



# On the Horizon

2022 Regional Electricity Outlook

ISO



25 years

new england

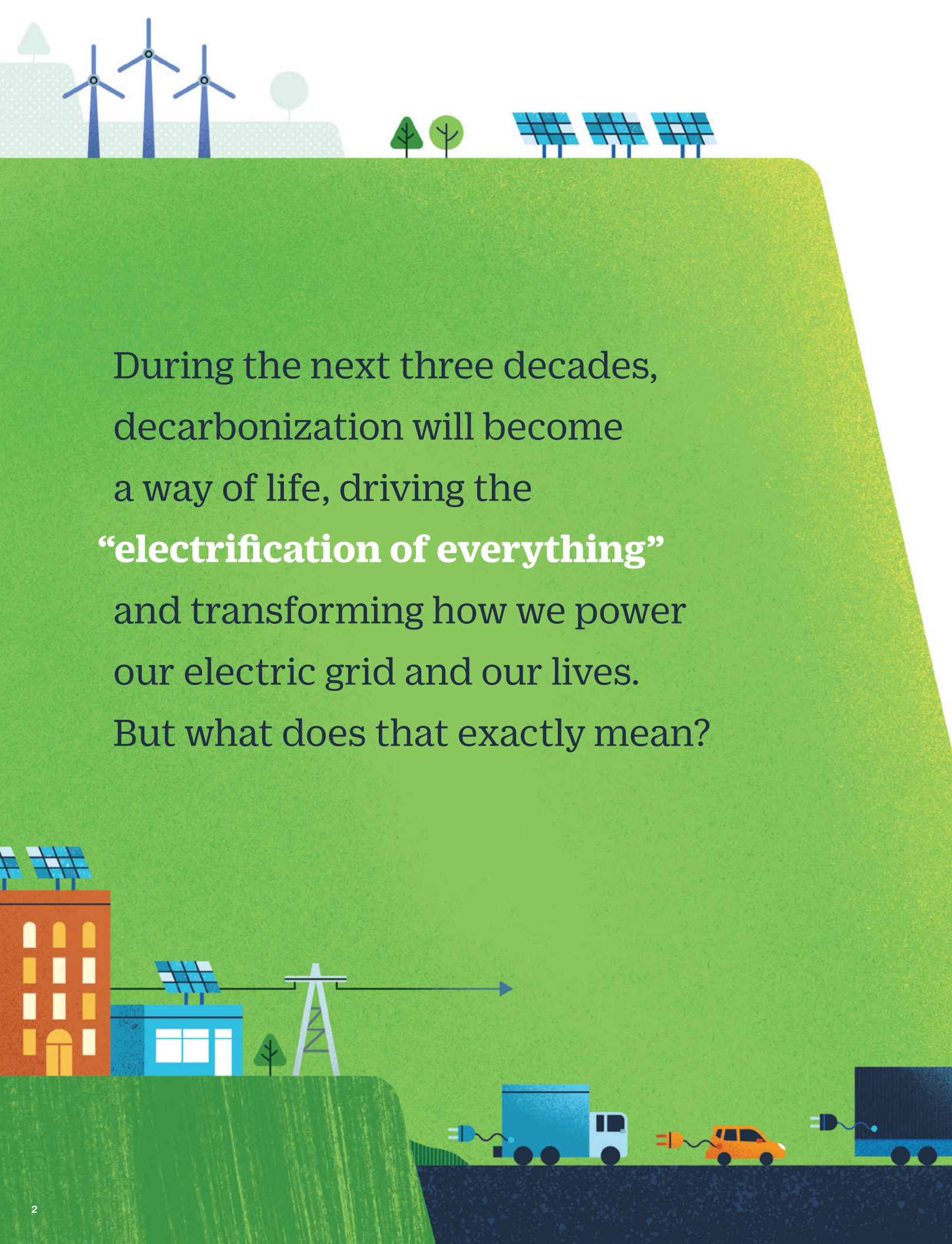




At ISO New England,  
we recognize that  
**climate change is real  
and happening now.**

Climate change poses  
an existential threat to  
our planet. Reducing  
carbon emissions is  
critical to combating it.





During the next three decades,  
decarbonization will become  
a way of life, driving the  
“**electrification of everything**”  
and transforming how we power  
our electric grid and our lives.  
But what does that exactly mean?

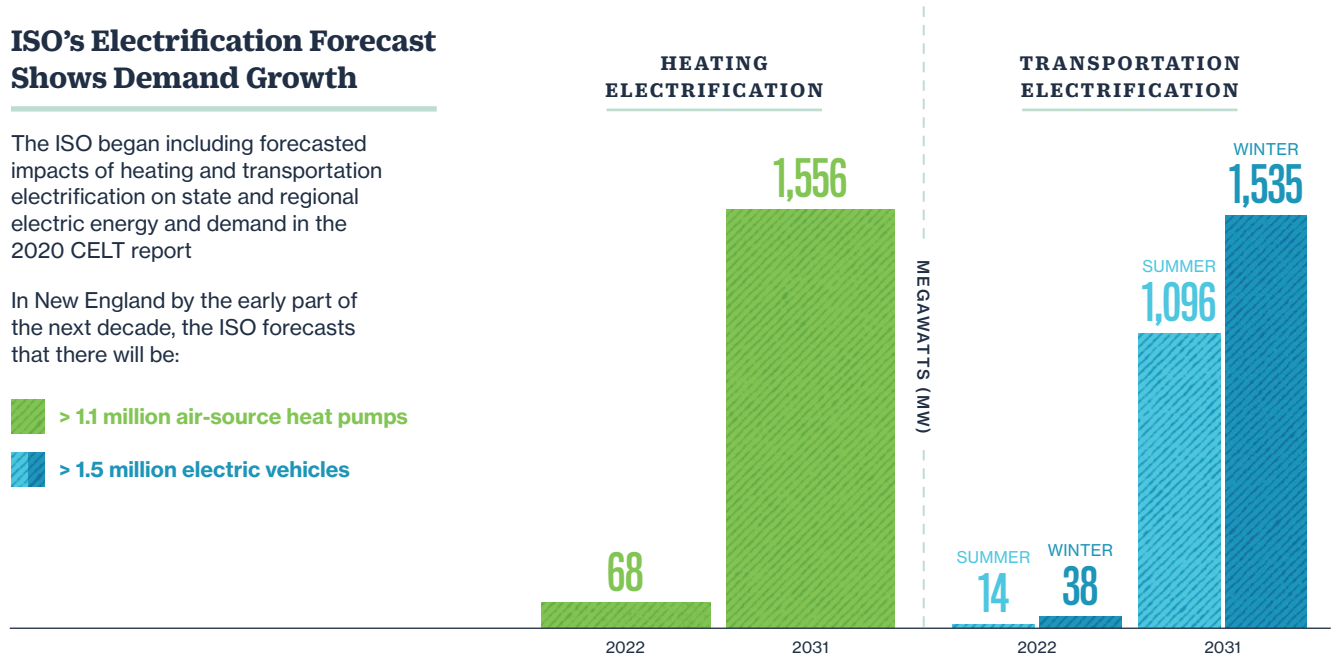
- ▶ Economic sectors still powered by fossil fuels will need to electrify
- ▶ The electric power grid will become largely decarbonized, with older fossil-fueled resources retiring and new clean-energy resources coming online
- ▶ The future grid, fueled primarily by renewable resources, will need to meet significantly increased demand and do so reliably

**ISO’s Electrification Forecast Shows Demand Growth**

The ISO began including forecasted impacts of heating and transportation electrification on state and regional electric energy and demand in the 2020 CELT report

In New England by the early part of the next decade, the ISO forecasts that there will be:

- > 1.1 million air-source heat pumps
- > 1.5 million electric vehicles



Source: ISO New England 2022-2031 Forecast Report of Capacity, Energy, Loads, and Transmission (2022 CELT Report). Heating Electrification Forecast 2022. Transportation Electrification Forecast 2022



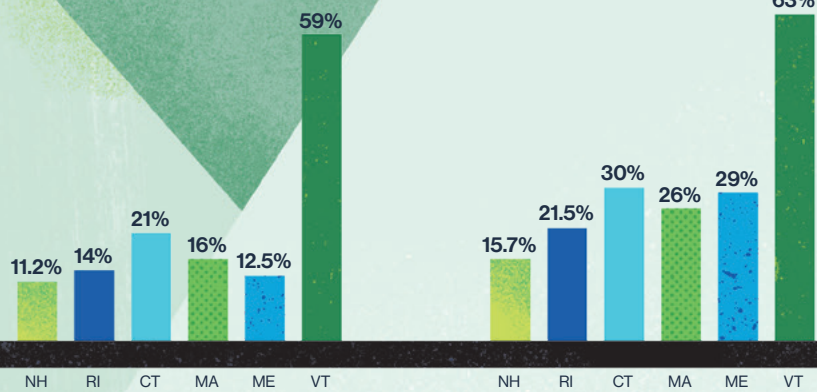


The New England states are moving to reduce carbon emissions from the electric, heating, and transportation sectors, setting aggressive targets **to increase renewable energy resources and reduce greenhouse gas emissions to nearly zero by 2050.**

