Reducing UW-River Falls' Energy Use and Carbon Emissions: Briefing Document

David Trechter
Blake Fry

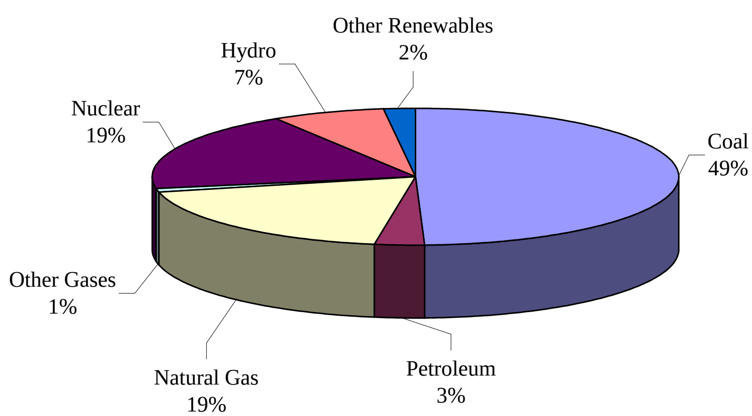
Survey Research Center Report 2008/19
July 2008

Contents

Introduction

There is a consensus among the world's leading climate scientists that human activities are causing a build-up of greenhouse gasses (carbon dioxide, methane, chlorofluorocarbons, and nitrous oxides) in the earth's atmosphere. The burning fossil fuel (coal, oil, and natural gas) is the primary force behind this build-up. For example, Figure 1 shows that the U.S. is heavily dependent upon the burning of coal and natural gas for our electrical energy (68% of total generation). Burning coal generates particularly high levels of greenhouse gases. Non-greenhouse gas emitting sources of electricity account for 28% of total electricity generation in the U.S. and renewable sources (hydro and other renewables) account for less than 10%.

Figure 1: U.S. Generation of Electricity, 2005
(Luskin, "Vermont's Energy Future")



The Intergovernmental Panel on Climate Change, which shared the 2007 Nobel Peace Prize with former Vice President Al Gore for their work on this issue, has said, "*Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level*." (http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf). In addition to rising sea levels, global climate change is expected to result in increases in species extinction and more severe weather events (drought, more powerful hurricanes, etc.).

During the summer of 2007, Governor Doyle selected UW-River Falls as one of four UW-System campuses to "go off the grid" by 2012. This is being interpreted to mean that the University will attempt to dramatically reduce our greenhouse gas emissions. The University is working in partnership with the City of River Falls and Wisconsin Public Power Inc. toward this goal.

A recently completed energy audit estimates that to "go off the grid" completely UWRF would need to invest between $12.5 and $26.4 million. In addition, annual operating costs are expected to go up by between $400,000 and $900,000 per year if we are to achieve Governor Doyle's goal. Campus opinion is that the actual cost might be higher than this range given some of the assumptions included in the estimate. This price tag could be lowered if less than full energy independence is sought. The consultants who did the energy audit indicate that UWRF could achieve 74 percent of total energy independence with an investment of $18.6 million, which would reduce our energy costs by about $800,000 per year. We could achieve 58 percent of energy independence for a capital investment of $5.6 million, which would generate about $400,000 in annual energy cost savings per year. The cost of energy independence is also dependent upon future energy prices – the net cost of energy independence falls and the types of actions taken would be expected to change if the cost of energy goes up faster than assumed in the consultant's model.

Some policy makers are interested in establishing a "cap and trade" system to help deal with greenhouse gas emissions. In this system, the government sets a "cap" on the total amount of greenhouse gas emissions for the country as a whole and for individual organizations in the U.S. This cap would be somewhat lower than historic level of emissions. Individual organizations could either invest in measures to reduce their greenhouse gas emissions or it could go to other organizations that have already reduced their emissions below their assigned limit and buy some of that organizations emission credits. In such a system, UWRF might be able to sell some of its emissions credits. The energy audit suggests that the sale of emission credits could cut the $19 - $51 million price tag of achieving energy independence by about $7 million.

The workshop you have agreed to participate in is designed to gather input from students about how the University should attempt to achieve the goal of going off the grid or significantly reducing our greenhouse gas emissions and how best to pay for needed changes. Chancellor Betz is committed to taking into account the opinions of students as to how best to transition to greater environmental sustainability.

The purpose of this briefing document is to provide some background information about energy use on campus and to outline the options we have for reducing our carbon emissions as we move "off the grid." We hope that this information will help you make an informed choice as to how we should go about reducing our carbon emissions.

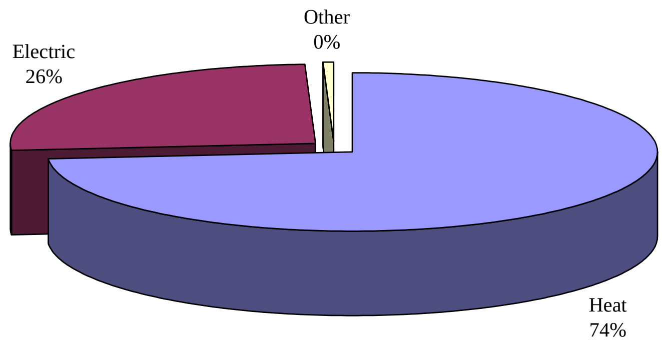
Energy Consumption at UW-River Falls

UW-River Falls generates greenhouse gasses from three primary sources:

- electricity consumption
- generating heat at the campus power plant
- fuel used by faculty, staff, and students for university travel, on the campus laboratory farms, and commuting to campus.

