A Farmer's Guide to Energy Self Reliance

How to decrease energy consumption and increase profits

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Introduction

The following guide is a tool to help farmers increase energy self-reliance and profitability. Reducing operating costs and finding new sources of revenue can give farms the edge they need to compete in the marketplace. In addition, farmers have a long tradition of being stewards of the land. Investing in renewable energy and reducing energy use are important steps to protecting the land, air, and water. This guide offers suggestions that fit into three interrelated categories: improving energy efficiency, using biomass, and utilizing other renewable energy sources such as wind and solar. The suggestions outlined in this guide do not cover every aspect of energy use, but are a starting point. Energy management is not easy. However, there are many benefits to it. This guide is intended to serve as a resource to help farmers increase profits while decreasing some of the harmful environmental effects of farming.

This guide is organized by price point. The suggestions range from efficiency measures that cost little or nothing to substantial investments in renewable energy technology. While some of the suggestions outlined will apply equally to most farms, it is important to recognize that not all suggestions will be appropriate for every farm. The effectiveness of many of these techniques will be impacted by your size, farming sector, regional weather patterns and individual state legislation. Included throughout the guide are stories describing how other farmers have used these tools to achieve energy self-reliance and improve their bottom line. We hope these stories will both inspire you and give you a better idea of the type of farms where a specific technique may be most appropriate and successful. More detailed information on all of the suggestions contained in this guide can be found on our website, www.agenergysolutions.org.

Energy Conservation Tips That Don't Cost a Thing

The least expensive, quickest, and easiest way to save money on your farm is by using energy efficiently. The following list includes some important common sense measures that are easy to forget, but should always be in practice. By incorporating these energy saving techniques into your operation, you can decrease your expenses and increase the profitability of the farm.

Gear Up and Throttle Down

Running your machinery at the proper RPM is essential to fuel efficiency. In all cases consult the guidelines issued with the tractor to make sure that you don't overload the engine. However, if you are hauling a heavy load of hay bales or pulling a rake, consider reducing the engine RPM by "gearing up and throttling down."

Photograph by Paul Anderson. MourgeFile.

Check Your Tire Pressure

Tires should always be inflated to the proper pressure. Under-inflated tires decrease traction, create ruts in soft soil, and can deteriorate sidewall tread. Also, be careful to not over-inflate your tires. Over-inflated tires can cause pre-mature tire wear, increased soil compaction, and increased fuel consumption resulting from increased rolling resistance. A University of California study demonstrated that correctly inflated tire pressure required 20 percent less fuel than those tires that were under or over inflated. Check your equipment owner's manual or consult your local tire distributor for the proper inflation information.

Routine Machine Maintenance

Make sure to perform general maintenance on your farm equipment, especially before and after harvest season. Properly lubricated tractors and equipment will result in better fuel efficiency. Also, be sure to change the filters in the air and fuel systems. Finally, use appropriate equipment ballast to keep wheels from slipping and using more fuel. Ensuring that you follow the proper maintenance schedule will not only increase fuel efficiency, but will extend the life of the tractor.

Low-Input Farming Techniques

A typical farmer using conventional methods spends between 22 percent and 62 percent of total variable cash expenses for manufactured inputs such as commercial fertilizers and fuel. Indeed, a majority of these products (including fertilizers, pesticides and herbicides) are derived in total or in part from petroleum. Reducing dependence on these inputs can help farmers stabilize cash flows and decrease expenses as the price of oil continues to rise. There are a number of models of successful organic, integrated pest management, and low input farming available through local extension services and organic grower's associations. One valuable resource is the USDA's Sustainable Agriculture Research and Education program at www.sare.org.

Another method for reducing petroleum based inputs is to reduce the number of "trips" across the field using a conservation tillage technique such as ridge tillage. In ridge tillage, special implements are used to heap the soil into a series of raised ridges for planting. The soil is not tilled between harvest and the next planting. Farmers who use the ridge tillage method improve their energy efficiency without reducing productivity. In addition, ridge tillage can drastically improve soil quality and water absorption, halting excess runoff and soil erosion.

