# Solar 2002 Conference: Abundance Ecovillage
# Care of the Earth, Care of the People, Share the Surplus

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ABSTRACT

Abundance Ecovillage is a housing development in Fairfield, Iowa where energy, waste treatment, water, and food production are provided on site. Energy needs are met by solar and wind; water is supplied by rainwater catchment; wastes and nutrients are recycled and treated as resources; local forests provide building materials; the landscape is full of edible and useful plants; annual vegetable production and perennial fruit production are integrated into the project. This paper describes the organization, design, and initial stages of construction of the project. In addition to modern environmental and ecological design (permaculture, for example), we have used the ancient design system of Maharishi Sthapatya Ved for layout of the project and placement, orientation, and proportion of the homes on the land. The project is under construction and will eventually consist of 21 single-family homes and 3 multifamily structures with 3 units in each.

## 1. INTRODUCTION

If you have an ethic for living your life that involves care of the earth, what can you do to live in harmony with this ethic in a conventional subdivision in the USA? Well, you can select the right brand of toilet paper, buy recycled paper for your printer, and separate your trash. You can agonize about buying the politically correct laundry and dish soap. And, in most places these days, you can choose paper or plastic. But where does your water come from, where does your electricity come from, where does your food come from, and how is it grown? What happens when you flush the toilet? Where do the building materials come from for the places you inhabit? In conventional subdivisions, the systems that provide these services are often grossly out of tune with an ethic that involves care of the earth.

Electricity is a good example. Despite all the publicity about "green electricity" programs by electric utilities, the fact remains that 95-99% of most utility energy and capacity requirements are met by fossil fuels (natural gas, coal, oil) or nuclear power.[1] Worse yet, the fuels are used in a thermodynamic cycle, delivered in a transmission system, and used in inefficient appliances that, in the case of electricity delivered to an incandescent light bulb, throws away 95 to 97% of the energy in the fuel as waste and delivers only 3-5% as useful light.[2] The practical choices available for most people in the US mean that perhaps 95% of life is lived out of tune with an ethic for the earth. In addition, the money spent on these services goes to perpetuate their delivery. Often more money goes

to produce undesirable side effects than the desired product or service, as demonstrated in the example for electricity above.

Abundance Ecovillage is an attempt to turn this ratio around, and to take the money that people are already spending for energy, water, food, and housing and use it to provide services that are in tune with an ethic of care for the earth and are economic at the same time. (There is a pervasive idea in the USA that economy and care for the earth must be mutually exclusive goals. This idea is rapidly being shown to be false, and there are now many examples where the opposite is true.[3])

## 2. PROJECT OVERVIEW AND ORGANIZATION

### 2.1 Site Description and Resources

Abundance Ecovillage is located in Fairfield, Iowa. Fairfield is located in Southeast Iowa in Jefferson County. The project is within one mile of a university (Maharishi University of Management) and two miles of the city center. Fairfield is a town of 13,000 and home to Maharishi University of Management and the center in the US for Transcendental Meditation. It is located at 41 degrees north latitude, 92 degrees west longitude. Below are some statistics about the climate and site.

TABLE 1: ECOVILLAGE STATISTICS

Acres of land: 15 (6 hectares)
Avg annual rainfall: 35 in (89 cm)
Ann gal of rainfall: 15,000,000 gal (56,000,000 l)
Heating degree-days: 6000 (base 65 deg F)
Cooling degree-days: 583 (base 65 deg F)
Avg max summer temp: 84 deg F (28 deg C)
Avg max summer humidity: 72%
Avg minimum winter temperature: -13 deg C
Avg last frost date in spring: May 10
Avg first frost date in winter: Oct 10

The site is a 15-acre rectangle measuring 600 feet north to south and 1200 feet east to west. Building lots are 4900 square feet, with most of the rest of land dedicated to common amenities. Amenities include a common building, common greenhouse and garden space, ponds, orchards, vineyards, and a hostel. An aerial photo and site plan are shown below. We are using Village Homes in Davis, California as a model for the density, look, and feel of this project.[4]

