Greenhouse Gas Emission – A Perspective

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Climate change is an ongoing discussion especially concerning greenhouse gases and their emission. Greenhouse gases and emission are terms used in newspapers, television and much of today's common press often without an explanation of the terms' definition or meaning. Discussing these terms classifies their genesis together with greenhouse emission sources and creation. Concerns and consequences of greenhouse gas emissions, together with current reporting guidelines, are summarized to provide an understanding of the enormity of the issues. A sample of corporations' existing goals, aims, and projects illustrate how the entities plan to meet their net-zero greenhouse gas emission promises illustrate efforts underway to harness environmental contamination.

Keywords: greenhouse gases, emissions, climate change, environmental disclosure

INTRODUCTION

Climate change, global warming, and the recognition of greenhouse gas impact is an ongoing topic in the public press with businesses, professionals, and politicians arguing the pros and cons of the issues. A consequence of the debate is that decision-makers do not know what to believe and make rushed decisions that could significantly impact the economy, politics, and financial world. This paper discusses various aspects of greenhouse gas sources, concerns, and consequences in addition to approaches to the accounting and reporting guidance Selected corporate firms' conservation activities and emission reduction plans together with activities are presented together with the year the companies aspire to produce net-zero emissions. Conflicting evidence about greenhouse gas disclosure and its effects enables a conclusion.

GREENHOUSE GASES

Joseph Fourier proposed the greenhouse effect concept in 1824 (DiMento & Doughman, 2007, p. 22). Fourier hypothesized the planetary energy balance concept by arguing the Earth obtains its energy from solar radiation in the atmosphere primarily to warm the planet. That is, planets acquire energy from several sources that increase in their temperature. Although Fourier was the first to articulate the components of the earth's temperature, John Tyndall was the first to experiment in 1858 to prove the concept (DiMento & Doughman 2007). Almost forty years later in 1896, Svante Arrhenius documented the greenhouse effect quantitatively (DiMento & Doughman 2007, p. 35).

Natural Greenhouse Gases

Gases that contribute to the greenhouse effect are vapor components of the atmosphere that absorb and release radiation at certain wavelengths within the range of the thermal infrared radiation emitted by the Earth's surface, atmosphere, and clouds (Lucis, Schmidt, Rind & Ruedy, 2010; Tans, Lan, Vimont & Dlugokencky, 2023). Greenhouse gases are essential to maintaining the Earth's temperature, but they are not the only factor affecting the Earth's temperature. Without these gases, the planet would be so cold it would be uninhabitable. This warming of the atmosphere, due to the change in the thermal equilibrium temperature of the atmosphere, is referred to as the greenhouse effect (Lucis *et al*.,2010). The basic breakdown of the greenhouse effect begins with solar energy being absorbed into the surface and evaporating water. When the water is condensed in the atmosphere, it releases the energy to power storms that cools the surface by radiating heat energy upward. The warmer the surface, the more heat energy radiates upward. Only a small amount of the heat energy passes through the atmosphere to space. Greenhouse gas molecules absorb most and contributes to the energy that warms the lower atmosphere and Earth surface (Lucis *et al*.,2010; Latake, Pawar & Ranveer, 2015; Yoro & Daramola, 2020; Tans *et al*., 2023). Three current field experiments in the US and abroad are tweaking the Earth's atmosphere to cool the planet until a more permanent cooling solution is found. The first experiment injects reflective particles into the stratosphere 60,000 feet above Israel to mimic the reflective cooling effect of volcanic eruptions. The second effort off the coast of Australia also involves solar radiation by spraying saltwater mist into the air to increase the number and surface area of clouds to reflect sunlight to shade the ocean surface and subsequently cool the planet. The third experiment is adding a liquid solution of sodium hydroxide to the waters off the coast of Martha's Vineyard in the US to lower the acidity of the ocean to enable the seawater to absorb more carbon dioxide from the atmosphere to cool the surface (Niler, 2024).

