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Corporate Climate Change Disclosure: A Survey of the U.S. Dow Jones 30 Companies

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Abstract
As the public has become increasingly aware of the climate change risks for businesses in recent years, U.S. companies are facing climate disclosure pressure from investors, governments, and environmental agencies. Hence, there is an urgent need to pay attention to whether and how U.S companies disclose climate change risks for businesses. This study presents the U.S. Dow Jones companies as examples, and we manually collect the climate change report data voluntarily disclosed by U.S. Dow Jones 30 companies in 10-K and corporate sustainability reports. We conduct a descriptive qualitative content analysis exploring whether these companies provide climate change reports, whether they follow national and international climate reporting guidelines, and what commitments they have made to mitigate and respond to climate change. Our results confirm that large U.S. companies have attached importance to global warming issues and made efforts to save energy and reduce carbon emissions, as demonstrated through multiple channels, including disclosure reports, climate change guidelines, energy certificates, and third-party assurance. By integrating multi-dimensional and comparable corporate climate change disclosure frameworks, this research provides investors, policymakers, and other stakeholders with appropriate corporate climate disclosure assistance, responding to the government and society's call for a low-carbon economy.

Keywords: climate change, corporate climate change disclosure, corporate sustainability reporting, environmental accounting, sustainability accounting

1. Introduction

One of the most significant risks facing society and organizations today relates to climate change (Burke et al., 2018). As people have become more aware of such risks in recent years, public opinion has become increasingly concerned and uncertain regarding the issues related to climate change (Patt and Weber, 2014). The large-scale and long-term nature of the climate change problem presents unique challenges, particularly in the context of economic decision-making and business impact. As stated in the Recommendations of the Task Force on Climate-related Financial Disclosures (TCFD), it is difficult for investors to determine which companies are most affected by climate change and which companies are taking action (TCFD, 2018).

In September 2016, the U.S. Securities and Exchange Commission (SEC) launched an investigation into ExxonMobil and its auditor PricewaterhouseCoopers, and New York Attorney General Eric Schneiderman examined whether ExxonMobil had engaged in misleading investors about climate change risks over the past few years (Olson and Viswanatta, 2016). Although SEC regulators dropped this investigation due to insufficient evidence later in 2018, the SEC's probe of the oil giant ExxonMobil has caused turmoil in the States (Michaels and Olson, 2018). Investors and government institutions have been questioning how large companies disclose climate change risks. Companies face tremendous pressure from investors, governments, and other environmental agencies to fully disclose the impact of climate change on business operations and companies' responses to climate risks (Campiglio et al., 2018; Cong et al., 2020; Griffin et al., 2017).

In order to help stakeholders better understand climate change risks from the perspective of corporate climate disclosure, our study examines the large U.S Dow Jones companies, including ExxonMobil, about disclosing climate change risks. We focus on whether companies disclose and how they disclose their support for policies that address climate change risks and how they seek to mitigate the damage climate change poses to investors and consumers. In order to weaken the adverse effects of this century's climate change, nearly 200 countries adopted the Paris Agreement to reduce their greenhouse gas (GHG) emissions and encourage a low-carbon economy. The call of transition to a low-carbon economy presents risks and creates opportunities for companies that focus on climate change mitigation and solutions (TCFD, 2018). According to a survey by Ernst & Young (2021), the biggest incentives for most companies to disclose climate change risks are enhancing company reputation and complying with policy and regulatory requirements.

The purpose of our research is to explore the climate change reports of the U.S. Dow Jones companies, in particular, to assist company managers and stakeholders in addressing the following research questions: (1) Do major U.S. companies report climate change information? (2) What guidelines are adopted by

U.S. firms when they report climate change issues? (3) What external assurances on climate change reporting can policymakers rely on? (4) How do U.S. firms respond to the development of global climate change reporting in practice, and how do they report on climate change issues? Questions 1-3 are addressed in Section II, and Question 4 is addressed in Section IV as the main results of the study.

To answer our research questions, we manually collected 10-K financial reports and sustainability reports of the U.S. Dow Jones 30 companies following the SEC dropping its climate disclosure investigation into ExxonMobil in 2018. From these public reports, we gathered the content related to climate change issues. We conducted a descriptive qualitative content analysis exploring whether these companies provided reports on climate change, how they reported climate change issues and risks, and the reporting guidelines and assurances they adopted. According to our analysis, positive progress has been made in corporate climate change reports. All 30 U.S. Dow Jones companies have publicly disclosed climate change business risks, and most companies sought third-party assurances for their climate change reports. At the same time, international guidelines for climate change reporting have been progressively enriched.

This study contributes to the literature in different ways. First, our research adds value to the literature on corporate climate change reporting and disclosure guidelines. Although some scholars have begun to study corporate climate disclosure (e.g., Matsumura et al., 2014; Tang and Demeritt, 2018), to the best of our knowledge, there is no study summarizing the multi-source climate change reporting of all Dow Jones companies to guide company managers and help investors on future climate change reports. Second, our research expands the literature on corporate energy certificates and third-party supervision for climate change (e.g., Iatridis and Kesidou, 2018; Manetti and Becatti, 2009). This summary provides policymakers with a reference and template based on our study of how major U.S. corporations report climate change issues, energy certifications, and third-party assurance. Third, our study has practical significance. Since FASB, PCAOB, and SEC do not currently provide mandatory guidelines on reporting climate change, our study integrates transparent and comparable corporate climate change disclosures, helping guide investors, policymakers, and other stakeholders to better understand the corporate climate disclosure framework and the impact of climate change on business operations.

The paper is organized as follows: Section I highlights the importance of companies' motivation to provide climate change reports in an international context. Section II provides detailed background on the theoretical framework of climate change disclosure and introduces current reporting guidelines. This section also introduces the third-party assurance of climate change reporting. Section III explains the research design and methodology. Section IV presents our study findings according to the U.S. Dow Jones 30 companies' climate change reporting and develops further discussions. Section V concludes our research contributions and discusses future research directions.

