Rapid Transformation of the New England Power System and Implications for the Region's Wholesale Electricity Markets

Energy Systems Integration Group

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New England Has Embarked on a Journey

From restructuring the wholesale power industry to decarbonizing the economy

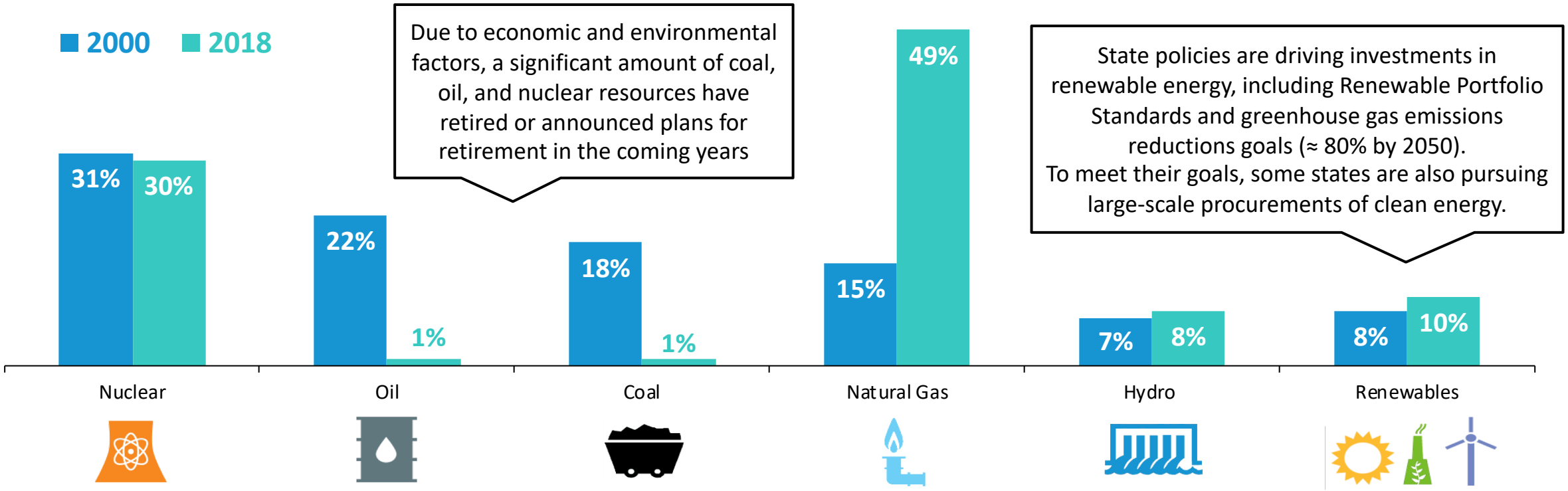
- In the late 1990s, New England restructured its wholesale power industry with three key principles in mind
  - **Competitive markets** are the most efficient means to ensure the availability of sufficient resources and the day-to-day optimization of the resources needed to meet demand
  - **Efficiency and transparency** spur innovation and investment in new technologies
  - **Investment risk** shifts from consumers to private investors

- Today, and for decades to come, New England will be focused on decarbonizing the economy
  - **Reducing carbon emissions** from the electricity sector and, in time, the transportation and buildings sectors
  - **Greening the grid** with more renewable energy sources to meet decarbonization goals

The Resource Mix Is Transforming Rapidly

From Coal, Oil, and Nuclear Power to Natural Gas-Fired Generation and Renewable Energy

Percent of Total Electric Energy Production by Fuel Type



Source: ISO New England Net Energy and Peak Load by Source

Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, municipal solid waste, and miscellaneous fuels.

This data represents electric generation within New England; it does not include imports or behind-the-meter (BTM) resources, such as BTM solar.

The Emergence of an Energy Constrained System

Retiring and Emerging Resources Exhibit Very Different Characteristics

- Resources with **onsite fuel storage** are being replaced by resources that cannot always get fuel or are entirely weather-dependent
- The remaining **nuclear power** stations are at risk for retirement, until policymakers price carbon at the level implied in renewable energy contracts, or provide them power purchase agreements
- Regional **energy storage** is important; current electric storage technology is limited in the quantity of energy stored and is useful only for short-duration events (hours)
  - Gas pipeline constraints and the variability of renewable energy create a need for **"seasonal"** energy storage that can provide services over a period of multiple days and weeks
  - For the foreseeable future, that will be oil and LNG and the energy stored in resources with onsite fuel, or energy from "firm" resources in adjacent regions

The ISO's Winter Energy Security Improvements Are Designed to Address *Three Inter-related Problems*

- **Problem 1. Incentives and Compensation (P1)**
  - Inefficiently low market incentives for resources that face production uncertainty to make advance fuel/energy supply arrangements
- **Problem 2. Operational Uncertainty (P2)**
  - There may be insufficient energy available to withstand an unexpected, extended (multi-hour to multi-day) large generation/supply loss during cold conditions, particularly if that energy supply loss is non-gas generation
- **Problem 3. Inefficient Schedule (P3)**
  - Premature (inefficient) depletion of energy inventories for electric generation, absent a mechanism to coordinate and reward efficient preservation of limited-energy supplies

The ISO's Long-Term Solution Focuses on Energy Optimization

Market-based solution optimizes use of limited energy over extended periods at least cost

1. **Change the Current Day-Ahead Energy Market to a *Multi*-Day-Ahead Market (M-DAM).**
   Procure resources over a rolling, multi-day-ahead horizon (*initially expected to be 2–3 days, and could be extended up to 7 days*); will provide a forward price signal for resources to replenish fuel inventories when prospective supplies are tight and to avoid prematurely depleting limited energy (Focus: P3)

2. **Three New Ancillary Services Co-optimized with a Multi-Day-Ahead Market for Energy.**
   - Replacement Energy Reserves – if a day-ahead cleared resource is unable to perform
   - Generation Contingency Reserves – for fast-start/fast-ramping generation contingency response
   - Energy Imbalance Reserves – when forecast load exceeds day-ahead cleared physical supply

   These services, combined, provide the 'margin for uncertainty' in an increasingly energy-limited system and model the types of actions system operators need to take to ensure reliability over a multi-day horizon (Focus: P1 and P2)

3. **New (Voluntary) Forward/Seasonal Market Ahead of the Winter Period.**
   Would procure replacement energy commitments, providing incentive for resources to arrange firm energy inventory logistics and a means to recover the costs of doing so

Questions