

Wisconsin's Electrical Energy Situation in 2001

By Wm. Hurre

Changes in scale and technology have IOUs (investor owned utilities) frozen in the headlights of onrushing history. Voters won't buy new nuclear generators, neither will investment bankers. Coal is almost as bad a business proposition unless IOUs reject free market restructuring and get approval for new coal plants as regulated assets with guaranteed returns, i.e. shift the risk to ratepayers. A new coal plant is a \$500 million, 20-year bet in the face of global warming, acid rain, mercury pollution and new technologies. People are more interested in clean air. There are alternatives to coal-fired electrical generation of electricity. There are no alternatives to clean air.

Clinton tried for a carbon tax and was shot down. It is happening in Europe, and it is likely in the next 20 years that a fair-haired politician here will sell taxing the bads of pollution and inefficiency instead of the goods of property and wages. A carbon tax would change the economics of a coal plant investment, though it would be a pass-through cost for a regulated asset. Capitalism sits on a three-legged stool: banking, the market, and insurance. Insurance, at least in Europe, wants carbon taxes. Climate change weather events are bankrupting it.

The big reason IOUs are not investing in the old ways is that micro and combined cycle turbines, fuel cells, reciprocating and Stirling engines, battery-less storage, cogeneration packages, and renewable technologies are already taking away customers and are poised to take more in the near future. These technologies, necessary environmental laws, economic downturns, and ever more efficient end uses make big bets risky, and IOUs have a corporate culture of risk aversion. The muscle behind these technologies—Chevron, General Electric, Enron, Texaco, Westinghouse, Siemens, Carrier, British Petroleum, the EPA—has the capacity to rapidly change the market. Investors are betting on the next big thing. Look at the interest in stocks for Proton Energy, Plug Power, DCH Technology, Capstone, AstroPower, Ballard, Ceramic Fuels, Fuel Cell Energy, HPower, etc.

But it is worse. A digital economy demands a different standard of power quality than a big-iron economy. Interruptions, spikes, voltage drops, etc. are unacceptable. When a mega mall goes in on the metro edge, when a business 'park' pops up in a corn field, when an internet server fills a building with high-demand electronics, the local grid is destabilized. Wildly various end uses mangle the clean, 60-cycle sine wave form. The plastic exploding inevitable has become too complex for a center-margin system to supply reliably. Estimates on outages cost to business last year exceed \$100 billion. Businesses are investing in non-interruptible service and power quality. It is a short step to larger investments in their own generation capacity, which are increasingly being seen as part of a sustainability/profit strategy. E.g. Georgia Pacific (Fort James) shut its Green Bay papermaking operations last summer, workers took contract-required vacations, and GP made money selling kW from its coal-steam generator at premium peak demand prices. Cleveland Cliffs in the UP did it, too.

Michigan's attorney general has a class action suit against IOUs over 'stray voltage.' It is not voltage; it is current. It is not stray; it is there by design, and the system working as designed. The system is the multiple grounded neutral distribution system—many places a neutral enters the ground. A majority of the electrons return to sub stations through ground loops. Copper is more conductive than dirt, but there is also a factor in the equation for size. Bigger wires carry more current. Earth is very large; it carries lots of current. With more demand; more current. If health effects or the issue of trespass—I did not give the utility permission to use my land as part of its distribution network—dominate, IOUs will have to spend tons of capital to put current in

heavier wires. Their denial and stalling make them vulnerable to massive class action suits just like the tobacco executives. Legal wolves trail them. Risk.

With increased population, and with increased awareness in the larger population, there are no empty backyards to build new generation plants and run transmission lines. Siting them is a fight, expensive, bitter and long. Lines have to be maintained and soak up 10-12% of the power put into them. And, if constructed they put the system at risk from weather. Winds in the Valders area tumbled several giant steel transmission towers last spring. Ice took out New England for weeks a couple years ago. The original transmission system was built piecemeal; not designed for the large interregional power transfers needed if we continue with the center-margin, fossil-fuel generation model.

NIMBYism (not in my backyard) contributes to the IOU's slow build up of new facilities. It is sure to be fueled by a recently released report on EMF (electric and magnetic fields caused by voltage and current) by the California Department of Health Services that notes a stronger correlation between miscarriages, cancer rates and EMF exposure. The report suggests a 50% potential correlation between exposure to EMF and childhood leukemia, adult brain cancer and Lou Gehrig's disease. Up to 40% of the 60,000 miscarriages a year in California "might be attributable to exposure to maximum EMF fields," says the report. However, correlation is not causation. Two decades of big science probing EMF's health effects has been inconclusive, and this study is sure to attract flak. But the door remains open.

