TENNENBAUM PROGRAM FOR FACT-BASED POLICY

Climate Change Is Not an Apocalyptic Threat—Let's Address It Smartly

Bjorn Lomborg

Some 60 percent of people in rich countries believe that unmitigated climate change is likely or very likely to lead to the end of humanity.[1] That high percentage is hardly surprising. Armageddon-laden rhetoric has been pervasive since 2018, when the United Nations' Intergovernmental Panel on Climate Change published a report that was reported by CNN—along with many other outlets—as saying that the "Earth has 12 years to avert climate change catastrophe."[2]

This claim is broadly wrong: although climate change is an overall problem, it is not about to bring on the end times. Yet, pervasive fear about climate leads to exaggerated demands for unrealistically rapid solutions and has pushed leaders of most nations to make highly implausible promises of carbon cuts and to advocate for incredibly costly climate policies, such as the achievement of net-zero carbon emissions within a few decades.

Despite political rhetoric, there is little to suggest that the world is rapidly moving toward net zero. Globally, emissions keep rising, and it is more likely that we will not complete the transition until the later part of the next century. The reason is largely because the costs of a quick transition are turning out to be unfathomably large—and especially onerous for the world's poorer nations.

Indeed, even though most voters say they are incredibly concerned and worried about climate change, they are unwilling to pay much for climate policy. This contradiction means that most of the proposed, fantastically expensive policies are likely to be rejected or—if enacted—will be reversed or reduced and stretched out over time.

At the same time, the world faces many other challenges such as poverty, malnutrition, disease, and poor education that also need to be addressed in this century. We must do better, both to actually fix the climate and to conserve resources for all the world's many other

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problems. In this article, I first address the fear that climate change is apocalyptic and the mistaken belief that we are already well underway in making a green transition. I then propose five ways to address climate change smartly.

THE WORLD IS NOT ENDING

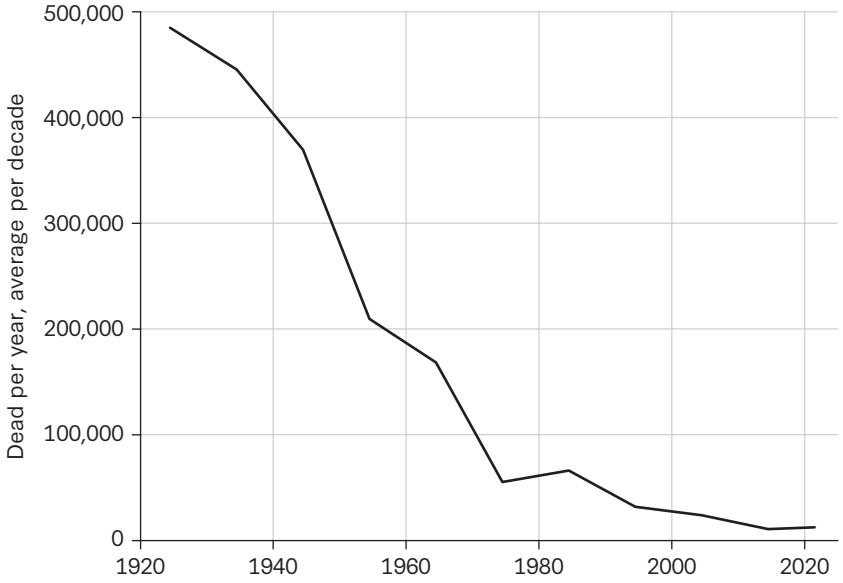
Widespread concern about climate change stems largely from the influence of media, environmental campaigners, and politicians who tend to exaggerate its potential impacts. Various stakeholders have strong incentives to portray the most alarming narrative about the climate: the media benefits from sensational stories, campaigners gain attention and funding, researchers focusing on doomsday scenarios receive more recognition and resources for their institutions, and politicians who emphasize dire consequences can promise to save the day while securing resources for their proposed solutions. Yet, humans have a long history of adapting to changes in their environment, a fact often overlooked in climate change projections.

Today, the world is actually much safer from climate-related disasters—droughts, floods, storms, and wildfires (see figure 1). The most accurate database available, the International Disaster Database, shows that the number of deaths resulting from climate-related disasters has significantly decreased over the past century. In the 1920s, these disasters on average claimed the lives of nearly a half-million individuals annually, primarily affecting developing nations through devastating floods and droughts. Globally, the number of climate-related deaths has diminished to fewer than ten thousand per year in the 2020s. That means that over the course of the last hundred years, fatalities have plummeted by an astounding 98 percent. It is crucial to consider that the world's population quadrupled during that same period. Consequently, the individual risk of death in a climate-related disaster has diminished by an impressive 99.5 percent. This is because increased prosperity and resilience drown out any potential climate signal.

