CHAPTER 5:
Down Home Economics: Priorities, Case Studies, The Way Forward

In mid-2006 Governor Brian Schweitzer convened the Montana Climate Change Advisory Committee. The Committee was charged with developing an inventory and forecast of greenhouse gas (GHG) emissions in Montana and, by July of 2007, presenting the Governor with an action plan recommending how to reduce those emissions.

Many climate scientists state that to keep carbon dioxide concentrations in Earth's atmosphere below 500 PPM (parts per million) and thus reduce the risk of severe climate perturbations, the United States, the planet's largest emitter of carbon dioxide and other greenhouse gases, will have to reduce its GHG emissions by 80 percent by 2025. Others are projecting less stringent targets—for example, giving ourselves another 25 years to achieve that 80 percent reduction (by 2050)—but the point is, we have no hope of meeting any target unless we make a serious commitment, region by region, state by state, to start now.

Adopting the programs recommended in this *Blueprint* would dramatically reduce GHG emissions in Montana and enliven our economy.

To have any hope of doing this, we first need to develop an aggressive approach to conservation and efficiency. Ramping up conservation and efficiency measures is the quickest and surest means to lower greenhouse gas emissions, reduce energy consumption, and save money.

There are many actions that state, city and county governments, businesses, industry, agriculture, and individual citizens can take to dramatically reduce our use of fossil fuels, and our use of raw materials. On the state level, programs such as Energize Montana and the Montana State Buildings Energy Conservation Program promote energy conservation and efficiency. Through utilities such as Northwestern Energy there are programs to provide free home energy audits, lighting rebates for residential and commercial customers, and more.

All these are a commendable start. Unfortunately, many Montanans do not know of these programs and resources. Informing consumers about these

energy-saving programs should be high on the Governor's agenda.

Adopting the programs recommended in this *Blueprint* also would allow Montana to move toward producing all of the energy we need right here, and eventually do so using little or no fossil fuels.

Reducing fossil fuel use, decreasing "throughput" of raw materials, and transforming waste to wealth will increase jobs in both rural and urban areas, revitalize communities, and preserve the environment. If we do this wisely, we will stop misusing our resources, stop abusing our land, water, air and our own well-being, and begin investing our time, energy and money in more truly beneficial ways.

FINANCING FOR AN ENERGY EFFICIENT FUTURE

Securing affordable financing is often one of the biggest hurdles to implementing aggressive efficiency programs and dispersed alternative energy development projects, whether by individuals, cooperatives, small businesses, or communities. Outside investors and entrepreneurs have been somewhat leery of funding larger projects such as wind farms or ethanol plants because they fear return on investment will be too low.

Commercial lenders are usually inexperienced with the technology and therefore have little history on which to base risk evaluations and the probability of timely repayment. The problem for the individual wanting to put in a heat pump system or install solar panels is finding attractive financing options rather than capitalizing the full cost.

Montana is already using some "smart funding" tools; they could be strengthened and others should be considered.

Raising the capital to fund an energy-efficient and sustainable future is not any more difficult than creating the capital to build houses, buy recreational sport vehicles or large diesel pick-ups. Motivation to develop funding streams and finance methodologies is slowed by the pretense that today's conventional energy sources will meet future demand and not overstep environmental limitations. Most leaders have been reticent to convey the challenging news that this is not so; they fear political damage from doing so. A new perspective is necessary. Conserving energy and converting to sustainable energy sources are proactive, positive initiatives that also can grow our economy in appropriate ways. Presenting these as opportunities rather than limitations will encourage investment. Likewise, innovative financial aid programs will hasten acceptance and demonstrate that "best use" practices will discourage "excessive use" patterns.

There are a number of methods for capitalizing efficiency and sustainable energy systems. For example:

- Grant programs (through federal, state, municipal and energy co-ops)
- Rebates (by manufacturers of ENERGY STAR rated products and energy companies)
- Tax Credits (federal and state)
- Green Investment Funds (via concerned investors and consumer choice programs)
- Energy Efficient Loan Funds (Montana could adopt the Ohio Department of Development model[88]).
- Energy Backed Securities
- Debt Financing (through banks)
- Carbon Credits (once adopted)
- Interest Free Bonds (through counties and cities)
- Revenue Bonds (through cities and counties – these don't require voter approval)
- Third Party Financing (by, for example, Energy Service Companies)
- Equity Capital Pools (created by the state)
- Self Financing (for those who see a direct return on investment)

With each of these programs, political will and public understanding are necessary building blocks to a sustainable future.

RATHER THAN SUBSIDIZING LOW INCOME MONTANANS TO KEEP PAYING HIGH HEATING BILLS, WE COULD FUND A PERMANENT SOLUTION: ENERGY EFFICIENT RETROFITTING OF HEATING SYSTEMS AND POORLY INSULATED HOUSING.

One tool to raise money for funding energy efficiency education, alternative energy project grants and loans, etc., has been successfully used in a number of states, including Montana. It is the **Universal Systems Benefits (USB) Fund**, also known as Public Benefit Funds, System Benefit Funds, or Public Good Charges. These are state controlled funds generated by levying a small surcharge on consumer electricity consumption. In Montana, 2.5 percent of a utility's retail sales are to be set aside to fund "energy conservation, renewable resource projects and applications, low-income energy assistance, and conservation education."[89] Currently 21 percent of this fund is allocated toward low-income energy assistance. This includes bill-paying

88 Ohio Department of Development: <www.odod.state.oh.us/cdd/iee/GrantsLoans.htm>. See also Ohio's Clean Power Estimator <www.clean-power.com/ohio>.

89 MCA 69-8-402. Universal System Benefits programs.

assistance, weatherization, and small low-income renewable energy projects.

Rather than just giving subsidies to help low-income Montanans with high heating bills, a wiser course would be to **fund the retrofitting of inefficient heating systems and poorly insulated housing**. This would reduce heating requirements permanently, enhancing local business while reducing greenhouse gas emissions. The more energy efficient we become *now*, the better positioned our entire society will be when energy costs become excessive. By putting forth funding and policy efforts to *plan* for higher energy costs, we can avoid calamitous energy bill increases and ill-conceived radical reforms.

Another tool that Montana State government currently uses is the Montana State Building and Conservation Bond program.[90] This program, administered by the Department of Environmental Quality (DEQ), is designed to **finance energy improvement projects** including lighting upgrades, building re-commissioning, and insulation upgrades on state-owned buildings. Bonds are repaid through energy savings.