An answer to most of the above problems is distributed generation. Make energy where it will be used, which is where technology is going, viz. micro and combined cycle turbines, fuel cells, reciprocating and Stirling engines, battery-less storage, cogeneration packages, and many renewable technologies.

High performance homes only buy 1.5 Btu/sf-DD vs. the average builder home that uses 5.0 Btu/sf-DD, the mpg for buildings (British thermal units per square foot of heated building space per degree day, a measure of how cold it has been). It costs 3-5% more for HP homes, but the total cost of owning one is less. We are close to building homes that produce more energy than they use. Fuel cells, new window technology, LED (light emitting diodes) and electro-luminescent lights, more efficient appliances, cheaper, building integrated photovoltaics (pv), thermal solar assisted air conditioning, etc. will make this an economic no-brainer soon.

Helping that happen will be real time pricing for electricity. Real time pricing is needed to make the market give signals that will reduce peak demand. Prudent managers will not build a business or a building that puts them in the way of demand and use charges for electricity at peak. Prudence dictates time of use strategies, an efficient shell, cool daylighting and building integrated pv—minimizing exposure to out-of-control, budget-busting energy bills. Prudence means investing in internet controls over the electrical load, buying futures, options, forward- and guaranteed-price contracts. Smart managers will turn the increased risk into opportunity. They'll position their businesses to sell power at fat profits to the less aware and those with less ability to shape their loads.

California's deregulation problems are due to bad law, inappropriate economic models, and market manipulation. Deregulation was driven by greed, the IOUs desire to recover huge sums stranded in failed nuclear plants, the used-to-be-low price of natural gas (NG), and the errant assumption it would be forever cheap. Generation there is NG and hydro intensive. California is even more of a summer peaker, 34,400 MW winter and 45,800 MW summer than Wisconsin, 9,000 MW winter and 11,000 MW summer. In winter it has more than a 25% margin of reserve generation capacity. Shortages then stink of manipulation. With only seven suppliers dominating an ill-conceived, poorly-regulated market, and billions to be gained, it is difficult to imagine fair play.

The *Los Angeles Times* reports that \$228 million of demand side (efficiency/conservation on the customers' side of the meter) money was boondoggled by California IOUs. Had it been spent properly it would have saved 1,000 MW, about two large power plants' production, enough

to avoid recent shortages. California, which has one of the lower per capita consumption rates in the U.S., was saving less energy before the troubles began than it was five years ago. If war is too important to be left to the generals, electrical generation is too important to be left to the IOUs. That is the real lesson of California's deregulation fiasco.

Utilities can't compete with more nimble merchant power outfits and their natural gas turbines. Merchant plants are also built cheaper, to a 20-year design life vs. the IOUs' usual 40. NG is touted as the transition fuel, the fuel of the future. But Wisconsin doesn't have any, well heads have frozen in the past (winter '88-'89), WWII-era pipelines are corroding, and everyone is going for it. Electricity providers plan to build 180,000 megawatts of gas fired generation plants by 2005. NG is like the lifeboats on the *Titanic*. There isn't enough. Production has been flat for 20 years. Easy to get big producer wells are gone. New wells produce less and die sooner. Texas, source of a third of our NG, has to drill 17 wells a day to keep production level; 20 a day in Alberta, source of 15 percent of our gas. The Department of Energy says 16,000 new wells were drilled in 2000, up from 10,400 in '99. But output rose only two percent. We haven't run out of gas, but there is no way to grow the supply. Prosperity through exhaustion is the national energy policy. It benefits Bush's fossil greaseballs. Wisconsin must do something else.

For Wisconsin the sensible strategy now is not to make a 20-year commitment to a damaging fossil technology, but to invest in RE (renewable energy), efficiency technologies and serious demand side measures. This makes better use of IOU resources by evening out the load. It reduces risk by buying capacity in smaller than multi-billion dollar packages, it can be implemented quickly vs. the agony of time needed to bring a giant power plant on line, it makes the generation portfolio more diverse and less vulnerable, and it is not technically challenging.