Other Greenhouse Gas Sources

Sources such as industrial, transportation, residential, commercial, and agricultural processes (see Table 1), contribute to the creation of greenhouse gases (McCarthy 2001; EPA 2023a; EPA 2023b). Carbon dioxide is the primary contributor released through burning fossil fuels and forests cleared for agricultural purposes. Although carbon dioxide adds to the greenhouse effect, plants absorb some of the gas from the atmosphere to produce oxygen. This is why it is so crucial for loggers to plant new trees after harvesting mature trees. The principal greenhouse gases humans release into the atmosphere are carbon dioxide, methane, nitrous oxide, and fluorinated gases. Methane is emitted during the production of coal, natural gas, and oil in addition to agricultural practices, and the decay of organic waste. Nitrous oxide is discharged into the air during industrial and agricultural activities by burning fossil fuels and solid waste. Another powerful fabricated greenhouse gas is fluorinated gas that is a synthetic product released during industrial processes (Latake, Pawar & Ranveer., 2015; Yoro & Daramola, 2020).

Measurement Concerns

The US Environmental Protection Agency (EPA) developed a national greenhouse gas inventory due to the results of an increase in human activities that produce greenhouse gases (EPA, 2023a). The inventory tabulates the amount of greenhouse gases released to, or removed from, the atmosphere over a specific period. The EPA also provides information regarding greenhouse gas creation as well as the methodology used to produce the inventory calculations (EPA, 2023a). Policymakers use the inventory data to track emission trends, develop strategies and policies, and assess containment.

Not only are scientists and politicians getting involved with the accounting for greenhouse gases, but financial accountants are also taking notice that there could a potential problem with accounting and recognizing the gases' liabilities in the future (Young 2007; Simons, 2011; Wilcox, Wilcox & Jares, 2014; Linnenluecke, Birt & Griffins, 2015; Gulluscio, Pantillo, Luciani & Huisingh, 2020; Kaplan & Ramanna, 2021; Rodella & DeGiacomo, 2023).One of the greatest difficulties in dealing with the problem is that it is not fully understood. There is uncertainty about how rising concentrations of greenhouse gases and their effect might impact the Earth's climate and how ecosystems might be affected by climate changes (Milne & Grubnic, 2011; Yoro & Daramola, 2020). Scientists do not know what the changes mean for humans or whether action taken now to avoid the problem will be effective. There are also questions about the economic costs connected with different solutions for the potential global warming issues (Gulluscio *et al*., 2020; McCarthy, 2001).

TABLE 1
GREENHOUSE GASES EMITTED BY HUMAN ACTIVITIES

Gas Type	Overall Percent	Sources	Economic Sector	Sector Percent	Life-time in the Atmosphere
Carbon Dioxide	79	Fossil fuel combustion	Transportation	35	100+ years
CO2		Industrial processes	Electrical	31	
		Land uses	Industrial & land mgt	15	
			Residential & Commercial	11	
			Nonfossil fuel combustion	8	
Methane	11.5	Coal, oil & gas production	Gas & oil systems	29	12+ years
CH 4		Livestock mgt	Fermentation	25	
		Agricultural practices	Landfills	15	
		Land use & forestry	Manure management	8	
			Coal mining	6	
			Flooded lands (farming)	6	
			All other	12	
Nitrous Oxide	6	Agriculture	Ag and soil management	73	114+ years
N2O		Fuel combustion	Combustion & burning	5	
		Wastewater mgt	Wastewater (farming)	5	
		Industrial processes	Manure management	4	
		Mfg fertilizer	Transportation	4	
		Mfg semiconductors	Land use & forestry	8	
Fluorinated	3.5	Industrial processes	Ozone depleting gases	92	
Hydro(HFO)		Manufacturing	Electric transmission	3	HFO270+ years
Perfluor (PFO)		Industrial processes	Electronic industry	3	PFO↑ to 50,000 yrs
Sulfur hex(SF6)		Power grids	Industrial & mfg products	2	SF63200+ years
Nitrogen Tri(NF3)		Transportation systems			NF3 740+ years

Sources: EPA 2023a, EPA 2023b

Green Movements

Meanwhile, green has gone mainstream in the US with the clean-energy movement gaining momentum in both big and small ways (Beatson, Gottlieb & Pleming, 2020). Consumers use reusable shopping bags (van der Wal, van Horen & Grinstein, 2016). Automakers have sold over 140,000 hybrid cars led by the Toyota's Prius since 2020 (Carfigures, 2023). In 2022, solar power grew by some 34 percent, while wind energy had a banner year, and new energy projects in Texas, Utah and other US locations created 90,000 new jobs (IREC, 2023; USEER, 2023).

