Online Appendix for "Global Evolution of Environmental and Social Disclosure in Annual Reports"

Contents

Appendix OA.A. Technical Appendix

In this technical appendix, we describe how we process PDF annual report files and train the *Word2Vec* model.

1. Parsing PDF Files into Texts

The first step in data analysis is to extract text from the PDF files. This process is challenging because PDF files were created to display printable documents, not to store text in a structured way (as in the case of HTML or Standard Generalized Markup Language (SGML) formats). Our task presented a number of specific challenges because PDF files only record characters and their placement on the page. There is little information about what constitutes paragraphs, sentences, or even words. The unit of text in a PDF file is called a glyph, which is a graphical shape subject to all graphical manipulations (Adobe 2007). As a result, extracting text from PDF files always involves using layout analysis algorithms to reconstruct the structures (words, lines, and paragraphs) of the characters. Currently, there are several proprietary or free packages available on the market, such as Adobe Acrobat Pro DC, iTextSharp, and pdfminer, that are capable of such text extraction. We briefly describe the layout analysis algorithm used by the open-source Python package *pdfminer.six*. Readers can refer to its documentation[1] and source code[2] for more details.

The layout analysis algorithm proceeds by grouping objects in a hierarchy: it first groups characters into words and lines; then lines are grouped into text boxes. Text boxes are also grouped with other objects such as figures, lines, and images on the same page under the page root.

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[1] https://pdfminersix.readthedocs.io/
[2] https://github.com/pdfminer/pdfminer.six

Figure OAA1. Illustration of a PDF File
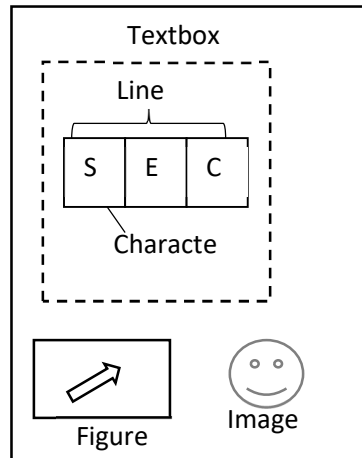
To group characters into lines, the algorithm relies on the coordinates of each character to identify the position of the characters relative to each other to determine which characters belong to the same line. Essentially, characters that are close to each other both horizontally and vertically are considered to be on the same line. Lines are also grouped into boxes based on their relative positions. For horizontal text, horizontally overlapping and vertically close lines are considered to be in the same textbox.

The above is a simplified description of how to extract text from a PDF file. In reality, software packages often rely on their own complex rules to determine the elements in a PDF file. The other problem we faced when parsing PDF files is that a significant number of annual reports are scanned PDFs. Unlike regular PDFs, which contain text that can be directly selected, copied, and extracted, scanned PDFs contain only scanned images of the original documents. These are typically older filings that were later scanned for digitization. Dropping these files might cause us to miss important information contained in the scanned PDFs. Hence, our strategy is to recover text from these scanned PDFs using optical character recognition (OCR). After much

experimentation, we decided to use a tool called Solid Commander to convert PDF files into Microsoft Word documents for further processing. We chose Solid Commander for two reasons: First, the technology behind the software is reliable and widely used in practice. For example, both Adobe Acrobat and Foxit use this technology to convert PDF files into Word documents. Second, the conversion process not only recognizes text in scanned PDFs but also reconstructs document elements such as tables and figures with very high quality, allowing us to perform further analysis and processing with tables and figures.

2. Technical Details on Training the *Word2Vec* Model

Li et al. (2021) have shown the advantages of the word embedding model in developing dictionaries in the financial context, especially when the constructs are multidimensional and may be discussed in a subtle way. We follow their study to construct a dictionary of terms related to corporate E&S disclosure in annual reports.

1) *Sentence Segmentation*

Our first step is to segment texts into sentences so that they can be used as input in the phrase generation step. There are several approaches to sentence segmentation. The simplest is to use a list of end marks (i.e., period, question mark, or exclamation mark) to determine the boundaries between sentences. Alternatively, one can use dependency parsing to determine syntactic dependencies between words and use the parsing results to identify sentence boundaries. Figure OAA2 below shows the dependencies from the sentence "Service-on-demand escalators were installed to reduce unnecessary usage of electricity." We choose the latter approach for its accuracy.[3]

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[3] We use a fast natural language processing package called spaCy (https://spacy.io) to segment texts into sentences.

Figure OAA2. Illustration of Sentence Segmentation
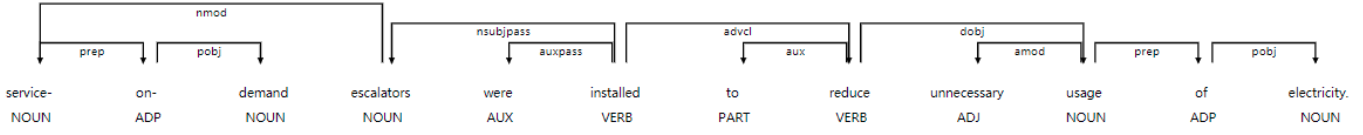
2) Named Entity Recognition (NER) and Replacement

Following Li et al. (2021), we use *Named Entity Recognition* to identify entities in the sentences and replace them with corresponding tags such as CARDINAL, DATE, EVENT, MONEY, ORDINAL, ORG, PERCENT, PERSON, PRODUCT, QUANTITY, TIME, and so on. For example, Apple is replaced with *[NER: ORG]* and $1000 is replaced with *[NER: MONEY]*. This allows us to remove words that are less relevant to our task while maintaining their relative positions in the sentences.

3) Dependency Parsing

Dependency parsing is the process of analyzing the grammatical structure of a sentence and the relationships between its words. In this step, we use dependency parsing to identify a group of words, called compounds, that together convey a single meaning or idea and should therefore be treated as one word. Some relevant examples in our case include "carbon dioxide," "greenhouse emissions," and "energy efficiency." We rely on the dependency parser module in spaCy to generate the dependencies among words and identify compounds. These compounds, along with the phrases we generate in the next step, are treated as words in our embedding modeling.

4) Phrase Generation

We also generate phrases such as "environmental health" and "occupational safety" and treat them as words in our model. Following existing practice (Mikolov et al. 2013a), we identify phrases in the sentences by calculating the following score for two adjacent words w_i and w_j:

$$Score(w_i, w_j) = \frac{count(w_i w_j) - \delta}{count(w_i) \times count(w_j)} |V|$$

where $count(w_i w_j)$ is the count of the consecutive words w_i and w_j, and $count(w_i)$ and $count(w_j)$ are counts of the two words, respectively. δ is a discount coefficient to prevent the inclusion of phrases generated from infrequent word combinations. In our case, δ is set to 5. $|V|$ is the size of the vocabulary. If the score for the word pair (w_i, w_j) is greater than 1, we consider the pair to be a phrase and concatenate the words using the underscore symbol "_". We use the Gensim package, which provides a function called *Phrases* for phrase identification.

5) Modeling

There are different ways to train the word embedding model. Two are popular in the literature: the skip-gram model and the continuous bag-of-words (CBOW) model. We use the CBOW algorithm described by Mikolov et al. (2013b) to train the word-embedding model for its efficiency given the relatively large corpus we have. The algorithm uses the neighboring words (called context words) to predict the target word. Users often specify a window size for what should be considered context words; for instance, words that are no more than five words (as in our case) away from the word of interest are considered context words.

The implementation of CBOW is a shallow neural network with a hidden layer that uses the context words to predict the target word. Specifically, the model uses the average of the context words to predict the probability of the target word. During the training process, each context word passes through an embedding layer, which maps the word into its word embedding vector. The average embedding vector is then fed into a one-layer neural network to predict the

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target word. The embedding layer is a matrix of learnable parameters of size $|V| \times |D|$, where $|V|$ is the size of the vocabulary, and $|D|$ is the dimension of the vector (e.g., 300). Essentially, it is a lookup table for the embedding of a word in the vocabulary. The training process uses the data to update these parameters (i.e., the embeddings of the words) for several iterations (20 in our case) so that the embedding vectors can capture meaningful information about the words. Training the CBOW model can be done using general machine learning frameworks such as TensorFlow[4] or PyTorch, or dedicated packages such as Gensim. We use the Gensim package for its efficiency and convenience.

After training the word embedding model, we expand the seed words into a complete E&S dictionary. First, for each subtopic, we identify the top 500 words and phrases that are most similar to the subtopic. We estimate the similarity of a word (or phrase) to the subtopic by the highest cosine similarity score between the word (or phrase) and every seed word within the subtopic. For a word that appears in both subtopics, we assign it to the subtopic with which it has the highest similarity. Second, we remove words and phrases that are among the top 1500 most frequently used words and phrases in annual reports, as they are too general to be categorized into any subtopic (Dolamic and Savoy, 2010). Finally, we manually inspect the word list and remove words or phrases that are too general or misclassified (Li, et al. 2021). The list of removed words is provided in Panel C of Table OA.1.

3. Technical Details on Identifying Tables and Figures in PDF Files

As discussed earlier, we parse PDF files into Word documents for further analysis. A Word document (with the .docx file extension) is a collection of elements (such as text, tables, and

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[4] The official TensorFlow tutorial for training the model can be found at:
https://www.tensorflow.org/tutorials/text/word2vec

images), along with formatting instructions and other metadata (such as author information) for representing word processing documents. The central part of a Word document is an Extensible Markup Language (XML) file, which is a textual document that follows the Office Open XML schemas developed and published by Microsoft and adopted as an international standard.[5] Tables and Figures all have their dedicated markups in the document. For example, tables are defined with a <w:tbl> element,[6] whereas a figure (picture) is defined with a <pic> element.[7]

We rely on these markups to identify tables and figures in the documents. Specifically, we create a Python script to unpack the Word document and parse the XML file, where the main text elements contain the tables and figures we are looking for. We use the "Beautiful Soup" and "py-docx" Python packages for this task. For figures, we first identify all elements marked with "<pic>", then navigate through the document using the "Beautiful Soup" package to extract the 300 words before and after the figure element. For tables, we first identify them using the python-docx package, which looks for the "<w:tbl>" elements, and then extract the text within those tables. We then retain figures that appear within 300 words before or after an E&S disclosure sentence. For tables, we classify a table as E&S-related if it contains words or phrases from our E&S dictionary.

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[5] http://officeopenxml.com/
[6] http://officeopenxml.com/WPtable.php
[7] http://officeopenxml.com/drwPic.php

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Appendix OA.B. Summary of ESG Disclosure Voluntary Framework and Mandatory Regulation

Panel A of this appendix presents a summary of selected voluntary disclosure frameworks. Panel B of this appendix presents a summary of mandatory ESG disclosure regulation for the countries included in our sample.

Panel A. Voluntary ESG disclosure frameworks

Framework	Year of Founding	Disclosure Location	Material Standards	Types of Environment-Related Information	Types of Social-Related Information
CDP The Carbon Disclosure Project questionnaires	2000	Released on CDP website	Each of the annual questionnaires (climate change, forests, and water security) has an individual scoring methodology which CDP publishes annually with the score reports. Companies receive scores from A to D in each area for which disclosure has been requested. Companies that do not submit a response after receiving a request to disclose receive an F. Every year, CDP also publishes A-List reports showcasing the companies and cities leading in environmental performance.	Climate change: How effectively are organizations managing climate risks, carbon emissions, and low-carbon opportunities? Forests: How are organizations verifying and monitoring commitments for using forest commodities? Are forest issues an integral part of business strategy? What is the exposure and risk associated with deforestation in production and/or procurement? Water security: How are water-related issues and risks managed, including governance, use, and stewardship of water resources?	N/A
CDSB CDSB Framework for reporting environmental and social information 2022	2007	Annual reporting packages in which organizations are required to deliver their audited financial results under the corporate, compliance, or securities laws of the country in which they operate.	Environmental and social information is material if: 1)The environmental and social impacts or results it describes are, due to their nature and magnitude, expected to have a significant positive or negative impact on the organization's financial condition and operational results and its ability to execute its strategy over the short, medium, and long term; 2) Omitting, misstating, or obscuring information could reasonably be expected to influence the decisions that users of mainstream reports might make.	– GHG emissions, including from land; – Renewable/non-renewable energy generation, use and consumption; – Non-GHG emissions to air, land and water; – Deforestation and ecosystem conversion; – Renewable and non-renewable material resource use; – Water use, including consumption and changes in quality; and – Waste and spillages.	– The organization's workforce; – The workforce of entities in the organization's upstream and downstream value chain who have a role in the development or distribution of the company's products or services; – Community members that can be affected by the organization's own operational sites or infrastructure or that of entities in the organization's value chain; and – Consumers, end users, or others impacted by the use of the organization's products or services.

