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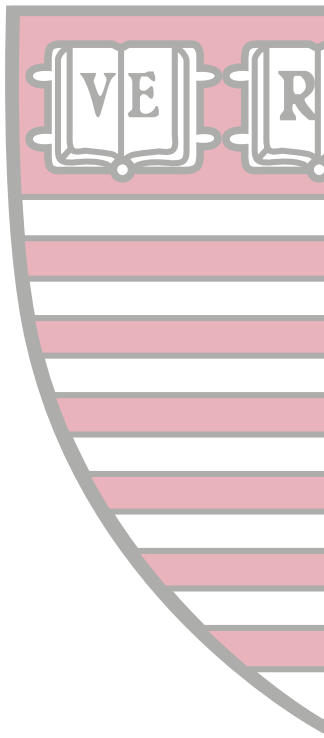

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About the Author

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About the Rajawali Foundation Institute for Asia

The Rajawali Foundation Institute for Asia is housed at the Ash Center for Democratic Governance and Innovation, one of twelve research centers at Harvard Kennedy School. In 2008, under the leadership of Anthony Saich, the Asia Programs at HKS (now the Rajawali Foundation Institute for Asia) joined the Ash Institute for Democratic Governance and Innovation. Two years later, the permanently endowed Rajawali Foundation Institute for Asia was established as part of the Ash Center to bring together academics and practitioners from around the world to enhance research, teaching, and training on public policy and governance issues of critical importance in Asia.

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The Bangladesh Public Administration Project is a multiyear initiative housed at Harvard Kennedy School's Rajawali Foundation Institute for Asia. The purpose of the project is to strengthen the institutional capacity of the Bangladesh civil service and the individual capacity of its civil servants. The project mainly focuses on three interrelated activities: curriculum review at the nation's civil service training institutes, training on interactive pedagogy and core competencies essential for the civil service, and policy research on Bangladesh's most pressing issues.

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Executive Summary

As Bangladesh considers options for decarbonizing its economy, this policy paper explores complementary approaches to meet clean energy goals while upskilling the labor force and developing the economy. Currently, the private sector is underused as a delivery mechanism for climate finance, with merely 1% of these funds being channeled through it at the national level. As Bangladesh approaches its graduation from the least developed country status in 2026, it is essential to diversify financing strategies and engage the private sector more robustly to manage the rising costs of finance and debt servicing. Financial assistance from key international partnerships, such as the Just Energy Transition Partnership, can play a significant role in supporting the country to pursue its goals. By developing strategic policies and programs in this key area, Bangladesh can facilitate such partnerships.

Bangladesh's goal, as outlined in its updated Nationally Determined Contributions in 2021, is to reduce greenhouse gas (GhG) emissions by either 5% (without international support) or 15% (with international support) by 2030, below "business-as-usual" emissions based on 2011 levels. Since then, the Mujib Climate Prosperity Plan (MCPP) set a renewable energy generation goal—of 30% by 2030 and up to 40% by 204—to build national domestic energy security and independence, which was later revised in mid-2023 to be 15% renewable energy by 2030 and 40% by 2040, preparing the country to reach 100% by 2050. In addition, the MCPP outlines the creation of an energy-efficient vehicle (EEV) manufacturing hub, with electric vehicle (EV) manufacturing contributing up to 10% of gross domestic product (GDP) by 2030. The Energy Efficiency and Conservation Master Plan also aims to achieve a 20% reduction in primary energy consumption per GDP compared to 2015. These targets show that Bangladesh recognizes the importance of decarbonization, energy security, and opportunities for economic development.

To reach these climate goals, the country's financial, resource, and geographic limitations are important considerations. Significant financing gaps remain for the required investment in the clean energy transition, and attracting international funding and participation from the private sector is crucial. In addition, Bangladesh faces a high cost of imported fossil fuels, lack of a domestic supply chain for energy technologies, and dependency on foreign direct investment and aid. A high population density, finite land, and natural disasters can also affect the progress of the rollout of renewable energy technologies. Conversely, the progress Bangladesh has made in enhancing its education system and bolstering private sector investments will help accelerate its transition to renewable energy and anticipated graduation to a middle-income country.

The United States has set large goals concerning decarbonization and clean energy expansion, such as a net-zero economy by 2050, 60 gigawatts (GW) of solar capacity annually until 2030, 30 GW of offshore wind by 2030, and all new vehicles purchased

to be zero-emission by 2035. Decarbonization, or reducing carbon dioxide emissions, is increasingly seen as an opportunity to create jobs, upskill the workforce, and strengthen local economies. The US has benefited from unprecedented economic and job growth coinciding with its efforts to decarbonize, especially since the passage of the Inflation Reduction Act in 2022. Passed during the Biden-Harris administration, the act invests $369 billion in energy security and climate change programs over 10 years.

However, the both countries have vastly different economies and energy policy systems and cannot be directly compared solely at a national level of analysis. Despite recent and significant federal investments, energy policy is largely driven at the state level in the US. As a result, four US states have been selected for a comparative analysis on framing clean energy expansion policies and programs. From innovation and manufacturing to the deployment of clean energy technologies, these states embody four pathway models in clean energy expansion:

- Deployment model: Texas is #1 nationally in wind energy generation capacity and #2 in solar energy generation capacity.[1]
- Manufacturing and supply chain model: Georgia is #1 in EV manufacturing investments and announced jobs.[2]
- Innovation model: Massachusetts is a leader in clean energy and climate technology innovation (climatetech).[3]
- Comprehensive model: New York has successfully pursued all three of the above pathways simultaneously.[4]

To inform the priorities of Bangladesh, this policy paper reviews literature on clean energy commitments or targets put forth by these states, as well as literature related to the context or history in which each of the four states, or four models, is developing its policies or programs. Following this context, the paper studies each model's approach to identify how and why the policies or programs were implemented and what opportunities and challenges the states faced during implementation. Finally, it explores Bangladesh's energy sector, including its operational, financial, geographic, and infrastructure challenges; current financing plans; and education and private sector involvement in economic development to help inform possible next steps for Bangladesh in its energy transition.

Key Findings

- **Without a significant historical infrastructure or abundant resources, developing any of these areas—innovation, manufacturing, and deployment—is expensive and requires leveraging existing strengths to have the greatest impact.** In Texas, due to the state's abundant resources and an open, business-friendly market, the deployment of clean energy technologies is driven by the private sector without government policy or investment. Massachusetts leverages its established innovation ecosystem, while Georgia's extensive

automobile manufacturing industry, alongside its business-friendly environment, aids the state's movement toward clean technologies. New York has fewer existing advantages and therefore is deploying a more comprehensive strategy to build a robust market with key incentives to maximize local products, services, and labor—a more expensive and challenging approach but one that is already paying off economically.

Deployment Model:

- **The deployment model is a critical component of clean energy expansion as it translates into the creation of a domestic market. For it to succeed, fostering competition and having a trained workforce is crucial.** Texas and New York, while both successful, have taken very different approaches to attracting clean energy developers and investors. Yet, significantly more effort is required by New York than Texas in the pursuit of clean technology deployment.
- **Texas uses a hands-off approach** with minimal goals but uses a free and deregulated market to drive competition. **The state has found considerable success in deploying solar, wind, and battery storage technologies through the lack of regulations, availability of resources, and a uniquely independent electric grid.** Texas's success follows its own long history of prioritizing local autonomy and maintaining a business-friendly landscape, which has attracted many companies that have driven the state's clean energy expansion. **Its last legislated clean energy goal was outlined in 2005**—a 10 GW target for renewable energy generation by 2025—**and achieved in 2011.**
- Meanwhile, **New York has a hands-on approach** with many clean energy expansion activities and large state goals, such as 70% clean energy by 2030 and 100% by 2040. **The state invests a lot of money to drive competition and creates a large market potential that companies want to access**. Through programs like NY-Sun, it invests in contractors and developers to reduce costs and make solar technologies **more accessible for low- and moderate-income households**.

Manufacturing and Supply Chain Model:

- **The manufacturing and supply chain model demonstrates that building a domestic supply chain and manufacturing base can be achieved by simultaneously moving away from globalization and stimulating a local market.** As many parts of the world seek to limit their import economy and expand their export economy, a homegrown market must exist so that a growing export economy can thrive. The model proves effective when it leverages existing or historical manufacturing strengths to build from and revamp, along with incentive programs to attract manufacturing companies. Though slowly becoming more

automated, the ready-made garment (RMG) industry, a staple of Bangladesh's economy, has an abundance of low-skilled and uneducated workers. Workers transitioning from RMG to clean energy technology manufacturing may benefit from the upskilling involved in recent RMG automation efforts, such as the use of fabric-cutting machines.

- **Both Bangladesh and Georgia aim to become a hub for EV manufacturing to pursue economic growth**. Bangladesh plans on offering financial incentives with tax breaks to attract EEV manufacturing companies. Domestic companies involved in the country's automobile industry, including Bangladesh Auto Industries Limited (BAIL) and Palki Motors Limited, have already begun pursuing EV manufacturing, with 80% of investments for BAIL's EV plant sourced locally. Despite the lack of significant clean energy expansion goals, Georgia has positioned itself to serve the US market and live up to Governor Brian Kemp's goal to become the "electric mobility capital of the country."[5] **The state is building off existing automobile manufacturing infrastructure and creating workforce and business development programs that incentivize EV manufacturers.**
- **New York, alternatively, is using the energy transition as a way to rebuild its manufacturing industry.** The state attracts developers through investment opportunities and local markets while incorporating **local supplier and labor requirements** in its project development solicitations to foster regional economic growth and to build state capital.

Innovation Model:

- **The innovation model found success through creating a domestic, or home-grown, market and strategically investing in and procuring innovative clean energy and climate-related technologies. This approach secures a competitive advantage in the nationwide movement toward clean technology expansion.** This model supports its knowledge economy through partnerships with and investments in state-based, prestigious universities to give students hands-on work experience and opportunities for developing their ideas. In addition, with targeted investments in start-ups, it has successfully helped companies avoid the entrepreneur's typical "death valley curve" and pursue commercialization.
- **Massachusetts has maintained a strong innovation ecosystem** that has branched out from biotechnology and information technology to climate technology. **The proximity of multiple stakeholders**—such as academic institutions like Harvard University and the Massachusetts Institute of Technology, research facilities such as Greentown Labs, private companies, and government entities—**has generated great synergies under the strong leadership of the Massachusetts Clean Energy Center (MassCEC)**. In conjunction with these activities, the state's Clean Energy Standard outlines a goal to procure 60% of renewable

energy sources for electricity outputs by 2030, creating a homegrown market for developing technologies.

- **With direct government support, substantial funding, and large outreach, strong agencies, such as MassCEC and the New York State Energy Research and Development Authority, can drive states' clean energy activities and programs**.

Conclusion

This policy paper aims to serve as a framework for the Bangladeshi government to consider policy and program development for reaching the nation's clean energy goals. It is not intended to recommend solutions but to provide a structure for discussions with the government. The paper provides a detailed analysis of a suite of policies and programs implemented by each model or state, followed by a summary of the Bangladeshi energy market. Immediately below is a summary table of select targets covering Bangladesh and the US states highlighted in this analysis. The paper also offers guidance on models that can spur innovation, support local manufacturing, and accelerate the deployment of clean energy technologies. Additionally, it explores different policy approaches in detail, with customized preliminary recommendations for Bangladesh to consider.

Based on our current understanding of the Bangladeshi government's priorities, we suggest adopting elements of the comprehensive New York strategy for broad-scale economic growth, incorporating elements that foster innovation, enhance supply chain manufacturing opportunities, and deploy broad-scale clean energy projects using local, high-skilled labor. Such an approach will require national investment, global financial and technical support, and significant private sector investment.

Table 1. Select Targets or Goals for Priority Regions

Region	Document/Policy Name (if applicable)	Target or Goal
Bangladesh	Nationally Determined Contributions	Reduce greenhouse gas emissions (GhG) by either 5% without or 15% with international support by 2030, below "business-as-usual" emissions based on 2011 levels.
	Mujib Climate Prosperity Plan	Reach 30% of renewable energy generation by 2030 and up to 40% by 2041.
	Mujib Climate Prosperity Plan	Create an energy-efficient vehicle manufacturing hub, with energy vehicle (EV) manufacturing to contribute up to 10% of the nation's GDP by 2030.
	Energy Efficiency and Conservation Master Plan	Reduce primary energy consumption per GDP by 20%, below 2015 levels.
United States	Federal Sustainability Plan	Achieve 100% zero-emission vehicle acquisitions by 2035.
	Federal Sustainability Plan	Achieve a zero-emission building sector by 2045.
		Reach a net-zero economy by 2050.
		Reach 60 GW of solar capacity annually until 2030 and 30 GW of offshore wind by 2030.
Texas	2005 Senate Bill 20 (79(1))	Reach 10 GW of renewable energy generation by 2025—achieved in 2011
Georgia		Governor's announced goal for the state to become the "electric mobility capital of the country."
Massachusetts	An Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy & Global Warming Solutions Act	Reduce GhG emissions by 50% by 2030 and 75% by 2040, below 1990 levels, to reach net-zero emissions by 2050. This was an update to the previous goal of reducing GhG emissions by 25% by 2020 and 80% by 2050, below 1990 levels.
	Clean Energy Standard	Reach 60% clean energy generation by 2030 and 80% by 2050.
		Put 1 million EVs on the road by 2030.
New York	Climate Leadership and Community Protection Act	Reach 70% renewable energy generation by 2030 and 100% carbon-free electricity by 2040. Reduce GhG emissions by 40% by 2030 and 85% by 2050, below 1990 levels. Reach 9 GW of offshore wind-generated electricity by 2035.
	Governor Hochul's 2022 State of the State Address	Reach 10 GW of distributed solar energy by 2030 and create 6,000 new solar jobs. Reach 1.5 GW of energy storage capacity by 2025 and at least 6 GW by 2030. Achieve 100% zero-emission passenger vehicle acquisitions by 2035.