In addition, the Inflation Reduction Act (IRA) is sustaining millions of existing jobs in the clean energy economy. The Inflation Reduction Act passed in August 2022 is one of the more significant pieces of legislation enacted in the US. The Act is estimated to generate an average of 912,000 new jobs annually over the next decade through a combined $3 trillion in public and private investments (Pollin, Lala & Chakraborty, 2022; Rubin & Ramkumar, 2024). Although the Act is estimated to raise $739 billion in revenue from corporate minimum taxes, drug pricing reforms, tax enforcement, and curtailed interest loopholes, the Act includes an estimated $369 billion investment in energy security and climate change projects (Kess, 2022). The energy and climate investments include funds for disadvantaged communities, projects that repurpose retired fossil fuel infrastructure, and pollution reduction in low-income and disadvantaged communities. With the passage of the IRA, energy costs are estimated to decline, clean energy production will increase, and greenhouse gas emission reductions are expected to reach 40 percent by 2030 (Barbanell, 2022; Wang & Shittu, 2023).

ENVIRONMENTAL CONSEQUENCES

Scientists agree that the atmospheric concentration of greenhouse gases such as carbon dioxide is increasing, partly due to human activities. They also agree that if the temperatures rise over the next century, there will be significant impacts worldwide. These scientists conclude that developing countries will have a harder time dealing with global change than developed countries (McCarthy, 2001; Boon, 2009; Mohajan, 2017; Emanuel, 2018; Manabe. 2019; Tuckett, 2019; Wang & Shittu, 2023).

Weather, Health, and Ecosystems

Some of the potential effects that concern scientists are changes in weather patterns, health problems, problems with wildlife, and changes in the sea level. Scientists profess that the consequences of higher temperatures would produce more powerful and dangerous hurricanes, droughts, wildfires, and heavier rainfall. Hurricane seasons have become more active, and category 4 and 5 hurricanes have steadily increased over the past 35 years (Clarke, Otto, Stuart-Smith, & Harrington, 2022). The changes in weather patterns increase the probability of droughts that enhances the risk of wildfires. Conversely, warmer temperatures increase the energy of the climatic system and can lead to heavier rainfall in some areas (Emanuel 2007; Kossin, 2018; Clarke *et al*., 2022).

Health risks increase with increased temperatures (Clarke *et al*., 2022). Higher temperatures lead to deadly heat waves that often result in heat-related deaths. Increasing temperatures also increase smog pollution which can aggravate allergies and asthma for some people. Plus, warmer environments are breeding grounds for disease-carrying mosquitoes that lead to malaria outbreaks and other illnesses (Watts, *et al*.,2018).

Global temperature increases also change the ecosystems resulting in some animal species becoming extinct. Scientists (Agrawal, 2011; Boon, 2009; Emanuel, 2018; King, 2017; Pounds & Bustamante, 2006; Yanik & Aslan, 2018) have studied global warming and its effects on animals and predict more than one million species could become extinct by 2050. These studies also argue a 3.6 degree increase in temperature would wipe out 97 percent of the world's coral reefs.

It is logical to hypothesize that a temperature increase would melt glaciers. The melt will raise the sea level as much as 23 inches by 2100 if the current warming patterns continue (Clarke *et al*., 2022; Cui, Li, & Wu, 2022). As a result, coastal wetlands and barrier islands would be lost and coastal communities flooded. Areas like the Gulf of Mexico and Chesapeake Bay will be especially vulnerable. Given these possible environmental consequences, actions should be underway to arrest or minimize future greenhouse gas emissions and communicate the actions to consumers, investors, owners, and the general public.

EMISSION SCHEMES AND RECOGNITION

US Approaches

Some claim (Pata, 2021) that the industrial community in general and the US in particular should bear primary responsibility for elevated carbon dioxide concentrations and, therefore, shoulder a disproportionate burden in controlling future emissions. Although Pata (2021) asserts the world would benefit from an agreement to reduce greenhouse gas emissions, he admits that the costs and benefits would differ across nations.

