Carbon Accounting: A Social and Corporate Perspective

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Abstract

Global greenhouse gas emissions and the escalating implications of climate change need the development of new, more comprehensive approaches in preventing and reducing the harmful effects of climate change. As a result, governments, enterprises, academic institutions, and non-profit organizations will require improved methods of anticipating and fulfilling new information responsibilities and guidance on using evolving accounting systems to promote transparency. Scientific, political, economic, and corporate carbon accounting are only a few of the several developed types of accounts. They are related in policy or strategy, but they are not sufficiently interwoven in execution. Corporations may benefit from carbon accounting in two ways: using carbon accounting to identify and eliminate unsustainable behavior and improving sustainability. Manufacturing, distribution, procurement, supply chain management (SCM), innovation, communication, and marketing are just a few corporate services becoming more reliant on both methodologies. It makes little difference if a department's principal purpose is to ensure compliance with regulations, better organize energy and material flows to minimize large reduction impacts, increase eco-efficiency, product innovation, or legitimacy, or any combination of these objectives. Carbon management accounting has the potential to benefit decision-makers at all levels. It is hoped that the findings of this study would assist academics and policymakers in understanding how businesses respond to the requirements imposed by governments and non-governmental organizations (NGOs) to report their carbon emissions.

Keywords

Carbon accounting · Carbon disclosure · Social · Corporate perspective

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1 Introduction

1.1 Contextualizing Carbon Accounting for Sustainable Development and Climate Change

As one of the six primary sustainability challenges (together with deforestation and biodiversity loss, population growth, poverty, water scarcity, and climate change), climate change is probably the most pressing issue facing the world right now (Yohe and Tol 2008). Many of climate change's most severe consequences may be traced back to a variety of economic and societal activities. The following figure indicates the top Carbon-di-Oxide producers, expressed in gigatons of carbon produced. One has to keep in mind that the overall production of 465 Giga tons of Carbon will end up raising the global temperature by 2 °C, resulting in massive amounts of changes in global weather patterns. Therefore, it is paramount that this importance as with passage of time the CO_2 accumulation in the

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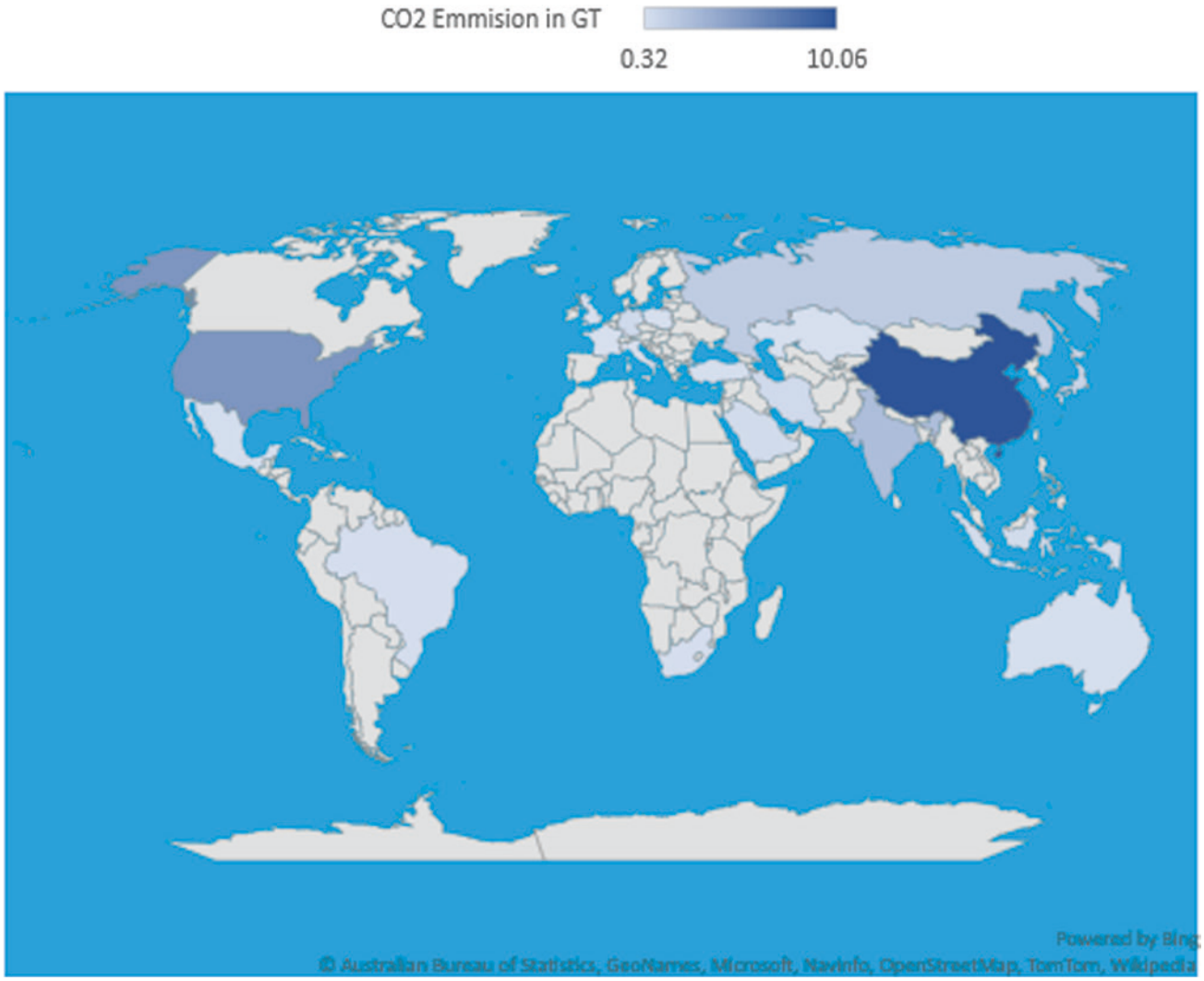


Fig. 1 Map indicating the top 20 countries w.r.t CO_2 omissions.

atmosphere is rising by the day, as indicated by the Figs. 1 and 2.

When it comes to the issues related to accumulation of Greenhouse gasses and their adverse impact on global climate and overall ecology, most of the time carbon di oxide is taken as standard, the simple reason being that it makes up almost 75% of the global "Green House Gas" emission as depicted in Fig. 3.

When it comes to global emissions the main cause is the fuel combustion, mainly the combustion of fossil fuel and in this respect China leads the global trend. Figure 4 depicts the total contribution of top economies in terms of their part in global CO_2 emissions.

The problem of global emission does not stop here as with passage of time not only the global emissions are increasing but at the same time one has to keep in mind that many economies have scaled up their CO_2 emissions. One of the parameters for measuring this is the per capita emissions. The top twenty countries in this respect are presented in Figs. 5 and 6.

The above stats also provides information regarding the extant of the problem as many new countries such as Saudi Arabia, Kazakhstan and Iran have joined this club. This also indicates how much damage is caused in terms of CO_2 emission as a consequence of their economic growth. Apart from this in-depth analysis of the greenhouse gas emission it is indicated that that almost two third of these gasses including CO_2 are produced as result of production of electricity used for industrial processes and heating for domestic and industrial purposes, along with the use of carbon-based fuels for manufacturing processes, the snapshot of which is provided in Fig. 7.