Table 2. Selected Policies or Programs for the Four Model Approaches

Approach	Policy/Program	Description
Deployment	NY-Sun Initiative	Works to lower barriers for solar energy deployment in New York by offering financial assistance and education programs to encourage home and business owners to adopt solar energy
Deployment: Workforce	New York State Energy Research and Development Authority's (NYSERDA) On-the-Job Training for Energy Efficiency and Clean Technology Program	Offers wage subsidies for employers based in New York to offer work-based learning, or internship, opportunities to support the clean energy industry through workforce development and training
Manufacturing and supply chain	Georgia Quick Start	Incentivizes electric vehicle (EV) manufacturers to develop projects in Georgia by offering workforce development solutions, including consulting, training for upskilling, and hiring support
Manufacturing and supply chain	NY supply chain investment plans	A component of project proposal for nacelle and blade manufacturing facilities to support the offshore wind energy industry in New York. In these plans, project proposers must include their intentions for creating jobs, engage local stakeholders, use local supply chain partners, and assess local economic benefits, especially to disadvantaged communities. Selected projects are eligible to receive funding from NYSERDA
Innovation	Massachusetts Clean Energy Sector's (MassCEC) Investment Program	In Massachusetts, a division of MassCEC that offers investment opportunities to local start-ups in early and mid-stage development to help them reach commercialization
Innovation	Greentown Labs	In Massachusetts, a climatetech incubator and nonprofit organization founded by Massachusetts Institute of Technology graduates that supports climatetech start-ups in the state and facilitates opportunities for them to connect with well-established companies for potential fundraising

Introduction

This policy paper provides a comparative analysis of clean energy expansion approaches across four US states to inform Bangladesh's clean energy policy development as the nation works to achieve its ambitious renewable energy and economic development goals. With Bangladesh's goal to graduate from least developed country (LDC) status in 2026, the country faces an urgent need to diversify its financing strategies and more robustly engage the private sector in its clean energy transition. Currently, only 1% of climate finance is channeled through Bangladesh's private sector at the national level, highlighting a critical area for development.

Drawing from US state models, the analysis in this paper examines how clean energy expansion could provide valuable insights and frameworks for Bangladesh as it works to decarbonize its economy while simultaneously developing its workforce and industrial base. Specifically, the analysis focuses on four distinct state approaches: Texas's deployment-focused model, Georgia's manufacturing and supply chain strategy, Massachusetts's innovation ecosystem, and New York's comprehensive approach that combines elements of all three. For example, Georgia's success in becoming a hub for EV manufacturing through programs like Georgia Quick Start, which provides workforce development solutions and customized training, offers valuable lessons for Bangladesh's ambitions to develop its own vehicle-related component supply chain industry. Similarly, New York's approach to offshore wind (OSW) development, which includes detailed supply chain investment plans (SCIPs) requiring local hiring and community engagement, could inform Bangladesh's strategies for developing its renewable energy infrastructure while maximizing local economic benefits.

Massachusetts's innovation model—particularly Massachusetts Clean Energy Center's (MassCEC) Clean Energy Internship Program and partnerships between academic institutions and industry—provides insights for workforce development and technology advancement. However, the paper recognizes that Bangladesh's different educational and industrial context means these programs would need significant adaptation. For example, Texas's deployment model, while successful in rapidly scaling renewable energy installation, relies on abundant land resources and a unique regulatory environment that may not align with Bangladesh's geographic and regulatory constraints. Through detailed examination of these models, the paper identifies successful strategies for workforce development and economic growth through clean energy expansion, while considering how these approaches may be adapted to Bangladesh's specific context.

The paper's findings suggest that Bangladesh would benefit most from adopting elements of New York's comprehensive strategy, which integrates innovation, manufacturing, and deployment while emphasizing local economic benefits and workforce development. Specific aspects of New York's approach that could be relevant include its Regional Clean Energy Hubs for information dissemination, workforce development

programs targeting disadvantaged communities, and strategic approach to developing local supply chains. However, the state's approach must be carefully tailored to Bangladesh's unique circumstances, including its financial limitations, geographic challenges, and existing industrial strengths in sectors like ready-made garments that could be leveraged for clean energy manufacturing.

Rather than presenting prescriptive solutions, the paper serves as a framework for discussion, providing Bangladeshi policymakers with concrete examples and considerations for developing their own clean energy expansion strategies. This approach recognizes that while international models can provide valuable insights, successful policy implementation must be grounded in local realities and capabilities. The paper also emphasizes how Bangladesh might adapt successful US programs to its context, such as modifying Georgia's automotive workforce development programs to support the transition of textile workers to clean energy manufacturing, or adapting New York's community engagement requirements to Bangladesh's local governance structures.

The study concludes by emphasizing the importance of developing a balanced strategy that leverages Bangladesh's existing strengths while addressing its key challenges in areas of financing, workforce development, and infrastructure. Additionally, significant financing gaps remain for the required investment in clean energy transition. By examining these successful state-level approaches and considering their applicability to Bangladesh's context, this paper aims to contribute to the development of effective policies especially relevant as Bangladesh works toward its targets of 15% renewable energy by 2030, 40% by 2040, and 100% by 2050.

High-Level Overview of US National Clean Energy Targets

According to the US Nationally Determined Contribution from 2021, the country's national target is to achieve an economy-wide reduction of greenhouse gas (GhG) by 50%–52% below 2005 levels in 2030.[6] The Biden-Harris administration has dramatically pushed the agenda for clean energy since its start in 2021, with a goal of a net-zero economy by 2050. In 2022, the Inflation Reduction Act (IRA) was passed as the most significant investment in climate and energy in the country's history at $369 billion, targeting a 40% reduction in carbon dioxide (carbon or CO2) emissions by 2030 through domestic innovation and the deployment of renewable technology.[7] Built into the IRA are additional tax incentives for clean energy project developers that offer jobs at prevailing wages and include registered apprentice work hours on the project.[8] Federal policies have emphasized the need for collaboration to build a skilled and diverse workforce nationwide to achieve this goal.[9]

The US Department of Energy further elaborates on these goals for a carbon-free electricity sector by 2035 with accelerated deployment, sustained cost reductions, increased resource flexibility, and support for a modernized grid. Specific technology

targets include a deployment average of 60 gigawatts (GW) of solar capacity per year until 2030, 30 GW of offshore wind (OSW) by 2030, and 60 GW of geothermal and hydrothermal by 2050.[10] Moreover, the Federal Sustainability Plan outlines 100% zero-emission vehicle acquisitions by 2035 and net-zero emissions buildings by 2045, with a 50% reduction by 2032.[11]

Further, to contest alleged unethical labor and trade practices in China, the Biden-Harris administration has recently imposed tariffs on Chinese goods, including EVs, solar cells, batteries, and supplies used in clean technology development such as steel and aluminum, semiconductors, and ship-to-shore cranes.[12] Even before these tariffs, the Trump Administration began an "America First" approach to foreign trade. Relating to energy infrastructure, this included tariffs on foreign-made steel and aluminum and various Chinese goods.[13] As a result of these policies, developers, and other entities in the US have been looking at alternative options, notably *domestic* manufacturers and inventors, for obtaining these technologies and materials to meet the nation's clean energy targets and start building a more robust and independent economy. This shifting market dynamic has opened enormous opportunities for US states and businesses in the clean energy industry and has also affected costs.

It is clear that the US has made a commitment at the federal government level to substantially reduce carbon emissions to reach a net-zero economy by 2050. Through policies like the IRA ($369 billion), it has made significant investments in the clean energy industry to help meet these goals while also creating high-quality jobs. Yet, state governments and their localities continue to drive the majority of energy policy in the country. Federal funding supports states in implementing tailored initiatives and programs, allowing for greater expansion or deeper impact.

Comparative Analysis

Stakeholders across the US have considered increasing the deployment of clean energy technologies and fostering research and innovation as strategies for implementing clean energy programs and policies to reach their goals. Four states act as models for approaching clean energy expansion and resulting economic growth: Texas, a leader in installed wind, solar, and energy storage capacity, according to the American Clean Power Association;[14] Georgia, a leader in EV manufacturing; Massachusetts, a leader in clean and climate technology innovation (climatetech); and New York, which has sought a comprehensive approach that simultaneously incorporates deployment, manufacturing, and innovation programs. As they relate to clean energy and climate-related technology, each method—deployment, manufacturing, and innovation—drives competition within the economy, creates jobs, and fosters economic growth. This section discusses the stated clean energy targets and commitments of these four states and provides an overview of how each has driven clean energy advancement.

Deployment: Texas

Texas's Targets and Approach

Texas leads the US in energy production, producing a quarter of total domestic output, primarily from abundant crude oil and natural gas resources. More recently, it has become **the leading state in terms of wind energy production with 40 GW of generation and the second in terms of solar energy capacity with 13.5 GW in early 2023.**[15] In 2022, total investments in clean energy were over $83.2 billion, with renewables accounting for 25% of all electricity produced in Texas.[16] In 2005, state legislation set a goal of 10 GW of renewable generating capacity by 2025, which was quickly achieved in 2011.[17] Since then, the state government has set limited goals and initiatives while deployment is rapidly growing, primarily under federal funding and programs derived from the IRA.[18] At the same time, Texas has recognized the importance of developing its clean energy workforce and actively supports training and education by partnering with community colleges, trade schools, universities, and graduate schools.[19]

Successes and Setbacks

Despite the lack of support from local policies, renewable energy developers continue to invest in Texas due to **its abundant resources and deregulated market.** For example, cheap and wide-open land has attracted a recent wave of pioneering developers to build new power plants and battery storage facilities.[20] Unlike states with policy mandates to drive clean energy investment, Texas's free market has allowed these facilities to be quickly built, enabling potentially high returns for investors in key technologies.[21] Removing barriers also fosters competition and innovation among developers, leading to lower consumer costs.[22] Moreover, Texas benefits from a strong existing workforce in the oil and gas sector that has transferable skills to renewable technologies, such as hydrogen power and geothermal energy.[23]

The Electric Reliability Council of Texas (ERCOT) operates **Texas's isolated electrical grid**, representing about 90% of the state's electric demand with oversight by the Public Utility Commission of Texas.[24] It is made up of different electric power generation companies, transmission companies, and retail electric providers that allow residents to choose where their power is sourced from. As a result, there is no monopoly on electricity. This unique system has two main advantages. The first is technical, **as ERCOT does not have to manage power exchanges with other neighboring states, thereby making its system easier to control.** The second is organizational in that **Texas can quickly create and implement decisions for its power grid because it only involves state-level authorities.** For instance, the Competitive Renewable Energy Zone initiative led to the quick development of new power lines while incentivizing investment in wind generation.[25]

Projections in early 2024 show continuous deployment to support the renewable transition in Texas. The rapid construction of battery storage projects within the past two years has resulted in more than 5 GW of operational battery storage capacity, with

almost 11 GW expected by the end of the year.[26] This aids the significant increase in ERCOT's solar generation, as the US Energy Information Administration expects it to top coal-fired generation.[27] Based on proposed projects to 2028, over 100 GW of battery projects are expected to be operational in Texas, and they will be important in supplying electricity in the case of solar and wind generation gaps.[28]

Conversely, ERCOT's isolated grid structure poses questions on power generation reliability as it was a major factor in the Texas blackouts of February 2021, when extreme winter weather conditions caused a state-wide loss of electric generation. Combined with a local history of deregulation and privatization, this event resulted in more than 57 deaths and over $195 billion in property damage.[29] During Winter Storm Uri and its record snowfalls, power generation was unable to meet record demand in the single-digit and subzero temperatures, forcing ERCOT to order power cuts to maintain grid stability. This also disrupted natural gas production and processing facilities already struggling to operate in cold temperatures. At the same time, the temperatures impacted the wind turbine speeds and disrupted wind power generation. This resulted in a negative feedback loop of power supply, leaving many without power for an extended time in winter conditions while energy prices soared with companies making billions of dollars.[30] Since the blackouts, representatives have pushed legislation to connect Texas's electric grid to surrounding national grids to improve reliability and prevent future blackouts, as the state will continue to face hotter summers and colder winters.[31]

In conclusion, Texas embodies a deployment model in which business-friendly policies from the existing fossil fuel industry have been extended into the renewables sector. In other words, the state has continued its history of limited regulations that drives competition in the private sector, thereby lowering consumer costs and creating opportunities for new investment. Under funding from the IRA, Texas quickly became a leader in wind and solar power generation, surpassing many states that had an early focus on renewable generation through its large-scale and rapid deployment. This was a direct result of minimal regulations and federal oversight combined with abundant and available resources, which made it a prime location for renewable developers. However, Texas risks losing its appeal to renewable energy developers as other states accelerate their clean energy policies and programs to reach their goals.

Manufacturing and Supply Chain: Georgia

Georgia's Targets and Commitments

In 2024, Georgia released its Peach State Voluntary Emission Reduction Plan in accordance with the US Environmental Protection Agency's Climate Pollution Reduction Grant program that outlines its emissions inventories, reduction strategies, and analysis of low-income and disadvantaged communities' benefits.[32] Rather than establishing renewable energy targets or energy portfolio standards, Georgia continues to focus on incentivizing electric mobility manufacturing by attracting investors using subsidies and

developing its workforce. This is especially beneficial as it is projected that more than half of cars sold in 2030 will be electric if current trends remain.[33] According to Governor Brian Kemp, Georgia seeks to become the "electric mobility capital of the country."[34] With the 19 in-state clean energy and electric vehicle (EV) projects announced after the passing of the IRA, Georgia is expected to add $14 billion to its GDP and gain 39,000 jobs.[35] Consequently, the state has materialized an EV supply chain model of renewable energy investments and is positioning itself at the forefront of the domestic market.

