

nationalgrid



The Future of Electric Networks in Massachusetts

Building a Smarter, Stronger, Cleaner and More Equitable Energy Future

Executive summary

National Grid is Committed to Delivering the Clean Energy Future and a Just Transition

The nation and our region are at an inflection point on climate and energy. The Northeast has established leading climate change, clean energy, and equity goals – goals that we share at National Grid. To meet them, we must begin building for the future now. We have an opportunity to make real and lasting change for all our customers across New York and Massachusetts. It will take innovation, collaboration, and policy reform to achieve a clean energy future that is reliable, affordable and works for all.

At National Grid, we are ready — and excited — to do our part. And our work is already underway.

Our Clean Energy Vision is our plan to achieve the fair, affordable, clean energy transition for all our customers and communities.

It is rooted in a strategy that:

- Drives down energy use through efficiency and demand response, helping to reduce costs and maintain customer affordability.
- Advances smart electrification and builds the smarter, stronger, cleaner electric network of the future.
- Right sizes and decarbonizes the existing pipeline network, making it both leaner and cleaner.

Contents

Executive summary	02
Policy Changes to Build the Future Electric Network and Deliver the Fair, Affordable and Clean Energy Transition	03
Massachusetts Is on an Electrification-based Path to Achieve Net Zero Emissions	04
Investments Are Needed in Three Key Areas to Enable the Future Electric Network	05
Today's Electric Grid Is Neither Sufficient nor Ready to Meet Tomorrow's Needs	06
The Future Grid Plan Is a Roadmap to Accelerating Electrification and Achieving Net Zero Emissions	08
Executing the Energy Transition Requires a Ready Workforce and Available Supply Chain	10
A Fair, Affordable, and Clean Energy Transition Requires Policy Changes	12
Conclusion	14
About National Grid	15

Utilities, policymakers, regulators, and stakeholders all have a role to play in delivering a successful clean energy transition, including by working together to make the necessary policy changes at the state and federal levels to enable the timely and responsible build-out of necessary infrastructure, facilitate the rapid deployment and adoption of renewable energy and clean technologies, and ensure all customers and communities can participate in and benefit from the transition.

Policy Changes to Build the Future Electric Network and Deliver the Fair, Affordable and Clean Energy Transition

Policy Changes	Key Actions
<p>Accelerate investments to modernize and optimize the network to connect renewables, enable electrification, and build resilience to a changing climate, including through:</p>	<ul style="list-style-type: none"> • Reforming the permitting process to make it more transparent and predictable, • Advancing anticipatory planning and investment, • Adequately staffing and resourcing oversight agencies, and • Ensuring the timely review and approval of regulatory filings.
<p>Enable customer deployment and adoption of clean, decarbonized technologies and facilitate the cost-effective connection of local, clean energy resources, including through:</p>	<ul style="list-style-type: none"> • Reforming the interconnection process to support a “first-ready, first-served” model, and more fairly distributing the costs of system upgrades, • Advancing innovative and flexible rate designs to reduce peak demand, and • Enabling targeted electrification pilots through integrated energy planning.
<p>Ensure families and businesses can afford their energy bills and easily access savings and assistance programs that place equity at the heart of the transition, including through:</p>	<ul style="list-style-type: none"> • Expanding assistance program eligibility, • Transitioning to an energy burden-based approach for providing support, and • Providing financial support to upgrade customer premises to prepare for electrification.

The remainder of this document focuses on the Future of the Electric Network and the investments and policy changes needed so that it can:

- Deliver necessary and timely reduction of emissions along with renewable and electrification goals.
- Be reliable and resilient — regardless of changing weather — and ready when customers need it.
- Support the deployment and easy adoption of new end-use technologies like rooftop solar, heat pumps, and electric vehicles and chargers.
- Provide a more equitable, individualized, and seamless experience for all customers, regardless of where they live or their economic circumstance.
- Drive innovation, economic opportunity and growth, prioritizing communities that have historically been left behind and/or have borne the brunt of the fossil fuel-based economy.

