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Articles

Climate Change Related Risks and the Financial Statements of Small Businesses

Minga Negash

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The accounting for and reporting on climate change-related risks are on the agenda of regulators, environment sensitive companies, the investment community, and audit and assurance service providers. This paper explores the effects of climate-related risks on the financial statements of small and medium-sized enterprises (SMEs). Using the Security and Exchange Commission's (SEC) classification of climate-related risks into (i) physical risks (ii) chronic risks, and (iii) transition to decarbonization risks, the paper examined the recognition, measurement (monetization), and disclosure problems in the context of SMEs. The finding is that climate-related risks are complex and affect key elements of the balance sheet, the income statement, and the statement of cash flows. The paper finds that existing financial reporting concepts and standards are insufficient for recognizing and reliably measuring the financial statement effects of climate-related risks. The contribution of the paper to the literature is its problematization of climate related risks in the broader scientific debate and the identification of the sensitivity of financial statement items to carbon.

Introduction

Climate scientists continue to document that the rate of global warming is much greater than previously thought (IPCC, 2023a, IPCC, 2023b). The Paris Agreement (COP21 2015) was a landmark treaty that aimed at reducing greenhouse gases (GHG) that contribute to global warming. Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels." The link between GHG emission and climate change is almost certain but reaching global consensus on burden sharing has increasingly become a contentious issue.

The World Economic Forum (WEF 2022) classifies extreme weather into two. For WEF (2022) "weather-related events are shorter incidents such as tornadoes, deep freezes or heat waves" whereas "climate-related events last longer or are caused by a buildup of weather-related events over time." In its latest risk report, the WEF (WEF 2025) ranked climate change-related risk as the single most important pressing problem over the coming decades. Economists advanced abatement strategies (emission caps, credits, trade, taxes, subsidies). They underscored the need for the enforcement of the "polluter pays principle" which underpins most environmental laws and international agreements (Nordhaus, 2019). More recently the European Parliament (2023) stated that it "wants to build a circular and climate-neutral economy by 2050." A circular economy is about reducing the use of raw materials, reducing waste, and lowering GHG emissions.

The U.S Environmental Protection Agency (EPA) documents that "global average temperature has increased about 1.7F from 1970 to 2023" and states that "changes of one or two degrees in the average temperature of the planet can cause potentially dangerous shifts in climate and weather." The EPA discusses climate change under the subheadings of GHG, weather and climate, and oceans, snow and ice, health and society, and ecosystems. It also provides guidelines on how to scope, calculate, and report emissions.

Regarding the economic sectors, the EPA provides two types of classification. They are "(i) total U.S. GHG emissions by economic sector and (ii) total U.S. GHG emissions by economic sector including electricity end-use indirect emissions." That is when electricity end-use indirect emissions are included in the sectoral analysis the main contributors to GHG emissions are transportation, electricity production, industry, residential and commercial, and agriculture. In its Lender and Development Company Loan Programs, the U.S. Small Business Administration (SBA SOP 50 10 7 Appendix 6 pp 367-369) provides a list of environmental sensitive industries with their NAICS (North American Industry Classification System) codes.

The EPA's Center for Corporate Climate Leadership has a "Guide to Greenhouse Gas Management for Small Business & Low Emitters." It lists five principles (relevance, competency, consistency, transparency, and accuracy) of its "GHG accounting." The document does not directly address the financial or social costs of GHG emissions. Estimating the direct and the indirect costs of carbon (monetizing GHG emissions) is not easy. There is wide variation between the approaches to approximate these costs and actual levies set by States and federal governments (Interagency Working

Group on Social Cost of GHGs; United States Government; IWG 2021; Estrada et al., 2025; Tol, 2025). For instance, defining "carbon burden" as the present value of the social costs associated with its future GHG emissions, Pastor, et. al. (2024) attempted to quantify the "externality: damages from corporate GHG emissions" and concluded that the equity values of many carbons sensitive listed companies would vanish. Tol (2025) states that "an updated and extended meta-analysis confirms that the central estimate of the social cost of carbon is around $200–250/tC ($700–900/tCo2) with a large, right-skewed uncertainty and trending up as ethical views have changed."[1]

The Security & Exchange Commission (SEC 2010:27) requires registrants to "consider climate change and its consequences" when they prepare disclosure documents to be filed with the commission and investors. However, monetization of GHG emission has proved to be a difficult conversation. Emission disclosure studies have examined the capital market effects of voluntary disclosures, and the explanations are found on business cases for GHG emission and the notions of stock market efficiency (Fan et al., 2021; Matsumura et al., 2014). Qualitative research in turn has explained the observed phenomenon using various versions of neo institutional theories (Di Maggio & Powell, 1983; Scott, 2014). The link between GHG emissions by small and medium size enterprises (SMEs) and the financial statements of these companies is not examined in the extant literature.

Climate change and unlisted companies

The size and shape of unlisted companies are many and include private equities, venture capital, special purpose entities, unicorns, small business investment companies and the likes. Cumming & Hammer (2025) broadly define private equity as "encompassing the provision of equity (and sometimes debt) to privately held companies throughout their life cycle." There is also an emerging trend of permitting institutional investors (pension funds and sovereign funds) to invest in private equities. Hence, the accounting, auditing, and due diligence needed for investing in these companies have become important public (investor) interest issues.

The increase in investment in unlisted companies is concomitantly occurring with a steady decline in the number of listed companies. For instance, between 1996 and 2012 the number of companies listed in U.S. stock exchanges was down by 46% and this decline continued in the next decade (Citizen Bank December 2024). This trend is not limited to the United States. According to JP Morgan (Fortune January 20, 2017; Harvard Law School Forum May 18, 2017) there are three reasons for the decline in the number of listed companies. They are "(i) the cost of going public is high, with underwriting & registration costs estimated at around 14% of the funds raised, increasing regulatory burden, (ii) market volatility, and (iii) cheaper & easier to raise huge amounts of money without going public nowadays."