Socially it is difficult. We must persuade the political-economic power structure to force IOUs into honorable behavior. It is not honorable to ask for more of the same technology that is destroying public health and the environment. It is not honorable to ask ratepayers to foot the bill for a baseload build up not needed in Wisconsin. IOUs would sell the juice out of state, great for their bottom lines, bad for our environment.

We have to make people feel responsible for their energy use, a bullet we have to bite sooner or later. Relamping the commercial sector, increasing air conditioner efficiency (we're whining about going to SEER 13; the Japanese are on SEER 27), adding photovoltaics and solar hot water (there are 600,000 electric water heaters in Wisconsin and a two panel solar system added to one saves almost two tons of coal a year), mandating Energy Star appliances, installing hourly metering technology, planting shade trees, etc. buys time. In that time more supply—and more efficiency—options will be on the market. For Wisconsin much new supply has to be biomass baseload generation in smaller units distributed around the state. Carbohydrates replace hydrocarbons. It's happening in New England and Scandinavia. Minnesota has started down that path, the Minnesota Wood Energy Scale Up Project, Fibrominn, alfalfa burning, etc. Tapping into our okay winds and the glorious winds of the prairie is also part of the way to a sustainable future.

The California Power Authority is negotiating for 1000 MW of renewable energy, mostly wind and biomass, to come on line by next summer. It also seeks bids for fuel cells, microturbines, and photovoltaic systems. Governor Davis' goal: 17% of electrical energy should be from renewable sources by 2006. www.capowerauthority.ca.gov.

Efficiency, conservation and RE investments make great economic arithmetic, especially when local economic multipliers are factored in. The PSC says we now have an 18% reserve, adequate, that demand grows by 2.2-3%/year, and that we need to add 250-300 MW a year to keep up. Negawatts are as good as watts, better, they are cheaper. (Negawatts. Amory Lovins' term for energy freed up by efficiency. E.g. if Jones' new fridge uses less electricity; it can be used by Smith's computer without investment in more generating/transmission capacity.) By buying the cheapest sources—efficiency—first, we can stop increases in demand and stretch current capacity adequacy. And, there is no end to ever more efficient lights, motors, pumps, appliances, etc. to buy.

Governor Davis says last year Californians cut weather-corrected peak load 12.2%, and electricity usage 10.5%. This is before surcharges started to boost bills. See: www.energy.ca.gov/electricity/peak_demand_reduction.html. This is voluntary. The news from California is that there is now a surplus of electricity. The state contracted for 43% of IOU electricity, but now needs only 35%. The surplus must be sold on the open market. With weak demand; lower prices. So far the loss to the state is \$46 million. Weather and the economy have been cooler, helpful, but efficiency gains shrunk the market. Watch utility attitudes change. If Californians can reduce use by 10%, can't we?

In California 85% of the customers are served by IOUs. They were offered a 20/20 deal: use 20% less electricity, get a 20% rebate. And 34% of them did it, almost 40% in San Diego, earning \$66 million in rebates and saving a whopping 5,500 mega watts. The lesson: demand side management works when deals are attractive enough to make customers feel part of the system.

A working group from five US national labs, Argonne, Lawrence Berkeley, National Renewable Energy, Oak Ridge and Pacific Northwest, concludes that a "wide array of policy and technology options provides many low-cost pathways to a cleaner energy future." They used three scenarios, Business as Usual (BAU), Moderate and Advanced for adoption of efficiency and RE technologies. The Moderate scenario is driven by a domestic carbon trading system that equilibrates at a carbon permit value of \$25/tC. The Advanced uses \$50/tC. In the Advanced scenario "the nation consumes 20% less energy in 2020 than it is predicted to require in the BAU forecast."

"In both the Moderate and Advanced scenarios. . . the nation pays less for its energy than in the BAU forecast. This is largely due to the accelerated development and deployment of energy-efficient technologies." They put downward pressure on energy prices. "The net effect is that by 2020 the Advanced scenario's energy bill is \$23 billion lower than in the Moderate scenario and \$124 billion lower than in the BAU forecast, even with the cost of carbon permits included." The benefits don't include reduced vulnerability to oil supply disruptions, cleaner air and improved balance of payments. There would be "no net cost to the U.S. economy."

There is an argument to be made that an efficiency and renewable energy strategy is necessary for the nation's security. We spend billions on keeping access to Middle Eastern oil. We spend more billions for the oil. Neither expenditure promotes security, as recent events demonstrate. If a fraction of the money were spent inside the U.S. on efficiency and renewables we would be both more secure and richer.

