, if and how this differs from the scope

20 http://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf

21 UK Department of Environment, Food and Rural Affairs (2013) Environmental Reporting Guidelines: Including mandatory greenhouse gas emissions reporting guidance. Available from: https://www.gov.uk/government/publications/environmentalreporting-guidelines-including-mandatory-greenhousegas-emissions-reporting-guidance.

22 Companies listed on the main market of the London Stock Exchange, a European Economic Area, or have dealt on the New York Stock Exchange or NASDAQ. Companies incorporated outside of the UK are not required to include energy and carbon information in their Directors' Report under this legislation, including foreign parent companies of UK subsidiaries.

of the consolidated financial statement. Disclosures should cover the same annual period as the financial year, or an explanation should be provided to show why this is not the case. Also, there is a "comply or explain" clause for disclosure of GHG emissions. If a GHG emission metric is not practical to obtain, a statement explaining what information has been omitted and why must be included.

Last, all the sample companies are members of the EU Carbon Emission Trading System[23], which also requires companies to report GHG emissions. Moreover, all the five companies disclosed that they adopted reporting guidelines of GRI and TCFD, which also recommend the disclosure of GHG information and the GHG Protocol as the calculation methodology.

All these mandatory disclosure policies on the GHG emissions of the EU and UK, together with the influence of the international climate-related and environmental NGOs such as GRI and TCFD, made UK-listed companies disclose most of the emission metrics using similar methods.

(2) There are still some differences in the measurement unit, reporting boundaries and the categories of breakdown of Scope 1 and 2 emissions, which make some of the emission metrics less comparable across companies.

Although the sample companies showed strong consistency in the disclosure of the overall emission metrics, this study finds that there are still some differences in the disclosure of breakdown information of Scope 1 and Scope 2 emissions, the measurement units of emissions intensity, the categories of Scope 3 emissions, the approaches adopted to define the GHG reporting boundary as well as whether to report the change of the reporting boundary when companies compared GHG emissions with previous years.

Companies disclosed the breakdown information of Scope 1 and Scope 2 emissions by different classifications. Some companies disclosed the breakdown of Scope 1 emissions by business region, while others disclosed by the categories of greenhouse gases or business activities; some companies disclosed the breakdown of Scope 2 emissions by the source of emissions (purchased electricity or energy losses from distribution and transmission), while others disclosed by the countries where the business was located. Most of the companies used "millions of tons" and "gCO_2/kWh" as the measurement unit of GHG emission amounts and emission intensity respectively, while the other companies used "tons" and "$kgCO_2$/kWh".

As for the reporting boundary of GHG emissions, some companies chose the equity share method, some companies adopted a financial control approach, while others chose to adopt the operational control approach. Although all three approaches are allowed in the UK, this difference in defining the GHG reporting scope greatly reduces the comparability of the reported GHG emissions. In addition, when companies compare their current GHG emissions with the emissions of the previous period, two of them disclosed the change of the reporting boundary while the other three did not, which caused some important information to be lost for the investors or stakeholders of the three companies. This makes it difficult for them to understand whether the emissions reduction is due to the change in reporting scope or other factors.

(3) Are the Scope 3 emissions comparable, accurate and verifiable?

Although all five companies disclosed Scope 3 emissions, there is considerable difference among the categories disclosed, which would cause low comparability of disclosed Scope 3 emissions.

Scope 3 emissions are those generated indirectly beyond a company's operations in its value chain. It includes upstream emissions associated with the suppliers and downstream emissions associated with customer use of products. Calculation of Scope 3 emissions requires companies to collect reliable data of GHG emissions from third parties, which could be a big challenge for all the companies. The GHG Protocol provided 15 categories for Scope 3 emissions, but companies need to choose which category they could get reliable data of GHG emissions based on their own situation. Table 3.2 shows the difference of categories disclosed by the five UK-listed companies. The various categories of Scope 3 emissions disclosed by companies reduce the comparability of Scope 3 emissions among companies. Moreover, most of the companies include Scope 3 emissions into the calculation of the total GHG emissions, the incomparability of Scope 3 emissions further leads to the total GHG emissions being incomparable.

Although all the UK companies sampled reported Scope 3 emissions, sometimes they could not get reliable data of material emissions from the third party, so they had to adopt some methods to estimate the

23 European Union: http://ec.europa.eu/clima/policies/ets/monitoring/documentation_en.htm

downstream of upstream emissions using the low-confidence "industry average" data or estimation of emission factor. However, they usually do not disclose how they estimate their upstream and downstream GHG emissions, which makes it unclear what really causes differences in estimations across companies. This low accuracy and comparability could also be evidenced by the GHG assurance reports provided by third-party professionals. According to Table 3.3, some companies' assurance level for Scope 1 and Scope 2 emissions are "reasonable", while all the companies' assurance level for Scope 3 emissions of companies are "limited", which also shows the low verifiability of Scope 3 emissions.

