the University of Alaska Fairbanks SUSTAINABLE VILLAGE

The University of Alaska Fairbanks (UAF) Sustainable Village is a living laboratory for students and researchers to learn about sustainable design, construction, and community planning. The project is a partnership between the Cold Climate Housing Research Center (CCHRC) and UAF to drive sustainable housing forward using student input. It started with four homes in 2012 and will grow with more homes and infrastructure in coming years.

Students worked with CCHRC to design the four, 1,600-square-foot homes, each with large south-facing decks, shed-style roofs, and big solar windows. Each has a super-insulated building envelope (R-50–60) with a unique combination of wall assembly, foundation, and heating and ventilation systems. This allows researchers to compare the energy performance and cost of various techniques.

Three homes use the REMOTE wall developed by CCHRC with 5.5 inches of batt insulation in the wall cavity and 8 inches of rigid foam outside the sheathing. The southwest home uses an Arctic Wall, with 5.5 inches of batt insulation in the wall cavity and a 12-inch standoff wall filled with densely packed cellulose insulation. The ventilated roofs contain 20 inches of cellulose and a continuous 2-inch air gap underneath the roof deck to keep the roof cold and dry.

The community was deliberately built on permafrost, permanently frozen ground, in order to test foundation techniques for these conditions. Two homes are built on standard piling foundations that isolate the heated home from the ground, a conventional method for building on permafrost. The other two have innovative “raft-style” foundations that rest directly on the ground, yet protect the permafrost from the heated building with a thick layer of polyurethane foam. CCHRC is studying the raft foundation as a lower-cost alternative to pilings.

Tamarack, one of four innovative prototype homes at the UAF Sustainable Village.

Several types of heating systems were incorporated at the Sustainable Village, including solar hydronic, propane, and diesel. Two homes used the BrHEAThe System, an integrated heating and ventilation system that consists of an efficient diesel heater that injects heat into incoming air after it has passed through the HRV (heat recovery ventilator). The BrHEAThe System ties together heating and fresh air in order to ensure healthy indoor air quality in tight homes.

Local and recycled materials were also incorporated as much as possible. Steel pilings were recycled from the North Slope, steel siding was reclaimed from old dredge pipe in Fairbanks, and trees from the building site were chipped to build walkways. Minimal site disturbance was emphasized during and after construction to preserve the natural environment.

CCHRC worked with students to monitor the homes’ performance for the first two years of occupancy–including fuel use, water use, electricity use, indoor air quality, and ground temperature. This report presents and discusses the data collected at the four homes from September 2012 to September 2014.


Sustainable Village residents for the Fall 2013 semester.

AVERAGE ANNUAL ENERGY USE DURING FIRST TWO YEARS OF OCCUPANCY

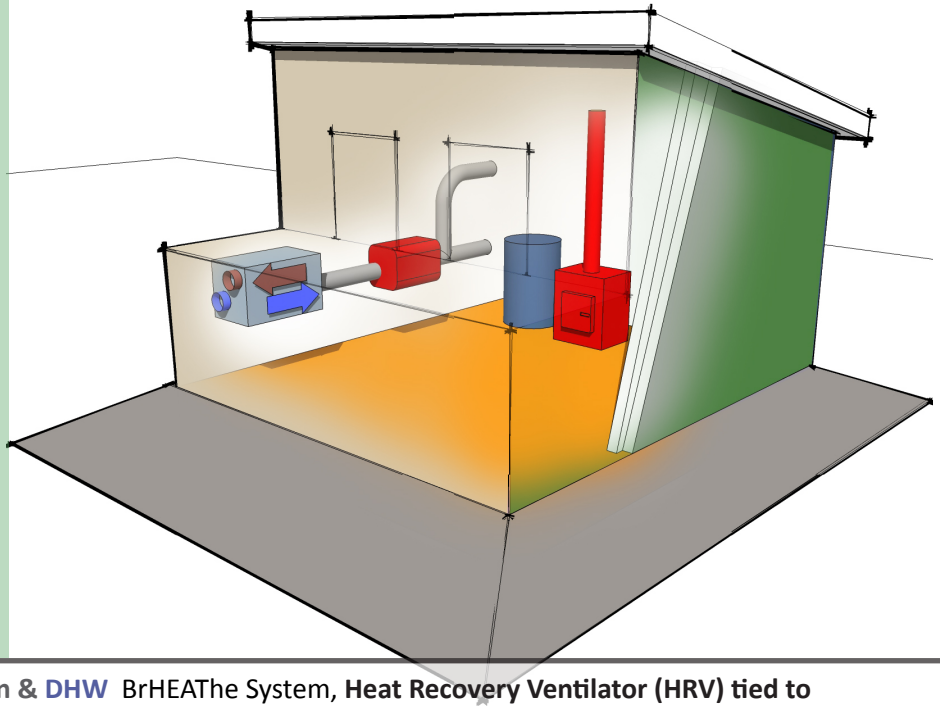
displayed in gallons of fuel oil equivalent for comparison between the four homes

