Mandatory Corporate Carbon Disclosures and the Path to Net Zero

Patrick Bolton, Columbia University, NBER & CEPR
Stefan J. Reichelstein, University of Mannheim & Stanford Graduate School of Business
Marcin T. Kacperczyk, Imperial College London & CEPR
Christian Leuz, University of Chicago, Booth School of Business & NBER
Gaizka Ormazabal, IESE Business School & CEPR
Dirk Schoenmaker, Rotterdam School of Management, Erasmus University & CEPR

forthcoming: **Management and Business Review**

Executive Summary

Despite widespread concern about global climate change, the overwhelming majority of publicly listed companies around the world still do not disclose their carbon emissions. Even fewer privately held companies do. Making carbon disclosures mandatory for both public and private companies is an elementary but essential step in the drive towards a net zero carbon economy. Firms should be required to report their annual direct greenhouse gas emissions, called Scope 1 emissions, as measured in CO_2 equivalents, with possible deductions for high quality offsets. Going forward, firms should also be required to report the history of their annual carbon emissions. Such a disclosure mandate is simple, transparent, and readily implemented. It will aid policy makers and asset managers alike in managing the risks of carbon transition and accelerate the pace of future carbon emission reductions.

Introductory Note

To advance progress toward a net zero carbon economy, Patrick Bolton, Stefan Reichelstein, Marcin Kacperczyk, Christian Leuz, Gaizka Ormazabal, and Dirk Schoenmaker recommend that

governments impose a mandate on corporations requiring them to report their annual direct carbon emissions.[1]

According to the latest IPCC report, for the world to have at least an 83 percent chance of limiting global warming to no more than 1.5ºC, it must limit its total additional carbon emissions to no more than 300 gigatons (Gt) of CO_2 equivalents starting in 2020.[2] If the economies of the world continue to match last year's global energy-related emissions, which amounted to 31.5 Gt of CO_2, the entire carbon budget will be exhausted in the next eight and a half years.[3] The path to reach carbon net zero in time is narrowing day by day. Success depends on a universal and ambitious drive by all governments, corporations, financial institutions, and consumers to eliminate or capture carbon emissions.

In order to reduce and ultimately eliminate net carbon emissions, we must begin with the mundane tasks of measuring and reporting them. In 2005, Trucost estimated the yearly carbon emissions of 2,993 listed companies. Only 217 of those, or 7.25 percent of companies, disclosed their emissions voluntarily. By 2018, Trucost reported on 8,446 companies and the voluntary disclosure rate had risen to 15.94 percent, representing 1,346 companies.[4] So despite significant progress by some corporations in reporting their carbon emissions, the overwhelming majority of listed companies still do not disclose this information. Among privately held companies, disclosure rates are even lower.

Many global corporations from a wide range of industries have recently issued carbon reduction pledges, often promising to reach net zero by 2050.[5] Yet as a recent article in the Economist pointed out, these voluntary disclosures and pledges lack a coherent framework for measurement and reporting: "Firms disclose reams of irrelevant puffery, while often failing to reveal the few things that matter. Ideally an asset manager would be able to work out the carbon footprint of

their portfolio and how it may change over time. But many firms failed to disclose their emissions rigorously and often the measures made public by individual firms overlap, leading to double-counting when you add them all up."[6]

Mandatory carbon disclosures must be simple, and straightforward to interpret, and the mandate must be enforceable.

With COP26, the 26th United Nations climate change conference, ongoing, we suggest that making carbon disclosures mandatory is a critical component of reaching net zero. It would reveal much of the data that policy makers and asset managers need to manage the risks of carbon transition and, perhaps more importantly, to accelerate the reduction of carbon emissions. These mandatory carbon disclosures must be simple, straightforward to interpret, and the mandate must be enforceable.

The International Greenhouse Gas Protocol provides a commonly referenced methodology for measuring and reporting greenhouse gas (GHG) emissions. According to its guidelines, firms should measure their carbon footprints by including all direct (scope 1) and indirect (scope 2 and 3) emissions. Indirect emissions include all upstream emissions associated with the firm's entire supply chain, as well as the downstream emissions associated with the use of the firm's products. Our immediate concern is with mandating firms to report their direct (scope 1) emissions.