This idea could be applied on a much broader scale in Montana. Pennsylvania, for instance, uses an independent public financing authority to award grants, loans, and loan guarantees to finance clean, advanced energy projects within the state, including wind, solar energy, biomass, and demand-management projects. In 2005, the New Mexico legislature passed the Energy Efficiency and Renewable Energy Bonding Act to provide $20 million in bonds to fund solar and energy efficiency retrofits for public buildings.[91] The state expects to save $46 million in energy savings over the life of the project.

Industrial development bonds are a type of funding where private investors provide loans to companies through the state or local government. The government sells bonds to investors and uses the proceeds to make loans to private businesses.

Montana currently has an **alternative energy revolving loan program** offering ten-year low interest loans up to $40,000 that can be used by homeowners, small businesses, non-profits, and government entities to install alternative energy systems.

States can use several financial mechanisms to make renewable energy investments more attractive to outside investors and entrepreneurs; these include loan guarantees, subordinated debt, and accelerated depreciation. **Loan guarantees** are guarantees to a commercial lender that if a developer defaults

90 <deq.mt.gov/Energy/buildings/StateBuildings.asp>.

91 New Mexico Statutes. Chapter 6. Public Finances. Article 2ID. Energy Efficiency and Renewable Energy Bonding Act. N.M. State. Ann. § 6-2ID-2. <www.dsireusa.org/documents/Incentives/NM07F.htm>.

on the loan, the state will perform on the loan. **Subordinated debt** can help lower private investor risk by subordinating state loans to development projects to those made by private interests; in case of default the private lender will have first right of recovery. Lastly, states can allow **accelerated depreciation** for the cost of renewable energy project development, whereby developers can write off equipment costs to renewable energy-related projects more quickly than under regular depreciation rules.

Tax incentives and grants are the most popular mechanisms used by governments to encourage adoption of alternative energy technologies, but they often only capture "early adopters." The availability of **long-term, low interest loans** to finance projects has had much more success than relying solely on tax incentives and grants.

These creative finance options need not necessarily be provided directly through governments or even through banks. Several private companies have set up "distributed energy utilities" where they provide services to residential and commercial customers. These companies frequently retain full or partial ownership of installations, and also make low interest loans, or incorporate loan repayment into monthly utility bills.

CASE STUDY:
A NEAR-ZERO ENERGY HOME IN RED LODGE, MONTANA

Borrowing a 20-year-old design from Suncraft Homes of Billings, Montana (a now defunct solar design-and-build firm that flourished in the era of the old tax credits for solar energy) Dopler Solar (DS) built a modern version of a Sun-Terra home in 2006. The goal is near-zero energy use: design the home to use as little energy as possible and incorporate sensible solar.

The home is located in Red Lodge, Montana, on Sixth and Cooper, and is occupied by Brent and Jody Moore. The primary features that differentiate the home from ordinary residences:

Home Envelope

- The **insulation in the walls** is approximately R-30.[92] This was achieved by using blown-in cellulose between the 2x6 studs (R-21). The outside of the framing has a 1" Thermax sheeting (R-6.5). The inside of the wall has a 1/2" Thermax sheeting (R-3.25). The primary advantage of blown-in cellulose is that it covers the entire cavity area. There are no voids around wiring and plumbing. The product is also Montana-made from recycled newspaper. There are also a number of ways to create well-insulated walls

92 R is a value that measures resistance to heat transfer. The higher the R-value the more insulation is provided.

using double-stud construction and foam panels. *Added cost to the home beyond ordinary insulation practices (cellulose is the same cost as fiberglass batts which are normally used) are for Thermax $1,540, additional labor $600, for a total of $2,140.*

- The **ceiling is insulated** to R-60 using the blown-in cellulose. *Added cost for extra quantity of insulation: $225*
- An **airtight vapor barrier** was created on the inside of the home by caulking all electrical boxes and foaming all interior framing penetrations. *Added cost of labor and materials: $250*
- Because there is an airtight vapor barrier, some sort of ventilation is necessary. A Denmark **air-to-air heat exchanger** was used. This recovers 80 percent of the exhausted heat. *Added cost $1600 less costs of other fans that would have been used (-$500). Total $1100*

Thus, the total costs of the extra insulation and heat exchanger were *$3,715*.

According to heat-loss calculations done by Jim Maunder of the National Center for Appropriate Technology, the annual cost to heat this home with natural gas would be $590.14. This represents a savings of approximately $200 to $400 per year over a standard ENERGY STAR home. The 10 to 15-year payback period assumes that the price of natural gas will remain stable, which is highly unlikely. Super-insulation insulates the owner from exorbitant price hikes in energy.

Compared to a non-ENERGY STAR home, or a home with ineffective fiberglass batts for wall insulation, the difference would be far more dramatic, and yield a much quicker payback period.

Solar Aspects

Passive solar design does not cost more than any other design. The basic idea is to put the large windows on the south side of the home and keep the north windows to the minimum required for emergency egress. Windows on the east and west side should be used with discretion to avoid overheating.

Calculating the exact savings is more difficult as most heat-loss models do not take window placement into account. Determining heat savings also requires homeowner habits be part of the formula.

In this example, the 110 sq. ft. of glass facing south equals enough glass to certainly supply most daytime heating needs, and more. Red Lodge and most of Eastern Montana have sunshine about 75 percent of the time.

The **solar thermal system** consists of three evacuated tube collectors for a total of 116 sq.ft collector area. Cost of the system installed was $10,500.

According to calculations by USA Solar, the primary source of data in

this area, and also with confirmation of figures from Stiebel-Eltron (German manufacturer of solar tanks), the heat put out by this system is rather amazing, topping out at 28,051 Btu's per hour, and with a payback of 15.66 years, assuming a $2,000 Solar Tax credit, and no inflation for the price of fuel.

This installation will essentially pay for all of the domestic hot water (DHW) and about 50 percent of the heat.

The European-made tubes have been in use for over 20 years and have a solid history of performance, especially in colder climates. The system will last 20 to 30 years and the price of energy will in all likelihood increase, making the cost-to-savings ratio very attractive. The entry of Chinese manufacturers into this market has made newer installations even more cost-effective. The Chinese manufacture evacuated tubes, similar to those used in this example, at a much lower cost than those manufactured in Europe.

A smaller domestic hot water-only system has a payback of just over 24 years. Efficiency of scale using Solar Thermal Systems on commercial levels today can produce simple no-tax-credit paybacks of 10 years.