Foltin & Holtzblatt (2022) indicated the "changing face" of U.S. corporations and questioned the relevance of "traditional accounting." Weitzman (2023) raised concern about the public accountability of private equities and asked whether the U.S. economy is "going dark" and pondered whether regulators and policy makers should "push for more financial transparency." Weitzman's (2023) concerns were raised before the ongoing policy change (de-regulation, tariff-trade balance, near-shoring, reshoring) and the changing views about climate change and sustainability.[2]

Climate change and small businesses

Like private equities and the likes, SMEs are not listed and hence not required to publish their financial statements or report on their GHG emission levels. Studies also indicate that though GHG emissions by an individual SME may be contributing less, they collectively account for significant percentage. For instance, in an OCED survey, Marchese & Medus (2023) reported that " SMEs accounted for 64% of business-driven GHG emissions at the EU level, with a more recent estimate reaching similar results." BDO USA (2025) noted that.

> "Smaller and mid-size companies are often suppliers to these large companies, and they're subject to cascading expectations to support decarbonization, human rights, and other sustainability goals, because the supply chain tends to be where the majority of emissions are generated, and where other externalities pose the greatest risks…"

The U.S Small Business Administration (SBA) provides industry based size standards. It uses the number of employees and revenues as thresholds. SBA classifies companies that have between 100 and 1500 employees as small and the variation in financial threshold depends on the sector. The European Union [Article 3 of Directive 2013/34/EU] has three categories. The classification is based on their balance sheet total, net turnover, and average number of employees during the fiscal year. The European Financial Reporting Advisory Group (EFRAG 2024) distinguishes between micro, small and medium companies. The World Bank states that SMEs "represent about 90% of businesses and more than 50% of employment worldwide and in emerging markets, most formal jobs are generated by SMEs…" In the United States SMEs account for between 43.5% and 50. 7% of the GDP and employ 45.9% of the population (U.S. Chamber of Commerce 2024).

1 For instance, IWG's estimation of the social cost of carbon (SC-GHG) in the State of Colorado was $43/ton. For more on this, see Colorado Energy Office, Colorado Air Quality Control Commission.

2 On January 20, 2025, the United States withdrew from the Paris Agreement for a second time (The White House).

Purpose of the paper

There are two reasons for deploying this research. First, as documented in Amel Zadeh & Tang (2025), "the transition from voluntary to mandatory climate disclosure and reporting poses serious challenges for accounting professionals aiming to support firms in achieving net-zero goals." That is, there is a need to explore a novel traveling theory that cuts across the two (GAAP/IFRS and sustainability) disjoined reporting systems. Second, since GHG emissions by SMEs are significant, one needs to explore an appropriate method of accounting for carbon in general and for this segment of the economy in particular. Hence, the purpose of this paper is to explore contextually one of the stubborn issues of climate-related risks in the preparation and analysis of the financial statements of SMEs.

The research question is framed as the exploration of the list of financial statement items that are likely to be affected by climate change related risks. The methodology is document analysis. Reexamining AICPA's Financial Reporting Framework (FRF) for Small and Medium sized entities (2017) and IFRS for SMEs provides an important starting point for the discourse. Exploratory research that uses document analysis is part of the qualitative research regime (Creswell & Poth, 2016; Guba & Lincoln, 1994). The paper does not use text analysis software (e.g., Nivio, MAXDQA). Grimmer & Stewart (2013) caution the pitfalls of using automated methods and urge that there are no substitutes for careful thought and close reading and require extensive and problem-specific validation.

Using document analysis as a method of exploratory research, the paper finds that climate related risk is indeed a difficult conversation for accountants and auditors. The challenge is beyond obtaining reliable systems and processes for tracking GHG emissions but integrating them into financial statements. The paper finds that neither AICPA's FRS for SMEs nor IFRS for SMEs provide for the accounting for and reporting on climate change related risks. There are many financial statement items that are sensitive to climate change related risks. In other words, individual and institutional investors in these companies, lenders and creditors, and users of due diligence reports require better recognition, measurement, and analytical framework. The contribution of the paper to the financial reporting literature is its problematization of climate risk in the broader scientific debate.

The rest of the paper is organized as follows. Section II reviews pertinent literature. Section III examines various documents including the Securities & Exchange Commission's (SEC) March 6, 2024, rules, regulatory challenges, and the international trend in sustainability reporting and assurance (attestation). Section IV examines AICPA's (2017) FRF for SMEs and IFRS Foundation's IFRS for SMEs and reports the findings. Section V contains discussion while section VI provides concluding remarks and indicates the direction(s) for future research.

Review of the literature

For accounting researchers GHG emission reporting (assurance/attestation) has been part of the sustainability genre literature. Journals that prefer publishing quantitative oriented papers provided the notion of a "business case" for environmental, social and governance (ESG) reporting and attestation (Dhaliwal et al., 2011, 2014; Gipper et al., 2024). In an ESG study that involved 17,680 firms across 65 countries between 2002 and 2020, Krueger, et. al. (2024) document that the "effects are strongest if the disclosure requirements are implemented by government institutions, not on a comply-or-explain basis, and coupled with strong enforcement by informal institutions." In other words, there is evidence which shows that the stock market discriminated against firms based on their emission levels and penalized those that do not report at all. Studies that extend this line of research to private equities are few (Abraham et al., 2024).