Uncontrolled use fossil fuel for economic development and progress already is having severe consequences on the global weather pattern and in countries where population density is high, there is rising sea level and constant

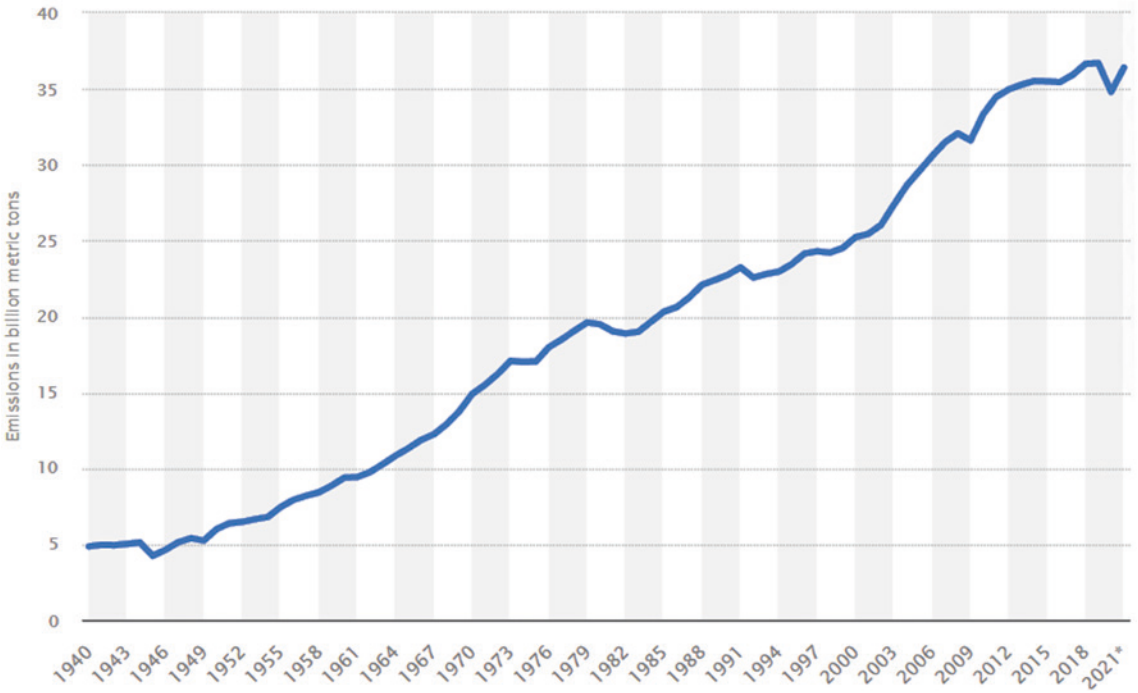


Fig. 2 Global CO_2 emissions from 1940 upto 2020

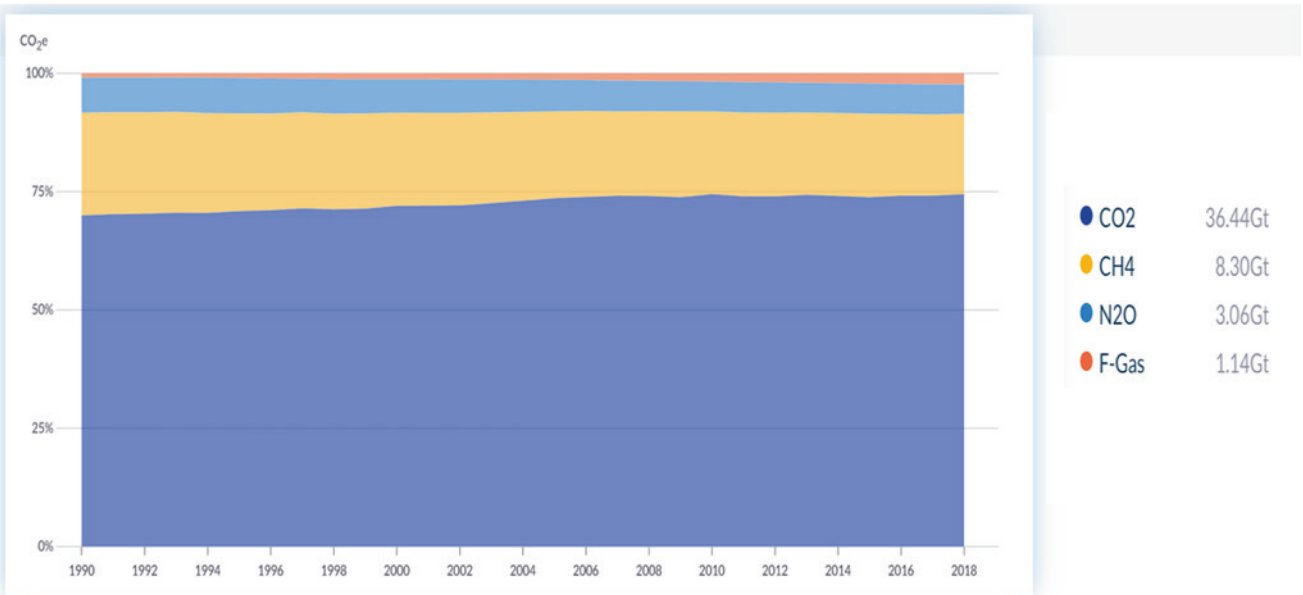


Fig. 3 Composition of global green house gas emission from 1990 upto 2018

changes in weather patterns that have resulted in droughts, typhons, and other natural disasters. The implication of such changes has a devastating impact on the population both in terms of social and economic issues. The battle against climate change is a critical problem for the long-term development of the world economy (Banuri and Opschoor 2009). Scholars have discovered that the global 'carbon bottom line' is continuously growing, putting ecosystems and present economies at risk of collapse on a scale never seen before in human history. Climate-changing greenhouse gas emissions have increased significantly over the past decade, mostly attributable to ever increasing emission of greenhouse gasses such CO_2, whose underlying cause is rapid urbanization and population growth in emerging economies such as India and China. while the developed economies such as USA, have paid little to no