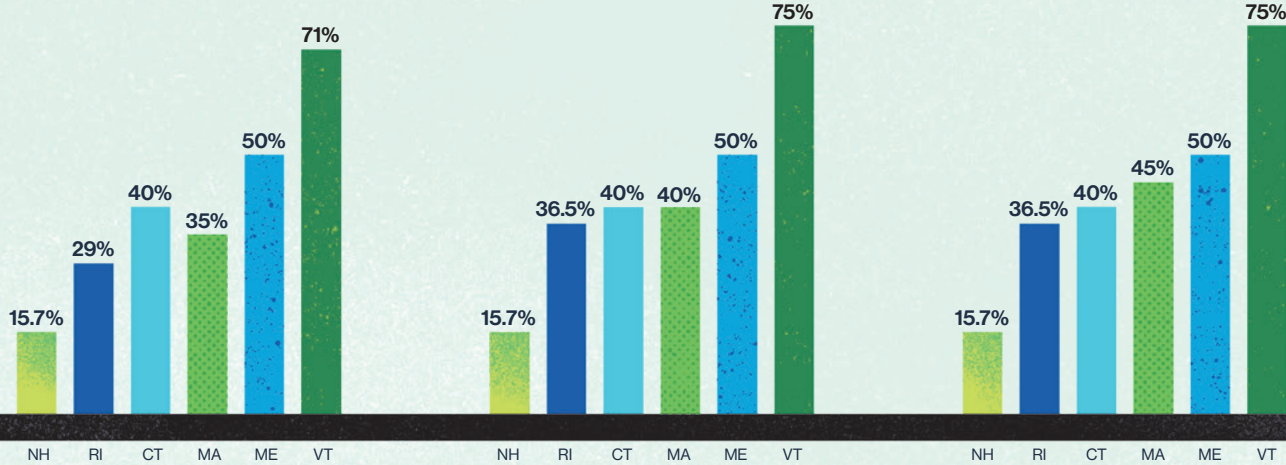
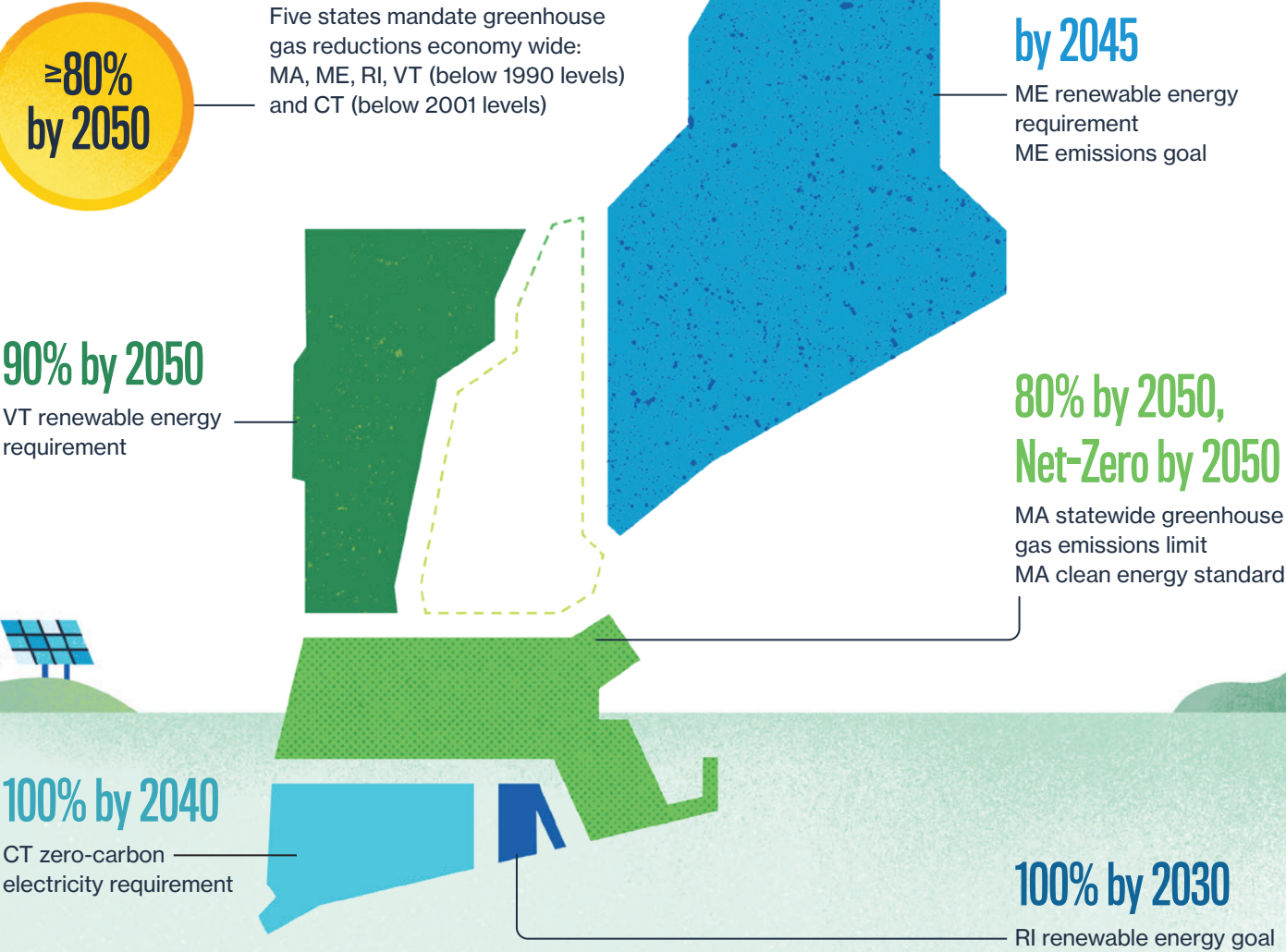
ISO New England supports the states' environmental objectives through our three roles as the region's independent system operator: operating the power grid, administering the wholesale electricity markets, and planning the high-voltage transmission system.

State Renewable Portfolio Standards Are Rising

Class I or new renewable energy resources (%)



States Target Deep Reductions in Carbon Dioxide (CO<sub>2</sub>) Emissions





We are New Englanders. We care about the environment and, as the grid operator, we have an important role to play in securing the region's clean and reliable energy future.

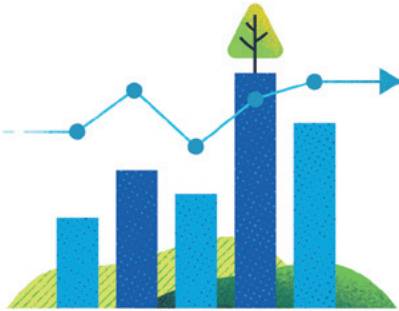
We will help ensure that our future energy markets and changing grid deliver what consumers want: cost-effective electricity that's as reliable as it is clean. To be sure we're ready for the future, we've called upon our quarter century of experience planning the region's power system, as well as expertise from the industry at large, and identified **four pillars** that are critical to developing and maintaining a clean, decarbonized grid.



Understanding the criticality of these components to achieving and maintaining tomorrow's greener grid, this *Regional Electricity Outlook* examines each and explores how the region can support their development.



**1 Significant amounts of clean energy** to power the economy with a greener grid



**2 Balancing resources** that keep electricity supply and demand in equilibrium



**3 Energy adequacy** – a dependable energy supply chain and/or a robust energy reserve to manage through extended periods of severe weather or energy supply constraints



**4 Robust transmission** to integrate renewable resources and move clean electricity to consumers across New England



- ▶ **We believe tomorrow's clean-energy future is within reach**, but it will require all industry stakeholders—the ISO, policymakers, market participants, and consumers—to be realistic about what it will take to make it a reality, and to work collaboratively to make it happen. The safe and reliable transformation of the region's electric system depends on it.



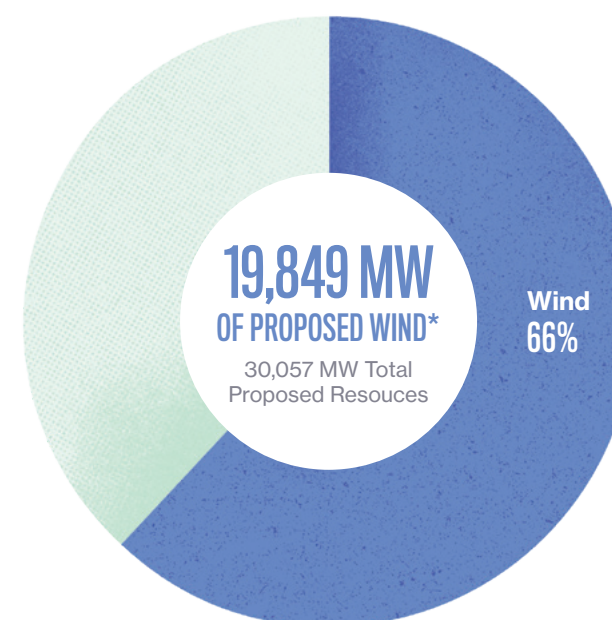


# Powering the Economy with a Greener Grid



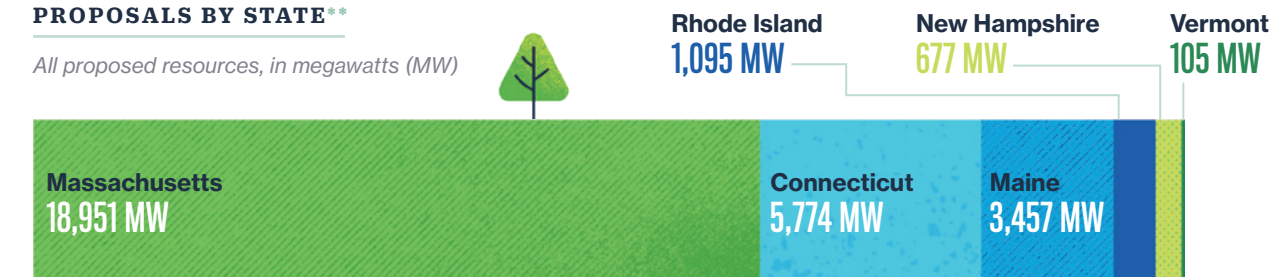
In New England, the shift toward renewable resources to power our electric grid has been underway for years and continues apace as the region's decarbonization goals accelerate. A near net-zero carbon emission grid will be powered primarily by renewable resources that displace dirtier fossil-fueled resources most, but not all of the time, significantly reducing harmful greenhouse gas emissions. Eventually, renewables will become the new baseline resource, meeting most consumer demand, with other resources such as energy storage and efficient natural gas generation needed to fill the gaps.

## Wind Power Comprises Two Thirds of New Resource Proposals in the ISO Interconnection Queue



## PROPOSALS BY STATE\*\*

All proposed resources, in megawatts (MW)



\*Source: ISO Generator Interconnection Queue (March, 2022); FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings Note: Some natural gas proposals include dual-fuel units (with oil backup). Some natural gas, wind, and solar proposals include battery storage. Other includes hydro, biomass, fuel cells and nuclear uprate.

