

Kent Boyum - state and federally funded Rebuild America coordinator for Vedic City, Fairfield, and Jefferson County.

Cool Daylighting Collaborative - www.daylighting.org

International dark-sky association - www.darksky.org - their mission statement - "To preserve and protect the nighttime environment and our heritage of dark skies through quality outdoor lighting."

Iowa Association of Municipal Utilities - www.iamu.org

American Council for an Energy Efficient Economy - www.aceee.org The American Council for an Energy-Efficient Economy is a nonprofit organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection Here is where to find lists of the most efficient home appliances.

Government energy star web site - www.energystar.gov - Ratings of various home appliances and info on compact fluorescent lights.

Thomas Brown, Architect - www.tombrownarchitect.com - Wisconsin based architect experienced in high performance design and energy efficient construction. Excellent web site with lotsa of references for the cold Midwest.

Kill-a-watt energy meter - less than \$35 easy to use energy meter -

conservatives and liberals alike, and has tremendous popular support. I am puzzled why this is not part of national or local political debate, and I encourage you to ask your favorite politicians why. We should make sure that our homes and our public buildings use energy wisely. It saves money and makes the transition to renewables easier. Do not let another public building like a school, library, or civic center be built in your town without considering wise energy use. With the knowledge you gain retrofitting your home for wise energy use, you can become a energy efficiency guerilla, replacing wasteful bulbs in public places with energy efficient ones.

"For every virtuous man there are 1000 patrons of virtue"

- Henry David Thoreau

Resources and Access

(Possible sidebar?)

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Abundance Ecovillage - www.abundance-ecovillage.com - Solar and wind powered subdivision located in Fairfield, Iowa, under construction now, will eventually consist of 30 units. The author is one of the developers. This web site has lots of additional information and resources that wouldn't fit in this article, and will have all the articles in this series on-line.

Surya Nagar Farm - www.solarfarm.com - The author's web site with lots of additional information that wouldn't fit in this article, plus all the articles in this series on-line.

Havelka Construction - Michael Havelka - Michael is expert in the practical details of renewable energy and efficiency. expert in Southeast Iowa. Michael has been 100% solar and wind powered for 13 years in Southeast Iowa. michaelh@lisco.com, 641-472-1853.

Home Power Magazine - www.homepower.com -

Iowa Renewable Energy Association - www.irenew.org - great resource for efficiency and renewables, they host an annual energy fair in September at Prairiewoods in Cedar Rapids..

Midwest Renewable Energy Association - www.the-mrea.org - they host one of the largest energy fairs in the country in June in Wisconsin.

Iowa Energy Center - www.energy.iastate.edu

Laptop computer use 1/10 the energy of desktop computers, are portable, and often have better screens.

Making Energy Usage Visible

How do you know what uses a lot of energy in your house and what doesn't? Why do people continue to pay to provide energy to appliances that are shut off? The short answer is that, unless someone tells you, like I just did, there is no easy way for you to measure usage directly. The power and energy usage that are listed on most appliances are often grossly inaccurate (most appliances, particularly electronics, take less power than their name plate rating would suggest). Your electric meter is located outside and typically uses cryptic 19th century technology to display energy use. (see the Surya Nagar Farm or Abundance Ecovillage web sites for info on how to read your electric meter) The time delay from when you hear the refrigerator come on to when you get the bill for the energy is weeks or months apart, making it impossible to know for sure how much energy is being used by each appliance.

Just being able to see how much power you are currently using can drastically effect energy usage and allow you to use energy wisely. I have installed dozens of renewable energy systems in hoems, and I always install meters to display energy usage in a prominent place in the home. I estimate that people can cut energy usage by 30% just by being able to monitor it effectively and easily. In these days of digital displays on toothbrushes, it should be possible to install an easy to read energy meter in a convenient location in your home. Unfortunately, this device does not exist. You can buy a device for less than \$35 that will allow you to plug in any appliance and it will give a digital display of usage - see resources list in this article for more info. (Anyone want to donate one to the public library?) This is especially useful in monitoring usage of items like refrigerators that turn on and off all day long and to test for phantom loads (appliances that use power when they are shut off.)

