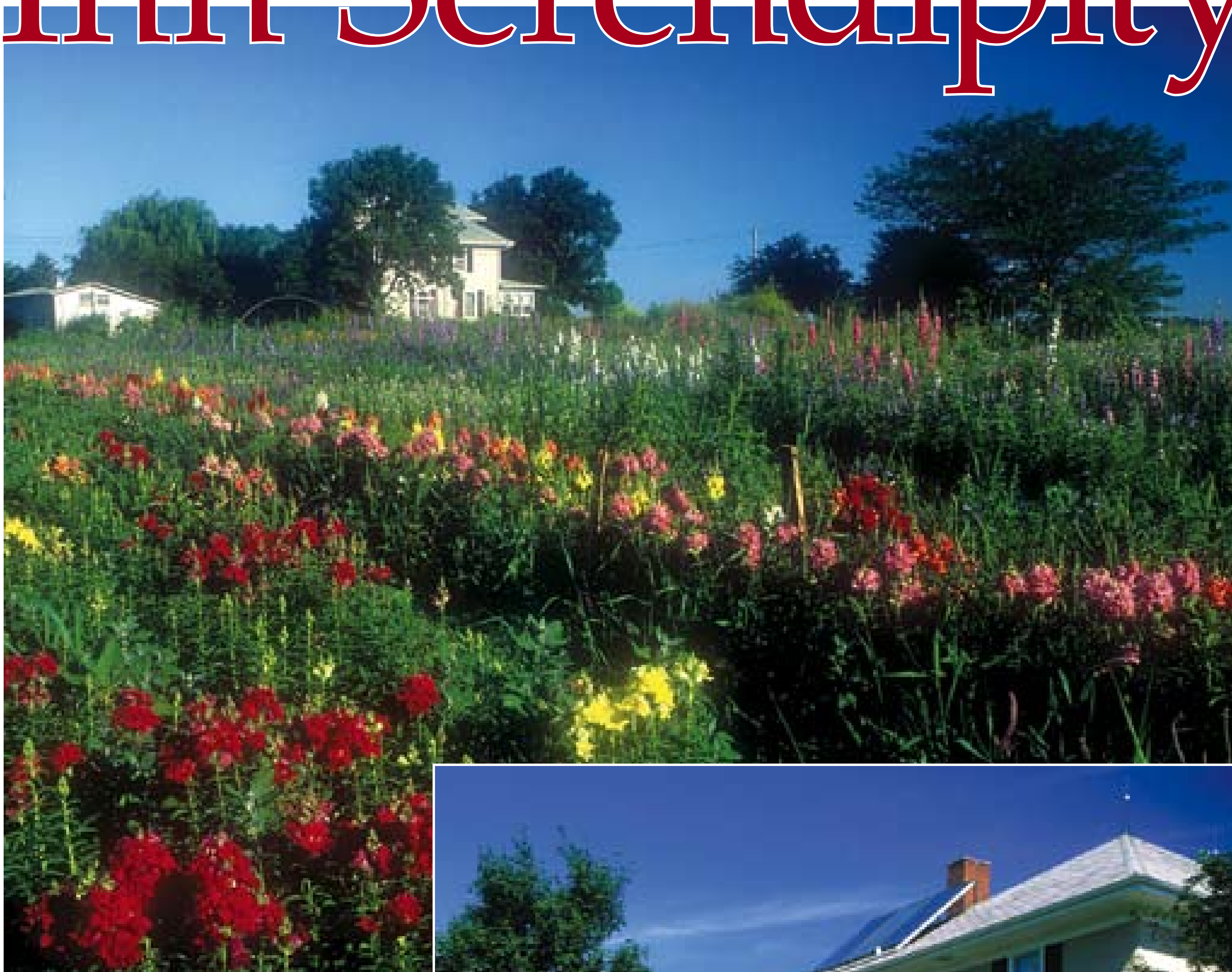
Inn Serendipity



Photos © John D. Ivanko

A business pursuit need not be motivated by "bigger is better," or always selling more products or services. Being successful can be based on generating enough revenue to cover your costs and leave you with enough profit to satisfy your needs, pay the property taxes, and for renewable energy enthusiasts like us, take some time off during the summer and attend an energy fair or two.