Investments Under $100

Wrap Your Water Heater

Wrapping your home, barn or work space water heater can save between an estimated 25 to 45 percent of the energy used by your heater. The insulation blanket will reduce standby heat loss and you will likely recover the cost of the blanket through reduced water-heating bills within a year. Nearly all new energy-efficient water heaters have very high insulation levels, which eliminates the need for adding an insulation blanket. Models older than 5 years will generally not be insulated. Most hardware or country general stores carry heater insulation kits. Cost $20 to $35

Compact Fluorescent Light Bulbs

Lighting presents one of the biggest opportunities for savings in homes and farm buildings. Initially more expensive, compact fluorescent light bulbs (CFL) save money in the long run because they use 1/3 the electricity and last up to 10 times longer than normal incandescent bulbs. Replacing a 100-watt incandescent bulb with an equivalent 25-watt CFL can save a farm $2 per lamp each month in energy costs, assuming a 100-watt bulb is used for ten hours per day at $0.085 kWh. Thus, replacing ten 100-watt bulbs can save $20 a month on your energy bill and up to $500 over the life of the bulb. Replacing all of the incandescent lights in a building with energy efficient fluorescent lights can save up to 75 percent on the costs of energy for lighting. Further savings can result from the use of motion sensors instead of timers to only light areas when you need them. Another important efficiency tactic is to design your lighting so that it only illuminates the area where you will be working.

A single 25 watt CFL bulb will cost you between $2.50 to $6.00. Check with your power company as many utilities offer a reduced rate to customers on compact fluorescent bulbs. Buying in bulk can also save money on the initial switch from incandescent bulbs to fluorescent bulbs. Cost $10 to $100

Weatherize Buildings

Photograph by Mary R. Vogt. MourgeFile.

Air leaks are a major cause of heat loss in homes, barns and greenhouses. Windows, doors, and roofs are the primary culprits. Caulking and weather-stripping around windows and doors can reduce heat loss up to 37 percent in those areas. The total amount saved varies, but older structures usually realize the most savings. For more information, including cost savings, visit www.eere.energy.gov/weatherization. The only supplies you need for this project are caulk, an applicator, and weather stripping for the edges of doors and windows. One thing to remember is not to insulate your barn without consulting an extension agent or an animal science expert. Most barns need constant air flow and insulation will stop the air exchange necessary for animals to stay healthy. Cost $30 to $50

Investments Under $500

Install Energy Efficient Fans

High volume, low speed fans are an efficient way to move large amounts of air in a work space. Generally fans that have an efficiency rating of 20 cubic feet per minute, per watt used, are the best option. Efficiency can also be improved by making sure that your fans are clean. Dirt and grime can lower fan efficiency by 20 percent or more. Finally, when the fan is operating, open a door or window slightly in order to supply fresh air. During warm months, providing a cross flow of air to cool the work space is particularly important. These simple practices will increase the fan's effectiveness and ultimately reduce your energy bill. Some of the most important selection tips to keep in mind include: larger diameter fans will be more efficient than smaller diameter fans; fans with a discharge cone will be more efficient than those without; machete, straight and teardrop blade designs are more efficient and accumulate less dust than cloverleaf shaped fan blades. Cost $200 to $500

Night Setback Temperature Controls for Greenhouse

Temperature control systems are available to perform a number of functions to optimize greenhouse operation. If plant types grown can accommodate reduced temperatures during nighttime periods, significant energy and cost savings can be achieved by installing a thermostat that can control space temperature as a function of time of day. Note that temperature setback is dependent on the type of crop and growth cycle. It may not be applicable to all greenhouse operations. Typical thermostats used for heating system control are single and dual stage thermostats. However, a thermostat that has multiple time set points per day will meet the needs of many types of greenhouses. Having multiple time set points can minimize energy consumption by reducing nighttime temperatures. For example, by installing a night setback temperature controller and reducing the temperature in a power vented greenhouse 5 degrees Fahrenheit from 9pm to 8am, a farmer can save $618 for a typical year's operation. Reducing the temperature in a power vented greenhouse 10 degrees Fahrenheit from 9pm to 8am saves $1,146 for a typical year's operation. Cost $250 to $350