Local and National Implications

"At first people refuse to believe that a strange new thing can be done. Then they begin to hope it can be done. Then they see it can be done. Then it is done and all the world wonders why it was not done centuries ago"

- Frances Hodgson Burnett, Author, *The Secret Garden*
(taken from the 100 th Issue of Home Power Magazine)

If we made it a national priority to implement and further develop these Next Industrial Revolution technologies, we could transform and this country and create a vital economy. We could become world leaders in teaching both the post industrial and the industrializing world how to do this. We could export this knowledge instead of war. This is something that cuts across political boundaries, appealing to both

The largest energy user in most households is the refrigerator. By choosing carefully, it is possible to find one that uses 1/2 to 1/4 the energy of typical 10-15 year old models.

Bought a horizontal axis washing machine that uses 1/3 the energy and 1/4 the water of a conventional vertical axis machine

Overall, they were able to reduce their electric bill by 90%, which, after the changes, was less than \$15 per month (around 100 kwh per month). It was then easy to provide this energy from a solar and wind system, and cost effective when the savings from the energy efficiency improvements were applied to the cost of the solar and wind system. The Isbells spent thousands of dollars improving the efficiency of their energy use, but saved tens of thousand of dollars in the cost of powering their home with solar and wind power.

A note of caution - most conventional builders, electricians and plumbers will not understand this, will think you are crazy, and will strongly discourage you or will give you bad recommendations. Be careful when hiring the professionals you may need to make these kinds of substantial reductions in energy use without reducing comfort and convenience. As the Isbel family demonstrated in the example above, the best solutions improve comfort and convenience while lowering energy use by up to 90 per cent.

Often, state regulators require utilities to help pay the cost of these kinds of efficiency improvements, because it is far cheaper to make more electricity available by wisely using less than it is to build new power plants. If we implemented a design revolution, implementing these kinds of cost effective measures society-wide, we would never have to build a conventional coal, oil, or nuclear power plant again, and we would create many new jobs and keep more money in our local economies.

Many other examples of this kind of radical resource productivity exist in Iowa. In my home in Fairfield, I use about 35 kwh per month (again, compared to the average 1000 kwh for a family of 4), and I am a geek electrical engineer with 2 TVs, 3 computers, satellite internet service, a music studio, and a shop full of power tools. Abundance Ecovillage is a real estate project I am developing with Michael Havelka in Fairfield, Iowa and is completely solar and wind powered. The first home there, the Walton house, is about 3200 square feet with 4 bedrooms and 4 bathrooms. Four adults live in the home, and electrical energy use has averaged about 60 kWh per month over the last 9 months.

Here is another idea for using electrical energy wisely:

for the daylighting system in just a few months. See the web site of the University of Wisconsin's Daylighting Collaborative (listed in the references section of this article) for more info.

While we are talking about lighting, I'd like to mention outside lighting at night. If you look at a picture of the earth from space at night, you will see dots of light where people live. Using outdoor lighting fixtures that send light into outer space wastes energy and ruins the view of the night sky. It is possible to have adequate and safe outdoor lighting without blotting out the night sky. Check out the web site of the Dark Sky Society for lighting strategies and lists of appropriate fixtures to use to avoid ruining a beautiful night sky.

Put items that use power when they are shut off on switched outlets - Many appliances are designed to use energy even when they are shut off. These are sometimes called phantom loads. It takes four nuclear power plants to provide energy to all the things are actually shut off and providing no useful service. The short term solution to this problem is to put phantom loads on a switched outlets or power strip, the long term solution is to redesign appliances to maintain convenience but eliminate phantom loads.

These first two actions saved the Isbells 350 kWh or over 25% of their previous energy usage.

Change stove from electric to propane

Change water heater from electric to solar with on demand tankless propane backup.

Change electric dryer to propane.

All the above items convert electricity to heat, and use lots of energy. Electric water heating can use more energy than all the rest of your uses combined. Avoid items that convert electricity to heat (electric water heaters, electric cookers, electric cloths dryers, electric space heaters) wherever possible - use propane, natural gas, wood, or systems that take advantage of the sun's heat directly without having to change it into electricity first (Fairfield resident and solar hot water advocate Roy Tonneson claims that solar hot water systems are the most cost effective way of using the sun to provide energy for your home - look for a future article solar hot water systems). Some uses, like blow-drying your hair are OK as long as they aren't used for long periods of time. If you have solar and wind generated electricity and have extra power, as is often the case on sunny and windy days, you can use it to cook with or run a bread maker.

Replace fridge with one that used 1/10 the energy of old unit.

month used by a typical family of four. They found that building a solar and wind system to provide them with the energy they were currently using would be prohibitively expensive.