Sustainability as the Bottom Line

John Ivanko and Lisa Kivirist, with Phil and Judy Welty

We call it equilibrium economics. It's been our ticket to the good life while operating a portfolio of small businesses, including Inn Serendipity Bed and Breakfast and a marketing and creative services consulting company. Both are operated from our five-and-a-half-acre farm located in southwestern Wisconsin.

When it comes to energy, the more we can conserve, use more efficiently, or generate ourselves, the better our bottom line. We strive to avoid waste in our bed and breakfast kitchen and in our home-office, and we explore ways to use readily available renewable energy (RE) resources—sunlight, wind, and locally abundant wood. Our goals are to be fossil-fuel free and produce net zero emissions when combined with other carbon-dioxide sequestering activities, like planting trees.

We're not reading by kerosene lamps or hand-cranking our telephone. Our home office has enough computer power to scan and store John's professional photos, prepare a book manuscript, and complete a marketing plan. The two-room bed and breakfast has most of the amenities you'd expect in an 80-year-old, 1,969 square foot (183 m^2) farmhouse turned hospitality business, like a bedside clock and lamp—and hot showers.

In both our home-based business and lifestyle, energy conservation and the addition of energy-efficient appliances were among the many steps we took before moving into generating our own electricity. We purchased a Sun Frost refrigerator, Maytag Neptune front-loading washer (we line dry laundry), and several other Energy Star appliances. Our KitchenAid convection oven saves electricity by reducing cooking times. Phantom loads are eliminated with switched power strips. An old vertical freezer was replaced by a Frigidaire chest unit and placed in the cool northeast corner of the basement, rather than adjacent to the oven in the kitchen where it had been previously.

Photo © Mick Sagrillo

View of the Inn Serendipity farmstead from atop the 120 foot, guyed, lattice tower for the 10 KW Bergey wind turbine.

Interconnected RE Systems

Nature is our model. It guides us in our organic kitchen gardens, from which we harvest about seventy percent of our food. It illuminates our pathway toward more self-reliant and ecologically mindful living. Our decisions related to employing renewable energy systems were no different. All our RE systems were added incrementally, as budgets permitted. The evolution of the once fossil-fuel-based farm to an organic, sun and wind powered Inn Serendipity homestead is explained in our book, *Rural Renaissance: Renewing the Quest for the Good Life.*

Our first entry into renewable energy systems, paralleling our energy conservation efforts, was to add a solar thermal system for domestic hot water, and two years later, a woodstove for heat in the winter. Next we developed a grid-intertied hybrid renewable energy system using both solar and wind electricity generation, which lets us produce all of our electricity on an annual basis. Excess electricity generated, coming as a credit from our utility, is used to offset summer electricity use and anticipated maintenance costs for the entire hybrid RE system.

To become eco-effective, our frugal lifestyle needs to complement our goals to generate more electricity than we use in our all-electric home and business. Our electricity use was reduced about 40 percent from that of the previous owners, now averaging about 8,500 KWH per year for home, business, and farm. Soon we'll be exploring ways to achieve net zero

The solar thermal system for Inn Serendipity's straw bale greenhouse, with dairy barn in background, now home to two llamas.

Photo © John D. Ivanko

emissions with our car and other transportation. Our ten second walking commute to our office on the second floor was our first step.

Capturing Heat from Sunlight

Recognizing that 10 to 15 percent of an average home's energy use goes toward heating water, we added a domestic solar hot water system. Three, 4 by 8 foot (1.2 x 2.4 m) flat-plate American Solar King collectors were installed on our south-facing roof at about a 45 degree angle, optimized for spring and fall solar gain. Our collectors, like so many of our other systems, are experiencing a second life. They had previously been installed on the Packerland meat processing facility in Green Bay, Wisconsin. We're proponents of the reuse and recondition economy.

Nontoxic propylene glycol is used in our closed-loop active solar thermal system. A Heliotrope DTT-84 differential temperature controller senses when the collector fluid is hotter than the water in the basement storage tank. A super-efficient Grundfos 1/12 hp pump circulates the fluid through a Quad Rod heat exchanger where the heat is transferred to our domestic water.