\*\*Source: ISO Generator Interconnection Queue (March, 2022) FERC and Non-FERC Jurisdictional Proposals

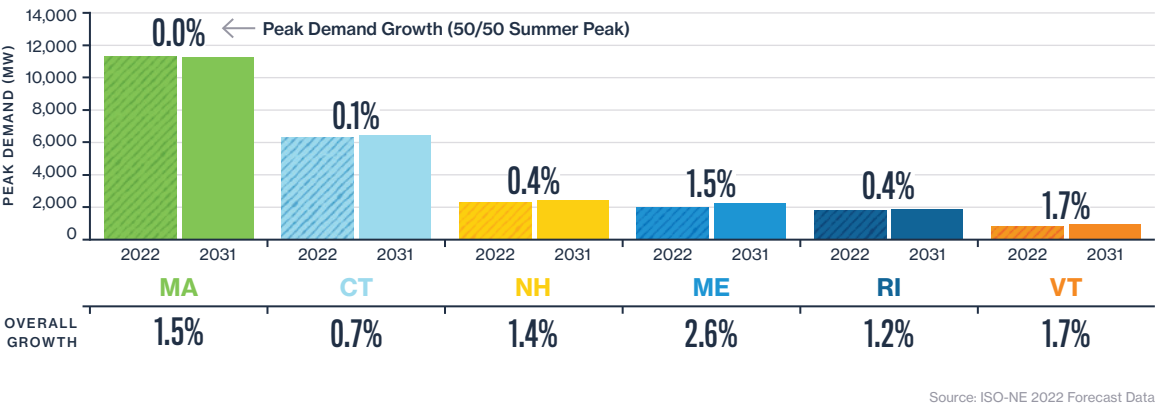


While the ISO Interconnection Queue is dominated by proposals for clean energy, “proposed” is not “built.” Retirements of older, more traditional generation are happening. At the same time, planned large-scale renewable projects have been canceled or delayed.

Today, almost all large-scale renewable projects are developed through state-sponsored long-term contracts funded by ratepayers. Creating a marketplace that compensates renewable projects for their environmental attributes would shift the financial risk from ratepayers to developers, and best maintain the competitive forces that have benefited New England consumers for 25 years.

ISO Forecast Shows Demand Growth

Compound annual growth rates for peak demand and overall electricity use, net of energy efficiency and solar photovoltaics (PV), 2022-2031



As the region seeks economy-wide decarbonization, state policy goals have evolved to focus not only on least cost, but also on the type of resources that produce electricity. The six New England states first introduced renewable energy credits as a way to drive development in renewable energy. More recently, states have focused their efforts on direct, one-to-one contracts with specific clean resources in an effort to speed development of these resources as the impact of climate change intensifies. However, these state-sponsored contracts have not utilized the region's competitive wholesale markets.

There have been adjustments made to better sync up the design of the wholesale marketplace with this policy shift so that all resources providing energy to New England's consumers can participate in the competitive markets – regardless of whether they have a separate state contract. These improvements have not worked as desired to accelerate the region's transition away from higher-emitting power plants to clean and renewable resources. Now, efforts are underway to evaluate other market designs to promote a greener grid.

*Evaluations of Pathways to a Future Grid*, released in early 2022, is a report developed to guide the region's discussion on the next generation market design, aimed at meeting the states' decarbonization goals. The report looked at four potential approaches, including keeping the status quo or introducing different market mechanisms to value different generation types and attributes.

Pathways to a Future Grid:

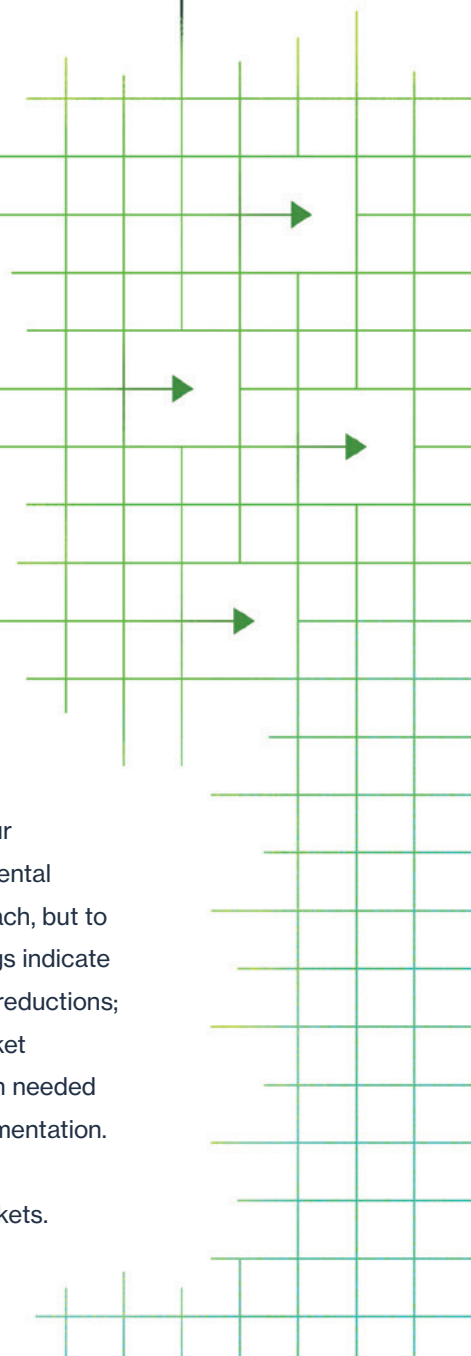
**Status Quo:** New England states continue to sign long-term power purchase agreements with renewable energy developers

**Forward Clean Energy Market (FCEM):** Centralized clean energy market with a forward procurement that awards certificates for clean energy production

**Net Carbon Pricing:** A price is imposed on carbon emissions for each unit of carbon emitted and revenues are returned to consumers

**Hybrid Approach:** Combines net carbon pricing applied to existing resources, and an FCEM for clean energy that only awards clean energy certificates (CECs) to new resources

The *Pathways Study* provides significant data and analysis to evaluate four approaches that could meet the New England states' ambitious environmental goals. The objective of the study was not to determine a preferred approach, but to examine key differences and tradeoffs between the pathways. The findings indicate all of the approaches can achieve substantial greenhouse gas emissions reductions; however, each approach has different implications for economic and market outcomes. In addition, each approach differs in the degree of coordination needed among the six New England states and in the level of complexity in implementation. Also, as detailed in the *Pathways Study*, certain approaches have greater implications for the sustainability of competitive wholesale electricity markets.





# Keeping Electricity Flowing Across the Region

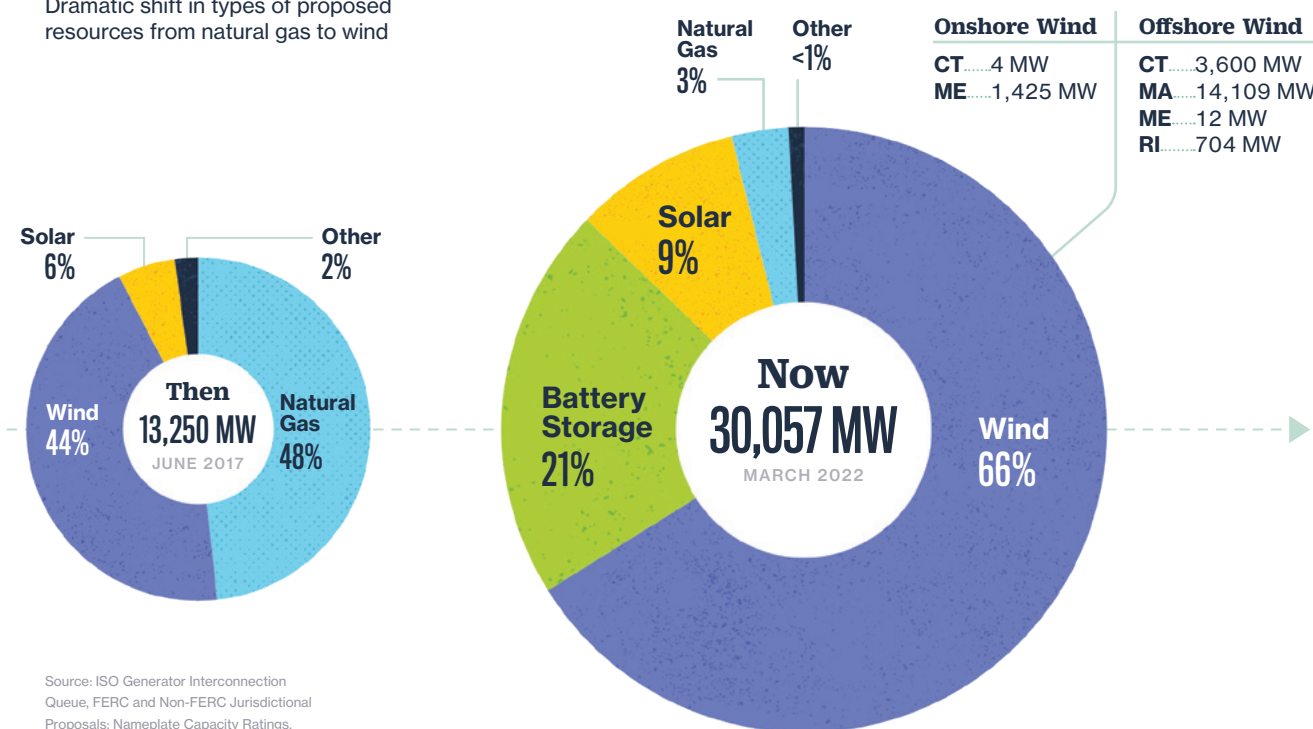


➔ **The ISO remains certain** that some resources will be necessary to balance renewable energy on a routine basis. This fleet of balancing resources will keep energy flowing when intermittent resources aren't able to run, ensuring a greener future grid that New Englanders can rely on to power their lives.

Stakeholders are currently determining if a consensus can be reached on market approaches to spur the development of clean energy. It's also necessary for the region's energy stakeholders to consider how balancing resources will be compensated for their reliability value in a future system with significant amounts of renewable resources. This is particularly critical as older, fuel secure resources seek to retire.