Figure 2 shows an estimate of how much energy UWRF used in 2006, excluding the fuel used by the vehicles used by faculty, staff and students. The heat component includes some natural gas but is primarily the coal burned in the physical plant. The campus spent slightly more than $2 million dollars in 2006 on energy from the sources shown in Figure 2.

Figure 2: UW-River Falls Energy Use



There is both good news and bad news imbedded in Figure 2. The bad news is that compared to the country as a whole, our campus is more dependent upon fossil fuels than is the country as a whole. Essentially all of our heat and 75% of our electricity comes from fossil fuels. So, about 93% of our total energy use is based on fossil fuels. In contrast, according to the US Department of Energy (http://www.eia.doe.gov/emeu/aer/pdf/pages/sec1.pdf) fossil fuels account for only 86 percent of total energy use in the country. On the other hand, a recently completed energy audit concludes that the campus used 121,175 Btu/square foot in 2006 and this is the second lowest energy use intensity in the UW-System.

Factors to Consider in Evaluating Options for Reducing Carbon Emissions

A key goal of reducing carbon emissions at UW-River Falls is to move the university toward our strategic goal of operating sustainably. Sustainability is defined as ***the use of human and physical resources to meet current needs without decreasing opportunities for future generations***. Something is said to be sustainable if it is sound in economic, ecological, and social terms. Some factors to consider as we look at options for reducing carbon emissions include:

- Economic dimensions: how much does it cost to build or install, how much does it cost to operate, what is the total cost per unit of energy over time.
- Environmental dimensions: how does the option impact air quality (particulates, heavy metals, etc.), how does it affect greenhouse gas emissions, how does it affect water quality, what other environmental impacts does it have (e.g. transportation of fuel, storage/disposal of waste, biodiversity, etc.)

- Social dimensions: how does the option affect jobs in the area, local income levels, or individual and public health.
- Other dimensions: flexibility (can the option be started or stopped easily/cheaply), constancy (can the option be used to deal with average energy needs and/or spikes in energy demand), how risky/dangerous is the option, how long would it take to implement the option, what are the aesthetic impacts.

In addition to these sustainability factors, different people will assess the options based on values such as:

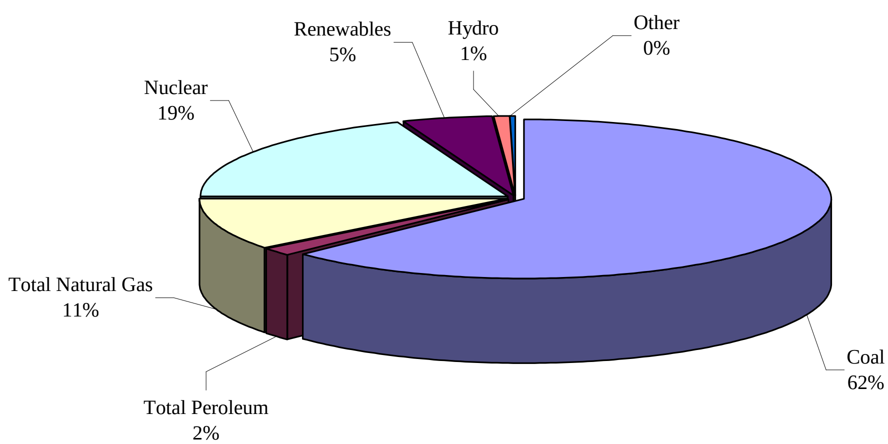
- Predictability – how consistent will the cost of the energy supply be
- Reliability – can we be certain that the energy supply will be there when we need it
- Independence/Self-Reliance – can we be free of dependence on foreign supplies of energy and reliant on our own resources and ingenuity

The remainder of this document will rely heavily on materials developed by Professor Robert Luskin, University of Texas at Austin, for a deliberative poll on a similar topic for the state of Vermont. We will discuss the key options available for reducing greenhouse gas emissions from electrical use, heating and travel and issues that cut across all the options.

Options for Electrical Power Used at UW-River Falls

The campus buys its electricity from River Falls Municipal Utility (RFMU), which, in turn, is supplied by Wisconsin Public Power Incorporated. The mix of fuels used to generate the electricity that UW-River Falls purchases from RFMU is shown in the following pie chart. The chart shows that 75 percent of the electricity we use on campus comes from fossil fuels (coal, natural gas and petroleum).

Figure 3: River Falls Muni Energy Sources



Coal

Coal currently accounts for 62% of the energy generated by UWRF's energy supplier.

Advocates say that coal has to be an element of our country's energy policy because it is an abundant national resource that currently plays a huge role in electrical energy production (see Figure 1). Coal gasification, which converts coal to a cleaner-burning gas, is currently being developed. This technology would also make it more feasible to capture carbon dioxide emissions.

Opponents say that coal, as currently used, should be phased out because of its heavy contribution to greenhouse gas emissions and its emissions of mercury and other particulates. Opponents say that coal gasification is an unproven technology and that mining and transporting the coal to gasification plants create additional environmental concerns.