2. Background and Theoretical Framework

2.1 Climate change disclosure theoretical framework and literature background

The issue of climate change has become an essential aspect of corporate social responsibility (TCFD, 2017, 2018). Corporate concerns and disclosures about climate change are closely related to the theoretical frameworks of stakeholder theory and legitimacy theory. Stakeholder theory argues that the purpose of business operations is to create as much value as possible for stakeholders in order to align the business with the interests of customers, suppliers, employees, and shareholders (Miles, 2012). As climate change mitigation has become a focal point for sustainable development, stakeholder theory has been corroborated in previous literature (e.g., Deegan, 2002; Griffin et al., 2017; Jaggi et al., 2018; Liesen et al., 2015). Corporations must proactively address climate issues in response to societal expectations for mitigating climate change risks (Jaggi et al., 2018) and protecting the rights of investors and other stakeholders (Cotter and Najah, 2012; Haigh and Shapiro, 2012).

Legitimacy theory explains an organization's behavior in conducting voluntary social and environmental disclosures to fulfill its social contract (Burlea and Popa, 2013). According to Suchman (1995, p. 574), "Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions." At present, energy and emission reductions have become a universal initiative for societal sustainability. By voluntarily disclosing environmental policies and coping strategies that address climate change issues, companies raise their corporate reputation and social value (Chu et al., 2013; Deegan, 2002) and reduce potential financial risks (Matsumura et al., 2014). In addition, high-quality corporate climate disclosure in line with social legitimacy has positive impacts and financial consequences for investors' decision-making (Albertini, 2013; Busch and Lewandowski, 2018; Deegan and Rankin, 1997; Endrikat et al., 2014; Hrasky, 2012).

The issue of climate change has aroused widespread attention and interest from academic scholars. The number of climate change disclosure publications has increased since 2008 after the Kyoto Protocol and reached a second peak following the Paris Agreement in 2015 (Borghei, 2021). Previous literature has focused on corporate carbon disclosures from a wide variety of perspectives. Some scholars have explored the determinants of corporate carbon disclosure, such as company size (Freedman and Jaggi, 2005), corporate governance (Prado-Lorenzo and Garcia-Sanchez, 2010), environmental performance (Dawkins and Fraas, 2011; Jaggi et al., 2018), and more. Other literature has studied carbon accounting (Ascui and Lovell, 2012) and assurance of disclosure (Martínez-Ferrero et al., 2018) in terms of improving disclosure quality. In addition, an extensive literature has investigated the disclosure consequences through analyzing the impact of climate disclosure on companies and investors (Clarkson et al., 2015; Lee, 2012; Matsumura et al., 2014). However, while increasing companies have begun to disclose climate change risk and carbon information voluntarily, investors remain deeply concerned about the quality of the information and content companies voluntarily disclose (de Faria et al., 2018; Dragomir, 2012). A large body of prior literature has relied on secondary data from corporate CDP reports for quantitative research (e.g., Eleftheriadis and Anagnostopoulou, 2015; Griffin et al., 2017; Matsumura et al., 2014), while qualitative research on corporate multi-source voluntary climate disclosure is extremely limited. Many scholars have previously argued that the current literature has not fully addressed the comparability, comprehensibility, and reliability of climate change disclosure (de Faria et al., 2018; Depoers et al., 2016; Kolk et al., 2008; Sullivan and Gouldson, 2012). Therefore, in this study, we preliminarily explore the multi-source climate change reports of 30 U.S. Dow Jones companies through multi-dimensional qualitative content analysis, trying to find a high-quality reporting framework that would help enhance the comprehensibility and comparability of corporate climate change disclosure.

2.2 Climate change reporting guidance, energy certificates, and disclosure assurance

In February 2010, the United States SEC released the Interpretive Commission Guidance Regarding Disclosure Related to Climate Change (Release Nos. 33-9106; 34-61469; FR-82) (hereafter, the SEC's 2010 guidance) to assist public companies in meeting disclosure obligations under the federal securities laws. This release is significant as, for the first time, it urges corporation managers to review climate change issues and assess the impact on their business. Four sources of disclosure and four topics of climate-change-related issues are described in the SEC's 2010 guidance. The four sources of required disclosure are as follows.

1. **Item 101: Description of business.** This item requires companies to disclose the "material effects that compliance with federal, state and local environmental provisions that regulate the discharge of materials into the environment, or otherwise relate to the protection of the environment, may have upon the capital expenditures, earnings, and competitive position of the company and its subsidiaries."

2. **Item 103: Legal proceedings.** This item requires describing "material pending legal proceedings (actions) to which the company or any of its subsidiaries is a party (the subject of the litigation)."

3. **Item 303: Management's discussion and analysis (MD&A).** This item stresses that the MD&A section should highlight "known trends, events, demands,

commitments and uncertainties that are reasonably likely to have a material effect on financial condition or operating performance."

4. **Item 503(c): Risk factors.** This item requires providing "a discussion of the most significant factors that make an investment in the company speculative or risky."

The four main topics concerning climate change disclosures required by the SEC's 2010 guidance are the following:

1. **Impact of legislation and regulation.** The guidance emphasizes the impact, negative and positive, of both existing and pending climate change legislation and regulation in determining disclosure obligations in items 101, 103, 303, and 503(c).
2. **International accords.** The guidance stresses considering the disclosure of the impact of international agreements or treaties, such as the Kyoto Protocol, the Paris Agreement, and the European Union Emissions Trading Scheme (EU-ETS), if material.
3. **Indirect consequences of regulation or business trends.** The guidance notes that new opportunities or risks arising from legal, technological, or other developments related to climate change, such as increased (decreased) demand for new (existing) products or services, as well as the impact of climate change on a company's reputation that needs to be considered.
4. **Physical impacts of climate change.** The guidance states that businesses vulnerable to severe weather or climate-related events should consider disclosing material risks of, or consequences from, such events.