## The ISO Generator Interconnection Queue Provides Snapshots of the Future Resource Mix

Dramatic shift in types of proposed resources from natural gas to wind

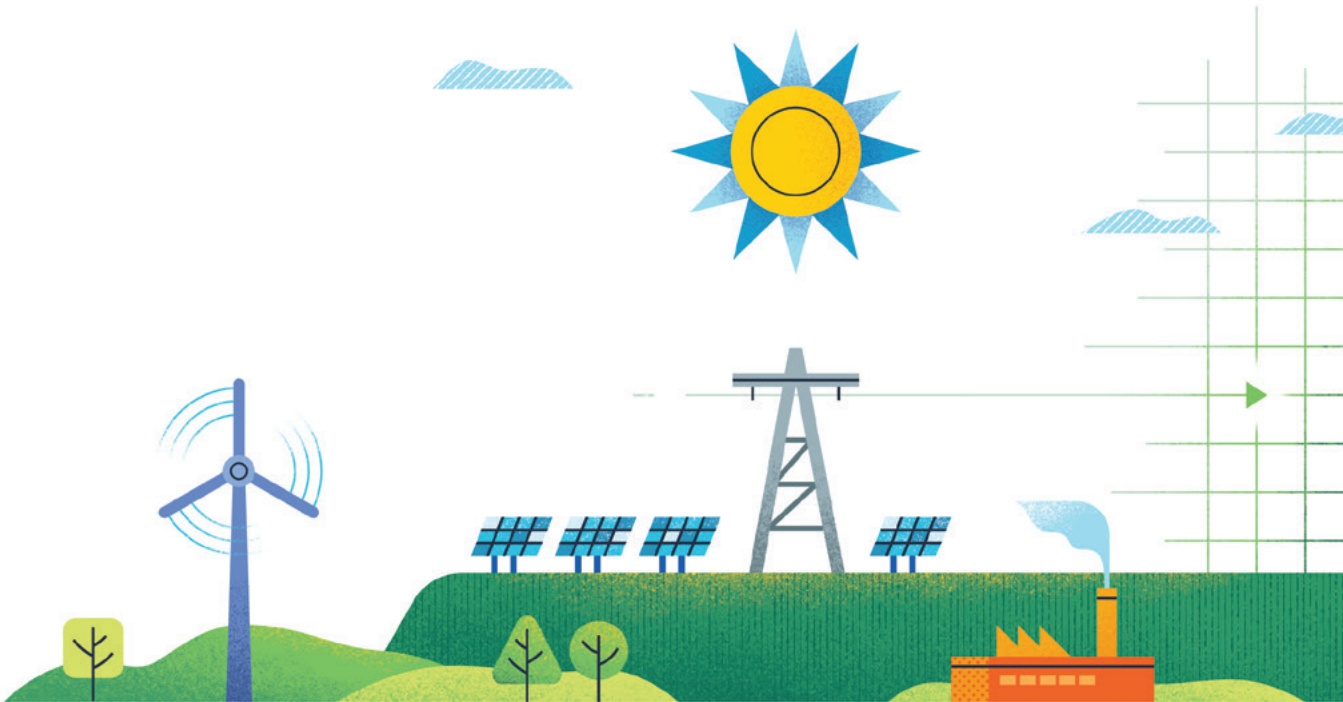
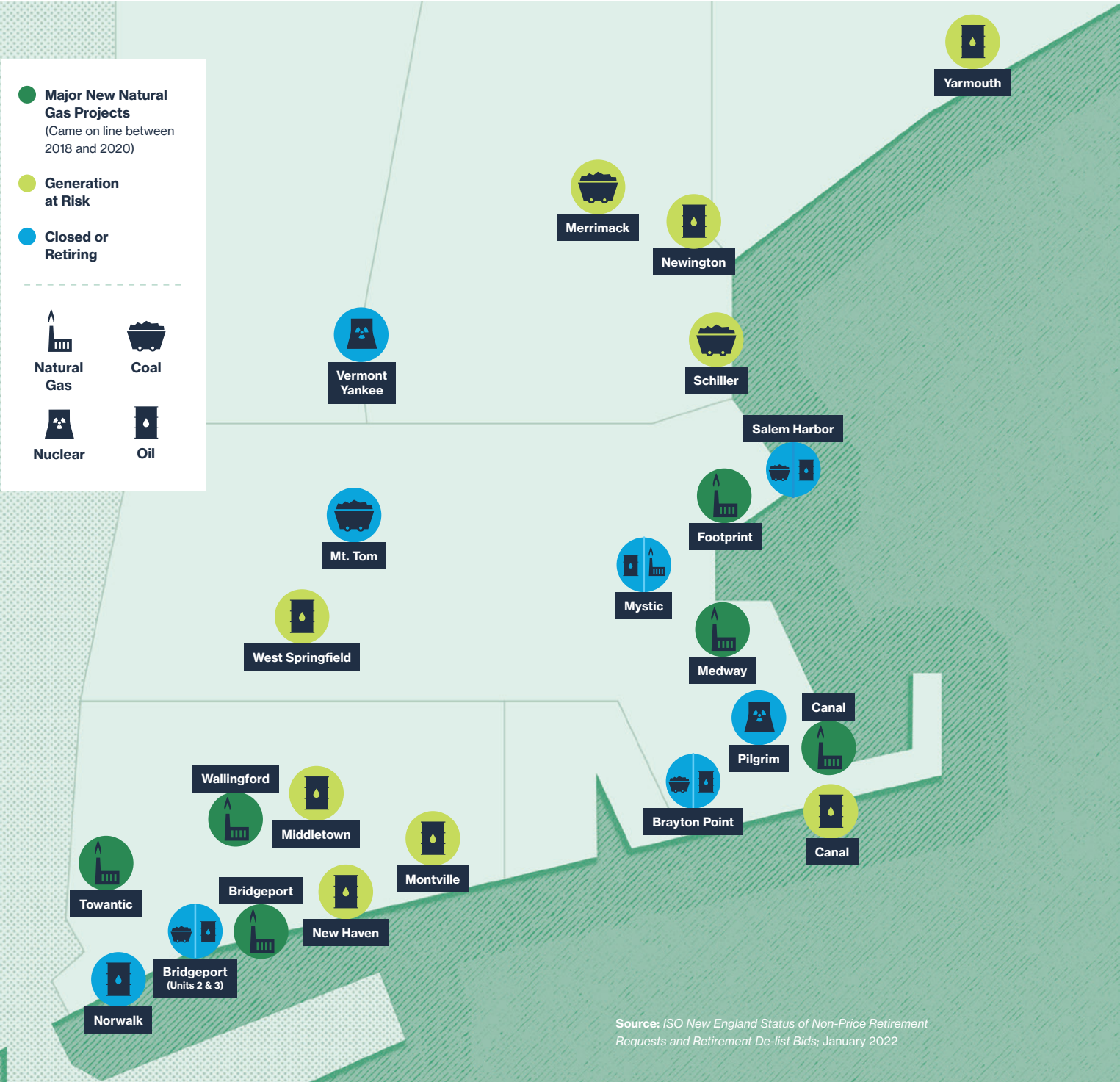


Source: ISO Generator Interconnection Queue, FERC and Non-FERC Jurisdictional Proposals; Nameplate Capacity Ratings.



# Since 2013, Roughly 7,000 MW of Generation Have Retired or Announced Plans for Retirement in the Coming Years

- ▶ Predominantly coal, oil, and nuclear resources
- ▶ Another 5,000 MW of remaining coal and oil are at risk of retirement
- ▶ These resources have played an important role in recent winters when natural gas supplies are constrained in New England



## Supporting a Reliable Transition to Clean Energy

Reliability is the focus of key initiatives the ISO is working on with stakeholders.

In **The Future Grid Reliability Study** (FGRS), ISO staff are studying how our regional grid will operate when it is powered primarily by renewable resources and serving significantly increased demand. The FGRS examines 24 different future grid scenarios, developed through stakeholder discussions, to better understand the implications for reliability when most of the electricity in the region comes from weather-dependent resources. Phase one of the study was launched in March 2021, with results expected in summer 2022.

Another project, known as **Resource Capacity Accreditation**, is focused on developing ways to more accurately reflect a generator’s contributions to resource adequacy, which will be critical to a reliable and efficient clean energy transition.

A third project, **Day-Ahead Ancillary Services**, seeks to ensure the market is providing the services needed for a reliable, next-day power system operating plan with the region’s evolving generation fleet.