<u>Advantages</u>

- **Economic advantages**: Can lock in cost via long-term contracts, price has been less volatile than petroleum and natural gas
- **Ecologic advantages**: Shipping distances are less than for oil
- **Social advantages**: None identified
- **Other advantage**: a U.S.-based source of fuel (national security/energy independence), can be stored at power plants in large quantities to enable rapid response to changing conditions, is a relatively dense fuel (lots of energy per pound), and, while estimates of known reserves vary, most analysts feel reserves are adequate for the next several decades

<u>Disadvantages</u>

- **Economic disadvantages:** Uncertainty about commercial viability of gasification technology, uncertainty about technical viability of capturing and sequestering greenhouse gas emissions, and transportation costs of coal have escalated dramatically in recent year
- **Ecologic disadvantages**: Higher emissions (greenhouse gases, particulates, heavy metals) than all other options using existing technology, disposal of ash after burning
- **Social disadvantages:** Few local jobs created from this technology
- **Other disadvantages:** Increasing supply of power from coal comes in large increments (building a new power generating facility) which are expensive, take a long time to build, and face lots of resistance from locals who don't want a coal-fired power plant in their back yard.

Nuclear

Nuclear currently accounts for 19% of the energy generated by UWRF's energy supplier.

Proponents of nuclear power point to the fact that this technology emits no greenhouse gases, offers stable prices, has been providing power in the U.S. with few problems for more than 40 years, and offers greater energy independence since the U.S. has several hundred years worth of uranium supplies.
http://www.wilsoncenter.org/index.cfm?fuseaction=wq.essay&essay_id=204363

Opponents cite concerns about safety (Three Mile Island http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle.html , Chernobyl http://en.wikipedia.org/wiki/Chernobyl_disaster) and the possibility of accidents, say that nuclear plants are a possible target for terrorists, the ecologic concerns posed by nuclear waste and a lack of a national depository for such waste.

Advantages

- **Economic advantages**: potential to lock in long-term costs
- **Ecologic advantages**: no greenhouse gas emissions
- **Social advantages**: none identified
- **Other advantage**: reliable power source for every day needs, U.S. has substantial supply of uranium (national security/energy independence)

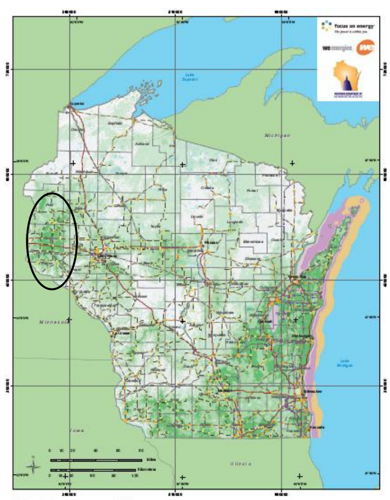
Disadvantages

- **Economic disadvantages:** reliance on large "point source" of energy so impact of shut down of a plant is large, potential target for terrorists,
- **Ecologic disadvantages**: no long-term solution to safe storage of nuclear waste, risk of serious accidents, supply of nuclear fuel is finite (not a renewable source of energy)
- **Social disadvantages:** Few local jobs created from this technology
- **Other disadvantages:** Existing nuclear plants are nearing the end of their expected useful life meaning they will need to be re-licensed, decommissioned, or replaced, increasing supply of power from nuclear plants comes in large increments which are expensive, take a long time to build, and face lots of resistance from locals who don't want a nuclear plant in their back yard.

Purchasing Renewable Energy Units

UW-River Falls' current energy provider obtains about 5.7% of its power from renewable sources. In addition, the students purchase 510 300 kWh blocks of energy to run the new University Center. In total, therefore, purchased renewable energy accounts for 5.7% of our electric power.

Proponents of purchasing renewable energy units say that fundamentally, we have few good alternatives. Credible estimates project adequate supplies of oil and gas for another 20-50 years (USGS' estimate is for production to peak 2037), the widely accepted view is that there is enough coal for 150 years though some recent studies indicate it might be much less, and it is believed that we have several hundred years for nuclear fuels. There is little argument that these are "finite" fuels and will eventually run out. Solar, wind, biomass, geothermal, and hydro are all renewable indefinitely. While renewable energy costs more per unit (currently UWRF's electrical provider charges $2.00/300 KWH above the normal price for renewably-sourced energy), proponents argue that this is largely because conventionally-sourced energy don't bear the full cost of their kilowatt production. For example, the cost of electricity produced by burning coal doesn't include the costs associated with global climate change and nuclear-sourced electricity doesn't cover the full cost of storing nuclear waste for thousands of years. Finally, some forms of renewable energy could utilize resources that are relatively abundant in the local area. For example, using biomass (waste wood, wood chips, or switch grass) or methane produced on local dairy farms' methane digesters or in land fills could increase our local energy independence and provide an income boost to local producers/businesses. In addition, this map of wind resources indicates that relative to other parts of the state, Pierce and St. Croix Counties have moderately good average wind speeds, averaging about 15 miles per hour.



Wind Resource of Wisconsin *Mean Annual Wind Speed at 70 Meters*

Opponents of purchasing renewable energy units say that the current supply is woefully inadequate to meet most of the needs of society at large. Some forms of renewable energy have issues of either reliability, predictability or both. For example, wind and solar power only work when the wind is blowing or the sun is shinning. Neither the sun nor the wind is very reliable or predictable. Further, River Falls' natural endowment of both wind and sun are somewhat limited. These forms of renewable energy units can probably be produced more efficiently outside the area, which raises some issues of transmission and limits the local social impacts of these technologies.

