REPOWERING MONTANA

A Blueprint for Home Grown Energy Self-Reliance

HOW ALL OF MONTANA'S POWER NEEDS
CAN BE MET USING CONSERVATION AND CLEAN,
RENEWABLE ENERGY WHILE CREATING JOBS, SAVING MONEY,
AND REVITALIZING RURAL AND URBAN COMMUNITIES.

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Preface: Executive Summary

Montana can meet all its energy needs in the future through effective conservation measures and clean renewable energy. The more rapidly Montanans move toward that future, the better off we will be.

Otherwise, our prospects appear bleak: ongoing degradation of our air, water, land, health and economic well being; greenhouse gases continuing to pour into our atmosphere; centralized production and distribution systems becoming more and more vulnerable to natural or human-caused disasters; and Montanans remaining at the mercy of escalating energy prices governed by larger forces beyond our borders and beyond our control.

The basis of the *Blueprint* is making smart, aggressive energy efficiency, coupled with conservation, our highest priority. This will reduce demand for both fuels and electricity without diminishing our quality of life. And this can and must happen in all sectors of our economy: residential, commercial, industrial, agricultural, and transportation. Sun, wind, flowing water, growing plants, and Earth's own internal heat—combined with the ingenuity of our citizens—can then provide more and more of the energy this state requires, and eventually all of it.

Steadily phasing into diverse sources of renewable energy means that we can steadily phase out of extracting and burning fossil fuels. This includes proposals to gasify and liquefy coal and to sequester carbon, technologies which at best are very expensive and many of which are unproven.

In this *Blueprint* AERO not only details strategies for investing in energy efficiency, in sustainable production of biofuels (both biodiesel and ethanol), and in dispersed wind, small hydro, and solar power systems, but also advocates localizing ownership and control of these energy systems as much as possible. This will keep dollars circulating in our communities (instead of exporting them elsewhere) and will create useful and fulfilling work for our citizens, in both the countryside and in cities.

The foundation of this plan, focusing on energy efficiency and conservation, is the quickest and least expensive option. Translated into the cost of electricity, efficiency measures generally range from 1 to 2 cents per kilowatt hour, far cheaper than generating electricity by coal-fired power plants, windfarms, or even existing hydropower. An array of conservation and efficiency measures are available at every scale. Replacing incandescent lightbulbs with compact fluorescent bulbs can be done on an individual level. Designing "green" houses, office buildings and other structures that use very little energy happens building by building. Land use planning to minimize the costs of "sprawl" development must occur on a broader societal level involving both public and private interests. At all levels we can save money and energy by plugging leaks, doing more with less, transforming waste to wealth, and re-imagining ourselves and our society not as passive consumers but as active conservers of energy.

Turning to the production of fuels, Montana has the potential to grow all the "carbon-neutral" fuels it needs to handle all in-state heating and transportation needs. Biodiesel refined from a variety of oilseed crops can provide an immediate "second crop" for Montana farmers, first to power their own trucks and tractors, next to contribute to local supplies. For ethanol production, Montana has neither the soils nor water to grow corn as a major feedstock, but this seeming disadvantage actually is an advantage. Advances in cellulosic ethanol technology enable farmers and foresters to harvest a variety of native grasses, shrubs, forest and crop residues, sustainably and locally, to produce this alcohol fuel for blending with petroleum-based gasoline, then gradually to replace it.

Another seeming disadvantage for Montana—a "bottleneck" in high voltage electric transmission lines out of this state—also can turn to an advantage. Today Montana typically generates about 4,000 megawatts of electricity, twice as much as we typically use in state. The remaining 2,000 megawatts fill existing powerlines heading out of Montana. But why build more powerlines to sell more electrons to distant markets (be they "dirty" electrons from coal or "green" electrons from windfarms) when those markets may not exist by the time the lines are built?

Instead, we Montanans can shift our priorities toward meeting our own power needs first, as cleanly, reliably and inexpensively as possible. New windpower and micro-hydro installations are cheaper than new coal, even before adding in coal's pollution and health costs. Solar technologies are rapidly falling in price; geothermal energy offers huge potential; and new, inventive ways to store electricity are coming online. Decentralized, locally scaled development of these abundant sources—their intermittency perhaps "firmed" (backed up) by power from Montana's own hydroelectric dams—not only can bring down the price we pay for electricity today but also eliminate the environmental costs we would pay into the future.

How to get from here to there? Montana farms and ranches need to develop second crops—energy crops—to help reinvigorate endangered rural economies. The seven major population centers in Montana, meanwhile, need to focus on energy efficiency, and on providing markets for those energy crops. To quote from the final chapter of this *Blueprint*:

Green buildings in the cities. Biofuels and windpower in the countryside. Solar energy everywhere. Greenhouses dot the landscape, extending the growing season. More local foods, less long distance hauling. More local energy, less long distance transmission. More carpooling, vans, buses, passenger trains. More inter-city bicycle and horse trails.... More fun. More joy. More beauty.

This is a vision, but a practical one, rooted in commonsense economics and AERO's goal of working with all Montanans to nourish and sustain our land, water, air, forests, grasslands, animals, communities and quality of life.

CHAPTER I:
Call to Action

> MONTANA CAN PROSPER BY HANDLING ALL IN-STATE ENERGY NEEDS FOR FUELS AND ELECTRICITY BY INVESTING FIRST IN ENERGY EFFICIENCY, THEN IN THE STATE'S ABUNDANT, CLEAN RENEWABLE SOURCES —WIND, SUN, BIOFUELS, AND MORE.

Energy is one of the critical challenges facing Montana, and indeed the nation and planet, in this first decade of the 21st Century.

Energy prices continue to skyrocket. Dependence on foreign oil increasingly dictates our economic and political decisions, while demand continues unabated. Global terrorism, war, and unstable regimes threaten secure and reliable supplies of oil and natural gas. Many experts both in and outside the petroleum industry foresee dramatically increased costs in exploration, development, and recovery in the near future as we approach (and some say already have passed) "Peak Oil"—that point where the amount of oil already extracted equals the amount remaining in the ground.

Exacerbating the problem, there is growing and alarming evidence along with nearly unanimous consensus among climate scientists, that global warming not only is occurring, but is accelerating; its effects are profoundly felt worldwide, and will only get worse unless we substantially reduce our greenhouse gas emissions immediately. Many suggest that greenhouse gas emissions must be curtailed by up to 80 percent by mid-century to keep atmospheric carbon dioxide (CO_2) levels low enough to prevent catastrophic changes in our climate, our environment, and our lives.

Many proposals have been made on how best to address these challenges as communities and businesses urge government to help orchestrate solutions. Montana's Governor Brian Schweitzer has committed the state to "secure a long-term, sustainable, reliable and affordable energy future for our citizens and businesses, and to secure economic growth from energy development in targeted areas of the state."[1] In addition, the Governor mentions Montana's "obligation to the nation to help secure energy independence" and has committed this state to programs that are sweeping the nation, like the Apollo Alliance[2] and 25 x '25[3].

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1 "Tapping Montana's Power Potential: The Schweitzer Energy Policy." Governor's Office of Economic Development. 2006. <www.business.mt.gov/docs/EnergyPolicy.pdf>.

2 The Apollo Alliance for Good Jobs and Clean Energy. <www.apolloalliance.org>.

3 "25 x '25: America's Energy Future." <www.25x25.org>.

The Apollo Alliance has brought together 35 national and local labor unions with 135 businesses, farms, environmental and other groups in a 10-point plan to make America energy independent with 20 percent of its energy coming from renewable energy by 2020.[4] The goal of 25 x ’25 (a member of the Apollo Alliance) is for farms and ranches to meet 25 percent of U.S. energy needs from renewable resources like wind, solar, and biofuels[5] by the year 2025 while continuing to produce safe, abundant, and affordable food, feed and fiber.

Proposals like Apollo Alliance and 25 x ’25 show us that, as desperate as our situation sounds, opportunities are arising that equal those during the Industrial Revolution. The profound cultural shift and astonishing economic growth of that period was based on **spending our energy capital—**ancient sunlight “banked” in the form of coal, oil and gas.

Today’s shift, no less profound, will move us away from exhausting the last of our energy capital toward **living off our energy income**. We will move away from finite fossil fuels toward energy that comes to us in many forms: sun, wind, flowing water, growing plants, and Earth’s own internal heat. Spending our income wisely we can create an economy based not on uncontrolled growth but on prudent development of the gifts that Nature gives us.

The nation resounds with voices from all walks of life, all parts of the political spectrum, calling for action. So too in Montana. Our state, rich in natural resources (both finite and renewable) and rich in its history of innovative industries and self-reliant people, is well positioned to take advantage of existing technologies and native ingenuity. Careful analyses show that Montana can meet all of its own energy needs cleanly, affordably, and elegantly—and become a model for other states to emulate.

This report, *Repowering Montana: A Blueprint for Homegrown Energy Self-Reliance,* outlines how this can be accomplished.

A PRACTICAL VISION

Montana can prosper with an energy policy based entirely on conservation and clean renewable resources. It is feasible to do this, both technically and financially, without damaging our air, water, land or quality of

4 The effects of the proposed Apollo plan investments over a 10-year period include the addition of $1.35 trillion in Gross Domestic Product and 19,463,949 person-years of employment. (“The Ten-Point Plan for Good Jobs and Energy Independence.” <www.apolloalliance.org/strategy_center/ten_point_plan.cfm>.

5 Biofuels are liquid or gaseous fuels derived from processing organic material. They are used as a substitute for fossil-based fuels.

life—and without further loading Earth's atmosphere with carbon dioxide and other greenhouse gases.

Montanans can maintain and grow our economy through smart, aggressive investments in energy efficiency, and by developing diverse and decentralized renewable energy systems—wind, solar, biofuels, and more. This will:

- create useful and fulfilling work for our citizens,
- broaden local ownership of production and distribution systems,
- reduce our vulnerability to natural or human-caused disasters, and
- enhance the resilience and well-being of our rural and urban communities.

Smart planning requires first describing specific goals, then ascertaining the starting point—current conditions—and finally mapping promising routes to desired future conditions. So where is our starting point?

In 1975, the price that a Montana farmer received for a bushel of wheat and the price of a barrel of oil were about the same, $3.50. By 2006, with oil ballooning to over $70 a barrel and wheat still stuck at $3.50 a bushel, the vulnerability of Montana's economy to multinational energy companies had become painfully obvious. And in another thirty years how will the price of oil compare with the price of wheat?

Montana oil refineries currently produce more than twice as much gasoline and diesel fuel as is sold at retail in the state. Yet consumers in Montana consistently pay more than the national average for petroleum fuels. Each year nearly $1.5 billion leaves our economy to pay for these fuels.[6] By fall of 2005, then again during late summer 2006, Montanans were paying at an even higher rate, as retail prices spiked to $3 per gallon for gasoline and diesel, both produced by these same refineries. Oil companies told us that we were paying this price for fuel because of a hurricane in the Gulf of Mexico and demand in China.

What about the price of electricity? Montana generates almost twice as much electricity as we consume in the state.[7] Prior to deregulation in 1997, Montana had the fifth or sixth lowest electrical rates in the nation.[8]

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6 "Energize Montana" <www.deq.mt.gov/energy/index.asp>, 2006.

7 "Understanding Energy in Montana: A Guide to Electricity, Natural Gas, Coal, and Petroleum Produced and Consumed in Montana: Summary"—Department of Environmental Quality Report. October 2004. <www.leg.mt.gov/content/publications/lepo/2005_deq_energy_report/summary.pdf>.

8 Deregulation eliminated the protection from competition that a regulated power company—which handled all aspects of electrical generation, distribution and customer service in about two-thirds of the state—enjoyed. Citing open competition as an improvement for rate payers, the company, Montana Power, divided generation from distribution and customer service, then sold these separate functions to two out-of-state corporations.

After deregulation, when Montana entered the so-called “free market” for power, the supply rate doubled. Meanwhile, the new owner of most of our state’s private dams and power plants, Pennsylvania Power and Light (PPL-Montana), was an unregulated utility, “freed” to sell low-production-cost Montana electricity to out of state markets, primarily on the West Coast, at much higher West Coast prices. Now, even though our state produces excess power, Montanans face paying for the construction of expensive new generating capacity to replace low-cost electricity that formerly came from the state’s hydroelectric dams and paid-off older coal-fired power plants. Electricity from any new coal-fired power plants will end up costing three to five times more than electricity from dams long since paid for by Montana ratepayers. (This is based on an approximate price of 2 cents per kilowatt hour (kWh) for hydropower and a range 6 to 10 cents per kWh for power from new coal.)

Deregulation was devastating because it allowed Montana Power Company (MPC) to divest itself of generating and transmission infrastructure, which Montanans had already largely paid for. Once utility property is paid for and depreciated, it should no longer be part of the rate structure, and the price of power should go down. However, when MPC’s dams and power plants were sold to PPL-Montana, people buying power generated by these new owners have ended up paying again—for the same dams and power plants. Low power rates, a competitive advantage once enjoyed by Montana businesses, have vanished. Public ownership or at least a revival of effective regulation could break this cycle.

The now-regionalized market for electricity and the global market for fossil fuels—replete with erratic price spikes and plunges—operate far beyond Montana’s control, yet they dominate our economy. Access to our abundant energy supplies becomes uncertain; energy prices become unpredictable. Federal energy policies and often-ineffective state regulation offer citizens of states like Montana little or no protection. This is one reason that in October 2005 Governor Brian Schweitzer convened a Montana Energy Symposium at Montana State University in Bozeman. Expressing dissatisfaction with federal energy policy, the Governor challenged Montanans to think big about energy, to come up with Big Ideas.

HERE’S A BIG IDEA: THINK SMALL.

AERO acknowledges the need to see our world wholly and comprehensively, and to understand our connections with all things human and natural, but the authors of this *Blueprint* believe our focus must be on what we can accomplish right here, where we live. A host of diverse, decentralized, appropriately scaled technologies can achieve those “Big” ends. In contrast to the global energy economy, an economy emphasizing energy efficiency and local ownership and production of fuels and electricity can ensure reliable supplies at predictable costs; can help revitalize Montana agriculture and manufacturing; can reverse the decline of rural and urban communities around our state; and where communities are thriving, can help ensure their continuing vitality.

A sound Montana energy policy will remove legal and regulatory barriers to implementing energy efficiency and renewable energy. Futhermore, a sound Montana energy policy will create incentives to support such alternatives. Today there are many mechanisms, both public and private, to finance large, centralized energy generation and distribution systems. Most financial institutions are comfortable writing large checks to a few borrowers instead of writing many checks to a variety of smaller clients. Yet if one or two of those large borrowers fail to repay their loans, what then? We need financing mechanisms that acknowledge the value of diverse enterprises—large, medium and small. A farm can flourish by growing a variety of crops to sell; a bank can flourish by supporting a variety of localized conservation and renewable energy systems.

> Localizing energy transactions is the most effective way to achieve swift and equitable economic development.

Today, a localized approach is the most effective means to achieve swift and equitable economic development. Conventional scenarios of extracting non-renewable resources and shipping them out of state—or, in the case of coal, burning it here and polluting our air, water and soil in order to spin off electrons to transmit elsewhere—are not sustainable practices over the long term. Additionally, technology has developed to the point that even high outputs of energy generate very few jobs. And centralized facilities distribute those limited jobs very unevenly.

We Montanans recognize our obligation to contribute to the energy needs of this nation, but these must be true needs, not driven by insatiable appetites, by exploitation and waste. Montana's best contribution to the nation, and to the planet at large, will be to move beyond our historic role as a mineral and energy colony, shipping our wealth and profits elsewhere. We can forge a new role. Montana can stand as a regional model of clean energy, local self-reliance and "homeland security" by identifying and meeting our own true needs first, then sharing our excess with our neighbors.

The key to this new role is conserving energy. Moving decisively, Montanans can eliminate excess consumption and needless waste of our resources, investing first in simple low-cost efficiencies and later by encouraging elegant, comprehensive design. Moving carefully but steadily, Montanans can develop our state's clean renewable resources with an eye to eventually supplying all—

100 percent—of our state's internal energy requirements. Such a transition has its challenges, but much of the infrastructure and most, if not all, of the technologies are here now to accomplish it.

Let us be clear. Montana wind, sun, hydropower and biofuels will not soon (if ever) replace Montana's coal in supplying export markets at current or expanded levels. This *Blueprint* is NOT suggesting that Montana should suddenly stop mining its low-sulfur sub-bituminous coal, three-fourths of which currently is shipped to power plants out of state, with the remainder burned in existing power plants in state (about half of this coal-fired electricity flows out of state). This is an entrenched export economy that will not soon pass.

However, this *Blueprint* makes the case that investing in new coal-fired generating plants, or in producing synthetic fuels from coal, is both unnecessary and uneconomical: too costly in money and too costly for our air, water, land, and ultimately our local communities. This will become clear once Montana sets out seriously to conserve energy and, with efficiency and grace, tune into our abundant, clean, renewable energy sources. AERO offers *Repowering Montana: A Blueprint for Homegrown Energy Self-Reliance* as a catalyst for citizen participation and as a template for Montana's public and private sectors to create this sound statewide energy policy.

AERO'S TEST CRITERIA FOR ENERGY RESOURCES

1. Is the resource sustainable and renewable?
2. Does its development emphasize conservation and efficiency?
3. Does it originate from current solar energy (direct or embodied in living plants) or wind or other regenerative energy?
4. Does it avoid polluting our air, water, soil, bodies and views?
5. Does it avoid producing greenhouse gases that exacerbate global warming?
6. Is it produced close to the end-user?
7. Is it scaled to allow wide participation in its production and distribution?
8. How much of it is financed, owned and/or operated by Montanans?
9. Is it priced accessibly for all Montanans?

CONTRASTING ENERGY ASSUMPTIONS

Underlying any policy or program are assumptions that often are unstated or unquestioned. Here are some assumptions underlying conventional energy scenarios in Montana—Business As Usual—compared with AERO's Energy Assumptions.

BUSINESS AS USUAL	AERO'S ENERGY ASSUMPTIONS
• Continuing growth in energy use, in Montana and the U.S., is inevitable, desirable and sustainable. (Carbon pollution of the atmosphere, furthering global warming, is not addressed or is addressed only minimally.)	• Continuous growth in energy use is neither inevitable nor desirable, and certainly not sustainable.
• Montana has both the capacity and obligation to help supply, with no defined ceiling, this upward trend in energy consumption.	• Montanans may continue to export surplus energy, prompted by the market, but should not encourage wasteful consumption of either non-renewable or renewable energy resources, in or out of state, by constantly increasing supply.
• Doing so will benefit the Montana economy, reduce dependence on foreign oil, add to national security, and will not harm the environment or society.	• It is in Montana's best economic interest to control, as much as possible, production, distribution, management and financing of our energy resources, with an eye to serving Montana needs first.
• Coal can and should be a major on-going part of this scenario. A viable market will exist for fossil fuel energy—especially coal-generated electricity—for the foreseeable future. Carbon dioxide levels will be controlled by various "sequestration" techniques, many as of yet unproven in Montana.	• Coal should be gradually phased out as a primary energy source, both within Montana and to supply Montana's export markets.
• Leave the solutions to "experts" already in the energy business.	• Citizens must play a central, participatory role in shaping Montana's energy future.

AERO's Energy Assumptions are based on a critical analysis of current and likely future economic and environmental conditions; on the geopolitical energy landscape; on global population and development trends; and on the precautionary principle—that is, taking only those actions that are proven to be beneficial or that (at worst) do no harm. The rationale behind these assumptions above can be summarized in five points.

1. **Cost-effective investments in energy efficiency** can stabilize and eventually reduce overall energy consumption. However, in both the short and the long term, we need to ensure that gains in efficiency do not spur heedless increases in energy consumption.
2. **Smaller, decentralized production facilities** keep dollars circulating in local communities and thus are favored. The financing needs of larger, centralized production facilities guarantee that the bulk of investment dollars will flow in from outside the state, with the bulk of profits flowing back out, subverting the influence and economic stability of Montana communities.
3. **An orderly transition to a clean, renewable, sustainable energy economy** ultimately will be less expensive for Montana consumers and will create new jobs. Government at all levels should act to minimize transition costs and create incentives for job opportunities in the new economy, in the same sectors where workers have lost jobs with the passing of the old economy.
4. **The transition to conservation and renewables will occur over a number of years**, as people come to understand its advantages, including the realization that the "highest and best" use of Montana coal is not to be extracted for a one-time burn, gasification, or liquefaction, but rather to remain where it is, in the ground. Coal is the primary aquifer for much of eastern Montana, and as an intact aquifer it helps assure the continued integrity of springs, wells and streams, the lifeblood of this semi-arid region.
5. **Citizen participation can and must occur** through a variety of methods, including open public forums. Decision-makers must be held accountable to the public through measurable results in energy conservation, sustainable energy production, and localized economic flows.

THE PATH AHEAD

Montana stands at a crossroads. Intelligent, informed decisions made now can lead to a relatively stable, locally grown energy economy and a healthy environment for us, our grandchildren, and our grandchildren's grandchildren—or we default to continued dependence on fossil fuels, foreign imports, and an ever more degraded environment.

Understanding the need for action, in September 2006, Governor Schweitzer released his proposed Energy Policy, titled "*Tapping Montana's Power Potential*".[9] This policy promotes eight specific points:

1. Diversified Energy Development including "the nation's largest reserves of coal" and "abundant oil, natural gas, and coal bed methane opportunities."
2. Renewable Energy Development including wind generation, hydro, ethanol, biodiesel, biomass, and other renewable forms of energy.
3. Cleaner Energy Development that is market-driven and socially responsible. "State government will focus substantial efforts and resources on promoting energy development projects that meet the rising demand for cleaner energy."
4. Development with Clean Coal Technologies: "The state will focus energy development of coal, including state-owned coal, on coal-to-liquids plants, IGCC electrical power plants,[10] and other clean coal technologies."
5. Value-adding Energy Development: "The state will commit itself to adopting policies and practices that emphasize more value-adding in the energy field, whether the initial source is bio-based or carbon-based."
6. Energy Efficiency and Conservation: "State government will focus resources on energy efficiency and conservation, through both direct assistance to Montana's lower income families and support of industries, businesses, and practices to promote energy efficiency."
7. Adherence to Environmental Laws and Community Acceptance: "The use of public resources to promote new energy projects will follow a high standard, concentrating on the cleanest projects proposed by industry and those that find community acceptance."
8. Supportive of Infrastructure Development: "We will commit the state ef-

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9 "Tapping Montana's Power Potential: The Schweitzer Energy Policy." Governor's Office of Economic Development. 2006. <www.business.mt.gov/docs/EnergyPolicy.pdf>.