NW: Birch House

323 gallons
ANNUAL HEATING
Energy Breakdown

	million BTUs	gallons of Fuel Oil #1 equivalent
Space &DHW	43	323
Space	39	295
domestic hot water	4	29

electric	7,534 kWh/year (628/month)
water	15,100 gallons/year (1,258/month)



Combined Space Heating, Ventilation & DHW BrHEAThe System, **Heat Recovery Ventilator (HRV) tied to 17,000-BTU diesel heater** | forced air distribution
Walls REMOTE R-51 **Foundation** Polyurethane Foam Raft R-60

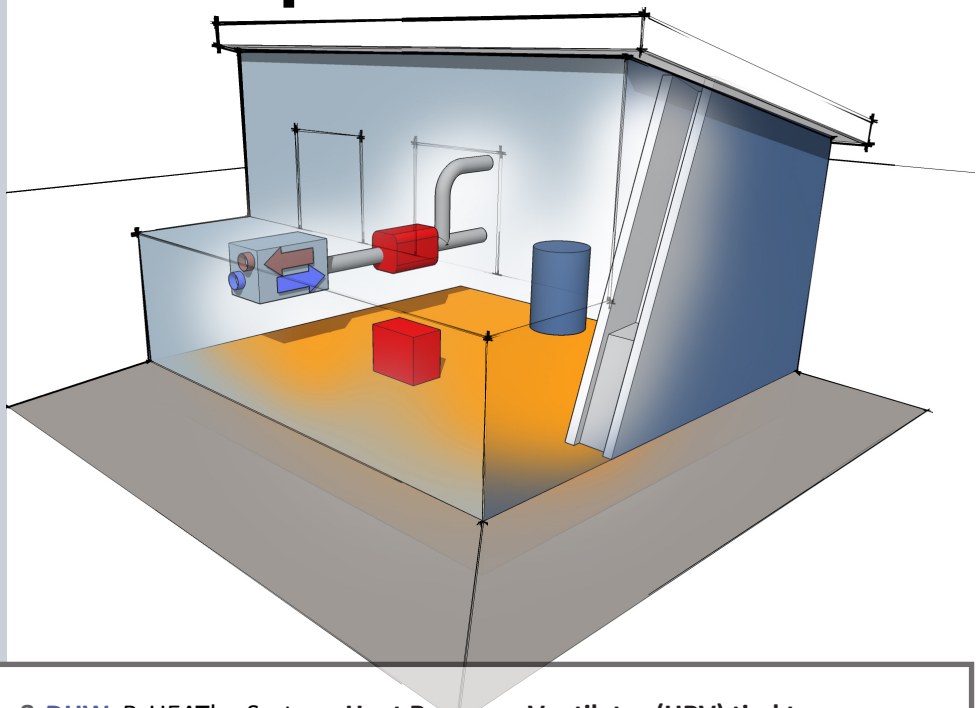
SW: Spruce House

463 gallons*
ANNUAL HEATING
Energy Breakdown

	million BTUs	gallons of Fuel Oil #1 equivalent
Space &DHW	61	463
Space	58	438
domestic hot water	3	25

electric	6,187 kWh/year (515/month)
water	16,850 gallons/year (1,650/month)

