# ADVANCING CORPORATE SOCIAL RESPONSIBILITY BY DELAYING HIGH-CARBON PROJECTS

Carolin Schellhorn *

\* Department of Finance, Saint Joseph's University, Philadelphia, USA
Contact details: Department of Finance, Saint Joseph's University, 5600 City Avenue, Philadelphia, PA 19131, USA

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## Abstract

Existential threats from climate change require rapid decarbonization. Corporate capital allocation decisions have an outsized impact on its progress. When cash flow estimates are highly uncertain and early climate action is preferred, the economic value to society of delaying carbon emissions by postponing high-carbon projects may be substantial and should be considered in capital allocation decisions. Results derived for the time value of carbon storage by Parisa et al. (2022) can be used, with estimates of the social cost of carbon (SCC) and project carbon emissions, to calculate the economic value created when a project is postponed. Delaying a high-carbon project may ultimately lead to deployment with lower emissions or abandonment of the project altogether. This study provides estimates for two hypothetical examples that are part of many corporate capital budgeting projects. The results are relevant for researchers and policymakers who are called upon to provide up-to-date public information regarding the net social discount rate and the SCC. Firms should be required to report their carbon emissions. Business leaders, who aim to advance corporate social responsibility (CSR) and progress with sustainability-related solutions, need to have the ethical and interdisciplinary skills to recognize when a decision to delay is appropriate.

**Keywords:** Artificial Intelligence, Capital Budgeting, Carbon Emissions, Climate Change, Corporate Social Responsibility, Sustainability

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## 1. INTRODUCTION

The challenge, introduced by the Paris Agreement of 2015, to keep the global average temperature increase above pre-industrial levels to below 2°C has resulted in research and innovation that aims to deeply decarbonize production processes across all industries (Johnson et al., 2023). Governments, too, have taken a variety of approaches to policy setting in efforts to support decarbonization (International Energy Agency [IEA], 2024), but progress with the transition to a low-carbon economy has remained slow (United Nations Environment Program [UNEP], 2024). In its recent report (World Meteorological Organization [WMO], 2025), the WMO assigns a high probability to an average increase in the global mean temperature that exceeds 1.5°C for the 2025–2029 period. As scientists point to dynamics that may lead to irreversible planetary changes if current carbon ($CO_2$) emissions continue unabated and planetary tipping points are crossed, early action to reduce emissions has long been viewed as being preferable to later action (American Association for the Advancement of Science [AAAS], 2014; Intergovernmental Panel on Climate Change [IPCC], 2023). Yet, little is known about what can be done presently to stop carbon emissions from growing. This study suggests that, as a first

step, it may be possible in some cases to delay carbon-intensive projects. While a time delay may not reduce carbon emissions in the atmosphere permanently, it will create economic value for society as long as the time value of carbon is positive. Beyond that, a delay provides additional time for firms to find lower-carbon solutions that may, ultimately, reduce the emissions that remain forever.

Businesses, especially corporate boards, have an important role to play in the global effort to address the climate challenge (COP30, 2025). Corporate collaborations on decarbonization may help with driving progress to net-zero carbon emissions while creating equity value for shareholders (Schellhorn, 2023). However, collaborations have been criticized based on antitrust concerns (Hearn et al., 2023), and decarbonization requires costly long-term investments in clean energy, technology, and innovation. While these solutions may ultimately mitigate global risks from climate change and stabilize economies and society in the long term, short-term financial challenges and political resistance are frequently difficult to overcome, thus perpetuating a situation of insufficient climate action.

