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Comparison Of The Operationalization Of Carbon Emission Disclosure Measurement In Corporate Research In Indonesia: A Systematic Literature Review

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Abstract

This study examines how Carbon Emission Disclosure (CED) is operationalized in empirical research on companies in Indonesia. The review compares measurement sources, indicator structures, scoring procedures, index denominators, and reporting transparency. Six empirical studies published between 2020 and 2026 were examined at the full-text level for which measurement information could be verified. The studies use different approaches, including the 18-item Choi et al. (2013) index based on the Carbon Disclosure Project (CDP), the CDP information request sheet, the seven disclosures in GRI 305, and researcher-developed instruments. The findings show that the use of binary scoring does not by itself make CED indices comparable because the underlying items, denominators, aggregation procedures, and level of disclosure detail differ. In particular, a 37-item checklist developed with reference to GRI 305 should not be interpreted as 37 official GRI disclosures, since GRI 305 contains seven topic disclosures. The review identifies the absence of an item-level crosswalk and inconsistent reporting of scoring rules and formulas as key measurement issues. The findings highlight the need for transparent instrument documentation and explicit explanations of adaptations when measuring CED. The search and screening log must be completed and reported before the review can be considered a fully reproducible SLR.

Keywords: Carbon Emission Disclosure; Measurement Operationalization; Disclosure Index; CDP; GRI 305; Systematic Literature Review.

INTRODUCTION

Carbon Emission Disclosure (CED) is a disclosure of a company's information about greenhouse gas emissions, the impacts they cause, and its management policies

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and actions. In accounting research, CED is often treated as a construct measured through an analysis of the content of annual reports, sustainability reports, or other corporate documents. The narrative and quantitative information in the report is then classified into specific indicators to produce a disclosure score or index. Therefore, the operational quality of the measurement determines what information counts as a disclosure and how the company's disclosure rate is represented quantitatively (Borghei, 2021).

CED research in Indonesia has been reviewed through a literature review that maps the development of topics, method characteristics, and factors related to carbon disclosure. (Nursulistyo et al., 2023) for example, studying 30 articles in Indonesian journals indexed by SINTA, while (Nilasakti et al., 2024) mapping 60 articles that discuss CED in the Indonesian context. Both studies provide an overview of the development and direction of CED research. However, the focus of the research development mapping differs from a detailed examination of how each study constructs and applies CED measures, especially on the equivalence of indicators, denominators, weighting, and index formulas.

Measurement differences can be seen in the use of the index (Bae Choi et al., 2013) developed based on CDP information, the use of GRI 305, or instruments developed contextually by researchers. The differences relate not only to the number of items, but also to the substance of the information being assessed, the grouping of items, the scoring rules, and how to aggregate the scores into an index. GRI 305: Emissions 2016 itself contains seven topic disclosures (305-1 to 305-7), while certain studies develop additional checklists that refer to those standards. Thus, the term "GRI 305-based" does not necessarily mean that the study uses the seven standard disclosures directly or uses an identical structure.

This problem is important because two studies can both refer to their variables as CED and both use dichotomous scores, but produce indices that represent different information coverage. Different index values therefore cannot be directly interpreted as differences in the level of transparency of the company if the instruments, denominators, and aggregation procedures are not equivalent. Comparability of results requires adequate information about the origin of the instrument, the list of items, the scoring rules, and the formula applied.

Based on these problems, this study conducted a systematic review with a descriptive-comparative approach to answer three questions: (1) what instruments and indicators are used to measure CED in corporate research in Indonesia; (2) how the CED scoring system and index formula are applied; and (3) what are the similarities and differences in measurement approaches reviewed from the source of the instrument, the scope of indicators, the scoring system, and the index formula. The contribution of the

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study lies in the synthesis of the operationalization of measurements, not in the re-examination of the determinants or consequences of CED.

LITERATURE REVIEW

2.1 Carbon Emission Disclosure

CED refers to information submitted by a company regarding carbon or greenhouse gas emissions and the company's response to the impact of these emissions. The information disclosed may include the amount of emissions, calculation methods, emission coverage, energy consumption, emission reduction targets and realizations, and governance responsibilities related to climate change. In empirical research, CED is generally measured through content analysis by identifying the presence of information based on a list of indicators set by the researcher. The identification results can be presented as item scores, percentages, or composite indices.

2.2 Operationalization of CED Measurement

The operationalization of CED measurement includes at least five elements: the source of the instrument, the unit or scope of the indicator, the coding rule, the denominator or weight, and the aggregation formula. The source of the instrument indicates the framework on which the indicator is compiled, e.g. CDP/Choi or GRI 305. The coding rule describes the conditions under which an item is assigned a certain score. The denominator indicates the maximum number of items that are divisive, while the aggregation formula describes whether the score is summed directly or calculated first for each group of indicators.