Similarly, the *cost* of climate disasters is declining. Globally, we have good data since 1990: from then until 2022, the cost in proportion of GDP decreased from 0.26 percent of global GDP in 1990 to 0.19 percent in 2022.[3] A recent study examined both deaths and damage caused by weather hazards, including floods, flash floods, coastal floods, heat waves, cold spells, drought, and wind damage. It found that across all these hazards—and in both wealthy and impoverished nations—human and economic vulnerability has diminished dramatically, about fivefold or more.[4]

Because we almost exclusively hear about problems that are exacerbated by climate change, our understanding of the issue is biased. Perhaps the best example is the popular perception of the number of deaths caused by extreme heat and cold. It is common knowledge in the academic literature that the number of cold deaths vastly outweighs heat deaths. For instance, *The Lancet* finds that each year, almost 600,000 people die globally from heat compared to 4.5 million from cold.[5] It is true that as temperatures have increased, which we would expect from global warming, warmer temperatures have increased the number of deaths

FIGURE 1 Deaths per year from climate-related disasters of droughts, floods, storms, and wildfires, averaged over decades from 1920 to 2023



Source: Data from EM-DAT, International Disaster Database, Centre for Research on the Epidemiology of Disasters (CRED), https://www.emdat.be/.

from heat and decreased those from cold. Yet, a key study of such deaths from 2000 to 2019 reached this conclusion: "Earth's temperature increased by 0.26 degree Centigrade per decade. This reduced cold-related deaths by 0.51% and increased heat-related mortality by 0.21%, which led to *a reduction in net mortality* due to hot and cold temperatures."[6] The total impact of temperature rise since 2000 is equivalent to 116,000 more heat deaths each year and 283,000 fewer cold deaths annually, meaning that we are seeing 166,000 fewer deaths from temperature extremes each year.

And yet media stories on climate focus each summer on heat waves and heat-related deaths. Hearing only about deaths caused by heat means we end up believing matters are much worse than they are. It also means that we focus on the smaller problem of heat deaths, which can often be solved relatively easily by simple adaptation measures, such as increasing the availability of air conditioning. And we focus too little on the bigger and often stubborn problem of cold deaths. This is an example of the broader problem with media-hyped fear: it drives us to look in the wrong direction.

These examples show that the common understanding of imminent climate doom is simply wrong. Climate-related deaths and costs are declining, although without climate change they might have declined even faster.

As we will see later, the realistic cost of climate change, according to the models of the only climate economist to win the Nobel Prize—William Nordhaus in 2018—is equivalent to about a 3 percent loss of GDP. This more forcefully emphasizes that even though climate overall is a

problem, leaving us 3 percent less well off than we otherwise would have been, it is not by any means an existential threat (still leaving us with 97 percent of our welfare).

WE ARE NOT GOING TO REACH NET ZERO ANYTIME SOON

For all the talk and hype, the green energy revolution has barely begun. Why? Because without breakthrough innovations, the transition from fossil fuels remains enormously expensive. Simply put, carbon dioxide emissions are an inevitable outcome of the affordable and reliable energy provided by fossil fuels. That energy has been a foundational element for more than two centuries of progress and human advancement. The task of completely eliminating our dependence on fossil fuels within a few decades comes with an astronomical price tag that goes well beyond a hundred trillion dollars over the next three decades.

Two papers published in 2023 in *Economics of Climate Change* estimate the cost over the century of reaching net-zero emissions by 2050. The average undiscounted cost of these estimates comes to just over $200 trillion by 2050 and $2,000 trillion by 2100, both in 2023 US dollars. When compared to the climate benefits, the costs outweigh the benefits in every year of the twenty-first century, on average delivering just 17 cents back on each dollar spent.[7]

Such an endeavor would likely lead to significant political turmoil in most developed nations. Consequently, instead of pursuing this costly path, many affluent countries opt to invest billions of dollars in subsidizing showy but relatively ineffective solar and wind energy projects. Meanwhile, poorer nations lack the financial means to spend such colossal amounts for so little reward—and yet still want to solve the challenge of energy access, which can only be done cheaply and effectively for quite some time using fossil fuels.