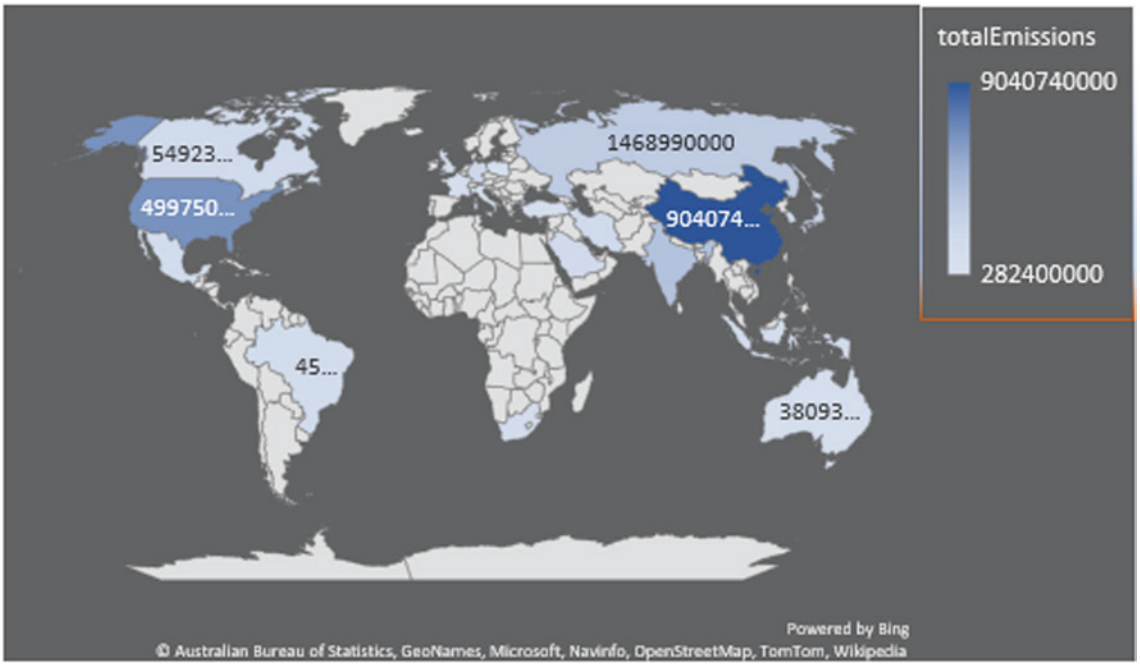
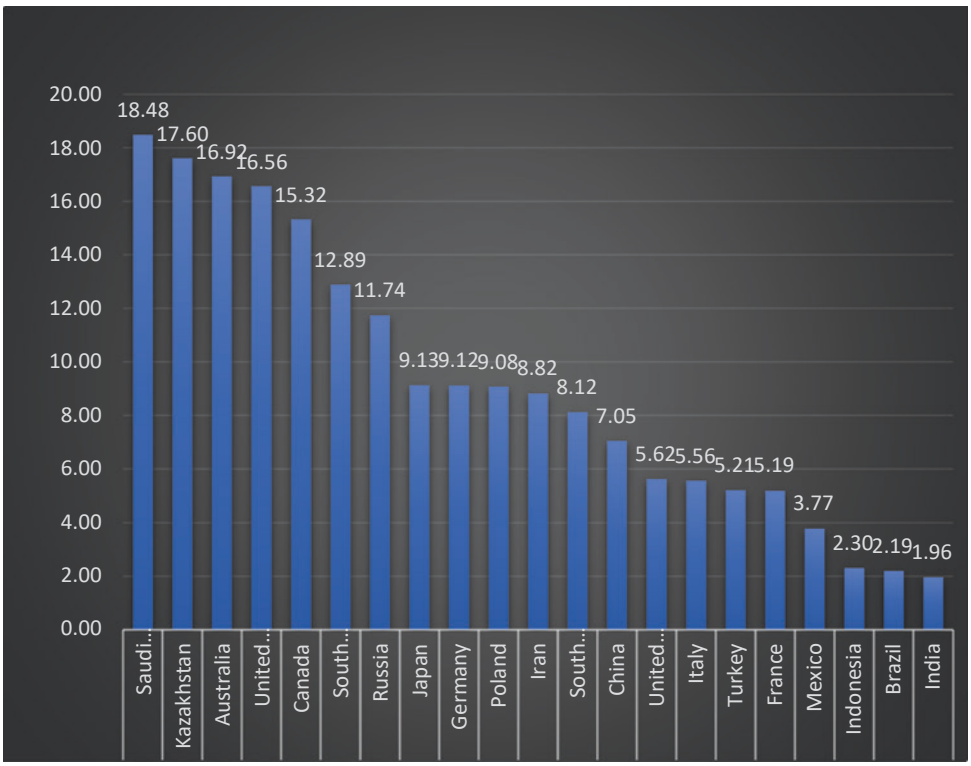


Fig. 4 Data is for carbon dioxide emissions from fuel combustion in tons in 2015

Fig. 5 Top 20 countries ranked according to Per-capita CO_2 Emissions



attention to decreasing their carbon emissions. The following Figs. 8 and 9 provide an overview of these emissions by world's major economies and economic zones. These figures also indicate the targets set by these countries, and their actual performance in terms of controlling and reducing their emissions' targets from 1995 to 2005.

As it the above graphics clearly indicate that, in the absence of any policy the emissions will have devastating

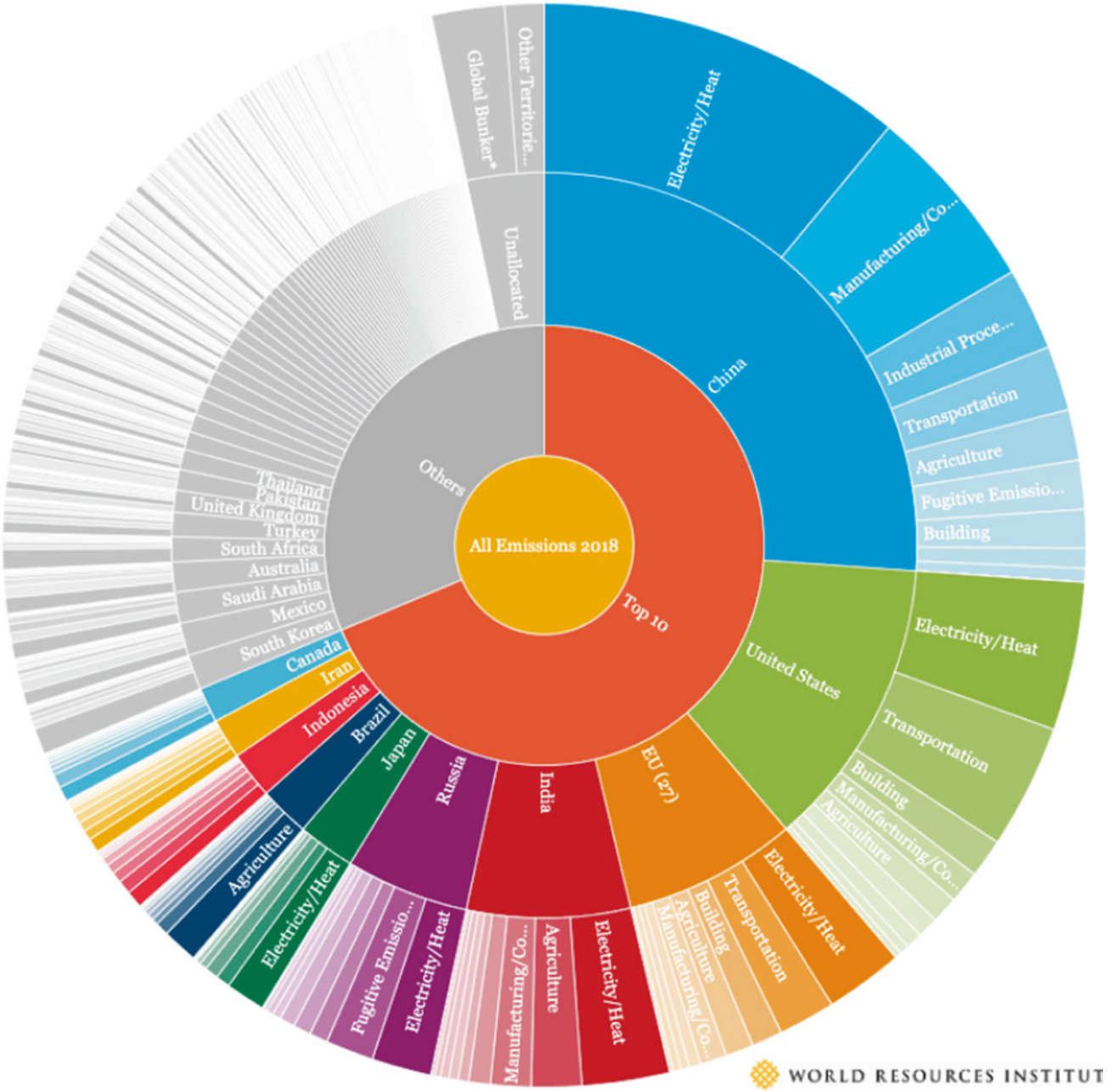


Fig. 6 The top 10 GHG emitters contribute over two-thirds of global emissions

consequences for the entire planet while in the case of adopting and flowing the Paris agreement the global emissions cannot only be controlled but can also be curtailed. In the fight against climate change, Germany and the Netherlands are at the forefront of reducing greenhouse gas emissions. At the same time, vulnerable countries such as those in the 'Coalition of Pacific Island States' encourage the international community to become more involved in climate change prevention and adaptation activities. In their efforts to reduce per capita carbon emissions, other countries, such as Australia and China, are following their predecessors' footsteps. Through technological advancements, Europe has partially isolated GHG emissions from GDP growth over the previous two decades.

