Abandon or Replace

Pathways to Decarbonization: An Overview

February 9, 2023

Energy+Environmental Economics

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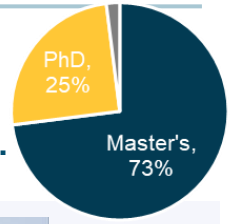


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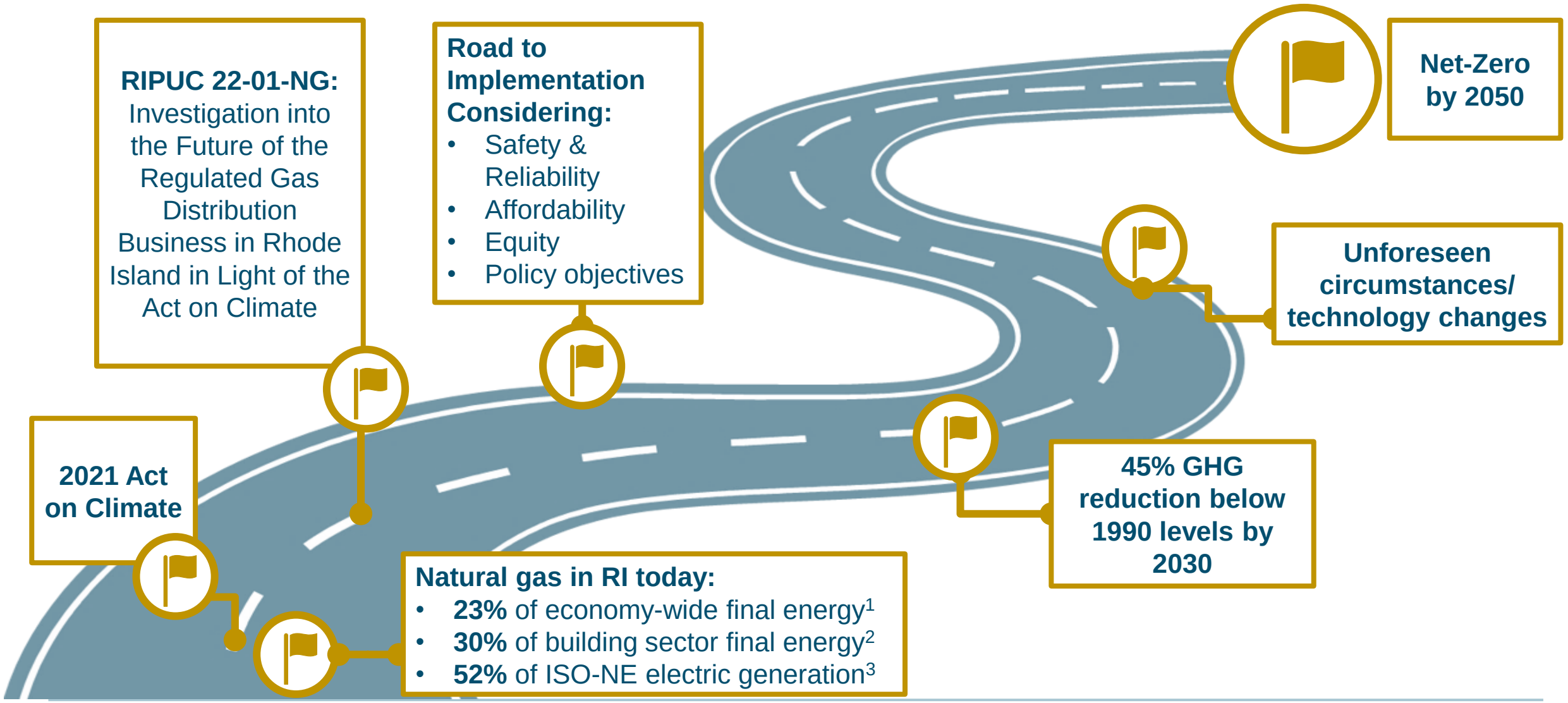
Our Mission