The **photovoltaic system** consists of 1100 watts of panels with a Sunny Boy inverter. Sundance Solar of Luther, Montana, installed the system, for a bid price of $9,500. A grant of $3,500 was received from Northwest Energy (NWE). The system produces an average of 175 kWh of electricity per month. Currently one kilowatt hour from NWE costs $0.089 which means the system saves about $187 per year. With a $2,000 solar tax credit, this nets a payback of about 24 years.

The good news here is that the system will operate for a very long time. In 50 years, it is estimated that the collectors will operate at 95 percent of their current level of efficiency.

Lighting and electrical use. This leads us back to the basics. At the heart of the ENERGY STAR home program is the requirement of 50 percent usage of compact fluorescent light bulbs, and the use of at least two ENERGY STAR light fixtures, which use a non-screw-in light bulb that has a standard life expectancy 30 times that of a regular incandescent bulb. Compact florescent bulbs use 30 percent of the electricity of incandescent bulbs. The Red Lodge home has 22 light fixtures and all but six of these fixtures use the ENERGY STAR products. It is also required that all hard-wired fixtures use ENERGY STAR appliances (for example, a dishwasher). In the Red Lodge home all the appliances are ENERGY STAR compliant.

ENERGY STAR bulbs and fixtures have become so common that the fixtures are the same price as regular fixtures. Likewise, ENERGY STAR appliances are similar in cost to higher energy using models.

A regular new refrigerator may use 550kWh per year. However, twenty years ago, a refrigerator may have used 2,000 kWh/year! When it's time to upgrade or replace an appliance, buying a new model is much better and cost effective choice in terms of energy savings and efficiency.

The goal in this home is to reduce the consumption of electricity from a NorthWestern Energy (NWE) average of 750 kilowatt hours/month to around 350kwh/month and have solar provide 50 percent of that electricity. Again, behavior plays a key role. Restrictions in many new neighborhoods are counter-productive to saving energy (for example, banning outdoor clothes lines and restricting orientation to face the street instead of facing south toward the sun).

Conclusions and Recommendations

All of the conservation measures used in the home were cost-effective and easy to implement. The active solar systems have begun to become much more cost-effective because of tax credits and support from Montana's Universal Systems Benefit (USB) program, as well as from technological innovations which continue to drive down costs and increase efficiency.

Another aspect that makes an active components system feasible is that there is a growing market for the product. Likewise, the conservation of natural gas saves the consumer money directly, as does net metering of electricity. According to the July-August 2006 issue of Solar Today, programs that support the use of renewables with direct economic benefits to parties who purchase and install them have had the most widespread success.[93]

A total of $5,400 in **federal and state tax credits** is available to the purchasers of this home.

The $500 tax credit offered by Montana is a good start, but it is the only tax credit available and applies to everything from new windows and insulation to active solar systems. A progressive tax credit that begins with insulation and ends with active solar would be more useful, and could be paid out in proportional increments according to energy savings. In other words, a 30 percent tax credit for insulation, vapor barrier, windows and ENERGY STAR upgrades would provide a strong incentive for energy-wise building practices. After an initial conservation level has been achieved, this credit should be followed by another credit for active solar, wind, biomass, and heat pumps.

The State of Montana has taken positive steps by increasing the standards for building insulation, but needs to follow up by assuring that these standards are effectively implemented. Laws that are never enforced in the

93 "Confronting the Climate Change Crisis". Solar Today. July-August 2006. <www.solartoday.org/2006/july_aug06/toc_JA06.htm>.

counties, and only sporadically in selected cities, do not add up to better building practices.

The new concept of energy efficiency and conservation recognizes that **it is worthwhile for society to pay for energy NOT needed** (conserved) and therefore not produced. All energy providers are paid currently for product sold, not for product—or energy—saved. Turning that system around will generate incentives and cost savings for producers and consumers, as well as reduce consumption of non-renewable resources.

In light of this, it is obvious that all aspects and techniques of conservation should be implemented before building new electrical generating facilities, especially those that pollute. They simply may not be needed.

NorthWestern Energy, the investor-owned utility that serves this Red Lodge home and the surrounding area, has done a reasonable job promoting ENERGY STAR, net metering of solar photovoltaic and wind energy, and legitimately using USB monies for conservation. The rural electric co-ops, however, have some catching up to do as they do not yet allow net metering, and their conservation programs need much greater visibility and support.

LEVELING THE PLAYING FIELD

A frequently heard claim: all would be well in the economy if we "just let the market work."

POLLUTION OF AIR, WATER AND SOIL ARE THREATS TO OUR HEALTH. IF ENERGY COMPANIES ARE ALLOWED TO PASS ON THESE COSTS TO THE PUBLIC, THEY BECOME HIDDEN SUBSIDIES.

In the case of energy, that would be a fantastic idea. The United States government has subsidized the production of oil, gas, and coal-based energy in the U.S. since the 1920s, and the nuclear industry since the 1940s. The U.S. government covers most of the costs of clean-up of nuclear waste. Taxpayers contribute between $4 billion and $30 billion annually to the energy sector.

Between 1948 and 1998 the federal government spent $111.5 billion on energy research and development (R&D). Sixty percent of this was dedicated to nuclear R&D and 23 percent to fossil fuel R&D, while just 10 percent went to renewable energy R&D and 7 percent went to conservation.

In the Energy Policy Act signed by President George Bush in 2005, the percentages are a little better, but still very lopsided. The act grants $4.3 billion for nuclear power, $2.8 billion for fossil fuel production, and another $1.6 billion for 'clean coal' facilities. A renewable electricity production credit is slated to get $2.7 billion, with $1.3 billion going to energy efficiency and conservation and $1.3 billion to alternative motor vehicles and fuels. The bill contained no provisions for increasing vehicle fuel efficiency (CAFE)

standards or requiring increased reliance on non-greenhouse gas (GHG) producing energy sources.

Oil companies have seen previously unheard of profits in the past few years, and definitely do not need extra subsidies. In fact, past subsidies—presumably to enhance exploration and recovery—have often been used by these companies to invest in shopping malls, grocery chains, timber products, and mining ventures. In addition, there are a variety of tax loopholes that benefit the oil companies to the tune of about $15 billion annually, and benefit auto companies by about $10 billion annually. Yet oil companies are still receiving incentives to explore for more oil, and are given depletion allowances after they find it, and royalty holidays to develop it.

