CORNELL JEB E. BROOKS SCHOOL OF PUBLIC POLICY

Cornell Policy Review

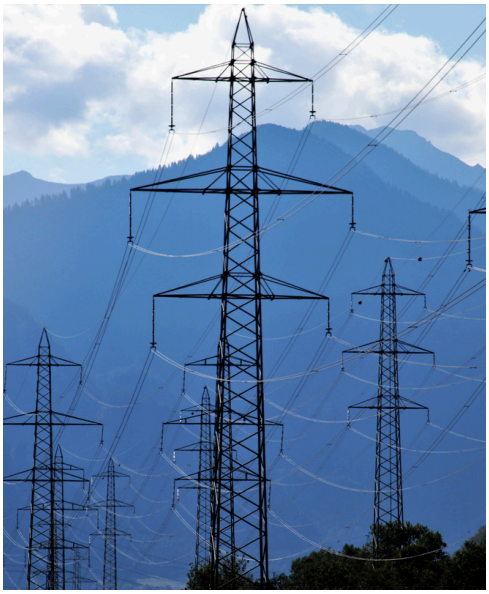
Special Issue on Energy

Powering Progress:

Navigating the Future of Energy Amid Uncertainty

Cornell Brooks Public Policy

Inside: 10 Articles on Innovations and Policies Shaping Energy's Future



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Senior Editorial Team

CORNELL
POLICY REVIEW

Watt's Next? Powering Progress Ahead

As Editor-in-Chief of the Cornell Policy Review, it is with great excitement that I introduce our latest special edition, "Powering Progress: Navigating the Future of Energy Amid Uncertainty." This edition continues our mission of advancing informed dialogue and offering critical perspectives on the pressing issues that define our time.

Energy is at the heart of progress, intersecting with every dimension of modern life, from environmental sustainability to economic growth and geopolitical stability. In this edition, we explore the challenges and opportunities shaping the future of energy. From breakthroughs in carbon management and energy storage to strategies for enhancing grid resiliency and addressing climate risk, these articles provide forward-looking insights into one of the most complex and vital policy areas of our era.

I would like to extend my sincere gratitude to Adam Sieminski for his thoughtful foreword, which frames the critical themes of this edition and underscores the importance of innovation and collaboration in navigating the uncertainties of the global energy landscape.

I am deeply appreciative of the authors, staff, and contributors who have made this edition possible. Special thanks to Johanna Van Fleet, managing editor and environmental policy enthusiast, whose vision and leadership have been instrumental in shaping this special edition.

On November 22, 2024, The Cornell Policy Review proudly co-hosted the 2024 Cornell Energy Connection event, titled "Building the Energy Future Amid Uncertainty," at the Cornell Tech campus on Roosevelt Island. As part of our commitment to fostering intellectual growth and engagement, we sponsored five CPR writers to attend, providing them with a unique opportunity to delve into critical discussions shaping the future of energy.

Let us embark on this exploration together, advancing solutions and fostering dialogue that will shape a sustainable and resilient energy future. Thank you for joining us on this journey!

Alejandro J. Ramos
Editor-in-Chief
Cornell Policy Review

Powering Progress:
Navigating the Future of Energy Amid Uncertainty
Published by The Cornell Policy Review
Publication Date: January 9, 2025
Editors: Andrew Bongiovanni and Associate Editors Ava LaGressa, Maddie Miele, Stephen Wang
Designer: Alejandro J. Ramos

| Foreword |

Adam E. Sieminski

Senior Advisor to the Board and past President of the King Abdullah Petroleum Studies and Research Center

With much hindsight since earning my Cornell MPA in 1971, my career would have been smoother in some ways if I had the opportunity available to today's MPA students to work on and contribute to a journal like *The Cornell Policy Review* (CPR). Evidence-based research and writing is critical to the formulation, analysis, and implementation of good public policies. Every job I've had since Cornell – as a financial analyst following energy and commodities, to heading up a government statistical agency, and then running an energy and sustainability think tank – has required identifying the critical issues of the day and anticipating what's coming or needed next. This special issue of CPR follows that same information pathway.

There are few topics as important as the relationship between energy and climate, and this energy-focused CPR edition, *Powering Progress: Navigating the Future of Energy Amid Uncertainty*, addresses key topics such as sustainable finance, electric grid and data center resiliency, energy justice, the problems of climate-induced migration, how climate change is altering the risk landscape for insurance – and for agricultural work too, the role of multilateral development banks, and the value of clean energy infrastructure spending.

Brittanie Schneider recommends a set of policies designed to make the U.S. electric grid more reliable and resilient, including grid modernization, demand-side flexibility, support for emerging technologies, and flexible and regionally specific policies.She warns that prematurely abandoning fossil fuels could leave gaps in supply reliability.

Indrie Yuli Pratiwi notes that emerging markets and developing economies are forecast to be the main sources of energy growth over the next 20 years and examines the role of multilateral development banks in supporting the large-scale projects needed to facilitate the flow of funds into energy transition projects.

Larasati Eka Wardhani reminds us of the deep interconnections between energy and environmental sustainability with social and financial equity concerns. She highlights the Indonesian 'Just Energy Transition Partnership' and the significant challenges associated with coal production and use.

Maddie Miele looks at the growing challenges of climate migration in both the United States and around the world. The movement of people due to climate and weather-related events is worsening, and governments seem ill-prepared to deal with either the causes or the effects.

Mira DeGregory calls attention to the energy, climate, and labor issues embedded in the lattes consumed in New York State – and recommends that the state government should consider measures to strengthen its migration, climate, and agriculture links.

Muhammad Rifki Darmawan ponders the irony that Republican-leaning states have been beneficiaries of Inflation Reduction Act (IRA) spending made possible with very little Republican party support. He argues that Republicans should support the continuation of IRA projects that aim to keep the U.S. competitive in clean energy technology.

Ojasvi Rana looks at the risks to electricity grid stability associated with over-reliance on renewables and calls for a pragmatic and balanced approach to the energy transition that includes nuclear power and strengthening electricity transmission infrastructure.

Parmis Mokhtari-Dizaji notes that rising demand for electricity from data centers can be met more sustainably with renewable-based power purchase agreements (green PPAs) – and advocates for expanding green PPAs to small and medium-sized data centers.

Stephen Shiwei Wang contends that climate-influenced insurance needs to be reconsidered – with more emphasis on approaches that reward both insurance companies and policyholders for hazard resilience and mitigation.

Yiming Zhong comments on the growing demand for environmental, social, and governance (ESG) investing and the need for sustainable finance. He compares the progress being made in China and the European Union with slower advances in the United States, and sees the need for measurement, reporting, and verification systems.

The articles in this special issue of the CPR offer a set of policy recommendations covering many of the critical challenges of providing the energy and materials required to support current and future needs of energy users while avoiding environmental harm.

A decade ago, every United Nations member state agreed to support the 17 Sustainable Development Goals that recognize the importance of improving health and education, reducing inequality, spurring economic growth, and tackling climate change. Goal 7 calls for ensuring access to affordable, reliable, sustainable, and modern energy for everyone. Accomplishing this goal will require generations of effort to craft the public policies needed to get the job done.The Cornell Jeb E. Brooks School of Public Policy and The Cornell Policy Review are playing an important and valuable role in developing the leaders who will be tasked to ask the right questions, craft viable policies, and implement good solutions.

Adam E. Sieminski
Cornell B.S. Civil & Environmental Engineering 1969
Cornell Master of Public Administration 1971

Adam Sieminski is currently a Senior Advisor to the Board, and previously (2018-2022) served as President, of the King Abdullah Petroleum Studies and Research Center. KAPSARC is a non-government, non-profit, think tank and advisory institution located in Riyadh, Saudi Arabia. Its mission is to advance understanding of energy, economics, and sustainability. After working in Riyadh at KAPSARC for five years he moved back to Washington, DC, in 2023.

Prior to joining KAPSARC, Mr. Sieminski held the Schlesinger Chair for Energy and Geopolitics at the Center for Strategic and International Studies (CSIS). Sieminski served as Administrator of the U.S. Energy Information Administration (EIA), the statistical and analytical division of the Department of Energy in 2012-2017. While awaiting U.S. Senate confirmation for the EIA appointment, he was the Senior Director for Energy and Environment at the U.S. National Security Council.

He was previously Deutsche Bank's chief energy economist and integrated oil company analyst, and before that held several positions as an energy financial analyst in Baltimore, London, New York, and Washington, DC.

Mr. Sieminski is an active member of the International Association for Energy Economics (IAEE), a Senior Fellow and former President of the U.S. Association for Energy Economics (USAEE) and was President of the National Association of Petroleum Investment Analysts. He earned both an undergraduate degree in civil engineering and a master's degree in public administration from Cornell University and is a Chartered Financial Analyst (CFA). Sieminski is currently serving on the curriculum advisory committee for the MPA program at Cornell's Brooks School.

He is the President of the Friends of Peirce Mill, a non-profit organization working with the U.S. National Park Service to restore and maintain a 200-year-old operating water-powered flour mill in Rock Creek Park, in Washington, DC.

Powering the Future: Aligning Grid Reliability with Clean Energy Goals

Brittanie Schneider is a recent graduate of the Executive MPA program at Cornell's Jeb E. Brooks School of Public Policy. She serves as a Government and Regulatory Affairs Specialist at the municipally owned utility in Colorado Springs, Colorado. In her work she focuses on building collaborative relationships with policymakers and advocating for sustainable energy policies that ensure equitable energy access and community strength, as well as policies that support reliable, resilient, and affordable public utilities.

The word "energy" is everywhere, relating to nearly every aspect of modern life. Access to energy has become foundational to the functioning of today's world, almost as essential to daily existence as water or air. Consider this: these words are likely being read on a device powered by energy, in a well-lit, temperature-controlled room. While the convenience of charged devices and instant lighting is undeniable, the importance of energy reliability goes much further—potentially creating life-or-death situations. As climate change continues to create more dramatic weather patterns, people are increasingly dependent upon functioning heat and air conditioning to survive. This creates a twofold problem: increasing the necessity of a reliable energy grid while also increasing the stress put upon it. A reliable energy grid is the backbone of modern society, yet, as the United States accelerates decarbonization efforts to limit the impacts of climate change, the risks to the reliability of the grid are rapidly increasingly. If these risks are not properly addressed, it could not only threaten public health and safety, but ultimately undermine necessary climate objectives.

Risks to the Grid

In order to function properly, the grid must be balanced at all times with supply (generation) equaling demand (load).[1] The ability to maintain this equilibrium and provide power when needed is what makes the grid reliable.[2] Most power outages are small and caused by events like falling trees, severe weather, or equipment failure, rather than generation supply shortages.[3] These types of outages can usually be quickly repaired, with power restored within hours. This capacity, in particular, means that the U.S. grid is quite reliable.[4] However, according to the North American Electric Reliability Corporation (NERC)—the regulatory authority responsible for assuring the reliability and security of the grid in North America—this may not be the case for much longer.[5]

NERC's most recent Long Term Reliability Assessment has identified serious challenges for the reliability of the U.S. grid over the next decade, as it goes through its most profound transformation since its beginnings in the late 19th and early 20th centuries.[6] [7]

Increased Demand and Decreased Generation

The demand for electricity is skyrocketing as we push toward widespread electrification of things like vehicles and heating systems. Coupled with this, is a new demand surge from data centers, as the proliferation of AI is expected to drive a 160% increase in the power demands from existing centers.[8] Simultaneously, while demand is going up, traditional generation resources are being retired faster than they are being replaced by clean energy resources, creating a resource adequacy gap.

Due to the intermittent nature of renewables, to maintain reliability there needs to be about four times the amount of renewable energy to replace traditional sources.[9]

Permitting Delays

While renewable resources are actively being deployed, they are not coming online in time to replace retiring fossil fuel generators. Part of this is due to permitting bottlenecks.[10] [11] Although new projects have been planned out, permitting and siting delays as well as labor and supply shortages are preventing sufficient clean energy resources from coming online in time.[12] Last year, the head of the country's largest grid operator, PJM Interconnection, told the Senate Energy and Natural Resources Committee that they have more than double the amount of megawatts needed to replace their retiring generators waiting in the queue, but they are concerned about getting them built in time to replace the resources that are retiring.[13]

Outdated Infrastructure

This rapidly evolving energy mix also requires significant modernization of the existing grid infrastructure. Much of the current infrastructure was not built to accommodate such a fluctuating and variable energy mix.[14] Additionally, many grids are regionally limited and as such, can only access available renewables nearby. To connect enough new, large scale renewables to where they are needed, double the amount of existing cables will be needed globally—roughly the distance between Earth and the Sun.[15] This will take significant investment to both connect renewable energy sources from where they are generated to where they are needed and to strengthen existing infrastructure, all while ensuring that people have reliable access to energy.[16]

Climate Threats

One of the biggest threats to grid reliability comes as climate change continues to drive more extreme weather patterns with more intense wildfires, heatwaves, snowstorms, and generally higher high and lower low temperatures. These events create two-fold challenges as they both threaten infrastructure and reliable generation, while also driving increased demand and higher energy loads, thus making it more difficult to balance supply and demand, ultimately threatening reliability.[17]

Why it Matters

Without a reliable grid and affordable energy, homes cannot maintain safe temperatures, businesses cannot operate, and hospitals cannot continue to provide critical care. Grid failures could cause rippling economic consequences by disrupting business operations, creating additional inflated costs, diminishing job opportunities, and hindering economic growth.

Perhaps more importantly, underlying the risks to grid reliability is energy affordability. As grid operators strive to upgrade infrastructure, compete for finite existing renewable resources, race to build new generation sources, and modernize the grid, the costs to continuously provide reliable energy steadily climb. This means that energy bills climb. For the average household, the cost of electricity has increased more than 28.5 percent from 2019 to 2024.[18] For many, this is simply unaffordable. As energy poverty affects more people, many are forced to make impossible financial choices between keeping their homes at safe temperatures or foregoing other necessities like food or medications.[19]

Additionally, and perhaps paradoxically, grid failures during this transitional phase could cause significant climate goal setbacks. The

successful decarbonization and transition of the grid hinges upon maintaining public trust. Public confidence, in turn, hinges upon keeping the lights on and keeping energy affordable. Without consistent and affordable power, people may grow to oppose future climate goals, if they see them as harmful to their family's well-being today.