Advantages – Wood/Switch grass/Biogas

- **Economic advantages**: Wood, switch grass, and biogas are a relatively abundant, renewable, and potentially local energy sources. Burning waste wood or methane from biogas would generate electricity from what is now considered to be a waste product. It is possible that most of the campus needs for these materials could be produced relatively near River Falls, resulting in low transportation costs (and the greenhouse gas emissions such transport would create). At current oil and natural gas prices, these options are increasingly competitive in price.

- **Ecologic advantages**: While burning any of these products to produce electricity releases greenhouse gasses, the CO_2 emitted is subsequently recycled in the next generation of trees, switch grass, and feed for livestock. Burning biogas would prevent the release of this methane into the atmosphere.
- **Social advantages**: Local producers of wood, switch grass, and biogas would have a local market for their product. The sales of these products are expected to increase the income of these local providers and generate additional local employment opportunities.
- **Other advantages**: Wood, switch grass and biogas have some ability to be stored and could, therefore, provide both a reliable source of power and electrical output could be increased to meet peaks in demand.

<u>Disadvantages – Wood/Switch grass/Biogas</u>

- **Economic disadvantages:** the supply of waste wood is uncertain so price could be expected to fluctuate in unpredictable ways. While biogas could be transported via pipeline, wood and switch grass would have to be transported, probably via truck, resulting in greenhouse gas emissions. Switch grass production might displace acreage devoted to food crops, resulting in increased food prices. A facility to burn these materials to generate electricity would either have to be built or an existing facility modified to accept these fuels. Both of these could be expensive. Biogas from land fills might have to be transported long distances and biogas from manure digesters would require the installation of additional pipelines to collect this resource from relatively small and dispersed producers.
- **Ecologic disadvantages**: Switch grass production might cause land that is currently not in agricultural production because it is highly erodible to come back into use. It would also likely require the application of some sort of fertilizer (chemical or manure) to maintain production levels, which could result in damage to water resources and the use of fossil fuels to generate (in the case of chemical fertilizer) and apply (both types) the fertilizer. Burning wood or switch grass would generate some additional particulate pollution. Burning wood, particularly if it is not from waste sources, would result in additional deforestation. Cattle, the primary source of methane from on-farm digesters, emit large amounts of methane (e.g. through normal breathing) that cannot be captured. Methane from landfills might encourage/enable our "throw-away" culture.
- **Social disadvantages:** None identified.
- **Other disadvantage:** There are limits on the number of kilowatts that could be generated locally by burning wood, switch grass or biogas so the ability to meet local needs in a sustainable fashion is uncertain.

Advantages – Solar/Wind/Hydro

- **Economic advantages**: Long term contracting may be more feasible for these sources of energy given that their prices are more predictable than, for example, fuel oil or natural gas prices. Wind and solar projects are potentially expandable in smaller increments than is true of other technologies (hydro, nuclear, coal-fired plants), which means that investment costs are lower. Solar generating capacity often peaks during hot summer days and clear cold winter days, which are also times of peak energy demand.
- **Ecologic advantages**: All of these options have low or no greenhouse gas emissions and are renewable sources of energy. Small hydro projects can use "run-of-river" designs that require little or no impoundment (dams).
- **Social advantages**: Some of these could be produced locally with positive ramifications for incomes. Installation and maintenance of the equipment to generate these sources of electricity (especially wind and solar) would create local employment opportunities.
- **Other advantage**: All reduce our dependence on foreign sources of energy. Solar power could "double up" on existing campus infrastructure by placing solar panels on building roof tops.

Disadvantages – Solar/Wind/Hydro

- **Economic disadvantages:** Hydroelectric sources can be unreliable in drought years and energy generated cannot easily be increased to meet peaks in demand. Getting permits and building hydro plants are usually very expensive. Wind and solar power is available only when the wind blows or the sun shines, which makes these sources somewhat unreliable. Storage of power generated by the wind or by solar panels is more challenging (e.g. charging batteries, using this energy to create hydrogen gas, etc.). Windy and sunny locations may be remote from where the energy is used, requiring the building/upgrading of transmission lines. The costs of all of these are incurred primarily at the start of the project and it may require many years of operation to recoup these costs.
- **Ecologic disadvantages**: There are limited numbers of sites that are appropriate for hydroelectric projects and these projects disrupt stream flow with negative ecologic consequences. Wind projects, to be successful, require steady and fairly high wind speeds and the number of suitable sites near River Falls are believed to be somewhat limited. Some view solar panels and wind turbines as visual pollution.
- **Social disadvantages:** None identified.
- **Other disadvantages:** None identified.

Generating Renewable Energy on Campus

UW-River Falls could generate electricity from renewable resources. The campus has a dairy herd and could install a methane digester, we have land that might be suitable for wind turbines (e.g. the top of hills on lab farm number 2), and we could install solar arrays to generate electricity or to provide hot water. Estimates are that it is realistic to cover 25-33 percent of the campus electrical needs from these sources. In addition to the advantages and disadvantages of these sources of energy noted above, generating renewable energy could be expected to have the following pros and cons.