Table of Contents (Bae Choi et al., 2013) The CDP-based consists of 18 items grouped into five categories, namely climate change risks and opportunities, accounting for greenhouse gas emissions, accounting for energy consumption, emission and cost reduction, and carbon emission accountability. Another approach uses GRI 305: Emissions 2016. The standard has seven topic disclosures, namely 305-1 to 305-7. Researchers can operationalize these disclosures directly or compile additional items that refer to the standard. The two approaches need to be explicitly distinguished.

Dichotomous systems generally give a value of 1 when information is found and 0 when information is not found. However, the same scoring system does not necessarily result in a comparable index. Indices with denominators of 18, 37, or an inter-group average formula measure the composition of different information. Therefore, index comparisons need to consider the equivalence of the substance of the indicators, not just the similarity of the name of the variable or the type of score.

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RESEARCH METHODS

This research is designed as a Systematic Literature Review (SLR) with a descriptive-comparative approach. Unit analysis is an empirical research article that uses companies in Indonesia as a research context and operationalizes CED as a variable or construct to be measured. The focus of extraction is not on the direction of the relationship between variables, but on the source of the instrument, the number and structure of indicators, the scoring system, denominators, index formulas, and the completeness of measurement reporting.

3.1 Literature Search Strategy

The search strategies listed in the working document establish Google Scholar and GARUDA as search sources. Keywords designed include "carbon emission disclosure", "carbon disclosure", "carbon emissions disclosure", "carbon disclosure index", "measurement", "indicators", "scoring", "CDP", "(Bae Choi et al., 2013) and GRI 305". Search combinations used in strategy designs include: (1) "carbon emission disclosure" AND measurement AND Indonesia; (2) "carbon emission disclosure" AND index AND Indonesia; (3) "carbon disclosure" AND CDP AND Indonesia; (4) "carbon emission disclosure" AND "GRI 305" AND Indonesia; and (5) "Disclosure of carbon emissions" AND index AND Indonesian companies.

The literature search was reportedly carried out on October 20, 2026 through Google Scholar and GARUDA, and was equipped with reference search from relevant articles. Based on the recapitulation of the selection flow submitted by the author, 65 records were obtained: 45 from Google Scholar, 15 from GARUDA, and 5 from reference search. After the 10 duplicates were removed, 55 records were filtered by title and abstract; 35 records were removed and 20 articles were searched at the full-text stage. Two full texts were not successfully obtained, so 18 articles were assessed for eligibility and 12 articles were excluded. Six articles were included in the synthesis. The figure is a recapitulation of the selection submitted by the author; before submission, the exact query, the export of search results, and the reasons for exclusion at the article level need to be stored as audit documentation.

3.2 Inclusion and Exclusion Criteria

Inclusion criteria include: (1) empirical research articles published in the period 2020–2026; (2) using companies in Indonesia as a context or research object; (3) measuring or operationalizing CED as one of the variables or constructs; (4) full text is available so that measurement information can be traced; and (5) the identity of the article can be verified through the publisher's page and/or DOI. Literature review, conceptual,

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or mapping articles are not included in the synthesis of empirical instruments, but can be used to explain the position of the study and the research gap.

An article is excluded if it does not measure CED, only discusses emissions without disclosure indicators, does not use the context of a company in Indonesia, does not provide traceable measurement information, is duplicate, or has unverifiable metadata. If an article uses the term CED but the measurement procedure is not explained, the limitation is noted and not filled with the reviewer's assumptions.

3.3 Data Selection, Extraction, and Synthesis

The literature selection follows the stages of identification, duplication, title and abstract filtering, full text checking, and assignment of articles for synthesis. PRISMA 2020 is used as a guideline for reporting the selection flow. The author's recapitulation shows that 65 records were identified, 10 duplicates were removed, 55 records were screened, 35 were removed at the title/abstract stage, 20 full texts were searched, 2 full texts were not obtained, 18 articles were assessed for eligibility, 12 were excluded, and 6 articles were included in synthesis. Query documentation, database exports, lists of excluded articles, and one main reason for exclusion for each article need to be attached or saved as an audit file for the process to be replicated.

Summary of the literature selection flow

Stages	Quantity
Footage from Google Scholar	45
Footage from GARUDA	15
Reference search	5
Total records identified	65
Duplicates removed	10
Recording after deduplication	55
Issued at title/abstract screening	35
Full text searched	20
Full text not obtained	2
Articles are assessed for eligibility	18
Issued after a full text check	12
Articles in final synthesis	6

Data extraction was carried out by recording authors and years, titles, journals, DOIs, company context and sectors, sample size, CED instruments, indicator sources, number of items, categories or themes, score rules, denominators, index formulas, and completeness of item lists. The analysis was carried out in a descriptive-comparative manner by comparing each element of measurement. Information that is not stated in the

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article is described as "unexplained" or "not yet certain", rather than inferred based on general practice.