Fig. 1: Ecovillage aerial view

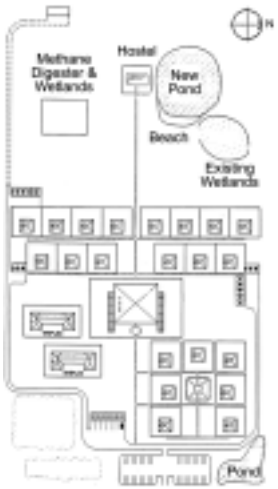


Fig. 2: Ecovillage Plan and Contours (1 ft)

### 2.2 Project Structure and Organization

The project has three individuals as partners, one of whom is a builder (his company is building the houses), one a licensed professional engineer, and the other a biologist. The project is organized as a corporation, which owns all the land and common facilities. Homeowners receive long-term (275 year) leases on their building lots.

## 3. SYSTEMS DESIGN OVERVIEW

Solar and wind generated electricity, two qualities of water, and sewer services are provided to each lot. The project is broken down into blocks of 6 to 8 homes, which we call a neighborhood. Each neighborhood has its own solar and wind generation, battery storage, and inverter. Each neighborhood has a 50,000-gallon underground tank for storing water from rooftops. This modular design allows utilities to be built as the project develops, rather than all at the beginning. Sewer and low-grade water systems are provided for the entire project rather than per neighborhood.

Agriculture is an important part of the project. 85 percent of the food eaten in Iowa comes from somewhere else,

and we feel that it is important from an environmental, economic, and cultural standpoint to grow food locally.[5] Useful and edible plants are widely planted. There is a common greenhouse space, and we are helping to establish two independent agriculture related businesses by providing land and greenhouse space and a market for plants and food. The first business is a permaculture plant nursery for the Midwest; the second business is a market garden.

For home design, an integrated, high performance design approach is being used. All the partners have attended Energy 10 training. All homes are heavily insulated, use the appropriate glazing for each façade, and use earth tubes to temper incoming air in summer and winter. Two houses have been built so far and another is under construction. We have the additional design constraint of Maharishi Sthapatya Ved, which is an ancient system for determining the orientation and placement of buildings that has been recently revived by Maharishi Mahesh Yogi. Each system will be briefly described next.

## 3.1 Energy

### 3.1.1 Energy Use and Metering

A key element in making utilities affordable is to use energy and water wisely. This does not mean doing without services. Using energy wisely means careful attention to design and the efficiency of systems, technologies and appliances. Each home has a maximum monthly energy budget of 250 kWh, and we are designing each home to use about 100 kWH per month for lighting, refrigeration, electronics, appliances, and HVAC.[6] A typical energy budget for 120 kWh per month is shown below.

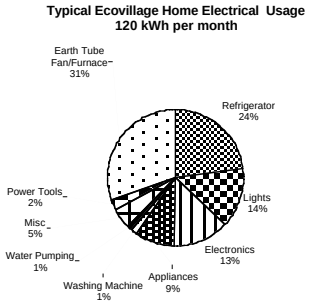


Fig. 4: Typical Ecovillage home electrical energy use

As you can see from the chart, the largest energy users are refrigeration, lighting, and HVAC. Energy use guidelines have been developed that help homeowners select appliances and systems for their homes. These guidelines recommend things like daylighting, high efficiency compact fluorescent and LED lighting, laptop computers, horizontal axis washing machines, earth tube cooling, and control of phantom loads. The net result is that the same or better services as used in a conventional home are delivered with 1/4 to 1/10 of the energy use. We have also been careful in the design of the common water pumping and sewage systems, using the most efficient pump technology available and gravity feed solutions whenever possible.