<u>Advantages – Campus Generation of Renewable Energy</u>

- **Economic advantages**: Generating electricity on campus would reduce our cost of operations since we would be paying less for energy received from the electric power grid. On days that are particularly good for producing renewable energy, it is conceivable that the campus could be supplying electricity to the grid rather than receiving it from the grid.
- **Ecologic advantages**: Because the energy would be generated very near where it would be used, fewer resources (and associated carbon emissions) would be used in transmission.
- **Social advantages**: This would be expected to generate some additional local employment and income during installation of the equipment used to generate this energy and, to a lesser extent, for annual maintenance and repairs to the equipment.
- **Other advantages**: The existence of a methane digester, wind turbine(s), and solar panels could be incorporated into the curriculum of some classes. Because UW-River Falls is prominent in the region, our efforts, if successful, would demonstrate the feasibility of these technologies and could encourage other communities, businesses and individuals to adopt them.

<u>Disadvantages – Campus Generation of Renewable Energy</u>

- **Economic disadvantages:** There are two primary economic disadvantages to on-campus generation of renewable electricity. First, there would be a considerable amount of up-front expenditures to buy and install the needed equipment. Based on data available from the U.S. Environmental Protection Agency (http://www.epa.gov/agstar/faq.html#5) and the number of cows on lab farm number 2, a digester could be expected to cost about $100,000. The cost of installing a standard 1.5 megawatt wind turbine could be as high as $2.0 million and according to rough estimates by Wisconsin Public Power Inc. (WPPI) would cost approximately $0.30 per kWh (considering investment costs and annual operating costs). Maintenance of a wind turbine can be expensive because it requires specialized equipment and knowledge. In contrast UWRF is currently charged $0.10 per kWh for renewable energy purchased through River Falls Municipal Utility. It currently costs about $3.00 per kilowatt to produce electricity using solar panels, including the cost of purchasing and installing the panels. So, to compare to the wind turbine, a comparable solar array would cost about $4.5 million to generate 1.5 megawatts. A second issue is that it is not clear that the campus could efficiently generate energy from these sources. It isn't clear that the campus has enough animal units to use a digester efficiently, enough wind to efficiently drive a wind turbine, or enough sunny days to make photovoltaics a reasonable alternative. Additional research will need to be done to determine their feasibility.

- **Ecologic disadvantages**: The only ecologic disadvantage to campus generation of renewable energy is if such energy could be produced more efficiently elsewhere, the emissions generated by the production of the equipment are not generating as big an ecological bang for the buck if we purchase it.
- **Social disadvantages:** None identified.
- **Other disadvantages:** Some see wind turbines as visual pollution.

Conservation/Invest in Energy Efficient Equipment

Many argue that the best way to reduce greenhouse gas emissions from the generation of electrical power is to simply curtail our use of kilowatts. Yale University, for example, has a goal of reducing their greenhouse gas emissions to 10 percent below their 1990 emission levels by the year 2020 and more than 25% of their expected reductions are expected to come from conservation (http://www.yale.edu/sustainability/greenhouse_fin1.pdf). A 2006 study for Vermont's Department of Public Service concluded that nearly 15 percent of that state's energy needs could be met from conservation and efficiency programs.

The recent campus energy audit indicates that perhaps 20 percent of the savings needed to achieve energy independence in their least-cost scenario are expected to come from conservation and energy efficiency investments. In particular, consultants have recommended improved building efficiency and conservation ($5.4 million in investments and $130,000 in additional operating costs. Retrofitting the heat distribution system ($4.3 million in investments and no additional operating costs), and technical changes to how the heating plant is operated ($300,000 additional investments and $35,000 in additional operating costs) would reduce our energy use by another 12-13 percent.

Advantages – Conservation/Energy Efficient Equipment

- **Economic advantages**: By using less energy, the University's operating costs would decline. Conservation is generally the cheapest alternative per unit of energy saved.
- **Ecologic advantages**: Reducing demand reduces the number of kilowatt hours generated from all sources. Since most of those kilowatt hours were produced by greenhouse gas emitting technologies (coal, natural gas), reducing demand also reduces the greenhouse gas emissions that the campus generates.
- **Social advantages**: By broadening the responsibility for reducing energy use to virtually everyone on campus (did you turn off lights that you were no longer using?!), the campus effort to "go off the grid" becomes a shared experience. Habits developed in this effort are likely to carry over into our off-campus lives. Installation of more energy efficient equipment could create additional local jobs and income.
- **Other advantage**: Campus comfort might increase as a result of investments in energy conserving technologies.

Disadvantages – Conservation/Energy Efficient Equipment

- **Economic disadvantages:** There would be up-front costs associated with buying energy efficient equipment. The UWRF energy audit anticipates spending about $5.4 million dollars to retrofit campus equipment to be more energy efficient.
- **Ecologic disadvantages**: Some of the old equipment to be replaced with energy efficient models could not be recycled and would likely end up in a land-fill.
- **Social disadvantages:** The primary disadvantage of some of the energy reduction strategies is that success depends upon the actions of faculty, staff and

students. Because efforts to conserve energy (e.g. by turning off unneeded lights) would likely be inconsistent across campus, the greenhouse gas reductions would be uncertain.

- **Other disadvantages:** It is more difficult to quantify the impact of efficiency measures on greenhouse gas emissions (requires "what if" calculations – what if we hadn't invested in this more energy piece of equipment, how many more tons of CO_2 would we have emitted).