Lessons to be Learned

These risks and challenges are not isolated to the U.S. The rest of the world is grappling with similar challenges. The Energiewende was Germany's incredibly ambitious plan to rapidly phase out fossil fuels. However, it has been marked by soaring energy prices and serious reliability concerns.[20] While quickly shuttering traditional fuel sources, Germany's complicated and slow permitting process prevented adequate renewables from coming online in time to replace the lost generation.[21] This forced them to import Russian natural gas to make up the gap. However, when Russia invaded Ukraine these gas imports halted, forcing Germany to reopen several coal plants, effectively counteracting their previous climate progress.[22] Additionally, the financial burden on the people of Germany has been significant. Energy rates in Germany are among the highest in Europe and they are still encountering periodic blackouts.[23] From one of the strongest European economies only a few years ago, Germany now has the worst performing economy of the major developed countries with overpriced and unreliable energy access, causing serious public and political backlash.[24]

Domestically, California has spearheaded the transition to renewables, however, this rapid transition has also encountered reliability concerns. In 2020 California faced severe heatwaves that forced regulators to introduce rolling blackouts to prevent grid failure.[25] Without adequate backup power sources to replace solar generation when the sun set, coupled with extraordinary demand, the grid failed to maintain reliability.[26] Energy costs then skyrocketed as California officials attempted to import energy and compete for finite resources from other nearby stressed grids. In 2022 the state recognized the dangers of prioritizing speed over achievability. They decided to extend operations of several natural gas plants that were scheduled to be retired.[27] Germany and California's transitions underscore the importance of balancing renewable energy integration with grid reliability to prevent vulnerabilities and achieve climate objectives. [28]

Policy Recommendations

The United States must transition and modernize its energy grid to combat climate change. However, to succeed, policymakers should adopt a balanced, thoughtful, and carefully planned approach to align decarbonization with grid reliability. It is paramount that policymakers set realistic and achievable timelines that allow for sufficient infrastructure development, encourage diversified energy portfolios to mitigate the risks from over dependence on any singular resource, and work collaboratively with energy providers to find affordable solutions. Key strategies should include the following:

Phased Reductions in Fossil Fuels

Transitioning away from coal and natural gas must be carefully phased to avoid leaving power generation gaps. Renewable energy sources should be scaled up in parallel with investments in storage and backup systems to maintain stability and should be made fully viable before prematurely shutting down other sources.

Investments in Grid Modernization

Modernizing the grid is critical to accommodate a more complex and variable energy mix and withstand the effects of climate change. Over 70% of transmission lines are now approaching the end of their typical lifecycle.[i] While this creates an increased risk of equipment failures, it also poses an opportunity to make modernization investments to replace aging infrastructure that must already be replaced. This should include upgrading transmission infrastructure to connect renewable energy sources to population centers and deploying more advanced technologies like energy storage and microgrids.

Encouragement of Demand-Side Flexibility Programs

Part of the solution should also include involving the public. Encouraging smarter energy consumption can help to reduce strain on the grid during peak load times. Demand response programs that incentivize consumers to shift energy use to off-peak hours can help reduce grid stress, encourage consumers to assume a more active role in their energy use, and enable them to make choices that directly impact their energy bills. Programs that encourage distributed energy resources (DER) such as rooftop solar or home battery systems can also help reduce demand stress.

Support for Emerging Technologies

Long-term grid stability will depend on continued innovation. Policymakers should support research and development for large-scale, long-duration energy storage to address renewable intermittency. Additionally, there should be investment in new dual fuel transmission technologies. A prime example is pipelines that can switch from natural gas to green hydrogen, thus saving building costs and providing a source of reliable energy.

Enabling Flexible, Regionally Specific Solutions

The U.S. electric grid is as diverse and complicated as the country itself. Different regions face unique energy resources, climate conditions, and grid infrastructure. As tempting as a one-size-fits-all solution may be, policymakers should encourage regionally specific approaches that are tailored to local needs and resources. This includes prioritizing investments in diverse energy portfolios such as geothermal, hydrogen, offshore wind, and hydropower, while also promoting federal coordination to ensure interconnectedness between regional grids. A flexible, regionally adaptive policy framework ensures resilience and reliability without imposing generalized mandates that may not suit all areas and may place outsized costs on consumers.

| Grid Reliability |

Conclusion

The stakes could not be higher; a resilient and reliable energy grid is not just a technical necessity, but the linchpin of public trust and safety as well as climate success. By taking bold yet pragmatic action, the United States can lead the world in demonstrating how to achieve a clean energy future that does not leave reliability and affordability behind.

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Financing Uncertainty: How Multilateral Development Banks Support Emerging Markets in Climate Goals

Indrie Pratiwi is a second-year MPA student at Cornell University, focusing on economic and financial policy with a specialization in infrastructure finance. She has worked at Indonesia's Ministry of Finance for 10 years, with her first seven years in internal audit. In January 2022, she began working closely with the Special Advisor to the Finance Minister on Fiscal and Macroeconomic Policy. With an undergraduate degree in accounting, Indrie is transitioning from internal audit to fiscal policy.

The 2024 United Nations Climate Change Conference (COP29) in Baku, Azerbaijan, finished strong on Sunday, November 24th, 2024, with a significant milestone in global climate finance. With nearly 200 nations in attendance, the conference achieved a breakthrough agreement to triple annual funding for developing countries, increasing it from the previous target of US $100 billion to US $300 billion by 2035.[1]

The Paris Agreement, signed by nearly 200 countries, sets a collective ambition to limit global warming to below 2°C, ideally 1.5°C, compared to pre-industrial levels. Transitioning to renewable energy is essential to mitigating climate change and offers co-benefits such as improved air quality, energy security, and job creation. However, despite technological advancements and decreasing costs, the global energy mix remains dominated by coal, oil, and gas.[2] Emerging markets and developing economies (EMDEs), which account for the majority of future energy demand growth, must embrace clean energy at scale. This is a daunting task given the structural and financial barriers they face, requiring international cooperation and innovative financing mechanisms.

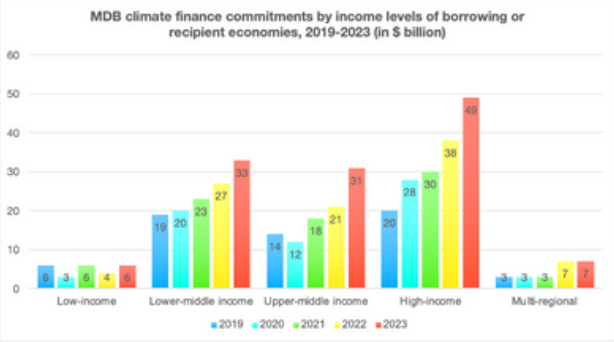
Emerging markets face numerous barriers to clean energy adoption, many of which are financial. High upfront costs for renewable energy infrastructure deter investment, especially in countries with limited access to affordable financing. While solar and wind technologies are becoming more cost-competitive, many EMDEs lack the financial ecosystem needed to support large-scale projects. Regulatory and political instability further compound the problem. Many investors perceive EMDEs as high-risk environments due to policy inconsistencies, currency volatility, and underdeveloped financial markets.[3] Additionally, these countries often lack the technical expertise and infrastructure required to design, implement, and maintain clean energy systems.

Finally, the prioritization of immediate economic development over long-term climate goals poses a challenge. Governments in EMDEs may be reluctant to allocate resources to clean energy projects without clear economic incentives or substantial international support. For example, Indonesia's commitment to reducing coal usage has encountered obstacles, particularly in securing international funding. The 2022 Just Energy Transition Partnership (JETP) pledged $20 billion to assist Indonesia's energy transition. However, as of September 2024, these

funds have not been disbursed.[4] This has been holding back plans to retire coal-fired power plants like the 660-MW Cirebon-1. Senior Indonesian officials have expressed concerns over the lack of grants and the high costs associated with plant retirements. The delay hampers Indonesia's efforts to decrease emissions from coal power, especially given its status as a leading coal producer.

Multilateral Development Banks (MDBs) are uniquely positioned to bridge the financing and capacity gaps in EMDEs to support clean energy projects and achieve climate goals. The commitments made at COPs align closely with the mandates of MDBs, which are designed to provide financial and technical support to developing countries. By mobilizing resources and reducing investment risks, MDBs can help translate COP29's climate finance goals into tangible progress. Created by multiple countries to promote economic development and poverty alleviation, each MDB has a specific geographical focus and development mandate.

However, despite the geographical significance, all MDBs have been stepping up to become strategic partners for global climate actions. According to the latest annual Joint Report on Multilateral Development Banks' Climate Finance released in September 2024, MDBs contributed a record-breaking $125 billion in public climate finance in 2023, with 60% ($74.7 billion) allocated to low- and middle-income countries.[5] This report is composed by AfDB, ADB, AIIB, CEB, EBRD, EIB, IDBG, IsDB, NDB, and WBG.[6]



Source: 2023 Joint Report on Multilateral Development Banks' Climate Finance[7]

MDBs' commitment to addressing climate challenges in emerging and developing economies can be seen based on the below graph. Between 2019 and 2023, MDBs allocated substantial and steadily increasing climate finance to low-, lower-middle-, and upper-middle-income countries, with a rise from approximately $39 billion in 2019 to $70 billion in 2023.[8]

A major barrier to clean energy investment in EMDEs is the high level of perceived risk. MDBs mitigate these risks through various de-risking mechanisms, such as guarantees, insurance products, and concessional loans. For example, the World Bank's Multilateral Investment Guarantee Agency (MIGA) offers political risk insurance, protecting investors against risks like expropriation and contract breaches. Similarly, ADB provides credit enhancement tools to attract private investment into renewable energy projects.[9] By sharing investment risks, MDBs make clean energy projects in EMDEs more attractive to private investors. The financial viability of clean energy projects in EMDEs is often uncertain due to underdeveloped regulatory frameworks, volatile markets, and weak infrastructure.

MDBs address this challenge by providing concessional financing, which lowers the cost of capital for project developers. Concessional loans, offered at below-market interest rates, help projects achieve financial sustainability. MDBs also facilitate public-private partnerships (PPPs), blending public-sector support with private-sector innovation. The AfDB's support for the Noor Ouarzazate Solar Complex in Morocco exemplifies how MDBs can drive successful renewable energy projects in EMDEs. Transparency is vital for ensuring the efficient and equitable use of climate finance. MDBs enforce rigorous standards for project appraisal, monitoring, and reporting, reducing the risks of inefficiency and corruption.

Uncertainty is what MDBs have been dealing with. In terms of financing, MDBs often struggle to attract private sector investment for climate projects due to perceived high risks and insufficient risk mitigation strategies. For instance, asset managers have noted that the risks and restrictions imposed by development banks can deter private investment.[10] The demand for climate finance far exceeds the current supply. Developing countries have called for over $1 trillion annually by 2030, but recent commitments, such as the $300 billion target set at COP29, fall short of these needs.[11]

For example, in Indonesia, MDBs have faced challenges in mobilizing private investment for renewable energy projects, primarily due to inconsistent regulatory frameworks and concerns over project bankability, which have disincentivized private sectors to participate.[12] Similarly, in Africa, the Inga Dam project in the Democratic Republic of Congo has faced repeated delays due to political instability and inadequate risk-sharing mechanisms, which then discouraged private investors from committing to this large-scale renewable energy initiative.[13]

Shifts in political leadership can significantly impact MDBs' long-term strategies and planning. When leaders skeptical of climate change, such as Donald Trump, are elected or re-elected, it can result in reduced political support for global climate initiatives and a rollback of climate-friendly policies. This shift can diminish MDBs' ability to align their goals with the international climate agenda.[14] Moreover, MDBs often operate in a wide array of countries, each with its own unique regulatory framework. In some cases, they are subject to sudden changes due to political volatility. For instance, inconsistent environmental regulations or unexpected policy shifts can lead to project delays, increased costs, or even project cancellations. This heightened level of uncertainty and risk complicates project implementation. Then it is difficult for MDBs to ensure the timely and effective deployment of climate finance.

In dealing with financial uncertainty, MDBs should expand their capitalization through contributions from member countries, allowing them to scale up concessional financing and risk mitigation instruments. Risk-sharing mechanisms, such as guarantees and blended finance, should be further developed to attract private-sector investment and reduce the perceived risks of clean energy projects. For example, MDBs can emulate the World Bank's Multilateral Investment Guarantee Agency (MIGA), which provides political risk insurance to de-risk investments in high-risk countries. Crowding in private investment has always been one of the most important strategies in supporting climate finance. MDBs should actively engage with private investors by offering co-financing opportunities, green bonds, and structured financial products that align with private-sector risk appetites. Partnerships with institutional investors, such as pension funds and sovereign wealth funds, can unlock large pools of capital for renewable energy projects.

| Climate Financing |

Uncertainty over the availability of long-term funding often discourages private investors from participating in MDB-led projects. MDBs should prioritize multi-decade financial commitments to align with the lifecycle of clean energy infrastructure. A strategy to implement it could be by structuring financing mechanisms, such as sustainability-linked bonds, to provide stable and predictable long-term project funding. MDBs should also advocate for streamlined access to international climate funds, such as those committed at COP29, to ensure timely and transparent disbursements. This includes simplifying application processes and aligning disbursement schedules with project timelines. To do this, MDBs could act as intermediaries between international climate finance providers and recipient governments to facilitate the flow of funds.

