



# NORA'S VIEW OF THE FUTURE AND HOW WE GET THERE

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NORA*



# CHALLENGES

- 1) Global Warming is Considered Major Problem in Heating Oil States
- 2) Electrification is Seen as a Universal Answer, Trucks, Cars, Buildings
- 3) Equipment and Fuel Changes – Keeping Up with the Speed of Change

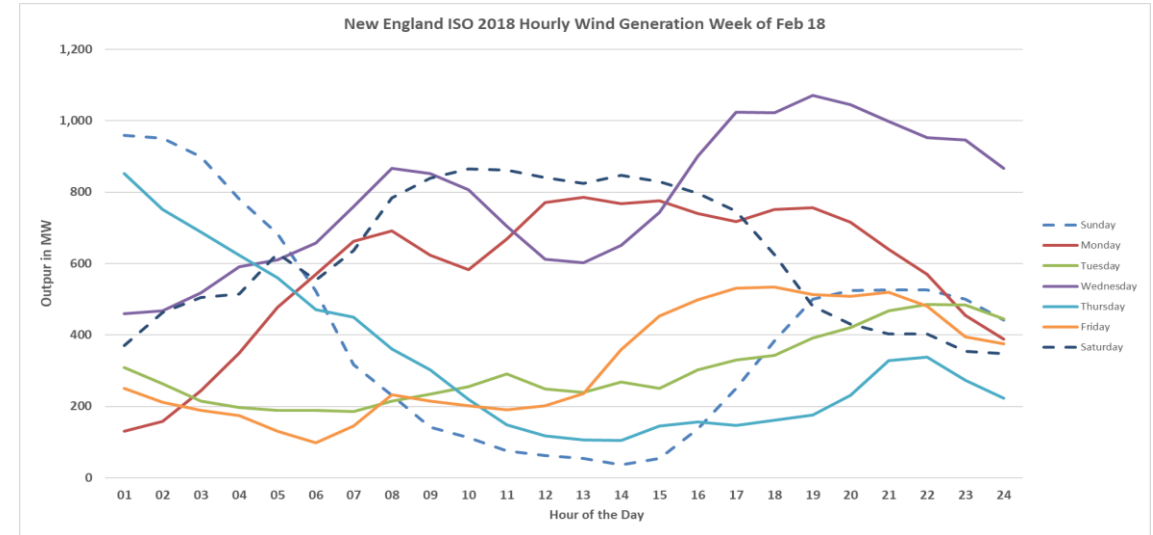
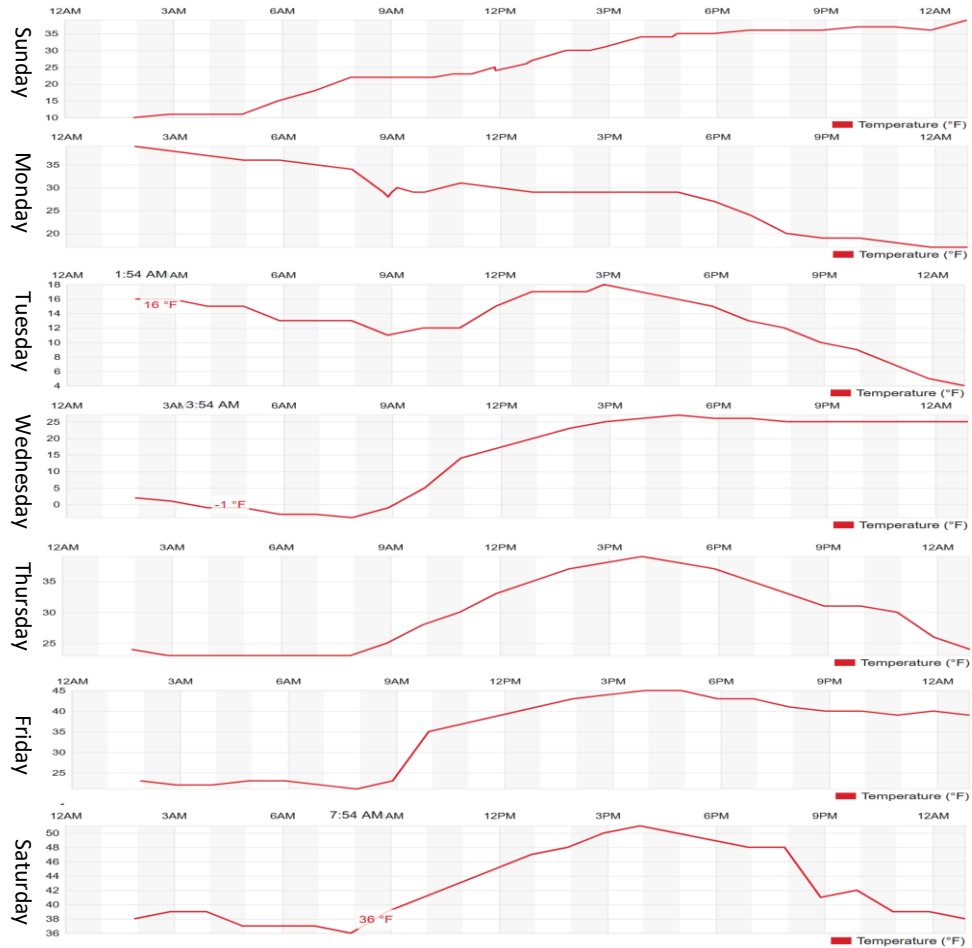
# ADVANTAGES