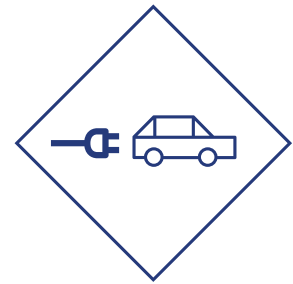
Massachusetts is on an Electrification-based Path to Achieve Net Zero Emissions

Massachusetts is advancing an electrification-based pathway to achieve its climate and clean energy goals, as established in the 2050 Clean Energy and Climate Plan (2050 CECP). Delivering the emission reductions mandated by law over the next two decades requires a shift from a multi-fuel energy delivery system to one that primarily relies on electricity. Today, customers meet their energy needs through a combination of electric, gas, and delivered fuel networks, as well as a vast network of fueling stations for their cars, buses, and trucks. In the future, customers will rely on the electric network to power most aspects of their lives

and it will become the foundation for our future economic growth and prosperity.

By 2050, the future electric network in Massachusetts must meet customer demand forecast to be more than two-times higher than today. Peak demand will occur in the winter as opposed to summer, driven by the electrification of heating and transportation systems. It must also connect and manage at least 5 times the amount of energy storage, 10 times the amount of renewable energy, 20 times the number of EVs, and 75 times the number of heat pumps than today.

This exponential increase in renewables, demand and electrified end use technologies necessitates a major build-out of the electric grid, and a transformation of how the network operates and the functions it performs.



By 2050, Massachusetts will need to connect and manage 20 times the number of EVs.






Investments are Needed in Three Key Areas to Enable the Future Electric Network

Ultimately, the pace and scale of decarbonization will be driven by two key factors: 1) the ability to decarbonize and connect clean and renewable energy to the grid, and 2) the pace at which customers adopt clean, efficient, and electrified technologies. The functioning and cost of the future network will be driven by its ability to leverage and optimize the use of clean energy resources for the benefit of both customers and the grid. To do this, investments are needed in three key areas:

<p>Network Infrastructure</p>	<p>▶ To make both transmission and distribution networks stronger and ready to accommodate increased power flows and connections by, for example, expanding and upgrading substations and feeders.</p>
<p>Technology and Platforms</p>	<p>▶ To make both the transmission and distribution networks smarter, more flexible, dynamic, and efficient and provide greater visibility into and control of the system by, for example, upgrading IT and communications networks.</p>
<p>Customer Programs</p>	<p>▶ To deliver cleaner energy solutions and put customers in control of their energy choices and use by, for example, providing new product and rate offerings.</p>

The resulting investments will transform the electric grid of the past into a more resilient, two-way electricity superhighway of tomorrow that powers sustainable communities well into the future and provides all customers the opportunity to participate in and benefit from the clean energy transition.

<p>Smarter</p> 	<p>A more intelligent, smarter system will enable a self-healing network and the seamless orchestration and optimization of the system, while providing customers with more control over their energy usage and choices.</p>
<p>Stronger</p> 	<p>A stronger system will ensure the grid is ready, more robust, and better able to withstand the impacts of climate change and is protected against evolving threats – both cyber and physical.</p>
<p>Cleaner</p> 	<p>A cleaner system can connect more renewable resources, energy storage, and electrified transportation and heating more quickly at all levels and leverage these resources to create value for the grid and customers alike.</p>

Today's Electric Grid is Neither Sufficient Nor Ready to Meet Tomorrow's Needs

To serve our diverse customer base, National Grid operates and maintains an electric system that consists of more than 2,500 miles of electric transmission lines. These transmission lines carry electricity long distances at high voltage levels to nearly 150 transmission substations that step power down to a lower voltage. It can then be safely carried across 18,000 miles of smaller distribution lines, which are supported by hundreds of thousands of poles and approximately 140 strategically located distribution substations throughout the Commonwealth. Power is then stepped down again at thousands of smaller transformers to safely deliver it to homes and businesses.

This extensive network will need to nearly double in size and capacity over the next 20 years — including

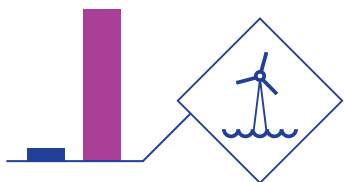
adding a substantial number of new substations and expanding others — to meet our customer's future needs and achieve the 2050 CECP goals. Absent these system investments, the expected demand growth will overload existing equipment, which would impact the safety and reliability of network operations for all customers.

