

Equitable and Affordable Solutions to Electrification (EAS-E) Home Electrification Prize



National Renewable Energy Laboratory (NREL)
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3.9.1.73 (Admin) and 3.9.1.67 (Prize)
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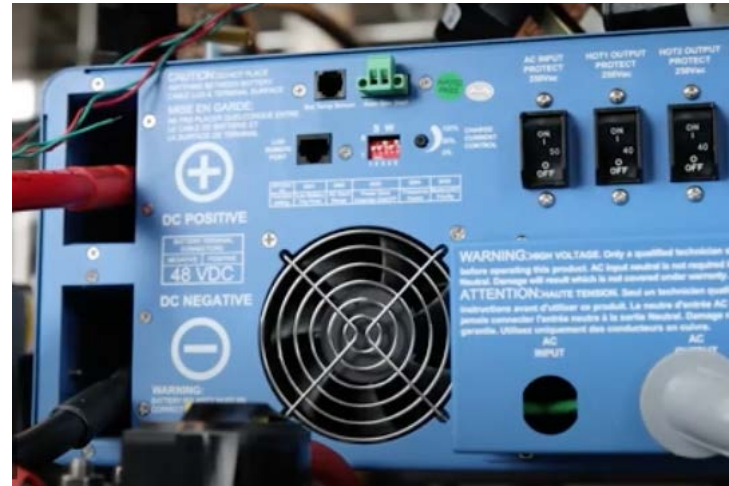
Project Summary

OBJECTIVE, OUTCOME, & IMPACT

The goal of the EAS-E Prize is to support the development of a suite of design solutions, tools, and/or technology innovations that make electrification more affordable and accessible in existing U.S. homes.

TEAM & PARTNERS

- **DOE Technical Monitor:** Wyatt Merrill
- **Prize Admin Team (NREL):** Emily Welp, Rachel Romero, Sarah Truitt, Rebecca Bennett, Rebecca Talley
- **Technical Team (LBNL):** Iain Walker, Jordan Shackelford, Brennan Less, Rich Brown.
- ADL Ventures and the American Made Network Power Connectors
- Vouchers: NREL, ORNL, and LBNL



Top: David Goldstein, CEO of Hydronic Shell Technologies and runner-up in EAS-E prize, showcasing the envelope integrated HVAC

Bottom: Equipment that is part of B&B Technologies, Inc to provide smart panel operation with the upgrade

Photos by U.S. Department of Energy American Made Program



Problem

- End-use electrification is required to meet building sector decarbonization goals.
- Building electrification upgrades fuel-burning appliances to more efficient, electric alternatives.
- Upgrades can trigger many additional building and grid infrastructure needs.
- In some cases, upgrades are not feasible with existing technologies.
- In some homes, load reduction strategies such as building envelope or window upgrades can improve the reliability, affordability, and performance of electrification upgrades.
- Development and deployment of technology innovations that facilitate electrification are thus needed for widespread adoption.



Solution: EAS-E Prize

Introducing the Equitable and Affordable Solutions to Electrification (EAS-E) Home Electrification Prize

The EAS-E Prize seeks novel, cost-effective technology solutions for whole-home electrification of all types of residential buildings.

EAS-E Prize competitors will develop and demonstrate “easy electrification” approaches that are faster and more affordable for homeowners and simplify electrification processes for contractors and implementers.



Alignment of the Prize with the DOE Blueprint

| DOE Decarbonization Blueprint | EAS-E Prize Rules Encourage... |
|--|---|
| Cross-cutting Goal 1: Equity | Particularly working with challenges faced in low-income communities, multifamily homes, mobile homes, older homes, and homes located in colder-climate regions |
| Cross-cutting Goal 2: Affordability | Addressing solutions that meet the broader retrofit market; teams' solutions support DOE's Affordable Home Energy Shot goals to reduce the cost of upgrading homes by at least 50% while lowering energy bills by 20% within a decade |
| Strategic Objective 2: Accelerate On-site Emissions Reductions | Addressing home electrification to reduce on-site combustion of fossil fuels through technology advances; Prize seeks to limit impacts on electricity generation and electrical distribution networks |



Impact of Prizes

American-Made Prize Challenges...

