Hydronic Heat Pumps with Thermal Storage

Efficiency Maine's Innovation Program

Goals of the Pilot

- Goal 1: Prove the potential to retrofit standard Maine homes heating with boilers to air-to-water (hydronic) heat pumps
  - 64% of single-family homes in Maine have a boiler
    - Requires 180F+ hot water
  - We are currently using the highest temperature units on the market (179F)
    - Ongoing efforts to determine true water temperature needs of a home
- Goal 2: Demonstrate that thermal storage can be used to shift load
  - To reduce stress on the grid during periods of peak demand
  - To take advantage of time-of-use rates today
- Goal 3: Show the potential to take advantage of abundant renewable energy
  - Moving heating demand from high cost, high carbon hours to low cost, renewable hours

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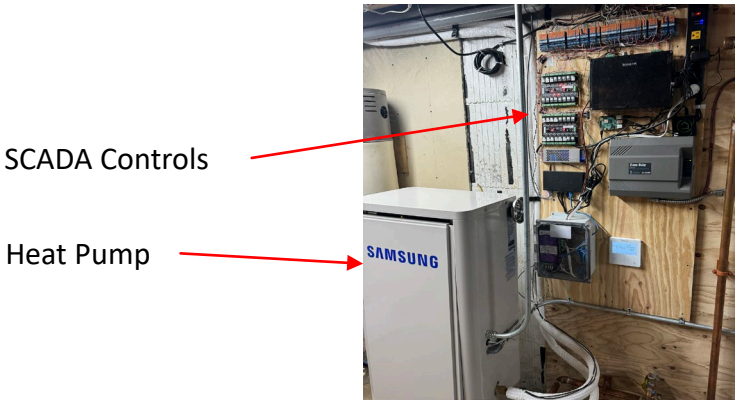
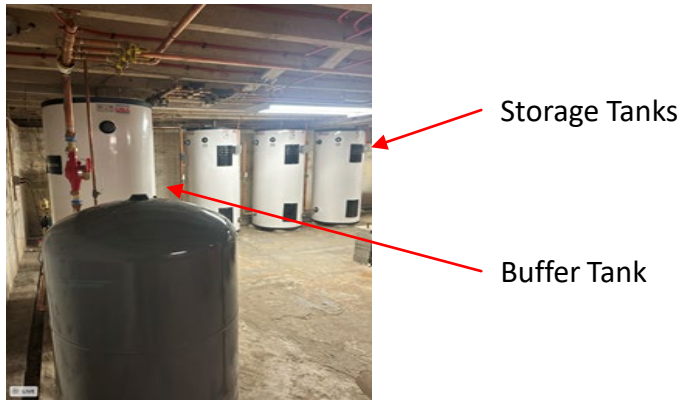
How Does the System Work?

- We are currently testing the technology in 5 typical Millinocket homes
- Hydronic Heat Pump with three 120-gallon water tanks and a buffer tank





These systems can run on a Versant Time-of-Use rates, turning off the heat pump completely from 7AM to Noon and 4PM to 8PM every weekday, and keeping houses warm with storage heat even on the coldest days