Corporate efforts to transition to a low-carbon economy have also been complicated by the fact that they have long been viewed as being in conflict with shareholder wealth maximization. More recently, LoPucki (2023) presents evidence that suggests an end to the long-held doctrine of shareholder wealth maximization and argues that firms are now expected to maximize the economic value of a corporation. However, what exactly this means for the capital allocation decisions that corporate boards and executives must make is not entirely clear. Non-government organizations like Ceres, Rainforest Alliance, and Global Canopy have tried to help firms focus on sustainability-related issues and advance towards environmental and societal goals. Research on corporate social responsibility (CSR), sustainability, and the related policy implications has been growing (Chopra et al., 2024; Wedayanti et al., 2025), but it remains difficult for corporate boards to establish priorities in the face of a large number of interrelated societal challenges and policy uncertainty at local, national, and global levels.

This study offers a relatively simple path to early climate action by arguing that corporate boards may create economic value for society by delaying high-carbon projects. The value that is created by delaying carbon emissions stems from society's preference for early reductions of carbon emissions, which implies a positive time value of carbon, i.e., a positive rate that can be used to discount future carbon emissions. The research methodology used in this paper applies the results of Parisa et al. (2022) and Richards (1997) for temporary carbon ton storage to identify the conditions under which a time delay of the decision to invest in a business project with positive net carbon emissions creates economic value. It is shown that the value created increases with the amount of carbon emissions that are delayed, the length of the delay, the price of carbon, and the time value of carbon. While reducing the economic value of carbon tons that remain in the atmosphere with an emissions delay does not necessarily reduce the physical tons of carbon permanently remaining there, a project delay may lead to future investment decisions that do reduce the physical carbon tons ultimately

emitted. Future carbon emissions could be lower either because a project with uncertain cash flows is later abandoned altogether, or because subsequent innovation makes the project's installation and operation possible with less carbon-intensive energy and processes.

The economic value created by delaying the emissions associated with high-carbon projects tends to be ignored in conventional capital budgeting analyses, because this value is measured with a hypothetical carbon price such as the social cost of carbon (SCC) (Rennert et al., 2025). In large parts of the world, a carbon price is not explicitly charged, and if there is an explicit carbon price in the form of a tax or a price determined in a carbon market, it varies across jurisdictions[1]. However, if financial markets are to facilitate the transition to a low-carbon economy, estimates of a carbon price and a time value of carbon should be incorporated in capital budgeting and financial analyses that inform corporate investment decisions and their timing. It is the responsibility of governments and policymakers to regularly update this information and make it publicly available.

This research has important implications for corporate governance, data gathering and reporting, as well as for policy setting. The results offer support to boards of directors and policymakers who may wish to proceed with caution when considering the adoption of new carbon-intensive projects or ventures with highly uncertain cash flows. Business leaders can create economic value for society and the firm immediately by choosing to delay these investment decisions. The withholding of carbon emissions in the short term may provide the time companies need to reduce the increase of carbon emissions more permanently, thus facilitating the process of decarbonization.

The paper is structured as follows. Section 2 provides an overview of the literature related to CSR and the role of business in addressing sustainability-related risks. Section 3 outlines the research methodology. Section 4 offers results for two examples that are components of many corporate projects and can generate economic value by being delayed. Section 5 discusses the results and their implications, and Section 6 concludes the research.

## 2. LITERATURE REVIEW

As market participants with economic power and substantial environmental and societal impact, corporations are expected to drive the global transition to low-carbon energy and sustainability, while ensuring that this transformation is socially just. The issues that firms need to address are complex and include, for example, clean technological innovation, renewable energy production, distribution, and use, regenerative agriculture, ending deforestation, and protecting ecosystems, animal welfare, and human rights. A large literature has developed to examine how CSR efforts along these dimensions affect firms' financial performance and long-run survival. Corporate boards, at the top of organizational hierarchies, are particularly powerful in developing CSR strategies and their implementation.

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[1] https://carbonpricingdashboard.worldbank.org/

## 2.1. Corporate social responsibility, firm performance, and financial system stability

Numerous research studies have been devoted to examining the link between firms' CSR efforts and their performance in various countries and industries (Sharma, 2023). The relation appears to be positive. CSR has been shown to increase firms' ability to compete and their longevity in the marketplace (Al-Shammari et al., 2022; Jashari Goga, 2025). Since corporate owners, executives, and employees are all part of society, which benefits from CSR strategies, the business case for CSR appears to be obvious.