Despite the continuous hype surrounding solar and wind power, the inconvenient reality is that these sources can only generate electricity when the sun is shining or the wind is blowing. As a result, they can only serve as a small supplement to the consistent baseload power provided by fossil fuels and other reliable sources. To significantly increase the pickup of solar and wind energy, we need backup power options like idle fossil-fuel-powered gas turbines or energy storage systems like batteries. However, these additional measures significantly drive up the cost of implementing solar and wind energy.

The battery storage capacity required for solar power to be viable is often underestimated. By January 1, 2023, the United States possessed enough batteries nationwide to store less than four minutes of the country's average electricity consumption. The vast expansion of battery capacity using current technology would require huge increases in lithium, cobalt, nickel, and rare earth minerals, which are currently mined—with ugly environmental consequences—in China, Russia, and the Democratic Republic of the Congo.

These fundamental economic and technological challenges explain why no major nation has come close to relying predominantly on renewable energy sources. Instead, in the United States and elsewhere, renewables only make modest contributions to overall energy consumption. Even

with huge subsidies and political support, solar and wind delivered just 10 percent of global electricity in 2021.[8] Heating, transport, and vital industrial processes account for much more energy use than electricity. This means that solar and wind deliver just 1.8 percent of the global energy supply.[9] And electricity is the easiest of these components to decarbonize: we have not yet made meaningful progress greening the remaining four-fifths of global energy.[10]

Part of the difficulty of understanding the size of our energy challenge is that, generally, the scale of our energy use is poorly understood. Much of the global energy conversation remains focused on electricity, which plays only a small role, and many people only associate it with their electricity use at home. As a result, we miss most of the energy used, as is evident in a US example of energy consumption.

In 2022, the average American used 4,200 kWh of electricity to power their home. They also indirectly used electricity generated by businesses and industries, such as refrigerators in supermarkets and street lighting in cities. In total, each American actually consumed 12,500 kWh of electricity annually.

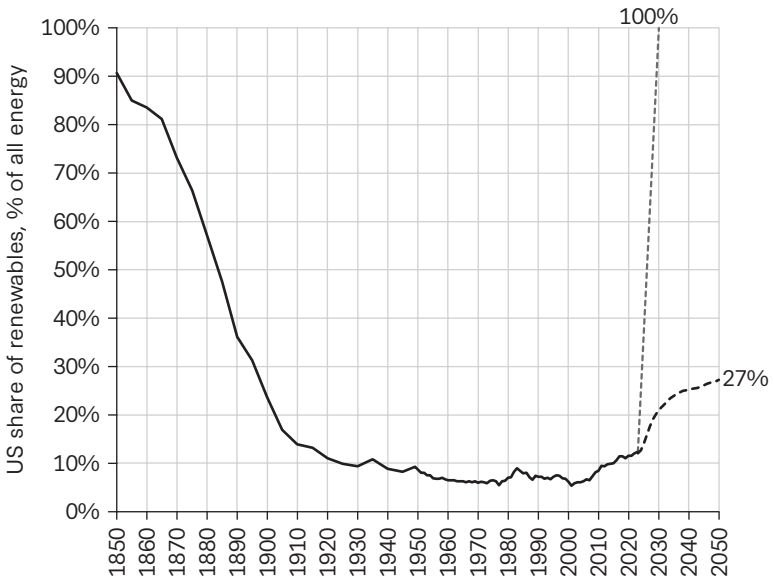
Yet more than 85 percent of all energy consumed by the average American does not come from electricity. Most comes from fossil fuels transformed into gasoline for transport, oil and gas for heating; energy in retail and agriculture (such as fertilizer and gasoline for tractors); and plastics, steel, cement, and a myriad of other products and processes for industry. Each American uses about four hundred gallons of gasoline each year, equivalent to 14,000 kWh.

In total, all the energy used by the average American is equivalent to the energy in 86,600 kWh each year. If we just look at the personal electricity consumption of 4,200 kWh annually, we miss 95 percent of all energy consumption!

The United States obtained about 13 percent of its energy needs from renewables in 2022 (see figure 2). Reaching 100 percent of these energy needs from renewables anytime soon is simply unrealistic. The Biden administration's newest estimate for 2050 is that the renewable share will rise sharply, mostly because of the implementation of the Inflation Reduction Act. But even with extensive political pressure, the United States is only on track to reach 27 percent of its energy needs supplied by renewables by 2050—a smaller percentage than in 1890. On a linear trend from 2023 to 2050, it will only reach 100 percent by the end of the next century, based on US data up to 2024 and US government projections from 2023. The almost vertical line in figure 2 showing 100 percent renewables by 2030 represents unrealistic promises to achieve rapid conversion to all renewables.