Georgia's Manufacturing and Supply Chain History and Approach

Since the assembly of its first automobile in 1909, Georgia has established itself as a center for automotive manufacturing. It is now home to General Motors, Ford Motor Company, school bus manufacturer Blue Bird, and a growing number of international companies such as Honda, Kia, and Panasonic. These companies have found success by having a state labor force of 5.3 million people where only 4.7% of private company workers are unionized due to right-to-work laws.[36] This means that workers are not required to join a union as a condition of employment.[37] In the 2010s, Kia actively looked for areas without support for worker unions when siting its first US plant due to experiencing barriers with the Korean Confederation of Trade Unions in Korea.[38]

Georgia has advantages in logistics and infrastructure with Hartsfield-Jackson Atlanta International Airport—the world's busiest airport—as well as the Port of Savannah, the country's third busiest port for shipping access.[39] This greatly complements its geographic position in the Southeast as a central supplier for the automotive industry in the surrounding states of Alabama, Tennessee, North Carolina, and South Carolina.[40]

The state government has also created effective programs to support the development of its automotive and EV industries. For instance, the Georgia Department of Economic Development has spearheaded many programs and alliances through public-private partnerships (PPP) to ensure the success of companies such as the **Georgia Electric Mobility and Innovation Alliance**. The most prominent program is **Georgia Quick Start**, which was created in 1967 to work directly with incoming companies to develop their workforce for various industries. These services include strategic workforce consulting, preemployment assessment, customized post-hire and job-specific training, and continuous leadership and professional development.[41] **Georgia Made** is another program led by the Department of Economic Development, which supports manufacturing companies by removing barriers and facilitating partnerships with logistics, research, and educational institutions.[42]

More recently, the **Electric Vehicle Career Pathway** was created by Georgia's Department of Education in response to Rivian (an American EV manufacturer) announcing in 2021 that it would invest $5 billion to build a carbon-conscious manufacturing campus in the East Atlanta Megasite, expected to create approximately 7,500 jobs.[43,44] Electric Vehicle Career Pathway equips high school students with the skills to

enter the EV industry while also providing early career exposure to elementary and middle school students. Coursework includes EV-specific instruction in engineering, manufacturing, and designing in addition to automotive technologies. This program indicates the state's willingness and quick response to develop the EV manufacturing workforce that will be mutually beneficial to incoming investments.[45]

PPPs have also fostered innovation efforts in the automotive industry, with laboratories such as the **Curiosity Lab** and **The Ray** developing next-generation technologies in autonomous transportation.[46] Players in the automotive innovation market include AT&T Drive, Novelis, Panasonic Automotive, and Heliox, covering technologies from charging solutions for EVs to vision and sensing.[47]

Successes and Setbacks

Since early 2015, Georgia has transformed into the US capital of EV manufacturing, with both the greatest amount in investment funding and number of jobs announced in EV manufacturing compared to all other states. Between early 2015 and early 2024, $31.2 billion of investment, alongside 38,700 jobs, were announced for EV-related projects in Georgia.[48] Companies like Kia will begin assembling their new EV models this year, while Hyundai and SK Group are investing in battery manufacturing facilities.[49] Among the 129 clean vehicle manufacturing projects announced since the passing of the IRA, Georgia is one of the three states with the largest number of these projects.[50]

However, **the state has recently faced a setback in becoming the US electric mobility capital as Rivian has decided to suspend the construction of its $5 billion manufacturing facility**, which was initially constructed to produce Rivian's new R2 SUV model. Instead, Rivian has moved all of the model's production to its current manufacturing facility in Illinois, which is expected to save the company roughly $2.25 billion. Rivian has laid off 10% of its workforce in its third round of job cuts in just two years while struggling to increase the value of its share's value after falling 40% this year. The EV market is becoming increasingly competitive, with big-name brands such as Ford, Hyundai, General Motors, Mercedes-Benz, Volkswagen, and Volvo all signing agreements with Tesla. Still, Rivian has not given up on its new Georgia facility and still claims to have plans for it in the future.[51] Furthermore, the plant faced opposition due to concerns about its potential environmental impacts and the allocation of $1.5 billion in subsidies awarded by the state. Blocking the plant was a central aspect of one of Governor Kemp's adversaries in the 2022 Republican primary election.[52] Local pushback has materialized into litigation against the factory's complex financing structure, which relies on taxpayer money, and doubts have been raised whether Rivian will fall short of its commitment to Georgia's economic development and job creation.[53]

Similar to Texas, the right-to-work laws and low unionization rates in Georgia attract clean energy businesses that seek lower labor costs. This poses a challenge for Texas and Georgia as these businesses want to receive full IRA benefits that

require offering prevailing wages and using union labor. Other major auto manufacturing states, such as Michigan, which follows Georgia in the largest investment for EV-related projects announced between 2015 and 2024,[54] may offer both an established industry and unionized workers without right-to-work laws. Thus, Georgia must consider how to continue attracting EV manufacturers and investors while balancing between federal IRA priorities and state-level right-to-work policies to compete with other major auto manufacturing states.

Overall, Georgia has succeeded in developing its EV supply chain and attracting domestic and international investors using its decades-long reputation as an automotive manufacturing hub in the Southeast US. State leaders like Governor Brian Kemp and agencies such as the Department of Economic Development have played an active role in providing necessary resources to foster the growth of EV manufacturing, leading to an ecosystem of alliances, workforce development programs, and innovation hubs. State subsidies have also resulted in many planned production facilities that will continue to bring economic benefits to George and jobs for its citizens, thus approaching its goal of becoming the nation's electric mobility capital.

Innovation: Massachusetts

Massachusetts's Targets and Commitments

The state's Renewable Portfolio Standards (RPS), set out and overseen by the Renewable and Alternative Energy Division of the Massachusetts Department of Energy Resources, place Massachusetts at the forefront of climate change action in the US by being one of the first to mandate a percentage of the state's electricity come from renewable energy.[55] This applied to all **"retail electricity suppliers (both regulated distribution utilities and competitive suppliers)" who must obtain "a percentage of the electricity they serve to their customers from qualifying renewable energy facilities," and in 2003, the RPS declared that requirement to be 1%**.[56] The Green Communities Act of 2008 created two classes of qualifying renewable energy facilities (Class I and II) for the RPS and added that **for retail electricity suppliers obtaining renewable energy from Class I facilities, their renewable energy requirement would increase by 1% annually**.[57]

The 2008 Massachusetts Global Warming Solutions Act (GWSA) was another demonstration of the state's leadership in climate action by creating significant targets for reducing GhG emissions. It requires GhG emissions to be reduced below 1990 levels of 25% by 2020 and 80% by 2050.[58]

The Executive Office of Energy and Environmental Affairs within the Massachusetts Department of Environmental Protection also established a Clean Energy Standard (CES) in 2017 to reduce carbon emissions from power plants in the state. With the goal of reaching "a fully decarbonized electricity sector in 2050," the CES put additional requirements on electricity suppliers and set emission limits on large fossil fuel-powered

plants.[59] **Since 2018, under the CES, electricity suppliers have been required to obtain at least 16% of their electricity sales from clean energy sources established after 2010. This percentage requirement was set to increase annually and reach "60% in 2030 and 80% in 2050."**[60] **Additionally, 24 large fossil fuel-powered plants in the state could not emit more than 9.15 million metric tons of carbon dioxide, with this limit continuously declining to reach 1.8 million metric tons in 2050.** The CES allowed for RPS compliance to count toward its own requirements and also established a carbon emissions trading program.

In 2021, the Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy updated the GWSA measurements and created the **goal of reducing GhG emissions, still below 1990 levels, to 50% by 2030 and 75% by 2040, paving the way for net-zero emissions by 2050**.[61] That same year, the state aimed to **reduce its carbon footprint, or contribution to carbon dioxide emissions, by 845,000 metric tons between 2022 and 2024**.[62] In addition to its carbon reduction goals and commitments to increase renewable energy procurement within the electricity sector, in 2015 "Massachusetts committed to the bold goal of **300,000 zero-emission vehicles registered in the state by 2025**,"[63] and in 2023 it pledged to **put 1 million EVs on the road by 2030**.[64]

Massachusetts's Innovation History

Massachusetts has been a major innovation hub for several decades, focused primarily on information technology (IT) and biotechnology (biotech) before becoming a hub for climatetech innovation. It has an unparalleled collection of academic institutions, research centers, and organizations that attract students, researchers, and businesses from across the globe. The Boston metropolitan area[65] has over 60 colleges and universities, including two world-class academic institutes: Harvard University and the Massachusetts Institute of Technology (MIT).[66] The state has also been recognized for having the largest percentage of adults with bachelor's and advanced degrees.[67]

The presence of high-quality academic institutions in the state has attracted researchers and entrepreneurs from all over the world; led to supportive research policies and early momentum in medical and biotech advancement, which highlighted a local environment that fosters innovation; and recruited private businesses that have created jobs and attracted investment into start-ups and research projects. In biotech, for example, early activities and state legislation promoting research include the first public demonstration of ether anesthesia in 1846 at Massachusetts General Hospital;[68] the establishment of the American Research and Development Corporation in 1946 by a former MIT president, which became a prominent venture capital firm that worked closely with start-ups in Cambridge;[69] and 1977 legislation passed by the Cambridge City Council that first allowed for the research of recombinant DNA.[70] In addition, in 1989, Biogen, a large biotech company, received early

Federal Drug Administration approval for a Hepatitis B vaccine that attracted similar companies to the area.[71] Massachusetts is a well-known destination where researchers, start-ups, and big biotech companies are in close proximity to form partnerships and implement technological advancements from ideas to commercialization.

Alongside a history of cutting-edge research underway in Massachusetts, key collaborations and establishments in the state have contributed to the state's pathway to becoming a leading innovation hub. MassBIO, created in 1985 as the world's first biotech trade organization;[72] the Cambridge Innovation Center (CIC), founded in 1999 by an MIT graduate;[73] and the Massachusetts Life Sciences Center (MLSC), established as a quasi-public agency in 2007 to facilitate economic development through life sciences research and innovation,[74] have all played a role in the state's biotech advancements. Today, Massachusetts receives the most funding per capita from the National Institutes of Health, the country's medical research agency, and around 1,000 companies in the biotech industry are located located in the Greater Boston region.[75]

MassBIO and the CIC have helped many of those 1,000 companies by creating a diverse professional network of thought leaders and innovators in the biotech industry. Both organizations prioritize creating spaces for professional networking and supporting business development, for example, by hosting events for companies and stakeholders, both new and established, in the biotech industry. An economic development and investment agency, **the MLSC is a key player in the biotech industry, having invested over $700 million in the state's biotech research and workforce efforts since 2007**. These investments have generated more than $3.1 billion in additional investment in Massachusetts and created more than 13,000 jobs. The MLSC also supports the biotech workforce pipelines at public middle and high schools as well as by facilitating internship programs.[76]

The success of these key resources is clear as Massachusetts has become a leading IT and biotech innovation hub. With increased attention to climate change around the world, the state has turned to leveraging its academic institutions, position at the heart of industry-worker-creator collaboration, previous triumphs, and stature to lead the climatetech innovation surge.

Massachusetts's Approach: Using Existing Assets and Infrastructure to Tackle Climate Change

Soon after the GWSA passed, MassCEC and Greentown Labs were established, using the state's preexisting innovation experiences, assets, and talent, while focusing on climate change. **MassCEC, a quasi-public agency established in 2009, has been an integral actor in supporting the state's efforts in reaching its clean energy goals.**

MASSCEC

MassCEC was established to pursue economic development in support of the state's clean energy goals, similar to the MLSC. Three of the agency's five approaches involve funding climatetech innovators and companies, advancing climatetech to

commercialization, and scaling climatetech.[77] MassCEC supports entrepreneurs and researchers working on solutions to advance clean energy and climate technologies, with a special focus on supporting early stage start-ups and closing common gaps in entrepreneurial funding streams. It brings together industry, government, and academic stakeholders; supports workforce pipelines into the clean energy space; and, along with partnering organizations, offers many programs that encourage clean technology project development in low-income and underserved communities. Overall, since 2010, the agency has awarded more than $650 million.[78]

MassCEC actively partners with employers and industry experts, policymakers, academic institutions, developers, and other cleantech and clean energy industry stakeholders across the state to administer needed programs and foster collaboration in the industry.[79] The agency is funded by two main sources: the Renewable Energy Trust Fund, which was transferred to MassCEC in 2009 through legislation by Governor Deval Patrick, and the Alternative and Clean Energy Investment Trust Fund. The latter is financed by surcharges to customers of the state's investor-owned electric utilities, customers of municipal lighting plants in Massachusetts, and Mass Save, a collaboration of gas and electric utilities serving the state. MassCEC operates with approximately $34 million annually, and it is estimated that each household, or residential customer, contributes $0.29 a month, or $3.48 a year, to the Renewable Energy Trust Fund.[80]

The current opportunities/programs of MassCEC's investment division aim to support climatetech start-ups, small businesses, and academic institutions by targeting those who are either in early state research and development (R&D) or are between early stage development and commercialization.[81] In the first quarter of 2024, MassCEC announced $2.5 million in funding for climatetech innovation companies across the state through three programs: Catalyst, DICES, and InnovateMass. The awardees are in early stage development or early stage demonstration phases, exploring advancements in zero-carbon cement production, high-efficiency heating, ventilation, and air conditioning (HVAC) systems; OSW technologies; EV batteries; and more.[82] With these financial supports, innovators can develop and test their climate solutions, overcome the "death valley curve" that is typical in the entrepreneurial industry,[83] and contribute to the state's clean energy economy.