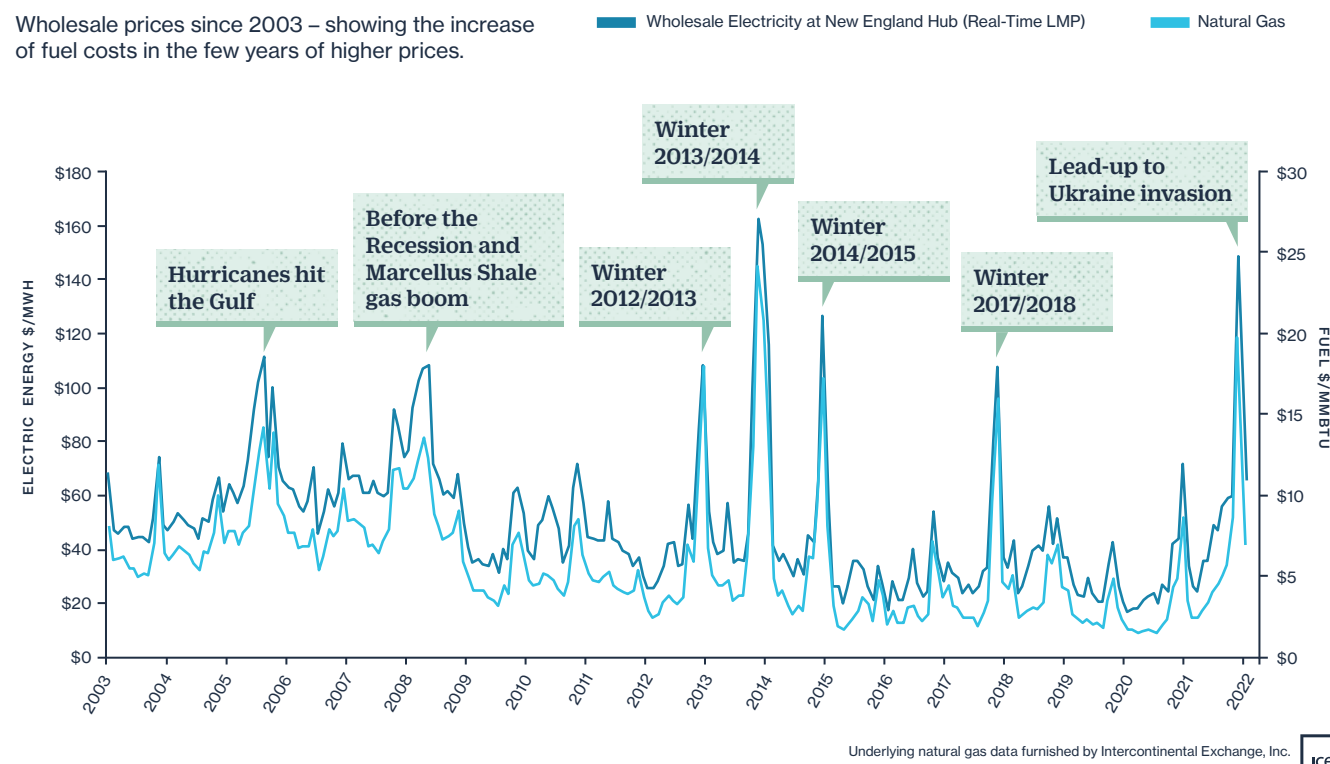
➔ **As the region's power generation fleet transforms** over the coming decades, the competitive wholesale markets will become even more critical to ensuring that balancing resources—in particular, generation that can produce electricity on demand, as well as different types of storage, which rely primarily on market revenues—remain viable to support the demands of the future grid.

New England has a successful track record of developing wholesale markets that deliver on regional policy objectives. In the late 1990s, that objective was lower cost – and over the past 25 years, the wholesale markets we designed have largely achieved it. We believe a robust marketplace, one that fosters wholesale competition and efficient economic outcomes among new and existing resources, can meet the region's evolving objectives to decarbonize the electricity sector while maintaining system reliability.

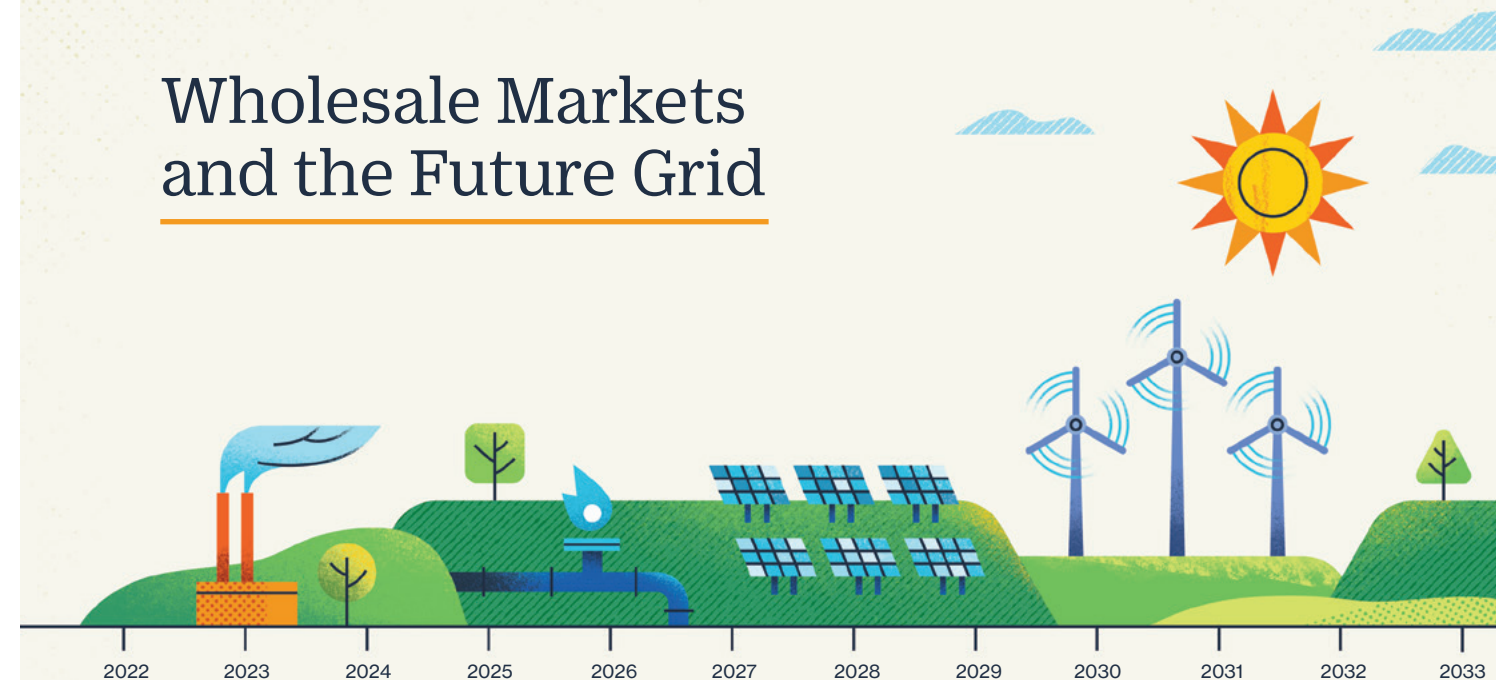


### Prices Reflect the Cost of Inputs

Wholesale prices since 2003 – showing the increase of fuel costs in the few years of higher prices.



## Wholesale Markets and the Future Grid



New England's energy future relies on a foundation of stakeholder input and consensus. Our energy stakeholders will determine how wholesale markets will be used to reliably achieve our clean energy goals.

How will we pay for clean energy—by rewarding clean energy attributes, pricing carbon emissions, or a combination of both?

We will also need to gain consensus on the reliability benefits of balancing resources and determine how to maintain their financial certainty.

Long-term market mechanisms for decarbonizing the energy system are presented in the *Pathways to a Future Grid* report.



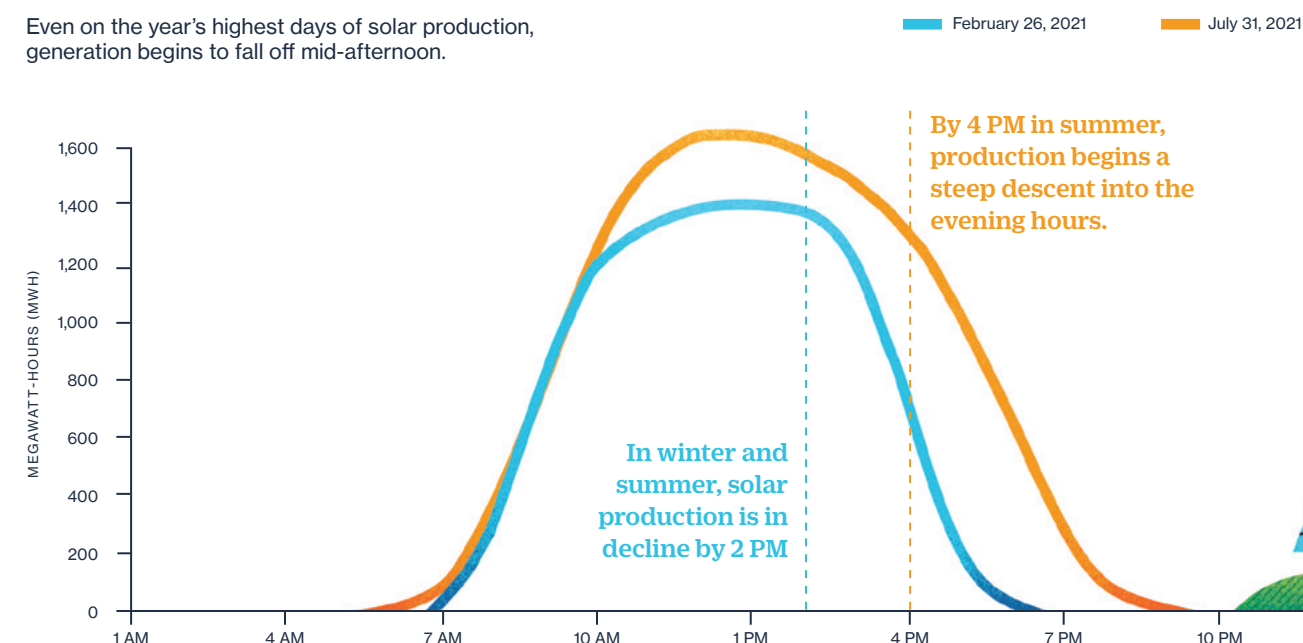
# A Dependable Energy Supply Chain and/or a Robust Energy Reserve

► **A robust, secure supply chain for electricity is crucial for the safety and security of the region's 15 million residents.** When the winds die down or solar production wanes—in variable, sometimes unpredictable cycles that could last moments or weeks—balancing resources that don't rely on the weather must fill the gaps to keep electricity flowing in New England.

Our markets ensure the power system has the capacity to meet demand, but they don't guarantee those resources will have access to the energy sources they need to produce electricity. For balancing resources to pick up when renewables drop off, the energy inputs they require—whether natural gas, green hydrogen, or another fuel—must be available when they're called upon.