Moreover, awareness is growing regarding the threat that climate change poses to financial system stability (Battiston et al., 2021). For instance, Bressan and Du (2025) find that higher climate change risks from growing greenhouse gas emissions are associated with lower equity values of insurance companies. Similar to firms in other industries, insurers struggle with increasingly extreme weather events, and their equity values would benefit from large-scale climate change mitigation. Nonetheless, insurers have been slow to disclose and address climate risks (Ceres, 2025). The industry's CSR efforts have fallen far short of what is required to address the systemic risks from climate change.

The insurance industry is not alone in failing to respond appropriately to the growing climate challenge. In spite of investor concern with environmental, social, and governance issues, progress across all industries has been slow and hampered, in some cases, by political headwinds (Donefer, 2023). The fossil fuel industry, among others, continues to lobby to obstruct climate action (Lantushenko & Schellhorn, 2023; Leippold et al., 2024), and firms in the paper, packaging, and food industries, among others, are not doing enough to end deforestation and protect human rights (Almeida, 2025; Forest 500, 2025). In spite of the benefits they could be reaping from strong CSR actions, most firms continue to endanger the planet, society, the economy, and the stability of the financial system with weak CSR commitments and actions. Corporate executives and the members of corporate boards are in the best position to effect change. Not surprisingly, researchers have tried to highlight the importance of competence and social responsibility at the board level.

## 2.2. The importance of socially responsible boards

For businesses and their leaders, the challenge lies in aligning an effective CSR strategy that creates value for society with profitability and value creation at the firm level. Several non-government organizations offer assistance with designing solutions to climate-related risks (Science Based Targets Initiative [SBTi], 2025). The Center for Climate and Energy Solutions (C2ES), for instance, provides guidance for greenhouse gas accounting and target setting, internal carbon pricing, and developing an awareness of climate-related financial risks and opportunities. Green patent development and innovation can help power a low-carbon transition, but tend to require supportive government policies (Hasna et al., 2023). Interestingly, Yu and Chen (2023) find that, even in an environment of policy uncertainty, firms that are committed to CSR tend to maintain their green innovation activities.

Grove et al. (2022) recommend that directors on corporate boards take responsibility for their firm's climate strategy and implementation, and that investors hold them accountable. As pointed out by Khan and Khan (2024), independence and competence among the members of a corporate board are indispensable for financial performance, but these qualities are also necessary for progress with climate change mitigation and adaptation. In fact, board members need a specific interdisciplinary skill set to address the large, interconnected problems faced by society, economies, and multiple interconnected societal systems (Climate Governance Initiative, 2022). Combined with the relevant skills, appropriate executive compensation policies can be very effective in setting incentives and driving firm performance along sustainability-related dimensions (Zhu et al., 2024).

Importantly, Muzata (2023) points out that some technological innovations that are intended to advance sustainability and help with climate risk mitigation may create new environmental and social problems. Awareness and competence on the part of board members and executives when allocating time and capital to innovation for sustainability are therefore essential. Beyond an understanding of the finance function, corporate leadership must have a deep appreciation of societal values (Schellhorn, 2024).

Supportive government policy that requires data collection and reporting on greenhouse gas emissions, as well as climate-related risks and opportunities, would help. Even in its absence, there is much that corporations can do voluntarily. This paper fills a gap in the existing literature by offering boards and executives another tool in the form of an option to delay carbon-intensive projects. The following section outlines the theoretical foundation of this research in the literature on carbon storage in forests and its application to postponing corporate high-carbon projects.

## 3. RESEARCH METHODOLOGY

### 3.1. The value of temporary carbon ton storage

Permanent storage of carbon in natural systems is not possible because previously sequestered carbon is eventually released. Therefore, the environmental economics literature has focused on estimating temporary, or short-term, storage. The values of temporary carbon storage and carbon emission delays are isomorphic because, in both cases, carbon is temporarily withheld from the atmosphere.