10 Integrated Gasification Combined Cycle (IGCC) is a method of converting coal to gas to be burned to produce electricity. It captures many polluting gases such as sulfur dioxide (SO_2) and nitrous oxides (NO_x) which are common by-products of burning coal. It does not reduce carbon dioxide emissions.

forts to strengthening our energy delivery links internally and to the rest of the world."

The above policy is augmented by a large collection of data and statistics which are maintained by the Montana Department of Environmental Quality (DEQ).[11] Although there are a number of programs and incentives available, unfortunately much of this information is not widely distributed or promoted.

Analyzing which of the above eight items on the Governor's list are most readily do-able—economically, socially and technically—and combining those options with others that have been successfully implemented in other regions, there appear to be three broad paths from which Montanans can launch an energy policy: Business as Usual; Supply Side Strategy; or, Demand Side Management.

Only one energy path appears to be truly sustainable.

The assumptions of the first path—**Business as Usual**—have been set forth previously. It is the default position. It assumes, indeed requires, continued growth in the economy based on continuing resource extraction and a continuing rise in energy consumption, primarily of fossil fuels. Under Business as Usual, Montanans can expect continuing price increases for transportation fuels, home heating, electricity, food and other necessities, and increasing vulnerability to interruptions in supply. Weather and geo-political instability – two elements beyond our control – will largely dictate how severely we are affected. Business as Usual seems like a dead end.

The second path, emphasizing the **Supply Side**, includes a mix of fossil fuels and "clean" energy sources. One plan, titled *Montana Vision 2020: Montana's Portfolio for the Future*, was developed in 2003 in response to the Montana Legislature's House Resolution No. 26. It resolved "to take all possible steps to move Montana into a hydrogen-based economy." *Montana Vision 2020* appeared as Appendix B of "Hydrogen, Wind, Biodiesel, and Ethanol: Alternative Energy Sources to Fuel Montana's Future," a document published in 2004 by the Montana Department of Environmental Quality. Since then it has been difficult to discern what, if any, "possible steps" have been taken toward a hydrogen economy. This plan appears to favor maximizing energy production, with few targets to stabilize or reduce overall energy production and consumption.

Governor Schweitzer's energy policy as outlined in ***"Tapping Montana's Power Potential"*** **is biased toward the Supply Side**. Although energy effi-

11 See "Energize Montana" at <deq.mt.gov/energy/index.asp> that summarizes current energy statistics and programs, including conservation, commercial and home building codes, alternative energy loans, net metering, biofuels, wind and solar/geothermal programs.

ciency and conservation are listed in the Governor's policy, they are not its foundation. The foundation appears closer to something that speakers at the October 2005 Energy Symposium, including the Governor, referred to as TED—Total Energy Development:

- Develop improved "clean coal" technologies that can add electricity to the grid while liquefying coal to feed the nation's demand for fuel;
- Develop alternative energy technologies to serve local communities and provide additional electricity for export over the grid;
- Increase transmission capacity for electricity and transportation infrastructure for fuels (including coal-derived synthetic fuels) as well as for the water required to produce these fuels and for the potentially distant "sequestering" of carbon produced during the process;
- Do all this in an environmentally acceptable way.

The coal portion of this plan is premised on the unproven theory that through the efforts of industry, academia, advocacy groups, and government agencies, Montana can develop methods to make coal environmentally safe for this state and, through sequestering carbon, safe for the world. Governor Schweitzer has said he wants Montana to pioneer this so-called "clean coal" technology; wisely, he also has indicated that if this cannot be done cleanly and cost-effectively—without exacerbating global warming—coal should not be further developed at all.

Financing this "clean coal" initiative would require a mix of private and public sources willing to invest billions of dollars to design, develop and implement workable technologies and significant upgrades and expansions of multiple aspects of energy infrastructure—pipelines, power lines, railroads, sites for sequestering carbon, etc. The primary participants would be major corporations and, almost certainly, the federal government. This effort does not seem to include significant roles for small business, local entrepreneurs or those lacking major venture capital. Likewise, economic "boom" development would be, geographically, highly centralized. Failure to accomplish the "clean coal" goal would not only cost investors but also negate desired benefits—jobs, property tax income, etc.—and leave a massive bill on the doorsteps of all Montanans.

The third path, **Demand-Side Management**, is based on the recognition that endless growth in energy production and consumption is neither possible nor desirable, so that the first step is making significant investments in conservation and efficiency. Beyond this, the goal is to develop only environmentally friendly forms of energy—something Montana is uniquely suited to do. This *Blueprint* demonstrates that all fuels and all electricity consumed in Montana can be produced in Montana without degrading our environment or economy. And finally, this *Blueprint* recommends that any excess energy available for export (in whatever form: electricity, fuels, food, building materials, etc.) meet AERO's Test Criteria outlined earlier, particularly no damage to our soil, water, air or quality of life, and keeping the bulk of the profits in our communities and in our state.

This third path promotes progress on multiple fronts, allowing broad participation from people and institutions at many economic levels. Corporations, small businesses, private entrepreneurs and community-financed systems are all encouraged to participate. A multi-pronged approach invites localized solutions tailored to local needs and allows investments of all sizes to be made incrementally. Even setbacks can contribute to success; learning from occasional failures can help in achieving overall goals.

Following this third path, Montana can become an inspiration for other states as we:

- Foster more Montana jobs over the long term,
- Spend less, both short- and long-term,
- Create long-term stability in Montana's energy markets,
- Create more security from disruption from natural disasters (earthquakes, storms, etc.) and man-made disruptions (terrorism, operator error, Enron-like market manipulations, etc.),
- Reduce pollution and emissions of greenhouse gases,
- Promote healthier rural and urban communities,
- Renew Montana as a place of economic opportunity and cultural richness, and preserve her natural beauty.

CHAPTER 2:
Starting at Home: Conservation & Efficiency

GOAL: BY THE YEAR 2020, TO REDUCE ELECTRICITY USE IN MONTANA BY 30%, TRANSPORTATION FUEL USE BY 20%, AND HEATING FUEL USE BY 27% WHILE ADDING THOUSANDS OF JOBS AND MILLIONS OF DOLLARS TO THE STATE'S ECONOMY, ACCOMPLISHED THROUGH ENERGY CONSERVATION AND EFFICIENCY PROGRAMS AND POLICIES.

Demand Side Management of energy use and energy development in Montana is the basis of this *Blueprint*. Conservation and efficiency are the foundation. This means that any supply-side energy development, whether from finite polluting sources like coal or clean renewable sources like wind, sun and growing plants, must follow a serious commitment to energy conservation and efficiency.

Current projections are that electricity use in Montana will grow by about 1.6 percent annually. This includes a 2.9 percent projected growth rate for commercial and a 1.4 percent rate for residential sectors.[12]

Two recent studies, "A Balanced Energy Plan for the Interior West"[13] and "Repowering the Midwest"[14] suggest that a goal of a 30 percent reduction in electricity use by 2020 is reasonable. These savings result from a deliberate energy efficiency program based on the assumption that "there will be several concerted, long-term, and successful public policies and private sector initiatives to increase adoption of efficiency measures." Both studies found these efficiencies could be achieved cost-effectively, between 2.0 to 2.4 cents per kilowatt hour, which is considerably less than generating, transmitting, and

12 "Draft Montana Greenhouse Gas Inventory and Reference Case Projections." Montana Department of Environmental Quality. July 2006. <www.mtclimatechange.us/ewebeditpro/items/O127F8927.pdf>.

13 "A Balanced Energy Plan for the Interior West." Western Resource Advocates. Boulder, CO. 2004. <www.westernresourceadvocates.org/energy/clenergy.php>.

14 "Repowering the Midwest: The 21st Century: Opportunities for Clean Energy Development." Environmental Law and Policy Center. 2006. <www.repowermidwest.org/plan.php>.

distributing electricity from any source (except, possibly, existing hydropower).

The first and cheapest thing to do is reduce demand. In part, that's saying "no" to increasing supply—building new power plants, for instance—until we've said "yes" to energy efficiency and conservation. Effective and well-implemented conservation measures would cost a fraction of a conventional fossil fuel power plant. Conserving energy frees up existing energy generation to be used elsewhere. One estimate suggests that reducing energy use nationwide by just 10 percent would be equivalent to increasing our current solar and wind power output ten-fold.

Chapter 1 of this *Blueprint* stressed that to get to a specific goal, you need to know where you are starting from. The following statistics paint that picture. Despite Montana's apparent rural character and low population, this state contributes far more greenhouse gases per capita than the national average. Alarming? Read on to find out why, but first, let's put this in context.

U.S. citizens constitute 6 percent of the globe's human population yet consume 25-30 percent of the energy produced on Earth today. In doing so, each U.S. citizen generates, on average, 50,000 pounds of greenhouse gases (25 metric tons) per year. That's twice the greenhouse gases produced by a citizen of Germany and almost 20 times that of a citizen of India. When you include industrial and commercial outputs, Montanans emit about 40 metric tons of greenhouse gases per capita, which is 60 percent more than the national average! This imbalance occurs largely because such a small population (less than one million) is averaged in with large coal-fired generation plants and motor vehicle exhaust that exceeds the national per capita and per unit gross product.

Nationally, 82 percent of U.S. greenhouse gas emissions come from burning fossil fuels to generate electricity and to power trucks and cars. In Montana the figures are a little different due to agricultural emissions.[15]

Conservation and efficiency are not primary energy sources, but they are the most cost-effective tools within the scope of any sound energy plan. They can be viewed as our cheapest "strategic energy reserves." Considered as resources, conservation practices and energy-efficient technologies also stand a chance of being our only truly sustainable actions. (Sustainable—like renewable—refers to the rate of use matching the rate of replenishment, and the ability of the ecosystem to neutralize or ameliorate the wastes generated from these processes.)

Integral to conservation practices and efficiency technologies is recog-

15 Methane and N_2O from manure management, fertilizer use, and livestock is higher in Montana than nationally: 27 percent compared to 7 percent.

nizing that **energy and materials cannot be written off as waste products**. Cradle-to-cradle use of resources, rather than cradle to grave (i.e. disposable waste), recognizes that there is no waste in nature. What cannot be absorbed by earth, water, or air is reused.[16]

We can transform waste to wealth by salvaging by-products from industrial, agricultural and commercial processes and re-using, recycling, or re-manufacturing them into energy or usable products. This transformation, which creates a "restorative economy" in the process, is most efficient on local and regional scales, and suggests that in Montana, remote as we are from major markets for recycled materials, we can create vibrant commercial enterprises to turn our own waste material into products or processes to be used here.

> The first and cheapest things to do:
>
> Reduce demand.
>
> Transform waste to wealth.
>
> Do more with less.

In rethinking how we use by-products from agriculture, industry and commerce we can begin to design and engineer products to be re-used or recycled with a minimum of energy and technological infrastructure.[17] We can, in some instances, ensure that manufactured items consist of materials that do not degrade the ecosystem but actually *feed* it as the item wears out (for example, plastics made of corn-based polymers). Likewise, reducing the transportation of raw materials and finished products greatly reduces embodied energy and greenhouse gas emissions. In fact, localization at all levels is a critical element in energy conservation/efficiency strategies. As much as possible we must localize and support:

- Food production, processing, transport and consumption.
- Production of building materials for homes and commercial buildings.
- Application and production of energy conservation and efficiency technologies.
- Decentralization of energy production.

In addition, an effective energy policy must apply AERO's Test Criteria described in Chapter 1 for materials necessary for energy production and conservation, such as the raw materials for wind generators and solar cells, or for double- or triple-paned windows and insulation.

1. Is the resource sustainable and renewable?
2. Does its development emphasize conservation and efficiency?
3. Does it originate from current solar energy (direct or embodied in living plants) or wind or other regenerative energy?

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16 McDonough, William and Michael Braungart. "Cradle to Cradle: Reinventing the Way We Make Things". New York: North Point Press, 2002.

17 Buckminster Fuller described this as "anticipatory design."

4. Does it avoid polluting our air, water, soil, bodies and views?
5. Does it avoid producing greenhouse gases that exacerbate global warming?
6. Is it produced close to the end user?
7. Is it scaled to allow wide participation in its production and distribution?
8. How much of it is financed, owned and/or operated by Montanans?
9. Is it priced accessibly for all Montanans?

ENERGY EFFECTIVENESS FOR ECONOMIC STABILITY

What really is the goal of a sound economic policy? From an energy perspective it is **doing more with less**: getting the most productivity from the least amount of energy with the least amount of environmental and social degradation. Before considering new sources of energy, we must take a hard look at how we can make our current use of energy most *effective*. It makes no sense to save energy at one end of the grid so that it can be wasted somewhere else. Every aspect of our economy can and must be scrutinized. The goal of this *Blueprint* is to enhance the speed at which this process takes place and to make clear the many ways this can be achieved.

There is a small window of opportunity for Montanans to respond before current escalating energy costs exceed our ability to implement the necessary changes. Add to this the specter of Peak Oil, limitations in the availability of key resources and the very real threat of catastrophic climate change, and this must become a priority. Although some recommendations seem challenging, each idea can play some role in helping to create a triple-win situation for our economy, our people and our environment.

There are five sectors of energy use in Montana: **residential, commercial, industrial, transportation and agricultural.** Every planning and development decision, from buying an appliance to building a subdivision, significantly affects energy use. A misplaced stop sign, for example, over its lifetime can waste thousands of gallons of fuel due to unnecessary braking then acceleration of vehicles. A dozen misplaced stop signs send ripples throughout the economy on a grand scale. Viewing energy use from a holistic perspective takes into account both upstream effects (production-processing-distribution) and downstream effects (consumption and disposal—or reuse).

We use electricity for lighting, appliances, home entertainment, business equipment, computers and their support systems, running motors, manufacturing processes, etc. We use fuels for heating our homes and buildings, for transportation and for some industrial processes. Opportunities for reducing existing and projected use of both electricity and fuels abound in all five sectors of our economy.

In 2004 electricity generation actually produced more greenhouse gas GHG emissions in the United States than cars, trucks, and planes combined. And buildings consume up to 40 percent of all electricity generated in the U.S.[18] Focusing on the built environment in Montana offers a major challenge and major opportunity to usher in a more energy secure economy.

Electricity sales in the **Residential, Commercial and Industrial** sectors each amount to more than 4,000 million kilowatt hours (MkWh): residential 4,120 MkWh, commercial 4,438 MkWh, and industrial 4,267 MkWh. For natural gas use, residential accounts for 20 billion cubic feet (bcf), commercial 15 bcf, and industrial 24 bcf.[19]

Residential Sector

Existing Homes. Here the first place to save comes from replacing incandescent lighting with compact fluorescent light bulbs and replacing older appliances, particularly refrigerators, freezers, furnaces, air conditioners, and water heaters with those earning the ENERGY STAR rating. According to the U.S. Government's ENERGY STAR website[20], using ENERGY STAR rated lighting can deliver savings 60-70 percent over standard new products. Getting a free energy audit from one's utility company will identify the next steps to saving energy in a home. Taking advantage of Montana's Energy Efficiency tax incentives for increased floor, wall, and ceiling insulation and replacing old windows with energy efficient ones can put money back in your pocket as well as save up to 20 percent of energy costs. These are benefits that last for years, and add to the value and comfort of your home.

Montana offers an Income Tax Credit of up to $500 ($1000 per couple) for making new or existing Montana homes more energy efficient.[21]

New Homes. Here lies the opportunity to design buildings to use less energy from the start, using better insulation, siting to take full advantage of the sun, correct placement of windows, etc. Building in efficiency beyond

18 "RMI Adopts the '2030 Challenge': Carbon-Neutral Buildings in 24 Years the Ultimate Goal". RMI Solutions. Rocky Mountain Institute. Volume xxii. Fall 2006, p1. <www.rmi.org/images/other/Newsletter/NLRMIfallwinter06.pdf>.

19 "Draft Montana Greenhouse Gas Inventory and Reference Case Projections". Montana Department of Environmental Quality. July 2006. p 16. <www.mtclimatechange.us/ewebeditpro/items/O127F8927.pdf>.

20 "Compact Flourescent Light Bulbs" ENERGY STAR. <www.energystar.gov/cfm?c=cfls.pr_cfls>.

21 <deq.mt.gov/Energy/NEEM_tax_credit.htm>.

current energy code requirements can reduce energy use in new homes 20-40 percent and make owners eligible for Montana Income tax credits. While investing in efficiency can increase some construction costs, other costs go down—a smaller furnace or boiler may be needed, and less air conditioning or none at all. The U.S. Energy Policy Act of 2005 includes a "$2,000 credit paid to the builder of new homes whose space heating and cooling energy consumption is 50 percent below the annual consumption of a home that is constructed to the standards of the IECC[22] and its supplements and current federal minimum equipment requirements."[23] Unfortunately few in Montana are taking advantage of this credit due to a low number of people qualified to certify buildings for the tax credit.

Montana Energy Codes are currently being upgraded for both Residential and Commercial buildings and will be released in July of 2007 but compliance is spotty. Self-monitoring is the primary form of compliance. And even Montana's updated codes are weaker than those in Oregon and other states in the Northwest, which have a stronger public policy commitment to energy conservation. Codes for mobile homes, a national issue, must be improved. Banks are beginning to recognize that energy efficient homes and buildings cost less to operate over their lifetimes and have developed special mortgages for energy efficient houses to encourage the purchase of these types of homes.

ENERGY EFFICIENCY MEASURES

For Residential Buildings

- Efficient lighting such as compact fluorescent bulbs
- Efficient appliances such as water heaters, refrigerators, air conditioners
- Multi-pane windows with low emissivity
- More insulation, particularly in the attic
- Shade trees

For Commercial Buildings

- Efficient lighting
- Efficient air conditioners and chillers
- Duct sealing
- Reflective roofing

Commercial Sector

Buildings and Operations. Office buildings, hospitals, universities, government buildings, commercial retail space, retail malls, and manufacturing plants all are major users of energy that can benefit from conservation and efficiency measures. A recent Department of Energy (DOE) funded study of "commissioning" (a highly cost-effective way to verify that a building is performing as intended) concluded that "commissioning is indeed cost-effective for both new and existing buildings over a range of facility types and sizes, not only in terms of energy savings but also in savings from improved equipment lifetimes, reduced maintenance, fewer contractor callbacks, and other non-energy benefits". Nationally, building managers are hesitant to use commissioning because of the perceived costs. But the study showed that:

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22 International Energy Conservation Code

23 "Federal Tax Credit" Northwest Energy Star. <www.northwestenergystar.com/index.php?cID=433>.

- Among existing buildings, commissioning cost a median of $0.27/sq ft, and yielded energy cost savings ranging from 7 to 29 percent, with a median savings of 15 percent, for quick payback times of 0.7 years. The median payback time for new buildings was 4.8 years, and when non-energy impacts were factored in, those payback periods were considerably reduced, often to zero.[24]
- Building design can yield great savings. A new interactive science center in Helena, Exploration Works!, is being designed to save 60 percent in energy costs. The new headquarters of the Northern Plains Resource Council in Billings will be the first commercial office building in the state to qualify for Gold Certification from the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED)—and possibly could earn a rating as high as Platinum. LEED is a voluntary certification for high-performance, environmentally friendly buildings.[25]
- Wasted energy not only adds pressure to build more polluting, centralized power stations and inefficient transmission lines, but the money that leaves a community to pay energy bills is gone forever. Investment in efficiency and conservation immediately plugs those leaks out of the local economy and creates local jobs. A serious commitment to a conservation economy would embrace and encourage the practices highlighted throughout this report.

Some of the actions that can save money and energy in the commercial sector are:

1. Computer simulation of existing individual commercial buildings, to initiate strategies for energy efficiency retrofits.
2. Efficient lamps and ballasts, including exit lighting.
3. More efficient air conditioners and chillers.
4. Duct sealing and upgrading insulation.
5. Reflective roofing elements or a green roof (planted with vegetation).
6. Closer attention to heating and cooling cycles, turning systems down or off prior to a building's being vacated for the day.
7. Optimizing natural daylighting and "task-lighting" interior spaces instead of huge full-room lamps.

24 Better Bricks is an initiative of the Northwest Energy Efficiency Alliance, a non-profit supported by the electric utilities throughout the Northwest. See Lihach, Nadine. "Meticulous Study Makes the Case for Cost-Effective Commercial-Building Commissioning" (Better Bricks. 2004).

25 The U.S. Green Building Council's website, <www.usgbc.org/LEED>, provides a full description of the LEED Certification Program.

8. Production of photovoltaic (solar) energy in larger-footprint buildings.
9. Use of locally or regionally produced renewable resources—including foods and other materials—to minimize transportation costs and support local economies.
10. Cooperative strategies to use waste from one production stream as feedstocks for other production.
11. Government incentives for clean, energy-efficient commercial operations.
12. Landscaping around buildings and parking lots to provide shade and moderate summer temperatures.

Industrial Sector

Even though Montana does not have a huge industrial sector with respect to jobs, the industrial sector (including coal-fired generation facilities—the largest emitter of greenhouse gases in the state) accounts for approximately one third of electricity consumption (4,267 MkW hours purchased) and a significant percentage of consumption of natural gas.