- **Make innovation easy, fast, and agile** with rapid innovation cycles, which help boost innovators' competitive spirit and advance inventions to market
- **Inspire the next generation** of scientists, engineers, entrepreneurs, and community leader to solve important problems and challenges
- **Expand participation** from innovators with diverse backgrounds, while backing those innovators with a broad range of Network support
- **Provide opportunities** for public-private partnerships to leverage government investment to grow new businesses, solutions, and opportunities
- **Create a pipeline of new innovators** that are ready to participate in other DOE programs such as Small Business Innovation Research, Funding Opportunity Announcements, grants, etc.



Solar Prize Awards Demo Day; Photo by: NREL



\$260M
in cash prizes and
support



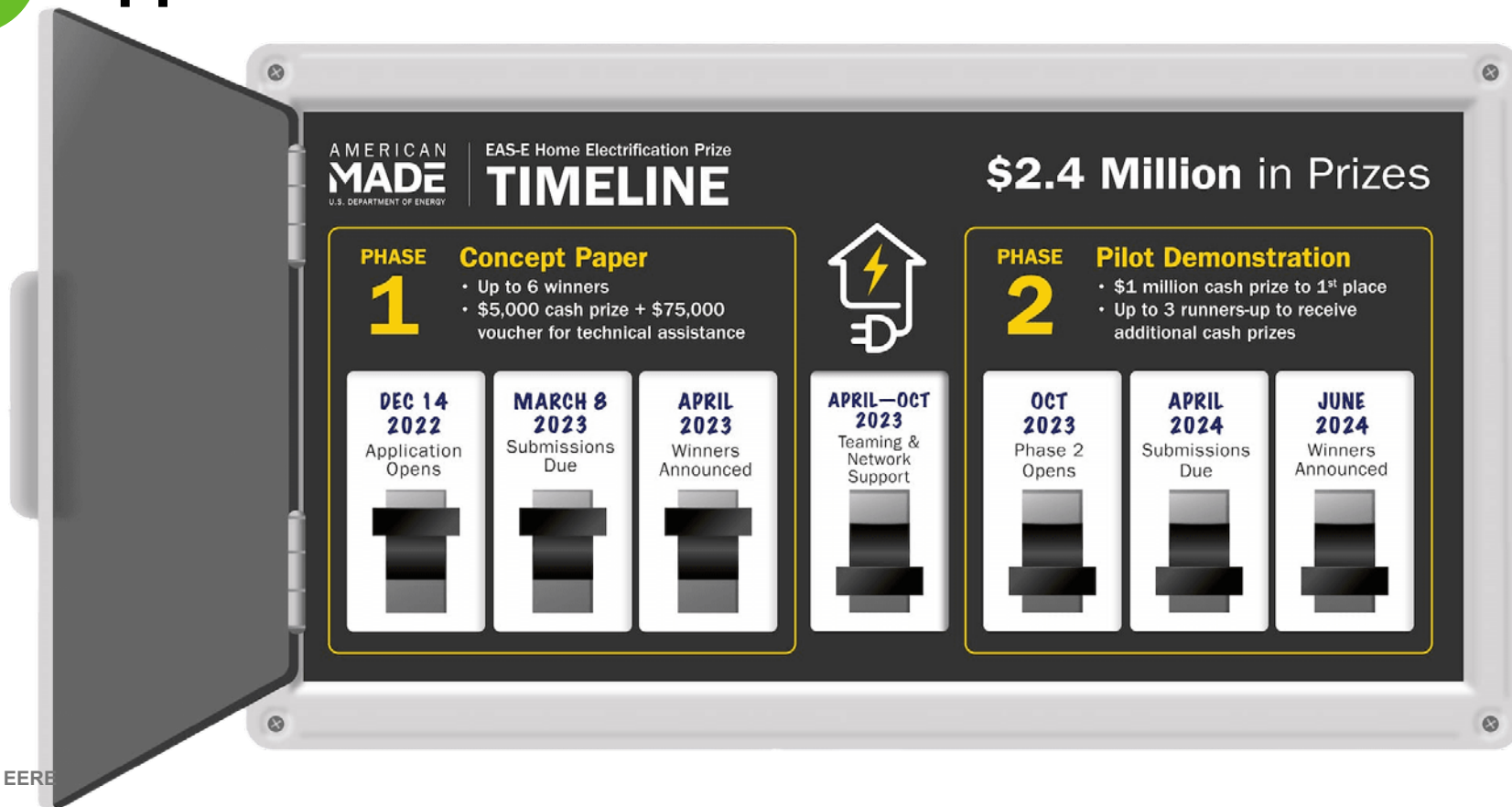
70+
prizes



400+
Network
members



Approach: EAS-E Prize Timeline





Submissions

Phase 1: Concept Paper

- Present an innovative design and/or technology solution that advances affordable electrification.
- Phase 1 is focused on presenting the proposed solution, comparing them with current practice, forming a capable team, identifying market opportunities, outlining risks, and describing the intended Phase 2 demonstration.
- Up to six Phase 1 winners will:
 - Receive a **\$5,000 cash prize** each
 - Be eligible to compete in Phase 2
 - Receive a **\$75,000 voucher**.