Options for Generating Heat at UW-River Falls

Status quo

Coal is currently burned in the campus power plant to generate heat and hot water. In 2006 the campus burned nearly 3,400 tons of coal plus about 638,000 therms of natural gas, which as shown in Figure 2 above, accounts for 74 percent of our direct energy use and, based on data in Figure 3, 93 percent of total energy use. The pros and cons of burning coal to generate electricity were discussed above and most are relevant to the issue of how the campus generates heat and hot water. It would, however, be prohibitively expensive to retrofit the plant to a coal gasification unit.

Advantages – Status Quo

- **Economic advantages**: Can lock in cost via long-term contracts, price has been less volatile than petroleum and natural gas, current system is designed for using coal
- **Ecologic advantages**: Shipping distances are less than for oil
- **Social advantages**: None identified
- **Other advantage**: a U.S.-based source of fuel (national security/energy independence), can be stored at power plants in large quantities to enable rapid response to changing conditions, currently have adequate supply and known reserves

Disadvantages– Status Quo

- **Economic disadvantages:** Uncertainty about technical viability and cost of capturing and sequestering greenhouse gas emissions and transportation costs of coal have escalated dramatically in recent year
- **Ecologic disadvantages**: Higher emissions (greenhouse gases, particulates, heavy metals) than all other options using existing technology, disposal of ash after burning
- **Social disadvantages:** Few local jobs created from this technology
- **Other disadvantages:** None identified

Use a Renewable Fuel as Physical Plant Feedstock

Tests are being planned to burn waste wood briquettes in the physical plant this year. Waste wood, switch grass, or wood chips might also be feasible feedstocks for the physical plant. The pros and cons identified earlier with respect to using these renewable energy sources to generate electricity are largely applicable if they are used to generate heat. The estimated cost of converting the plant to efficiently burn a renewable fuel is $2.5 million and add approximately $300,000 in additional annual operating costs.

Advantages – Wood/Switch grass

- **Economic advantages**: Wood and switch grass are (or could be) relatively abundant, renewable local energy sources. Burning waste wood would generate electricity from what is now considered to be a waste product. It is probable that most of the campus needs for these materials could be produced relatively near River Falls, resulting in low transportation costs (and the greenhouse gas emissions such transport would create). If coal prices rise, these options become more competitive in price.
- **Ecologic advantages**: While burning either of these products to produce heat releases greenhouse gasses, the CO_2 emitted is subsequently recycled in the next generation of trees or switch grass.
- **Social advantages**: Local producers of wood and switch grass would have a local market for their product. The sales of these products are expected to increase the income of these local providers and generate additional local employment opportunities.
- **Other advantages**: Wood and switch grass can be stored and could, therefore, provide a reliable source of heat and could be increased to meet peaks in demand.

Disadvantages – Wood/Switch grass/Biogas

- **Economic disadvantages:** the supply of waste wood is uncertain so price could be expected to fluctuate in unpredictable ways. Wood and switch grass would have to be transported, probably via truck, resulting in greenhouse gas emissions. Switch grass production might displace acreage devoted to food crops, resulting in increased food prices.
- **Ecologic disadvantages**: Switch grass production might cause land that is currently not in agricultural production because it is highly erodible to come back into use. It would also likely require the application of some sort of fertilizer (chemical or manure) to maintain production levels, which could result in damage to water resources and the use of fossil fuels to generate (in the case of chemical fertilizer) and apply (both types) the fertilizer. Burning wood or switch grass would generate some additional particulate pollution. Burning wood, particularly if it is not from waste sources, would result in additional deforestation.
- **Social disadvantages:** None identified.
- **Other disadvantage:** There are limits on the amount of heat that could be generated locally by burning wood or switch grass, so the ability to meet local needs in a sustainable fashion is uncertain. Campus experts estimate that rather than one to two truckloads of coal per week, we would need two truckloads of

woodchips or switch grass per day during the peak heating season. Not only would this increase greenhouse gas releases from the trucks but would increase traffic on campus and increase the risk of accidents involving these trucks with pedestrians and/or vehicles.

Increase Efficiency

There are a number of investments that the University could make to reduce the amount of heat we need to generate. The recent University energy audit indicates that the best ways to increase efficiency of the heat we generate would be to reduce heat loss as its transmitted from the power plant to buildings, installing more energy efficient windows in residence halls and classrooms, increasing insulation in campus buildings, etc. The cost of these efforts, as noted above are expected to be about $10 million in investments and about $135,000 in additional annual operating costs.

Advantages – Increase Efficiency

- **Economic advantages**: By using less energy, the University's operating costs would decline.
- **Ecologic advantages**: Reducing the amount of heat generated in the physical plant has a direct impact on the amount of carbon the campus emits.
- **Social advantages**: Some conservation measures (e.g. shorter showers) would require many on campus to participate with the attendant advantages that changed habits might have on people's off-campus actions.
- **Other advantages**: None identified.

