



national**grid**

# Future Grid Plan:

Empowering Massachusetts by  
Building a Smarter, Stronger, Cleaner  
and More Equitable Energy Future

Executive Summary  
January 2024

# Building Tomorrow's Energy System

## A Smarter, Stronger, Cleaner, More Equitable Energy Future

A network that supports the Commonwealth's climate, clean energy, and equity goals and delivers the fair, affordable, and clean energy transition for all our customers and communities.

## Customer Programs

Provide customers with information, products, and services to enable clean energy, efficiency, and demand management options so they can make the energy choices that work for them, when they want them.

## Communications and Technology Platforms

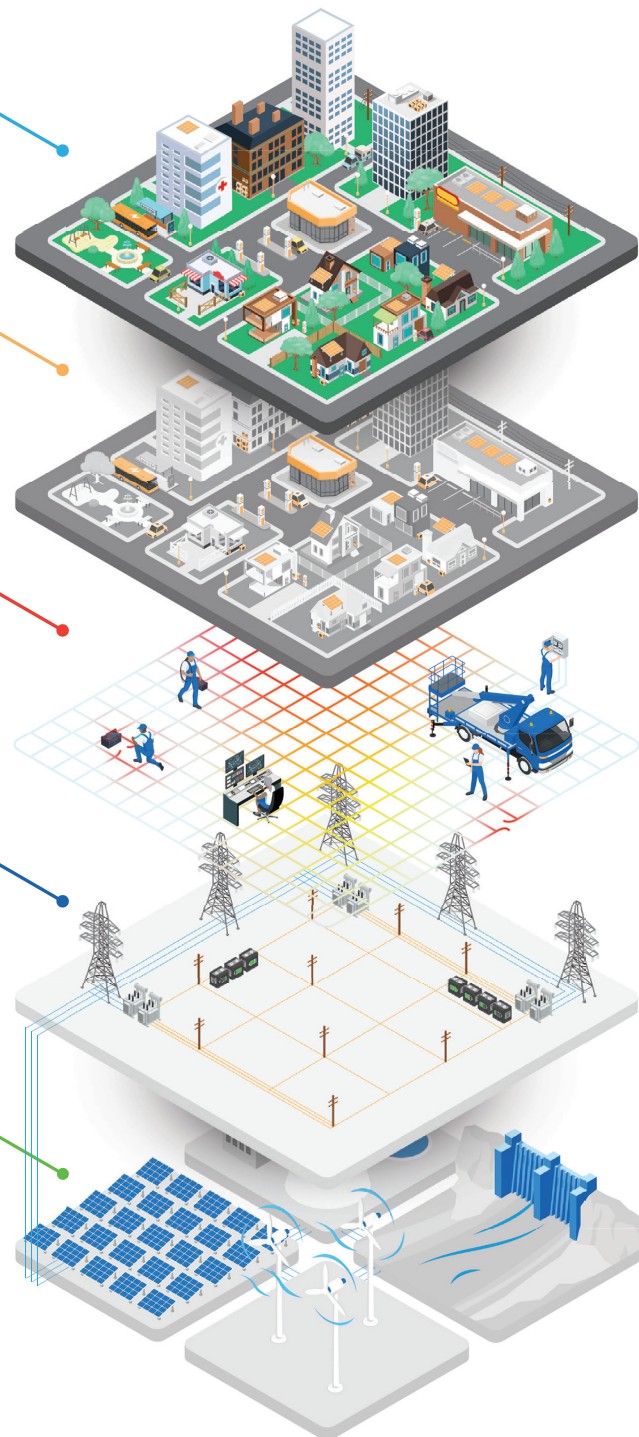
Create a smart, flexible, and dynamic grid that can manage the future supply mix and energy needs, and leverages distributed resources with real-time communications to solve grid problems and provide grid resiliency.

## Network Infrastructure

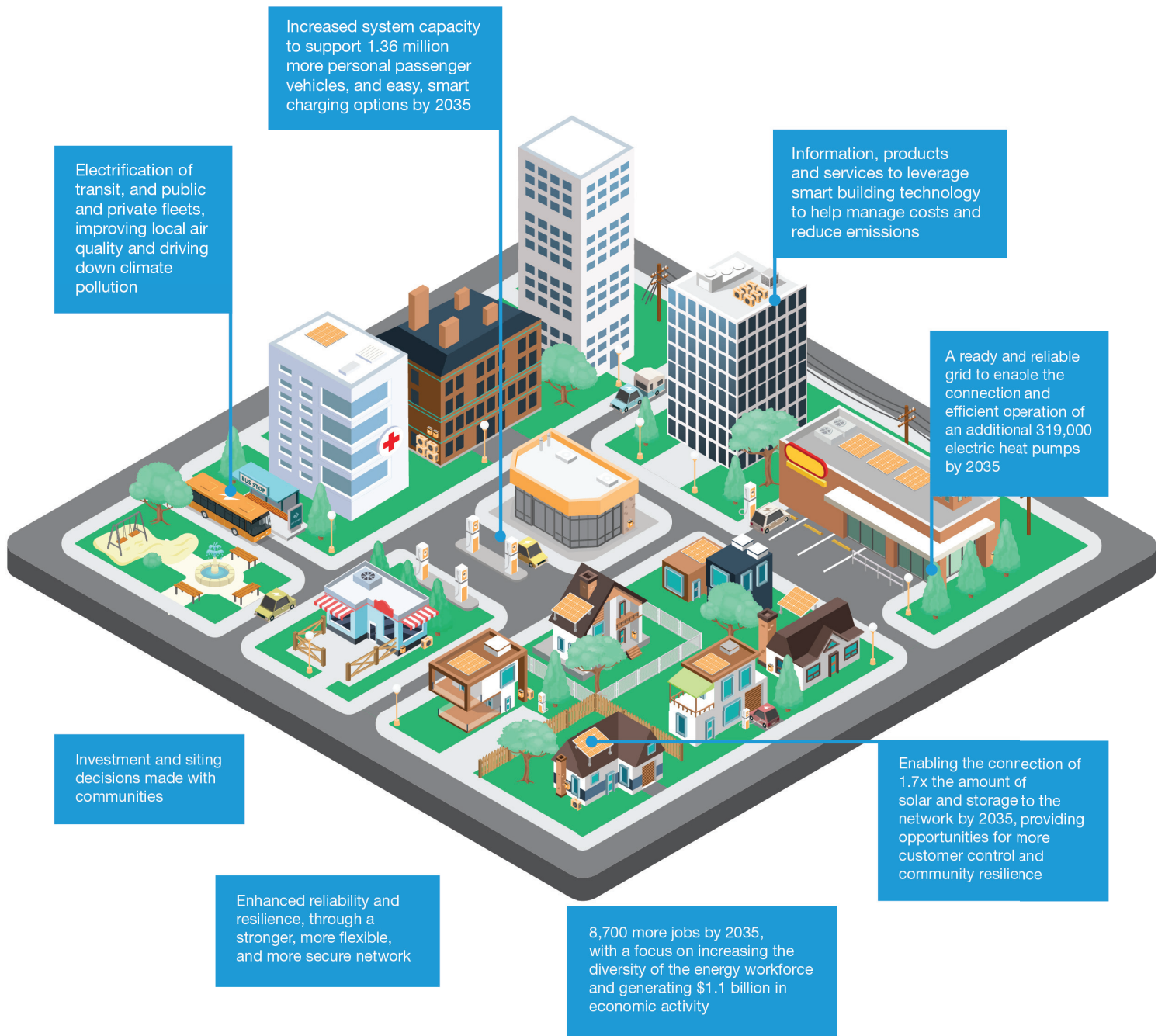
Build a strong network that is one step ahead of customer needs, ready to respond to developer requests, and is reliable, resilient, and secure, regardless of weather or evolving threats.

## Connecting our Customers to Renewables

Enable and connect our customers to the increased renewable generation on the grid – wind, solar, hydro, geothermal, and storage.



The investments proposed in this Future Grid Plan will empower our customers and communities throughout Massachusetts by building a smarter, stronger, cleaner, and more equitable energy future....



.... and enable customer adoption of clean, electrified technologies to drive down greenhouse gas emissions while improving their energy experience.



#### Improving comfort and convenience

Before Tina comes home, her house is cooled to a pre-set temperature so it's comfortable for her when she arrives.

#### Optimizing battery and solar to provide resources and value

Tina settles in and does a load of laundry. Given peak demand conditions, with other neighbors also coming home, her battery in the garage cycles on and off based on solar panels from her roof and grid conditions (charging and discharging where optimal) to offset those costs.

#### Saving money and reducing peak demand

Tina just finished dinner and loaded the dishwasher. Tina's dishwasher and dryer start automatically when electric prices are lowest to optimize her bill and her demand on the grid.

#### Filling the "tank" at the lowest cost and carbon footprint

While Tina is sleeping, car charging is actively managed based on grid conditions, and will be fully charged when she needs it in the morning for work.

#### Leveraging innovation to save energy and money

Tina's home and the grid talk to each other constantly. With her permission, extra energy can be sent back to the grid, allowing her to potentially earn money from her solar panels. Alternatively, when Tina needs extra power, her devices are managed so well that they will allow her to avoid a costly service transformer upgrade.

## A message from our leadership



Lisa Wieland  
President  
New England



Nicola Medalova  
Chief Operating  
Officer, New England

**Every day at National Grid, our more than 6,500 team members work together to build a smarter, stronger, cleaner, and more equitable energy future for our customers and communities in more than 240 towns and cities across 5,900 square miles.**

**We know what we do matters immensely, and how we do it matters even more.**

We are at an inflection point. To meet the Commonwealth's ambitious climate change and clean energy goals – goals that we share – we must begin building this future now. And, we know that we cannot build it alone and that we don't have all the answers. Massachusetts is a state known for solving big problems and delivering big results. It is a state with an innovation ecosystem and is focused on equity that drives collaboration, partnership, and new ways of thinking. We will need to harness this innovative and collaborative spirit to achieve the energy future that works for all.

By developing and filing this Future Grid Plan proposal as our Electric Sector Modernization Plan, we are taking a first step toward defining the scope and scale of what we collectively must do over the next 25 years to combat climate change and enable a more electrified future. We are doing this by identifying the system investments and changes needed in the electric distribution system, engaging broadly to stimulate ideas, and encouraging input to ensure this proposal is responsive to and supportive of the needs and expectations of all our customers and communities. In the developing of this Plan, we have listened earnestly to stakeholders, and incorporated the vast majority of this feedback to ensure we are delivering for everyone.