Panel A. Voluntary ESG disclosure frameworks (Cont'd)

Framework	Year of Founding	Disclosure Location	Material Standards	Types of Environment-Related Information	Types of Social-Related Information
GRI GRI Standards 2021	1997	Stand-alone sustainability reports or annual reports or other published materials that include sustainability information	Material topics are topics that represent an organization's most significant impacts on the economy, environment, and people, including impacts on their human rights.	Materials, energy, water, biodiversity, emissions, effluents, waste, environmental compliance, and supplier environmental assessment	Market presence, procurement practices, employment, Labor/management relations, occupational health and safety, training and education, diversity and equal opportunity, non-discrimination, freedom of association and collective bargaining, child labor, forced or compulsory labor, security practices, rights of indigenous peoples, local communities, supplier social assessment, public policy, customer health and safety marketing and labeling, customer privacy
IIRC International Integrated Reporting Framework 2021	2010	Standalone sustainability or integrated report	Matters that substantively affect the organization's ability to create value over the short, medium, and long term.	Environmental challenges, such as climate change, the loss of ecosystems, and resource shortages as planetary limits are approached	Societal issues, such as population and demographic changes, human rights, health, poverty, collective values and educational systems
SASB Conceptual Framework 2020 Materiality Map 2021	2011	SEC filings	Information is financially material if omitting, misstating, or obscuring it could reasonably be expected to influence investment or lending decisions that users make on the basis of their assessments of short-, medium-, and long-term financial performance and enterprise value.	– Environment: GHG emissions, air quality, energy management, water and wastewater management, waste and hazardous materials management, ecological impacts – Business Model & Innovation: Materials sourcing and efficiency, physical impacts of climate change	– Social Capital: Human rights and community relations, customer privacy, data security, access and affordability, product quality and safety, customer welfare, selling practices and product labeling – Human Capital: Labor practices, employee health and safety, employee engagement, diversity and inclusion – Business Model & Innovation: Supply chain management

Panel A. Voluntary ESG disclosure frameworks (Cont'd)

Framework	Year of Founding	Disclosure Location	Material Standards	Types of Environment-Related Information	Types of Social-Related Information
TCFD TFCD Guidance on metrics, targets, and transition plans 2021 Recommendations of TCFD 2017	2015	Standalone sustainability reports or annual reports or other published materials that include climate-related information	Organizations should determine materiality for climate-related metrics consistent with how they determine the materiality of other information included in their financial filings.	– GHG emissions: Absolute Scope 1, Scope 2, and Scope 3; emissions intensity – Transition risks: Amount and extent of assets or business activities vulnerable to transition risks – Physical risks: Amount and extent of assets or business activities vulnerable to physical risks – Climate-related opportunities: Proportion of revenue, assets, or other business activities aligned with climate-related opportunities – Capital deployment: Amount of capital expenditure, financing, or investment deployed toward climate-related risks and opportunities – Internal carbon prices: Price on each ton of GHG emissions used internally by an organization – Remuneration: Proportion of executive management remuneration linked to climate considerations	

Panel B. Mandatory ESG disclosure regulations

Country	Regulation	Issuance date	Effective fiscal year ending date	First Environmental Disclosure Reg? *	First Social Disclosure Reg? *	Biggest Environmental Disclosure Reg? *	Biggest Social Disclosure Reg? *	Integrated in Annual report?
Australia	ASIC RG 247	08/12/2019	08/12/2019	Yes	No	Yes	No	Yes
Austria	Accounting Amendment Act 2004	12/30/2004	01/01/2005	Yes	Yes	No	No	Yes
	Sustainability and Diversity Improvement Act	12/06/2016	12/31/2016	No	No	Yes	Yes	Yes
Belgium	Act of 13 January 2006 Amending the Code of Companies	01/13/2006	2006	Yes	Yes	No	No	Yes
	Law on Disclosure of Non-financial and Diversity Information by Certain Large Companies and Groups	09/03/2017	01/01/2017	No	No	Yes	Yes	Yes

Panel B. Mandatory E&S disclosure regulations (Cont'd)

Country	Regulation	Issuance date	Effective fyear date	First E? *	First S*	Biggest E? *	Biggest S? *	Integrated report?
China	Notice on Listed Companies' Preparation for 2008 Annual Reports	12/30/2008	12/31/2008	Yes	Yes	No	No	Yes
	Guidelines No. 2 on Contents and Formats of Information Disclosure by Listed Companies (Revised in 2017)	12/26/2017	12/26/2017	No	No	Yes	Yes	Yes
Denmark	ACT No. 99 of 18/02/2004	02/18/2004	01/01/2005	Yes	Yes	No	No	Yes
	ACT No. 1403 of 27/12/2008	12/27/2008	01/01/2009	No	No	Yes	Yes	Yes
	ACT No. 738 of 01/06/2015	06/01/2015	01/01/2016	No	No	No	No	Yes
Finland	Recording, calculation, and presentation of environmental issues in the financial statements	10/24/2006	2006	Yes	Yes	No	No	Yes

Panel B. Mandatory E&S disclosure regulations (Cont'd)

Country	Regulation	Issuance date	Effective fyear date	First E? *	First S*	Biggest E? *	Biggest S? *	Integrated report?
Finland	Law on Amending the Accounting Act 1376/2016	12/29/2016	12/31/2017	No	No	Yes	Yes	Yes
France	New Economic Regulations Amendment: Item L225-102-1	05/15/2001	01/01/2002	Yes	Yes	No	No	Yes
	New Economic Regulations Amendment: Item L225-102-1	07/14/2010	01/01/2011	No	No	No	No	Yes
	Ordinance No 2017-1180 on Disclosure of Non-financial Information by certain large undertakings	07/19/2017	08/01/2017	No	No	Yes	Yes	Yes
Germany	The Reform Act on Accounting Regulations ("BillReg")	12/09/2004	01/01/2005	Yes	Yes	No	No	Yes
	CSR Directive Implementation Act	04/11/2017	04/11/2017	No	No	Yes	Yes	Yes

Panel B. Mandatory E&S disclosure regulations (Cont'd)

Country	Regulation	Issuance date	Effective fyear date	First E? *	First S*	Biggest E? *	Biggest S? *	Integrated report?
Greece	LAW 3487/2006	11/19/2006	01/01/2007	Yes	Yes	No	No	Yes
	Law 4403/2016	07/07/2016	07/07/2016	No	No	Yes	Yes	Yes
Hong Kong	HKEX Listing Rules Update No. 115	01/01/2016	01/01/2016	Yes	Yes	No	No	No
	HKEX Listing Rules Update No. 128	12/01/2019	07/01/2020	No	No	Yes	Yes	No
India	Securities And Exchange Board of India (SEBI) CIR/CFD/DIL/8/2012	08/13/2012	03/31/2012	Yes	Yes	No	No	Yes
	SEBI Listing Obligations and Disclosure Requirements Regulations, 2015	09/02/2015	01/04/2016	No	No	Yes	Yes	Yes
Indonesia	Law No. 40 of 2007	08/16/2007	08/16/2007	Yes	Yes	No	No	Yes
	Government Regulation No. 47 of 2012	08/01/2012	08/01/2012	No	No	Yes	Yes	Yes
Ireland	S.I. No. 116/2005 European Communities Regulations	02/24/2005	01/01/2005	Yes	Yes	No	No	Yes

Panel B. Mandatory E&S disclosure regulations (Cont'd)

Country	Regulation	Issuance date	Effective fyear date	First E? *	First S*	Biggest E? *	Biggest S? *	Integrated report?
Ireland	Disclosure of Non-financial and Diversity Information by Certain Large Undertakings and Groups	08/04/2017	08/21/2017	No	No	Yes	Yes	Yes
Italy	Legislative Decree, N. 32	02/02/2007	04/12/2007	Yes	Yes	No	No	Yes
	Legislative Decree, N. 254	12/30/2016	01/25/2017	No	No	Yes	Yes	Yes
Malaysia	Main Markets Listing Requirements 2007	2007	12/31/2007	Yes	Yes	No	No	Yes
	Main Markets Listing Requirements 2016	2016	12/31/2015 – 2017	No	No	Yes	Yes	Yes
Netherlands	Amendments to the Article 2:391 subsection 1 Dutch Civil Code	07/25/2005	12/31/2005	Yes	Yes	No	No	Yes
	Official Gazette 2017	03/23/2017	01/01/2017	No	No	Yes	Yes	Yes
Norway	Act of 19 April 2013 No. 15 Amendments to the Accounting Act	04/19/2013	12/31/2012	Yes	Yes	No	No	No

Panel B. Mandatory E&S disclosure regulations (Cont'd)

Country	Regulation	Issuance date	Effective fyear date	First E? *	First S*	Biggest E? *	Biggest S? *	Integrated report?
Norway	The Norwegian Code of Practice for Corporate Governance 2014	10/30/2014	10/01/2014	No	No	Yes	Yes	No
Pakistan	Companies (Corporate Social Responsibility) General Order 2009	11/18/2009	07/01/2009	Yes	Yes	Yes	Yes	Yes
Singapore	SGX-ST Listing Rules Practice Note 7.6 Amendments to Sustainability Reporting Guide	07/01/2016	12/31/2017	Yes	Yes	Yes	Yes	No
South Africa	King II Report on Corporate Governance for South Africa 2002	02/28/2002	03/01/2002	Yes	Yes	No	No	No
	King III Report 2009	09/01/2009	03/01/2010	No	No	Yes	Yes	Yes
	King IV Report 2016	11/01/2016	04/01/2017	No	No	No	No	Yes
Sweden	Annual Accounts Act, Amendments (ÅRL, Chapter 6)	2005	2005	Yes	Yes	No	No	Yes
	Guidelines for External Reporting by State-owned Companies 2007	11/29/2007	01/01/2008	No	No	No	No	No

Panel B. Mandatory E&S disclosure regulations (Cont'd)

Country	Regulation	Issuance date	Effective fyear date	First E? *	First S*	Biggest E? *	Biggest S? *	Integrated report?
Sweden	Act Amending the Annual Accounts Act (1995:1554) 2016	11/03/2016	12/31/2016	No	No	Yes	Yes	Yes
Turkey	The Corporate Governance Communiqué dated 3 January 2014, serial II, No. 17.1	01/03/2014	01/03/2014	Yes	Yes	Yes	Yes	Yes
United Kingdom	The Companies Act 1985 Regulations 2005	03/21/2005	04/01/2005	Yes	Yes	No	No	Yes
	The Companies Act 2006 Regulations 2013	08/06/2013	09/30/2013	No	No	Yes	No	Yes
	The Companies, Partnerships and Groups Regulations 2016	12/16/2016	01/01/2017	No	No	No	Yes	Yes

Note: we list only mandatory ESG disclosure regulations not voluntary guidance/recommendation by governance agencies in Panel B. Legal requirements that are related to environmental and social issues but do not require corporate annual reporting are beyond the scope of this study. Moreover, mandatory ESG disclosure regulations that became effective before/during 2001 or after 2020 are not included.

Appendix OA.C. Human Validation Results

To boost confidence in and demonstrate the quality of our methodology and measures, we conduct a validation test that verifies the overlap between the E&S disclosure selected by our machine learning algorithm and the E&S disclosure identified by humans.[8] We describe the details of the task and validation results in this appendix.

Although machine learning has many advantages over human capabilities when dealing with an extensive amount of data, humans may be more discerning and outperform machine learning algorithms in small samples (Morris 1994; Brynjolfsson and Mitchell 2017). Therefore, we use a group of 15 research assistants (undergraduate business students) with abundant knowledge of ESG reporting through a selective application and interview process to validate whether our word embedding approach can accurately extract relevant E&S information from annual reports.

We first require each of the selected individuals to complete a training session to ensure that they are able to identify E&S disclosure with relatively high accuracy. In this step, we prepare the students with the same knowledge of E&S seed words that we give to the machine. We also familiarize them with E&S disclosure in annual reports and illustrate the idea of expanding seed words to synonyms. Specifically, we start by presenting students with all the seed words related to E&S disclosures. We then compile a sample of 140 sentences, all extracted from the annual

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[8] In addition to human validation, some of the empirical results in Section 4 provide further support for the validity of our measure. For example, in Section 4.2, we find that several determinants of E&S disclosure quantity (e.g., firm size; standalone ESG report; ESG rating coverage) are significant associated with our key E&S disclosure measures. Moreover, findings of the increase in E&S disclosure length surrounding the adoption of voluntary framework and most comprehensive E&S disclosure mandate in Sections 4.3 and 4.4 also help to enhance the credibility of our key measure. Using the same machine learning technique (i.e., *Word2Vec*), Li et al. (2021) measure corporate culture and use corporate activities and performance to validate their measures. In contrast to their setting, E&S disclosure in annual reports does not necessarily lead to ESG action in firms' operation, so a similar validation analysis doesn't fit our setting. As a result, we do not directly link our measures to corporate ESG performance.

reports in our sample. Half of the 140 sentences contain our seed words or their synonyms (10 sentences for each subtopic), and the remaining sentences only discuss financial accounting information. We ask students to read the 140 sentences in mixed order and categorize these sentences. We then review and explain to them 1) which 70 of these sentences are E&S-related, and why; 2) under which subtopic(s) should each E&S-related sentence be classified.[9]

Next, we conduct our post-measurement machine and human agreement test. First, every student is provided with 420 sentences that have already been classified by the machine. Half of these sentences contain words or phrases in the machine-generated E&S dictionary, and the remaining half do not contain any E&S disclosures according to the machine. These 210 E&S-related sentences are composed of 30 randomly selected machine-identified sentences from each of the seven subtopics. We ask each rater to 1) independently identify whether a sentence is E&S-related and if so, 2) classify such sentences into at least one of the seven subtopics.

To evaluate the general difficulty of identifying E&S disclosure and the underlying topics for human raters, we first conduct an agreement test among our research assistants using the kappa statistic. Compared to calculating the simple percentage of agreement, the kappa statistic is a more robust measure of inter-rater reliability for qualitative items (e.g., McHugh 2012; Sim and Wright 2005; Viera and Garrett 2005). We report the kappa statistics among our 15 human raters in Panel A of Online Appendix C. The kappa statistic is 0.84 for classifying sentences as E&S-related and non-E&S-related, suggesting that human raters exhibit high agreement in this task. However, inter-rater reliability is significantly lower (ranging from 0.52 to 0.71) when it

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[9] Although we argue it is important to give our student raters proper training prior to asking them to independently complete the task, one potential concern is that they have already been exposed to our seed words and how we program machine to classify these words, which may bias their coding toward the machine. To address this concern, we further perform an additional expert validation task where we invite three experts in the ESG field and ask them to independently classify these 140 sentences without any training from the coauthor team or knowledge of our seed words. We still observe a significant overlap between these three experts and machine under this alternative validation approach (an average expert-machine agreement rate of 95.47% and a Kappa statistic of 0.91).

comes to identifying the subtopics associated with E&S-related sentences, especially for some of the more nuanced social topics that likely require more nuanced judgment (e.g., other stakeholders). Overall, the results suggest that different human raters can identify E&S disclosure relatively consistently and highlight the inherent difficulty of classifying E&S disclosures into subtopics.