Several emission allowance approaches are presently permitted in the United States. The first of these approaches is a cap-and-trade scheme. The cap-and-trade approach involves the government issuing tradable allowances to participating entities. The cap-and-trade scheme requires companies participating in the program to produce their issued allowances equivalent to the company's emissions. The allowances are collected at the end of a prescribed compliance period. If the company is found to have more emissions than they have allowances, the company pays a levied fine. An exchange market has developed for these allowances and companies trade their anticipated extra allowances in the open market. Any unused allowances are allowed to be used in future compliance periods (Chen, Wang, Nie, & Chen, 2020; Legal Information Institute, 2022; Ramstein, *et al*., 2019).

A baseline and credit scheme is another approach currently allowed and used in the US. Under this approach the government places a limit on the emissions of participating companies. If the imposed limit is exceeded, the violating company must purchase allowance credits equal to the difference between their limit and the actual gas emission. The company receives allowance credits if their actual emissions are lower than their imposed limit (Tang, *et al*., 2020; OECD, 2018).

The US is employing a means to decrease greenhouse gas emissions by issuing renewable energy certificates (EPA, 2023c) (EPA, 2023b). The certificates govern the minimum amount of renewable energy that an energy producing company must produce. The company must buy certificates to cover their surplus emissions if it does not meet the minimum requirements. As with other programs, the certificates can be bought and sold on the open market.

Reporting Guidance

The Federal Energy Regulatory Commissions (FERC) is a US federal agency within the Department of Energy that regulates the transmission and wholesale sale of electricity and natural gas in interstate commerce. It also regulates the interstate transportation of oil by pipelines. In addition to these regulatory processes, the FERC is responsible for administering regulated companies' accounting and financial reporting. The FERC's Uniform System of Accounts provides the only financial reporting for regulated entity guidance available in the US (FERC, 2023). The FERC regulations are based on the historical cost principle, which requires all emissions to be recorded at their historical cost. As the emissions are used, the companies expense the emission liability using a weighted-cost basis. Although most US companies follow the FERC guidelines, some companies account for their emissions using the same recognition method used to account for intangible assets (FASB 2023a). The FERC guidelines, however, only apply for cap and trade and/or baseline and credit schemes.

The Financial Accounting Standards Board (FASB) sought to address areas of inconsistency such as accounting for emission trading schemes (ETS) by adding an item to their Emerging Issues Task Force (EITF) agenda. After one meeting the EITF removed the item from their agenda and forwarded accounting for ETS concerns to the FASB for consideration. After several years of staff evaluations, the FASB removed the project from its agenda in January 2014 (FASB, 2023b).

FASB *Topic 845 Nonmonetary Transactions* (2023c) creates more confusion about accounting for ETS because its guidance is not specific. It is unclear whether emissions allowances should be recorded at their fair value or recognized on a carryover basis. Several FASB meetings have included discussions regarding the accounting treatment for ETS that result in various recognition methods currently being used.

In May 2022, the FASB added a project to its agenda to consider the recognition, measurement, presentation, and disclosure of financial instruments with environmental, social and governance (ESG) that are legally enforceable and tradable *i.e.,* environmental credits (FASB, 2023d). Environmental credits enable entities to accomplish their carbon reduction goals. The credit is a legal instrument representing the ownership of one metric ton of carbon dioxide equivalent that can be held, sold, or retired to meet a mandatory emission cap or voluntary emission reduction target (Knachel, 2023). To date, FASB's ongoing project deliberations (2023e) regarding environmental credits recognition, compliance, and programs include but are not limited to the following topics.

a. Cap and trade and baseline allowance programs
b. Renewable energy credits or certificates
c. Renewable identification numbers
d. Carbon offset credits.

The different potential treatments for carbon-related disclosures can create material differences in the company's financial reports. The different treatments open the door to potential inflation of profits or losses and perhaps forms of fraud (Ross, 2021). Deloitte (2023) report that different recognition policies drastically impact profit or loss figures among companies in the same industry. The differences make comparison among companies extremely difficult if not impossible. Deloitte suggests that companies involved in carbon-related disclosures should disclose in detail the exact accounting procedure used to develop the company's financial reports to keep the statements as transparent as possible until a reporting resolution by FASB is reached (Deloitte, 2023).