Similarly, National Grid's distribution operations systems must be modernized and readied for the future. Our vast interconnected network is kept in balance by our operations control centers, which monitor and manage the network 24/7/365. The control center is the "orchestrator" of the network with real-time visibility into network conditions and is responsible for dispatching assets and field operations crews as needed, including during storms and other emergency events.

The role of control centers is changing with the accelerated adoption of distributed energy resources (DER) and electrification across the network, and they require new tools, processes, and resources to operate a more dynamic and reliable network. These investments will leverage DER as providers of grid services both at the distribution level and to the Independent System Operator of New England (ISO-NE) wholesale markets, as Federal Energy Regulatory Commission (FERC) Order 2222 takes hold and creates additional value streams for local clean generation, energy storage, and demand response.



The 2050 Electricity Network in Massachusetts



23 GW

Installed capacity

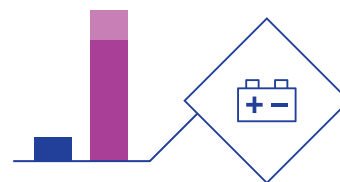
Offshore Wind



28 GW

Growth in capacity

Onshore Solar and Wind

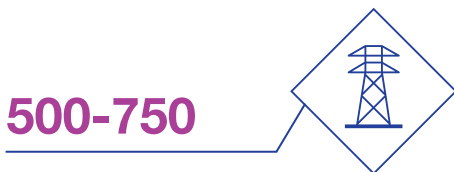


6 GW

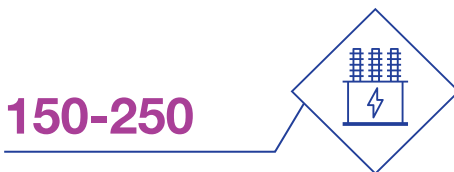
Installed capacity

Storage

Delivery of this transition requires significant upgrades and extensions to our electricity networks. While the details of what this will look like by 2050 are under development, National Grid forecasts based on Net Zero Targets show:



500-750
New and upgraded miles of transmission in National Grid right-of-ways

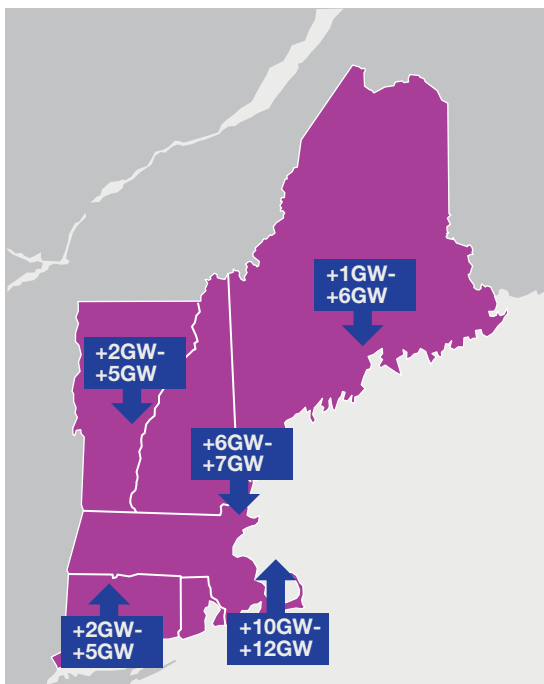


150-250
New and upgraded substations in National Grid's network



4.5k-8k
New and upgraded distribution miles in National Grid's network

New Renewable Generation Capacity in New England 2050



Up to **5 million**

Electric Vehicles

Up to **3 million**

Heat Pumps

Will be garaged and installed at buildings in Massachusetts by 2050

Increase in network capability required at points on the network, and direction of electricity flow.

The Future Grid Plan is a Roadmap to Accelerating Electrification and Achieving Net Zero Emissions

National Grid is taking action to deliver a fair, affordable, and clean energy future to 2.3 million customers in more than 240 Bay State towns and cities – including its 1.3 million electric customers. As part of a statewide effort, Massachusetts electric distribution companies (EDCs) prepared plans – known as Electric Sector Modernization Plans (ESMPs) – that presented the investments needed in the local distribution

system and supporting electric networks to meet the state's greenhouse gas, electrification, and clean energy goals over three distinct planning horizons - a 5-year forecast, a 10-year forecast and a demand assessment through 2050.