Cement production, smelting, mining, silicon refining, milling, coal burning and export, all have tremendous conservation potential. Colstrip, for example, whose coal-fired power complex is Montana's single largest emitter of carbon dioxide, could better utilize its waste process hot water to heat acres of greenhouses where food could be grown and carbon dioxide sequestered. In this case, further conservation comes in the form of reduced transportation costs, as the food is grown closer to its end users.

Examples for energy saving recommendations for the industrial sector include the following:

1. Re-tooling whole industries with state-of-the-art motors, saving 10 to 20 percent in electrical consumption.
2. Altering time-of-day consumption cycles to reduce peak demand.
3. Sharing processes and off-puts (waste) internally or within collaborative industries implementing what's known as *industrial ecology*[26].
4. Establishing and optimizing industrial waste exchange networks within the state or region, as well as co-locating facilities that may share the use of feedstocks, wastes, processes or transported goods.
5. Co-generation using waste heat to radically increase efficiencies.

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26 Industrial ecology is the shifting of industrial process from linear (open loop) systems, in which resource and capital investments move through the system to become waste, to a closed loop system where wastes become inputs for new processes. See Industrial Engineers for Industrial Ecology at <www.Ie4ie.org> or Indigo Development at <www.indigodev.com>.

6. Incorporating central district heating in areas where it is appropriate, such as industrial parks.
7. Better daylighting of industrial complexes to reduce lighting energy consumption.
8. Converting existing incandescent lighting to fluorescent or, better yet, Light Emitting Diodes (LEDs).
9. Using improved lubricants that can increase energy efficiency by 8-10 percent in motors and bearings.
10. Improving combustion technologies and fuel mixing.
11. Capturing waste or under-utilized resources that could be used as value-added alternatives for feedstock (e.g., fly-ash from coal plants that can be used as a substitute for energy intensive cement production).
12. Reducing the impact of *embodied* energy[27] in manufactured goods and construction materials by designing products for long life, durability and re-use/recycling.
13. Recycling and re-using existing process water to optimize water use in industrial applications.
14. Using concrete, asphalt or recycled glass regrind as aggregate.

Transportation Sector

Another major producer of greenhouse gases in Montana (approximately 18-20 percent) is transportation: 500 million gallons of gasoline and 373 million gallons of diesel fuel were consumed here in 2003. And transportation is expected to contribute the largest increase of greenhouse gases (GHG) by 2020, due a projected 3 percent annual increase in vehicle miles traveled over the next 15 years especially from increased trucking of freight.[28]

If American cars averaged 40 miles per gallon, which is technologically achievable and available in some cars today, oil consumption in the United States would go down as much as 3 million barrels a day from its current 21 million barrels a day. American autos are the only area of the American economy that is less energy-efficient than 20 years ago. Low gas mileage sports utility vehicles made up just 5 percent of the American fleet in 1990; today they make up almost 54 percent. Montana constitutes too small a market to directly influence decisions of automobile manufacturers, but Montanans can choose

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27 Embodied energy is the energy consumed by all of the processes associated with the production of materials and equipment, from the acquisition of the natural resources to product delivery.

28 "Draft Montana Greenhouse Gas Inventory and Reference Case Projections." Montana Department of Environmental Quality. July 2006. p8. <www.mtclimatechange.us/ewebeditpro/items/O127F8927.pdf>.

to buy the most energy-efficient vehicles available, to reduce unnecessary travel around our vast and sparsely populated state and maximize their automobile's efficiency through appropriate driving and maintenance[29].

Ultimately, the main tools for reducing consumption in the transportation sector are to **localize energy, food and materials transactions** (from production through processing to consumption and re-processing); design communities that require less driving for daily chores and job commutes; substitute ethanol and biofuels for gasoline and diesel; and make wise selections by purchasing highly fuel efficient vehicles.

Food travels an estimated 1,500 miles on average from farm to plate. Effective Buy Local campaigns can make locally grown food and other goods desirable, profitable and more available. Housing materials may travel much farther than food. Kitchen cabinets, for example, an easy product to build locally with local materials, are typically being shipped from China.

Requiring all gasoline sold in the state to be 10 percent ethanol would lead to the quickest decrease in gasoline consumption (10 percent or 50 million gallons a year) and, combined with other incentives, could stimulate a local ethanol industry (discussed in Chapter 3). Another incentive would be to require 2 percent biodiesel blend in diesel fuel (B2) be available.[30] Some cities (Bozeman, for example) have been using up to B20[31] and even B100 without ill effects in their city diesel fleet. Again, done right, this could kick-start a local biofuel industry; higher mileage diesel cars would join gas/electric hybrids as more fuel efficient choices for driving. The ubiquitous trucks, so important to Montana's agricultural and rural life style, could run, at least partially and someday completely, on homegrown fuel. Low-rolling resistance tires, properly inflated, can reduce fuel use another 5 percent or 25 million gallons.[32]

Incentives play a key role in any habit-changing scenario. Cheap oil has made us habitually inefficient drivers. How many stop to think that the fuel for a 20 mile round trip to the store for a gallon of milk can cost as much as the milk? There are a variety of incentives and disincentives, state and local government policies, that along with education about our fossil fuel use can stimulate significant reductions in consumption.

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29 Learn how to improve your miles per gallon at <www.fueleconomy.gov>.

30 Legislation first proposed in the Montana legislature, 2007.

31 20 percent biodiesel blended with regular petroleum-based diesel

32 A study done by the European Union cited by the New Mexico Climate Change Advisory Committee.

Some policies to implement:

1. Incrementally increase the **state fuel tax** across the board with revenue targeted toward travel alternatives.
2. Retrofit or replace governmental **fleets with more efficient vehicles—** hybrids, plug-in hybrids, flex fuel cars, etc.—and require use of biodiesel in government diesel cars and maintenance vehicles.
3. Inefficient vehicles could pay a **"Carbon Fee"** in addition to the state fuel tax.
4. Up-front fees charged on inefficient new vehicles or **"fee-bates"** credited to efficient new vehicles at the time of purchase would encourage sales of efficient vehicles, while discouraging sales of high fuel consuming vehicles. One example: in Washington, D.C. the City Council raised the excise tax to 8 percent on vehicles over 5000 pounds, at the same time eliminating the vehicle registration fee and 6 percent excise tax on clean fuel and electric/hybrid vehicles. Other versions give a permanent tax exemption to hybrid vehicles that get better than 40 mpg and rebates to low greenhouse gas emitting vehicles along with higher registration fees for vehicles with higher GHG emissions.
5. Require mandatory **inspections of exhaust systems** with respect to pollution and efficiency as a requirement for licensing a vehicle as is done in other states. (Not only are emission standards important for fuel efficiency, but they are becoming required by the Clean Air Act for airsheds in places such as Missoula and Flathead Counties.) An additional benefit from increased efficiency here is lower health care costs for the community.
6. Significant opportunities for reduced fuel consumption lie **in better land use planning** at the city and county level. Suburban sprawl adds a huge overall yet unspoken burden to society by sending much hard-won money to fuel producers elsewhere. For each mile a person must drive per day to town or work, there is a fuel-burden of 18 gallons per year (estimate for a 20 mpg vehicle). For a 50 lot subdivision 10 miles from town, where each household has two vehicles commuting an average of 20 miles each, this equates to a fuel-burden of approximately 36,000 gallons or about $90,000 at $2.50 per gallon. Compare this to the same subdivision placed one mile from town or one-tenth the total at $9000 and 3600 gallons consumed. In this example $80,000 leaves the local economy. Our land use choices have large impacts, financial as well as environmental.
7. Reduce the **speed limit**. It was 55 miles per hour (mph) in the 1970s and 1980s. While it is true that some vehicles today are engineered to function very efficiently at speeds above 55 mph, it is also true that a general day-

time speed limit below 70 mph could produce substantial fuel savings in the range of 15-20 percent per vehicle.

8. Provide information when registering vehicles and through driver education programs that describe the many ways paying attention to **driving patterns and vehicle maintenance** can greatly increase fuel economy.
9. Provide incentives and opportunities for people to buy vehicles with real-time **miles per gallon gauges** or to install such devices after purchase. Drivers of hybrid cars such as the Prius that show mpg in real time report they have altered their driving behavior to maximize savings. Others have reported friendly competitions with friends and family to see who can average the highest number of miles per gallon.

Neither mandates nor taxation are sufficient methods for accomplishing positive change. Education and leadership are needed. Better information showing the consequences for not taking action now will be key for encouraging positive action. Thoughtful community and statewide planning requires thoughtful leadership. The question remains, do we pay for efficiency changes now or, by doing nothing, pay an even greater price when energy costs soar?

Agricultural Sector

Cheap oil allowed farmers to buy low-cost fertilizer, pesticides and insecticides while the Farm Bill allowed them to produce below cost. But this era is ending. Agriculture is keenly impacted by rising energy costs and is a major contributor to Montana's greenhouse gas (GHG) emissions as well.[33]

Energy expenditures as a percentage of total production costs are highest in grain and oil seed production, 9 percent, and are likewise high in beef cattle ranching, 7 percent.[34]

Fertilizers and on-farm chemicals today depend heavily on fossil fuels, in both their manufacture and their delivery to farm and fields. Farms in Montana consumed 153 million gallons of diesel fuel in 2003, while electricity is a major cost in running irrigation pumps and motors used in processing.

Farm practices, inputs, tools, and machinery are all targets for improved efficiency and conservation. In the ranching community pasture and range land management practices offer opportunities for carbon capture. Conservation

33 "Draft Montana Greenhouse Gas Inventory and Reference Case Projections". Montana Department of Environmental Quality. July 2006. p8. <www.mtclimatechange.us/ewebeditpro/items/O127F8927.pdf>.

34 Brown, Elizabeth and R. Neil Elliott. "On-Farm Energy Use Characterizations". American Council for an Energy-Efficient Economy. March 2005. p9. <www.aceee.org/pubs/052full.pdf>.

practices are already gaining a larger share of Farm Bill dollars. There is an increasing possibility that policies to cap carbon emissions will lead to a carbon sequestration market that provides an important role for agricultural lands.

Farmers and ranchers are quiet leaders in dispersed energy production and use. They are key members of Rural Electric coops in the state and also own land ideal for dispersed wind generation that can feed into local transmission lines. They have a wealth of experience and expertise developed from the installation and maintenance of many remote wells and livestock tanks using solar panels for pumping.

Likewise, there are many additional opportunities for energy savings and innovations.[35] Waste from livestock feeding operations can create methane which in turn can fuel small scale ethanol plants. A variety of crops can be processed for biodiesel to provide on-farm fuel and sold into local markets. If these plants are locally owned, dollars stay in the local community. (For more on this, see Chapter 3, Homegrown Fuels.)

It is well known that agriculture faces challenges attracting younger farmers and ranchers. There are many reasons but key is the difficulty making enough income to support a family while also investing in land, equipment, seed and livestock. Taking advantage of emerging social and financial incentives for low input farming and in farm-based energy production can help keep another generation to act as stewards of Montana's varied agricultural landscape, providing many other benefits to local communities, the state and the nation.

Understanding the full potential savings from efficiency in the agricultural sector is hampered by lack of data on farm energy use. One of the first tasks then is to gather more accurate data on the actual savings of installed energy efficiency measures.[36]

Other steps to take include:

1. Encourage production, and use, of **locally produced fuels** such as ethanol, biodiesel, and agricultural waste methane in motorized vehicles in the agriculture sector. Biodiesel fuel in particular, produced from local oilseed crops, is less polluting than diesel from petroleum sources, and not only could reduce farm production costs, but increase demand for an existing cash crop, and keep money in local economies. (See Chapter 3.)

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35 American Council for an Energy Efficient Economy provides several publications of interest to agricultural producers. See www.aceee.org, search word agriculture. Examples include "Using GPS Guidance Products to Improve Energy Efficiency on the Farm", and "Reducing Energy Costs of Farm-Related Transportation", and "Using Solar Power in Grazing Systems and Capturing Energy Efficiency on Dairy Farms", etc.

36 Ibid, ACEEE. "Potential Energy Efficiency Savings in the Agriculture Sector", April 2005.

2. Encourage **"no-till" or "reduced till" cropping**. This decreases the need to plow, which saves energy, builds soil health and potentially helps sequester carbon. Organic material is left in soil, thus carbon is kept in the ground instead of being released. However, energy and GHG savings are significantly lessened if chemical-intensive approaches are used rather than eliminating fossil fuels in the process. The Natural Resources and Conservation Service (NRCS) in Montana is investing $1,250,000 in no-till incentives in Fiscal Year 2007, primarily in eastern Montana.
3. Encourage **organic farming** practices, including the growing of nitrogen-fixing cover crops, which reduce the requirements of fossil-fuel-based fertilizers and herbicides. (Helping farmers switch to organic production will save even more in indirect energy consumption. Even existing organic grain production can gain efficiencies by organic minimum till methods.)
4. Determine **energy efficiency targets for irrigation pumps** and other motors used in agriculture, similar to the ENERGY STAR program. Provide policies and incentives to reach these targets. For example, an $18 million program in California focused on irrigation pump repairs lead to a reduction of 83.6 megawatts of peak load. While reductions in Montana would not be this dramatic, this illustrates the potential for conservation.[37]
5. Encourage the use of smaller, more **fuel-efficient farm equipment**, such as tractors, trucks and other farm equipment where appropriate.
6. Encourage on-site **wind and solar generation** of electricity.
7. Follow the progress of research into thermal **gasification of biomass** ("wood gas" or "producer gas" which was used in Germany in WWII) for decentralized fuel/power production and search for ways to apply the research to Montana agricultural practices. Low grade grain screenings, straw, spoiled grain and other biomass sources may also expand the range of where this technology could be deployed. Currently, research is being conducted at Montana State University Northern in Havre.[38]
8. Research and implement **solar drying** of certain crops, instead of using natural gas.
9. A more long range goal would be **electrolysis of reservoir water** (by renewably generated electricity) into oxygen and hydrogen, once storage and effective on-site or **local use of hydrogen fuel** becomes more economically viable.

37 Brown, Elizabeth, R. Neil Elliott, and Steven Nadel. "Energy Efficiency Programs in Agriculture". American Council for an Energy-Efficient Economy. January 2005. p 92. <www.aceee.org/pubs/ie051full.pdf>.

38 Research by Ron Carter, phone 406-283-1830.

Using less fossil fuel derived inputs and creating more fuel and electricity close to the end user leaves Montana less vulnerable to oil supply and price shocks, and strengthens local economies. Of course, energy conserving practices in farm and ranch homes and outbuildings, as discussed in the Commercial and Residential sections, will also save dollars for farm families and businesses.

HOMEGROWN CONSERVATION AND EFFICIENCY

A low-profile house subtly alters a ridgeline east of Lavina, Montana. The house overlooks the Musselshell River to the south. To the north is a long view over rolling prairie toward the Big Snowy Mountains. From a distance this house looks unremarkable. Even close up it looks quite normal. But it is an example of what can be accomplished in Montana through energy efficient design.

A visitor notices that what initially looked like a one-story house is actually two stories, with the bottom floor dug into the ridge. Two stories face south, windows drinking in sunlight. On the upper floor few windows face any direction but south.

Inside the house, one notices all windows are modest in size and double paned, graced with insulating curtains or shades. The visitor must pay close attention to perceive that the walls are one foot thick. This is a super-insulated structure, from ceiling to floor.

There are baseboard electric heaters, but they rarely kick in. By day there is some “solar gain” through those south windows, but mostly what keeps this house warm is heat thrown off by electric lights, refrigerators, freezers and other appliances, and heat from the bodies of people and pets sitting or moving around —“waste heat” this is called, but the thick walls of this house do not let it go to waste.

This house appeared in the 1980’s on a working hay, sheep and cattle ranch. Since then many houses have sprouted on ridgetops around Montana, many of them not truly ranch houses, many of them far from modest in size, many of them inhabited only part of each year. Some of them jut up into wind, tall windows facing the view—ignoring the sun. Some give only a nod to insulation, relying instead on energy-intensive heating, usually from propane or natural gas. While this probably is not the owners' intention, consumption is conspicuous, and seems to imply that the more energy a building consumes, the wealthier its owners are.

But are people who live in a super-insulated ranch house outside Lavina, and pay virtually no heating bills, any less wealthy? There is another way to measure wealth, based not on how much is consumed but on how much is conserved. What if we refuse to be defined merely as consumers? What if, instead, we call ourselves conservers?

What's the difference between conservation and efficiency? Efficiency sounds more active. Efficient motors, efficient light fixtures, efficient vehicles, efficient heating systems all convey a sense of doing something well. Conservation conveys a sense of doing nothing—or rather, not needing to do something. Conservers are efficient consumers. Why? They have designed their houses, towns, lives effectively. If efficiency is "yes, please" then conservation is "no thanks". We need both the yes and the no.

Yes, to replacing standard incandescent light bulbs with compact fluorescent lights (CFLs). CFLs produce the same amount of light using 66 percent less energy. Even though a CFL costs more, it can last up to ten times longer. Replacing four 75-watt incandescent bulbs in your home that burn for two or more hours a day with comparable 23-watt CFL bulbs will save around $200 over the life of the bulbs. If every household in Montana would install just one CFL bulb, especially where bulbs are left on for four hours or more a day, we would conserve enough electricity to light more than 7,000 homes and prevent greenhouse gases equivalent to the emissions of nearly 2,700 cars. Just one light bulb per household![39] Imagine what we could save by using CFLs in commercial and industrial buildings too!

> THERE ARE TWO WAYS TO MEASURE WEALTH:
> BY HOW MUCH WE CONSUME
> OR HOW MUCH WE CONSERVE.

Just say no to leaving the lights on—any lights, CFLs or incandescents—when you leave a room. No to TVs, computers, etc. left on when not in use. Even when the power switch is turned off, TVs, VCRs, DVD and CD players, and cordless phones with built-in display clocks, memory chips and remote controls account for 5 percent of total U.S. electricity use.[40] This costs consumers more than $1 billion per year. Putting such equipment on a power strip that can turn them completely off is a great energy saver.

Yes, to installing insulated shades or curtains.

Yes, to raising them on a winter day and lowering them at night.

No, to cranking up your thermostat to 75 degrees in cold weather.

Yes, to leaving it at 65 and putting on a sweater.

Yes, to setting it at 55 at night or when you go away for a few days. (You'll save 5 to 20 percent on heating bills.)

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39 Compiled from information from the U.S. Census Bureau and the U.S, Department of Energy at <www.energystar.gov>.

40 Alliance for Safe Energy. "Take the 6 Degree Challenge". <www.sixdegreechallenge.com>.

Yes, to using ENERGY STAR rated appliances and CFL bulbs.

Yes, to using warm or cold water for your laundry instead of hot. And when it's warm outside, why not let the sun and the wind dry your clothes instead of an electric clothes dryer?

SENSIBLE SOLAR

The real lesson of the U.S. excursion into alternative energy in the 1970s and '80s was that conservation and energy efficient structures are where the real savings are. Solar heating systems are highly ineffective for heating drafty barns, but very successful in energy efficient homes.

Another lesson of the '80's is that the key component in any energy system is the user. In one study of 100 homes in the Denver area where $2,000 was spent on winterizing, more than 50 percent of the utility bills went up! The people were no longer worried about conserving energy, and became careless. Energy-conscious owners of apartments often have to plead with tenants to open the drapes on south-facing windows on sunny winter days or set their thermostats to turn down at night or when they are away from home.

> WHAT IF WE REFUSE TO BE DEFINED AS PASSIVE CONSUMERS?
> WHAT IF WE DEFINE OURSELVES AS ACTIVE CONSERVERS?

Basic education is needed in any building or energy program to help people understand the concepts of energy efficiency and conservation as well as the unintended consequences—environmental and economic—of wasting energy.

Passive Solar[41] combined with sensible building practices is the most cost effective use of the sun's energy in home heating. The key, at least in a northern climate like Montana's, is simply to put the majority of the windows on the south side of the building. Windows on the south gain heat (and of course with the use of insulated curtains or shutters help retain heat at night). Windows on the east and west as a rule come in about even in energy loss and gain. Windows on the north side are a net loss. Simply designing the home with this in mind can reduce energy consumption by 25 percent.

Large windows need to be balanced with an interior thermal mass system to absorb the incoming BTUs[42] so the sun's energy can be used in the evening but not overheat the home during the day. Incorporating these concepts into a "better building practice" program, perhaps based on LEED standards (see

41 Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces where the orientation, design and materials in the home all moderate temperatures without the use of mechanical systems or non-renewable energy input.

42 British Thermal Unit—a measurement of heat.

footnote 25 on page 19) combined with mortgages that reward energy efficient buildings, may be the best ways to start making passive solar design commonplace.

Passive solar is still largely ignored by builders due to their basic training to install a mechanical solution instead of accommodating to existing conditions. But passive solar is becoming more and more appealing to consumers because of its comfort and energy cost efficiency. Combine passive solar with super insulation (which means insulating the home to the point where the only real heat loss is required air exchange) and integrate other common sense strategies, such as strategically locating a water tank to preheat domestic hot water or tempering fresh air by bringing it inside only after it passes through a pipe buried in the ground, and energy bills go down as comfort goes up.

While passive solar and super insulation may not sound like strong investment incentives, the Environmental Protection Agency (EPA) has found that a home's value rises an average of $20 for each $1 decrease in the annual utility bill. Look at this situation in reverse: say that a home's value goes down $20 for every $1 rise in the annual utility bill. Recent price increases have sent utility bills up by as much as $1500 or more per year: 20 times $1500 equals $30,000. Figures like that make sensible solar and super-insulation even more attractive.

Active Solar[43] systems fall into two main categories, photovoltaic and solar hot water. Photovoltaics—electricity produced with solar panels—will be discussed in Chapter 4 in more detail.