The investments proposed in this Plan will enable a smarter and more intelligent system that provides customers with more options and the ability to make clean energy decisions that work for them. They will result in a stronger system that is more robust, better able to withstand the impacts of climate change, and protects against evolving threats. And, they will support the quicker connection of more renewable resources, energy storage, and electrified transportation and heating at all levels to create a cleaner system that leverages these resources to create value for the grid and customers.

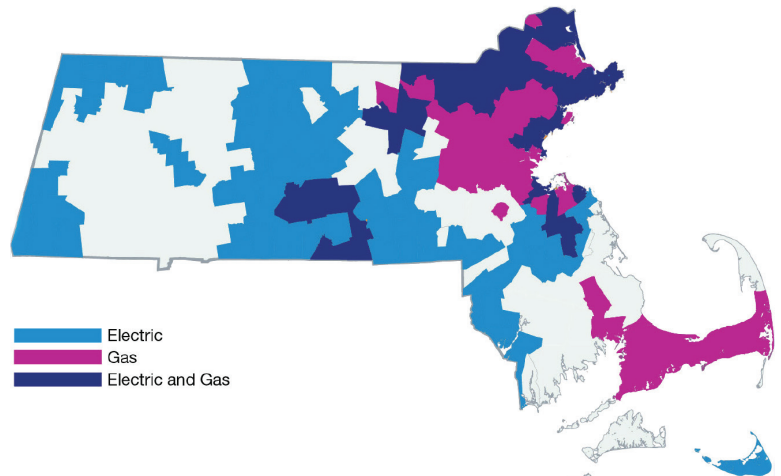
We have an opportunity to make real and lasting change. And, while we are building and preparing the grid and our broader energy system for the future, we remain focused on what is right in front of us. Our customers expect and deserve great service and safe, reliable and affordable energy today, which we will continue to deliver. We are committed to empowering Massachusetts by building a smarter, stronger, cleaner, and more equitable energy future. And we are excited to share our Plan to do that and truly look forward to being a partner for progress in all our communities across the Commonwealth.

Lisa Wieland  
NE President

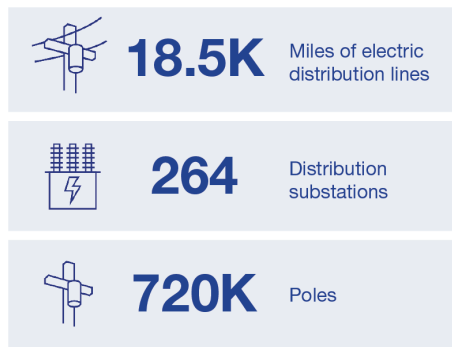
Nicola Medalova  
Chief Operating Officer, NE Electric

## About us

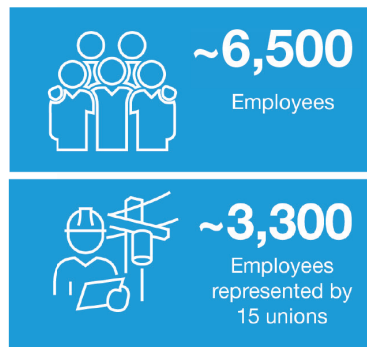
We're taking action to achieve net zero greenhouse gas emissions and to deliver a **fair, affordable and clean energy future to 2.3 million customers** in more than **240 towns and cities...**



### Serving our 1.3M electric customers via our networks...



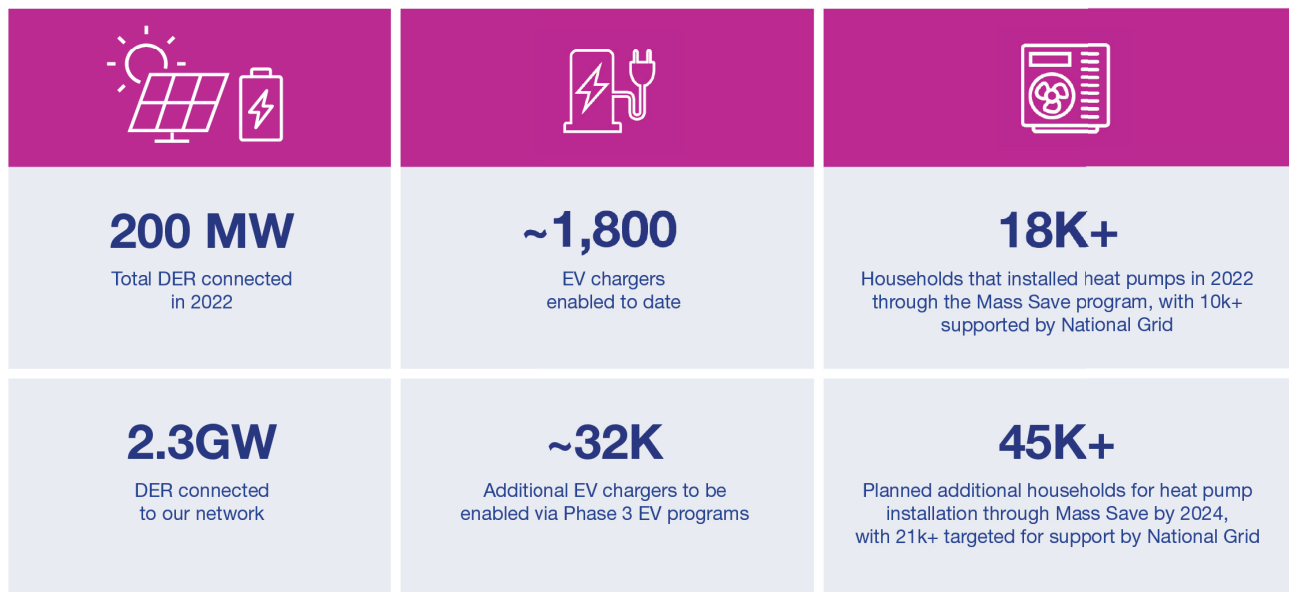
### ...by our teams...



### ...while supporting our communities...



### ...and making customer connections.



# 1.0 Executive Summary

National Grid is committed to enabling the fair, affordable, clean energy transition for the 2.3 million customers in more than 240 towns and cities it is privileged to serve across the Commonwealth for both electricity and gas. Meeting the Commonwealth's nation-leading decarbonization goals established in the 2050 Clean Energy and Climate Plan (2050 CECP) will require significant amounts of new renewable and clean energy resources to be connected to the electric grid, and customers across the Commonwealth to accelerate the adoption of clean, electrified technologies.

By 2050, the Commonwealth's electric distribution system will be the primary energy network powering the economy and all aspects of everyday life – including cooking, heating, and transportation. Enabling this new energy future requires investment at pace and scale to make the grid fundamentally smarter, stronger, and cleaner than it is today.

National Grid crafted this Future Grid Plan (Plan), which serves as the Company's Electric Sector Modernization Plan (ESMP) submission, to meet the Commonwealth's 2050 decarbonization and equity goals and interim milestones. The Plan was informed by recommendations from the Grid Modernization Advisory Council (GMAC) and feedback gained through robust and meaningful dialog with a broad and diverse range of its customers and stakeholders from across the Commonwealth, including from its environmental justice communities (EJCs). This feedback guided the Company's planning considerations and decision making on proposed investments.

This Plan provides a roadmap of the electric distribution system investments (i.e., network infrastructure, communications and technology platforms, and customer programs), policy recommendations, innovations like non-wires alternatives (NWA), rate design principles, and expanded stakeholder outreach and engagement necessary to successfully deliver the 2050 CECP goals and a just transition. Successful delivery will also require parallel efforts on transmission infrastructure investments, regulatory and policy changes, large-scale clean electricity generation, customer demand-side programs, including energy efficiency, and increasing levels of coordinated, integrated energy planning between gas and electric systems to achieve this transition reliably, safely, and affordably.

At its core, a transformation of the entire energy ecosystem is required to equitably achieve the net zero ambitions of the Commonwealth. The electric distribution network is foundational to enabling this transformation. It will require new and expanded infrastructure in all communities to meet growing demand and collaboration and engagement among all of society.

Recognizing that as the Commonwealth makes the energy transition it must keep affordability and equity at the fore, the Future Grid Plan is deliberately designed to make progress towards the 2030, 2035 and 2050 decarbonization goals. To do this the Company uses transparent, data-driven, proactive distribution system planning to identify and ensure the most cost-effective solutions are implemented and an assessment of the tradeoffs between the pace of proactive investments and overall affordability to customers. The Plan leverages distributed energy resources (DER) to address reliability needs and defer system upgrades through NWAs, provides economic benefit and opportunity, with a focus on traditionally underrepresented communities, and empowers customers to make the energy choices that work for them and their budget, when they want to make them.

The 5-year Future Grid Plan will enable 31.3 MMT of greenhouse gas (GHG) emissions reductions, by increasing distribution network capacity by 1 GW. Compared to today, this will enable up to 50% more solar and storage on our system, 15 times more EVs on the road and 8 times more heat pumps installed. Importantly, this is incremental to what the rest of our system is already built to deliver. This holistic Plan builds on investments underway and proposed that will collectively enable a smarter,

stronger, cleaner, and more equitable energy future and achieve the Commonwealth’s net zero climate goals. This includes supporting our share the Commonwealth’s 2035 goals of 1.1 million EVs on the road and 330,000 heat pumps installed. The below table outlines the incremental outcomes delivered by the Future Grid Plan only, not our existing collective investments of base spending.