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Navigating Indonesia's Renewable Energy Transition and Balancing Environmental Goals with Workers' Equity

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The world is grappling with a climate emergency that necessitates a rapid shift toward low-carbon development.[1] The International Energy Agency stated that there can be no new fossil fuel energy projects that can proceed if the world wants to meet the goal of limiting global temperature rise.[2] To avoid the worst effects of climate change, countries worldwide have prioritized limiting global warming to 1.5°C by the end of this century.[3] Suppose the world crosses the 1.5°C threshold; according to IPCC, it will cause severe climate change impacts (i.e., more frequent and severe droughts and heatwaves).[4] To minimize its impact, countries worldwide have committed to reducing their greenhouse gas (GHG) emissions, such as carbon dioxide (CO2), to align with the Paris Agreement. GHG emissions are generated through energy production, such as burning fossil fuels for electricity and heat. To reach net zero carbon emissions, the decarbonization effort should primarily focus on increasing the share of Renewable Energy (RE) that produces low or no CO2 emissions.[5] The need for a transition to RE is a pressing issue in Asia, as it is the world's highest projected carbon emissions and where most of the world's proposed coal-fired power plants are planned to be built.[6]

According to the European Union's emissions database, Indonesia ranked seventh in global GHG emissions in 2023; Indonesia emits 1.20 GtCO2e of the total 52.96 GtCO2e globally.[7] Indonesia has thus committed to retiring 15% of Coal-Fired Power Plants (CFPP) by 2030. This is a significant shift because over 60% of power in Indonesia is produced with coal. Specifically, over 80% of electricity is from coal, gas, and diesel power plants. To reduce the dependence on coal, based on Indonesia's National Energy Planning, Indonesia planned to install 45.2 GW of RE capacity in 2025, or around 17 to 19% of the energy mix, and 31% by 2050.[8] Further, the state-owned electricity company, Perusahaan Listrik Negara (PLN), pledged to be carbon neutral by 2060.[9]

The Energy Transition and Its Social Aspects

The energy transition is defined as a geographical process that involves the reconfiguration of current patterns and scales of economic and social activity.[10] [11] There is an increasing awareness that societies are important for the energy transition's success. [12] This perspective emphasizes the importance of examining the transition in the places where it occurs and highlights the interconnectedness of actors and changes at different scales. [13] [14] [15] Additionally, there is a need to emphasize the importance of examining re-scaling processes in energy governance, as these can reveal "who is impacted, who holds the capacity to act, and where the boundaries of responsibility are drawn."[16]

The switch to RE in Indonesia has significant social and economic consequences.[17] The social and economic impacts of the energy transition are varied, as they influence employment patterns, income distribution, and overall societal well-being. Even though the energy transition is anticipated to benefit the environment by reducing emissions and generating new opportunities in the energy sector, it may also pose significant socioeconomic challenges, particularly for the workforce. Specifically, the changes in the economy's structure could potentially create (green) job opportunities and trigger job losses. Thus, addressing the implications for job losses in conventional energy industries is essential. Recent studies emphasize the importance of implementing fair and sustainable policies to support displaced workers and underserved communities during this shift.[18] Incorporating RE into Indonesia's energy mix can boost the economy, reduce fossil fuel reliance, create jobs, improve energy access, and lower environmental impacts. However, to achieve this objective, the government, private sector, and civil society should collaborate and solve the need for partnership.[19]

The Indonesian Just Energy Transition Partnership (JETP)

The involvement of the private sector and foreign investment has a critical role in helping the transition in Indonesia. By working with the government and international financial institutions, Indonesia can increase the growth of RE infrastructure and improve access to clean and affordable energy for the Indonesian population.[20] This effort is connected to Indonesia's global agenda in meeting GHG emissions goals outlined in the Paris Agreement. To keep Indonesia's commitment to the Paris Agreement and the global warming limit of 1.5°C above pre-industrial levels. In 2022, Indonesia and the International Partners Group (IPG), led by the United States and Japan, announced the Just Energy Transition Partnership.[21] The JETP Joint Statement aims to limit emissions in the energy sector to a peak of no more than 290 MtCO2 by 2030, with a goal of achieving net-zero emissions by 2050. The JETP mobilized a $20 billion funding package with financial support and technical assistance from countries in the Global North to support Indonesia's just-energy transition.[22] Given Indonesia's significant dependence on coal, the Joint Statement outlines several measures to reduce reliance on both on- and off-grid coal-fired power plants. These include accelerating the retirement of existing plants, halting the development of new on-grid coal-fired power plants, and limiting the construction of captive coal-fired plants.

The JETP partnership is more than financing. It is about a transition that balances environmental sustainability with socioeconomic equity. It is about justice in all forms. Central to this approach is the concept of a "just transition," which is built on three principles:

1. distributive justice, which ensures the economic benefits of energy transitions are shared broadly;
2. procedural justice, which emphasizes the importance of accountability and the inclusion of all stakeholders in decision-making processes;
3. restorative justice, which seeks to address the historical and ongoing harms caused by environmental degradation.

The JETP emphasizes the importance of ensuring a just transition for workers, communities, and vulnerable groups directly or indirectly impacted by the accelerated energy shift. A just energy transition should create jobs in emerging sectors,

ensure affordable energy, and enhance community resilience. Those who are most impacted by economic changes must have an opportunity to participate actively in the transition process.

The energy transition brings its own set of challenges. As Indonesia moves toward RE and retires its aging coal-fueled power plants, workers in the coal industry will lose their jobs, and businesses reliant on the sector, such as coal transportation workers and equipment maintenance teams, will become obsolete. This will affect individuals and communities in coal-dependent regions. Per the OECD, job gains are expected to be distributed across multiple sectors, with significant growth in electricity, gas, and manufacturing areas. In contrast, job losses are likely to be concentrated in fossil fuel-related industries, particularly in sectors like coal mining.

According to the Global Energy Monitor, Indonesia will experience one of the most significant layoffs in the coal mining sector, as the country is the world's leading coal producer. Indonesia has 160 coal mines and 234 coal-fired power plants.[23] The country relies on the coal industry to employ roughly 160,000 workers. Based on the calibrated Indonesian Labour Force Survey Data, it is estimated that approximately 31,000 jobs will be lost by 2030, while the energy transition is expected to create 1.12 million jobs during the same period.[24] Even though Indonesia has an opportunity to create new jobs through this transition, it also brings significant challenges: high initial costs, technological constraints, and the need for extensive infrastructure upgrades.

To minimize the negativities of the energy transition, a broader perspective on the opportunity costs associated with coal suggests that companies should compensate coal workers for lost wages resulting from the early closure of coal mines to support workers during the transition away from coal effectively.[25]

This compensation should address the immediate financial impact on these workers and include the costs associated with retraining and reskilling programs. As the coal industry gradually declines and RE sources expand, retraining programs are essential to help workers transition into emerging sectors, particularly the rapidly growing RE industry. These programs could offer new skill sets that align with the evolving energy landscape, ensuring that workers can take advantage of new employment opportunities. For example, coal workers who risk losing their jobs due to the coal phase-out could be retrained to qualify for positions in solar, wind, or other RE sectors. This approach ensures a just transition for coal workers and supports the broader goal of accelerating the shift to cleaner, more sustainable energy sources. The development of JETP policies supported this perspective as it included many stakeholders, from government and policymakers to investors, civil society organizations, and affected communities. This approach is critical for drafting effective and equitable policies that serve the broad public interest without burdening the most vulnerable populations.

Conclusion

Inclusivity is not merely a choice but an absolute necessity for achieving lasting change. As we navigate the complexities of the global transition toward sustainability, it is critical that the journey is rooted in the core principles of equity, collaboration, and justice. These principles must guide the policies we implement and how we approach challenges at every level—from local communities to international negotiations. In addition to these values, the commitment of developed nations to provide substantial financial support at concessionary rates plays a crucial role in making this transition possible, especially for countries with fewer resources, like Indonesia. This narrative holds great promise for Indonesia, but it also offers valuable lessons for the world at large. It reminds us how deeply interconnected environmental sustainability is with social and financial equity, both within individual nations and across the globe. The challenges we face, whether in energy, climate change, or poverty, cannot be solved in isolation. The experiences and innovations emerging from one part of the world can inspire and guide others, shaping a shared vision for progress.The JETP initiative is reimagining the global energy landscape and redefining what it means to make progress together. This re-imagination is not just about transitioning from fossil fuels to RE; it is about doing so in a way that ensures inclusivity, fairness, and shared prosperity. By engaging all stakeholders, such as governments, businesses, civil society, and communities, we are fostering collective action that makes it possible to achieve a cleaner, more sustainable energy future without leaving anyone behind.

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Bracing for the Storm: Addressing Climate Migration in the United States

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Climate migration will become a major threat to the United States. It is not hyperbole to say people are going to be fleeing their homes from climate disasters. Some research has shown that this is already occurring. A study by the First Street Foundation, a research firm that studies climate threats to housing, "found that roughly 3.2 million Americans have already migrated, many over short distances, out of flood zones, such as low-lying parts of Staten Island, Miami and Galveston, Texas."[1] This is a crisis that requires much more attention to help facilitate life-saving resources to communities. The United States needs a comprehensive framework and strategies to provide protections for climate migrants. Frequently, an extreme weather event happens, communities are overwhelmed, officials are not prepared to act accordingly, and avoidable tragedies ensue. As disasters become more frequent, climate migration will escalate.[2] This paper will analyze current climate policies, and the strategies needed to assist with climate migration in the United States.

Background

Climate migration refers to "the movement of a person or groups of people who, predominantly for reasons of sudden or progressive change in the environment due to climate change, are obliged to leave their habitual place of residence, or choose to do so, either temporarily or permanently, and who move within their country or abroad."[3] A broad definition, like this, gives the ability to include many diverse circumstances due to the unpredictability of environmental threats. In the United States, these threats include cold wave events, tropical cyclones, tornadoes, hurricanes, wildfires, heatwaves and droughts.[4] According to the NOAA Centers for Environmental Information (NCEI) in 2023, there were 28 separate climate disasters costing the United States a historic one-billion dollars in damage.[5]

A ProPublica article written by Abrahm Lustgarten, an award-winning investigative reporter on global migration, said that "over the next thirty years, 7.5 million people are projected to leave those perennially flooded zones [in the United States].[6] Movement from high-risk areas to lower-risk zones like the Midwest or Northeast will become more common as climate migration increases in the coming decades. However, a New York Times analysis from September 2024, explained that currently Americans tend to still move into disaster-prone areas like Florida, Arizona, California, Texas and the Carolinas.[7] These are examples of states experiencing different climate effects like dangerous record-high temperatures, hurricanes and wildfires. With more movement to these areas, this has increased people's exposure to

climate disasters. It gives these extreme weather events "more chances to hit populated areas, a trend scientists call 'the expanding bull-eye's effect.'"[8]

Regarding the decision to relocate, economic concerns usually outweigh climate change. People are seeking better job opportunities, a cheaper cost of living, family proximity, or are enticed by the warm weather.[9] Many factors go into the reasoning to relocate and in the United States; environmental threats are not high up on the list. However, systemic issues frequently act as a force multiplier forthe economic factors, increasing the salience of these factors. Individuals who move to these areas should not be viewed as ignorant. Instead, the lens needs to be repositioned to analyze what is making an influx of people move to these locations, and why. The inequalities with access to credible environmental information creates a large barrier for low-income communities. An example of this is the Flint Water Crisis. The Flint residents, predominantly low-income and Black, were not informed about lead contamination in their water until long after the crisis began. This "environmental injustice that endangered families for 18 months was prolonged because the [city and state of Michigan] cheated on water tests, was hostile to outside researchers sounding the alarm, and betrayed the public's trust by repeatedly insisting the brown, smelly, lead-laden water was safe to consume."[10]

Environmental advocates warn that BIPOC communities, low-income communities and children are disproportionately vulnerable to changing climate conditions and have the fewest resources to prepare for and recover from extreme weather events.[11] The government must recognize their responsibility to support these communities in the wake of the growing climate crisis.

Preparing for Migration

Climate migration is a complex phenomenon for the policy sector to digest. Environmental threats can look vastly different based on the location—ranging from rising sea levels in Florida, to wildfires in California, to desertification in Arizona. This makes it challenging to adapt the country towards a path of resilience. There are initiatives that are well suited to help improve the country's current dismal performance.[12] A new framework for the United States is necessary to address the impact climate change has on humans. There must be action taken to slow the effects of climate change and build adaptive capacity to address climate migration. First, there needs to be a sufficient understanding within the policy sector of the direct connection between the climate crisis and migration. One way of doing this is by better understanding the data. Policymakers and relevant government personnel cannot shy away from the numbers, nor the predictions for the future in which they depict. The Internal Displacement Monitoring Center estimated that "21.5 million people per year on average over the past decade have had to flee their homes due to storms, floods, wildfires, droughts, and other weather events. This represents nearly three times more than those internally displaced due to conflict and nearly nine times more than those who apply for asylum in other countries due to a fear of persecution at home." Evidently, the data authenticates that climate migration is growing increasingly more severe.

It is often difficult to attribute one's dominant reason for migrating to climate change. As stated previously, there are a wide range of reasons to emigrate. Existing legal and governmental systems struggle to recognize or provide protections specifically for climate migrants. The United States is an example of the unwillingness or inability to address this challenge.

The Center for Strategic and International Studies explains that "under current U.S. immigration law, people displaced by natural disasters and environmental degradation…have traditionally not been considered eligible for protection as refugees."[13] This creates the ongoing issue of climate migrants being overlooked. Even though it is difficult to pinpoint climate change as the sole cause for migrating, it should still be recognized in U.S. immigration law, as within immigration law, climate migrants can be considered members of a "particular social group."[14] The United States needs to showcase the importance and feasibility of accommodating climate migrants through proactive U.S. immigration policy.

