



# *ENERGY CROPS*

*and Their Potential  
Development in  
Michigan*



**Michigan Biomass Energy Program**

August, 2002

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### **A Report of the Michigan Biomass Energy Program**



The goal of the Michigan Biomass Energy Program (MBEP) is to encourage increased production and/or use of energy derived from biomass resources through program policies, information dissemination, and state and regionally funded research and demonstration projects.

#### **Discussion Paper Information:**

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#### **Disclaimer:**

The views expressed in this paper are those of the MBEP staff and do not necessarily reflect the views of the U.S. Department of Energy or the Michigan Dept. of Consumer & Industry Services.

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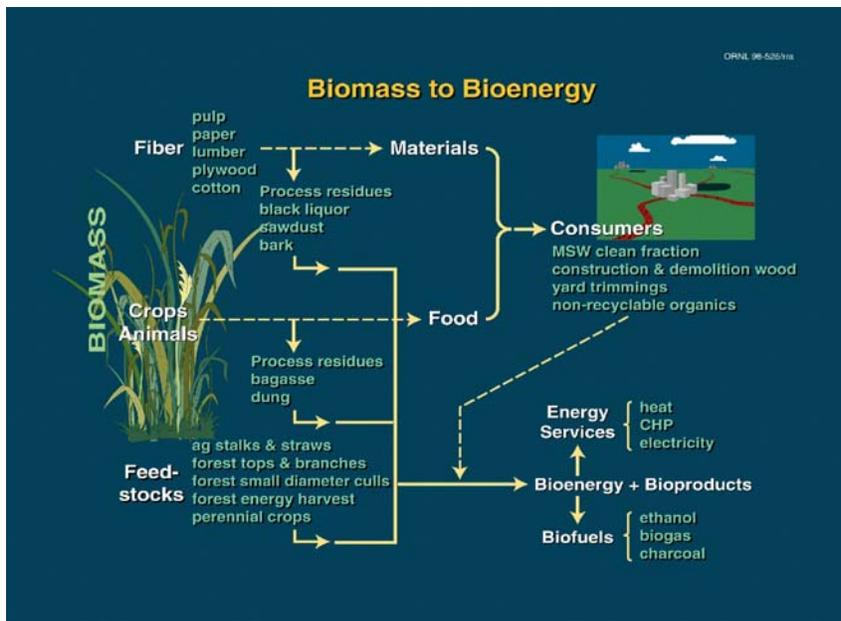
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# Introduction

Although the term energy crops may be unfamiliar to some, the concept of energy crops has been around for many years. In fact, agricultural and forestry crops and their residues were a major source of energy until the discovery of oil in 1859.

Energy crops are a type of biomass. Biomass is any organic matter which is available on a renewable basis through natural processes or as a by-product of human activity such as agricultural crops and crop residues, wood and wood waste, and portions of the municipal solid waste stream. Biomass is used to generate electricity, and to produce fuels and other consumer products.



Source: Oak Ridge National Laboratory website

Shortly after the discovery of oil, biomass began to be replaced by fossil fuels which were less expensive and had a higher energy content.<sup>1</sup> Since then fossil fuels have dominated as the major source of energy generation and transportation fuels and now supply about 85% of U.S. energy demand. However, because they are non-renewable, oil and natural gas can not be relied on indefinitely. Exactly when fossil fuels will be

depleted is fervently debated. The American Petroleum Institute has stated that petroleum reserves should last for about 43 years.<sup>2</sup> According to a National Research Council report some geologists believe that oil reserves could be depleted within 20 years.<sup>3</sup> Some experts predict that the recent increases in oil prices are just the beginning to a steady decrease in supply and increase in prices.

Unlike oil and natural gas, the cost of renewable energy (especially biomass) is expected to continue to decline as technology improves. A majority of the cost of biomass energy production is in the conversion process. As technological improvements

reduce processing costs for biomass energy, it will be better able to compete with petroleum based energy.<sup>4</sup>

Due to the impending decrease in supplies of non-renewable sources of energy, a focus of the Michigan Biomass Energy Program (MBEP) has been to research the use of renewable sources of energy, such as energy crops. When the MBEP began to research energy crops it was discovered that there was a lack of comprehensive information and almost no

information on the use of energy crops in Michigan. This paper provides basic energy crop information, explores the opportunities and constraints for the development and use of energy crops, and discusses some of the crops which could be grown in Michigan. The use of energy crops for electric generation is a primary focus of this paper. However, information on using crops to produce ethanol is also included.



# What are Energy Crops?

Energy crops are specifically grown to produce some form of energy. Energy may be generated through direct combustion or gasification of the crops to create electricity and heat, or by converting them to liquid fuels such as ethanol for use in vehicles.

Energy crops are generally divided into two types: herbaceous and woody. Since 1980, Oak Ridge National Laboratory (ORNL) has studied approximately 125 different species of herbaceous and woody crops to determine which crops would be most appropriate for energy crops.<sup>5</sup> Poplar, willow and switchgrass were found to be very promising and much of the subsequent research has focused on them. These three crops will be the focus of this paper.

## **Herbaceous Crops**

Herbaceous energy crops are mostly types of grasses, which are harvested like hay. Perennial grasses, such as switchgrass, miscanthus, bluestem, elephant grass, and wheatgrass could all potentially be grown as energy crops. These grasses regrow from their roots and therefore do not require replanting for long periods of time (15 years or more).<sup>6</sup>

## **Switchgrass**

Switchgrass has become a main focus for research over other types of energy crops because yields are higher and production costs lower. One reason switchgrass has lower production costs is that standard farming equipment can be used for cutting and baling. Another benefit of switchgrass over other types of energy crops is its drought tolerance and adaptability to many types of soils and climates. This allows for more widespread use of switchgrass in various regions of the U.S.<sup>7</sup>



Unlike many traditional crops, switchgrass is a perennial so it doesn't need to be planted each year. Once established it can be harvested up to twice a season. Switchgrass reaches full yield capacity after 3 years. Its permanent root system can extend over 10 feet into the ground and coupled with its large temporary root system it can improve soil quality through increased water infiltration and "nutrient-holding capacity".<sup>8</sup> Additional benefits of switchgrass are summarized in the box below.<sup>9</sup>



## **Switchgrass**

- Requires 1/4 of the water and fertilizer used for traditional crops, such as corn
- Can grow up to 10 feet in one season
- Extensive root system can help prevent soil erosion
- Pest and disease resistant
- Average yield in Michigan is estimated to be about 5 tons per acre each year

One problem with switchgrass is that it's susceptible to be overtaken by weeds until it establishes itself.<sup>10</sup> However, this can be overcome with proper weed control by mowing weeds to 4-5 inches, or through burning in late winter or early spring before new switchgrass has started to grow.<sup>11</sup>

## **Short Rotation Woody Crops**

The other type of energy crops are Short Rotation Woody Crops (SRWC). This includes many types of trees such as cottonwood, silver maple, black locust, and poplar.

SRWCs can be grown for a primary purpose such as paper production and the by-products can be utilized for energy. In fact the U.S.