Phase 2: Pilot Demonstrations

- Phase 1 winners complete solution design documentation, evaluate the size of the market and the commercial viability of the solution, and demonstrate functional prototype solutions.
- Pilot demonstrations: show that the technology is reliable and capable of broad application and makes a substantial difference in the economic viability of electrifying the homes in question.
- Up to three prizes will be awarded under Phase 2:
 - With a top prize of **\$1 million**
 - The remaining prize pool will be shared equally between the other Phase 2 winners (3 runners-up).



Key Objectives for Submissions

Key objectives for the prize seek innovations across 10 areas

| | |
|------------------------------|---|
| 1. Scale | Applicable to a large number of homes. Competitors must be able to estimate the number of households to which the proposed solution is applicable. |
| 2. Impact | Substantially impacts the ease of retrofits/upgrades and/or load reduction (as demonstrated by estimating the magnitude of electric load reduction in each affected home relative to existing electrification options). |
| 3. Affordability | Affordable for the majority of homes. Affordability considerations may include the net monthly cost of ownership, financing approaches, and reductions in installation and/or operation costs. |
| 4. Speed | Faster to implement than current solutions. Solutions should facilitate rapid end-use electrification in homes, shortening time periods such as those attributable to third-party requirements, permits, supply chain, and inspections. |
| 5. Ease | Simplifies the experience during installation and/or usage. |
| 6. Flexibility | Supports solutions that can be applied across multiple end uses, housing types, climates, and configurations/situations. |
| 7. Novelty | Offers performance and affordability that goes beyond existing commercial products or services, providing a clear advantage over business-as-usual solutions. |
| 8. Rapid Deployment | Is capable of rapid deployment by the close of the EAS-E Prize contest period, with consideration of workforce constraints for the technologies in question. |
| 9. Equitable Benefits | Makes electrification easier in low-income communities, not only through affordability but also by targeting solutions specific to dwellings more common in these communities. |
| 10. Multiple Benefits | Provides more than one benefit (e.g., load sharing to avoid panel replacement combined with time-of-use electricity pricing controls). |



Scenarios for Technology Application

HUD Code Manufactured



Multifamily Walkup



Single-Family Mild Climate



Single-Family Cold Climate

- Illustrative scenarios are intended to give competitors ideas for opportunities and challenges to tackle.
- Competitors are not required to target these scenarios, but must detail a specific scenario to qualify.
- Scenarios emphasize the whole-home, system-level approach the prize seeks.



Innovating: Vouchers

- **Vouchers are additional prize funds that teams use to help test and demonstrate their prototypes.**
- Winners of Phase 1 each received a **\$75,000 voucher** to spend on technical assistance or demonstration resources at national laboratories and/or American-Made Network Connector facilities to pilot and demonstrate their Phase 2 solutions.
 - These vouchers are intended to offset the cost of Phase 2 demonstration. They may not cover the entire effort of the demonstration.
- ADL Ventures (EAS-E Prize Power Connector) assisted Phase 2 teams with matching with a voucher service provider to demonstrate their innovations.



Approach to Vouchers

April 2023: Phase 1 finalist winner announcement.

May 2023: Required voucher webinar for Phase 1 finalists.

April to June 2023: Matchmaking with national laboratories & Network VSPs conducted by ADL Ventures.



EAS-E Prize Voucher Process & Timeline

July 2023: 90% completed Statement of Work or Joint Work Statement due to Prize Administrator for approval.



April 2024: Submission deadline for Phase 2.

October 2023 to April 2024: Conduct work outlined in agreement and have data collected with enough time to develop submission materials before the Phase 2 deadline in April 2024.

July to October 2023: Agreement finalization and execution with chosen national laboratory's technology transfer office.