It is a striking fact that over the past two centuries, humanity has steadily moved *away* from renewable energy sources like burning wood and dung and shifted *toward* fossil fuels. The industrial revolution was powered by fossil fuels. Despite significant advancements, the global share of renewables has remained relatively stagnant at around 13 to 14 percent for the past fifty years. And this level of renewables reflects the continued dependence of the world's poorest populations on wood, dung, and other renewable sources for energy.

FIGURE 2 Percentage of US energy consumption (not just electricity) that comes from renewables, 1850–2050



Source: Data from the US Energy Information Administration, *Annual Energy Outlook 2023,* March 16, 2023, https://www.eia.gov/outlooks/aeo/.

Looking to the future, the latest global edition of the Energy Outlook from the International Energy Agency in 2023 expects that if every government delivers on their current promises, renewable energy will meet less than one-third of all global energy needs by 2050. And the latest estimates from Biden's Energy Information Administration expect even less energy to come from renewable energy (see figure 3). Achieving 100 percent reliance on renewables by 2030 or 2050—as touted by green optimists around the world—is not in the cards.

SO, WHAT SHOULD WE DO INSTEAD?

The current approach to fixing climate change is not working, as shown by increasing emissions, the tiny shift away from fossil fuels, and the significant cost of climate policies. We need to adopt smarter and more effective policies. Here are five ways to address climate change smartly.

A CARBON TAX

We should first look at what can be achieved by implementation of a carbon tax, which is designed to reduce emissions and limit the damaging effects of global warming at a relatively low cost. A carbon tax corrects the market failure by putting a price on carbon dioxide emissions, ensuring that the cost of products and services reflects their impact on the climate. This in turn encourages consumers to make more climate-friendly choices and incentivizes energy producers to reduce emissions.

FIGURE 3 Global share of energy that is renewable, 1800–2050, with projections from the International Energy Agency and the US Energy Information Administration

Source: Data from 1800 to 1970 from Bjorn Lomborg, "Welfare in the 21st Century: Increasing Development, Reducing Inequality, the Impact of Climate Change, and the Cost of Climate Policies," *Technological Forecasting and Social Change* 156 (2020): 119981, https://doi.org/10.1016/j.techfore.2020.119981. Data from 1971 to 2022 from the International Energy Agency, and projection to 2050 from IEA, *World Energy Outlook 2023,* https://www.iea.org/reports/world-energy-outlook-2023, and EIA *International Energy Outlook,* October 11, 2023, https://www.eia.gov/outlooks/ieo/.

The size of the carbon tax should be set by balancing the costs of climate change and the costs of climate policies. Ignoring climate change entirely would result in significant damage and costs, whereas implementing a very high carbon tax risks imposing extreme economic costs for little climate gain. In general, the public discussion focuses on the costs of climate change but very little on the costs of climate *policy*. Because we will have to pay for both, we should minimize the sum of climate damage and climate policy damage. In the following, I use the standard climate economic model by Professor William Nordhaus of Yale University, who established the field of climate economics and, as mentioned, is the only climate economist to win the Nobel Prize.

Reducing temperature increases through aggressive climate policies is costly. Achieving lower temperature targets requires higher carbon taxes, which come with higher costs for individuals and the economy. The challenge is to find the right balance between reducing emissions and minimizing the economic impact.

The size of a carbon tax should vary over time. It should be set at a level that accounts for future reductions in emissions being achieved at a lower cost because of technological advancements and the increasing value of carbon cuts as temperatures and climate damage rise. By gradually increasing the carbon tax, emissions can be effectively reduced while minimizing economic disruptions.

It is likely that total GDP across the next five centuries, discounted to today, will add up to $4,629 trillion—a huge figure. If we do nothing to tackle climate change, Nordhaus's model estimates total climate damages of $140 trillion, or about 3 percent of total future GDP. This gives us a baseline from which to evaluate policies. Clearly, a 3 percent cost is not the end of the world, as described earlier, and it also suggests that paying more than 3 percent for a solution will, on balance, be a bad idea.

What happens if we pursue much more ambitious climate targets by imposing a very high level of carbon taxes? Trying to keep the temperature rise to 2.15°C by 2100 (which is less ambitious than the popular commitment enshrined in the Paris Agreement to keep temperature rise under 3.6°F or 2°C) would generate an overall loss, from climate change and policy damage, that would amount to a staggering $391 trillion in discounted costs over the next four centuries. This is equivalent to 8.4 percent of the GDP over the next four centuries. Compared to a discounted cost of $140 trillion, or 3 percent, loss from doing nothing, doing too much leaves us overall worse off.