Except for the U.S. SEC, international agencies, governments, and organizations are also aware of the significant impact of warming on the global economy. Robust guidelines for climate change and environmental protection rely on solid support from local and international environmental organizations. Following the Kyoto Protocol, the 2015 United Nations Climate Change Conference (also known as the 2015 Paris Climate Conference) reached a legally binding global climate agreement, the "Paris Agreement," that aimed to keep global warming below 2°C and to strive to limit it to 1.5°C (COP 21, 2015). The 5th and 6th Assessment Reports of the Intergovernmental Panel on Climate Change (IPCC) provide a robust scientific basis for the Paris Agreement (IPCC, 2014, 2017).

The Carbon Disclosure Project (CDP) measures companies' environmental impact and manages a global information disclosure system for investors, corporations, cities, states, and regions (CDP, 2022). The Greenhouse Gas (GHG) Protocol provides the world's most widely used accounting standards for greenhouse gases and establishes a comprehensive global standardization framework for measuring and managing emissions (GHG Protocol, 2022). The Global Reporting Initiative (GRI) develops globally applicable guidelines for sustainable accounting reporting (GRI, 2022). Meanwhile, according to our survey, energy companies are more willing to obtain voluntary certifications, including ISO 14001 and ISO 50001, Leadership in

Energy and Environmental Design (LEED), ENERGY STAR®, and Renewable Energy Certification (REC), to show that they have implemented energy management systems and made efforts to combat climate change issues.

Additionally, the SEC's 2010 guidance encouraged public companies to disclose material climate change impacts in their financial statements. Based on the GRI External Assurance Guidance, three general types of firms provide external assurance: accountancy firms, engineering firms, and sustainability services firms. Assurance firms are well versed in domestic climate policies and international assurance regulations, for instance, the International Standard on Assurance Engagements ISAE 3000, the AccountAbility AA1000 Assurance Standard, and the GRI Standards. An assured report ensures data quality for reporters and users. It promotes recognition, trust, and credibility of climate change and sustainability disclosures, ultimately enhancing the company's public reputation and the value of the business (GRI, 2013; García-Sánchez, 2020; Martínez-Ferrero et al., 2018; Manetti and Becatti, 2009).

3. Methodology

After the SEC dropped its climate disclosure investigation into ExxonMobil in 2018, we investigated all 30 U.S. Dow Jones companies' climate change disclosure in the same year. According to Hahn et al. (2015), as narrative corporate climate disclosure contains comprehensive and detailed content, in-depth qualitative research became critical. However, a large body of prior literature has relied on secondary data from corporate CDP reports for quantitative research (e.g., Eleftheriadis and Anagnostopoulou, 2015; Griffin et al., 2017; Matsumura et al., 2014), while qualitative research on corporate multi-source voluntary climate disclosure (e.g., financial reports, sustainability websites, and corporate sustainability reports) is extremely limited. We conducted the descriptive qualitative analysis to explore whether these companies provided relevant reports and how they reported the risks and impact of climate change. We also collected the regulations and guidelines these companies followed, together with their applicable reporting frameworks and third-party assurances. First, we manually collected climate change disclosure in the 10-K financial statements of all 30 companies by searching with keywords including "climate," "climate change," and "emission." Following the SEC's 2010 guidance, we classified climate change disclosure in 10-K reports by sources and main content topics. Second, we manually collected all 30 companies' climate-change-related content (mainly in the "Climate and Energy" section) from the corporate sustainability reports and the sustainability pages on the company's official website. Further, we explored all previously collected corporate climate-change-related content based on climate change commitments, reporting techniques, disclosure formats, guidelines, and third-party assurances and identified the current climate change reporting framework used by these major U.S. companies.

4. Results and Discussion

4.1 Climate change disclosure in 10-K filings

The SEC's 2010 guidance is the SEC's guidance on disclosing climate change issues (SEC, 2010). As described in Section 2.2.1, the SEC's 2010 guidance provides detailed instructions for climate change disclosure and divides main disclosure contents into different topics (SEC, 2010). This section discusses the climate change disclosures in the 10-K financial statements of 30 U.S. Dow Jones companies (see Table 1) and summarizes our findings based on the SEC's 2010 guidance.

Table 1

Summary of 10-K climate change disclosures for the U.S. Dow Jones 30 companies

U.S. Dow Jones 30 Company	10-K Sources	10-K Topics			
		Impact of legislation and regulation	**International accords**	**Indirect consequences of regulation or business trends**	**Physical impact of climate change**
MMM 3M	Business	√		√	
	Risk Factors				√
	Financial Statements and Supplementary Data	√			
AXP American Express	-				
AAPL Apple	Risk Factors				√
BA Boeing	-				
CAT Caterpillar	Risk Factors	√			
CVX Chevron	Business	√			
	Risk Factors	√	√	√	
	MD&A - Environmental Matters			√	
CSCO Cisco	-				
K.O. Coca-Cola	Risk Factors			√	√
	MD&A				√
DIS Disney	-				
DWDP DowDuPont	-				
XOM Exxon Mobil	Risk Factors	√		√	√