Investments Under $5,000

Heat Your Workshop with Radiant Heating

Instead of warm air circulating throughout your work area using ducts and vents, a radiant heating system can be embedded under your workshop floor. The installation of electric heat coils or warm water pipes under the entire floor can evenly distribute low-temperature heat, saving on average 20 percent of the energy needed to heat the space in question. Radiant heating systems generally require more up front expense than other heating sources, but they also offer several advantages. For example, radiant heating systems are very efficient at low shop temperatures because the radiant heat warms the surfaces it strikes, providing comfortable equipment and surface temperatures. Also, radiant sources lower heat loss when large entry-doors are opened since it is not the air in the work shop that is doing the heating, but the workshop itself. Finally, radiant heating systems can provide about the same comfort level as forced air heaters at a 10 degree lower shop temperature. This means lower energy use by you, and increased savings on your energy bills!

Experts estimate that a radiant heating system will cost about $3 to $4 per sq. foot for tubing and matting materials. A 25 by 10 foot work area would then cost between $750 and $1,000 for the parts. This does not include your labor installing the system beneath your workshop floor, nor does it include the cost of the water heater. It should be noted that retrofitting an older building can be much more expensive than installing radiant heating for new construction.

Cost $750 to $5,000

Photograph by Mary R. Vogt, MourgeFile.

Photograph by Click. MourgeFile.

Energy Efficient Heating Systems for New Greenhouses

If you are constructing a new greenhouse consider using a power vented heater instead of an atmospherically vented heater. Unit heating systems with power vented exhaust, as opposed to atmospherically vented systems, stop airflow through the flue when the unit is not operating. In atmospherically vented systems, continuous airflow through the exhaust system during non-operating hours allows the greenhouse to cool down by venting warm air out of the structure. The net result is that the efficiency of the heating system is reduced. Power vented exhaust systems use combustion air metered through the heater unit by separate fans. When the unit is off, warm air venting is cut off which increases efficiency. Results indicate that the additional costs of installing a power vented unit heater have a relatively short payback, even for greenhouses that operate only a portion of the year. The results apply to both new and retrofit opportunities. The cost difference between a greenhouse heated with a power vented heater ($3,580) versus an atmospherically vented heater ($2,700) is $880 more initially, but results in $855 in energy cost savings over a typical year. Thus, the payback period is just one year.
Cost $3,000 to $4,000

Investments Under $25,000

Invest in a Wood Boiler

Looking at average fuel costs, wood chips and pellets provide more energy per dollar than other energy sources such as electricity, natural gas, liquid propane and fuel oil. Some wood boilers are a concern because they produce emissions that contribute to local air pollution. There are newer models however, that are not only extremely efficient, but also burn cleaner than older models. Two brands to consider are Tarm and Greenwood. Before installing any wood heating system, be sure to check on particulate emissions and how clean the system burns.

Boilers are normally connected to central heating and hot water systems, while stoves generally circulate warm air. Wood boilers are suitable for pellets, logs or chips, and are generally larger than 15 kW. The output of each system is an important consideration because your system choice will depend on the size of the area being heated. Higher output will be needed to heat more space. In the U.S., pellets are sold by the bag (40 lbs), by the ton (50 bags), and by the skid (60 bags). The selling price currently ranges from $120 to $200 per ton ($2.40 to $4.00 per bag) and averages $150 per ton ($3.00 per bag). Similar to other heating fuels, price varies by region, availability, and season. The average pellet-stove user will consume at the rate of about one 40 lbs bag of wood pellets every 24 hours for every 1,500 square feet being heated. Pellet consumption varies depending on overall home efficiency and stove settings.

The cost of a wood boiler will depend on the size of the space you need to heat and the brand that you select. Lifetime savings depend on your source for fuel wood, the system you are replacing, and the efficiency of the boiler you decide to install. Cost $5,000 to $20,000

Dewar Hog Farm, Prince Edward Island

Norman Dewar's hog farm uses a wood chip system to heat his 100 sow farrow-to-finish operation. His 130 kW wood chip system heats the sow barn, nursery, farrowing barn, office and storage building. It also produces enough hot water to supply a four gal/min. pressure washer as well as hot water for personal use in the barn.

Dewar's wood chips are produced from waste slabs from a small sawmill about 9 miles away. It costs him a little over $3,000 a year for wood chips. Although this is slightly more than he was paying for oil, he is now able to heat a much larger area. The extra heat is good for his hogs, especially when temperatures plummet well below freezing during the winter months.