At the end of 2022, MassCEC announced its 2030 Fund, which will provide $50 million to increase investment in early stage start-ups in Massachusetts working in climatetech and with carbon emission reduction technologies. This fund will target start-ups developing technologies for achieving a net-zero grid, high-performance building, clean transportation, and OSW, along with other areas MassCEC considers "high-impact."[84] Additionally, MassCEC works to advance innovation among historically underserved populations and communities through programs like EmPower Massachusetts and Accelerating Clean Transportation for All.[85]

Through MassCEC, the state has driven innovation and workforce development in climatetech, not only with direct investment but also with strategic partnerships, high school education, and tax incentives. For example, its Clean Energy Internship Program, a PPP between MassCEC and clean energy employers across the state, is designed to support clean energy and water innovation companies registered in Massachusetts while providing college students and recent graduates with industry exposure. MassCEC funds participating companies, enabling them to offer paid internship opportunities to these college students and graduates. To date, almost 6,000 interns have been placed (65% of whom identify as women and minorities), and over 600 companies from across the state, with a high concentration in or around Boston, have participated since the program's beginnings in 2011. This program facilitates a strong pathway for entry into the clean energy and water innovation workforce, as around 1,000 interns have moved into full- or part-time employment at the companies with which they completed their internships.[86]

Local employers, workforce development boards, and high schools collaborate to develop and deliver the state's Innovation Career Pathways initiative, which offers high school students no-cost opportunities to explore and gain experience in high-demand industries such as IT, advanced manufacturing, and clean energy.[87] Participants can gain work-based learning experience and receive lessons tailored to their chosen pathway. The Innovation Career Pathways first started in 2017, but only recently, in 2024, will a Clean Energy Pathway be incorporated. Five high schools will be piloting this new pathway during the 2024/2025 school year with the hope for it to be fully implemented the following school year.[88]

Tax incentives are another method that Massachusetts uses to support businesses and economic growth in innovation and climatetech. In 2024, the Healey-Driscoll administration submitted a bill to invest in programs that support the innovation of new clean technology and provide employment for residents. The bill includes $1.75 billion in bond reauthorizations eligible for programs that drive economic growth and another $1 billion for those that contribute toward a competitive, affordable, and equitable economy (referred to as the 2024 Economic Development Bond). The bill's launch also included the Climatetech Tax Incentive Program, which provides MassCEC with $30 million to distribute among climatetech companies across the state to increase employment and economic growth in such sectors.[89]

GREENTOWN LABS

Greentown Labs is a large climatetech incubator and nonprofit organization in Greater Boston that was created in 2011 by four start-ups founded by MIT graduates. The organization is focused on tackling climate change through entrepreneurship and collaboration with start-ups and policymakers.[90] In total, Greentown Labs has raised over $5.7 billion in funding, created over 11,000 jobs, and helped support over 500 start-ups. The

incubator provides more than $1 million worth of resources to members, including equipment, programming, and staff support.[91]

Greentown Labs's priority is to accommodate the constantly changing needs of a start-up, such as flexible facility leases and opportunities to discuss pilot projects with potential investors. The organization is another example of how the assets in Massachusetts function together to facilitate innovation. It has strong connections to MIT, well-established companies involved in or interested in energy technologies and climate solutions, and diverse, climatetech start-ups.

Greentown Labs hosts the Greentown Industry Leadership Council, which includes industry professionals from Amazon, Shell, and TotalEnergies, among others, who provide guidance to climatetech start-ups. Additionally, Greentown Labs partners with multinational corporations such as Chevron, Amazon, Aramco, and Microsoft to facilitate connections with start-ups. It also hosts various programs like Advancing Climatetech and Clean Energy Leaders, which receives funding from multiple investors such as MassCEC, Microsoft, and BP to provide BIPOC-led[92] start-ups with additional funding, resources, and networking opportunities.[93]

SWTCH, an EV charging solutions company, is one example of a successful alumnus from Greentown Labs. It installed 929 Level 2 EV chargers across Canada in 2022 and 100 public EV chargers in New York State in 2023, and currently generates an estimated annual revenue of $24.6 million per year.[94]

Greentown Labs's Partnership Program bridges start-ups with its partners so that the start-ups can obtain business development outside of direct investment. Through this program, start-ups can attend lunch and learns, office hours, corporate innovation days, and other networking opportunities with the partners, allowing them to discuss business development. Partners also offer mentorship and advice on purchasing hardware, software, professional services, prototyping equipment, and more.[95] In addition, the incubator's Investor Program was designed to facilitate fundraising opportunities for start-ups,[96] while the Advisor Program emphasizes getting advisory services to start-ups. Through this program, start-ups are assigned an expert or advisor to discuss business development, fundraising, marketing and sales, communication, and more during one-on-one sessions. The advisors help ensure that the start-ups are well prepared to launch their products into the clean energy market.[97]

Massachusetts's dive into climatetech innovation and development demonstrates how it is pursuing economic development through technological advancement to tackle climate change. As the country looks to increase the deployment of clean energy and climate technologies and use domestically manufactured goods, Massachusetts is taking advantage of this new market while also supporting its own local workers and start-ups, especially seed and early stage climatetech start-ups, and increasing both investment into and output from the state. In contrast, unlike Texas, Massachusetts has much less land and regulations that can limit the likelihood of innovative ideas reaching commercialization.

Successes and Setbacks

Massachusetts has seen an overall increase in stage 1, 2, and 3 investments since 2012, with a higher concentration of investment deals in stage 1. In 2022, $3.5 billion was invested in clean energy companies in Massachusetts through both public and private funding. Since its creation, MassCEC's investments in clean energy businesses have led to the creation of more than 500 jobs and the avoidance of over 62 million metric tons of carbon dioxide emissions. In addition, 89% of start-ups that received financial awards from the agency's Technology Development and Innovation Program are still in business.[98] Meanwhile, Greentown Labs has supported over 400 start-ups, which have in turn "collectively raised more than $1.3 billion in funding and created more than 6,500 direct jobs," all of which play a role in climatetech R&D.[99]

However, there are challenges to consider with this type of approach. For example, Evergreen Solar, a solar energy technology company founded in 1994, became well-known due to its exclusive rights to String Ribbon technology, developed at MIT. With this technology, the company could produce wafers for solar photovoltaic (PV) systems with 50% less silicon.[100] By increasing the production of solar panels more cost-efficiently, Evergreen Solar set up a plant in Massachusetts and received significant support from the state government, including a $58 million grant, loan, and tax incentive package to create jobs and boost the local economy. While it appeared that the company would be profitable with lower production costs and increasing shipments, in 2011, less than four years after receiving the support package, Evergreen Solar filed for bankruptcy and laid off hundreds of workers. The company attributed its lack of profitability to a slow economy in the US, low labor costs in China, and low solar panel prices on the market.[101] The situation that Evergreen Solar faced shows that while supporting innovation and local businesses could lead to local job creation and economic growth, policy environments and markets at both the national and international levels have major impacts on longer-term results and sustained growth.

At the same time, Massachusetts must also examine how to encourage the start-ups that have reached commercialization to remain in the state. Once more established, they may significantly contribute to the state's GDP and create local, middle-class jobs. Thus, a key component of this model is developing additional policies or programs to incentivize businesses to continue operating in the state for local economic benefits.

Comprehensive—Deployment, Manufacturing and Supply Chain, and Innovation: New York

New York's Targets and Commitments

For several years, the state of New York has been committed to reaching goals set by its former governor, Andrew Cuomo, who was in office from 2011 to 2021. The 2015 State Energy Plan is a foundational document for how New York is tackling climate change action[102] and includes the following climate and clean energy targets:

- 50% of electricity from renewable energy sources by 2030
- A 40% reduction in GhG emissions from 1990 levels by 2030
- An 80% reduction in GhG emissions from 1990 levels by 2050
- 600 trillion additional British thermal units (BTUs) in energy efficiency
- Higher adoption of commercial and community solar energy

In 2016, Governor Cuomo committed to eliminating all coal generation in New York by 2020.[103] At the end of 2019, he introduced an amendment to the plan known as the Green New Deal, which, once passed, became the **Climate Leadership and Community Protection Act (Climate Act)**.[104] This act became another foundational piece of legislation in the state's climate and clean energy efforts, as it updated the previous targets laid out in the 2015 State Energy Plan to accomplish the following:

- 100% carbon-free electricity by 2040
- **70% of electricity from renewable energy sources by 2030**
- **A 40% reduction in GhG emissions from 1990 levels by 2030**
- **An 85% reduction in GhG emissions from 1990 levels by 2050**
- **9 GW of OSW-generated electricity by 2035**
- 3 GW of energy storage by 2030
- 6 GW of distributed solar electricity by 2025
- **185 trillion additional BTUs in energy efficiency, or on-site energy savings in 2025, to be 185 trillion BTUs more than energy savings in a 2015 baseline**
- **At least 35% (with a goal of 40%) of overall benefits from clean energy and energy efficiency investments realized by disadvantaged communities (DACs), which make up 35% of the state's total population**
- Zero GhG emissions produced on-site at new construction after 2027
- Governor Kathy Hochul, whose administration began in 2021, updated these goals and added new targets in her 2022 State of the State Address.[105] These updates and new targets include, but are not limited to, the following:
- Increasing the previously established distributed solar energy goal of reaching 6 GW by 2030 to **10 GW of distributed solar by 2030 in addition to creating 6,000 new solar jobs**
- Increasing the previous goal of 3 GW of energy storage by 2030 to **at least 6 GW of energy storage by 2030, while reaching 1.5 GW by 2025**
- **Net-zero investment portfolios by 2040** for New York State authorities, public benefit corporations, and the State Insurance Fund—totaling approximately $40 billion in assets

Governor Hochul also made additional commitments related to alternative fuel transportation and energy efficiency improvements in 2022:

- Alternative transportation
  - **Zero-emission passenger vehicles (cars, SUVs, and pickup trucks) are to be the only ones sold in the state after 2035.**[106,107]
  - Significantly increase EV sales by 2030, with **light-duty EV sales reaching 90% and medium- and heavy-duty EV sales reaching 40% by 2030.**[108]
  - **Electrify New York's light-duty vehicle fleet by 2035**, similar to the federal commitment of electrifying the federal light-duty vehicle fleet by 2035.[109]
- Energy efficiency
  - Update Governor Cuomo's Executive Order 88 from 2012, which set forth and publicized the target of increasing energy efficiency in all state buildings by 20% from a 2010/2011 baseline by 2020,[110] to Governor Hochul's 2022 Executive Order 22, affirming the state's goal of reaching "**11 trillion BTU of energy savings at state facilities by 2025."**[111]
  - **Electrify at least 1 million New York homes by 2030, prepare another 1 million homes for electrification (electrification ready) by 2030, and ensure at least 800,000 of these homes are low- or moderate-income households.**[112]
  - **Eliminate fossil fuel combustion at building construction sites by 2025 and 2028 for smaller and larger buildings, respectively.**[113]

New York's Approach

New York has a history of profitable manufacturing, is home to many prestigious academic institutions, and has many collaborative industry groups. To reach its clean energy targets, the state has taken a comprehensive approach by taking the following steps: investing in local clean energy manufacturing and supply chains with intentional provisions for local economic benefits, investing in climatetech innovation, supporting local start-ups and attracting bigger companies to the state, and increasing the deployment of clean energy technologies in the state by expanding access to them through financial means and better awareness.

The New York State Energy Research and Development Authority (NYSERDA), alongside the Governor's Office and other state agencies, has spearheaded clean energy activities, becoming a major leader in the national energy transition. Similar to MassCEC, NYSERDA is primarily funded by gas and electric utility customers and partly funded by the state's Clean Energy Fund (CEF), Clean Energy Standard, the Green Jobs–Green New York Financing program, bonds, and more. The CEF is financed through a System Benefits Charge that is collected by investor-owned gas and electric utility companies operating in the state and paid by their customers via utility bills.[114] Most of the programs administered by NYSERDA are funded by the CEF or the System Benefits Charge.[115]

DEPLOYMENT

To increase the deployment of clean energy technologies, Governor Cuomo, Governor Hochul, and multiple state agencies have kicked off many initiatives intended to support New York in reaching its climate and clean energy goals by (a) increasing access to clean energy technologies, especially for DACs; (b) increasing awareness and knowledge of these technologies and their related incentive programs; and (c) developing collaborative groups of industry stakeholders. In addition, the state offers discounts on installations of clean energy technologies, especially solar energy, to residents and businesses to increase the deployment of these technologies. It has also recognized the importance of ensuring that stakeholders, including researchers, businesses, and policymakers, have a space to work together to promote and drive innovation, find solutions to deployment challenges or limitations, and align on goals and strategies.

Efforts to increase the deployment of electric power generation technologies in New York have been primarily focused on deploying solar, grid, and energy storage technologies and have largely involved increasing their usage and installation for all residents. This is carried out with a focus on DACs through financial, informational, and advisory means.

New York has several solar-focused deployment programs and initiatives emphasizing help to households with lower financial means. Its NY-Sun initiative is administered by multiple state agencies (NYSERDA, Long Island Power Authority, PSEG Long Island, and the New York Power Authority [NYPA]) intended to help the state reach its solar generation capacity goal.[116] As part of this initiative, solar contractors and developers receive funding to reduce costs for residents and customers.[117] NY-Sun includes multiple solar programs such as the Value of Distributed Energy Resources incentive, Megawatt Block Incentive, K-Solar, and Affordable Solar Program/EmPower+. *Appendix A contains more information on selected NYSERDA solar deployment programs under NY-Sun.*

Outside of NY-Sun, the state has implemented various other programs to incentivize the installation of clean energy technologies while lowering energy and utility bills for households and businesses. The governor's Shared Renewables Initiative, launched in 2015, was intended to incentivize and promote participation in communal renewable energy projects.[118] This initiative made it more feasible for low-income households to access and use renewable energy sources and lower energy bills through a utility bill credit for energy contributions.[119] ReCharge NY, an NYPA program from 2010, offers a low-cost payment system for companies and nonprofits that purchase power or energy from NYPA and have committed to "paying back" the state through local business development, job creation, investments, and more.[120] In this way, more entities are getting power from cleaner sources and committing to support the region's economic development.