	MD&A - Financial Condition and Results of Operations	√	√	√	√
GS Goldman Sachs	Risk Factors	√		√	
HD Home Depot	Business		√	√	
IBM IBM	-				
INTC Intel	Business	√		√	
	Risk Factors	√		√	√
JNJ Johnson & Johnson	Cautionary Note Regarding Forward-Looking Statements				√
JPM JPMorgan Chase	-				
MCD McDonald's	Business			√	√
	Risk Factors and Cautionary Statement Regarding Forward-Looking Statements			√	√
MRK Merck	Business			√	
MSFT Microsoft	Risk Factors			√	√
NKE Nike	Risk Factors	√			√
PFE Pfizer	Business			√	√
	Risk Factors				√
PG Procter & Gamble	-				
TRV Travelers Companies	Business				√
	Risk Factors	√			√
	MD&A	√		√	√
	Financial Statements and Supplementary Data				√
UTX United Technologies	Business	√		√	
	Risk Factors	√		√	
UNH UnitedHealt	-				

h					
VZ Verizon	-				
V Visa	-				
WBA Walgreens Boots Alliance	Risk Factors			√	
WMT Wal-Mart	Risk Factors				√

Notes: -: There is no climate change disclosure in the company's 10-K annual report.
√: The selected topic is included in the company's climate change disclosure in the company's 10-K annual report.

(1) Counts: Twenty of the 30 Dow Jones companies (67%) disclosed climate change issues in their financial reports, which shows that after the SEC's 2010 guidance was issued, most U.S. large companies followed the guidance and attached great importance to the financial risks that climate change has brought to business operations. A KPMG Survey (2017) indicated that only 28% of the global N100 companies and 48% of the global G250 companies acknowledged the financial risks of climate change in their annual reports. Our results show that the U.S. Dow Jones companies have paid more attention to climate change issues than the global average. According to the stakeholder theory, U.S. business leaders are increasingly aware of the risks that climate change has brought to their companies' performance and operations and are protecting the environmental interests of investors and other stakeholders through voluntary disclosure (SEC, 2010).

(2) Sources: Regarding the four sources specified in the SEC's 2010 guidance, most 16 companies mentioned the risks and impacts of climate change in the Risk Factors section, confirming that U.S. companies have begun to recognize climate change as a risk and disclose it in their reports (SEC, 2010). Nine companies reported climate change issues in the Business section, and four in the MD&A section. Based on our statistics, nine companies discussed climate change issues in more than one section in 10-K reports, revealing that large public companies are paying attention to the impact of climate change on business operations and management. Echoing the legitimacy theory, companies make voluntary climate disclosure in order to fulfill their low carbon social contract.

(3) Topics: Following the four categories of topics discussed in the SEC's 2010 guidance, we found that nine firms, for example, Nike, Caterpillar, and 3M, explicitly mentioned the first topic, "Impact of legislation and regulation," in their reports. They emphasized that corporate operations are subject to carbon emission laws and regulations, which could increase product design costs and environmental compliance expenditures. This supports the legitimacy theory of carbon disclosure, indicating that companies use carbon disclosure to reduce potential environmental litigation risks (Li et al., 2018; McCormick et al., 2018)

Moreover, twelve companies, including McDonald's and Walmart, mentioned the "Physical impact of climate change," especially the climate disasters as discussed in the literature (e.g., Hsiang et al., 2017; Martinich and Crimmins, 2019). Additionally, we noticed that in 2018, many companies participated in the CDP or followed international climate change guidelines (see Table 3). However, only three firms — Home Depot, Chevron, and ExxonMobil — mentioned "International accords" in their 10-K filings. For example, Home Depot indicated its CDP participation. 27 of the 30 Dow Jones companies only disclosed international accords information in corporate sustainability reports, confirming that companies are more inclined to disclose climate change information in corporate sustainability reports than financial reports (TCFD, 2018).

(4) Among the 30 Dow Jones companies, we found that companies in specific industries, for instance, Chevrolet, ExxonMobil, and Travelers Insurance, were highly concerned about climate change issues, devoting pages to the detailed discussions of climate change risks and measures to mitigate global warming and reduce carbon footprints. This confirms that industries closely related to carbon emissions, such as the energy industry and related insurance companies (e.g., Campiglio et al., 2018; Grant et al., 2014), pay more attention to disclosing climate change information and take the lead in carbon disclosure (Tang and Demeritt, 2018; TCFD, 2018).

4.2 Other climate change disclosure sources, commitments, guidelines, and assurances

In addition to the 10-K climate disclosure source, corporate sustainability reports and corporate sustainability websites are two other relevant sources for companies to disclose climate change policies. In this section, we investigate (a) sources of climate change disclosure other than financial reports, (b) commitments and target settings, (c) guidelines and certificates, and (d) third-party external assurances for the U.S. Dow Jones companies. We summarize our survey results in the following five tables (Tables 2 to 6) and discuss the study findings further.

Table 2
Summary of climate change disclosure sources for the U.S. Dow Jones 30 companies

Company	CSR Report Source	Website Source
MMM 3M	Climate and Energy	Energy & Climate
AXP American Express	Reducing Our Carbon Footprint	-
AAPL Apple	Climate Change	Environment - Climate Change (whole section)
BA Boeing	Airplane Technology and Emissions & Sustainable Aviation Fuel & Energy Conservation & Emissions	-
CAT Caterpillar	Energy & Climate Policy	Energy & Climate
CVX Chevron	Addressing Climate Change Risks (Highlights & separate report)	Climate Change (whole section)
CSCO Cisco	Energy and GHG Emissions	-
KO Coca-Cola	Climate Protection	Climate Protection
DIS Disney	Environmental Stewardship	Reducing Emissions
DWDP DowDuPont	CDP Climate Change Response	-
XOM Exxon Mobil	Managing Climate Change Risks	Climate (whole section)
GS Goldman Sachs	Climate Change	Climate Change
HD Home Depot	Carbon Footprint	-
IBM IBM	Energy Conservation and Climate Protection (separate report)	Climate Protection (whole section)
INTC Intel	Global Climate Change Policy Statement (separate report)	Climate Change Policy
JNJ Johnson & Johnson	Climate & Energy	-
JPM JPMorgan Chase	Investment Perspective on Climate Risk (separate report)	Sustainable Investing: Investment Perspective on Climate Risk
MCD McDonald's	Climate Change Position Document (separate report)	Climate & Energy (whole section)
MRK Merck	Carbon Emissions	Climate Change & Energy Use & Air Emissions (multi-section)
MSFT Microsoft	Microsoft Carbon Fee: Theory & Practice; Making an Impact with Microsoft's Carbon Fee; CDP Climate Change Response; Data	Carbon & Energy (multi-section); Microsoft Green Blogs