According to CDSB, GRI, IIRC, SASB and TCFD, accuracy, comparability and verifiability are important principles of climate-related or environmental disclosure. It seems that Scope 3 emissions are not in compliance with these disclosure principles at the current time. It is worth noting that many companies (three of the five companies in the UK-listed sample) defined their total GHG emissions as the sum of Scope 1, 2 and 3 emissions. Given the lower comparability and accuracy of Scope 3 emissions, integrating Scope 3 emissions into the calculation of total GHG emissions would also reduce the comparability and accuracy of total emissions.

(4) How to distribute climate-related information between the annual report and sustainability report, especially what climate-related information should be disclosed in the annual report?

As shown in Table 3.1, there are 32 parameters (51.6%) marked in a darker shade of green, which indicate that these metrics were disclosed in both the annual report and sustainability report. The result raises the question of how to distribute the emission metrics or even the whole climate-related information between the annual report and sustainability report (CSR or ESG report), especially what climate-related metrics and climate-related information should be disclosed in the annual report due to their financial materiality for investors and what should not be disclosed.

This study defines the annual report as the report disclosed in one document with the annual financial report. Sustainability, CSR and ESG reports are usually issued separately from annual reports. The objectives and functions of the annual report and sustainability report are different. The annual report takes the financial report as the core, and mainly reflects the financial situation and important factors that affect the financial situation. Sustainability reports, on the other hand, reflect the environmental and social impact of a company's activities, and how this may affect the company's sustainable development. The scopes of the users of the annual report and sustainability report are also different. The primary users of the annual report are mainly investors, lenders and creditors, while the users of the sustainability report are stakeholders whose scope is much broader than investors.

Whether information should be disclosed in the annual report or the sustainability report is determined by the "materiality" of the information to each report. Climate-related emission metrics are actually "material" for both the financial report and sustainability report. On one hand, companies' GHG emissions have impacts on climate, environment and society (impact materiality); on the other hand, climate-related emissions will in turn affect the company's future financial performance due to climate-related risks and opportunities, which have the potential to impact investors' financial return (financial materiality).

Although climate-related information is important to both the financial report and sustainability report, it is important to explore what climate-related metrics should be disclosed in the annual report, and what should not be. There are three reasons. First, according to the Conceptual Framework for Financial Reporting (2018), if financial information is to be useful, information included in financial reporting must be relevant, faithfully represented, comparable and verifiable for making an investment decision. Climate-related information includes many modules and elements disclosed in different levels of detail, not all the climate-related elements meet the conditions of having objective impacts on the company's future financial performance. For example, scenario analysis, which might reflect a company's capability for responding to climate-related risks, is based on some assumptions which may or may not happen. The result of scenario analysis is based on rough estimates rather than accurate calculations. What is more, there is not a single and widely adopted implementation model for scenario analysis and most of the companies just disclose the result of scenario analysis but do not disclose how they get the result from their self-developed models, which means the scenario analysis may fail to meet the quality requirements of financial reporting and

provide relevant information for investors. A qualitative expression seems better for scenario analysis than a quantitative estimation which cannot be proved to be reasonable. Second, climate-related information includes many elements which have different levels of detailed disclosure; not all the elements meet the principle of materiality for disclosure in financial reporting. For example, the breakdown information of Scope 1 and 2; only one company of the 10 UK-listed and China-listed sample companies disclosed them in its annual report, which shows that companies might think the detailed information of Scope 1 and 2 emissions are not material enough to be disclosed in annual reports, so this breakdown information is usually disclosed in the sustainability report only. Last, too much duplicate disclosure between the annual report and sustainability report will cause the failure of the functional distinction of the two reports on climate-related information, and also increase preparing and reading costs of these reports.

Climate-related emission metrics are commonly used to assess a company's exposure to climate-related risks and to provide material and objective information to understand the business model exposure to climate change. However, according to the element framework of emission metrics (Table 2.2), there are 14 content elements, which could have a different level of materiality for investors to make decisions, thus whether all the content elements should be disclosed in the annual report should be considered. The five UK-listed companies made their disclosure choices shown in Table 3.4.

However, there is no guideline or standard to design or suggest the distribution of climate-related disclosure between the annual report and sustainability report. Companies usually decide the distribution of climate-related information between the two reports by themselves. Some companies usually disclose the same or very similar climate-related information in their annual report and sustainability report. The duplicate disclosures exist in not only climate-related emission metrics but also climate-related governance, strategy, risks and opportunities and performance, which are nearly all the modules of climate-related disclosure for the UK-listed sample companies. For example, the duplicate disclosure rate of climate-related governance between the annual report and sustainability report for the five UK companies is 66.6%[24] (Appendix 2). Cross-reference is a possible way to avoid the duplication of disclosure.