National Grid and the other EDCs submitted these ESMPs to the Grid Modernization Advisory Council (GMAC) in September 2023. National Grid's plan – the Future Grid Plan – provides a roadmap that outlines investments needed to deliver an electric network that meets the goals of and is consistent with the decarbonization pathways established by Massachusetts, including investments in 1) network infrastructure, 2) technology and platforms, and 3) customer programs. Investments in these areas are necessary to deliver smart, electrified, and decarbonized buildings, electrified transportation, and clean power at all levels.

1. Required Network Infrastructure Investments

Network infrastructure investments are needed to expand the capacity of the existing system – including in assets like substations, transmission lines, and distribution feeders – to accommodate increased flows of electricity due to rising customer usage driven by the electrification of transportation, heating, and industrial processes, as well as higher air conditioning loads as summers get hotter.

Without the necessary investment, accelerated rates of electric end-use technology adoption will outpace the grid's ability to keep up with demand in a manner that preserves reliability.

As the economy grows increasingly reliant on electricity as its primary fuel source, the electric network must be stronger and even more reliable and resilient than it is today. This requires hardening of existing infrastructure and building new infrastructure to even higher operating and security standards to withstand more frequent and severe weather events as well as evolving physical and cyber threats.



2. Required Technology and Platform Investments

Investments are needed in new planning tools, systems, and processes to drive smarter decision-making. This includes installing state-of-the-art data and monitoring systems to provide greater visibility into how the grid and interconnected devices are operating to ensure system safety and stability. It also requires evolving our distribution system control centers to function as a distribution system operator – or orchestrator of the local energy network.

Upgrading IT systems and communications networks will support two-way information flows and control and provide greater system flexibility, security, and more timely information to customers. This will enable the better utilization of customer-owned technologies as grid solutions, creating an opportunity to use them to deliver localized capacity and operational

needs, such as through distributed solar and batteries to create “Virtual Power Plants.” In addition, these upgrades will accommodate newly deployed Automated Metering Infrastructure, which will be rolled out in Massachusetts beginning in 2024, to advance time varying rates and managed charging, among other customer-focused products and offerings.

3. Required Customer Program Investments

Investments in customer programs and tools will deliver a more seamless experience and enable customers to more quickly adopt new decarbonized end-use technologies. This includes make-ready infrastructure to support electric vehicle charging and a more automated interconnection process for solar and storage.

In addition, providing new product and rate design offerings and pilot programs focused on electrification

and decarbonization will help residential and commercial power consumers reduce their carbon footprint, adopt cleaner energy solutions, and drive smart energy choices, helping them to better manage costs and build community resilience and agency.

At the same time, there is a need to expand financial and technical support to customers to enable them to pursue clean energy and energy efficient solutions. Programs need to be better tailored and targeted to meet the needs of individual customer segments and circumstances and address historic inequities, including through policy changes that focus on distributional and procedural equity to address issues related to energy burden and access.



Executing the Energy Transition Requires a Ready Workforce and Available Supply Chain

The scale and pace of the transition and corresponding work to achieve it are significant and success of this effort relies on the alignment of many external factors, including the ability to procure equipment and the availability of a ready and well-trained workforce. The Commonwealth is one of many states and regions across the country – and the world – making the energy transition. As such, there is competition for limited resources, workers, and equipment.

Workforce Needs are Significant and Offer Opportunities to Advance a Just Transition

The clean energy transition in Massachusetts will result in significant employment opportunities and needs, according to multiple analyses commissioned by the Commonwealth and others — including National Grid. For example, a study by the Massachusetts Clean Energy Commission projects thousands of workers – engineers and field crew – are required across transmission, distribution, and construction activities.



Our Future Grid plan projects that **11,000 full- and part-time jobs will be created** in just the first five years of the transition.