	Factsheet: Environmental Indicators (multiple reports)	
NKE Nike	Carbon and Energy	Minimize Environmental Footprint
PFE Pfizer	Climate Change Position Statement; Pfizer's Green Journey	Climate Change (whole section)
PG Procter & Gamble	Climate Change & Greenhouse Gas Emissions	Climate Change (whole section)
TRV Travelers Companies	CDP Climate Change Response; Insurer Climate Risk Survey	-
UTX United Technologies	-	Greenhouse Gases (GHG) & Solvent Air Emissions
UNH UnitedHealth	Our Impact: The Environment (no climate subtopic)	The Environment: Green Business Practices
VZ Verizon	Energy & Emissions; GHG Emissions Reporting Standards (separate report)	Sustainability: Reduce Carbon Emissions, etc. (whole section)
V Visa	Energy and Climate	Environmental Stewardship
WBA Walgreens Boots Alliance	Energy	Healthy Planet: Tackling Climate-Related Risks
WMT Wal-Mart	Reducing Energy Intensity and Emissions in our Operations	How We're Staying on Track to Fight Climate Change

Notes: -: There is no climate change disclosure in the selected reporting source.

(1) Other sources: All 30 companies (100%) chose at least one source other than 10-K financial reports to disclose climate change information; 29 of the 30 companies (97%) described climate change issues in separate sustainability reports. Firms were more inclined to disclose climate change content in separate sustainability reports and on corporate websites (97% and 77%, respectively) than in 10-K financial reports. A single source of climate change reports may not adequately meet business users' demands from different industries representing different interests.

Table 3
Climate change disclosure guidelines and certifications for the U.S. Dow Jones 30 companies

Company	Guidelines & Certifications[1]	Self-designed Guidelines
MMM 3M	DOE Superior Energy Performance (SEP™) Certification; GHG Protocol Scope 3 Standard; IPCC AR4; ISO 14064-2; ISO 50001; Montreal Protocol; Science-Based Targets Initiative	3M Air Emission Reduction Program Standard; 3M GHG Management Operations Standard; 3M Global Climate Change Position Statement
AXP American Express	American Business Act on Climate Pledge; CDP; Energy Star; GRI G4; IPCC AR; ISO 14001:2004; LEED; Paris Agreement; RECs; UNFCCC	-
AAPL Apple	Certification Programs such as Green-e Energy and contractual provisions; LEED; Paris Agreement; RECs; Renewable Portfolio Standards	-
BA Boeing	Australian National Greenhouse and Energy Reporting Act 2007; EPA GHG Mandatory Reporting Rule; GHG Protocol Scope 2 Guidance; GHG Reporting Guidance for the Aerospace Industry; IEA CO2 Emissions from Fuel Combustion Highlights; International Civil Aviation Organization Global Agreements: New Fuel-Efficiency Performance Standard for Aircraft & Carbon Offset and Reduction Scheme in Aviation (CORSIA); IPCC Quadrennial Defense Review; LEED; National Greenhouse and Energy Reporting (NGER) Scheme; RECs; UK Carbon Reduction Commitment CRC Energy Efficiency Scheme; 2006 IPCC Guidelines for National GHG Inventories	-
CAT Caterpillar	eGRID; GHG Protocol Scope 2 Guidance; Guidance from the IEA, WRI, and Energy Technologies Institute (ETI)	-

1 Please see the explications of abbreviated guidelines & certifications in the appendix table in Table 3 notes.

CVX Chevron	CDP; EIA Guidance; IEA New Policies Scenario; IEA World Energy Outlook; IEA 450 Scenario; LEED	Chevron Climate Change Policy Principles; Chevron Energy Index (CEI)
CSCO Cisco	CDP; Clinton Global Initiative (CGI) Commitment; Energy Star; EPA Climate Leaders Commitment; GHG Protocol Scope 2 Guidance & Scope 3 Standard; GRI G4; IEA Emission Factors; IPCC AR; ISO 14040; ISO 14064-3; WWF "The 3% Solution" Report	-
KO Coca-Cola	CDP; Paris Agreement; U.N. Environment Programme (UNEP) and Greenpeace Guidance	-
DIS Disney	CDP; Ceres Climate Declaration; GHG Protocol; GRI; IPCC AR; LEED	Self-designed Energy Guidelines & Environmental Policies
DWDP DowDuPont	CDP; GRI; ISO 14001	-
XOM Exxon Mobil	CDP; COP 21 & 22 Guidelines; EIA Annual Energy Outlook; Guidance from the American Petroleum Institute, International Association of Oil and Gas Producers, and the International Petroleum Industry Environmental Conservation Association; IEA New Policies Scenario; IEA World Energy Outlook; IEA 450 Scenario; IPCC AR; Item 1202 of SEC Regulation S-K; Paris Agreement; U.S. Global Change Research Program; U.S. National Climate Assessment Report	ExxonMobil's Outlook for Energy; Self-designed Climate Change Policies
GS Goldman Sachs	CDP; IPCC AR; LEED	Enhanced Due Diligence Guidelines for Carbon Intensive Sectors; Self-designed Carbon Accounting Methodology & Environmental Policy Framework
HD Home Depot	CDP; Energy Star; GHG Protocol Scope 1, 2, 3; GRI G4	-