RESULTS AND DISCUSSION

4.1 Characteristics of the Study Studied

A full-text audit and publisher metadata of six relevant empirical articles showed that CED research in Indonesia includes the manufacturing sector, polluting industries, companies listed on the Indonesia Stock Exchange, and SOEs. The observation period and sample size also vary. (Evana et al., 2021) using 264 company observations for the period 2015–2018; (Ratmono et al., 2021) using 45 observations from nine companies in 2013–2017; (Yauri & Widianingsih, 2023) using 117 observations from 34 manufacturing companies in 2016–2020; (Houten & Wedari, 2023) using 77 observations on polluting industries; (Fransisca et al., 2024) developing indicators and testing their determinants on 225 companies; while (Scott, 2026) using 76 observations of state-owned companies. This difference in context is an important background when interpreting the choice of instruments.

Table 1. Comparison of the operationalization of CED measurement in the empirical article reviewed

Research	Instrument base	Indicators/coverage	Scores and formulas	Audit records
(Evana et al., 2021)	Choi et al. (2013)/CDP	18 items; 5 categories	Score 1/0; the index of the number of items revealed divided by 18	Instruments and formulas are identified on the full PDF.
(Ratmono et al., 2021)	Choi et al. (2013)/CDP	18 items; 5 categories	Index 18 items; average 0.401 (about 7 out of 18 items revealed). The item score rules are not spelled out in detail in the measurement section.	Online publication recorded in 2020; article is in Vol. 11 No. 1 of 2021.

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Research	Instrument base	Indicators/coverage	Scores and formulas	Audit records
(Yauri & Widianingsih, 2023)	Choi et al. (2013), CDP-based checklist information request sheet	18 items; 5 categories	The article reported an average disclosure of 22.5% of 18 items; the formula and scoring rules are not explicitly spelled out in the methods section.	It is inappropriate to state a detailed formula has been reported if it is not listed in the article.
(Houten & Wedari, 2023)	GRI 305	7 GRI 305 disclosure	A score of 1 if an item is disclosed and 0 if it is not; the proportion is calculated per disclosure, then averaged over 7 disclosures.	Use an aggregation of the average between disclosures, rather than a single denominator of items.
(Fransisca et al., 2024)	Instruments developed from literature review	37 items grouped into 14 themes	N/37 percentage; score 2 if >50% and score 1 if <50%. The exact treatment of 50% is not described.	Contextual instruments of development; not to be confused with the official GRI 305 index.
Satria (2026)	Index of 37 items	37 items; scope includes Scope 1,	Score 1/0; The total	GRI 305 officially

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Research	Instrument base	Indicators/coverage	Scores and formulas	Audit records
	developed by the author with reference GRI 305	Scope 2, Scope 3, intensity, reduction initiatives, and verification	items are revealed divided by the maximum score.	contains 7 disclosures; 37 items are operationalized by the author. A complete list of items needs to be presented for replication to be possible.

Source: processed from the empirical article reviewed; the details of each measurement follow the information stated in the full text of the article.

4.2 Differences in Instrument Source and Indicator Structure

The three articles, namely Evana et al. (2021), Ratmono et al. (2021), and Yauri and Widianingsih (2023), use an approach rooted in the Choi et al. (2013) index and CDP. The index contains 18 items in five categories. This similarity of references provides a comparatively closer basis for comparison than instruments built from different frameworks. However, the similarity of instrument sources does not automatically guarantee the similarity of implementation procedures. Researchers still need to explain whether all items are used, how items are coded, and how the final score is calculated.

Houten and Wedari (2023) used GRI 305 with seven topic disclosures. The article scored 1 for the disclosed items and 0 for the undisclosed items, calculated the proportions on each disclosure, and then flattened out the proportions. Consequently, each disclosure gained equal weight at the aggregation stage, although the number of requirements or details within each disclosure could differ. This approach is not identical to counting all items in a single list and dividing them by the total number of items.

Fransisca et al. (2024) developed the CED indicator based on a literature review and produced 14 themes with 37 items. This instrument is a contextual development, so its contribution lies in the preparation of indicators for the Indonesian context. Satria (2026) also uses 37 items, but states that the index is based on GRI 305. The two instruments should not be combined just because they have the same number of items. The origin of the development, the definition of the item, the scope of the theme, and the scoring rules are different. Furthermore, GRI 305 officially contains seven topic disclosures, instead of 37 disclosures; the 37 items in Satria should be understood as an operational list developed by the author with reference to the standard.