Using the Bern Simple Climate Model (Joos et al., 2013; Strassmann & Joos, 2018) and work by Zickfeld et al. (2021), Richards (1997), Fearnside et al. (2000), and Moura Costa and Wilson (2000), Parisa et al. (2022) developed a closed-form solution for the number of carbon tons that must be stored temporarily to offset the value of one ton of carbon emissions permanently released into the atmosphere. The authors specify the value of one-year storage, i.e., the carbon rental rate, as the difference between the value of one ton of carbon released forever now versus one year from now, in Eq. (1).

$$Carbon\ rental\ rate = R(t) = P_c(t) * (1 - e^{-\lambda}) \qquad (1)$$

where, $P_c(t)$ is the price of carbon at time $t$, and $\lambda$ equals the difference between the social discount

rate, $r$, and the rate of growth in the carbon price, $g$. The variable $g$ is positive as the growing amount of carbon in the atmosphere increases the incremental damages from climate change. When $r$ exceeds $g$, the time value of carbon, $\lambda$, is greater than zero, and the value of short-term carbon storage, as measured by the carbon rental rate, is positive. If continued carbon emissions lead to the crossing of planetary tipping points, the growth of damages will likely accelerate (Lenton et al., 2020), and, hence, the growth in the carbon price could exceed the benefits of storage, causing the time value of carbon and the value of temporary storage to become negative.

However, as long as the time value of carbon can reasonably be assumed to remain positive, the temporary storage of carbon adds economic value by reducing the present value of carbon tons ultimately remaining in the atmosphere. The closed-form solution provided by Parisa et al. (2022) for the number of carbon tons that must be stored temporarily to offset the value of immediately emitting one ton of carbon into the atmosphere forever is:

$$N = \frac{1}{1 - e^{-\lambda \tau}} \qquad (2)$$

The value of $N$ increases with a shorter time delay, $\tau$, and with a decrease in the time value of carbon, $\lambda$. The time value of carbon may decline either because society considers future actions to be more significant than current actions, causing the social discount rate to decrease, or because climate damages grow more rapidly as a result of unabated carbon emissions into the atmosphere.

The purpose of this paper is to apply the results for temporary carbon storage to valuing a temporary emissions delay that occurs when a business project with positive net carbon emissions is postponed. A temporary delay has

the same valuation effect as temporary storage because the carbon tons are temporarily withheld from the atmosphere. A delay has the added advantage of allowing for the possibility that the project will ultimately be abandoned altogether, thus withholding the carbon emissions from the atmosphere forever. Even if the project or a similar one is later implemented, it may emit fewer carbon tons as innovation may have occurred in the meantime to lower the carbon content of the required energy or implementation and operation processes.

## 3.2. The value of carbon emissions delay

When a traditional financial capital budgeting analysis results in net present value estimates that are low due to highly uncertain future cash flows, delaying the investment decision is a reasonable choice. When a business project with $E$ tons of net carbon emissions is delayed, the delay ($\tau$) that will equate the value of the delayed emissions to the value of one ton of carbon emitted today, derives from Equation (2) as follows:

$$\tau = \frac{\ln E - \ln(E - 1)}{\lambda} \qquad (3)$$

The higher the net social discount rate, $\lambda$, which is the time value of carbon, the shorter the delay required to match the value of one carbon ton emitted today. The required delay, $\tau$, is also shorter when a greater number of carbon emissions are delayed.