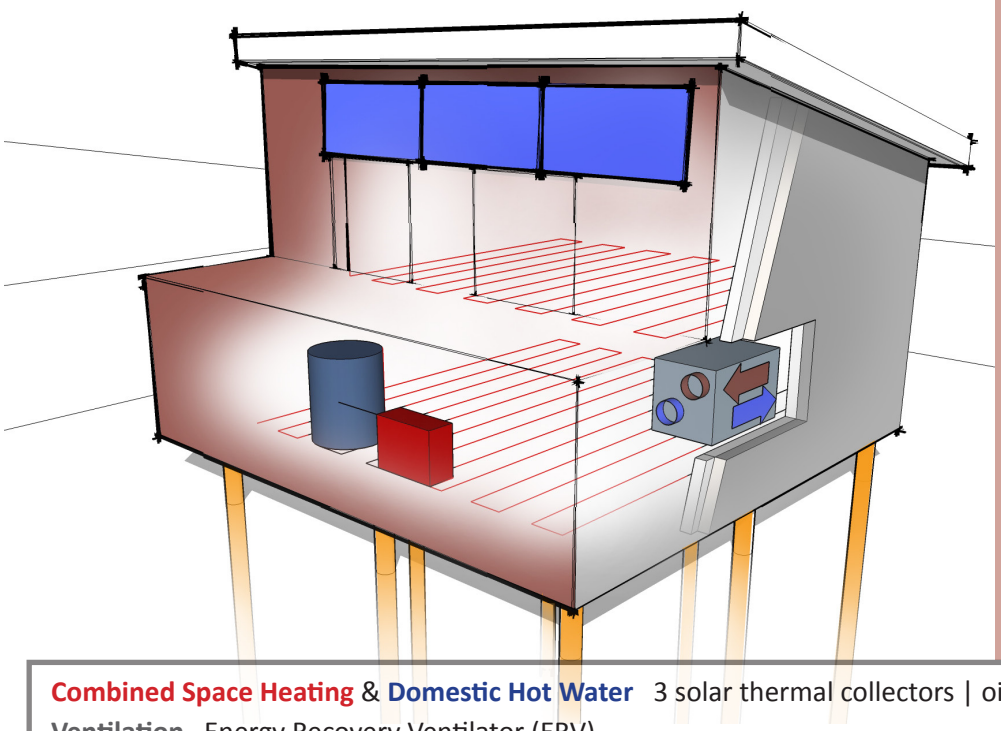
This table shows 2012-13 numbers, as 2013-14 data was not available



Combined Space Heating, Ventilation & DHW BrHEAThe System, **Heat Recovery Ventilator (HRV) tied to 17,000-BTU diesel heater** | forced air distribution
Walls double wall with cellulose insulation R-64 **Foundation** Polyurethane Foam Raft R-60

*Spruce house shows 2012-2013 data only as data collection was interrupted during 2013-2014.