The Security and Exchange Commission (SEC) that has been responsible for the financial reporting and oversight for US publicly traded firms since the Securities Exchange Act of 1934 proposed a new reporting rule "The Enhancement and Standardization of climate-related Disclosure" in March 2022 (SEC, 2024). The proposed new rule provides disclosure guidance for climate-related information and risk metrics such as the impact of climate change on the firm as well as the firm's impact on climate change in the firm's periodic financial reports i.e., Form 10-K. Many of the comment letters responding to the Federal Register's publication of the proposed rule claim the rule requires companies to implement a data gathering process that adds significant company costs to collect, analyze, and report the data that far outweighs the information's benefit (Kiernan & Mai-Duc, 2023; SEC. 2024). Comment letters regarding the proposed rule continue to be posted while the SEC works on finalizing the disclosure rule. Meanwhile, the SEC relies on the general principle that firms should disclose decision useful information for investors and allows managers to determine how to disclose that information. Thus, it is difficult, if not impossible, for investors to compare climate change strategies or performance across firms (Ross, 2021).

International Reporting Projects

FASB began working on an ETS project with the IASB in 2008 (Allini, Giner & Caldarelli, 2018). The project's objective was to provide comprehensive clear guidance on the accounting issues relating to emission trading schemes.

The meeting between FASB and IASB in November 2008 included discussions regarding the receipt of allowances in a cap-and-trade scheme and a baseline credit scheme (IASB 2008). The meeting was educational in nature as no decisions were reached regarding the accounting treatment to provide an all-inclusive guide to account for all tradable rights and emissions trading schemes (IASB 2008). According to the IASB, the ETS joint project with FASB did not have an established completion date. During 2010, The FASB and the ISAB had several joint meetings to discuss the ETS project (Allini *et al*., 2018). Asset recognition, measurement and impairment, liability recognition and measurement, profit and loss recognition timing, accounting for vintage year swaps, and presentation and disclosure accounting issues were excluded from the joint project deliberations. However, on January 29, 2014, the FASB met to prioritize the Board's agenda and voted to remove the project from its deliberations (FASB, 2023e).

The IASB became active again in 2015 with the deliberation for pollutant pricing mechanisms (IASB, 2015). The Board canceled all previous tentative decisions making a fresh start relating to emission reporting. The ISAB's agenda was to produce a Discussion Paper to consider the different possibilities regarding the valuation criteria, and the reporting of assets and liabilities. Given the project's economic focus, it requires amending IAS 32 to expand the definition of assets (Allini *et al*., 2018) which is still pending.

Presently, the predominate framework for firms reporting greenhouse gas activities is the Greenhouse Gas Protocol (GHG Protocol) created by the World Business Council on Sustainable Development (WBCSD) and World Resources Institute (WRI) (WBCSD and WRI, 2004). The protocol guidance identifies and reports greenhouse gas emissions and is widely adopted for emission reporting schemes (Green, 2010). The European Parliament adopted a sustainability reporting directive that refers to the GHS Protocol in terms of reporting emissions. The International Sustainability Standards Board (ISSB) also incorporated the GHS Protocol in its disclosure standards (Kasperzak *et al*., 2023).

Given the inconsistency in greenhouse gas and climate change reporting, many companies continue to announce meaningful and measurable emission reduction commitments. However, companies such as Exxon Mobil do not participate in environmental disclosure questionnaires pertaining to the management of environmental impacts including emission reduction targets (Alvarez, 2022), Thus sources of emission reduction and environmental information helpful to investors and other interested parties are frequently not available.

EMISSION REDUCTION COMMUNICATION

With the establishment of the GHS Protocol as a global standard, climate-related data has become a part of firm's reporting practice, especially in their sustainability report. More often than not, companies publish their sustainability report on their web page that includes details of their climate change goals and information about their achievements. The publications tend to be glossy, four-color reports of products and production sites that include little or no financial savings or monetary benefits relating to emission or climate activities.

Using data gleamed from published Sustainability Reports, Table 2 displays 25 companies' 2022 plans and goals to reduce their carbon footprint together with the firm's type of business and market capitalization. Recent publications by Sustainability (Buchholz,2023) and Green Earth (Anonymous, 2022) identify companies leading the way toward renewable energy change and investing in the future by implementing carbon offset schemes. Most of the companies in Table 2 strive to achieve net-zero emissions by 2030 or 2050 by reducing their carbon footprints. A commonly planned activity to achieve net-zero emission is the electrification of fleet vehicles or the conversion to renewable energy for their operating and production activities even though alternative fuels such as biofuels, hydrogen or biogas offer the potential to be superior power sources (Jaffe, 2023).