The economic value of a decision delay can be estimated using the SCC. The social cost of one ton of carbon is the social value of withholding or avoiding one ton of carbon permanently. The social value of delaying the carbon emissions of a given project for $x$ years is:

$$Social\ value\ of\ project\ emissions\ delay\ (SVPED_x) = \frac{x}{\tau}(SCC) \qquad (4)$$

where, $x$ is the number of years the project is delayed, and $x/\tau$ equals the number of tons of carbon withheld permanently that are equal in value to the value of carbon tons of project emissions delayed for $x$ years. High-carbon projects with small values of $\tau$ have great potential for economic value creation from an investment decision that is delayed.

The future damages resulting from continued increases in carbon emissions that raise the global average temperature can only be estimated with great uncertainty, because the changes in planetary processes affecting the climate and ecosystems are unknown. The social cost of one ton of carbon varies inversely with the net social discount rate, and is similarly difficult to estimate. Tol (2023) reports an increase in estimates of the SCC over time. Over the past 10 years, estimates have ranged from \$9 to \$40 per carbon ton for high net social discount rates to a range of \$122 to \$525 per carbon ton for low discount rates. The U.S. Environmental Protection Agency (EPA) provides a range of estimates for discount rates of 1.5%, 2% and 2.5% for emission years 2020–2080. Estimates of the SCC range from \$120 to \$600 (EPA, 2023, p. 4).

Regardless of which SCC estimate is chosen, the impact on social value creation can be substantial when the adoption of high-carbon projects is delayed. The next section explores the potential for value creation from delaying projects that require the training of select carbon-intensive artificial intelligence (AI) models and projects that require long-distance air travel.

## 4. RESEARCH RESULTS

Carbon emissions accounting and reporting are currently not mandatory in the U.S., but the EPA and various consulting firms and non-government organizations, such as the Greenhouse Gas Protocol, offer guidance and tools. The training of AI models and long-distance air travel are both carbon-intensive components that are part of many corporate projects. Some other project components may be even more carbon-intensive, but these two components are chosen as simple examples because they are likely relevant as parts of several different types of capital budgeting analyses in various industries.

## 4.1. Delaying high-carbon artificial intelligence model training

A variety of AI models and applications are expected to transform all industries, but the costs and benefits of these technological advances are widely debated (Rashid & Kausik, 2024). Progress may come at the expense of workers and human employment. On the other hand, human productivity and economic growth may be enhanced (Baily & Kane, 2024). While the potential for beneficial innovation has created great interest in the development and adoption of AI, it is becoming increasingly clear that impacts on the environment may be more harmful than initially realized (Walther, 2024; Zewe, 2025), and the economic and financial payoffs may be lower than some expect (Nathan, 2024; Herrman, 2024). As many of the risks and benefits are currently not well understood, Acemoglu and Lensman (2024) advocate for slower growth in adoption (Dizikes, 2025).

A major challenge of widespread AI deployment is the rapidly growing energy demand, especially from data centers. Certain AI applications offer some potential for carbon emissions reductions, but it is also likely that substantial increases in emissions will accelerate global warming and the associated damages (IEA, 2025). In most parts of the U.S., these social costs are implicit, but there may come a time when an explicit carbon tax or price will be imposed. Currently, little is known about the exact quantity of carbon emissions that will be released by training and operating the different AI systems. In the face of increasing complexity, size, and deployment, Lin (2023) has called for better transparency and disclosure of this information, and a greater focus on developing a policy framework that will protect, rather than threaten, planetary stability.

Using carbon emission estimates from Chapter 1 of the 2025 AI index report (Human-Centered Artificial Intelligence [HAI], 2025, p. 50) for training three AI models (GPT-3, GPY-4, and Llama 3.1 405B), the economic value created is estimated for project delays of one and two years ($SVPED_x$). Estimates of the SCC are based on the EPA's report on the social cost of greenhouse gases: estimates incorporating recent scientific advances (EPA, 2023, p. 4) for two different assumed estimates of the net social discount rate (time value of carbon), $\lambda$. Panel A of Table A.1 (Appendix) shows $SVPED_x$ estimates for a net social discount rate of 2.5% and a corresponding SCC of $125. Panel B of Table A.1 (Appendix) holds the SCC constant and lowers $\lambda$ to 1.5%. $SVPED_x$ results for this lower net social discount rate with a correspondingly higher SCC in line with the EPA estimates are shown in Panel C of Table A.1 (Appendix).