We then study the extent of agreement between machine and human coders by computing inter-rater reliability in identifying E&S disclosure between our methodology and each rater. We report the statistics by rater in Panel B of Online Appendix C. On average, our methodology and a human rater agree on whether a sentence is E&S-related 94.98% of the time, and our average kappa statistic is 0.90, indicating excellent machine-human agreement. We also report the average machine-human agreement rate and kappa statistic for each of the seven subtopics in Panel C of Online Appendix C. Although the average agreement rate remains above 90% for all the subtopics, we observe significantly lower kappa statistics compared to Panel B, consistent with the argument that identifying E&S subtopics is inherently complex. Overall, the results in Panels B and C suggest that our methodology identifies E&S disclosures and the underlying topics with relatively high accuracy and increases our confidence in applying this methodology in our empirical analyses.

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Panel A: Human Inter-rater Agreement

Topic	# of Raters	Kappa	Z	Prob>Z
Overall E&S	15	0.84	176.62	0.00
Climate Change	15	0.68	141.77	0.00
Natural Resources	15	0.63	132.87	0.00
Pollution & Waste	15	0.68	143.56	0.00
Ecosystem	15	0.71	148.27	0.00
Human Capital	15	0.70	147.32	0.00
Products & Customers	15	0.52	108.68	0.00
Other Stakeholders	15	0.53	111.60	0.00

Panel B: Overall Human-Machine Agreement

Rater	Agreement	Kappa	Z	Prob>Z
1	97.36%	0.95	19.32	0.00
2	98.33%	0.97	19.82	0.00
3	95.00%	0.90	18.47	0.00
4	96.67%	0.93	19.16	0.00
5	96.18%	0.92	18.93	0.00
6	88.07%	0.76	15.91	0.00
7	97.38%	0.95	19.42	0.00
8	90.95%	0.82	16.79	0.00
9	95.48%	0.91	18.64	0.00
10	84.82%	0.70	14.68	0.00
11	98.33%	0.97	19.82	0.00
12	97.86%	0.96	19.62	0.00
13	94.99%	0.90	18.45	0.00
14	95.00%	0.90	18.49	0.00
15	98.33%	0.97	19.82	0.00
Mean	94.98%	0.90	18.49	0.00

Panel C: Average Human-Machine Agreement by Topic

| Topic	Agreement	Kappa	Z	Prob>Z
Climate Change	94.41%	0.69	14.37	0.00
Natural Resources	93.76%	0.70	14.46	0.00
Pollution & Waste	96.59%	0.80	16.50	0.00
Ecosystem	97.48%	0.81	16.72	0.00
Human Capital	95.62%	0.76	15.85	0.00
Products & Customers	96.05%	0.67	13.86	0.00
Other Stakeholders	95.14%	0.65	13.42	0.00

Figure OA.1. The Distribution of E&S Information in Annual Reports

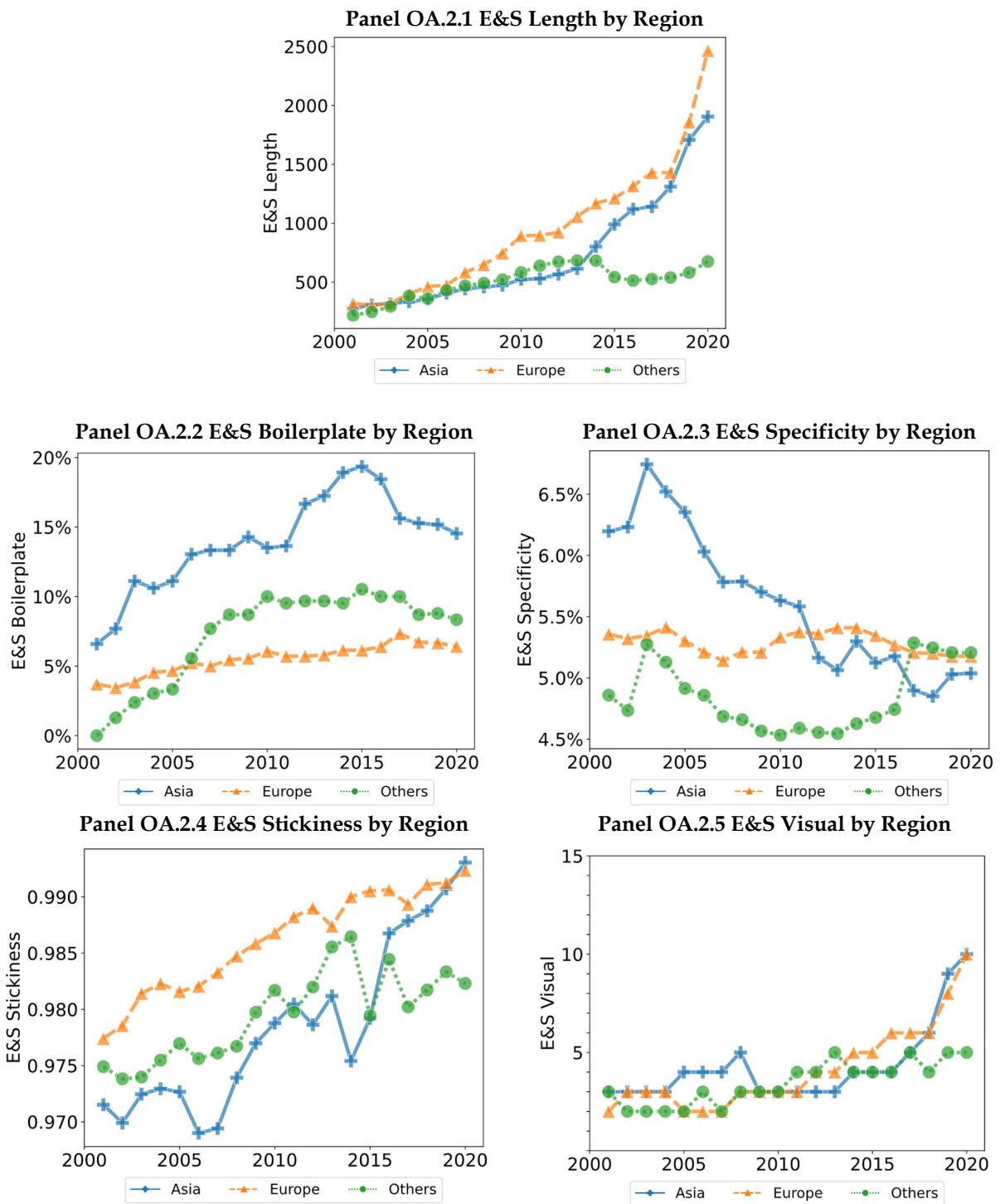**Panel OA.1.1 Heatmap of E&S Information**
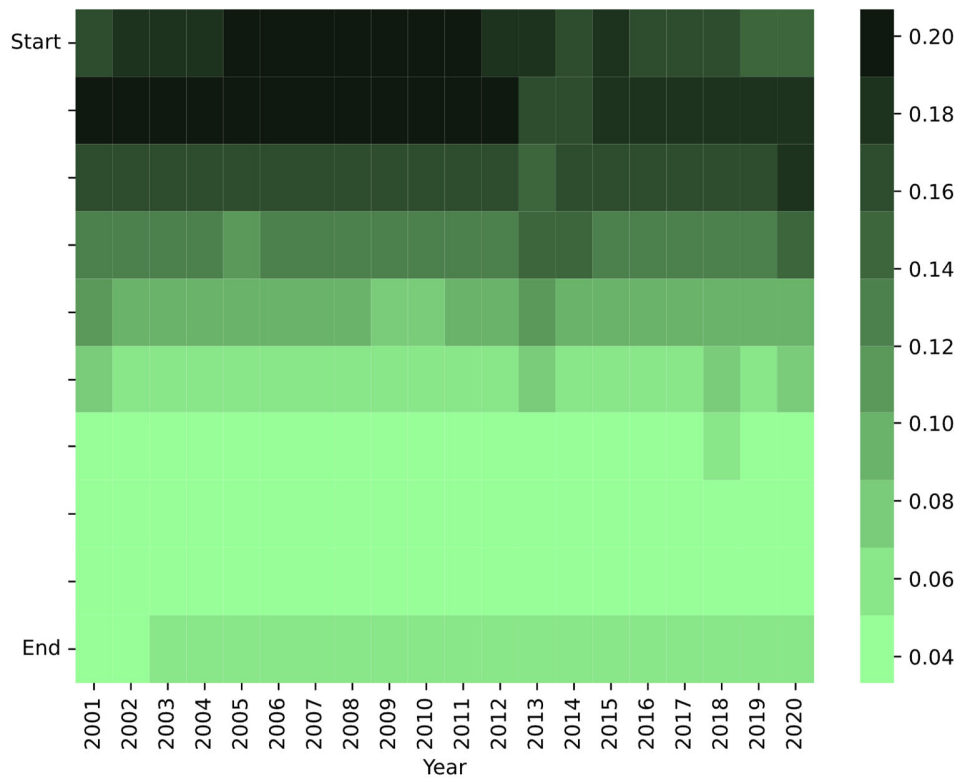
Note: This heatmap shows the distribution of E&S information within annual reports. We divide each annual report into ten equal parts and count the occurrences of environmental- and social-related words and phrases based on our dictionary. We use these frequency counts to create a normalized histogram that adds up to 1 for each annual report. This heatmap is created based on the normalized histograms of all annual reports in each year. A darker shade indicates a more frequent occurrence of E&S information within a given part of the annual report.

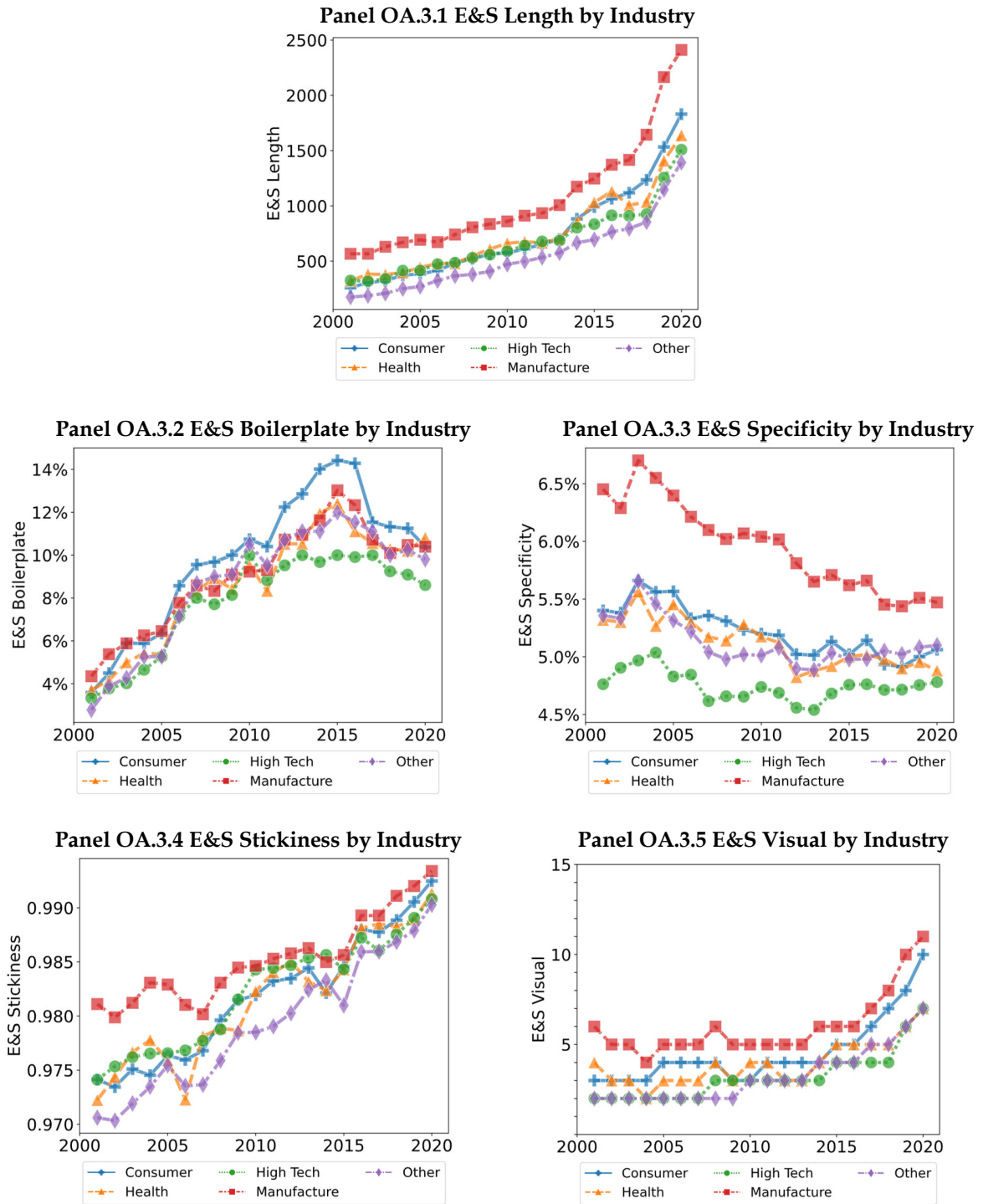**Panel OA.1.2 Heatmap of Financial Information**
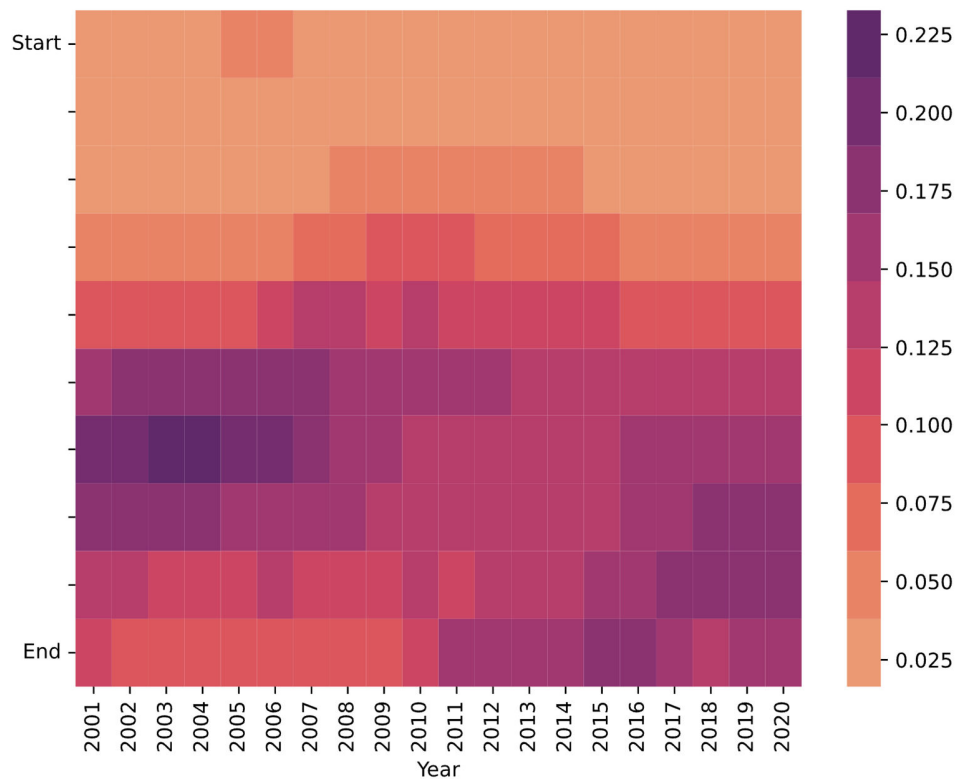
Notes: This heatmap shows the distribution of financial statements within annual reports. We use the following keywords to identify the location of the financial statements: "consolidated financial statements", "consolidated balance sheet", "consolidated income statement", "consolidated statement of financial position", "consolidated statement of comprehensive income", "consolidated statement of cash flow". Keywords appearing in the index are excluded. A darker shade indicates a more frequent occurrence of financial statements within a given part of the annual report.