In 2023, President Biden created the country's first-ever National Climate Resilience Framework. It addresses three actions: (1) Assess Climate-Related Threats and Opportunities, (2) Partner for an Integrated Approach, and (3) Invest in Collective Resilience.[15] This is a historic step, but it remains to be seen how it will be implemented. Strategies are frequently implemented, but regressive infrastructure choices continue to be made. There are still large buildings being built on the shorelines across the country.[16] This significantly disrupts the coastline which can lead to beach erosion and increases vulnerability to storm surges. Additionally, in 2022, the Biden Administration approved the Willow Project in Alaska, which "could extract more than 600 million barrels of oil over 30 years."[17] The contradiction of Biden's action has created friction with his climate goals. This is why environmental awareness and education are imperative.

Preparing for migration in the face of climate change is a multifaceted challenge that requires attention and long-term commitment. While progress has been made, like the establishment of the National Climate Resilience Framework, much work remains to be done to ensure that climate migrants are protected and supported. The United States must prioritize aligning infrastructure development, immigration policies, and environmental strategies to address the realities of climate migration. This includes integrating climate migration into legal frameworks, investing in environmental awareness, and committing to sustainable practices that reduce reliance on fossil fuels. Without decisive and cohesive action, the country risks perpetuating a cycle of unpreparedness that amplifies the vulnerabilities of those most affected by climate change.

Conclusion

As the climate crisis continues to emerge as an unavoidable challenge, it is evident that the United States must embrace a transformative approach to policy and adaptation. The country must take substantial steps to protect communities. The current gaps in infrastructure, climate migration protections, and resource allocation leave vulnerable populations at risk and the United States unprepared for the escalating impacts of climate change. Addressing this crisis requires bold action: crafting comprehensive policies that recognize climate migrants, implementing climate resilience practices, and investing in education and equitable access to information. The United States must recognize that overlooking climate migration will not nullify the issue. They have the opportunity to lead by example. However, this will only be achieved through collaboration and a commitment to prioritizing the well-being of all communities. Decisive action now can ensure budding generations a more sustainable and equitable future.

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Your Latte's on the Line: The Unequal Energy Exchange of Climate, Immigration, and Agriculture from Costa Rica to New York

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Every morning, millions of New Yorkers sip their lattes, unaware of the complex network of agricultural, immigration, and climate systems that make this ritual possible. The seemingly simple act of drinking coffee masks a global supply chain reliant on Costa Rican coffee and New York dairy. These ingredients depend on immigrant labor, ecosystems increasingly strained by climate change, and policies that fail to address the inequities and vulnerabilities within this nexus. To sustain this interconnected system, New York must adopt equitable and sustainable policies that protect both the environment and the laborers who sustain it.

The Energy Exchange Behind a Latte

The production of a latte's core ingredients—coffee and dairy—relies on intensive human labor and ecosystems vulnerable to climate change. In New York, dairy farms produce 15.7 billion pounds of milk annually,[1] supported by a workforce where 51% of workers are immigrants,[2] primarily from Mexico and Guatemala.[3] Many of these workers, often undocumented, face systemic vulnerabilities such as exclusion from labor protections and substandard housing.

In Costa Rica, coffee—hand-picked, dried, and processed by peons—relies on a migrant workforce,[4] 75% of whom are Nicaraguan and Ngäbe-Buglé Indigenous peoples from Panama.[5] These laborers endure physically grueling tasks and harsh conditions for minimal wages, often earning as little as USD 60 a day. This system underscores the inextricable link between human energy and agricultural production across borders.

Source: Mira DeGregory

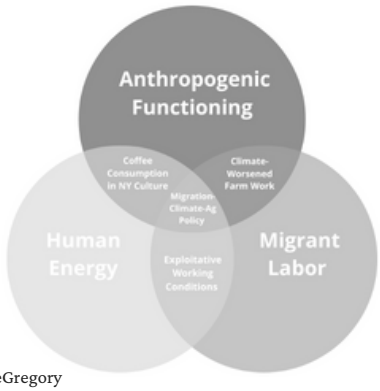
Labor Dynamics in Coffee and Dairy Production

Farm labor in both industries demands immense physical effort. Costa Rican coffee pickers harvest up to 200 pounds of coffee cherries daily by hand, bending and lifting under the sun on uneven terrain.[6] In New York, dairy workers milk cows, clean barns, and handle livestock, often working sixty to eighty hours per week.[7] In both industries, physically taxing work leads to chronic fatigue, musculoskeletal injuries, and mental strain[8] and is further enabled by insufficient health insurance[9] options, lack of transportation, and high out-of-pocket costs for migrant farm workers.

Climate Impacts

Climate change is set to exacerbate the harsh conditions for farm laborers in the U.S. and Costa Rica. In upstate New York, dairy workers will face more frequent heat waves and rising humidity levels, increasing the risk of heat-related illnesses.[10] Tasks like cleaning barns and handling livestock will become more hazardous as extreme weather events compromise barn ventilation and worker safety. In Costa Rica, coffee farmers will confront rising temperatures and unpredictable rainfall, leading to prolonged harvest seasons, landslides, and the spread of pests like the coffee berry borer.[11] These shifts will demand more hours in the field under hotter, more dangerous conditions. For both industries, climate change intensifies an already arduous work environment, further endangering the health and well-being of farmworkers vital to global food and beverage supply chains.

There is an inextricable link between human energy, migrant labor in New York and Costa Rica, and how New Yorkers function in an anthropogenic world. To sustain this system, we need solutions that build resilience across all parts of this nexus, including political protections for migrant workers through immigration reforms and climate resilience laws.



Source: Mira DeGregory

New York must secure justice for the laborers who make it possible to continue enjoying the benefits of coffee.

Policy Analysis: Costa Rican Framework for New York State

New York's policy landscape demonstrates progress but falls short compared to Costa Rica's comprehensive approach. The Farm Labor Fair Labor Practices Act (FLFLPA)[12] provides rights to farm workers except for undocumented workers, leaving them vulnerable to exploitation and without organizing and collective bargaining rights. Similarly, the federal Migrant and Seasonal Agricultural Worker Protection Act (MSPA)[13] offers baseline protections for workers but lacks robust enforcement, perpetuating unsafe working conditions. Systems like the New York State Migrant Education Program (NYS-MEP)[14] provide crucial educational resources for the children of migrant workers but fail to address systemic inequities faced by adult laborers. On the climate adaptation front, New York's dairy farms remain significant contributors to greenhouse gas emissions, mainly methane. Cornell Cooperative Extension's experimental Payment for Environmental Services (PES)[15] models could incentivize climate-conscious production and mitigate NY's footprint. However, PES modeling is in the preliminary stages in New York and will not be scaled to the dairy industry without a successful pilot. These gaps reflect an absence of interconnectedness between policies; labor protections, education programs, and sustainability efforts operate in silos rather than synthesizing. Bridging these gaps requires a holistic framework considering how the nexus of labor, human energy, and anthropogenic policies can be mutually reinforcing.

Costa Rica exemplifies an innovative and integrated framework for addressing this nexus. The approach is summarized in the following table. [16] [17] [18] [19] [20]

Costa Rican Policy	Description	Applicability to NY
Regularization of Migrant Workers	The Migrant Labor Traceability System (SITLAM)[16] enables real-time processing and documentation of migrant workers, thereby providing legal work permits and formalizing agricultural labor. In 2022, SITLAM became permanent through the establishment of a special category for the immigration regularization of foreigners working temporarily in the agricultural sector, successfully registering thousands of workers, mainly Nicaraguans and Indigenous Panamanians.	New York could develop a system like SITLAM to regularize dairy workers, provide legal pathways, and reduce exploitation in agriculture.
Payment for Environmental Services (PES)	Payment for Environmental Services (PES)[17] program compensates landowners for conserving forests, reforesting degraded areas, and adopting sustainable land-use practices. By financially incentivizing environmental stewardship, this program has reversed deforestation trends and increased biodiversity, aligning economic benefits with ecological preservation, and directly impacting the agricultural sector.	A PES-like program, codified by law, could incentivize NY dairy farmers to adopt practices like rotational grazing, reducing emissions and improving soil health.
Climate-Smart Agriculture (CSA) Practices	Climate-Smart Agriculture (CSA)[18] practices across agri-food chains address climate challenges. CSA focuses on improving productivity while reducing greenhouse gas emissions and increasing resilience to climate variability, incorporating strategies like crop diversification, water-efficient irrigation systems, and agroforestry techniques. These approaches have helped Costa Rican coffee farmers adapt to erratic weather patterns and rising temperatures.	NY could adopt CSA practices like renewable energy systems and sustainable feed sources to enhance productivity and reduce environmental impact on dairy farmers.
Bilateral Labor Agreements	The Binational Agreement to Regulate the Temporary Hiring of Nicaraguan Workers[19] formalizes cross-border labor mobility and ensures compliance with legal standards. Employers can request and transport workers directly through SITLAM, minimizing the risks associated with informal hiring.	The U.S. could negotiate labor agreements with Mexico and Central American countries to formalize labor pathways and address shortages.
Innovative Work Permit Development	Costa Rica cross-border worker permits[20] allow Nicaraguans and Panamanians to enter and exit the border while earning wages and contributing to the Costa Rican Social Security Fund. Temporary work permits for migrant workers hired in specific sectors like agriculture, and dual nationality permits for Indigenous peoples, recognize the shared heritage and mobility along the Costa Rica-Panama border. These measures have created legal pathways for migrant workers, reducing exploitation and strengthening labor rights.	NY could adopt similar policies to fill gaps in access to education and health services for migrant workers and their families.

Together, these policies create a web of resilience and strengthen all facets of the labor-energy nexus by integrating migration systems, sustainable environmental incentives, and climate-adapted agricultural practices. This interconnected approach prioritizes ecological sustainability and social equity, providing a model for holistic policy development in New York.

Recommendations for New York

To strengthen its migration-climate-agriculture nexus, New York State government can adopt the following measures:

1. Implement a system like SITLAM to regularize undocumented workers.
2. Facilitate a PES pilot to be expanded across New York State with integrated CSA practices.
3. Advocate for federal bilateral labor agreements to formalize migration pathways for Mexican and Guatemalan workers in-state.
4. Establish heritage acknowledgment and mobility provisions for individuals with H2-A visas traversing from the U.S-Mexico Border to New York State.

Conclusion

A latte isn't just caffeine and milk—it's an energy exchange that connects the labor of immigrant workers to the energy New Yorkers rely on daily. But this exchange is imbalanced, with the hands that fuel the system exploited and unsupported. New York cannot continue to consume this energy without reinvesting in the human capital that sustains it. By adopting policies that protect migrant workers and promoting climate-smart agriculture along the nexus, New York can build a resilient system where energy is exchanged in a just, sustainable, and shared manner.

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Agriculture Waste to Energy: Navigating Renewable and Clean Energy Solutions in the US Second Trump Administration

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The incoming 47th President of the United States, Donald Trump, has expressed a strong political commitment to reversing several progressive policies implemented during the Biden-Harris administration. These include rolling back social, healthcare, immigration and especially climate and environmental policies. Since President-elect Trump is empowered by Republicans, this leads to setbacks on key climate and environmental policies. Additionally, a strong presumption occurs based on what he did in his first term presidency and promises he created during his presidential campaign. For example, he withdrew the United States from the Paris Agreement in 2017,[1] to fulfill his promises during his campaign trail.

One of his primary promises is to undo environmental regulations that will be rolling back the Biden-Harris administration's climate-focused priorities. A policy that could potentially have twists and turns is the environmental policy called the Inflation Reduction Act (IRA). Trump will try to stop it and prioritize brown sector energy over green and clean energy initiatives, especially for oil and gas. During the 2024 presidential campaign, he signaled that he could reinforce a deregulatory agenda by reciting "drill, baby, drill." However, rejecting a well-established act is not that easy during his second term. This notion appears because Republican elected officials have received benefits from the IRA policy establishment and officially sent a letter supporting clean energy tax credits in August 2024.[2] [3] [4] This article argues that policy like the IRA under the second term of Trump's administration must be seriously supported not only to boost energy inside the country but also to advance economic resilience and global leadership.

Trump's Energy Policy: "Drill Baby Drill"

Trump has thrown around a lot of intense claims relating to environmental protection. He called the Paris Climate Accord "a disaster, a death sentence,"[5] and the climate crisis a "big hoax."[6] Lastly, "drill, baby, drill" is a rhetoric that he used during his campaign trail to emphasize a return to aggressive fossil fuel exploration. To better understand his view on why he is opposing the climate agenda, we must know about the American Petroleum Institute's (API) stance on the United States energy. They believe that the United States must develop domestic energy to maintain national and energy security, as well as economic prosperity. According to the API's "10 in 2022" policy plan, the United States must lead global energy through increasing oil and gas production.[7]

Moreover, it is essential to examine why and how the Republican Party persistently advocates brown industries across the United States. From 1990 until now, the Republicans have received a huge amount of financial support from the oil and gas industries in the United States.[8]

This relationship indicates that Republicans favor fossil fuel development. Knowing that context, it is no wonder why Trump's campaign strategy consistently promoted oil and gas.

The Inflation Reduction Act: Where the Red States is the Main Beneficiaries

The IRA has marked a pivotal moment in the United States' commitment to clean energy and environmental sustainability as it was signed by President Biden in 2022. This policy provides nearly $400 billion in funding towards clean and innovative technologies.[9] This transformation landmark legislation has led to a surge in funding which is not only fostering innovation but also expected to create numerous jobs. The law itself encouraged domestic energy production to have energy security and eventually triggered other nations to enhance their climate policies and investments to remain competitive. This positioned the United States as a leader in clean energy.[10]

According to a McKinsey report, the IRA makes investments across a wide range of sectors including: Energy ($250.6 billion), Manufacturing ($47.7 billion), Environment ($46.4 billion), Transportation and Electric Vehicles ($23.4 billion), Agriculture ($20.9 billion) and Water ($4.7 billion).[11] These funds will be channeled through tax incentives, loans and grants mechanisms. However, despite the United States' commitment to addressing the climate crisis through this policy, the Republican Party strongly opposed it from the start. In 2022, zero Republicans voted for the IRA.