The estimated value created by a one-year project delay under the assumptions presented in Table A.1 ranges from $1,102 to $3,084 for GPT-3. For GPT-4, the range of $SVPED_1$ is $9,719 to $27,213, and for Llama 3.1 405B, the lowest estimate of $SVPED_1$ is $16,743, while the highest estimate is $46,880. A two-year project delay would double these $SVPED$ values. If, based on a capital budgeting analysis, training and operating one of these AI models adds relatively little financial value for the firms' shareholders, these estimates may be used to argue for a delayed decision that adds economic value for society.

## 4.2. Delaying long-distance air travel

Long-distance air travel is a component of many corporate projects. For common business and personal activities, carbon footprint calculators that are readily available on the internet can be helpful. Using the calculator provided by Terrapass for business air travel[2], Table A.2 (Appendix) provides estimates of $SVPED_x$ for three hypothetical cases: 1) 20 employees traveling annually, with each employee making on average 10 long-haul flights (5 round-trip) per year. 2) 40 employees traveling annually, with each employee making on average 40 long-haul flights (20 round-trip) per year. 3) 100 employees traveling annually, with each employee making on average 50 long-haul flights (25 round-trip) per year. Note that Terrapass defines a long-haul flight as any flight exceeding four hours. The estimated amounts of carbon emissions are provided in pounds (lbs) by Terrapass and converted to metric tons before being reported in Table A.2 (Appendix).

Panels A, B, and C in Table A.2 (Appendix) correspond to the panels in Table A.1 (Appendix), but instead of using carbon emission estimates for training AI models, Table A.2 (Appendix) displays the carbon emission estimates for the three scenarios of employee air travel. The estimated value created by a one-year delay using carbon emissions estimates from Terrapass for the case with the lowest annual air travel ranges from $734 to $2,055. For the medium amount of air travel, the range of $SVPED_1$ is $5,866 to $16,425. For the example with the highest amount of air travel, the lowest estimate of $SVPED_1$ is $18,329, while the highest estimate is $51,321. In the event of a two-year delay, the economic value estimates would double. For an international long-distance flight, the duration often exceeds four hours, so these are likely to be conservative estimates. If companies decide to go ahead with projects involving substantial amounts of air travel or widespread AI adoption, the benefits to society should at least equal the costs that are imposed.

## 5. DISCUSSION

Table A.3 (Appendix) summarizes the findings. It is important to note that the net social discount rate, $\lambda$, and the SCC are policy choices, while the amount of project $CO_2$ emissions and the length of project delay are controlled by the firm. The delay needed to match one ton of carbon withheld permanently, $\tau$, is a function of both $\lambda$ and $E$. If the net social discount rate decreases, either because society considers future actions to be more significant than current actions or because climate damages grow more rapidly, the value of $\tau$ increases and $SVPED_x$ falls. However, a decrease in $\lambda$ increases the SCC, and this effect dominates so that $SVPED_x$ rises. Firms may increase $SVPED_x$ by delaying more project carbon emissions, $E$, or by increasing the time of project delay, $x$.

The examples provided for AI and long-distance air travel above are common components of many corporate projects. Other components, e.g., buildings, production facilities, operations, and supply chains, have Scope 1, 2, and 3 carbon emissions[3] that may far exceed the carbon emissions

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[2] https://terrapass.com/carbon-footprint-calculator/
[3] https://climate.mit.edu/explainers/scope-1-2-and-3-emissions

associated with the examples provided in this paper. But even these conservative estimates document potentially non-negligible social costs from corporate projects.