## Hourly Solar Production

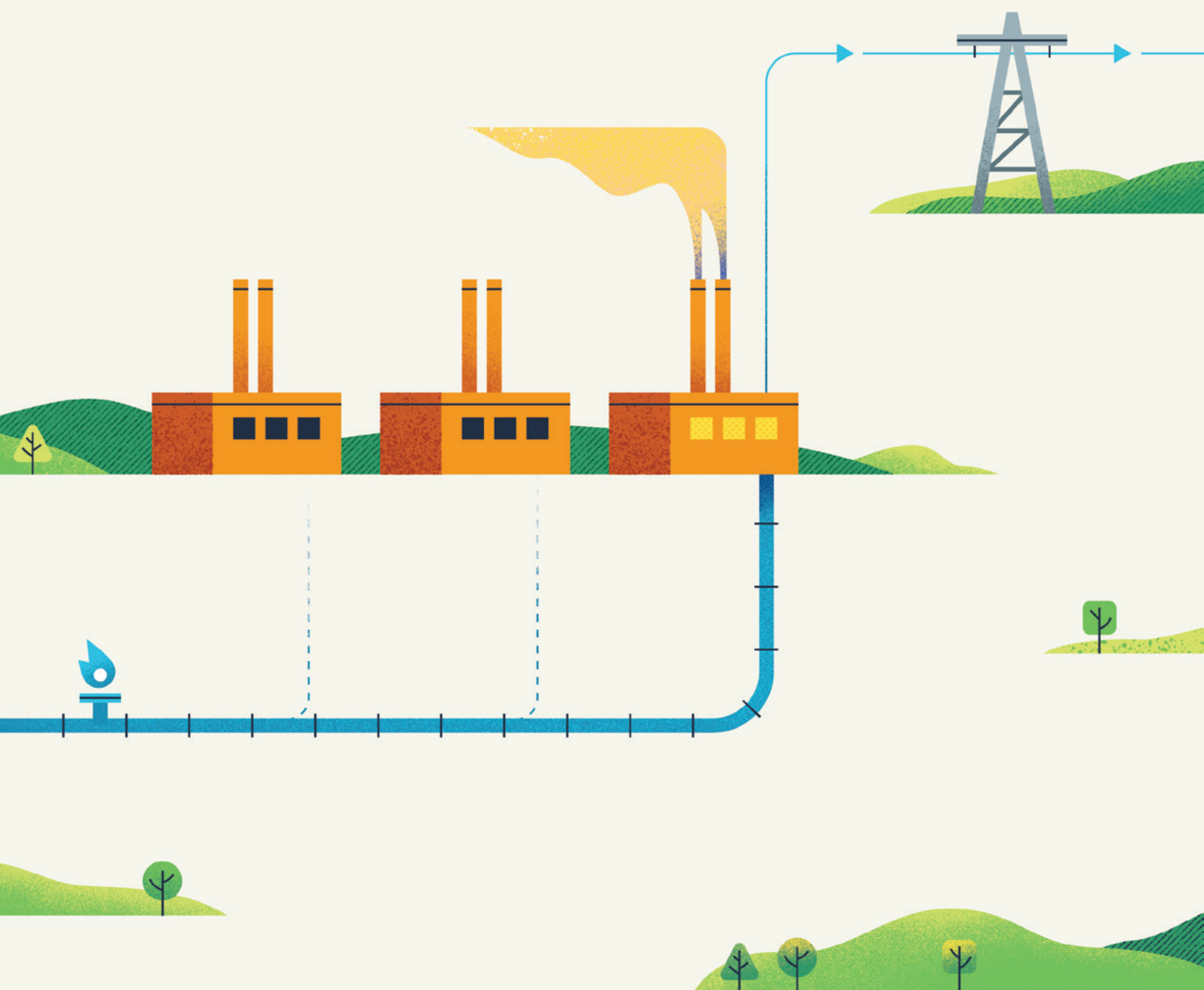
Even on the year's highest days of solar production, generation begins to fall off mid-afternoon.





► **It may seem obvious: a power plant with no fuel is just another building, with no potential to produce electricity when needed.**

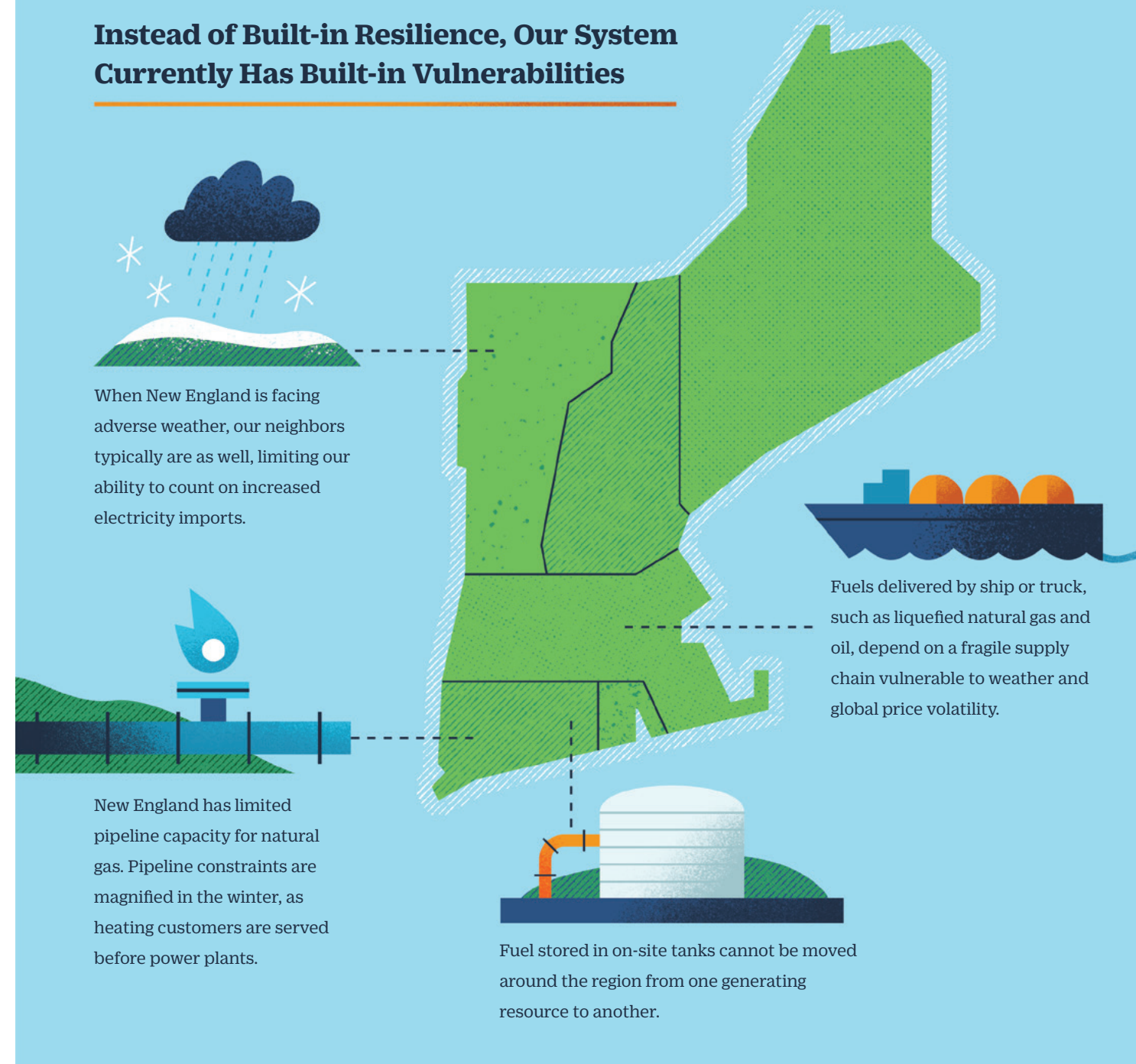
But for years the belief that fuel will be available at a moment's notice has only been an assumption—that having enough generating resources in place, with enough generating capacity, will ensure reliability. To navigate the clean energy transition, we must update our assumptions.



New England's power system needs enough built-in resilience to deal with severe weather, long-duration disruptions due to supply chain issues, and the possibility that multiple challenges could arise at once. That scenario has already become reality, and illustrates the system limitations we face every day.

Those limitations will be tested further as the heating and transportation sectors electrify, increasing the gap that needs to be served when weather-dependent resources aren't available, as well as the need for stored energy.

### **Instead of Built-in Resilience, Our System Currently Has Built-in Vulnerabilities**





## ► Regional Challenges Require Regional Solutions, and We All Play a Part

**Our most acute concerns involve prolonged cold snaps—especially as electrification of heating and transportation begins to shift peak demand to the year’s coldest months.** In New England, widespread loss of electricity in the winter can present a health and safety crisis just as easily as it did in Texas in February of 2021. The region will need a sustainable solution to withstand wind and solar “droughts,” otherwise known as the winter doldrums, by the end of this decade.

We have taken steps toward addressing these issues through market changes, as well as improvements to our operational procedures and forecasting abilities, to provide early warning of potential energy shortfalls.

The years ahead will require diligent work with the states and stakeholders to identify a preferred course of action for stabilizing the energy supply chain – whether the states and FERC support a market solution or an approach that would share costs across the region, similar to transmission.

That said, nothing within the scope of the ISO’s authority will result in a comprehensive solution to the problem. Rather, a suite of solutions, which fall into two broad categories, will require the active support of the states.



### **Demand-side Solutions,**

such as the state-sponsored efficiency measures we have integrated in the wholesale markets, further investment in conservation and demand response programs for retail users, and public conservation appeals.



### **Supply-side Solutions,**

such as regional energy storage reserves that can supply electricity for multiple weeks, and new technologies for clean, long-duration energy storage—though the latter may be years from becoming reality.

Decarbonization of our regional economy and the “electrification of everything” will require a multi-step process, unfolding over the coming decades. As the region moves forward, swapping out high-emitting resources with clean and renewable resources is the essential first step – and it’s currently underway. How fast it will happen will depend on which path the regional stakeholders take.

## **Study Examines Energy Security Risk Under Extreme Weather Scenarios**

The ISO is collaborating with the Electric Power Research Institute (EPRI), an independent, nonprofit energy research and development organization, to conduct a study that assesses energy security risks over the next decade under different extreme weather scenarios, identifying those that pose the greatest risk to the future power system and studying them to account for different variables, such as renewable energy output, consumer demand for electricity, and generator availability.

The ISO will use its enhanced 21-day energy assessment tool to assess the power system impacts of these scenarios. This effort, which began in earnest in late 2021, is expected to conclude in 2023.