Figure OA.2. The Evolution of E&S Disclosure Attributes by Region

Panel OA.2.1 E&S Length by Region

Panel OA.2.2 E&S Boilerplate by Region

Panel OA.2.3 E&S Specificity by Region

Panel OA.2.4 E&S Stickiness by Region

Panel OA.2.5 E&S Visual by Region

Notes: This figure displays the evolution of the five disclosure attributes variables in three regions: Asia, Europe, and others from 2001 to 2020. The x-axis is the year. From Panel A to Panel E, the y-axis is E&S Length, Boilerplate, Specificity, Stickiness, and Visual. Variable definitions are provided in the Appendix.

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Figure OA.3. The Evolution of E&S Disclosure Attributes by Industry

Panel OA.3.1 E&S Length by Industry

Panel OA.3.2 E&S Boilerplate by Industry

Panel OA.3.3 E&S Specificity by Industry

Panel OA.3.4 E&S Stickiness by Industry

Panel OA.3.5 E&S Visual by Industry

Notes: This figure displays the evolution of the five disclosure attributes variables in the Fama-French five industries: Consumer, High Tech, Healthcare, Manufacturing, and Other, from 2001 to 2020. The x-axis is the year. From Panel A to Panel E, the y-axis is E&S Length, Boilerplate, Specificity, Stickiness, and Visual. Variable definitions are provided in the Appendix.

Table OA.1. Words and Phrases in the E&S Dictionary

This table lists the words and phrases included in and excluded from the E&S dictionary after we use the *Word2Vec* method to expand the seed word list into the complete E&S Dictionary. All words and phrases are listed in alphabetical order. Panel A lists all the words and phrases included in the dictionary. Note that parsing imperfections may lead to duplicate words and phrases in our dictionary that only vary slightly in format (e.g., "co²_emission" and "co2_emission") and we only keep one of them in the dictionary to avoid confusion although we consider all variations in our analyses. Panel B presents words and phrases that are related to E&S disclosure but too general to be classified into any subtopics. Panel C reports words and phrases in the original word list generated by the algorithm but are excluded from the dictionary in our screening process.

Panel A: Words and Phrases Included in the E&S Dictionary

Subtopics	Words and phrases included
Climate Change	about_global_warming, absolute_emission, address_climate_change, air_pollutant, air_pollutant_emission, anthropogenic, antibiotic_resistance, atmospheric_pollutant, baseline_emission, burning_of_fossil_fuel, carbon, carbon_and_water_footprint, carbon_balance, carbon_consumption, carbon_dioxide, carbon_dioxide_co2, carbon_dioxide_co2_emission, carbon_dioxide_emission, carbon_emission, carbon_emission_intensity, carbon_emissions, carbon_foot_print, carbon_footprint, carbon_impact, carbon_intensity, carbon_intensive, carbon_management, carbon_neutral, carbon_output, carbon_performance, carbon_profile, carbon_reduction, carbon_usage, carbon-dioxide_emission, carbon-footprint, ch4_emission, climate, climate_action, climate_adaptation, climate_agenda, climate_challenge, climate_change, climate_change_adaptation, climate_change_and_biodiversity, climate_change_and_global_warming, climate_change_and_resource_scarcity, climate_change_and_water_scarcity, climate_change_biodiversity, climate_change_climate_change, climate_change_environmental_degradation, climate_change_mitigation, climate_change_mitigation_and_adaptation, climate_concern, climate_crisis, climate_disruption, climate_emergency, climate_emission, climate_footprint, climate_gas, climate_impact, climate_issue, climate_mitigation, climate_policy, climate_protection, climate_resilience, climate_risk, climate_strategy, climate_transition, climate_warming, climate-change, co_e, co_emission, co_equivalent, co2, co2_emission, co2_emission_datum, co2_emission_from_energy_consumption, co2_emission_from_fossil, co2_emission_intensity, co2_emission_level, co2_emission_reduction, co2_emission_tonne, co2_emit, co2_emmision, co2_equiv, co2_equivalent, co2_equivalent_emission, co2_equivalent_tonne, co2_footprint, co2_gas_emission, co2_impact, co2_intensity, co2_nox, co2_output, co2_production, co2_reduction, co2_tonne, co2e, co2-e, co2e_emission, co2-e_emission, co2emission, co2-emission, co2eq_emission, coc_emission, combat_climate_change, combat_global_warming, combustion_of_fuel, company_carbon_footprint, company_emission, consumption_of_fossil, coz_emission, decarbonisation, decarbonization, diffuse_emission, direct_emissions, due_to_global_warming, eco_efficiency, eco_footprint, eco-efficiency, ecological_impact, effect_of_global_warming, electricity_emission, embodied_carbon, embody_carbon, emission, emission_breakdown,

| | emission_datum, emission_emission, emission_factor, emission_figure, emission_footprint, emission_from_purchased, emission_increase, emission_intensity, emission_level, emission_of_air_pollutant, emission_of_carbon_dioxide, emission_of_co2, emission_of_fossil_carbon_dioxide, emission_of_ghg, emission_of_greenhouse_gas, emission_of_methane, emission_of_pollutant, emission_of_so2, emission_reduction, emission_reporting, emission_result, emission_scope, emission_scopes, emission_source, emission_tco2e, emission_to_air, emission_tonne_co2e, emission_total, emission-reduction, emissions, emissions_scope, emmission, employee_commuting, en16, energy_and_carbon, energy_and_climate, energy_emission, energy_footprint, energy_insecurity, energy_issue, energy_reduction, energy_transition, environmental_burden, environmental_degradation, environmental_load, equivalent_tco2e, extreme_weather_event, fight_against_global_warming, fleet_emission, food_shortage, fossil_carbon_dioxide_emission, fossil_co2_emission, fossil_fuel_emission, fugitive, fugitive_emission, g4-en16, g4-en5, gas_emission, ghg, ghg_emission, ghg_emission_across, ghg_emission_associate, ghg_emission_calculation, ghg_emission_datum, ghg_emission_decrease, ghg_emission_generate, ghg_emission_intensity, ghg_emission_reduction, ghg_emission_scope, ghg_emission_tco2e, ghg_emissions, ghg_footprint, ghg_intensity, ghg_inventory, ghg_protocol, ghg_reduction, ghg_scope, global_warming, green_house, greenhouse_effect, greenhouse_emission, greenhouse_gas, greenhouse_gas_carbon_dioxide, greenhouse_gas_co2, greenhouse_gas_emission, greenhouse_gas_emission_across, greenhouse_gas_emission_and_energy_consumption, greenhouse_gas_emission_and_waste, greenhouse_gas_emission_associate, greenhouse_gas_emission_co2, greenhouse_gas_emission_datum, greenhouse_gas_emission_generate, greenhouse_gas_emission_ghg, greenhouse_gas_emission_greenhouse_gas_emission, greenhouse_gas_emission_intensity, greenhouse_gas_emission_link, greenhouse_gas_emission_reduction, greenhouse_gas_emission_scope, greenhouse_gas_emission_volume, greenhouse_gas_emissions, greenhouse_gas_emit, greenhouse_gas_footprint, greenhouse_gas_generate, greenhouse_gas_ghg, greenhouse_gas_ghg_emission, greenhouse_gas_in_the_atmosphere, greenhouse_gas_intensity, greenhouse_gas_protocol_scope, greenhouse_gas_reduction, greenhouse_gas_release, greenhouse_gases, greenhouse-gas, greenhouse-gas_emission, gross_emission, group_carbon_emission, group_carbon_footprint, group_co2_emission, group_emission, group_energy_use, group_greenhouse_gas_emission, house_gas_emission, ide_emission, impact_of_global_warming, indirect_emission, indirect_emissions, indirect_energy_consumption, indirect_ghg_emission, indirect_greenhouse_gas_emission, indirect_scope, intensity_emission, issue_of_global_warming, kgco2e, kt_co2e, ktco2e, kyoto_protocol, logistic_emission, methane_emission, mt_co2e, mtco2e, n2o_emission, nitrous_oxide_emission, nitrous_oxide_n2o, no2_emission, nox_and_so2, nox_and_sox_emission, nox_emission, noxious_emission, office_emission, other_indirect_emissions, oxide_emission, oxide_hydrofluorocarbon, ozone_deplete_substance, ozone_deplete_substance_ods, packaging_weight, paper_usage, paper_use, perfluorocarbon, pfc_emission, plant_emission, process_emission, reduce_global_warming, resource_scarcity, reuse_and_recycle, |

	scope_1, scope_2, scope_3, scope1, scope-3, scopes, scopes_1, scopes_1_2, scopes_1_and_2, sdg, sf6_emission, so2_and_nox_emission, so2_emission, solvent_emission, sox_and_nox_emission, sox_emission, sox_nox, substance_emission, sulfur_dioxide_emission, sulfur_hexafluoride, sulphur_dioxide_so2_emission, supply_chain_emission, sustainability_performance, t_co2e, t_scope, tco_e, tco2, tco2_e, tco₂e, tco2e, tco2e_emission, tco2e_emissions, tco2e_scope, tco2eq, tonne_co2, tonne_co2e, tonne_of_co2, tonne_of_co2e, tonnes_co2e, total_emission, total_scope, transition_risk, transport_emission, travel_emission, uk_emission, upstream_emission, urban_sprawl, value_chain_emission, warming
Natural Resources	accident_rate, air_conditioning, air_consumption, air_generation, air_usage, air_washer, akd_consumption, alternate_fuel, alternative_fuel, ammonia_condenser, anone_plant, arrest_air_leakage, atmospheric_emission, auxiliary_power_consumption, bagasse_moisture, bagasse_saving, bf_gas, bf_gas_consumption, bio_fuel, biodiesel, biofuel, biogenic_fuel, biomass, boiler, boiler_blow, boiler_coal_consumption, boiler_efficiency, boiler_feed_pump, boiler_feed_water, boiling_house, brine_system, brown_coal, burn_fossil_fuel, capacitor_bank, carbon_source, caustic_consumption, cdu-1, cdu-i, cheap_fuel, chemical_usage, chill_plant, clean_energy, clean_fuel, cm2_g, coal, coal_and_gas, coal_and_oil, coal_boiler, coal_consumption, coal_fire_generation, coal_mill, coal_usage, cod_emission, coke_consumption, coke_moisture, coke_rate, compress_air_consumption, compress_air_pressure, compressed_air_consumption, compressor_air, compressor_load, compressor_power, condensate_recovery, condensate_recovery_system, conserve_water, consumption, consumption_level, consumption_of_coke, consumption_of_diesel, consumption_of_electricity, consumption_of_energy, consumption_of_fuel, consumption_of_steam, consumption_of_water, conventional_fuel, cool_tower, cool_tower_pump, cool_water_circulation, cool_water_pump, dc_energy_consumption, dc_power_consumption, de_aerator, deaerator, dependence_on_fossil_fuel, diesel, diesel_consumption, diesel_fuel, diesel_fuel_consumption, diesel_usage, diesel_use, discharge_pressure, district_heating_consumption, dm_plant, dm_water, dm_water_consumption, drier, drinking_water_consumption, effluent_generation, effluent_load, ejector, electric_power_consumption, electrical_consumption, electrical_energy_consumption, electricity, electricity_consume, electricity_consumption, electricity_cost, electricity_demand, electricity_generation, electricity_intensity, electricity_production, electricity_reduction, electricity_saving, electricity_usage, electricity_use, energy_and_water, energy_and_water_consumption, energy_bill, energy_carrier, energy_consume, energy_consumption, energy_cost, energy_demand, energy_efficient_compressor, energy_efficient_motor, energy_efficient_pump, energy_expenditure, energy_fuel, energy_generation, energy_intensity, energy_loss, energy_mix, energy_production, energy_profile, energy_requirement, energy_resource, energy_saving, energy_source, energy_usage, energy_use, esp_fan, ethanol, etp_load, evaporator, fan_power_consumption, feed_pump, feed_water, feedstock, fibre_loss, finite_resource, flash_steam, flue_gas_temperature, fo_consumption, fossil, fossil_base, fossil_energy, fossil_energy_carrier, fossil_energy_source, fossil_fuel, fossil_fuel_coal, fossil_fuel_consumption, fossil_fuel_energy, fossil_fuel_like, fossil_fuel_natural_gas, fossil_fuel_oil, fossil_fuel_source, fossil_material, fossil_oil, fossil_resource, fossil_source, fossil-fuel, fresh_water_consumption, fresh_water_intake, freshwater_consumption, freshwater_intake,