There are important implications for policymakers, business leaders, and researchers. Companies should be required to account accurately and extensively for their carbon emissions, consider them in capital budgeting analyses, and report them to shareholders and other stakeholders. Policymakers are called upon to provide up-to-date estimates of the net social discount rate and the SCC. To act responsibly as business leaders, board members, and executives need to display competence in multiple interdisciplinary areas and be incentivized to reach sustainability-related goals in a timely manner. To help accomplish this, it is important to recognize when the best decision is a project delay.

## 6. CONCLUSION

In order to avoid the worst consequences of climate change, companies must move rapidly towards sustainability. The complexity and magnitude of the challenge require a multi-pronged approach. Low-carbon energy sources, green technologies, and innovation can help, but require time and may also create new environmental and social problems. This study fills a gap in the literature by pointing out the opportunity to create economic value presently by delaying high-carbon projects and withholding, at least temporarily, additional increases in carbon emissions that may later prove unnecessary.

Since permanent carbon storage in natural systems is not possible, the environmental economics literature has explored the valuation of short-term storage of carbon tons. The results are structurally equivalent to the valuation of a delay in emitting carbon tons because, in both cases, carbon tons are temporarily withheld from the atmosphere. When forecasted cash flows from a business project are highly uncertain and net present value estimates are low, estimating the economic value of an investment decision delay can offer a useful alternative perspective. As continued innovation may reduce the carbon footprint of energy use, it is possible that a delayed decision results in lower-carbon deployment in future years, while preserving the option to abandon the project and to withhold the associated carbon emissions altogether. In any event, as long as the time value of carbon is positive, society benefits economically from a carbon emissions delay. The results support corporate boards and business leaders who may wish to proceed carefully and deliberately before adopting carbon-intensive innovations and projects.

The main limitations of this research arise from the current lack of comprehensive data on company and project carbon emissions. Firms will have to supply this information, and policymakers must continue to provide updated estimates of the net social discount rate and the SCC. Importantly, business leaders should learn to appreciate the complexity of value creation, which goes well beyond financial value that accrues to the firms' shareholders, and includes the social value created from withholding carbon emissions at least temporarily. Future research may help to advance a better understanding of the conditions under which more widespread use of the choice to delay high-carbon projects becomes possible.

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# APPENDIX

**Table A.1.** Estimates of the economic value of a delay for training select artificial intelligence models

| Project number | Estimated project emissions E (tons of $CO_2$) | Net social discount rate $\lambda$ (%) | Delay to match one ton of carbon withheld permanently $\tau$ (years) | One-year equivalent number of carbon tons withheld permanently $1/\tau$ | Two-year equivalent number of carbon tons withheld permanently $2/\tau$ | SCC ($) | Economic value of project delay for 1 year $SVPED_1$ ($) | Economic value of project delay for 2 years $SVPED_2$ ($) |
|---|---|---|---|---|---|---|---|---|
| *Panel A: Using estimates of the SCC corresponding to the net social discount rate ($\lambda$)* | | | | | | | | |
| 1 | 588 | 2.5 | 0.0681 | 14.7 | 29.4 | 125 | 1,836 | 3,672 |
| 2 | 5,184 | 2.5 | 0.0077 | 129.6 | 259.2 | 125 | 16,198 | 32,397 |
| 3 | 8,930 | 2.5 | 0.0045 | 223.2 | 446.5 | 125 | 27,905 | 55,809 |
| *Panel B: Holding constant the SCC and using a lower net social discount rate ($\lambda$)* | | | | | | | | |
| 1 | 588 | 1.5 | 0.1135 | 8.8 | 17.6 | 125 | 1,102 | 2,203 |
| 2 | 5,184 | 1.5 | 0.0129 | 77.8 | 155.5 | 125 | 9,719 | 19,438 |
| 3 | 8,930 | 1.5 | 0.0075 | 133.9 | 267.9 | 125 | 16,743 | 33,486 |
| *Panel C: Using estimates of the SCC corresponding to the lower net social discount rate ($\lambda$)* | | | | | | | | |
| 1 | 588 | 1.5 | 0.1135 | 8.8 | 17.6 | 350 | 3,084 | 6,169 |
| 2 | 5,184 | 1.5 | 0.0129 | 77.8 | 155.5 | 350 | 27,213 | 54,427 |
| 3 | 8,930 | 1.5 | 0.0075 | 133.9 | 267.9 | 350 | 46,880 | 93,760 |