Journals that publish qualitative research explained the isomorphism observed in the reporting and assurance of sustainability related information by listed companies using a range of behavioral, critical, and neo institutional theories (Di Maggio & Powell, 1983; Negash & Lemma, 2020; Rana et al., 2022; Scott, 2014; Thornton et al., 2015). More recently corporate social responsibility (CSR) research in the U.S.A. evolved to "ESG integration" (Kaplan & McMillan, 2021) and recognize "circularity" in the economy (EU 2020; WEF 2022). Most textbooks use three-dimensions (economic, environment, and social) of "sustainable" earnings. Environmental accounting research has subtopics. Climate change, biodiversity, soil, watercourse & coastal contamination, eco-efficiency technology, landfills, rehabilitation, and waste management. When seen through the accounting lens, each subtopic has a financial (capital market) consequence.

There is a growing number of papers that claim to have used systematic (bibliometric) reviews of prior literature. In this respect, Setiawan, et. al. (2025) examined 278 articles to understand "carbon disclosure" covering the period from 2004 to 2024 and reported that their approach "successfully identified the most relevant authors, sources, countries, and affiliations related to carbon disclosure. It also analyzed the "intellectual structure," influential journals, thematic evolution, trending topics, and selective data sources, as well as theoretical foundations in the field." Lin, et.al. (2023) examined insurance against climate risk. They examined 1082 papers published between 1975 and 2022 and reported growth in the number of papers published, research methods, and themes. These systematic reviews of prior papers do not enable the framing of the accounting research questions as part of the broader scientific debate.

From the practice literature Mezzio, et. al. (2022) discusses ESG integration in small businesses and classified "ESG risk" into four categories. They are (i) cost of capital, (ii) stakeholder engagement, (iii) unpredictable factors and (iv) reputation, brand, and market share. Even though this set of literature documents the link between mandatory (voluntary) ESG disclosures and capital markets, how one

integrates (recognizes and measures) climate-related risk in the financial statements of listed and unlisted companies and SMEs remains an unanswered question.

In what follows, the review focuses on (a) carbon information and stock prices, (b) SEC's March 6, 2024, rule for the standardization of climate related risks disclosure, (c) SEC's climate related risk and small businesses, and (d) the regulatory challenges.

GHG emission information and stock prices

In the 1980s corporate finance research provided evidence which shows that stock markets incorporate publicly available information "instantaneously" and "in the right direction." Exceptions were considered anomalous until the emergence of counter evidence and behavioral finance (De Bondt & Thaler, 1985; Fama & French, 2016; Grossman & Stiglitz, 1980; Kahneman & Tversky, 1979). Capital market based empirical accounting research followed suit and focused on finding the value relevance of financial statement information (Botosan & Plumlee, 2002; Lev & Sougiannis, 1999; Ohlson, 1995; Verrecchia, 1983). Statistically significant associations between financial statement data and stock market determined risk indicators were reported (Beaver et al., 1970). Taking a cue from the disclosure genre literature, and using "dictionary" of words, several papers provided evidence about the association between firm value and GHG disclosure (Fan et al., 2021; Jiang et al., 2021; Matsumura et al., 2014; Radu & Maram, 2021).

Recent studies have documented the link between GHG emission reduction schemes (caps, credits, markets, taxes), stock returns and risk indicators (Diamond & Kuan, 2024; Pan et al., 2024). Florackis, et. al. (2025) examined the effects of mandatory GHG disclosure in the UK by listed firms and reported that companies with "high carbon intensity and substantial institutional ownership experienced negative abnormal stock returns." Alsaifi, et.al. (2020), using data from London Stock Exchange (LSE) across a period of 2009 to 2015, and applying event study method reported that "investors respond significantly negatively to carbon disclosure announcements" and outlined the implications for "investors, management and sustainability institutions." Similar findings are reported from China and South Africa (Lemma et al., 2020; Lin et al., 2023; Zhu et al., 2024).

Anquetin, et. al. (2022) examined the scopes of carbon emissions and their impact on "green portfolios" using a "constrained mean-variance optimization framework, and results show that it is possible to cut emission intensities in half at least with virtually no loss in Sharpe ratio for reasonable levels of the carbon constraint." Radu & Maram (2021) used a version of the Ohlson (1995) model to examine the value relevance of carbon emissions disclosure by Canadian firms. They reported "a negative association between GHG emissions and firm value" and stated that "investors use the total level of GHG emissions to assess future environmental liabilities, and industrial sector polluting level moderates the negative association between these emissions and firm value." Grahn (2025) examined GHG disclosure by German private firms and reported "legitimacy theory arguments hold for private firms as well."

The overall message of this strand of research is that the stock market is pricing GHG emissions. However, interpretations of the empirical findings are confusing. There are also limitations. First, the studies did not inform policy as to whether GHG emission should be mandatory or voluntary. Second, the studies did not give direction on how carbon footprints should be incorporated in the financial statements of emitters.

The SEC and its risk disclosure rule

In his Nobel Prize Memorial Lecture entitled "climate change: the ultimate challenge for economics," Nordhaus (2019) documented that "the theory of public goods applies as well to climate change… Here, we are speaking of a negative externality or public bad in the form of greenhouse gas (GHG) emissions…" and underscored that factors that contribute to climate change have "costs or benefits [that] spill outside the market and are not captured in market prices."

