

# A Net-Zero Home in Hanover, NH

Karl Kemnitzer



The Kaiser Gish house in Hanover, NH is retrofitted to achieve net-zero status. It includes three all-weather air-source heat pumps and an 8-kW rooftop solar array. Photos by Karl Kemnitzer.

With the recent release of reports from three main climate organizations (UN IPCC, U.S. National Climate Assessment, and World Meteorological Organization) saying that we need to drastically reduce our greenhouse gas emissions, increasing the energy efficiency of our homes has never been more important. In our region, buildings are second in energy consumption and emissions only to transportation.

Many homeowners in the Upper Valley have weatherized their homes, which often yields a 10% to 30% savings on fuel bills. Other homeowners set the goal even higher. Robin Kaiser and Peter Gish have a long history of caring for their community, and when they decided to move back to Hanover, they wanted to live in a net-zero-energy house. After working with UPC Wind Partners during the 1990's, Peter co-founded First Wind in 2001 and has worked on wind and solar renewable energy projects in North America, Europe, Africa, and Asia.

However, both Robin and Peter have strong family ties to Dartmouth, and when it came time to choose a location to settle, they decided to renovate their family home here. Robin's parents, Bob and Evelyn Kaiser, were integrally involved with the Dartmouth community for nearly fifty years, and their home was often a gathering place for students and alumni. Robin and Peter would like to continue this tradition, because they feel the pressing issue of climate change is only solvable with community action and giving people a chance to meet in a net-zero home will help them envision what is possible.

From the beginning of the project, Robin and Peter prioritized efficiency. After analyzing their old house, they realized that it would be very difficult to achieve net zero

with the existing structure and decided to replace the walls and roof with a pre-fabricated panel construction shell with preinstalled foil-faced foam insulation (rated at R36 for the walls and R55 for the ceiling) from Yankee Barn Homes. A blower door was used by contractor G. R. Porter and Sons during installation of the panels to find and seal any leaks in the seams, because air infiltration is often a significant heat loss in a building. The shell was designed to fit onto the old foundation to save the embodied energy in the concrete. Both operational energy and embodied energy were considered during the design, and parts of the old building (such as the foundation and exterior cedar trim) were reused. Around 80% of the building is locally sourced or fabricated in New Hampshire or Vermont. The Marvin Integrity windows were selected over triple-glazed units because of their predicted ability to seal better than other choices many years from now, saving on air infiltration losses instead of adding to embodied energy from repair or replacement.

With a shell this tight, no fossil fuel furnace is necessary. The heating system, installed and designed by ARC Mechanical Contractors, includes three Mitsubishi Electric MXZ all-weather air-source heat pumps connected to a ducted heating system that pulls in fresh air through a Broan HE series Heat Recovery Ventilator. While this system can supply both heating and cooling, the house was designed to use natural convection for cooling to minimize the use of AC. Domestic hot water is supplied by a Rheem Prestige Professional series heat pump water that has a room temperature sensor and will switch to standard resistance heating elements if the room temperature becomes too cold. Waste water heat recovery was considered, however based on frequency of use, it was decided to

not be effective enough to include. All of the lighting is LED, with most of the fixtures using standard Edison base bulbs for easy replacement, and only a few custom fixtures using a flat LED element. Appliances are selected EPA Energy Star rated commonly available appliances.

An 8kW solar array is installed on the garage roof by Apparent brings the building's energy use to net zero. Each of the panels has an Apparent Smart Grid Utility Interactive microinverter on it. This system not only maximizes each panel's output to compensate for shading effects and tracks each panel's output to help diagnose problems, but it is California Rule 21-compliant and offers grid support such as voltage ride through, surge withstanding, anti-islanding capabilities, and voltage-ampere reactive correction. This is more functionality than Liberty Utilities is capable of handling at this moment, however the Apparent master controller also offers load tracking using a built-in learning algorithm and can calculate the best times for heating water and charging or discharging an electric vehicle (EV) or battery storage. The battery storage will be either a modular system from Apparent that is built with BYD lithium cells or a Sonnen battery system. Robin and Peter currently drive a standard internal combustion engine car and a hybrid but have plans to move to electric vehicles as part of this overall project. They are installing bidirectional level 2 chargers that allow the car batteries to become part of the household energy storage system and have prewired the main roof for additional solar panels for the cars.



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It's now possible to build a net-zero home using readily available materials, or as project architect Andrew Garthwaite of Haynes and Garthwaite Architects said, "Leading edge but not bleeding edge." The Kaiser Gish house is showing us that clean, efficient, and exciting buildings are here.

Karl Kemnitzer serves on the Sierra Club Upper Valley group, and likes building electric cargo bikes. He hasn't had a car for over a year and looks forward to VTrans spending more of their budget on bicycles, pedestrians, and transit, and less on cars. ☘

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