Install Solar Panels

The sun's energy can be harnessed to provide electricity through the installation of photovoltaic (PV) cells, which convert sunlight into electricity. Farmers can utilize solar panels to power electric fences, water pumps, irrigation systems and much more. There are two main ways to configure a solar energy system: stand-alone or grid connected. Stand-alone systems simply provide energy when the sun is shining, therefore the more sun, the more electricity the system can produce. Since the sun doesn't shine all the time, a stand-alone system is more flexible when coupled with batteries to store the energy for later use at night or on cloudy days. Grid-connected systems can utilize net metering to sell excess electricity to public utilities when the PV cells are producing more electricity than the farm needs. There may be local ordinances regarding rooftop structures or reflected light. Therefore, you should either contact an area expert or your local zoning commission before installing solar panels. You may also want to check on the property tax implications of installing a solar energy system.

Who should install solar panels? A sunny location is the key to benefiting from solar panels. Farms located in a region with moderate to full sunlight are best suited for solar panel installation. To get a rough idea of whether or not your property receives a sufficient amount of sunlight please refer to the National Renewable Energy Lab's solar days map. The map is available online at www.nrel.gov/gis/solar.html.

How do I install solar panels? First, decide what will be powered with your solar system. Smaller systems can be used to power remote applications such as electric fences and automated water/feed distribution systems. Larger systems can power your whole farm or provide electricity for your home and some farm buildings. The more power (kilowatts) needed, the more PV cells you will need.

Once you have settled on a system size, you should contact your local zoning commission to ensure no permits are required and no ordinances restrict installation. Then contact your local public utility commission. They should be able to suggest retailers and a licensed electrician to install the solar panels. The public utility commission can also provide further information on net metering options for grid-connected systems. You should work with the installation company to determine the size, placement and type of solar panels that are right for your farm.

Small stand-alone systems cost around $1,000, while larger grid-connected systems that power an entire building may cost close to $25,000. To save on expensive up front costs, an incremental installation is often easiest to manage. There are also several state and federal incentive programs available to alleviate the costs and encourage solar resource development. For a cost estimate calculation for your home and farm needs, see www.findsolar.com. Cost $1,000 to $25,000

Farm & Granary, New York State

Michael Siegel and Barbara Caldwell installed a solar energy system on their 14-acre farm to cut electricity costs and reduce their environmental impact. Their system is comprised of 30 PV cells each rated at 140 Watts, for a combined power rating of 3.5 kW. The system, installed on the roof of their barn, reduces their electric bills by 85 percent, while also reducing their contribution of greenhouse gases that cause global warming. The system had a total installed cost of $34,200. However, the state incentive chipped in $16,800, making it a good long-term investment for the farm and the environment. The New York State Energy Research and Development Authority also helped arrange for qualified technicians to install the system.

Investments Under $100,000

Produce Your Own Biodiesel

Biodiesel is a fuel made with vegetable oils, fats, or greases. Biodiesel can be run in diesel engines without making alterations, or in some cases, with minor alterations. Producing biodiesel for on-site use in farm equipment and heating can be a cost effective investment. However, while potentially economically sound, the production of biodiesel is time intensive and can include significant regulatory challenges including zoning, fire and health code compliance, and disposal of hazardous waste products. To date, small-scale biodiesel production regulation is unclear in a majority of states. Farmers entertaining the idea of starting a small scale production facility should take the time to speak with a local bio-fuels organization about regulations and support available in their area.

Biodiesel production requires two processes: extracting the oil from the seed and processing that oil into biodiesel. First, you need oil seeds. If you grow your own seeds, the cost of the equipment needed to successfully farm these seeds should be taken into consideration. Assuming you have the farming equipment necessary to grow oil seeds or you buy your seeds from another local source, the next major process involves extracting oil from the seeds. Extracting oil from the seeds is accomplished using a seed cleaner to remove husks or seed coats (about $1,600 new) and an oil seed press (about $10,000).