NE: Tamarack House



371 gallons
ANNUAL HEATING

Energy Breakdown

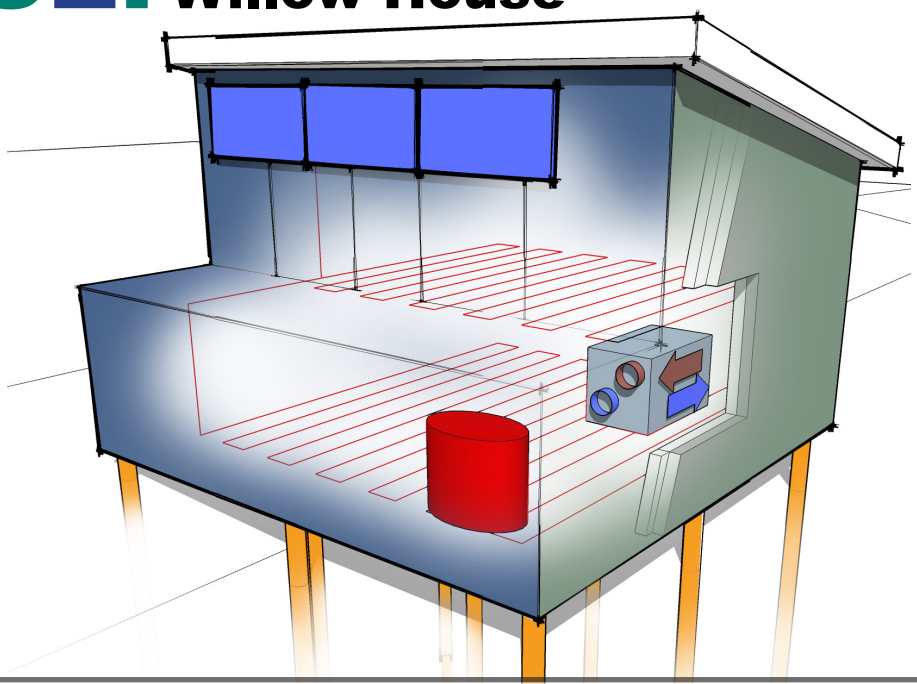
	million BTUs	gallons of Fuel Oil #1 equivalent
Space &DHW	50	371
Solar offset [1]	6	46
Oil boiler	50	325

electric	6,807 kWh (567/month)
water	12,550 gallons (1,046/month)

[1] Amount contributed by solar

Combined Space Heating & **Domestic Hot Water** 3 solar thermal collectors | oil boiler | radiant floor distribution
Ventilation Energy Recovery Ventilator (ERV)
Walls REMOTE R-51 **Foundation** driven steel pilings | R-60 polyurethane floor insulation

SE: Willow House



406 gallons
ANNUAL HEATING

Energy Breakdown

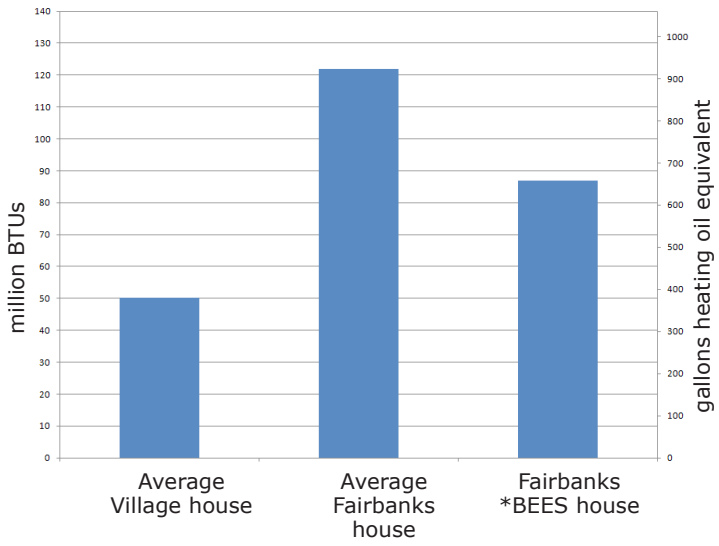
	million BTUs	gallons of Fuel Oil#1 equivalent
Space &DHW	54	406
Solar offset [2]	8	62
Propane Boiler	46	345

electric	5,503 kWh (459/month)
water	15,300 gallons (1,275/month)

[2] Amount contributed by solar

Combined Space Heating & **Domestic Hot Water** 3 solar thermal collectors | propane boiler | radiant floor distribution
Ventilation Heat Recovery Ventilator (HRV)
Walls REMOTE R-51 **Foundation** driven steel pilings | R-60 polyurethane floor insulation

Energy Use at the Sustainable Village



* includes both space heating and domestic hot water use

The average 1,600-square-foot house in Fairbanks uses the equivalent of 920 gallons of fuel oil for both space heating and domestic hot water, according to the Alaska Housing Finance Corporation's Alaska Retrofit Information System (ARIS) database. The average new house built to BEES standards (Alaska Building Energy Efficiency Standard) of the same size uses 660 gallons of fuel oil a year.

