

In Episode 56PY: Two January 2024 conventions, ASHRAE and CES, looked at Cold Climate Heat Pumps, and in July 2023 the leading Cold Climate Heat Pump innovators were profiled. Melanie, "Look what they done to my song", 2015. <https://www.youtube.com/watch?v=LL4BHMSreF8> Look What They Done to My Song, By Melanie, performed in 2015, is a protest song, of sorts, with humor, and sometimes sung in French. From the song: "I wish I could find a good book to live in, I wish I could find a good book. Because if I could find a good book, I could never come out and look, at what they done to my song". Stay inside a sealed home with air purifiers running and you won't be slammed in the face with the PM2.5 from nearby indoor residential wood burning. Advice for the present, but hopefully not the only solution to air pollution in the future. The solution could be Heat Pumps that work down to 40 degrees below zero, as advertised. Residents Against Wood Smoke Emission Particulates is working with Expert Match at the Department of Energy to write a grant for a pilot project including a subsidy for a Heat Pump that works down to 40 degrees below zero to a wood stove owner who turns in his or her wood stove and does not use wood burning for heat again. This RAWSEPresidents subsidy would be in addition to the up to \$8,000 rebate for a Heat Pump that the United States Federal Government is offering in 2024. The rollout of subsidies is staggered because each U S State has their own method of releasing Heat Pump rebate monies. The rebate amount up to \$8,000 is based on a sliding income scale. Achieving reliance on Heat Pumps down to 40 degrees below zero may rely also on a backup. That backup for replacement of a wood stove must be a clean energy backup. RAWSEP View: Perhaps a natural gas powered furnace could be a backup to a heat pump or possibly a gas powered generator. Wood burning emits 450 times the PM2.5 as a natural gas furnace. Or there may be a breakthrough in technology to make Heat Pumps viable at 40 degrees below zero, even without a backup. A Window Cold Climate Heat Pump was a Sustainable Solutions Winner at the Chicago ASHRAE convention, held in January 2024. ASHRAE was formed as the American Society of Heating, Refrigerating and Air-Conditioning Engineers by the merger in 1959 of American Society of Heating and Air-Conditioning Engineers (ASHAE) founded in 1894 and The American Society of Refrigerating Engineers (ASRE) founded in 1904. <https://www.ashrae.org/news/ahr-today/meet-the-2024-ahr-expo-innovation-awards-winners> Excerpts edited by RAWSEP for brevity and clarity and relationship to Residents Against Wood Smoke Emission Particulates, a 501c3 nonprofit organization. Sustainable Solutions. Winner: Midea Residential Air Conditioning Midea PWHP Innovation: Midea's Packaged Window Heat Pump is a window-mounted cold climate air-source heat pump, designed for DIY installation and high-performing, energy-efficient heating and cooling. Developed to support multifamily buildings' transition toward electrification, the Midea PWHP provides a cost-effective solution for buildings looking to quickly meet future sustainability requirements. Unit performance is 9,000 Btu/h (2.6 kW) heating and cooling, a 2.35 COP @ 17°F (-8.3°C), up to SEER2 21.8 and HSPF2 11.6. This is accomplished without the use of auxiliary heat. Finalists in this category include: Blue Frontier, Blue Frontier, Liquid Desiccant DOAS; Mitsubishi Electric Trane HVAC US, Mitsubishi Electric, Hybrid VRF®. RAWSEP View: Minus 23 degrees below zero Fahrenheit achieved by Rheem and by Trane in Heat Pump testing, or Minus 13 degrees below zero Fahrenheit achieved by Bosch in Heat Pump testing seem to be leading the way in Heat Pump cold climate technology, at least according to the articles below, the first from the January 2024 Consumer Electronics Show (CES) held from January 9th through 12th, 2024 in Winchester, Nevada. January 2024. <https://www.cnet.com/home/energy-and-utilities/heat-pumps-can-struggle-in-coldest-winter-but-new-models-at-ces-show-promise/> Heat Pumps Can Struggle in Coldest Winter, but New Models at CES Show Promise. Photos: two Heat Pump photos from Bosch and one Heat Pump photo from Mitsubishi. Heat pumps electrify your heating and cooling to be more efficient. New technology could solve one of their lingering problems. January 16, 2024. Excerpts edited by RAWSEP for brevity and clarity and relationship to Residents Against Wood Smoke Emission Particulates, a 501c3 nonprofit organization. All-electric, energy efficient [heat pumps](#) are great because they can both heat and cool homes, replacing your home's furnace and air conditioner in one go. They can also [save serious money](#). they don't work as well as gas furnaces at very low temperatures. newer versions are part of an effort to solve that problem and catapult heat pumps forward to become the future of both heating and air conditioning. Case in point: a model just unveiled by Bosch at [CES 2024](#) (where we've seen [other great energy tech](#) and [exciting developments across the board](#)). Heat pumps are seen as a [key tool in America's electrification and decarbonization](#). They can replace [furnaces](#), which largely run on fossil fuels like natural gas, with an electric appliance. If that electricity is coming from a clean, renewable source like solar or wind, it cuts fossil fuels largely out of the energy equation. Bosch's new heat pump, the IDS Ultra, is the company's first air-to-air heat pump designed specifically for colder climates. The model, which Bosch says can maintain a home's temperature down to 5 degrees Fahrenheit and keep working down to minus-13 degrees, is one of several that has passed the first stage of the Department of Energy's Residential Cold Climate Heat Pump Challenge. Others include products from Daikin, Midea, Johnson Controls, Lennox International, Carrier, Trane and