**Summary of what the Future Grid Plan delivers for our customers, communities and the Commonwealth, incremental to pending investments\***

	Today	Our 5-year plan (2025 – 2029) delivers...	Our 10-year plan (2030 – 2034) delivers...
<b>Our Network</b>	264 substations 1,318 distribution feeders	13 upgraded substations Expansion of 14 feeders	32 new/upgraded substations Expansion of 13 feeders
<b>Solar and Energy Storage</b>	2.3 GW connected	Supports an incremental 1 GW, including capital investment projects (CIPs)	Supports an incremental 3GW
<b>EVs</b>	32,000 on the road	Enables up to 492k additional EVs	Enables up to 870k additional EVs
<b>Heat Pumps</b>	10,000 installed	Enables up to 84k additional electric heat pumps (EHPs)	Enables up to 235k additional electric heat pumps (EHPs)
<b>NWAs &amp; Enabling Tech</b>	One battery project on Nantucket to avoid an undersea cable	Advances 17 Bridge-to-Wires NWAs & 2 deferral NWAs including equity-focused VPP offerings	Expanded NWAs to defer investments, at scale
<b>Economic Activity &amp; Jobs Created</b>		More than 3,900 full- and part-time jobs, and \$500 million of incremental economic activity, for the proposed ESMP investments	More than 8,700 full- and part-time jobs and \$1.1 billion of incremental economic output, for the proposed ESMP investments

\*Outcomes presented in the above table are associated with Future Grid investments only. Once combined with our pending base investments, in 2034, economic activity and jobs created are \$3.6B and 28,000, respectively.



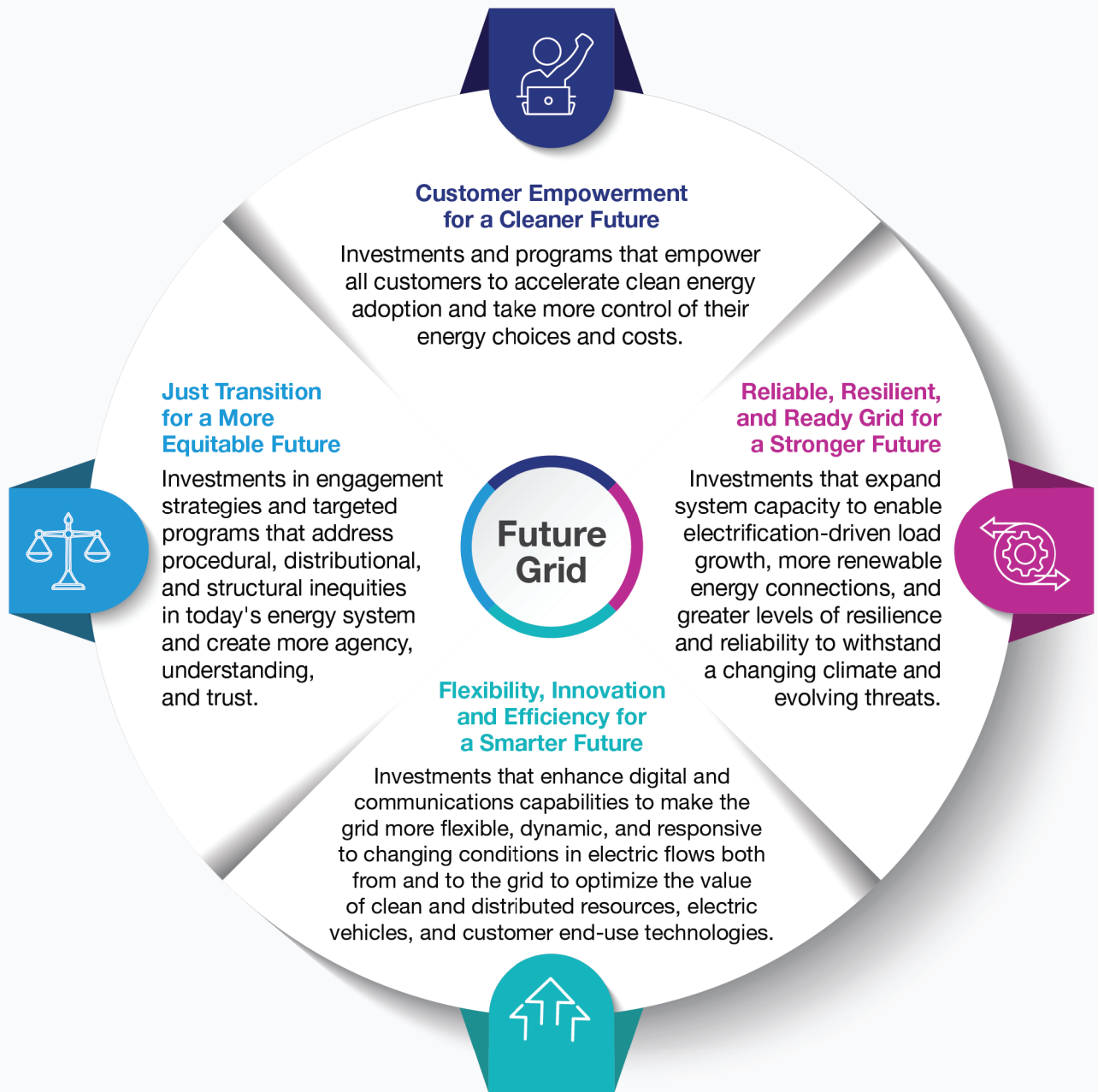
## 1.1 Vision: Enabling a Just Transition to a Reliable and Resilient Clean Energy Future

National Grid is committed to enabling the fair, affordable, and clean energy future and a just transition. This requires re-imagining the future of the electric network, its relationship to customers and communities, its capabilities and opportunities, and the corresponding regulatory paradigms necessary to ensure we are:

- ▶ Empowering customers to make clean energy choices;
- ▶ Creating a ready, reliable, and more resilient grid capable of withstanding extreme weather and evolving threats;
- ▶ Leveraging innovation, driving efficiency, and enabling greater system flexibility; and
- ▶ Enabling a more just and equitable energy future that provides benefits for all.

National Grid's approach to the clean energy transition starts with the customer—understanding their evolving energy needs, giving them more information and more choices, and supporting their side of the clean energy effort through programs, rates and other offerings. It then establishes the investment pathway necessary to deliver these outcomes, using specific criteria to assess and develop the required investments in network infrastructure, technology and communications platforms, and customer programs, with the goal of enabling a just and equitable energy transition.



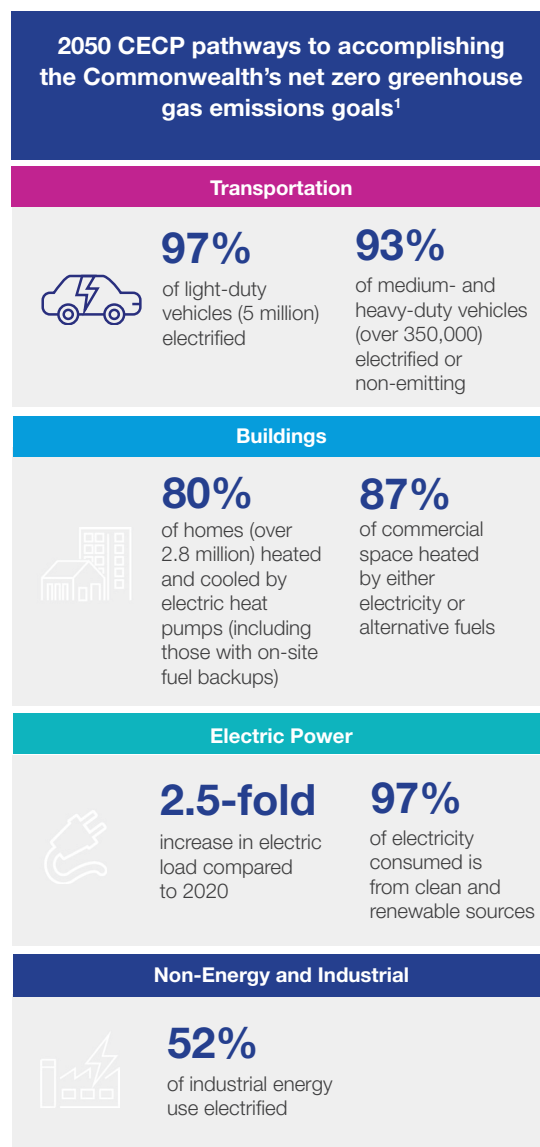


## 1.2 Plan Overview and Alignment with the Clean Energy and Climate Plan

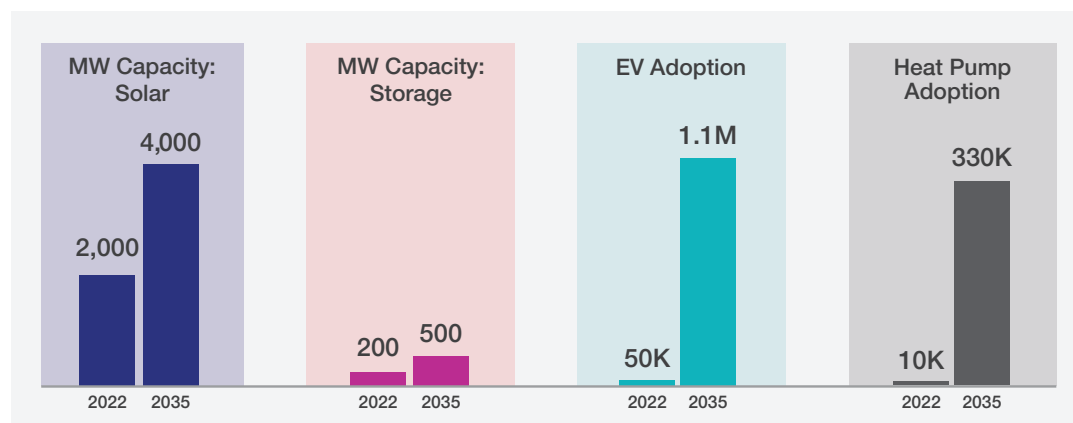
Massachusetts' 2050 CECP establishes nation-leading goals and supporting pathways to reduce climate pollution and reach net zero greenhouse gas emissions by 2050 – goals we share at National Grid. The 2050 CECP is an equity-centered plan rooted in decarbonizing the electricity consumed by all customers and using this clean electricity to power all aspects of the economy. The CECP's electrification-based approach to achieving net zero emissions requires the Commonwealth's electric networks to become the foundation of the economy and our region's primary energy system.