Most regulators interfere with the market to either correct market failures or for advancing public interest. The SEC's March 6 2024 final rule entitled "The Enhancement and Standardization of Climate-Related Disclosures for Investors" takes an investor protection perspective and relates its action to the Commission's primary mission of protecting investors, maintaining fair, orderly, and efficient markets, and facilitating capital formation (SEC). The rule is 885 pages long and defines climate change related risk as:

> "…the actual or potential negative impacts of climate-related conditions and events on a registrant's consolidated financial statements, business operations, or value chains." (SEC, p. 73)

The Commission classified climate related risks as (i) physical risks, (ii) chronic risks, and (iii) transition to decarbonization risks. The SEC's framework is based on the recommendations of the Financial Stability Board (FSB) and the Task Force on Climate Related Financial Disclosures (TCFD 2017). Both the FSB and TCFD stated "climate change presents financial risk to the global economy." Four thematic areas are identified in the TCFD's disclosure framework. They are governance, strategy, risk management, metrics, and targets. In the strategy section the TCFD's final report (p.6) refers to "the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning." Furthermore (on page 8) the TCFD report discusses financial impact of climate change in connection with financial statements. The two main points of the SEC March 6, 2024, rule, are requirements for large accelerated filers (LAFs) and accelerated filers (AFS) to disclose (p.26):-

> "(i) Any climate-related risks identified by the registrant that have had or are reasonably likely to have a material impact on the registrant, including on its strategy, results of operations, or financial condition in the short-term (i.e., the next 12 months) and in the long-term (i.e., beyond the next 12 months),"and

> (ii) "an attestation report for scope 1 and/or scope 2 GHG emissions."

Furthermore, the SEC required registrants to provide a clear link between financial statement information filed under Regulation S-X and general risk disclosure filed under Regulation S-K. On page 138 the SEC reminds registrants that:

> "...while they are permitted to cross-reference to information in their financial statements to satisfy their Regulation S-K disclosure obligations, they are not permitted to cross-reference to Regulation S-K disclosures in their financial statements, unless otherwise specifically permitted or required by the Commission's rules or by U.S. Generally Accepted Accounting Principles ("U.S. GAAP") or International Financial Reporting Standards ("IFRS") as issued by the International Accounting Standards Board ("IASB"), whichever is applicable. *See* 17 CFR 230.411 and 17 CFR 240.12b-23."

That is, the rule tried to close the gap between textual disclosures found in sustainability/assurance reports and financial statement risks arising from climate change. More specifically, Regulation S-K (Section 229.105, 17 CFR 229.105) requires:-

> "Where appropriate, provide under the caption "Risk Factors" a discussion of the material factors that make an investment in the registrant or offering speculative or risky. This discussion must be organized logically with relevant headings and each risk factor should be set forth under a sub-caption that adequately describes the risk. The presentation of risks that could apply generically to any registrant or any offering is discouraged, but to the extent generic risk factors are presented, disclose them at the end of the risk factor section under the caption "General Risk Factors.""

Relevance of SEC's climate related risks for SMEs

The important question is whether climate related risks stated in SEC's March 6, 2024, rules are relevant for SMEs' governance, strategy, risk management, and metrics and targets (TFCD, 2017). Strategy and (risk) management are directly connected with financial planning. That is, the entity's (forecast) financial statements must reflect the risks arising from physical risk (e.g. reduced revenue, decreased production capacity, supply chain disruptions, damage to property, higher insurance), acute or chronic risks (e.g. increased operating costs, inadequate water supply for plants, increased capital costs, increases in insurance premiums in high-risk locations). Transition risks are unexpected changes in policy, technology & market. Table 1 assembles SEC's climate related risk types, TCDF's description of these risks, and EPA's guidance for SMEs, and asks whether these risks are pertinent to the SMEs sector. The finding is that these risks are indeed relevant to the SMEs sector. The table reveals the financial statement effects and the sources of the damage (column 1,2,4 and 5).

Regulatory challenges

Regulatory challenges are not unique to the SEC's March 6, 2024 rule. It is observed in public policy, including in the spheres of public health, rights, and the environment (public goods). The challenge may stem from over (under) regulation, burden & offsetting, enforcement problems, shifts in the balance of power, and outright capture of the regulation process (Becker et al., 2023; Laffont & Tirole, 1991; Watts & Zimmerman, 1979, 1986).

The SEC's March 6, 2024, rule passed with the tie breaker vote of its chairperson. Soon after the vote, the matter came before the courts. The contests were assembled to the Eighth Circuit. The legal contest was concurrent with the leadership changes at the SEC following the November 4, 2024, election. On Nov. 21, 2024, the SEC announced that its 33rd Chair will step down from the Commission. On January 14, 2025, one of the main architects of the March 6, 2024, rule, the chief accountant, announced his retirement. On February 11, 2025, the Acting Chairperson of the SEC stated the following:-

> "Today, I am taking action on The Enhancement and Standardization of Climate-Related Disclosures for Investors rule that was adopted by the Commission on March 6, 2024 (the "Rule").[1] The Rule is currently being challenged in litigation consolidated in the Eighth Circuit[2] and the Commission previously stayed effectiveness of the Rule pending completion of that litigation.[3] The Rule is deeply flawed and could inflict significant harm on the capital markets and our economy."

On March 27, 2025, the SEC under its new chairman "voted to end its defense of the rules requiring disclosure of climate-related risks and greenhouse gas emissions." Litigation analysts like DLA Piper (April 17, 2025) questioned whether the case is "actually over" and speculated the possible legal avenues in the coming months. A similar opinion about the Commission's next move of rescinding, repealing, or modifying the rules and the Eighth Circuit Court's final decision are being discussed (Harvard Law School Forum August 13, 2025).

The crucial point from the above discussion is that climate related risks are ubiquitous and encountered in investment and financing settings. Outside of the legal discourse, in an article entitled "The SEC eliminated climate rules. Other governments are doing the opposite, Ainsworth (2025) stated:-

> "California, European Union and many other nations are moving ahead with their own rules...consequently many large U.S. companies may be subject to climate disclosure in one jurisdiction or another ... additional disclosure is inevitable."