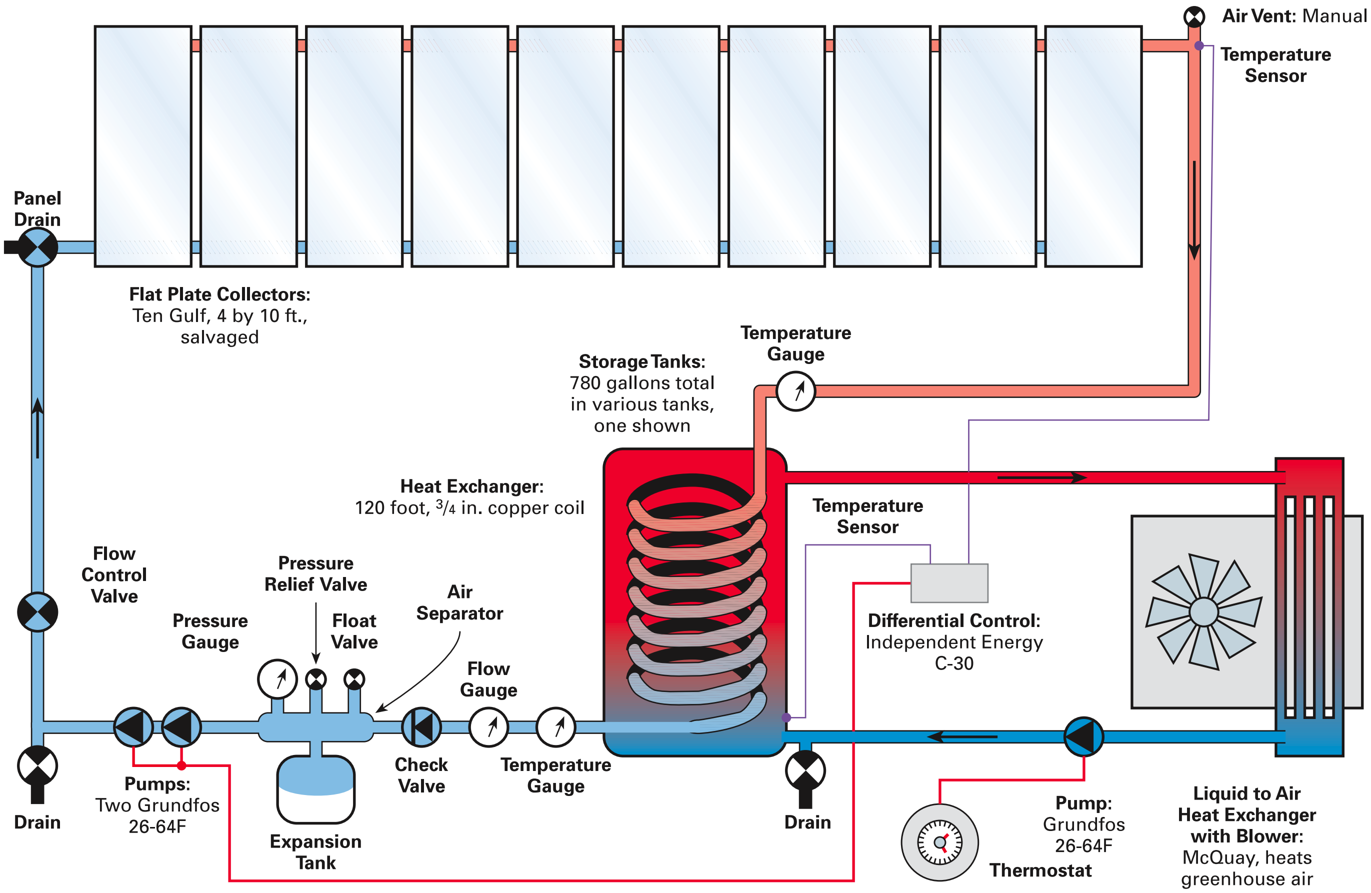
The hot water is stored in a standard 80 gallon (300 l) Rheem water tank that is connected to our existing 65 gallon (250 l) electric water heater tank. Had we to do it over, we would have mounted the collectors on the ground for easier installation and winter access (to brush off snow).