Winners of EAS-E Prize Phase 2

Winners were announced
September 19, 2024

- **Grand Prize: Aris Hydronics, Milwaukie, Oregon**
- Runner-Up: B&B Technology Solutions, Henderson, Nevada
- Runner Up: Hydronic Shell Technologies, Long Island City, New York
- Runner Up: Redwood Energy and NeoCharge, Arcata, California



Check out the video of winners: <https://youtu.be/UpK6EeKGPnA>

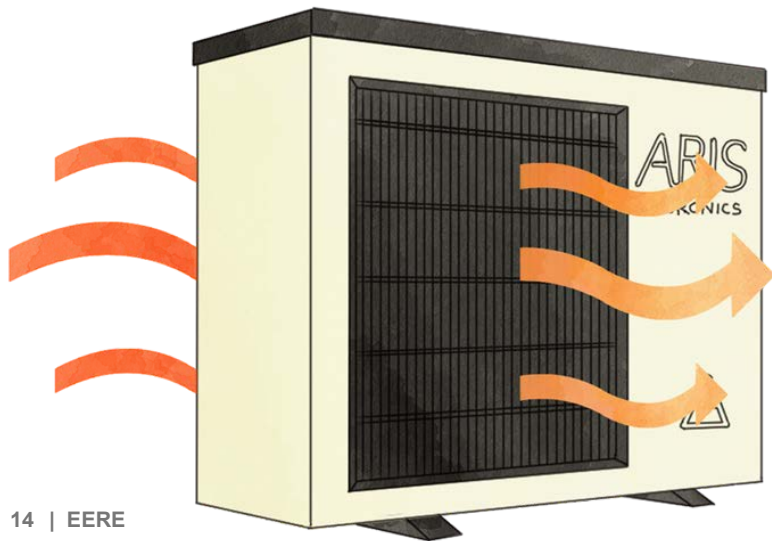


Grand Winner: Aris Hydronics, Inc. - Modular Multi-Function Heat Pump System

Modular, multi-function air-to-water heat pump system with unified grid-interactive energy management control platform that provides heating, cooling, and domestic hot water.

The system is applicable to all climate zones, building types, and building sizes. It offers a particular set of advantages for the electrification of multi-family buildings in cold climates (more than 10M units in the US).

- 20-30% reduction in peak electricity use over 24-hr period
- 30-50% reduction during peak demand times for heating
- 40-70% reduction during peak times for cooling
- 33-54% upfront cost savings
- 60-70% reduction in occupied 110V circuits required to service same building area



SYSTEM BENEFITS OVER BUSINESS AS USUAL

- More efficient delivery and storage of thermal energy with water than central air systems
- Safe use of higher performance low GWP refrigerants (R290 and R32 option) wholly contained inside a pre-charged outside unit resulting in 45-50% lower volumes of refrigerant used
- Fits into mass electrification strategy better than other solutions
- Built-in low cost multi-function thermal energy storage
- Integrated cross-system controls
- Dynamic variable speed operation all system components
- Centralized thermal energy generation and storage with decentralized energy distribution when and where it's needed for added flexibility of tracking sub metering costs
- Complete modularity in the configuration and installation

Voucher Use: Aris Hydronics

- System modeling
 - Modelica simulations of systems and controls
 - Focused on 6-unit multifamily building in climate zone 6
 - Compared Aris system to baseline HP + HPWH
- Quantified benefits including:
 - Reduced equipment capacity
 - Reduced circuit ampacity
 - Reduced peak demand
 - Energy savings
 - Demand flexibility



Photo Credit: National Renewable Energy Laboratory

Voucher Use: Aris Hydronics

- Assessed potential grid benefits and value streams available to utilities and customers who install Aris heat pump systems
 - Assessment of demand flexibility potential
 - Assessment of market fit and opportunity for capitalizing on demand flexibility
 - Technical support for technology integration, data collection, and modeling





Runner-up: B&B Technology Solutions/ SimpleSwitch – Integrated Energy Management System