Practice literature and GHG reporting

Professional organizations, societies, nonprofits, and audit firms have been revising and updating their "GHG accounting," and assurance (attestation) standards. Regarding content, most standards are not mutually exclusive. Big

Table 1. SEC's climate risks and the financial statements of SMEs

(1)	(2)	(3)	(4)	(5)	(6)
Climate change related risk (SEC 2024)	Consequences (TCFD's 2017)	Scopes & guide for SMEs & low emitters (EPA)	Financial statement effects	Does this risk type apply to SMEs?	Sources
Physical risk	reduced revenue from decreased production capacity (e.g., transport difficulties, supply chain interruptions), reduced revenue and higher costs from negative impacts on workforce (e.g., health, safety, absenteeism) and write-offs and early retirement of existing assets (e.g., damage to property and assets in "high-risk" locations)."	EPA 2020 states that "An inventory is a list of emission sources and the associated emissions quantified using standardized methods." Scope 1 emissions "are from sources that the organization owns or controls, like natural gas-fired boilers or vehicle fleets, include boilers used to heat buildings, refrigerant leakage from air conditioners, or travel in a fleet vehicle, include leased vehicles or equipment for which the organization pays the fuel bills or can access the fuel use data."	Bankruptcy, escalating insurance costs, inability to get insurance coverage, emission regulation compliance costs at the source controlled or owned by the entrepreneur.	Yes. Physical damage because of extreme weather, loss of inventory & PPE, disruption of operations, supply chain & distribution network. insurance costs, carbon taxes, loss of higher internal carbon tax if the SMEs are in a supply/ distribution network.	• TCFD • SEC • EPA • SBA • Chamber of Commerce • FASB 2021 • IFRS for SMEs • PCAOB AS 2105 • PCAOB AS 2501
Chronic risk	Chronic risks are resulting in "increased operating costs (e.g., inadequate water supply for hydroelectric plants or to cool nuclear and fossil fuel plants), increased capital costs (e.g., damage to facilities), reduced revenues from lower sales/ output, increased insurance premiums and potential for reduced availability of insurance on assets in "high-risk" locations."	Scope 2 emissions are "a consequence of the operations of the organization but occur at sources owned or controlled by another organization. These are most typically electricity, heat, or steam. These are also called indirect emissions."	Higher than normal operating costs, inability to get insurance coverage. In running the business, the SMEs are likely to use energy in its heating/cooling system, rentals in the premises, as well as use input/outputs of others which might have passed costs to the entity, worsening the likelihood of chronic risks	Yes. Increased operating costs, price of electricity & water, location choice, supply chain & distribution effects, market size, insurance premium escalation.	Same as above
Transition risks	This set of risks is related to policy and legal, technology & market. Abrupt & unexpected shifts in energy costs, re-pricing of assets (e.g., fossil fuel reserves, land valuations, securities valuations.	Scope 3 emissions are "indirect emissions that are not covered in scope 1 or 2, including business travel, employee commuting, and product transport. Guidance on identifying and quantifying scope 3 emissions and identifying advantages of reporting them, is provided in the calculator."	Health & safety issues, labor rights violations, brand and reputation costs (intangibles), new transitioning costs. In short higher (i) cost of capital, (ii) stakeholder engagement, (iii) transition risks and (iv) reputation, brand, and market share.	Yes. Write-offs and early retirement of existing assets, unexpected changes in energy costs, expenditures on new & alternative technologies, regulatory compliance costs, research & development.	Same as above Mezzio, et.al. (2022)

audit and consultancy firms have significant market share in the provision of GHG reporting and assurance services, and produce guidance and interpretations (E&Y 2024; Deloitte 2024; KPMG 2023; PWC 2024). In November 2021, following the COP 26 meeting in Glasgow, the IFRS Foundation announced the establishment of the International Sustainability Standards Board (ISSB). The International Integrated Reporting Council (IIRC) and the SASB (U.S. Sustainability Accounting Standards Board) frameworks were subsumed in ISSB's standards. On July 30, 2025 the European Commission adopted the European Financial Reporting Advisory Group's (EFRAG) simplified sustainability reporting for SMEs targeting those outside the scope of the corporate sustainability reporting directive (CSRD).[3] The Commission recommended that "non-listed SMEs and micro-undertakings that wish to voluntarily report sustainability information do so in accordance with the voluntary sustainability reporting standard set out in Annex I."

In 2023/2024 the ISSB issued its IFRS S1 (General Requirements for Disclosure of Sustainability-related Financial Information) & IFRS S2 (Climate-related disclosure). ISSB"s standards purport to serve "in the public interest." IFRS S1 "prescribes how an entity prepares and reports its sustainability-related financial disclosures." In substance IFRS S2 contains a similar message and

> "requires an entity to disclose information about climate-related risks and opportunities that could reasonably be expected to affect the entity's cash flows, its access to finance or cost of capital over the short, medium or long term (collectively referred to as 'climate-related risks and opportunities that could reasonably be expected to affect the entity's prospects')."