Solar for All and NY Prize were also created to increase community-owned solar and microgrid projects, respectively. By owning these projects, communities can increase the amount of clean (solar) power that feeds into local grids and lower electricity transfers across the grid. Additionally, the Charge NY initiative helps to increase the deployment of clean transportation in the state.[121]

New York has also recognized the need to distribute information on financial assistance programs available for clean energy technologies to advance their deployment. For example, Regional Clean Energy Hubs were created to disseminate information on viable technology options and available incentive and rebate programs to households and businesses across the state. These hubs help residents stay updated in a continuously changing energy market.[122] Additionally, Governor Cuomo's $454 million New York State Clean Heat Initiative, established in 2020 to run through 2025, incentivizes heat pump installations and serves as a resource for New Yorkers to access information on available rebates and loans. Finally, the Build Smart NY program also provides planning, guidance, and technical assistance to state entities, including state college campuses, on energy efficiency programs.[123]

Multiple consortiums or groups of industry stakeholders in various clean energy technologies have been created to effectively identify strategies and solutions for promoting innovation and increasing the deployment of these technologies. These consortiums, involving both public and private stakeholders, include the NY BEST Consortium, the New York State Smart Grid Consortium, NY Grid CONNECT, and the National Offshore Wind Research and Development Consortium.[124]

Last, NYSERDA's **On-the-Job Training for Energy Efficiency and Clean Technology program** provides wage subsidies to eligible businesses to incentivize work-based experience opportunities, similar to MassCEC's Clean Energy Internship Program. The subsidies are intended to incentivize employers by reducing their financial risk of hiring and training new workers. The program supports New York's CEF objectives and advances the climate equity goals of the Climate Act by developing a workforce ready for jobs in clean energy, particularly in DACs. NYSERDA works with the New York State Department of Labor to develop training plans and assess necessary skills for new hires in the clean energy industry.[125]

Considerations

New York's gross state product ranks third in the nation, allowing for a significant state budget[126] and the capacity to support the clean energy industry from both the supply and demand side. The state invests heavily in clean energy innovation and state-level supply chain expansion, in addition to greater deployment of renewable technologies. Incentives and direct investments in deployment create the market that feeds innovation and the supply chain, all while localizing the resulting economic benefits and jobs. As with the other states, New York still must be cautious on how quickly new electric power

generation can connect to the grids as a result of regulations, domestic manufacturing capabilities, and the active domestic market. However, given the costs of New York's comprehensive approach, many US states cannot follow this approach in their efforts to advance their own clean energy industry.

MANUFACTURING AND SUPPLY CHAIN

History

Since 1825, the Erie Canal has connected the Great Lakes to the Atlantic Ocean via the Hudson River and has facilitated efficient transportation and trade throughout New York. This critical infrastructure project boosted the local economy and positioned the state as a vital trade center, fostering economic growth and innovation.[127] The manufacturing industry in New York was highly profitable and employed around two million workers in the mid-1940s. Although employment dropped by roughly 60% by the early 2000s, manufacturing remained a large industry in upstate New York with high-quality jobs. In the early 2000s, many upstate regions saw the industry as a large contributor to their private sector GDP, including the Rochester, Elmira, and Buffalo–Niagara Falls metropolitan areas, whose manufacturing industries contributed more than 20% to their GDPs. During this time, machine manufacturing accounted for the largest share of workers, followed by computer and electronic equipment manufacturing and fabricated metal product manufacturing.[128]

Approach: OSW Manufacturing

With a history of manufacturing, a population of high-skilled workers, and preexisting port infrastructure in New York, the state is well positioned to support the clean energy transition through its manufacturing industry and local supply chains.[129] New York has recognized the importance of domestic manufacturing for economic development and has leaned into clean energy manufacturing as the country looks to expand clean energy deployment. By producing local goods and services, New York can maximize its economic benefits. Local supply chains can help prevent international market fluctuations, support demand for clean technologies to reach climate goals, and create high-quality jobs with a large share of unionized local labor in the state. Supporting local supply chains and workers also provides employment opportunities for residents in DACs and growth opportunities for businesses owned by underrepresented and underserved residents (MWBEs and SDVOBs).[130] This approach aligns with New York's policies, notably its project solicitations and Climate Act, that aim to ensure economic benefits to DACs.

For example, New York has actively supported the supply chain in the emerging OSW energy industry as the state aims for 9 GW of OSW-generated electricity by 2035 under the Climate Act. Five ports around the Hudson River, New York City, and Long Island are supporting the OSW industry, involved in secondary steel manufacturing for

turbine foundations, staging and marshaling, operations and maintenance, turbine manufacturing, and more.[131]

In 2017 and 2018, Governor Cuomo developed New York's "Offshore Wind Master Plan 2017–2025," outlining the state's commitment to developing this sector. In 2020, the Offshore Wind Training Institute was launched with $20 million in funds, led by the State University of New York (SUNY) at Farmingdale and Stony Brook.[132] A New York Offshore Wind Master Plan 2.0 was developed in 2022, focusing on 2023 and 2024 strategies, under Governor Hochul. This plan targets research efforts on OSW technologies, cost-benefit analyses, and supply chain analyses, as well as an emphasis on procuring local suppliers and workers. Overall, in these master plans, New York intends to advance floating OSW opportunities, assess technology costs and benefits, and plan a smooth transition to floating technologies while expanding its role as an OSW hub.[133]

When seeking developers for clean energy projects in the state and offering funding opportunities, New York has included requirements in its requests for proposals for community engagement, local supplier partnerships, and local hiring to ensure a better distribution of economic benefits to residents. Since 2018, the state has solicited four OSW projects and one manufacturing and logistic project. The third OSW solicitation in 2022 for port, manufacturing, and other supply chain infrastructure investment had a total budget of $500 million. Applicants could submit SCIPs to potentially receive up to $300 million. Those in blade or nacelle manufacturing could apply for up to $300 million from the state (to cover eligible expenses at their SCIP facility), and other manufacturing facilities could apply for up to $150 million.[134] Since only $300 million was allocated in the 2022 solicitation, the remaining $200 million has been incorporated into the latest 2024 solicitation budget. This 2024 solicitation was only targeted to manufacturing and logistics support in the OSW industry.[135]

SCIP requirements to maximize in-state benefits from OSW developments involved multiple components, including direct job creation estimates, a stakeholder engagement plan, a supply chain localization plan, and an economic benefit plan. **Depending on its primary production activity/OSW component, the proposed SCIP facility had to commit to covering specific production processes and supporting a certain number of direct jobs.** For example, a blade manufacturing facility awarded money under SCIP funds had to produce blades in their entirety and "support at least 500 long-term direct jobs."[136]

New York's assessment of the submitted SCIPs also included an evaluation on the plans' ability to provide jobs to New Yorkers who may lose their current jobs due to the clean energy transition, intentions for equitable economic benefits such as to residents in DACs, and ability to produce goods at competitive pricing. Through an incorporated stakeholder engagement plan, applicants had to outline how their SCIP facility would engage the representatives of local stakeholders, notably DACs and environmental justice communities, and assess these groups' support or opposition to the facility.[137]

Moreover, applicants had to submit a supply chain localization plan for their facility components and subcomponents to ensure the facility's operations would lead to domestic and in-state economic growth. **Facilities could use local supply chain partners, for which the state provided additional funding opportunities, or identify opportunities to connect their preexisting global supply chain partners with local ones**. Last, an economic benefit plan was added to quantitatively and qualitatively estimate the anticipated economic benefits from the construction, operations and maintenance, and other activities of the SCIP facility and serve MWBEs and SDVOBs, long-term jobs, and DACs.[138]

Considerations

Given the domestic market for OSW infrastructure and New York's dominance in OSW electricity demand, the state is in an optimal position to take advantage of the domestic manufacturing opportunities to bring companies and investment into the state while ensuring that the revenue and wages from the manufacturing exports remain in the region. As leaders in the US are considering more tariffs on foreign goods, consumers and developers will turn to domestic goods and New York will be there to supply. The demand for OSW components has created a local market, and the state has designed its project development policies in a way that maximizes the local economic benefits. The SCIPs, which provided additional state funding opportunities, exemplified how the state approached this through community engagement, partnerships with local suppliers, and local job creation. Nonetheless, New York's large budget offers significant funding opportunities to incentivize and attract developers and leverages its status as a top consumer of OSW electricity in the US, based on its policy and planned capacity,[139] to compel companies seeking access to its market to meet its requirements.

New York has been making major strides toward reaching its 9 GW of OSW capacity goal between the active South Fork Wind project and the developing Sunrise Wind and Empire Wind projects. Although the state was well positioned with a $300 million investment in manufacturing and three committed OSW developers by late 2023, the technological advancement did not meet expectations and reversed much of this progress.[140] Additionally, although it did not lose its investment, the state must now reissue its project solicitations and find new ways to reach its OSW energy procurement and local benefits goals.

INNOVATION

History

New York's academic resources and technological pioneering have significantly contributed to its innovative landscape. The state is home to two Ivy League institutions, Cornell University and Columbia University, along with the SUNY system, which have produced groundbreaking research across various fields, such as medicine, social sciences, and agriculture. **Thomas Edison's founding of General Electric** established

a strong industrial presence in New York, with contributions to technology and industry that have had a lasting impact on both the state and the nation.[141] Similarly, in Rochester, **the invention of the first successful roll-film hand camera by Eastman Kodak Company** marked a significant advancement in photography.[142]

New York has also been at the forefront of **scientific research with institutions such as Cold Spring Harbor Laboratory and the Memorial Sloan Kettering Cancer Center**. Founded in 1890 on Long Island, Cold Spring Harbor Laboratory became one of the earliest independent centers for biology research in the US, making significant contributions to genetics, heredity, and the evolution of plants and animals.[143] Memorial Sloan Kettering Cancer Center, established in 1884, has grown into a leading biomedical research institution, pioneering cancer research and treatment since its formation through the combination of Memorial Hospital and the Sloan Kettering Institute in the 1940s.[144]

Established in 1947 in Upton, **Brookhaven National Laboratory** was originally built to explore the peaceful applications of atomic energy. Over the years, its research scope has expanded to include nuclear physics, chemistry of materials, nanoscience, energy and environmental research, national security and nonproliferation, neurosciences, structural biology, and computational sciences.[145]

Moreover, the 1990s saw the emergence of Silicon Alley in New York City, a growing tech hub that exemplifies modern innovation districts. Launched by the New York City Economic Development Corporation, these districts are formed through PPPs with universities, tech firms, and media companies. Silicon Alley's growth has been supported by the expansion of a highly skilled tech workforce, the establishment of incubators and accelerators, and collaborations with real estate developers. This region functions as an industrial district where growth is driven by the interdependencies between producers, fostering an ecosystem of innovation.[146]

Approach

Innovate@NYSERDA, a division of NYSERDA, has been a key player in advancing innovation in clean energy technology in New York. It aims to establish a premier center for clean energy research and technology advancement, fostering innovation and commercialization. The agency strategically invests in companies across various stages of growth, from seed companies and early stage companies to later-stage companies. With a focus on eight different subject areas—advanced buildings, clean transportation, climate resilience, energy storage, grid modernization, hydrogen and clean fuels, OSW, and tech to market—it seeks to strengthen the state's innovation across the energy landscape, promoting resilience and equity.

NYSERDA has many multifaceted initiatives and programs, spearheading innovation from various focus areas. The following are a few of the organization's leading programs. NYSERDA's Advanced Buildings Program is dedicated to advancing innovations aimed at decarbonizing New York's building stock. By creating innovation-based opportunities,

the program addresses critical needs and technology gaps in the building sector, tackling both building performance and decarbonization to create a more sustainable built environment in New York.[147] The Clean Transportation Program oversees R&D efforts to progress products from prototype to commercialization. Its noteworthy successes include the development of hybrid transit buses and an adaptive traffic signal system.[148] The Climate Resilience Initiative focuses on fostering innovative solutions to predict, prepare for, and swiftly recover from the impacts of climate change. It specifically aims to empower electric utilities and rural electric cooperatives by providing them with tools to deliver clean and resilient energy services, enabling them to effectively address climate-related events and extreme weather conditions.[149]

NYSERDA's Renewable Optimization and Energy Storage Innovation Program provides over 100 solutions for energy storage, tackling challenges such as intermittent availability and low-capacity factors.[150] Additionally, the agency's Grid Modernization Program facilitates the integration of renewable energy sources in smart grid technologies to reduce GhG while cutting operating costs. Through this program, organizations and research teams can receive grants as participants in initiatives such as the Future Grid Challenge and Vehicle Grid Integration Program, which were developed to encourage innovation in electric power transmission, distribution, and EV integration.[151] So far, the Grid Modernization Program has helped 60 companies reach widespread market deployment.[152]

New York has also established the CEF and the NY Green Bank to support investment into clean energy projects and research. The CEF was established in 2016 to support the Reforming the Energy Vision (REV) initiative as a state financial commitment of $5 billion over 10 years to energy efficiency and renewable energy deployment at scale.[153] The NY Green Bank, currently a division of NYSERDA, is an investment fund to help the state better target its clean energy and sustainable infrastructure investment money. The bank identifies areas in the market that cause concern for private investors and deploys its own funding to reduce the private sector's unease around green project investing.[154] It has funded deployment and innovation efforts across multiple clean technologies, advancing its goals in clean transportation, green affordable housing, building decarbonization in DACs, and energy storage. In the 2022–2023 fiscal year, NY Green Bank invested $858 million.[155]

New York's universities and colleges have also advanced clean energy innovation and deployment, leveraging innovative student ideas and projects for advancing building decarbonization efforts and increasing the use of high-efficiency and renewable energy technologies on campus. To support research and innovation for clean energy and carbon emission reductions in the state, Governor Cuomo developed REV Campus Challenge in 2015, later renamed to NYSERDA's Clean Green Campuses Initiative.[156] This initiative is directed at two- and four-year colleges and universities with the goal of fostering innovation and deployment efforts for decarbonization on campus. Those who join a network of institutions working toward similar goals can receive funds

and other assistance to complete energy audits and energy efficiency assessments, develop new energy manager positions, install solar panels and networks, connect faculty and staff to energy efficiency trainings, and more.[157] As part of this initiative, the Energy to Lead Competition ran in 2015, 2016, 2017, and 2020, challenging these institutions to develop projects that would involve student engagement and cost-effectively reduce GhG emissions and increase energy savings on campus. Selected colleges or universities received financial awards to help them complete the projects.[158]

While the Energy to Lead Competition is no longer active, NYSERDA has two other competitions—the Commercial & Industrial (C&I) Carbon Challenge[159] and Carbon Neutral Community Economic Development Program[160]—that similarly encourage the development of carbon-reducing or carbon-neutral projects. The C&I Carbon Challenge supports innovation by providing funding to organizations and businesses, specifically large energy users, to implement carbon reduction projects. With up to $15 million available, it encourages projects in electrification, carbon capture, and low-carbon fuels. The Carbon Neutral Community Economic Development Program also offers incentives for projects that strive for net-zero carbon emissions and energy efficiency, supporting the design, construction, and scaling of such facilities and community development projects. Winning projects showcase real-world examples of sustainable economic development initiatives.