Homes have energy and power metering for both the individual home and for each cluster, with a display in a prominent place in each home. In a situation like this, where energy systems are shared and some homeowners may be better educated and careful about energy consumption than others, there is always the possibility that someone will use more than their share of energy. We handle energy sharing like this: If monthly electric usage of each home in a neighborhood is within 10% of the other homes, then the costs for backup power (from a biodiesel powered generator) are shared equally. Otherwise, the largest user pays for fuel that month. It is estimated that biodiesel fuel will cost $4.00 per gallon. We will also spend a lot of time with new families in the first few months as they learn about energy efficiency and the use of solar and wind generated electricity. Our experience with dozens of solar and wind powered homes in Fairfield over the last 10 years indicates that the biodiesel back up option will be required less than 3% of the year.

### 3.1.2 Energy Resources

Southeast Iowa has abundant solar and wind power resources, and the complimentary nature of the two together provide a reliable power supply. Below is a chart showing the relative amount of energy available from each source per month, averaged over a 20-year period.

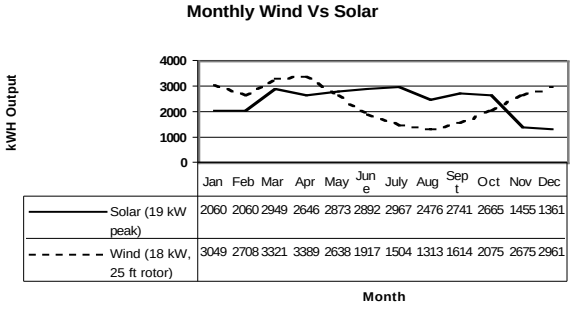


Fig. 5: Monthly solar and wind, Fairfield, Iowa[7]
(For the purposes of this chart, the solar array is sized to match annual output of wind generator.)

As you can see, the months that are not sunny are often windy. What is not shown here is that solar and wind power are complimentary on short-term cycles as well. When a front comes through, it gets cloudy, but it also gets windy. At night, when there is never sun, any wind is a bonus. The developers have been involved with the installation of dozens of solar and wind powered homes in the area over the last 10 years, and two of us have been living with solar and wind power in Fairfield for 9 years. Our experience backs up the data from this chart indicating that a combination of solar and wind power provides a very reliable energy source in this area.

3.1.3 Energy System Design and Modeling

Each neighborhood (6-8 homes) will have a 4 kW PV array, a 7.5 kW, 23-foot diameter wind generator[8] on a 100-foot tilt down tower, and 100 kWh of lead acid battery storage, a 5600-watt sine wave inverter, and an 8kw biodiesel back up generator.

Fig. 6: Innovative tower designed and fabricated by Nelson LaFrancis [9] (Model shown – actual tower is under construction)


Fig. 7: Energy system design

The Iowa Energy Center has an on-line modeling program that has a typical year of wind statistics and the energy output profiles of various wind turbines.[10] The Iowa Energy Center also has a program for modeling the energy output of a PV array. Tom Factor, who is located in Fairfield, developed both of these tools. The average annual kWh production per kW of peak PV capacity is 1534 kWh per square foot (16567 kWh per square meter). The average annual kWh production per square foot of wind generator blade swept area is 59.4 (641.52 kWh per square meter)[11].

We have also done modeling using the TMY data and data from other sources.

3.2 Water

Two sources of pressurized water are delivered to each home. The first comes from the rain catchment tanks and is filtered and treated with UV light. The second is from ponds. The rain catchment water is higher quality and suitable for bathing and washing. The filtered pond water is suitable for uses like flushing toilets and watering plants. Further purification of rain catchment water for human consumption is up to the homeowner and could include filtering, reverse osmosis and further UV treatment.[12] Water is pumped using the highest efficiency pumps we could find (positive displacement pumps).

3.3 Waste and Nutrient Cycling

Black and greywater are separated at each house. Greywater can be used at the lot or can be sent to a greywater processing system that serves the whole project. Blackwater is sent to a methane digester, which provides a first stage of treatment, reduces the volume of material, and generates biogas (methane). The liquid portion of the material that exits the digester is fed into a constructed wetland, and the solid portion is dried and buried in a timber tree area every few months. The methane digester was designed and construction supervised by Al Rutan, our biogas consultant. A photo of the digester during installation is shown below.