After two years, despite the resistance, funding from this policy has flowed disproportionately into Republican-held states and congressional districts.[12] According to data from the Massachusetts Institute of Technology and Rhodium Group through Clean Investment Monitor, investments for clean energy were poured across ten states, nine of which are led by Republicans.[13] These Republican-leaning states are major fossil fuel producers while also having robust agricultural industries. With the support of the IRA, agricultural waste in these states has the potential to become a valuable input for the clean and renewable energy industry.[14] This further incentivizes the continuation of the bill as these states increasingly benefit from it.

Since IRA emerged, approximately 107 of the 191 total clean energy projects have been located in 72 congressional districts across the country that are represented by House Republicans.[15] As the IRA also focuses on the agriculture sector, it is the chance to consolidate energy and agriculture of the United States mission through the Agricultural Waste-to-Energy (AWE) to achieve the United States climate commitment, especially to enhance Republican participation in the policy implementation of the IRA.

Agricultural Waste-to-Energy: The United States' Energy and Political Transition

It is inevitable that renewable and clean energy create three times as many jobs per dollar spent compared to fossil fuels.[16] Oil and gas companies can provide a short-term profit. However, in the long-term, the economic prospects are hard to gain due to the global shift towards renewable and clean energy. Besides the bill funding clean energy, the money will also go towards more general conservation efforts and sustainable agricultural development and economy. The act's Title II, commits to generate approximately $40 billion towards investments and projects designed to promote climate-smart models of farming, as well as protect the livelihood of farmers and foresters.[17]

The agricultural production in the United States is led by California (11.8 percent), Iowa (8.0 percent), Nebraska (6.1 percent), Texas (5.7 percent), Minnesota (5.0 percent) and Kansas (4.4 percent).[18] The Democratic-leaning states (California and Minnesota) produce agricultural output 16.8 percent in total. Around 24.2 percent of agricultural waste in the United States is coming from the Republican-leaning states, such as Texas, Iowa, Kansas, and Nebraska. These Republican-leaning states, which dominate the agricultural sector, can have additional investment if only they convert their agricultural waste into valuable things such as clean energy. The abundance of its agricultural product, including its waste, also can be beneficial to the communities who live there.

For instance, a state who is already doing this innovative approach is California. In April 2023, California announced that $3 million boost innovative technologies that would transform biomass to carbon-negative energy, which will also improve forest health, reduce wildfire risk, and improve the state's watershed in the Sierra Nevada.[19] While this disbursement is about forest waste, we still can learn from it. The forest waste is often simply collected and burned right after or left to decompose which results in increased greenhouse gas emissions. One example within this idea is Yosemite Clean Energy, LLC. This company was supported by the state government to develop a 50-megawatt forest waste biomass-to-hydrogen plant that will process more than 90,000 tons of forest biomass annually and create 55 jobs benefiting foresters and their surroundings.

If we expect the 24.2 percent of agricultural waste is adding value by converting to clean energy, it is not only transforming the clean energy landscape in the United States, but it is also shifting Republican's political idealism toward the IRA. Additionally, investing in AWE projects will have a chance to stimulate rural economies by creating new industries centered around biomass conversion. A recent publication from Sustainability Science shows that investing in clean energy can create more jobs than traditional fossil fuel industries.[20] Meanwhile, Republican-leaning states that are benefitting from this federal investment (re: incentives), are bridging political divides by demonstrating bipartisan support for energy solutions in the United States. This was indicated by eighteen Republican representatives who sent an official letter to the Speaker of the House.[21]

U.S. Should Stay in Global Climate Fight

Former President Donald Trump who is now elected again as 47th President of the United States might hamper the progressive policy like the IRA. But economic realities and the strong demand for the IRA from Republican-leaning states suggest that it is not that easy for Trump to withdraw the IRA during his second term. They have received more money than Democratic-leaning states and proved that the IRA has catalyzed economic growth and climate resilience in conservative regions – showing a complete reversal of the IRA would face resistance from within the party itself indicated by the official letter from Republicans.

Moreover, this environmental blueprint preserves a growing pace for the domestic clean energy industry. Thus, the temporary conclusion is if only Trump successfully repeals Biden's climate and clean energy law, the Republican-leaning state will stand to lose the most. Many experts agree that no matter what happens to the IRA, it will continue to expand its foothold because of technological advances and economic benefits.[22] Lastly, the IRA is considered a giant leap for renewable energy and climate challenges across the globe. By repealing this act, it would be disastrous for domestic economic growth and degrade the environment.

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Renewables Risk Being the Biggest Misallocation of Resources in History

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The global push for net-zero emissions by 2050 faces a harsh reality: fossil fuel production is unlikely to reach a peak (and eventually decline) in the foreseeable future. Global energy demands are surging, driven by energy-intensive emerging technologies, increased economic activity and the growing impact of extreme weather.[1] While renewables like solar hold promise, their inability to ensure 24/7 grid reliability makes them ill-equipped to meet immediate energy needs. As such, investing heavily in renewables risks becoming a significant misallocation of resources. Nuclear energy stands out as the only viable short-term solution capable of balancing the demands of net-zero goals with current energy requirements. Transitioning to a renewable-dominated grid is a long-term endeavor, and prioritizing investment in renewables over nuclear and cleaner fossil fuel technologies may inadvertently increase reliance on fossil fuels, as renewables struggle to address immediate energy demands.

Global electricity demand is projected to grow at an average annual rate of 3.4% through 2026, with about 85% of this increase driven by emerging economies in Asia, including China and India.[2] Meanwhile, energy consumption from data centers, artificial intelligence (AI), and the cryptocurrency sector could double by 2026, adding further strain to electricity systems.[3] The first half of 2024 highlighted the challenges ahead, as intense heat waves spiked air-conditioning usage and pushed grid systems to their limits. A reliable electricity system operates seamlessly under normal "blue sky" conditions, while a resilient system withstands extreme "grey sky" climate events.

Renewable electricity sources are set to expand rapidly, with their share of global electricity supply projected to rise from 30% in 2023 to 35% by 2025.[4]

Solar photovoltaic (PV) energy and wind combined are expected to meet as much as three-quarters of the growth in global electricity demand over 2024 and 2025.[5] The U.S. grid requires significant expansion and modernization to be able to handle the increase in clean energy production. Current infrastructure struggles with interconnection capacity and regulatory hurdles, slowing the integration of renewables and storage solutions. While clean energy will be rapidly produced thanks to various production subsidies such as tax credits and Inflation Reduction Act (IRA) incentives, the question is, where will all the extra energy go?[6] A short-term grid management solution is presented by Australia, which is introducing a "sun tax" on households and businesses who export solar energy to the grid during peak hours when the network is congested.[7]

The goal is to balance supply and demand, stabilize the energy system, and avoid costly network upgrades. In the long term, however, extensive network upgrades will be essential, yet a US$14.3 trillion shortfall in global grid investment is expected by 2050, and the development timeline for grid infrastructure is three to seven times slower than that of renewable energy installations.[8] Without accelerated grid investments, the clean energy boom risks being stymied by infrastructure bottlenecks.

Excess solar energy production poses a problem for grid infrastructure and to "grey sky" reliability. The output from solar farms drops by 75% to 90% when clouds cover the sun.[9] The intermittency of solar and wind energy highlights a critical limitation: they cannot replace 24-hour dispatchable base load power sources like coal or gas plants without significant advancements in storage and grid infrastructure. This challenge is already evident in early adopters of intermittent renewables, such as California, Texas, and Germany, where grid instability and blackouts have highlighted the risks of transitioning too quickly without sufficient backup systems. California, for instance, has delayed the shutdown of the Diablo Canyon nuclear plant, maintained gas plants, and scaled back new residential solar installations to address reliability concerns.[10] [11] [12] Germany, after phasing out nuclear and fossil fuel power and relying too heavily on intermittent wind and solar power, has faced sole dependence on Russia's supply of natural gas, exposing vulnerabilities during geopolitical crises like the Russia-Ukraine war which drove up energy costs.[13] Texas, with its reliance on wind power, experienced catastrophic grid failures during the 2021 winter storm when freezing conditions disrupted both natural gas and renewable energy systems. The state's isolated grid, lacking interconnections with neighboring regions, compounded the crisis by preventing power imports during shortages.[14] These cases highlight the critical need for balancing renewable adoption with robust grid modernization, energy storage, and a diversified energy mix.

A practical solution lies in the implementation of self-sufficient microgrids—energy systems that combine two or more unrelated forms of energy generation with storage, all managed by a centralized control system, such as a microcontroller or specialized software. Microgrids are designed to operate independently or in conjunction with the main grid, serving specific geographic areas like college campuses, hospital complexes, business centers, or neighborhoods, ensuring reliable and localized energy solutions.

As the U.S. national grid aims to transition to 100% clean energy by 2050, a reliable buffer is essential to avoid pitfalls like Germany's energy struggles. France offers a compelling success story. In response to the 1973 oil crisis, France replaced nearly all its fossil fuel plants with nuclear power in under 15 years. Today, nuclear energy provides over 70% of France's electricity—reliably, cleanly, and affordably—with hydropower accounting for most of the remainder.[15] To meet growing energy demand, France plans to build at least seven additional nuclear plants, reinforcing its position as a global leader in nuclear energy.

Similarly, countries like Poland are fast-tracking nuclear adoption to reduce dependence on Russian gas. At COP28, 22 countries pledged to triple global nuclear power capacity.[16] In stark contrast, the United States lags behind. Decades of public opposition and industry lobbying halted the transition of coal and oil plants to nuclear, leaving the U.S. reliant on aging reactors that provide 20% of its electricity.

| Risks to the Grid |

With most of these reactors nearing retirement and only two new reactors constructed in the last 30 years, the U.S. risks falling further behind as global electricity demand surges at one of the fastest rates in decades.[17]

The roots of America's stalled nuclear progress can be traced to anti-nuclear power lobbying by Big Gas and Oil. Reacting to public fear, the U.S. government-imposed radiation limits for nuclear power plants far stricter than scientific evidence warranted—over 100 times stricter than levels proven to cause harm.[18] This hyper-cautious approach has stifled nuclear development.

The push for net-zero emissions demands a pragmatic and balanced approach to the clean energy transition. While renewables play a critical role in the long-term strategy, their limitations in reliability and resiliency make them insufficient as a sole solution for immediate energy needs. Nuclear energy, with its proven reliability and scalability, offers a viable path to bridging the gap between current energy demands and future climate goals. To avoid the pitfalls of hasty and imbalanced transitions seen in regions like California, Texas, and Germany, nations must prioritize investments in grid modernization, diversified energy systems, and nuclear power. Only with these measures can we meet the dual challenges of growing energy demand, security, and climate resilience effectively.

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Greening the Grid: Leveraging Green PPAs for Sustainable Data Centers

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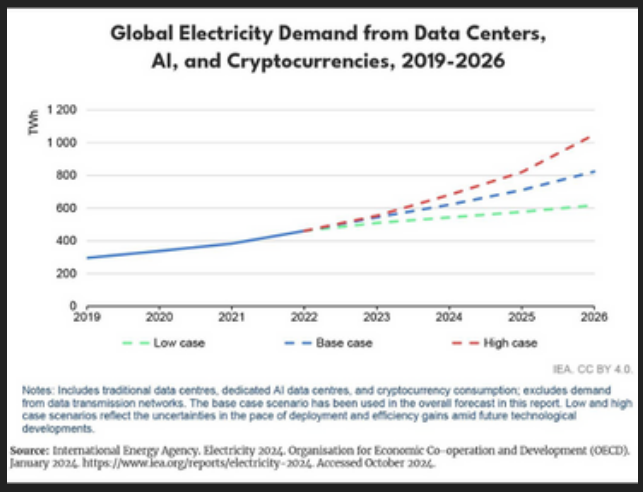
As we embrace a new digital era marked by the massive growth of artificial intelligence, machine learning, and neural networks, the demand for data centers, which are tasked with supporting these complex computations, is expected to rise substantially.

Data centers are the backbone of the digital era, providing the infrastructure needed to produce, store, process, and transmit vast amounts of data. Data centers are increasingly central to digital growth. By 2030, the global data center market is expected to exceed $500 billion.[1] Significant investment in server production and energy infrastructure will be necessary to meet this substantial market demand

With the rapid increase in energy demand and reliance on electricity generated from fossil-based power plants, a rise in carbon emissions is inevitable unless alternative clean energy sources are adopted.[2] The global data center industry is projected to emit 2.5 billion tons of CO2 by 2030, equivalent to about forty percent of the annual greenhouse gas emissions of the entire United States.[3] In response, governments worldwide are introducing regulations and legislation mandating businesses to reduce their carbon footprints, particularly in regions with the highest levels of pollution.[4]

On the other hand, the growth in energy demand comes with financial challenges, particularly in operating costs. Electricity consumption, driven by energy-intensive processes such as artificial intelligence computations and rising energy prices, remains the largest ongoing expense for data centers, comprising forty percent to sixty percent of their total expenditures.[5]

With the United States hosting nearly one-third of the world's data centers, it holds a critical responsibility in shaping the future of this industry.[6] Green Power Purchase Agreements offer a viable pathway to address these challenges, allowing data centers to secure renewable energy directly from producers, stabilize electricity costs, and significantly reduce carbon emissions. As global energy demand for data centers is expected to double within the next two years, leveraging green Power Purchase Agreements will be key to building a sustainable and resilient digital infrastructure for the future.[7]



How Green PPAs Address Energy Demands

Power Purchase Agreements (PPAs) offer a practical solution to the rising energy demands by enabling data centers to source energy from renewable energy suppliers or facilities. Buyers commit to purchasing renewable electricity through long-term PPAs, typically lasting over ten years.[8] These agreements outline critical terms such as the price of electricity, delivery schedules, financial conditions, maintenance responsibilities, and performance guarantees, ensuring the buyer receives a consistent and reliable supply of renewable energy.[9]

Additionally, green PPAs contribute to stabilizing local electricity grids by reducing peak demand on conventional power plants and encouraging investments in local clean energy infrastructure, such as solar panels, wind turbines, and other renewable technologies.[10] In 2023 alone, corporate renewable PPAs accounted for forty-six gigawatts of solar and wind contracts, representing a twelve percent increase over the previous record of forty-one gigawatts in 2022.[11]

Green PPAs in Practice: Case Studies in Tech

Green PPAs have garnered substantial support from tech giants such as Amazon, Microsoft, Google, and Meta, enabling these companies to meet the immense energy demands of their data centers and sustain their AI-powered growth.