*Note: Project: 1) Training GPT-3; 2) Training GPT-4; 3) Training Llama 3.1 405B.*

**Table A.2**. Estimates of the economic value of a delay for long-distance air travel

| Project number | Estimated project emissions E (tons of $CO_2$) | Net social discount rate $\lambda$ (%) | Delay to match one ton of carbon withheld permanently $\tau$ (years) | One-year equivalent number of carbon tons withheld permanently $1/\tau$ | Two-year equivalent number of carbon tons withheld permanently $2/\tau$ | SCC ($) | Economic value of a project delay for 1 year $SVPED_1$ ($) | Economic value of project delay for 2 years $SVPED_2$ ($) |
|---|---|---|---|---|---|---|---|---|
| *Panel A: Using estimates of the SCC corresponding to the net social discount rate ($\lambda$)* | | | | | | | | |
| 1 | 392 | 2.5 | 0.1022 | 9.8 | 19.6 | 125 | 1,223 | 2,447 |
| 2 | 3,129 | 2.5 | 0.0128 | 78.2 | 156.4 | 125 | 9,777 | 19,553 |
| 3 | 9,776 | 2.5 | 0.0041 | 244.4 | 488.8 | 125 | 30,548 | 61,097 |
| *Panel B: Holding constant the SCC and using a lower net social discount rate ($\lambda$)* | | | | | | | | |
| 1 | 392 | 1.5 | 0.1703 | 5.9 | 11.7 | 125 | 734 | 1,468 |
| 2 | 3,129 | 1.5 | 0.0213 | 46.9 | 93.9 | 125 | 5,866 | 11,732 |
| 3 | 9,776 | 1.5 | 0.0068 | 146.6 | 293.3 | 125 | 18,329 | 36,658 |
| *Panel C: Using estimates of the SCC corresponding to the lower net social discount rate ($\lambda$)* | | | | | | | | |
| 1 | 392 | 1.5 | 0.1703 | 5.9 | 11.7 | 350 | 2,055 | 4,111 |
| 2 | 3,129 | 1.5 | 0.0213 | 46.9 | 93.9 | 350 | 16,425 | 32,849 |
| 3 | 9,776 | 1.5 | 0.0068 | 146.6 | 293.3 | 350 | 51,321 | 102,643 |

*Note: Project: 1) 20 employees traveling annually, with each employee making on average 10 long-haul flights (5 round-trip) per year; 2) 40 employees traveling annually, with each employee making on average 40 long-haul flights (20 round-trip) per year; 3) 100 employees traveling annually, with each employee making on average 50 long-haul flights (25 round-trip) per year.*

**Table A.3.** Summary of key results

| Determinants of SVPED | Effect on SVPED of a variable change |
|---|---|
| *Policy choices* | |
| Net social discount rate, $\lambda$ | A decrease in $\lambda$ decreases the time value of carbon and increases the delay needed to match one ton of carbon emitted permanently, $\tau$. It also increases the SCC. A higher value for $\tau$ decreases $SVPED_x$ but a higher SCC increases $SVPED_x$. The effect of the change in the SCC outweighs. |
| SCC | A higher *SCC* increases $SVPED_x$. |
| *Firm choices* | |
| Tons of project $CO_2$ emissions that are delayed, E | An increase in E decreases $\tau$ and increases $SVPED_x$. |
| Length of project delay, x | An increase in x increases $SVPED_x$. |

*Note: The delay needed to match one ton of carbon withheld permanently, $\tau$, is a function of both $\lambda$ and E.*