Domestic hot water (DHW) is the most cost-effective application of active solar, yet it is not used extensively. For $3,500 to $5,000 one can purchase an **evacuated tube solar hot water system** that will supply approximately 75 percent of the hot water needs of a family of four. Domestic water heating averages $350 to $450 a year, with a purchase/installation payback of 10 years or less on a typical residence. Combine this with available federal and state tax credits and the payback becomes very reasonable. Remember also the payback in real estate value, even if it's likely the home will be sold in less than 10 years.

For home heating, combining a solar hot water heating system with **floor radiant heating** can achieve efficiencies of 50 to 60 percent.[44] This is quite a high efficiency since sunlight, the resource that feeds it all, is free.

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43 Active solar systems convert the sun's energy to electricity or use various types of solar collectors that heat air, water or other fluids, and disperse this heat mechanically.

44 The initial cost of installing radiant heating is somewhat higher but heating solid surfaces or materials instead of air is a far more efficient heating system.

MEETING OUR REAL NEEDS

A sound economic policy recognizes that as access to energy and material resources declines, strategies for conservation and efficiency need to be already in place. Otherwise, paying for them later may be difficult or even impossible, since the cost of efficiency (for example, insulated windows) is tied to the cost of energy and as energy prices escalate, money gets tighter. It is better to invest now and live efficiently than to squander energy and pay dearly for essential improvements later.

We must also be wary of optimistic solutions such as "the hydrogen economy" or "clean coal" technology, which may not turn out to be realistic for handling (or replacing) our current life style—nor even realistic for reducing greenhouse gas emissions. "Clean coal" has yet to prove itself, needs massive financing and is years from widespread practical implementation. Hydrogen, when derived from fossil fuels (and not from water electrolyzed via renewable energy sources), is very inefficient and ultimately polluting.

> We need to create a sustainable way of life beyond fossil fuels. Replacing what we use now is not the question; the question is, what are our real needs and how do we fulfill them?

Our present excessively consumptive life style can be sustained only as long as energy is cheap and abundant. However, every indicator—especially at the gas pump and in monthly bills—suggests that traditional fossil fuel based energy is neither cheap nor abundant. We need to find new ways to create a sustainable way of life beyond fossil fuels, and this is our ultimate quest.

Technology alone will not rescue us from our excesses; in fact, embracing technology, without considering long term consequences, is how we create our excesses. Therefore, replacing what we have now is not the question; the question is, what are our real needs and how do we fulfill them? How do we live in harmony with Nature, maintaining a healthy environment and viable economy, while preserving for future generations the possibility of living as well as we, at our best, live today?

CHAPTER 3:
Homegrown Fuels

GOAL: BY THE YEAR 2020, AS ENERGY EFFICIENCY AND CONSERVATION PRACTICES LOWER PER CAPITA DEMAND FOR FUELS, TO SUPPLY UP TO 50% OF MONTANA'S TOTAL TRANSPORTATION FUEL NEEDS (ON ROADS AND FARMS) WITH ETHANOL OR BIODIESEL PRODUCED IN-STATE IN DECENTRALIZED FACILITIES; TO CREATE A VIABLE SYSTEM FOR DISTRIBUTING THESE FUELS IN-STATE; TO PHASE OUT COAL-GENERATED ELECTRICITY AS A "BASELOAD" SOURCE FOR IN-STATE ELECTRICITY CONSUMPTION; TO HARVEST AND USE FOREST-BASED FUELS SUSTAINABLY; TO SET UP A PILOT PRODUCTION FACILITY USING RENEWABLY GENERATED ELECTRICITY TO ELECTROLYZE WATER AND PRODUCE HYDROGEN FUEL.

A VARIETY OF FUELS—AND USES

The majority of fuels used today in Montana are fossil fuels: coal, oil, natural gas. With rising costs and declining availability, and with the inherent problems with burning such fuels—pollution and global warming—it's time to look at some homegrown alternatives for transportation, electricity production and heating. Montana's agricultural base and the common sense ingenuity of the people who live here offer fertile ground for developing clean, sustainable options.

Fuels include liquids (such as gasoline, heating oil, diesel fuel, biofuels), gases (natural gas, hydrogen, biogas) and solids (primarily wood and coal). Fuels are often used to produce other forms of energy, such as electricity. In conventional power plants this process remains rather simplistic: coal or natural gas or wood is burned to heat water to steam which then spins turbines. In Montana the primary fuels used today are coal (mainly for electricity generation but in some places for space heating), petroleum distillates like gasoline, diesel fuel, aviation fuel, lubricants, etc (used for transportation and heating) and natural gas (used in Montana primarily for space heating and cooking).

Many of these fossil fuel uses could be readily replaced by biofuels or other renewable alternatives—for example, biodiesel instead of petroleum-based diesel or electricity generated not by coal but by wind, solar or small hydro.

Fuels Producing Electricity

Electricity generation and consumption are discussed in Chapter 4 of this *Blueprint*, but it is useful here to note that nearly two-thirds of Montana electricity today is produced from the burning of fuels. In 1986 coal overtook hydropower as the number one source of electrical generation, and since then coal has gradually risen to hover around 60 percent of Montana's generation, with petroleum and natural gas accounting for less than 3 percent.[45] Large scale hydropower now ranges between 33 and 38 percent, and wind power suddenly became a factor in 2005, as the Judith Gap wind farm and several other smaller installations came online.[46] From almost zero, wind power suddenly accounts for 2.5 to 3 percent of electrical production in Montana.

However, wind power needs "firming"—that is, backup power for when the wind is not blowing. Natural gas is a responsive fuel that can be used for quick activation so it has been used frequently for that purpose. There are scattered local projects underway in Montana designed to "firm" small scale wind power as well as small scale solar with micro-hydropower facilities or with generators powered by a renewable fuels such as biodiesel. (Firming is discussed in greater detail in Chapter 4.)

Fuels for Heating

Heating is critical to life; people heat water to steam not only to spin turbines, but also to send steam hissing through pipes and radiators in buildings; we heat water for baths, showers, to wash clothes and dishes, to cook; we heat spaces; we use heat in industrial processing. We do all this with a variety of fuels.

Natural gas is the main fuel used in Montana for space and water heating and for cooking, but since it is also in greater and greater demand for fueling power plants, its price has risen sharply. Propane is widely used in rural areas or towns lacking natural gas lines.

Biogas can replace natural gas in space heating for homes and businesses or provide process heat for industry. Biogas is produced by bacteria in anaerobic (without oxygen) fermentation of organic matter in a very simple process. Anaerobic bacteria digest just about anything containing carbon: manure, human waste, lawn clippings, agricultural and food processing residues—even automobile tires. Converting septic tanks to biogas digesters could supple-

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45 Montana Public Service Commission sources and "Energize Montana" <www.deq.mt.gov/energy/index.asp>, 2006.

46 Montana Public Service Commission sources, various news reports, and "Energize Montana" <www.deq.mt.gov/energy/index.asp>.

ment ever more expensive propane or petroleum-based diesel fuel for space heating in thousands of rural and suburban homes. A homegrown industry could result from manufacturing and installing biogas digesters geared to individual homes or to larger commercial buildings.

Every ten-cent increase in the price of gasoline or diesel costs the Montana economy $87 million. We could stop sending these payments out of state and invest them in fuels grown here at home.

Many Montanans still heat their homes with a renewable resource: wood. However, this practice has dwindled in recent years, in part due to restrictions in valleys such as Missoula where smoke from wood fires can lower air quality. A number of schools in Montana are realizing significant savings by converting heating systems to burn residues from logging or forest thinning. U.S. Forest Service grants helped pay for the installation of a number of wood-fired boilers, which is a significant public subsidy, but one that arguably could improve public forest lands, and certainly can help communities and schools in forested areas. The abundance of woody material that must be removed from the forests to reduce fire risk and improve forest health suggests a long-term supply, abundant and cheap. Much of this “wood slash”—the material now being used as fuel—formerly was considered waste and was simply burned on site.

Fuels for Schools

The full name of this program, run in six states by the U.S. Forest Service, is Fuels for Schools & Beyond.[47] Its purpose is to encourage not only schools but prisons and other public institutions to install heating and sometimes power systems that use woody biomass as their fuels.

Twelve Montana locations by 2006 had Fuels for Schools projects in various stages. Darby, Montana, was one of the first schools in the program, and Darby Mayor Rick Scheele projects that burning around 750 tons of wood chips will cut the local school district’s heating costs by 82 percent, down to $18,000 a year.

Depending on the site, installation costs can be recovered within three to 15 years.

The program cuts down on some of the smoke and other pollutants that fill the skies from the burning of an estimated one million tons of logging waste and other woody biomass in Montana each year. That’s enough to fuel 1,300 Darby-sized projects.

47 "Fuels for Schools...and beyond: Woody Biomass Utilization Program". DNRC Forestry Division. <www.dnrc.mt.gov/forestry/Assistance/Biomass/default.asp>.

The program has attracted controversy. Some forest experts believe that too much thinning has occurred, and they question the long-term sustainability of this fuel resource. Missoula forester Dave Atkins addressed these concerns like this: "We want to manage forests to retain woody debris as habitat for forest creatures and as nutrients, but not let it build up in ways that lead to atypical fires"—fires can get so hot that the duff, the partly decayed organic matter on the forest floor, also burns.[48] That puts vast amounts of CO_2 into the atmosphere, adding to global warming, and erosion is greater after a fire if the duff burns. More stream sedimentation and landslides generally occur where the forests that have not been thinned catch fire and burn intensely.

"Since the duff has a lot of the nutrients, we want to keep those nutrients from flowing (or burning) out of the system," Atkins said. These days Forest Service crews typically leave some dead snags, woody debris, larger trees, and other materials that hold moisture longer during the summer. Trees also hold moisture which, when released, creates rain in areas downwind from a forest. This helps prevent those areas from becoming overly dry. Tree roots also clean sediment salts from the ground water, helping to keep it usable for drinking and irrigation.

"Sustainability is the name of the game," according to Atkins. He believes that "we can sustain our forest eco-systems through prudent thinning, which in turn reduces the amount of high-severity fires. We can use the material removed to sustain our communities and economy." Assuming it is not overdone, Atkins hopes Fuels for Schools will provide renewable energy from a reliable source for years to come.

Fuels for Transportation

The present source of liquid fuels used in Montana is primarily petroleum. Set against the Test Criteria for Energy Resources (see Chapter 1, page 6), petroleum is unsustainable, polluting, and its economics (controlled by large multi-national corporations) place Montana in a less than tenable position as net financial benefits travel a one-way freeway out of state.

Transportation is the largest consumer of petroleum in Montana and in 2003 was the second largest sector of all forms of energy use in Montana. In 2004 gasoline sold in Montana totaled about 500 million gallons, with diesel sale totaling 220 million highway gallons (taxed) and 153 million "farm" gal-

48 Doty, Russ. "Sopris Conference Highlights Fuels For Schools Program". AERO Commentary on KUFM public radio, Missoula. July 27, 2006. <www.aeromt.org/kufmDoty%20July06.php>.

lons (untaxed).[49] Gasoline and diesel sales include all retail sales to Montana residents, to visitors, and to truck and railroad traffic passing through the state.

Consumption of transportation fuel in Montana has fluctuated with changes in the national economy, prices, and energy policy. For example, gasoline sales peaked in 1978 at about the same level as in 2004. **Figures show that nearly $1.5 billion leaves Montana's economy yearly to pay for petroleum-based fuel**.[50]

Oil companies in Montana pump about 19 million barrels of crude oil per year (one barrel of petroleum, abbreviated bbl, is 42 gallons)[51]. Montana experienced its "Peak Oil" moment in 1968, when crude oil production peaked at 48.5 million bbl and has been declining since, despite higher prices. Four Montana refineries, three in the Billings area and one in Great Falls, process about 181,000 barrels of crude oil per day. Because of the location and destinations of pipelines carrying crude oil and pipelines carrying finished product, most of the crude pumped in Montana actually is refined out of state, while most of the crude supplying Montana refineries comes from Alberta (75 percent) and Wyoming (20 percent). Of the crude oil refined in Montana, oil companies ship 55 percent of the final product out of state.[52]

Despite the state's oil pumping and refining industry, multinational corporations operating in global markets determine the prices that Montanans pay for transportation fuels. Increasing prices drain the Montana economy, especially the agricultural sector. Price increases in gasoline and diesel during the year 2005 drained an additional $375 million dollars out of the Montana economy[53]. This transfer of wealth is the same as a tax that creates no jobs (except for a small increase in oil exploration), that funds no public services, that builds no roads. Over the course of 2005, the average gasoline price in the Rocky Mountain region increased by 47 cents and the average diesel price by

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49 Figures on gasoline and diesel sales are from the Montana Department of Transportation; links on their website get you to gasoline and diesel sales numbers.

50 This is a simple calculated value: gasoline and diesel sales times price increase. Calculations by Cliff Bradley.

51 "Petroleum and Petroleum Products in Montana". Department of Environmental Quality Report. <www.leg.state.mt.us/content/publications/lepo/2005_deq_energy_report/petroleum.pdf>.

52 "Understanding Energy in Montana: A Guide to Electricity, Natural Gas, Coal, and Petroleum Produced and Consumed in Montana" and "Petroleum and Petroleum Products in Montana". Department of Environmental Quality Report. <www.leg.state.mt.us/content/publications/lepo/2005_deq_energy_report/petroleum.pdf>.

53 U.S. Department of Energy, Energy Information Administration. <www.usdoe.gov>.

38 cents.[54] Prices continued to rise briskly throughout most of 2006. **Every increase of one dime in the price of gasoline and diesel costs the Montana economy $87 million.**

Instead of sending our fuel payments to multinational oil companies, out of state, we instead could spend that money at home, buying renewable fuels derived from plant material – biofuels[55] —to the benefit of Montana's economy.

THE CASE FOR BIOFUELS

Two liquid fuels are derived chiefly from plants: ethanol and biodiesel. Since they substitute almost directly for fossil-based liquid fuel, they are used for agricultural and industrial processes and for space heat, but most prominently for transportation.

ETHANOL is produced from any carbohydrate: sugar, starch or cellulose. Starch or cellulose is first converted to simple sugars using enzymes, then ethanol is produced by fermentation with yeast and distilled to purify the final product. Most gasoline engines can be readily converted to run on E85 (85 percent ethanol, 15 percent gasoline) and many new cars come with dual fuel capability. Brazil is the unquestioned world leader in the use of ethanol, made chiefly from sugarcane, and in Brazil virtually all vehicles now are built to run on 100 percent gasoline, 100 percent ethanol, or any combination in between. Fueling stations offer all these choices.

BIODIESEL can directly substitute for petroleum diesel. Biodiesel is produced by extracting the oil from oil seeds. In Montana we use canola, safflower, flax or new crops such as camelina, and then convert the triglycerides in the vegetable oil to single chain fatty acids in a very simple process. Thus, ethanol and biodiesel can replace gasoline and diesel as primary transportation fuels and—properly implemented—could comply with AERO's Test Criteria.

Replacing gasoline with ethanol. Replacing all of the gasoline sold in Montana in the year 2004 with E85, a blend of 85 percent ethanol, 15 percent gasoline, would require about 425 million gallons of ethanol per year.[56] A significant fraction of this ethanol can come from starch or sugar based feedstocks. Current levels of feed barley production and low value starch (off spec malt barley, malt house residue, grain elevator screenings, etc.) could supply

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54 Ibid.

55 See <www1.eere.energy.gov/biomass/abcs_biofuels.html> for more information on all biofuels.

56 This is calculated from gasoline and diesel sales data from the Montana Department of Transportation (see footnote 49) and from price data for the Rocky Mountain region from U.S. DOE (see footnote 53). Calculations by Cliff Bradley.

about 80 to 100 million gallons.

If the price of sugar in the U.S. declines to world levels because of implementation of the Central American Free Trade Agreement (CAFTA), current Montana sugar beet production could supply an additional 50 million gallons. (For a sugar beet farmer, the per acre return of sugar beets for ethanol is about the same as the current, pre-CAFTA value of sugar beets for sugar, when ethanol is at $1.70 per gallon.)

Where could the rest of the ethanol come from? Over the past twenty years, a number of studies in Montana and neighboring states have evaluated the availability and conversion cost of cellulosic biomass[57]. Potential Montana sources include pulp and paper mill waste, agricultural residues (sugar beet pulp, etc.), wheat and barley straw, forest residue and perennial grasses grown as energy crops. The principal limiting assumption in all of these studies is the cost of collecting this biomass, evaluated against retail gasoline prices of less than $2.00 per gallon.

One half of the wheat and barley straw in Montana could produce 280 million gallons of ethanol per year. On most grain farms, half of the straw is now removed from fields for disease management, which would not affect its potential use for biofuels. Perennial grasses grown on Conservation Reserve Program (CRP) land with minimal inputs and with net improvement of soil fertility and erosion control could provide twice as much.

Biofuels can be produced sustainably and profitably on a family farm or a community scale that can boost rural economies.

Replacing petroleum diesel with biodiesel. Biodiesel yields vary with the crop and climate, but Montana has sufficient land in current production to supply the state's entire diesel demand. Montana has about five million acres in wheat production in any given year and at least an equal acreage in rotation crops. In many cases, oil seed crops provide an excellent rotation crop. Montana used to grow two million acres of flax for fiber and linseed oil. At $2.50 per gallon to a farmer, crops grown for biodiesel would exceed the income from dry land wheat in a typical year.

Co-ops or other farmer-owned groups could set aside a certain fraction of their land for biodiesel crops to displace petroleum-based diesel for on-farm use. (By 2006 many individual farmers around the state were doing just that.) It makes economic sense.

57 Cellulosic biomass—plant material that previously was considered too difficult to break down into simple sugars for biofuels production. See Chen, Chengci. "Cellulosic Biomass for Ethanol and Cropping Systems for Bioenergy". Montana State University. <www.harvestcleanenergy.org/conference/HCE5/HCE5_PPTs/Chen.pdf>.

Here is why Biofuels should assume a prominent—and immediate—role in Montana energy policy:

- Biofuels can replace a significant fraction of petroleum fuels in the short term—certainly in a much shorter time frame than coal-derived synfuels[58]. The technologies are proven, immediately available, can be brought on line in manageable increments. They are not capital intensive and employ more people per unit of capital investment than fossil energy technologies, and employment is not restricted to large centralized production sites. (See case study in Chapter 5.)
- Montana has sufficient resources to replace all of the retail gasoline and diesel fuel sold in the state in 2004 without adversely affecting soil fertility or cropping practices.
- Currently, biofuels compete economically with gasoline and diesel at retail prices (including taxes) above $2.50 per gallon. Well designed ethanol projects using low value or waste carbohydrates and biodiesel from waste cooking or processing oil are fully competitive at even lower retail prices.
- Burning biofuels does not increase greenhouse gases. Biofuels are made from real time carbon fixed by crops from atmospheric CO_2. Biofuels do not release fossil carbon that has been stored underground for millions of years.
- Integrating biofuels with agriculture will strengthen Montana's rural economy by adding value to Montana crops and keeping the value added from energy production in the local economy. A bushel of barley sold for feed brings about $2.00; converted to ethanol and high protein livestock feed it is worth over $5.00.
- Biogas and biomass fuels are cost competitive with natural gas as boiler fuel at many locations in Montana.

CELLULOSIC ETHANOL CONVERSION TECHNOLOGY IS HERE

- Iogen Corporation has proposed a 50 million gallon per year straw-to-ethanol plant in eastern Idaho.
- Montana Microbial Products (a Missoula based company) with funding from the Oregon Office of Energy has developed a process for ethanol production from grass seed straw—which in the past has simply been burned. The company estimates that this process could produce about 20 million gallons of straw-derived ethanol per year at an operating cost of about $1.20 per gallon.

58 Synfuels—in this case, diesel fuel derived from coal by the Fischer-Tropsch process of gasification and catalytic conversion.

BIOFUELS: ANSWERING THE CRITICS

Critics contend that biofuels (1) require more energy input than they yield; (2) divert crops from food production to fuel production and promote unsustainable industrial agriculture; (3) subsidize large agribusiness companies such as Cargill and Archer Daniels Midland (ADM).

And the critics may be right, if we simply replace Exxon-Mobil with ADM in fueling freeways full of single passenger SUVs. However, there is a fundamental difference between fossil fuels and biofuels. Unlike fossil fuels, biofuels can be done right without huge expense and without environmental degradation. With an efficient transportation system and sound energy policy, biofuels can replace fossil fuels, and do so sustainably.

Net energy? The debate about the net energy yield of ethanol is based on studies by two researchers, studies which have received a lot of publicity, but which used faulty assumptions and old data to conclude that ethanol's energy yield was negative. Other studies by, among others, the U.S. Department of Agriculture (USDA), U.S. Department of Energy (DOE), Argonne National Laboratory, and the Rocky Mountain Institute all show strongly positive energy yield.

Energy quality is the real issue: internal combustion engines won't run on straw, canola, unrefined crude oil, or lumps of coal. Mobile engines require high density liquid fuels, and low value fuels cannot be converted to high value fuels without expending energy. **The Rocky Mountain Institute estimates fossil energy input per unit of output for gasoline at 1.23 to 1.00, corn-based ethanol 0.74 to 1.00, and cellulose-based ethanol at an impressive 0.20 to 1.00.**[59] Biofuels have an advantage: their primary energy input is solar, in the form of fixed carbon in sugar, starch or cellulose, and production processes require only relatively low quality energy inputs which can come from non-fossil fuels such as biogas, process by-products or integration with co-generation or other process sources.

Displacing food crops? Biofuels production does not do this. This is not a simple issue of corn-to-ethanol taking away corn-as-food for poor countries. Hunger in the world is a function of poverty, not lack of food. Poverty is a misallocation of resources; in poorer countries much of the land that could grow food for local people instead is devoted to growing export crops. Meanwhile, in wealthier countries much of the land is devoted to crops grown for livestock feed—which is true of corn in the United States.