Over the past few years, several important initiatives to promote the reporting of carbon emissions have been underway. The Financial Stability Board, under the leadership of Mark Carney and Michael Bloomberg, has established the Taskforce on Climate-related Financial Disclosures (TCFD) to advise institutional investors and companies on how firms can effectively

report their climate risks. The Sustainability Accounting Standards Board (SASB) aims, more broadly, to define industry-specific standards for how environmental, social, and governance (ESG) metrics are disclosed. Meanwhile, the International Financial Reporting Standards Foundation (IFRS) is in the midst of creating the International Sustainability Standards Board (ISSB), whose purpose is to define globally consistent and comparable sustainability reporting standards. Its efforts are backed by the International Organization of Securities Commissions (IOSCO).

Setting standards is a time-consuming process, especially to measure something as complex as environmental impact. Nevertheless, time is running out and some metrics, including direct carbon emissions, are relatively straightforward to measure. It should therefore be possible for corporations to begin systematically reporting their scope 1 emissions without waiting for a comprehensive global consensus on sustainability reporting standards.[7] Organizations like the Carbon Disclosure Project (CDP) and Trucost have already developed considerable expertise in collecting and estimating information about GHG emissions. And according to a recent poll, there appears to be a broad consensus among economists as to the utility and effectiveness of requiring companies to report their direct carbon emissions.[8]

Publicly listed firms will report their global greenhouse gas emissions for the past calendar year in their annual reports.

Recommendation

With an eye to COP26, we recommend that governments adopt the following corporate carbon disclosure mandate:

- Publicly listed firms will report their GHG emissions for the past calendar year in their annual reports. Private firms beyond a certain minimum size will report their global GHG emissions for the past calendar year to a national registry in the country in which they are headquartered.
- Corporations will express their GHG emissions in tons of CO_2 equivalents, determining the aggregation weights for GHGs other than CO_2 according to current IPCC guidelines.
- The measure of corporate GHG emissions comprises direct (scope 1) emissions from all installations and operating assets in which the company or its subsidiaries have a majority interest.
- In addition to the above measure of gross direct carbon emissions (GDE), we support the reporting of corporate net direct carbon emissions (NDE), provided that GDE and NDE are separately reported. The NDE metric should only allow the subtraction of those carbon offsets from GDE that the firm or its subsidiaries have removed from the atmosphere in the past year and sequestered *durably*. Durability requires a reasonably high degree of confidence that the captured CO_2 will not be released back into the atmosphere for at least 100 years.
- In future years, firms will be required to report not only their GDE and NDE figures for the most recent calendar year, but also the trajectory of past GHG emissions, beginning with the year in which the reporting mandate went into effect.

Implementation and Regulatory Burden

Governments which adopt our recommended mandate for corporate carbon reporting will presumably do so within their own institutional frameworks. Some jurisdictions have already enacted significant parts of our recommendation. Publicly listed firms headquartered in the UK,

for example, have been obligated to include their scope 1 (and scope 2) emissions in their annual reports since 2013. Within the EU, all installations in carbon-intensive sectors covered by the European Trading System (ETS) must report their annual GHG emissions to the European Union Transaction Log (EUTL). However, these installation-level reports are not readily aggregated to infer a firm's entire emissions.[9] The European Union does have a monitoring, reporting, and verification framework in place to prevent the underreporting of carbon emissions. Carbon-intensive production facilities in the US are likewise obligated to report their emissions to the US Environmental Protection Agency. California's cap-and-trade system requires carbon-intensive production facilities in California to submit similar reports. Again, however, these are facility-level emission reports from which it is difficult to infer the entire a firm's total emissions. SEC chair Gensler recently indicated that the commission is considering carbon reporting requirements for publicly listed firms in the US.[10] More information on the implications and challenges of putting such reporting mandates into effect may be found in the Appendix.

Direct Versus Indirect Emissions

Companies that already disclose their carbon emissions voluntarily often report both direct and indirect emissions. The reporting of indirect emissions, however, especially scope 3 emissions, varies greatly from company to company. Google's scope 3 figures, for instance, include only employee commuting and travel.[11] By contrast, Toyota's scope 3 figures account for more than 98 percent of all emissions associated with vehicle production.[12] To reach this estimate, the company includes the upstream emissions which result from manufacturing the tens of thousands of parts that go into Toyota vehicles as well as the future expected emissions which using the vehicles will create, specifically their fuel combustion.