Interestingly, the airlines listed in Table 2 plan to switch or convert to carbon-free sustainable aviation fuel (SAF) to reduce emissions. The most common SAF is made by refining used vegetable oil and animal fat to remove oxygen and add hydrogen. Currently SAF must be used as blends with jet fuel that cost more than regular jet fuel. However, with higher consumption volume, the price will diminish. As of mid-2023 some 499,000 commercial flights have been flown worldwide on a blend of SAF (Anton, 2023).

TABLE 2
ENVIRONMENTAL SUSTAINABILITY GOALS BY COMPANIES WITH PLANNED ACTIVITIES

Company Name	Company Type	2022 Market Capital	Achieve net-zero emission	Planned activities
Alphabet	Technology	$1.15 T	2030	achieve net-zero emission across all operations
Inc.				operate on carbon free energy 24 hours-7 days all year
				enable 5 Gw new carbon-free energy for mfg through investments
Amazon	Merchandiser	$1.3 T	2040	add 10,000 EV vehicles to the fleet by 2025
Inc.				add 100,000 electric delivery vans by 2030
				power operations with 100% renewable energy by 2030
				convert packaging to 100% recyclable by 2025
Apple Inc	Manufacturer	$2.1 T	2030	achieve carbon neutrality for entire carbon footprint
				transition manufacturing supply chain to 100% renewable electricity
				use only recycled and renewable materials in products and packaging
				eliminate waste sent to landfill from corporate facilities and suppliers
British	Oil and gas	$105.7 B	2050	replumb and rewire energy systems
Petroleum				achieve net-zero operations, production and sales
				reduce methane intensity in production to less than 0.05%
				restore biodiversity and improve water efficiency
Boeing	Aerospace Mfg	$113.5 B	2050	reduce manufacturing greenhouse gas emission by 29%
Corporation				covert two largest factories to be powered by 100% renewable energy
				recycle 100% carbon fiber waste
				produce new airplanes that are 25% more efficient
Delta Air	transportation	$21.1 B	2050	switch to sustainable aviation fuel (SAF) by 2030
Lines				become a major buyer of carbon offsets
				electrify 50% of eligible ground service equipment fleet by 2025
				accrue 3% fuel savings actually across entire fleet through 2035
Dropbox	Technology	$8.1 B	2030	source 100% renewable energy for all data centers
Inc.				support organizations working for climate action
Facebook	Social network	$319.9 B	2030	power all operations with renewable energy
				remove 90,000 tons of CO2 through carbon removal projects
				invest in solar energy and build wind farms
Ford Motor Co.	Auto mfg	$46.8 B	2050	attain zero emissions from vehicles, facilities and supply chain
				reach true zero waste to landfills across operations
				eliminate single-use plastics from operations
				use 100% carbon-free electricity in all manufacturing by 23035
General	Industrial mfg	$91.6 B	2050	achieve carbon neutrality by 2030
Electric Co.				use lean practices to identify and reduce waste energy
				use SAF and other low carbon fuel to test engine operations
				create decarbonizing strategy for energy efficiency and electrification
General	Auto mfg.	$47.8 B	2040	attain carbon neutrality in all global activities and products
Motors Co.				reduce to zero emission vehicle technology
				utilize renewable energy in operations, productions and supply chains
				invest in carbon credits or offsets to cover residual carbon emissions
Honeywell	Technology	$144.1 B	2035	achieve carbon neutrality in all facilities and operations
International				increase energy efficiency via LED lighting
				conserve water and minimize waste
IBM Corp	Information tech	$126.3 B	2030	manage and enhance data center energy conservation
				use renewable electricity across operations
				design products to be energy efficient