- 1) A Liquid Fuel
- 2) Well Researched and Readily Available Biofuel Component
- 3) Any Transitions to Electricity will be Extremely Expensive

# ELECTRIFICATION IS NOT THE ANSWER IN THERMAL SECTOR

- 1) Conversions to Electricity Are Both Ineffective and Expensive
- 2) Converting Whole Load of Electricity to Renewable Will be Difficult if Not Impossibly Expensive
- 3) Matching Load and Supply Creates an Unnecessary and Expensive Challenge

# Hourly Winter Wind Generation versus Ambient Temperature



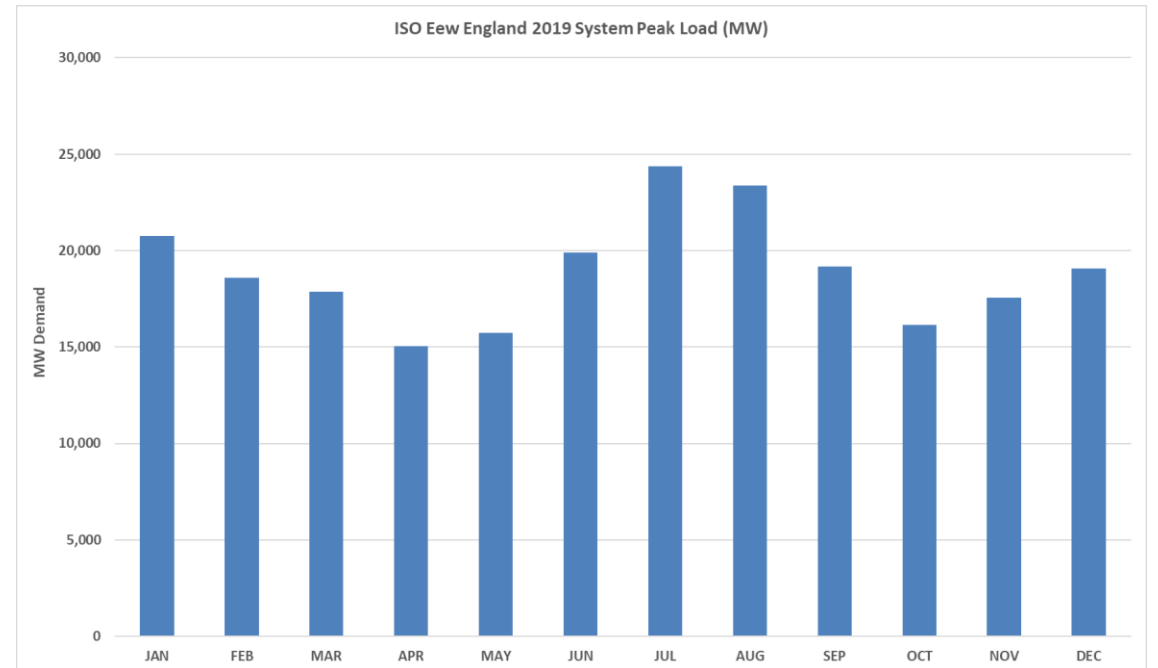
During the week of February 18, 2018 wind production varied for 37 MW to 1,071 MW. There is no time of day correlation for wind power production.

During the week of February 18, 2018 ambient temperature in Burlington, VT varied from a high of 56°F at 4PM on Saturday February 24 to a low of -5°F on February 21 at 8AM. Generally speaking, higher temperatures occur during the day due to solar radiation.

To have a safe and efficient grid will require these to match, and to do so with a significant margin of error.