Reporting indirect emissions also creates a double counting problem along the supply chain, with the direct emissions of suppliers being recounted as indirect emissions by downstream firms.

So the estimation of scope 3 emissions is inherently complex and also subjective. There are no comprehensive and widely accepted guidelines for how emissions should be allocated over time and between products and producers. Some recent studies therefore view the boundaries of scope 3 emissions as inherently fuzzy.[13] Reporting indirect emissions also creates a double counting problem along the supply chain, with the direct emissions of suppliers being recounted as indirect emissions by downstream firms.

We therefore recommend that, for the sake of simplicity and transparency, mandated corporate reporting be limited to direct emissions (and direct removals). Third party carbon data sources will be much better able to assess indirect emissions along a supply chain using corporations' global, comprehensive direct emissions reports. Meanwhile, efforts are underway to create a standardized format for the accounting of scope 3 emissions.[14] Once this work has come to fruition, policymakers may wish to consider extending the reporting mandate to indirect emissions, perhaps emphasizing scope 2 emissions which are easier to determine and verify.

Absolute Values versus Carbon Intensity Measures

The UK's 2013 mandate requires that firms provide a carbon intensity metric, but allows them to choose their denominator variable, whether it be sales, cost of goods sold, or a physical measure

of output. These measures of carbon intensity relative to production can help outside observers to gauge changes in carbon footprint, particularly for growing firms. Yet through the same ratio measure, firms may also mask their lack of progress in reducing absolute emissions, the variable that reflects progress toward net zero.

We recommend that regulators focus on requiring firms to disclose absolute values both because the empirical literature on the risks of carbon transition emphasizes the importance of absolute measures and because recent studies have found that equity prices respond to absolute emissions levels, but not to measures of emission intensity.[15] Meanwhile, the readers of annual reports can easily calculate the emissions intensity of public firms so long as the denominator is based on reported financial variables. Admittedly, intensity metrics may be more informative in evaluating private firms. Still, there is nothing to prevent any company from voluntarily disclosing suitable carbon intensity metrics if it wishes to provide more information on the reduction of its carbon footprint.

Carbon Offsets

Many companies currently calculate net emissions for their voluntary carbon reports by subtracting offsets from their gross emissions. Companies can claim these offsets by, for example, building a renewable power plant which sells clean electricity to the local grid. They can, and increasingly do, also purchase offsets in voluntary carbon offset markets. While these markets have grown rapidly, the average price of offsets has fallen to a mere $3 per ton of CO_2 as of 2020.[16]

Voluntary carbon offsets have reached this extremely low market price (compared with the price of 60 euros per ton recently established by the European Union's emissions trading system, or ETS) probably because of the predominance of avoidance offsets. Here, one party claims a

carbon credit for x tons of CO_2 because another party agreed to avoid emitting x tons of CO_2. As such, avoidance offsets are essentially based on counterfactual claims. Because of A's intervention, B did not emit the CO_2 it otherwise would have. We advise that mandated NDE reports should include only durable removal offsets and not avoidance offsets. Firms should be permitted to claim offsets only when they, or their contractors, directly removed x tons of CO_2 from the atmosphere, for example by direct air capture and geological sequestration, or by any of a range of natural removal mechanisms such as reforestation or carbon mineralization.[17]

Anticipated Effects of the Carbon Reporting Mandate

We intend this reporting mandate not only to provide additional information to policy makers, asset managers, and the general public, but also to spur companies to reduce their future GHG emissions. With firms subject to a reporting mandate, stakeholders will be in a better position to evaluate and benchmark the firm's GHG emissions. Moreover, firms will come to expect pressure from investors, customers, employees, and other stakeholders to improve their disclosed annual emissions.