TABLE 3
ENVIRONMENTAL SUSTAINABILITY GOALS BY COMPANIES WITH PLANNED ACTIVITES

Name	Company Type	2022 Market Capital	Achieve net-zero emission	Planned activities
JetBlue Airway Corp.	Air transportation	$2.1 B	2040	convert 10% of jet fuel to SAF by 2030
				convert most common owned ground service equipment types to EV
				eliminate single use plastic use in serviceware
				collect and recycle inflight waste
Microsoft	Software Tech	$1.7 T	2030	increase energy efficiency, decarbonization and reach 100% renewable
Corp				develop hydrogen fuel cells for datacenters
				convert campuses to thermal energy
				electrify all campus fleets
NRG Energy	Power company	$7.3 B	2050	achieve electrification of vehicle fleet by 2030
				provide sustainable energy products and solutions to customers
Nestle	Food and Beverage	$318.6 B	2050	achieve and maintain deforestation free primary supple chain
				source key ingredients through regenerative agriculture methods
				aim for key ingredients to be produced sustainable
				design packaging for recycling or being reusable
NextEra	Electric power	$166.1 B	2045	expand innovative energy efficiency programs
Energy Inc				invest in water-free power generation from wind and solar
				identify reuse and recycling programs to minimize waste products
PepsiCo Inc	Food and beverage	$248.9 B	2040	develop sustainable manufacturing warehousing and distribution
				scale sustainable agriculture and regenerative practices
				enhance packaging recyclability
				shift to renewable electricity and fuels across operations
Plug Power Inc	Power company	$7.2 B	n/a	design efficient fuel-cell structures
				produce electricity using renewable energy sources i.e., wind and solar
				prioritize sustainable transportation options
Shell	Oil and gas	$199.4 B	2050	design process to shift to renewable electricity
Company				develop alternatives to traditional fuels including biofuels and hydroge
				work with customers to decarbonize use of conventional fuels
Siemens Energy	Power generation	$13.5 B	2030	decarbonize products and supply chain
				increase utilization of renewables and electrification
				design carbon capture removal technologies
Tesla	Auto mfg	$388.9 B	2024	strive for all factories to be carbon neutral
				build more sustainable factories from the ground up
				cover all facilities' roof space with solar panels
				leverage AI to make energy use more efficient
Walmart Inc	Retailer	$383.4 B	2040	reduce and/or avoid supply chain emissions
				initiate efficient energy initiatives, maintenance and conversions
				design sustainable production and distribution initiatives
				attain mitigation and adaptation strategies to ensure continuous service
Walt Disney	Entertainment	$158.4 B	2030	purchase or produce zero carbon electricity
Company				invest in natural climate solutions
				achieve zero waste to landfills for parks, resorts and cruise lines
				reduce or eliminate single-use plastic at parts, resorts and cruise ships

Source: MarketLine 2023; Buchholz, 2023; Anonymous, 2022.

Several of the 25 companies in Table 2 plan to purchase renewable energy and environmental credits (REC) primarily from US wind-power projects. Wind power-produced electricity typically costs more to produce than electricity produced by conventional coal or natural gas plants. To help defray the premium and prod wind power's growth, a market has been created in which wind-power developers sell certificates to companies that want to offset their emissions. The certificate market works like the market for 'carbon credits' in which companies offset their emissions by buying credits that go toward a range of projects from renewable energy to forest preservation (Wen *et al*., 2023; Chrysikopoulos *et al*., 2024).

Although the energy projects are typically emission and environmental sustainability, water conservation and the minimization of waste by recycling efforts are reported as goals for the company and their supply chain. Overall, there appears to be a commonality among the companies' emission reduction projects and activities.

CONCLUSION

While Table 2 reflects a small group of company emission reduction plans, it is not all-inclusive, as large numbers of domestic and international companies engage in accounting for carbon emissions (Kasperzak *et al*., 2023). Understanding the various aspects of greenhouse gas emission reporting, trading schemes, and reduction efforts are important to investors and current and future stakeholders. Citizens must look past political speeches and examine the evidence of emissions related to global warming (Tyson, Funk, & Kennedy, 2023). As the world continues to shrink, the US needs to explore the successful effects of implementing the reporting and operating guidance and be aware of the experiences of other countries and the climate change outcomes they experience.

There seems to be evidence to disprove global warming and some to prove it (Xia *et al*., 2022). However, given the environmental reporting guidance established in the US, political and company decision-makers need to know and understand how to successfully manage the business aspect of the issue. Thus, a credible and reliable system of rules and regulations should be defined and communicated to assist decision makers concerning these hotly debated and difficult management issues to appropriately recognize and record emission efforts and costs.

This discussion contributes to the literature by investigating firms' approach to reaching an operational net-zero emission by a specific date and achieving emission sustainability. Based on the firms' reported projects, goals, and approaches, policymakers, standard setters, and company leaders should evaluate how and whether current greenhouse gas reporting advances environmental sustainability and supports climate change mitigation.

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