Besides the initial cost of the processing equipment, biodiesel production expenses include the chemicals used in the reaction (typically lye and methanol), gas or electricity expenses, and labor. Learning how to grow oilseed crops, use the equipment, and get the right mix of oil, lye, and methanol to produce biodiesel can require a significant time investment. The more biodiesel you hope to produce, the more chemicals you will need to convert your oil into biodiesel. Near pure methanol costs about $2.40 per gallon in bulk, but can vary significantly, depending on where you get it. Almost all methanol is manufactured from natural gas and is really an industrial by-product. Methanol is a hazardous chemical and shipping and disposal costs can be significant. Unless you have a local source, online sources are probably the best bet for finding lye. A ten pound box of lye can be purchased for around $25, not including shipping costs.

Vermont Biodiesel

John Williamson and Steve Plummer are working to produce biodiesel. They grow sweet sorghum and have also learned how to make lye from wood ash. At one end of their shed, a metal container is nearly overflowing with oil the color of melted butter. With a cost-sharing grant from the University of Vermont, Williamson and Plummer bought a $9,000 screw-auger press from Sweden that squeezes the seeds, sending oil down a pipe and the pressed "seed cake" into a hopper below. Stainless steel reactor tanks sit on the concrete floor near hoppers of dry seed. The mixing process necessary to create biodiesel from the seed oil takes place inside these safely sealed tanks. The residue from the sorghum fuels a furnace that both heats the oil in the biodiesel reactor and fires an ethanol distillery located in the same place. The pressed seeds also have value as a food source and can be used as a component in animal feed stock. Vern Grubinger, an Adjunct Extension Professor at the University of Vermont, says, "This model supports energy independence, reduces consumption of fossil fuels and contributes to a sustainable fuel-food cycle."

Small scale biodiesel operations can run anywhere from $15,000 to $100,000 or more, depending on whether you grow your own oil seed or purchase it from another supplier. Costs can also be offset by marketing the seed meal by-product of the biodiesel production process. Another way to increase the return on investment is to use biodiesel for home heating. Biodiesel may also be used in blends up to 20 percent with home heating oil. At this concentration, no modification is necessary to your fuel tanks, pumps, or burners. If you plan to increase the percentage of biodiesel in your home heating oil, special precautions and modifications to the equipment are required. For more information on blending biodiesel with home heating oil, please refer to the National Biodiesel Board's website at www.biodiesel.org/markets/hom/faqs.asp. Finally, there are a variety of tax incentives available under state and federal programs. For example, the Small Agri-Biodiesel Producer Credit provides a 10 cent per gallon credit if you produce less than 60 million gallons of biodiesel annually and meet certain federal requirements. Cost $15,000 +

Install a Wind Turbine

Farmers have been harnessing the power of wind for centuries, using windmills to grind grain and pump water. Today, wind turbines can be used to turn the power of the wind into electricity. The main factor to consider when installing a wind turbine is size. The larger the diameter of the turbine, the more electricity it can generate. In addition, wind speeds increase exponentially the higher you go. Therefore, the energy output of a wind turbine will be greater the higher it is mounted off the ground. If you are looking to offset the energy needed to power your home or building, a small, "micro-wind" unit may be sufficient. However, if you are looking to produce enough electricity for an entire farm, a larger "industrial" turbine may be necessary. Regardless of the size of your renewable energy system, it is important to remember that increased size and power output increases capital costs. Also, repair and maintenance costs should be calculated into your budget. Regulatory issues, such as site permits and local height or location restrictions, need to be addressed before you begin construction. It is common courtesy to discuss your plans with neighbors before you begin construction. Finally, we strongly recommend consulting a wind expert, financial advisor, and a lawyer before installing larger wind turbines.

Who should install a wind turbine? Installing wind turbines is not a viable solution for every farm. The National Renewable Energy Lab's wind speed map will give you a rough idea of whether or not your property has the proper wind speeds. The map is available online at www.rredc.nrel.gov/win/pubs/atlas/maps.html. If the map suggests good wind resources at your location, the next step is to collect data on your farm to analyze the wind potential. Many wind development firms will do this for you, or you can participate in an anemometer (wind speed measurement device) loan program. If you have sufficient wind, the next step is to identify a suitable location for your turbine(s). Your wind turbine dealer will supply materials to help determine the best location on your farm.