Improvements in process efficiency and more energy-efficient consumer products are presently being utilized as indicators of greenhouse gas reduction. However, despite this being an important subject of study, the world's population and economic growth, particularly in big emerging economies, currently overwhelm the efficiency improvements. As a result, substantial reductions in the overall carbon emissions are more difficult to achieve through

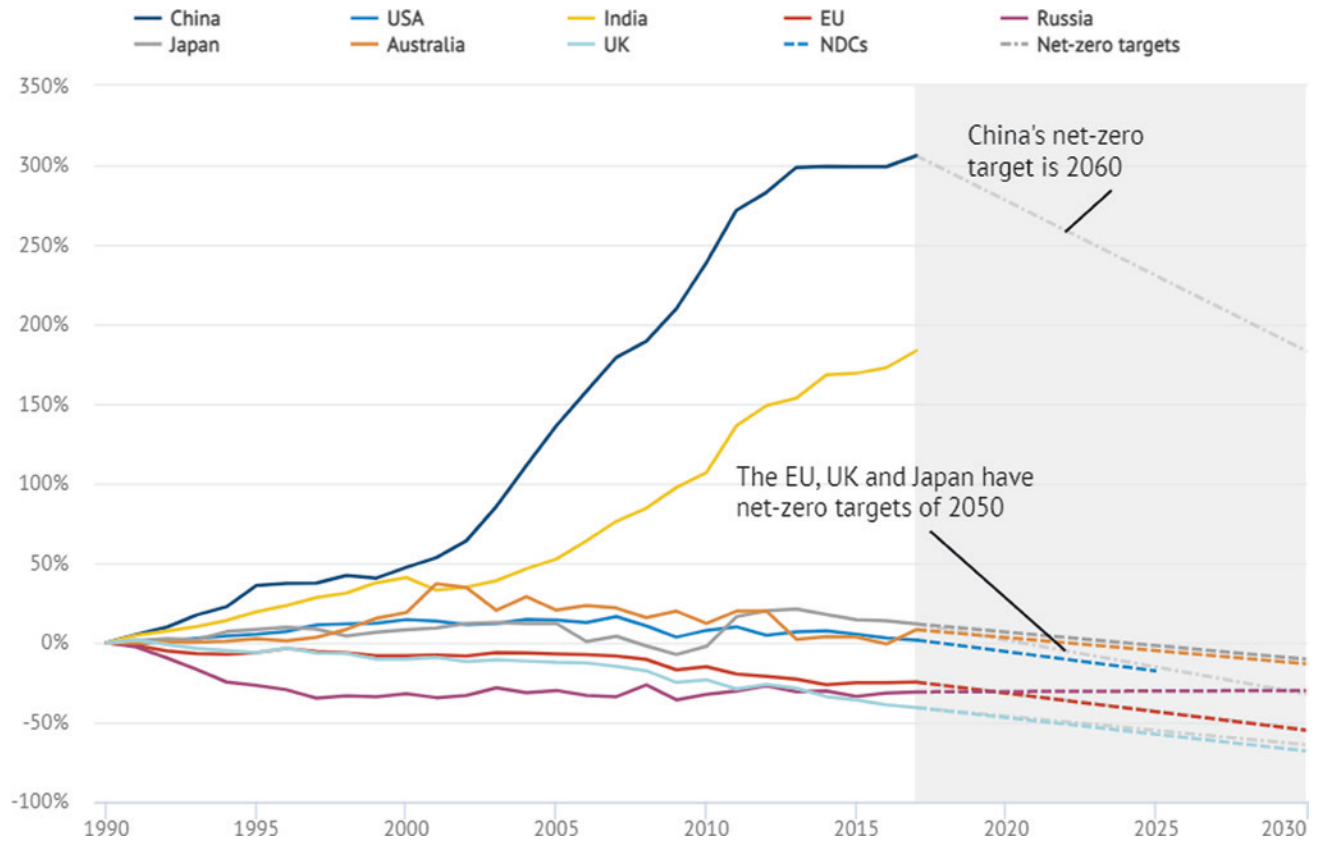


Fig. 7 Changes in emissions major economies since 1995

carbon accounting than increased efficiency (Busch and Lewandowski 2016).

Product carbon tagging and life cycle pricing are examples of accounting systems that consider the whole supply chain. However, they are not yet relevant in the actual world due to technological limitations. In the EU's environmental policy, product-oriented indicators have been added to industrial process control rules to improve their effectiveness. So far, product-related environmental policy has focused on large-scale sources of pollution such as industrial emissions and waste management rather than on smaller-scale causes of contamination. There are, however, raising concerns about the need for rules that cover the whole product life cycle, including the use phase, which are becoming more prevalent. Environmental effects across the life-cycle should be dealt with in an integrated way, rather than just changing from one phase of the life-cycle to another," this should ensure that the environment is protected throughout the life-cycle (Wilting and Vringer 2009).

Because it reveals where emissions originate and where they are absorbed, carbon accounting is critical in the battle against global warming. Earth's sinks and sources have changed throughout time, therefore those who make choices on how to reduce global emissions utilize the most accurate data available.

Many different things are included in the word "carbon accounting," which is a general term that can imply different things to various individuals. Physical carbon accounting is concerned with quantifying the actual quantities of greenhouse gas emissions released into the atmosphere, whereas financial carbon accounting is concerned with placing a monetary value on carbon.

Physical carbon accounting is one method of calculating emissions of carbon dioxide into the atmosphere. If you're a business person, you can use this to figure out how much carbon you're releasing into the atmosphere. Goals for reducing carbon emissions may be set after it is understood how much carbon is being emitted. Furthermore, this approach is critical in that it enables us to determine who is accountable for each individual's contribution to global warming emissions (Fig. 10).

2 Importance of Carbon Accounting

When it comes to dealing with climate change, carbon accounting is becoming more important. People who are interested in businesses want them to do what they can to help. You need to know where you are now and how it will change in the future to be able to make good decisions.