Several recent studies have found that the 2013 UK mandate caused firms to significantly reduce their absolute GHG emissions, in comparison to a control group of firms in other European countries.[18] A range of studies using different firms found these reductions to be between 8 and 16 percent. In addition, some contemporaneous studies found that the increase in the revenues and costs of sales of these UK firms was insignificant relative to the control group, suggesting that, at the end of the day, reducing emissions had no tangible effect on firm profitability.[19] Similar effects were observed in 2010, when the US Environmental Protection Agency (EPA) mandated carbon-intensive production facilities to report their direct emissions to a publicly accessible registry. One study found that, following the EPA mandate, US facilities reduced their

carbon emissions by roughly 8 percent. These reductions were attributed to pressure from stakeholders and capital markets as well as inter-firm learning.[20]

Indeed, a requirement that firms report their GHG emissions is likely to provide capital markets with additional useful information that will reduce uncertainty for investors.[21] After the UK introduced mandatory carbon disclosures, on average both stock return volatility and the carbon premium (the higher returns required to compensate investors for exposure to carbon transition risk) went down among companies that began disclosing their emissions to comply with the new regulation, though the companies with the highest emissions saw their carbon premium increase.[22]

We advise that the mandate to report annual GHG emissions should pertain to all corporations, not just publicly listed ones. If it does not, we anticipate that certain emissions-intensive activities might migrate to private firms,[23] or that the heaviest emitters would simply become private to avoid scrutiny. There is evidence of firms exiting the public market in order to avoid the regulation of publicly listed firms in financial markets.[24]

Concluding Remarks

The obligation to disclose essential information is the bedrock upon which capital markets are founded. As the climate crisis worsens, information about corporate carbon emissions becomes increasingly essential. Requiring all companies to report their carbon emissions could serve as a similar bedrock on the path to net zero. Our proposal is simple and immediately feasible, recommending that for now, regulators should mandate the disclosure only of direct greenhouse gas emissions. This mandate should have beneficial effects immediately, yet can later be expanded once useable frameworks for reporting more complex emissions and environmental metrics are agreed upon.

Research suggests that disclosure mandates have many benefits, but that they can also have unintended consequences.[25] Broadening the mandate to include other sustainability dimensions or environmental, social, and governance concerns will therefore require careful economic analysis. Reducing global GHG emissions in time to avoid a catastrophic rise in temperatures, however, is now so urgent that mandating the disclosure of direct GHG emissions would receive broad support around the world. We therefore call for regulators to establish an immediate mandate requiring comprehensive reporting of firms' direct GHG emissions before they consider extensions aimed at other sustainability or social issues.

We recommend that all firms be required to report their gross and net direct emissions, both for the most recent calendar year, and also an expanding trajectory of past emissions beginning with the year the mandate is imposed. We expect that an increasing number of firms will choose to supplement these reports with targets for future emission reductions. These targets become milestones on the path to net zero. The interested public will then be able to assess over time the extent to which a firm actually met its emission reduction targets. Management will likewise become more accountable for its emission forecasts and subsequent results.[26]

We recognize that a carbon reporting mandate is unlikely to solve the climate crisis on its own. Nevertheless, having examined the existing evidence, we are confident that the reporting requirement will contribute to the drive to net zero by giving corporations an incentive to reduce carbon emissions directly, and by facilitating the adoption of other CO_2 reduction policies such as carbon pricing.

The Montreal Protocol, which was established in 1987 to regulate substances that deplete the ozone layer, illustrates the international community's ability to quickly advance a comprehensive mandatory reporting and compliance requirement. Twenty-four governments rapidly agreed to

phase out chlorofluorocarbons (CFCs) by 2000, allowing the ozone layer to recover over the long term.[27] The reporting mandate we advocate could be an elementary step in addressing a similar but arguably even more pressing issue threatening the world's climate.

Appendix: Further Relevant Findings from the Academic Literature

Academic studies in accounting, economics, and finance provide a broad perspective on the adoption and effectiveness of reporting mandates.

Enforcement

The effectiveness of any reporting mandate depends, at least in part, on its enforcement. Many firms that currently do not report GHG emissions presumably have good reason to avoid the subject. Some firms may seek ways to underreport their GHG emissions in order to evade stakeholder pressure. Without the expectation of enforcement, these firms could attempt to game the system with boilerplate language or claims that certain information items are immaterial. The existing standards for carbon accounting do necessarily allow for some discretion. Both the Greenhouse Gas Protocol and the ISO 14064 standards entail flexibility in methodology, assumptions, and estimation with regard to emission factors, boundaries, and the use of primary or secondary data. Some firms may be tempted to use this flexibility to find ways to underreport their GHG emissions. Applying the standards unevenly could also make the information less comparable, even if firms do not intend to conceal or mislead. These issues must be addressed because accurate and comparable information is essential to the efficient allocation and pricing of carbon risks. If the goal of the GHG reporting mandate is to change firm behavior and move toward net zero, effective enforcement is critical.