There is a sweet spot. A realistic, moderate, and slowly increasing carbon tax could keep the average global temperature rise to 3.75°C by the end of the century. The total costs of climate change policy and damage would be around $122 trillion, or 2.6 percent of total GDP. This means that humanity would have 97.4 percent, or slightly more than $4,500 trillion, of the world's future GDP left for welfare. Thus, the damage to GDP ends up 0.4 percent less than in our scenario with no climate change policy. If implemented smartly, carbon taxes therefore are part of a sound response to climate change, but by themselves they do not provide nearly enough of a solution to climate change.

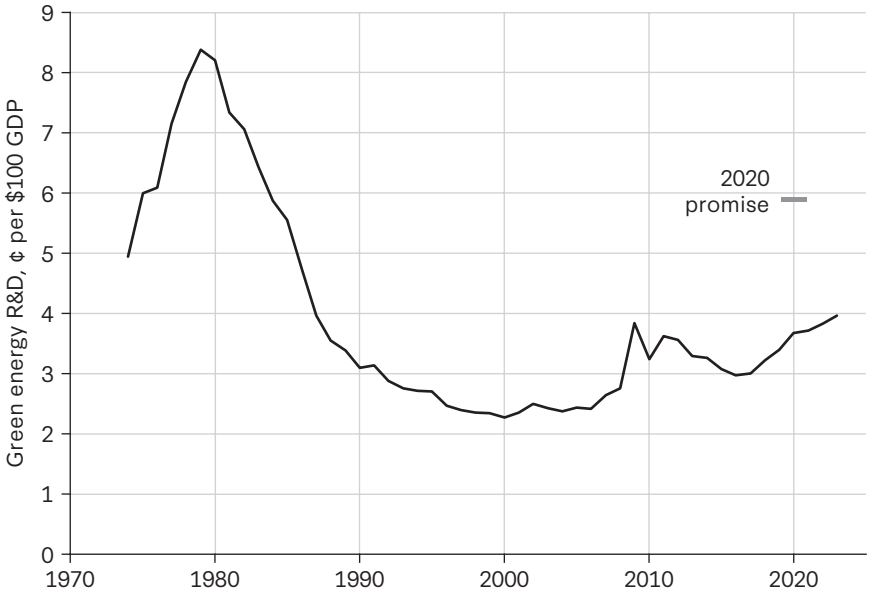
INNOVATION: GREEN R&D

What is needed most is innovation. Humanity has relied on innovation to fix other big challenges. We did not solve air pollution by forcing everyone to stop driving but by inventing the catalytic converter that drastically lowers pollution. We did not slash hunger by telling everyone to eat less but through the 1960s Green Revolution—the development of high-yield wheat and rice, along with the use of fertilizer, pesticides, and irrigation—that enabled farmers to produce much more food.[11]

Yet, innovation in green energy has been neglected for three decades. In 1980, rich countries spent almost 8 cents of every $100 of GDP on green energy technologies, as shown in figure 4.[12] As climate policies focused on making fossil fuels more expensive, green research spending dropped precipitously and is still less than 4 cents on every $100. Although nations promised in Paris in 2015 to double spending on green R&D by 2020, their actions fell far short.

Researchers for the think tank Copenhagen Consensus, including three Nobel laureate economists, have shown that the most effective long-term climate policy is to increase green R&D spending fivefold, to $100 billion per year.[13] This would still be much less than the $1.1 trillion the world spent in 2022 on often ineffective, current green technology.

FIGURE 4 Green energy R&D budgets for rich countries 1974–2023 in cents per $100 GDP, along with rich countries' pledge for 2020



Source: International Energy Agency, Energy Technology RD&D Budgets Data Explorer, https://www.iea.org/data-and-statistics/data-tools/energy-technology-rdd-budgets-data-explorer.

We do not know where the next breakthroughs will happen. They could come in nuclear energy, which can provide reliable power around the clock in contrast to intermittent solar and wind but at a much higher cost than fossil fuels. With more R&D, "fourth-generation" nuclear power could end up providing much cheaper, safer power. But we need to look for breakthroughs across all areas of energy technology—from cheaper solar and wind with massive and very cheap storage capacity to CO_2 extraction, fusion, second-generation biofuels, and many other potential solutions.

Research indicates that every dollar spent on green energy R&D will avoid $11 of long-term climate damages, making this likely the most effective global climate policy.