3.22 CHINA-LISTED SAMPLE COMPANIES

(1) The voluntary disclosure policies of GHG emissions reported in the annual report and CSR (or ESG) report led to different GHG disclosure practices among companies listed in mainland China.

Although it is not mandatory to disclose GHG emissions in the annual report and CSR (or ESG) reports in mainland China, three of the five sample companies disclosed GHG emissions (Scope 1, Scope 2 and emission intensity) in their ESG reports. The companies which voluntarily disclosed GHG emissions in ESG reports all claimed that they referred to GRI's Sustainability Reporting Standards in which Scope 1 and 2 emissions are general metrics which need to be disclosed. Also, this study finds that these companies which voluntarily disclosed GHG emissions are also listed on the Hong Kong Stock Exchange which required listed companies to disclose Scope 1, Scope 2 emissions and emissions intensity in the ESG report. The other two companies did not disclose GHG emissions in the annual report or CSR (or ESG) report. The difference in GHG emissions disclosure by these companies is mainly due to voluntary GHG disclosure policies of the annual report and CSR (or ESG) report.

According to the "Guidelines for the Content and Format of Information Disclosure by Companies Offering Securities to the Public No. 2 – Content and Format of Annual Reports"(2017 and 2021) issued by the China Securities Regulatory Commission (CSRC), listed companies which are defined as the key pollutant enterprises by the Ministry of Ecology and Environment should disclose pollutant discharge information including the names of main pollutants, discharge methods, total approved discharge amount, excessive discharges, implemented pollutant discharge standards etc. GHG emissions are not included in pollutant discharges; companies are encouraged, but it is not mandatory, to disclose GHG emissions and the actions they have taken to reduce carbon emissions during the reporting period.

"Industrial Information Disclosure Guidelines for Listed Companies No. 4 Electricity" (2020) by the Shanghai Stock Exchange also regulates listed companies engaged in electricity industries to disclose the discharge amount of NOx, SO_2, dust and waste water in annual reports, but the GHG emissions are still not included in the disclosure requirements of the information disclosure guidelines for the electricity industry.

24 The number of darker green grids divided by the number of filled grids. (16/24)

From the above policies, it seems that the current focus of environmental information disclosure in the annual report is still on the discharge of polluting gases, water and solid waste, while GHG emissions are not included in the mandatory disclosure list although they are encouraged to be disclosed. There is no mandatory disclosure requirement for GHG emissions in CSR or ESG reports either.

Although it is not mandatory to disclose GHG emissions in the annual report and ESG report, some thermal power generation companies chose to disclose GHG emissions in their ESG report. There are possible reasons for their voluntary disclosure. First, the three companies which disclosed GHG emissions are also listed on the Hong Kong Stock Exchange. According to ESG Reporting Guide of Hong Kong Exchange (2020), listed companies are required to disclose their GHG emissions of Scopes 1 and 2 as well as emission intensity in their ESG report. It is convenient for these companies also to disclose GHG emissions in the ESG report issued at the Shanghai Stock Exchange. Second, all three companies which disclosed GHG emissions also claimed that they referred to GRI's Sustainability Reporting Standards when they prepared their ESG reports. According to GRI-305, Scope 1 and 2 emissions are general metrics required to be disclosed.

(2) Although it is voluntary to disclose GHG emissions in the annual report and ESG report, it is mandatory for key GHG emitting companies of the key GHG emitting industries to report GHG emissions to the Ministry of Ecology and Environment and then to the public through the designated website.

Although some thermal power companies did not disclose GHG emissions in their annual report or ESG report, it doesn't mean they need not calculate and report their GHG emissions.

In order to prepare for China Carbon Emission Trade Exchange (CCETE), the National Development and Reform Commission launched a Carbon Emissions Reporting, Verification and Monitoring Program in 2017. The program required the key emitting enterprises (whose GHG emissions are more than 26,000 tons of CO_2 equivalents each year) in the key emitting industries[25] to calculate GHG emissions and report to the National Development and Reform Commission after third party verification. Since 2018, this program has been taken over by the Ministry of Ecology and Environment, which continued the same requirements for the key GHG emitting enterprises to report GHG emissions to them. In addition, the Ministry of Ecology and Environment has required the key GHG emitting enterprises to submit their GHG emissions to the public pollutant permit information platform[26] together with the pollutant gases, water and waste since 2021.

Moreover, the Ministry of Ecology and Environment issued the "Administrative Measures for Enterprise Environmental Information Disclosure"[27] in 2021, which extended the scope of mandatory reporting of GHG emissions. Besides the key emitting enterprises in the key emitting industries, listed companies and bond-issuing companies which have been punished due to the violation of environment regulations also need to submit their GHG emissions to the system of environmental information. However, this regulation doesn't suggest whether GHG emissions should also be disclosed in the annual report or CSR report.