Amazon, under its Climate Pledge, stands as the world's largest tech purchaser of renewable energy, with investments in over 500 projects across twenty-five countries.[12] Microsoft aims to achieve carbon-negative status by 2030, utilizing green PPAs to power its data centers while advancing energy storage technologies and grid decarbonization. Similarly, Google is pursuing its 24/7 carbon-free energy goal for data centers, and Meta depends on green PPAs to fuel its AI and metaverse initiatives.[13]

These companies have not only embraced renewable energy but have also invested billions of dollars in driving innovation and expanding renewable energy infrastructure. This strategy has allowed them to exert significant influence over the location and development of green energy facilities, ensuring proximity to their data centers and strategically investing in solar and wind farms near their operations.[14]

While this demonstrates the transformative potential of green PPAs for large-scale energy consumers, it also raises a critical question: can green PPAs become a viable solution for small and medium-sized data centers as well?

Expanding Green PPAs to Small and Medium-Sized Data Centers

Over fifty percent of U.S. data centers are small to medium-sized, primarily serving metropolitan communities—major emission sources.[15] Adopting local renewable energy sources could allow these centers to significantly reduce urban emissions, often having a greater localized impact than larger data centers situated in remote areas.[16]

Green PPAs can provide a practical way for these smaller data centers to access renewable energy at stable, competitive rates. For instance, a fifteen-year green PPA utilizing solar energy could enable a small data center to lock in consistent electricity prices while significantly cutting emissions. Legislative support, such as carbon taxes and renewable energy tax credits, could further encourage small and medium-sized businesses to adopt green PPAs, allowing them to collectively negotiate agreements at scales like those of major tech companies.

Consider the partnership between Cyxtera Technologies, a provider of hybrid IT infrastructure and data center services, and NextEra Energy, one of North America's largest

renewable energy developers. In 2020, Cyxtera partnered with NextEra to source clean energy for its data centers and to develop next-generation facilities with sustainable technology.[17] As part of this collaboration, NextEra supports Cyxtera by installing distributed renewable energy systems across its North American data center footprint, which has a power capacity of more than 200 megawatts, accelerating Cyxtera's progress toward carbon neutrality.[18] By leveraging NextEra's expertise as a leading generator of wind and solar energy, Cyxtera has reduced its environmental impact and achieved its sustainability goals more efficiently. This partnership demonstrates how mid-sized data center providers can overcome financial and logistical challenges in securing green energy by collaborating with established leaders in the renewable energy sector.

However, a significant barrier to adoption remains the long-term nature of many PPAs, which can be less appealing in an industry prone to economic, technological, and regulatory shifts. A key risk of long-term contracts in a volatile energy market, particularly with renewables like wind and solar, is that advancements in technology or market shifts could lower energy prices, leaving buyers locked into contracts with fixed rates that exceed market prices, resulting in financial losses.[19] Additionally, regulatory changes, such as the upcoming replacement of the U.S. Production Tax Credit for wind energy in 2025, could add further uncertainty to long-term agreements.[20] Shorter contracts, such as five- to seven-year agreements, could mitigate these risks while aligning with the expected thirty percent growth in the global PPA market over the next decade.[21] Offering flexible contract terms and adjustable pricing could make these . agreements more accessible without compromising the financial viability of suppliers.

Incorporating Renewable Energy Certificates (RECs) into these agreements could further enhance sustainability efforts.[22] RECs verify that energy is generated from renewable sources, allowing data centers to offset carbon emissions or earn carbon credits. This approach provides an additional incentive for adopting green PPAs and supports broader sustainability objectives.

To ensure reliability, even during periods of low solar or wind energy generation, green PPAs can incorporate strategies to address these challenges. One effective solution is "24/7 matching," which ensures renewable energy sources align with a data center's energy needs on an hourly basis every day of the week. This is achieved by combining diverse renewable energy sources, such as wind and solar, with battery storage to save excess energy for later use, supplemented by additional energy purchased from the grid when necessary.[23] Although implementing this method may involve higher upfront costs, government support could encourage adoption by ensuring a consistent clean energy supply and reducing reliance on non-renewable power sources. By adopting these measures, small and medium-sized data centers could access renewable energy solutions that are both practical and impactful. This would enable them to contribute meaningfully to emissions reduction and support the broader transition to a cleaner and more sustainable energy future.

Conclusion

All these efforts collectively highlight the critical role of green PPAs in fostering sustainable data center resilience. They facilitate the shift to renewable energy, help reduce carbon emissions, stabilize energy costs, and improve reliability in the face of grid instability and evolving regulatory demands. These agreements are not just tools for environmental impact—they also offer a strategic pathway for data centers to manage their energy use more effectively. Small and medium-sized data centers, often overlooked, stand to benefit significantly by becoming more efficient and resilient, while larger players continue to lead in advancing innovation and infrastructure development.

That said, challenges persist. Limited financial resources, difficulty in negotiating favorable terms, and the risks tied to long-term contracts in a volatile energy market present real barriers. While long-term agreements provide stability, they can lock buyers into fixed rates that may become uncompetitive as renewable energy prices decline due to technological advancements. For smaller players, these risks are even more pronounced, making it crucial to explore solutions such as shorter contracts, flexible agreements, targeted support, and reliable renewable energy availability to level the playing field.

As the digital era continues to grow at an unprecedented pace, addressing these challenges and refining green PPAs will be essential to ensuring data centers meet rising energy demands responsibly. By balancing growth with sustainability, green PPAs can help shape a digital infrastructure that is not only robust but also aligned with long-term environmental and economic goals.

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Subsidize the Price or Resilience? Rethinking Climate Insurance in a Changing Risk Landscape

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Home insurance prices increased by 11.3 percent in 2023[1] averaging $2,601 annually.[2] Bloomberg News reported that the inflation index is projected to rise further should home insurance costs be included.[3] For decades, insurance companies have operated on a model based on statistically feasible pricing. With climate change and a milder perception of its ramifications, the recent surge in insurance policy premiums may appear excessively rapid to bear. The challenge arises from the fact that a model that has always worked is no longer functioning as intended, considering the rapid climate change. While both climate change and corporate responsibilities are significant factors, an additional administrative problem is that insurers are hesitant to amend the existing pricing structure, primarily due to the absence of an alternative method to pool economically feasible and risk-responsive policies.

To deal with out-of-control home insurance prices and a mass exodus of insurance companies in high-risk states, policymakers are trying to put a price ceiling on insurance policies. Ceteris paribus, homeowners can take the extra consumer surplus. In practice, however, capping policy premiums tends to reduce insurers' motivations to offer the policy in the first place—that's why there are higher home insurance rates, and there are even fewer to offer those policies, reducing home insurance accessibility. What can policies do to help Americans? In this article, I'm exploring alternative public financing routes to give homeowners and insurers a break in the tug-of-war from climate change. My proposition is that a policy can lead to socially optimal insurance by combining grants with subsidies. The problem to explore is who to subsidize and who to give the grants to. Ultimately, this proposal aims to accomplish the following objectives: 1) to enhance community resilience in response to severe weather brought by climate change; 2) to encourage and provide incentives for insurers to develop new pricing models instead of simply exiting risky states; and finally, 3) to implement a combination of premium subsidies and grants to facilitate the transition of objectives 1) and 2).

Climate Change and High-Risk States

Climate change brings extreme weather events. The Federal Emergency Management Agency (FEMA) compiled a map to showcase the National Risk Index for states and counties prone to newly developed natural disasters.[4] The map contains eighteen climate risks and expected annual loss, social vulnerability, and community resilience by county. Picking attributes such as "drought," "flooding," "hurricane," and "wildfire" as map attributes, it is significant to see some counties and states are unanimously at risk, as shown in Appendix A. The pattern is that coastal states have a higher expected annual loss.[5]

No One's Fault

Insurance is fundamentally a negotiation of dilemmas revolving around loss, responsibility, justification, and compensation.[6] Before proceeding to the pricing models and alternative funding schedules, it is worth noting that rising insurance premiums adversely impact homeowners and insurers; this is no one's fault. Think of the home insurance market through the lens of supply and demand: policies are purchased only when consumers' willingness to pay meets or exceeds suppliers' willingness to produce. The variable influencing market equilibrium is the expected loss resulting from the accelerated pace of climate change. As prices rise, sellers are more willing to offer policies at a cost, but the actuarial volumes of transactions will decrease. This affects homeowners looking for a policy and insurance companies striving to optimize profits based on previously elevated prices. Ultimately, the basics are still that insurers want to provide insurance products for consumer purchase, while homeowners seek to hedge their risk exposures.

How Do Insurers Operate?

Home insurance policies are created based on three ideas: 1) homeowners want to pay little by little over time to avoid paying a hefty sum for a catastrophe; 2) these devastating events are probable; and 3) some homeowners have high chances to fall victim to these devastating events, some have low risks. Therefore, insurance companies come in and offer policies that allow homeowners to pay little over time to avoid devastating amounts. Of course, the little payment over time must be smaller than the potential lump sum. Otherwise, risks remain uncovered. At this point, homeowners would rather take the risk where there are still chances for no loss, whereas the policy guarantees a payment.

When insurers feel their risks are high, they demand higher regular payments from their clients to hedge the larger risks. If a fire rebuild costs the homeowner $100, and the insurance policy asks for $10 per month over half a year, then the premium-claim spread is $40, where the homeowner pays the insurer $60 in total but avoids a $100 rebuild cost. When a fire happens, the insurer gives $100 to the homeowner, so they save $40; when the fire doesn't happen, the insurer profits $60 from the homeowner, and everyone is happy because there are no accidents. The spread is a simplified idea representing how much the insurer gains, dictated by the probability of fire. For home insurance in the context of climate change, when the insurer perceives the house is at a dangerous location, they would want clients to pay more so that the insurance can lose less in extreme weather.

The entire insurance market is purely a demand-and-supply transaction. As long as someone is willing to purchase at a particular price, the price is not considered to be "overpriced" in theory because the transaction happens if and only if the buyer is willing to pay for the compensation service—as long as the price is being paid, it's always fair.

What is the US home insurance providers' current pricing model?

Insurance companies are risk-based and use statistics models to calculate the expected values of a given client based on traits disclosed and observed.Non-life insurance pricing has three risk factors: 1) properties of the policyholder, 2) properties of the insured objects, and 3) properties of the geographic region. Insurance companies use Generalized Linear Models (GLMs) extensively to deal with probabilities with categorical assumptions to describe data distributions for the group to be insured. At the end of the day:

$$Premium = Claim\ Frequency \times Claim\ Severity$$ [7]

Since home premiums vary greatly each year, home insurance uses dynamic pricing. For dynamic pricing regulation and welfare, Aizawa and Ko believe that stricter pricing regulation has a limited impact on improving consumer welfare, reducing insurer profits, and increasing market concentration.[8]

As to how higher insurance prices "permeate" to low-risk regions, it is a process whereby insurers are attempting to redistribute risks from high-risk states to the incomes of low-risk states internally. This practice exacerbates the systemic influences on the variable of climate change and may seem inequitable to the majority of homeowners. Consequently, policy interventions are imperative to mitigate systemic risks and enhance fairness.

Alternative Financing

Grants and subsidies are the two biggest strategies for the home insurance market. There are many tools the government can explore to mitigate price increases. Since price capping (price ceiling) decreases accessibility, as demonstrated in the Introduction, would universal coverage lower the prices as it succeeded in the health insurance industry?

The answer is no. Universal coverage does not extend to home insurance. The distinction lies in whether the traits are observable. In the case of health insurance, high- and low-risk types are unobservable, so this is a situation characterized by "invisible traits".[9] When insurers are unable to identify high-risk individuals, universal coverage integrates everyone, thereby simplifying the insurers' probability-based calculations. Conversely, home locations are the first accurate information for insurers under climate change. By correlating this readily available property location with natural disaster risk maps that illustrate extreme climate histories, insurers can observe the high-risk groups that are likely victims of climate change. While universal coverage can be adequate when policies also prohibit price discrimination by insurers, it remains a significantly less efficient form of regulation.

First Alternative: Subsidies

Premium subsidies are a method where the government pays a part of the insurance premium to reduce the cost to policyholders.[10] This method is commonly used in agriculture industries where high- and low-risk types, like home locations, are also observable across farms and types of crops. Subsidies significantly increase social welfare by increasing consumer and producer surplus through increasing equilibrium transaction quantities, lowering consumer prices, and maintaining producers' revenues at larger quantities.

Policyholders pay a lower monthly premium for home insurance, but insurers maintain their high prices. Actuarially, more homes are insured in risky states. While this is a great short-term solution, the burdens are solely placed on government subsidies. Thus, the government becomes a social risk redistributor, not the insurance companies. The most apparent downside of a premium subsidy is that the government pays insurers to keep offering their policies at their own pricing pace. This means insurance companies have no stimulus and incentives to adapt and evolve new pricing models.