From its beginning as a weapons program, the nuclear energy industry has continuously relied on federal subsidies to survive, and has thus shown its inability to compete economically on its own as a viable power source. In an effort to revive nuclear power, its proponents have been attempting to present it as a safe, clean, renewable, and viable option to meet our energy needs. History and economics clearly show the opposite.

There are other hidden costs and subsidies that are never figured into energy costs, like environmental and health damages. These are often referred to as **externalities**. They include air pollution, GHG emissions, mercury, and acid rain. Power plants burning coal and other fossil fuels, emit sulfur dioxide and nitrogen oxides, which create concentrations of fine particles (soot) and ozone (smog), degrading the health of 175 million U.S. citizens each year. Each year, soot alone is estimated to cause 30,000 premature deaths; 20,000 hospitalizations and 7,000 emergency room visits; 18,000 cases of chronic bronchitis; 160,000 asthma attacks; and 5 million lost work days. Overall, the cost of illness and death associated with air pollution in the U.S., mostly from fossil fuel use, has been estimated at $182 billion annually.[94] Military protection of oil facilities and transport is a difficult subsidy to quantify, especially in the wake of present "difficulties" in the Persian Gulf region, but it is a subsidy to the oil and gas industries estimated to cost U.S. taxpayers (ten years ago) as much as $50 billion dollars annually.

Nuclear and coal-fired power plants use up enormous amounts of water for cooling purposes. The scarcity of water and continuing droughts exacerbated by global warming make this a huge cost for humans and the natural environment. Mining for uranium and coal, and drilling for oil and

94 "The Bush Administration Air Pollution Plan: More Soot and Smog Means Staggering Toll of Avoidable Health Damage"—Clear the Air Organization <www.cleartheair.org/proactive/newsroom/release.vtml?id=24761>. Also G.P. Dauncey and Massa, "Stormy Weather" (New Society Publishers, Gabriola Island, B.C., 2001.

natural gas, can be immensely destructive of riparian zones, wildlife areas, and other sensitive ecosystems. The health of Earth and its plants and animals are compromised to subsidize this kind of energy development.

Environmental degradation is a form of subsidy when energy companies pass the cost of air pollution, water consumption, and land degradation onto the public. Energy companies must accept full responsibility for, and implement total reclamation. In passing this cost onto consumers, energy companies will more accurately demonstrate the true cost of fossil fuels. To ensure that taxpayers do not get stuck with reclamation bills, Montana should allow no new coal mines until coal companies fully reclaim existing mined land.

Many alternative energy sources can favorably compete with fossil fuels in today's market, even with these unequal subsidies. If these unfair loopholes and subsidies were curtailed, it would greatly enhance the speed with which conservation, efficiency, and clean alternative power is adopted in the nation and in Montana. If a percentage of these subsidies were transferred to alternative energy and conservation research and development, assistance, and implementation, it would speed the process even more.

As most of the above-mentioned tax loopholes and subsidies are federal, Montanans need to elect representatives who will support the elimination of these loopholes and subsidies to fossil fuels and nuclear energy, and thus, level the playing field for alternative energy and conservation development in Montana.

CASE STUDY: THE HIGHWOOD COAL PLANT—WINDPOWER IS A BETTER DEAL, CONSERVATION BEST

By early fall 2006, the fate of the proposed Highwood Power Plant, east of Great Falls, resided in the hands of one state and one federal agency. Both the DEQ—Montana's Department of Environmental Quality—and the U.S. Rural Utilities Service already had indicated their provisional approval of this 250-megawatt (MW), "fluidized bed" coal-fired electrical generating facility, before soliciting additional public comments which flooded their offices. Then in February 2007, both agencies said yes to the plan and invited final public comments.

If Highwood does receive all necessary permits despite the many concerns raised—especially by Montana Environmental Information Center and a local group called Citizens for Clean Energy—this coal-fired plant may be able to secure much of the financing through the federal government. If so, taxpayers need to ask whether it is appropriate that tax dollars are helping to finance a 250 megawatt "solution" to a 37 megawatt problem.

Highwood was conceived by the Southern Montana Electric Generation and Transmission Cooperative (SME) comprised of five rural electric cooperatives in south-central Montana. SME is partnering with the City of Great Falls, counting on that city's rights to Missouri River water.

According to figures culled from public records, the five SME co-ops annually consume about 57 average megawatts (avMW), of which 20 avMW are supplied by a long-term contract with the Western Area Power Administration (WAPA), while the other 37 avMW come from the Bonneville Power Administration (BPA).[95] BPA is pulling back from supplying its relatively inexpensive (largely hydro) power outside its own region; Montana east of the Rockies is outside BPA's region. The impending expiration of the co-ops' contract with BPA is the stated rationale for the Highwood power plant.

However, if the Highwood plant actually is built and if it produces about 225 avMW annually (a realistic 90 percent of its 250 MW "capacity"), it would instantly be looking for customers to buy 188 avMW (225 minus 37) of its relatively high-priced "new coal" power (new coal plants are selling power in the range of 5-7 cents per kilowatt hour, or even higher).

The City of Great Falls now is served by NorthWestern Energy. Will "new coal" power from Highwood be able to undersell NWE's mix of sources – "old coal" and "old hydro" from PPL-Montana's power plants and dams, new windpower from the Judith Gap windfarm, plus some "spot market" purchases? This seems unlikely.

Even if Great Falls, as a partner with SME, is allowed to reject NWE power and chooses to buy Highwood power, this would still leave approximately 125 avMW (225 minus 100) to sell…somewhere. But where in Montana is there demand for an additional 125 to 188 average megawatts of power? Montana currently consumes only half of the power now generated in-state, and the remainder fills existing power lines.

This means that Highwood is a merchant power plant, looking for customers to buy the excess power that it produces. Is it the mission of the Rural Utilities Service to facilitate merchant power plants?

Likewise, where is the transmission capacity to wheel this much power (leaking all the way) to distant markets? Even if expensive new transmission capacity were constructed (and not just talked about), many of those distant markets (California, Oregon, Washington) are investing more and more in localized solutions, including conservation and renewable energy, and are refus-

95 Information about SME can be found at <www.smegt.net>. More information about Highwood project impacts can be found at the Montana Environmental Information Center website, <www.meic.org> and also at the Citizens for Clean Energy website, <www.cce-mt.org>.