Fig. 8: Methane Digester Installation

This continuous process digester will process the waste from the first 8 to 10 homes. For optimum gas production, the digester needs to stay above 90 deg F year round. Very little heat leaves the tank, and we only have to supply the losses from the tank to its environment and any energy required to heat material coming into the digester. Our design solution is to use high insulation around the tank, a water bath that is heated by active solar, and a unique solar building. Mr. Rutan has designed a greenhouse that uses movable insulation and glazing for climate control, utilizing garage door track technology. We are building a prototype under his direction to house the digester.

### 3.4 Agriculture

Agriculture and food production are an integral part of Abundance Ecovillage. For the initial phases of construction, we have installed 4000 square feet of greenhouse and have collected several thousand edible and useful plants from similar climates around the world. We are giving this collection and greenhouse space to someone as an enticement to start a nursery business at the ecovillage. We are also giving land and greenhouse space to someone to start an annual vegetable market garden. Our initial collection will be propagated out to tens of thousands of edible and useful plants, which will be planted throughout the ecovillage. We have had some of the top permaculture designers in the US working with us on selecting species, plant guild establishment strategies, and land water flow and storage structures (ponds and swales)[13]. Our model for the density of planting and the emphasis on edible and useful plants is Village Homes in Davis California.[14] Iowa has one of the greatest diversities of native fruit and nut trees in North America. We can use the best selections and named varieties of these plants, augmented by seedling varieties, with undesirable seedlings removed in later years. The common names of natives and a few of the non-native edible species are listed below.

TABLE 2: COMMON NAMES OF SOME ECOVILLAGE PLANTS

| | | |
|---|---|---|
| Mulberry | Aronia | Shipova |
| Persimmon | Akebia | Sea Buckthorn |
| Black Walnut | Serviceberry | Maypop |
| Paw Paw | Bush Cherries | Edible Dogwood |
| Native Plum | Elderberry | Gooseberries |
| Hardy Kiwi | Medlar | Hazel |
| Chestnut | Butternut | Blackberry |

Space does not permit a complete list as we have over 400 varieties of perennial tree, shrub, vine, and herbaceous plant, all of which are edible or medicinal, most of which have beautiful flowers, foliage, and fragrance. See the web site for a complete list (www.abundance-ecovillage.com).

### 4. STHAPATYA VED

Sthapatya Ved is an ancient system of architecture from India. It prescribes the placement, proportion, orientation, and materials for human habitats, from homes to neighborhoods to cities to countries. The central tenant of Sthapatya Ved is that the orientation, proportion, and placement of the built environment have dramatic effects on occupants. The purpose of Sthapatya Ved is to maximize the positive effects and eliminate the negative ones, to bring the occupants of the building more in tune with natural law. Maharishi Mahesh Yogi, the founder of the Transcendental Meditation movement, (the US branch of Transcendental Meditation is headquartered in Fairfield) is reviving the knowledge of Sthapatya Ved. This revived Sthapatya Ved is called Maharishi Sthapatya Ved. The organization that does reviews and approvals for Maharishi Sthapatya Ved, Maharishi Global Construction, is also located in Fairfield.

There has been over $150,000,000 worth of Sthapatya Ved construction in Fairfield over the last 5 years, and Fairfield now has the largest concentration of Sthapatya Vedic buildings outside of India. The reports from the occupants of these buildings have been very positive, and there is a continuing strong demand for Sthapahya Ved housing in Fairfield. However, most Sthapatya Vedic construction has not taken into account basic energy efficiency and environmental design.[15] One goal of our project is to incorporate environmental and ecological design principles into Maharishi Sthapatya Ved. Maharishi Sthapatya Ved introduces a variety of additional design criteria, none of which are insurmountable in developing an energy efficient and earth friendly home. Some of these criteria include no recycled materials, emphasis on the use of natural materials, orientation of homes, and placement of the rooms with regard to the path of the sun. This is not, however, the same kind of placement and orientation that is recommended by passive solar design. Here are a couple of examples: Sthapatya Ved requires that the door of a home face east, never south. The roofline of a home must run north-south.