Second Alternative: Grants

According to FEMA, grants are usually lump sums with a specific purpose, such as supporting "critical recovery initiatives" pre- or post-emergency disasters.[11] Grants are government-funded projects that assist states after extreme weather events. For example, FEMA has six types of grants, ranging from extreme weather preparedness to hazard mitigation. In July and August 2024, Governor Kathy Hochul extended the application deadline for emergency repair grants for the state of New York. According to her public comments, "extreme weather events have become all too common in our state."[12] With the absence of universal coverage requirements in home insurance, many homeowners choose, or are unable to, cover their home with a policy. This means many have already been relying on grants in case of extreme weather for repair.

In a sense, grants function as a substitute for insurance policies. An interesting behavior of substitute goods is as the quantity of substitute goods increases, the price of another good decreases. Consider grants as a substitute for homeowner's insurance. An increase in the availability of grants for homeowners affected by extreme weather would lead to a diminished demand for climate change-related home insurance policies, resulting in lower policy premiums. However, grants are funds that spread "lousiness": 1) grants don't incentivize insurance companies to return to risky states they've withdrawn; 2) climate emergency grants are typically restrictive in their designated usage. An increase in grants suppresses insurance prices in the weather damage policies but may still cause a further price increase in other insured areas, such as theft; 3) homeowner grants do not promote additional resiliency measures from homeowners. This way, homeowner grants may become an ineffective and myopic solution for hiking home insurance prices and changing climates.

Recommendations

If grants to homeowners cannot provide incentives for resilience-building, then grants directed toward insurers may prove effective. Grant-based insurance companies can become impact insurers by strategically using state or federal funds to improve coverage in high-risk areas, as the grant specifies. According to Nathan Maggiotto, grant-based insurance companies are motivated to employ specifically purposed grants to foster climate change resilience within their coverage offerings.[13] This approach fulfills the grant's intent and positively responds to climate change challenges. This grant-based insurance plan aims to motivate insurers to create innovative models to cope with climate change.

Subsidies should combine grants to insurers and reward positive behaviors that build extreme weather resilience. Instead of subsidizing the price takers, governments compensate for home reinforcements, such as solar panels, for self-sustenance electricity. In addition, the government should provide monetary support for hazardous areas to incentivize emigration to safer places. When subsidies to homeowners match the direction of grants to insurers, the result is more resilient houses with affordable and available insurance policies.

If unreasonable home insurance premiums are the symptom, finding alternative financing to lower the price is only temporary. In the face of extreme weather caused by accelerated climate change, houses and insurance models both need a quick update to meet the latest challenges. The root of this symptom is a lack of home resilience and insurers' incentive to evolve. With policies geared toward building long-term resilience, the subsidy-grant hybrid model can become the key to the solution.

Appendix: FEMA Map of Expected Annual Losses by States

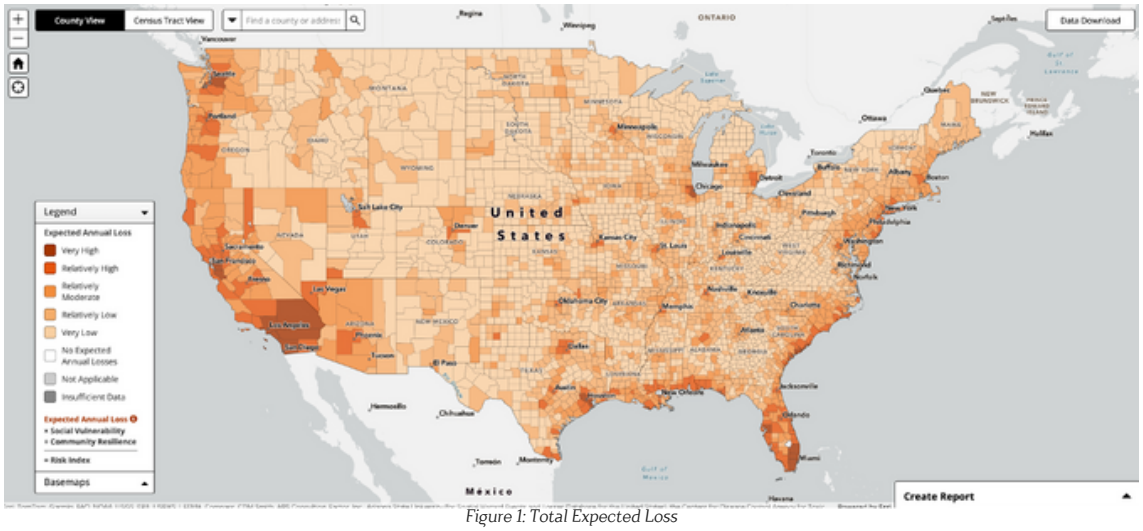

Figure 1: Total Expected Loss

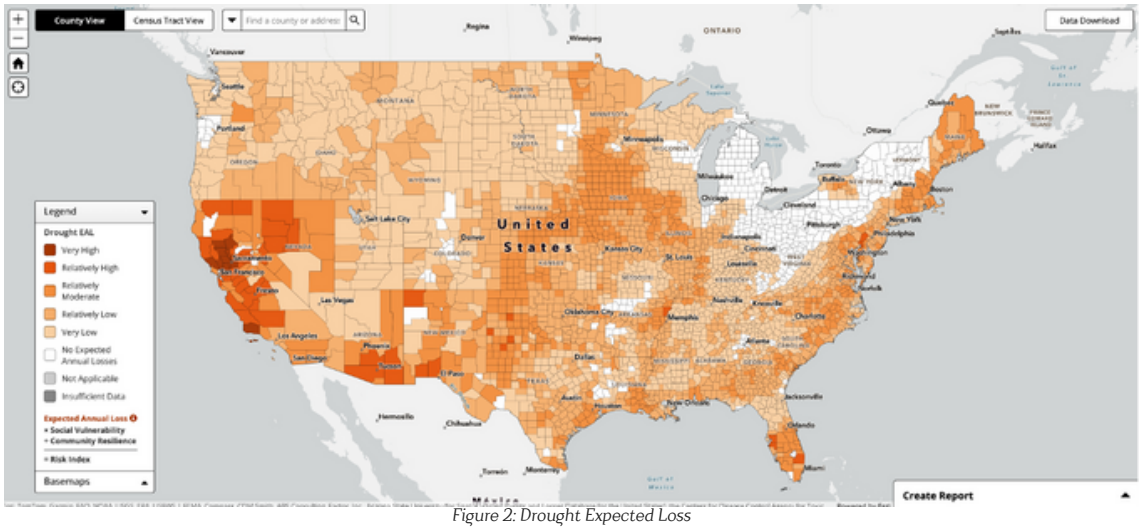

Figure 2: Drought Expected Loss

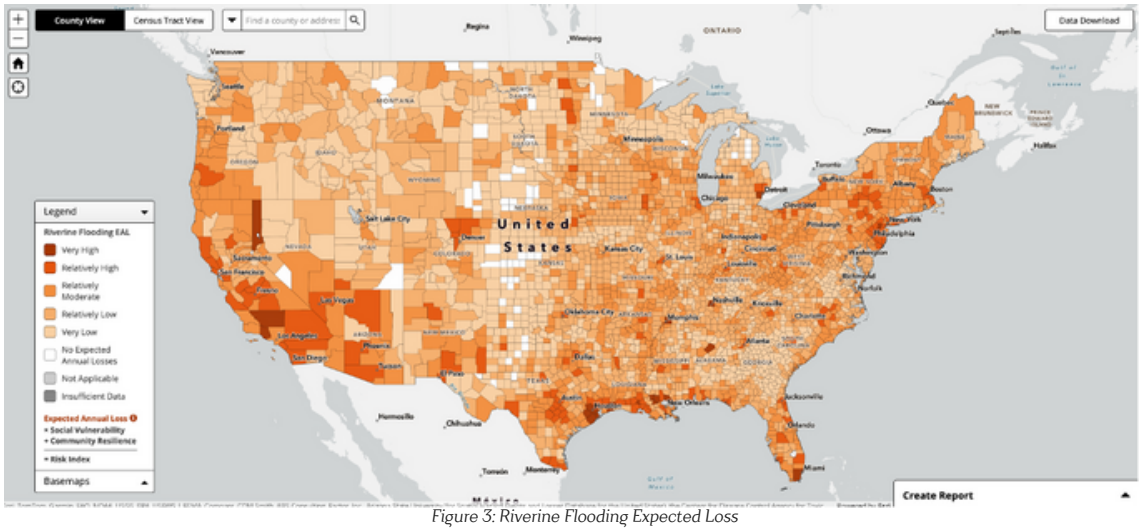

Figure 3: Riverine Flooding Expected Loss

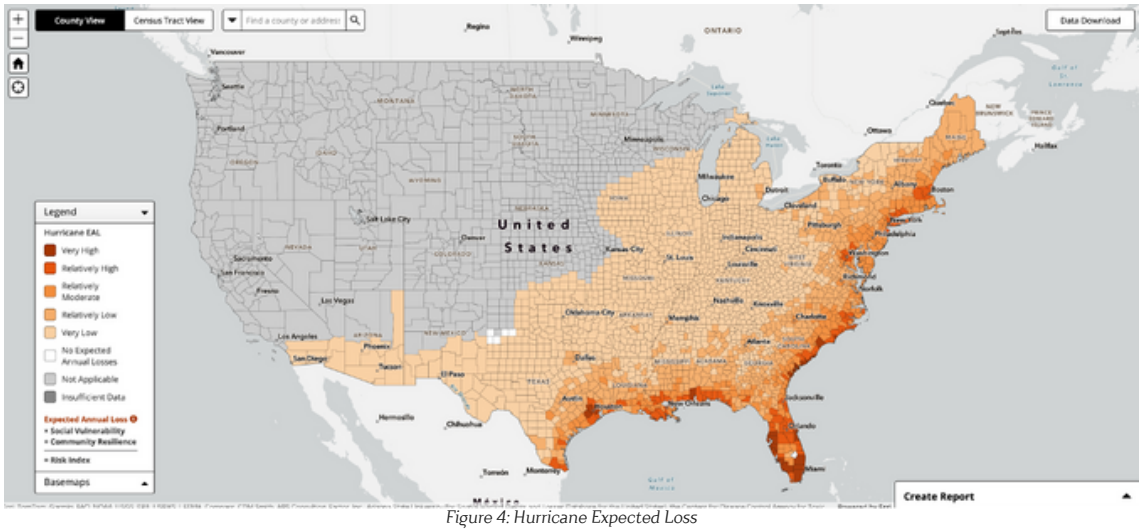

Figure 4: Hurricane Expected Loss

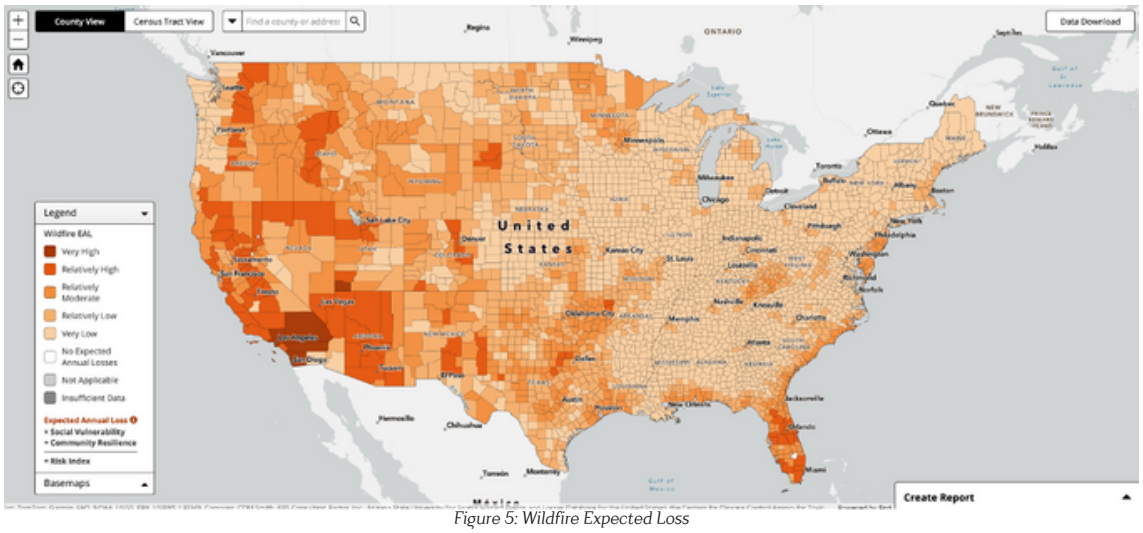

Figure 5: Wildfire Expected Loss

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The Sustainable Finance Frontline: US Economic Security in a Low-Carbon Future

Yiming Zhong is an environmental policy and climate finance practitioner with five years of experience spanning both emerging markets and developed economies. He currently serves as a Policy Fellow at truCurrent, where he focuses on analyzing federal and state policies related to electric vehicle supply equipment (EVSE), fleet electrification, microgrids, and solar panel deployment. Yiming holds an MPA from Cornell University, specializing in Economic and Financial Policy. Previously, he worked at the Center for Strategic and International Studies (CSIS) and the Wilson Center.

In the face of an existential threat, the world seems to finally be turning towards a sustainable future. The growing demand for environmental, social, and governance (ESG) investing and climate finance has made it clear that the financial sector must adapt to this new reality. The United States, in particular, is lagging behind, with its carbon market still in its infancy compared to China's burgeoning carbon trading market.[1] As the global economy pivots towards sustainability, it is imperative that countries, and particularly the United States, develop a comprehensive strategy to address the intersection of ESG investing, climate finance, and economic security. The consequences of inaction will be catastrophic, whereas a proactive approach will yield a more resilient and sustainable future for all.

The race for sustainable finance is not only about addressing climate change but also about securing economic and climate security. China and the EU are leading the way with robust sustainability regulatory frameworks, such as the EU's Taxonomy Regulation and China's upcoming sustainability disclosure standards aligned with ISSB by 2030.[2] Foreign entities might face challenges and resource constrains by complying with the local disclosure standards. Many US small and medium enterprises (SMEs) have already faced challenges in ESG compliance. The challenges manifest in resource constrains, data privacy concerns, and confusion on standards and methodologies.