Because all five thermal power generation companies in the sample all belong to the key emitting enterprises of the key emitting industries, they had to report their GHG emissions to the Ministry of Ecology and Environment and the National Carbon Emission Trade Exchange although some of them did not report GHG emissions in their annual report or ESG report.

(3) GHG calculation methodology and assurance

Although only one company disclosed the method they adopted to calculate and report GHG emissions, there is a prescribed calculation and reporting methodology to report their GHG emissions. In 2015, the National Carbon Emission Management Standardization Technical Committee (NDRC) issued national carbon emission management standards for 11 key carbon emission industries. From 2013 to 2015, the NDRC successively issued "Guidelines for Accounting Methods and Reporting of Greenhouse Gas Emissions (Trial)" for 24 industries, which referred to the GHG Protocol (2004). The key GHG emitting enterprises in the key emitting industries must refer to the NDRC's guidelines when they report GHG emissions to the Ministry of Ecology and Environment.

25 The key emission industries include electricity, petrochemical, chemical, building materials, steel, non-ferrous metals, paper and aviation industries.
26 http://permit.mee.gov.cn
27 This regulation takes effect in April 2022.

In 2021, the Ministry of Ecology and Environment issued "Guidelines for Accounting Methods and Reporting of GHG Emissions: Power Generation Facilities", which replaced the guidelines issued by NDRC in 2013. The guidelines specify accounting and reporting of GHG, which includes reporting boundaries, calculation methods, activity data, emission factors and assurance.

Compared with the Greenhouse Gas Protocol (2004), the "Guidelines for Accounting Methods and Reporting of GHG Emissions: Power Generation Facilities" (2021 and 2022) has some differences as follows:

- Although the guideline mentioned CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3, it only defines CO_2 as the GHG in the guideline, and does not provide any information to calculate the CO_2 equivalents.
- Different from the equity share or control approach proposed in the GHG Protocol, the guideline defines the GHG reporting boundary based on "power generation facilities", it doesn't suggest rules for consolidating carbon emissions for a group.
- The calculation of Scope 1 and Scope 2 emissions is limited to emissions by production facilities, the emissions by auxiliary production systems and ancillary production systems are not included.
- There is no calculation suggestion for Scope 3 emissions in the guideline.
- The default value of carbon emission factors comes from the "China Energy Statistical Yearbook" and "Guidelines for Compilation of Provincial Greenhouse Gas Inventories", which are slightly different from the value provided by the Intergovernmental Panel on Climate Change (IPCC).

It is worth mentioning that the Ministry of Ecology and Environment requires local government to organise third-party professional verification on GHG emissions reported by the key committing enterprises, to supervise and inspect the GHG emissions results, and to publish the results on the official website of the local environmental authority. Moreover, the Ministry of Ecology and Environment issued "Guidelines for the Verification of Corporate GHG Emission Reporting (Trial)" in 2021, which regulates the principles, basis, procedures, key points, review and disclosure of the verification work in detail.

(4) Is it necessary for GHG emissions to be disclosed in the annual report?

According to Table 3.5, all three companies which disclosed GHG emissions reported their GHG emissions in the ESG report but not in annual reports. Only one company disclosed breakdown information of Scope 1 emissions in its annual report. This raises a question: is it necessary for GHG emissions to be disclosed in the annual report?

According to TCFD, SASB standards, IR framework and ISSB's ED of S2, companies' GHG emissions and response to climate change will not only affect climate and the environment, they also impact companies' future financial position as reflected in its income statement, cash flow statement and balance sheet. The users of annual reports need to understand how climate-related risks and opportunities are likely to impact on an organisation's future financial performance. GHG emissions are the core element for investors to understand a company's climate-related business model, risks and opportunities, strategy and emission reduction performance. If information on GHG emissions doesn't appear in the annual report at all, it would be difficult for investors to evaluate companies' climate-related risks and opportunities and make relevant investment decisions, which would also reduce the market efficiency of green investment and financing. Although investors could find these climate-related emission metrics in the ESG report (if they publish an ESG report) or on companies' websites, it would be more convenient and direct to access GHG emission metrics in the annual report.

Different from the voluntary disclosure requirement for GHG emissions in the annual report, some other environmental pollution discharge metrics such as air pollutant emissions, water and waste discharges have been required to be disclosed in annual reports for a long time. According to "Guidelines for the Content and Format of Information Disclosure by Companies Offering Securities to the Public No. 2 Content and Format of Annual Reports" (2017, 2021) issued by the China Securities Regulatory Commission (CSRC) and the"Industry Information Disclosure Guidelines for Listed Companies No. 4 Electric Power" (2020) by Shanghai Stock Exchange, listed companies engaged in power generation should disclose their discharge of NOx, SO_2, dust, waste water and solid waste in annual reports.