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4.3 Comparison of Score System and Index Formula

The findings show that dichotomous scores were used explicitly in Evana et al. (2021), Houten and Wedari (2023), and Satria (2026). However, the aggregation formula is different. In Evana et al., the number of items disclosed is divided by 18 items. Houten and Wedari calculate the proportions on each GRI 305 disclosure and then flatten them out. Satria calculates the proportion of items disclosed against the maximum score of 37 items. Thus, although the basic scoring scheme is similar, the resulting index does not have the same mathematical structure.

Ratmono et al. (2021) stated that the measurements used 18 items of Choi et al. (2013) and reported an average index of 0.401, which was interpreted as about seven items out of 18 items. However, the measurement section does not elaborate in detail on each item's scoring rules. Yauri and Widianingsih (2023) also used 18 items and reported an average of 22.5% of the 18 items, but the scoring formula and rules were not explicitly outlined in the methods section. Both articles remain relevant for comparing the source and scope of the instruments, but the rate of repeatability of the scoring procedure is more limited than the article explicitly stating the rules.

Fransisca et al. (2024) applied the N/37 percentage and changed the results to dummy categories: a score of 2 for percentages above 50% and a score of 1 for percentages below 50%. The article does not explain the treatment of the exact value of 50%. This ambiguity is important because incomplete classification rules can lead to differences in coding decisions when the study is replicated. Therefore, formula reporting should be accompanied by an N definition, denominator, category limit, and treatment of the limit value.

4.4 Measurement Transparency and Comparability

The transparency of measurement is not sufficiently judged by the mention of the name of the instrument or the number of items. The article needs to provide or clearly refer to the list of indicators used, explain any changes from the original instrument, establish coding rules, and present the index formula. In self-developed instruments, researchers need to explain the process of forming themes and items, sources of literature, and the reasons for including or removing indicators. Without such information, the reader cannot be sure whether the differences in the index come from the company's disclosure behavior or from the measurement design.

A comparison of the six articles reveals three sources of inequality. First, differences in coverage: an index of 18 CDP/Choi items, seven GRI 305 disclosures, and a local development instrument of 37 items do not measure identical sets of information. Second, differences in aggregation: the proportion to all items differs from the average proportion per group. Third, differences in transparency: some articles explain scores and

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formulas, while others mention checklists and report percentage results without presenting all operational rules. Therefore, CED index values cannot be directly compared without checking the equivalence of indicators and calculation procedures.

4.5 Synthesis and Research Gap

This synthesis identifies that CED measurement in corporate research in Indonesia does not rely on one uniform instrument. The Choi/CDP index, GRI 305, and the instruments developed by the researcher come with different indicator structures and aggregation procedures. The similarities lie in the use of content analysis or checklists to convert company report information into quantitative measures. The differences lie in the substantive scope, number of items, grouping of indicators, clarity of scores, denominators, and aggregation formulas.

The research gap that arises is not just the need to increase research on the determinants of CED. A more fundamental problem is the lack of item-level or crosswalk comparisons that show the equality of substance between the CDP/Choi instrument, GRI 305, and the locally developed instrument. In addition, not all studies have adequately reported a list of items and measurement rules to be replicated. This study fills some of this space by comparing the dimensions of operationalization, but it has not been able to conclude the most dominant or most appropriate instrument for all sectors because the final corpus of SLRs and their selection flows still have to be confirmed through a complete search log.

Implicitly, subsequent CED research needs to report on the source and version of the instrument, a list of indicators, an operational definition of each item, scoring rules, denominators, weighting, aggregation formulas, and treatment of irrelevant items. For comparative research, item-level crosswalks need to be arranged first so that similarities and differences in substance between instruments can be assessed before the indices are compared.

CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

The results of the review of six empirical articles show that the measurement of Carbon Emission Disclosure (CED) in Indonesia uses a variety of approaches, including the CDP-based Choi et al. (2013) index, the CDP checklist, GRI 305, and the instruments developed by the researchers. Differences can be seen in the number of indicators, scoring systems, denominators, and aggregation formulas. These findings show that the use of dichotomous scoring does not always produce indices that can be directly compared. The limitation of the details of indicators and measurement procedures in some articles is also an obstacle to replication. Thus, the comparability of CED

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measurement results needs to consider the characteristics of the instrument used, not just the value of the disclosure index.

5.2 Suggestions

Further research is recommended to present the instrument in a transparent manner by including the source and version of the standard, list of items, operational definitions, scoring rules, denominators, weighting, and index formulas. If indicators are developed or adapted, the development process and its relationship to the original instrument need to be explained. Comparative research also needs to establish an item-level crosswalk before comparing scores across companies, sectors, or periods. To complete this SLR, direct database searches, deduplication, screening, and exclusion reasons should be documented so that the number of final studies and PRISMA diagrams can be replicated.

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