If the United States battens down the hatches against the carbon market, Beijing will become the new Wall Street for the carbon trade. China, as the top polluter with 11.4 billion metric tons of GHG emissions, allocated its 225-255 million metric tons of carbon emissions annually through a voluntary carbon credit trade program;[3] its potential impact may bear on global climate cooperation and the global carbon market. In 2024, China's launch of the CCER program further cemented its leadership in carbon trading.[4]

Growing Market with Active Changes

According to a 2022 Global Sustainable Investment Alliance (GSIA) report,[5] global sustainable investing assets have grown dramatically over the past decade. Despite the regulatory changes in 2020, EU sustainable assets in 2023 recovered to 2018 levels. The US market for sustainable investments has dropped materially from US$17.1 trillion to US$8.4 trillion due to methodology changes.[6] Over the past eight years, sustainable assets have averaged 22.4 percent of total assets under management (AUM).[7] In 2022, global sustainable assets increased by 38.3 percent—an US$8 billion growth excluding the US region.[8]

	2012	2014	2016	2018	2020	2022
Europe	8758	10775	12,040	14,075	12,017	14,054
Canada	589	729	1,086	1,699	2,423	2,358
Australia & NZ	134	148	516	734	906	1,220
Japan	0	7	474	2,180	2,874	4,289
United States	3740	6572	8,723	11,995	17,081	8,400
Total	13221	18231	22839	30683	35301	30321
Growth Rate		38%	25%	34%	15%	-14%

Figure 1. Global Sustainable Investment Alliance. 2023. "Global Sustainable Investment Review 2022." https://www.gsi-alliance.org/wp-content/uploads/2023/12/GSIA-Report-2022.pdf

Millennials are taking a firm grip on investment directions. Representing 75 million people in the United States, millennials are anticipated to inherit an estimated US$30 trillion in wealth from baby boomers.[9] MSCI research reveals that 88 percent of high-net-worth millennial investors prioritize reviewing ESG reports and related information before making investment decisions.[10] Bank of America predicted that over the next 2-3 decades, millennials could invest between US$15-20 trillion in US-domiciled ESG investments, potentially doubling the size of the entire US equity market.[11]

Given the polarized nature of climate change in US politics, the risk of insufficiently responding to these challenges could prove significant. ESG investing and climate finance are crucial components of a green and sustainable economy. The market seeks clarity on who has the authority to define climate finance, what qualifies as sustainable assets, and how the underlying processes and methodologies function. The foundations of emerging green financial instruments as well as corporations considering meeting carbon emissions goals include carbon emission calculations, price setting, ESG disclosure and regulations, and monitoring systems, among others. The emerging regulatory bodies and groups are attempting to steer the course of the green economy by way of their definitions and regulations that will shape it.

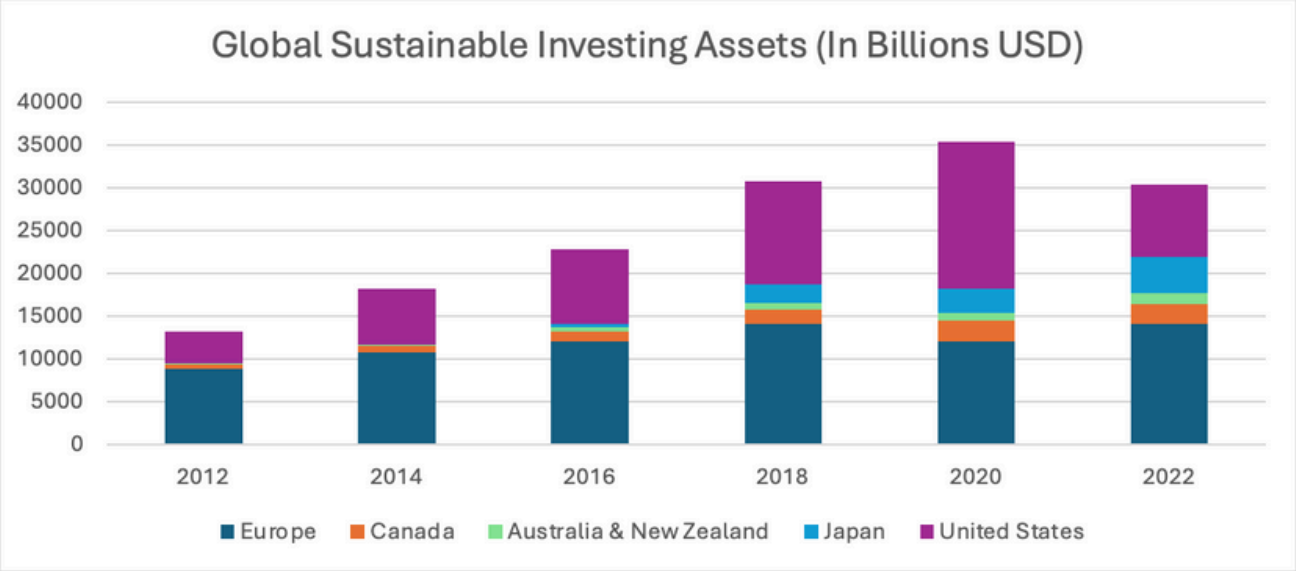

Figure 2. Global Sustainable Investment Alliance. 2023. "Global Sustainable Investment Review 2022." https://www.gsi-alliance.org/wp-content/uploads/2023/12/GSIA-Report-2022.pdf

Global Pivot to Sustainability

Financial institutions in the United States are considering the trend of investment. According to Morgan Stanley, sustainable funds returned to their long-term trend of outperformance in 2023, generating a median return of 12.6 percent, nearly 50 percent ahead of traditional funds.[12] While the US hesitated, China and EU are taking more affirmative actions. On May 27, 2024, China's Ministry of Finance opened a public consultation on the Exposure Draft of the Chinese Sustainability Disclosure Standards for Businesses.[13] This document indicated China intends to create a mandatory system aligned with the International Sustainability Standard Board (ISSB) by 2030, setting fundamental sustainability and climate-related disclosure standards by 2027.[14]

In 2020, the EU Parliament approved the EU Taxonomy Regulation, which aims to define environmentally sustainable economic activities and to reduce the greenwashing of financial products. In 2021, the EU published Sustainable Finance Disclosure Regulation (SFDR) to help institutional asset owners and retail clients compare, select, and monitor the sustainability characteristics of investment funds. The Corporate Sustainability Reporting Directive (CSRD) took effect in 2023, requiring eligible companies to issue annual sustainability reports.[15]

The race for sustainable finance is not merely about addressing climate change and meeting the net zero goal; it is a battle for dominance over the emerging industry of sustainable finance. Those who establish and enforce disclosure standards and methodologies will steer the global economy toward sustainability.

Sustainable Finance = Economic and Climate Security

Foreign entities investing or establishing an office in the EU must comply with the CSRD under certain criteria.[16] China may develop similar requirements for foreign investors. Proprietary data needs to be audited, carbon emissions determined by local methodology; and green and sustainable classifications dominated by the regulatory bodies.

Data disclosure

The degree of data an entity discloses is informed by financial materiality. Short-term or long-term finance-related data must be disclosed. Regulatory bodies and auditing firms will play a significant role in the data selection and examination process. Foreign entities must decide how much information to disclose under EU ESG requirements. Currently, at least 10,000 foreign companies are affected by EU sustainable rules, with American entities making up a third of them.[17]

Resource Constrains

Small and medium-sized enterprises (SMEs) face challenges in disclosing comprehensive ESG reports because of limited financial resources and professional personnel compared to listed enterprises. The complexity of ESG data collection, analysis, and reporting can be a significant burden. ESG disclosure requirements might limit opportunities in foreign trade, sustainable finance, investment, and subsidies. SMEs may face disadvantages compared to EU and Chinese counterparts with better access to relevant resources.

Rules Setting

China and Europe lead in setting standards for sustainable finance and carbon trading, similar to China's dominance in the critical minerals sector.[18] If US private entities remain reluctant, China will continue to lead, evidenced by its control over the critical minerals supply chain. Competition over metrics and methodologies in sustainable finance and emissions scenarios will determine who controls this emerging industry.[19] [20]

Rule-setting is crucial for dictating the global economic landscape and ensuring long-term security in climate and economic realms.

Beijing Green Exchange – The New Wall Street for Carbon?

China is the largest market for energy transition investment, reaching US$676 billion in 2023.[19] It is 38 percent of the global energy transition investment and more than double the United States' investment.[20] As an active participant in carbon mitigation, China explores opportunities to transform its status as the largest emitter into significant advantages.

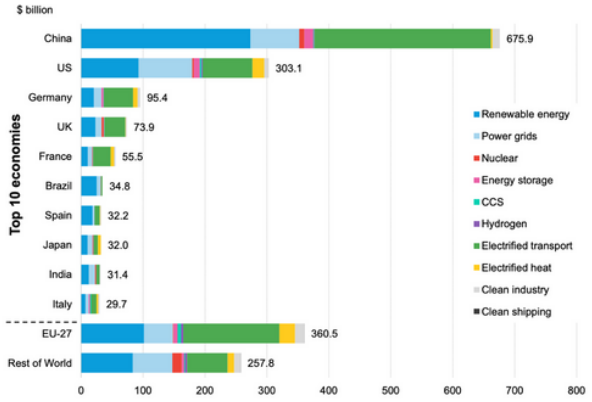

Figure 3. BloombergNEF. 2024. "Energy Transition Investment Trends 2024." January. https://assets.bbhub.io/professional/sites/24/Energy-Transition-Investment-Trends-2024.pdf

On January 22, 2024, China launched the China Certified Emission Reduction (CCER) program, incentivizing industries to trade carbon reduction credits voluntarily.[21] The program focuses on forestation, mangrove cultivation, solar thermal power, and grid-connected offshore wind power projects, as the Ministry of Ecology and Environment (MEE) released methodologies for these industries in 2023.[22]

If only counting the Chinese emission trade system (ETS) launched in 2021 with limited designated emission quotas for the power plant industry,[23] it stands as the largest carbon trading market by GHG emissions volume in the world.[24] The CCER, in the long run, might become a monopolized market, giving powerful firms the ability to set the price of global carbon emissions.

It can, on one hand, increase the emission costs for high-emission enterprises, and on the other, provide additional revenue for new energy and low-carbon assets, forming a positive cash flow that brings new vitality to China's carbon market.

Most academic and market participants are bullish on the potential of the carbon market. McKinsey estimates annual global demand for carbon credits could reach up to 1.5 to 2.0 gigatons of carbon dioxide (GtCO2) by 2030 and 7 to 13 GtCO2 by 2050.[25] Accenture reports that carbon markets could become a US$2 trillion physical market by 2050 and more than a US$10 trillion traded market when considering derivatives, with an expected carbon price of US$120 per ton.[26]

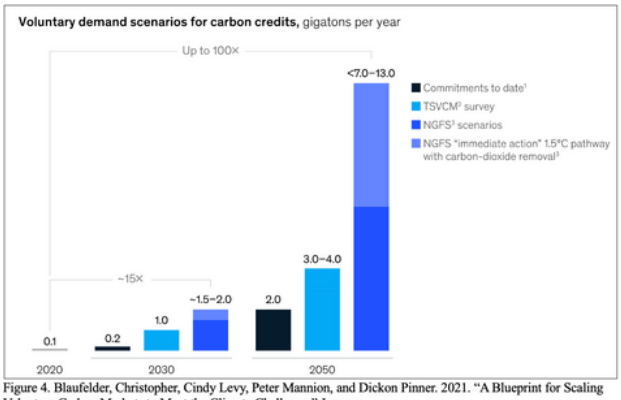

Figure 4. Blaufelder, Christopher, Cindy Levy, Peter Mannion, and Dickon Pinner. 2021. "A Blueprint for Scaling Voluntary Carbon Markets to Meet the Climate Challenge." January. https://www.mckinsey.com/capabilities/sustainability/our-insights/a-blueprint-for-scaling-voluntary-carbon-markets-to-meet-the-climate-challenge [27]

Until 2021, there were 65 carbon pricing initiatives implemented or scheduled. 35 of them are carbon taxation-based and 30 of them are ETS mechanism-based. They cover approximately 22 percent of global GHG emissions and are responsible for raising US$53 billion in revenue.[28]

Currently with the carbon market only including the power sector, the theoretical maximum annual demand for CCER is around 225-255 million metric tons,[29] valued at 12.889 billion yuan (US$1.8 billion).[30] Although the global carbon market value hit US$949 billion in a record high in 2022,[31] Chinese carbon emissions alone were 11.4 billion metric tons—

more than the those of Europe (5.62 billion) and the United States (5.06 billion) combined.[32]
Massive demand in the carbon trade will lead carbon pricing and the carbon trade market towards Beijing's vision, aligning with theFourteenth Five-year Plan to lead global climate cooperation and strengthen South-South Cooperation. China, with its high carbon emissions, transforms this into an advantage, potentially manipulating the global carbon market.

To be Green or Not to be Green, that is the Question

It is not a question of whether the United States should prioritize sustainable finance, but rather whether it chooses to prioritize the well-being of the planet alongside its own economic interests. The consequences of inaction will be dire, as the very foundations of the global economy and way of life are built upon the unsustainable practices of the past. The question is no longer whether we can afford to be green, but whether we can afford not to. After all, what are the alternatives?

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16. Detailed Criteria
    a. Over 250 employees
    b. More than 40€ million in annual revenue
    c. More than 20€ million in total assets
    d. Publicly-listed equities and have more than 10 employees or 20€ million revenues
    e. International and non-EU companies with more than 150€ million annual revenues within the EU and which have at least one subsidiary or branch in the EU exceeding certain thresholds Any EU company that meets those criteria is required to file an annual report using the CSRD's forthcoming sustainability taxonomy on how sustainability influences their business, as well as the company's impact on people and the environment.
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