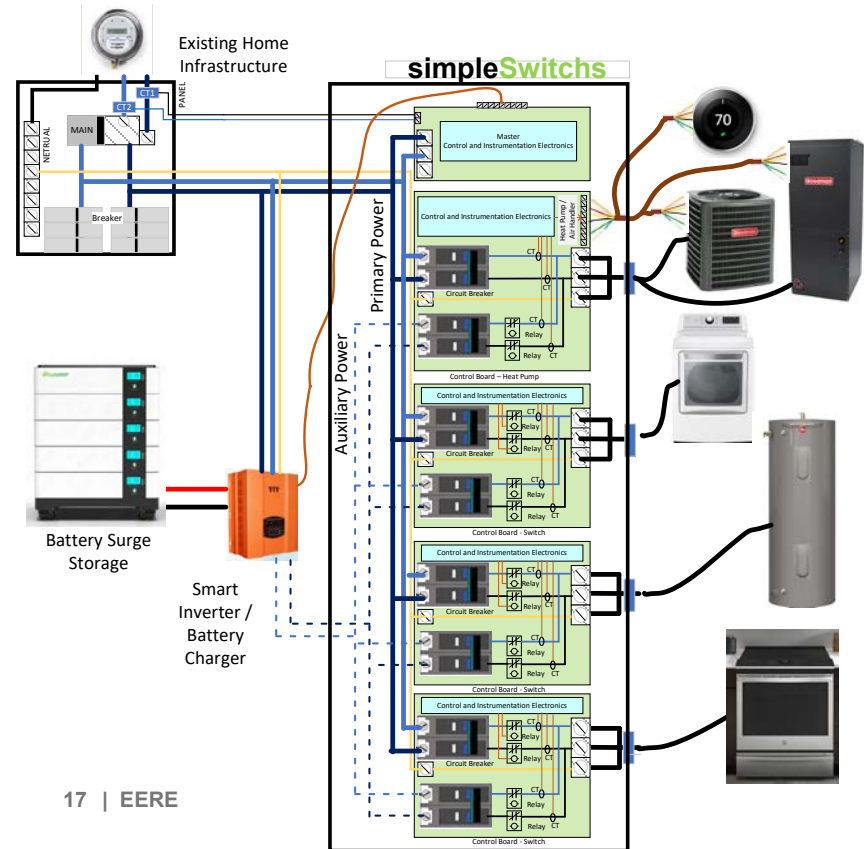


This proposal utilizes smart circuit switching between 240-V electric end uses while monitoring whole-home current draw to provide control logic. It provides benefits associated with smart panel operation without the need for a panel upgrade.

Two modes of operation

Appliance Share – turn off one device (i.e. EV charging, water heating) when a higher-priority device needs power for a short time (i.e. ovens, dryers)

Whole Home Share – turn off a device (i.e. EV charging, water heating) when current transformers measure over 80% of panel capacity in use.



Voucher Use: B&B Technology Solutions/ SimpleSwitch

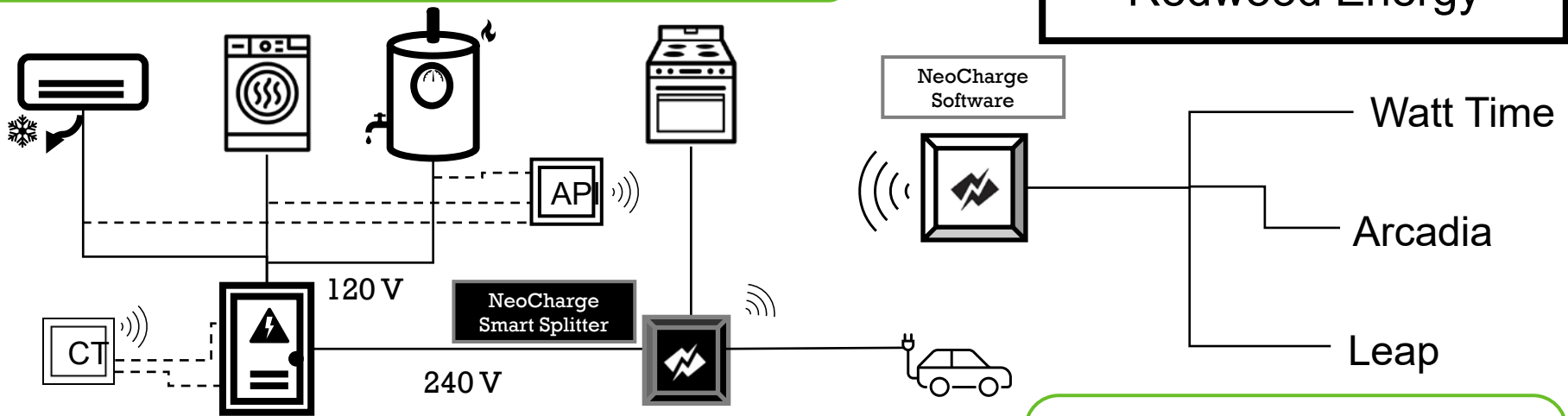
- Co-developed integrated test plan
- Completed simulation analysis and setup
- Supported B&B Tech in setting up the hardware
- Established monitoring points
- Executed the “Day-In-The-Life” power hardware in the loop simulations
- Provided data from the simulations





Runner-up: NeoCharge/Redwood Energy – Low Power Load Balancing Whole Home Solution

The proposed design involves the electrification of all major gas appliances in the home with 120V alternatives selected from our database of market options. With 120V appliances, a panel upgrade can be circumvented.



