Near Net Zero Energy Renovation — Idso Residence

Project Data:

Home Owners: Ivan & Mary Idso
Location: Rochester, MN
Style: 1890-Era Home
Size: 4 bd, 1,817 sq ft
Climate Zone: IECC 6
Completion: February 2017

Before

After

Goal:

"With our children grown, our goal was to build a home that we could live in the rest of our lives. We love our neighborhood and want to stay here, but to enjoy the benefits of a modern home. It needed to be sustainable, practical, low energy use, and to still fit into the neighborhood. We wanted to keep it small because we don't need a large home for the two of us, but when our family is home for the holidays we need room to accommodate large groups. We wanted everything essential on one floor with an attached garage and no step into the house…[And] we want to have as little a carbon footprint as possible."

Planning & Design

The design for the renovation incorporated both passive and active solar design. Separate heating sources were installed for the main and upper level, since the upper level with guest rooms is rarely occupied. A structured plumbing design was also incorporated, with the two bathrooms located above one another to keep hot water runs short.

Passive Solar

South-facing windows on the main floor are double pane to obtain heat gain in the winter. The remainder of windows are triple pane R-5 for maximum efficiency. Energy blinds and a thermal-absorbing floor helps retain heat in the winter. The roof overhang on the south-facing side blocks solar gain and prevents overheating in the summer.

Active Solar

Roof slope is optimized for best year-round solar production, so snow melts off. A 4.7KW solar PV system is installed with battery backup to power essential loads during outage.

Other

- Separate grey-water and black-water drains to enable future grey-water recycling system
- Power purchased from the grid uses Renewable Energy Credits (RECS) for 100% renewable energy use
- Durable, maintenance-free exterior includes metal roof and vinyl siding
- 220 volt AC power is wired to the garage for an electric vehicle
- Green roof concept is utilized on the overhang to minimize water runoff

Modeled Performance Data:

Annual Data

Estimated Energy Use:	**13,939** kWh
Actual Energy Use:	**13,200** kWh
Includes 1,950 kWh used for electric vehicle charging	
Actual Energy Produced:	**5,700** kWh
Net Energy Use:	**7,500** kWh
EUI	**14.78** kBtu/ft²
Total Energy Use:	**26** MMBtu

Other Data

HERS Index Score:	**27**
	(without PV) 45
Blower Door Results:	**0.93 ACH50**
	303 CFM50

EARTH FEST

Featured home at Rochester's EarthFest

Foundation

The original limestone foundation remains. Rather than trying to seal the old foundation, the basement became unconditioned space and was insulated and sealed around it with 7" open-cell foam insulation between the main floor and the basement for an R-value of 26.7. The addition consists of R-25 under slab foam insulation.

Thermal Barrier

10" double 2x4 wall R-30+ with thermal break. R-25 under slab. Unvented roof R-40+ with thermal break.

Open-cell spray foam throughout the majority of the attic with closed-cell spray foam along the peak of the roof.

Low VOC paint was used as the vapor barrier.

Heating & Cooling

The main floor uses radiant hydronic in-floor heat. The upper level uses baseboard electric heat. This enables flexibility with heat sources, since the upper level is rarely occupied. There is also an air-source heat pump on the main level as the sole cooling source for the home, that can also manage heating loads in off-peak seasons.

Water Heating

Making the switch from an electrical storage tank water heater to a hybrid heat pump lowered the estimated energy usage from 4,622 to 1,255 kwh/year. The energy monitoring system showed an actual usage of 480 kwh/year based on an average of three months.

Ventilation

An ERV exchanges air regularly while retaining the hot/cold air and moisture. The system is set to run at 20%, with a switch installed in the bathroom to run it for 20 minutes when showering to lower the humidity level.

Appliances

All electric appliances throughout the home, including an induction range. A ventless condensing clothes dryer is used, leaving one less penetration to the outside.

Energy Monitoring

An energy monitoring system is used to monitor electric usage and determine opportunities for improvement. The TED energy monitor measures data from the grid, backup panel, heating/cooling sources, domestic hot water, electric vehicle and induction range.

Key Features

Building Shell	
Foundation	R-25 under slab, R-10 edge R-26.7 over unconditioned basement
Walls	R-30+ 10" double 2x4 wall
Roof	R-40+ open-cell spray foam
Windows	South — Double pane U-Value: 0.3, SHGC: 0.5 Other — Triple pane R-5 U-Value: 0.2, SHGC: 0.25
Mechanical Systems	
Solar	4.7 kW solar PV 330 SF, 40 degree tilt 93% inverter efficiency
Heating & Cooling	Electric hydronic distribution 100% EFF Air-source heat pump 21 SEER, 12 HSPF
Water Heating	Rheem Hybrid DHW 3.69 EF, 50 Gal.
Ventilation	ERV, 130 cfm, 102 watts
Miscellaneous	
Lighting	100% LED
Appliances	All electric — Energy Star Induction range Ventless heat pump dryer
Energy Monitoring	TED energy monitor

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