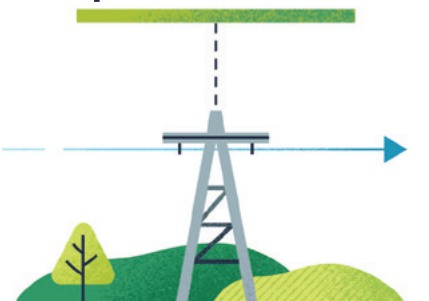
## Unlock the Power of Renewables



Solar arrays and wind turbines are the most recognizable components of a decarbonized electric grid, and already are a part of our landscape in New England. Equally important to achieving our clean-energy future, however, are the substations, high-voltage lines, and underwater cables that make up our transmission grid, the interstate highway system for electricity. **Our transition to a cleaner electrical grid depends on a robust transmission system ready to interconnect an influx of renewable resources and safely transmit that energy to where it's needed.**

In the past two decades, the region has made significant transmission investments to better connect existing resources to protect reliability and reduce congestion. But enabling a new fleet of renewable resources and greater electrification of the economy will require substantial new transmission. It is important for the New England states and industry to determine how to fund these infrastructure investments, as well as how to work through siting and permitting delays.

**\$12 Billion**

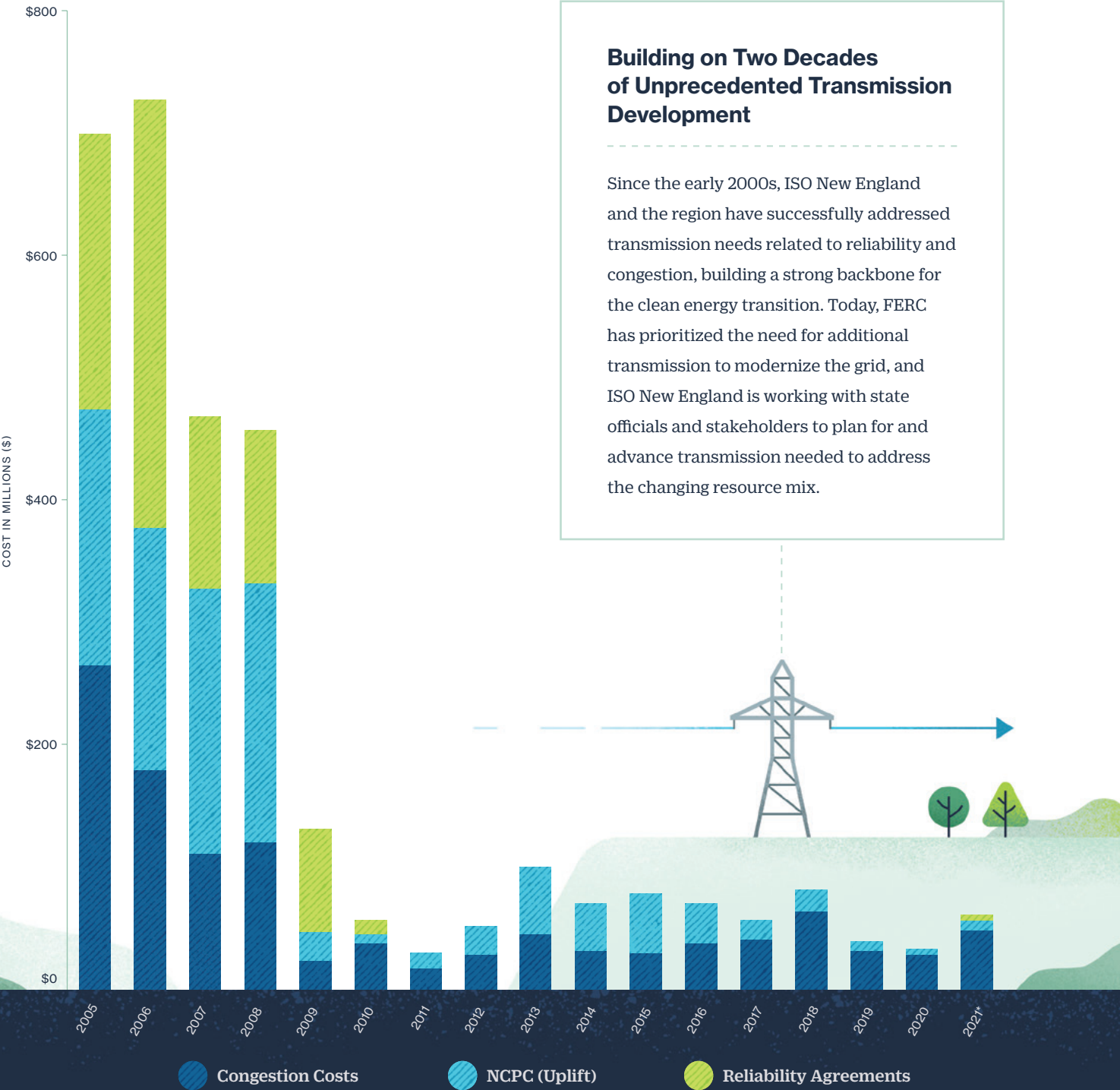


*Transmission projects to maintain reliability represent a near \$12 billion investment since 2002.*



# Transmission and Resource Developments Have Reduced Energy and Reliability Costs

New England Costs for Congestion, Uplift, and Reliability Agreements

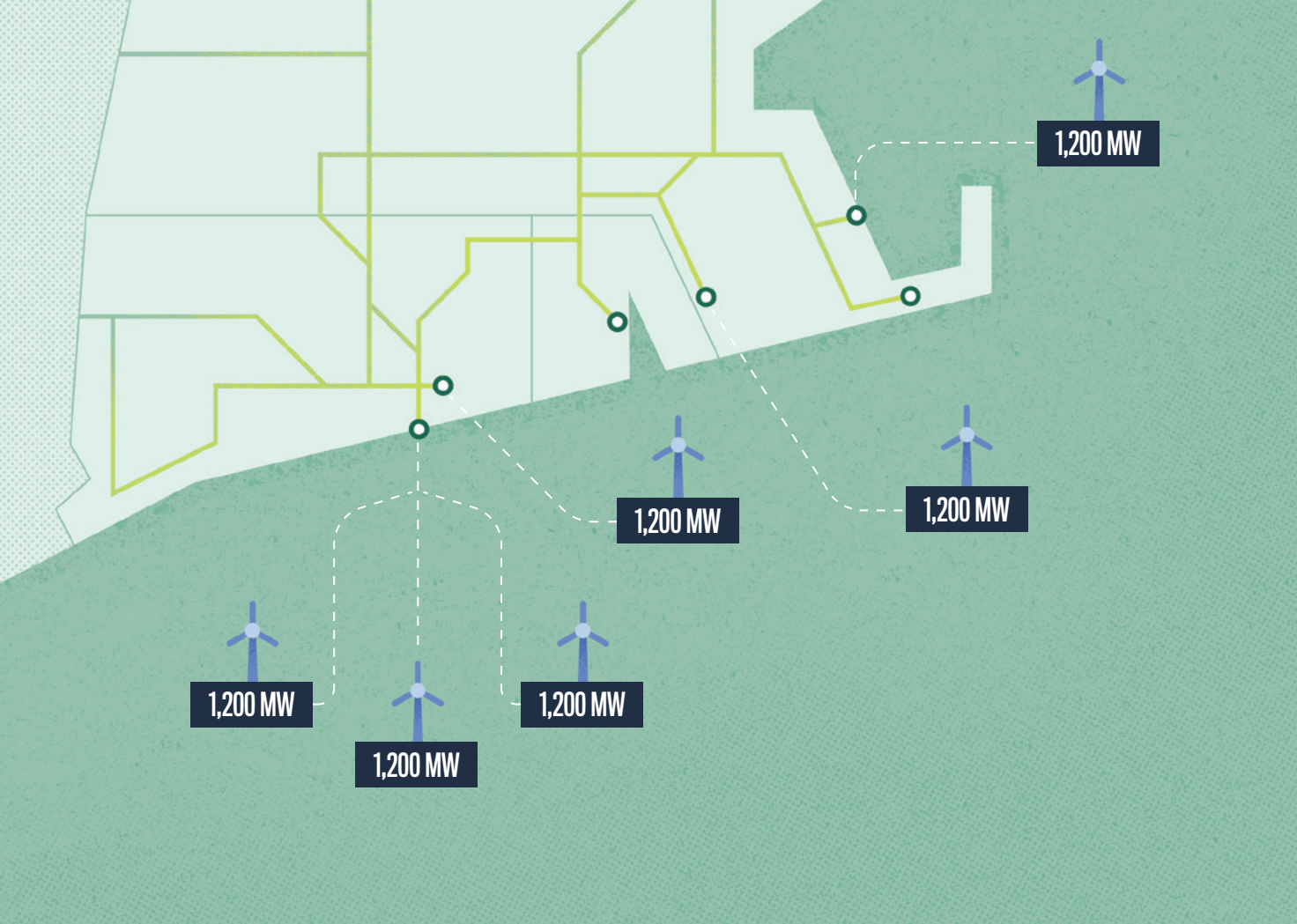


Note: Congestion is a condition that arises on the transmission system when one or more restrictions prevents the economic dispatch of electric energy from serving load. Net Commitment-Period Compensation is a payment to an eligible resource that operated out of merit and did not fully recover its costs in the energy market. Reliability Agreements are special reliability contracts between the ISO and an approved generator whereby the generator continues to operate, even when it is not economical to do so, to ensure transmission system reliability. Sources: Regional System Plans, ISO-NE Annual Markets Reports.

\*2021 data subject to adjustment.

# Ongoing System Impact Studies for a Total of 7,200 MW of Offshore Wind

System Impact Studies for Offshore Wind Underway



In the meantime, we are conducting research to provide the region with information on the transmission needed to meet New England states' energy policies. Some studies have focused on Cape Cod, where proposed offshore wind projects have the potential to power millions of homes. Another, the 2050 Transmission Study, looks beyond the typical 10-year planning horizon at possible scenarios for generation and electricity consumption, based on different state policies set to meet their decarbonization goals in the coming decades.