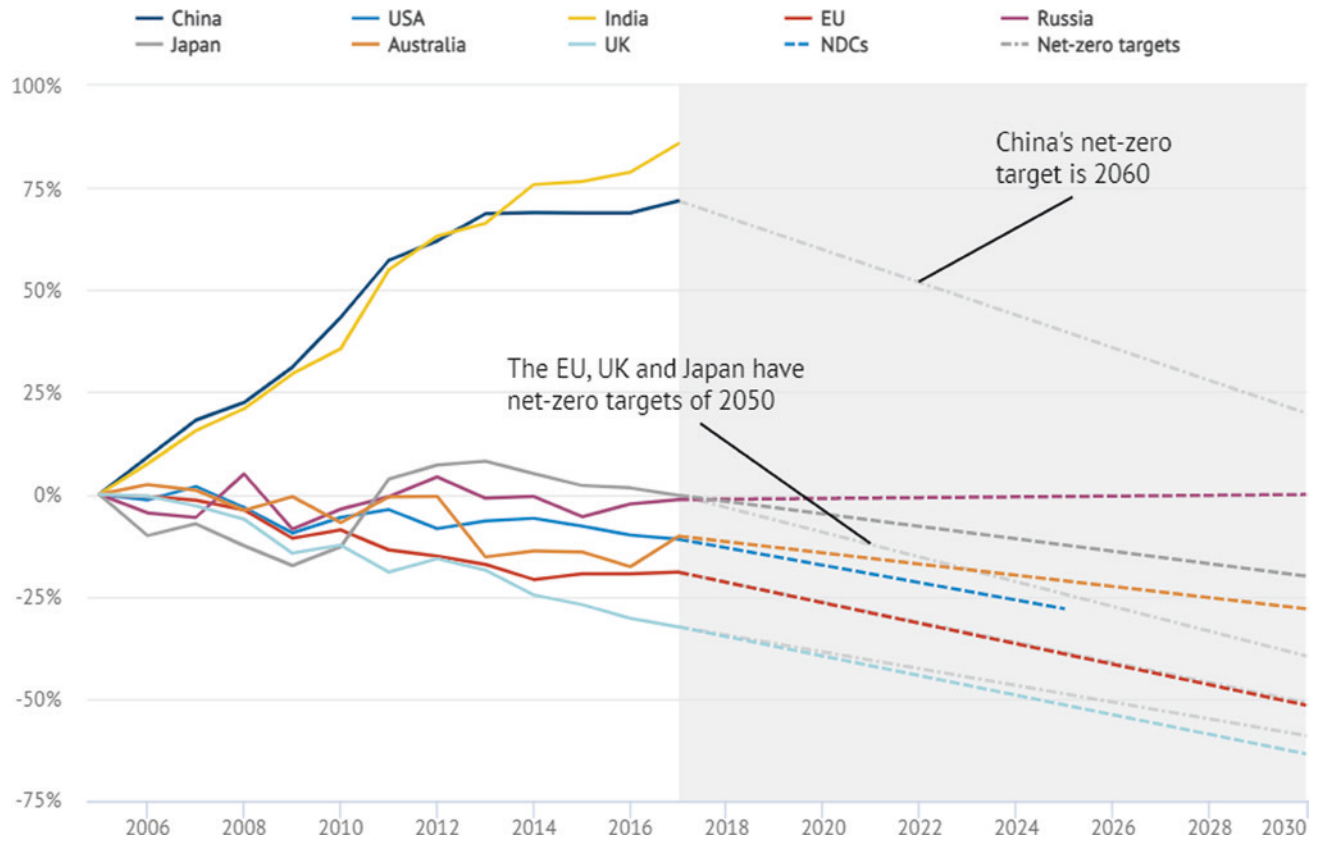


Fig. 8 Changes in emissions major economies since 2005

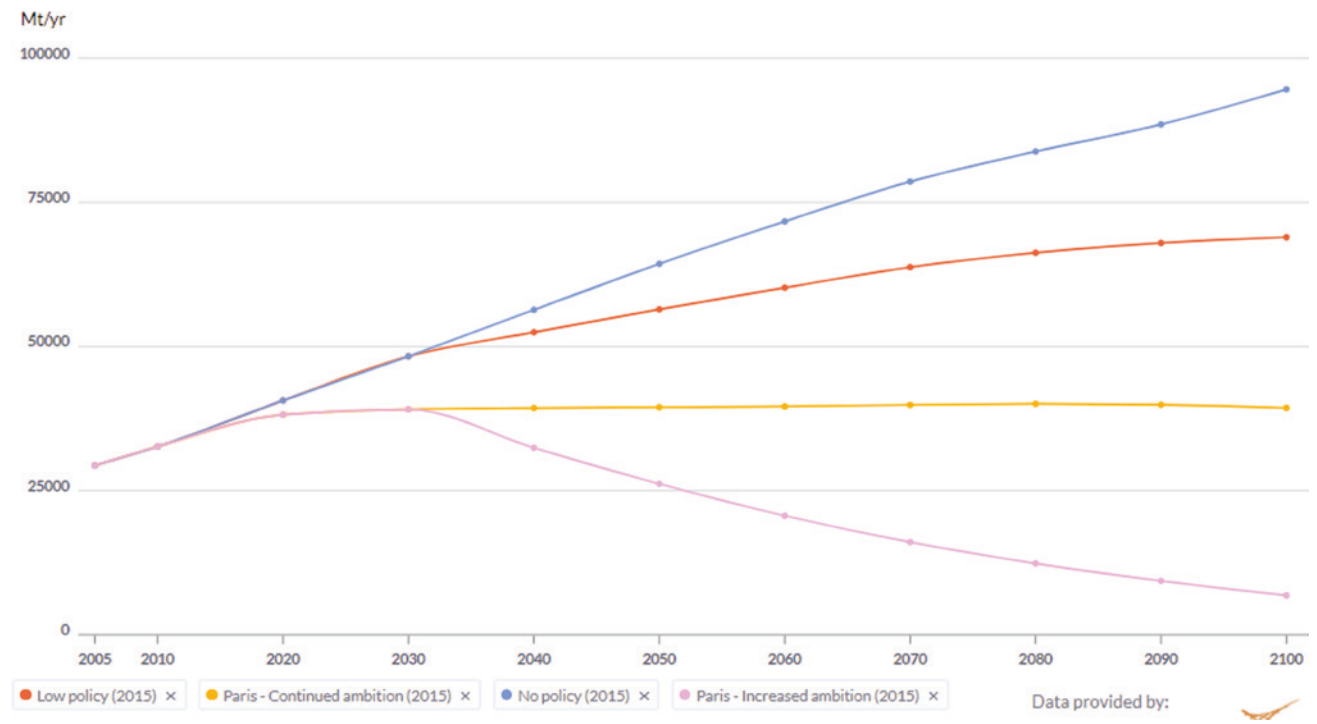


Fig. 9 Projections of CO_2 emissions in different scenarios

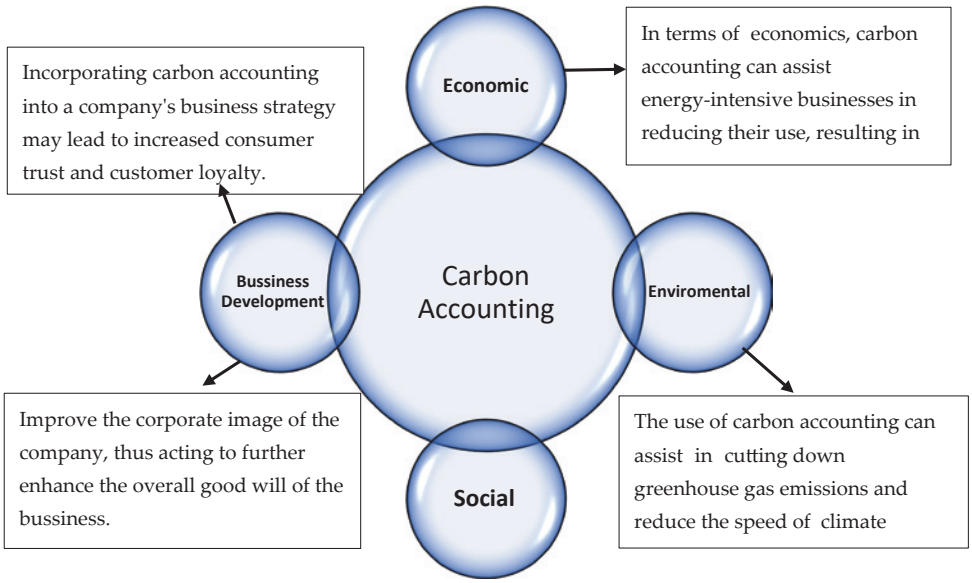


Fig. 10 Different aspects of carbon accounting

Climate change is caused by carbon dioxide and other gases that trap heat. There is already a global consensus that this is the case. Carbon dioxide emissions must be counted in order to figure out how to reduce them and improve the air and water on our planet. In this case, carbon accounting can be used to help. In the fight against climate change, one of the most important things governments and businesses can do if a disaster is near is to use carbon accounting to figure out how much carbon they use (Delay et al. 2009).