Considerations

Like Massachusetts, innovation in New York has spurred significant investment in climatetech innovation companies across all stages, bolstered by well-funded academic institutions, large investor companies, and collaborative systems that encourage and support innovators. However, unlike Massachusetts, these actors are spread across the state, and New York is still building a strong network of stakeholders, leaving it with further to go in reaching an ecosystem like that of Massachusetts. Additionally, while growing, the state's manufacturing industry continues to lag behind Georgia partly due to Georgia's continuous auto manufacturing presence and lack of regulations. Meanwhile, New York is working to *rebuild* its manufacturing industry. In both cases, the state must invest more funding and develop aggressive policies to achieve a larger energy transition and clean energy expansion than the other states.

Following this comparative analysis is a literature review of Bangladesh's clean energy goals and challenges the nation may face when developing a policy framework to drive clean technology expansion. Similar to the states' histories and environments examined in the comparative analysis, this next section provides a context in which Bangladesh's own framework can begin to be developed.

Bangladesh National Clean Energy Targets

Bangladesh's earliest policy response to clean energy at a national level started with its Climate Change Strategy and Action Plan in 2009.[161] Recognizing the nation's significant

vulnerability to climate change, the plan builds its adaptation and mitigation strategy upon six pillars:

1. Food security, social protection, and health
2. Comprehensive disaster management
3. Infrastructure
4. Research and knowledge development
5. Mitigation and low-carbon development
6. Capacity building and institutional strengthening

Using this foundation, further documents have been developed such, as the Mujib Climate Prosperity Plan (MCPP) in 2022 or the current draft of the National Solar Energy Roadmap submitted in 2020.[162] In the Nationally Determined Contributions from 2015, updated in 2021 and driven by the Paris Agreement, Bangladesh aimed to reduce GhG emissions in the power, industry, and transport sectors in two scenarios based on 2011 levels: 5% below "business-as-usual" GhG emissions by 2030 using only domestic resources, and 15% below business-as-usual GhG emissions by 2030 with sufficient and appropriate support from developed countries.[163]

To fund these plans, the government of Bangladesh established the Bangladesh Climate Change Trust Fund (BCCTF) in 2009, gathering government and nongovernment sources. By 2022, approximately $490 million was allocated to 851 projects led by different government ministries, divisions, and nongovernment organizations. Other funding sources include the international Green Climate Fund (GCF) and the Green Climate Adaptation Fund.[164]

Electric Power Generation

Many energy targets have been made in the electric power generation technology sector. According to the 8th Five-Year Plan (FYP) in 2020, targets from the previous 7th FYP were mainly met or surpassed in indicators of electricity generation installed capacity, access to electricity by percentage of households, per capita generation of electricity, and share of renewable energy to total electricity generation (including hydropower). Per the last point, the MCPP outlines a 30% renewable energy goal by 2030 and up to 40% by 2041 with grid resilience and modernization, with international funding support.[165] This would allow Bangladesh to build its climate resilience, energy independence, and security.[166] In early 2024, the government updated these MCPP goals, outlining a 15% renewable energy target by 2030, 40% by 2040, and 100% by 2050.[167] Domestically, energy security will be driven by solar investments (rooftop, grounded, and floating), OSW, tidal power, and ocean thermal energy conversion. The National Solar Energy Roadmap draft prompts the government of Bangladesh to opt for its outlined high deployment case that aims for 30 GW of installed solar PV by 2041.[168]

Energy Efficiency

Starting with the Energy Efficiency and Conservation Master Plan, released in 2015, the primary goal in this sector is to achieve a 15% reduction of primary energy consumption per GDP by 2021 and 20% by 2030, compared to the 2015 level. This translates to a total savings of Bangladeshi taka (BDT) 768 billion, which is crucial in increasing national energy security by reducing the import of expensive fuels.[169] According to the MCPP, the Green Exports Program will help achieve this goal by enhancing energy efficiency in the manufacturing and agriculture industries and certifying exports that use LEED-certified factories and implement sustainability standards.

Transportation

Regarding transportation, the MCPP seeks improvement for both urban and rural areas through the deployment of technologies and incentives for investment. For instance, Bangladesh plans to establish an energy-efficient vehicle (EEV) manufacturing hub to promote production, as well as fiscal incentives through tax breaks for electric transportation by 2024, with the goal of enabling EEV and EV manufacturing to contribute up to 10% of GDP by 2030. Given the large population in cities such as Dhaka, 80% of public transport and the rideshare fleet will be electric by 2030. Therefore, the government is creating a significant domestic market for EVs while looking to enter regional and global markets through manufacturing. In addition, at least 50% of railway infrastructure will be energy efficient and climate resilient by the same year.

Efforts to pursue EV manufacturing in Bangladesh have already been underway. Significantly, two local auto manufacturers, Bangladesh Auto Industries Limited (BAIL) and Palki Motors Limited, are expanding the country's EV manufacturing industry. BAIL's EV plant, which started with an initial investment of $200 million, expects to launch its EV products in 2024.[170] Palki Motors Limited began as a start-up in Bangladesh in 2022 and is now considered the first EV manufacturer in Bangladesh with an EV plant in Dhaka.[171]

Bangladesh Considerations and Limitations

Meeting Bangladesh's clean energy targets and fostering economic growth through the clean energy sector will require addressing several key challenges and limitations. Bangladesh faces significant financing gaps in mobilizing the required investments for its clean energy transition, including limited national resources and a heavy reliance on international assistance and climate finance through bilateral, multilateral, and private finance sources.

Accounting for the MCPP's 30% renewable energy goal by 2030, 40% goal by 2041, and the high deployment case that aims for 30 GW of installed solar PV by 2041 as outlined in the National Solar Energy Roadmap draft, attracting the level of investment required to meet such targets, both from public and private sectors, remains a critical challenge. The MCPP's estimated level of investment up to 2030 is $89.72 billion.[172]

Bangladesh's Energy Sector Overview

Bangladesh uses a diverse array of both local and imported energy sources, such as natural gas, coal, oil, liquified petroleum gas, liquified natural gas (LNG), and hydroelectric power. Biomass alone makes up about 25% of the nation's primary energy use, while commercial energy sources such as natural gas account for roughly 59%.[173] In terms of electricity generation, solar home systems deliver approximately 723.68 megawatts (MW), agricultural biogas adds about 0.69 MW, and biomass gasification contributes 0.4 MW.[174]

The country's total energy consumption stands at about 57.20 million tonnes of oil equivalent, with a yearly increase in energy use averaging 6%. However, per capita energy consumption and power generation remain relatively low compared to other South Asian countries.[175]

Bangladesh's power sector is therefore at a crossroads, and the transition toward clean energy presents several challenges.[176] Major investments are required to upgrade grid infrastructure and cultivate local expertise to manage and expand renewable technologies effectively. The role of international financial and technical assistance remains crucial.

Bangladesh's energy sector faces several challenges, including overcapacity, rising generation costs, and fuel shortages. The installed capacity greatly surpasses the actual demand for power, a discrepancy due to overly optimistic projections of growth. As a result, only 40% of installed capacity was used during the 2019–2020 fiscal year.[177] The depletion of natural gas reserves in Bangladesh has necessitated a greater dependency on imported fuels such as coal and LNG. This shift has been further exacerbated by global economic pressures, notably the dollar crisis exacerbated by the current exchange rate regime and by policies enacted by the US Federal Reserve in 2022. Consequently, this increased reliance on imported fuels has driven up the cost of power generation by 33% during the 2021–2022 period, and power tariffs and energy subsidies are likely to continue rising as a result.[178]

Bangladesh has fallen short in meeting its renewable energy targets. By June 2023, the country had managed to produce less than 5% of its electricity from renewable sources, well below the initial target of 10% set for 2020.[179] As stated earlier, new objectives aim for 15% by 2030,[180] 40% by 2041,[181] and a complete transition to renewables by 2050.[182] Some promising studies have shown that solar power alone could meet about 80% of the country's expected energy demand by 2041,[183] emphasizing the potential for renewables to significantly reduce dependence on imported fossil fuels and enhance the national economy.[184]

Support and Readiness for Climate Finance

Bangladesh faces considerable challenges in readiness for climate finance, ranking 163rd globally with an ND-Gain score of 37.5, highlighting its position as one of the least ready yet most vulnerable countries to climate impacts.[185] Additionally, it ranks 7th in climate vulnerability per the Global Climate Risk Index.[186] Following COP26, Bangladesh

was chosen as a pioneering nation for a climate finance task force aimed at facilitating the execution of national climate strategies through capital grants.[187] The country has also benefited from the GCF's Readiness and Preparatory Support Programme, which has bolstered institutional capacities and financial access, essential for developing the Green Climate Adaptation Plan.

Despite being one of the top recipients of climate finance globally, Bangladesh faces significant financial limitations. Traditionally, it has received funds from a range of donors, including multilateral development banks (MDBs), the Global Environment Facility (GEF), Climate Investment Funds (CIF), various bilateral sources (e.g., the US Agency for International Development, the Swedish International Development Cooperation Agency, the German Corporation for International Cooperation, and the United Kingdom's Foreign, Commonwealth, and Development Office), and United Nations agencies such as the UN Development Programme and the UN Environment Programme. From 2016 to 2019, the country received approximately $5.19 billion in climate-related development finance, with the International Development Association, the Asian Development Bank (ADB), and the government of Germany being the top contributors.[188]

Local efforts, including the BCCTF (a national climate fund that can be supplemented through fund matching by international climate funds) and the Country Investment Plan for Environment, Forestry, and Climate Change, have mobilized domestic resources.[189] CIF, the GEF, and the GCF are examples of international climate funds and support for green growth that comes from both multilateral and bilateral sources.

To date, Bangladesh has received funds from several key international climate finance sources—$160 million in the form of grants and $1.037 billion in additional co-financing for 58 projects under the GEF, $374.0 million for 7 projects, and $380.1 million including US$ 6.1 million in grants for 8 readiness activities under the GCF. Additionally, 12 projects have been approved in Bangladesh with $193.82 million from CIF funds and $1.85 billion in co-financing from MDBs, the government, the private sector, and others.[190]

Strategies for Climate Finance and Green Growth

Bangladesh's approach to green growth and climate resilience includes anticipatory climate and disaster risk management. National funds such as the BCCTF are instrumental, potentially enhanced by international fund matching. The strategic withdrawal of capital from sectors like coal and the redirection into renewable energy, storage, and grid modernization are pivotal. This transition requires innovative financing structures to improve debt conditions and reallocate subsidies toward climate mitigation and adaptation efforts.

Over $200 billion will be required in climate action financing in the next two decades, according to a recent green growth document prepared by World Bank and presented to the Economic Relations Division in June 2023.[191] The Minister of Environment, Forest,

and Climate Change recently announced the government is working committedly for climate adaptation actions by spending $3.5 billion every year but requires $9 billion annually for climate adaptation alone.[192]

An $8 billion fund has been unveiled by a coalition of development partners to help Bangladesh mitigate and adapt to the effects of climate change. Led by the International Monetary Fund, the Bangladesh Climate and Development Platform is being supported by the ADB, the World Bank, the International Finance Corporation, the Multilateral Investment Guarantee Agency, the Asian Infrastructure Investment Bank, the Agence Française de Développement, the GCF, the government of South Korea, the Japan International Cooperation Agency, the United Kingdom, and the European Union and the European Investment Bank, as part of Team Europe.[193]

In Bangladesh, the private sector is now underused as a delivery mechanism for climate finance, with merely 1% of these funds being channeled through it at the national level.[194] With the impending LDC graduation in 2026, the country must seek to diversify financing strategies and engage the private sector more robustly to manage rising costs of finance and debt servicing.

Gaps in Supply Chain and Infrastructure

Drawing upon the experiences of Georgia, Massachusetts, New York, and Texas, several specific policy recommendations emerge for Bangladesh's clean energy transition that could help develop critical capabilities, workforce skills, and industrial capacity. These recommendations focus on leveraging Bangladesh's existing industrial strengths while building new capabilities for the clean energy economy. Bangladesh lacks comprehensive domestic supply chains and manufacturing capabilities for renewable technologies, primarily relying on imports that inflate costs and foster dependency.[195] Strengthening local supply chains, boosting manufacturing, and advancing technical skills in clean energy are vital for affordable and sustainable energy solutions.[196] Moreover, integrating power from variable renewable energy sources, primarily solar power, poses additional challenges for the existing grid infrastructure and management.[197]

In the manufacturing sector, Bangladesh would do well to consider building on its existing strengths and can learn valuable lessons from Georgia's successful EV manufacturing transition. To leverage Bangladesh's strong textile and apparel industry, we recommend exploring opportunities to manufacture advanced building products, such as mineral wools and fiber-based building products. Specifically, Bangladesh could consider retooling its textile manufacturing sector to a) produce efficient textiles that conserve energy, energy-efficient window and door coverings, and other thermal applications; b) use captive renewable energy resources to meet demand for production; and c) implement new equipment and processes to reduce energy consumption. There may also be an overlap in producing wind blade "kits" that can be exported for final assembly. Workers experienced with automated fabric-cutting machines and precise manufacturing

processes could be retrained to produce components for solar panel backing materials and energy-efficient building products.