For homes that have 240 V lines installed, the NeoCharge Smart Splitter will be utilized to allow circuit sharing between appliances and allow for smart EV charging.

NeoCharge
Redwood Energy

The energy output from these appliances will then be moderated and controllable using NeoCharge's API-interactable software, providing load flexibility, grid resiliency and home energy insights.

Voucher Use: Redwood Energy & Neocharge

- Verified the effectiveness of NeoCharge Connect's API-interacting software with a variety of appliances, devices, and home scenarios.
- Demonstrated the amount of load able to be reduced and the effectiveness of the CT clamp and software solution to keep panels within safe capacity limits.





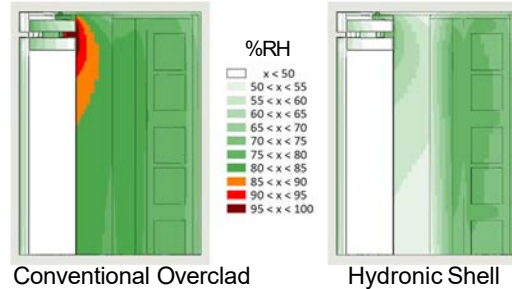
Runner-up: Hydronic Shell Technologies – UpCycling Buildings for Better Living



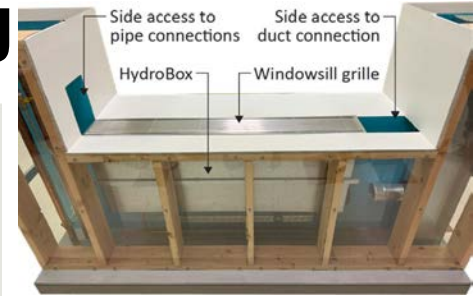
An HVAC-integrated façade panel system installed from the building exterior for cost-effective and non-invasive building electrification.



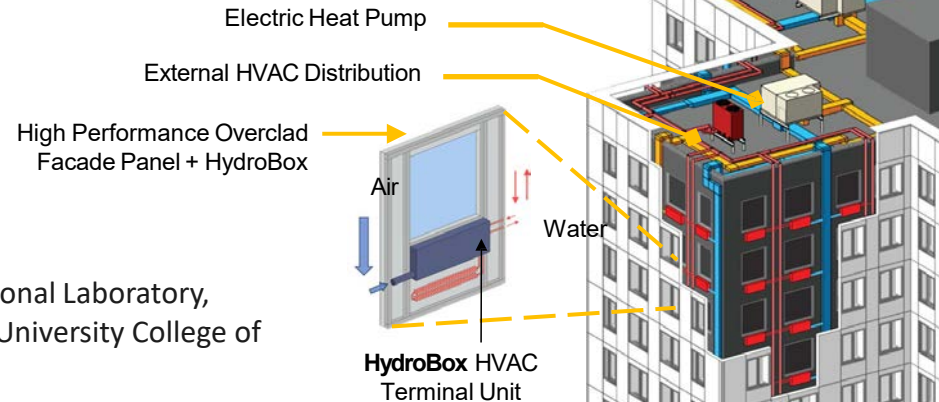
Environmental Chamber Performance Testing



2D Hygrothermal Analysis shows eliminated risk of condensation and mold



Serviceability Mock-up: All tasks completed in <15 mins and full replacement in <60 mins
Demonstration Partners:



Demonstration Partners: Cycle Architecture + Planning, Oak Ridge National Laboratory, Radicle Development Center, GTI Energy, RDH Building Science, Syracuse University College of Engineering & Computer Science

Voucher Use: Hydronic Shell

- Tested an optimized panel design including masonry construction within the chamber
- Demonstrated system performance with optimized convector design and testing thermal storage with masonry construction
- \$30K self-funded by HST in addition to the voucher





Future Work

- The EAS-E Prize concluded with the Phase 2 winner announcement in September 2024.
- There is interest in an EAS-E Prize Round 2 from the industry and competitors.

Thank you

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