Thermal Systems Costs

SDHW System	Cost (US$)
Hired labor	$928
3 Solar King collectors, 4 x 8 ft. (used)	750
Misc. plumbing	396
Copper pipe, 3/4 in., 100 ft.	360
Quad Rod heat exchanger	287
Mount for collectors	225
Grundfos circulation pump, 1/12 hp	187
Freight	187
Water tank, 80 gal.	128
Heliotrope DTT-84 controller	117
Sales tax	113
Extrol #30 expansion tank	91
Total SDHW System	$3,769

Wood Heating System	
Chimney system	$994
Lopi Endeavor woodstove	900
Terra Green recycled glass tiles	66
Hired labor	1,352
Total Wood Heating System	$3,312

Greenhouse Solar Heating & Hot Water System



Thermal Costs, cont.

Greenhouse Solar Heating System*	Cost (US$)
10 Gulf solar collectors, 4 x 10 ft. (used)	$5,475
Misc. plumbing, insulation, etc.	901
Desert Sun fiberglass tank, 700 gal.	855
10 Gulf mounting frames	650
Heat recovery ventilation system	380
2 Grundfos 26-64F pumps	360
Blower	345
McQuay heat exchanger, 20 x 19 in.	315
10 Posts, 4 x 4 in, 12 feet	180
Glycol antifreeze, 20 gal.	180
Independent Energy C-30 control	143
Heat exchanger (for hot tub)	140
Storage tank, 82 gal.	128
Solar tank, 250 gal. (hot tub)	115
Thermostat (for storage tank)	105
March pump	104
Circulating pump (for hot tub)	100
Controller (for hot tub)	49
Flow indicator	42
Expansion tank	36
Phase change salts storage	33
Total Solar Heating	$10,634
Total Heating Systems Costs	$17,716

Owner/Volunteer Labor Estimates	
Solar heating system	$8,400
SDHW system	495
Wood heating system	150
Total Installation Labor Estimates	$9,045
Total Costs with Labor	$26,761

Rebates & Grants	
Alliant Energy Corp. (utility)	-$3,000
Grand Total	$23,761

* Items mostly from old, reused system; costs estimated & adjusted to present-day amounts.

The solar thermal system for the 1,200 square foot (111 m^2) greenhouse, designed by our neighbors Phil and Judy Welty, collects heat with ten, 4 foot by 10 foot (1.2 x 3 m) Gulf collectors, also reused from previously dismantled systems. The greenhouse itself is a renovated corncrib and granary, with two-thirds of the structure using straw bales as insulation material surrounded by more than 2 inches (5 cm) of stucco.

The heated glycol solution is pumped through underground insulated piping into a heat exchanging coil of 120 feet (37 m) of 3/4 inch copper piping. This allows the heat to be transferred and stored in 780 gallons (2,950 l) of water in several fiberglass tanks inside the greenhouse. The stored heat is then transferred to the air inside the greenhouse through a McQuay liquid-to-air heat exchanger.

In the middle of the winter, with the collectors angled at about 52 degrees for optimal solar gain, about 240,000 BTUs can be collected each sunny day. So when it's a frigid but sunny 10°F (-12°C) outside, the collectors will heat up the water tanks inside to more than 90°F (32°C). The goal and on-going experiment with the greenhouse is to have a net zero heating cost by using both passive and active solar thermal systems, passive solar design, and the super-insulating qualities of straw bale walls. As much as 45 percent of the annual operation cost in traditional greenhouses is associated with heating. Successfully growing with net zero heating cost means more profit per vegetable or fruit crop sold.

Solar Electricity

Generating electricity using renewable energy for our home and business came in two phases—sun and wind. First, we installed a 480 watt PV system, estimated to generate about 500 KWH per year. Four, 120 watt Kyocera PV panels were mounted on a UniRac fixed rack that we attached to the south-facing wall of an existing equipment shed. The tilt angle of the rack is adjusted four times a year, roughly midway between the equinoxes and solstices.