IBM IBM	Electronic Industry Citizenship Coalition (EICC) Environmental Reporting Initiative; Energy Star; GHG Protocol Scope 2 Guidance; Guidelines from the EPA, WRI, and WWF; LEED; RECs	Self-designed Climate Protection Guidelines
INTC Intel	CDP; Climate Change Action Plan (CCAP); Energy-Related Products (ErP) Directive in Europe; Energy Star; EPA Clean Power Plan Rule; Guidance from the American Council for an Energy-Efficient Economy and the Center for Climate and Energy Solutions; G8+5 Academics' Joint Statement on Climate Change; IPCC AR 4 & 5; ISO 14001; RECs; Renewable Portfolio Standards (RPS); UNFCCC; U.N. Global e-Sustainability Initiative (GeSI); U.N. 2050 Goals;	Self-designed Climate Change Policy
JNJ Johnson & Johnson	CDP; eGRID; EPA Climate Leaders Publication; EPA SmartWay program; E.U. Emissions Trading System program; GHG Protocol; Global Warming Potentials from IPCC AR5; GRI 302-4 & 305; IEA CO2 Emissions from Fuel Combustion Report; LEED	Johnson & Johnson Sustainable Procurement Program
JPM JPMorgan Chase	Ceres Guidance; GRI; LEED; Paris Agreement; Task Force on Climate-Related Financial Disclosures (TCFD) Recommendations	J.P. Morgan Self-designed Climate Change-related Guidelines
MCD McDonald's	American Business Act on Climate Pledge; Corporate Renewable Energy Buyers' Principles; GHG Protocol; Global Sustainability Framework and Guidance from the WWF and WRI; IPCC AR5	McDonald's Green Building Guidelines; McDonald's Renewable Energy Commitments
MRK Merck	CDP; Energy Star; E.U. Energy Efficiency Directive; Guidance from the American Chamber of Commerce to the E.U. (AmCham E.U.); ISO 50001; LEED; RECs	Merck's Energy Design Guide; Merck's Energy Treasure Hunts Recommendations & Energy Manager Certification; Merck's Green & Sustainable Science Program Guidelines

MSFT Microsoft	Carbon Reduction Commitment (CRC) Energy Scheme; Ceres Roadmap for Sustainability; Dow Jones Sustainability Index; EPA GHG Reporting Program; EPA Green Power; GHG Protocol Scope 2 Guidance; Green Power Purchase Agreements (PPAs); Guidance from Non-Governmental Organizations, including CDP, Ceres, Environmental Defense Fund (EDF), Greenpeace, Natural Resources Defense Council (NRDC), EPA, WRI, and WWF; RECs; Renewable Portfolio Standards (RPS); Voluntary Carbon Standard and the Gold Standard; 2013 Carbon Performance Leadership Index (CPLI)	Guidance from Cross-Organizational Carbon Neutral Council set up by Microsoft; Microsoft Carbon Neutral Policies; Microsoft Self-designed Carbon Fee Guidelines
NKE Nike	American Business Act on Climate Pledge; CDP; Ceres BICEP Project (Business for Innovative Climate & Energy Policy); DOE Better Buildings Initiative; eGRID; GHG Protocol Scope 2 Guidance; IPCC AR2; LEED; Paris Agreement; RECs; RE100	NIKE Energy and Carbon Program Initiatives
PFE Pfizer	CDP; GHG Protocol; U.N. Global Compact “Caring for Climate” Initiative	-
PG Procter & Gamble	GHG Protocol; WWF Report	P&G Adjusted GHG Emissions Baseline
TRV Travelers Companies Inc.	CDP; Dow Jones Sustainability Index; Energy Star; EPA Climate Leaders Program; GHG Protocol; Guidance from the Connecticut Institute for Resilience and Climate Adaptation and the Connecticut Department of Energy and Environmental Protection; IPCC AR2; LEED; National Association of Insurance Commissioners (NAIC) Insurer Climate Risk Survey Report	Self-designed Catastrophe Modeling Guidelines; Travelers Coastal Wind Zone Plan
UTX United Technologies	IPCC Target; ISO 14064; U.N. Food and Agricultural Organization “Food Wastage Footprint & Climate Change”	United Technologies’ 2020 Sustainability Goals

UNH UnitedHealth	CDP; Climate Disclosure Leadership Index; Dow Jones Sustainability Index; Energy Star; LEED	-
VZ Verizon	CDP; EIA Voluntary Reporting of GHG Form EIA-1605; Energy Star; GHG Protocol Corporate Standard; Guidelines from EPA, IPCC, and IEA; LEED	-
V Visa	CDP; Energy Star and Energy Policy Act Certifications; GHG Protocol; Green Mark and Building Research Establishment's Environmental Assessment Method (BREEAM) Certifications; GRI G4; LEED; National Australian Built Environment Rating System (NABERS) 4-Star Energy Rating; U.N. Sustainable Development Goals (SDGs)	-
WBA Walgreens Boots Alliance	CDP; DOE Better Buildings; EPA SmartWay Program; GHG Protocol Scope 1, 2, 3 Guidance; GRI; Paris Agreement; U.N. SDGs	Walgreens Boots Alliance's innovative EnergyCare program
WMT Wal-Mart	CDP; Corporate Renewable Energy Buyers Principles; Dow Jones Sustainability Index; EPA Green Power; GHG Protocol; GRI G4; Guidance from the Natural Resource Defense Council, Solar Energy Industries Association, and the Resource Efficiency Deployment Engine (RedE); Paris Agreement; RE100; Science-Based Targets Initiative	Walmart "Leadership 2025" Agenda; Walmart Self-designed Factory Energy Efficiency Program

Notes: -: There is no climate change disclosure guideline in the company's reports.