Department of Energy (DOE) has stated that, “Even if SRWCs are used for pulp and paper, roughly 25 to 40 percent of the harvested biomass would be available for energy use.”<sup>12</sup>

During the first two years when the trees are establishing themselves weed control is absolutely necessary. Some experts also suggest planting groundcover between the rows of trees during this development period to help prevent soil erosion. Fertilization is normally applied after the 2<sup>nd</sup> or 3<sup>rd</sup> year when the trees can fully utilize the nutrients. From 3 years to harvest (4-10 years) the trees require little maintenance.<sup>13</sup>

Some benefits of SRWC’s are summarized in the box below.<sup>14</sup>

<p style="text-align: center;"><b>Woody Crops</b></p> <ul style="list-style-type: none"><li>— Selected fast growing hardwoods can grow 8-12 feet per year and up to 80 feet in 8-10 years under optimum conditions</li><li>— Can be cofired with coal to reduce power plant emissions</li><li>— Yield two to ten times as much wood per acre as natural forests</li><li>— Average yield in Michigan is estimated to be about 4-5 dry tons per acre a year</li></ul>
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### Poplar

Hybrid poplars have been touted for their potential as an energy crop due to their high yield rates and adaptability to many growing conditions. In some research areas they have reached a foot in diameter and 70 feet tall within 6 years. Some hybrid poplars have had yields up to 10 tons of dry biomass per acre, per year, which is 5-10 times larger than the



yields from natural forests. Because of these attributes, hybrid poplars are also being grown for use in the paper industry. By 1995, approximately 62,000 acres of hybrid

poplars had been established in the Pacific Northwest for paper and energy use.<sup>15</sup> Scientists continue to crossbreed hybrids to create trees that will grow faster, are more drought tolerant, and insect resistant.<sup>16</sup>



### Willow

Willow is another SRWC that researchers have recently focused on

for its potential as an energy crop. Willow grows 3-5 feet in the first year and then is cut to produce multiple stems from the stump the next spring. It then needs to grow for another 3 years (in which it can reach 18 feet) before it can be harvested. Once established, willow can be harvested every 3 years and will resprout after each harvest. Willow can be harvested with modified traditional farm machinery, so harvesting costs are lower than with other woody crops.<sup>17</sup> There are currently about 150 acres of willow established in the U.S.<sup>18</sup>

A barrier for utilizing willow as an energy crop is the up-front expense of the planting stock and equipment. Establishment costs are approximately \$650-890 per acre.<sup>19</sup> Planting stock costs make up a significant portion of those costs at \$400-\$700 per acre. One way to cut those high costs are through the formation of Cooperatives. A Co-op could produce and store the planting stock and sell it to members at a lower cost or could buy it in bulk and reduce costs that way. The reductions that can be gained through Cooperatives can be significant as, “for every cent reduction in the cost of the planting stock...costs are reduced approximately \$62 per acre, or...7-10%.”<sup>20</sup> Establishment costs could be further reduced if a Cooperative purchased and then rented the expensive willow planting equipment, which may only be needed once every 20-25 years (unless crops are rotated.)<sup>21</sup>

### Section Summary

Many energy crops are currently being investigated, but those included in this section (switchgrass, poplar, and willow) have been

touted as the crops with the most widespread promise. Other crops may be better suited for a particular area but are not as suitable for widespread use. Further research and demonstrations are needed to establish what crops can be successfully grown and used for energy generation. The next section will discuss how energy crops can be used to generate energy.



# Use of Energy Crops

Renewable energy currently accounts for a very small percentage of the total energy produced in the United States (about 3%). Biomass energy facilities generate a majority of the renewable energy. In 1999, over 100 million tons of biomass was used to generate about 7,500 MW of power in the U.S.<sup>22</sup> Most biomass facilities use wood waste as an energy source.<sup>23</sup> Many of these facilities are operated in the wood manufacturing and paper industries where wood waste is readily available for energy generation.

Energy crops can be used to generate electricity, and for the production of transportation fuels such as ethanol. Currently they are only used on a demonstration basis for these purposes.

## Electricity Generation

Energy crops could fuel a significant number of energy production facilities in the United States. According to a report by the Union of Concerned Scientists, energy crops and crop residues could potentially generate the same amount of electricity generated by coal in the Midwest.<sup>24</sup>

## Steam boiler/Cofiring

One way energy crops can be used to generate electricity is in a steam boiler, which is the same process used to convert coal to electricity. Energy crops can be used alone or cofired with coal.

Conversion of coal energy production facilities to allow cofiring is a relatively simple and inexpensive process with costs as little as \$50 per kW.<sup>25</sup> Typically modifications include new fuel handling and storage systems, but some facilities may also need to add drying or feedstock reduction equipment.<sup>26</sup> Eventually facility conversions may not be necessary. A demonstration project in Alabama is currently researching how to co-fire switchgrass with coal without retrofitting power plants.<sup>27</sup>

One challenge in using crops for energy generation is that a considerable amount is needed to generate significant amounts of electricity. It is estimated by the Iowa Department of Natural Resources that 1,500 acres of switchgrass (per year) would be required for each megawatt of electricity generated.<sup>28</sup> (This will vary according to how much of the crop is successfully harvested and transported to the generation facility and the capacity and efficiency of the power plant.) To cofire switchgrass with coal (using 5% switchgrass) approximately 50,000 acres (200,000 dry tons) are needed per year for a 750 MW power plant.<sup>29</sup>

There are currently some demonstration projects cofiring energy crops with coal. As part of the Chariton Valley Biomass Project, a Cooperative has been formed to grow switchgrass, which will be cofired with coal at an existing power plant.<sup>30</sup> Cofiring tests and an assessment of the environmental benefits of growing and cofiring switchgrass are to be completed this year. Another project being conducted by the New York Salix Consortium, will be cofiring willow with coal. One electric power plant participating in the demonstration (New York State Electric and Gas Company's Greenidge Station) is already cofiring wood with coal and plans to cofire about 5,000 tons of willow per year.<sup>31</sup> In addition to these demonstration sites, there are five commercial plants cofiring coal with wood waste in the United States.<sup>32</sup>

## Gasification

Through gasification, energy crops could be used for electricity generation, heating and the production of chemicals. The biomass gasifier in the photo was constructed in 1995 and operated by the Pacific International



Center for High Technology Research (PICHTR) in Hawaii.<sup>33</sup> The gasifier was part of a demonstration project using bagasse (a by-product from the sugarcane to sugar process). Although the gasifier is currently not operating due to a lack of funding, PICHTR is pursuing commercialization of the technology.

There is also a biomass gasification demonstration currently being conducted at Burlington Electric's McNeil station in Vermont. The McNeil station gasifies approximately 200 tons of wood chips per day and generates 8 megawatts of power.<sup>34</sup>

It is predicted that gasification systems could have efficiencies double that of current combustion systems. A major challenge for gasification development is the high capital investment required to build new facilities. Unlike co-firing, current coal or wood burning facilities cannot be inexpensively converted to a gasification process.

### Combustion

Energy crops could also be used to generate electricity through combustion. Most wood-to-energy facilities currently use combustion to create energy. A challenge in using a combustion process is it's less efficient than coal or gas-fired power plants. Capital costs for new wood-burning plants are comparable to coal but are considerably more expensive than natural gas-fired plants. However, researchers have stated that improvements (such as the addition of dryers and "more rigorous steam cycles") are "expected to raise the efficiency of direct combustion systems by about 10%... and lower the capital investment from the present \$2,000/kW to about \$1,275/kW."<sup>35</sup>

### Ethanol

Energy crops could also be used to produce ethanol. Ethanol can be blended with gasoline and used for passenger vehicles. Blends up to 10% ethanol (with 90% gasoline) can be used in all vehicles. Blends up to 85% ethanol can be used in vehicles modified to use ethanol.