	freshwater_withdrawal, fuel, fuel_consumption, fuel_energy, fuel_oil, fuel_oil_consumption, fuel_source, fuel_usage, fuel_use, furnace_oil_consumption, gas, gas_consumption, gas_demand, gas_usage, gas_use, gas_volume, generate_electricity, green_energy, group_consumption, group_energy_consumption, gwh, hard_coal, heat_consumption, heat_integration, heat_loss, heat_recovery, heater_efficiency, heating, heating_consumption, heating_demand, heating_energy, heating_energy_consumption, heating_oil_consumption, heating_requirement, heavy_fuel_oil, hot_blast_temperature, hot_water_generator, hot_water_pump, hp_pump, hsd_consumption, hydrocarbon_fuel, hydrogen, id_fan, impeller_size, import_coal, installation_of_vfd, kcal_kwh, kerosene, kiln, kwh, kwh_annum, kwh_m2, kwh_mt, kwhr, ldo_consumption, lighting_load, lighting_power_consumption, lime_consumption, liquid_fuel, lp_steam, lp_steam_consumption, lpg_consumption, main_water_consumption, material_consumption, more_polluting, motor_capacity, mp_steam, mwh, natural_gas, natural_gas_consumption, natural_resource, ng_consumption, nitrogen_consumption, nuclear_energy, nuclear_power, office_energy, oil, oil_consumption, pa_fan, paper_consumption, plate_type_heat_exchanger, pm#2, portfolio_energy_consumption, pot_voltage, potable_water_consumption, potable_water_usage, power_consumption, power_demand, power_norm, power_reduction, power_requirement, power_saving, power_usage, power_use, prds, pre_heater, pre_heating, preheat, preheater, preheating, pressure_drop, process_steam_consumption, process_water_consumption, production_volume, propane_consumption, radiation_loss, raw_mill, raw_mill_fan, reboiler, recycling_rate, reduce_energy_consumption, refining_energy, refractory_consumption, refrigeration_load, refrigeration_power, renewable_biomass, renewable_energy, renewable_energy_source, renewable_fuel, renewable_resource, renewable_source, renewable_source_of_energy, resource_consumption, resource_usage, reuse_water, ro_reject, root_blower, save_water, shale_gas, sludge_generation, solar_energy, solid_fuel, solvent_consumption, source_of_energy, specific_coal_consumption, stack_temperature, steam, steam_condensate, steam_consumption, steam_cost, steam_economy, steam_ejector, steam_generation, steam_header, steam_heater, steam_loss, steam_norm, steam_optimization, steam_pressure, steam_reduction, steam_requirement, steam_saving, steam_temperature, suction_pressure, super_heater, thermal_energy_consumption, tph_boiler, transfer_pump, transportation_fuel, turbine_heat_rate, unit_consumption, utility_consumption, utility_usage, vapour_absorption_machine, vegetable_oil, virgin_material, virgin_raw_material, voc_emission, waste_consumption, waste_generation, waste_level, waste_output, waste_production, waste_quantity, waste_send_to_landfill, waste_to_landfill, waste_volume, wastewater_generation, water, water_addition, water_and_energy, water_and_energy_consumption, water_conservation, water_consume, water_consumption, water_consumption_intensity, water_efficiency, water_footprint, water_impact, water_intake, water_intensity, water_loss, water_ratio, water_reduction, water_saving, water_scarcity, water_shortage, water_stewardship, water_usage, water_use, water_use_intensity, water_utilisation, water_withdraw, water_withdrawal, wind_and_solar_power, wood
Pollution & Waste	air_and_noise_pollution, air_and_water, air_and_water_pollution, air_contamination, air_emission, air_pollution, air_quality, air_water, air_water_and_soil_pollution, air-pollution, air-quality, ambient_air_quality,

	ammonia_nitrogen, aqueous_effluent, asbestos_waste, atmospheric_pollution, b3_waste, backwash_water, bio_filter, biodegradable_waste, biomedical_waste, biosolid, bottom_ash, carbon_monoxide, carbon_monoxide_co, chemical, chemical_waste, chemical_water, city_sewage, clean_wastewater, coal_dust, combustible_waste, compost, construct_wetland, construction_noise, construction_waste, contaminant, contaminate_water, contaminated_soil, contaminated_waste, contaminated_water, contamination, cool_water, dangerous_waste, dioxin_emission, dirty_water, discharge_of_sewage, discharge_of_wastewater, discharge_water, discharged_water, disposal_area, disposal_site, domestic_sewage, domestic_wastewater, drainage_water, drink_water, drinking_water, dump_site, dust, dust_and_noise, dust_control, dust_emission, dust_management, dust_noise, dust_pollution, dust_reduction, effluence, effluent, effluent_and_emission, effluent_discharge, effluent_stream, effluent_treatment, effluent_treatment_plant, effluent_waste, effluent_water, electronic_waste, emission_and_waste, emission_control, emission_of_dust, emission_of_nitrogen_oxide, emission_of_nitrogen_oxide_nox, emission_of_nox, energy_efficiency, energy_performance, environment_pollution, environment_quality, environmental_damage, environmental_hazard, environmental_pollution, etp_plant, etp_water, exhaust_emission, exhaust_gas, exhaust_gas_emission, factory_waste, fine_dust, flue_gas, food_waste, fresh_water, fugitive_dust, garbage, gardening_purpose, grey_water, greywater, ground_pollution, groundwater, harmful, harmful_emission, harmful_waste, hazard, hazardous, hazardous_chemical, hazardous_emission, hazardous_material, hazardous_solid_waste, hazardous_substance, hazardous_waste, hazardous_waste_generate, hazardous_waste_generation, hazardous_waste_stream, hazardous_wastewater, health_hazard, household_garbage, household_sewage, household_waste, hydrocarbon_separator, impoundment, incinerate, incineration, incinerator, indoor_air_pollution, indoor_air_quality, industrial_effluent, industrial_waste, industrial_waste_water, industrial_wastewater, into_the_atmosphere, kitchen_waste, lake_water, land_fill, landfill, land-fill, landfill_site, landfill_waste, landfilling, light_pollution, liquid_effluent, liquid_waste, manufacturing_waste, marine_pollution, material_recycling, material_waste, membrane_water, mine_effluent, mine_water, mineral_waste, mixed_waste, municipal_sewage, municipal_waste, municipal_wastewater, nitrogen_dioxide, nitrogen_dioxide_no2, nitrogen_oxide, nitrogen_oxide_emission, nitrogen_oxide_nox, noise, noise_and_dust, noise_and_odor, noise_and_vibration, noise_control, noise_disturbance, noise_dust, noise_emission, noise_impact, noise_level, noise_nuisance, noise_pollution, noise_reduction, nonhazardous, nonhazardous_waste, nox, nuisance, odor, odour, office_waste, oil_contaminate, oily_waste, organic_waste, packaging, packaging_waste, paint_sludge, palm_oil_mill_effluent, paper_and_cardboard, paper_waste, particle, particle_concentration, particle_emission, particulate, particulate_emission, particulate_matter, particulate_matter_emission, particulate_matter_pm, plant_effluent, plastic, plastic_pollution, plastic_waste, pm10, pm2.5, pollutant, pollutant_emission, pollute, pollute_emission, polluted_water, pollution, pollution_emission, pollution_level, pollution_risk, pond_water, potable_water, prevent_pollution, process_effluent, process_waste, process_waste_water, process_wastewater, process_water, processing_waste, product_waste, production_waste, production_wastewater, production_water, purification_and_treatment, purification_station, purified_wastewater, purify_wastewater, putrescible_waste, quantity_of_waste, quarry, rain_water,

	rainwater, rainwater_and_wastewater, rainwater_collection, raw_sewage, raw_water, raw_water_supply, recirculate_water, recyclable_material, recyclable_waste, recycle_and_reuse, recycle_material, recycle_reuse, recycle_waste, recycle_wastewater, recycle_water, recycled, recycled_waste, recycled_water, recycling, recycling_and_reuse, recycling_of_waste, recycling_of_wastewater, recycling_process, recycling_reuse, recycling_waste, respirable_dust, reuse, reuse_and_recycling, reuse_of_water, reuse_recycle, reuse_recycling, river_pollution, road_safety, rubbish, runoff_water, sanitary_wastewater, schedule_waste, scheduled_waste, sea_water, sedimentation_tank, segregation_of_waste, send_to_landfill, service_water, sewage, sewage_and_waste_water, sewage_effluent, sewage_management, sewage_pipeline, sewage_plant, sewage_sludge, sewage_system, sewage_treatment, sewage_treatment_facility, sewage_treatment_plant, sewage_treatment_plants, sewage_treatment_station, sewage_treatment_system, sewage_water, sewer_system, sewerage, sewerage_system, site_waste, slag, sludge, sludge_produce, sludge_treatment, sludge_waste, smog, so2, soil, soil_contamination, soil_erosion, soil_pollution, solid_waste, soot_emission, sort_waste, sound_emission, sound_nuisance, sound_pollution, sox_and_nox, spillage, storm_water, storm_water_runoff, stormwater, storm-water, stormwater_runoff, stp_water, sulfur_dioxide, sulphur_dioxide, sulphur_dioxide_emission, sulphur_oxide, surface_water, suspend_solid, tailing, tailings_pond, toxic_and_hazardous_waste, toxic_waste, trade_effluent, transport, trash, treat_effluent, treat_pome, treat_sewage, treat_wastewater, treat_waste-water, treat_water, treatment_facility, treatment_of_effluent, treatment_of_sewage, treatment_of_wastewater, treatment_plant, ultrafine_particle, urban_wastewater, used_water, vehicle_emission, visual_pollution, vocs, wash_water, washing_water, wastage, waste, waste_air, waste_and_effluent, waste_and_recycling, waste_and_wastewater, waste_battery, waste_chemical, waste_collection, waste_discharge, waste_disposal, waste_divert, waste_dump, waste_effluent, waste_flow, waste_food, waste_footprint, waste_gas, waste_generate, waste_item, waste_landfill, waste_management, waste_material, waste_oil, waste_paper, waste_product, waste_recycle, waste_recycling, waste_reduction, waste_rock, waste_separation, waste_sludge, waste_sort, waste_sorting, waste_stream, waste_treatment, waste_type, waste_water, waste_water_treatment, waster, wastes, wastewater, waste-water, wastewater_and_sewage, wastewater_and_sludge, wastewater_collection, wastewater_discharge, wastewater_disposal, wastewater_effluent, wastewater_generate, wastewater_purification, wastewater_quality, wastewater_reuse, wastewater_sewage, wastewater_treatment, wastewater_treatment_facility, wastewater_treatment_plant, wastewater_treatment_station, wastewater_treatment_system, water_and_soil, water_and_waste, water_body, water_contamination, water_discharge, water_effluent, water_extraction, water_management, water_plant, water_pollution, water_purification, water_quality, water_recycling, water_reuse, water_supply, water_system, water_treatment, water_treatment_plant, water_wastage, water_waste, water-quality, wet_waste, wwtp
Ecosystem	afforestation, agroforestry, amphibian, amphibian_and_reptile, animal_and_bird, animal_and_plant, animal_habitat, animal_specie, animal_welfare, aquatic, aquatic_ecosystem, aquatic_environment, aquatic_habitat, aquatic_life, aquatic_specie, archaeological, archeological_site, avifauna, benthic, bio_diversity, biodiverse, biodiversity, bio-diversity,

	biodiversity_and_conservation, biodiversity_and_ecosystem, biodiversity_biodiversity, biodiversity_conservation, biodiversity_fauna, biodiversity_impact, biodiversity_loss, biodiversity_management, biodiversity_preservation, biodiversity_protection, biodiversity_rich, biological_diversity, biosphere, biotope, bird_and_animal, bird_habitat, bird_life, bird_population, bird_reptile, bird_specie, birdlife, boreal_forest, buffer_zone, carbon_sequestration, caribou, cetacean, circular_economy, coastal_ecosystem, combat_deforestation, conservation, conservation_area, conservation_of_biodiversity, conservation_of_forest, conservation_reserve, conservation_status, conserve_biodiversity, coral_reef, critical_habitat, critically_endanger, critically_endanger_specie, cultural_heritage, danger_of_extinction, de_forestation, deforestation, degraded_area, desertification, dugong, eco_system, eco-environment, ecological, ecological_balance, ecological_continuity, ecological_corridor, ecological_environment, ecological_footprint, ecologically_important, ecology, ecology_and_biodiversity, ecosystem, eco-system, ecosystem_and_biodiversity, ecosystem_biodiversity, ecosystem_conservation, ecosystem_restoration, ecosystem_service, endanger_animal, endanger_animal_specie, endanger_flora, endanger_specie, endangered, endangered_animal, endangered_specie, endemic_plant, endemic_specie, entire_ecosystem, entire_value_chain, environmental_conservation, environmental_preservation, environmental_sustainability, fauna, fauna_and_flora, fauna_flora, fauna_habitat, fauna_specie, faunal, fish_habitat, floodplain, flora, flora_and_fauna, flora_and_fauna_specie, flora_fauna, flora_or_fauna, flora_specie, floral_specie, floristic, food_security, forest, forest_area, forest_biodiversity, forest_conservation, forest_degradation, forest_ecosystem, forest_environment, forest_habitat, forest_landscape, forest_maintenance, forest_management, forest_protection, forest_regeneration, forest_reserve, forest_restoration, forestation, forested, forested_area, fragile_ecosystem, fynbo, gere_specie, grassland, green_lung, green_space, greenery, ground_vegetation, habitat, habitat_and_biodiversity, habitat_and_specie, habitat_area, habitat_conservation, habitat_destruction, habitat_for_bird, habitat_for_wildlife, habitat_restoration, hcv_area, hcv_forest, heritage, heritage_resource, heritage_site, high_conservation_value, illegal_logging, indigenous_flora, indigenous_flora_and_fauna, indigenous_forest, indigenous_heritage, indigenous_plant_specie, indigenous_specie, indigenous_tree, indigenous_vegetation, insect, invasive_alien_specie, invasive_specie, invertebrate, jungle_reserve, land_degradation, landscape, landscape_and_biodiversity, living_creature, local_fauna_and_flora, local_flora, local_flora_and_fauna, local_wildlife, malnutrition, mammals, mangrove, mangrove_area, mangrove_ecosystem, mangrove_forest, mangrove_habitat, mangrove_swamp, marine_and_coastal, marine_biodiversity, marine_ecology, marine_ecosystem, marine_environment, marine_fauna, marine_habitat, marine_litter, marine_organism, marshland, migratory, migratory_bird, national_park, native_animal, native_bird, native_ecosystem, native_fauna, native_flora, native_flora_and_fauna, native_habitat, native_plant, native_plant_specie, native_specie, native_tree_specie, native_vegetation, native_wildlife, natural_ecosystem, natural_environment, natural_forest, natural_habitat, natural_habitats, natural_heritage, natural_landscape, natural_surrounding, natural_vegetation, nature_conservation, nature_conservation_area, nature_reserve, nesting_area, ocean, ocean_pollution, orangutan, orchid_specie, overfishing, palm_oil, palm_oil_production,