A Mitsubishi Window Cold Climate Heat Pump Won a Sustainable Solutions Award at ASHRAE in Chicago January 2024



Rheem Heat Pump, July 2023.



A Trane Heat Pump, July 2023.

Rheem. A senior advisor in DOE's Office of Energy Efficiency and Renewable Energy and program manager to the Office of State and Community Energy Programs (talked about technology advancement). Here's why your next heating system might be all-electric, even if you get snow and frost. Why cold-climate heat pumps matter. There are generally two types of heat pumps: air-source and geothermal heat pumps, but they both use similar principles to operate. To heat, they capture thermal energy from a source outside of your home (the air or the ground) and transfer it to your home using a pumped refrigerant. To cool your home, they do the same thing, just in reverse. "In very simple terms, a heat pump is transferring heat from one side to the other," a Bosch director said. "In the summertime it's transferring heat from the inside to the outside. In the wintertime it's the opposite." Air source heat pumps even work when it's cold -- there's still thermal energy outside, just less of it, despite how it may feel. But they don't work as well. That's why it's important, both for the homeowners in cold climates and for the [US energy transition generally](#), for heat pump technology to get better at operating below freezing. A wide range of changes are needed to improve energy efficiency and reduce fossil fuel emissions all across the country. "These cold-climate heat pumps, especially those that are next generation that can provide more heat in heat pump mode when temperatures get even colder, are just part of the suite of solutions that are needed to reduce energy consumption and also reduce onsite carbon emissions." Making a heat pump work in the cold. The problem with heat pumps in cold weather is the same as what anyone who's been through a northern winter will tell you about roads: Ice makes everything stop. The heat pump is cycling refrigerant through coils outside of your home, trying to pick up what thermal energy is available in the air. When it gets too cold, water in the air starts to condense on the coils and then freeze around them, blocking the refrigerant from being able to absorb that energy. Heat pumps are equipped with defrosting technology to keep this from happening, but that usually means the pump's energy is being spent trying to warm those coils up rather than warming up your house. At a certain point, if it's too cold, it becomes a losing battle. "In very cold weather situations it just ends up doing that the whole time and it never heats up the inside,". If the temperature drops below minus-15 degrees, a backup electric heater in the Bosch IDS Ultra will kick on and still provide some heat. Will a heat pump save you money? Bosch conducted a survey of homeowners that bears out the current problem with heat pumps: Ownership rates in colder places like New England and the Upper Midwest were six to seven times lower than in warmer places, like the Southeast. Even if you have a heat pump in a cold-climate area, you might also have a gas-powered furnace or other fossil fuel heating system for those extra-cold days and months. Not only is that burning fossil fuels, but it's keeping you connected to the gas lines, adding to your monthly bills. "If you don't have a unit capable of efficiently using electricity in the wintertime, even if you have green electricity you won't be able to use it reliably for heating in the wintertime." How you heat and cool your home is somewhat less important than how well insulated it is. "These efficient heat pumps, especially when paired with efficiency measures from households like more efficient windows, better insulating walls, better insulating attics, will help reduce energy bills as well as reducing carbon emissions from your home," Armstrong said. An extra incentive to get a heat pump. Heat pumps aren't cheap. Basic ductless models from Bosch can run you a few thousand dollars, and that doesn't include installation. The IDS Ultra connects to your existing ductwork, and it'll cost a bit more than other air-source systems when it comes to market, likely in late 2024. But a big part of the cost of a heat pump -- likely the majority of the cost -- is in the installation. And that doesn't change. This model installs just like any other air-source model. There is some help available with that: [Federal tax credits and rebates can offset some of that cost](#). The federal [Energy Efficient Home Improvement Credit](#) offers a tax credit of 30% of the cost of an air-source heat pump, up to \$2,000. (Geothermal heat pumps are covered under the [Residential Clean Energy Credit](#), which is also 30% but with [no cap](#).) There are also rebates available, if your income is below a certain level, that will cover up to 100% of the cost of a heat pump. Bosch's cold-climate heat pump is just one bit of [home energy tech we've seen at CES](#). Check out some of this other new stuff, like a [home battery that can go on the road](#) and a [giant steel cube that can harvest water from the air](#). July 2023. The Cold Climate Heat Pump Technology Challenge (CCHPTC) Photos, Alphabetically : 3) A Carrier Heat Pump, July 2023, 5)A Lennox Heat Pump, July 2023. 8)A Mitsubishi Heat Pump, July 2023. 9) A Rheem Heat Pump, July 2023. 10)A Trane Heat Pump, **July 2023**. Unpictured in July 2023, Alphabetically: 1)Bosch, 3)Daikin, 4)Johnson Controls, 6)LG, and 7)Midea Heat Pumps. RAWSEP View: Let's talk about Heat Pumps. The best solution, for those who are problematically still using wood stoves for home heating, is a Heat Pump that works down to 40 degrees below zero, as advertised. As of March 2023 a caveat was attached to Heat Pumps "Most cold-climate heat pumps can run at total capacity until the outdoor temperature gets to about 5 F or below. It will still heat your home at those lower temperatures, but not necessarily keep it as warm as you may typically like. That's where backup heat sources come in." RAWSEP View: Nothing is perfect, yet, including Heat Pumps, and that is why the Department of Energy is holding a residential cold climate heat pump challenge. The United States Department of Energy is holding a residential cold climate heat pump challenge. <https://www.energy.gov/eere/buildings/residential-cold-climate-heat-pump-challenge> by



