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Electric Thermal Storage Residential Hybrid Central Heating System

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NEOTHERMAL ETS

A supplemental Electric Thermal Storage (ETS) device using salt hydrate to electrify residential boilers and furnaces

Neothermal ETS 2019 Prototype Integrated with Oil Forced-Air Furnace in Halifax, NS, CAN

Neothermal ETS 2021 Module Design Concept

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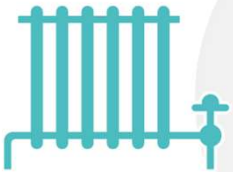
NET ZERO NEW ENGLAND

90% of heating systems today will remain in use by 2030 – 70% by 2050 [1]



3.7M

homes with fuel-burning central heating [2]

1.5M

heated with NG

2M

heated with oil

200k

heated with propane

State	NZ Target Year
CT	2050*
MA	2050
ME	2045
NH	2050
RI	2050
VT	2030** – 2050

* Fed gov target by default
** City of Burlington, VT

Infeasible to rely on attrition or premature replacement to achieve Net-Zero

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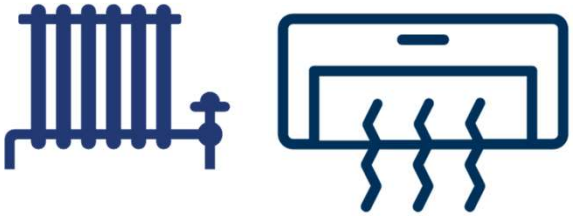
[1] US EIA (2009); StatCan (2007)
[2] US EIA (2009)

NET ZERO NEW ENGLAND

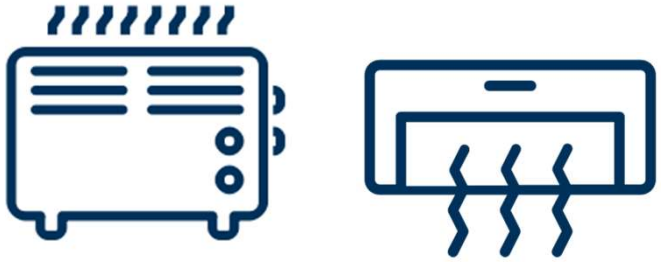
Current, monolithic Net Zero buildings solutions grow peak load and overlook load flexibility and challenge energy resilience

Electric supplemental heating retrofit



4-5 kW On-Peak electric heating load

All electric new construction



4-15 kW On-Peak electric heating load

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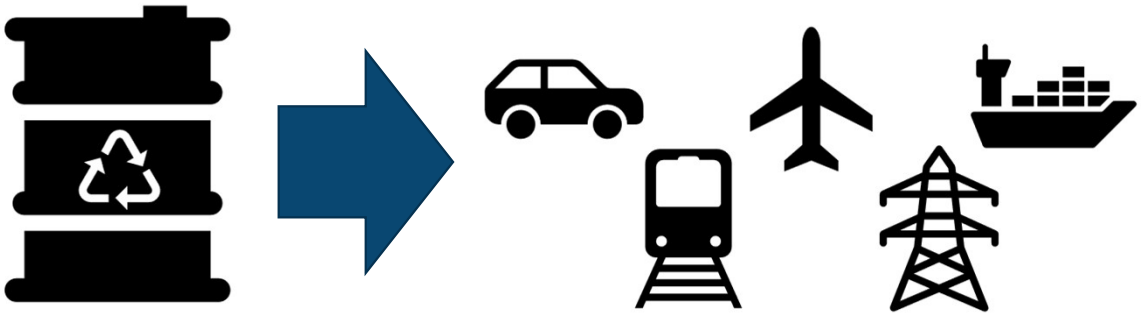
NET ZERO NEW ENGLAND

Biofuels alone are unable to decarbonize the residential heating sector

- > 50x more global biofuel capacity needed to achieve 2030-50 climate targets[3]
- Govt mandates in US prioritize biofuels for transport and electricity sectors[4]
- Food crop fuels, land-use change, and biodiversity/deforestation are problematic[5]