	peak_wilderness, peatland, pitcher_plant, planet, plant_and_animal, plant_specie, plant_species, plant_tree, plantation_boundary, planting, planting_mangrove, planting_of_tree, plastic_in_the_ocean, pollinator, preservation_of_biodiversity, preservation_of_ecosystem, preservation_of_the_environment, preserve_biodiversity, preserve_the_biodiversity, preserve_the_environment, prevent_soil_erosion, promote_biodiversity, protect_biodiversity, protect_flora_and_fauna, protect_habitat, protect_specie, protect_wildlife, protection_of_biodiversity, rain_forest, rainforest, rare_and_endangered, rare_animal, rare_specie, re_vegetation, reafforestation, reforest, reforestation, reforestation_activity, reforestation_program, regenerative_agriculture, remnant_vegetation, replanting, reptile, restore_biodiversity, restore_habitat, rice_field, rich_biodiversity, riparian, riparian_area, riparian_forest, riparian_zone, river, riverbank, sea_grass, sea_life, sea_turtle, seagrass, sensitive_habitat, shrub, shrub_planting, silviculture, slash_and_burn, soil_and_biodiversity, soil_and_water, soil_conservation, soil_degradation, soil_fertility, soil_protection, soil_quality, soil_water, soil_water_air, soil_water_and_air, specie, specie_and_habitat, specie_composition, specie_conservation, specie_habitat, specie_of_fauna, specie_of_flora_and_fauna, species, species_diversity, species_rich, suitable_habitat, sumatran_tiger, surround_ecosystem, surround_environment, surround_landscape, sustainable_agriculture, terrestrial_and_aquatic, terrestrial_ecosystem, threaten_specie, threatened_or_endanger, tree_planting, tropical_rain_forest, urban, urban_biodiversity, urban_environment, valuable_habitat, vegetation, vegetation_cover, vulnerable_specie, wasteland, water_catchment, water_resource, water_soil, water_source, waterbodie, watercourse, waterway, wetland, wetland_area, wetland_habitat, wild, wild_animal, wild_life, wildlife, wildlife_area, wildlife_conservation, wildlife_corridor, wildlife_habitat, wildlife_movement, wildlife_population, wildlife_protection, wildlife_sanctuary, wildlife_specie, woodland
Human Capital	accident_prevention, advancement_of_woman, anti_bribery_and_corruption, anti_corruption_and_bribery, anti_racism, associate_engagement, board_diversity, board_gender_diversity, boardroom_diversity, boardroom_gender_diversity, business_ethic, career_advancement, career_aspiration, career_development, career_enhancement, career_goal, career_growth, career_guidance, career_management, career_mobility, career_opportunity, career_path, career_plan, career_planning, career_progress, career_progression, career_prospect, career-development, career-path, celebrate_diversity, champion_diversity, child_and_force_labor, child_and_force_labour, child_exploitation, child_labor, child_labor_and_force_labor, child_labor_force_labor, child_labor_or_force_labor, child_labour, child_labour_and_force_labour, child_or_force_labor, child_or_force_labour, client_satisfaction, climate_survey, coaching, colleague, colleague_engagement, colleague_support, company_culture, competence_development, competency_development, compulsory_labor, compulsory_labour, continuous_learning, contractor_safety, core_convention, corporate_culture, cr&s, cultural_diversity, culture_of_inclusivity, culture_survey, customer_advocacy, customer_centricity, customer_engagement, d&i, d&i_initiative, d&i_policy, disability_inclusion, discrimination, discrimination_in_the_workplace, diverse_and_inclusive, diverse_and_inclusive_workforce, diverse_and_inclusive_workplace, diverse_workforce, diverse_workplace, diversity_agenda, diversity_and_equality, diversity_and_gender_equality, diversity_and_inclusion,

	diversity_and_inclusion_d&i, diversity_and_inclusiveness, diversity_and_inclusivity, diversity_awareness, diversity_diversity, diversity_effort, diversity_equality, diversity_in_the_workplace, diversity_inclusion, diversity_initiative, diversity_management, diversity_objective, diversity_policy, diversity_programme, diversity_strategy, diversity_target, diversity_work, education_and_training, ehs, ehs_management, embrace_diversity, emergency_preparedness, employability, employee_advocacy, employee_attitude, employee_career, employee_climate, employee_commitment, employee_communication, employee_connect, employee_development, employee_diversity, employee_engagement, employee_experience, employee_feedback, employee_health, employee_involvement, employee_loyalty, employee_morale, employee_motivation, employee_network, employee_opinion, employee_perception, employee_productivity, employee_recognition, employee_relation, employee_retention, employee_right, employee_safety, employee_satisfaction, employee_sentiment, employee_skill, employee_survey, employee_talent, employee_training, employee_value, employee_wellbeing, employee_well-being, employee_wellness, employee-engagement, employer_brand, employer_branding, employment_discrimination, employment_engagement, employment_equity, engagement_and_enablement, engagement_index, engagement_initiative, engagement_level, engagement_score, engagement_survey, environment_hse, equal_opportunity, equality, equality_and_diversity, equality_and_inclusion, equality_diversity, equality_diversity_and_inclusion, equality_in_the_workplace, ethic, ethic_and_anti_corruption, ethical, ethical_business_practice, ethnic_diversity, female_participation, female_representation, fire_safety, food_safety, force_labor, force_labour, forced_and_child_labor, forced_and_child_labour, forced_and_compulsory, forced_and_compulsory_labor, forced_and_compulsory_labour, forced_bond, forced_compulsory_or_child_labour, forced_labor, forced_labor_and_child_labor, forced_labor_child_labor, forced_labour, forced_labour_child_labour, forced_or_child_labor, forced_or_child_labour, forced_or_compulsory, forced_or_compulsory_labor, forced_or_compulsory_labour, forced_or_involuntary_labour, forced_or_mandatory, form_of_discrimination, form_of_modern_slavery, foster_diversity, freedom_of_association, freedom_of_expression, fundamental_convention, fundamental_freedom, gender, gender_and_ethnic, gender_and_ethnicity, gender_and_race, gender_and_race_diversity, gender_balance, gender_balanced, gender_diversity, gender_equality, gender_equality_and_diversity, gender_equity, gender_ethnicity_and_age, gender_inclusion, gender_parity, gender_representation, gender_target, global_diversity, group_employee_engagement, harassment_and_abuse, health_and_hygiene, health_and_safety_ehs, health_and_safety_h&s, health_and_safety_in_the_workplace, health_and_wellbeing, health_protection, health_safety, health_safety_and_environment, health_safety_and_environment_hse, health_safety_and_environmental, health_safety_and_environmental_hse, health_safety_and_the_environment_hse, health_safety_and_welfare, health_safety_and_wellbeing, health_safety_and_wellness, hr_initiative, hr_strategy, hr_team, hse, hse&s, hse_management, hse_policy, hsse, human_and_labor, human_and_labour, human_capital, human_dignity, human_resource, human_resource_hr, human_right, human_right_and_fundamental_freedom,

	human_right_anti_corruption, human_right_labor, human_right_labour, human_right_violation, human_rights, human_trafficking, hygiene_and_safety, illegal_labour, ilo_convention, ilo_core_convention, inclusion_and_diversity, inclusion_and_equality, inclusion_d&i, inclusive_culture, inclusive_workplace, inclusiveness, inclusivity, inclusivity_and_diversity, industrial_hygiene, injury_prevention, intellectual_capital, internal_mobility, job_rotation, job_satisfaction, knowledge_capital, labor_and_child_labor, labor_practice, labor_right, labor_standard, labour_practice, labour_right, labour_standard, leadership_development, leadership_diversity, leadership_engagement, leadership_training, learning_and_development, lgbt+, lgbtq+, management_development, measurable_objective, mental_health_and_wellbeing, modern_slavery, modern_slavery_and_human_trafficking, morale, motivation, non_discrimination, nurture, occupational_health, occupational_health_and_hygiene, occupational_health_and_safety, occupational_health_and_safety_ohs, occupational_health_safety, occupational_safety, occupational_safety_and_health, occupational_safety_and_health_osh, ohs, ohs_policy, ohse, operational_excellence, organisational_capability, organisational_culture, osh, people_development, people_diversity, people_engagement, people_initiative, people_management, people_policy, people_practice, people_section, people_strategy, percentage_of_woman, performance_culture, performance_management, personnel_development, plant_safety, prevention_of_discrimination, process_safety, product_safety, prohibition_of_child_labor, promote_diversity, promotion_of_diversity, proportion_of_woman, pulse_survey, qhse, race_and_gender_diversity, race_diversity, recruitment_training, representation_of_woman, responsible_gambling, retain_talent, right_principle, safe_working, safe_working_environment, safety_and_environmental_protection, safety_and_health, safety_and_hygiene, safety_and_welfare, safety_and_wellbeing, safety_awareness, safety_compliance, safety_culture, safety_health, safety_health_and_welfare, safety_health_and_wellbeing, safety_health_and_wellness, safety_in_the_workplace, safety_issue, safety_management, safety_measure, safety_performance, safety_policy, safety_practice, safety_procedure, safety_process, safety_programme, safety_safety, safety_standard, safety_training, self-development, sexual_discrimination, sheq, site_safety, skill_development, skill_enhancement, skilled_workforce, slave_labour, slavery, slavery_and_human_trafficking, slavery_servitude, staff_development, staff_engagement, staff_satisfaction, staff_survey, staff_wellbeing, talent, talent_acquisition, talent_development, talent_management, talent_pool, talented_people, talented_workforce, team_engagement, training_opportunity, transport_safety, underage_labour, value_diversity, voice_survey, wellbee, wellbeing_and_safety, work_environment, work_place, work_practice, work_safety, work_satisfaction, worker_engagement, worker_right, worker_safety, workforce, workforce_diversity, workforce_engagement, working_environment, work-life, work-life_balance, workplace, workplace_climate, workplace_culture, workplace_discrimination, workplace_diversity, workplace_environment, workplace_equality, workplace_health, workplace_health_and_safety, workplace_inclusion, workplace_safety, workplace_safety_and_health, workplace_wellness
Products & Customers	advanced_technology, advertising_and_labelling, advertising_code, advertising_labelling, advertising_practice, aesthetic, anti_terrorism, anti-_virus,

| | brand_image, brand_reputation, breach_of_customer_privacy, breach_of_privacy, business_compliance, business_continuity, client_confidentiality, client_datum, client_privacy, competitive_advantage, competitive_edge, competitive_pricing, competitiveness, compliance_management, compliance_program, compliance_programme, compliance_risk, compliance_training, component_quality, confidentiality, construction_quality, consumer_communication, consumer_information, consumer_privacy, consumer_protection, consumer_safety, consumer_satisfaction, continuous_effort, continuous_improvement, continuous_innovation, cost_competitiveness, cost_efficiency, cost-competitiveness, cost-effectiveness, cost-efficiency, customer_benefit, customer_care, customer_confidentiality, customer_data, customer_data_privacy, customer_datum, customer_datum_privacy, customer_delight, customer_expectation, customer_experience, customer_focus, customer_health, customer_information, customer_need, customer_orientation, customer_perception, customer_privacy, customer_privacy_gri, customer_product, customer_protection, customer_requirement, customer_safety, customer_satisfaction, customer_service, customer_value, customer_welfare, cyber, cyber_risk, cyber_security, cyber_security_issue, cyber_threat, cybersecurity, cyber-security, cycle_time, data_breach, data_classification, data_confidentiality, data_encryption, data_governance, data_integrity, data_leakage, data_loss_prevention, data_privacy, data_protection, data_protection_and_privacy, data_protection_officer, data_security, data_security_and_privacy, data-protection, datum_privacy, datum_protection, datum_retention, datum_security, datum_subject, delivery_capability, delivery_performance, delivery_quality, delivery_reliability, delivery_time, dependability, differentiation, drug_quality, durability, efficiency_and_productivity, employee_privacy, encryption, end_product, end-product, enhance_productivity, entire_supply_chain, environment_hsse, environmental_friendliness, environmental_responsibility, equipment_reliability, ethical_sourcing, eu_gdpr, eu_general_data_protection_regulation, eu_general_data_protection_regulation_gdpr, eu_regulation_2016/679, export_control, fair_operating_practices, financing_of_terrorism, food_quality, forefront_of_everything, freshness, fuel_efficiency, functionality, gdpr, global_supply_chain, gri_417, gri_418, guest_privacy, high_quality, hygiene, icc_code, improve_efficiency, improve_productivity, improved_efficiency, information_confidentiality, information_management, information_privacy, information_protection, information_security, information_system, ingredient, innovative_product, it_governance, it_policy, it_security, it_security_policy, labelling_and_marketing, labelling_marketing, law_enforcement, legislative, localization, logistical, manufacture_quality, manufacturing_capability, manufacturing_efficiency, manufacturing_method, manufacturing_process, manufacturing_quality, manufacturing_standard, manufacturing_system, marketing_and_labeling, marketing_and_labelling, marketing_code, marketing_communication, marketing_ethic, marketing_practice, material_quality, network_quality, network_security, nutrition_information, operating_efficiency, operational_efficiency, packaging_quality, patient_care, patient_privacy, patient_safety, pdpa, people_safety, personal_data, personal_datum, personal_datum_protection, personal_privacy, physical_and_logical, plant_efficiency, plant_reliability, popi_act, popia, precision, prevent_underage, prevention_of_money_laundering, price_competitiveness, print_quality, privacy, privacy_and_confidentiality, |