Facilitating the clean energy transition and combating climate change with intellectual honesty, rigor, and a 360-degree perspective on the energy industry

Key themes

- With the ***Act of Climate (2021)*** RI is in the early stages of its transition to net-zero GHG emissions economy-wide by 2050.
- Given the large role of natural gas in Rhode Island's energy system, the transition of that sector will need to ***balance key priorities like safety & reliability, affordability, equity, and state policy objectives***.
- ***Alternative gas sector decarbonization strategies have advantages and challenges,*** portfolio-based approaches can help to balance priorities and manage the challenges of reducing GHG emissions from gas.

Rhode Island's gas sector transformation will need to balance near-and long-term considerations.



[1,2] Source: EIA State Energy Profile Data, 2020

[3] Source: ISO-NE for 2022

There are multiple strategies to decarbonize gas end-uses; they are not mutually exclusive

Energy Efficiency & Demand Response

 **Electrification**	Customers adopt all-electric heat pumps and other electric appliances
 **Hybrid electrification**	Customers adopt heat pumps paired with a gas furnace or boiler
 **Renewable Gas**	Utilities inject biomethane, hydrogen or Synthetic Natural Gas (SNG) into the gas pipeline
 **Innovative technologies**	Networked geothermal, gas heat pumps, on-site carbon capture

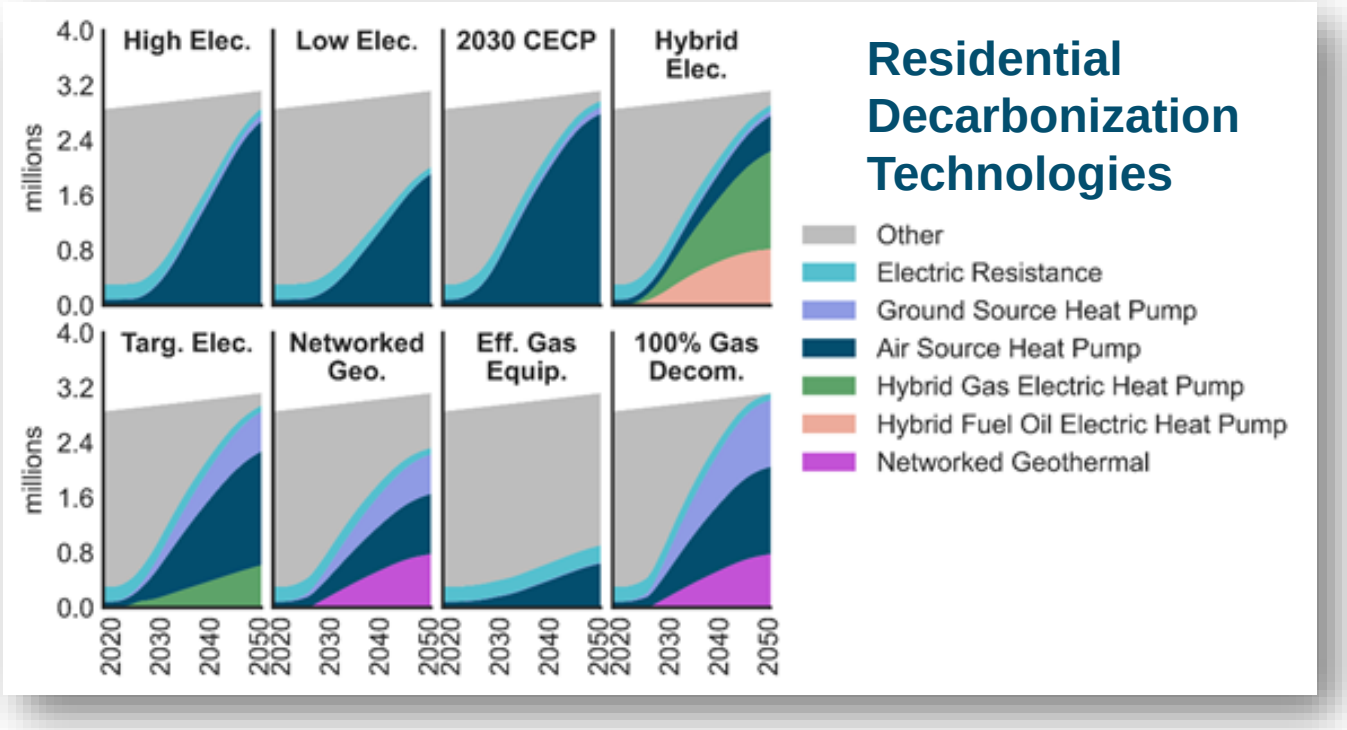
Each strategy has advantages and challenges; portfolio-based solutions are likely needed