Carbon accounting might imply different things to different people. According to experts, it is the "process of obtaining scientifically rigorous and trustworthy measurements of GHG [greenhouse gas] emissions" (Green et al. 2017). With the United Nations Clean Development Mechanism (CDM) market, emissions reductions are measured against a hypothetical baseline. Additional processes are carried out to form a new trading commodity: carbon credits (Ministry of Environment 2009). When it comes to emissions trading systems, the International Accounting Standards Board (IASB) is particularly interested in accounting for tradable emission rights and liabilities (Lovell and MacKenzie 2011). Because of the increasing number of businesses that are reporting to the Carbon Disclosure Project (CDP), The Climate Registry, or other similar schemes, it is necessary to monitor and disclose greenhouse gas emissions, for which the businesses take varying degrees of accountability (Bebbington and Larrinaga-Gonzalez 2008). In various methods, carbon accounting is used in many of society's most significant climate change solutions, including governmental emission limits, corporate climate change goals, and carbon markets. Despite this, it is usually overlooked in its significance and influence. Even more significantly, the interconnections between various carbon accounting firms have not received nearly enough rigorous consideration (Kauffmann and Tébar Less 2010). There are distinct institutional structures, normative practices, and academic literature for carbon accounting distinct from those for other types of carbon accounting. This research provides a complete picture of what carbon accounting includes across industries and organizations to make sense of the inconsistencies between different types of carbon accounting (Allan Cook 2009).

Today's carbon accounting field is characterized by the convergence of at least five primary "framing" processes, where the "hot" new world of political commitments and carbon markets meets the somewhat "cooler" foundations of physical carbon accounting, financial accounting, and social/environmental accounting. Understanding different aspects of carbon accounting and their interconnectedness more effectively solve the accounting-related challenges that hamper attempts to mitigate climate change (Hahn et al. 2015).

When discussing the "political" aspect of accounting of carbon in terms of national inventories. In that case, physical carbon measurement predates and influences the more technical literature on "market-enabling" carbon accounting, as well as the literature on "market-enabling" climate change. The financial accounting of rights and duties in carbon markets has only lately been brought to the attention of financial accountants, even though such markets have begun to have significant ramifications for corporate balance sheets (Lovell and MacKenzie 2011). A significant amount of research on social and environmental accounting has been conducted concerning examining corporate carbon disclosure and reporting practices. There has been little research on the politics and practices of carbon accounting (Allan Cook 2009); thus, this is a welcome addition to the

field. Discussions about carbon accounting have tended to occur in isolated settings with only a few ties between them (Alrazi et al. 2015).

3 Literature on Carbon Accounting

The Kyoto Protocol, approved by 195 countries, provides a market-based framework for countries to limit or control their greenhouse gas emissions. In the wake of establishing the carbon emissions trading market, new accounting issues have arisen, which must be addressed. The new method has ignited a debate in the accounting literature about various climate change mitigation and adaptation measures (Milne and Grubnic 2011). Collective experiments to reinvent "the forms of organization of economic, political, and scientific activity" are now underway in the carbon market, and they are referred to as "ongoing collective experiments." It's also worth mentioning that there is some skepticism about the success of various climate change programs in terms of cutting greenhouse gas emission.

(Andrew and Cortese 2013; Boston and Lempp 2011), as well as (Çalışkan and Callon 2009) state that while the policy debate focuses on the general impact of climate change on business, some academics are more interested in the particular accounting implications of the shift and the problems involved with carbon accounting, both in terms of study and in terms of practical application. There is a thorough discussion of the issues associated with carbon trading and accounting and numerous ways that accounting may be utilized to communicate the various climate risks and uncertainties (Hahn et al. 2015). From the perspective of management accounting, carbon accounting is discussed to stimulate more research into carbon management and control. The early conceptual inquiries into carbon accounting will greatly assist future research in the field (Hartmann et al. 2013).

3.1 Financial Accounting for Carbon Assets and Liabilities

With the advent of a new emission related restrictions and taxes, the question of how to report carbon emissions in financial statements arises. The argument places a strong focus on the value of free allowances and the volatility caused by varied asset values, and the recognition of obligations in the financial statements and other documents. The difficulty in calculating carbon allowances is a significant factor in the problem. It is both a financial instrument that may be traded on the market and a carbon emission permits, with the latter functioning as a legislated upper limit on carbon emissions (Bebbington and Thomson 2013) Standard-setting agencies have found it challenging to develop a universal accounting standard that is compatible with both carbon-related assets and liabilities as well as other general assets and liabilities because of this distinguishing characteristic.

According to the IFRS,[1] Due to a dispute over the accounting of carbon allowances, Emission Rights were abolished in June 2005 as reported by (Kollmuss et al. 2008). Because the actual standards for accounting for emissions allowances have not yet been determined in practice, and there are three widely used methods.

Allowances can be accounted for in various ways, including net liability, gross liability, and inventory techniques. There are two approaches to accounting for free allocations: a gross liability technique that accounts for free allocations at fair value and an inventory method that accounts for free allocations at zero value. Because corporations can choose whether carbon allowances should be classed as assets, liabilities, or even expenses, accounting discrepancies might make, issues with standards related to disclose the nature of business, the comparison of financial statements for different types of business becomes difficult (Warwick and Ng 2012). Because of this, academics have called for accounting standard-setters to adopt a standardized approach to accounting (Trifts and Asare 2015).

Since 2014, there has been no mention of carbon allowance accounting in accounting literature or textbooks. However, there is still an issue, and it may worsen if additional countries worldwide choose to employ ETSs to control their greenhouse gas emissions. More research into the issue of carbon financial accounting may be beneficial to the field of carbon financial accounting. One of the many climates change-related difficulties in financial accounting is the management of carbon allowances, which is only one example. (He et al. 2020) develop a model that considers a wide range of carbon-related characteristics, including emissions allowances, carbon sequestration, and emissions control capabilities. Assets that are stranded and assets that regulate emissions are also worthy of consideration (Dr Lovell et al. 2010). It can be that accounting's increased inclusion of carbon concerns will be a rewarding study subject to examine further as the effects of climate change on the value of business assets become more substantial (Pitrakkos and Maroun 2020).

[1] In November 2021 the Trustees published a revised *Constitution* and a Feedback Statement that responds to the feedback from Exposure Draft *Proposed Targeted Amendments to the IFRS Foundation Constitution to Accommodate an International Sustainability Standards Board to Set IFRS Sustainability Standards*.

4 Carbon Disclosure

Net-zero carbon emissions are becoming more and more difficult to achieve, and their success depends on a worldwide effort by governments, businesses, financial institutions, and people to remove or capture carbon emissions. It all begins with simple activities like calculating and reporting carbon emissions each year. A considerable improvement in measuring and reporting corporate carbon emissions has occurred, although the vast majority of publicly traded corporations and even fewer privately owned businesses continue to avoid disclosing the amount of carbon they emit. Another issue with present voluntary disclosures is that they lack a consistent methodology for measuring and reporting information: "Firms publish reams of meaningless puffery, while often failing to reveal the few items that matter. An ideal situation would be for an asset manager to be able to calculate their portfolio's carbon footprint and track changes over time. As a result, many companies have failed to disclose their emissions in a comprehensive manner, and the metrics made public by different companies sometimes overlap, resulting in double counting" (The Economist 2021).

Capital markets are built on the foundation of mandatory disclosures of important financial information. As the climate situation worsens, it's critical that we learn more about how much carbon dioxide we're producing. Individual firms' progress toward the net zero target may be gauged by requiring both publicly listed and private enterprises to publish their carbon emissions. Our suggested reporting obligation has already been enacted in certain jurisdictions, notably the United Kingdom (Bolton et al. 2021).