	privacy_and_data_protection, privacy_and_datum_protection, privacy_and_freedom_of_expression, privacy_awareness, privacy_compliance, privacy_governance, privacy_issue, privacy_legislation, privacy_management, privacy_matter, privacy_policy, privacy_protection, privacy_regulation, privacy_right, privacy_risk, privacy_security, privacy_standard, process_capability, process_control, process_efficiency, process_improvement, process_optimization, process_quality, process_reliability, process_technology, procurement_practice, product_availability, product_competitiveness, product_consistency, product_delivery, product_design, product_development, product_differentiation, product_durability, product_efficiency, product_feature, product_formulation, product_functionality, product_innovation, product_integrity, product_labelling, product_manufacturing, product_offering, product_performance, product_property, product_purity, product_quality, product_range, product_reliability, product_responsibility, product_security, product_selection, product_specification, product_stability, product_standard, product_stewardship, product_supply, product_sustainability, product_technology, product_traceability, product_value, production_capability, production_chain, production_efficiency, production_procedure, production_process, production_quality, production_standard, production_system, production_technology, production_yield, productivity, productivity_and_efficiency, project_execution, promote_responsible_drinking, protection_of_privacy, protocol, quality_and_durability, quality_and_quantity, quality_and_reliability, quality_aspect, quality_assurance, quality_assurance_system, quality_consistency, quality_control, quality_enhancement, quality_excellence, quality_improvement, quality_issue, quality_level, quality_management, quality_management_system, quality_material, quality_parameter, quality_performance, quality_process, quality_product, quality_production, quality_requirement, quality_service, quality_standard, quality_system, raw_material_procurement, raw_material_supply, reliability, reputation, responsible_drinking, responsible_gaming, responsible_marketing, responsible_sourcing, responsiveness, safety_and_reliability, safety_health_and_well-being, sapin_2, security_awareness, security_compliance, security_control, security_management, security_measure, security_policy, security_practice, security_protocol, security_risk, security_standard, service_delivery, service_excellence, service_labelling, service_level, service_quality, stakeholder_involvement, standardization, stringent, substantiated_complaint_concern, substantiated_complaint_regard, superior_quality, supplier_chain, supplier_collaboration, supplier_diversity, supplier_engagement, supplier_management, supplier_quality, supplier_sustainability, supply_chain, supply_chain_management, supply_chain_responsibility, supply_chain_sustainability, supply_chain_transparency, supply_reliability, sustainability_footprint, sustainable_sourcing, sustainable_supply_chain, system_performance, system_security, technical_capability, technological, technological_capability, technological_innovation, technology_innovation, terrorist_financing, throughout_the_supply_chain, time_delivery, timely_delivery, traceability, trade_compliance, user_experience, user_privacy, user-friendliness, value_engineering, vigilance, workforce_health, workmanship
Other Stakeholders	413-1, aboriginal, aboriginal_community, aboriginal_people, abuse, advocacy, affected_community, anti_bribery, anti_bribery_and_anti_corruption, anti_bribery_corruption, anti_competitive_behaviour, anti_competitive_practice,

| | anti_corruption, anti_corruption_anti_bribery, anti_corruption_law, anti_corruption_policy, anti_fraud, anti_money_launder, anti_money_laundering, anti_money_laundering_and_sanction, anti_social, anticorruption, bribe, bribe_and_corruption, bribery, bribery_and_corruption, bribery_and_extortion, bribery_and_money_laundering, bribery_blackmail, bribery_corruption, bribery_extortion, bribery_extortion_fraud, bribery_fraud, bribery_kickback, bribery_money_laundering, bribery_or_corruption, bullying, bullying_and_harassment, business_community, business_crime, business_partner, capacity_building, charitable_giving, child_abuse, citizen, civic, civil_society, combat_corruption, combat_fraud, combat_money_laundering, communite, communitie, communities, community_action, community_activity, community_affair, community_and_charitable, community_around, community_aspect, community_assistance, community_awareness, community_benefit, community_building, community_care, community_commitment, community_community, community_connection, community_consultation, community_contribution, community_development, community_education, community_effort, community_empowerment, community_engagement, community_enhancement, community_enrichment, community_environment, community_event, community_group, community_health, community_impact, community_in_the_vicinity, community_initiative, community_interaction, community_interest, community_investment, community_involvement, community_leader, community_leadership, community_level, community_liaison, community_life, community_member, community_need, community_neighbour, community_organisation, community_organization, community_outreach, community_outreach_program, community_outreach_programme, community_participation, community_partner, community_partnership, community_program, community_programme, community_project, community_projects, community_relation, community_relations, community_relationship, community_resident, community_service, community_sponsorship, community_stakeholder, community_strategy, community_support, community_surround, community_training, community_upliftment, community_welfare, community_wellbeing, community_well-being, community_work, competition_law, compliance_violation, condemn_corruption, corporate_citizen, corporate_citizenship, corporate_philanthropy, corrupt, corrupt_activity, corrupt_behavior, corrupt_behaviour, corrupt_business_practice, corrupt_practice, corruption, corruption_action, corruption_activity, corruption_and_bribery, corruption_and_fraud, corruption_and_influence_peddling, corruption_and_influence-peddling, corruption_and_money_laundering, corruption_and_unethical, corruption_bribery, corruption_case, corruption_corruption, corruption_extortion, corruption_fraud, corruption_money_laundering, corruption_offense, corruption_or_bribery, corruption_practice, corruption_prevention, corruption_risk, corruption_violation, corruptive, corruptive_practice, counter_corruption, crime, criminal, criminal_activity, criminality, cultural, cybercrime, dialogue_with_stakeholder, disadvantaged_community, discrimination_and_harassment, discrimination_harassment, dishonest, education_and_entrepreneurship, educational, educational_initiative, employee_care, employee_volunteering, employee_volunteerism, employment_opportunity, engagement_activity, engagement_project, environmental_stewardship, estate_community, extortion, |

| | extortion_bribery, facilitation_payment, farming_community, fight_against_corruption, fight_corruption, fishing_community, fraud_and_corruption, fraud_and_money_laundering, fraud_bribery, fraud_bribery_and_corruption, fraud_corruption, fraud_money_laundering, fraud_prevention, fraudulent_activity, g4-so1, g4-so5, gambling_addiction, gift_and_entertainment, gift_and_hospitality, gift_and_invitation, gift_bribe, good_corporate_citizen, good_neighbour, government_relation, grassroots_level, grey_economy, gri_413, harassment, harassment_and_bullying, harassment_and_discrimination, harassment_bullying, harassment_in_the_workplace, harassment_or_discrimination, health_and_education, health_and_well-being, health_education, host_community, human_right_abuse, human_right_infringement, humanitarian, humanity, illegal, illegal_activity, illegal_behavior, inappropriate_behavior, inappropriate_behaviour, indigenous, indigenous_community, indigenous_people, influence_peddling, infringement, labour_exploitation, less_fortunate, livelihood, living_environment, local_authority, local_charity, local_communities, local_community, local_inhabitant, local_iwi, local_municipality, local_populace, local_population, local_resident, local_school, local_villager, malpractice, marginalise_community, mining_community, misconduct, money_launder, money_laundering, money-laundering, nearby_community, nearby_resident, neighbor, neighborhood, neighboring_community, neighbour, neighbourhood, neighbourhood_community, neighbouring_community, ngos, offence, offense, organize_crime, organized_crime, outreach, outreach_programme, passive_corruption, people_live, people_with_disability, philanthropy, power_harassment, prevent_corruption, prevention_of_corruption, privileged_community, prohibit_bribery, rejection_of_corruption, responsible_corporate_citizen, right_violation, rural_community, sense_of_community, sexual_harassment, sexual_harassment_in_the_workplace, social_and_cultural, social_capital, social_cultural, social_dumping, social_fabric, social_impact, social_investment, social_upliftment, socially_responsible, society_at_large, socioeconomic, socio-economic, socio-economic_development, staff_volunteerism, stakeholder_community, stakeholder_engagement, stakeholder_management, stakeholder_relation, stakeholder_relationship, street_to_school, surround_area, surround_community, sustainability_education, sustainability_programme, tax_evasion, terrorism, trafficking, training_and_education, uk_bribery_act, unacceptable_behaviour, undeclared_work, underprivileged, underprivileged_community, underserved_community, unethical, unethical_behaviour, unfair_competition, upliftment_of_community, village_community, villager, violation, violence, violence_against, violence_and_harassment, violence_in_the_workplace, volunteering, volunteerism, vulnerable_community, welfare, welfare_of_the_community, well_being, wellbeing, well-being, wellbeing_of_the_community, well-being_of_the_community, whistle_blow, whistle_blowing, whistleblowing, wide_community, workplace_bullying, workplace_violence, worthy_cause, wrongdoing, young_people, youth, youth_development |

Panel B. General E&S Words and Phrases

conserve_the_environment, corporate_responsibility, cr_initiative, csi_initiative, csr_effort, csr_initiative, csr_perspective, csr_program, csr_programme, enviromental, environment_impact, environmental_and_social, environmental_and_societal, environmental_awareness, environmental_footprint, environmental_impact, environmental_protection, environmental_social, environmental, environmentally, esg, protect_the_environment, protection_of_the_environment, social_and_environmental, social_responsibility, socially, sustainability_agenda, sustainability_challenge, sustainability_impact, sustainability_initiative, sustainability_issue, sustainability_management, sustainability_strategy, sustainable_development, sustainable_society

Panel C: Words and Phrases Excluded from the E&S Dictionary

Subtopics	Words and phrases excluded
Climate Change	**Top 1500 frequent words:** sustainability **Manually excluded:** baseline, health_issue, hiv_aids, obesity, phenomenon, societal
Natural Resources	**Top 1500 frequent words:** energy **Manually excluded:** bf_#, consumption, instal_vfd, massecuite, maximum_demand, stripper, vfd
Pollution & Waste	**Manually excluded:** sort
Ecosystem	**Top 1500 frequent words:** environment **Mannually excluded:** alliance, across_the_globe, across_the_value_chain, across_the_world, architecture, arena, array, business_ecosystem, business_platform, capability, chain, collaborate, collaboration, collaborative, connectivity, cut_edge_technology, daily_life, digital, digital_ecosystem, digital_platform, digital_solution, digital_technology, digital_transformation, domain, everyday_life, footprint, global, global_scale, heart, help, holistic, hub, human_health, increasingly, industry, infrastructure, innovate, innovation, innovation_ecosystem, innovative, innovative_solution, innovative_technology, intelligent, lifestyle, marketplace, mobility, nation, network, next_generation, partnership, platform, player, poverty, powerful, service_platform, smart, solution, sustainable, technology, technology_platform, truly, unique, value_chain, value_proposition, vibrant, world
Human Capital	**Top 1500 frequent words:** culture, diversity, health_and_safety, skill, training **Mannually excluded:** awareness, flight_safety, governance, human, safety
Products & Customers	**Top 1500 frequent words:** consumer, efficiency, product, regulatory **Mannually excluded:** care_deeply, cleanliness, compliance, continuous, continuously_improve, effort, enforcement, organisational, organizational, packaging_design, paper_quality, prevention, procedural, procedure, purity, quality, speed, superior, vacy, very_seriously
Other Stakeholders	**Top 1500 frequent words:** community, fraud, social, society, stakeholder **Mannually excluded:** around_the_world, behavior, caring, competition, encourage, foster, health, incident, initiative, investor_relation, local, people, surrounding, worker

Table OA.2. E&S Disclosure Examples

Panel A: Environmental Disclosure Examples:

Subtopic	Example
Climate Change	We all must maintain and protect ecological balance of the earth by preserving and growing more trees for avoiding catastrophic global warming situation on the earth.
Natural Resources	Electrical consumption was decreased from 1,028 kWh to 786 kWh while water consumption has decreased from 5.2 m^3 to 2.4 m^3.
Pollution & Waste	For odor generated from wastewater treatment, we have planted greenbelts around the gas sources and collected it for bio-treatment in order to meet national emission standards.
Ecosystem	The Group's approach to biodiversity includes striving to preserve the quality of water ecosystems and supporting existing biodiversity.

Panel B: Social Disclosure Examples:

Subtopic	Example
Human Capital	Balco's equality policy includes goals and measures described for the following areas: working conditions, parenthood and work, prohibition on discrimination and harassment, gender breakdown, skills development and recruitment as well as wage issues.
Products & Customers	These products may also present data security and data privacy risks and be subject to certain laws, government policies or regulations not applicable to more traditional products, such as the U.S. Children's Online Privacy Protection Act of 1998 and the EU Data Protection Directive.
Other Stakeholders	We also support the economic and social well-being of our communities through tailored social development programs.

Table OA.3. E&S Dictionary based on the First Half of the Sample

This table presents empirical results on the evolution of E&S disclosure attributes over time, the effects of voluntary ESG reporting frameworks on E&S disclosure attributes, the changes in E&S disclosure following the most comprehensive disclosure mandates when only using words and phrases that have appeared in the first half of our sample (i.e., 2001 to 2010) to construct E&S disclosure measures. The dependent variables include *Length*, *Boilerplate, Specificity*, *Stickiness*, and *Visual*. In Panel A, the key independent variable, *Trend*, is the year of the annual report minus 2000. In Panel B, the key independent variable, *Framework*, is a dummy variable which takes the value of one if a firm has adopted a voluntary ESG reporting framework, and zero otherwise. In Panel C, the key independent variable, *Mandate Comp*, is an indicator that equals one after a country's most comprehensive E&S disclosure mandate during our sample period has become effective. We control for the same set of environmental factors, social factors, and market forces as our main analyses. We also control for *Total boilerplate*, *Total specificity*, *Total stickiness*, or *Total visual* in the regression when the corresponding ESG disclosure attribute is the dependent variable. The definitions and sources of the variables are available in the Appendix. The standard errors are clustered at the country level and reported in parentheses. ***, **, and * indicate significant levels at 1%, 5%, and 10%, respectively.