Maharishi Sthapatya Ved design is a complex and involved discipline, and cannot be summarized by rules of thumb. Maharishi Global Construction is the only organization in the US that is authorized to do Maharishi Sthapatya Ved design reviews and approvals. The entire project layout has been reviewed and approved, and all home plans are required to have Sthapatya Ved review

and approval. For further information on Sthapatya Ved contact Maharishi Global Construction.[16]

## 5. HOUSE DESIGN

House design at the ecovillage is a team effort made up of the following – the homeowner and his/her designer/architect, the builder (one of the ecovillage partners is the builder for the project), the HVAC, plumbing, and electrical contractors, plus other consultants in geothermal, passive solar design, daylighting, and Maharishi Sthapatya Ved.[17] The homes have a maximum monthly electrical energy budget of 250 kwh, about 1/4 the national average, and it is important that the heating and cooling systems do not require lots of electrical energy at the worst times of the year (cold windless nights preceded by a cloudy windless day, for example). Energy 10 software is used to model home performance. We take an integrated approach that starts on the first day of design, as advocated in the Energy 10 design manual.

Cooling provides a special challenge for off grid homes in our climate. We sometimes get weeks of temperatures with highs near 100 degrees with fairly high humidity. The compressor driven expansion type systems we looked at took too much energy (with the exception of very small room sized units) and for most of the year it is too humid to permit effective use of direct evaporative cooling. We found someone with extensive experience in earth tubes for cooling in humid climates[18] (200 homes in Michigan and Texas) and we have built earth tube systems into the first three homes. The earth tube systems only require a small fan (25-50 watts) to provide cooling and dehumidification in summer or fresh air tempering in winter.

### 5.1 Test House

Fig. 9: Test house completed Fall 2001

Before we obtained the ecovillage land, we started building a test house to try ideas that could later be incorporated into the ecovillage. The test house is located about a mile and a half to the west of the ecovillage.[19]

The house has a footprint of 500 square feet with a basement and a loft. The test house was completed in late summer 2001 and has the following features and systems:

TABLE 3: TEST HOUSE FEATURES

-Post and beam, straw bale infill construction with natural earth and lime plasters on the inside and outside. The posts were made from local lumber.
-14 inches of cellulose insulation with radiant barriers in the ceiling.
-high performance argon filled low-e windows
-Passive solar - direct gain system
-Active solar - simple solar hot air system on the south-facing roof, with fans powered and controlled by a small PV panel.[20]
-Roof rain catchment with a 12,000-gallon water tank in the basement.
-A Solviva style flush composting toilet[21]
-Separate systems for grey and black water
-Domestic water heated by solar, with a PV panel powering and controlling the pumps directly
-Extensive use of cool daylighting

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Fig. 10: Clerestory for daylighting and passive gain, test house[22]

-All construction powered by solar and wind power; the home is not grid connected and is solar and wind powered.
-Earth tube system for cooling air in the summer and tempering air in the winter.

Fig 11: Earth tube system installation, test house

The earth tube system consists of four 80-foot long, 8-inch diameter flexible poly pipes, buried 6 feet below the

surface of the ground. The pipes are buried two feet away from the foundation and wrapped around the house. Installation was inexpensive as the only excavation required was to dig a slightly larger hole.

Fig 12: Test house under construction, all framing from locally harvested and milled lumber

Fig 13: Test house with Bales installed, ready for earth and lime plaster

Fig 14: Test house with earth and lime plaster and roof solar hot air system installed

Fig. 15: Test house interior, locally harvested and milled soft maple floor and kaolin clay plaster.