Businesses publish their emissions disclosures in a number of ways. It is a legal requirement for certain firms to disclose their GHG emissions to government agencies, while other companies choose to do so voluntarily through the Carbon Disclosure Project (CDP) or other sustainability or social responsibility reporting. Carbon accounting has given a considerable deal of attention to the subject of carbon disclosure. One of the most common types of carbon disclosure studies is qualitative or quantitative. As of now, there are three distinct study areas focused on the factors that impact organizations' decisions about whether or not to disclose their carbon footprints, including the quality and appropriateness of such disclosures, among other things (Hahn et al. 2015).

4.1 Determinants and Motivations of Carbon Disclosure

The legitimacy theory, stakeholder theory, signaling theory, and institutional theory are a few of the most prevalent theories on voluntary carbon disclosure. These are typically cited as supporting ideas in inquiries into the causes and motivations for carbon disclosure. A firm's readiness to reveal its genuine stance on carbon emissions and management is linked to social, commercial, economic, regulatory and institutional constraints when they are translated into disclosure incentives, according to the theories (Louche et al. 2021). Based upon the previous literature the following model has been formulated to reflect the relationship between different factors that impact the decision regarding the disclosure related to carbon accounting or in simple terms the disclosure of carbon emissions at the firm level (Fig. 11).

4.2 External Pressures

The impact of governmental and institutional mandates on company carbon disclosure is also a topic of debate in

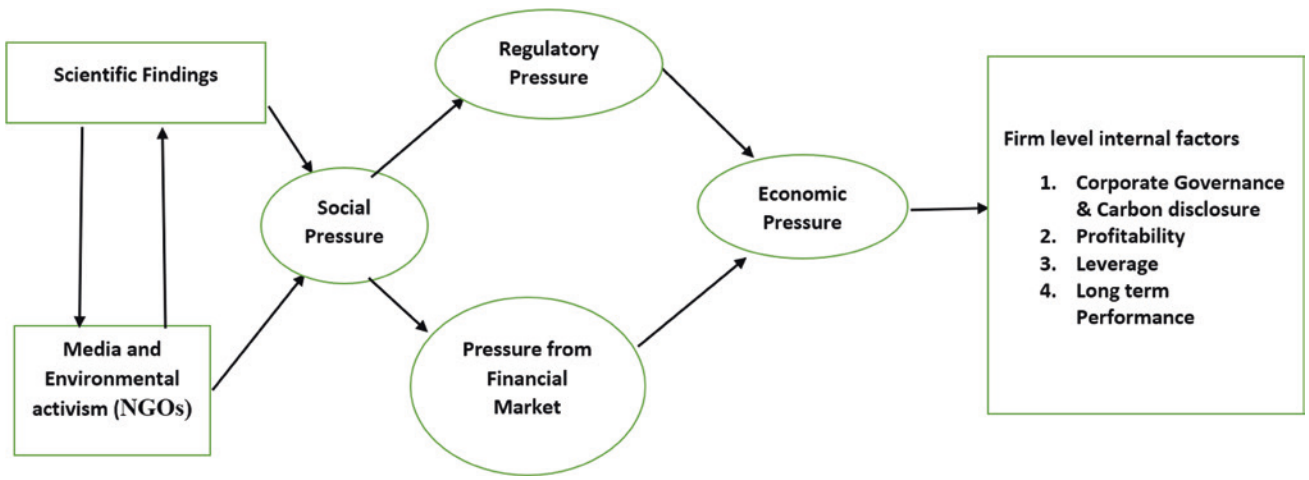


Fig. 11 Disclosure of carbon emissions at the firm level

academic circles. According to a new research, voluntary carbon disclosure is more likely to occur in nations where investors are well-protected and have stringent environmental regulations (Nor et al. 2016). Due to the stricter laws that apply to these businesses, Companies in carbon-intensive businesses are more likely than their peers in other industries to disclose their carbon footprint (He et al. 2020, 2021a). According to research conducted in Australia, the United Kingdom, the United States, and China, the reporting requirements of emission imposed by governments and financial markets disclosure have a beneficial influence on the willingness of corporations to voluntarily disclose information about their carbon emissions (Yang and Farley 2016). Furthermore, non-governmental organizations corporate carbon disclosures can benefit from non-governmental organizations like the Global Reporting Initiative (GRI) and the Carbon Disclosure Project (CDP) (Green et al. 2017).

Certain studies have also considered the impact of economic pressure on carbon disclosure as a potential driver of carbon disclosure. As a result of the implementation of climate legislation, internalized carbon pricing has emerged as one kind of economic pressure (Bebbington and Larrinaga-Gonzalez 2008; Bebbington and Thomson 2013; de Aguiar and Bebbington 2014) Researchers at the World Resources Institute found that companies with headquarters in countries that have signed the Kyoto Protocol are more likely to disclose their efforts and outcomes when they are compelled to do so by the Protocol's regulations. Economic pressure can also be exerted on a company through the operational environment it operates in. According to (Ott et al. 2017) businesses' decision to voluntarily publish their carbon emissions may be impacted by competitive pressures. Researchers at the World Resources Institute found that companies with headquarters in countries that have signed the Kyoto Protocol are more likely to disclose their efforts and outcomes when they are compelled to do so by the Protocol's regulations. Economic pressure can also be exerted on a company through the operational environment.

In addition to social and financial market dynamics, the literature has addressed the role of government in the economy. Because the media and authorities are more interested in and examining larger organisations, academics frequently use their data on company size as a proxy for social pressures. According to a growing body of studies, people's willingness and ability to report their carbon emissions is strongly influenced by societal pressure (Freedman and Park 2014; Freedman and Park 2017). A major factor in growing financial market pressure on management to reveal more information about greenhouse gas emissions is the involvement of investors, who are expected to play an important role. However, empirical research also shows that capital raising or ownership concentration and public carbon disclosure have no connection and, in some situations, a negative correlation (He et al. 2021b).

4.3 Firm Characteristics

The firm's board of directors' structure has been investigated as a potential element in carbon disclosure requirements. Research done in Australia by (Green et al. 2017) indicates a positive relationship between a company's overall governance quality and the probability and extent to which it discloses carbon emissions. It has been demonstrated that having a higher proportion of carbon disclosure preparedness is correlated with the presence of female directors on the board of a corporation (Pitrakkos and Maroun 2019). Several studies, including that of (Alrazi et al. 2015) and (Green et al. 2017), talk of their various experiences and lack of financial investment in the company, where independent directors advocate greater comprehensive carbon disclosure (Cooper et al. 2018). Those who have a higher interest in the firm may be hesitant to engage in carbon abatement initiatives, such as transparency, due to the uncertainty of a financial return on such a significant environmental investment. Contrary to the popular belief, those who have found a link between corporate ownership and carbon disclosure believe the exact opposite (Pitrakkos and Maroun 2019). They argue that management ownership would enable managers to better align their own interests with those of their shareholders, increasing their willingness to engage in climate change discussions with their shareholders.

Financial characteristics like profitability, leverage, and long-term development possibilities are explored in the academic literature. In accordance with (Freedman and Park 2014), because higher profitability improves the company's available financial resources, researchers often assume a positive link between corporate profits and carbon disclosure. According to a past study, a company's profitability has no significant influence on the likelihood or extent to which it discloses its carbon footprint. To put it another way, a large corporation with a great deal of power may be expected to disclose information about its carbon impact if asked (He et al. 2020, 2021b). Nonetheless, a heavily leveraged corporation may choose to keep sensitive information like carbon risk under wraps for fear that full disclosure of such information could damage its bargaining power in the future (Luo 2019). Some studies have found a negative correlation between the carbon disclosure and profitability of the firms (Luo and Tang 2014), with the majority finding no correlation at all (He et al. 2020, 2021a, 2021b; Luo 2019); firms with significant development potential, particularly in less developed countries, are less likely to declare carbon emissions than other enterprises.