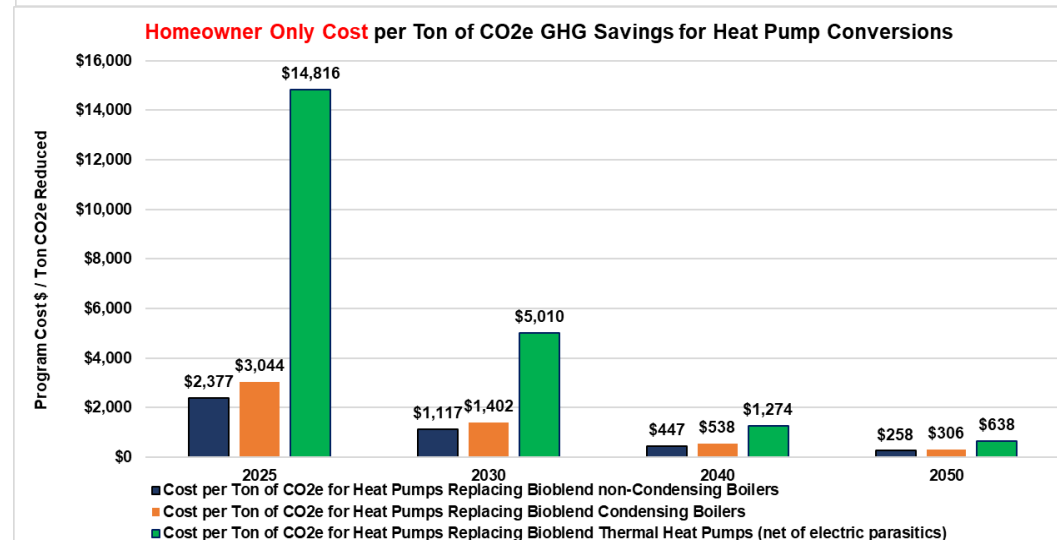
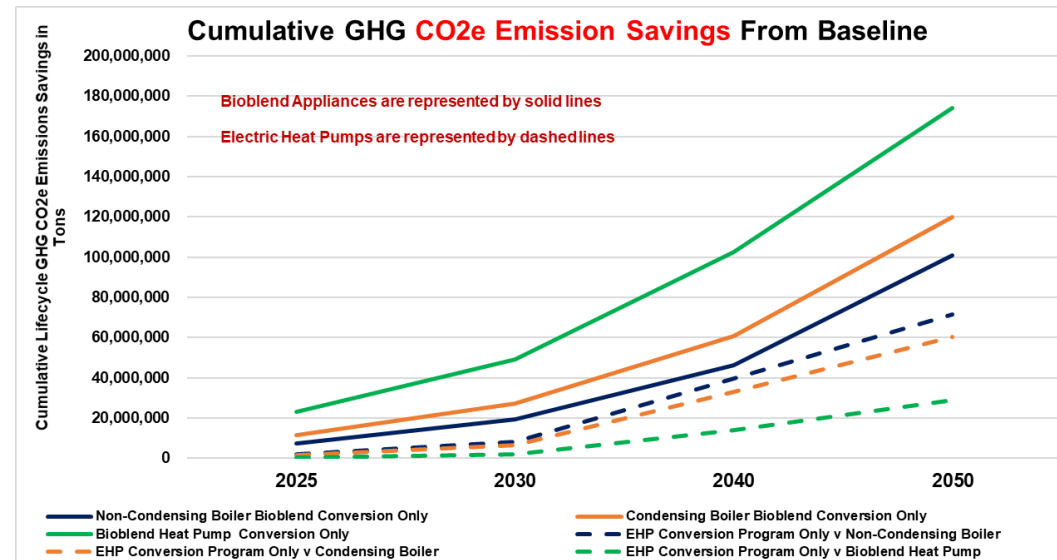
# Average Impact on ISO New England Transmission & Distribution Infrastructure

- 2019 Summer Peak 24,361 MW
- 2019 Winter Peak 20,773 MW
- Potential HP Transition Impact 13,901 MW
- New Winter Peak with HP Transition Increase over 2019 Summer Peak of 10,313 MW
- Imagine 3,000 MW of batteries for peak reduction this would yield 7,313 MW increase.