Then they began to look at how they were using energy. The Isbell family has a 1600 sq ft home. They were paying \$150 dollars per month for electricity (1,380 kwh). They did not want to reduce comfort and convenience. They did the following simple things to reduce their electrical energy consumption:

Upgrade 45 incandescent lights with 4 times more efficient compact fluorescents - Conventional incandescent lights convert less than ten per cent of the energy they use into useful light. The rest produces heat. So 90 per cent of the energy is thrown away, and in the summer, you have to use more energy to run air conditioning to get rid of the waste heat produced by the bulbs. Lighting your home with conventional light bulbs is like lighting your home with toasters. If you look at the over-all efficiency of converting fuel into electricity at a coal, oil, or nuclear plant (97 percent of Iowa's electricity comes from coal, oil or nuclear power) only 2-3 per cent of the energy in the fuel becomes useful light. If every household in the US replaced just one conventional incandescent bulb with a CF, we could shut a nuclear power plant off overnight, we just wouldn't need the energy. And CF bulbs last 10 times longer than conventional ones. CF bulbs are one of the best investments available - you can purchase one for \$3-\$10, and, at current rates, you will save \$50-\$75 in energy costs over the life of the bulb, guaranteed. This is at least 10 times greater than the return available from any other legal investment.

Compact Fluorescent lights are also safer. A typical halogen bulb, often used in floor lamps or torchieres, operates at 1000 degrees. These bulbs and fixtures are responsible for many home fires every year. Compact fluorescent bulbs, in contrast, operate at around 100 degrees, cool enough to touch.

Even better technologies are on the horizon. A few years ago someone figured out how to make light emitting diodes that are 10,000 times brighter than the LED indicators on your stereo or microwave. This new lighting technology uses 1/10 the energy of conventional incandescent lighting. Last year, researchers from Sandia National Labs and Hewlett-Packard Co. predicted that LED lighting applications would chop energy costs by \$100 billion annually by 2025. Demand for electricity would be reduced by 120 gigawatts (the output of 120 large size nuclear power plants), resulting in carbon-emission reductions of 350 million tons a year.

An even better idea is to design your home, school, office, factory or shop to use cool daylighting strategies. The Iowa Municipal Utilities building near Des Moines is an excellent example of this, providing glare free daylighting all year round, using automatic control systems that provide just the amount of extra artificial light if needed. A North Carolina study shows that students and teachers do better in daylight buildings. Wal-Mart did a study, using daylighting in half a store and conventional lighting in the other half. Sales in the daylight half were 10 percent greater, paying

article on how we can improve our lives and enrich the local economy by growing all the food we need right around where we live).

You align yourself with the economy of nature rather than the economy of man. The economy of nature includes the systems on earth that purify our air and water, maintain the fertility of our land, maintain a temperate climate favorable to life over much of the earth's surface, maintain a healthy diversity of life, concentrate minerals for easy access, and protect our planet from dangerous radiation from outer space.

These systems use thousands of times the energy used by the economy of man, which is a small subset of the economy of nature. And while the smaller economy of man is run largely on fossil and nuclear fuel, the economy of nature runs on the sunlight that strikes the earth each day. Each day, the sun delivers 14,000 times more energy to the surface of the earth than is used by all of mankind. We could convert our current outmoded fossil fuel based economy to an economy based on renewables, an economy that operates on the 4 billion year developed principles of nature's economy. And people like Paul Hawkin, Amory and Hunter Lovins, and William McDonough are showing us how we can do this at a profit.

"We have the mistaken notion that we are producing oil when what we are actually doing is digging it up and burning it."

- Amory Lovins, founder, Rocky Mountain Institute

Using Energy Wisely: Electricity

The key to making renewable energy affordable is using energy wisely. Using energy wisely is doubly important if you are using coal, oil, and nuclear generated electricity from a utility. Overall, at least 2/3 of the energy we consume provides no useful service, making wasted energy the main output of our coal, oil, and nuclear powered economy. At home, 50 to 90 percent of the energy we use can be cost effectively saved, and we can provide ourselves with the same or better quality services. Your beer can be just as cold, your shower as hot and tingly, while using 1/2 to 1/10 the energy used in a conventional home. It then becomes easy to power your home with unused sun that falls on your roof and the unused wind rustling in the trees.