This study also analyses the disclosure of environmental pollutant emission metrics for the five thermal power generation companies. Table 3.36 shows that all the five companies disclosed all the information of the non-GHG pollutant emissions, water use and discharge, coal ash and other waste management in both their annual report and CSR (or ESG) report.

In Table 3.36, all five companies disclosed the emissions of NOx, SOx, dust and other significant air pollutant emission, water use and discharge, coal ash and other waste in both the annual report and CSR or ESG report.

It is worth mentioning that although the environmental pollutant emission metrics are disclosed by the five companies in both the annual report and ESG report, they are well designed and organised to avoid duplicated information between the two reports. For example, companies usually disclosed in their annual report that "their discharge of air pollutant, waste water and solid waste all meet the standards of the discharge permit" or provide a link to the prescribed public information platform in which the discharge information is presented in detail and disclose the detailed discharge amounts in their ESG report. Only one company disclosed the same information of "Water use and discharge" and "Coal ash and other solid waste" in its annual report and sustainability report.

To sum up, GHG emission metrics are material for investors to understand and estimate how much climate-related risks the company is facing, which are becoming one of the major effects that investors consider when they make investment decisions . Disclosing GHG information in annual reports is consistent with the principles of relevance, objectivity and materiality of financial reporting. Moreover, given the current mandatory disclosure requirement for pollutant discharges in the annual report, it seems there is no reason for GHG emissions not to be included in the mandatory disclosure list when the conditions of GHG calculation and reporting become mature.

Table 3.36 Disclosure of non-GHG pollutant emissions, water and waste

ELEMENTS	CATEGORY	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
ENVIRONMENTAL POLLUTANT EMISSION METRICS	NOx, SOx, dust and other significant air pollutant emission	AR CSR	AR CSR	AR ESG	AR CSR ESG	AR ESG
	Water use and discharge	AR CSR	AR CSR	AR ESG	AR ESG	AR ESG
	Coal ash and other solid waste	AR CSR	AR CSR	AR ESG	AR ESG	AR ESG

Note: If the same information was disclosed in companies' annual report and sustainability report, it is coloured with a darker shade of green.

4 CONCLUSIONS AND SUGGESTIONS

4.1 CONCLUSIONS

UK

Mandatory GHG emission disclosure policies and relatively clear detailed regulations of the EU and the UK have prompted great consistency in the disclosure of climate-related emission metrics. All the sample companies in this study disclosed most of the climate-related emission metrics and adopted the GHG Protocol as their GHG calculation methodology. All the sample companies got their GHG emissions verified by professional third parties.

However, differences still exist in the disclosure of some climate-related emission metrics, making the metrics less comparable across companies. The differences mainly relate to the breakdown of Scope 1 and Scope 2 emissions; the measurement units of emissions and intensity; categories of Scope 3 emissions; and the control approaches adopted to define reporting boundaries, as well as whether changes of the reporting boundary are reported when comparing with GHG emissions in previous years.

The categories of Scope 3 emissions disclosed by the sample companies showed considerable differences, which make the Scope 3 emissions less comparable across companies, and also reduce the comparability of the total GHG emissions if Scope 3 emissions are included. As for the reporting boundary of emissions, some companies chose the equity share method, some companies chose the financial control approach while others chose the operational control approach. These differences in defining the reporting boundary also reduce the comparability of the reported total GHG emissions.

When companies compared their current GHG emissions, some companies did not disclose changes to the reporting boundary. This meant investors or stakeholders lost important information about whether emission reduction is a result of the change of reporting scope, or of other factors.

Most UK sample companies disclosed most emission metrics, or even all the climate-related information, in both their annual report and sustainability report. A possible policy reason is that the UK requires listed companies to disclose some climate-related information in the Directors' report or Strategic report, both of which are included in the annual report. Some companies disclosed climate-related information in a non-financial report, included in an integrated annual report. Therefore, climate change related information disclosed in the annual report overlaps to some extent with climate-related information disclosed in the sustainability report. This highlights a question of what kind of climate-related information should ideally be disclosed in the annual report, and how to distribute climate information between the annual report and sustainability report.

Although climate-related emission metrics are material to both financial reporting and the sustainability report, it is important to consider what metrics should or should not be disclosed in the annual report. According to the conceptual framework of financial reporting, information included in financial reporting must be relevant, objective and material for making investment decisions. Not all the elements of climate-related information meet the conditions of materiality and relevance for investors for disclosure in financial reporting. Including too much climate-related information in the annual report would cause the failure of functional distinction between the annual report and sustainability report on climate-related information and lead to an increase in preparation and reading costs for the two reports.