In November 2024 the International Auditing and Assurances Standards Board (IAASB) issued ISSA 5000 (General Requirements for Sustainability Assurance Engagements, and withdrew IASE 3410). The World Resource Institute and World Business Council for Sustainable Development issued the Greenhouse Gas Protocol (GHG accounting) which is also featuring in the United Nations' Principles of Responsible Investing (PRI). Despite the chorus about sustainability, it is important to note that none of the standards mandate emitters to monetize (recognize, measure) GHG emission, identify and set materiality thresholds for physical, chronic and transition risks in financial statements (PCAOB AS 2105).[4]

Climate-related risks and financial statements

As noted earlier, the central question for this paper is whether climate-related risks are relevant for SMEs. It is an extension of Weitzman's (2023) questions about unlisted companies. This is important because unlisted companies include large private equities, venture capital companies as well as special purpose entities (e.g., acquisition companies) that invest in SMEs (Cumming & Hammer, 2025). Unlisted companies are public interest entities in that they control significant capital, employ thousands of people, and serve as intermediaries for large firms (BDO 2025). This set of entities are not out of the radars of SEC as they deal with "securities" and mostly prepare their financial statements under GAAP or AICPA's FRF. In contrast SMEs are governed by less stringent rules and governments try to reduce regulatory burden and provide direct support (e.g., SBA loans) to the sector. It is important to examine whether the SME segment of the economy is exposed to climate related risks and whether the current financial reporting framework provides adequate guidance that enables better governance, strategy (financial planning), and risk management.

In the U.S. A. the AICPA's FRF (financial reporting framework) for SMEs (revised in 2017) is the standard. It is optional as the AIPCA has no legal authority to enforce. The document is organized in 31 chapters (207 pages, 79303 words). A preliminary search using Microsoft find and navigate for key climate change terms and phrases (such as climate risk, climate change, extreme weather, sustainability, energy use, carbon, greenhouse gases and emissions) led to "no matches." A similar search for key terms in IFRS for SMEs (revised 2025) resulted in "no matches." In other words, both AICPA's FRS for SMEs and IFRS for SMEs do not provide for the accounting for and reporting on climate change related risks.

In its *Staff Educational Paper,* the FASB (2021) published a document entitled "Intersection of Environmental, Social, and Governance Matters with Financial Accounting Standard." The paper underscored that ESG matters may affect the "entity's business strategy, cash flows, financial position, and financial performance." The discussion focused on environmental factors and outlined topics and subtopics that are likely to affect the firm's financial statements. Chief among items is the going concern status of the company (Subtopic 205-40), risks and uncertainties (Topic 275), asset retirement and environmental obligations (Topic 410), inventory (Topic 330), intangibles (Subtopic

3 Corporate Sustainability Reporting Directive (CSRD) is not the only ESG reporting framework. CSRD is one of EU's regulations that requires companies to disclose detailed information about their sustainability practices. European Sustainability Reporting Standards (ESRS), Carbon Disclosure Project (CDP), Global Reporting Initiative (GRI), International Sustainability Standards Board (ISSB), Sustainability Accounting Standards Board (SASB), FSB-TCFD, and the International Integrated Reporting Council (IIRC) are frameworks that are in used in practice. The focus of each of the reporting framework vary, and reporting entities in many jurisdictions have choice.

4 Note that FASB's (2024) Proposed Accounting Standards Update" (Topic 818) deals with the "recognition, measurement, presentation, and disclosure requirements for all entities that purchase or hold environmental credits or have a regulatory compliance obligation that may be settled with environmental credits." Its roots go back to the "cap and trade" policy and carbon disclosure project. At the time of authoring this paper the FASB has deliberated on the 42 comment letters. Analysis of the exposure draft and the comment letters is beyond the scope of this paper.

350), property, plant, and equipment (Topic 360), taxes (Topic 740), and fair value measurement (Topic 820).

Like FASB (2021), in July 2023 the IFRS Foundation issued *Educational Material* entitled "the effects of climate-related matters on financial statements prepared applying IFRS Standards." The reason for this educational material, the authors claimed, is.

> "To remind stakeholders of the long-standing requirements in IFRS Accounting Standards to report on the effects of climate-related matters in the financial statements when those effects are material."

FASB (2021) is looking for the 'intersection" between financial and ESG information while the IFRS Foundation is looking for "consistency" between information based on the IFRS series of standards and ESG standards (IFRS 1 & IFRS S2). Both standard setting bodies recognize the disjoint between the two (financial and sustainability) reporting systems. In other words, there is concern whether one gets the same message from reading financial statements and actual ESG practices. The IFRS Foundation's educational material also lists the standards that are likely to be affected. They are IAS 1 (Presentation of Financial Statements, replaced by IFRS 18), IAS 2 (Inventories), IAS 12 (Income Taxes), IAS 16 (PPE, Property, Plant and Equipment), IAS 38 (Intangible Assets), IAS 37 (Provisions, Contingent Liabilities and Contingent Assets and IFRIC 21 Levies), IFRS 7 (Financial Instruments: Disclosures), IFRS 9 (Financial Instruments), IFRS 13 (Fair Value Measurement) and IFRS 17 (Insurance Contracts).

Regarding SMEs, in May 2023 the IFRS Foundation published another *education materia*l entitled "Effects of climate related mattes on financial statements prepared in accordance with IFRS for SMEs Accounting Standard" and argued that even though the IFRS for SMEs does not explicitly deal with climate related risk, "companies are required to consider climate related matters in applying IFRS for SMEs when the effect of those matters is material in the context of financial statements taken as a whole."

The educational material for IFRS for SMEs refers to criticalities in financial reporting, including going concern and estimation uncertainty. The document states that material expenditures in transition to decarbonization may affect specific financial statement items, namely, financial instruments, fair value measurement, property, plant, and equipment (PPE), intangible assets, and provisions & contingent liabilities. Neither the IFRS Foundation's (2023) *educational material* nor FASB's (2021) *staff educational paper* set out specific materiality thresholds.