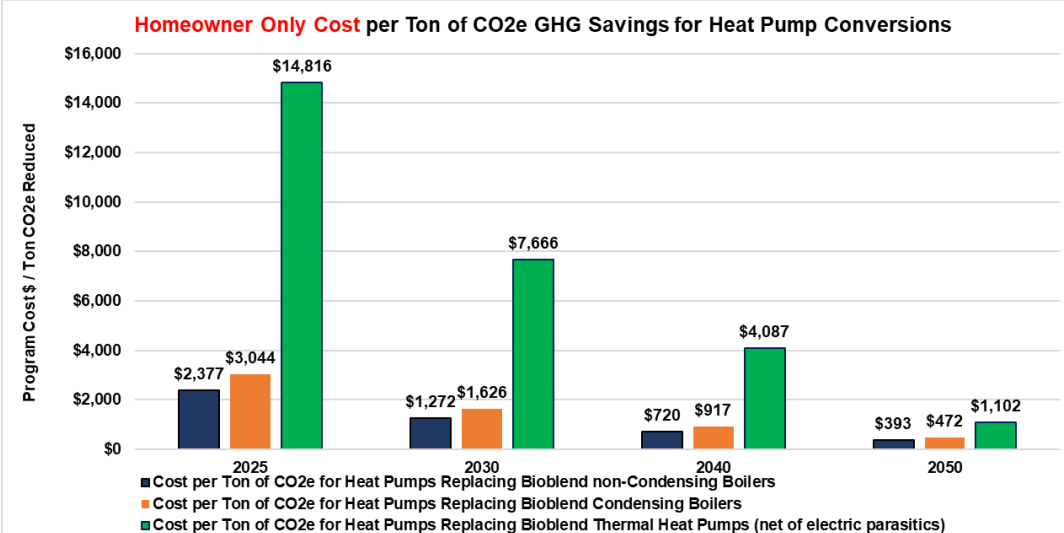
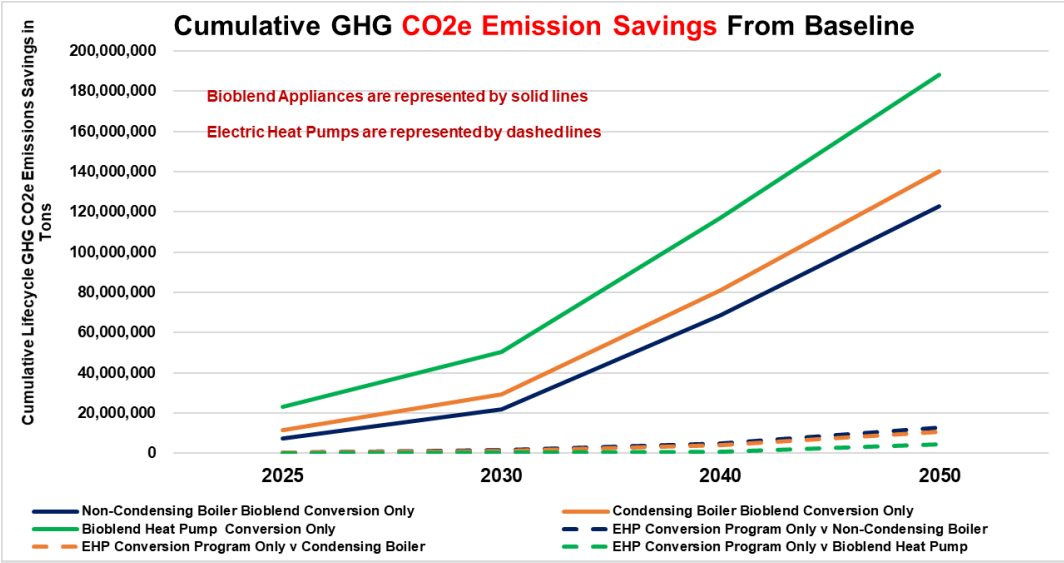
# Use Case: High EHP Whole House Conversion Rate with Slow Bioblend Adoption Rate

Worcester, MA
20 Year Lifetime-AR5
Average Bioblend of Feedstocks
78%
86%
95%
135%
HP7
100%
100
Scenario 1: B5 2021-2024, B20 2025-2039, B50 2040-2049, B100-2050
Scenario 3: 15%@2025, 25%@2030, 50%@2040 & 100%@2050
646,103
5.00%
32,305
High Conversion Cost Scenario 1
100.0%
\$35,000
2.00%



# Low EHP Whole House Conversion Rate with Aggressive Bioblend Adoption Rate

Worcester, MA
20 Year Lifetime-AR5
Average Bioblend of Feedstocks
78%
86%
95%
135%
HP7
100%
100
Scenario 2: B5 2021-2024, B20 2025-2029, B50 2030-2039, B100 2040-2050
Scenario 3: 15%@2025, 25%@2030, 50%@2040 & 100%@2050
646,103
1.00%
6.461
High Conversion Cost Scenario 1
100.0%
\$35,000
2.00%





# WHAT DO WE NEED TO DO

- Equipment must be Bioready for Biodiesel, Renewable Diesel, Novel Biofuels
- New High Efficiency Equipment
- We Must Generate Electricity from Biofuel,
  - Huge Advantage for Energy Security
- Must Develop New Fuels to Avoid Feedstock Shortages
- Most Importantly we Have to Hold Share