Burmeister Farm, Central Kansas

Since 1984, Paul Burmeister has been enjoying the benefits of his 10 kW Bergey EXCEL-S wind turbine, which supplies 183,000 kWh of reliable, clean energy to his farm near Clafin, Kansas. With his net-metered system, Paul's monthly electric bills fell from $50–$60 to about $5. Plus, at the end of each year, his electric utility pays him a few hundred dollars for the excess power he sold back to the grid. Paul first installed his wind turbine because of a concern with his reliance on fossil fuels and their negative environmental impacts—greenhouse gases, acid rain, smog forming pollutants, and harmful mercury emissions. But once the electricity bills started falling, Paul realized that wind power isn't just good for the environment, it's good for his bottom line.

The cost of installing a wind turbine varies by a number of factors, including size, tower type and height, generating capacity, fees, service agreements, installation, equipment, and maintenance. There a number of federal and state incentives for wind turbine installation, including grants, loan guarantees, and tax benefits. Check with your utility company for information on available incentives programs in your state. The following are a sample of smaller options including installation fees: Cost $15,000 +

Southwest Windpower Skystream 3.7: 1.8 kW rated output, 40 ft. guyed tilt-down tower, $16,000 to 18,000.

Abundant Renewable Energy ARE 110: 2.5 kW rated output, 40 ft. guyed tilt-down tower, $24,000.

Bergey Excel 10 kW: 10 kW rated output, 60' fixed lattice tower, $64,000.

Investments Over $500,000

Install an Anaerobic Digester

Anaerobic digesters are used to convert liquid manure into biogas (methane) and electricity. Anaerobic digestion provides a variety of benefits. Biogas systems can significantly reduce odor, which often plagues larger farms near suburban areas. Digesters also help to control agricultural water runoff which is a large contributor to non-point source water pollution in the U.S. Additionally, using an existing product, manure, to generate biogas and electricity can improve a farm's balance sheet. This is especially true if there were disposal costs originally associated with the manure. The anaerobic digestion process also concentrates nutrients to create a richer fertilizer for on-site use or for sale to other farms, greenhouses, or nurseries.

Colorado Swine Partners Hog Farm

Colorado Swine Partners is considered a small- to medium-sized operation with the hogs producing about 12,500 gallons of waste each day. A typical farm of this size would normally use $10,000 to $11,000 of electricity a month to handle its operations. Colorado Swine Partners, however, uses its hog waste to produce a significant amount of electricity for the farm with an anaerobic digester. This system meets about 35 percent of the electrical needs of Colorado Swine Partners, as well as about half of the peak power use (power used at any one time). Today, the farm purchases only about $3,500 worth of electricity a month.

As a result of this project's electricity generation and complimentary energy conservation devices, such as compact fluorescent lights, Colorado Swine Partners' low monthly electricity bill provides an overall savings of about $48,000 per year over comparably sized hog farms with similar product output. Since the whole system cost $375,000, the payback on the initial investment is roughly eight to ten years.

A covered lagoon digester operation is simple and straightforward. A pool of liquid manure is topped by a pontoon or other floating cover. As the manure is digested by bacteria in the lagoon, the methane is collected and sent directly to a modified natural gas generator and the micro turbine; both of which produce electricity. Covered lagoons are designed to use manure with two percent or less solid content. This type of digester requires high throughput in order for the bacteria to work on enough solids to produce gas. These systems are dependent on temperature and, as a result, methane production is greater in summer than in winter.

Photograph by Mary R. Vogt. MourgeFile.

The capital costs of an anaerobic digester can be very high and may range from a few hundred thousand to a few million dollars, depending on the size. Payback periods can range from 5 to 16 years, depending on the conditions of operation. It is also important to keep in mind that the value of the biogas from the digester will vary depending on the type of fuel that it is replacing. A general rule of thumb is that an anaerobic digester will not be cost effective for a farm with fewer than 300 head of livestock. For smaller farms, a cooperative operation used by multiple farms may be an option. The following vignette provides a good example of capital, operation and maintenance costs, benefits, and anticipated payback period for anaerobic digester use on a small- to medium-size hog farm. Cost $400,000 +

Government Incentives and Complimentary Programs

Government Incentives

The federal government and many state governments have programs that support investment in renewable energy technology. The federal Renewable Energy Systems and Energy Efficiency Improvements Program (known as Section 9006 Program) offers farmers grants for 25 percent of eligible renewable energy system investment costs, up to $500,000. In addition, the program offers to guarantee loans for 50 percent of eligible project costs up to $10 million. In fiscal year 2007, there is approximately $11.4 million available in grants and $176.5 million in guaranteed loans.