COMPARATIVE COSTS —COAL VERSUS WINDPOWER

	HIGHWOOD (COAL)	EQUIVALENT WINDPOWER
Megawatts	250	250
Construction cost	$515 million (original estimate; possibly as high as $750 million due to increased costs)	$377 million (based on Judith Gap Windfarm costs, inflated to account for increases in material costs)
Time to construct	5 or more years	1 to 2 years, depends on demand
Optimal longevity	30-35 years	25-30 years or more
Land use	Mines, plant site, railroads, roads, powerlines	Windfarms, service roads, powerlines
Water use per year	1.7 billion gallons (enough for 26,000 people)	Zero
Fuel cost	Coal—1.2 million tons/year, $7.50-$15/ton plus shipping at $9/ton	Zero (no shipping cost)
Emissions	Oxides of sulfur, nitrogen, carbon. Toxins such as mercury. Greenhouse gases. Soot, ash.	Zero
Health Effects	Diseases of lungs, blood, neurological systems	Zero
Price per kWh (Does not include distribtion costs)	5 to 9 cents (5 is unrealistically low for new coal; 9 assumes future carbon penalties or costs to sequester)	3.5 to 4.5 cents (includes "firming power costs estimated at 1/2 cent/kWh)
Customers	Five southern Montana co-ops, average demand 37 MW. (If Great Falls buys, could rise as high as 100 MW.)	Utilities like Northwestern Energy or customers demanding lower priced and/or "green" power
Excess Power	90% of 250 MW = 225 MW 225 avMW - 37 = 188 excess (If Great Falls buys power, 225 avMW - 100 = 150 excess.)	Zero (Assuming windpower remains cheapest new power source and comes online following demand.)

This chart illustrates comparative costs of the proposed "baseload" Highwood coal-fired power plant and an equivalent amount of "supplemental" windpower, either from large scale centralized windfarms like Judith Gap or smaller dispersed facilities. NorthWestern Energy contracts to buy Judith Gap windpower for an average 3.116 cents per kilowatt hour (kWh) but since the winds do not blow constantly, this needs to be "firmed"—or backed up—by other power sources, bumping the actual price to 3.6 to 4.1 cents/kWh. To be safe, we project 3.5 to 4.5 cents per kWh. The increase in coal plant construction costs is derived from a Feb. 2007 "Review of the Proposed Highwood Generating Station" done for the City of Great Falls by R.W. Beck, a Seattle engineering firm.

ing to import electricity that is not generated by "clean" sources. The Highwood power plant, if it is built, would not be clean.

What the "comparative costs" chart does **not** address is one more factor: whether generating any new electricity is actually necessary.

Cheaper even than existing hydropower (in the range of 2-3 cents/kWh) or new windpower (3.5-4.5 cents/kWh) is energy conservation in its myriad forms.[96] From replacing incandescent lightbulbs with more efficient compact fluorescent bulbs, and unplugging the computer from the power strip when it's not in use, to weatherstripping doors and windows: all such energy efficiency investments and energy conserving actions reduce demand. If priced in terms of "avoided costs" (electricity that does not need to be produced, power plants that need not be built), they are worth 1 to 2 cents/kWh. Some cost no money at all, only time—the time it takes on a winter morning to raise an insulated curtain on a south-facing window and the time it takes to lower it at night.

Montana's rural electric cooperatives, the City of Great Falls, and Montana as a whole would avoid enormous capital investments in another expensive, polluting, centralized fossil fuel generating plant, if instead they invested in cost-effective energy conservation measures, then in decentralized, diverse renewable energy facilities like wind, solar, small hydro, bio-fuels and geothermal.

In the co-ops' case, wind generators could be sited on their own members' properties, earning income for those members, with power flowing into the co-ops' own lines. Then if they then continued to work with their members to insulate, weatherize, invest in co-generation and other forms of energy efficiency, Montana's Rural Electric Cooperatives ultimately could aim to produce all the power they needed from a variety of decentralized, clean, renewable sources.

The numbers don't lie.

JOBS IN RENEWABLES OUTPACE JOBS IN FOSSIL FUELS

AERO's *Blueprint* for sustainable energy policy in Montana does more than repower our homes; it will repower our economy as well. Not only does renewable energy provide more jobs than finite fossil fuel power plants, but it also offers greater diversity in jobs on a larger geographic scale—a perfect fit for our unique state. The U.S. Department of Energy agrees that large, centralized power plants are no longer cost-effective, nor desirable, for meeting energy demands, especially in rural areas.[97] According to the Union of Concerned

96 For details and sources, please refer to Chapters 2 and 4 of this document.

97 <wwwI.eere.energy.gov/biomass/economic_growth.html#biomass>.

Scientists (UCS), if the U.S. commits to producing 20 percent of its electricity from renewables by 2020, combined with a commitment to improved energy efficiency, consumers would save $440 billion dollars in energy costs and farmers would benefit from increased and diversified income that would counteract swings in commodity prices.[98]

It is a complete myth that clean energy is too expensive and is a threat to job security; in fact, renewable energy policy yields the exact opposite. Because a majority of the renewable potential affects agricultural and rural areas, Montana's farmers and ranchers stand to benefit greatly from clean energy. Whether it be from increased conservation and support for energy efficient homes, individual solar systems, wind turbine lease payments, biomass from agricultural residues, or production of high-energy crops for fuel, Montana will benefit from a repowered system based upon conservation and clean energy development.

By making our homes and businesses more energy efficient, we can create and sustain jobs, and invest in our own communities. According to a study done by the Regional Economics Applications Laboratory and the Environmental Law & Policy Center, if the Midwest invested in energy efficiency, that would save 17 percent of electricity under our current status (Business as Usual) by 2010, and up to 84,000 jobs can be created with local income of up to $1.8 billion.[99] Under this same plan, saving 28 percent of Business as Usual electricity by 2020 would create 140,000 jobs and generate a local income of $3.2 billion.

According to the Renewable Energy Policy Project (REPP), from fuel collection, manufacture, plant construction and operation, renewable energy provides greater job prospects and stability than coal power per megawatt (MW) generated and $1 million spent.[100 & 101] This study demonstrates how solar power and wind offer 40+ percent more jobs per dollar spent than new coal power plants. Solar energy has an annual growth rate of 9 percent nationally and 43 percent worldwide, while wind power has an annual growth rate of 49

98 "Clean Energy Blueprint Benefits Farmers and Rural Economies". Union of Concerned Scientists. <www.ucsusa.org/clean_energy/clean_energy_policies/clean-energy-blueprint-benefits-farmers-and-rural-economies.html>. Last viewed 2/7/07.