Materiality threshold is both an accounting and legal concept. It is one of the sticky issues in accounting. In the interpretation of the concept of materiality in auditing, the PCAOB's AS 2105: Consideration of Materiality in Planning and Performing an Audit refers to the Supreme Court, which held the view that determination of materiality requires "delicate assessments of the inferences a reasonable shareholder would draw from a given set of facts and the significance of those inferences to him. . . ." The IFRS (2017 practice statements paragraph #5) states that "information is material if omitting it or misstating it could influence decisions." The audit standards (PCAOB AS 2105, ISA 450) require the auditor to consider qualitative and quantitative factors but did not prescribe quantitative thresholds.

The Corporate Finance Institute (CFI) refers to the work of the Norwegian Research Council and discusses two methods of setting quantitative threshold:- single rule method (5% of pre-tax income, 0.5% of total assets, 1% of shareholders' equity, 1% of total revenue) and variable size rule focused on the pretax profit. Setting quantitative thresholds has been a sticky point. In a statement, the SEC's former Chief Accountant, describes the process followed by the Commission in detecting misstatements (Minter 2022). Earlier the SEC Staff Accounting Bulletin: No. 99 provides interpretation and cautions about the use of "rule of thumb" quantitative thresholds. PCAAOB AS 2501: Auditing Accounting Estimates, Including Fair Value Measurements is another relevant standard.

Taking a cue from the standards, practice statements and the FASB and IFRS Foundation's *educational materials*, the paper examined the AICPA's 2017 FRF for SMEs. Defining climate related risk as "the actual or potential negative impacts of climate-related conditions and events on a registrant's consolidated financial statements, business operations, or value chains" (SEC March 6, 2024, p. 73)", Table 2 assembles relevant laws and regulations (Section A), the SEC's classification of climate related risks and a list of relevant chapters and paragraphs in AICPA's FRF for SMEs (Section B). The finding is that there are specific paragraphs that are sensitive to climate related risk governance, strategy, risk management and metrices and targets (TCFD framework). The list is indicative and not exhaustive.

Discussion

The paper examined the climate changed related risk in the contest of SMEs (Tables 1 & 2). The finding is that these risks are complex and ubiquitous and hence affect key elements of financial statements. Climate related risks are pertinent for SMEs and require setting materiality thresholds. The analysis in tables 1 &2 indicates that the existing financial reporting standards are insufficient for recognizing, and reliably measuring, and reporting climate related risks. The absence of reliable recognition and measurement leads to omission of material information from financial statements.

Consideration of social costs of carbon (carbon burden, externalities) suggests imputing externalities and abatement policies in the firm's financial statements (IWG, 2021; Nordhaus, 2019; Pastor et al., 2024). This is true for both large and SMEs that are GHG emitters (EPA's scope 1, 2 and 3). The challenge at microeconomic level is how to recognize, monetize and report negative public goods by the individual entity in the absence of enforceable rules. The SEC's insistence on making a clear link between what gets reported in financial statements (Regulation S-X) and integrated disclosure (Regulation S-K) have merits.

For SEC, physical risks "include both acute & chronic risks to a registrant's business operations and those with whom it does business" (SEC 2024, p. 74). Physical risks are

Table 2. Legal & regulatory frameworks, climate related risks and AICPA's Financial Reporting Framework (FRF)

Section A Legal & regulatory frameworks	• SEC, Statement Regarding Climate-Related Disclosures Rule Litigation: The Commission has Left the Building • SEC, Acting Chair Statement on Climate-Related Disclosure Rules, Feb 11, 2025 • SEC Standardization of Climate-Related Disclosures for Investors, March 6, 2024 • SEC A Small Entity Compliance Guide, updated April 23, 2020 • SEC Commission Guidance Regarding Disclosure Related to Climate Change. Final Rule, February 8, 2010 • Inflation Reduction Act & H.R. 191-1119th Congress (2025-2026)		• EPA Impact of climate change • EPA Guide to GHG Management for small businesses and low emitters • EPA Air Quality Index by Zip code • EPA proposed rule to rescind the 2009 Greenhouse Gas Endangerment Finding, July 29, 2025	• SBA U. S. Small Business Administration Table of Small Business Size Standards • SBA NAICS's based "environment sensitive industries" (SOP 50 10 5(J) Appendix 4)
Section B (1) SEC's climate risks	(2) Definitions	(3) Accounting & reporting concepts & principles	(4) Relevant chapters & standards in AICPA (2017) FRF for SMEs	(5) Indicative paragraph(s) or section(s) that may be considered in amendments
Physical risks	SEC states that "physical risks include both acute & chronic risks to a registrant's business operations or the operations of those with whom it does business (page 74).	Going concern, materiality thresholds, transforming uncertainty to risk, state contingent assets & liabilities, hedging, PPE, Asset Retirement Obligations (AROs), provisions & contingencies, insurance against physical risks & revenue losses, industry classification & firm size	1 Financial statement concepts 2 General principles 3 Transition 8 Statement of cash flows 10 Risks & uncertainties 12 Inventories 13 Intangibles 14 Property, Plant & Equip 16 Commitments 17 Contingencies 19 Revenues 21 Taxes 22 Subsidiaries	1.09,1.10,1.17,1.24,1.25,1.32,1.43 2.07,2.08,2.10,2.20 3.11,3.12,3.14,3.16 8.19,8.31 10.02,10.03 12.02,12.04,12.21 13.07,13.15 14.03,14.04,14.11,14.20 16.02 17.02,17.03,17.05,17.07,17.12,17.20 19.19,19.21,19.22 21.16,21.19 22.03
Chronic risks	Chronic risks are "those risks that a business may face as a result of longer-term weather patterns and related effects, such as sustained higher temperatures, sea level rise, drought, and increased wildfires, as well as related effects such as decreased arability of farmland, decreased habitability of land, and decreased (p74)."	Study of weather patterns and location choice, going concern, materiality thresholds, transforming uncertainty to risk, state contingent assets & liabilities, hedging, PPE, Asset Retirement Obligations (AROs), provisions & contingencies, insurance against physical risks & revenue losses, industry classification & firm size, budgets & forecast financial statements, valuation of environment sensitive companies (NAICs).	1 Financial statement concepts 2 General principles 10 Risks & uncertainties 11 Equity, debt & other investment. 12 Inventories 14 Property, Plant & Equip 16 Commitments 17 Contingencies 19 Revenues 21 Taxes 22 Subsidiaries	Same as above
Transition risks	Transition risks "are the actual or potential negative impacts on a registrant's consolidated financial statements, business operations, or value chains attributable to regulatory, technological, and market changes to address the mitigation of, or adaptation to, climate-related risks" (P75)	PPE, Asset Retirement Obligations (AROs), provisions & contingencies, Compliance costs, cost of installing climate related risk and GHG emission monitoring system management, carbon derivatives, trades, social costs of carbon, parent & subsidiary/supplier relationship management.	1 Financial statement concepts 2 General principles 3 Transition 10 Risks & uncertainties 14 Property, Plant & Equip 16 Commitments 17 Contingencies 19 Revenues 21 Taxes 22 Subsidiaries 25 Leases 26 Related party	Same as above 25.03,25.7,25.65, 25.66 26.03,