Energy Efficiency & Demand Response

	Potential advantages	Potential challenges
 **Electrification**	Commercially available, complementary to decarbonized electricity, improves air quality	Requires retrofits and high upfront capital costs, electric infrastructure impacts, may result in equity issues/stranded costs
 **Hybrid electrification**	Commercially available, utilizes existing infrastructure, reduces demand for renewable gas, reduces grid impacts	Reduces gas system utilization while maintaining capacity needs, requires renewable gasses
 **Renewable Gas**	Leverage existing infrastructure with minimal consumer disruption, fuel diversity/reliability	Costs, limited supply potential, limited commercialization, lifecycle and criteria pollutant emissions
 **Innovative technologies**	Higher efficiency, reduced electric grid impacts, better fit for certain applications	Limited commercialization, cost, not immediately scalable

Challenge 1: Decarbonization pathways include large scale customer adoption of decarbonization technologies

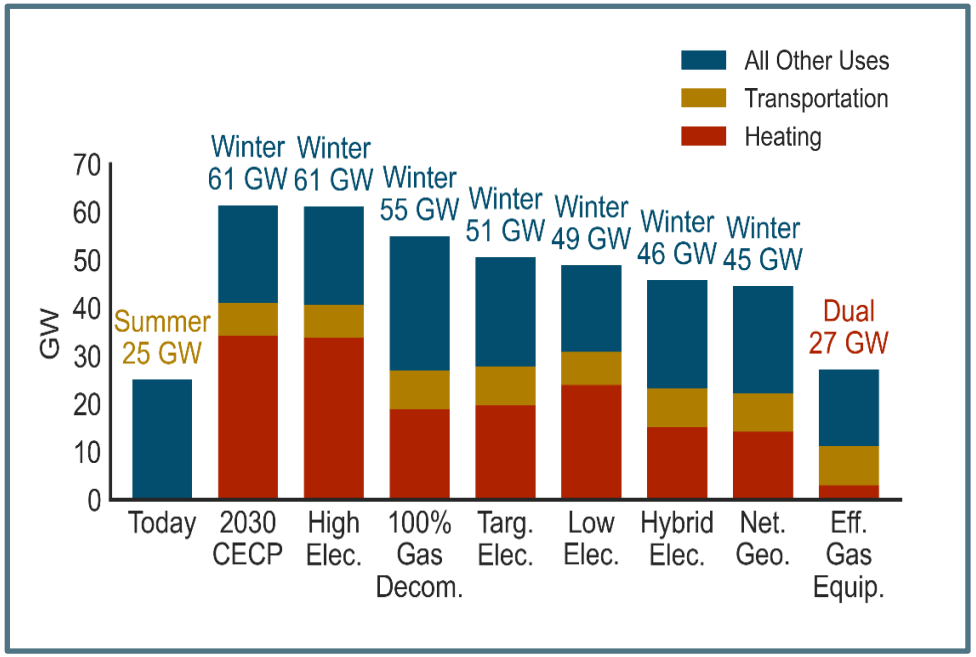
- **Strategic electrification and efficiency are primary tools to reduce GHG emissions from gas end-uses.**
- **Customer adoption of electrification and efficiency measures must begin early to achieve scale by mid-century, but cost and practical barriers exist.**
  - Heating-sector or economy-wide wide, rather than single-fuel, policy will be needed to avoid unintended consequences.
- **Customer transitions will take time, so measures to ensure safe, reliable and affordable natural gas service are needed.**