ADAPTATION

A carefully designed carbon tax has the potential to prevent some of the most severe damage from climate change, and substantial investments in innovation can accelerate the transition away from fossil fuels. However, it is crucial to acknowledge that even with these measures in place, the Earth's temperature will continue to increase. Some of this future warming is a consequence of past carbon emissions. Furthermore, it is important to recognize that neither carbon taxes nor innovation alone can completely eliminate future emissions, particularly in the short to medium term. So, what all of this means is that in addition to a carbon tax and investment in innovation, increased adaptation will be required.

Fortunately, humanity has shown remarkable adaptability to various challenging environments across the globe. From the icy extremes of Siberia to the scorching desert in the Sahel, people have demonstrated their ability to endure significant temperature and rainfall variations. Moreover, the declining per capita death rates from natural disasters indicate that our resilience has increased over time.

Adaptation, in its simplest form, means making common-sense responses to changing circumstances like climate change. As the world becomes warmer, individuals will continue to adapt by using air conditioners more frequently and reducing their reliance on heaters. More people who do not currently have air conditioners will likely purchase them, facilitated by increasing global prosperity. Similarly, tourists will adjust their travel destinations in response to a warming world.

Although reducing emissions incurs significant costs, it does provide modest benefits that are shared with everyone worldwide and far into the future. In contrast, adaptation often offers immediate and very localized advantages. Businesses recognize that investing in adaptation measures makes good financial sense. For instance, chemical giant BASF has installed additional water pumps in the River Rhine to ensure sufficient water availability for production, even if climate change leads to lower water levels. Unilever collaborates with tomato suppliers to encourage the installation of drip irrigation systems, enabling crop cultivation during droughts. Technology such as artificial intelligence will help better optimize the food production system, given changing water and energy needs.

Farmers in both wealthy and poorer countries already adapt their agricultural practices to suit changing climates. In South America, farmers grow crops according to local climate conditions, opting for fruit and vegetables in warmer areas, and wheat and potatoes in cooler regions. As temperatures rise, farmers may further adapt. Additionally, their crop choices may depend on whether the climate becomes wetter or drier.

Certain adaptation measures will require government action. Governments should ensure that public policies do not hinder adaptation in the private sector. They should avoid, for example, imposing high taxes on air conditioners or the electricity they consume. Moreover, governments should implement policies that facilitate adaptation, such as improving access to education and agricultural information and resources.

Certain types of adaptation rely on public policy intervention. Individuals cannot be expected to adapt their homes to rising sea levels or cope with catastrophic threats alone. Governments must take the lead in implementing flood defenses and early-warning systems—and ensuring that more properties are not built in harm's way. Additionally, appropriate infrastructure like green areas and water features can help cool entire cities during heat waves. Public policy is particularly essential in assisting vulnerable populations, including the elderly and marginalized, during extreme weather events.

Despite adaptation's inherent common-sense approach, it has often been overlooked in climate change policy discussions. Some climate change campaigners claim that adaptations

divert attention from reducing carbon dioxide emissions. However, if we are to effectively address climate change, we must prioritize adaptation alongside carbon taxes and innovation as integral components of our policy response.

GEOENGINEERING

There is one controversial tool that should be looked at by policymakers considering the full range of options to respond to climate change: geoengineering.

Geoengineering is the deliberate manipulation of the climate to reduce temperature rise. Scientists believe that the effects of a volcanic eruption—such as when Mount Pinatubo's 1991 eruption lowered global temperatures for eighteen months by one degree Fahrenheit—could be replicated without the carnage of a natural disaster. One proposal is to shoot tiny sulfur particles into the upper layers of the atmosphere to create a thin sunscreen. Many other geoengineering proposals have been proposed, including extracting and depositing CO_2 directly from the atmosphere or using autonomous ships to spray sea water into the air to make marine clouds that will reflect more sunshine.

Geoengineering interventions are incredibly cheap: research for the Copenhagen Consensus shows marine cloud whitening could cost less than $9 billion and would avoid most of the twenty-first century's temperature rise.[14] This means that even a small government, a well-intentioned NGO, or a single billionaire could act unilaterally to cool the planet—a risk researchers recently found "technically possible, economically feasible, and potentially politically disruptive."[15] A lot more research is needed, and we owe it to future generations to investigate the potentially huge upsides of geoengineering. The whole world should also know the potential negatives *before* any individuals or governments implement geoengineering solutions. Being better informed means having more tools in our toolbelt, should they be needed.