99 Environmental Law and Policy Center 2001. "Job Jolt. The Economic Impacts of Repowering the Midwest: The Clean Energy Development Plan for the Heartland." <www.repowermidwest>.

100 The following analysis does not include jobs resulting from the multiplier effect or jobs for manufacturing basic inputs such as steel for wind turbine towers.

101 Singh, Veranda and Jeffrey Fears. "The Work that Goes into Renewable Energy". REPP: November 2001. <www.crest.org/repp/index.html> scroll down to link to report.

percent nationally and 28 percent worldwide.[102] This study also maintains that while co-firing with biomass may not employ more people on a power output basis, the range of job opportunities with biomass production is greater than that required by coal power. Thus, co-firing with biomass will ultimately employ more workers than coal. It will also cost less as co-firing does not require construction of a new power plant, and risk the potential of imported jobs rather than supporting the employment marketplace in Montana. Whether the move toward renewable energy capacity stems from environmental regulation or consumer choice, these trends indicate increasing renewable energy policy practices.

According to the Apollo Alliance's plan to make the U.S. independent from foreign oil in 10 years, Montana has the potential to create 7,670 new jobs in manufacturing, transportation, construction, *and* in coal mining.[103] The Western Resource Advocates maintain that under this plan, Montana stands to gain $453 million in economic activity with $299 million of that from increased income. This same study shows that if we keep using energy under Business as Usual, seven states of the Rocky Mountain west will lose $7.3 billion dollars annually to energy monopolies by 2020 than would be necessary if these states committed to an energy plan with 20 percent electricity from wind and renewables by 2020. Not only will the latter create the thousands of jobs stated earlier, but it will create 98 more megawatts, a cleaner environment and better future for our families.

The American Wind Energy Association (AWEA) ranks Montana as fifth in the nation in wind energy potential, with the capability to produce 1020 billion kWh of electricity.[104] The AWEA also maintains that a single, utility-scale wind turbine provides a minimum of $2,000/year or more in income to a landowner leasing his wind rights, with farmers still being able to grow crops up to the base of the turbines on their land.[105] Experience with more lucrative leases puts the figure at $4,000 and above.

According to the U.S. Department of Energy, generating 5 percent of the country's electricity with wind power by 2020 would create 80,000 new jobs. The REPP estimates that boosting U.S. wind energy installations to generate 50,000 MW of electricity could create 150,000 manufacturing jobs alone

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102 Ibid. Singh, Veranda and Jeffrey Fears.

103< www.apolloalliance.org/regional_projects/apollo_in_the_regions/montana/index.cfm>.

104 <www.awea.org/news/Annual_Industry_Rankings_Continued_Growth_031506.html>; <www.awea.org/projects/montana.html>.

105 American Wind Energy Association. "Wind Energy Fast Facts." <www.awea.org/newsroom/FastFacts2006.pdf>.

nationwide. Montana has the potential to create 867 of these jobs at active manufacturing firms that can enter the wind turbine market right now.[106] According to this same study, with a large-scale national investment in wind power, Montana also stands to bring in up to $70 million as a result of this investment in already active firms in our state with the means to manufacture wind turbine components.

One study projects that an aggressive clean energy development program in a ten-state area in the Midwest would create 200,000 new jobs by 2020, generate up to $5.5 billion in additional workers' income, and up to $20 billion in increased economic activity.[107] This study highlights two projects in particular. One is a 107 MW wind project in Minnesota in 1998 that created 10 full time jobs, brought $1 million in property tax revenue to counties annually, and $50-55 per acre lease payments to farmers. The other is a 240 MW Iowa project that provided 200 six month long construction jobs, 40 permanent jobs, $2 million per year in taxes, and $640,000 per year in direct lease payments.

DECENTRALIZED RENEWABLE ENERGY PROVIDES MORE JOBS THAN CENTRALIZED FOSSIL FUEL POWER PLANTS, AND THESE JOBS ARE MORE DIVERSE AND SPREAD OVER A LARGER AREA —A PERFECT FIT FOR OUR STATE.

In Montana, the Judith Gap wind farm paid impact fees to Wheatland County and is paying property taxes as well. Private ranchers and the State of Montana all receive lease money for generators on their lands (the state income goes into the school fund). There have been 11 permanent jobs created for this 135 MW wind farm, which comes close to the 10 job for 107 MW ratio in the Minnesota project.[108]

The Renewable Energy Policy Project maintains that wind farms that generate 37.5 MW yield an average of 4.8 job-years of employment for every megawatt (MW) produced. The same study also maintains that for every $1 million dollar spent throughout the 10 year operation of the plant (including capital and construction), wind energy will create 5.7 job-years, whereas coal yields only 3.96 job-years. According to the Union of Concerned Scientists, if Washington state moves to generate 15 percent of its electricity from renewable energy sources by 2015, they will create 2,000 new jobs by

106 Sterzinger, George and Matt Svrcek. "Wind Turbine Development: Location of Manufacturing Activity". REPP: September 2004. p63. <www.crest.org/wind_turbine_dev.htm>.

107 Environmental Law and Policy Center 2001. "Job Jolt. The Economic Impacts of Repowering the Midwest: The Clean Energy Development Plan for the Heartland." <www.repowermidwest.org>.

108 Puckett, Karl. "A year into project, Judith Gap turbines a huge success." Great Falls Tribune. 11/19/2006.

2025, 2.6 times more the employment opportunities that could be created by fossil-fuel energy generation.[109]

Capturing the sun's energy can save Montanans a lot of money beyond meeting its electric needs. By drying crops, heating buildings, or powering a water pump, photovoltaic (PV) systems can make Montana farms more efficient. Solar power also has the capacity to create and enhance jobs as a decentralized source of power. According to the REPP, distributed 2-kW solar photovoltaic systems create 35.5 job-years per MW installed.[110] Residential solar power requires skilled builders and electricians to install the solar panels, introducing new skills for existing jobs and creating new jobs as well, all across the state of Montana.

Because biomass uses crop residues and energy crops for power production, Montana has the potential to be a leader in biofuels nationwide. According to the UCS Clean Energy Blueprint, the Department of Energy maintains that if the U.S. uses biomass for energy at three times the current levels, farmers and rural communities would receive as much as $20 billion dollars in new income.[111] Using biomass for energy production not only reduces greenhouse gases and fossil fuel dependence nationwide, but also provides greater income for farmers, more employment opportunities, and a boosts the economy. Biomass will support economic development for farmers and rural areas in Montana. It helps growing rural areas keep the wealth in local communities while meeting increasing energy and economic demands with minimal environmental impact and maintaining of the Montana's high quality of life.