Installation crew for the 480 watt PV system that was part of the Midwest Renewable Energy Association's educational workshop.

Photo © John D. Ivanko

The PV system was a part of an installation workshop with the Midwest Renewable Energy Association (MREA). Students ran a short DC line through the wall into an Advanced Energy, Inc., 1,000 watt inverter, and tied it into the nearest breaker box in the equipment shed. We sized our inverter to allow us to expand our system to include additional modules.

Wind Electricity

Sitting high on the ridge where we can see for many unobstructed miles in every direction, our farm is well positioned for electricity generation with a wind turbine. A partially state-funded site assessment was completed by Mick Sagrillo of Sagrillo Power and Light. He estimated that a 10 KW Bergey Excel-S system, with our annual wind speed of 13 mph (5.8 m/s) at the tower height of 120 feet (37 m), would generate about 1,130 KWH per month, or 13,560 KWH per year.

Our last, and most significant, investment in renewable energy generation was completed in May 2003 when we added this turbine, also as an MREA educational workshop. Lake Michigan Wind and Sun rebuilt a used Bergey that we had purchased, with any parts most likely to wear out replaced with new ones.

Our public utility, Alliant Energy, required a simple contract, certificate of liability insurance in excess of

PV System Tech Specs

System Overview

System type: Batteryless grid-intertied PV

Location: Browntown, Wisconsin

Solar resource: 4.5 average daily peak sun hours

Production: 44 AC KWH per month average estimated

Utility electricity offset by PV system: 6 percent

Photovoltaics

PV: Four Kyocera KC-120, 120 W STC, 12 VDC

Array: 480 W STC, 48 VDC

Array combiner box: Inverter integrated, 10 A series fuse

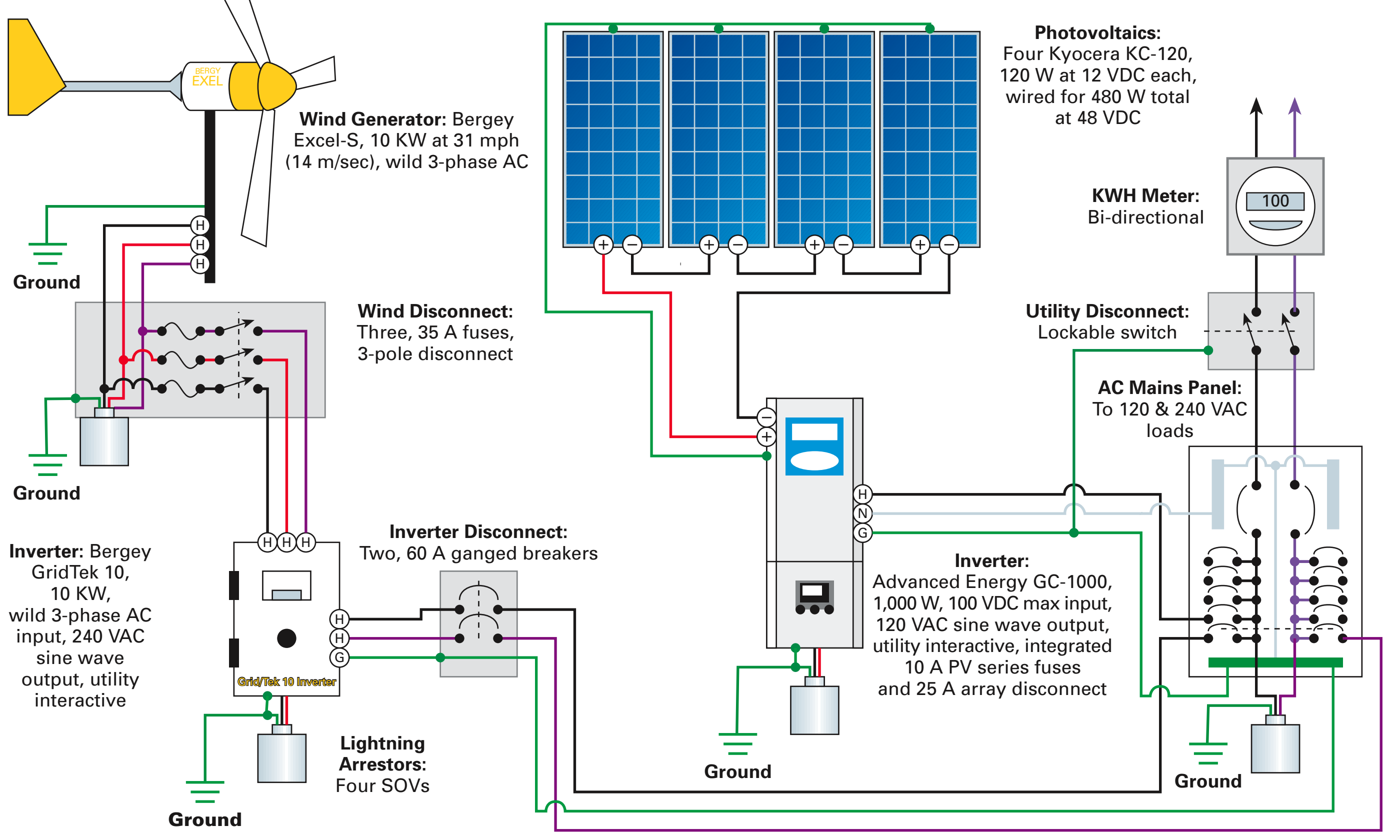
Array disconnect: Inverter integrated, 25 A