Sustainably produced biofuels capable only to supplement electrification

[3] ETIP Bioenergy (2021)
[4] US EIA (2020); US DOE (2016); US DOE (2014); GVR (2020); NREL (2016)
[5] Energy News (2019); UN CTAD (2009); US EPA (2021); ETIP Bioenergy (2021)

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INNOVATIVE SOLUTIONS

Ideally, a new electric, home heating solution should be…

Add-on (supplemental)

Powered by Off-Peak Electricity

Central Heating Integrated

Designed for Cold Climates

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NEOTHERMAL ETS

Integrated, Net Zero ready, hybrid home heating system using heat stored from Off-Peak electricity with fuel heat as back up

- Reduces oil/propane/NG fuel use by up to 90% - fuel used as back-up only
- Net Zero ready when paired with biofuels (2^{nd}/3^{rd} gen biodiesel, RNG, wood pellets)
- ETS automates selection of HVAC heat delivery source (set-and-forget configuration)
- Functions in all cold climate conditions

0.14 kW On-Peak electric load

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SOLUTION – NEOTHERMAL ETS

- Modular thermal storage – typically 4 modules per home (32 kWh) – equal to 2.5x PowerWall 2
- $7,500 MSRP + $1,000 installation cost – 1/4 the cost of battery electric storage
- Smart DR control including DHW tank lower element on/off control
- Electrical supply: 23.5 A/240 VAC
- Heating rate: 34-51MBtu/h (10-15 kW)
- 90-95% AFUE (annual fuel utilization efficiency)
- > 15 year design life – very low mechanical wear

Neothermal ETS 2021 module design concept

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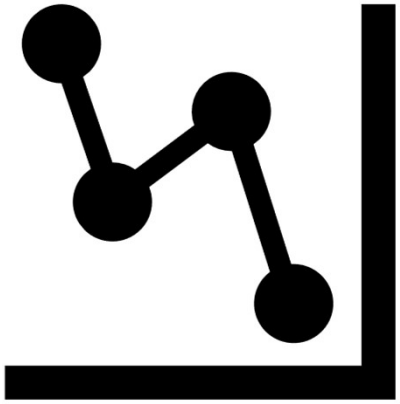
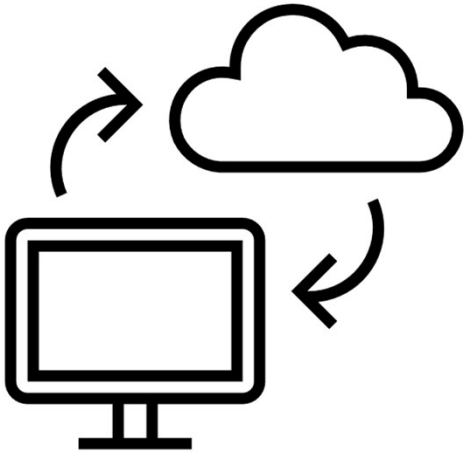
BUILDING ENERGY SIMULATIONS

- Offering simulation service for utilities and govts
- Model of Neothermal ETS co-developed with NRCan CanmetENERGY-Ottawa

Capabilities:

- Dynamic HVAC/DHW end-use profiles
- Dynamic/static DR control of ETS





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ASK: PARTNERSHIPS/PROJECTS

Electric Utilities:

- Residential ETS NWA pilots to curb peak capacity growth
- Simulate ETS response to rate designs, bill credits, virtual power plant control/aggregation

Gas Utilities:

- Collaborate on sales/install/servicing of Neothermal ETS
- Pilots/simulations for ETS as non-pipes alternative to curb peak demand
- Pair Neothermal ETS with RNG

Efficiency Utilities, PUCs & ISOs:

- Study energy system and societal benefits of Neothermal ETS
- Determine impact on reaching state net zero targets
- Evaluate climate change policy pathways for Neothermal ETS
- Evaluate Neothermal ETS for clean heat rebates

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