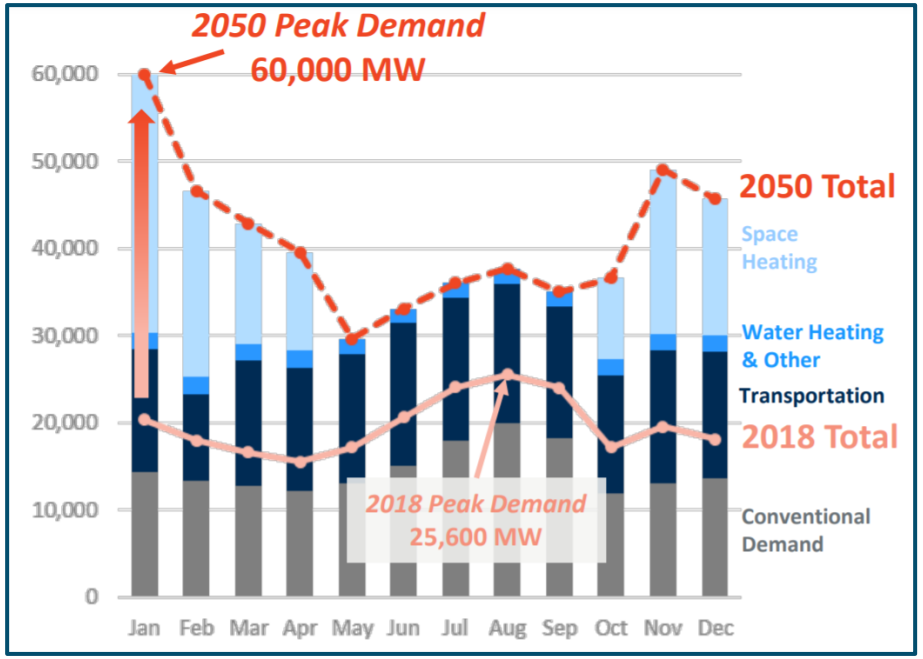
Transition of space heating stocks in MA. Figure reference: Massachusetts 20-80 Consultant Independent Report, page 29

Challenge 2: electrification will drive significant increases in load– hybrid strategies can mitigate those impacts

Median Year Peak Demand Forecast (GW)



Monthly Peak Demand (MW)



Sources: *(left)* E3 & ScottMadden (2022) 20-80 Decarbonization Pathways Report; *(right)* Coalition for Community Solar Access (2019, provided by Brattle): Achieving 80% GHG Reduction in New England by 2050

+ **ISO-NE peak demand shifts to winter by ~2030 and could more than double by 2050. The installed capacity of generation and storage resources will triple to meet higher loads and decarbonize.**

+ **Firm capacity is needed to reliably meet winter peak heating demands during periods of low wind and solar generation. Hybrid approaches could provide that capacity in place of grid-scale resources like gas generation or non-commercialized alternatives.**