Array installation: Wall-mounted UniRac SolarMount, oriented true south; adjustable tilt angle

Balance of System

Inverter: Advanced Energy, Inc. GC-1000, 100 VDC maximum input, 120 VAC output, 52–92 VDC MPPT window

Solar & Wind System



Note: All numbers are rated, manufacturers' specifications, or nominal unless otherwise specified.

Wind System Tech Specs

System Overview

System type: Grid-tied, batteryless wind

Wind resource: 13 mph (5.8 m/s) annual average

Production: 7,049 KWH for first year

Utility electricity offset: Projected in excess of 100 percent

Wind turbine: Bergey (BWC) Excel-S

Rotor diameter: 23 feet (7 meters)

Energy output: 900 AC KWH at 12 mph (5.4 m/s) average per month (grid-tied)

Power output: 10 KW @ 31 mph (14 m/s) peak

Tower: 120 foot (37 m) Rohn, guyed, lattice

Balance of System

Inverter: Excel-S GridTek 10 Power Processor, wild 3-phase AC input, 240 VAC output

System performance metering: AC KWH meter and integrated inverter LCD display

US$300,000, equipment specification sheets, and a lockable external AC disconnect for the project. The only unanticipated aspect of the system came with the computations contained in our first "credit" electric bill in December 2003. While we have a bi-directional meter, we are only able to "bank" (and get a credit for) our excess generation at Alliant Energy's retail rate, not the "green energy" rate, due to the way green energy is purchased by our utility.

Photo © John D. Ivanko

Inn Serendipity's grid-intertied, hybrid electric system features a 10 KW Bergey wind turbine on a guyed, lattice tower.

The MREA installation class in front of the 10 KW Bergey turbine and tower prior to being raised.

Photo © John D. Ivanko

Heating with a Woodstove

We don't mind getting snowed in with our Lopi Endeavor woodstove ablaze, using dry, seasoned, hardwoods that are readily available locally. We can snuggle self-sufficiently around the stove, strategically placed between our kitchen and front room. By using this efficient, high-tech, noncatalytic woodstove, our winter heating bill plummeted, conversations around the hearth mushroomed, reliance on fuel oil largely disappeared, and environmental impacts lessened.

According to the Midwest Renewable Energy Association, the cycle of burning wood and regrowth of trees produces no net increase in carbon dioxide to the atmosphere. We make sure our tree planting efforts more than replace the trees that we end up burning.