Montana does not grow much corn, but does grow a lot of barley, which also is used mainly for livestock feed. Thus, barley-to-ethanol has a similar

59 Glasgow, Nathan and Lena Hansen. "Setting the Record Straight on Ethanol: Focusing on the Nexus of the Agriculture and Energy Value Chains." <www.rmi.org/sitepages/pid1157.php>.

minimal impact on the human food supply as corn-to-ethanol. Converting sugar beets to ethanol would displace sugar produced in Montana for human consumption; however, as previously pointed out, if the rules of CAFTA are actually enforced, this would reduce government subsidies to the U.S. sugar industry. If this happens, converting sugar beets into ethanol may be the only way for certain Montana farmers to make a living.

Other issues are embedded in this discussion: low commodity prices, overproduction of certain crops in the U.S., subsidies for crops like corn, and the U.S. practice of dumping commodities on poor countries. A Mexican agricultural economist recently wrote an article contending that if the entire U.S. corn crop were converted to ethanol, this would be the best thing that could possibly happen to rural Mexico, because the U.S. would stop dumping its subsidized corn on Mexico. This occurs under the rules of NAFTA, the North American Free Trade Agreement, and unintended consequences result from this practice. The flood of U.S. corn undercuts the price of Mexican corn; this forces Mexican farmers to leave their land to find work in cities, and many of them head north looking for work in the U.S.

This analysis holds true for a number of U.S. crops—cotton, for example. If farmers in the U.S. replanted their cotton land with perennial native grasses, as feedstock for ethanol, this would end the dumping of government-subsidized cotton. World prices for this commodity would not be forced down, and cotton farmers in Africa and India would benefit. So would the American taxpayer.

Montana grows no cotton, but taking marginal lands now producing annual monoculture crops like dryland wheat, and replanting them with mixed native perennial grasses, could work to Montana's advantage. The land could be used for livestock grazing, which properly done will stimulate plants to grow, and then in a rotational regime the plants could periodically be harvested as cellulosic feedstock for ethanol.

A ten-year, on-the-ground study[60] led by David Tilman, professor of ecology at the University of Minnesota, shows that mixed native perennial grasses and other flowering plants growing on degraded lands could provide more usable energy per acre than either soybean-based biodiesel or corn-based ethanol.[61] Perennial prairie plants have many benefits. They require little energy to grow, and all parts of the plant above ground are usable. They reduce global

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60 Reported in the December 8, 2006, issue of the journal, Science. This research was supported by the University of Minnesota Initiative for Renewable Energy and the Environment and by the National Science Foundation (NSF) and since 1982 has been conducted at Cedar Creek Natural History Area, an NSF Long-Term Ecological Research site (<www.lter.umn.edu/>).

61 Perennial native plants on marginal land are producing 51 percent more energy per acre than corn grown on fertile land.

warming by removing carbon dioxide from the atmosphere, and do so far more effectively than annual crops like corn and soybeans. They store far more carbon in their roots and in the soil than is released by the fossil fuels needed to grow them and convert them into biofuels. And they renew soil fertility, clean up surface waters, preserve wildlife habitat, and yield higher income for farmers and ranchers.

Industrial agriculture? Replanting marginal Montana crop lands to perennial grasses would signal a movement away from, not further into, fossil-fuel intensive, chemical-intensive industrialized agriculture. It would re-value Montana grasslands that have been devalued as sources of high quality livestock feed by subsidized crops, like corn. However, Montana farmers will continue growing grains, legumes and oilseed crops on both irrigated and dryland acres, and more and more are likely to convert a portion of these into biofuels. The impact on food production will be minimal and besides, farmers need rotation crops to keep their soils healthy. They also, arguably, need livestock.

Integrating livestock and crops is crucial to the economic viability of biofuels production, and again, this moves away from the monoculture patterns of industrialized agriculture. Ethanol production removes the starch, leaving a product containing the original protein and therefore, the livestock feed value. Converting corn, barley or other crops to ethanol depends on obtaining value from this protein co-product by feeding it to livestock. (See diagram: Integrated Agriculture Biofuels System, page 45). None of these actions subsidize large agribusiness corporations, if done on an appropriate local scale.

Undercutting Corporate Control

Large agribusiness corporations receive massive subsidies, and because they exert enormous control over agricultural policy in the United States, they could end up controlling biofuels. But this does not have to happen.

Minnesota enacted policies that effectively limited the size of ethanol plants, and promoted farmer-owned cooperatives for ethanol production. This prevented a single large ethanol producer such as Archer Daniels Midland from monopolizing ethanol production in that state.

Now farmers are making money, rural economies are growing, and more than 200 gas stations in Minnesota are selling E85 (85 percent ethanol, 15 percent gasoline) at the pump. Citizens can ally themselves with family farmers and demand public policies that work for a sustainable future.

As noted before, most corn grown in the U.S. is used as livestock feed. The second biggest use of corn is corn sweeteners, the high fructose corn syrup in soda pop and a variety of other products. The primary use of ethanol from corn is to replace MTBE (methyl tertiary butyl ether) as the octane and pollution control additive in gasoline. MTBE pollutes ground water and causes cancer. It seems reasonable to argue that replacing a toxic compound with ethanol is at least as useful as producing sweeteners for soda pop.

Critics of biofuels are right on two points:

(1) In the long run, the subsidies and high-input agricultural practices used to

grow corn in the U.S. are not sustainable. This is true regardless of whether the corn is used for cattle feed, high fructose corn syrup or ethanol. As part of energy and agriculture policy, sustainable agricultural practices and an economy where farmers can make a living are both crucial.

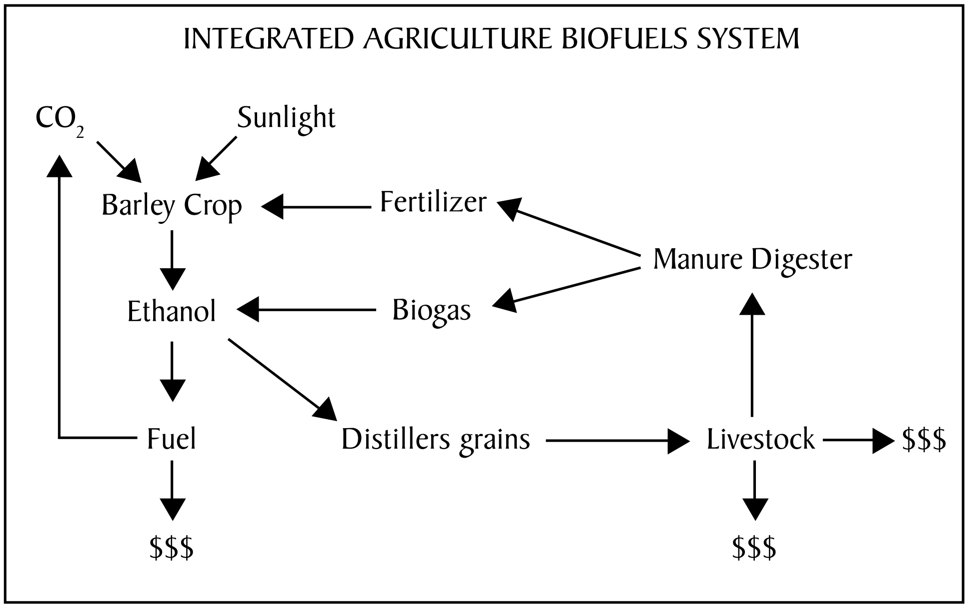
(2) Corn-based ethanol cannot replace the 20 million barrels of oil consumed per day in this country. However, more public transportation, more energy-efficient vehicles, more localized production and consumption of food, more clustering of residential areas and workplaces all would combine to reduce this high demand, and this would allow ethanol made from cellulose to meet most of the revised demand for transportation fuels. Perennial grasses and shrubs can be grown sustainably as energy crops, without soil erosion and without massive inputs of fossil-fuel-based fertilizers and pesticides. In Montana, converting marginal dry land wheat ground to perennial grasses would improve the soil and provide a greater return to farmers.

INTEGRATING AGRICULTURE AND BIOFUELS

Biofuels can be produced sustainably and profitably following the principals set out in this *Blueprint*. This can happen on a scale that fits community or farmer-owned production, boosts rural economies and does not deplete finite resources nor increase global warming. The accompanying diagram depicts an "Integrated Agriculture Biofuels System" that is technically feasible and economical using existing proven technology. Details may vary with specific sites, especially if there are local sources of low value ethanol feedstocks such as grain elevator waste, or the ability to integrate straw or other cellulose into the process. However, the basic principals of integration and appropriate scale apply across a wide range of situations that fit local resource bases in rural Montana.

Ethanol production elegantly fits the sustainability model where, emulating nature, the output from one process is not waste, but rather is feedstock or building blocks for the next process. Sunlight, the principal energy input to this system, is captured by the barley and stored as starch. The starch is converted to ethanol and sold by the farmers as an octane booster in gasoline or as E85 transportation fuel. Producing ethanol converts the barley starch but leaves the high protein distillers grains, a valuable livestock feed. Manure from the livestock feeds a biogas digester generating the fuel for process energy to distill the ethanol. The biogas does not provide all of the process energy for the ethanol; some additional energy in the form of wind or small hydro generated electricity to run pumps would be necessary. The residue from the digester provides fertilizer for the crop.

The benefits continue, since burning the ethanol in a car and burning the biogas for process energy generates CO_2 but it is "current" CO_2, fixed from the atmosphere by the barley, rather than stored CO_2 from fossil carbon in petroleum or coal thus not adding greenhouse gases that cause global warming.



In summary, ethanol and biogas can integrate in energy efficient and value added processes: high protein distiller grains, a by-product of ethanol is fed to livestock, whose manure makes biogas, supplying process heat for the ethanol distillation.

Farmers could also add biodiesel to this integration, setting aside a portion of their land to grow oil seeds to supply enough biodiesel to fuel tractors and trucks. The residual "meal" after the oil is extracted also makes excellent high protein livestock feed.

Most Montana barley is grown for livestock feed with a market value of about $2.00 per bushel less freight[62]. Converted to ethanol and distillers grains, the market value is about $5.00 per bushel. Producing ethanol and feeding livestock in-state would add value to rural economies and provide high-quality feed for livestock, reducing the need to send animals out of state for finishing. Local processing to sell steak instead of feeder steers would add more value.

Biofuels provide an opportunity for finance and ownership structures that keep the value added in the local Montana economy. Biofuel production can be diverse and scaled to match locally available feedstocks and capital resources. With this flexibility, farmers and people in local communities can own biofuel production facilities. There is also no reason why local ownership structures can't operate retail fuel sales networks. The state could support financing and receive a return on investment through loan guarantees or as an equity investor. Montana also has the expertise to help evaluate technology and provide technical support.

62 USDA National Agriculture Statistics Service, Montana Department of Agriculture. State and county data accessed through <www.nass.usda.gov>.

BIOFUELS ENERGY POLICY RECOMMENDATIONS

Policy recommendations must begin with the recognition that all energy sources, in particular petroleum and coal, receive taxpayer subsidies in many direct and indirect forms. **As taxpayers we should have the choice of subsidizing the energy supplies we want and penalizing or taxing those that are not sustainable**. Truly clean, renewable energy sources are technologically feasible and cost competitive with fossil fuels, so these are political choices on how we will spend our money.

FINANCE is the most critical issue in energy policy. Energy corporations and financial institutions (both public and private) have the mechanisms to finance big, capital intensive and centrally controlled energy production. To create a future of renewable energy benefiting the Montana economy, mechanisms that finance appropriately-scaled, diverse and locally-owned energy production are needed.

Until lending institutions are comfortable, the state should create a capital pool to provide equity capital and loan guarantees for financing renewable energy projects. A tax of 10 percent of the incremental increase in gasoline, diesel and natural gas costs, above the average 2002 prices, would be more than adequate. In 2005 this would have generated more than $50 million.

MARKET TRANSITIONS—these comprise the second most critical policy issue. Energy users need to see assured supply, and lenders need to see markets. State and local governments can spur markets by using biofuels in most government vehicles and in public buildings where feasible. Minnesota, North Carolina and New Mexico have such programs. Besides creating markets, it will save taxpayers money.

ELIMINATING SUBSIDIES FOR PETROLEUM AND COAL is policy issue number three. Oil companies do not need tax breaks, especially as they reap record profits in the tens of billions of dollars per quarter. Nor do oil companies need incentives to drill for oil, and the government does not need to fund research and finance pilot plants for coal synfuels. The tax codes already include huge subsidies and perverse incentives for petroleum such as depletion allowances. Simply by removing industry subsidies and adjusting the tax code to a level playing field, Montana and the federal government could generate significant savings which could be applied to biofuels and renewable, sustainable energy. This would keep the investment local in order to strengthen and sustain our communities.

CHAPTER 4:
Homespun Electricity

GOAL: BY THE YEAR 2020, HAVING IMPLEMENTED CONSERVATION MEASURES THAT HAVE REDUCED MONTANA'S ELECTRICAL DEMAND BY ONE-FOURTH (FROM 12 TO 9 GIGAWATT HOURS PER YEAR), TO BE MEETING ALL OF MONTANA'S IN-STATE ELECTRICITY NEEDS WITH DIVERSIFIED CLEAN AND RENEWABLE SOURCES, INCREASINGLY DECENTRALIZED, INCLUDING HYDROPOWER, WIND, SOLAR, GEOTHERMAL, SOME BIOFUELS, AND ADVANCED METHODS OF STORING AND DISTRIBUTING ENERGY.

Montana's electrical generating capacity stands at approximately 5400 megawatts (MW)—although the dams, thermal power plants and wind generators in this state rarely (if ever) generate this amount of power at one time. Forty-four entities are currently involved in providing electricity to industrial, agricultural, commercial and residential customers around the state. Four investor-owned utilities serve approximately 63 percent of these customers while 30 electric cooperatives serve approximately 33 percent[63]

Over the past 15 years electricity consumption in the state has decreased overall by an average of about 0.1 percent (one-tenth of one percent) per year, but this is primarily due to a decrease in electrical use by large industries (including aluminum refining), with the big dive occurring in 2000-2001. That was when electrical rates rocketed into the stratosphere during an "energy crisis" that wasn't—it was manipulated by a handful of electricity merchants like Enron. Over that same 15-year period, both commercial and residential consumption rose, commercial at a rate of 2.1 percent per year and residential at a rate of 1.4 percent per year.

Conventional projections forecast an annual rise in commercial use of 2.2 to 2.9 percent through 2010 and an annual rise in residential use of 0.02 to 1.5 percent through 2010, followed by slight decreases projected in each sector for the decade from 2011 through 2020[64]

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63 "Understanding Energy in Montana: A Guide to Electricity, Natural Gas, Coal, and Petroleum Produced and Consumed in Montana: Summary". Department of Environmental Quality Report. October 2004. <www.leg.mt.gov/content/publications/lepo/2005_deq_energy_report/summary.pdf>. Also see Climate Change Strategies, "Draft Greenhouse Gas Inventory", 2006.

64 Ibid.

Each year Montanans use an average of approximately 14,000 kilowatt hours (kWh) per capita, which compares to the average U.S. per capita consumption of 12,000 kWh. (This average rolls in industrial uses, which if agriculture is included are significant.) Total electricity consumption in Montana currently is about 12,180,000,000 kilowatt hours per year (or about 12.2 gigaWatt hours). Approximately one-third of this consumption is residential, one-third commercial and one-third industrial. For the past 15 years Montana has exported between 37 percent and 47 percent of the electricity produced in the state.[65]

Some 60 to 65 percent of Montana's electricity is provided by burning coal, with 33 to 38 percent coming from hydroelectric dams. Only two decades ago, in 1986, coal and hydropower were even. Before that, hydropower had always been the leader. The other three main sources are petroleum, natural gas, and wind.

Until 2005, windpower in Montana contributed a miniscule amount of electricity. This is ironic, in a state once dotted with wind machines such as the Jacobs Windcharger—but that was before the Rural Electrification Administration extended its lines across the landscape in the 1930s and 1940s. Since 2005, however, windpower has seen a resurgence in Montana. The upper Musselshell Valley has become a favored spot, sprouting clusters of secondhand, refurbished wind generators in the 65 to 100 kilowatt range and, on another scale altogether, seeing 90 imposing towers rise into the sky at Judith Gap, each tower topped by a 1.5 megawatt turbine. That single leap of 135 megawatts at Judith Gap moved Montana from last place to 15th in windpower production among the 50 states.

Montana's hydroelectric dams and windfarms do not pollute the air. For that, we must turn to the burning of fossil fuels and, to some degree, wood. Not surprisingly, the largest quantity of greenhouse gas emissions in Montana comes from coal. The power plant complex at Colstrip alone is responsible for 82 percent of all GHG emissions in the state[66]. Colstrip's four units have a combined capacity of nearly 2200 megawatts, which is approximately 40 percent of the total electrical generating capacity in Montana.

Electricity is used primarily for lighting and running motors and switches. It is also used for space heating and for heating water. Heating is a very inefficient use of electricity, and therefore some of the quickest gains in conserving electricity come from changing to compact florescent light bulbs (which are much more efficient than incandescent bulbs, and do not produce nearly as much heat), and switching to other forms of space and water heating. In many

65 Ibid. "Understanding Energy in Montana".

66 Op.cit. "Understanding Energy in Montana" and Climate Change Strategies 2006.

cases, space heating can be produced or augmented through intelligent design (passive solar heating), and the same is true of heating water ("waste" heat can be captured, for instance, and used for this purpose).

Electricity in the modern era typically has been produced in large power plants in central locations, and transmitted to end users often hundreds of miles away (this is mostly the case in Montana today, and certainly is the case with excess Montana electricity that is exported out of state). There are significant losses of power the farther electricity is transmitted. On the other hand, electricity is well suited to decentralized production and consumption, from the community level to the individual level. This localized approach is often referred to as "distributed generation".

THE ELECTRICAL GRID IS LIKE A GIANT LAKE WITH INFLOWS AND OUTFLOWS, CHARGES AND DISCHARGES. MONTANA RENEWABLE RESOURCES LIKE WINDPOWER, DISPERSED WIDELY, COULD BE REFILLING THIS 'LAKE' NEARLY ALL THE TIME.

To accomplish the goals cited at the beginning of this chapter—3-plus gigaWatt hours per year decline in consumption, along with an increase in generation from renewable sources such as wind, solar, small hydro and others—Montana would have to produce approximately 9 GWhr (gigaWatt hours) of electricity for use each year in this state. Currently hydroelectric production amounts to less than 40 percent of Montana's total electricity production, including exports. Assuming that large hydro could supply 20 percent of Montana's in-state electricity needs, could the remaining 7.2 GWh be produced each year using clean, renewable energy sources?

The answer is yes, and this chapter will demonstrate how.

BLOWIN' IN THE WIND

Wind power is the fastest growing energy resource in the world. The market for wind turbines in Europe is growing 40 percent per year (Denmark and Germany are world leaders: Denmark gets 20 percent of its electricity from wind and now is aiming for 30 percent.) The price per kWh of wind-electricity has been dropping constantly, as wind turbines of all sizes have become more efficient, and as the market expands. In fact, wind can compete directly with existing coal-produced electricity today, and is considerably cheaper than new coal power. Coal power costs are trending upward (even without factoring in the "externalized" costs of air and water pollution, carbon emissions, and threats to human health) while wind power costs, despite the rising cost of materials, are increasing less rapidly than coal. This is likely to continue.

In Montana, besides Judith Gap and the clusters of smaller wind turbines in the upper Musselshell, six large turbines now overlook Great Falls, and more are appearing elsewhere. But Montana has only begun to take advantage of its tremendous wind resource.

In 2002 the *Renewable Energy Atlas of the West* estimated that Montana had the highest windpower potential of seven states in the intermountain west, totaling more than one million gigaWatt hours (GWhr) per year. Yet, in the scenario set forth in this chapter, with Montanans acting to reduce by 30 percent the electricity now consumed in-state, Montana would require only 9 GWhr. That would leave 999,991 GWhr of windpower potential. (Since that study was released, the National Renewable Energy Laboratory has increased the land area in Montana considered windy enough for electricity production by another 7 million acres.) Clearly Montana has a nearly untapped energy resource "blowin' in the wind".

However, before envisioning phalanxes of wind towers marching across Montana skylines, scooping up air and converting that motion into static on a TV set in Seattle or the hum of a refrigerator in Portland, let us return to the present.

THE CASE FOR TRANSMISSION BOTTLENECKS

While in theory Montana can produce about 5,400 megawatts of electricity at any given time, this would happen only if every turbine were spinning in every coal-fired or other fossil fuel generating plant, every hydropower dam and wind generator, with full sunlight agitating electrons on every solar photovoltaic collector. Rarely is this the case. Large coal plants such as those at Colstrip are typically shut down for maintenance about 12 percent of the time. Reservoirs behind Montana's dams are rarely full—especially during the last 20 to 25 years of lower than average rain and snowfall. And everyone knows how fickle the wind is.

Typically, these days, the state has been generating about 3,900 megawatts, and despite official statistics that say 37 to 47 percent of Montana-produced electricity is exported, other indications are that more than half of those 3,900 megawatts, about 2,000 MW, are going somewhere else. Since 2,000 megawatts is the approximate capacity of the Colstrip coal-fired plants, one can envisage Colstrip essentially handling all Montana's export markets, while in-state use is covered by everything else.

The electrical grid, of course, does not distinguish between "green" electrons from dams or windfarms and "black" electrons from coal. Nonetheless, these figures suggest how feasible it is to see renewable energy sources very soon being able to handle all of Montana's in-state electricity needs.

Those 2,000 megawatts of excess power essentially fill the power lines that head out of state. If only we had more space on those lines, some people lament, or if only we built more power lines, then more coal could be mined and burned, more wind turbines raised to spin, and Montana could ship more electrons out of state.

Complaints have filled the air about this lack of transmission capacity, these "bottlenecks" in the power grid west, south and east out of Montana. There is also a lack of transmission capacity to the north, into and out of Canada, but a Alberta-Montana power line is being promoted to make that connection. (This line would terminate near Great Falls. From that point, however, more lines would have to be built to ship Alberta and Montana coal- or wind-generated power out of state.) These bottlenecks are portrayed as an unfortunate restriction on Montana's ability to export power to supposedly growing markets in California, the Southwest and the Pacific Northwest.