Over time, economies of scale and technological advancements may streamline manufacture of plant components and lower operation and maintenance needs. However, coal will inevitably become more expensive with its continued use and declining supply as will the ability to sequester CO_2 from burning coal. According to the Worldwatch Institute, from 1980 and 1999, U.S. coal production increased by 32 percent, whereas employment in the coal industry fell from 242,000 to 83,000 workers, with an expected future job loss of an additional 30,000 jobs by 2020, regardless of future coal demand.[112] In

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109 Union of Concerned Scientists. "Clean Energy Ballot Initiative Expected to Save $1.1 Billion on Electric Bills by 2025". <www.ucsusa.org/news/press_release/clean-energy-ballot.html>

110 Ibid. Singh, Veranda and Jeffrey Fehrs.

111 Power, Tom. Coal Development as Economic Development. May 15, 2006 <www.ucsusa.org/clean_energy/clean_energy_policies/clean-energy-blueprint-benefits-farmers-and-rural-economies.html>.

112 "American Energy: The Renewable Path to Energy Security." Worldwatch Institute: Center for American Progress: Washington, DC. September 2006. <images1.americanprogress.org/il80web20037/americanenergynow/AmericanEnergy.pdf>.

the last half of the century, coal employment dropped by 75 percent even as coal production doubled.[113] Specifically, in the past twenty years, Montana's coal production has increased by 25 percent but coal employment dropped by nearly 50 percent. Labor-displacing technology in a nonrenewable resource based industry exacerbates unemployment in fossil fuel industries.

Numerous studies have shown that improving efficiency, ramping up conservation efforts, and increasing the use of clean, renewable energy resources can have large positive impacts on job creation and local economies, especially rural communities. The fossil fuel industry does not sustain communities, it only creates ghost towns. Businesses do not like to invest in their boom and bust cycles, nor does anyone want environmental devastation in their own backyard. Renewable energy offers greater and more diverse job potential and new opportunities for workers in Montana.[114] The AERO blueprint supports conservation and diversified, decentralized energy opportunities for Montana. A combination of wind, solar, and biomass production will support the economy by creating and sustaining jobs and communities, and will also safeguard the high quality of life that all Montanans should never have to give up. Renewables are a smart investment for energy, jobs, the environment, and Montana.

CASE STUDY: BIODIESEL— CHEAPER, FASTER, CLEANER THAN COAL-DERIVED SYNFUEL

When Governor Brian Schweitzer announced industry plans to build a coal-to-liquid-fuel plant in the Bull Mountains, Wilbur Wood, one of the authors of this report, asked Jeanne Charter, a Bull Mountain rancher, for her reaction.

"While we have environmental concerns about this proposal," Charter said, "right now the issue is sensible energy policy for Montana. Renewables like wind and biodiesel are cheaper, faster and cleaner. We think the Governor is backing the slowest horse in the race."[115]

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113 Power, Tom. "Coal Development as Economic Development". May 15, 2006 <www.mtpr.net/commentaries/212>.

114 Climate Solutions 2001. "Poised For Profit." <www.climatesolutions.org/pubs/pdfs/CleanEnergyReport.pdf>; Economic Policy Institute 2002. "Clean Energy and Jobs"; Environmental Law and Policy Center 2001. "Job Jolt. The Economic Impacts of Repowering the Midwest: The Clean Energy Development Plan for the Heartland." <www.repowermidwest.org>; Economic Policy Institute and the Apollo Alliance 2006. "Clean Energy for a Growing Economy." <www.apolloalliance.org/strategy_center/reports_and_resources/index.cfm>.

115 Jeanne Charter, reported by Wilbur Wood, "How Real Is Synfuel Plant for Bull Mountains?" in Billings Outpost, Oct. 12, 2006.

Schweitzer claimed the $1.3 billion project would take seven years to be pumping out 22,000 barrels of synthetic diesel fuel per day, and also generating 300 megawatts of electricity. Charter countered that the project could take up to ten years to build, and those billions of dollars would be better spent on energy efficiency and renewable technologies.

"They could come on line within a year or two and do a lot more to support widespread prosperity in rural Montana and provide more affordable energy," she said. "This project will likely be obsolete before it is built, given that renewable energy costs (like solar electric cells) are coming down very rapidly."

Biodiesel is the obvious alternative, and as the chart on page 91 shows, it indeed is cheaper, faster and cleaner. And it uses virtually no water.

Converting coal to a gas, then to a liquid, is very energy-intensive. A significant portion of those 300 megawatts of electricity that the plant generates could go to running the plant itself. (In a traditional coal-fired plant running the facility takes about one-tenth of the output.) Montana has a surplus of electricity, consuming about half of what is generated in state, with the excess power filling existing transmission lines running out of state. Where will another couple hundred megawatts go?

While the IGCC (Integrated Gasification Combined Cycle) plant would reduce emissions of pollutants, a great amount of carbon dioxide is produced in the entire gasification-liquefaction process. It has to be captured, compressed, and pumped through a pipeline—all of which takes a lot of energy—to places like depleted oil fields. There, injected into the ground, it can force the last recoverable oil to the surface. But if the oil field isn't next door, transporting carbon to a distant site adds another layer of cost and another impact on the land.

Carbon sequestration is an infant technology. No one really knows the long-term effects. Will carbon dioxide stay underground or migrate to the surface? Scientists testing deep disposal of CO_2 report that so far it does tend to stay where it's put. But what it does there is not pretty. It interacts with surrounding strata and breaks down minerals, producing an unsavory mélange of metals and organic compounds. Scientists fear this chemical reaction may weaken or destroy the very strata that keeps the carbon in place, so that eventually the carbon could escape.

The largest immediate obstacle is water. Assuming the plant is not air-cooled (there are reportedly a few air-cooled coal-to-liquid plants in Europe, but they are comparatively small and the liquids they produce are high-value industrial chemicals, not lower-value fuel), then finding a source for the enormous quantity of water the Fischer-Tropsch process demands is a challenge.