In addition to textiles, Bangladesh could expand its growing sectors related to ship building to support the OSW industry. Furthermore, to build on the IT sector, the country could focus on EV charging systems, which more closely resemble computer hardware than electrical devices.

Several textile worker skill sets align with clean energy supply chain activities. For instance, machine setters and binders, with appropriate short-term technical assistance, can be trained for a number of important occupations, from metalworking necessary for the OSW and automotive sectors to Computer Numerical Control machines, which are critical for secondary steel, automotive, battery, and renewables component manufacturing. The innovation and technical training approach could be modeled after Massachusetts's highly successful MassCEC program but adapted to Bangladesh's specific context. A centralized clean energy center could coordinate workforce development, innovation initiatives, and industry partnerships across the country. This center could establish specialized technical training programs for solar installation and maintenance, targeting the country's ambitious solar energy goals. Additionally, it could develop comprehensive training programs for manufacturing energy storage components and implementing quality control protocols for clean energy products. Together, these initiatives could be particularly focused on creating pathways for young workers entering the workforce and mid-career professionals transitioning from traditional industries.

Drawing from New York's comprehensive approach to supply chain development, Bangladesh could implement policies that strengthen some aspects of domestic manufacturing capabilities while ensuring local economic benefits. This could include requirements for clean energy projects to source a minimum percentage of components from domestic manufacturers, with percentages gradually increasing as local capabilities develop. Projects could also be required to submit detailed plans for training and hiring local workers, similar to New York's SCIPs. Furthermore, partnerships between project developers and local technical institutions could be mandated to ensure sustainable workforce development and knowledge transfer.

While Texas's deregulated approach to renewable energy deployment may not directly translate to Bangladesh's context, valuable lessons can be drawn from its transmission planning and grid integration strategies. Bangladesh could develop specialized workforce training programs focused on grid modernization and renewable energy integration. Additionally, technical certification programs could be established for renewable energy installation, with standards adapted to Bangladesh's unique climate and infrastructure challenges. The country could also focus on building expertise in battery storage integration and management, critical for managing intermittent renewable energy sources in a developing grid system.

While ready-made garment production has been a significant and profitable industry in Bangladesh's economy, providing employment opportunities to many women and

youth without access to education, the lack of high-skilled labor may present challenges as the country looks to bolster advanced manufacturing for clean energy technologies.[198] At the same time, recent movements toward increasing automation in the textile industry, such as fabric-cutting machines, may provide upskilling opportunities for workers and more transferable skills for the clean energy industry.[199]

Geographic and Environmental Challenges

The geographical and environmental conditions of Bangladesh, a densely populated and low-lying nation, pose unique challenges to deploying clean energy technologies. Natural disasters such as cyclones and floods, coupled with limited land for large-scale renewable projects, necessitate innovative approaches such as OSW or floating solar systems.[200] The country's high humidity and salinity also impact the efficiency and longevity of technologies such as solar panels and wind turbines, requiring more robust maintenance and adaptation strategies.[201]

Additional hurdles include Bangladesh's large informal labor market. Agriculture is a key component of the country's economy, and developing climate-smart processes has been recognized as a critical element in enhancing the resilience of the industry. However, because the majority of farmers are smallholders, many might not be able to afford or have the time to obtain the training or other support that would facilitate this transition.[202]

It can also be difficult to find skilled human resources in Bangladesh with the expertise required in the energy sector to promote clean energy, such as those who can install, maintain, and service solar energy equipment. Creating retraining programs to overcome these skills gaps for workers impacted by the energy transition could advance the transition and lead to more equitable results.[203]

Bangladesh's Education Sector Overview

Bangladesh is making considerable progress in enhancing its education system, particularly by expanding fundamental educational facilities, increasing access to secondary and vocational education, and boosting skills development aimed at economic transformation.[204] Initiatives are being taken to promote inclusive, quality education, accelerate higher education programs, target NEET (not in education, employment, or training) populations, broaden technical and vocational education, and refine the higher education framework to build a robust educational infrastructure.[205] These measures are crucial in supporting sectors such as clean energy, yet they necessitate continued investment in educational infrastructure, teacher development, and curriculum modernization to meet the needs of a technologically advanced and green economy.[206]

Across the country, nearly 1.7 million short-term skills trainings were offered in the 2019–2020 fiscal year, across 58 agencies within various government ministries and divisions.[207] Almost 1.3 million of these trainings were considered fresh skills trainings,[208] and 25% of the total trainings were hosted by Bangladesh's Skills for Employment and Investment Programme. While the highest concentration of the 1.7 million trainings

focused on the information and communications technology (ICT) sector (17%), the light engineering and construction sectors also hosted significant proportions of the trainings, 14% and 8%, respectively. According to a US Energy and Employment report, these industries will be very important to the energy transition in Bangladesh given that they involve many types of construction and manufacturing activities.[209] The light engineering and construction sectors will cover the majority of trainings for the direct installations of clean energy technologies, including electrical systems, HVAC systems, welding, and industrial machines. Additional clean energy trainings can be found throughout multiple sectors such as transport, informal, and ICT to advance skills in driving, solar installation, computer-aided design, and administration. To align with the country's 2021 National Skills Development Policy, Bangladesh anticipates over 8.6 million trainings across the 58 agencies from 2022 to 2027, with more than 12% in light engineering and nearly 10% in construction.[210]

BRAC, an international development organization headquartered and founded in Bangladesh, has also implemented skills development programs across the country. BRAC targets vulnerable and geographically isolated youth to help them develop professional skills and find jobs. Over 441,000 Bangladeshis, of whom 60% are women, have accessed BRAC's skills development offerings, and 78% of participants have secured jobs after completing the programs.[211]

Cross-cutting programs, inspired by New York's comprehensive strategy, could help tie these various elements together. Regional clean energy training centers could be established in alignment with existing industrial clusters, providing locally relevant training and certification programs. Apprenticeship programs could be specifically designed to facilitate the transition from textile manufacturing to clean energy component production, building on existing workforce skills while developing new capabilities. Quality control certification programs could also be implemented to ensure that domestically manufactured clean energy components meet international standards, improving export potential and domestic reliability.

To support the country's clean energy transition and expansion efforts, the Bangladeshi National Skills Development Authority, alongside other agencies that offer education and work training, should identify and support the anticipated trainings involved in clean energy-related activities, such as those mentioned previously. Support in terms of the total number offered, increased accessibility, and interest or enrollment in the trainings can help Bangladesh's workforce grow and prepare for the energy transition. Similar to Georgia's Electric Vehicle Career Pathway program, Bangladesh agencies may also want to consider incorporating clean technology-specific curriculums into the education system's lessons and the anticipated training offerings to expose students and training participants to potential specializations they may pursue.

Bangladesh's Private Sector Involvement in Economic Development

The private sector has been instrumental in Bangladesh's goal to become a middle-income nation by 2031 and a developed country by 2041. During the 2021–2022 fiscal year, private investments accounted for 24.06% of the country's GDP, while $2.66 billion in foreign direct investment flowed into Bangladesh between January and September 2022.[212] To increase private sector-driven economic growth, the government has taken steps by setting up special economic zones, extending incentives to attract investors, and establishing specialized agencies. Institutions such as the Bangladesh Investment Development Authority, the Bangladesh Export Processing Zone Authority, the Bangladesh Economic Zones Authority, banks, and nonbank financial institutions have been supporting private sector and PPP initiatives in infrastructure, energy, manufacturing, and economic zones. This in turn has increased investments, loan disbursements to small- and medium-sized enterprises, commercial production, and employment opportunities in Bangladesh.[213] The private sector continues to show interest in fields such as ICT, energy, and education and is playing a crucial role in diversifying into renewable energy through both local and global initiatives. Historically, the private sector played a critical role in driving economic growth in industrial clusters such as textiles and garments, making Bangladesh a key exporter in the field.

Currently, the private sector shows significant interest in diversifying into renewable energy sectors. Around 30 renewable energy projects in Bangladesh have seen a total investment of approximately $1.374 million, with the private sector contributing around $850 million—62% of the total.[214]

Conclusion

There are multiple approaches to clean energy expansion, as demonstrated by the US state models analyzed in this policy paper. These models have succeeded by leveraging existing strengths before an existing domestic market. Although each state has its own set of challenges to consider when implementing policies and actions, the strategy instilled in each model's approach can provide a strong framework for the Bangladeshi government's program development in clean energy and decarbonization efforts.

While the Massachusetts model provides an important framework for developing new technologies, creating high wage jobs, and attracting significant foreign investment, Bangladesh faces critical obstacles that would suggest a more balanced approach to clean energy policy development. These obstacles include historically low levels of investment in R&D among government agencies and the private sector—in fact, some of the lowest levels in the world as a share of GDP. Investment, particularly from government, is critical to assist burgeoning start-ups.

Bangladesh faces other key challenges regarding supply chain development. While some of its strongest sectors have some overlap with clean energy technologies, the

solar, wind and battery technology industries require higher value-added labor skills to produce such advanced manufacturing. Components such as wind nacelles, turbine blades, and EV batteries must meet strict performance metrics, with little tolerance for defects in extreme temperature environments. The demand for highly skilled workers in these areas is therefore quite high. This aligns with the government's upskilling goals and underscores the need for significant investment in workforce development, technical assistance, and financing for equipment upgrades. Furthermore, with globalization appearing to be in continuing retreat and protectionist measures becoming more common in the region, Bangladesh cannot expect to rely solely on exports and will need to develop a local market for its manufacturing strategy to be effective.

Bangladesh also cannot expect to have a hands-off approach to deployment and expect results similar to Texas, which has abundant natural resources, high electricity demand, and a large labor force of middle-skill workers. Bangladesh lacks the land, cost structures, and workforce to expect results from merely reducing or eliminating regulations. However, domestic demand will be critical to attracting investment in both R&D and manufacturing.

Adopting a comprehensive approach that mirrors similar frameworks to the ones adopted in New York will require a multifaceted strategic approach. First, Bangladesh should consider adopting a robust suite of policies to support an innovation ecosystem. Such strategies could include tech transfer and partnership support with global academic institutions, robust incubator and accelerator programs focused on clean energy deployment and not mere shared workspaces, microgrants and loans to start-up endeavors, and collegiate internship programs that defray the cost to employers in the ecosystem.

Additionally, innovation support can lead to stronger supply chains, and policy can play an important role in its development. New York offers interesting models in how to support manufacturing, particularly in precision manufacturing and fabrication. These include grants and low-interest financing for factory improvements, technical assistance and training, market development guidance, and vocational training and retooling programs. Together with more traditional economic development incentives related to land, energy, tax, and labor, these efforts can create significant new opportunities for upskilling workers in Bangladesh. They also allow important diversification and expansion of businesses and workers in the existing textile industries.

Bangladesh would also be wise to consider expanding its own domestic market, similar to how New York has spurred its burgeoning OSW supply chain by creating project incentives that maximize local labor and components. In Bangladesh, this would include accelerating clean energy targets, providing tax credits and incentives for projects that source goods locally, and workforce training programs to develop a high-skilled construction trade sector to further stimulate the economy.

These recommendations recognize that successful implementation will require significant coordination between government agencies, educational institutions, and private

sector partners. They also acknowledge the need to balance ambitious clean energy goals with practical workforce development considerations and existing industrial capabilities. By carefully adapting successful elements from US state programs while considering Bangladesh's unique context, these policies could help facilitate a successful clean energy transition while supporting economic development and workforce advancement.

Given these unique constraints and opportunities, we recommend that Bangladesh consider the more balanced and comprehensive approach to policy and investment that has been adopted in New York. We further recommend that the government of Bangladesh conduct a rigorous Strengths, Opportunities, Weaknesses, and Threats (SWOT) analysis of its current infrastructure, labor market, policy mechanisms, foreign public and private investments, and potential and appetite for new domestic and foreign investment. This analysis should include a prioritization of goals and activities and a balance of domestic energy production and export market development. The resulting data can serve as a basis for necessary policy frameworks and ensure that Bangladesh adopts a thoughtful, comprehensive, and synergistic approach to expanding and decarbonizing its economy while significantly upskilling its workforce and creating wealth for its citizens.

The key to successful implementation will be phasing these programs appropriately, ensuring adequate funding and support, and maintaining flexibility to adapt to changing technological and market conditions. Regular evaluation and adjustment will also be essential to ensure that these programs effectively meet the needs of both workers and the emerging clean energy sector in Bangladesh.

Appendix A: Programs and Policies

Below is a table of selected programs and policies implemented in Massachusetts and New York mentioned in the paper.