Twenty-three states and the District of Columbia have implemented renewable portfolio standards (RPS), which require a certain percentage of the electricity sold by utilities in the state to come from renewable energy sources. In some states, this requirement can be satisfied by the purchase of tradable renewable energy credits (RECs). This means that a farmer who installs renewable energy systems may produce valuable RECs that can be sold to electric utilities through net metering (see below). Many businesses and non-profit organizations also purchase RECs from renewable energy producers to offset greenhouse gas emissions. A state's RPS and tradable RECs provide additional sources of revenue for farm-powered renewable energy systems. Each state's RPS is different but every RPS creates strong incentives for renewable energy production.

Net Metering

Unlike a standard electric utility meter that measures only how much energy is consumed by the customer, net metering uses a bi-directional meter that records the flow of electricity, both to and from the customer. Net metering allows utility customers to sell

unused electricity that is generated by renewable energy systems back to their utility for use by other customers connected to the grid.

One of the challenges of electricity is the inability to store it in large quantities. With net metering, when energy consumption is lower than energy production, the excess electricity produced is sold back to the local utility. The credits from energy sold back to the local utility are then used to offset the cost of electricity consumed during peak hours, when energy consumption is greater than energy production. The "net" result can be significant savings for your farm. Unfortunately, net metering is not available in every state, and even where it is available, it may come with significant limitations. Contact your local utility company to learn whether net metering is an option available in your area. For more information on net metering online, see: www.newenergychoices.org/uploads/netMetering.pdf.

Water Trusts

In the Western United States, reducing water consumption is one of the most important efficiency measures that farmers can undertake. Irrigation consumes a large portion of available water resources in the interior West where water is already a scarce resource. Most Western states use the prior appropriation doctrine to allocate water rights according to the principles of "first in time, first in right" and "beneficial use." This can lead to inefficient use of available water resources and dangerously low water tables in ecologically important lakes, streams and rivers. The combination of water scarcity and the prior appropriation doctrine has led some organizations to create incentives for farmers to use water more efficiently. One of these options is paying farmers to reduce their water consumption through a Water Trust. For instance, the Montana Water Trust will provide a variety of services including irrigation efficiency programs, once a landowner agrees to work with them to transfer a portion of their water right back to in-stream flow. The Water Trust will then enter into lease agreements for the conserved water, essentially paying farmers for being more efficient in their irrigation practices! Check with your state's local water trust to learn more.

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Achieving Energy Self Reliance on the Farm

The American farmer is facing a crisis of historical proportions. Oil prices are at an all time high. Electricity rates are volatile and growing rapidly. Transportation costs are ever-increasing. This energy squeeze is occurring at a time when shrinking profit margins and increased competition threaten the very existence of small farms. Incorporating the use of energy efficiency, biomass, and renewable energy sources can help make farms more robust and profitable. This checklist provides a snapshot of some of the techniques that farmers can employ to increase their energy self-reliance.

Checklist for Energy Efficiency:

- ☐ Gear Up and Throttle Down
- ☐ Check Tire Pressure
- ☐ Routine Machine Maintenance
- ☐ Low-Input Farming Techniques
- ☐ Wrap Water Heater
- ☐ Compact Fluorescent Light Bulbs
- ☐ Weatherize Buildings
- ☐ Install Energy Efficient Fans
- ☐ Night Setback Temperature Controls for Greenhouse
- ☐ Radiant Floor Heating
- ☐ Energy Efficient Heating for New Greenhouses
- ☐ Install a Wood Boiler
- ☐ Install Solar Panels
- ☐ Produce Your Own Biodiesel
- ☐ Install A Wind Turbine
- ☐ Install an Anaerobic Digester
- ☐ Government Incentives for Alternative Energy
- ☐ Net Metering Opportunities
- ☐ Water Trusts