If Wisconsinites reduce electrical energy use by three percent a year, no new plants with their increased costs and pollution would be needed. States with fossil fuel components to their economies, e.g. coal mines, will take a hit if efficiency and RE are developed. Wisconsin has no fossil fuels. The growth of wind, bioenergy, efficiency and other green industries would bring new business opportunities here. Agriculture, bioprocessing, lightweight materials fabrication, sensor and control systems, and energy service companies would grow. We are good at these. An efficiency first and RE strategy would create new jobs, put wind in Wisconsin's economic sails, reduce environmental and public health damages, and begin the shift to sustainability.

Social and environmental goals can conflict with capitalist institutions need to grow. The IOUs cited Wisconsin's low electrical growth rate when they argued to remove the investment cap. They said they had to go out of state to get better returns to stay competitive, and with the cap's removal they can. It is in our interest to lower the electrical use rate even more. It is also in our interest to have healthy, Wisconsin-based IOUs. With the current legal structure, we should be able to do both. A three percent yearly growth rate may sound low, but if continued results in a doubling over 24 years.

We have to start to reward IOUs for providing services instead of selling kWh. Nobody wakes up saying, "I must have 30 kWh today." We want light, pleasant temperatures for inside spaces, hot coffee, cold beer, tunes and conversation. IOUs running on a service instead of a manufacturing model would make money installing smart meters, selling information on hourly

energy costs, selling and installing communications, controls and software that would enable customers to save more than they spend on the hardware and services. IOUs would train building managers in energy management and advise them how to contract for energy in a deregulated market. Operating on a service business model is cheaper and less risky than buying more coal and NG generation plants, the manufacturing model. It would help make them good guys instead of corporate predators who destroy the environment, public health and community economies to build their bottom lines.

We are buying efficiency. From the early 1970s to now appliances bought in Wisconsin use 50% less electricity. The population increases 1.1% a year, but residential energy use only increases 0.5% a year. The number of commercial users increases 1.5% / year, use in that sector only increases 1%. Commercial buildings use a third of the energy for lighting that 1970-era ones use. In 1990 \$1.41 worth of electricity produced \$1,000 of gross state product, in '99, \$1.34. We are wringing more light and shaft horsepower out of every kWh, and we can get better at it. The hardware is on shelves. A population hip to efficiency needs to become a Wisconsin characteristic.

Two score high performance homes in Oneida have bills of \$350-\$400 for all energy, all year. Maybe this year they are up to \$600. Some homes spend that much a month. Oneidas don't go to Tulsa to buy groceries. Money saved on energy bills spends at least one more time in Wisconsin. Every high performance home adds \$1,000 to our cash flow every year. There are 25,000 housing starts in Wisconsin annually. If they were built to high performance standards, it would add \$25 million to the state's economy this year, \$50 million the next, etc. It is economic development by import substitution, and we now export \$10 billion a year on imported fossil fuels. Wisconsin's Energy Star Home program shows contractors how. Getting them and the market to care is another matter.

About 90% of commercial, industrial and institutional facilities were built before 1985 and fewer than 25% have been upgraded with more energy-efficient HVAC and lighting systems. The 100+ Wisconsin companies in the Focus on Energy Program have identified \$1.5 million in energy cost savings at a cost of \$2.2 million. The investments average a 1.5 year payback, a 35% return. However, if we can't manage a fraction of the savings Californians have, there is still growth in demand. It has to be dealt with. Aging fossil and nuclear plants need replacing. Think of the disaster a terrorist-commandeered jumbo jet would create if crashed into a nuclear plant! Wisdom would remove the targets, no?

Wind generation is ready. Germany gets 6,100 MW from wind. The Danes have 12,000 jobs related to wind generation of electricity, get 13% of their load now, and are aimed at 50% by 2030. Government tax, investment structures, and laws have opened the door to 175,000 Danes joining wind cooperatives. The Colorado PUC ordered Xcel to build a 162 MW wind farm near Lamar. Texas plans to have 2,000 MW of wind electricity by 2009. Getting 200 MW a year, 130 or so 1.5 MW turbines, is doable, but will excite NIMBY responses, change the visual landscape, and require backup when winds don't blow. We will eventually run out of suitable sites but are a long way from saturation now.