An Act Driving Clean Energy and Offshore Wind (2022 Climate Act or Act), directed each Massachusetts electric distribution company (EDC) to file an ESMP that identifies "upgrades... needed to meet the Commonwealth's climate and clean energy goals over three planning horizons: 1) a 5-year forecast, 2) a 10-year forecast and 3) a demand assessment through 2050." The Company conducted these forecasts and assessments and identified the investments necessary to transform our electric distribution network at the pace and scale necessary to meet the Commonwealth's long-term and interim climate and clean energy goals,

*The 2050 CECP forecasts suggest that solar, storage, EVs, and heat pump adoption is expected to soar statewide by 2035 and the grid must be ready\**



\*These are approximate values



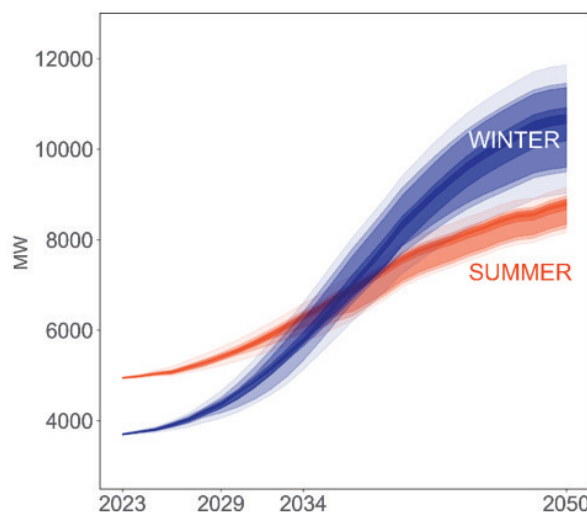
<sup>1</sup> These are statewide goals from the Clean Energy and Climate Plan (CECP).

## The Company's Future Grid Plan enables the Commonwealth to achieve its goals

National Grid is responsible for the safety and reliability of the electric distribution system, including the planning and building of infrastructure and implementation of technologies needed to meet future electrification and growth in DER. The Company's assessment of both the needs and solutions of the electric distribution grid over the next five and ten years is informed by its view of what it will take to achieve the objectives described in the 2050 CECP, meet the established interim milestones, and continue to provide safe and reliable service to our customers.

The electric distribution grid must be expanded to connect at least twice the amount of energy storage and 10 times the amount of renewable energy than today to decarbonize the electricity being used to meet this demand in 2050. Concurrently, driven by heating and transportation electrification, as presented in Section 8: 2035 – 2050 Policy Drivers: Electric Demand Assessment, electric demand growth will continue to rise beyond 2035 and is projected to more than double from a peak of 4.9 GW today to 10.7 GW by 2050. This peak will occur in the winter as opposed to summer, which has implications for system operations, performance, and availability of energy resources, such as solar, to meet growing need.

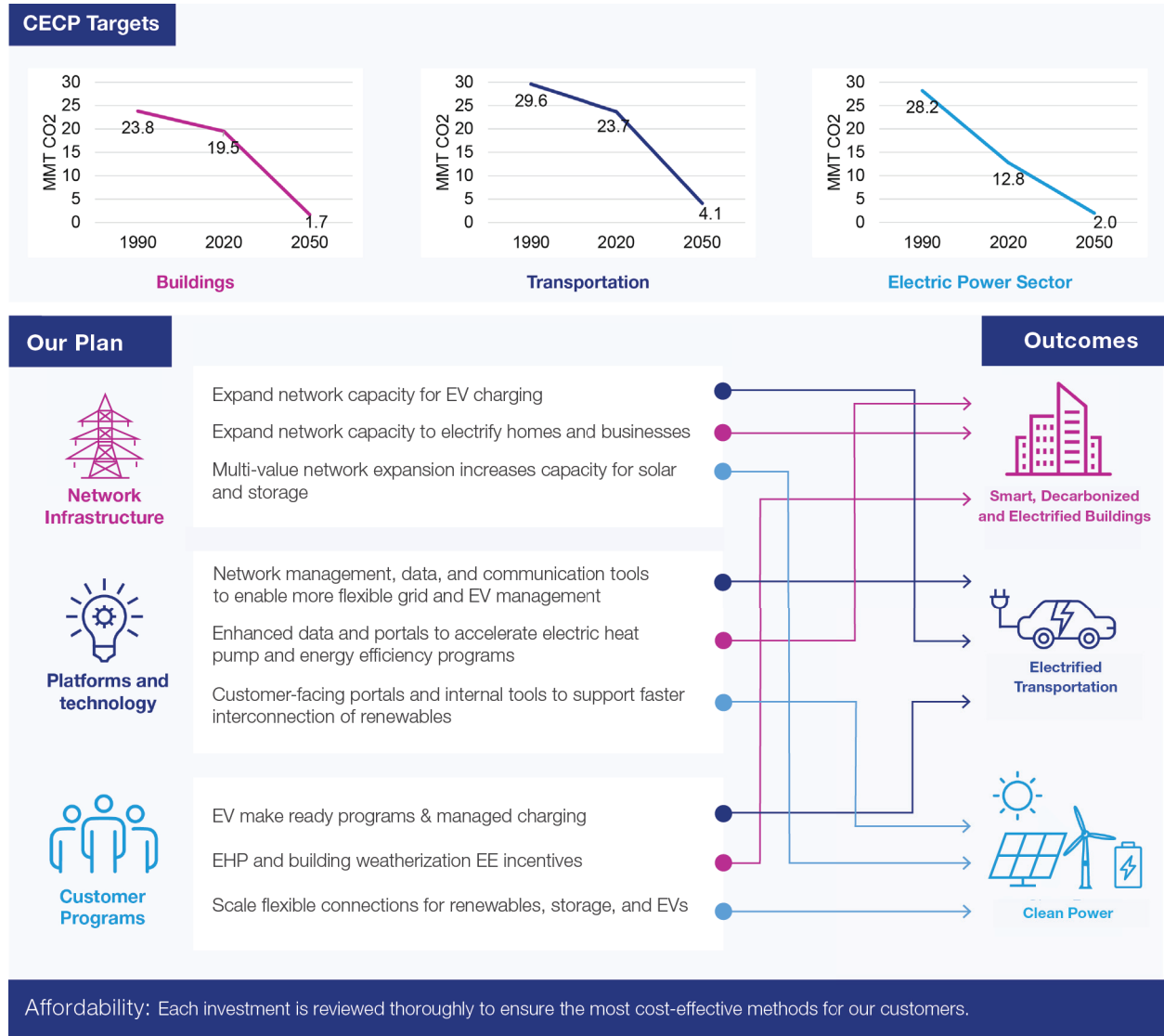
*The Company's peak demand is forecasted to more than double by 2050, and shift to the winter in the mid 2030's*



System Peak	Summer (GW)	Winter (GW)
2023	4.9	3.7
2029	5.4	4.3
2034	6.3	5.7
2050	8.8	10.7

To meet the 2050 CECP goals and interim milestones, the Company designed an investment plan focused in three key areas: 1) the network infrastructure upgrades and expansion needed to increase systemwide and local network capacity and strengthen the system, 2) the communications and technology platforms necessary to optimize DER, including local solar and storage, and smart end-use technologies for grid benefit, and 3) customer programs to support accelerated adoption of clean, electrified technologies. The graphic below illustrates the 2050 CECP's sectoral emissions reduction goals, and how the Plan's elements map to those goals. Section 5: 5- and 10-Year Electric Demand Forecast provides more detail into how the plan achieves 2050 CECP goals.

## How The Company's Future Grid Plan Elements Map to CECP Goals



This Plan links the Company's planning efforts together into an innovative, holistic roadmap for the near term and long term. The Company used an efficient and forward-thinking planning process to develop a coordinated sequencing of network infrastructure improvements with available electrification and hosting capacity for every year within the 10-year forecast period, based on an electric forecast synced to the Commonwealth's clean energy plan. National Grid will continue working with policy makers on future iterations of climate and clean energy policies and evolve its long-term planning for future ESMPs, accordingly. Future proposed investments will be reviewed to ensure that long-term infrastructure buildout is appropriately sized and can maintain high levels of reliability, support accelerated customer adoption of clean technologies, and manage overall costs.

As a significant portion of the Commonwealth's decarbonization will result from the electrification of gas customers, increased coordination is required between gas and electric utilities in the Commonwealth. Data sharing and increased mutual understanding of gas plans developed by gas local distribution companies ("LDCs") and electric plans developed by the EDCs is a necessary first step to enable this coordination, with the ultimate objective being coordinated EDC-LDC long-range capital planning, in compliance with the directives from the Department in its recent Order 20-80-B. Pending Department

review of the stated objectives in Section 11: Integrated Gas-Electric Planning, which outlines proposed process, and approvals of investments in the people, data analytics, tools and technologies necessary to successfully execute on integrated energy planning, the EDCs will: (1) proceed with establishing the Joint Utility Planning Working Group, including reporting out to GMAC on an agreed upon cadence; and (2) pursue near-term opportunities to engage in IEP, such as EDC-LDC collaboration on non-pipe alternatives and targeted electrification pilots.

## 1.3 Service Territory Overview

Our customers and communities are at the foundation of what we do and why we do it, and they are critical to the success of the Commonwealth's decarbonization plans. We must understand their expectations, circumstances, and energy needs as we evolve today's energy network, and plan and build for the future.

### **Customer Characteristics**

Today, National Grid provides electric service to more than 1.3 million customers in 172 towns and cities, across a service area that spans approximately 4,625 square miles — from the Berkshires to Brockton and Cape Ann to Cohasset. We are the electric provider in many of the Commonwealth's Gateway Cities, and we serve many EJs, representing customers in municipalities such as Adams, Worcester, Somerset, Lowell, Lawrence, Lynn, and others. We serve rural, suburban, and urban areas — including coastal and mountainous communities. Our customers live in single-family homes, multi-family homes, and apartment buildings. They run farms, small retail businesses, restaurants, grocery stores, food processing facilities, and more. They include municipalities and schools, ports and transportation hubs, academic institutions, manufacturing facilities, hospitals, healthcare, and life sciences.