BIODIESEL VS. COAL-DERIVED SYNFUEL

	BIODIESEL	PROPOSED BULL MOUNTAIN COAL TO LIQUID FUEL PLANT
Capital Cost per gallon of annual production	Less than $1.00	$6.00 or more
Time to Construct	3 to 12 months	5 to 10 years
Economies of Scale	Biodiesel cost effective on farm and in oilseed processing facilities dispersed statewide	Vast capital outlay including large government subsidies for one centralized facility
Investment/Fuel yield	$300-350 million to meet Montana's current annual highway and farm diesel fuel consumption (373 million gallons/yr.)	$1.3 billion creates capacity to produce 337 million gallons of synfuel annually
Return on Investment	To local economy	To fossil fuel companies, big financial companies
Water Consumption	Minimal, mostly recycled (no additional usage within current agricultural practices)	5 gallons per gallon of synfuel. 924,000 gallons synfuel/day = 4,620,00 gallons water/day (1,686 billion gallons water/year)
Source of Water	Local sources used in agriculture	Probably Madison Aquifer, 8,600 feet below mine, water hot and salty
Air/Global Warming	No fossil carbon added to air; uses current, recycled CO_2	Coal produces 3 pounds of CO_2 per pound of fuel. Sequestration site uncertain, but tailpipe emissions from burning synfuel cannot be sequestered underground.
Land Use	No additional land use beyond current agricultural practices	Mining; water extraction; disposal of salts removed from water; carbon sequestration pipeline; railroad, powerline
Jobs	Biofuels employ more people per unit of capital investment than fossil energy facilities. Statewide employment potential, strengthens rural agriculture-based economy	Estimated: 6,800 construction and 1,800 permanent. Jobs are centralized in one region. (Job figures seem high when referenced against "Jobs in Renewables Outpace Jobs in Fossil Fuels" in this chapter.)

A conservative estimate is that 5 gallons of water will be consumed for each gallon of fuel created. It is possible that the real ratio is much higher than that, 7 to 1 or even 10 to 1, or more, but at 5 gallons of water to 1 gallon of synfuel, a plant atop the Bull Mountains would still require one billion 686 million gallons of water per year. No surface water source in the Musselshell River basin to the north can come close to meeting this demand, and the water rights on the Yellowstone River to the south are all assigned; buying them, and buying a right-of-way for a pipeline from far upriver to the top of the Bull Mountains, and building that pipeline would be expensive.

The only other source of water in sufficient quantities is 8,600 feet underground: the Madison Aquifer. The Madison, under the Little Belt and Snowy Mountains, yields some of the finest drinking water on the planet. By the time it has dived under the Bull Mountains, however, it has become both hot (a test well at the mine site yields 190 degrees Fahrenheit water) and quite full of minerals and salts. Pulling water up from that depth costs money; replacing bits costs money; removing the salts from this water costs money; and "disposing" of these salts—assuming there's a convenient place to permanently put them—costs money.

More water problems arise with mining coal in eastern Montana because the coal seams generally are the aquifer, albeit a much shallower aquifer than the Madison. Large-scale mining means large-scale disruption of wells and springs upon which this semi-arid country depends.

De-watering an aquifer to extract coal, then de-watering another to turn coal into liquid fuel sounds very questionable.

Finally, diesel fuel made from coal is likely to cost about six times more than diesel made from oil seeds. (It might run higher than that. In a public "energy conversation" in Billings, Montana, November 2006, sponsored by Conoco-Phillips Oil Company, a research and development expert for the company estimated that diesel fuel made from coal would have to sell for $15 a gallon—at least initially.)

Who's buying?

PROPOSAL: PHILIPSBURG AS A MODEL OF ENERGY SELF-RELIANCE

Montana has many choices to make about our energy future. Although there may be decades of coal to supply our nation, its continued use pollutes the air and lowers the overall global standard of health. As irrefutable as global warming has become, we must, as a nation, address this issue with more forethought and regard for future generations.

Montana's huge coal reserves constitute a very important aquifer for agriculture and wildlife in this state and ultimately will better serve our long term interests by remaining that way. Many scientists believe that we may be able to rely solely on the annual carbon cycle, Earth's natural recycling of carbon atoms which are necessary to the nourishment and survival of every living thing on the planet, to produce what we consume while remaining truly sustainable worldwide.

MONTANA COMMUNITIES HAVE A HISTORY OF OPERATING WITH LITTLE CAPITAL, MUCH INVENTIVENESS, AND EVEN MORE HARD WORK, COMBINING SELF-SUFFICIENCY WITH COOPERATION.

If Montana is to make an important difference in the future, it will not be as an energy colony. The most important contribution Montana can make is to lead the nation with sound examples of a restorative and sustainable economy. In this state of such diverse renewable energy potential, whether from wind, solar, or biofuels, there are communities that could serve as models to demonstrate how to retool our energy systems to optimize the use of our resources.

Historically, communities in Montana have a long record of operating with little capital, much inventiveness, and even more hard work. Combining self-sufficiency with cooperation also helped Montana's early communities thrive. The state's present dependence on a global fuel economy and a regional electricity market goes against its tradition of self-reliance and sustainability. By selecting at least one community as a model of energy self-sufficiency, Montana can illustrate how a mix of existing and renewable technologies can be developed for the future in all energy sectors.

Philipsburg is a small community, a former mining town nestled up against mountains but centered in an agricultural valley. There is an abundance of forests, both public and private. Using a true "healthy forest initiative" Philipsburg could be providing building materials, small diameter poles, fuel pellets, and sawdust. The resulting large supply of cellulosic wastes, combined with other organic wastes in Granite County (including agricultural wastes), could be diverted from the landfill or slash piles, and instead, provide feedstock for ethanol/methanol production and serve as a source of alternative transportation and heating fuel.

With one of the highest annual incidences in the state of solar energy

falling per square meter of horizontal surface, Philipsburg can satisfy the enormous space and water heating demand in its residential buildings. Passive solar retrofits on existing buildings, and encouraging new construction with south-facing glass and super-insulated walls and ceilings, can yield measurable decreases in energy consumption within a five-year timeline. Photovoltaic panels which are already installed at the local courthouse provide some electricity with a great potential for more.

Wind is not the widely available resource here that it is east of the Continental Divide, but micro-hydroelectric power already exists in Philipsburg, providing electricity for the downtown street lights and other municipal uses. It may be possible to expand this micro-hydro capacity.

Philipsburg would be an excellent demonstration community, a Montana town with a small population and an economy mingling agriculture, forestry, tourism, and mining. High solar incidence and high-elevation climate exemplify many Montana communities. Philipsburg would be an excellent choice for Montana's first statewide model of energy self-reliance.