The Isbell family of Vinton, Iowa is a good example of what can be done if we use electrical energy wisely. (I'll discuss efficiently heating and cooling your home and providing hot water later in a later article). Dan Isbell and his family decided to get off the coal, oil, and nuclear powered grid and power their home on the banks of the Cedar River with solar and wind power. They used about 1380 kWh per month, more than the average 1000 kWh per

McDonough uses for the Next Industrial Revolution is not a mechanical one but one based on how nature designs (nature's billions of years of design experience, with all design failures automatically recalled their maker). Again, from McDonough:

"Consider the cherry tree: Thousands of blossoms create fruit for birds, humans, and other animals, in order that one pit might eventually fall to the ground, take root and grow. Who would look at the ground littered with cherry blossoms and complain, "How inefficient and wasteful!" The tree makes copious blossoms and fruit without depleting its environment. Once they fall on the ground, their materials decompose and break down into nutrients that nourish microorganisms, insects, plants, animals, and soil. Although the tree actually makes more of its "product" than it needs for its own success in an ecosystem, this abundance has evolved (through millions of years of success or failure or, in business terms, R&D), to serve rich and varied purposes. In fact the tree's fecundity nourishes just about everything around it.

What might a human-built world look like if the cherry tree had produced it? ...What if all the byproducts of human activity were wetlands, wildlands, and beauty?... it is time for designs that are creative, abundant, prosperous, and intelligent from the start."

This is the hopeful vision of the next Industrial Revolution, and cutting edge technology for this revolution is being developed now people like McDonough, Amory and Hunter Lovins, and John Todd.

This is the first in a series of articles that will explore how to use these emerging next Industrial Revolution technologies to become more regionally self sufficient and locally interdependent for the energy, water, food, building materials and economy that support your home. This article will focus on how to use energy wisely at home. The next article will look at generating the energy we need for a comfortable life from the sunlight that falls everyday on our back yard, the wind that howls over our rooftop, and the constant temperature of the earth available just a few feet below the surface.

People often talk about this as being self sufficient or independent, but I like to call a life based on this kind of web of locally available resources local interdependence. Currently, most people are dependent on remote sources of energy and expertise, with side effects like war and the degradation of the environment through the extraction and conversion of oil, coal, and nuclear fuels into cold beer, hot showers, and lighting. In contrast, as you become more connected, more interdependent, with a web of energy and expertise in your local area, there are side benefits of local employment opportunities, better reliability, elimination of the concept of waste (materials flow in closed cycles), and peace of mind.

Rather than being cut off from the environment that you live in, you have a direct connection with the energy that flows over where you live. The sun and wind are friends that provide you with energy to watch a movie or take a shower, the rain fills your water tank (look for a future article on creating your own water supply) and waters the useful and edible plants that surround your home and fill the public spaces in your community (look for a future

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Living Wisely and Well: Energy

"I sit on a man's back, choking him and making him carry me, and yet assure myself and others that I am very sorry for him and wish to ease his lot by all possible means - except by getting off his back."

-Leo Tolstoy

In his book "Cradle to Cradle", Willam McDonough gives the following design assignment:

"Imagine that you have been given the assignment of designing the Industrial revolution -retrospectively. With respect to its negative consequences, the assignment would have to read something like this:

Design a system of production that

- puts billions of pounds of toxic material into the air, water, and soil every year
- Results in a gigantic amount of waste (approximately 75% of the energy we provides no useful service, and 95 % of the materials we use ends up in a land fill within 6 months, making wasted energy and materials the largest output by far of our industrial system)
- Puts valuable materials in holes all over the planet, where they can never be retrieved
Requires thousands of complex regulations - not to keep people and natural systems safe, but rather to keep them from being poisoned too quickly
Measures productivity by how few people are working, and by the number of smokestacks - if especially proud, put the name of your company on the smokestack.
Creates prosperity by digging up or cutting down natural resources and then burning or burying them.
Erodes the diversity of species and cultural practices.
And, while you are at it, produce a few materials so highly toxic, like nuclear isotopes, that they will require constant vigilance by future generations while living in terror."

This is the system created by our forefathers in the first industrial revolution which is perpetuated and financed by us every time we pay our electric bill, buy a car, or eat a big mac.

William McDonough, dean of the school of architecture at the University of Virginia, uses this exercise to contrast the system created by the first Industrial Revolution with the emerging technology of what he calls the Next Industrial Revolution. The image