The Lopi stove is among the cleanest burning large stoves ever tested, in part because of the use of fire brick and baffles, which ensure that the gases are burned in the

Electrical System Costs

Wind Turbine System & Workshop	Cost (US$)
Bergey Excel-S 10 KW wind genny, lattice tower, & GridTek 10 inverter (used or rebuilt)	$23,000
Excavation	1,668
Sales tax	1,348
Utility service upgrades	1,324
Tower wiring kit	950
MREA workshop costs	716
Shipping	566
Wire run to tower	485
Permits	438
Crane rental	422
Misc. hardware	158
Total Wind System Costs	$31,075

PV System	
4 Kyocera PV modules, 120 W	$2,680
AE, Inc. GC-1000 Inverter	1,785
Misc. electrical (wire, etc.)	326
UniRac U-LP/106 PV rack	250
Sales tax	244
Freight	142
Misc. hardware	55
PV wiring	45
Total PV System Costs	$5,527
Total Electrical System Costs	$36,602

Owner/Volunteer Labor Estimates	
Wind system	$8,390
PV system	2,825
Total Installation Labor Estimates	$11,215
Total Costs with Labor	$47,817

Rebates & Grants	
WI Focus on Energy (wind system)	-$15,595
WisconSUN (PV system)	-3,000
WI Focus on Energy (PV system)	-536
Total Rebates & Grants	-$19,131
Grand Total	$28,686

combustion chamber. The combustion air is preheated along the sides of the firebox, and the five-sided convection chamber surrounding the firebox draws in cool room air, circulates it around the outside of the firebox, and returns heated air to the room.

The new woodstove models have up to 75 percent fewer emissions according to the EPA, which implemented woodstove standards in 1990. In contrast, an open fireplace sends up to 80 percent of a fire's heat up the chimney and significantly contributes to air pollution because of incomplete combustion of gases. The key to burning wood cleanly is burning all the gases that the wood releases. These are not only dangerous if left unburned, but contain more than 50 percent of the available energy. The gases burn only at temperatures in excess of 1,100°F (593°C), which can rarely be achieved other than through modern, airtight woodstoves.

Passive Solar Redesign & Daylighting

Passive solar features capture the heat of the sun entering our house. Daylighting allows sunlight to naturally light a space or room, and reduces the need for electric lighting. We employed daylighting when remodeling our attic, and used passive solar design as much as possible in the greenhouse. Our attic remodel involved the addition of a south-facing dormer with low-emissivity (low-E), gas-filled, double-pane Andersen windows. Overhangs above the attic windows help shade them from the hot summer sun.

In the greenhouse, extra thermal mass in the concrete slab floors, a 250 gallon (950 l) water tank, a phase-change salt tube, and water-filled Sun-Lite thermal storage tubes,

Energy Independence & Community Interdependence

We're not tinkerers. Nor are we financially independent. Our systems were selected based upon their reliability, affordability, and the recommendations from the "hired hands" who made our renewable energy journey possible. We chose some of the seasoned and experienced designers, consultants, and dealers that served our state.

Our success in employing the RE systems would not have been possible without these experienced guides, plus numerous neighbors pitching in with a tractor or construction expertise, and MREA's installation workshops. Various statewide funding programs helped us to the tune of US$19,131. In our quest for energy independence, we rediscovered social and community interdependence.

each in their own way, absorb and store extra heat, which slowly radiates at night.

Sun-Lite thermal storage tubes, made from fiberglass-reinforced polyester, resemble cylindrical fish tanks. They, like the phase-change salts, passively collect and store heat, which is then slowly released at night. The 250 gallon (950 l) open water tank takes advantage of the same passive heat-capturing opportunity, doubling as our hot tub. The water for the hot tub is made safe by an ultraviolet light placed next to the transparent filter canister.

Being Part of the Solution

Adding renewable energy systems goes beyond saving energy and reducing our ecological footprint. These are some of the many advantages.

Direct energy savings. Our hybrid wind and solar-electric system should offset about US$1,000 in electricity bills paid each year.

Tax credits and accelerated depreciation (for businesses only). Cash in on the federal renewable energy tax credit of US$0.018 per KWH generated for wind, or 10 percent tax credit for solar energy equipment. You can also accelerate the amortization for the system with the federal modified accelerated cost recovery system (MACRS; Section 169 of the Internal Revenue Code). Consult your tax advisor for the latest information.