Comparison with an average house

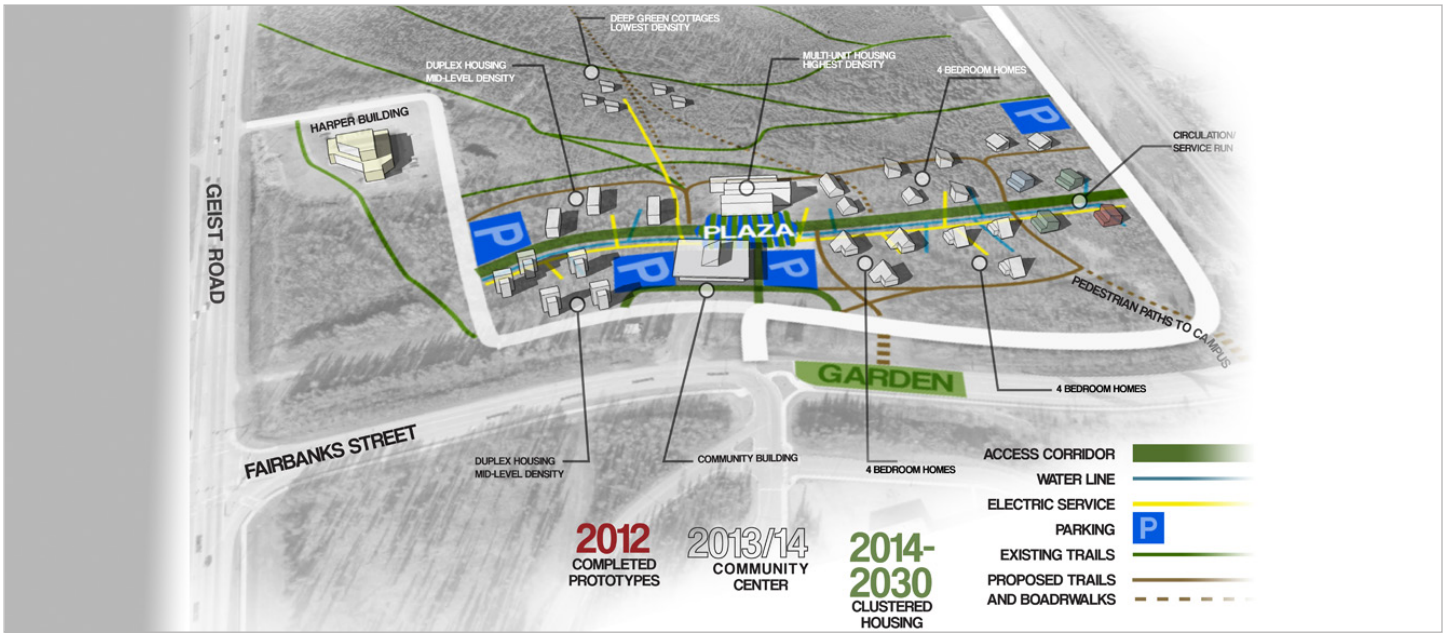
Over two years, the Village homes used half as much energy as the average new house in Fairbanks and 40% less than the average energy efficient home, demonstrating the importance of a good building envelope.

While each of the homes had roughly equal heating demand, there was a signicant difference in energy use between homes, in the same year and comparing the first and second year. For example, the Birch house used less than 280 gallons of heating oil the second year, 25% less than the previous year. And in Year Two, it used 40% less than the Spruce house. This can be attributed to weather, occupancy, the efficiency of different heating systems, and user behavior–for example, the number of showers, appliance use, and set point of the thermostat.

Construction costs were competitive with energy efficient building in the Interior – averaging about $185 per square foot including water and wastewater, electrical, and roads. This does not include land, which UAF already owned.

This first phase of the Sustainable Village is the beginning of a larger campus community, as shown in the plan below. Each buildout will test new innovations in building science and renewable energy, collect new data, and incorporate the students' vision for their community.

SUSTAINABLE VILLAGE FUTURE PLAN



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