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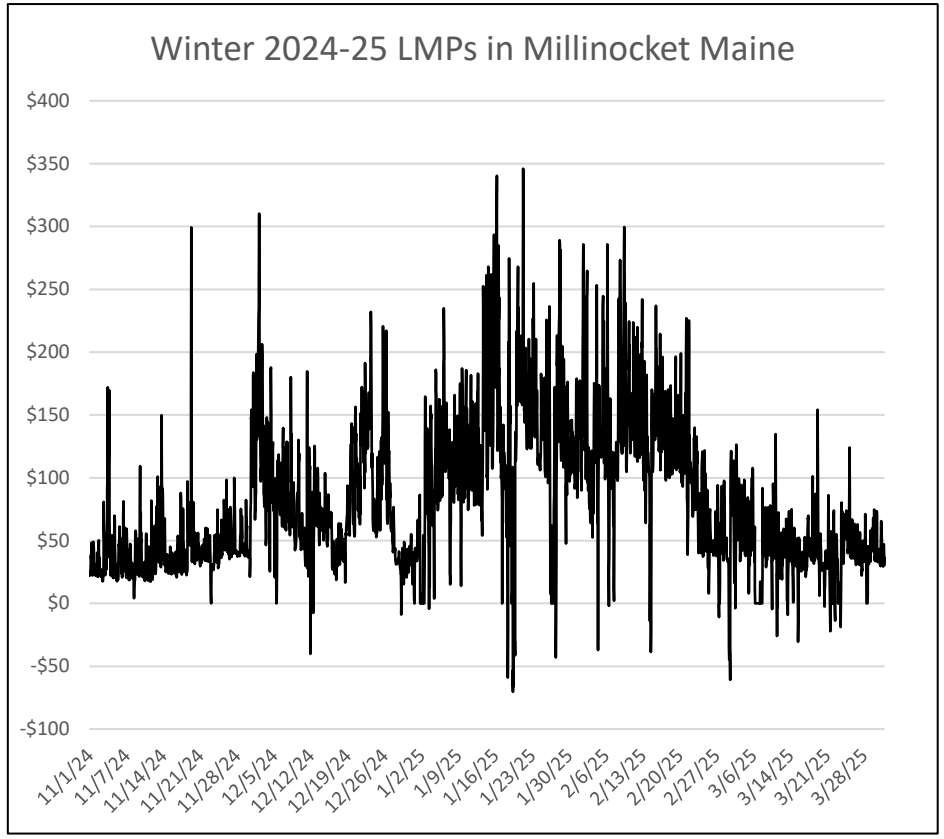
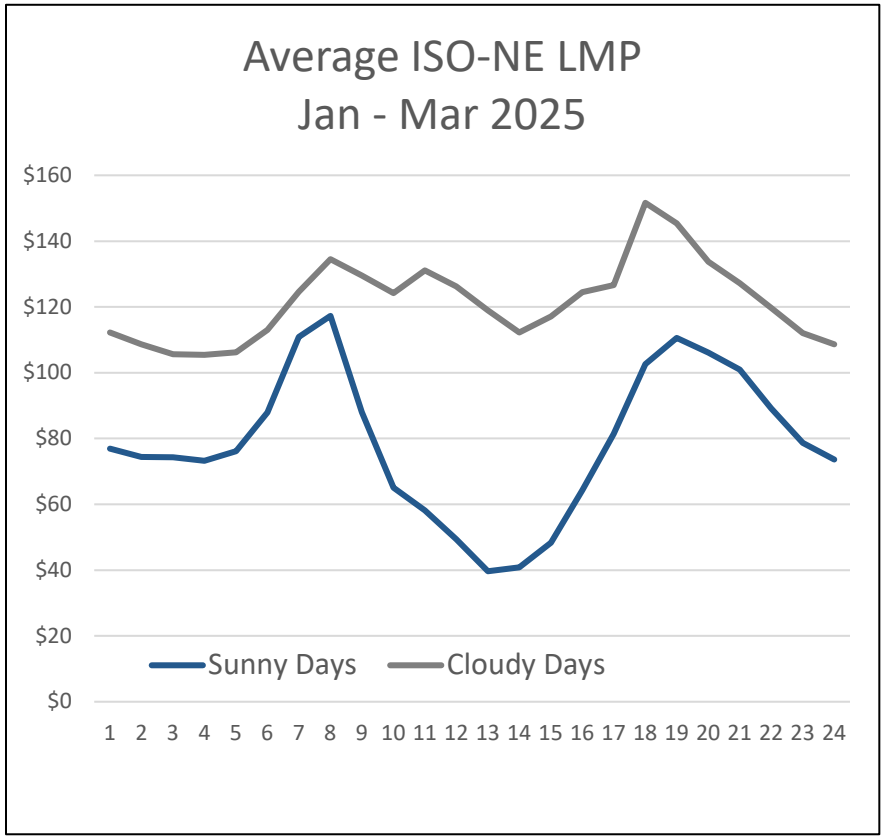
Hot water tanks heat the house for five hours

Designed for the Future

- These systems have the potential to achieve additional cost savings by taking advantage of low prices when renewable energy is abundant and reduce the need for fossil fuel when it is not.



NB: At present, load cannot purchase energy at nodal prices. However, we are working with ISO-NE to allow DER aggregators to become DARDs (Dispatchable Asset Related Demand), which currently can settle on nodal prices.



NB: On 16 of the 90 days in 1Q25 the wholesale price of electricity went to $0 or below in ISO-NE

Results so far

- We can keep an average home warm on the coldest days in northern Maine with a hydronic HP
  - Temperatures have dropped as low as negative teens this last winter without issues
  - Hydronic HPs can produce water up to 179F, but with an efficiency penalty compared to a lower water output temperature
- Thermal Storage can significantly reduce the operating costs by lowering the cost of buying the electricity;
  - Accessing only Versant Power's Time-of-Use delivery rates, we are beating the cost of oil heat today and demonstrating what could be possible in the future

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Annual Heating Cost Comparison Estimates