The markets for 10% and 85% ethanol blends have steadily increased in the last few years. The National Ethanol Vehicle Coalition has predicted that over 2 million E85 vehicles will be on the roads by the end of 2002.

According to the National Renewable Energy Laboratory (NREL) ethanol produced from energy crops could displace as much as 25% of the gasoline currently consumed in the United States. Planting herbaceous and/or woody crops on "two-thirds of the nation's idled cropland... [approximately 35 million acres] could produce between 15 and 35 billion gallons of ethanol each year."<sup>36</sup>

Currently, most ethanol is produced from corn but it is predicted that ethanol costs can be greatly decreased through the use of other biomass resources for production. The DOE estimates that energy crops "will result in ethanol costs under \$1.00 per gallon by 2005, and under 70¢ per gallon by 2010."<sup>37</sup> One reason for the decrease in cost is that approximately 1/5 the amount of energy is needed to produce ethanol from energy crops versus food crops such as corn.<sup>38</sup>

An increasing number of ethanol production facilities are now using feedstocks other than corn. Georgia Pacific Paper operates an ethanol production facility in Washington that produces 7 million gallons of ethanol per year from a pulping by-product. A demonstration plant in Canada is producing ethanol from agricultural residues. Plant operator Iogen, predicts that a full-scale commercial facility will be constructed by 2004.<sup>39</sup> Additionally, BCI is planning to construct the first cellulosic ethanol plant in Jennings, Louisiana. The production facility would use bagasse to produce 20 million gallons of ethanol per year.

### Use in Michigan

Although there currently isn't a market for energy crops in Michigan there is potential for their future use at wood-to-energy facilities in the state.

A 1994 Michigan wood and paper residue study found that out of 940,937 tons of wood, pallet and paper residues produced annually, approximately 64% were used to generate energy and only 1.4% were landfilled. Therefore, as energy needs continue to increase additional feedstocks may be needed to meet production demands at commercial and industrial biomass energy facilities in the state.<sup>40</sup>

Another potential market for energy crops in Michigan is cofiring at the large number of coal power plants in the state. Approximately 75% of the electricity in Michigan is from coal-fired plants.<sup>41</sup>

### **Section Summary**

The use of energy crops for energy production is still in the developmental stage, but is predicted to grow. Increased use and development of energy crops may be accelerated through the completion of detailed economic analyses and demonstrations.

Benefits from increasing the use of energy crops include providing additional markets/income for farmers, producing a domestic source of energy, and environmental benefits. These benefits are discussed further in the next section.



# Why Use Energy Crops?

There are many potential benefits from the use of energy crops. The three benefits discussed in this section are: increased rural economic development, energy security, and environmental benefits.

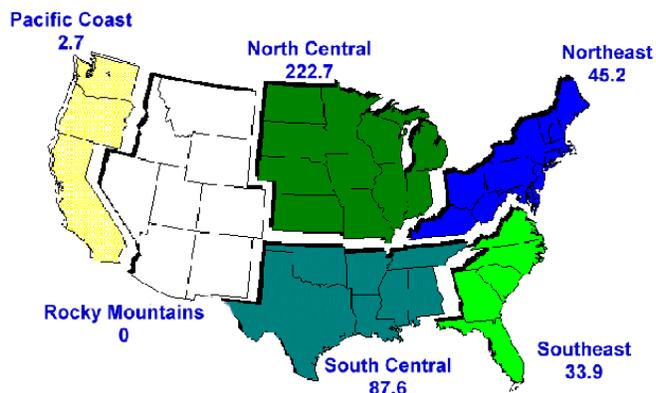
## Rural Economic Development

One compelling reason for generating energy from crops is to develop a new and profitable crop market in the United States. In recent years crop prices have been extremely low, which means low profits or losses for farmers. A report by the Michigan Agriculture Preservation Task Force stated that, “prices for agricultural products... are at their worst levels since the Depression”.<sup>42</sup>

## Land Availability

Decreasing crop prices and profitability has resulted in an increase in the amount of land taken out of production. Throughout the 90's an average of 50-55 million acres were taken out of production each year in the United States.<sup>43</sup> In Michigan cropland acreage decreased by approximately 870,000 acres between 1987 and 1997.<sup>44</sup> As of 1999, Michigan was one of the top ten states for cropland and forest area converted to development.<sup>45</sup> Development may be slowed through the creation of markets for energy crops, which would provide farmers with a new source of income. An ORNL study found that planting and harvesting 188 million dry tons of switchgrass would increase the total U.S. farm income by \$6 billion.<sup>46</sup>

Energy crops can be planted on underutilized cropland, pasture lands, and land currently used for traditional crops. It is estimated by ORNL that there are 392 million acres of land potentially suitable for energy crops in the United States. Over 200 million acres of this land is in the North Central U.S. (See map). Approximately 10% of the total suitable land could potentially be used for energy crops

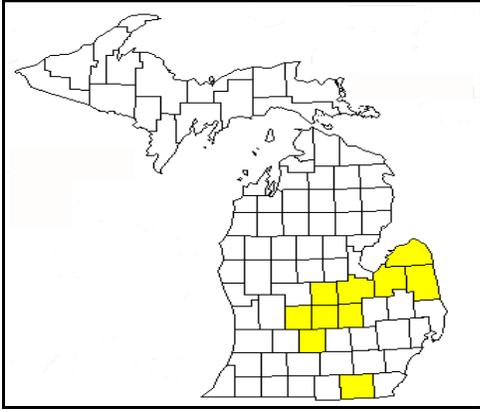


**392 million acres of land is potentially suitable for energy crop production**

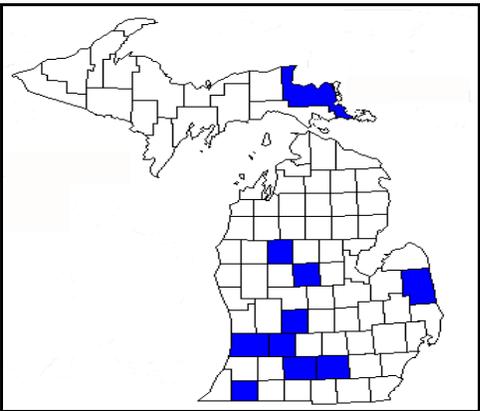
without affecting food crop production.<sup>47</sup>

The potential for energy crop development in the Midwest is discussed in a Union of Concerned Scientists' report, which estimated that “up to 250 million dry tons of switch grass and 20 million dry tons of hybrid poplar... [could] be grown across the Midwest without competing with food crops”. Converting these crops to energy would meet up to 22% of the Midwest's demand (using 1994 demand statistics). It was also estimated in this report that 2.2 million dry tons of hybrid poplar, and 6.74 million dry tons of switchgrass, could be grown in Michigan, which would meet more than 5% of the state's energy demand.<sup>48</sup>

According to the ORNL Energy Crop County Level Database, there are at least 8,055,481 acres in Michigan suitable for growing switchgrass and/or short rotation woody crops (willow or poplar). This includes 700,000 acres of pastureland<sup>49</sup> and 7,339,690 acres of cropland. Cropland suitable for energy crops is defined in the database as “all cropland in the county except that cropland used for pasture, orchards or vegetables”. The top ten counties in Michigan with the largest amount of cropland and pasture land suitable for energy crops are shown in the maps on the next page.