In addition, it will take thousands of electricians and energy efficiency specialists to make homes and businesses more efficient and ready to adopt new electrified technologies. And it will require a new generation of EV vehicle and charging stations technicians to keep people and commerce moving. National Grid's own analysis of its Future Grid plan projects that 11,000 full- and part-time jobs will be created in just the first five years of the transition because of the company's proposed investments.

The need for an expanded workforce offers opportunities to create generational wealth and mobility in communities that were burdened by the fossil fuel-based economy. A 2021 survey by the National Association of State Energy Offices found that the U.S. energy sector has below-average representation of Black, Hispanic, and Latino, and women workers, and high rates of union members with low diversity representation.

The survey shows that just 8% of energy workers are Black compared to a 12% average across the national workforce. Similarly, Hispanic and Latino individuals comprise 16% of energy workers yet represent 18% of the national workforce. Only 25% of energy

workers are women, even though they account for 47% of the national workforce. On the other hand, union membership in the energy sector is 11%, while the national average is 6%.



Addressing these disparities in Massachusetts will take intentional work across both public and private sectors. National Grid has launched its comprehensive Workforce Development (WFD) Strategy, which is being conducted in collaboration with more than a dozen local and statewide academic institutions, community organizations and government partners to develop and scale workforce training and education programs that span from middle school through work-ready adults.

To appropriately scale these programs and hire the future workforce requires predictability in the timing and approval of necessary investments, as it will be nearly impossible to pursue a “just in time” hiring strategy given the technical and skills-based nature of the work required.

Securing a Reliable Supply Chain Is Enabled by Long-Term Planning

The electric sector is an equipment-heavy industry that is reliant on a limited set of manufacturers for some of the most foundational needs, including transformers, cable, and meters. While we are moving rapidly toward the energy transition, the industry is battling more severe and more frequent weather events and defending against security threats (both cyber and physical), all of which is putting upward pressure on the availability of critical supplies to meet current and future needs.

Over the past several years, multiple disruptions to supply chains driven by the pandemic, lack of available workers, and the war in Ukraine have created logistics bottlenecks, shortages of raw materials, and scarcity of components. These

conditions have widened the gap between demand and supplies, driving up costs and threatening to slow progress on, and drive up the cost of, the clean energy transition. For example, coming out of the pandemic, a lack of semiconductors created challenges for advanced metering infrastructure and smart inverter technology, delaying building electrification and DER deployment. Residual impacts remain today.

National Grid and other electric power companies are working to develop more secure and sustainable supply chains, while managing third-party risk to ensure resilience in the face of future disruptions. A key element is having assurance surrounding investment plans and recovery, as well as permitting timelines so that we can lock in contracts with suppliers over a multi-year period and

provide clarity on specifications and delivery dates.

For example, in the United Kingdom, National Grid was granted responsibility for delivering 17 major onshore electricity transmission lines by 2030 to connect load centers to offshore wind. This decision gave National Grid the certainty required to launch the Great Grid Upgrade Partnership — a major procurement initiative aimed at delivering the largest overhaul of the grid in generations. In May 2023, National Grid announced the first phase of supply chain partnership opportunities under the initiative, seeking partners for approximately \$5.4 billion worth of network construction, including design, engineering, and building for new overhead lines and substations.



A Clean, Fair, and Affordable Energy Transition Requires Policy Changes

To successfully enable the future electric network and deliver a clean, fair, and affordable energy transition will take coordination and collaboration at all levels. It also requires policy changes to provide predictability, accelerate the build-out of needed infrastructure, and ensure a just transition. These changes and

regulatory action must occur at the state, regional and federal levels to deliver the Future Electric Network. Without them, achieving a just and equitable energy transition at a cost that is affordable and sustainable will not be possible in the time frames needed to meet the Commonwealth's goals.

State and Regional Actions

Action is already being taken by various government and regulatory entities in Massachusetts to improve planning, accelerate investment and scale solutions, but these efforts must go further and occur at a faster pace to enable Massachusetts to attain its clean energy goals.

This includes the following:

Adopt policies that enable and encourage anticipatory planning for, investment in, and construction of the electric grid to modernize and optimize the network to connect renewables, enable electrification, and build resilience to a changing climate.