Abbreviation	***Explication***
CDP	Carbon Disclosure Project Reporting Guidance
Ceres	Coalition for Environmentally Responsible Economies
COP	United Nations Climate Change Conference
DOE	U.S. Department of Energy
eGRID	U.S. EPA Emissions & Generation Resource Integrated Database
EIA	U.S. Energy Information Administration
EPA	U.S. Environmental Protection Agency
E.U.	European Union
GHG	Greenhouse Gas
GRI	Global Reporting Initiative Guidance
IEA	International Energy Agency
IPCC	United Nations Intergovernmental Panel on Climate Change

IPCC AR2/4/5	The Second/ Fourth/ Fifth Assessment Report from the IPCC
ISO	International Organization for Standardization
LEED	U.S. Green Building Council's Leadership in Energy and Environmental Design Certification and Design Guidelines
RECs	U.S. EPA Renewable Energy Certificates
RE100	Global Renewable Energy 100% Initiative
U.N.	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WWF	World Wildlife Fund

Table 4
Counts of climate change disclosure guidelines and certifications for the U.S. Dow Jones 30 companies

Guidelines	***Counts***
CDP Guidance	21
SEC's 2010 Guidance	20
GHG Protocol	19
Self-designed Guidelines	17
IPCC Assessment Report	15
GRI Guidance	10
Paris Agreement	9
Certifications	***Counts***
LEED	14
Energy Star	11
ISO	8
RECs	8

(2) Guidelines & Certifications: All 30 companies (100%) adopted multiple guidelines regarding climate change disclosure in addition to the SEC's 2010 guidance (see Table 3). The most frequently cited guidelines are summarized in Table 4, and the top three are CDP guidelines (adopted by 21 companies), GHG protocol guidelines (adopted by 19 companies), and self-designed guidelines (adopted by 17 companies). Other guidelines, such as the Paris Agreement and GRI standards, were also mentioned by various companies in their sustainability reports, showing that major U.S. companies attach importance to international climate change disclosure norms and standards. Around 60 percent (17 of 30) of the Dow Jones companies chose self-developed climate reporting guidelines based on the company's unique circumstances and experiences. However, increasing literature has criticized that the lack of uniformity in sustainability reports may reduce the comparability and transparency of the reports, making it more difficult for regulators and investors to judge company values effectively (Cho et al.,

2015, 2018; Gray, 2006).

Furthermore, our results indicate that energy-intensive companies are more willing to obtain voluntary energy-related certifications. Among the 30 U.S. Dow Jones companies, most companies chose LEED green building certification, followed by Energy Star certification, ISO energy certification, and renewable energy certificates (RECs). Energy companies use these certifications to prove their efforts in enhancing efficient energy management systems, saving resources, and reducing climate change risks (Iatridis and Kesidou, 2018).

Table 5
Summary of climate change commitments in the U.S. Dow Jones 30 companies' climate change reports

Company	GHG Emissions Reduction	Energy Efficiency Optimization	Renewable Energy Adoption	Green Technology Innovation	Operation Efficiency Improvement	Green Customer Engagement
MMM 3M	*	*	*	*		*
AXP American Express	*	*	*			*
AAPL Apple	*	*	*	*		
BA Boeing	*	*	*	*	*	*
CAT Caterpillar	*	*	*	*	*	
CVX Chevron	*	*	*	*		*
CSCO Cisco	*	*	*	*	*	
KO Coca-Cola	*		*			*
DIS Disney	*	*	*	*		*
DWDP DowDuPont	*	*	*	*		
XOM Exxon Mobil	*	*	*	*	*	*
GS Goldman Sachs	*	*	*	*	*	*
HD Home Depot	*	*	*			
IBM IBM	*	*	*	*		*
INTC Intel	*	*	*	*		
JNJ Johnson & Johnson	*	*	*			
JPM JPMorgan Chase	*	*	*	*	*	
MCD McDonald's	*	*	*			*
MRK Merck	*	*	*			
MSFT Microsoft	*	*	*	*	*	*
NKE Nike	*	*	*	*		

PFE Pfizer	*	*	*	*	*	
PG Procter & Gamble	*	*	*	*		
TRV Travelers Companies	*	*	*	*	*	*
UTX United Technologies	*	*		*		
UNH UnitedHealth	*	*				*
VZ Verizon	*	*	*	*		
V Visa	*	*	*			
WBA Walgreens Boots Alliance	*	*	*	*		*
WMT Wal-Mart	*	*	*	*		
Total Counts	***30***	***29***	***28***	***22***	***9***	***14***

Note: *: The selected climate change commitment is reported in the company's climate change disclosure.

(3) Commitments: We collected energy-saving and emission-reduction targets and commitments set by Dow Jones 30 companies in their CSR reports/websites. All commitments can be grouped into six categories: GHG emissions reduction, energy efficiency optimization, renewable energy adoption, green technology innovation, operation efficiency improvement, and green customer engagement, as shown in Table 5. Among these categories, all 30 companies explicitly mentioned the reduction of GHG emissions, indicating the environmental awareness of major U.S. companies in addressing climate issues and reducing emissions (Grant et al., 2014; TCFD, 2018). More than 28 companies promised to invest in energy efficiency optimization and the high-tech development of renewable energy to achieve green operations and optimize energy efficiency (Grant et al., 2014; Kammen and Sunter, 2016). Multiple companies planned to improve operational efficiency and call on employees and consumers to participate in energy-saving and green projects. Our results proclaim that companies respond to stakeholder theory and legitimacy theory by voluntarily disclosing their green energy policies and commitments to address global warming issues. In line with societal expectations for mitigating climate change risks, increasing companies have turned to proactive environmental and carbon strategies, exhibiting a sense of responsibility and foresight when considering climate change issues (Lee, 2012; TCFD, 2018).