Top ten counties with largest amount of cropland suitable for energy crops



Top ten counties with largest amount of pasture land suitable for energy crops

Another potential source of land for energy crops is cropland currently enrolled in the Federal Conservation Reserve Program (CRP). This program was enacted in 1985 to take environmentally threatened cropland (usually due to erosion) out of production in exchange for payment from the government. As of September 2001, there were approximately 287,200 acres in Michigan enrolled in the CRP.<sup>50</sup> This same year, there were a total of almost 33.6 million acres in the U.S. enrolled in the CRP at a cost of over \$1.5 billion.<sup>51</sup>

Due to provisions included in the 2002 Farm Bill energy crops can now be grown and harvested on CRP lands. CRP payments will be reduced according to profits received from the crops.

Four pilot projects were approved by the U.S. Department of Agriculture (USDA) previous to the 2002 Farm Bill to grow and harvest crops on CRP land for energy production. One project in Iowa is planning to grow and harvest grasses to cofire with coal at the Alliant Energy Generating Station. A Minnesota pilot project may harvest hybrid poplar for a power plant in St. Peter. In New York, willow and switchgrass may be harvested and cofired with coal at two power plants. The fourth pilot project in Pennsylvania plans to cofire switchgrass in a coal-fired fluidized-bed combustor.<sup>52</sup>

Implementation of these projects will depend on whether proper financing and permits are obtained. The USDA approval did not include financing for the projects.

In addition to these pilot projects there are also other areas in which grasses, such as switchgrass are already grown on CRP land for soil erosion protection. In a Dartmouth College study it was reported that if the grasses already grown on CRP land were used to produce ethanol it would supply enough ethanol to meet 25% of the U.S. yearly gasoline needs.<sup>53</sup>

### Economic Activity and Employment

By utilizing available cropland there would be an increase in economic activity and employment in rural areas. A 500 MW biomass energy facility for example, could bring about 2,500 jobs (5 new full-time jobs for each megawatt the facility generated) into the community.<sup>54</sup> The total annual tax revenue generated from a 500 MW facility would be approximately \$236,000 (including federal and state income tax, property tax, and sales tax).<sup>55</sup>

A 100 million gallon ethanol plant could create over 2,000 local jobs and much of the plant profits would be retained in the local community. The Corn Marketing Program of Michigan estimates that, “nearly 80% of the money generated by an ethanol plant is spent within a 50 mile radius of the factory.”<sup>56</sup>

**Energy Security**

Energy generated through the use of energy crops would have the additional benefit of being a source of domestically produced, renewable energy.

The use of energy crops to produce transportation fuels could increase our energy security by decreasing our dependency on foreign oil. (Our reliance on foreign energy sources is by far the largest in the transportation fuel sector.) Currently the U.S. imports more than 50% of the oil used for transportation fuels and the DOE estimates imports could increase to 75% by 2010.

Dependency on foreign imports has significant economic and social costs. The costs of defending foreign oil supplies (such as in the Persian Gulf) are estimated to be \$10-23 billion dollars a year.<sup>57</sup> There are additional costs in maintaining the Strategic Petroleum Reserve, which consists of almost 590 million barrels of oil. At our current consumption rates, if all foreign imports were halted, the reserve would last about 75 days. The cost of maintaining this reserve is more than \$200 million dollars a year.<sup>58</sup>

**Environmental Benefits**

Environmental benefits from the use of energy crops include water quality improvements, emission decreases at generation facilities, and wildlife habitat improvements (over traditional

crops.)

**Water & soil improvements**

Energy crops act as filter systems, removing pesticides and excess fertilizer from surface water before it pollutes groundwater or streams/ivers. Because of these filtering capabilities, energy crops are being considered as a supplemental crop to be planted with traditional crops for pollution control.<sup>59</sup> An ORNL article on the use of energy crops for pollution control stated that a buffer zone of trees or grass only 22 yards wide can protect a “stream’s bank and water from erosion, siltation, and chemical runoff” and can still be harvested for energy.<sup>60</sup>

Most energy crops also require less fertilizers, herbicides and insecticides than traditional row crops. Table 1 below compares herbicide and insecticide use for energy crops (switchgrass and SRWC) versus corn and soybean crops.<sup>61</sup> The reduction in herbicide and pesticide use reduces the potential for water pollution and other environmental problems due to nonpoint source pollution. ORNL has concluded that, “any change from annual to perennial herbaceous or woody crops will reduce groundwater and surface-water contamination significantly”.<sup>62</sup>

Research has also shown that energy crops have “increased soil stability, decreased surface water runoff, decreased transport of

**Table 1:**

***Projected Annual Herbicide and Pesticide Use on Energy crops vs. Corn & Soybean crops***

	Corn	Soybeans
Switchgrass Herbicide Use	12 times less than	7 times less than
Switchgrass Insecticide Use	19 times less than	5 times less than
SRWC Herbicide Use	same*	same*
SRWC Insecticide Use	100 times less than (no insecticide used)	100 times less than (no insecticide used)

\*Would require the same amount during establishment of SRWC but none after established.

nutrients and sediment, and increased soil moisture”, in comparison to traditional crops.<sup>63</sup> The Union of Concerned Scientists has stated that, “converting a corn farm of average size to switchgrass could save 66 truckloads of soil from erosion each year”.<sup>64</sup>

The soil erosion benefits of energy crops may be of particular interest to certain areas in Michigan. The USDA National Resources Inventory has listed 557,300 acres in the state as having “high potential for soil erosion.”<sup>65</sup>

Emission Reduction

Another environmental benefit from the use of energy crops versus fossil fuels for energy production is a decrease in emissions.

Unlike fossil fuels, plants grown for energy crops absorb the amount of carbon dioxide (CO<sub>2</sub>) released during their combustion/use.<sup>66</sup> Therefore, by using biomass for energy generation there is no net CO<sub>2</sub> generated because the amount emitted in its use has been previously absorbed when the plant was growing.

The amount of carbon emitted during energy production is considerably less for switchgrass and some woody crops, such as poplar in comparison to natural gas, petroleum and coal. A comparison of emissions is shown in Table 2.<sup>67</sup>

By 1994, 20% of the worldwide CO<sub>2</sub> emissions was generated by the United States.<sup>68</sup> According to ORNL, “utility power plants...account for 72% of SO<sub>2</sub> [Sulfur dioxide], 35% of CO<sub>2</sub>, and 33% of NO<sub>x</sub> [Nitrogen Oxide]” emissions in the United States. Coal power plants (which supply 74% of the electricity in the Midwest) are the worst contributor of these emissions.<sup>69</sup> This problem is exacerbated by the fact that many of the midwestern coal plants were built between 1940 and 1970 and therefore often don’t have modern pollution control systems.<sup>70</sup> ORNL reports that substituting biomass for coal as a fuel source would reduce emissions of these key pollutants. If approximately 35 million

**Table 2:**  
***Comparison of Carbon Emissions in Energy Production***

Energy Source	Carbon Emissions (gram/kWh)
Poplar	3,961
Switchgrass	6,841
Natural Gas	49,618
Petroleum	80,260
Coal	88,758

Note: Carbon emissions includes production, transportation and conversion processes.