- Complete review and receive approval in 2024 from the Massachusetts Department of Public Utilities (DPU) for the company's Future Grid plan, which proposes the investments needed in National Grid's electric distribution network to enable the Bay State's clean energy transition and accommodate increasing amounts of electrification.
 - Complete review of and approve regulatory investment mechanisms, as part of the company's current rate review filing at the DPU, which moves to a forward-looking regulatory approach that allows for proactive and anticipatory investment to ensure that the grid is not a blocker to achieving the State's clean energy goals, while providing a clear roadmap as to the supply chain and talent needed over the duration of the investment period, allowing the company to secure resources.
 - Establish equitable cost-allocation approaches to utility funding of electric distribution system upgrades to facilitate customer-owned DER development and interconnection. This includes completing the review and approval by the DPU of the Capital Investment Proposals, which have been developed to allow distributed renewable generation to connect to the grid in a more timely and cost-effective manner.
 - Enact legislation in 2024 that builds on the findings that come from the Governor's Commission on Clean Energy Infrastructure Siting and Permitting Reform to:
 - 1) Improve the transparency and accessibility of the current process,
 - 2) Provide greater agency to potential host communities, and
 - 3) Establish a more predictable and timely applicant process.
 - Adequately resource and staff permitting and regulatory agencies to support the timely review and processing of applications for energy infrastructure.
-

Enable customer deployment and adoption of clean, decarbonized technologies and facilitate the cost-effective connection of local, clean energy resources.

- Approve new electric rate designs in 2024 at the DPU, such as the innovative electrification pricing offering in the pending Massachusetts Electric Company (MECO) rate review filing, to align rates more closely with evolving customer needs and electrification uptake.
- Support drivers of electric vehicles — including cars, trucks, and buses — by passing legislation in the current legislative session to enable the next phase of transportation electrification through a highway charging action plan that focuses on advancing the necessary grid upgrades to create reliable charging corridors traveling both north-south and east-west in Massachusetts.
- Advance, either at the DPU or through legislation, neighborhood-level targeted electrification and integrated energy planning pilot demonstrations to better understand the investment and resource needs, and system dynamic at the customer, distribution, and transmission levels.

Ensure families and businesses can afford their energy bills and easily access savings and assistance programs that place equity at the heart of the transition.

- Address affordability challenges experienced by our most financially challenged customers by offering more progressive bill discounts to low-income customers based on energy burden, such as the company's proposal currently before the DPU as part of MECO's rate review filing.
- Expand energy assistance programs to cover more customers and improve affordability of energy bills and enact legislation that directs the Department of Energy Resources to study and make recommendations on how to address household energy equity.
- Improve intergovernmental coordination between local and state governments, as well as regulatory agencies, to better serve communities' total needs, while ensuring they have the resources necessary to fully participate in the clean energy transition.
 - This coordination should include reviewing and improving (where necessary) formulas for determining eligibility for and participation in reduced energy rates and/or expansion of participation in existing programs.
- Expand state funding for electrification — including support for customer premises upgrades — with particular attention on meeting the needs of low- and moderate-income customers and communities.
- Explore the "LIHEAP Direct" model, which provides for direct application of LIHEAP funds on utility bills to eligible customers, without customers having to apply.

Federal Level



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Our Clean Energy
Vision for Massachusetts

Recent federal government actions to support clean energy — including the Bipartisan Infrastructure Law and the Inflation Reduction Act — have helped position the energy sector in Massachusetts for faster growth at a lower cost to customers.

Additional policies and regulatory changes under consideration in Congress and at pertinent agencies — most notably the Department of Energy (DOE) and the Federal Energy Regulatory Commission (FERC) — have the potential to further bolster progress toward decarbonization and

electrification, while improving outcomes for Commonwealth communities and customers. These primarily include policies and regulatory actions that, amongst other things:

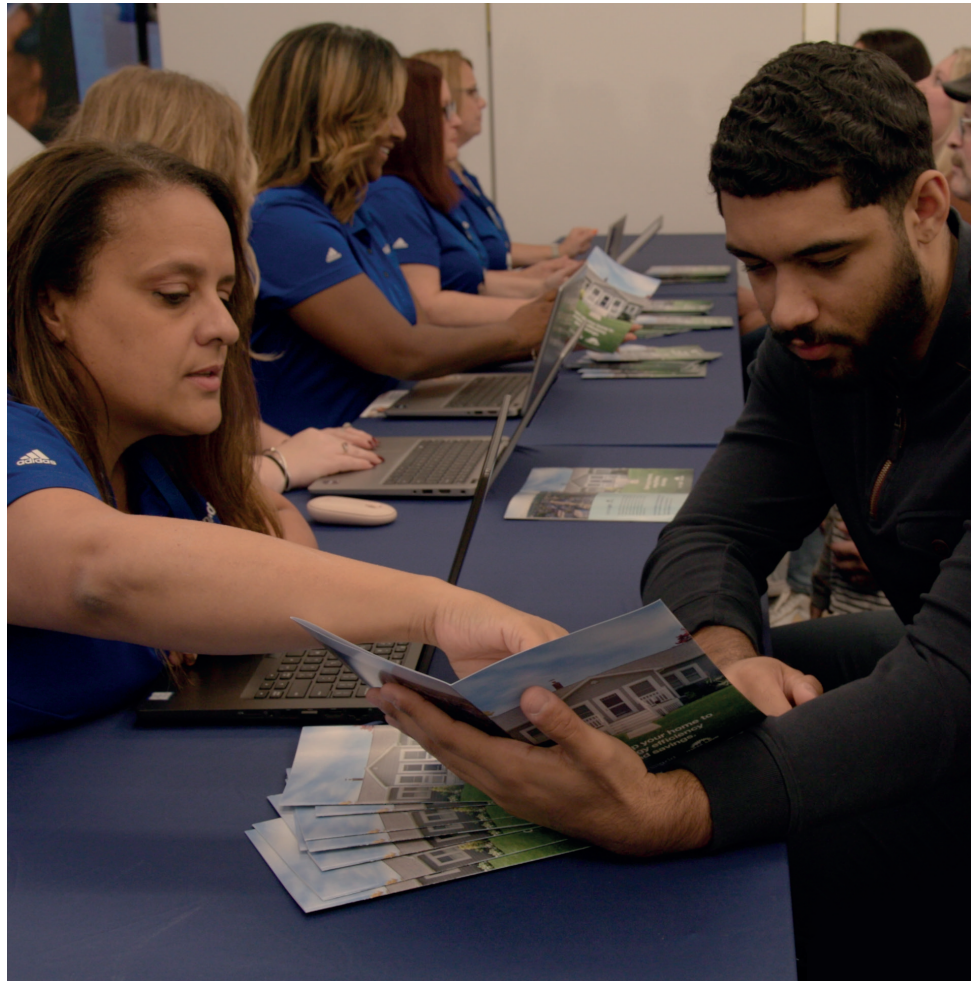
- Enable more streamlined development of utility infrastructure and clean energy through permitting and interconnection reforms, while ensuring protection of environmental resources and vulnerable communities.
- Allow for continued anticipatory transmission planning and investment.
- Encourage coordinated and interregional transmission planning to leverage offshore wind resources.

Conclusion

We have an opportunity to make real and lasting change as we work collectively to deliver the clean energy future. While National Grid is building and preparing the Future Electric Network for this transition, we continue to focus on our day-to-day foundational mission of providing the great service and safe, reliable, and affordable energy delivery our customers expect and deserve.

National Grid will continue to be a trusted partner in supporting our customers' changing needs, while prioritizing safety, reliability, affordability, and resilience, as we navigate this important transition together.

We are committed to empowering Massachusetts by building a smarter, stronger, cleaner, and more equitable energy future, and look forward to continuing to be a partner for progress in all our communities across the Commonwealth.



About National Grid

National Grid (NYSE: NGG) is an electricity, natural gas, and clean energy delivery company serving more than 20 million people through our networks in New York and Massachusetts.

National Grid is focused on building a path to a more clean, fair and affordable, energy future. We are transforming our electricity and natural gas networks with smarter, cleaner, and more resilient energy solutions to meet the goal of reducing greenhouse gas emissions.

For more information, please visit our [website](#), follow us on [X \(formerly Twitter\)](#), watch us on [YouTube](#), like us on [Facebook](#) and find our photos on [Instagram](#)

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