CHINA

The voluntary disclosure policies for GHG emissions in the annual report and ESG report have led to different GHG disclosure practices between the sample companies. Although it is not mandatory to disclose GHG emissions, three of the companies disclosed Scope 1, Scope 2 and emission intensity in the ESG report while the other two did not. The companies which voluntarily disclosed their GHG emissions all claimed that they followed the GRI standards and these companies are also listed on the Hong Kong Stock Exchange, which requires listed companies to disclose their GHG emissions in the ESG report.

Although some thermal power companies did not disclose GHG emissions in either their annual reports or ESG reports, it doesn't mean they do not need to calculate and report GHG emissions. In order to prepare for China Carbon Emission Trade Exchange (CCETE), there is a mandatory disclosure policy for the key GHG emitting industries to report GHG emissions to the Ministry of Ecology and Environment first, and then to the public. To ensure the accuracy of the GHG emission information submitted, the Ministry of Ecology and Environment has issued guidelines to specify GHG reporting boundaries, calculation methods, activity data, emission factors and assurance requirements.

Although the current GHG calculation methodology prescribed by the Ministry of Ecology and Environment is slightly different from internationally accepted standards, the mandatory GHG emissions disclosure system for the key emitting industries is maturing.

Considering the crucial role of GHG emissions disclosures in green investment and financing, it is time to consider whether a mandatory disclosure policy of GHG emissions should be adopted, perhaps for qualified companies or industries first.

Different from the UK-listed sample companies, which disclose most of the emission metrics in their annual reports, the China-listed companies which voluntarily disclosed emission metrics all chose to disclose in their ESG report. This raises a question: is it necessary for GHG emissions to be disclosed in the annual report? According to TCFD, SASB standards, IR framework and IFRSS2, investors need to evaluate climate-related risks and opportunities and make climate-related investment decisions. GHG emissions have become a commonly used metric to assess a company's exposure to such risks. Disclosing some GHG emission metrics in annual reports is consistent with the principles of relevance, objectivity and materiality of financial reporting. Moreover, given the current mandatory requirement for disclosure of pollutant discharges in the annual report, it seems no reason for GHG emissions not to be included in the mandatory disclosure list when the conditions of GHG calculation and reporting become mature.

Overall, the targets of peaking carbon dioxide emissions by 2030 and achieving carbon neutrality by 2060 make the disclosure of GHG emissions important and necessary. When the conditions of calculation, reporting and assurance of GHG emissions become mature, a mandatory disclosure policy of GHG emissions in the annual report or ESG report should help to improve the market efficiency of green financing and investment.

4.2 SUGGESTIONS

FOR UK

(1) Whether to put Scope 3 emissions into the mandatory disclosure list for all industries and whether Scope 3 emissions should be included in the total GHG emissions calculation need more consideration.

Scope 3 emissions is an integrated emission metric which is composed of the GHG emission of 15 categories. However, the results from UK-listed companies show that the categories of Scope 3 emissions disclosed by the companies are various and inconsistent, which leads to the current data of Scope 3 emissions provided by companies being incomparable. Moreover, the incomparability of Scope 3 emissions further reduces the comparability of companies' total GHG emissions because some companies include Scope 3 emissions into the calculation of the total GHG emissions.

Besides, the reason why companies provide GHG emissions data of various categories is that it is quite difficult for companies to get reliable GHG emissions data for all the 15 categories, they can just choose to disclose some categories for which they could get accurate and verifiable data. The difficulties of getting access to the GHG emission data for their upstream and downstream companies also affects companies' ability to get complete and accurate GHG emissions of Scope 3 emissions.

(2) A consistent method, approach or measurement unit for climate-related emission metrics should be defined to ensure comparability across companies.

Considering the low comparability and accuracy of the current Scope 3 emissions provided by companies, it would be better for the UK to keep the current voluntary disclosure policy of Scope 3 emissions until the conditions are mature for companies to provide comparable and accurate information of Scope 3 emissions. For some special industries, such as the financial services industry, whether the investment funds flow into low-carbon emission companies plays an important role in reducing GHG emissions for the whole society. Compared with companies in other industries, financial companies have less difficulty in obtaining GHG emission data of their downstream companies due to investors' natural convenience attributes of obtaining information from investees. The mandatory disclosure requirement of downstream GHG emission or a "comply or explain" policy could be applied for the financial services industry, but not for other industries.

Defining the organisational boundary is a key step in corporate GHG accounting. There are three approaches allowed in the UK: the equity approach, financial control approach and operational control approach. Among the five sample companies, one company adopted the equity share approach, two adopted the financial control approach while the others chose to adopt the operational control approach. The different approaches of defining the GHG reporting boundary adopted by companies could lower the comparability of GHG emissions across companies. In addition, the measurement unit of the GHG emissions amount and emission

intensity adopted by companies, as well as the classifications of the breakdown of Scope 1 and Scope 2 emissions are still disclosed differently by companies, which lower the comparability of the information of emission metrics.