On the contrary, this *Blueprint* argues that these transmission bottlenecks actually constitute an advantage for Montana. The reasons are threefold:

(1) The demand for exported power may not be there. This is true particularly for coal-generated electricity. Wyoming has virtually no transmission bottlenecks, and has taken advantage of this to sell a great deal of its coal- and wind-generated electricity beyond its borders; however, Wyoming (and also Nevada) recently were forced to scale back plans to sell more coal-fired power to California because California now officially balks at buying "dirty" electricity, as from conventional coal plants or any source that emits more carbon dioxide than a modern natural gas plant.[67] However, even "clean" electricity, like that generated by the wind, must travel hundreds or thousands of miles with massive leakage of power along the way—up to 25 percent loss at those distances.

There is now a serious internal discussion among utilities, regulators and other key players in California (and other areas with high electricity demand) whether to invest in (a) long-distance power from places like Montana, (b) building generating facilities nearer to where the power actually will be used, which would allow smaller facilities to be built due to less "line loss" or (c) cutting demand and obviating the need for new power.

On that last point, Californians have demonstrated their ability to reduce their electricity demand rapidly, by as much as 10 percent, as they did during the "energy crisis" of 2000-2001. This was when the state's deregulation law led a handful of energy suppliers such as Enron to shut down power plants and artificially reduce supply to raise prices.

67 "California Bans Buying High-Pollution Power", Associated Press story in Billings (MT) Gazette, January 26, 2007, page 3A.

Further evidence of a lack of demand for power exported from Montana came in October 2006, when the Northwest Power and Conservation Council announced an unexpected 2,400 MW surplus of electricity going into the winter of 2006-07. Adding this to an existing 1,500 MW "buffer"—the Council's term—brought the actual surplus in the Pacific Northwest to nearly 4,000 MW. This excess capacity came from implementing cost-effective conservation measures and also from some recently built natural gas power plants and windfarms coming online.

In short, out-of-state demand for newly generated Montana electricity, from whatever source, appears to be weak or even non-existent.

(2) **It is to Montana's advantage to meet its own power needs first, as reliably, as cleanly, and as inexpensively as possible.** Instead of counting on exporting electrons through very expensive new high voltage transmission lines, why not build enough local capacity to avoid having to "bid" against the low cost—but now higher priced—hydro and "old" coal power that PPL-Montana now is exporting?[68] This could encourage all Montana consumers, large and small, to find the most cost-effective and environmentally benign ways to meet our needs.

First, as outlined in Chapter 1 of this *Blueprint*, reduce demand by financing smart and aggressive energy conservation measures. Next, meet any legitimate new in-state power needs by favoring co-generation and renewable energy over the construction of large, expensive, centralized thermal generating plants (coal or natural gas). At this point, aside from certain local micro-hydropower opportunities (used very effectively in towns like Philipsburg), windpower is the cheapest form of new electrical generation. And in the future, as the costs of solar photovoltaic systems keep coming down, more and more electricity can be generated, building by building, directly from the sun.

One advantage of generation from wind, micro-hydro, solar and other localized renewable energy sources is that generating capacity can come online incrementally, as needed. Therefore, smaller capital investments are required at a time—and over time—as opposed to a massive capital investment all at once for a large centralized power plant. Another advantage is that renewable sources can be widely distributed.

(3) **Distributed energy systems are more resilient than centralized systems**. Scaled to local needs, these systems are less vulnerable to disruption from natural disasters (high winds, ice storms, etc.) or from human intervention (accidents at power plants, manipulation of energy markets with

68 New powerline construction costs average one million dollars per mile.

resultant price hikes, or deliberate sabotage). "Renewable energy is homeland security" reads a popular bumper sticker. Placing the word "decentralized" in front of "renewable" clarifies this Montana advantage even more.

THE CASE FOR TAKING OVER THE DAMS

One way to make certain that Montana's own electricity needs are met first would be for citizens to take public ownership—or at least public control—of the privately owned hydroelectric dams within our borders. It is true that this has already been tried. A citizen initiative to "Buy Back the Dams" failed in the 2002 election. However, early opinion polls that year showed voters favoring the idea by about 2 to 1. Only after the owners of the dams, PPL-Montana and Avista, waged an expensive advertising campaign in the months before the election did those figures flipflop: the initiative lost by a 2 to 1 margin.

Still, the idea has merit. The dams, after all, are a renewable energy source and could form a foundation for Montana to handle all its in-state electricity needs with renewable energy, backed up by sensible conservation incentives (for example, charging customers less for power used during "off-peak" demand periods).

Montana's large hydroelectric dams formed the basis of our state's historically inexpensive power, what economists call a "competitive advantage". Montanans lost this advantage after 1997, when deregulation of electric utilities resulted in the breakup of the Montana Power Company, its dams and coal plants sold to PPL and its distribution system sold to NorthWestern Energy (NWE).

Are there potential drawbacks to Montanans' taking over these dams? Yes. For one thing, citizens would be acquiring an aging resource in need of maintenance and repair. Moreover, the dams are a resource that customers already have purchased several times over, during decades of paying their Montana Power Company electrical bills. Another downside is that if current climate change trends continue (see "Water and Climate Change in Montana" in this chapter), there may be less precipitation to fill the reservoirs, and less hydropower capacity than in the past.

The upside of taking over the dams—or at least those dams best suited to the task—is that their relatively low cost hydropower immediately could be dedicated to serving Montana consumers as a baseload supply. Then as other clean, renewable generating sources continue to come online, the dams could gradually be converted from providing baseload power to providing "peaking" power (during times of high demand) and back-up or "firming" power for

Water and Climate Change in Montana

Water is the lifeblood of the land, especially in semi-arid Montana.

Every time someone talks about building a new coal-fired power plant like the proposed Highwood facility east of Great Falls or, more recently, a proposed coal-to-liquid-fuel plant in the Bull Mountains south of Roundup, someone else asks: "Where's the water coming from?"

This a realistic question and—since Montana is not rich in surface water where coal is abundant—it is one more reason for Montanans to step away from long-term commitments to coal,

To be specific:
(1) Mining coal means mining the aquifers for most of eastern Montana.

(2) Coal bed methane extraction means pumping the water out of that aquifer to release gas "trapped" by water pressure.

(3) Coal-fired power plants (and any thermal power plant fueled by fossil or radioactive fuels) require large amounts of water, as do facilities that first gasify then liquefy coal to produce synthetic fuel. (See Chapter 5 for case studies on the Highwood and Bull Mountain proposals.)

In the longer term, "Where's the water coming from?" takes on urgency because of possible climate changes associated with global warming. A November 2006 press release from Montana State University begins: "Montana will become a desert by 2100 if nothing is done to slow global warming." The story cites research by four MSU students (from Montana, South Dakota, Oregon and Turkey) that spurred their request that the local City Commission in Bozeman endorse "The 10 Percent Challenge", a voluntary program to reduce carbon dioxide emissions by 10 percent. (Among other measures, this program recommends that businesses turn down thermostats by one degree, turn off office equipment when not in use, replace incandescent bulbs with florescent bulbs, and use ENERGY STAR appliances.)

Not all climate change projections for Montana are so dire. A few actually foresee a slight overall increase in precipitation; however, most projections see longer periods of drought (especially east of the Rockies) punctuated by rain or snow coming in bursts; less snow accumulation in the mountains; earlier and quicker run-off in spring, and consequently reduced flows in streams and rivers come summer—conditions most Montanans have been experiencing since the early to mid-1980s.

The impacts of this scenario are widespread and include more forest fires; more insect invasions in trees stressed by drought and disease; more erosion; diminished wildlife habitat; diminished fishing, boating and other recreational opportunities; and less water for municipalities and—most tellingly—for agriculture.

Impacts of energy development extend beyond less available water to pour into coal facilities. Hydropower capacity would decline with less water behind the state's large dams. This would also mean less water in the future to electrolyze into hydrogen. Less infiltration by rain or snow could reduce the flow of geothermally heated water. And even if Montana farmers focused on non-irrigated, dryland "energy crops"—oilseeds for biodiesel; barley, grains and native forbs and grasses for ethanol—less, or more erratic, precipitation would reduce production of those feedstocks.

Wind, solar and some forms of geothermal energy, once installed, are among the few systems requiring virtually no water to produce or consume.

the mix of electricity flowing into the system from intermittent wind, solar and small hydro sources. Geothermal energy, by the way, is also renewable but generally is not considered intermittent, so that most geothermal power plants could join the dams in acting as “firming” power sources. (See “The Case for Geothermal” in this chapter.)

In practice, taking over the dams could happen in a number of ways. It could mean forming a statewide public entity, perhaps a utility or a cooperative, to buy suitable dams from their current owners. Alternatively, taking over the dams could mean not buying them but empowering the existing regulatory system to monitor production and distribution of electricity from the dams with an eye to ensuring that Montana consumers benefit.

In any event, public control should ensure that the dams are managed in a more balanced way, not only to benefit Montana consumers but also to preserve and enhance Montana’s environment. Generating electricity would be just one factor that is weighed among others, including maintaining adequate streamflow for wildlife, fisheries, agricultural, municipal, industrial and recreational purposes, and, in the future, maintaining adequate storage of water from which to produce hydrogen fuel by electrolysis.

Taking over the dams is not an indispensable step toward achieving the goal of this *Blueprint for Homegrown Energy Self-Reliance*. However, done in the right way, it could enhance Montana’s progress toward that goal.

(Note to readers: Potential hydropower sites are mapped at <http://nris.state.mt.us/nsdi/nris/FC2.gif>.)

‘FIRMING’ RENEWABLE ENERGY

Whenever someone advocates using more renewable energy sources to generate electricity, skeptics ask, “What do we do when the wind does not blow or the sun does not shine?” The same question, however, can be asked about hydro or coal or nuclear power. In China, in October 2006, water levels at key hydropower reservoirs were down 12 percent from a year earlier, substantially cutting production. In India during a recent drought, when water stopped flowing over a dam, more than 200,000 people were left without electricity. As mentioned earlier, large coal-fired plants typically are shut down 12 percent of the time for maintenance or other reasons. And as for nuclear power, 41 U.S. plants have experienced 51 shutdowns that each lasted more than a year, due to safety concerns.[69] Every method of electric generation requires “backing” or “firming”. This is why the best policy is to diversify generation sources.

69 See <www.ucsusa.org/clean_energy/nuclear_safety/unlearned-lessons-from>.

Generating no power of its own, and tied to buying the majority of its electricity from a single supplier, NorthWestern Energy chose to diversify its sources by buying windpower. This decision led to the creation of the windfarm at Judith Gap and NWE's 20-year contract to buy that power at an average price of $31.16 per megawatt hour (or 3.116 cents per kilowatt hour). This is an excellent price. In 2006, Judith Gap produced about 40 percent of its capacity of 135 megawatts, which is outstanding performance for a windfarm.[70] Nonetheless, backing up or firming windpower must always be considered in the overall price, and in the case of Judith Gap this has sent the price from $31 to between $36 and $41 per megawatt hour.

This firming cost is likely to move downward as power dispatchers become more familiar with the generation characteristics of Judith Gap (and with windpower in general). But for the moment, windpower skeptics have pointed out NWE's passing onto its customers the price of 25 more megawatts of firming windpower, and have blamed fluctuating winds for $4,000 in fines paid by NWE for not balancing electrical load on the grid.[71]

Handling $4,000 in fines is a minor issue. If NWE apportions this amount among its more than 300,000 electrical customers, the average share comes to about $0.0133—a mere penny and one-third per customer. The larger question is the cost of firming windpower, but even when NWE adds between half a cent and one cent to Judith Gap's contracted price, the result is still a bargain—3.6 to 4.1 cents per kilowatt hour. At that price Judith Gap still is providing NWE's least expensive new source of electricity, and at the prices currently charged by PPL and various "spot market" suppliers, Judith Gap likely is providing NWE's cheapest electricity from all sources, old or new.

For NWE, wind, though, still serves a relatively small portion of its total load. What happens when a utility like NWE begins to rely heavily on windpower and the wind simply stops blowing?

For starters, it is highly unlikely that wind will stop blowing everywhere at once. To quote a Utility Wind Interest Group (UWIG) report by three major electric utility industry groups: "A sudden loss of all wind power on a system simultaneously due to a loss of wind is not a credible event".[72] Rarely is the

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70 Testimony in the 2007 Montana legislature gave a figure of 37 percent; other sources have said 38, 40, and even 42 percent. Whatever the final performance figure for 2006 turns out to be, in a 2006 Montana public television program, Judith Gap's project manager stated that this windfarm was the best performing facility in the entire United States.

71 Newspaper article in Choteau (MT) Acantha, Jan. 11, 2007 at <www.choteauacantha.com/articles/2007/01/11/news/news2.txt>.

72 Utility Wind Integration Group. "Utility Wind Integration State of the Art." May 2006. <www.uwig.org/UWIGWindIntegration052006.pdf>.

wind consistent in velocity or direction (this is especially true in Montana's varied terrain) so at least some of the wind turbines dispersed around a region should be able to catch a breeze. This is even true on a single windfarm such as Judith Gap where 90 turbines are dispersed over an area of more than 8,200 acres of state and private land. Rarely does one pass by this site without seeing at least a few of these turbines revolving.

The UWIG report states that in any system where "wind capacity is properly discounted in the determination of generation ... no additional generation needs to be added to provide back-up capability." Such "proper discounting" would seem appropriate for NorthWestern Energy's present system, where the amount of windpower feeding the grid cannot be considered anything more than an additional energy source—not yet a "capacity source" capable of contributing to the system's ability to serve peak times of maximum demand.

For utilities with a higher percentage of windpower than NWE at present, the Utility Wind Interest Group reports that "requirements for additional reserves will likely be modest....In two major recent studies, the addition of 1,500 MW and 3,300 MW of wind (15 percent and 10 percent, respectively, of system peak loads studied) increased regulation requirements by 8 MW and 36 MW, respectively, to maintain the same level of...control performance standards."

On average, according to the UWIG report, when windpower provides up to 20 percent of a system's peak-level electricity on a grid, firming power adds another 1/2 cent per kilowatt hour. As previously noted, NWE's cost of firming Judith Gap power has been ranging from 1/2 cent to 1 cent per kilowatt hour. NWE now buys windpower not only from Judith Gap but from smaller "qualified facilities" for about 3.27 cents per kilowatt hour. If these smaller dispersed sites as well as new larger windfarms perform even close to the level of Judith Gap—and if NWE moves toward 20 percent windpower in its system—Montanans could see NWE's windpower firming costs come down.

Forecasting when winds are likely to blow and trying to match a system's demand with those windy times is crucial. When the wind does not blow, "existing dispatchable generation" must compensate. Power dispatchers adjust supply with fluctuating demand over three periods:

(1) regulation (day by day, 24 hours and beyond),
(2) ramping (hour by hour, from 1 to 24), and
(3) load-following (minute by minute, 0 to 60).

For each of these periods, dispatchers use different mixes of what are called **spinning reserves** or **non-spinning operating reserves** to firm the power or to make the power quality acceptable. Spinning reserves come from increasing the output of power plants where generators are already turning. Non-spinning reserves are idle power plants that can be "ramped up"[73].

Many reserves can be ramped up quickly. These can include turbines in hydroelectric facilities and geothermal power plants; conventional generators burning diesel, biodiesel, natural gas, or methane from anaerobic digesters; and compressed air storage or hydrogen fuel cells used to produce electricity. These sources can firm windpower during the shorter "ramping" and "load following" periods. Other reserves, such as thermal power plants fueled by radioactive ore or pulverized coal, take longer to ramp up and are suitable for firming windpower during the longer "regulation" period.

There is one type of coal technology called Integrated Gasification Combined Cycle (IGCC) which gasifies coal then burns the gas and thus, like a conventional natural gas power plant, can be ramped up fairly quickly. IGCC plants also produce less toxic pollutants and use less water than conventional coal plants and would therefore be more suited to "firming" wind electric generation during both shorter and longer periods.

Despite these advantages, IGCC is more complicated and expensive than conventional burning of pulverized coal, and actually results in more carbon to be dealt with, either to be released into the air or—at significant additional cost—captured and sequestered underground. For these economic and environmental reasons, this *Blueprint* contends that any new coal generating facility, including IGCC, is inappropriate for Montana. There are simply too many cleaner, cheaper and faster options than coal.

Some predict that solar power from large new plants coming online in Colorado, Nevada and elsewhere could work well with windpower. Each could, in a sense, help "firm" the other because the sun often shines when the wind does not blow, and vice versa. However, while centralized solar facilities have their place, and are a definite step up from centralized fossil fuel or nuclear facilities, solar electricity ultimately will be utilized most effectively in decentralized ways, produced on rooftop after rooftop and, with minimal to zero transmission losses, used on site.[74]

73 "Ramped up" means the power generation sequence is initiated, brought up to production level and begins generating electricity at a level ready for distribution.

74 Energy consultant and windpower entrepreneur Russ Doty, based in Billings, Montana, provided much of the information in this chapter and in the Blueprint as a whole. More can be learned by visiting his website at <www.newworldwindpower.com>.

The Case for Geothermal Power Plants

The entire eastern part of Montana north and east of Billings has geothermal potential, as well as sites near Bozeman and several other Montana cities. Of the three types of geothermal power plants, Steam, Flash, and Binary, the last is probably most suitable for Montana.

Binary plants rely on relatively low temperature hot water (100° to 300° F), which is much more common than geothermally heated water at higher temperatures. This hot water passes through a heat exchanger along with a second fluid that has a lower boiling point (usually a hydrocarbon such as isobutane or isopentane). This secondary fluid vaporizes, which turns turbines and creates electricity. Both fluids are recycled, the remaining secondary fluid through the heat exchanger and the geothermal water condensed and returned to the reservoir. This self-contained cycle means that nothing is emitted or wasted.

According to the National Renewable Energy Laboratory, energy produced by binary plants currently costs about 5 to 8 cents per kWh. Almost certainly this is less than the cost of power from an IGCC coal plant, particularly if the cost includes sequestrating carbon emissions.

Geothermal potential is high all over the western United States. The Western Governors' Task Force on Geothermal Development excluded seven states (Montana, Wyoming, the Dakotas, Nebraska, Kansas and Texas) and still came up with almost 13,000 MW of geothermal energy that could be developed within a reasonable timeframe.[75] The geothermal industry considers 5,600 of these megawatts viable for commercial development within the next 10 years, at prices ranging from 5.3 to 7.9 cents per kilowatt hour (assuming continuation of a production tax credit). Eighty-eight sites in California and Nevada contain 3,900 potential MW close to areas of large demand. Many more geothermal sites are yet to be discovered.

Water use by geothermal plants would be far less than in other thermal plants. According to A Guide to Geothermal Energy and the Environment (Kagel et al, April 22, 2005, pages 43-47), "Comparing two recent power plant applications in California, a new geothermal flash plant would use 5 gallons of freshwater per MWh, while a new gas facility would use 361 gallons per MWh.

Alternatively, a binary, air-cooled geothermal facility would consume no water. Also, the fluids used to generate geothermal power are kept separate from drinking water and are continuously recycled through the geothermal system, so they are not depleted through geothermal use."

Land use is minimized—up to nine times less than a coal fired power plant of equal capacity—and geothermal facilities generate not only electricity but taxes, royalty payments and jobs. Twenty-one geothermal steam-generating plants at the Geysers Geothermal Field in California together can produce almost 1,000 MW of electricity and employ 425 people full-time plus 225 additional full-time equivalent contract workers; in 2003 the plants paid more than $11 million in property taxes to Lake and Sonoma counties.

To view a map of Montana's geothermal potential see http://geothermal.id.doe.gov/maps/mt.pdf.

75 See <www.westgov.org/wga/initiatives/cdeac/Geothermal-full.pdf>.

NEW BATTERIES TO BACK UP RENEWABLE ENERGY

New developments in battery technologies give promise of storing the intermittent energy of the sun or wind, economically, on both large and small scales.

For example, a "flow" battery now in use on King Island, between Australia and Tasmania, is explained in an article in *The New Scientist*.[76] King Island has no connection to a mainland power grid, so it relies its own small wind farm along with diesel generators for electricity. In 2003 the local utility company installed a mammoth rechargeable battery that can deliver 400 kilowatts for two hours at a time. This reserve power has increased wind-derived electricity on the island's grid from 12 to 40 percent, and has cut diesel consumption nearly in half, saving money and avoiding carbon dioxide emissions of 2,000 tons per year.

For decades electricity generated by wind or sun has been stored in chemicals inside batteries, the most common being the lead-acid battery. What's different about the system on King Island is that, when the wind is blowing, the energy-enriched chemicals don't remain inside the battery but are pumped into storage tanks. Fresh chemicals in the battery then can soak up more charge. When the wind stops blowing, the flow is reversed: the energy-enriched chemicals are pumped back into the battery.

Though more complex than conventional batteries, flow batteries last far longer and their storage capacity can be expanded simply and inexpensively by building larger tanks and adding more chemicals. This technology is still being refined, but is now in use in a variety of applications from the King Island power grid to electric golf carts. Ultimately the flow battery could supplant many conventional electricity storage systems—from batteries in electric cars to large-scale hydroelectric pumped storage reservoirs.

Installing a type of "flow" battery allowed PacifiCorp, an Oregon-based utility operating around the western U.S., to avoid millions of dollars in costs and still achieve its aim. The story (according to Jon Coney of PacifiCorp, phone 503-813-7070) is that the company's power transmission into Castle Valley, Utah, was operating at full capacity, and the utility faced building a new substation and 16 miles of transmission lines through environmentally sensitive lands at a cost of $5.6 million. Instead, the company brought online the first Vanadium Redox flow battery to be used in North America. This utility scale battery, which stores energy and offers it back to the grid when the time is right, balanced power loads in the valley and cost just $1.3 million. The savings: $4.3 million.