The Bosch IDS Ultra heat pump, January 2024 photo 2 of 2.



**LAB TESTED:** A Carrier engineering team with a heat pump. From left are a software engineer, a staff engineer, a principal systems engineer, an executive engineering director, and a senior manager of systems engineering.

July 2023, the halfway point of the challenge, there were 10 contenders. <https://www.achrnews.com/articles/153301-does-heat-pump-challenge-at-halfway-point> DOE's Heat Pump Challenge at Halfway Point. Models from 10 OEMs at various stages of laboratory and field testing. July 20, 2023. Excerpts edited by RAWSEP for brevity and clarity and relationship to Residents Against Wood Smoke Emission Particulates, a 501c3 nonprofit organization. "The challenge is focused on addressing common technical and market barriers to wider adoption by consumers, which include performance at temperatures of 5°F and below, installation challenges, and electricity grid impacts during peak demand periods." - U.S. Department of Energy. The U.S. Department of Energy (DOE) is about halfway through its Cold Climate Heat Pump Technology Challenge (CCHPTC), a program designed to help manufacturers speed the development of the next generation of [heat pumps](#) and ensure that they will perform reliably during chilly winters in North America. Ten HVAC manufacturers are participating in the challenge; some heat pump models were deployed last winter during an initial phase of field testing, while others are in various stages of laboratory testing. The Environmental Protection Agency (EPA) and Natural Resources Canada (NRCan) are also partners in the challenge, and number of utilities and energy cooperatives as well as state agencies in Northern states from Alaska to Maine are supporting it. "The challenge is focused on addressing common technical and market barriers to wider adoption by consumers, which include performance at temperatures of 5°F and below, installation challenges, and electricity grid impacts during peak demand periods," the DOE said in statement to The ACHR NEWS. [The challenge](#) is for electric, centrally ducted residential heat pumps of between 24,000 and 65,000 Btuh. There are two segments to the challenge — one for heat pumps optimized for operation in temperatures down to 5°F, the other for models optimized for operation at temperatures down to -15°F. DOE officials are still exploring the best way to publish and share data from the CCHPTC once it's concluded. The department's goal is to have heat pumps developed through the challenge brought to market by 2024. Here's where each of the 10 participating manufacturers recently stood in the challenge: Alphabetically. 1) Bosch is "fully aligned" with the DOE's goal of electrification. 2) Carrier. Carrier was testing three prototypes based on its Infinity 24 model but could not yet share results. 3) Daikin. Daikin had completed internal testing and private field trials, but testing in a DOE lab is scheduled for later this summer, so the company was not in a position to provide results. "As an industry leader in inverter compressor technology, a key component for heat pump performance and efficiency in Northern climates, Daikin is excited about its continued commitment" 4) Johnson Controls. Johnson Controls has completed design and internal testing of its model, which was undergoing testing in July at the Oak Ridge National Laboratory in Tennessee. "We are pushing the limits of performance at extremely cold ambient temperatures." 