acres were used to grow energy crops and replace the use of coal for electric generation, it would eliminate 6% of annual CO<sub>2</sub> emissions in the United States.<sup>71</sup> If a mix of 10% willow was co-fired with 90% coal, NO<sub>x</sub> and SO<sub>2</sub> emissions would be reduced by 10%.<sup>72</sup>

Emissions from power plants have many environmental and health impacts. CO<sub>2</sub> contributes to global warming.<sup>73</sup> SO<sub>2</sub> and NO<sub>x</sub> emissions contribute to acid rain and NO<sub>x</sub> also contributes to ground level ozone. Acid rain causes acidification of lakes and streams, which can kill fish. It can also cause significant damage to forests, vehicles, buildings and other structures.<sup>74</sup> Reduced air quality due to emissions has also been linked to increases in respiratory ailments such as asthma. Total health care costs linked to air pollution were estimated by the American Lung Association to be 50 billion dollars a year.<sup>75</sup>

Wildlife/Natural Habitat Benefits

An additional environmental benefit from the use of energy crops is the habitat it provides for wildlife. A scientist from the National Audubon Society stated that energy crops such

as switchgrass and poplars are a definite improvement for wildlife compared to traditional row crops. In a 6-year old hybrid cottonwood stand owned by the James River Corporation, the scientist logged the presence of 26 birds, representing 9 different species within a brief period of time. At a 50 acre switchgrass area in Iowa the scientist logged 62 birds representing 15 species.<sup>76</sup>

Energy crops may also protect natural forests by providing an alternative source of wood, which can be grown on farm or pasture land that is no longer suitable for traditional row crops (due to crop surpluses or overworked land).<sup>77</sup>

### **Section Summary**

Using crops for energy will create additional markets for crops and a new source of income for farmers, put underutilized land to use, create environmental and energy security benefits, and provide employment opportunities.

With the projection that our electric generation needs will increase 33% and that 75% of our oil could be imported from foreign countries by 2010, it makes sense to look to renewable, non-fossil fueled based energy sources such as energy crops to meet new demand.<sup>78</sup> The next section discusses some of the barriers and potential solutions for increased use of energy crops.



# Constraints & Potential Solutions

There are many benefits that could be realized from the increased use of energy crops. However, there are some barriers that need to be addressed before energy crops can be used on a larger scale. In this section some of the constraints for energy crops being established and used for energy production will be discussed. Potential solutions and ideas of how to address the constraints are included in the shaded boxes.

## **Initial Establishment of Energy Crops**

There is a chicken and egg syndrome when it comes to growing and utilizing energy crops (ie: what happens first). Farmers are reluctant to adopt new crops that have uncertain markets as well as uncertain yields and paybacks. They want a reliable demand for crops before they invest the money to plant them. Conversely, energy producers want a guaranteed supply of an energy source before making the capital investments to build new facilities.

In addition to uncertain markets and yields for new crops, farmers are also reluctant to plant energy crops due to their establishment costs, which can be quite high in some cases. Establishment costs range from about \$100/ acres for switchgrass, to about \$200-\$250/acre for poplars (with 600-1200 trees/acre), and as high as \$650-\$890/acre for willow (established at high densities of 6000 trees/acre). The higher cost of willow may be partially offset

## **Education**

Farmers need to receive information that address their concerns with adopting energy crops.

- i Need to obtain feedback from farmers on their concerns and what information they need before adopting energy crops.
- i Develop educational programs for farmers, utilities, investors and consumers.
- i Post energy crop materials on the internet and encourage farmers to use these resources.

## **Cooperatives**

A Cooperative is a business controlled and organized by members. An energy crop



Cooperative could have the following benefits:

- i Allow farmers to share costs and risks
- i Could secure markets for crops instead of individual farmers having to do that themselves
- i Provide energy producers with a consistent and uniform supply of fuel
- i Cut down on costs by sharing equipment and purchasing planting stock in bulk
- i Could negotiate annual payments to farmers for woody crops based on annual growth rates so they don't need to wait 3-10 years to receive returns on their investment

by shorter harvest time (3-4 years) compared to the 5-10 years for poplar. In addition to the establishment costs, investments may also be needed for planting and harvesting machinery.<sup>79</sup>

Establishment costs to supply a typical 50 MW biomass power plant (which would require the establishment of approximately 50,000 acres of an energy crop) could range from \$5-\$45 million.<sup>80</sup> Costs at this level would most likely necessitate cost-sharing by the energy producer.

Energy producers are often hesitant to invest capital to build new production facilities, particularly those that rely on new technologies or feedstocks. The establishment of new energy production facilities may be especially risky in states where utility restructuring has been initiated. In these states utilities will not be able to directly pass along facility investments to the consumer through rate increases. This will most likely make utilities wary of investing in new biomass facilities until green pricing programs and/or biomass energy demand greatly increases.

Some solutions on how to bridge the gap for the development of energy crops are

### **Marketing Green Energy**

Green marketing or green pricing to promote the use of biomass energy is one strategy to educate consumers and enable biomass to compete with cheaper fossil fuels.



- i Green pricing is when utilities sell renewable “green” energy at a premium rate to customers who prefer to have their power come from environmentally friendly sources.
- i Utilities in 29 states offer green pricing programs.
- i 15 states are requiring utilities to disclose their fuel sources and related emissions on their electricity bills so consumers can make an educated choice when they purchase electricity.
- i In Michigan, approximately 275 residential and commercial customers participate in Traverse City Light & Power’s green pricing program for wind power. An additional 80 customers are on a waiting list to join the program. Green power programs are also offered by the Lansing Board of Water & Light, and Consumers Energy.

summarized in the “Education”, “Funding/Research” and “Cooperatives” boxes. Increasing demand for biomass energy and encouraging new facilities is addressed in the “Legislation/Incentives” and “Green Marketing” solution boxes.

### **Lack of Funding/Research**

According to a New Uses Council newsletter, “there has been extreme under-investment in new-crops research and development compared to the established agronomic crops, which are frequently in surplus.” Therefore, new crops have not been developed to the level where they are accepted by the farming community and will receive research and

development funding from the private sector.<sup>81</sup> The funding that has been made available for energy crop research has mostly been used to perfect a few plant species and little has been used for demonstrations and researching environmental benefits of energy crops. Suggestions for research and funding is included in the “Funding/Research” box.

### **Lack of Consumer Education/Marketing**

Another potential barrier for energy crop development may be public perception of biomass generated energy. A recent survey by the National Council on Competition and the Electric Industry (NCCEI) indicates that there is a negative public perception regarding biomass and that many believe biomass energy is not environmentally friendly. The survey asked consumers to rank energy sources by perceived environmental impact and general preference. “Wood and other biomass” was ranked lowest of all the renewable energy sources, as well as below natural gas. In fact, it ranked right above oil and coal.<sup>82</sup>

A lack of understanding about what biomass energy entails may contribute to this negative public perception. Discussions of wood-to-energy facilities for example, may lead people to conclude that forests are being cut down to fuel the facilities. Yet wood *waste* is the primary source of fuel in these facilities.

### **Funding/Research**

The acceptance of energy crops can be encouraged through additional demonstration sites and funding.



- i More funding should be provided for energy crop research and commercialization.
- i An increase in the number of demonstration sites is needed so farmers can see the technology at work and gain experience with new crops.
- i The environmental benefits of energy crops should be investigated further.
- i Support could be provided to equipment manufacturers to develop improved planting and harvesting equipment.