Studies of the introduction of global accounting standards,[28] insider-trading laws,[29] and new securities regulation in the EU[30] offer extensive evidence on the importance of enforcement. Regulators can achieve appropriate enforcement in various ways. Private enforcement relies upon private parties, such as investors or interest groups, to induce firms to comply through market discipline, private litigation, and non-regulatory methods like public shaming.[31] Such private enforcement relies heavily on a strong legal system, which only some countries can

provide.[32] Private enforcement should therefore be combined with public enforcement by government or quasi-governmental oversight agencies.[33]

An effective enforcement system for GHG reporting will require as a first step the careful selection of a supervising body. The agencies that oversee compliance with securities regulation and financial reporting do not necessarily have the skills and resources to extend their oversight to carbon emissions. Enforcing emissions reporting will therefore involve a substantial investment in verification expertise.

The enforcement bodies of different countries will also have to coordinate their efforts in order to obtain globally comparable emission estimates.

The enforcement bodies of different countries will also have to coordinate their efforts in order to obtain globally comparable emission estimates. The EU's Single Supervisory Mechanism for banking and the IOSCO's Multilateral Memorandum of Understanding, an international agreement for securities regulation, offer ample evidence that coordination can make enforcement more efficient.[34] Indeed, IOSCO supports the establishment of the International Sustainability Standards Board. If governments cannot cooperate to establish a central enforcement mechanism for GHG reporting, we recommend that a supranational institution be entrusted with achieving at least a minimum degree of coordination between national enforcement agencies.

The literature also shows, unsurprisingly, that enforcement bodies which are understaffed or lack authority are significantly less effective at enforcing regulations.[35] We therefore emphasize the necessity of carefully defining the powers conferred on institutions established to enforce GHG reporting. The variability of enforcement of financial reporting suggests that GHG reporting could easily end up being equally variable, which again would encourage firms to avoid clear reporting and potentially move high-carbon activities to areas with weaker enforcement.[36] Governments must therefore select their enforcement strategies with care. One popular approach to financial reporting and corporate governance is referred to as "complain or explain." We advise against this approach since it would allow firms could give perfunctory explanations for their non-compliance. A second common strategy is for enforcers to disclose information about the oversight process, whether it be advance information about their priorities and criteria or subsequent information about their outcomes. It is not uncommon for regulators to publish statistics about the firms they have reviewed, including compliance issues, non-compliance rates, or corrective actions. Some even publish the names of non-compliant firms. These regulatory disclosures may contribute to successful enforcement.[37]

Regardless of the enforcement architecture, however, it is clear that simply mandating global reporting standards for GHG emissions will achieve little until those standards are backed up by robust enforcement mechanisms and other incentives for compliance. Moreover, for carbon reporting to succeed globally, it will be vital to coordinate enforcement across jurisdictions. While a global mandate to report corporate carbon emissions has its challenges, we note that those jurisdictions that have already implemented carbon regulation mechanisms, in particular carbon pricing, did successfully adopt verification and enforcement procedures, like, for instance, the

Monitoring, Verification and Reporting framework that the EU adopted in connection with its emission trading system.

Incentives

A consistent finding in the accounting literature is that many of the incentives that drive firms are shaped by capital market forces. Capital markets, and in particular institutional investors, can also provide incentives for firms to disclose their carbon footprints. The financial reporting by firms has been shown to be strongly influenced by the need to raise outside capital.[38] It has also been demonstrated that institutional investors can promote not only transparency of reporting but also a reduction in carbon emissions and, more broadly, increased corporate responsibility.[39] While capital market forces alone cannot ensure consistent and universal GHG reporting, carbon disclosure activism can reinforce regulatory efforts. The effectiveness of activism by other stakeholders or the general public has been shown with regard to other corporate disclosures and tax avoidance.[40]

Banks can also promote the disclosure of carbon emissions. If banks were to report the emissions of their loan portfolios, they would, in turn, demand disclosure from their borrowers, many of them relatively small private firms which are difficult for public enforcers to oversee.

Regulators should also consider an audit mandate for GHG reporting, since some assurance of transparency is vital for GHG reporting, even more than for financial reporting. Research suggests that accounting firms make better certifiers than consultants because of their financial experience.[41] And while accounting and consulting firms may not currently have the capacity and expertise to produce high-quality emissions audits on a large scale, they have begun the process of building that capacity.