Panel A: Overall trend in E&S disclosure

Dependent variable:	*Length*	*Boilerplate*	*Specificity*	*Stickiness*	*Visual*
	(1)	(2)	(3)	(4)	(5)
Trend	0.149***	0.313**	-0.097**	0.087***	0.222
	(0.027)	(0.141)	(0.036)	(0.017)	(0.203)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No
Obs.	155,317	152,152	155,317	93,327	155,313
Adj. R²	0.751	0.567	0.395	0.386	0.620

Panel B: Voluntary framework and E&S disclosure

Dependent variable:	Length	Boilerplate	Specificity	Stickiness	Visual
	(1)	(2)	(3)	(4)	(5)
Framework	0.569***	-0.736***	0.006	0.279**	2.252***
	(0.134)	(0.197)	(0.047)	(0.102)	(0.509)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	155,317	152,152	155,317	93,327	155,313
Adj. R²	0.760	0.568	0.397	0.389	0.624

Panel C: E&S disclosure changes around the most comprehensive disclosure mandate

Dependent variable:	Length	Boilerplate	Specificity	Stickiness	Visual
	(1)	(2)	(3)	(5)	(6)
Mandate Comp	0.306***	1.615*	-0.357**	0.377***	0.027
	(0.079)	(0.936)	(0.145)	(0.137)	(0.667)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	155,317	152,152	155,317	93,327	155,313
Adj. R²	0.757	0.569	0.398	0.389	0.622

Table OA.4. Detailed Analysis of Table 4 Panel A

This table repeats the analysis in Table 4 Panel A by examining the effects of environmental factors, social factors, and market forces separately without any fixed effects. The empirical model is:

$$Length = \beta_0 + \beta_1 \times Environmental\ Factors + \beta_2 \times Social\ Factors + \beta_3 \times Market\ Forces + \varepsilon$$

Length is the total number of words from E&S-related sentences scaled by 1000. Environmental factors include *Forest pct*, *GHG per capita*, *Natural resource rent*, and *Renewable energy*. Social factors include *Female labor pct*, *Life expectancy*, *Population*, *Rule of Law*, and *Unemployment*. Market forces include *Agriculture pct*, *GDP growth*, *GDP per capita*, *Market cap / GDP*, and *Opaqueness*. The standard errors are clustered at the country level and reported in parentheses. ***, **, and * indicate significant levels at 1%, 5%, and 10%, respectively.

Dependent variable:	*Length*		
	(1)	(2)	(3)
Environmental factors			
Forest pct	0.016***		
	(0.004)		
GHG per capita	-0.022**		
	(0.009)		
Natural resource rent	-0.094***		
	(0.031)		
Renewable energy	-0.006		
	(0.007)		
Social factors			
Female labor pct		0.003	
		(0.009)	
Life expectancy		0.158***	
		(0.035)	
Population		0.141**	
		(0.055)	
Rule of law		-0.842***	
		(0.185)	
Unemployment		0.117***	
		(0.032)	
Market forces			
Agriculture pct			-0.036
			(0.022)
GDP growth			-0.072**
			(0.031)
GDP per capita			0.002
			(0.005)
Market Cap / GDP			-0.000
			(0.001)
Opaqueness			-0.883***
			(0.217)
Country FE	No	No	No
Firm FE	No	No	No
Year FE	No	No	No
Obs.	200,605	196,298	193,327

Table OA.5. Detailed Analysis of Table 4 Panel B

This table repeats the analysis in Table 4 Panel B by removing all fixed effects. The empirical model is:

$$E\&S\ disclosure = \beta_0 + \beta_1 \times Environmental\ Factors + \beta_2 \times Social\ Factors + \beta_3 \times Market\ Forces + \varepsilon$$

The dependent variables include *Length*, *Boilerplate*, *Specificity*, *Stickiness*, and *Visual*. Environmental factors include *Forest pct*, *GHG per capita*, *Natural resource rent*, and *Renewable energy*. Social factors include *Female labor pct*, *Life expectancy*, *Population*, *Rule of Law*, and *Unemployment*. Market forces include *Agriculture pct*, *GDP growth*, *GDP per capita*, *Market cap / GDP*, and *Opaqueness*. The standard errors are clustered at the country level and reported in parentheses. ***, **, and * indicate significant levels at 1%, 5%, and 10%, respectively.

Dependent variable:	Boilerplate (1)	Specificity (2)	Stickiness (3)	Visual (4)
Environmental factors				
Forest pct	0.066	-0.010*	0.018	0.017
	(0.042)	(0.005)	(0.011)	(0.028)
GHG per capita	0.195**	-0.007	0.073**	0.111*
	(0.077)	(0.012)	(0.029)	(0.062)
Natural resource rent	-0.203	0.049	-0.066	-0.084
	(0.172)	(0.031)	(0.052)	(0.125)
Renewable energy	0.040	-0.008	0.028**	0.095***
	(0.049)	(0.006)	(0.012)	(0.034)
Social factors				
Female labor pct	-0.184*	0.004	-0.008	0.049
	(0.094)	(0.020)	(0.038)	(0.081)
Life expectancy	0.417**	0.001	-0.101	-0.134
	(0.178)	(0.043)	(0.074)	(0.138)
Population	1.603***	-0.194**	0.416***	-0.236
	(0.411)	(0.073)	(0.098)	(0.377)
Rule of law	-4.309**	0.228	-0.137	-1.535
	(1.623)	(0.313)	(0.439)	(1.317)
Unemployment	0.368***	-0.016	-0.021	-0.171
	(0.128)	(0.030)	(0.069)	(0.125)
Market forces				
Agriculture pct	0.032	0.064	-0.147	-0.444*
	(0.244)	(0.043)	(0.110)	(0.228)
GDP growth	-0.036	-0.021	-0.089	-0.300**
	(0.107)	(0.025)	(0.067)	(0.122)
GDP per capita	0.137**	-0.006	0.027*	-0.045
	(0.052)	(0.009)	(0.014)	(0.042)
Market Cap / GDP	0.010	0.001	0.005	0.014*
	(0.006)	(0.002)	(0.003)	(0.008)
Opaqueness	1.075	0.037	-1.028***	-1.585**
	(0.727)	(0.294)	(0.371)	(0.665)
Firm characteristics				
Analyst coverage	-0.199	0.086	0.359**	0.789*
	(0.253)	(0.066)		(0.410)
ESG rating	-0.193	0.128	0.017	3.186***
	(0.843)	(0.082)	(0.254)	(0.660)
ESG report	-0.221	0.078	-0.015	1.649**

	(0.264)	(0.076)	(0.187)	(0.610)
Firm returns	-0.344***	0.054***	0.041	0.074
	(0.088)	(0.015)	(0.078)	(0.096)
Firm return volatility	3.377	-0.245	-7.887***	-4.962
	(9.805)	(1.310)	(1.833)	(6.912)
Inst ownership	2.359	-0.890***	-0.189	4.334
	(1.628)	(0.299)	(0.548)	(2.689)
Leverage	0.962**	0.032	-0.178	-0.926**
	(0.432)	(0.155)	(0.275)	(0.449)
ROA	-0.028	-0.125***	0.706***	-0.002
	(0.269)	(0.044)	(0.156)	(0.341)
Size	0.150	0.005	-0.098	0.092
	(0.253)	(0.036)	(0.106)	(0.157)
Tobin Q	0.081	-0.030***	-0.004	0.109*
	(0.083)	(0.010)	(0.031)	(0.058)
Total words	-2.327**	0.933***	3.186***	0.553
	(0.911)	(0.144)	(0.388)	(0.572)
Country FE	No	No	No	No
Firm FE	No	No	No	No
Year FE	No	No	No	No
Obs.	154,513	157,821	113,501	157,754

Table OA.6. Trend and Framework Analyses Using Firms with at least 10 Years of Data

We re-estimate equation (2) in Panel A and equation (3) in Panel B by only including firms that have appeared in the sample at least ten times. The dependent variables include *Length*, *Boilerplate*, *Specificity*, *Stickiness*, and *Visual*. In Panel A, the key independent variable, *Trend*, is the year of the annual report minus 2000. In Panel B, the key independent variable, *Framework*, is a dummy variable which takes the value of one if a firm has adopted a voluntary ESG reporting framework, and zero otherwise. We control for the same set of environmental factors, social factors, and market forces as our main analyses. We also control for *Total boilerplate*, *Total specificity*, *Total stickiness*, or *Total visual* in the regression when the corresponding ESG disclosure attribute is the dependent variable. The definitions and sources of the variables are available in the Appendix. The standard errors are clustered at the country level and reported in parentheses. ***, **, and * indicate significant levels at 1%, 5%, and 10%, respectively.

Panel A: Overall trend in E&S disclosure

Dependent variable:	*Length*	*Boilerplate*	*Specificity*	*Stickiness*	*Visual*
	(1)	(2)	(3)	(4)	(5)
Trend	0.122***	0.327**	-0.111***	0.045	0.169
	(0.025)	(0.146)	(0.036)	(0.069)	(0.198)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No
Obs.	116,198	114,361	116,198	86,799	116,142
Adj. R²	0.765	0.547	0.381	0.460	0.623

Panel B: Voluntary framework and E&S disclosure

Dependent variable:	*Length*	*Boilerplate*	*Specificity*	*Stickiness*	*Visual*
	(1)	(2)	(3)	(4)	(5)
Framework	0.450***	-0.802***	0.013	0.607***	2.210***
	(0.107)	(0.193)	(0.051)	(0.205)	(0.504)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	116,198	114,361	116,198	86,799	116,142
Adj. R²	0.773	0.548	0.383	0.462	0.627

Table OA.7. Mandate Analyses with Firms Existing Both Before and After Mandates

We re-estimate equation (4) by including firms with available observations both before and after the country's E&S disclosure mandate. The dependent variables include *Length*, *Boilerplate, Specificity*, *Stickiness*, and *Visual*. *Mandate* is either an indicator that equals one after a country's first E&S disclosure mandate (*Mandate First*) during our sample period has become effective or an indicator that equals one after a country's most comprehensive E&S disclosure mandate (*Mandate Comp*) during our sample period has become effective. We control for the same set of environmental factors, social factors, market forces, and firm characteristics as our main analyses. The definitions and sources of the variables are available in the Appendix. The standard errors are clustered at the country level and reported in parentheses. ***, **, and * indicate significant levels at 1%, 5%, and 10%, respectively.

Panel A: E/S disclosure changes around the first disclosure mandate

Dependent variable:	*Length*	*Boilerplate*	*Specificity*	*Stickiness*	*Visual*
	(1)	(2)	(3)	(4)	(5)
*Mandate First * Post*	0.009	-0.287	-0.147	0.125	-0.685
	(0.063)	(0.546)	(0.096)	(0.223)	(0.532)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	121,697	119,303	121,697	87,364	121,644
Adj. R²	0.762	0.562	0.393	0.467	0.618

Panel B: E/S disclosure changes around the most comprehensive disclosure mandate

Dependent variable:	*Length*	*Boilerplate*	*Specificity*	*Stickiness*	*Visual*
	(1)	(2)	(3)	(4)	(5)
*Mandate Comp * Post*	0.230***	1.601*	-0.340**	0.465*	0.070
	(0.062)	(0.901)	(0.138)	(0.238)	(0.624)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	128,847	126,220	128,847	94,257	128,787
Adj. R²	0.770	0.575	0.398	0.479	0.629

Table OA.8. Falsification Tests

This table presents empirical results from falsification tests of the effects of voluntary ESG reporting frameworks on E&S disclosure attributes and the changes in E&S disclosure following the most comprehensive disclosure mandates. The dependent variables include *Length*, *Boilerplate, Specificity*, *Stickiness*, and *Visual*. In Panel A, we randomly assign firms to the voluntary ESG reporting framework pseudo adoption group and the key independent variable, *Framework Pseudo*, is a dummy variable which takes the value of one if a firm-year is after the pseudo adoption of a voluntary ESG reporting framework, and zero otherwise. In Panel B, we randomly assign an effective year of the most comprehensive E&S disclosure mandate to each firm with a uniform distribution between 2001 and 2020. The key independent variable, *Mandate Comp Pseudo*, is an indicator that equals one after the pseudo effective date of the most comprehensive disclosure mandate. We control for the same set of environmental factors, social factors, market forces, and firm characteristics as our main analyses. The definitions and sources of the variables are available in the Appendix. The standard errors are clustered at the country level and reported in parentheses. ***, **, and * indicate significant levels at 1%, 5%, and 10%, respectively.

Panel A: Pseudo voluntary framework adoption and E&S disclosure

Dependent variable:	*Length*	*Boilerplate*	*Specificity*	*Stickiness*	*Visual*
	(1)	(2)	(3)	(4)	(5)
Framework Pseudo	0.003	0.035	-0.009	0.005	-0.017
	(0.006)	(0.058)	(0.010)	(0.026)	(0.049)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	155,317	152,088	155,317	111,231	155,250
Adj. R²	0.772	0.523	0.397	0.476	0.625

Panel B: E&S disclosure changes around pseudo most comprehensive disclosure mandate

Dependent variable:	*Length*	*Boilerplate*	*Specificity*	*Stickiness*	*Visual*
	(1)	(2)	(3)	(5)	(6)
Mandate Comp Pseudo	0.001	0.038	0.007	0.025	0.044
	(0.004)	(0.047)	(0.016)	(0.026)	(0.057)
Controls	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	155,317	152,088	155,317	111,231	155,250
Adj. R²	0.772	0.523	0.397	0.476	0.625