5.2 First Ecovillage House

Fig. 16: Walton House

In addition to the test home, two homes have been started at the ecovillage. As of this writing (mid March 2002) one is nearing completion and is scheduled for occupancy in April. This home is being built for Ken Walton, a university Auyervedic medical researcher, and has 3000 square feet of finished space with approximately 1500 feet on one floor. This home has the following elements:

TABLE 4: WALTON HOUSE FEATURES
-R-30 walls, r-40 ceiling
-Framing lumber locally harvested (cottonwood and walnut) and milled by a biodiesel-powered sawmill.
-Passive solar design with sunspace
-Active solar design with hot water panels and in floor tubing, partial annual cycle storage
-Solar hot water
-Construction solar powered
-High performance windows
-Grey and black water separation
-Edible landscaping, drip irrigation

5.1.3 Size restrictions and affordability
Another goal we have is to make energy efficient Sthapatya Ved homes more affordable. We have not been able to find any "magic bullet" construction techniques (our costs range from $75 to $135 per square foot) and we concluded that one of the few options for making homes less expensive these days is to make them smaller.[23] Therefore, we have no minimum size requirement. We do have a maximum footprint of 1500 sq feet on one level, with a finished basement and half second story bringing the total maximum sq footage to about 3500. We have chosen to go with fairly conventional but heavily insulated stick frame construction because that is what our builder is most familiar with.

6. ZONING AND PERMITTING ISSUES

The project is located in Jefferson County, which doesn't have building codes. Also, if land is not subdivided, there

are no restrictions on the amount and type of structures that are allowed on the land. In order not to have to subdivide the land, we chose to offer long-term leases on building sites. It has not been necessary to present our plan for review and approval.

There is a requirement for review of the human waste handling system, which, with a project this size, requires review and approval at the state level.

## 7. PROJECT STATUS

Land was purchased for the project in the fall of 2000. Basic road and civil works (water, sewer, ponds) are installed, 4000 sq feet of greenhouse constructed, a collection of several thousand edible and useful plants gathered, a nursery started, a market garden/CSA started, a solar electric system installed, a methane digester designed, built, and delivered to the site, a test home has been completed, one home is almost ready for occupancy, and a second is under construction. In the summer of 2001 we implemented an intern program, with 12 permaculture design course graduates from around the country living and working at the ecovillage through the spring, summer, and fall.

Fig 17: Summer intern camp in greenhouse

An adobe floor was installed in one of the greenhouses[24] and it was the site of a variety of community events – concerts, lectures, film and slide presentations, a permaculture design course, and workshops.

## 8. LOT AND HOUSING COSTS

Lot price at Abundance Ecovillage is $35,000 and includes the following:

1. Lease on a 70 by 70 plot of land to build a house
2. Common greenhouse space
3. A common building
4. Lots of edible and useful plants in the landscape
5. A solar and wind electric system
6. Water delivered from two sources – a pond, and roof catchment tanks
7. Sewage handling services
8. Roads and parking
9. Sthapatya Ved review and approval of the project layout.

Finished home costs are in the range of $75 per sq foot to $135 per sq foot, with no minimum size requirement. These costs ranges are similar to other subdivisions in Fairfield.

## 9. SUMMARY AND CONCLUSIONS

This paper has presented the design, organization, and first stages of construction of a residential housing project that will eventually have 21 single-family homes and 9 units of housing in multifamily homes. The difference with Abundance Ecovillage is that all the electrical energy, water, waste treatment, and food production are designed into the site. We have tried to use the consciousness of design and intelligence of nature to replace materials and energy (like rainwater) that are often considered problems or waste products in conventional development into resources. We have found that, through integrated design, we have been able to do this for a cost that is similar to the cost of conventional subdivisions that get their water, energy and food in ways that are, for the most part, destructive to the earth's ability to nourish living things. To paraphrase William Mcdonough[25], we strive to have the inputs and outputs of the Ecovillage be wetlands, wildlands, food forests, and beauty. We have used many of the principles of permaculture design (two of the developers have permaculture design certificates). Permaculture has stated ethics that we have used as guiding principles in all our design decisions. These are:

Care of the earth
Care of the people
Share the surplus

This paper helps us to share the surplus of knowledge that we have gained in putting this project together. We would like to thank all those that went before us; we have been the benefactors of their generous sharing of knowledge.