Finally, we note that mandated disclosures are not only useful to the general public and to investors, but potentially also to competitors, customers, and suppliers. Some firms may argue that forcing them to reveal proprietary information will reduce their incentive to innovate. Yet these concerns are more likely to arise over fairly specific or detailed disclosures, not over highly aggregated ones.[42] By limiting the required disclosure to firm-level direct GHG emissions, regulators substantially reduce the risk of forcing firms to reveal sensitive information to competitors, while still creating the desired incentives and pressures to drive firms to reduce their GHG emissions.

PATRICK BOLTON is the Barbara and David Zalaznick Professor of Business at Columbia University and a visiting professor at Imperial College London. He is a former president of the American Finance Association, a fellow of the Econometric Society, and of the American Academy of Arts and Sciences. PP2208@columbia.edu

STEFAN REICHELSTEIN is the director of the Mannheim Institute for Sustainable Energy Studies (MISES) at the University of Mannheim. He is also the William R. Timken Professor Emeritus at Stanford Business School. His recent research has focused on decarbonization and the cost competitiveness of different clean energy technologies. reichelstein@stanford.edu

MARCIN KACPERCZYK is a professor of finance at Imperial College Business School. He is a research advisor at the European Central Bank and former president of the European Finance Association. His research interests concern asset management, financial stability, and sustainability, with a focus on carbon transition risk. m.kacperczyk@imperial.ac.uk

CHRISTIAN LEUZ is the Joseph Sondheimer Professor of International Economics, Finance, and Accounting at the University of Chicago's Booth School of Business. His research examines the role of disclosure and transparency in capital markets and other settings, and the economic effects of regulation. Christian.Leuz@chicagobooth.edu

GAIZKA ORMAZABAL holds the Grupo Santander Chair of Financial Institutions and Corporate Governance at the IESE Business School, University of Navarra. He also serves as academic director of the IESE Center for Corporate Governance. His research focuses on executive compensation and corporate governance. gormazabal@iese.edu

DIRK SCHOENMAKER is a professor of banking and finance at the Rotterdam School of Management, Erasmus University Rotterdam. He has published in the areas of sustainable finance, financial supervision and stability, and European financial integration. Dirk is the author of several books, including *Principles of Sustainable Finance*.
schoenmaker@rsm.nl

Endnotes

[1] This article is a slightly modified version of CEPR Policy Insight No. 111, originally available at https://cepr.org/sites/default/files/policy_insights/PolicyInsight111.pdf

[2] IPCC Report (2021). *Climate Change 2021: The Physical Science Basis*. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf.

[3] IEA Report (2021). *Global Energy Related CO2 emissions, 1990-2020*. https://www.iea.org/data-and-statistics/charts/global-energy-related-co2-emissions-1990-2020.

[4] Bolton, P. and Kacperczyk, M. (2021). *Signaling through Carbon Disclosure*. Imperial College Working Paper, available at: https://ssrn.com/abstract=3755613.

[5] Comello, S., Reichelstein, J. and Reichelstein, S. (2022). *Corporate Carbon Reduction Pledges: An Effective Tool for Mitigating Climate Change?* in press, Frontiers in Social Innovation. N. Malhotra (Ed.). Harvard Business Press.

Bolton, P. and Kacperczyk, M. (2021b). *Firm Commitments*. Imperial College Working Paper, available at: https://ssrn.com/abstract=3840813.

[6] The Economist (2021). *Sustainable finance is rife with green wash. Time for more disclosure*. May 22.

[7] Busch T., Johnson, M. and Pioch, T. (2018). *Consistency of corporate carbon emission data*. University of Hamburg Report WWF Deutschland, Hamburg.

[8] See https://www.igmchicago.org/surveys/climate-reporting-mandate/.

[9] Downar, B., Ernstberger, J., Reichelstein, S., Schwenen, S. and Zaklan, A. (2021). *The Impact of Mandatory Carbon Reporting on Emissions and Financial Operating Performance.* Review of Accounting Studies 26: 1137-1175.

[10] Gensler G. (2021). *Prepared Remarks Before the Principles for Responsible Investment "Climate and Global Financial Markets" Webinar*. https://www.sec.gov/news/speech/gensler-pri-2021-07-28.