weather related, which are shorter incidents like tornados, deep freezing or heat waves and require immediate attention (TCFD 2017; WEF 2022). The consequences of physical risks are physical damage, loss of inventory & PPE, disruption of operations, supply chain & distribution networks, insurance costs, higher internal carbon tax if the SMEs are in a supply/distribution network of a larger company. The key accounting issues are going concern, materiality of damages, state contingent assets & liabilities, hedging (financial instruments), PPE, asset retirement obligations (AROs), provisions & contingencies, insurance, & revenue losses.

Chronic risks are "those risks that a business may face as a result of longer-term weather patterns and related effects, such as sustained higher temperatures, sea level rise, drought, and increased wildfires, as well as related effects such as decreased arability of farmland, and decreased habitability of land" (SEC 2024, p. 74). For WEF (2022) these are climate related "events that last longer and are caused by buildup of whether related events." The consequences of chronic risk are location related high operating costs, price of electricity & water, supply chain & distribution effects, market size, and location specific insurance premium. This class of risks are likely to affect the entity's business continuity, financial planning & strategy in the firm. The accounts that are likely to be affected by chronic risks are in the budgets & forecast financial statements, as well as in the valuation of GHG emitters (EPA 2020; SBA 2023; TCFD 2017).

Transition risks are "the actual or potential negative impacts on a registrant's consolidated financial statements, business operations, or value chains attributable to regulatory, technological, and market changes to address the mitigation of, or adaptation to, climate-related risks" (SEC 2024, p. 75). The effect of transition risks features in the write-offs and early retirement of existing assets, unexpected changes in energy costs, expenditures on new & alternative technologies, regulatory compliance costs, and research & development. This class of risk requires financial planning and strategy. The financial statement items likely to be affected are PPE, replacement of existing technology, provisions & contingencies, compliance costs, and systems and processes in "GHG accounting."

Concluding Remarks

The paper problematized the climate related risk disclosure issue in the context of the broader scientific debate. The review of the literature revealed that climate change-related risk is a multidisciplinary subject. There is a strong link between GHGs emission, climate change risks, and finance. Environmental economists advance the Polluter Pays Principle (PPP), which translates to the emitter pays principle, and propose abatement strategies (Nordhaus, 2019). The authors of the SEC's March 6, 2024, rule took a risk perspective and classified the risk faced by an investor. Implicit in this discourse is extreme weather events are both private bad and public bad where regulation alone is not resolving the problem. This line of argument is consistent with the commission's 2010 guidance and the recommendations of FSB/TCFD.

Capital market-based accounting research on GHG emissions has provided evidence of signaling. That is, the stock market has reacted to the mandatory (voluntary) disclosure and assurance of negative public goods (Dhaliwal et al., 2014; Gipper et al., 2024; Krueger et al., 2024). Noncapital capital market-based studies in turn relied on borrowed neo institutional theories and identified the actors and their logics (Scott, 2014). Hence, it is important that accounting research pays attention to how the accounting for negative public goods are developed, regulated, organized, and accounted for and reported on. This is important because the regulatory process for public (environmental goods such as clean air & water) is complex.

This paper assembled the relevant rules and regulations (EPA, SEC, SBA, FSB/TCFD) in tables and examined the financial consequences of climate-related risks for small businesses. Furthermore, it identified that important financial statement items are sensitive to climate change related risks. Climate change-related risks are ubiquitous and present themselves in various forms. They are part of strategy and financial planning for SMEs (Table 1). Table 2 documents the relevant standards, indicative paragraphs, and the type of climate related risks that an SME is exposed to. When the findings of this paper are added to the educational materials of FASB and IFRS Foundation, it becomes clear that financial statements continue to omit essential information that are threats to the wellbeing of small businesses.

This finding is important. First, investors in SMEs face the same type of extreme weather and climate change as listed companies. SMEs face at least proportional physical, chronic, and transition to decarbonization risks. Second, the accounting for SMEs is limited to AICPA's FRF for SMEs and IFRS for SMEs. The AICPA's FRF are optional and there are no quantitative and qualitative materiality thresholds for assessing the risk and quantifying the monetary effects in financial statements.

The main limitation of the paper is that it is exploratory. Extending this research into cross-country settings and exploring materiality thresholds for the effects of climate change risk are avenues for future research.

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