PROSPERITY, ALSO FOR CLIMATE RESILIENCE

It is crucial to include poverty alleviation as part of climate change policies, especially because the world's poorest are disproportionately affected by climate change. Lifting people out of poverty reduces their vulnerability to climate-related hazards, such as heat waves. Prosperous societies have the means to provide improved healthcare, social protections, and investments in climate adaptation. They can also make the transition from weather-affected agriculture to more secure industries and invest more in environmental preservation, reducing deforestation and promoting conservation efforts.

By prioritizing prosperity alongside climate change policies, societies can achieve multiple benefits beyond climate resilience. Increased access to education, job opportunities, healthcare, and social protections significantly improves people's lives. Although implementing cost-effective climate policies is essential, it is crucial to consider their costs and benefits in relation to other policy areas. Helping the world's poorest escape extreme poverty emerges as a highly effective climate policy strategy.

The case for viewing prosperity as a climate policy is strengthened by comparing two low-lying nations, Bangladesh and the Netherlands, in terms of their vulnerability to climate change and their response to it. Even though both countries are flood prone, their experiences differ significantly. The Netherlands, after a devastating flood in 1953, invested heavily in flood prevention measures, developing a highly effective system of dams and storm-surge barriers. In contrast, much poorer Bangladesh did not make that investment and continues to face large-scale flooding, with significant human and economic costs.

The main factor that differentiates these two nations' responses to climate change is their level of wealth. Rich countries like the Netherlands can afford to invest substantial resources in protecting against climate change, whereas worse-off countries like Bangladesh face significant challenges in doing so. Therefore, lifting countries out of poverty becomes a crucial complementary approach to mitigating the damage caused by climate change.

As Bangladesh becomes richer, it will have the capacity to invest more in adaptation measures. Flood defenses, infrastructure protection, and erosion control will become more affordable, leading to increased resilience to climate impacts. With sustained development, it is likely that Bangladesh will implement flood and sea defenses comparable to those in the Netherlands by the end of the century. As Bangladesh gets developed, it can shift its spending from fossil fuel subsidies to carbon taxation and investments in green energy R&D. As people's incomes rise, they can afford cleaner energy sources and contribute to climate mitigation efforts.

Choosing high-growth pathways that prioritize development, human capital investments, and green taxes can be considered a climate policy in itself. Despite the potential increase in carbon emissions, the positive effects of widespread prosperity will likely outweigh the negative impacts by leading to increased climate resilience, sustainable long-term climate policies, and overall development.

The idea of prosperity as a climate change policy has been raised since the early days of climate negotiations. Thomas Schelling, a Nobel Prize–winning economist, first posed the question whether cutting CO_2 emissions and adaptation were the best ways to help the poor or whether focusing on prosperity would yield greater results. The so-called Schelling conjecture suggests that lifting people out of poverty is a more effective way to reduce vulnerability to climate change. Studies have shown that even slight reductions in poverty levels can significantly enhance resilience to weather shocks. Policies that boost growth and prosperity must be fundamental to the climate change response.

CONCLUSION

The climate challenge requires a thoughtful policy response so we can ensure the best possible use of scarce global resources. It is crucial to ensure that our focus on climate change does not overshadow other critical challenges if we genuinely aspire to create a better world. Opening up global trade; combating diseases like tuberculosis; and ensuring access to vital

resources such as nutrition, contraception, healthcare, education, and technology are all crucial. Responding to all these challenges would not only do far more to improve the lot of the world's worst-off people today but would also cost far less than the trillions of dollars needed for proposed climate policies. Overspending on flawed climate policies not only squanders scant capital that could be spent on these other challenges but also detracts from the pursuit of effective climate solutions. It is not only inefficient but also immoral.

Throughout the past century, human ingenuity and innovation have played a pivotal role in advancing the state of the world. Now, we are faced with a choice: whether to continue to allow fear to drive our decision making and produce relatively poor policies or to harness our ingenuity and innovation to create the best possible world for future generations.

NOTES

1. Antoine Dechezleprêtre, Adrien Fabre, Tobias Kruse, Bluebery Planterose, Ana Sanchez Chico, and Stefanie Stantcheva, "Fighting Climate Change: International Attitudes toward Climate Policies," OECD Economics Department Working Papers, July 12, 2022, https://www.oecd-ilibrary.org/economics/fighting-climate-change-international-attitudes-toward-climate-policies_3406f29a-en.

2. CNN, "Earth Has 12 Years to Avert Climate Change Catastrophe, Warns UN Report," October 18, 2018, citing Intergovernmental Panel on Climate Change, *Special Report on Global Warming of 1.5 °C* (Geneva: IPCC).