Magnet for visitors and a competitive advantage. We are one of the few bed and breakfasts in the world powered by renewable energy—guests choose us over other lodging options because of our concern for the environment.

Free advertising. In nearly every significant renewable energy system addition (wind turbine, PV system, straw bale greenhouse, and solar thermal systems), we found an interested and engaged media, eager to report on our sustainable living methods.

Operating cleaner and greener. Our decision to use renewables was more than about the economics of energy, since reducing carbon dioxide, nitrous oxide, and mercury emissions and achieving greater energy self-reliance were just as important. It's a matter of operating our business as responsibly as possible, given financial limitations.

Economics and the environment do go hand-in-hand. It comes down to our understanding that the health of our community and success of our business is connected in much the same way as our physical health is based on what we eat and drink. In striving for a more ecologically responsible model of conducting our business that sustains

An old granary and corncrib was reconstructed as a straw-bale-insulated greenhouse with the help of neighbors, friends, and installation workshops by the Midwest Renewable Energy Association.

Photos © John D. Ivanko

Photo © Jason Perry

Wind and sun farmers Lisa Kivirist and John Ivanko with their son, Liam, next to the perennial flower bed at Inn Serendipity Bed and Breakfast.

us and provides our livelihood, we discovered how to harness renewable energy and greater profits for our business.

Access

John Ivanko and Lisa Kivirist, Inn Serendipity Bed & Breakfast, 7843 County P, Browntown, WI 53522 • 608-329-7056 • info@innserendipity.com • www.innserendipity.com

Rural Renaissance: Renewing the Quest for the Good Life, John Ivanko and Lisa Kivirist, 2004, ISBN 0-86571-504-1, 304 pages, US$22.95 from New Society Publishers, PO Box 189 Gabriola Island, BC V0R 1X0 Canada • 800-567-6772 or 250-247-9737 • Fax: 250-247-7471 • info@newsociety.com • www.newsociety.com

Rural Renaissance Network (RRN), PO Box 811, Monroe, WI 53566 • www.ruralrenaissance.org • Nonprofit program of Renewing the Countryside, supporting sustainable living and livelihood in rural communities

Mick Sagrillo, Sagrillo Power & Light, E3971 Bluebird Rd., Forestville, WI 54213 • 920-837-7523 • msagrillo@itol.com • MREA wind workshop instructor

John Hippensteel, Lake Michigan Wind & Sun, 1015 County Rd. U, Sturgeon Bay, WI 54235 • 920-743-0456 • Fax: 920-743-0466 • info@windandsun.com • www.windandsun.com • Wind turbine supplier

Bob Ramlow, Artha Renewables, 9784 County Rd. K, Amherst, WI 54406 • artha@wi-net.com • Solar thermal consultant

Chris LaForge, Great Northern Solar, 77480 Evergreen Rd. Suite #1, Port Wing, WI 54865 • Phone/Fax: 715-744-3374 • gosolar@cheqnet.net • MREA PV workshop instructor

Chris and Ken Hulet, Engineering Services Co., 21025 Hwy. 78, Blanchardville, WI 53516 • 877-417-4610 or 608-523-3726 • Fax: 608-523-3727 • esco@revolutionearth.com • www.revolutionearth.com • Consultation and PV equipment

Matt Sterling, Native Earth Construction, c/o MREA, 7558 Deer Rd., Custer, WI 54423 • Straw bale builder and MREA straw bale workshop instructor

Database of State Incentives for Renewable Energy (DSIRE) • www.dsireusa.org

Midwest Renewable Energy Association (MREA), 7558 Deer Rd., Custer, WI 54423 • 715-592-6595 • Fax: 715-592-6596 • info@the-mrea.org • www.the-mrea.org • RE fair and workshops

Andersen Windows, Inc., 100 Fourth Ave. N., Bayport, MN 55003 • 800-426-7691 or 651-264-5150 • Fax: 651-264-5279 • commercialgroup@andersenwindows.com • www.andersenwindows.com • Efficient windows

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Solar Components Corp., 121 Valley St., Manchester NH 03103 • 603-668-8186 • Fax: 603-668-1783 • solarcomponents@yahoo.com • www.solar-components.com • Sun-Lite thermal storage tubes