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76 Thwaites, Tim. "A Bank for Windpower", The New Scientist, January 13, 2007. <environment.newscientist.com/article/mg19325861.400>.

On a smaller scale, William Von Brethorst of Ennis, Montana, installs renewable energy systems in homes and says he always backs them up with sealed, dry batteries, even when they are tied into the electrical grid. “When the sun goes down or when the wind is not blowing the entire electrical load is picked up by the utility,” he writes. “Massive amounts of power must be generated continuously. The grid cannot be throttled back as a result of a slight decrease in demand resulting from small scale renewable energy production…. Battery based, grid-tied home systems do not just sell back power to the utility, but reduce the overall home load profile permanently and decisively.”

The way these systems are wired is key to their efficiency, Von Brethorst says, with all critical loads placed on the inverter/battery system rather than returning to the power grid when the sun is not shining or the wind not blowing.

To critics who claim that battery systems reduce overall efficiency and burden owners with maintenance and disposal problems, Von Brethorst replies that AGM (dry) batteries perform well, are long-lived and maintenance-free, can be easily recycled, and “fit in any home safely without concerns about leaking chemicals or venting gases.” In ways not possible with non-battery grid-tied systems, he says, homeowners become aware of their overall energy consumption patterns and adjust them, often reducing their electric loads by 50 to 80 percent.[77]

THE CASE FOR DECENTRALIZED GENERATION

A giant rechargeable battery: this is one way to think about the electrical grid, that network of power lines and substations transmitting electrons from place to place. The analogy is not exact, since the grid by itself is a “real time” supply-demand network with no actual storage capability, but it is suggestive.

Better yet, think of the electrical grid as a giant lake: it has inflows and outflows, charges and discharges.

One interesting feature of windpower in Montana is that, if it were widely enough dispersed, it could be recharging this battery nearly always, re-filling this lake.

In many other states graced with rich windpower potential, the wind tends to be more uniform. North Dakota is an example. When the wind blows in one part of this relatively flat state, it probably is blowing in all parts—but the reverse is also true. As previously pointed out, thanks to Montana’s widely varying terrain, the wind may not be blowing at Judith Gap (as difficult as this

77 E-mail communication with AERO Energy Blueprint authors, December 3, 2006, from William Von Brethorst, Planetary Systems, Inc., Ennis, Montana.

may be for local residents to believe) but likely could be blowing at Big Timber or Plentywood.

This is a prime virtue of decentralized generation. All our windpower "eggs" would not reside in the baskets of a few giant windfarms. And our other means of generating electricity would not be reduced to a few centralized power plants.

Some argue that "economies of scale" dictate construction of large centralized generating facilities, be they coal-fired power plants or windfarms. It is true that purchasing steel, concrete, wire, meters, transformers, etc. is cheaper in large quantities, or renting a giant crane and raising not nine towers but 90, brings down the cost. If you divide total cost by total output, a single 400 megawatt facility would generate electricity more cheaply than four 100-MW facilities.

But what happens when that 400 MW facility shuts down for maintenance or repairs? This is what a 2005 study asks. Answer: the utility needs 400 megawatts of "reserve capacity" to replace it. The study, "Z Method for Power System Resource Adequacy Applications",[78] moves beyond cost per kilowatt hour to examine the total cost of serving customers reliably in a number of scenarios.

For example, the study asks if it is likely that all four of those 100 MW plants would shut down at the same time? It is not likely. It is not even likely that two would shut down at the same time; however, if they did, then just 200 MW would be needed, and the study indicated that this amount of reserve capacity should suffice. So, while those four 100 MW plants do produce power at a higher kilowatt-hour cost than one 400 MW plant, in the end the utility likely would save a lot of money building and running four smaller plants instead of one large one, because it would not need so much reserve power.

"The lesson to be drawn," according to the Northwest Energy Coalition's (NWEC) report on this study, "is that it's often cheaper to use several small plants than a few large ones, even if the larger plants cost less to operate."

NWEC concludes: "This effect is even more dramatic for small, distributed resources such as solar power on roofs and geographically diverse wind farms. As utilities develop plans and review portfolio options for serving load growth, they must seriously consider the economy of small scale."[79]

One virtue of windpower (pointed out earlier) is that it can be added

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78 Prepared for PacifiCorp by Ken Dragoon and V. Dvortsov.

79 "Small is Beautiful: When it Comes to Utilities, Economy of Scale Sometimes Works in Reverse", The Transformer, Volume 3, Issue 5, December 21, 2006. Published by the Northwest Energy Coalition, Seattle, Washington 98104; <www.nwenergy.org>.

gradually, as need arises, a megawatt or two at a time. Windpower doesn't have to come only from large, centralized windfarms like Judith Gap.

There are very effective wind machines of all sizes, including your backyard. Southwest Windpower in Flagstaff, Arizona, designed a 1.8 kilowatt machine in collaboration with the U.S. Department of Energy's National Renewable Energy Laboratory. It's called the Skystream, a backyard machine that can sit on a 35 to 50 foot free-standing tower or on guyed towers up to 105 feet. Company officials say it can quietly produce power for 5 to 10 cents per kilowatt hour and that it works best on property greater than 1/2 an acre with wind speeds above 10 miles per hour. Installed, the turbine costs from $9,000 to $12,000. Company officials say it can trim $500 to $800 off an average home's yearly electric bill, and pay for itself in 5 to 12 years—but this depends on wind speeds in the area, local prices of electricity, and various rebate programs. (The company figures may be optimistic. Payback time in Montana could be considerably longer. And there are other challenges like local zoning rules that prohibit wind turbines in backyards or restrict a tower's height.)

Green Electric Buying Cooperative (GEBCO) of Billings, Montana, is promoting the idea of neighbors getting together, about 30 of them, to purchase a 100 kilowatt machine—as opposed to each family's buying a 3 kW machine. They could place the machine on a favorable site, arrange with the utility for net metering (when the wind blows the meter turns backward) and, as GEBCO's CEO Russ Doty says, "This distributed generation would keep the tax base of energy generating units close to home (where the energy is used) rather than having the folks pay for centralized power plants based in a few places."

Some laws might have to change to allow this to happen. Current Montana law allows net metering only up to 50 kW. Doty suggests this be increased to 2 MW as it is in Colorado, New Jersey and Pennsylvania. "This would allow a school like Rocky Mountain College in Billings or the St. Labre Indian School in Ashland, Montana, to aggregate their individual loads and own a utility scale windmill."

Or there is this scenario sketched by (among others) Windpark Solutions, LLC, the firm that developed the Judith Gap windfarm before selling it to Chicago-based Invenergy Corporation. Windpark Solutions CEO Bob Quinn now wants to work on a smaller scale and is interested in keeping ownership of windpower facilities in local hands. An organic farmer from Big Sandy, Montana (also active in biodiesel production to handle the fuel needs for his own farm operation), Quinn has suggested that windpower entrepreneurs should set a goal of installing 3 megawatts of windpower capacity at every electric power substation in the state where there is a decent breeze.

Financing mechanisms to accomplish this include attracting investors who need tax write-offs for a period of years—usually ten—after which ownership of the windpower facilities would revert to local community members or co-operatives. This arrangement is working well in places like Wisconsin and Minnesota, as well as Germany and Denmark. Montanans in both the private and public sectors would need to work together to find the best financing mechanisms to provide for as much local control as possible.

PHOTOVOLTAICS: OBSTACLES AND OPPORTUNITIES

Local control is what photovoltaic technology—electricity directly from the sun—is all about: control not just community by community, but household by household. However, there are still some real financial obstacles to widespread adoption of photovoltaics (PV).

Solar electricity was first developed widely as part of the space program. The panels used today on space satellites are about 35 percent efficient. Those used in homes are generally of a lower quality; they cost far less but are only about 15 percent efficient.

Although costs have been coming down, a PV system is still expensive unless you can garner subsidies from certain utility or government programs, or are pumping water for livestock in remote locations, or have built a house at least a mile from the nearest power line. In the latter two instances, paying to construct feeder lines is so expensive that "going solar" makes sense. In the case of a home electric system, one might combine PV with small scale windpower, a battery storage system, and perhaps a biodiesel powered generator.

At an AERO solar workshop back in the 1970's, it was suggested that the U.S. military invest a billion dollars a year to install PV panels on the roofs of buildings on military bases. This technology could have evolved in a similar way that microchips subsequently evolved: with "economies of scale" kicking in to reduce manufacturing costs, by now many if not most of the homes in the U.S. could have been energy independent. This sort of intervention by government, to create a market, could still happen.

In the meantime, with or without government aid, private industry has been making great strides at bringing PV costs down. In August 2006 researchers at the University of Johannesburg and at Nanosolar[80], announced major breakthroughs in solar electric cell technologies using an alloy of copper-indium-gallium-selenide deposited in an extremely thin layer on a flexible

80 A private company in Palo Alto, California.

surface. Both companies claim the technology reduces solar cell production costs by a factor of 4 to 5. This would bring the cost to or below that of delivered electricity in a large portion of the world.

Half a dozen competitors are working along the same lines. As Dave Freeman and Jim Harding wrote in the August 10, 2006, *Seattle Post-Intellligencer,* "Thin solar films can be used in building materials, including roofing materials and glass, and built into mortgages, reducing their cost even further. Inexpensive solar electric cells are, fundamentally, a 'disruptive technology'…Much like cellular phones have changed the way people communicate, cheap solar cells change the way we produce and distribute electric energy."[81]

While we wait to see if such breakthroughs are not too good to be true, there are a number of current programs aimed at dipping the toes of the consumer into the PV world. The State of Montana, through money derived from the Universal System Benefits (USB) charges on electricity bills, sponsors a 50 percent discount on approximately 20 two-kilowatt PV systems per year for residential use. Henry Dykema of Sundance Solar Systems, near Red Lodge, Montana, points out that if the cost of a system is $15,000, then the discount reduces the net cost to the consumer to $7,500.

Note that the average Montana home on the NorthWestern Energy grid uses approximately 750 kWh per month; a two-kW system can provide about 300 kWh per month. Here is one more example of the wisdom of investing in conservation first—such as energy-efficient lighting and household appliances—before, or while, investing in PV systems, even discounted ones.

The State of Montana also sponsors PV systems for fire stations (which include a stand-alone battery system) and for schools.

Beginning in 2006 and through 2007 there is a federal solar tax credit for 30 percent of the cost of a PV system up to a maximum of $2,000, and various states also offer solar tax credits. Oregon, for instance, offers a solar tax credit of $6,000. The State of Montana could provide more incentives in this area.

Low interest loans are a way for governments to stimulate the market for clean energy. In Germany, the Credit Agency for Reconstruction offers low-interest loans for energy efficiency measures in residential buildings and also for solar PV systems. In 2005, with interest rates for PV at 4.1 to 4.4 percent, the Agency accepted more than 17,000 funding requests for a total of 139

81 Dave Freeman and Jim Harding, "Solar Cells Change Electricity Distribution" Seattle Post-Intelligencer, Seattle, WA, August 10, 2006. <seattlepi.nwsource.com/opinion/280625_solarcell10.html>.

megawatts. Germany now has passed Japan as the leading nation in installing new PV systems.

Creative new approaches are popping up to accommodate people who simply want reliable clean energy, and do not necessarily want to install and own these systems. One example: “distributed energy utilities” where a company owns the renewable hardware, say a solar array on a block of apartments in Missoula or on the roof of a large shopping mall in Billings, and sells the electricity to local residents or businesses on a long term contract. Such newly forming associations could provide innovative ways to distribute decentralized energy systems.

THRIVING WITH THE SMART GRID

New technologies are becoming available to create a “smart grid” that will allow utilities to move electricity from producer to consumer in ways that conserve energy or use energy at times when it is least expensive. Grid congestion can be diminished, blackouts and brownouts avoided. This can save communities and businesses money while reducing the need for costly new generation and politically contentious new transmission lines. The energy delivery system can become more reliable and resilient, and therefore less prone to system-wide disruptions and fluctuating voltages.

Rewiring the grid with advanced computer controls can allow power to be distributed more efficiently, safely, and reliably, and it also can help allay utility concerns about the complexities of bringing power onto the grid from smaller, dispersed sources.

According to a recent report by the Seattle, Washington-based group, Climate Solutions [82]:

> “The smart grid will...offer new capabilities to bring on-line varying power flows from wind farms, solar panels and other renewable power sources, and to integrate vast numbers of small-scale localized generators such as fuel cells and micro-turbines. The diversification of power sources plus the capability to manage end-use demands provides new security against blackouts. A RAND Corporation study found smart grid technologies could reduce power disturbance costs to the U.S. economy by $49 billion per year.”

Besides the obvious potential to save money, a further catalyst for the growth of smart grid technologies in Montana, Idaho, Oregon and Washington

82 Mazza, Patrick. "Powering Up the Smart Grid: A Northwest Initiative for Job Creation, Energy Security and Clean, Affordable Electricity". Climate Solutions. July 2005. <www.climatesolutions.org/pubs/pdfs/PoweringtheSmartGrid.pdf>.

is the Northwest Power and Conservation Council's Fifth Power Plan, which has called for 700 average megawatts (avMW) of conservation between 2005 and 2009 in this region.[83] Advanced metering infrastructure and meter data management are among the promising smart grid tools that send signals to the market encouraging energy efficient appliances; energy conserving building design and management; and facilitating real-time and time-of-use pricing for customers at all levels, from residential through commercial to large industrial.

Another smart grid catalyst in this region is a program of the Bonneville Power Administration (BPA) called the Non Wires Solution which seeks to provide "the most cost-effective solution to the region's transmission problems from an engineering, economic and environmental standpoint...before

83 One avMW equals 8,760 megawatt hours per year.

The Power of CHP—Combined Heat and Power

Now on the market are products which can replace the conventional natural gas powered furnace or boiler with a unit that generates electricity while heating the house or building. Combined Heat and Power—or CHP—units can dramatically lower overall energy use while reducing environmental impact. Efficient, quiet, and as clean burning as the best gas heaters on the market, CHP units are particularly effective in places where coal-fired electricity predominates, and where full-retail-value net metering is in place.

One example: Climate Energy's Micro CHP System in Massachusetts where, for the average user, as much as 4500 kilowatt hours of electricity can be generated annually, saving approximately $600 on one year of electrical bills. Displacing this much electricity otherwise generated by coal-fired power plants yields a 30 percent reduction in carbon dioxide emissions.

Coal-fired power plants have a net efficiency of about 35 percent due to waste heat of 61 percent added to transmission losses of at least 4 percent (much higher for long distance transmission). That means that such centralized power plants must burn the equivalent of 285 watts of fuel to light one 100-watt bulb.

With CHP, the "waste" heat warms the house, raising efficiency to 81 percent. Thus, the equivalent of 123 watts of fuel would light that same 100-watt bulb.

A California company, Capstone, has installed more than 3,500 CHP units worldwide in hotels, office buildings, health clubs—and to generate electricity during the burning-off of landfill methane or sour gas from oil drilling.

More than 23,000 homes in Japan use CHP. More than 40 percent of Denmark's electrical production is said to come from CHP (with another 20 percent coming from windpower).

In 1998 the U.S. Department of Energy launched the CHP Challenge to remove market barriers.

More information about CHP and other energy efficient systems is available from the Northwest Energy Efficiency Alliance. See "Alliance targets industrial efficiency" (May 3, 2005) at www.nwcurrent.com.

proceeding with the construction of transmission projects."[84] This effort supports numerous research and demonstration projects employing smart grid technologies and using real-time energy data.

Transmission systems fully and effectively utilized can mean that many expensive new generating plants and transmission lines will not need to be built. It will make sense for urban areas and manufacturing or industrial parks to utilize combined heat and power (CHP) facilities and micro-generators which get vastly better efficiencies than stand-alone power plants. For example, Portland General Electric (PGE) runs a Dispatchable Standby Program in which the company installs communications, control and switching equipment on customer-owned generators, and provides maintenance and fuel. In return, customers allow PGE to run these generators up to 400 hours per year. The goal of this program is to supply 100 megawatts of peaking power capacity; 38 MW are now online or under construction (contact PGE's Mark Osborne, 503-464-8347, for more information).

For both urban and rural areas, the smart grid makes the "practical vision" of this *Blueprint* even more practical: solar rooftops in cities and towns, wind turbines on farms and ranches, micro-hydro systems in the mountains, all contributing to Montana's energy supply and making large centralized power plants a thing of the past.

THE MODERN GRID INITIATIVE

The call for a smarter grid is coming not only from the conservation community but also from business, industry and the federal government. The Modern Grid Initiative is "a collaborative effort to integrate the resources and expertise of many contributors and create a comprehensive approach to modernizing the national electricity infrastructure."[85] Members include utilities, technology providers and researchers, consumers, regulators and government officials. Its web site offers links to resources including Power Point presentations from a regional summit on these topics in Portland, Oregon: *Modernizing the Grid Northwest Regional Summit,* April 18–19, 2006.

Smart grid infrastructure is more than just advanced metering and switching technologies. In the words of Alison Silverstein[86], "not just power plants and transmission lines, but also reliability rules, demand response, market rules,

84 Bonneville Power Administration. <http://www.transmission.bpa.gov/PlanProj/nonwires.cfm>.

85 For more information see <www.themoderngrid.org>

86 Alison Silverstein was the Senior Energy Policy Advisor to Chairman Pat Wood,III, at the Federal Energy Regulatory Commission, from July 2001 through July 2004.

information technology, and even meters are part of infrastructure. The smart grid itself is new technology, another form of infrastructure that we really need to have." (Silverstein was speaking in Atlanta, Georgia, at an April 2006 meeting of the newly formed Advanced Metering Infrastructure—Meter Data Management Working Group.)

To achieve increasingly sought after "demand response" solutions to electricity needs, smart grid technologies are critical. Silverstein has criticized the 2005 Energy Act as not going far enough to "give the industry adequate incentive and motivation to act on demand response".

Silverstein argues that utilities and regulating bodies need to take the modern grid seriously—in particular, she says, "We should take to heart the value of demand response for risk management, for making customers happy, and for peak price mitigation and volatility reduction. I'd like to see regulators mandate that 15 percent to 20 percent of load {customers} gets access to interruptible and curtailable programs, or time-of-use and critical pricing rates… Demand response is grossly under-valued and under-employed at this time and every utility should be doing it.…A healthy dose of demand response is the single most valuable element in a 'no regrets' electricity portfolio because it reduces risk, costs, and volatility."

ECONOMIC VITALITY AND CLIMATE CHANGE

A worldwide consensus has rapidly developed about the need to restrict and reduce greenhouse gas (GHG) emissions because they are the single greatest factor in our planet's current, dramatic climate change. The urgent need to design an economy that drastically reduces contributions to the buildup of GHG in the atmosphere is a key motivation for developing this *Blueprint*. A slowly dissolving myth is that curtailing GHG emissions will hurt the economy. Efforts taken by certain states and by other countries demonstrate that just the opposite is true. Cost savings from implementing solutions to save energy and reduce GHG are fast outstripping investments in those solutions.[87]

> COSTLY CENTRALIZED POWER PLANTS AND LONG DISTANCE TRANSMISSION LINES ARE LIKELY TO BE A WASTE OF TIME AND MONEY, AS 'SMART GRID', ENERGY CONSERVING, AND LOCAL RENEWABLE ENERGY TECHNOLOGIES COME ON LINE.

Some of those solutions revolve around the smart grid, and much of the innovative work in this area is happening in the Pacific Northwest. Oregon and Washington are already hubs

87 McFarling, Usha Lee, "Studies Support California Emissions Plans: Effort to Cut Greenhouse Gases could be Beneficial for California's Economy"; The Los Angeles Times, January 23, 2006.

of such activity, but the entire region can benefit economically from the growth of many local companies developing and selling smart grid technologies and software.

And for the nation as a whole, the Climate Solutions report, "Powering Up the Smart Grid," sums it up:

> "Tens if not hundreds of billions of dollars will be invested in the U.S. power grid over coming decades. Sixty percent of our energy system's aging infrastructure will need to be replaced in the next 10-15 years. A Pacific Northwest National Laboratory study shows that the smart grid's capability to smooth out peak power demands alone could eliminate the need for $46 billion to $117 billion in power plant and power line investments over the next 20 years."

This should help keep the lid on power bills, create new job opportunities and preserve jobs in all industries dependent on reasonably priced electricity. It is only prudent to recommend that the State of Montana cooperate with private electric utilities and rural electric cooperatives—and with economic development promoters, colleges and universities, residential and commercial building associations, and local government officials—to look for opportunities and funding to expedite the use of smart grid technologies in Montana.

Doing so can help Montana avoid making risky, costly commitments to power plants and long distance transmission lines, under the guise of solving the energy problems of other states. Such commitments are likely to be a waste of time and money as more and more investments are made, instead, in smart grid technologies, cost-effective energy conservation, and, locally available, clean and renewable energy.

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 as-

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.

sistance, 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 21D. Energy Efficiency and Renewable Energy Bonding Act. N.M. State. Ann. § 6-21D-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 fiber-glass 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 fiber-glass 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."

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.

> 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.

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 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.

If the Highwood plant actually is built, however, it would instantly be looking for customers to buy 213 megawatts (250 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 choose to buy Highwood power, this would still leave approximately 150 megawatts (250 minus 100) to sell…somewhere. But where in Montana is there demand for an additional 150 to 213 average megawatts of power? Montana currently consumes only half of the power now generated instate, 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 in particular) are investing more and more in localized solutions, including conservation and renewable energy, and are rejecting imported electricity that is not generated by "clean" sources. The Highwood

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	250 - 37 = 213 MW (If Great Falls buys 250 - 100 = 150 MW.)	Zero (assuming windpower remains cheapest new power source)

This chart illustrates comparative costs of the proposed Highwood coal-fired power plant and an equivalent amount of 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.