3. Roger Pielke Jr., "Weather and Climate Disaster Losses So Far in 2022, Still Not Getting Worse," *The Honest Broker* (blog), July 10, 2022, https://rogerpielkejr.substack.com/p/weather-and-climate-disaster-losses?s=r&utm_campaign=post&utm_medium=web.

4. Giuseppe Formetta and Luc Feyen, "Empirical Evidence of Declining Global Vulnerability to Climate-Related Hazards," *Global Environmental Change* 57 (July 2019), https://www.sciencedirect.com/science/article/pii/S0959378019300378?via%3Dihub.

5. Qi Zhao, Yuming Guo, Tingting Ye, Antonio Gasparrini, Shilu Tong, Ala Overcenco, Aleš Urban, et al., "Global, Regional, and National Burden of Mortality associated with Non-Optimal Ambient Temperatures from 2000 to 2019: A Three-Stage Modelling Study," *Lancet* 5, no. 7 (2021): E415–25, https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(21)00081-4/fulltext.

6. Neena Bhandari, "Climate Plans Lag as Asia Tops Temperature-Linked Deaths," *Sci Dev Net*, December 7, 2021,https://www.scidev.net/asia-pacific/news/climate-plans-lag-as-asia-tops-temperature-linked-deaths (emphasis added).

7. See Jennifer Morris, Y.-H. Henry Chen, Angelo Gurgel, John Reilly, and Andrei Sokolov. "Net Zero Emissions of Greenhouse Gases by 2050: Achievable and at What Cost?" *Climate Change Economics* 14, no. 4 (2023): 2340002, https://doi.org/10.1142/S201000782340002X; and Richard S. J. Tol, "Costs and Benefits of the Paris Climate Targets." Climate Change Economics 14, no. 4 (2023): 2340003, https://doi.org/10.1142/S2010007823400031. The dollar costs are based on an average of all 3 percent GDP cost estimates of net zero and 1.5oC targets in Morris 2023, and the 1.5oC target in Tol 2023, using the global GDP estimate from Morris 2023. See also https://twitter.com/BjornLomborg/status/1729916834600595632.

8. International Energy Agency (IEA), *World Energy Outlook 2022*, 438 (Paris: IEA, 2022).

9. IEA, *World Energy Outlook 2022*, 435.

10. Geoffrey Heal, "Economic Aspects of the Energy Transition," *Environmental Resource Economics* 83 (2022): 5–21, https://doi.org/10.1007/s10640-022-00647-4.

11. The Green Revolution is not to be confused with the green energy transition proposed by US Representative Alexandra Ocasio-Cortez.

12. "Energy Technology RD&D Budgets," International Energy Agency, last updated May 2024, https://www.iea.org/data-and-statistics/data-product/energy-technology-rd-and-d-budget-database-2.

13. Bjørn Lomborg, ed., *Smart Solutions to Climate Change* (Cambridge: Cambridge University Press, 2012).

14. J. Eric Bickel and Lee Lane, "An Analysis of Climate Engineering as a Response to Climate Change," Copenhagen Consensus, https://copenhagenconsensus.com/publication/fix-climate-climate-engineering-assessment-bickel-lane.

15. Jesse L. Reynolds and Gernot Wagner, "Highly Decentralized Solar Geoengineering," *Environmental Politics*, 29, no. 5 (2019): 917–933, https://doi.org/10.1080/09644016.2019.1648169.

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ABOUT THE AUTHOR

BJORN LOMBORG

Dr. Bjorn Lomborg researches the smartest ways to do good. With his think tank, the Copenhagen Consensus, he has worked with hundreds of the world's top economists and seven Nobel laureates to find and promote the most effective solutions to the world's greatest challenges, from disease and hunger to climate and education. He is a visiting fellow at Stanford University's Hoover Institution.

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The Tennenbaum Program for Fact-Based Policy is a Hoover Institution initiative that collects and analyzes facts and provides easy-to-digest nontechnical essays and derivative products, such as short videos, to disseminate reliable information on the nation's highly debated policy issues. Made possible through the generosity of Suzanne (Stanford '75) and Michael E. Tennenbaum and organized by Wohlford Family Senior Fellow and Stanford Tully M. Friedman Professor of Economics Michael J. Boskin, the program convenes experts representing a diverse set of policy perspectives, writing in tandem, to better inform not just policymakers and other stakeholders but also, most importantly, the general public.

Hoover Institution, Stanford University
434 Galvez Mall
Stanford, CA 94305-6003
650-723-1754

Hoover Institution in Washington
1399 New York Avenue NW, Suite 500
Washington, DC 20005
202-760-3200

HOOVER INSTITUTION