If 5,000 homes a year put 1 kW of grid-tied photovoltaics on their roofs, that is 5 MW, and they are at summer peak, the time of greatest need. Add 20 MW more on commercial and industrial roofs. "Solar technologies are uniquely suited to installation in dense markets in urban environments where it is difficult to build new plants and transmission lines and where air quality is an issue." ("Micropower: A Solar Opportunity," *Solar Today*, July/August '01).

Manure methane turbines will add more MW; 400 cows run a 100 kW generator. Can we retrofit 500, 400-cow and larger operations over a decade? That is 50 MW, improved surface water and more jobs. Such operations also take manure from nearby farms and other 'waste' such as whey from cheese plants. We can get 250 MW a year with renewables and increase the diversity and resiliency of Wisconsin's generation portfolio. With reduced growth in demand, the 550 MW of new generation under construction, and the 1,103 MW of PSC approved new

construction, there is enough new capacity to keep us responsibly positioned. Another 1,010 MW of applications are on file, and 2,025 MW more that applications are expected for, says the PSC—none of it coal. We have not fully explored how much at-peak power might come from industrial plants which, like Georgia Pacific's in Green Bay, can make money selling power instead of product. Wisconsin is not in a crisis, but it is time to make plans for what's next.

We need to structure laws and benefits to put pv on roofs, to build wind generation farms, and to enable regional biomass electric cooperatives to form. They would put a floor under the forest-based economies of the northern counties. We must start to grow energy crops such as industrial hemp, fast-growth poplars, and willows. More than half of farm income is government support. We might as well get something we want instead of more millions of pounds of low-quality surplus cheese.

A problem is peak power demand. Average demand ranges from 4,600 MW to 6,300 MW. It is expensive to build generators to deal with a few hundred hours of peak demand that sit idle for the rest of the year's 8,760 hours. The considerable capital for them has to be repaid every month, and they have to be maintained. The MW in capacity planned to come on line in the next few years, mostly merchant power, is enough to take care of growth in demand at peak in the near future and give us time to bring more efficiency and renewables on line. Another problem is the aging of existing base load plants. Nuclear ones should be retired asap; coal ones need rebuilding with 'cleaner' units sited right where the old plants are. Preferably, they can be replaced with much cleaner renewable energy technologies distributed all over the state.

The coal-steam generating plants IOUs want aren't built to service a few hundred hours a year of peak electrical demand. We are not that dumb. Wisconsin hydro, fossil- and nuclear-steam generation capacity now is 9,300 MW; non-peak loads are half to two-thirds of that. WEPCO, WPS and Alliant are trying to stampede us with the need at peak in a few geographic pockets and use sectors and with an unprecedented shut down of generators in the summer of '97 to build base load capacity so they can sell electricity out of state at the expense of Wisconsin's already stressed environment. We know cancers are caused by fossil combustion (radiation and hormones are the other drivers, and burning coal releases plenty of radiation, too). We know NO_x triggers smog. We know mercury is already too high for the health of animals who eat fish. What a tourist attraction! Besides destroying public health, the environment, and exporting money, building coal plants locks us into the past and blocks the way to the future. We must identify the economic and geographic sectors most responsible for increases at peak and devise programs targeted to control their demands. The IOUs are running around shouting, "The sky is falling, the sky is falling." It is not.

Utility and PSC priesthoods generate agitprop to convince us energy demand is inelastic (California shows this is not true), approaching crisis, and that there is no choice but to increase fossil-generated supply. This is jive. Regulated utilities are in the business of piling up assets to increase their guaranteed returns. The PSC is supposed to keep the build up in line with need. Utilities have a history of overbuilding. Business-as-usual Republicans have dominated the PSC for 15 years. It is not a control over IOUs. It is a rubber stamp, a cheerleader. Governor McCallum's energy plan is a package of concessions and welfare for IOUs that celebrates the status quo. It sets no goals. It is not good enough.

It is time for a paradigm shift. There is great confusion between price and cost. A \$0.06 kWh is low priced, but if the costs IOUs have shifted off their balance sheets are counted, it is not cheap. Think of breast cancers, trashed surface water—now all Wisconsin lakes—strip mines, global warming, destroyed forests, reduced tourism, grade F air on many days in eastern Wisconsin counties, and exported money. Efficiency negawatts cost less than the IOUs' wholesale price. Many clean, higher-priced RE kWh have a reasonable cost compared to coal-fired kWh when externalities and community economic effects are counted, i.e. when corporate voodoo economics is not the standard. They are competitive with kWh produced by turbines and

diesel generators that run only for peak demand's 200 hours a year. The cost of energy from them is fixed and will not gyrate unpredictably. People need to know this.