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 per kilowatt hour. 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 they decided to invest, first, in aggressive and effective energy conservation measures, then second, 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. As long as they then continued to work with their members to invest in insulation, weatherization, 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 <www1.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 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, reporters 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. A

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.)

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.

CHAPTER 6:
Recommendations

The preceding Chapters in this *Blueprint* have laid out this argument:

Montana stands at a crossroads. We can wisely choose a course today that will lead to a future where Montana's rural communities are revitalized and urban centers enhanced; energy used in Montana is produced in Montana from clean renewable sources; energy is used as elegantly and efficiently as possible; Montana's environment—air, water, soil, plants, animals, landscape—is sustained in perpetuity; and this state has become a leader and a model for other states and nations, as we create for ourselves a sustainable society.

The other choice—perhaps made by default—is a path that may seem easier in the short run, but in the end will prove more costly—socially, economically, and environmentally—and unsustainable.

So what do we do next?

First, we all (policy-makers, business-people, and individuals who work and play here) need to recognize that we are at this crossroads, that the choices we make in the next few years will have long-term ramifications.

Second, we need to understand that we face serious challenges. The U.S. is too dependent on foreign oil. In the 2005 State of the Union Address, President Bush admitted that Americans are "addicted to oil." We can extend this and say we are addicted to too much cheap energy in any form.

Concurrently the climate is changing due in large part to the excessive burning of fossil fuels. This change is occurring more rapidly than most scientists predicted only a few years ago. Global warming will affect Montanans in many ways, including the potential for increasing numbers and severity of wildfires, droughts, storms, and other unusual weather patterns. There will be negative and costly impacts to agriculture, forestry, and recreation—all mainstays of Montana's economy and way of life.

But we can do something about it, if we *care* enough. Changing long-ingrained habits can be difficult, but if we are motivated to reduce our impact on Earth's climate, change can be refreshing, especially when we also are rewarded with smaller power bills and less waste. Developing smart habits, like remembering to turn off the lights when we leave the room and turning down the heat in winter when we leave the house for awhile sets a good example for the whole family. **Small changes, like changing all your light bulbs to compact fluorescents and recycling paper and plastic, really do add up to big savings. But small changes alone are not enough.**

Educating ourselves and then advocating for sound, sustainable energy policies not only help our families but also our broader communities. Likewise, it's smart to support legislators and other political leaders who are willing to do the same.

There are hundreds, perhaps even thousands of useful recommendations on how to conserve energy, become more efficient, implement wind, solar, and biofuels projects; the list is constantly expanding. There are several excellent references at the end of this chapter. The problem isn't "What Do We Do?" so much as "Where Do We Begin?" The answer to this question will differ depending upon whether you are the Governor or a small-business owner; a legislator or a householder; a teacher or a preacher.

The number one thing that ALL stakeholders can contribute to implementing this plan is this: **Understand the difference between supply-side management and demand side management of energy**. Supply-side management relies on meeting the explicit and implicit—often unquestioned—desires of the marketplace; consumers are beholden to whatever prices and flow of goods that providers choose to offer**. Demand-side management of energy shifts responsibility and power to the consumer**. Consumers make the choice and regulate the market by becoming conscious "conservers"—modifying their demands to save money and energy. It's the difference between asking, "How can I get more gasoline and hopefully not pay too much more for it?" versus "How can I use less gasoline?"

From this understanding we can begin making changes in our own habits, in the policies of government at all levels, and in the way we think, to create an effective demand-side managed energy economy. When developing ANY supply-side energy project, run it through the Test Criteria for Energy Resources in Chapter 1. If it doesn't pass, it's not sustainable.

Specifically, we recommend the following:

Governor's Office

Government needs to foster positive change and provide true leadership by becoming a role model. Led by the Governor's office, Montana state government could take the lead by adopting building codes that encourage energy efficiency for new government buildings and energy-conserving retrofits for old ones; adopt transportation practices focused on efficiency and conservation, which also phase in use of biofuels; and reward all state employees who devise aggressive energy conservation strategies. This sets a tone for what is possible. This also helps build and stabilize markets for alternative energy projects, energy-efficient vehicles, and energy-efficient appliances.

Muster the courage to tell Montanans what is truly at stake, and build support to make the necessary changes. Make sure all information, accompanied by solutions, is freely and readily available. Make conservation and efficiency the underpinnings of a strong energy program. Focus on demand-side management.

Every Montanan needs to understand our situation, how each of us contributes to it, and what we can do about it. Government policies can change, but not until enough people demand change.

Legislators

1. Change the tax structure to reward actions that reduce energy consumption and greenhouse gas emissions. Some of those actions and some possible tax incentives include:
   - Purchasing “green” power;
   - Buying a bicycle or other fuel-efficient vehicle;
   - Planting trees, and also landscaping in ways that use little water and little energy;
   - Completing an energy-efficiency building upgrade;
   - Promoting the production of local foods and their purchase (initially by government entities or public schools).
   - Granting tax-free (or reduced tax) status to projects and investments that introduce clean energy or reduce greenhouse gas emissions;
   - Financing these incentives and tax-reductions through taxes on carbon emissions (for instance, institute a carbon tax on all fossil fuels, with revenues going to support clean power);
   - Charging a motor-fuel tax of $0.05 per gallon with income going toward property tax reduction;
   - Taxing fossil-fuel-based herbicides and pesticides with income going toward support of organic or other forms of sustainable agriculture;
   - Redirecting taxes on solid waste toward subsidizing recycling and composting.
2. Introduce, maintain, or strengthen programs and policies such as net-metering, Universal Systems Benefits, Renewable Portfolio Standards, renewable fuels standards, and updated building codes that encourage energy efficiency and the switch to home-grown fuels and electricity.
3. Support educational programs that train workers for the “new energy economy”—from designers and manufacturers to builders and installers. Encourage legislation requiring the hiring of personnel trained through state-approved educational and apprentice programs, setting job quality standards, and adopting Best Value Contracting.

Local/County Government

Like state government, counties and municipalities can step up to a leadership role and serve as role models for their citizens and other communities. Municipalities are encouraged to join Cities for Climate Protection Campaign.[116] Another simple leadership step is to buy green power. School buses and government vehicles can begin using biofuels, make their buildings more energy efficient, and where appropriate participate in existing or emerging programs using biomass for heat and co-generation.

High schools, vocational schools, colleges, and universities can develop programs to train workers for the new energy economy, as well as provide information and education to their constituents. Libraries can become resource centers.

Communities

Communities can support building a sustainable, energy efficient town, with design, infrastructure and policies that promote saving energy and enhance the quality of life of its inhabitants.

Promoting 'Buy Local" campaigns will keep money and goods circulating within the community and reduce transportation costs and impacts.

Civic Organizations

All civic organizations can actively promote and support the policies and programs needed to make the transition to an energy-efficient, home-grown energy economy.

Churches and fraternal or service organizations can adopt energy-efficiency measures, use energy efficient appliances and construct new buildings or remodel old ones to become highly energy-efficient, thus becoming visible models for the community. Schools and other public buildings can participate in existing and emerging programs using biomass for heat and energy.

Businesses

All businesses can adopt the Natural Step Framework, a program begun in Sweden in 1998 that encourages a step-by-step process for companies to become more environmentally friendly by re-aligning their operations with nature's laws.[117]

Businesses can opt to buy green power, become more energy efficient,

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116 See <www.iclei.org/index.php?id=800>, website for the International Council for Local Environmental Initiatives (ICLEI), a coalition of local municipalities that are addressing pressing energy issues and sustainability.

117 Natural Step Framework is a systematic approach to evaluating the sustainability of business, manufacturing and citizen actions. Find out more at <www.naturalstep.org>.

invest in fuel efficient vehicles and use biofuels. Just as housing is a high-energy consuming element of our society, so are commercial buildings. Opportunities abound for reducing energy consumption in heating, lighting, air-conditioning and in manufacturing processes.

Businesses can work to insure that the products they provide to consumers are manufactured sustainably and, in total, reduce waste and minimize CO_2 emissions. Experience has shown that businesses that sell environmentally safe products and promote green practices not only play an important role in educating consumers but also enjoy a profitable business advantage in customer appeal and sales.

Agriculture and Forestry

Agriculture and forestry in Montana can make an enormous contribution to the state's switch to a more energy-efficient economy. Agricultural practices that conserve soil and water, minimize the use of fossil-fuel based fertilizers and pesticides, and sequester carbon should be actively promoted. Wind power and biofuels can produce extra income for farmers while reducing on-farm fossil fuel use.

The forest industry can support policies that encourage sustainable forestry including Forest Certification programs and Forest Product "feebates" that penalize products produced by non-sustainable forest practices and subsidize those that are produced through sustainable practices. The U.S. Forest Service, in 2007, instituted a policy where cut trees are transported whole to a site where any salvageable material that can be chipped for biomass must be retained and available to meet energy needs.

Sequestering carbon in both growing forests and grasslands could produce income in the future.

Individuals

Every Montanan needs to understand the situation we are in, how we individually contribute to it, and what we can do about it. Government policies can change, but will not do so until enough people demand it. Given the plethora of climate change related legislation in the 2007 Montana and national legislatures, people are beginning to signal their desire for true leadership that serves them and future generations.

We, as citizens, send a signal to businesses and government through what we purchase as well as how we vote. Responsible citizens need to become educated and involved. Here are some of the ways to send those signals:

1. Support politicians and businesses that promote policies and products that help reduce energy consumption and encourage positive change toward a sustainable energy economy.

2. Conduct an energy audit of your contributions to greenhouse gas emissions, waste, and excess energy consumption. There are a number of websites that provide a simple calculator to estimate your and your family's carbon emissions. These sites provide great ideas for reducing your "carbon footprint"[118].
3. Consider what it would take to become carbon neutral. Purchase 'green power' when possible and purchase carbon offsets for the remainder of your carbon 'footprint.'

More excellent recommendations can be found at the following websites: "New Energy for States: Energy Saving Policies for Governors and Legislators" by the Apollo Alliance at <www.apolloalliance.org/docUploads/apollostate_report.pdf>.

"New Energy for Campuses: Energy Saving Policies for Colleges and Universities" by the Apollo Alliance at <www.campusactivism.org/server-new/uploads/newenergypolicy.pdf>.

A great site for learning more about energy saving measures that can be undertaken by consumers, policy-makers, businesses, educators, and Energy Professionals is the Alliance to Save Energy at: <www.ase.org/content/article/detail/3451>.

A source for ideas on energy conservation for schools can be found at "Flex Your Power.", <www.fypower.org/inst/edu.html>.

118 This website offers carbon footprint calculators: <www.carbonfootprint.com/>.

CHAPTER 7:

Energy for the Long Haul

A CONCLUSION AND A BEGINNING

Montanans can build and grow our way to *energy security and self-reliance*, leaving most of the coal in the ground to continue to act as the aquifer for large expanses of the Northern Plains.

Compelling evidence for this abounds: an explosion of real-time, real-place stories, along with a growing flood of studies showing that this is not only possible but profitable. Energy self-reliance and a quality environment can create significant economic benefits to the state equal to, and ultimately, greater than "Business as Usual" energy development relying on centralized coal-fired power plants, *so called* "clean coal" and wasteful long distance transmission of electricity.

> MONTANANS NEED TO CONVENE,
> SET GOALS, TARGETS, AND TIMELINES
> FOR REDUCING WASTE,
> INCREASING EFFICIENCY,
> AND TUNING INTO
> CLEAN RENEWABLE ENERGY
> TO GENERATE WEALTH AND
> A HIGH QUALITY OF LIFE FOR OUR FUTURE.

By the time a child today in Billings, or Plentywood, or Victor is in high school or is entering college—say around the year 2020—the concepts in this document will be commonplace. (In regions of the U.S. with critical energy challenges, some of these concepts already are commonplace.) At the same time, a coal-fired power plant that is permitted now, and built within the next few years, will still have—by that same year 2020—two or three decades left in its operating life. Yet another opportunity to restrain the degradation of the land by mining, the waste of water in cooling, the build-up of CO_2 in the atmosphere by burning, and the release of mercury downwind, will have been lost.

Investments made and policies crafted in the next few years will determine Montana's chances for achieving the goals in this *Blueprint* —to meet all of Montana's energy needs using conservation and clean, renewable sources while creating jobs, saving money, and revitalizing rural and urban communities.[119]

Ironically, even though solutions highlighted here promise to save busi-

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119 Richman, Dan, "Global Warming to Cost Us", Seattle Post-Intelligencer, reprinted in NW Climate Connection newsletter by Climate Solutions (www.climatesolutions.org) Seattle, Washington, January 2007.

nesses and households money in the long run, and typically have competitive payback rates, financing them continues to be a challenge. Investors and customers must relearn how to assess "technology risk" and payback times. Even with grants, tax credits, or loan programs, businesses, individuals and local governments are reticent to invest in distributed generation and decentralized energy. Technologies that are ready to go now, like cellulosic ethanol, are delayed from coming on line by these uncertainties, further delaying a secure energy future, and committing us to additional decades of inefficient, polluting choices.

New creative approaches for finance are becoming available, as people and institutions overcome their fear of change. The discussion of "distributed energy utilities" in Chapter 4, and other examples in Chapters 2 through 6, offer useful suggestions for action from both the public and private sectors. Local and state governments can set policies that reduce energy use or invest public money to build community infrastructure, but much of this change will need to come from the private sector, as individuals and businesses make choices about everything from building design and location, to appliances, manufacturing processes, and transportation.

This *Blueprint* is one of many from around the country to make the case for conservation and renewable energy. More than nine states and hundreds of municipalities are implementing measures to reduce contributions to global warming and use energy more efficiently. They are finding their investments being returned faster than anticipated, with no negative impacts on quality of life. Time and again the ideas suggested here rise to the top of the list.

Salt Lake City, Utah, and Portland, Oregon, provide excellent examples. In the Salt Lake area note the local utility initiatives, especially Rocky Mountain Power's Blue Sky and Demand Response programs.[120 &121] Prepare to be amazed! More examples can be found at the International Council for Local Environmental Initiatives (ICLEI) website.[122] ICLEI is a coalition of local municipalities concerned about sustainability that are addressing pressing issues like energy. The U.S. Conference of Mayors, a supporting partner of ICLEI, has a new report, *Energy and Environment Best practices 2007* highlighting programs in almost 100 cities around the U.S. Also check out the New Rules project of the Institute of Self Reliance.[123]

120 For information about Salt Lake City's efforts see <www.slcgreen.com>.

121 Follow the cost-savings and progress Portland has made at <www.portlandonline.com>.

122 See <www.iclei.org/usa>.

123 See <http://usmayors.org/uscm/best_practices/EandEB07.pdf>, <www.newrules.org/electricity/planningfordg.html>.

These references barely scratch the surface of the multitude of efforts that are springing from the grass-roots: people taking care of their needs and their futures without waiting for the federal government to develop and implement intelligent, sustainable solutions to energy crises and global warming.

SO WHERE DO WE START?

It is time to convene Montanans around the state to set specific goals, targets, and timelines for reducing energy waste, increasing efficiency, and taking advantage of clean, renewable opportunities in order to generate wealth, security and quality of life for our future. The Governor's Climate Change Advisory Committee plans to submit a list of recommended actions by July of 2007 to the Governor. Preliminary comparisons show this Blueprint and the climate change actions are complementary. But there is no reason to wait for formal state-level direction.

> SEVENTY-ONE PERCENT OF THE PEOPLE IN MONTANA LIVE WITHIN 40 MILES OF ITS SEVEN LARGEST CITIES. THESE HAVE BECOME THE STATE'S "ECONOMIC ENGINES"…
>
> —LARRY SWANSON, CENTER FOR ROCKY MOUNTAIN WEST, SPEAKING IN BILLINGS, 10/18/06.[124]

We propose that each of Montana's seven most populous areas embark on a Community Energy Assessment following the template offered by The Rocky Mountain Institute or the International Council for Local Environmental Initiatives mentioned above.[125 &126]

AERO members living in or near these "economic engines" are encouraged to get the process started and invite others to join in. The AERO web site (www.aeromt.org) has many links to a wide array of resources to help with all stages of the task. Targeting these seven population centers can focus and magnify our efforts as a state. Montana's many smaller towns are encouraged to take on the same challenge. Every community can all learn from what others are doing.

Why start in our communities with citizen groups? It's simple; cities are where most of the buildings are, and fully half the energy used in the United States is related to buildings and to the building industry, whether the buildings are old, new or in the process of being built.

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124 Dr. Larry Swanson, economist and regional planner, is Director of the Center for the Rocky Mountain West, Missoula, Montana.

125 The seven communities are: Billings, Bozeman, Butte, Great Falls, Helena, Kalispell, and Missoula

126 See Community Energy Opportunity Finder by Rocky Mountain Institute at <www.rmi.org and ICLEI at http:www.iclei.org/usa>.

According to experts at www.betterbricks.com, "Our current U.S. building stock consumes 35 percent of all energy, 65 percent of electrical energy and contributes 35 percent of our carbon dioxide emissions. The energy use of this stock costs building owners over $228 billion per year, 25 percent of which is wasted by building systems that are poorly designed or operated. Buildings clearly have a large energy and environmental impact. Green buildings help to minimize this impact."

> "Traditional sources of energy production and use are major culprits of atmospheric pollution. Buildings gobble close to 40 percent of the energy used annually in the United States to heat, cool, ventilate, light, and support other operations (doe, 2003). This operational energy, plus the energy used to extract, harvest, and manufacture products, transport materials, and construct buildings means the building industry chews through more than half of all the energy used in the United States each year."[127]

Setting minimum energy performance standards for new construction (residential, commercial, and industrial) and for renovation and conservation remodels of existing building stock could mean huge savings of energy supply, and avoided energy costs into the future. Fully addressing how we build our communities and businesses offers large immediate impacts, as well as widely diversifying investment and economic activity.

Business, community, healthcare industry, local government, and efficiency experts from the utilities can begin working together to identify strategies for overcoming energy vulnerabilities with integrated long term solutions. State government and Montana's colleges and universities could provide technical support for the participants. The state could enhance the existing *Energize Montana* website and more actively make those resources and programs understood and available.

Another benefit of communities beginning their own efforts to conserve and use energy from sustainable sources is that, having gone through the process of discovering and implementing cost effective local policies and solutions, it will be easier to marshal the consensus needed to effect change at the state and national levels. Of course it is a two way street. State and national standards and initiatives can go a long way toward jump starting and supporting these local efforts.

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127 RMI Solutions, Summer 2006 @ www.rmi.org The Colorado-based Rocky Mountain Institute is headed by Amory Lovins.

WHAT ABOUT THE REST OF THE STATE?

The cities are growing. On the other hand, rural Montana is in decline in many places, losing population and tax revenues.

Maybe it isn't such a bad idea to let certain areas of the "Big Open" go back to buffalo and elk, as has been suggested over the years, but another idea is that rural Montana's economic woes open up an opportunity, or rather many opportunities, spread around the state. The 2005 Energy Policy Act mandates the sale of 250 million gallons of cellulosic ethanol by 2013, a billion gallons by 2015!

David Morris of the Minnesota-based Institute for Local Self Reliance argues that the best way to meet those cellulosic ethanol objectives is to focus on the Act's qualitative objectives, which are to *maximize the benefit of cellulosic ethanol production to farmers and rural areas*. Practical ways to do this include using Department of Energy seed grants to nurture geographically dispersed, farmer-owned or locally owned pilot plants (500,000 gallons/year); nurturing the funding and development of many small-scale commercial plants (5-10 million gallon capacity); using loan guarantees to facilitate larger plant construction and operation.

> Rural Montana faces the harsh fact that in 2003 not one Montana county had total crop and livestock marketing receipts that exceeded the cost of production.
>
> —Larry Swanson, Billings, October, 2006[129]

A recent study by the Institute for Local Self-Reliance's New Rules Project noted that a local biorefinery can raise prices paid to the farmer for feedstock. In one example "a farmer-owned 40 million gallon facility could generate $10 million more each year in direct economic benefits than an absentee-owned plant of the same size."[128]

Imagine young people coming back to Conrad or Glendive or Poplar with an engineering degree from Montana State University to help build one of these ethanol or biodiesel plants. Our children would once again be able to work in their home communities instead of being forced to leave because of economic necessity. They can return, excited to be part of something new. Local farmers can now profitably diversify their income with new crops suited for various biofuels or lubricants. The increased availability of biofuels will motivate and allow more of us to drive biofueled vehicles.

128 New Rules Project. Institute for Local Self-Reliance.See < www.newrules.org/agri/celluloseethanol.pdf>.

129 Op. cit Swanson. (See footnote 124).

Imagine those in towns—driving electric cars, recharging them on the grid at home at night, and sending some of our power bills to pay landowner-cooperative owners of the wind turbine. Our individual efforts collectively multiply to revitalize Montana's rural communities, enhance life in Montana's towns.

Green buildings in the cities. Biofuels and windpower in the countryside. Solar energy everywhere. Greenhouses dot the landscape, extending the growing season. More local foods, less long distance hauling. More local energy, less long distance transmission. More carpooling, vans, buses, passenger trains. More inter-city bicycle and horse trails. Wherever there's a hiking path, explore it. Wherever there's hot water, soak in it. Wherever there's a sunset, sit down and watch it. More fun. More joy. More beauty.

We need to identify the opportunities of the moment, ride the rapidly growing tide of concern, and devote our attention and creativity to the crucial question of our energy future. Montana is not alone in this growing awareness. Montana is far from alone in seeking alternatives.

Innovative technologies and commonsense practice are indispensable, but even more central to the task are the commitment we bring to it, the creativity we unleash, the satisfaction we find along the way.

Montana is well situated to embrace the initiatives offered here for a secure, affordable, robust energy future. We just need a practical vision, focused desire, and a road map to get us started.

Thanks for reading AERO's *Blueprint for Homegrown Energy Self Reliance*. It's a beginning.

Visit AERO's website: www.aeromt.org.
Please let us know what you think and how we can work together.