### **Today's electric system characteristics and what the system delivers**

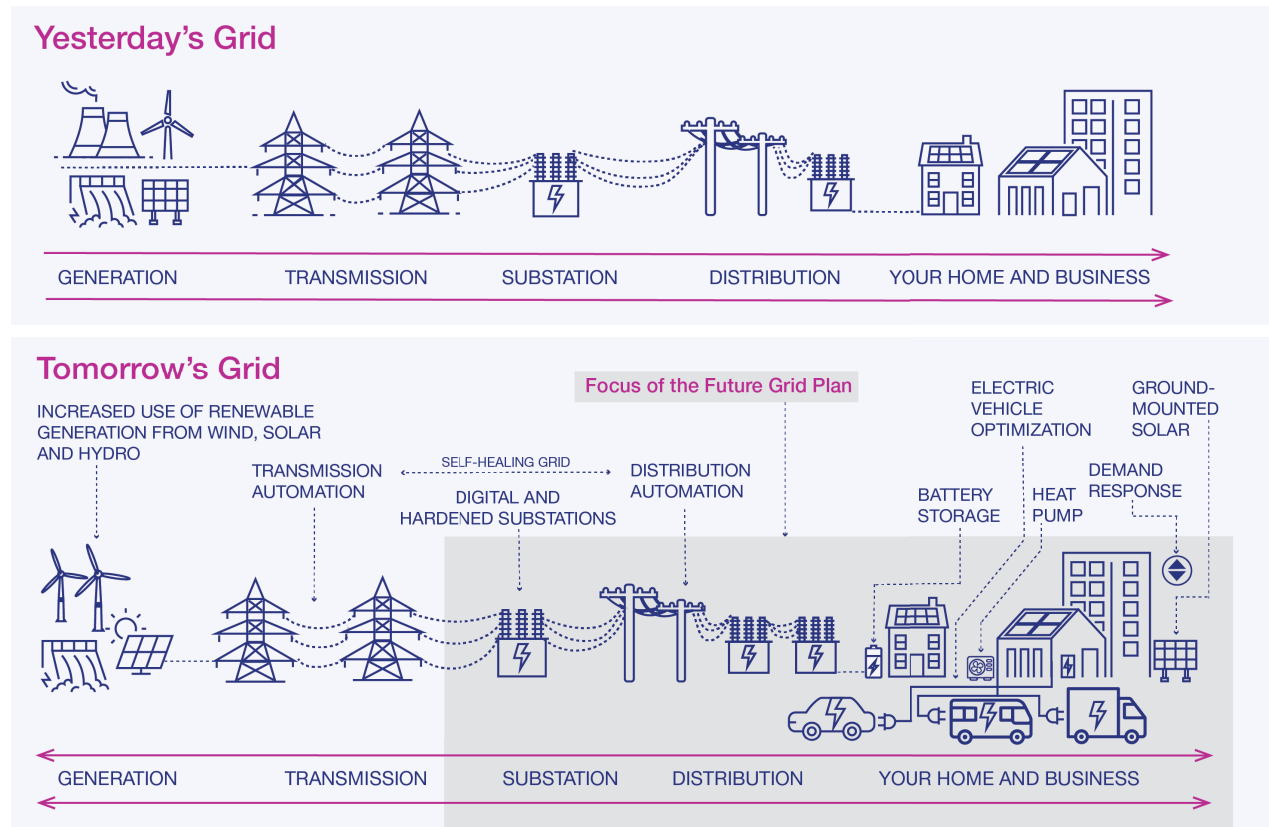
Beginning in the 1910s, electrification expanded rapidly in Massachusetts as electric lighting, industrial applications, and, by the 1920s, residential refrigeration became commonplace. In the 1950s and 1960s, the electric systems continued to expand, fueled by significant economic growth. Concurrently, many municipal- owned and small utilities consolidated into larger utilities. In 1962, nearly 100 small companies consolidated into the Massachusetts Electric Company (MECO). The company remained relatively stable until 2000, when it merged with the Eastern Utility Association. As a result, the Company's current electric distribution system consists of infrastructure with different voltage levels, asset types, and a pattern of "overlaid networks."

To serve our diverse, existing customer base, National Grid operates and maintains an electric network consisting of more than 2,500 miles of electric transmission lines that carry electricity long distances at high voltage levels to transmission substations, which step down this power to a lower voltage, making it safe to carry it across 18,500 miles of smaller electric distribution lines. These lines are supported by hundreds of thousands of poles and 264 strategically located distribution substations. Substations play a pivotal role in stabilizing the entire electric network and maintaining safe and reliable service. Substations must be located close to the load they serve; the median number of residential customers served per substation is 4,000 in the Company's electric distribution network, with a range of approximately 100 to 56,600 depending on its capacity rating. These substations can safely operate indoors or outside and do not emit pollutants that impact local air quality.

Once power is stepped down to appropriate voltage levels, electricity is distributed across a series of lower voltage circuits or wires, which run overhead or underground. This power is then stepped down again at smaller transformers close to homes and businesses and safely delivered to customers.

For more details on the current state of the distribution network, please see Section 4: Current State of the Distribution System. This extensive network will need to nearly double in size and capacity over the next twenty years, including expanding existing substations and adding a substantial number of new substations, while making it smarter by deploying technology to allow for two-way power flows and greater visibility into grid connected technologies like solar, storage and EVs to leverage them as grid assets, and maintaining the overall reliability, stability and safety of the network for all customers.

### The Commonwealth's Power Grid – Yesterday and Tomorrow

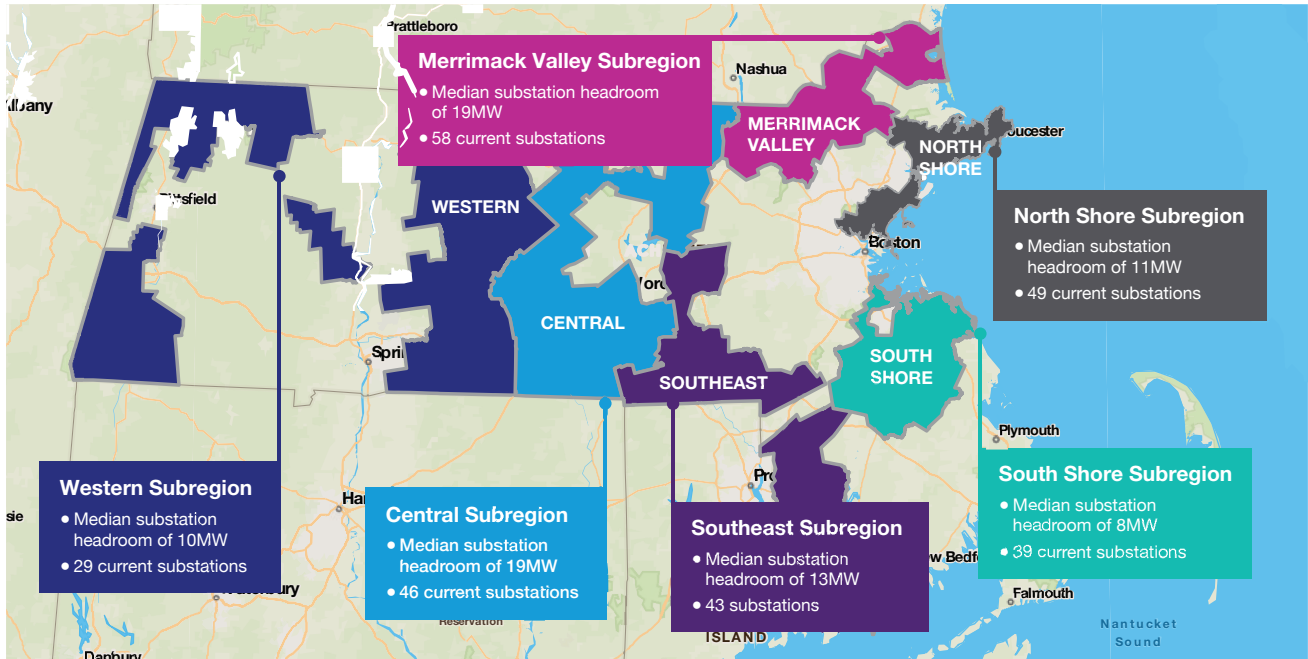


### Our community characteristics drive today's system and tomorrow's investments

The diverse communities we serve have unique physical, economic, and historical characteristics that have informed the Company's previous planning criteria and operations. For example, some communities previously supported the Commonwealth's textile and manufacturing economy, while others had limited economic activity. Some rural areas are now becoming suburban, and urban areas that once thrived may have experienced limited growth for a long time. The results of these varied and uneven economic development and settlement patterns across our service area mean that existing infrastructure and system capacity are also varied and uneven.

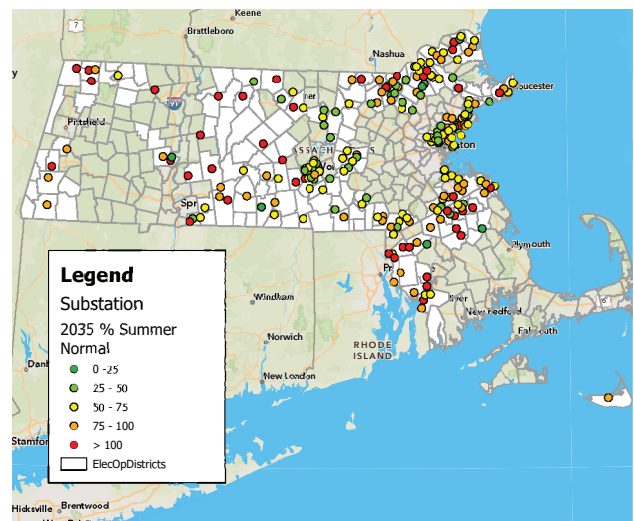
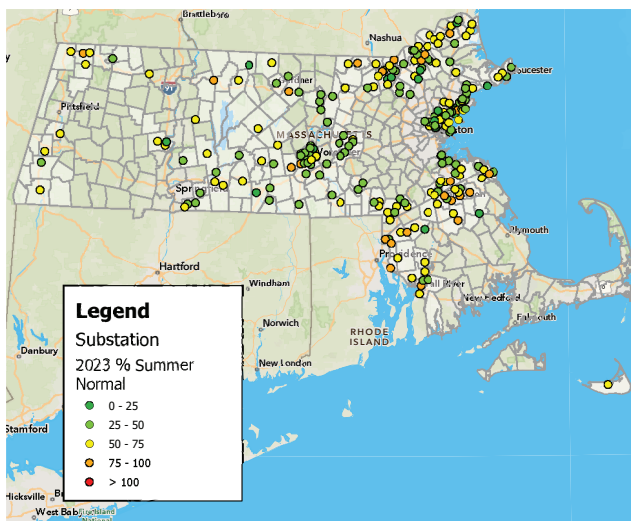
This foundation shapes and informs the investments needed to enable the clean energy transition and build resilience in each community. As we developed our Future Grid Plan, we took both high-level and granular views of our system, breaking it down into six different distribution sub-regions. These groupings are based on both geographic proximity and electrical system characteristics, which facilitate effective system planning and engineering analysis. The map below provides an overview of these six regions and current median substation capacity availability.