But we really don't have a choice. If we value our health and Earth's, we have to stop using fossil carbon to generate electricity and begin to use renewables. Corporate bosses don't want to hear that change message. It is the task of the culturally creative minority to convince a majority that the corporadoes' denial is neither honest nor honorable. We can't expect much help from bought off legislators and bureaucratic policy makers.

In the past we've not had leadership. If an organization wants to change its culture, leadership from the top is mandatory. Developing biomass base load electrical generation is attractive to Wisconsin's depressed agricultural sector, to folks Up North, and to many urbanites. It could unite hook and bullet people with environmentalists. Organizing the coop structures, laws and financing that make it happen would be a way an ambitious down state politician could reach enough voters to become governor. The really big idea: once in office s/he could form an alliance with Illinois, Minnesota, Iowa and the Dakotas to build wind turbine electric farms that electrolyze water into oxygen and hydrogen. Stored hydrogen would provide power when winds don't blow. Pipe it to the region's metros and make the Upper Midwest a lead in the switch to a hydrogen economy—the next big thing.

A problem with the efficiency and RE strategy is that it has been marginalized for decades. There are not many people able to do the work, few ESCOs (energy service companies, GENCOs and LINECOs are the others in utilspak) that can help educate, manage and evaluate the new workforce/programs. Wisconsin Energy Conservation Corporation, the Midwest Renewable Energy Association, and the Energy Center of Wisconsin are the biggest, Franklin Energy Services and a few others are also players. But it is thin. All are building up to manage Public Benefits money, the \$1.48 check off on IOU utility bills. Duke Power and other monsters are cruising, looking to take it away from local control. We don't want that any more than we want them buying our IOUs. Duke has a bigger bottom line than Wisconsin's. Sic the DNR, the PSC, the AG on it, ha! Mosquitoes vs. a mastodon.

The challenge is how to keep our GENCOs healthy and away from takeovers as they figure out their places in a historic/technical shift away from what they've always done. Electrical generation is no longer a natural monopoly, a business that burns fossil carbon in central plants and ships electrons to distant places. The IOUs are struggling to keep a coercive hold on the market by insisting the old ways are the only ways. Nonsense, and we can't keep IOUs from the pains of change at the cost of public health, worse environmental decline, holistic economics, missing the boat of new technologies' promise, and depressing Wisconsin-based ESCOs. The price is too high.

If it is the end of an era for IOUs, it is the end of an era for consumers, too. No more mindless slurping of cheap kWh. No more leaving it to the IOUs to produce endless quantities however. Citizens must take control of decisions about production, must produce more of their own electricity, and must certainly embrace efficiency. No more cheap-to-buy, expensive-to-run motors, pumps, fans, lights and appliances. No more fossil carbon pollution. From now on prices will rise to meet true costs, and sunshine will show the way to sustainability, economic and environmental. European nations are doing it, and have higher standards of living than we do. We've started the transition. We have to admit it, set goals and get on with it. Anything else prolongs the agony, increases the chaos and costs.

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Resources to a sustainable future:

No Regrets Remodeling: Creating a Comfortable Healthy Home that Saves Energy, by the editors of *Home Energy* magazine, ISBN 0-9639444-2-8, 222 pages, 1997, \$19.95.

Residential Energy: Cost Savings and Comfort for Existing Buildings, John Krigger, 2nd edn., ISBN 1-88012-008-9, 280 pages, 1996, \$35.00.

Web sites: www.buildingscience.com, www.healthhouse.org, www.epagov.homes.

Shelter Supply has a catalog with ideas and products that are helpful, 800-762-8399. It has the Energy Efficient Builders Association *Builder's Guide: Cold Climate Edition*, the bible for high performance house construction in the north. www.eeba.org sells it, too.

Wisconsin Energy Conservation Corp., 211 S. Paterson St., Madison 53703, 800-969-9322, www.weccusa.org, manages many programs funded by Public Benefits money. These include the Wisconsin Energy Star Home program and supports for renewable energy projects. The Energy Center of Wisconsin, www.ecw.org, also has programs and publications.