[11] Google Environmental Report (2019). https://www.gstatic.com/gumdrop/sustainability/google-2019-environmental-report.pdf.

[12] Toyota Industries Corporation (2020). https://www.toyota-industries.com/csr/environment/process/scope3/.

[13] Rocky Mountain Institute (2020). *The Next Frontier of Carbon Accounting: A Unified Approach for Unlocking Systemic Change*". Rocky Mountain Institute, https://rmi.org/insight/the-next-frontier-ofcarbon-accounting/

Comello, S., Reichelstein, J. and Reichelstein, S. (2021). *Transparency of the Net Zero by 2050 Club*. Steyer-Taylor Center for Energy Policy and Finance, Stanford University

[14] Impact Institute (2021). *Integrated Profit & Loss Assessment Methodology: The Core*. Amsterdam, https://www.impactinstitute.com/ipl-assessment-methodology/.

[15] Bolton, P. and Kacperczyk, M. (2021). *Do Investors Care about Carbon Risk*. Journal of Financial Economics 142 (2): 517-549.

Bolton, P. and Kacperczyk, M. (2021). *Global Pricing of Carbon Transition Risk*. Imperial College Working Paper, available at: https://ssrn.com/abstract=3550233.

[16] The Economist (2020). *Cheap Cheats: Why Are Carbon Offsets so Cheap?* September 25.

[17] Comello, S., Reichelstein, J. and Reichelstein, S. (2022). *Corporate Carbon Reduction Pledges: An Effective Tool for Mitigating Climate Change?* in press, Frontiers in Social Innovation. N. Malhotra (Ed.). Harvard Business Press.

[18] Downar, B., Ernstberger, J., Reichelstein, S., Schwenen, S. and Zaklan, A. (2021). *The Impact of Mandatory Carbon Reporting on Emissions and Financial Operating Performance.* Review of Accounting Studies 26: 1137-1175.

Grewal, J. (2021). Real Effec*ts disclosure regulation on voluntary disclosers*. Journal of Accounting and Economics, forthcoming.

Jouvenot, V. and Krueger, P. (2020). *Reduction in corporate greenhouse gas emissions under prescriptive disclosure requirements*. Working Paper, available at: https://ssrn.com/abstract=3434490.

[19] Downar, B., Ernstberger, J., Reichelstein, S., Schwenen, S. and Zaklan, A. (2021). *The Impact of Mandatory Carbon Reporting on Emissions and Financial Operating Performance.* Review of Accounting Studies 26: 1137-1175.

[20] Tomar, S. (2021). *Greenhouse Gas Disclosure and Emissions Benchmarking*. Working paper, available at: https://ssrn.com/abstract=3448904.

[21] Krueger, P., Sautner, Z. and Starks, L.T. (2020). *The Importance of Climate Risks for Institutional Investors*. Review of Financial Studies 33 (3): 1067-1111.

[22] Bolton, P. and Kacperczyk, M. (2021). *Signaling through Carbon Disclosure*. Imperial College Working Paper, available at: https://ssrn.com/abstract=3755613.

[23] Rauter, T. (2020). *The Effect of Mandatory Extraction Payment Disclosures on Corporate Payment and Investment Policies Abroad*. Journal of Accounting Research 58 (5): 1075-1116.

[24] Leuz, C. and Wysocki, P. (2016). *The Economics of Disclosure and Financial Reporting Regulation: U.S. and International Evidence and Suggestions for Future Research*. Journal of Accounting Research 54 (2): 525-622.

[25] Christensen, H. B., Hail, L. and Leuz, C. (2021). *Mandatory CSR and Sustainability Reporting: Economic Analysis and Literature Review*. Review of Accounting Studies 26: 1176-1248.

Dranove, D., and G. Z. Jin. (2010). *Quality Disclosure and Certification: Theory and Practice*. Journal of Economic Literature 48 (4): 935-963.

[26] Comello, S., Reichelstein, J. and Reichelstein, S. (2021). *Transparency of the Net Zero by 2050 Club*. Steyer-Taylor Center for Energy Policy and Finance, Stanford University.

[27] Schoenmaker, D. and Schramenade, W. (2019). *Principles of Sustainable Finance*. Oxford University Press.