5) Lennox. FIELD TRIALS: A Lennox heat pump of the kind being tested at three homes in the U.S. and one in Canada as part of the Cold Climate Heat Pump Technology Challenge. Lennox was the first OEM to finish lab testing, the DOE said. The company installed four systems in the field, three in the Northern U.S., and one in Canada, in late 2022 and early this year. "These systems are being monitored with data-recording equipment to log the performance and efficiency of the systems throughout the several seasons," The heating capacities of the models in the field were matched to the requirements of the sites at which they were installed. Most required a 3-ton heat pump. 6) LG, An LG heat pump with a capacity of 40,000 Btuh, using R-32 refrigerant, was being tested at the Oak Ridge laboratory. Testing is expected to be completed this summer. 7) Midea. "Midea has completed design and internal testing, and is waiting for official DOE testing before announcing performance criteria," Midea plans to market heat pumps of between 2 and 5 tons of capacity that exceed challenge requirements. 8) Mitsubishi. HYPER HEATING: Mitsubishi was awaiting Department of Energy testing of its entry into the Cold Climate Heat Pump Technology Challenge. Pictured is an H2i (short for hyper heating inverter) heat pump. Mitsubishi Electric was awaiting verification testing at the Oak Ridge lab of a 24,000 Btuh model and had not begun field testing. The model has an HSPF2 of 10.4 and a CoP of 1.9, both above the Energy Star heating performance metrics for cold climates, though it hadn't yet been tested under conditions specific to the CCHPTC. 9) Rheem. WEATHERPROOF: A Rheem heat pump, installed at a field-testing site in a Northern climate, meets the call for heat during snowy weather. Field trials of Rheem prototype heat pumps were ongoing. In DOE testing, a 35,000 Btuh model "delivered outstanding results,". At an ambient temperature of -15°F, the unit provided 77% of nominal heating capacity, and it continued operating uninterrupted down to -23°F. The unit's CoP and HSPF2 exceeded DOE specifications for the challenge. 10) Trane. CHALLENGING CONDITIONS: A Trane heat pump has been through its first winter of field testing at a residential building in Boise, Idaho, as part of the Cold Climate Heat Pump Technology Challenge (CCHPTC). Trane has a prototype cold-climate heat pump deployed at a residential building in Boise, Idaho and " during our first winter season, it operated primarily without the need for electric heat. The system will continue to run through the summer of 2023 and the winter of 2023, as required" by the challenge. During DOE testing at Oak Ridge, the prototype performed at temperatures down to -23°F. "Without giving away the full details of our performance across a broad range of very cold temperatures, I can say that we are performing at a significant capacity ratio above 50%, at -23°, as well as a CoP above the CoP of running electric heat alone, at that same temperature,". KEYWORDS: [Climate Action Plan](#) [Climate Change and HVACR](#) [Department of Energy \(DOE\)](#) [heat pumps](#) [Sustainability and HVACR](#) RAWSEP View: Good news was announced in January 2024: candidates had preliminarily met the challenge and would continue testing and then hopefully start manufacturing Heat Pumps that could effectively meet the needs of residents in cold climates, possibly without any need for backup energy sources.



Lennox Heat Pump, July 2023.



Mitsubishi Heat Pump, July 2023.



Rheem Heat Pump, July 2023.



A Trane Heat Pump, July 2023.