Disadvantages – Increase Efficiency

- **Economic disadvantages:** There would be up-front costs associated with buying energy efficient equipment. (give examples here of how much it would cost to buy equipment needed to implement the best options identified in the energy audit).
- **Ecologic disadvantages**: Disposal of equipment replaced with energy efficient models would create some additional environmental problems (for example, having to dispose of old equipment that may contain mercury, asbestos or PCBs)
- **Social disadvantages:** The primary disadvantage of some of the energy reduction strategies is that success depends upon the actions of faculty, staff and students. Because efforts to conserve energy (e.g. taking shorter showers) would likely be inconsistent across campus, the greenhouse gas reductions would be uncertain.
- **Other disadvantages:** None identified.

Options for Meeting Transportation Needs at UW-River Falls

Fuel Efficient Vehicles

Virtually all of the options available to UW-River Falls to meet its transportation needs while reducing greenhouse gas emissions revolve around increasing the efficiency with which we use gasoline. Efficiencies could be gained by replacing the current stock of university-owned vehicles with hybrid cars or other models that get more miles per gallon. For example, in 2007 the University had 19 vehicles fleet vehicles that were driven nearly 325,000 miles and we paid an average of $2.57 per gallon. If the average fleet mileage increased by 5 miles per gallon, we would save about $8,300. It could easily cost $500,000 to replace these 19 vehicles with more fuel efficient models.

<u>Advantages – Investing in Fuel Efficient Vehicles</u>

- **Economic advantages**: The primary economic advantage to the University of this option would be reduced operating costs since less fuel would be purchased.
- **Ecologic advantages**: Fewer greenhouse gases would be emitted.
- **Social advantages**: Reduction in dependence on foreign sources of oil.
- **Other advantages**: As an opinion leader, the University's demonstration of the feasibility of changing our fleet of vehicles might induce others in the community and beyond to replace less energy efficient vehicles.

<u>Disadvantages – Investing in Fuel Efficient Vehicles</u>

- **Economic disadvantages:** There would be substantial up-front costs associated with buying more fuel efficient vehicles. The pay-off time (how long it would take for the fuel savings to off-set the cost of purchasing the vehicles) would be much longer than the expected life of the vehicle.
- **Ecologic disadvantages**: Disposal of vehicles replaced could have negative ecologic consequences.
- **Social disadvantages:** Fewer purchases of fuel from local providers could result in lower incomes and fewer jobs at local gas stations.
- **Other disadvantages:** Disposal of non-recyclable portions of the vehicles.

Incentives for Commuters

Currently, students, staff, and faculty drive thousands of miles per year in their commute to campus. Incentives could be provided for commuters to form carpools as a means of reducing greenhouse gas emissions and helping alleviate the thorny issue of parking. For example, carpoolers with at least 3 riders could be provided free parking in a campus lot or given other monetary perks to encourage this habit. Those who choose not to carpool could be charged a higher fee for parking privileges.

<u>Advantages – Providing Incentives for Car Pooling</u>

- **Economic advantages**: Members of car pools would have lower costs and hence higher real incomes.
- **Ecologic advantages**: Fewer greenhouse gas emissions would result.
- **Social advantages**: Commuters might build additional social capital with those with whom they are riding to work.
- **Other advantages**: Public relations between the University and the community of River Falls could be expected to improve if fewer commuter vehicles are being parked on city streets.

<u>Disadvantages – Providing Incentives for Car Pooling</u>

- **Economic disadvantages:** The University might loose revenue if free parking is provided to car poolers and there are an insufficient number of non-carpoolers who pay a higher fee.
- **Ecologic disadvantages**: None identified.
- **Social disadvantages:** Less personal flexibility in terms of travel times for those who car pool.
- **Other disadvantages:** None identified.

What Attributes Are Most Important

All of the options identified above involve trade-offs that you should weigh as you consider the best way forward. Key trade-offs include:

- Costs. There are two types of costs that need to be considered when evaluating our options. One key cost is the up-front cost of acquiring the technology or equipment that will enable the campus to reduce our energy use and greenhouse gas emissions. For example, the costs of buying and installing solar panels and a wind turbine are quite different. The second cost to consider are operating costs – how much it costs us to use the equipment or technology in an on-going basis. The on-going costs associated with energy efficiency investments like high-efficiency windows are much lower than the on-going costs associated with buying renewable fuel (wood or switch grass) to burn in the physical plant.
- Risks. Risks come in many forms. Dependence on nuclear power, for example presents risks associated with storage of waste. Other technologies, such as wind and solar are still developing and investments in these that are made today might generate much less bang for our buck than if we waited to purchase equipment for 5 years. There are also risk considerations in terms of diversifying the means by which we reduce our energy use and greenhouse gas emissions. Is it "better" to reduce our energy use via one or two really big investments (e.g. a massive solar array) or via lots of little things (e.g. incentives for commuters to car pool)?
- Predictability. How important to you is it that future costs associated with reducing energy use and greenhouse gas emissions are predictable. For example, the future price of renewable fuel stocks (wood or switch grass) is likely to be less predictable than the operating costs of a wind turbine. Likewise, the impact on greenhouse gas emissions is likely to be greater by investing in more fuel-efficient vehicles than incentives for commuters).
- Sustainability. Some options for meeting the energy needs of the campus are more sustainable than others, depending upon your time reference. For example, there is some finite supply of nuclear fuel on earth while solar and wind are energy sources that will be renewed so long as our sun continues to burn (estimated to be several billion years)!
- Reliability. As noted in the introduction to this briefing booklet, reliability focuses on whether energy will be there when we need it. Reliability can refer both to the availability of a given type of energy in general or at a particular time. Nuclear energy, for example, is highly reliable in general since the reactions that generate the heat to produce electricity happen continuously at a very predictable rate. Nuclear, wind and solar are not necessarily very reliable at a particular point in time to deal with a short term increase in demand (e.g. during a particularly hot or cold day). The amount of energy generated by the nuclear plant cannot easily be ramped up and demand might peak at a time when the sun isn't shining or the wind blowing.
- Local Production. Energy produced in the immediate vicinity of River Falls has the advantages of lower transmission costs, increased local self-reliance, and the creation of more jobs and higher incomes for local residents. On the other hand, we may not be sufficiently large to use equipment/renewable feedstock in an efficient manner. In addition, some may not be happy with some of the local production alternatives (how