ACKNOWLEDGEMENTS

I'd like to thank my partners John Freeberg and Michael Havelka, and my wife Valerie Gamble, who have made this project a success and a joy. I'd also like to thank Ralph and Jill Bunker, Steve Druker, Ken Walton, and the Zenack family for having the vision and faith in us to become the first residents of Abundance Ecovillage. I'm also grateful for the help of Dr. Mark Olson and the kind words and good wishes from hundreds of our supporters in Fairfield.

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[1] As of 2001, 98 per cent of the electricity used in the Midwest is generated from fossil fuels and nuclear power - "Repowering the Midwest", page 7, Energy Law and Policy Center, 35 East Wacker Drive, Suite 1300, Chicago, Il 60601-2110. http://www.repowermidwest.org/

[2] The breakdown is as follows: for every 100 units of energy in the fuel delivered to the plant, 60-70 units are wasted at the plant because of the third law of thermodynamics, 10-15 units are wasted in transmission and distribution to get the energy to its point of use, and, in the case of an incandescent light bulb, 90 percent of the energy delivered to the bulb is turned into waste heat and 10 percent is then delivered as useful light.

[3] For examples, see Hawken, P, Lovins, A, and Lovins, LH, "Natural Capitalism," Bell, Jim " Eco-nomic Security on Spaceship Earth" http://www.natcap.org/ http://www.jimbell.com/

[4] Village Homes was designed by Michael and Judy Corbett and built in 1975-1979. See video tour in the film "Global Gardener", Corbett, J and Corbett, M, "Designing Sustainable Communities – Learning from Village Homes", Island Press, 2000 http://www.context.org/ICLIB/IC35/Browning.htm

[5] See Wendell Berry, "The Gift of Good Land", North Point Press, San Francisco, 1981 http://www.alteich.com/links/berry.htm

[6] Roughly 1/4 the energy used by a conventional grid connected home.

[7] From Iowa Energy Center web site energy tools, http:// www.energy.iastate.edu

[8] Manufactured by Bergey, Model Excel R 7.5 kW, 23-foot rotor diameter. http://www.bergey.com/

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[9] Nelson Lafrancis, 1863 Woodland Drive, Fairfield, Iowa.

[10] http://www.energy.iastate.edu

[11] Derived from Iowa Energy Center web site data – http://www.energy.iastate.edu

[12] There are a lot of different opinions on final stage treatment, each having its advocates and detractors. We chose to let the homeowner decide on his/her favorite method and install and maintain it. Most people in Fairfield are already using some type of home water treatment for city water and are familiar with the options.

[13] Douglas Bullock, Jerome Ostentowski, and Bruce Hill. http://www.permaculture-portal.com http://www.crmpi.org/

[14] See film "The Global Gardener," also film "Ecological Designers", and also book "Designing Sustainable Communities, Lessons Learned From Village Homes" by Michael and Judy Corbett. http://www.bullfrogfilms.com/catalog/tgghv.html

[15] For an exception see paper on Wisconsin Maharishi Sthapatya Ved solar house presented at the Solar 2000 ASES conference. http://www.ases.org/

[16] Maharishi Global Construction, 500 N 3rd Street, Fairfield, IA 52556 http://www.mgc-vastu.com Chief architect Jonathan Lipman, AIA, jon@mgc-vastu.com

[17] All homes have to pass a Maharishi Sthapatya Ved design review. The only authorized design review organization in the US is Maharishi Global Construction, address above.

[18] Larry Larson, Fairfield, Iowa.

[19] At Surya Nagar Farm, http://www.solarfarm.com

[20] Solviva, Anna Edey , 1998 http://store.ic.org/products/solviva.html

[21] Solviva, Anna Edey, 1998sh

[22] Architectural design by Deepak Bakshi, Architect, Fairfield, Iowa http://www.ads-vastu.com/

[23] Susanka, Sarah "Designing the Not So Big House" http://www.notsobighouse.com/

[24] Earth floor techniques learned in a workshop with Bill and Athena Steen, Canelo Project, New Mexico http://www.caneloproject.com/

[25] http://www.theatlantic.com/issues/98oct/industry.htm