## National Grid's Six Major Service Sub-regions



The Company analyzed the current demand, future needs, and existing system capacity in each of these sub-regions. **The maps below show that without any system upgrades, by 2035, every sub-region in our system will see forecasted demand that exceeds current capacity.**

## Substation load as percentage of capacity across the Company's, 2023 vs. 2035 forecast assuming no capacity expansion





The scale, scope, timing, and exact locations of investment needs are driven by a combination of factors, including 1) the physical and operational needs and the condition of the infrastructure used to serve these sub-regions, 2) the available capacity on the local electric network to meet future electric and economic development needs and enable DER, and 3) the current performance of the local network as it relates to reliability and resilience. This assessment provides the baseline for examining alternatives, including the use of NWAs, as the Company worked through the planning process. Refer to Section 5: 5- and 10-Year Electric Demand Forecast for more detailed information on our forecasting process and Section 6: 5- and 10-year Planning Solutions for more on our planning process.

## 1.4 How Customers Will Experience the Just and Equitable Clean Energy Transition

The future electric system will power all aspects of daily life -- appliances, electronics, lighting, cooling systems, cooking, heating, and transportation. Today, our customers rely on and use electric and gas networks as well as delivered fuels to meet their home and building energy needs, and a vast network of fueling stations for their cars, buses, and trucks. In the future, customers will become much more reliant on the electric network as their primary energy system, which will be more decarbonized, more digitized, and more decentralized. As depicted on page 3, customers will have more options and access to technologies and programs that can increase home comfort, convenience, and resilience, lower overall energy costs, and create potential revenue streams from grid connected devices, including appliances, cars, solar and storage.

National Grid customers are increasingly aware of this future and engaged in their energy experience. As a result, they have understandably high expectations for levels of service and options. They want immediate solutions when problems arise, when outages occur, and when opportunities emerge. Rising prices, supply security concerns, and climate change are front of mind. There are more active energy consumers seeking more interaction, driving a greater need for change in the customer experience. Each customer has unique needs, depending on a variety of factors, including customer type, electric use patterns, geography, income, and access to technology.

Affordability and equity also mean different things to different customers. For some business customers, electric costs may be a significant share of their overall operating costs, impacting profitability. For some residential customers, paying their monthly electric bill may require hard choices, such as choosing between heating or eating, because their energy burden is so significant, which is often exacerbated by distributional and structural inequities. We are aware of these key differences and are re-envisioning how we approach, interact with, and serve each set of customers. This deeper understanding of our customers' diverse needs helps us define the investments required to: improve operational efficiency; optimize our plans and programs to build only what is needed to meet reliability, resilience, and growth goals; and enable rate designs, energy efficiency, access to clean transportation, and customer and community-facing programs for bill management and other support.

### **Transparency, Equity, and Engagement**

To best understand how customers want to experience the clean energy transition and their expectations and needs for the future, National Grid is engaging with and listening to its customers and establishing an inclusive, equitable stakeholder engagement process. Submission of the Future Grid Plan to the GMAC in September 2023 was an important step in increasing the transparency and inclusiveness of the Company's investment decision making and reaching a broad range of customers and representatives of impacted communities. National Grid and the other EDCs collaborated with the

GMAC to gather further feedback on their respective ESMPs, which was incorporated into this filing, and gained additional insights through the two stakeholder workshops held in November 2023, along with a dedicated technical session with DER providers in December 2023.

National Grid also met with more than 80 municipalities, 10 business organizations, 7 state agencies, 20 community & nonprofit organizations, labor organizations, representatives of EJCs, energy assistance providers, organizations representing generators, renewables, DER providers, EV providers, housing developers, and others prior to making this submission to the Department (please see the Appendix for a full list). Finally, National Grid maintains a Customer Council comprised of all customer classes, service area communities, and impacted populations, including EJCs. In anticipation of our ESMP filing, we engaged customers through the Customer Council about their expectations for the future energy system. Feedback received through this engagement is outlined in more detail in Section 3: Stakeholder Engagement and was used to inform this Future Grid Plan.



### Key takeaways from our Customer Council input:

## Build a Grid that Serves Everyone

### Strengthen our system

Create clean energy solutions, fewer outages, and thousands of jobs.

### Keep Costs Down

Make smart investments that improve operational efficiency and enable customers to optimize and create value from energy systems.

### Put Customers in Control

Deliver products and services that put customers in control of their energy future to meet their priorities, not ours.

### Create a Seamless Experience

Continuously modernize our system so all customers can self-serve and more seamlessly access and sign up for products, services, and programs, with particular focus on our low- and moderate-income customers.

# 1.5 Demand Assessment and Investment Drivers

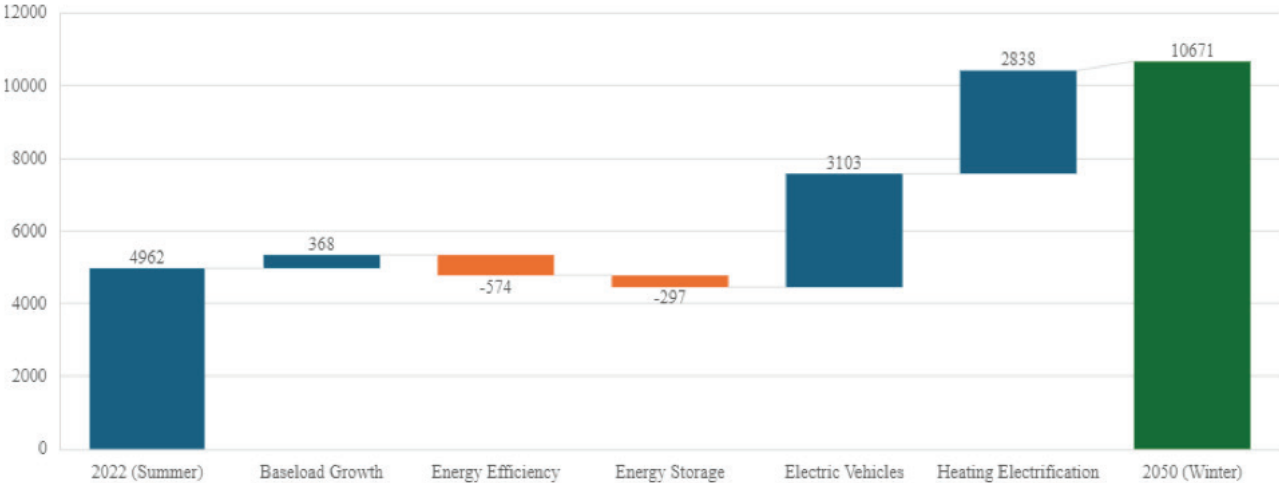
National Grid uses sophisticated modeling tools and a dynamic process to forecast future electric demand, including understanding the drivers and timing of demand. The Company employs an econometric model to first project a base load estimate. It then incorporates adjustments to this base load forecast to reflect policy changes, technology innovation and adoption, customer behavior, and historical load and weather data with other factors to develop a predictive load forecast model. Finally, the Company runs 2000 different scenarios of future electric load growth, including system-level and substation-level peak demand for purposes of investment planning and prioritization.

This integrated and iterative forecasting approach is a prerequisite to efficient capital investment decisions by pinpointing where constraints on the distribution system are projected to manifest. The Commonwealth faces an inflection point in electricity demand. Over the last 15 years, peak electricity demand has remained relatively flat despite increases in base load, due to offsetting energy efficiency actions taken through, for example, the nation-leading Mass Save program, demand response, and support from rooftop solar. However, over the next 10 years, the acceleration of beneficial electrification and underlying economic growth will outpace these offsetting actions, with electric demand forecasted to begin decades of robust growth.

Based on the in-depth forecasting and modeling, we are projecting a 130% increase in net electric demand in the 10-year forecast period in the areas served by National Grid. By 2050, total peak demand, which is the maximum demand on the system in a given year, will increase from a 4.9 GW current summer evening peak to a 10.7 GW winter morning peak. (For more details on the electric forecast, see Section 5: 5- and 10-Year Electric Demand Forecast.) Investments in the next five to ten years must be made with an eye toward the future to ensure that the system is ready to accommodate the expected increases in peak demand associated with the 2050 goals and interim targets, and the season in which the peak will occur. A winter peaking system has different operational characteristics and needs than a summer peaking system, which is a significant consideration in overall system and resource planning and associated investments.

The graphic below provides a breakdown of the components of forecasted load growth, at peak, including the potential impacts of Energy Efficiency (EE) and Distributed Energy Resources (DERs) such as Energy Storage (ES), Solar Photovoltaic (PV), Electric Vehicles (EV), and Heating Electrification (HE) through 2050. See Section 8: 2035 – 2050 Policy Drivers: Electric Demand Assessment for more detailed discussion of the 2050 demand assessment.

*Annual peak load growth through 2050 by components*



As illustrated, due to a shift to winter peak, PV does not play a material role in reducing peak demand, and even with demand reduction benefits of EE and ES, the Company must accelerate its pace of network investments and operational planning to meet the forecasted capacity needs. Without the necessary investment, the accelerated rates of electric end-use technology adoption to meet the 2050 CECP interim targets will outpace the grid's ability to keep up with demand by 2030 in a manner that preserves system reliability for all customers.

## 1.6 5-year Electric Sector Modernization Plan Investment Summary and Outcomes Achieved

This Plan builds on investments already underway to modernize the grid and complements the investments the Company continues to make to provide safe and reliable service, as approved in our periodic base rate reviews with the Department. For a comprehensive review of the investments already approved and/or pending by the Company, please refer to Chapter 6: 5- and 10-Year Planning Solutions: Building for the Future.