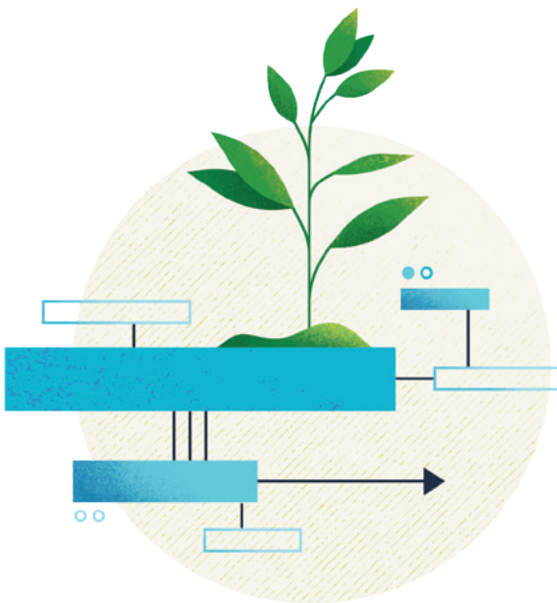
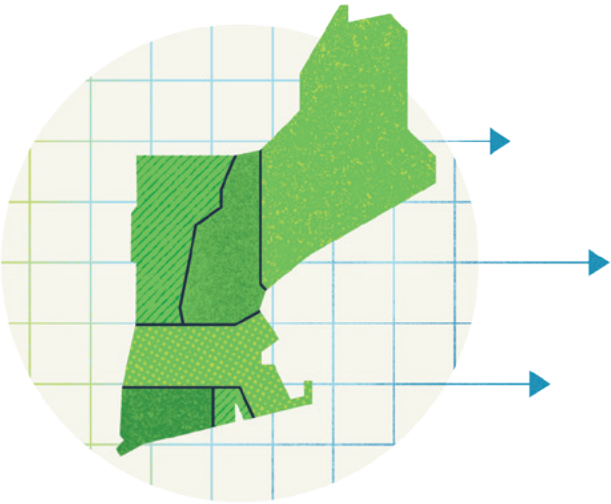
Understanding the importance of this longer-range planning, we have successfully revised our tariff to allow us to extend our system-planning horizon.



We’ve got the right people, aligned under the right mission and vision, to get the job done. New Englanders ourselves, we are unequivocally part of the region’s greener future and proud to be so.

Mission

Through collaboration and innovation, ISO New England plans the transmission system, administers the region’s wholesale markets, and operates the power system to ensure reliable and competitively priced wholesale electricity.



Vision

To harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy.

Values

Leveraging skills, experience, and industry knowledge to solve complex problems

ISO New England maintains a highly technical, skilled and diverse staff, many of whom are experts in their respective fields and all of whom are essential to the success of the mission.

EXPERTISE

Demonstrate commitment through integrity and accountability to each other and to all stakeholders

We have a long history of reliability in operating the grid, power system planning, and being available to serve and support all stakeholders; we are dedicated to our mission and take pride in our work and approach our responsibilities with enthusiasm and professionalism.

DEPENDABILITY

We value each other and our stakeholders

ISO New England promotes a positive work culture, treats all people with dignity, and cares deeply about the wellbeing of its employees; we value diversity, equity, and inclusion, which we cultivate internally and in all stakeholder interactions.

RESPECT

Ingenuity and inventiveness, developing new solutions to serve the region

Through creativity and ingenuity, we remain at the forefront of grid operation, market administration, and power system planning. We are always looking to create novel and more effective solutions to address complex industry challenges.

INNOVATION

Working together to meet our mutual goals

ISO New England’s employees are committed to teamwork and the flow of ideas within and between business functions and with stakeholders to achieve efficient and effective outcomes for the ISO and the region.

COLLABORATION



# From the Board Chair and C EO



**Cheryl LaFleur**  
*Board Chair*



**Gordon van Welie**  
*President and Chief Executive Officer*

This year’s *Regional Electricity Outlook* finds us at a pivotal point in the ISO’s and the region’s energy history: nearly equidistant from the formation of ISO New England in 1997, and the mid-century realization of regional climate goals aimed at drastically reducing carbon emissions. Over the course of the next two decades, our region’s electric grid will likely more than double in size, expanding to incorporate vast amounts of renewable resources and serve increasing demand for electricity as more sectors decarbonize.

This transformation is already well underway in the region’s power system, and the impact it will have on New England for generations to come cannot be overstated. The four key pillars required to support this future grid – significant amounts of clean energy resources, sufficient balancing resources to ensure reliability, a reliable fuel supply or energy storage reserve, and a robust transmission system – are explored in these pages, along with the ways in which the ISO is supporting each one through the execution of our responsibilities to operate the region’s electricity grid, administer the wholesale electricity markets, and plan for a reliable power system.

At the ISO, our talented workforce is striving to ensure New England’s grid is prepared to provide the region with clean, reliable, cost-effective electricity today – and throughout our journey to the clean energy future. We are proud of the work we’ve done since our inception to be good stewards of the region’s electricity system, including responding to states’ objectives in planning and operating our grid. We take our responsibility to fulfill our vision – to harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy – very seriously.

We are studying every aspect of today’s evolving electric system so the region is ready for the substantially changed one coming tomorrow. Achieving and maintaining a greener grid requires us to leverage all clean energy resources and technologies – from existing nuclear, hydro, wind, and solar generation, to all the new renewable resources under development or being proposed – including new wind, solar, and grid-scale battery storage. We also stand ready to support the development of other emerging clean technologies for the future. We believe competitive markets provide the best opportunity to cost-effectively meet states’ environmental goals, while also maintaining balancing resources to meet system reliability needs. In the short term, a key focus will be ensuring New England’s energy markets appropriately compensate balancing resources for the reliability services they provide. At the same time, we are exploring the impact climate-driven extreme weather and increasing electrification of other business sectors will have on power system operations and the need for additional transmission to transmit clean energy to New England’s homes and businesses.

We are eager to continue working through these complex challenges with all stakeholders to secure New England’s clean energy future. Consequently, we must acknowledge that some of the pillars discussed in these pages present issues that competitive markets alone can’t solve, and others that are beyond the ISO’s scope of responsibility. Decisions on siting and permitting, for example, can be delayed for years and neither the ISO nor wholesale markets can override these decisions. An agreed-upon mechanism for funding transmission development in support of decarbonization goals is also needed.

One of the most pressing challenges the region must address is energy adequacy, which the ISO has been concerned about for nearly two decades. Recently, events in the U.S. and around the globe continue to demonstrate that low probability, high impact risks cannot be




ignored. While the wholesale electricity markets drive resource development to meet the needs of the system, it is unlikely these markets will sufficiently incent investments to cover more extreme and uncertain scenarios, even though these scenarios are happening with more and more frequency. Finding a solution to this problem is critical for New England – not only for today, but for tomorrow. Reliability must be sustained throughout our journey, assuring stakeholders that our future electric power grid will be as reliable as it is clean.

Over the years, the region has become more reliant on imported fuels and the need for a robust and sustainable solution has grown more urgent. Increasingly, we are reminded – as we were during the pandemic, and more recently with the Russian incursion into Ukraine – that geopolitical events are quickly felt locally, exacerbating supply issues and increasing both supply risk and pricing uncertainty. Urgency is warranted – in the past two years, four out of seven independent service operators and regional transmission organizations in the U.S. have resorted to controlled outages because extreme weather limited energy supplies. Although that hasn’t happened here, the fact is New England’s grid is susceptible to risk from multiple factors throughout the coldest months of the year.

As ISO New England prepares for the upcoming winter and future winters, we are cognizant of these system vulnerabilities and will continue working with the states and regional stakeholders to solve the region’s energy adequacy needs while also doing our part to bring about a clean and reliable energy future.

Over the last 25 years, ISO New England has laid the foundation to support the four pillars discussed in this report and the region is already well along the path to a clean energy future. As we keep our eyes on the horizon, New England has an opportunity to serve as a model for what a sustainable, reliable, and efficient transition can look like.

  
Cheryl LaFleur  
Board Chair

  
Gordon van Welie  
President and Chief Executive Officer

“As we keep our eyes on the horizon, New England has an opportunity to serve as a model for what a sustainable, reliable, and efficient transition can look like.”



# ISO Board of Directors

As of May 2022



**Cheryl LaFleur**  
Board Chair



**Gordon van Welie**  
President and  
Chief Executive Officer



**Caren Anders**



**Brook Colangelo**



**Steve Corneli**



**Michael J. Curran**



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**Barney Rush**



**Mark Vannoy**



**Vickie VanZandt**

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As of May 2022



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President and  
Chief Executive Officer



**Vamsi Chadalavada**  
Executive Vice President  
and Chief Operating Officer



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Vice President, System Operations  
and Market Administration



**Janice S. Dickstein**  
Vice President,  
Human Resources



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**Anne C. George**  
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and Corporate Communications



**Maria Gulluni**  
Vice President, General Counsel,  
and Corporate Secretary



**Mark Karl**  
Vice President, Market Development  
and Settlements



**Robert C. Ludlow**  
Vice President, Chief Financial  
and Compliance Officer



**Rudolf "Rudy" Pawul**  
Vice President, Information  
and Cyber Security Services



# About This Report

ISO New England's unique role gives it an objective, bird's-eye view of trends that could affect the region's power system. The *Regional Electricity Outlook* is one of the many ways the ISO keeps stakeholders informed about the current state of the grid, issues affecting its future, and ISO initiatives to ensure a modern, reliable power system for New England. Please also see our Annual Work Plan at [www.iso-ne.com/work-plan](http://www.iso-ne.com/work-plan) for information on the ISO's major projects for the year to improve our services and performance.



# About Us

ISO New England is the not-for-profit corporation responsible for keeping electricity flowing across the six-state New England region: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. The company's power system engineers, economists, computer scientists, and other professionals ensure that the region has reliable, competitively priced wholesale electricity today and into the future. The ISO is independent – none of the ISO's board members, officers, or employees has a financial interest in any company doing business in the region's wholesale electricity marketplace. The Federal Energy Regulatory Commission (FERC) regulates the ISO.







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