many would be happy if the University constructed a nuclear power plant to replace our coal fired plant?).

- Local Environmental Impact. The alternatives we have discussed range from little or no local environmental impact (e.g. installation of solar panels) to moderate (the visual pollution some call wind turbines) to potentially serious (e.g. particulate release associated with burning renewable feedstock in the physical plant).
- Greenhouse Gas Emissions. Some of the options would result in greater greenhouse gas reductions (e.g. increased use of solar or wind power), others would have somewhat less (methane digesters and both of the options to reduce campus gasoline use).

Options for Paying for Energy and Greenhouse Gas Emissions at UW-River Falls

As noted, all of the options discussed in the preceding section involve either up-front investment costs and/or on-going operating costs. There are a relatively small number of ways by which these costs could be covered.

Increases in State Funding

Since one impetus for UW-River Falls' effort to "go off the grid" is a goal given to us by Governor Doyle, it is reasonable to expect the state of Wisconsin to cover some of the costs of this conversion. Funding our effort to reduce energy use and greenhouse gas emissions in this way would spread the cost over all the taxpayers of Wisconsin. It could be argued that there is a public benefit associated with our effort in that we could serve as a "demonstration" of what is possible in the way of reducing our ecologic impacts.

Advantages – Increasing State Funding

- Costs would be distributed widely
- Students would not bear the brunt of the cost of this effort
- It's equitable given that this is a priority of the Governor

Disadvantages – Increasing State Funding

- The legislature may not be willing to fund this effort
- Will require significant time/effort to build support in Madison for this funding (lobbying)
- Might reduce University funding in some other part of our budget

Grant Funding

Many states (including Wisconsin – Focus on Energy, which is funded by utilities based on charges paid by their customers) and the federal government have programs that help defray the cost of investing in energy reducing technologies. In addition, private foundations (including the one operated by the investor-owned utility Xcel Energy) have similar programs. The University has lots of experience writing grants and could ramp up its efforts to secure funds to cover the acquisition cost of technologies that would reduce our energy use. The University also has a Foundation that regularly solicits funds on our behalf. Individual donors might be inspired to donate money that would enable us to purchase energy saving/generating equipment and technology.

Advantages – Increasing Grant Funding

- Grant funding would bring additional, new resources to the university.
- Students would not bear the brunt of the cost of this effort.
- Grant funding would allow some donors to invest in the University to support a cause about which they care passionately.

Disadvantages – Increasing Grant Funding

- The university may not qualify for existing grant programs many of which are aimed at individuals (e.g. there are programs to subsidize the installation of methane digesters on farms but it is not clear if the University farm would qualify for such programs).
- Grant funding is uncertain – the grants we write may not be funded.
- Grant funders are very unlikely to fund on-going/operating expenses.
- Donors who give to finance this effort might reduce their giving for other things such as student scholarships.

Tuition/Fee Increases

With more than 6,000 students, an increase in tuition or fees of $100 per semester would generate more than $1.2 million dollars per year that could be used to fund our effort to reduce energy use and greenhouse gas emissions. This amount of money would allow the university to acquire many energy-saving/producing technologies and provide a source of funding to pay for on-going operations.

Advantages – Tuition/Fee Increases

- This is a revenue source over which the University has somewhat more control.
- It would produce a much more predictable stream of revenue with which to finance this effort.
- It would spread the cost of achieving energy savings/greenhouse gas reductions over future generations of college students.

Disadvantages – Tuition/Fee Increases

- It would increase the cost of attending UW-River Falls.

User Fees

One could argue that those who use more energy should be required to cover the full cost of that use. In this sense the full cost would include the larger environmental impact of energy use, including global warming. Fees charged for using energy would also provide people an economic incentive to reduce their energy use. For example, additional fees could be charged to intramural and university sports teams to cover the cost of lights, ice (e.g. for hockey), and heat. Monitors could be installed in showers to measure and assess a charge for the hot water used. Parking fees, as noted above, could be charged based on how many people ride to work in a given car. Surcharges could be added to the cost of using University vehicles to cover their greenhouse gas impact.

Advantages – User Fee Increases

- The cost of energy reduction would be borne more heavily by those who use the most energy.
- Heavy energy users would have a more obvious incentive to reduce their consumption of energy.

Disadvantages – User Fee Increases

- The cost of energy reduction would not be spread evenly over everyone and may fall disproportionately on people with less ability to pay.
- This may require the purchase and installation of monitoring equipment and additional administrative expenses associated with billing energy users.
- Would likely discourage such things as travel by faculty, staff, and students to do off-campus service learning projects since it would cost more to do so.