Table 6
Summary of internal and external assurances for the U.S. Dow Jones companies' sustainability reports

Company	Assurance
MMM 3M	Third-party: Bureau Veritas North America, Inc. (BVNA) in line with the AA1000 Accountability Principles
AXP American Express	Third-party: BVNA
AAPL Apple	Third-party: BVNA + Fraunhofer IZM
BA Boeing	Internal control and assessment with aviation stakeholders
CAT Caterpillar	Third-party: ERM Certification and Verification Services
CVX Chevron	Third-party: Lloyd's Register Quality Assurance, Inc. (LRQA)
CSCO Cisco	Both internal and third-party external audits in line with Cisco Environmental Management System and ISO 14001 requirements
KO Coca-Cola	Third-party: Ernst & Young LLP
DIS Disney	Qualified internal audits + Audit committee of the board + External verification
DWDP DowDuPont	Third-party: WSP company
XOM Exxon Mobil	Third-party: LRQA
GS Goldman Sachs	Internal Assessment: Environmental Markets Group + Business Intelligence Group
HD Home Depot	Third-party: Eco Options Program in conjunction with Scientific Certifications Systems
IBM IBM	Internal audits; No third-party assurance
INTC Intel	Third-party: Ernst & Young LLP

JNJ Johnson & Johnson	Third-party: ERM Certification and Verification Services
JPM JPMorgan Chase	Internal audits
MCD McDonald's	Independent third-party audits
MRK Merck	Internal verification + Stakeholders involvement
MSFT Microsoft	Microsoft Recognitions (MSCI ESG Ratings + Global CSR RepTrak 100)
NKE Nike	Internal audit team review + Third-party assurance: FLA
PFE Pfizer	Corporate Responsibility Management + Stakeholder Engagement
PG Procter & Gamble	Third-party audits + P&G internal risk-based audit program
TRV Travelers Companies	Third-party audits on CDP data; Oversight by both Board and Management Risk Committees; Third-party engagement: MSCI ESG Research Inc., NAIC Insurer Climate Group, Bloomberg LP ESG Group, RobecoSAM, and FTSE4Good
UTX United Technologies	Internal audits
UNH UnitedHealth	Not known
VZ Verizon	Internal audits
V Visa	Internal review process (executive oversight of subject matter reviews and validation); Not been externally assured
WBA Walgreens Boots Alliance	Third-party: Deloitte & Touche LLP
WMT Wal-Mart	Internal audit committee + Piloting third-party audit approach

(4) Assurance: In 2018, 29 of the 30 Dow Jones companies (97%) prepared assurance for their sustainability reports. Among the 30 companies, 19 (63%) provided third-party external assurance for climate change disclosure (especially for greenhouse gas emissions) or the entire sustainability report. This ratio is much higher than the 13% assurance rate in the 2009/2010 fiscal year (KPMG, 2011) and the 3% assurance rate in the 2005/2006 fiscal year (KPMG, 2005). This high percentage supports the findings in the prior literature (Manetti and Becatti, 2009; Martínez-Ferrero et al., 2018), illustrating the importance that domestic and global companies have placed on providing assurance for accurate and reliable environmental information to environmentally sensitive stakeholders.

5. Conclusion

Global warming caused by GHG emissions poses severe risks to numerous economic sectors (Burke et al., 2018; TCFD, 2017, 2018). A wide range of investors, social organizations, and government departments have been requesting companies to provide climate change reports. After SEC dropped its two-year climate change disclosure probe into oil giant ExxonMobil in 2018, our research investigates the corporate green strategies and disclosure reports of large U.S. companies responding to global warming and climate change. We explored whether the U.S. Dow Jones 30 companies provide climate change reports, whether they follow national and international climate reporting guidelines, and what commitments they have made to mitigating and responding to climate change issues.

Our survey results confirm that large U.S. companies have placed great emphasis on global warming issues and have made remarkable efforts to save energy, reduce carbon emissions, and transit to a low-carbon economy. First, the voluntary climate change guidelines issued by the SEC in 2010 have been widely promoted and popularized among large U.S. firms. Among the 30 Dow Jones companies, 67% disclosed climate change information in their 10-K financial reports. Our results reveal that the environmental awareness of large U.S. companies is ahead of the average level of large global companies. Second, all 30 Dow Jones companies disclosed climate change risks and solutions in their corporate sustainability reports or sustainability websites. Through committing to emission reduction and energy-saving goals, U.S. companies have demonstrated to consumers and society their resolve to improve energy efficiency and pursue a low-carbon green environment. Third, besides the SEC’s 2010 guidance, we have seen numerous domestic and international climate change reporting guidelines, such as the CDP and the GHG Protocol. Several climate change guidelines have been widely used in U.S. corporate climate change reports. Energy-intensive companies have obtained additional energy-saving certificates, such as the LEED green building and ENERGY STAR certificates. Fourth, compared with previous KPMG surveys, the U.S. Dow Jones companies have significantly increased their investment in third-party assurance for climate change reports.

Our research initially integrates transparent and comparable corporate climate change disclosure frameworks to help guide investors, policymakers, and other stakeholders in understanding corporate climate disclosure and the impact of climate change on business operations. However, more research is needed on corporate climate change disclosure, as we are concerned that the lack of uniformity in climate change reporting frameworks, reporting guidelines, and assurance may reduce the comparability, validity, and accuracy of corporate climate change reporting. Future research can study how to improve the disclosure quality of corporate climate disclosure, such as reducing the risk of greenwashing and information overload in climate reporting. Also, scholars can study the impact of corporate climate disclosure on the decision-making usefulness of different stakeholders, as well as the disclosure impact on carbon emission reduction and corporate sustainability. Additionally, besides the large public companies studied in this paper, we hope to explore the future trends of global climate change reporting for different samples, such as private enterprises and non-profit organizations, and would like to see how carbon disclosure practices differ in other countries. We expect an increase in research activities regarding the content analysis of corporate climate change disclosure.

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