The Company has Capital Investment Projects (CIP) pending before the Department to support additional DER capacity. The Company recently filed its Base Rate Case (BRC) for the Company to support the core investments needed to safely and reliably operate the electric distribution network, meet current customer demand, improve the overall efficiency and resilience of the system, and provide a more seamless experience for customers and those connecting to our system. The investments in the CIPs and BRC filing are core investments that establish the foundation for the incremental investments proposed in this Future Grid Plan that are necessary to meet the 2050 CECP goals and interim milestones. The Future Grid Plan comprises:

- ▶ **Network Infrastructure Investments:** New substation and distribution line upgrades to support electrification load growth and DER interconnections, as well as investments to install and manage additional technology to improve network operations and management.
- ▶ **Communication and Technology Platform Investments:** Technology investments to accelerate and support the transition to a clean energy-heavy grid, including network management technologies (including DERMS), telecommunications, cybersecurity, data management, and new digital products to support asset management, technology, and operations.
- ▶ **Customer Program Investments:** New programs and demonstrations to advance VPPs and use of DER for grid services, and investments in new clean energy customer portals & enabling technologies.

### Proposed 5-Year ESMP Investments (2025 to 2029) and CECP-related Outcomes

Over the next five years, through this Future Grid Plan the Company proposes to invest approximately \$2.5B to support the network infrastructure, communications and technology platforms, and customer programs necessary to meet the 2050 CECP goals and outcomes. These network infrastructure investments, coupled with investments in communication and technology platforms to expand and enhance network management tools, customer programs, enterprise-wide network communications, planning data management capabilities, and customer-facing portals will enable an additional 1 GW of solar capacity, 492,000 EVs, and 84,000 electric heat pumps, keeping the Commonwealth on pace to meet its cumulative 2030 and 2050 targets.

*Existing Base Rate Case and Active Regulatory Investment Summary*

Category	Summary	Recovery
<p><b>Base Rate Case</b></p>	<p>Electric operations to ensure safe and reliable service including:</p> <ul style="list-style-type: none"> <li>▶ Asset repair and maintenance</li> <li>▶ System capacity and performance projects</li> <li>▶ Damage/Failure projects required to replace damaged equipment</li> <li>▶ New customer connections</li> <li>▶ Non-infrastructure such as IT, fleet, etc.</li> </ul>	<p>Base rate recovery</p>
<p><b>Active Regulatory Investments</b></p>	<ul style="list-style-type: none"> <li>▶ AMI</li> <li>▶ EV make-ready charging</li> <li>▶ Capital Investment Projects (CIPs)</li> <li>▶ Grid Modernization</li> </ul>	<p>Individual projects filed with DPU, Grid Mod Mechanism (through 2028), EV mechanism (through 2026)</p>



Proposed ESMP Investments 2025 – 2029

Category	Summary	Recovery	CapEx (\$M)	OpEx (\$M)
<b>Network Investment</b>	<ul style="list-style-type: none"> <li>▶ Substation and distribution line upgrades/expansion for electrification load growth and DER interconnections</li> <li>▶ Pending DER interconnections with cost allocation (including 3 CIP projects)*</li> <li>▶ Installation and management of additional technology to improve the network capabilities</li> </ul>	Incremental ESMP	\$1,533	\$58
<b>Platform Investments</b>	<ul style="list-style-type: none"> <li>▶ Network management technologies (incl. DERMS)</li> <li>▶ Telecommunications</li> <li>▶ Cybersecurity</li> <li>▶ Data management</li> <li>▶ New digital products to support asset management, technology, and operations for a DER-heavy grid</li> </ul>		\$323	\$77
<b>Customer Programs</b>	<ul style="list-style-type: none"> <li>▶ New programs and demonstrations to advance VPPs and DER for grid services</li> <li>▶ Customer portals to enable clean energy and electric end use adoption</li> <li>▶ Continuation of existing EV make-ready and charging infrastructure programs</li> </ul>		\$84	\$315

\*In addition to the costs in this table, the Company also projects expending \$71 million in capital and associated operating and maintenance costs for new CIPs.

## Using NWAs to manage costs, maintain reliability, and drive innovation

As the Company conducted its system planning assessment and subsequent investment decision-making, it actively pursued opportunities to apply NWA solutions to meet distribution system needs in both the 5- and 10-year plans, including:

- ▶ **Bridge to Wires NWAs.** Solutions that can be deployed quickly in the highest needs locations to address an imminent need where a capital project cannot feasibly be delivered in the timeframe.
- ▶ **Deferral NWAs.** Solutions to defer substation projects from 2029 through 2034. Pilot programs were selected in areas where load growth is more manageable and capital projects can be implemented quickly should NWAs not materialize.

The NWA solutions proposed in this Plan serve as a first step in a multi-year process to develop and mature NWA capabilities. These initial NWAs will provide significant learnings on the capabilities of NWAs to reliably meet customer and system needs, including aggregated solutions such as Virtual Power Plants (VPPs) that can provide utility-scale grid services. The Company has several teams committed to successfully enabling NWAs with focus on 1) creating connections with leading technology developers and 2) transformation mapping of internal capabilities to test and scale avoided infrastructure investment with a specific goal of bill reductions. For more details on our NWA plans, see Section 6: 5- and 10-Year Planning Solutions.



The Company will pursue an NWA in the area surrounding Litchfield Street station in Leominster to defer a feeder expansion project. The proposed NWA is comprised of a combination of targeted EE, DR, managed charging incentives and market-based flexibility auctions, essentially creating a VPP to meet load during peak periods.

Importantly, the success of future, expanded use of NWAs is dependent on the timely implementation of the Company's Communication and Technology Platforms and Customer Programs proposed in this Future Grid Plan and other in-flight system modernization and customer program efforts, including Mass Save, AMI, and the deployment of Distributed Energy Resources Management Systems (DERMS), which will allow the Company to actively manage the DER connections that make up NWA solutions.

### Plan implementation will be transparent and inclusive

To promote a more resilient system and properly plan for and address the Commonwealth's energy needs, clean energy infrastructure must be deployed in a timely manner in communities across the state, including those that currently host major energy infrastructure and those that historically have not. The Company's Plan includes expanding or building new substations in dozens of municipalities over the next five to ten years. Key to successfully executing these projects is to ensure host communities have input and agency throughout the process.

Stakeholder engagement is foundational to a just and equitable energy transition. To further enhance its stakeholder and community engagement, National Grid and the other EDCs are proposing the development of a Community Engagement Stakeholder Advisory Group (CESAG). The primary objective of this group is to develop a community engagement framework, centered in equity, that can be applied

to major infrastructure projects related to the clean energy transition before they are submitted to the Department and/or the Energy Facilities Siting Board (EFSB). Additionally, as outlined in Section 3: Stakeholder Engagement, the Company developed an Equity and Environmental Justice Policy and Stakeholder Engagement Framework (Framework) based on building engagement in partnership with stakeholders that have not historically participated in the project development process and regulatory proceedings.

This Framework was informed by principles developed by the American Council for an Energy Efficient Economy (ACEEE) and rooted in enhancing 1) Procedural, 2) Distributional, and 3) Structural equity. National Grid proposed this Framework in its September submission to the GMAC and revised it to reflect feedback from the GMAC Equity Working Group and other stakeholders prior to finalizing and submitting it with this filing. Successful implementation of a repeatable framework will increase the efficiency and transparency of execution of major infrastructure projects while ensuring community feedback is reflected. In addition to such a community engagement framework, major siting and regulatory reform is also necessary to ensure timely construction of the infrastructure necessary to maintain safe and reliable service in a decarbonized future.

## 1.7 Climate Impacts and Building Resilience

Climate change is affecting the Commonwealth's weather in dramatic ways, today. Historically, National Grid's system could expect four major storm events with significant outage impacts each year; now the expectation has risen to 10 storms per year. These storms can also be more intense and localized, creating wind and flood damage. Higher summer temperatures and humidity levels are generating multiple effects, including increased customer cooling saturation rates, higher cooling usage, higher summer peaks, and de-rating of transformer capacity. Winters, while milder on average, are also subject to 'polar vortex' conditions that bring intense cold and snow, with corresponding outage risks and peak demand impacts. While National Grid has maintained reliability at levels exceeding 99.9% of system-wide availability, we recognize that such climate impacts present risks to sustaining these levels.

At the same time, the Commonwealth's climate and clean energy goals add potential system reliability risks as we integrate more large-scale renewable resources, DERs, including local solar and storage, and new loads from beneficial electrification. Distribution system resilience and reliability must address these among other contributing factors. National Grid has developed robust processes to respond to impacts on distribution system performance. Additionally, preparing for and responding to the potential impacts of climate change is embedded in the way we plan, construct, and operate our system.

To make our system stronger and better able to withstand more severe and frequent weather events, our BRC filing includes investments to increase system resilience and maintain high levels of reliability. Investments focused on reliability and resilience are considered core, or foundational, by the Company and, as such, were primarily included in our BRC. The investments which comprise the Future Grid Plan are proposed to address electrification-driven load growth and will provide a secondary benefit of improving reliability and resiliency of the distribution system, we took opportunities to also strengthen and make the system more resilient. For example, where the Company proposed upgrades as part of this Plan to ready the network for electrification demand growth, we also took advantage of the opportunity that upgrading the network offers to do things like, for example, adding Early Fault Detection technology.

To identify climate hazard risk, the Company applied a Climate Vulnerability Assessment (CVA), which is an innovative approach to mapping our electric infrastructure to potential climate hazards – such as floods, and heatwaves, and high winds. As our understanding of the magnitude, scope, and breadth



of climate-related challenges matures, the flexibility and robustness of the Company's processes will allow additional measures to be developed and implemented. Our overall approach to system reliability and resilience is summarized below, with more detail provided in Section 10: Reliable and Resilient Distribution System.

*The Company's distribution system reliability and resilience initiatives*

<b>Distribution Construction Standards</b>	Regular reviews and updates of distribution construction standards to address climate-related changes and its impact on system reliability performance.
<b>Vegetation Management</b>	Developing long-term strategy, planning, budgeting, and delivery of the vegetation management work plan to address vegetation impacts on safe and reliable service.
<b>Asset Management Practices and Distribution System Planning</b>	Practices and studies to identify existing and projected future system performance concerns and the infrastructure development required to address them.
<b>Infrastructure Development Programs</b>	Programs designed to address the addition, replacement, and/or modification of specific assets.
<b>Distribution Resiliency Hardening Programs</b>	An approach to identify, prioritize, and mitigate Company circuits that have demonstrated historical resiliency challenges with a focus on hardening assets to increase the resiliency of the distribution system.
<b>Asset Climate Vulnerability Assessments</b>	An approach to consider the impacts of climate change over the next several decades to determine future risk to our built and future electric infrastructure. Identifying climate hazards including flooding, heat waves and high temperature, extreme wind, ice accretion, and wildfires.