Firms emphasize financial objectives over environmental concerns, resulting in a reduction in the amount of time and money spent on lowering carbon emissions and publicizing the results of their research. Additionally, management's opinions and attitudes toward environmental preservation may impact a company's decision to disclose carbon data. Because cultural influences might significantly impact responses to major changes in climate (He et al. 2020). Observe the relationship between national culture and the replies of firms to the CDP survey. They come to the conclusion that cultural traits like masculinity, power distance, fear of the unknown, individualism, and a long-term outlook have a significant impact on whether or not people are willing to share their carbon statistics. Management systems for the environment are more likely to succeed than those that are not, managed firms to inform investors and the general public about their efforts to combat climate change (Bowen and Wittneben 2011; Haigh and Shapiro 2011) either because they have significantly lower disclosure propensity and credit risks associated with climate change (Ott et al. 2017) or because they have significantly lower disclosure propensity and credit risks associated with climate change.

4.4 Carbon Disclosure, Quality and Adequacy

Some experts are concerned about the quality of corporate carbon disclosure because it is still optional in the majority of countries (Cowan and Deegan 2011). Several studies have shown that corporate climate change disclosures are skewed in favor of what they consider to be the best outcomes (Haque 2017). Five of the seven pillars of (Comyns and Figge 2015) self-created disclosure quality index include accuracy; Completion, consistency, credibility, relevance, timeliness, and transparency round out the checklist. During their investigation, they find that disclosure quality has not much improved, and they believe that regulation is important to keep the practice under check (Haslam et al. 2014) have expressed dissatisfaction with present methodologies that provide irreconcilable numbers and narratives that contradict one another. According to (Haigh and Shapiro 2011), investors can benefit from more information about a company's carbon emissions. Still, carbon performance information may have minimal influence on investors' portfolio selections. Researchers discovered that investors were taking advantage of recognized inadequacies in public reporting on climate change by employing the accounting and reporting procedures that can be termed as deceptive (Andrew and Cortese 2013).

The inadequacy of corporate carbon disclosure information can be attributed to a misalignment amongst different stakeholders' and managers' expectations on the disclosure of carbon emissions. Climate change is a topic that management doesn't seem to care much about, even though green communities and environmental authorities are worried. Directors are more concerned with the costs and dangers of complying with rules and financial success for shareholders than they are with the impact of operations on carbon emissions. It is consistent with previous research (Haque 2017). The fact that carbon dioxide emissions declarations are purely voluntary enhances the prospect of inconsistency in statistics due to methodological heterogeneity, which may be addressed if mandatory regulation were implemented (Andrew and Forgie 2008).

Sustainability accounting and disclosure had its early detractors who were concerned about the reliability and quality of voluntary carbon disclosures in the literature which were shared by other early critics of sustainability disclosure and accounting (Hopwood 2009). According to (He et al. 2020, 2021b), the CDP system has improved, and carbon disclosure assists investors in making decisions about the market value of a firm (Matsumura et al. 2014). Because voluntary carbon disclosure is only advantageous if it correctly represents a company's true carbon performance, individuals worried about its quality are justified in questioning whether it does so. A common explanation for the relationship between carbon performance and disclosure is found in two conflicting theories: the signaling and legitimacy hypotheses. According to signaling theory, top performers are motivated to offer more trustworthy, objective, and quantitative disclosures to distinguish themselves from low performers and avoid being removed from the competition (Hughes 1986). Unfortunately, the empirical data in this particular study subject is unclear. The findings of (He et al. 2020, 2021b) provide validity to the signaling concept by revealing a relationship between a company's effectiveness in carbon moderation and the extent to which it discloses its carbon emissions and greenhouse gas emissions (Ott et al. 2017) have comparable evidence; however, it is of poor quality. As described by (He et al. 2020; Luo 2019), if carbon institutions are tight, firms' incentives to use carbon disclosure for legitimation attempts might be restrained. On the other side, using Chinese data, (Momin et al. 2017)discovered evidence that supports the legitimacy hypothesis.

According to (Pitrakkos and Maroun 2019), businesses in carbon-intensive sectors rely more on releasing behavioural information to demonstrate their genuine efforts to prevent global warming than their counterparts in low-carbon industries. Disclosures made by participating firms in the UK ETS and Energy Efficiency Scheme were used to make the organizations look more credible and shift the responsibility for fighting climate change to the government or suppliers, which slowed down progress. Businesses can influence their disclosure behavior in two ways: by

reporting their carbon emissions and by failing to declare their carbon emissions. Regardless of whether the goal of carbon disclosure is to achieve legitimacy or to send a signal, (Schaltegger and Csutora 2012) argue that the disclosure encourages subsequent organizational reform from the outside-in, rather than the other way around. According to the findings of the researchers, changes in carbon disclosure levels are linked to changes in carbon emissions performance in the future.

5 Conclusion and Outlook for the Future

It is doubtful that the carbon reporting obligation will solve the climate situation. Nevertheless, research shows that simply requiring corporations to record their past emissions will motivate them to reduce their emissions faster because of the attention that will be generated by future emissions reporting. In addition, a slew of multinational firms has lately established voluntary objectives (milestones) on their projected routes to net-zero energy usage. Companies may enhance their required yearly direct emissions reporting with extra optional disclosures. Mandatory and voluntary disclosures will eventually give additional information about a company's actual success of prior reduction goals. One such example was the agreement of global community on Montreal Protocol to adopt mandatory emission reporting in 1987, in regards to the emissions of Green House Gasses in order to save the rapid depletion of the Ozone layer. This led to recovery of the Ozone layer in following decades. Emission caps and the wider range of international mechanisms made available as a result of their adoption by more countries could help address some of these issues. A small number of countries will continue this effort, and it still raises questions about internationalizing policy and incentives in the most problematic areas, such as transportation and some land uses. Carbon accounting can serve as a bridge, which can be used to achieve the climate related targets in both long and short terms.

5.1 The Future of Carbon Accounting Will Be Based on Reasonable Targets Based on Science and Reduced Emissions.

Regarding the future of carbon accounting, the notions of quality versus quantity of disclosure present a significant challenge. The carbon footprints of both large and small businesses are investigated and the disclosure medium that businesses employ (integrated vs sustainability report). Carbon disclosures tend to be driven mostly by a desire to be perceived as legitimate, and corporations appear to be hesitant to commit to high-quality carbon reporting practices. Because of the "plethora of third-party ESG verifier companies" (Nasralla and Bousso 2019), as well as the "numerous voluntary initiatives and frameworks to unify carbon accounting and target setting; some overlap, but none have been universally adopted," investors are left to fend for themselves in a confusing maze of carbon accounting rules and regulations.

Management research has proposed that "science-based targets" for climate change implementation be established. Their comparison of four different science-based techniques (Faria and Labutong 2019) contributes to the literature on carbon accounting. When it comes to set target values, it is demonstrated in this study that mitigating possibilities are equally as important as the allocation principle, which is a noteworthy finding, assists businesses in their GHG emission reduction efforts, and policymakers must encourage them to pick models that are far less polluting than the 2degree C limitations. As part of their value propositions, several firms are altering their offerings to help clients minimize emissions from existing business models. For example, (Revellino 2020) in his research, discusses how this concept may be employed in an organization what it means for future attempts to reduce greenhouse gas emissions and adapt to climate change. While (Revellino 2020) examines how "climate change calculations become seductive forces for public engagement."

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