[28] Byard, D., Li, Y. and Yu, Y. (2011). *The effect of mandatory IFRS adoption on financial analysts' information environment.* Journal of Accounting Research 49 (1): 69-96.

Landsman, W. R., Maydew, E. L. and Thornock, J. R. (2012). *The information content of annual earnings announcements and mandatory adoption of IFRS.* Journal of Accounting and Economics 53 (1-2): 34-54.

Christensen, H. B., Hail, L. and Leuz, C. (2013). *Mandatory IFRS reporting and changes in enforcement.* Journal of Accounting and Economics 56 (2-3):147-177.

[29] Bhattacharya, U. and Daouk, H. (2002). *The world price of insider trading*. Journal of Finance 57 (1): 75-108.

[30] Christensen, H. B., Hail, L. and Leuz C. (2016). *Capital-market effects of securities regulation: Prior conditions, implementation, and enforcement*. Review of Financial Studies 29, 2885-2924.

[31] Jackson, H., and Roe, M. (2009) *Public and Private Enforcement of Securities Laws: Resource-Based Evidence*. Journal of Financial Economics 93: 207-238.

[32] La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. (1998). *Law and Finance*. Journal of Political Economy 106: 1113-1155.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and Vishny, R. (2002). *Investor protection and corporate valuation*. Journal of Finance 57: 1147-1170.

[33] Djankov, S., Glaeser, E., La Porta, R., Lopez-de-Silanes, F. and Shleifer, A. (2003). *The new comparative economics*. Journal of Comparative Economics 31 (4): 595-619.

Shleifer, A. (2005). *Understanding regulation*. European Financial Management 11: 439-451.

[34] Hirtle, B. (2020). *Bank Supervision: The perspective from economics*. Federal Reserve Bank of New York.

Lang, M., Maffett, M., Omartian, J. and Silvers, R. (2019). *Regulatory cooperation and foreign portfolio investment*. Journal of Financial Economics 138: 138-158.

[35] Kedia, S. and Rajgopal, S. (2011). *Do the SEC's enforcement preferences affect corporate misconduct?* Journal of Accounting and Economics 51: 259-278.

[36] Christensen, H. B., Hail, L. and Leuz, C. (2021). *Mandatory CSR and Sustainability Reporting: Economic Analysis and Literature Review*, Review of Accounting Studies 26: 1176-1248.

[37] Kleymanova, A. and Tomy, R. E. (2021). *Observing Enforcement: Evidence from Banking*. Working Paper, available at: https://ssrn.com/abstract=3327502.

[38] Ball, R., Robin, A. and Wu, J. (2003). *Incentives versus standards: properties of accounting income in four East Asian countries*. Journal of Accounting and Economics 36: 235-270.

Burgstahler, D. C., Hail, L. and Leuz, C. (2006). *The importance of reporting incentives: Earnings management in European private and public firms*. The Accounting Review 81 (5): 983-1016.

[39] Azar, J., Duro, M., Kadach, I. and Ormazabal, G. (2021). *The Big Three and Corporate Carbon Emissions around the World.* Journal of Financial Economics 142 (2): 674-696.

Christensen, H. B., Floyd, E., Liu, L. Y. and Maffett, M. (2017). *The real effects of mandated information on social responsibility in financial reports: Evidence from mine-saftey records*. Journal of Accounting and Economics 64 (2-3): 284-304.

Dyck, A., Lins, K. V., Roth, L. and Wagner, H. F. (2019). *Do institutional investors drive corporate social responsibility? International evidence*. Journal of Financial Economics 131 (3): 693-714.

[40] Dyreng, S., Hoopes, J., and Wilder, J. (2015). *Public Pressure and Corporate Tax Behavior*. Journal of Accounting Research 54: 147–186.

[41] Michelon, G., Patten, D. and Romi, A. (2019). *Creating legitimacy for sustainability assurance practices: Evidence from sustainability restatements*. European Accounting Review 28: 395-422.

[42] Breuer, M., Leuz, C. and Vanhaverbeke, S. (2020). *Reporting regulation and corporate innovation*. Working paper, available at: https://ssrn.com/abstract=3449813.

Christensen, H. B., Hail, L. and Leuz, C. (2021). *Mandatory CSR and Sustainability Reporting: Economic Analysis and Literature Review*, Review of Accounting Studies 26: 1176-1248.