## 1.8 Workforce and Societal Benefits of a Just Transition

The Future Grid Plan will enable a variety of economic, environmental, climate, health, and system benefits that will be realized at local and state levels through incremental economic activity and job creation, GHG emissions reductions, improvements in air quality, greater system safety, and resilience. All EDCs used a single third-party with a common methodology to produce the net benefit assessment, as recommended by the GMAC. In addition to monetizable benefits, the Plan's investments provide many non-monetizable benefits which support the Commonwealth's climate and equity goals. Importantly, the investments proposed in the 5-year plan are expected to have a cumulative reduction in GHG emissions of 31.3 MMT. A high-level summary of the overall benefits delivered are included below, with detailed information regarding the net benefits assessment provided in Section 12: Workforce, Economic, and Health Benefits:

- ▶ **Enhancing safety.** As the Company designs, builds, or maintains assets, we consider opportunities to enhance system safety. For example, investments to replace aging infrastructure, eliminate older equipment that has a higher operational risk profile than the current technology, and technologies that minimize or avoid service disruptions all contribute to improving employee and public safety.
- ▶ **Expanding stakeholder engagement and increasing transparency.** The Company's new Equity and Environmental Justice Policy and Stakeholder Engagement Framework, coupled with the proposed CESAG, will ensure a diverse group of interested stakeholders is proactively engaged and has a voice on a just transition to enable clean energy and the Company's proposed Future Grid related projects.

Benefit Type	Amount Expected (2025-2029)
<b>Total Estimated Benefit</b>	NPV of \$821 Million
<b>Emissions Abatement</b>	31.3 MMT of CO <sub>2</sub> ; 7,460 MT of NO <sub>x</sub> ; 160 MT of PM <sub>2.5</sub>
<b>Jobs Creation</b>	3,900 full and part-time jobs
<b>Economic Impact</b>	\$500 million in incremental economic activity

- ▶ **Enabling grid reliability and resilience.** Substation and feeder expansion and upgrades, deployment of new technology, and evolution of planning criteria and related investments will drive improvements in the Company's existing reliability performance. As described in Section 10: Reliable and Resilient Distribution System, the Company is also employing its innovative CVA to identify and mitigate climate risk hazards. Outside of this Plan, the Company has proposed resilience and reliability investments as part of its BRC, including the continued deployment of Reclosers and FLISR technology to reduce outage duration by up to 55% for impacted customers, and avoid disruptions by expanding our proactive vegetation management program and deploying tree-resistant wires.
- ▶ **Facilitating electrification of buildings and transportation.** As a result of the Plan, at the end of the 10-year period, the Company will have increased the headroom of the system to meet peak demand of 6 GW, which is 25% higher than today, keeping the Commonwealth on track to meet its EV goals of 870,000 million vehicles on the road by 2035 and 235,000 electric heat pumps in homes and businesses. This effort will be complemented by energy efficiency and demand response programs administered by the Company through Mass Save to minimize demand along with managed charging programs to help mitigate peak loading impacts of EVs. Over time, the use of AML, which begins roll out in 2024, will provide an additional tool to empower customers to actively participate in energy programs and manage their energy usage and costs, including through time-varying rates.
- ▶ **Connecting and integrating DER.** The Company has a longstanding commitment to improving the interconnection process and implementing projects to facilitate the integration of DER on its system. In total, the Company has connected more than 2.3 GW of DER and this Plan will support the connection of another 2 GW, essentially doubling the DER capacity on the electric distribution grid, and providing expanded opportunities for NWA's and other innovations.
- ▶ **Reducing greenhouse gas emissions and air pollutants.** The Company's 5- and 10-year plans will contribute to the Commonwealth's GHG emission reduction goals. Capacity expansion and grid

modernization will enable increased penetration of renewable energy and a shift away from fossil fuel generation, which will ultimately lead to reductions in GHG emissions and air pollutants. The net benefit modeling estimates that the Future Grid Plan will enable a reduction in CO2 emissions of approximately 31.3 MMT, NOx emissions of 7460 MT, and PM2.5 emissions of 160 MT.

- ▶ **Increasing economic activity and creating jobs.** The substantial investments necessary for the transition toward long-term GHG reduction goals will result in positive economic benefits. As described in Section 12: Workforce, Economic, and Health Benefits, the Company utilized United States Department of Commerce Bureau of Economic Analysis (“BEA”) Regional Input-Output Modeling System II (“RIMS II”) to assess the potential economic impacts of the Future Grid Plan.

The modeling forecasts approximately \$500 million of incremental economic activity from the Future Grid Plan capital expenditures during 2025 – 2029 and \$1.1 billion over the 10-year plan. The modeling also forecasts approximately 3,900 full- and part-time jobs from 2025 through 2029, and more than 8,700 jobs during the extended period of 2025 through 2034 from the Future Grid Plan. Inclusive of the Company’s BRC, which is foundational to ESMP investments, CIP proposals, and this Future Grid Plan, the modeling forecasts approximately \$1.7 billion of additional economic activity from capital expenditures during 2025 – 2029 and more than \$3.5 billion over the 10-year plan. The modeling also forecasts more than 13,100 full- and part-time jobs from 2025 through 2029, and approximately 28,000 jobs during the extended period of 2025 through 2034, inclusive of these investments.

In addition to the direct expenditures associated with the proposed network investments, increased construction activities and infrastructure build-out will have positive tax and revenue impacts for some communities that host the planned infrastructure.

## **Workforce, Economic Opportunity, and a Just Transition**

The Company is committed to training and hiring the future workforce and creating economic opportunities in historically underrepresented communities.

The jobs created through these investments are significant and include a mix of shorter duration work to support the build out of the network, and ongoing operational support. They also include jobs that support the planning and engineering of the system, the operation and management of grid performance, communications and IT platforms, and the design and implementation of customer programs that support the electrification of heating and transportation, DER deployment and energy efficiency.

The energy transition offers an opportunity to provide career pathways to local communities – particularly those that have not historically benefited from — or have been burdened by — such investment. To enable this and meet the significant need for a ready, available, and skilled workforce, National Grid launched a multi-pronged workforce development pilot program, focused on underrepresented communities, to provide the foundational training and education to create a talent pipeline from these communities.

The Company’s workforce development strategy is built around four strategic pillars:

- ▶ Work-ready adults ready to reenter the workforce;
- ▶ College/university graduates starting their careers;
- ▶ Traditional and vocational technical high school students passionate about learning in-demand skills; and

- ▶ Middle schools that promote STEM awareness of the Commonwealth's climate and clean energy goals.

National Grid launched its strategic Workforce Development Program (WDP) and pilot in March 2023. To date, more than 30 individuals have secured employment with the Company or its contractors, helping to build generational wealth for them and their communities. Our WDP was developed in partnership with community-based organizations, community colleges, universities, vocational and technical institutes, and middle and high schools, and is being implemented in coordination with efforts already underway by the state, including the work of the Massachusetts Clean Energy Center (MassCEC) and funding from the state through a STEM-Tech grant and from the federal government through the Infrastructure Investment and Jobs Act.

### **Equity, Environmental Justice, and Affordability**

Being fully cognizant that affordability is a major concern for all customers and communities, the Company will continue to support efforts to ensure that cost impacts are correlated with the benefits that accrue from improved reliability, resiliency, and clean energy investments and programs. The Company believes both the pace and scale of the proposed investments in this Plan across network infrastructure, communication and technology platforms, and customer programs are both appropriate and necessary to achieve the Commonwealth's 2050 targets and interim mandated milestones.

The investments proposed in the Future Grid Plan are projected to result in an estimated \$3 per month by the end of the 5-year investment period.. We understand that any cost increase can be a challenge for customers and that many lower-income customers may be disproportionately impacted. To address this, National Grid proposes to alleviate energy burden for its distribution customers through a tiered discount rate, which is pending before the Department as part of the Company's BRC filing, along with an expanded customer outreach and engagement program. This tiered discount program aims to keep energy burdens for eligible customers at no more than 6% of their total annual income by offering discount rates that would reduce an eligible customer's bill by up to 55%.

To the extent that the Department supports a different balance between the pace of proactive investments designed to meet the Commonwealth's 2050 CECP goals and overall affordability for customers, the Company has provided an assessment of the tradeoffs between investment pace and projected outcomes in Section 7: 5-Year Electric Sector Modernization Plan, which is underpinned by detailed analysis. The Company also recognizes and appreciates that the Department recently opened an inquiry to examine energy burden with a focus on energy affordability for residential ratepayers (D.P.U. 24-15). We look forward to actively participating.

## **1.9 Conclusion and Next Steps**

The Commonwealth's 2050 CECP is an equity-centered plan rooted in decarbonizing electricity and using this clean energy to power all aspects of the economy. Meeting the 2050 CECP goals requires all the Commonwealth's EDCs to develop comprehensive, thoughtful, and flexible plans that transform today's electric distribution grid, giving it new capabilities and expanding it at pace and scale to support this future, which will result in a doubling of electric demand over the next 25 years.

By developing and submitting this Future Grid Plan, the Company is taking an important step to defining the comprehensive scope and scale of what we collectively must do over the next 5, 10, and 25 years to combat climate change and enable a more electrified and equitable energy future. We are doing this by identifying the system investments and changes needed in the electric distribution system to meet growing demand, engaging broadly to stimulate ideas, seeking input to ensure our investments are

responsive to and supportive of the needs and expectations of all our customers and communities, and making it easy for customers to adopt the clean energy choices that work for them and their budgets.

Since release of the final GMAC recommendations and stakeholder workshops in the fall of 2023, the Company has worked to update this Plan to be responsive to feedback gathered, to date. As a part of the roadmap, in the near term, the Company contemplates: further work to stand up the CESAG to improve the process for efficiently soliciting and responding to stakeholder feedback; support for the Department's inquiry into affordability and rate design; and further efforts to gain alignment on the metrics and reporting required to ensure transparency in ESMP implementation efforts. Collectively, these next steps will improve the transparency and effectiveness of ESMP implementation and empower Massachusetts by building a smarter, strong, cleaner and more equitable energy future.