Due to the potential negative public perception and lack of understanding about biomass it is clear that some public education may need to take place before its widely accepted. Research by the University of Texas found that education on renewable energy can change peoples attitudes. The University polled 200 people regarding their attitudes on energy and then conducted two day learning sessions on energy issues. Prior to the learning sessions 51% were in favor of having their utility use more renewable energy and 48% favored the establishment of additional energy efficiency programs. After the sessions 76% wanted their utility to use more renewable energy, and 64% wanted additional energy efficiency programs.<sup>83</sup>

The use of green pricing to promote increased use of renewable energy is discussed in the “Marketing Green Energy” box.

**Lack of Energy Crop Policy & Incentives**

A recent DOE report identified policy-related issues as the major non-technical barrier for increased biomass energy development. The report stated, “Canada and the United States were most affected by barriers created by the differential costs between fossil fuels and biomass fuels and the lack of energy policy equalizing those costs”.<sup>84</sup>

Policies and/or incentives could be structured to “value” the benefits of using biomass (cleaner air and water) versus the use of fossil fuels. For example, the use of fossil fuels has resulted in oil spills, smog, acid rain, and a

**Emissions Credits**



There is currently an active trading market for SO<sub>2</sub> due to the EPA Acid Rain Program. This could be expanded to include other pollutants.

- i Establish program for greenhouse gas emissions where biomass energy producers could sell emission credits to other energy producers. NREL has reported that the market value of SO<sub>2</sub> emissions in 1999 was approximately \$200 per ton.
- i A greenhouse gas emission program would benefit many biomass energy producers as most have reduced emissions.

increase in greenhouse gas emissions and mining wastes. The costs for clean-up and steps to reduce emissions could be passed along in the cost of the fuel through an environmental tax.<sup>85</sup> Renewable energy like biomass on the other hand results in little or no increase in greenhouse gas emissions and doesn’t need to be mined or grown in environmentally sensitive areas. Arguably, biomass should therefore receive consideration for tax credits or incentives for these benefits over fossil fuels. Without policies to support and encourage the use of biomass, widespread production and use of energy crops may not be realized.

Additional solutions are included in the “Legislative/Incentives”<sup>86</sup> and “Emissions Credits boxes”<sup>87</sup>.

**Legislation/Incentives**



- i Incentives could convince farmers to plant energy crops until there is a steady market.
- i Tax incentives/credits could be provided for the environmental benefits of biofuels and biomass power generation to increase its ability to compete with fossil fuels.
- i If the biomass industry received a small portion of the subsidies, tax credits and other forms of government assistance that the fossil fuel industry has received during the last century, development of the biomass industry would most likely proceed at a much faster rate. (It’s estimated that the oil industry received between \$5.2 and \$11.9 billion in subsidies from the U.S. government in 1995.)



## Concluding Remarks

Developing and then increasing the use of energy crops for energy production can provide new markets and increased profits for farmers, decrease our dependency on foreign oil and non-renewable energy sources, and provide water, soil, and air quality benefits.

Using energy crops to generate electricity has become a timely issue as the U.S. has recently seen sharp increases in energy prices and the threat of terrorism has increased concerns about our reliance on non-domestic fuel sources. The price for petroleum based fuels is predicted to continue to increase, but the cost of renewable energy, such as biomass, is expected to continue to decrease with technological advances and increased production.

Another reason for encouraging the use of energy crops at this time is the increasing demand for electric power from renewable energy sources. In part, this is the result of electric utility restructuring in many states. Electric restructuring is the process of separating the electric industry into components (generation, transmission, and distribution). This permits consumers to choose their electricity supplier. Some states have included Renewable Portfolio Standards in their electric restructuring legislation. A Renewable Portfolio Standard requires electricity suppliers to generate a certain percentage of their energy from renewable resources. Recent surveys show that consumers may be influenced to choose a particular electric utility if their energy portfolio includes renewable energy. Although Michigan did not include a Renewable Portfolio Standard in the state deregulation legislation, there are utilities in Michigan currently offering green power programs.

An additional impetus for interest in renewable energy such as energy crops, is the new 8-hour

Clean Air standards recently implemented by the U.S. Environmental Protection Agency. These new standards are more stringent than previous standards and will most likely result in a large increase in the number of areas in non-attainment for emissions. Fourteen counties in Michigan may not meet attainment standards for ozone emissions when the 8-hour standards are enforced.<sup>88</sup> As discussed previously in this paper, energy crops can be cofired with coal to decrease emissions from coal power plants and therefore could be used as part of an area's plan for meeting emission attainment standards.

In Michigan there is a large potential for energy crop use at current biomass facilities and/or for cofiring at the large number of coal plants in the state. This paper assumes that switchgrass, poplars, and willow would most likely be the energy crops grown in Michigan. However, further research could determine that other crops would be even more appropriate for Michigan's climate and soil conditions.

The MBEP will attempt to increase awareness and interest in energy crop potential in Michigan through the distribution of this paper and by posting information on the program website. The MBEP will also attempt to facilitate partnerships between crop producers, state agencies, and energy producers to develop energy crop demonstrations within Michigan.



## Appendix A: Biomass Legislation/Incentives

### ***Relevant Legislation***

#### **Clean Air Act (CAA)**

The CAA of 1963 set emission standards for stationary sources such as factories and power plants. The CAA of 1970 established “primary and secondary ambient air quality standards, set new limits on emissions from stationary and mobile sources..., and increased funds for air pollution research.”<sup>89</sup> CAA amendments in 1978 resulted in the U.S. Environmental Protection Agency (EPA) adding lead to its list of criteria pollutants. The elimination of lead as an additive for gasoline octane enhancement opened up the market for new products, such as ethanol.<sup>90</sup>

In 1990, amendments mandated that areas with high carbon monoxide pollution use oxygenated fuels during winter months, and that areas with severe ozone pollution use reformulated gasoline. As a result, 39 areas in the U.S. are currently required to use oxygenated fuels and 9 areas are required to use reformulated gasoline.<sup>91</sup> The most commonly used additives for these fuels have been ethanol and methyl tertiary butyl ether (MTBE). However, it has recently been discovered that MTBE has been leaking into ground water. Due to the water contamination and potential health concerns from the use of MTBE, numerous states (including Michigan) have banned its use.<sup>92</sup>

#### **Energy Policy Act of 1992**

This Act mandated the purchase of alternative fueled vehicles in government and private fleets and established a goal of 30% replacement of petroleum fuels by 2010.<sup>93</sup>

#### **1999 Executive Order for Developing and Promoting Biobased Products & Bioenergy**

In 1999, President Clinton issued Executive Order 13134 to “develop a... national strategy,

including research, development, and private sector incentives, to stimulate the creation and early adoption of technologies needed to make biobased products and bioenergy cost-competitive in large national and international markets”. The executive order also set a goal of tripling the amount of biomass energy in the U.S. by 2010. To assist in fulfilling this goal, the National Biobased Products and Bioenergy Coordination Office was established.<sup>94</sup>

#### **2000 National Sustainable Fuels & Chemicals Act**

This Act provides \$49 million per year until 2005, to further develop biomass feedstocks and technologies.