State	Program/Policy	Brief Description	URL/Link
MA	Massachusetts Clean Energy Center's (MassCEC) InnovateMass	InnovateMass offers up to $350,000 in grants to clean technology start-ups to target those who have already received early stage support but still need support getting into the investment and commercialization stages of development. The funding through InnovateMass is offered on a rolling basis.	https://www.masscec.com/program/innovatemass
MA	MassCEC's AmplifyMass	Through AmplifyMass, climatetech project groups at small businesses and academic institutions in the state can receive financial assistance of up to $300,000 from MassCEC to cover cost-share requirements from federal/nonfederal prime awards or adder-funding for these awards.	https://www.masscec.com/program/amplifymass
MA	MassCEC's Catalyst and DICES	The Catalyst and DICES programs, through MassCEC and MassVentures, were developed to help innovators with their climatetech prototype demonstrations, running biannually. Catalyst awardees can receive up to $75,000 in grant funds as well as networking opportunities and business development guidance. Overall, Catalyst aims to increase the commercialization of Massachusetts's own climate and clean energy technologies and innovative ideas. DICES works in tandem with Catalyst by granting additional funds, up to $75,000, to three projects, targeting project leaders "who are underrepresented in the Climatetech industry or faced economic barriers entering the environmental or entrepreneurial landscape" (par. 3).	https://www.masscec.com/program/catalyst-and-dices
MA	MassCEC's Bridging Recovery for Innovators Driving Green Energy Solutions (BRIDGES) Program	In late 2020, MassCEC created its BRIDGES Program to increase and encourage early stage investing in clean energy companies during the COVID-19 pandemic, when many investors began pulling back due to widespread uncertainties. Through this program, MassCEC and its partners invested $1.9 million in eight clean energy start-ups to cover continued operations and development costs, which paved the way for an additional $9.4 million from other investors. As a result, these eight companies were either acquired by other companies or were able to receive even more funding later on.	https://web.archive.org/web/20230116011501/https:/www.masscec.com/press/masscec-led-syndicate-announces-19-million-funding-support-clean-energy-startups-impacted https://www.masscec.com/press/baker-polito-administration-launches-new-50m-venture-fund-focused-climatetech

State	Program/Policy	Brief Description	URL/Link
MA	Advancing Commonwealth Energy Storage (ACES)	The ACES program, part of the state's Energy Storage Initiative, aims to accelerate the adoption of energy storage technologies and address the evolving needs of the electric grid. It began in 2017 and is still active today, having awarded $20 million to energy storage demonstration projects. Overall, it has helped to educate stakeholders, reduced investment risks, and contribute to the rapid growth of the energy storage market.	https://www.masscec.com/program/advancing-commonwealth-energy-storage-aces
MA	MassCEC's Clean Energy Internship Program	A public-private partnership between MassCEC and clean energy employers across the state facilitates MassCEC's Clean Energy Internship Program, which was designed to support both clean energy and water innovation companies registered in the state, as well as college students and recent graduates interested in the field. MassCEC provides funds to participating companies so that they can offer paid internship opportunities to these college students and recent graduates. To date, almost 6,000 interns have been placed (65% of whom identify as women and minorities) and over 600 companies from across state, with a high concentration in or around Boston, have participated since the program's beginnings in 2011. This program facilitates a strong pathway for entry into the clean energy and water innovation workforce, as around 1,000 interns have moved into full- or part-time employment at the companies with which they completed their internships.	https://www.masscec.com/program/clean-energy-internship-program-employers https://www.masscec.com/clean-energy-internships-students
MA	Innovation Career Pathways Initiative	Employer, public, and academic institution partnerships enable the Massachusetts high school Innovation Career Pathways initiative, which provides opportunities for high school students in the state to gain exposure to, and experience in, high-demand industries such as IT, advanced manufacturing, and clean energy at no cost. Local employers, workforce development boards, and high schools collaborate to develop and deliver this initiative. Students participating can gain work-based learning experience and lessons in their chosen pathway. The Innovation Career Pathways first started in 2017, but only recently, in 2024, will a Clean Energy Pathway be incorporated. Five high schools will be piloting this Clean Energy Pathway during the 2024/2025 school year with the hope for full implementation the following school year.	https://www.mass.gov/news/healey-driscoll-administration-awards-new-innovation-career-pathways-to-36-high-schools#:~:text=The%20new%20Clean%20Energy%20Innovation,time%20to%20travel%20to%20Carver https://www.mass.gov/news/healey-driscoll-administration-announces-clean-energy-innovation-career-pathway-for-high-school-students

State	Program/Policy	Brief Description	URL/Link
MA	MassCEC's EmPower Massachusetts	EmPower Massachusetts, a MassCEC investment program, was specifically designed to incentivize clean energy and energy efficiency innovation and project development in low-income and underserved communities by providing grants to innovators and project developers. Community-based organizations, federally recognized and state-acknowledged tribes, clean energy technology installers, municipalities, individuals, and others are eligible to apply for funds. Applicants can receive an Innovation and Capacity-Building Grant between $5,000 and $50,000 to begin early exploration of innovative clean energy and energy efficiency solutions and increase organizational capacity to do so. For projects ready for implementation, recipients may be granted an Implementation Grant between $50,000 and $300,000.	https://www.masscec.com/program/empower-massachusetts
MA	Accelerating Clean Transportation for All (ACT4All)	The ACT4All program was implemented by MassCEC from 2021 to 2022 to simultaneously increase access to clean transportation options for low-income residents and people of color, who typically live in communities with historically poorer air quality and higher levels of pollution, and support the ideas and projects put forth by local organizations. The program gave $10 million in grants to 10 different projects, run by various community-based and nonprofit organizations. This funding helped to provide clean transportation options such as e-bikes, electrical vehicle education, and carpooling services. ACT4All was successful and has led to an ACT4All Round 2, which will be established in 2024 with the same purpose.	https://www.masscec.com/program/accelerating-clean-transportation-all-act4all
MA	Massachusetts Offshore Wind Industry Investment Fund	While the bill that introduced the Massachusetts Offshore Wind Industry Investment Fund primarily focuses on offshore wind (OSW) energy advancement, it also incorporated considerations for supporting low- and moderate-income households in making their homes more energy efficient and environmentally friendly.	https://cleanwater.org/new-england-offshore-wind

State	Program/Policy	Brief Description	URL/Link
MA	MassBIO	MassBIO creates networking spaces for biotech stakeholders by planning events hosted by industry leaders, for example, their upcoming DEI & Health Equity Roundtables, moderated by Chris Reddicka, a vice president at Takeda, and Caroline Mailloux, a senior director at Sarepta. MassBIO has also helped companies like Stealth BioTherapeutics,[215] Empiriko,[216] and Alexion[217] realize their ideas and products while growing their organizations. These professional networks have played an integral role in creating and maintaining the strong biotech industry in Massachusetts.	https://www.massbio.org/dei/ https://www.massbio.org/members/
MA	Cambridge Innovation Center (CIC)	To facilitate networking and business development, the CIC hosts weekly coffee gatherings to bring together the local biotech innovation crowd for networking.	https://cic.com/attend-an-event/#site/2048/event/29585
MA	Massachusetts Life Sciences Center (MLSC): Workforce efforts	The MLSC works to create jobs and increase investment into life science research fields. It also prioritizes increasing and supporting the workforce pipelines. The MLSC has provided STEM equipment to public middle and high schools in Massachusetts and worked to create pathways from the K–12 grade school level into the biotech workforce. It has also leveraged the brainpower of the local population by partnering with world-renowned universities and biotech companies in the Greater Boston area to support the workforce ecosystem, including funding over 4,000 internships.	https://www.masslifesciences.com/about/funding-impact/
NY	Value of Distributed Energy Resources (VDER) incentive	With the VDER incentive, or the Value Stack, attached to the NY-Sun program, customers or residents can pay a developer to install and connect a new distributed energy system. Once connected, the utility adds credits or discounts to the customers' bills based on the value of the energy produced in their new energy system.	https://www.nyserda.ny.gov/All-Programs/NY-Sun/Contractors/Value-of-Distributed-Energy-Resources
NY	Megawatt Block Incentive	The Megawatt Block Incentive encourages homeowners to install solar power, as in certain parts of the state, they can receive utility refunds for their installed solar power, per watt. These incentives will be phased out once solar installations become more affordable on the market.	https://www.nyserda.ny.gov/All-Programs/NY-Sun/Contractors/Dashboards-and-incentives

State	Program/Policy	Brief Description	URL/Link
NY	K-Solar	K-Solar, administered through New York State Energy Research and Development Authority (NYSERDA) and New York Power Authority (NYPA), was designed to increase solar deployment in public school districts and Board of Cooperative Educational Services (BOCES) facilities. Through this program, public school districts and BOCES can install solar energy at their facilities free of charge. In doing so, their electricity bills are reduced.	https://www.p12.nysed.gov/facplan/K-Solar.html
NY	EmPower	The EmPower program, which was originally started in 2004 and updated in 2023, becoming the EmPower+ program, is another effort to lower the cost of solar installation for low- and moderate-income households. It specifically targets households, both homeowners and renters, that are either earning 80% less than the New York median household income or are part of a utility payment assistance program.	https://www.nyserda.ny.gov/All-Programs/EmPower-New-York-Program#:~:text=EmPower%2B%20helps%20low%2D%20and%20moderate,made%20to%20their%20primary%20residence.&text=Households%20can%20receive%20a%20no,plan%20to%20lower%20energy%20usage https://www.epa.gov/system/files/documents/2024-01/empower-program-profile-draft_revised_2024-01-15_508.pdf https://www.nyserda.ny.gov/All-Programs/EmPower-New-York-Program/Eligibility-Guidelines
NY	Solar for All	Through New York's Solar for All program, eligible households who register, free of charge, are connected to a community solar project, and the power from that project feeds into the local grid. These households then receive credit from the utility companies for the solar power coming from the project the households are subscribed to, and these credits are added to household utility bills. On average, households are saving between $5 and $15 on their monthly bills. Eligibility is based on the number of people in the applicant's household and the household income.	https://www.nyserda.ny.gov/All-Programs/NY-Sun/Solar-for-Your-Home/Community-Solar/Solar-for-All https://www.nyserda.ny.gov/All-Programs/NY-Sun/Solar-for-Your-Home/Community-Solar/Solar-for-All/Solar-for-All-Eligibility
NY	NY Prize	NY Prize is a $40 million program that encourages the development of new microgrids to the energy infrastructure. Communities that come together and develop their own microgrid, or a "a self-sufficient energy system that serves a discrete geographic footprint," are eligible to earn financial awards through this program since their locally produced electricity is cheaper to transfer. In addition, the communities can sell any excess electricity they do not use back to the grid for other purposes.	https://www.microgridknowledge.com/about-microgrids/article/11429017/what-is-a-microgrid https://dos.ny.gov/system/files/documents/2020/10/jan8.pdf

State	Program/Policy	Brief Description	URL/Link
NY	Charge NY	Charge NY is an initiative run by NYSERDA to increase the number of electric vehicles (EVs) and charging stations on the road. Through the program, customers can get rebates for purchasing EVs and discounts on highway tolls for driving one. EV retailers can also receive rebates for purchasing EV stocks and assistance with marketing campaigns. To incentivize greater EV charging installations, Charge NY includes incentives for facilities to install level 2 EV charging stations.	https://www.nyserda.ny.gov/About/Publications/New-York-Clean-Energy-Industry-Report
NY	New York State (NYS) Clean Heat initiative	The NYS Clean Heat initiative is expected to result in four trillion BTUs in energy savings. Its website includes a functionality where residents can enter their home address and see all the heat pump rebates they are qualified for based on their locations. Through this website, residents can also receive low-interest loans for heat pump installations and view the federal government Inflation Reduction Act (IRA) heat pump tax credits for which they are qualified.	https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Programs/clean-heating-and-cooling/2022-NYS-Presentation-Deck.pdf https://cleanheat.ny.gov/
NY	Build Smart NY	The Build Smart NY program was administered by NYPA to help the state reach its energy efficiency goals. With approximately $800 million, NYPA supported many energy efficiency projects across the state, including at state university campuses. In 2022, NYPA created BuildSmart 2025 to provide additional resources for New York to reach its energy efficiency goal under Governor Hochul's Executive Order 22. Through this program, eligible NYS entities can complete energy audits, access advisory services on completing energy efficiency projects, and receive assistance with financial planning for these projects.	https://www.nypa.gov/news/press-releases/2017/20170308-buildsmartny-progress-report-highlights https://www.nypa.gov/services/clean-energy-solutions/buildsmart https://services.nypa.gov/en/Services/Incentives/BuildSmart-NY?_gl=1%2A3vnyow%2A_ga%2AMTk2MTg4NTA5MC4xNzEzNjM5NTcx%2A_ga_22LJF9FSS1%2AMTcxNDA2Nzk3MS40LjEuMTcxNDA2ODU3OC41Ni4wLjA
NY	NY Battery and Energy Storage Technology (NY BEST) Consortium	Since 2010, the NY BEST Consortium has been promoting the deployment, innovation, and commercialization of battery and energy storage technologies. As of 2024, the consortium has grown to include over 185 members.	https://ny-best.org/page/AboutNYBEST
NY	New York State Smart Grid Consortium	The New York State Smart Grid Consortium is a not-for-profit corporation that brings together stakeholders and industry leaders from both public and private sectors to work toward a common goal: the promotion and implementation of smart grids across the state.	https://www.nyserda.ny.gov/All-Programs/Grid-Modernization-Program/NYS-Smart-Grid-Consortium

State	Program/Policy	Brief Description	URL/Link
NY	NY Grid CONNECT	NY Grid CONNECT aims to drive innovation in New York by building a low-carbon and resilient grid. Through this collaboration, stakeholders together work to address the challenges of implementing new technology and devise solutions aligned with the state's electric grid priorities. The initiative focuses on five key areas: stability, resilience, flexibility, storage as a grid asset, and grid-enhancing technologies.	https://gridconnect.nyserda.ny.gov/
NY	National Offshore Wind Research and Development Consortium	To support OSW innovation, in 2018, NYSERDA and the US Department of Energy together funded ($20.5 million each) the start of a National Offshore Wind Research and Development Consortium. As a nonprofit organization, the consortium supports innovation efforts intended to find the most cost-effective OSW development strategies.	https://nationaloffshorewind.org/about/ https://nationaloffshorewind.org/wp-content/uploads/NOWRDC-Research-Development-Roadmap-4.0.pdf

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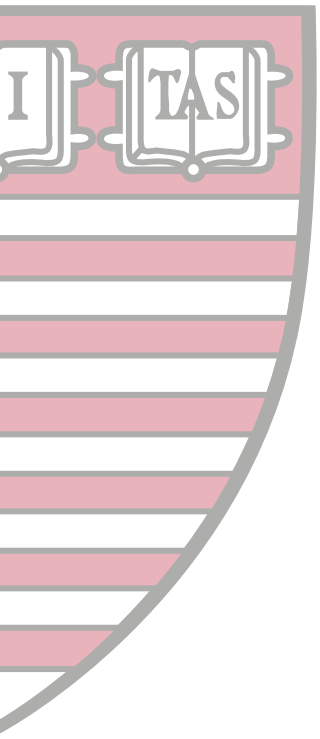

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