Future policies should narrow the options available to companies in terms of the approach of defining reporting boundary, the measurement unit of GHG emission intensity and the categories of emission breakdown to reduce the unnecessary incomparability of GHG emissions across companies.

(3) The change of the reporting scope should be required to disclose when companies compare their current emissions with emissions of previous years.

All the companies disclosed comparable emissions of previous years, but only a few disclosed the change of reporting scope when they compared them with previous years. Although the trend of GHG emissions could be easily captured by comparing current emissions with previous years, readers need to know how this trend happened. It is important for investors and other stakeholders to understand that the reduction or increase in emissions is due to the change of scope or other factors.

(4) Further research is necessary to explore what kind of climate-related information should be disclosed in the annual report and how to distribute the climate-related metrics between the annual report and sustainability report.

Due to the UK's mandatory policies of climate-related emissions in the directors' report or non financial report included in the strategic report (for some companies), it seems that most of the UK-listed sample companies disclosed most of the emission metrics or even climate-related information in both the annual report and sustainability report. According to guidelines developed by the main climate-related NGOs, there are a lot of content elements in the climate-related disclosure framework. These content elements reflect climate-related issues from different aspects and in different levels of detail. Although climate-related information is becoming more and more important for investors to make decisions, not all the content elements of climate-related information meet the thresholds of relevance, materiality and objectivity for disclosure in the annual report. Too much disclosure of climate-related information is irrelevant to investors' judgement in annual reports, is not in line with the original design intention of financial reporting, and causes too much overlapping disclosure between the annual report and sustainability report.

Future policies should be developed to provide guidance for companies on what kind of climate-related metrics should be disclosed in the annual report and what other metrics should not be. The UK requires listed companies to report their climate-related information in line with TCFD in 2022. Much of the information of TCFD has been required in the strategic report or directors' report. After ISSB issued the IFRS S1 and S2 in 2023, the UK announced that it will consider the endorsement of the IFRS sustainability disclosure standards to create UK Sustainability Disclosure Standards (SDS) by July 2024. UK endorsed standards will only divert from the global baseline if absolutely necessary for UK specific matters. How to organise the IFRS S2 disclosure within the existing reporting structure of climate-related information in the annual report also needs to be considered.

FOR CHINA

(1) The differences between the current GHG emissions calculation and reporting method and the internationally accepted methodology should be reduced.

There are still differences between the current GHG calculation guidelines and the widely accepted international GHG reporting methodology. Except for the Scope 3 emissions which might not be eligible for companies to disclose at this stage, the other differences in GHG reporting boundary, the measurement of Scope 1 and 2 emissions and the emission factors should be reduced to keep consistency with the widely adopted international methodology, which could decrease the GHG calculation and reporting cost for companies listed on international markets and improve the efficiency of green financing and investment on international capital markets.

(2) Mandatory disclosure policies of GHG emissions in the annual report or ESG report could be trialled to implement in key GHG emitting industries first, and then expanded to all industries.

According to TCFD, SASB standards, IR framework and ISSB's ED of S2, companies' GHG emissions not only affect climate and the environment, they also impact companies' future financial positions against

the background of the transition to a net zero society. Disclosure of GHG emissions is a core element for investors to understand a company's climate-related business model, risks and opportunities, strategy and emission reduction performance, and thus plays an important role in green finance and investment, which is an accelerator for implementing net zero.

After the long preparation for the China Carbon Emission Trade Exchange (CCETE), the calculation, reporting and verification of GHG emissions for the key GHG emitting industries are becoming mature, mandatory disclosure requirements of GHG emissions in the annual report or ESG report could be trialled in the key GHG emitting industries first, and then spread to all industries.

(3) The current focus of environmental information disclosure in the annual report or ESG report should be extended from pollutant discharge to GHG emissions.

Mandatory disclosure requirements for the non-GHG pollutant discharges such as pollutant gases, water and waste discharge recorded in the annual report and ESG report have existed for a long time. Considering the targets of peaking carbon dioxide emissions by 2030 and achieving carbon neutrality by 2060, disclosure of GHG emissions in the annual report or ESG report could play an important role in green finance and investment, which could greatly accelerate the process of achieving the targets.

The current focus of environmental information disclosure in the annual report or ESG report should be extended from pollutant discharge to GHG emissions. A shortcut would be to embed the GHG emissions into the current mandatory disclosure requirements of pollutant discharge in the annual report or ESG report.

(4) The distribution of climate-related emission metrics or the whole climate-related information between the annual report and ESG report is also necessary to consider.

Climate-related emission metrics contain measures covering a range of different respects. What metrics should be disclosed in the annual financial report and how specific they should be is still a question to consider when government designs the disclosure system of climate-related emission metrics, or even for the whole climate-related information.