#### **2002 Farm Bill**

The 2002 Farm Bill includes an Energy Title, which supports many renewable energy measures. One section included in the Farm Bill, which could greatly impact further use and development of energy crops, is the allowance to grow and harvest crops on CRP land. Switchgrass has been grown on a considerable amount of CRP land for conservation purposes, but until now it couldn't be harvested. Farmers will now be allowed to harvest these type of crops and CRP payments will be reduced in accordance with the income from the crop. This would make farmers investments much less risky and save the government money through reduced CRP payments. The Farm Bill also includes provisions to support research and development for the conversion of biomass to fuels, chemicals, and electricity.

#### **Pending Legislation**

Energy bills have been introduced in both the U.S. House and Senate, which include Renewable Energy Standards. The proposed standards would increase the amount of energy generated from renewable resources anywhere from 4% by 2010 to 20% by 2020.<sup>95</sup>

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## *Federal Incentives*

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### **Biomass**

#### ***Renewable Resources Production Credit***

This credit, which is currently 1.7¢/kilowatt hour (adjusted each year for inflation) is available for energy produced from closed-loop biomass, poultry waste, and wind energy. Closed-loop biomass means that the energy must be produced from a whole plant, specifically grown to produce energy. Therefore, wood and municipal solid waste facilities are not eligible for the credit. The credit is also not available for facilities co-firing energy crops with coal.

When the credit was initially enacted, facilities had to be placed in service between January 1, 1993 and July 1, 1999 to qualify and the credit would be available for the first ten years of production.<sup>96</sup> In 1999, the credit was extended to facilities placed in service by January 1, 2002 and was opened up to poultry litter facilities. The tax credit was recently extended again till the end of 2003.

Many organizations have been working to further extend this credit and to open the credit to other types of biomass energy facilities. Both Energy Bills proposed by the U.S. House and Senate would allow additional biomass facilities to take the credit.

#### ***Renewable Energy Production Incentive***

The current Renewable Energy Production Incentive is 1.7¢/kilowatt hour credit (adjusted each year for inflation). Government facilities and nonprofit cooperatives, which produce solar, wind, biomass, and geothermal energy, are eligible for the incentive. However, the incentive is not guaranteed as it is appropriated each year by Congress. If there isn't enough money available to make payments to all applicants then priority is given to Tier-1 facilities (wind, solar, geothermal, closed-loop biomass). If funds are available after Tier-1 payments are made, Tier-2 facilities (open-loop biomass such as

landfill gas and digesters) will receive payments. Facilities eligible for the credit must be put in service between October 1, 1993 and September 30, 2003. A facility is only eligible for the incentive for 10 fiscal years, beginning the first year it was eligible for the incentive (not from when they first apply for it).

Traverse City Light and Power is currently the only Michigan utility to receive payments from this incentive. They received payments from 1998-2001 for their wind generator.<sup>97</sup>

#### ***Crude Oil Windfall Profit Tax Act, Section 29-Biomass Gas Credit***

This Act created a tax credit for the production and sale of gas from biomass (includes combustion or gasifiers, landfill gas facilities, and anaerobic digesters) for facilities placed in service between January 1, 1980 and January 1, 1997. The credit expires January 1, 2008.<sup>98</sup>

### **Ethanol**

#### ***Blender Tax Credit***

Blenders ("businesses that mix alcohol with other motor fuels and use the mixtures in a trade of business or sell it for use as a fuel") can currently receive a 53¢ per gallon federal tax credit for ethanol blended with gasoline. The ethanol must be at least 190 proof, if 150-190 proof the credit is decreased to 45¢ per gallon.<sup>99</sup>

#### ***Small Ethanol Producer Tax Credit***

Small ethanol producers can receive a 10¢ per gallon credit for up to 15 million gallons. This is only available for production facilities under 30 million gallons per year.

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These ethanol tax credits were extended until the end of 2007. The blender tax credit has reductions in 2003-4 to 52¢, and 2005-7 to 51¢.

## Appendix B: Resources

### *Government*

#### **National Biobased Products and Bioenergy Initiative**

Website: [www.bioproducts-bioenergy.gov](http://www.bioproducts-bioenergy.gov)

Multi-agency effort to coordinate and accelerate all Federal biobased products and bioenergy research and development.

#### **U.S. Department of Agriculture (USDA)**

Website: [www.usda.gov](http://www.usda.gov)

Mission: “Enhance the quality of life...by supporting production of agriculture”. Website includes information on agricultural related environmental issues, the Conservation Reserve Program and a Crop Profile Database.

#### **Alternative Farming Systems Information Center (AFSIC)**

10301 Baltimore Ave, Room 304  
Beltsville, MD 20705-2351  
Phone: (301) 504-6559  
Website: [www.nal.usda.gov/afsic](http://www.nal.usda.gov/afsic)

Part of the National Agricultural Library, AFSIC focuses on “alternative crops, new uses for traditional crops, and crops grown for industrial productions”. Website includes an extensive list of publications

#### **Office of Energy Policy and New Uses**

Provides economic analysis on energy policy issues, coordinates energy-related activities, and studies new uses of agricultural products such as ethanol. Information and contacts for projects are available through the USDA website.

#### **U.S. Department of Energy (DOE)**

1000 Independence Avenue, SW  
Washington, DC 20585  
Phone: (800) 342-5363  
Website: [www.energy.gov](http://www.energy.gov)

Mission: To insure a “reliable energy system that is environmentally and economically sustainable...and to support continued U.S. leadership in science and technology”. The DOE website includes an extensive list of online publications.

#### **DOE Office of Energy Efficiency & Renewable Energy (EERE)**

Website: [www.eren.doe.gov](http://www.eren.doe.gov)

EERE focuses on developing “efficient and clean energy technologies” and oversees the Offices of Industrial and Transportation Technologies, the Biomass Power for Rural Development Initiative, and the BioPower Program. EERE also maintains the Energy Efficiency and Renewable Energy Network which includes information on energy efficiency, renewable energy, and EERE Programs.

#### **Biomass Power -Rural Development Initiative**

In collaboration with the USDA, this initiative provides funding for projects that demonstrate biomass power generating systems utilizing energy crops. The goal of this initiative is not only to demonstrate new technologies but also to encourage the development of jobs and income in rural areas, reduce greenhouse emissions, and improve biodiversity.

Current projects:

##### ★ *Iowa Chariton Valley Project*

Co-op of 40 farmers growing switchgrass on 5,500 acres of CRP land to cofire with coal at an existing coal power plant. Predict up to 50,000 acres of switchgrass will be grown by 500 local farmers for the plant. Also will be evaluating environmental benefits (soil and water quality, wildlife habitat, etc.), decreased CO<sub>2</sub> emissions, and maximizing switchgrass yields.

##### ★ *New York Salix Consortium*

Cofiring willow in an existing coal plant. During the first phase willow will be grown on 2,600 acres. By 2010 it is projected that up to 60,000 acres of willow will be grown.<sup>99</sup>

- k *Minnesota Whole Trees for Power*  
Initially demonstrated the whole tree harvesting technology with hybrid poplars and completed preliminary plant design. Goal is to establish 48,000 acres of hybrid poplars and construct a 50 MW power plant to utilize the trees for energy.

### **BioPower Program**

Website: [www.eren.doe.gov/biopower](http://www.eren.doe.gov/biopower)

Mission: “To expand domestic and global markets for renewable electricity from sustainable biomass resources by fostering partnerships with U.S. industry, agriculture, and forestry.” The BioPower Program also publishes *Biomass Monthly* which discusses environmental and electricity issues affecting biopower and is available with many other publications on their website.