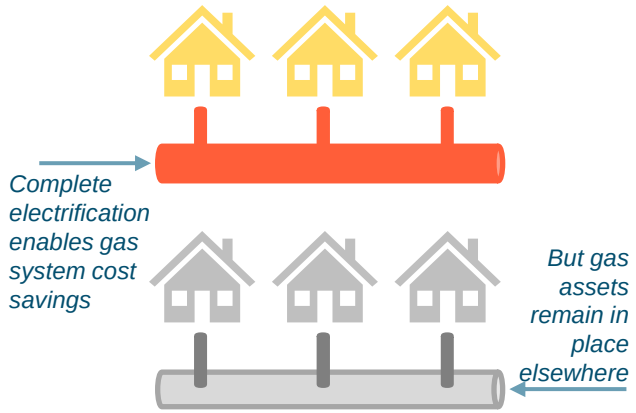
Challenge 3: managing gas system cost and utilization while prioritizing safe & reliable service

(Influence over) customer decisions	Level and pace of electrification comes down to **customer decisions**; an unstructured transition could occur due to individual customer decisions; a structured transition implies limits to consumer choice.
Increasing gas rates as customers electrify	Although some **gas distribution costs may decline** as customers exit the system, volumetric customer rates **increase significantly** for customers that remain
Risks of uncontrolled exits	An increase in gas rates could **spur customer departures**, increasing rates further and posing **equity challenges** for those unable to afford electrification

Abandon or Replace?

+ **Decisions about solutions to decarbonization challenges should be made in the context of a broader framework. Key priorities could include:**
  - ***Safety and reliability***
  - ***Affordability***
  - ***Equity***
  - ***State policy objectives***
+ **For example - abandonment via targeted (block- or neighborhood-level) electrification is a novel strategy that hasn't been tested at scale.**
  - ***Safety and reliability***. Can a gas system investment be avoided?
  - ***Affordability***. Does targeted electrification produce net benefits?
  - ***Equity.*** Can targeted electrification deliver benefits to disadvantaged communities?
  - ***State policy objectives***. Is there a role for some gas infrastructure that is consistent with net-zero?

Targeted Electrification (hypothetical example)



- Long-term scenario analysis suggests this strategy can help, but is not a panacea
- Near-term examples have had limited success due to regulatory, policy and practical challenges.

Targeted electrification efforts are in early stages, lessons learned point to key challenges

+ Progress to date

- ***Initial efforts in California and elsewhere have been small in scale and have had mixed success.*** For example, PG&E has pursued projects that require electrifying a small number of customers (e.g., one to four) in very costly parts of their system. Even capturing this "low-hanging fruit" has posed challenges.

+ Key policy and planning challenges:

- ***Customer Acceptance and Obligation to Serve;*** today, targeted electrification requires 100% customer opt-in. Eliminating obligation to serve would represent a paradigm shift in terms of customer choice.
- ***Engineering feasibility;*** some gas infrastructure replacement projects cannot be avoided without affecting the reliability of the system.
- ***Planning horizons;*** gas infrastructure projects often need to be conducted immediately for safety or reliability reasons. In CA, others are identified over a 3-year planning horizon, which may not be sufficient to implement electrification at a neighborhood level.
- ***Cost Effectiveness and Timing;*** limited cost-effectiveness today, more gas decommissioning could become cost-effective as baseline levels of building electrification grow.
- ***Funding / Use of Gas Avoided Costs;*** there is a tension between using avoided gas system costs to support electrification vs reducing gas rates.

+ Regulatory, policy and planning initiatives will be needed to address these challenges.

Key takeaways

- RI is in the early stages of its transition to net-zero GHG emissions economy-wide by 2050.
- Given the important role of natural gas in Rhode Island's energy system, the transition of that sector will need to ***balance key priorities like safety & reliability, affordability, equity, and state policy objectives***.
- ***Gas decarbonization strategies have advantages and drawbacks,*** portfolio-based approaches can help to balance priorities and manage the challenges of reducing GHG emissions from gas.
- ***Targeted electrification efforts have only just begun,*** key challenges identified include coordination of infrastructure planning, regulation, and customer choice.

Rhode Island specific considerations

- Age of customer equipment and housing stock
- Overlapping gas and electric service territories
- ISR program

Thank you

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