Wisconsin Focus on Energy, www.focusonenergy.com, has commercial and industrial programs. Forest products, metal casting, food processing, biotechnology, printing, chemicals and glass are areas of special interest. It also has programs for commercial buildings, schools, governments, production agriculture, water and wastewater facilities. Financing and technical support are part of the package.

Wisconsin Energy Statistics / 2000 is published by the Wisconsin Energy Division, Department of Administration. It comes in full, 130 p., and highlight, 26 p., forms. The Division also has a newsletter, "Wisconsin Energy News", that tracks happenings of interest in Wisconsin. WED, POB 7868, Madison 53707, 608-267-6931. www.doa.state.wi.us/depb/boe/index.asp.

Home Power: The Hands-On Journal of Home-Made Power, POB 520, Ashland, OR 97520, 800-707-6585, www.homepower.com. A 2nd class mail subscription is \$22.50 for six issues a year. This magazine covers small-scale renewable energy technologies.

Practical Photovoltaics: Electricity from Solar Cells, Richard Komp, 3d edition, Aatec Publications, ISBN 093794811X, 1999, \$18.95. The theory and practice of pv in a non technical presentation. It covers history, manufacture, use and politics.

Wind Power for Home and Business, Paul Gipe, Chelsea Green Publishing Co., ISBN 0930031644, 1993, 432pp, \$35. This is the most complete reference book on wind energy. If you are just learning or looking to buy, this is the book to read.

The Passive Solar House, James Kachadorian, Chelsea Green Publishing Co., ISBN 0930031970, 1997, 220 pp., \$24.95. This plus the *Builder's Guide* will provide the information needed to connect your house with the sun. A high performance home can get a third of its annual heat needs through south-facing windows. About eight per cent of the floor area in south-facing glass is optimum in Wisconsin.

Alternative Energy Sourcebook, ed. John Schaeffer, Real Goods, Ukiah, CA, 1-800-762-7325, www.realgoods.com. This is a fat catalog filled with all kinds of information about renewable and efficiency technology and materials, which Real Goods sells.

Powering the Midwest: Renewable Electricity for the Economy and the Environment, Brower, Tennis & Denzler, Union of Concerned Scientists, www.ucsusa.org, 2 Brattle Square, Cambridge, MA 02238, 617-547-5552. The book is out of print, but findable. The web site is a mine of information.

Rocky Mountain Institute, www.rmi.org, has a newsletter, \$20/yr., and a long list of publications, e.g. *Least-Cost Electricity Strategies for Wisconsin: Practical Opportunities to Save over a Billion Dollars a Year*, which was testimony in the PSC's advanced plan IV, 1985. (IOUs have since killed advanced planning.) RMI is involved in energy, transportation, water, climate change, economic renewal, corporate sustainability, forests and security. It advises nations and utilities as well as working with communities on resource issues and economic revitalization.

The Canadian web site for renewables is worth a cruise: <http://retscreen.gc.ca>. Canada is the lead for the Northern Tier. Housing is a fashion industry, the locus of which is south of St. Louis—that's where most people live. When you look at *House Beautiful* you see patios in Tucson, not basements in Minneapolis. We can no longer afford to build California homes powered by whatever to overcome climate realities. We have to build for our climate. The U.S.' popular media doesn't reflect that. Canadians do.

Energy Federation Inc., has catalogs for compact fluorescent lights and fixtures, weatherization and ventilation products, 800-876-0660.

Efficient appliances: www.homeenergysaver.lbl.gov/HES/ACEEE/intro.html and www.aceee.org.

Windows: www.efficientwindows.org

Green building: www.BuildingGreen.com, www.wgba.org.

Renewable energy, solar +: www.mrea.org (education, contractors); www.aaasolar.com (products), RENEW, www.renewwisconsin.org, (political action).

Natural Capitalism: Creating the Next Industrial Revolution, Paul Hawken, Amory and L. Hunter Lovins, ISBN 0-316-35316-7, Little, Brown & Co., 1999, 396 pg., \$26.95. The book describes a change in the way our economic activity is organized. The energy sector is one part of it.

Power Surge: Guide to the Coming Energy Revolution, Flavin & Lenssen, W.W. Norton, ISBN 0-393-31199-6 (pbk), 1994, 382 pp., \$10.95. This is a Worldwatch, www.worldwatch.org, Environment Watch Environmental Alert Series book.