FOR ISSB

(1) The difficulties of reporting comparable and reliable Scope 3 emissions in both developed and developing countries should be fully considered.

Different from TCFD and GHG Protocol, IFRS S2 climate-related standards stipulate that Scope 3 emissions should be disclosed along with Scope 1 and Scope 2. This study shows that the Scope 3 emissions disclosed currently are neither comparable nor accurate for the sample companies listed in the UK, a country with a highly developed economy and leading policies and practice of climate-related disclosure. Some companies explained in their reports that they have difficulties in obtaining GHG emission data for all the subcategories of Scope 3 emissions, that is why they could only report GHG emissions for the subcategories which they can access or estimate reliable carbon emission data. The difficulties of providing comparable and accurate Scope 3 emissions for companies listed in developing countries must be greater because most of them haven't established GHG measurement and reporting systems even for Scope 1 and Scope 2 emissions. All these current difficulties and the cost and benefit trade off to report Scope 3 emissions should be fully considered when the ISSB makes decisions on whether to put Scope 3 emissions into the mandatory disclosure list at this stage. A qualitative expression on the business model seems more meaningful for investors to understand companies' positions in the value chain than the quantitative but confused and incomparable numbers currently.

(2) Determine the sole and suitable approach of the reporting boundaries of GHG emissions to avoid significant differences in GHG reporting scopes among companies.

Although most companies in developed economies claimed that they adopted the GHG Protocol to define their GHG reporting boundaries, there are three different approaches provided by the GHG Protocol and it did not make recommendations for which approach the public GHG emissions reporting should be based on; the equity share approach, financial control approach or operational control approach. Companies could choose one or two approaches based on their own situation. There are significant differences in the GHG reporting scopes between the equity share approach and financial control approach, and differences also exist between

the financial control approach and operational control approach. These three different approaches adopted by companies could lead to significant differences in GHG reporting scopes, which will make their GHG emissions incomparable.

Moreover, for most of the developing economies, a complete GHG emission measurement and reporting system hasn't been established. The approach of how to define the reporting scopes of GHG emissions is still based on companies' own choice, or local policies, which are not clear and might be quite different to the three approaches provided by the GHG Protocol.

Determining a single and suitable approach to define GHG reporting boundaries is important and necessary for the ISSB to avoid different scopes of GHG emissions being adopted among companies and across countries.

(3) What climate-related information should be disclosed in the annual report and how to distribute climate-related information between annual report and sustainability report should also be explored.

Nearly all the current climate-related disclosure guidelines only suggest what climate-related content elements should be disclosed, few have suggested where the climate-related information should be disclosed and how to distribute the information between the annual report and sustainability (CSR or ESG) report, which means different companies choose different reports to disclose the climate-related information. It seems that most of the UK-listed sample companies disclose most of the climate-related emission metrics or other climate-related information in their annual report; however, most of the China-listed sample companies disclose the climate-related emission metrics and other climate-related information only in their ESG report. The different positions of climate-related disclosure result in different information effects of climate-related metrics.

Future research should explore what climate-related information should be included in the annual report to ensure it remains financially relevant for investors. Additionally, research should address how to effectively distribute climate-related content between the annual report and sustainability (CSR or ESG) reports to minimise duplication

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APPENDIX 1

Sample companies

UK SAMPLE		CHINA SAMPLE	
LSE-Code	**Name**	**SH-Code**	**Name**
0HBA.L	ELECTRICITE DE FRANCE ORD SHS	600886	SDIC POWER
0HIT.L	IBERDROLA ORD SHS	600027	HDPI
0NRE.L	ENEL	600795	GDPD
SSE.L	SSE	601991	DATANG POWER
0HA0.L	RWE A ORD SHS	600011	HPI

APPENDIX 2

Disclosure of climate-related governance for UK-listed sample companies

ELEMENT	CATEGORY	DETAILED CODES	SAMPLE 1	SAMPLE 2	SAMPLE 3	SAMPLE 4	SAMPLE 5
GOVERNANCE	STRUCTURE	Body or person responsible for climate-related affairs	AR[28]	AR SR	AR SR	NFR[29] SR	AR SR
	ABILITY	Management responsibility	AR	AR SR	AR SR	AR SR	AR SR
		Incorporate into risk management	AR	AR SR	AR SR	NFR	AR SR
		Incorporate into internal control		AR SR	AR SR		AR
		Incorporate into remuneration policies	AR	AR SR	SR	NFR SR	AR SR
		Employee incentives and culture	AR	SR			

28 The company did not issue a sustainability report, instead, they issued an ESG excel dataset to disclose the main ESG data.
29 The company issued a separate non-financial report and sustainability report.

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* includes parent companies. Source: ICAEW member data February 2024, Interbrand, Best Global Brands 2023

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