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### **DOE Office of Industrial Technologies (OIT)**

Website: [www.oit.doe.gov](http://www.oit.doe.gov)

OIT develops and supports technologies for energy efficiency, renewable energy, and pollution reduction. OIT also manages the Agriculture Industries of the Future Program, which focuses on the “development of plant/crop-based renewable resources” to decrease our dependency on fossil fuel.

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### **DOE Office of Transportation Technologies (OTT)**

Website: [www.ott.doe.gov](http://www.ott.doe.gov)

OTT partners with the transportation industry to “develop advanced transportation technologies and fuels... to help the United States decrease its use of petroleum fuels”. OTT also publishes *Biofuels News* and *Alternative Fuel News* which are available on their website.

### **DOE Office of Fuels Development (OFD)**

Website: [www.ott.doe.gov/ofd](http://www.ott.doe.gov/ofd)

As part of the OTT, Office of Fuels Development is primarily focused on reducing the cost of ethanol. It also oversees the Biofuels Program and Regional Biomass Energy Program.

### **Biofuels Program**

Website: [www.ott.doe.gov/biofuels](http://www.ott.doe.gov/biofuels)

Mission: “research, develop, demonstrate, and facilitate the commercialization of biomass-based, environmentally sound, ...technologies to develop clean fuels for transportation”

### **Regional Biomass Energy Program (RBEP)**

Website: [www.ott.doe.gov/rbep](http://www.ott.doe.gov/rbep)

The RBEP includes 5 Regions whose goal is to “increase the production and use of biomass energy resources in transportation and other energy-related areas”. The Michigan Biomass Energy Program is part of the Great Lakes Regional Biomass Energy Program

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## **DOE Research Laboratories**

### **National Renewable Energy Laboratory (NREL)**

1617 Cole Boulevard  
Golden, CO 80401  
Phone: (303) 231-1000  
Website: [www.nrel.gov](http://www.nrel.gov)

NREL focuses on “renewable energy and energy efficiency research, development and deployment”. NREL’s website includes weekly updates on renewable energy and energy efficiency issues as well as an extensive list of online publications.

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### **Oak Ridge National Laboratory (ORNL)**

One Bethel Valley Road  
Oak Ridge, TN 37831  
Phone: (615) 576-5454  
Website: [www.esd.ornl.gov](http://www.esd.ornl.gov)

Mission: conduct research and development to “increase the availability of clean, abundant energy; restore and protect the environment; and contribute to national security”.

### **Bioenergy Feedstock Development Program**

Website: <http://bioenergy.ornl.gov/bfdmain>

Mission: “to develop and demonstrate environmentally acceptable crops and cropping systems for producing large quantities of low-

cost, high quality biomass feedstock” Also periodically publish the *Energy Crops Forum*, which is available (including past issues) on the website.

### **Bioenergy Information Network**

Website: <http://bioenergy.ornl.gov>

Provides information on the use of energy crops for fuels and power. Also includes information on biomass related DOE programs, current news and publications on bioenergy issues, and biomass databases.

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### **U.S. Environmental Protection Agency (EPA)**

Website: [www.epa.gov](http://www.epa.gov)

Mission: “to protect human health and to safeguard the natural environment...” Website includes information on Pollution, Acid Rain, Global Warming, and Renewable Energy and numerous online publications/information. The website also includes emission data for power plants by state.

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### **Michigan Department of Consumer & Industry Services (CIS)-Energy Office**

#### **Michigan Biomass Energy Program (MBEP)**

6545 Merchantile Way, Suite 9  
Lansing, MI 48911  
Phone: (517) 241-6228  
Website: <http://michiganbioenergy.org>

In addition to publishing this paper, the MBEP has been working on other biomass issues since 1986. Project areas have included: agricultural biomass energy, ethanol education and infrastructure development, and wood/wood waste issues.

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### **Michigan Department of Agriculture**

525 W. Allegan  
Constitutional Hall, 6<sup>th</sup> floor  
P.O. Box 30017  
Lansing, MI 48909  
Website: [www.mda.state.mi.us](http://www.mda.state.mi.us)

The Dept. of Agriculture has been working to establish ethanol plants in Michigan. One 40-million gallons/year corn-to-ethanol plant is being constructed in Caro, Michigan and should be completed by November 2002.

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## **Organizations**

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### **American Bioenergy Association**

314 Massachusetts Ave., NE  
Washington, DC 20002  
Website: [www.biomass.org](http://www.biomass.org)

Mission: “advocate for progress in the production of power, transportation fuels, and chemicals from biomass.” Website includes legislative updates and large list of biomass/renewable energy links.

### **Common Purpose**

4514 Chamblee-Dunwoody Rd., Suite 327  
Atlanta, GA 30338  
Phone: (770) 381-1995  
Website: [www.serve.com/commonpurpose/](http://www.serve.com/commonpurpose/)

Focuses on “identifying and implementing regional and global market-based energy and environmental solutions”. Website includes energy fact sheets and links to state/city air pollution data.

### **Institute for Local Self Reliance**

1313 5<sup>th</sup> Street, SE  
Minneapolis, MN 55414-1546  
Phone: (612) 379-3815  
Website: [www.ilsr.org](http://www.ilsr.org)

“Research and educational organization that provides technical assistance and information on environmental sound economic development strategies.” Also publish *The Carbohydrate Economy* a quarterly publication “that covers new processing and manufacturing technologies, rural economic development, and policies that impact the plant matter-based product industry”. Back issues of the publication are available on their website.

### **National Corn Growers Association**

1000 Executive Parkway, Suite 105  
St. Louis, MO 63141  
Phone: (314) 275-9915  
Website: [www.ncga.com](http://www.ncga.com)

Represent U.S. corn growers and conduct corn-related research, education and promotion. Website includes information on ethanol.

### **Michigan Corn Growers Association (MCGA)**

504 S. Creyts Rd., Suite A  
Lansing, MI 48917-8230  
Phone: (517) 323-6601  
Or 1-888-323-6601 (MI only)  
Website: [www.micorn.org](http://www.micorn.org)

The MCGA develops new and expanded markets for corn and corn products in Michigan as well as organizing and assisting local corn grower organizations. They also fund ethanol-related research and provide ethanol information to corn producers and the general public.

### **New Uses Council**

295 Tanglewood Drive  
E. Greenwich, RI 02818-2210  
Phone: (401) 885-8177  
Website: <http://newuses.org>

Mission: “expanding development and commercialization of new industrial, energy, and non-food consumer uses of renewable agricultural products” Also publish *EverGreen* a bi-monthly newsletter which is available on their website.

### **Renewable Fuels Association**

One Massachusetts Ave., NW, Suite 820  
Washington, C.C. 20001  
Phone: (202) 289-7519  
Email: [info@ethanolrfa.org](mailto:info@ethanolrfa.org)  
Website: [www.ethanolrfa.org](http://www.ethanolrfa.org)

Mission: “to expand the production and consumer use of ethanol fuels by removing regulatory and marketplace barriers.” Also publish *Ethanol Report* a bi-weekly newsletter which along with many other publications is available on their website.

### **Union of Concerned Scientists**

2 Brattle Square  
Cambridge, MA 02238-5552  
Phone: (617) 547-5552  
Email: [ucs@ucsusa.org](mailto:ucs@ucsusa.org)  
Website: [www.ucsusa.org](http://www.ucsusa.org)

Conduct research on renewable energy issues and related topics. Have many publications posted on their website.

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